

COWLITZ COUNTY CRITICAL AREAS

Review of Existing Conditions and Best Available Science

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EXECUTIVE SUMMARY

Although Cowlitz County is not required to meet the comprehensive planning requirements of the Growth Management Act (GMA), it is required to periodically update its critical areas regulations. The County last completed a comprehensive update of its critical areas regulations in 2009. The County updated the wetlands section of its critical areas ordinance in 2014 to align with the updated Washington Department of Ecology Washington State Wetland Rating System. The State requires that Cowlitz County update its critical areas regulations on or before June 30, 2018, and every eight years thereafter (RCW 36.70A.130). This deadline must be met for the County to remain eligible to receive funds from the public works assistance and water quality accounts in the State Treasury. To support the County's Critical Areas Ordinance update, The Watershed Company and Parametrix prepared this review of existing conditions and best available science (BAS).

This review of existing conditions and BAS describes critical area resources within the County and documents BAS-based approaches to protecting the functions and values those areas provide. Existing conditions in the County are based on the County's GIS mapping, existing County documents, and other publically available documentation. The BAS review references recent BAS reports prepared for other jurisdictions and new information relevant to the County. Findings for geologically hazardous areas, critical aquifer recharge areas, wetlands; fish and wildlife habitat conservation areas (FWHCAs), including streams; and frequently flooded areas (FFA) are summarized in-brief below.

- **Critical Aquifer Recharge Areas:** Cowlitz County relies upon ground-water sources. As population grows and land use activities change, aquifers are affected in several ways: increased impervious surfaces reduces recharge surface area, increased use of wells draws down aquifer levels, and use of hazardous materials poses risk of contamination. To maintain potable water uses and potential uses of existing aquifers, both water quality and quantity should be managed.
- **Geologically Hazardous Areas:** There are four main types of geologically hazardous areas recognized in the GMA; erosion hazard areas, landslide hazard areas, seismic hazard areas, and areas subject to other geologic events such as coal mine hazards and volcanic hazards. Cowlitz County has a history of large landslides, active erosion and volcanic activity. In addition, the county is within the Cascadia Subduction Zone fault, which is expected to produce a magnitude 9.0 or greater earthquake in the future. The county is also susceptible to surface and crustal zone earthquakes. These areas are subject to periodic events that can result in property damage, injury, and the loss of life. Identifying hazard areas and managing land uses in those areas can help to reduce risks to public health.
- **Wetlands:** Cowlitz County contains thousands of acres of mapped wetlands. Wetlands are highly productive ecosystems that are valued for providing water quality functions,

hydrologic functions, and habitat functions. Primary BAS-based wetland protections include wetland identification, classification based on functions, and sufficiently protective buffers. When impacts to wetlands and/or buffers are proposed, mitigation sequencing, compensatory mitigation, and compliance oversight are central to maintaining wetland functions and values.

- FWHCAs: Several major rivers and many of their tributaries provide habitat for salmonids, including state- and federally-listed species. Other state- and federally-listed sensitive, threatened or endangered species, including bald eagle, peregrine falcon, northern spotted owl, Columbian white-tailed deer, marbled murrelet, larch mountain salamander and eulachon are documented within the county. FWHCAs support a variety of functions, including dynamic instream habitats, water quality, streambank stability, organic inputs, and habitat connections across the landscape. Streams are typically protected through identification, classification, and protective buffers. When priority habitats and/or species are present, Washington State Department of Fish and Wildlife (WDFW) species-specific management recommendations provide BAS-based management strategies.
- FFAs: Floodplain areas are mapped throughout the County. Some of the mapped floodplain areas are associated with large wetland complexes. Frequently flooded areas (FFA) are managed to reduce potential risks to public safety. FFAs can also provide valuable instream habitat benefits, such as low-velocity instream habitat during high-flow events.

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1 INTRODUCTION

1.1 Best Available Science Requirement

Cowlitz County is not subject to the comprehensive planning provisions of the State's Growth Management Act (GMA) [WAC 365-196-030(1)(c)], which only apply to the largest and fastest growing counties in the state. However, under the GMA, Cowlitz County is required to develop and periodically update its policies and regulations that designate and protect critical areas. Critical areas, as defined by the GMA (Revised Code of Washington [RCW 36.70A.030(5)]), include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas. When updating critical areas policies and regulations, jurisdictions must include the best available science (BAS). Any deviations from science-based recommendations should be identified, assessed and explained (Washington Administrative Code [WAC] 365-195-915). In addition, jurisdictions are to give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries.

The State requires Cowlitz County to update its critical areas regulations by June 30, 2018. This deadline must be met for the County to remain eligible to receive funds from the public works assistance and water quality accounts in the State Treasury.

The County last completed a comprehensive update of its critical areas regulations in 2009. The County updated the wetlands section of its critical areas ordinance in 2014 to align with the updated Washington Department of Ecology (Ecology) Washington State Wetland Rating System. In conjunction with the comprehensive critical areas regulations update, the County completed a BAS report (MacCorkle and Franklin 2006). Since that time, new information is available, which, together with the previously compiled document, comprises BAS. This report heavily references the review of BAS recently completed by other jurisdictions and from the Cowlitz County Shoreline Analysis Report (The Watershed Company 2014) to update the BAS and describe existing conditions.

This report provides an overview of the science relevant to the functions and values of wetlands, streams, and wildlife habitat, as well as brief description of existing critical areas in Cowlitz County. Rather than include a full and extensive review of general BAS related to critical areas, this report references recent BAS reports prepared for nearby jurisdictions and includes new information relevant to the County, as well as a description of local conditions. This approach increases efficiency and reduces the expense for the County. The BAS Review for the City of Woodinville Comprehensive Plan Update, available [here](#) (The Watershed Company 2014), provide a detailed and extensive review of the functions and values of streams, lakes, and associated riparian habitats, as well as recommendations for protecting those functions. The discussion of literature in the BAS review for the City of Woodinville is considered to be generally applicable to Cowlitz County. Additional BAS sources are described as necessary to

address conditions specific to Cowlitz County and new information available since the completion of the 2014 report.

BAS documents are prepared by qualified scientific experts and follow a valid scientific process. The scientific process, which produces reliable information, is generally characterized by peer review, standardized methods, logical conclusions and reasonable inferences, quantitative analysis, proper context, and references. Common sources of scientific information include research, monitoring, inventory, modeling, assessment and synthesis (WAC 365-195-905).

The scientific body of knowledge evolves as new studies are conducted and new technologies are employed. While the BAS information provided here is intended to provide a framework for critical area protections, it may not provide definitive criteria for all regulatory decisions. Ecological systems are complex and based on both landscape-scale and local processes, comprised of many variables. Where definite guidance is lacking or studies in the scientific literature show variable methods and results, a range of values is commonly provided here. In accord with WAC 365-195-920, where scientific information is incomplete with regard to a land use, a precautionary approach should be taken.

In addition to the summary of BAS-based recommendations, the location, extent, and general conditions of existing critical areas in Cowlitz County are identified based on available information. The Watershed Company's recent experience with the County's Shoreline Master Program Update will also serve to inform the BAS review.

Cowlitz County prepared a Shoreline Analysis Report in 2014 as part of the County's comprehensive update of its Shoreline Master Program. The Shoreline Analysis Report provides a detailed inventory and characterization of the shorelines of the state as defined by the Washington State's Shoreline Management Act. The Shoreline Analysis Report describes existing conditions, ecological functions and land use within the shoreline jurisdiction. This BAS report will draw on information from the Shoreline Analysis Report but will provide a much broader scope in that it will describe the existing conditions and ecological functions of all critical areas within Cowlitz County, including those outside of the shoreline jurisdiction.

1.2 Summary of Cowlitz County Ecosystem Conditions

Cowlitz County is situated in southern Washington to the north of the Columbia River. The County is approximately 1,166 square miles in size. 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 Saint 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.

Portions of four major watersheds are located within Cowlitz County, the Lewis watershed (Water Resource Inventory Area (WRIA) 27), the Cowlitz Watershed (WRIA 26), the Grays/Elochoman Watershed (WRIA 25), and the Upper Chehalis Watershed (WRIA 23). A map

of the WRIsAs within Cowlitz County is provided in Figure 1-1. The Lewis, Cowlitz, and Grays/Elochoman Watersheds all flow southward into the Columbia River. The Upper Chehalis Watershed flows north out of Cowlitz County and then west into Grays Harbor. Although not identified as a separate WRIA, given its unique features, processes, and functions, the Columbia River and its associated floodplain and wetland features are addressed separately in this document.

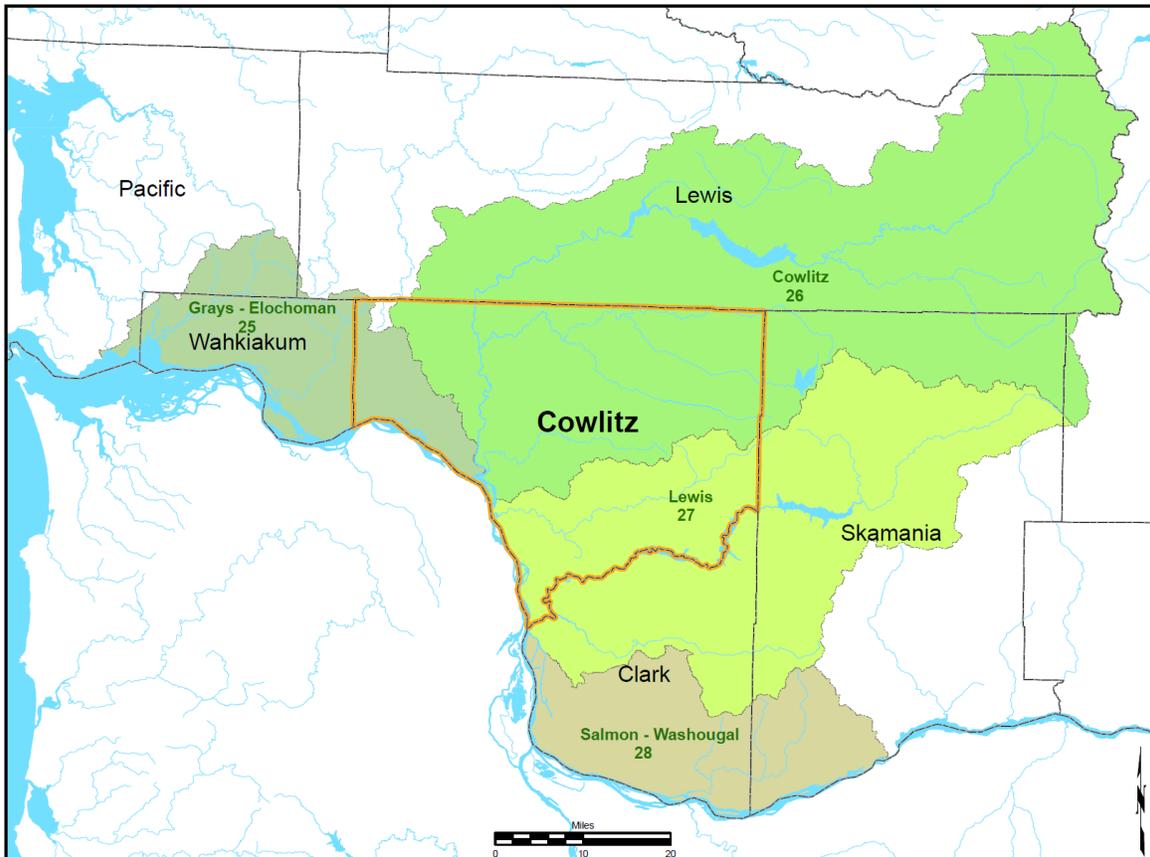


Figure 1-1. Map of Water Resource Inventory Areas in Cowlitz County (Source: Washington Department of Ecology, GIS Technical Services).

2 CRITICAL AQUIFER RECHARGE AREAS

2.1 Existing Conditions

Washington State's Growth Management Act (RCW 36.70A) requires local government to designate and protect "Critical Areas" to protect natural resources, including those areas that have a "critical recharging effect on aquifers used for potable water" (RCW 36.70A.030(5)). Such areas are called Critical Aquifer Recharge Areas (CARAs), and the goal of establishing and protecting CARAs is to protect the functions and values of a community's drinking water by

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both preventing the supply from being contaminated, and by maintaining the supply of water in the aquifer.

The Washington Administrative Code (WAC 365-190) further defines CARAs as; Areas with a critical recharging effect on aquifers used for potable water are areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water.

An aquifer is a geologic formation that readily transmits water to wells or springs. Aquifer recharge occurs when water flows into the ground to an aquifer. An aquifer can be confined or unconfined. An unconfined aquifer is one in which the upper boundary is the water table, with no aquitard (a geologic formation that does not readily transmit water) between the water and the ground surface. A confined aquifer is a deeper aquifer that is separated from the surface by an aquitard, and is often under pressure. Groundwater recharge areas are characterized by decreasing hydraulic head with depth (direction of groundwater movement is downward). Groundwater discharge areas are characterized by increasing hydraulic head with depth (direction of groundwater movement is upward, towards the surface) (The Watershed Company, 2014).

Cowlitz County is an area of major use of ground water in Washington. Industries and the rural population depend heavily on ground-water sources. The wells range in depth from less than 6 feet to more than 600 feet and have a wide range of water production yield depending on the percentage of clay and silt in the aquifer. Wells near the Columbia River are directly affected by river stage and are the most productive of the alluvial aquifers (Myers, 1970).

The County's ground water is primarily drawn from unconsolidated alluvial materials, followed by older, sedimentary and igneous rocks. The aquifers are recharged mainly by infiltration from precipitation, but recharge also occurs from streams during high stages and from induced infiltration with heavy well usage. The County's ground water levels in the alluvial aquifer generally rise between October 1 and March 31, the period during which about three-quarters of the annual precipitation falls. Water levels decline during spring and summer months due to lack of precipitation, higher pumping demands from wells and evapotranspiration. The consolidated rock aquifers generally hold a steady level of ground water throughout the year (Myers, 1970).

Barring a major geologic event or major climate change, the presence and potential function of aquifers remains fairly static. And, although the County experienced a major eruption of Mt. Saint Helen's in 1980, which did cause dramatic changes in the surface water landscape, that event did not change the underlying soil types that define aquifers throughout the County. However, as population grows and land use activities change, aquifers are affected in several ways: increased impervious surfaces reduces recharge surface area and can send precipitation directly into surface water systems, increased number of wells or use of wells draws down aquifer levels, and increased use of hazardous materials increases risk of ground water

contamination. To maintain potable water uses and potential uses of existing aquifers, both water quality and quantity must be managed.

2.2 Best Available Science for Protection of Functions and Values

The BAS review for the City of Woodinville Comprehensive Plan Update (The Watershed Company 2014) provide a full review of the functions and values of aquifer recharge areas, with the exception that Cowlitz County does not contain any sole source aquifers (aquifers that supply at least 50 percent of the drinking water consumed in the area overlying the aquifer).

The previous BAS documentation for the Cowlitz County CAO update in 2009 also provides a list of still applicable BAS resources with a summary of each, and is incorporated here by reference. There are two updates to the references listed in the 2009 BAS. The County currently utilizes an adaptation of the DRASTIC model to classify soil types into recharge susceptibility rankings, but did not include that reference in the 2009 BAS, thus it is included here (Aller et al. June 1987). The 2009 BAS lists a 2002 version of the U.S. Geological Survey Water Data for Washington. This information is now available online with more current data, so that reference is replaced (USGS, February 2016).

Recent BAS documentation in the City of Woodinville and in King County applies two additional factors to protecting the functions and values of aquifer recharge areas that were not explicitly considered in the County's 2009 CAO update: wellhead protection area data and high risk uses. As part of the current CAO update effort, Parametrix is working with the County to review well data and protection requirements, and this BAS report will be updated as that work progresses. BAS on high risk uses in the King County and City of Woodinville reports is incorporated here by reference.

3 GEOLOGICALLY HAZARDOUS AREAS

3.1 Existing Conditions

According to RCW 36.70A.030(9) and WAC 365-190-120, Geologically Hazardous Areas are "those areas that are susceptible to erosion, sliding, earthquake, or other geological events and are not suited to the citing of commercial, residential, or industrial development consistent with public health and safety concerns".

The four main types of geologically hazardous areas recognized in the GMA are 1) erosion hazard areas; 2) landslide hazard areas; 3) seismic hazard areas, and 4) areas subject to other geologic events such as coal mine hazards and volcanic hazards.

Whereas the goal with most other GMA mandated critical areas is to protect a valued ecological resource, the purpose of regulating activities in geologically hazardous areas is to protect the public from the hazard. These areas are subject to periodic events that can result in property

damage, injury and the loss of life. Human activity in these areas can pose a safety concern, and, in some cases, may actually increase the potential for a hazardous event. Such hazard events have the potential to affect not just one property, but also the neighboring properties. For example, improperly clearing a parcel in a sloping landslide area may increase the potential for a landslide that could damage not only the cleared property, but also the neighboring properties above and below it. Therefore, it is important to identify where such hazard areas are, and to ensure that activities and development in those areas is appropriate (The Watershed Company, 2014).

Cowlitz County has a history of large landslides (Burns, et. al, 2002; Fiksdal, 1973; Beckstrand, et. al, 2000), active erosion, and volcanic activity with the eruption of Mt. St. Helen's in 1980. In addition, the County is within the Cascadia Subduction Zone fault that stretches from Northern Vancouver Island to Cape Mendocino California. This fault separates the Juan de Fuca and North American plates, and is expected to produce a magnitude 9.0 or greater earthquake in the future (PNSN, 2016). The County also is susceptible to relatively frequent surface, or crustal zone earthquakes (Barnett, et. al, 2009).

3.2 Best Available Science for Protection of Functions and Values

The previous BAS documentation for the Cowlitz County CAO update in 2009 provides a list of still applicable BAS resources with a summary of each, and is incorporated here by reference. The geological conditions in the County have not changed significantly since 2009, and scientific understanding of the hazards has also not changed significantly such that it would affect how geologically hazardous areas are regulated within Cowlitz County. However, there are two updates to the references listed in the 2009 BAS included with this report to include information on the Cascadia Subduction zone seismic hazard and to update the maps used by the County.

The Washington State Geologic Information Portal (www.dnr.wa.gov/geologyportal) is an interactive web mapping application that allows for access to choose from various layers to overlay on an area of interest. The mapping application currently has eight different map themes that include geologic maps, seismic scenarios, natural hazards, subsurface geology, and earth resource permit locations. The portal contains most current information and allows users to manipulate data for areas of interest. Information associated with the geologically hazardous areas citations provided in this section can be accessed through the geologic information portal.

Additional mapping resources are listed below:

Czajkowski, J.L.; Bowman, J.D., 2014, Faults and Earthquakes in Washington State. Washington Department of Natural Resources, 1 plate, scale 1:24,000

Evarts, Russell C., 2001, Geologic map of the Silver Lake quadrangle, Cowlitz County, Washington: US Geological Survey miscellaneous field studies amp MF-2371, 1 plate, scale 1:24,000

Evarts, Russell C., 2004, Geologic map of the Woodland Quadrangle, Clark and Cowlitz Counties, Washington. U.S. Geological Survey Scientific Investigations Map 2827. 1 plate, scale 1:24,000.

Livingston, V.E., Jr., 1966, Geology and mineral resources of the Kelso-Cathlamet area, Cowlitz and Wahkiakum Counties, Washington. Washington Division of Mines and Geology Bulletin No. 54. 1 plate, scale 1:24,000.

4 WETLANDS

4.1 Existing Conditions

Through its National Wetlands Inventory (NWI), the U.S. Fish and Wildlife Service maps wetland areas in Cowlitz County. NWI-mapped wetlands are typed as riverine and palustrine freshwater emergent, scrub-shrub, and forested wetlands. NWI maps typically identify large wetland areas, but often do not identify smaller, more isolated wetland occurrences; therefore NWI-mapped wetlands are not an exhaustive survey of all existing wetlands. These mapped wetlands are used in the discussion below for a general characterization of the existing conditions.

Mapped wetlands in Cowlitz County are concentrated in a few locations near large shoreline waterbodies, especially along the Columbia River, in the vicinity of Silver Lake and within the channel migration zone of the Toutle River System. These wetlands are generally considered “shoreline-associated wetlands” under the Shoreline Management Act. The concentration of wetlands tends to be higher along the Lower Cowlitz River compared to the Coweeman River and Lewis River watershed.

The fringe of the Columbia River features the largest wetland complexes in the County, including a large, high-quality wetland complex near Burke Slough, and wetland areas surrounding the mouth of several tributaries, including Coal Creek, the Cowlitz River, the Kalama River, and the Lewis River. Many of these Columbia River fringe wetlands are tidally influenced. Tidal freshwater wetlands provide young salmonids with protection from large piscivorous predators (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.

The Toutle watershed features the highest concentration of NWI-mapped wetlands in Cowlitz County. The high concentration of NWI-mapped wetlands in Cowlitz County is a residual result of the Mount Saint Helens eruption, which distributed large amounts of sediment into the watershed. This sediment input filled and raised the existing stream bed resulting in extensive channel braiding and meandering and leaving wetlands in its path.

The Coweeman watershed contains very few NWI-mapped wetlands.

In the Mill, Abernathy and Germany Creek subbasin, the majority of the floodplain and NWI-mapped wetland area occurs in the Coal Creek delta. This delta supports a large emergent and scrub-shrub wetland complex with first and second order tidal channels that are particularly significant habitats for small fish throughout the year. This wetland complex also provides significant flood storage capacity for the Columbia River and Coal Creek.

No NWI-mapped wetlands exist in the South Fork Chehalis River watershed within Cowlitz County; however, the National Oceanic and Atmospheric Administration Coastal Change Analysis Program coverage identifies areas of emergent, scrub shrub, and forested wetland vegetation.

4.2 Best Available Science for Protection of Functions and Values

Wetland functions are affected by physical, chemical, and biological processes that occur within a wetland and the surrounding landscape (Sheldon et al 2005). Wetlands in the landscape provide essential conditions for growth of obligate and facultative-wetland plant species. Wetlands also provide habitat for reptiles, amphibians, birds, and mammals. Wetland scientists generally acknowledge that wetlands perform the following eight functions: 1) flood/storm water control, 2) base stream flow/groundwater support, 3) erosion/shoreline protection, 4) water quality improvement, 5) general habitat functions, 6) specific habitat functions, 7) cultural and socioeconomic values, and 8) natural biological support. Natural biological support refers to the ability to support diverse lifeforms, and is based on a wetland's vegetation structure and diversity, landscape-scale connectivity, surface water conditions, and organic accumulation and export potential (Cooke Scientific Services 2000). Wetland functions for flood and stormwater control, erosion protection, and water quality improvement are particularly valuable to protect infrastructure and limit the effects of development on water quality in the area's streams, rivers, and lakes.

The primary tools regulators rely on to conserve wetland functions and values are: accurate wetland identification and classification, buffer widths and composition, mitigation sequencing, compensatory mitigation, monitoring and maintenance periods, and financial surety.

Identification and classification

Per WAC 173-22-035, wetland delineations shall be conducted in accordance with the federal wetland delineation manual and applicable regional supplements. The U.S. Army Corps of Engineers (Corps) Wetland Delineation Manual (Corps 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0* (Regional Supplement) (Corps May 2010) should be the applied methodology.

The Washington Department of Ecology (Ecology) Washington State Wetland Rating System is the most commonly used and regionally-accepted wetland classification system. This rating system was last updated in June 2014 (Hruby 2014; Ecology Publication No. 14-06-019). It is a four-tier wetland rating system, which grades wetlands on a points-based system in terms of functions and values. Ecology specifically developed this tool to allow for relatively rapid wetland assessment while still providing some scientific rigor (Hruby 2004). This rating system

incorporates other classification elements, such as Cowardin (Cowardin et al. 1979), hydrogeomorphic) classifications (Brinson 1993), and special characteristics such as bogs and mature forests. As described in the Ecology Rating System guidance: “This rating system was designed to differentiate between wetlands based on their sensitivity to disturbance, their significance, their rarity, our ability to replace them, and the functions they provide” (Hruby 2004, Hruby 2014). The rationale for each wetland category under the Ecology Rating System is described below.

- Category I: These are the most unique or rare high-functioning wetland types that are highly sensitive to disturbance and/or relatively undisturbed wetlands with functions that are impossible to replace in a human lifetime.
- Category II: These wetlands are high functioning and difficult, though not impossible, to replace, and provide a high level of some functions.
- Category III: These wetlands provide a moderate level of functions and can often be adequately replaced with a well-planned mitigation project. They have generally been disturbed in some way and are characterized by landscape fragmentation and less diversity.
- Category IV: These wetlands are low functioning and can be replaced or improved. They are characterized by a high level of disturbance and are often dominated by invasive weedy plants.

Wetland categorization provides an important tool for managing impacts. “The intent of the rating categories is to provide a basis for developing standards for protecting and managing the wetlands. Some decisions that can be made based on the rating include the width of buffers needed to protect the wetland from adjacent development and permitted uses in, and around, the wetland” (Hruby 2014).

Wetland Buffers

Buffers are vegetated areas next to an aquatic resource that can protect it from or reduce the impacts of adjacent land uses. Buffers also provide terrestrial habitat for wetland-dependent species that need both aquatic and terrestrial habitats for their life-cycle (Sheldon et al. 2005; Hruby 2013). Widely recognized buffer functions include limited moderation of precipitation and stormwater inputs (hydrology maintenance), removal of sediment, excess nutrients, and toxic substances (water quality improvement), influencing microclimate, maintaining adjacent habitat critical for wetland-dependent species, maintaining habitat connectivity (wildlife habitat), and screening adjacent disturbances (disturbance barrier) (Sheldon et al. 2005). The factors that influence the performance of a buffer include vegetative structure, percent slope, soils, and buffer width and length. The scientific literature identifies four primary factors important in determining buffer width to adequately protect wetlands. These are 1) the functions and values of the subject wetland, 2) the characteristics of the buffer itself, 3) the intensity of surrounding land uses and their expected impacts and 4) the specific functions the buffer is intended to provide (Sheldon et al. 2005). Protection of wetland functions from effects

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of surrounding land uses is most commonly achieved through fixed buffers related to wetland functions.

A synthesis of scientific studies summarizing, among other wetland topics, effectiveness of various buffer widths relevant to Western Washington was published by the Washington State Department of Ecology (Sheldon et al. 2005). Water quality is the wetland function that has been studied most comprehensively in the context of adequate buffer width. Water movement and quantity, habitat, and disturbance protection functions have been addressed to a lesser extent. General studies on stream buffer widths were also deemed relevant to discussions of wetland buffer widths because a vegetated buffer often operates independently of the sensitive area it is intended to protect, particularly for “sink” functions such as sediment and pollutant removal. The effective buffer width ranges given below (Table 4-2-1) are broad and variations are largely dependent on buffer condition, landscape setting, and specific metrics. For example, effective buffer widths for water quality functions vary depending on the physical (slope and soil conditions), chemical (nutrient or contaminant loads), or biological (pathogens) conditions and input being treated. Similarly, effective buffer widths for wildlife habitat functions vary depending on the animal species the buffer is intended to protect.

Table 4-2-1. Range of Effective Wetland Buffer Widths in Existing Literature for Applicable Functions

Function	Range in meters (feet) of Effective Buffer Widths	Sources Consulted
Stormwater control (hydrology maintenance)	15-90 m (50-300 feet) (generally); vegetative structure and impervious surface in basin are more important factors	Wong and McCuen 1982; McMillan 2000; Azous and Horner 2001
Erosion control	Unknown: wetland size and buffer type are more important factors	Cooke Scientific Services 2000; Kleinfelter et al. 1992, in McMillan 2000
Water quality	5-100 m (15-325 feet)	Horner and Mar 1982; Lynch et al. 1985; Lee et al. 1999; Shisler et al. 1987, in McMillan 2000; Dillaha and Inamdar 1997; Daniels and Gilliam 1996; Magette et al. 1989; Sheldon et al. 2005
Wildlife habitat	14-90 m (45-300 feet)	Castelle et al. 1992b; Desbonnet et al. 1994; Semlitsch 1998; Richter 1997, in McMillan 2000; Cooke 1992
Disturbance barrier	14-60 m (45-200 feet)	Cooke 1992; Shisler et al. 1987, in McMillan 2000; Desbonnet et al. 1994

The synthesis of science review for buffers was re-evaluated by Ecology in 2013 (Hruby 2013). Most of the conclusions from the 2005 literature review are still valid (Sheldon et al. 2005; Hruby 2013). The primary conclusions of the 2013 review are as follows.

- Wetland buffer effectiveness at protecting water quality varies in conjunction with several factors, including width, vegetation type, geochemical and physical soil

- properties, source and concentration of pollutants, and path of surface water through the buffer.
- Wider buffers are generally higher functioning than narrower buffers.
 - Depending on site-specific environmental factors, different buffer widths may be needed to achieve the same level of protection.
 - To protect wetland-dependent wildlife, a broader landscape-based approach that considers habitat corridors and connections is necessary.
 - Many animals, particularly native amphibians, require undisturbed upland habitats for their survival (Hruby 2013).

As noted above, the Wetland Rating System was developed to categorize wetlands in accordance with the level of sensitivity and significance, and the categories may be used as a tool to assign appropriate buffer widths. For example, it is appropriate to provide the greatest buffer protection for the highest functioning wetlands that are most difficult to replace. In addition, because habitat protection requires the large buffers to protect the most vulnerable and sensitive species, those wetlands with higher habitat scores warrant wider buffers. On the other hand, lower functioning wetlands with low habitat scores typically primarily support water quality functions, and buffers at the smaller end of the range would tend to provide adequate protection for those functions. Buffers at the smaller end of the scale may be appropriate for small, structurally simple wetlands, with fragmented landscape connections resulting from adjacent development in the County.

Based on the above type of rationale, Ecology developed recommended buffer width management strategies in Appendix 8-C of Wetlands in Washington State, Volume 2 – Protecting and Managing Wetlands (Granger et al. 2005). Hruby's 2013 literature review of wetland buffer science did not prompt any new buffer width recommendations, although Ecology has updated its buffer width recommendations to correspond with the current outputs of the Wetland Rating System for Western Washington (Hruby 2014).

Mitigation Sequencing

To bolster protection of our national wetland resources, no net loss policy was adopted in 1988 and has been upheld through the present administration. The no net loss policy requires a balance between wetland loss due to development and wetland mitigation to prevent further loss of the country's total wetland acreage. In 2008, the U.S. Environmental Protection Agency (EPA) issued the Wetlands Compensatory Mitigation Rule. This rule emphasizes BAS to promote innovation and focus on results.

Wetland mitigation is typically achieved through a series of steps known as mitigation sequencing, a sequence of steps taken "to reduce the severity of an action or situation" (Ecology et al. 2006). Ecology recommends that the CAO contain clear language regarding mitigation sequencing. The mitigation sequence according to the implementing rules of the State Environmental Policy Act (SEPA) (Chapter 197-11-768 WAC) follows:

- (1) Avoiding the impact altogether by not taking a certain action or parts of an action;

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- (2) Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;
- (3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- (4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
- (5) Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or
- (6) Monitoring the impact and taking appropriate corrective measures.

Compensatory Mitigation

Per Ecology, compensatory mitigation should replace lost or impacted wetland and buffer functions, unless out-of-kind mitigation can meet formally identified goals for the watershed. Ecology recommends prioritizing mitigation actions, location(s), and timing.

Mitigation Actions

Following mitigation sequencing, after demonstrating that a proposed wetland impact is unavoidable and has been minimized to the extent practical, compensatory mitigation is required by local, state and federal agencies. In general order of preference the agencies recommend wetland compensation in the form of: 1) re-establishment or rehabilitation, 2) creation (establishment), 3) enhancement, and 4) preservation (Ecology et al. 2006).

Wetland re-establishment or rehabilitation occurs when a historic or degraded wetland is returned to a naturally higher functioning system through the alteration of physical or biologic site characteristics. Re-establishment is typically achieved by restoring wetland hydrology; this may include removing fill or plugging ditches. Re-establishment achieves a net gain of wetland acres. Rehabilitation is achieved by repairing or restoring historic functions in a degraded wetland. Restoring a floodplain connection to an existing wetland by breaching a dike is an example of rehabilitation. Rehabilitation does not result in new wetland area.

Wetland creation is the development of a wetland at a site where a wetland did not naturally exist. Proximity to a reliable water source and landscape position are key design requirements for successful wetland creation (Ecology et al. 2006).

Both wetland enhancement and preservation result in a net loss of wetland acreage. Wetland enhancement typically increases structural diversity within a wetland, thus improving functions. Preservation of high functioning wetland systems in danger of decline may also be proposed as mitigation. While enhancement and preservation do not increase wetland acreage, these actions may result in long-term functional gains (Ecology et al. 2006).

Mitigation Ratios

Mitigation ratios are intended to replace lost functions and values stemming from a proposed land use while also accounting for temporal losses. Mitigation ratios recommended by Ecology in 2005 for wetland impacts can be found in Table 4-2-2 below. As noted above, the Corps and Ecology have a mandate to maintain “no net loss” of wetlands. To that end, wetland creation and restoration are preferable to enhancement alone. Ecology guidance does allow for enhancement as sole compensation for wetland impacts at quadruple the standard ratio (Granger et al. 2005). The higher ratios for enhancement-only are intended to encourage actions that maintain existing wetland acreage and to ensure sufficient area of enhancement to retain wetland functions and values when a net loss of wetland acreage results.

Table 4-2-2. Ecology Recommended Mitigation Ratios (Granger et al. 2005)*

Category of Wetland Impacted	Creation	Re-establishment-Rehabilitation Only	Creation and Rehabilitation	Creation and Enhancement	Enhancement Only
Category IV	1.5:1	3:1	1:1 C and 1:1 RH	1:1 C and 2:1 E	6:1
Category III	2:1	4:1	1:1 C and 2:1 RH	1:1 C and 4:1 E	8:1
Category II	3:1	6:1	1:1 C and 4:1 RH	1:1 C and 8:1 E	12:1
Category I: Forested	6:1	12:1	1:1 C and 10:1 RH	1:1 C and 20:1 E	24:1
Category I: Bog	Not possible	6:1 RH of a bog	Not possible	Not possible	Case-by-case
Category I: based on total functions	4:1	8:1	1:1 C and 6:1 RH	1:1 C and 12:1 E	16:1 E

*This document, Appendix 8-C of *Wetlands in Washington State, Volume 2 – Protecting and Managing Wetlands* (Granger et al. 2005).

Legend: C = Creation, RH = Rehabilitation, E = Enhancement

Credit-Debit Method

To give regulators and applicants a functions-based alternative to set mitigation ratios, the Washington State Department of Ecology recently developed a tool called the credit-debit method. This method, like the Ecology wetland rating form, is a peer reviewed rapid assessment tool. The credit-debit approach may be used to calculate functional gain of the proposed mitigation and functional loss due to proposed wetland impacts. This generates acre-points that can be compared in a balance sheet. Depending on specific site conditions, this may result in less or more mitigation than would be required under a set the standard mitigation ratio guidance (Hruby 2011). Both the ratios from Table 4-2-2 and the Credit-Debit Method are scientifically defensible methods to calculate required compensatory mitigation.

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At present, the credit-debit method is used primarily for calculating credits for mitigation banks and in-lieu fee programs. Other local jurisdictions still use mitigation ratios, as described above, yet many also allow the use of the credit-debit method to enable use of mitigation banks and in lieu fee programs. Because it is still early in the application of the credit-debit method, it is difficult to directly compare the outcomes of the credit-debit approach to use of mitigation ratios. Because it is a site-specific tool, it is expected that the credit-debit approach may result in higher or lower mitigation requirements relative to mitigation ratios depending on specific site conditions.

Mitigation Location

The Agencies (Ecology, Corps, and the U.S. Environmental Protection Agency Region 10) recommend selecting mitigation sites based on proximity to the impact and potential ability to replace impacted functions. In order of preference, a mitigation site should be:

“in the immediate drainage basin as the impact, then the next higher level basin, then the other sub-basins in the watershed with similar geology, and finally, the river basin” (Ecology et al. 2006).

In the past decade, national and state policies have shifted toward using a broader scale approach for mitigation site selection. A recent forum convened by Ecology and composed of regulators, businesses, and environmental/land use professionals recommend that local jurisdictions “establish an ecosystem- or watershed-based approach to mitigation” (Ecology 2008). The ecosystem and watershed-based approach to mitigation looks beyond the property where the impact is proposed to evaluate if off-site compensatory mitigation within the local watershed is a viable option and would have greater benefit to ecosystem functions in the long-term. This is becoming more relevant as land use intensity increases and on-site mitigation has the potential to be more isolated on a landscape-scale, thus reducing some functional potential. Due to the limited success of on-site mitigation, particularly in highly developed areas, a broader watershed scale approach is increasingly desirable and is viewed by the regulatory agencies as more sustainable (Ecology 2008). To guide practical applications of BAS-based compensatory mitigation, the Agencies issued an Ecology publication, *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby et al. 2009). As noted by Azous and Horner 2001 (in Hruby et al. 2009), recreating or maintaining wetland functions in a highly developed landscape may not be sustainable. To account for this, the watershed approach may require a combination of on- and off-site mitigation to achieve functional gains equivalent to the proposed losses (Ecology et al. 2006).

Mitigation Timing

Mitigation actions may occur concurrent with the impact or before project impacts. The mitigation ratios provided by Ecology (Table 4-2-2) assume concurrent mitigation actions. The amount of mitigation required may be reduced for an advanced mitigation project that reduces the temporal loss of functions. In other words, compensatory mitigation that is completed at the time of impact will take several years to reach full functions; however, when mitigation is completed in advance of the impact, the mitigation area will be more mature and higher

functioning at the time the impact occurs. Because the lag period between impact and mitigation is reduced or eliminated with advance mitigation, mitigation ratios may be reduced.

Compensatory Mitigation Approach

Compensatory mitigation can occur through permittee-responsible mitigation (on-site or off-site), mitigation banks, or in-lieu fee programs. In recent years, with permittee-responsible mitigation as the typical approach, several studies have concluded that despite regulatory mechanisms to ensure “no net loss” of wetlands, substantial loss has occurred, both in terms of wetland area and wetland functions (Turner et al. 2001, Johnson et al. 2002, Matthews and Endress 2008). Losses through compensatory mitigation have been attributed to poor restoration success (Race and Fonseca 1996, Turner et al. 2001, Johnson et al. 2002) and a lag time between impacts and mitigation (Bendor 2009).

The increased establishment and use of wetland mitigation banking and in-lieu fee programs has been proposed as a solution to the issues that affect on-site mitigation because 1) regulators can devote more time to monitoring and ensuring the success of mitigation banks, 2) mitigation bank sites are generally situated in an ecologically significant area, and 3) mitigation banks tend to aggregate projects into larger wetlands that may provide more functions than small, isolated wetlands (Bendor and Brozovic 2007; Keddy et al. 2009). The Agencies have stated that, “Mitigation banks provide an opportunity to compensate for impacts at a regional scale and provide larger, better-connected blocks of habitat in advance of impacts” (Ecology et al. 2006). Mitigation banks are also advantageous because mitigation credits generally become available in stages as the wetland permit conditions are met and restoration is successful. This helps minimize the lag time that can create a temporal loss in wetland function (Race and Fonseca 1996, Bendor 2009). Based on this and similar rationale, in 2008, EPA and the U.S. Army Corps of Engineers jointly promulgated regulations revising and clarifying requirements regarding compensatory mitigation, and establishing a the following hierarchal preference for implementation of compensatory mitigation:

- 1 Mitigation banks
- 2 In-lieu fee programs
- 3 Permittee-responsible mitigation under a watershed approach
- 4 Permittee-responsible mitigation through on-site and in-kind mitigation
- 5 Permittee-responsible mitigation through off-site or out-of-kind mitigation

Despite the theoretical merits of wetland banking, early studies of wetland banking success were largely equivocal in terms of its documented merits (Mack and Micacchion 2006, Reiss et al. 2009). A review of vegetative metrics of wetland banks from around the United States found that only 63 percent of mitigation banks over five years old would be considered successful (Spieles 2005). It is expected that the success rate has improved since that 2005 study as wetland mitigation banking has become more common.

In Cowlitz County, Ecology and the Corps are reviewing the Coweeman River Wetland Mitigation Bank in Kelso. This bank would likely serve the entire Cowlitz watershed (WRIA

26). In neighboring Clark County, Ecology and the Corps are reviewing the Wapato Valley Mitigation and Conservation Bank, with a proposed wetland service area that includes the entire Lewis River watershed (WRIA 27), as well as the Columbia River to its mouth, and the lower reaches of the Cowlitz and Coweeman Rivers. This bank is also proposed to provide conservation credits for ESA-listed salmonids within a service area to include the full extent of anadromy in WRIA 26, as well as WRIA 27, and the Columbia River mainstem. The service area for the certified Columbia River Wetland Mitigation Bank extends into Cowlitz County along the Columbia River. To the north, in Lewis County, two mitigation banks serve the Upper Chehalis Watershed.

Approved mitigation banks go through a rigorous state certification process. The certification process includes financial assurance requirements. Oversight from Ecology, the Corps, and other relevant agencies and a phased release of bond funds as mitigation bank performance standards are achieved help support mitigation success.

Another mitigation option is an in-lieu fee program. In-lieu fee programs are similar to mitigation banks, except that projects are implemented after credits are purchased, rather than before. In-lieu fee programs are operated by public agencies rather than private entities. Cowlitz County does not presently have an in-lieu fee program, but it could develop one in the future.

From an economic perspective, it may be more cost effective for small projects to pay a third party for mitigation credits than to proceed with the design, permitting, and implementation of a small mitigation project (Bendor and Brozovic 2007). However, where mitigation banks include the cost of land acquisition credits tend to cost significantly more than on-site mitigation. Accordingly, large projects may be able to plan, permit, and implement a large mitigation project for less than the cost of mitigation bank credits.

The County may wish to develop a policy prioritizing use of on-site versus off-site mitigation. In addition to the concepts presented above related to reduced risk, greater oversight, and watershed significance of mitigation banking and in-lieu fee programs, the following considerations should factor into such a policy. From a landscape perspective, mitigation banking has a tendency to drive wetland mitigation from urban to rural areas (Bendor and Brozovic 2007). This migration may be driven by the lower cost of land in rural areas compared to urban areas or the availability of large areas of land for wetland restoration in rural areas (Bendor and Brozovic 2007; Robertson and Hayden 2008). A shift from small, urban wetlands to larger, rural wetlands may allow for a net increase in functions; however, small urban wetlands provide significant water quality functions and may be particularly important for controlling flooding in highly urbanized environments (Boyer and Polasky 2004). Urban wetlands may also provide recreational and educational opportunities and aesthetic values (Ehrenfeld 2000). Finally, developing urban wetlands may entail high "opportunity costs," meaning that once lost they will be difficult to replace because of the high price of land in urban areas (Boyer and Polasky 2004).

Mitigation Success

The Agencies recommend requiring financial assurances to ensure the success of a mitigation project. “Financial assurances may take the form of performance bonds or letters of credit. Applicants should check with their local planning department to determine if the local government will require performance bonds or other forms of financial assurances. A bond should estimate all costs associated with the entire compensatory mitigation project, including site preparation, plant materials, construction materials, installation oversight, maintenance, monitoring and reporting, and contingency actions expected through the end of the required monitoring period” (Ecology et al. 2006).

Compensatory mitigation projects should be protected in perpetuity. Legal mechanisms, such as deed restrictions and conservation easements, are typically used to achieve this (Ecology et al. 2006).

Additionally, physical site protection may be needed to keep people, pets, and equipment out of mitigation sites. Split-rail fencing and/or critical area signs indicating that the area should not be disturbed are typically required for site protection (Ecology et al. 2006).

5 FISH AND WILDLIFE HABITAT CONSERVATION AREAS

Fish and Wildlife Habitat Conservation Areas are defined in WAC 365-190-030(6a), as:

“areas that serve a critical role in sustaining needed habitats and species for the functional integrity of the ecosystem, and which, if altered, may reduce the likelihood that the species will persist over the long term. These areas may include, but are not limited to, rare or vulnerable ecological systems, communities, and habitat or habitat elements including seasonal ranges, breeding habitat, winter range, and movement corridors; and areas with high relative population density or species richness.”

Per WAC 365-190-130(2), the following areas must be considered for classification and designation as FWHCAs:

- Areas important to endangered, threatened, and sensitive species;
- Habitats and species of local importance, as determined locally;
- Commercial and recreational shellfish areas;
- Kelp and eelgrass beds;
- Forage fish spawning areas;
- Naturally occurring ponds under twenty acres;
- Waters of the State as defined in RCW 90.48.020;
- Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity; and
- State natural area preserves, natural resource conservation areas, and State wildlife areas.

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Commercial and recreation shellfish areas and kelp and eelgrass beds do not exist in Cowlitz County. In addition to those areas identified in the above list, counties and cities must also give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries (WAC 365-190-080).

Under the County's existing FWHCA's, the following criteria must be met for a species to qualify as a Habitat of Local Importance (CCC 19.15):

"Habitat: Unique or significant habitats which regionally rare wildlife species depend upon and that have high wildlife concentrations, including:

- Caves,
- Talus slopes,
- Snag-rich areas (outside forest practices)."

These areas are also a subset of state-listed priority habitats, which are presently all included as FWHCAs, discussed below.

Under the County's existing FWHCA's, the following criteria must be met for a species to qualify as a Species of Local Importance (CCC 19.15):

"Species: Wildlife species which require protective measures for their continued existence due to their population status or sensitivity to habitat alterations or are highly valued by the local citizens. Species meeting the above criteria but not depending upon a habitat of local importance (as listed above) to meet criteria habitat needs are those documented, verified, and mapped in Cowlitz County."

Under the current Cowlitz County Code (CCC) 19.15.130-A, all state priority habitats and habitats associated with state priority species are designated as FWHCAs. Priority species, as designated by WDFW are species that require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include state endangered, threatened, sensitive, and candidate species; animal aggregations (e.g., heron colonies, bat colonies) considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable.

5.1 Existing Conditions

Habitats and Vulnerable Species

Priority wildlife species and habitats, as reported to occur in Cowlitz County by WDFW are identified in Table 5-1-1. The habitats of sensitive, threatened, and endangered species (bolded in Table 5-1-1) are required to be protected under FWHCAs; however, other priority habitats and species and rare plant species may be considered for protection under species and habitats of local importance. Discussion in Section 5.2 of this report addresses management recommendations for aquatic habitats and species. Management recommendations from

WDFW are also referenced for priority habitats and species groups in Table 5-1-1. Where WDFW management recommendations do not apply, species-specific management recommendations and/or species background information are referenced in Table 5-1-1.

Table 5-1-1. Priority species and habitats in Cowlitz County (WDFW 2013).

Type	Species/ Habitats	State Status	Federal Status	Additional Management Recommendations
Habitats	Management recommendations in Rodrick and Milner, eds. 1991, See below for discussion of riparian and instream recommendations			
	Aspen Stands			
	Biodiversity Areas & Corridors			
	Caves			
	Cliffs			
	Freshwater Wetlands & Fresh Deepwater			
	Herbaceous Balds			
	Instream			
	Old-Growth/Mature Forest			
	Oregon White Oak Woodlands			Larson and Morgan 1998.
	Riparian			
	Snags and Logs			
	Talus			
West Side Prairie				
Fishes	See Section 5.2 for discussion of best available science for the protection of aquatic habitats			
	Bull Trout	Candidate	Threatened	
	Chinook Salmon	Candidate	Threatened (Upper Columbia Spring - Endangered)	
	Chum Salmon	Candidate	Threatened	
	Coastal Res./ Searun Cutthroat		Species of Concern	
	Coho		Threatened – Lower Columbia	
	Eulachon	Candidate	Threatened	NMFS 2011, WDFW and ODFW 2001
	Green Sturgeon		Threatened	NMFS 2002

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Type	Species/ Habitats	State Status	Federal Status	Additional Management Recommendations
	Kokanee			
	Leopard Dace	Candidate		
	Mountain Sucker	Candidate		
	Pacific Lamprey		Species of Concern	
	Pink Salmon			
	River Lamprey	Candidate	Species of Concern	
	Sockeye Salmon	Candidate	Endangered – Snake River	
	Steelhead	Candidate	Threatened	
	White Sturgeon			
Amphibians	Management recommendations in Larsen, ed. 1997, Also see section 4.2 for a discussion of wetlands			
	Cascade Torrent Salamander	Candidate		
	Dunn's Salamander	Candidate		
	Larch Mountain Salamander	Sensitive	Species of Concern	WDFW 1994
	Van Dyke's Salamander	Candidate	Species of Concern	
	Western Toad	Candidate	Species of Concern	Zevit and Wind 2010
Reptiles	Management recommendations in Larsen, ed. 1997, Also see section 4.2 for a discussion of wetlands			
	Pacific Pond Turtle (also known as Western Pond Turtle)*	Endangered	Species of Concern (under review)	WDFW 1999
Birds	Management recommendations in Larsen et al., eds. 2012, Also see discussion of wetlands in section 4.2 and riparian areas in section 5.2, which provide habitats for many birds			
	Bald Eagle	Sensitive	Species of Concern	USFWS 2007
	Band-tailed Pigeon			
	Cavity-nesting ducks: Wood Duck, Barrow's Goldeneye, Common Goldeneye, Bufflehead, Hooded Merganser			

Type	Species/ Habitats	State Status	Federal Status	Additional Management Recommendations
	Golden Eagle	Candidate		
	Great Blue Heron			
	Harlequin Duck			
	Marbled murrelet	Threatened	Threatened	USFWS 1997
	Northern Goshawk	Candidate	Species of Concern	
	Peregrine Falcon	Sensitive	Species of Concern	
	Pileated Woodpecker	Candidate		
	Purple Martin	Candidate		
	Sandhill Crane	Endangered		WDFW 2002
	Slender-billed White-breasted Nuthatch	Candidate	Species of Concern	WDFW 2012 Slater and Altman 2006
	Sooty Grouse			Schroeder 2010
	Spotted Owl	Endangered	Threatened	USFWS 2011
	Trumpeter Swan			PFC 2006
	Tundra Swan			PFC 2001
	Vaux's Swift	Candidate		
	Waterfowl Concentrations			
	Western grebe	Candidate		WDFW 2012
	Western WA nonbreeding concentrations of: Charadriidae, Scolopacidae, Phalaropodidae			
	Western Washington nonbreeding concentrations of: Barrow's Goldeneye, Common Goldeneye, Bufflehead			
	Wild Turkey			
Mammals	Management recommendations in Azerrad, ed. 2004, Also see discussion of riparian areas in 5.2, which provide riparian corridors for many mammals			
	Columbian Black-tailed Deer			ODFW 2008 Brookshier 2004
	Columbian White-tailed Deer	Endangered	Endangered	
	Elk			WDFW 2014,
	Fisher**	Endangered	Candidate, proposed	WDFW 2006

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Type	Species/ Habitats	State Status	Federal Status	Additional Management Recommendations
			Threatened (2014)	
	Harbor Seal			NOAA 2011
	Marten			Vasquez and Spicer 2005
	Roosting Concentrations of: Big-brown Bat, Myotis bats, Pallid Bat			Ferguson and Azerrad 2004, Hayes and Wiles 2013
	Townsend's Big-eared Bat	Candidate	Species of Concern	Woodruff and Ferguson 2005
	Wolverine	Candidate		IDFG 2014
Invertebrates	Management recommendations in Larsen et al., eds. 1995			
	Blue-gray Taildropper	Candidate		Burke 1999
	Valley Silverspot	Candidate	Species of Concern	

* The Pacific pond turtle is presently extirpated from Cowlitz County. The nearest known populations are in Klickitat and Skamania Counties.

** The fisher is likely extirpated in Cowlitz County

<http://explorer.natureserve.org/servlet/NatureServe?searchName=Martes+pennanti>

The meaning of state and federal statuses are described as follows:

- Federal Endangered: a species in danger of extinction throughout all or a significant portion of its range
- Federal Threatened: a species likely to become endangered in the foreseeable future throughout all or a significant portion of its range
- Federal Species of Concern: informal term, not defined in the federal Endangered Species Act, which commonly refers to species that are declining or appear to be in need of conservation
- State Endangered: wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state
- State Threatened: wildlife species native to the state of Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats
- State Sensitive: wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats

- State Candidate: fish and wildlife species that the Department will review for possible listing as State Endangered, Threatened, or Sensitive
- State Monitor: species that require management, survey, or data emphasis for one or more of the following reasons:
 - They were classified as endangered, threatened, or sensitive within the previous five years.
 - They require habitat that is of limited availability during some portion of their life cycle.
 - They are indicators of environmental quality.
 - There are unresolved taxonomic questions that may affect their candidacy for listing as endangered, threatened, or sensitive species.

Table 5-1-2 provides a summary of subbasins within the WRIAs in Cowlitz County, as well as anadromous salmonids associated with each basin.

Table 5-1-2. Summary of Cowlitz County subbasins from the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan and the Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22 and 23 (2010) (Fish status identified above in Table 5-1-1).

WRIA	Subbasin	County(s)	Watershed Area	Elevation (max)	Historic Anadromous Stream Miles	Anadromous Fish Species ¹
23	South Fork Chehalis	Cowlitz, Pacific, Grays Harbor, Thurston, Lewis	1,300 mi ²	2,400 ft*	5*	Coho, STW
25	Mill, Abernathy, Germany	Cowlitz, Wahkiakum	100 mi ²	1300 ft	110	CHF, Chum, Coho, STW
26	Cowlitz (lower)	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
27	Kalama	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

State Natural Area Preserves, Natural Resource Conservation Areas, and State Wildlife Areas

There are no State Natural Area Preserves in Cowlitz County.

Merrill Lake is a 114-acre Natural Resource Conservation Area managed by DNR.

The Mount Saint Helens Wildlife Area, managed by WDFW contains several management units that are within Cowlitz County. Abernathy Creek, Fisher Island, Nelson, Hall Road, Canal Road, Gardner and Mount Saint Helens are all management units within Cowlitz County.

Watershed-specific discussion

General watershed conditions and major modifications to watershed functions and processes are described by Water Resource Inventory Area (WRIA) in the following sections. This section encompasses a discussion of watershed processes, major modifications, known occurrence of vulnerable habitats and species, and documented water quality impairments.

Columbia River

The Columbia River is a shoreline of statewide significance, and as such, it is managed under the Shoreline Master Program. A detailed discussion of the Columbia River is included in the Cowlitz County Shoreline Analysis Report (Shoreline Analysis Report 2014), a summary of which is included here.

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). However, 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. 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). 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, 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 and limited the natural formation of new estuarine marshes (Bottom and Simenstad 2001, 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).

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.

Grazing and farming activities along the estuarine floodplain 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.

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). Current wild populations of salmon in the Columbia River basin represent only 12 percent of their historic numbers (Bottom *et al.* 2005).

Eulachon (smelt) 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 (NMFS 2011). The mainstem of the lower Columbia River provides spawning and incubation sites, as well as a migratory corridor to spawning areas in the tributaries.

In addition to listed salmonids, sensitive species documented to use the Columbia River in Cowlitz County include nesting bald eagles and peregrine falcons. Sandhill cranes are a state endangered species known to overwinter along the Columbia River area in Cowlitz County (WDFW 2002). Green sturgeon are federally threatened and occur in the Columbia River up to the Bonneville Dam (USFWS 2002). Columbian White Tailed Deer are state and federally endangered and occur on islands and low lying mainland areas adjacent to the Columbia River. There are no other documented occurrences of sensitive, threatened or endangered species in the Columbia River area in Cowlitz County. However, other species that are not mapped or documented may occur.

The Columbia River within Cowlitz County is listed as impaired (303(d) list) for bacteria, temperature, dieldrin, and PCBs (Ecology 2012). The Columbia River also has Total Maximum Daily Loads (TMDLs) for total dissolved gas and dioxin that are approved and actively being implemented (Category 4a).

Lewis Watershed

Precipitation in the Lewis River Watershed 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).

The Kalama watershed and Cowlitz County-portion of the Lewis watershed together are 95 percent forested. The remaining land uses are agricultural (3.7 percent) and residential (less

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than one percent)(SWLWMP 2006). Agricultural land is concentrated in the lower watersheds, near the Columbia River.

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, it is estimated that greater than 50% of the historic floodplain has been disconnected from the river, especially in the lower river where extensive diking has almost entirely disconnected floodplains. Despite significant degradation of natural functions of the lower Lewis River, the agricultural fields in the area do likely provide winter foraging habitat for migratory birds. Riparian vegetation is largely lacking in the lower watershed as a result of levees and floodplain development (Wade 2000). Where human disturbance occurs in the upper Lewis River watershed, it is typically limited in extent and associated with small tributaries or sheltered coves.

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).

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 lower reaches of Speelyai Creek support an important Kokanee spawning area and the Lewis River Hatchery.

The Lewis River Watershed has produced very large eulachon 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). The Lewis River, from the confluence with the Columbia River upstream to Merwin Dam is designated critical habitat for eulachon by the National Marine Fisheries Service.

In addition to listed salmonids, sensitive and endangered birds documented to occur in the Lewis watershed within Cowlitz County include nesting bald eagles and northern spotted owls. The state-listed sensitive Larch Mountain salamander has been documented in locations

surrounding Yale Lake. Other sensitive, threatened or endangered species that are not mapped in the area may occur.

Water quality impairments identified in the state 303(d) list within the Lewis River watershed in Cowlitz County are noted in Table 5-1-3.

Table 5-1-3. Summary of water quality impairments in the Lewis River watershed in Cowlitz County - State 303 (d) Listed (Ecology 2012).

Parameter Exceeding Water Quality Standards	Waterbody
Temperature	Kalama River
Total Dissolved Gas	Lewis River Swift Creek #2 Power Canal
PCB	Merwin Lake

Kalama Watershed

Hydrology in the Kalama River watershed 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). The Kalama River shoreline area includes extensive palustrine and riverine tidal channels.

The Kalama watershed is heavily-forested. Approximately 96 percent of the Kalama River Watershed is owned and managed by private timber companies. Extensive industrial development has occurred within the historic floodplains in the lower two miles of the Kalama, especially to the west of I-5. 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.

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.

Riparian conditions in the watershed are mostly impaired due to logging, but they are slowly improving in the watershed due to improved management programs detailed in the Forests and Fish report.

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The extent of eulachon spawning within the Kalama River extends from the confluence with the Columbia River to the confluence with Indian Creek (NMFS 2011). In addition to listed salmonids, sensitive and threatened bird species exist in the Kalama Watershed including bald eagles and northern spotted owls. Other sensitive, threatened or endangered species that are not mapped in the area may occur.

In smaller tributaries within the Kalama Watershed, hyporheic functions are diminished compared to the mainstem river functions because of the steeper terrain and sediment composition. The area surrounding Merrill Lake is primarily undeveloped and surrounded by steep slopes and unstable soils.

The Kalama River is listed as impaired (303(d) list) for temperature (Ecology 2012). The Kalama watershed also has one 303 (d) Category 4c listing. A category 4c listing is an impairment by a non-pollutant such as low-flow, channelization and aquatic weeds. Kress Lake is impaired with Eurasian water-milfoil (*Myriophyllum spicatum*).

Cowlitz Watershed

Hydrology in the Cowlitz River Watershed is driven primarily by rainfall. The upper reaches receive snowfall, and rain-on-snow events drive peak flow events. Glaciers in the upper reaches contribute to summer flows. The three dams on the Cowlitz have substantially reduced peak flows and have also served to increase low summer flows (LCFRB).

Forestry is by far the most dominant land use for all subbasins within the Cowlitz watershed. Despite a history of logging, the watershed still includes several areas of mature forests. Whereas forestry tends to predominate in the upper watershed, agricultural uses are also common in the floodplain valleys within the watershed.

The 1980 eruption of Mount Saint 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. 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). The eruption wiped out areas of existing forests, which are now recovering in young vegetative conditions. The eruption 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).

Following the eruption, in response downstream flooding concerns, 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 132-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 SRS, the Corps raised the height of the spillway by seven feet in 2013 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 Saint Helens, two new 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. Below the confluence with the Toutle River, the Cowlitz River channel is extensively armored and diked, and most of the floodplain is disconnected.

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. Today, dam operations limit the frequency and intensity of flood flows and result in higher flows during the summer low-flow period. The Toutle and Coweeman Rivers are unregulated, contributing to flow variability in the lower Cowlitz River.

Many tributaries in the Cowlitz River watershed have experienced losses in key habitat areas and habitat diversity for most salmonid life-stages due to channel simplification and diking. 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 that are affected by ground disturbance, including road building and vegetation clearing. Elevated water temperatures and turbidity are a concern in the Coweeman watershed.

Populations of anadromous salmon, although present, are substantially reduced from historic numbers. Sturgeon and pacific lamprey are present in the lower reaches of the watershed in reduced numbers, and eulachon runs still occur cyclically. The Cowlitz River is likely the most productive and important spawning river for eulachon 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).

In addition to listed fish species, mapped occurrences of bald eagle and marbled murrelet nest sites are documented in the Cowlitz watershed. Two marbled murrelet nest sites are documented, one near Silver Lake, and another near the Cowlitz River near the northern boundary of the county. No other sensitive, threatened, or endangered species have mapped occurrences within the Cowlitz watershed. Other sensitive, threatened or endangered species that are not mapped in the area may occur.

Water quality impairments identified in the state 303(d) list within the Cowlitz River watershed in Cowlitz County are noted in Table 5-1-4. The Cowlitz watershed also has one 303 (d) Category 4c listing; Silver Lake is impaired with Brazilian elodea (*Egeria densa*).

Table 5-1-4. Summary of water quality impairments in the Cowlitz River watershed in Cowlitz County (Ecology 2012).

Parameter Exceeding Water Quality Standards	Waterbody
Temperature	Alder Creek Arkansas Creek Baird Creek Coweeman River Cowlitz River Delameter Creek Goble Creek Herrington Creek Hoffstadt Creek Mulholland Creek Ostrander Creek Ostrander Creek, S.F. Schultz Creek Turner Creek Unnamed Creek (Trib To Coweeman Creek)
2,3,7,8-TCDD	Cowlitz River Silver Lake
Mercury	Cowlitz River
PCB	Cowlitz River Silver Lake

Mill, Abernathy, Germany Creek Subbasin

This subbasin includes the Mill, Abernathy, Germany, Coal and Clark Creek watersheds and the Longview ditch network. The upper subbasin area is heavily-forested and largely managed for public and private industrial timber production. Except for the Clark Creek watershed between 88-99 percent of these watersheds are managed for industrial timber production (WRIA 25 SSHLF 2002). The Clark Creek watershed is also predominantly managed for industrial timber production, however, approximately 30 percent of land is used as rural residential on the fringe of City of Longview. Historic logging contributed to the degradation of riparian and instream habitat, although riparian and forest conditions are recovering. The middle elevations of the watershed have considerable agricultural and development impacts, including limited vegetated riparian areas and disconnected floodplains. The lower watershed of Germany Creek consists of predominantly agricultural land uses.

These watersheds are predominantly rain dominated. The Germany Creek watershed receives more snowfall than the other watersheds in this subbasin; approximately one-quarter of the

Germany Creek watershed area is dominated by rain on snow events. Riparian condition in Mill, Abernathy and Germany Creek subbasin is primarily fair or poor throughout the subbasin, and is especially degraded in the lower reaches of the Coal and Clark Creek watersheds in the West Longview residential area.

Salmonid species in the watershed 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. 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.

These watersheds provide habitat for endangered species including northern spotted owl and Columbian white tailed deer. No other sensitive, threatened or endangered species are mapped to occur within the Mill, Abernathy and Germany Creek watersheds. Other sensitive, threatened or endangered species that are not mapped in the area may occur.

Water quality impairments identified in the state 303(d) list within the Grays/Elochoman watershed in Cowlitz County are noted in Table 5-1-5. This subbasin also has two 303 (d) Category 4c listings; Solo Slough and Willow Grove Slough are impaired with a variety of invasive aquatic weeds.

Table 5-1-5. Summary of water quality impairments in the Grays/Elochoman watershed in Cowlitz County (Ecology 2012).

WRIA	Parameter Exceeding Water Quality Standards	Waterbody
25- Grays/Elochoman	Temperature	Abernathy Creek Cameron Creek Coal Creek Coal Creek, E.F. Delameter Creek Germany Creek Harmony Creek Longview Ditches Mill Creek Mill Creek, S.F. Monahan Creek Unnamed Creek (Trib To Coal Creek) Unnamed Creek (Trib To Coal Creek) Wiest Creek
	Bacteria	Germany Creek Longview Ditches Sacajawea Lake
	PCB	Sacajawea Lake

South Fork Chehalis Watershed

The dominant land use in the upper South Fork is commercial forestry, and lower river land use is predominately agricultural. 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 inches 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).

Both agricultural and forestry uses have resulted in significant alterations to the South Fork Chehalis River watershed. 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).

The South Fork Chehalis River is used by fall and spring Chinook salmon, coho salmon, cutthroat, and steelhead (Grays Harbor County Lead Entity 2011). Within Cowlitz County, only winter steelhead and coho salmon are documented (WDFW SalmonScape 2016).

The Cowlitz County portion of the South Fork Chehalis watershed does not feature any other mapped occurrences of sensitive, threatened or endangered species. However, sensitive, threatened or endangered species may occur.

5.2 Best Available Science for Protection of Functions and Values

The BAS review for the City of Woodinville Comprehensive Plan Update (The Watershed Company 2014) provided a full review of the general functions and values of streams, lakes, and associated riparian habitats, as well as recommendations for protecting those functions. The summary and discussion of literature in the BAS Review for the City of Woodinville ([here](#)) is considered to be generally applicable to the Cowlitz County. The discussion of functions and values of streams, lakes, and riparian areas is generally transferable to Cowlitz County, although it is noted that unincorporated Cowlitz County occurs in a more rural setting, and supports a distinct suite of vulnerable species. Additionally, landscape scale factors such as the 1980 eruption of Mount Saint Helens and dammed river systems impact fish passage, channel stability, and hydrologic regime in several portions of the county. In addition, the tidal freshwater habitats of the Columbia River and lower reaches of its tributaries support additional functions and values for fish species, as noted above. Despite these differences, the foundational science discussed in-depth in the referenced BAS review is generally applicable to Cowlitz County.

Riparian and In-stream Habitat Management

The review addresses the role of riparian areas in maintaining stream functions important for supporting diverse and productive fish populations. These functions relate to:

- Water quality (i.e. sediment, nutrients, metals, pathogens, herbicides, and pharmaceuticals)
- Water temperature and microclimate
- Bank stability
- Invertebrate communities
- Inputs of organic detritus
- Instream habitat complexity, including large woody debris
- Dynamic habitat corridors

Error! Reference source not found. summarizes the ranges of effective buffer widths based on each function, as described in the BAS Review for the City of Woodinville Comprehensive Plan Update (The Watershed Company 2014).

Table 5-2-1. Range of Effective Buffer Widths for Each Applicable Riparian Function

Function	Range of Effective Buffer Widths	Notes on Function
Water Quality		
Sediment	4-30 m (13-98 feet), up to 120 m (394 feet) for fine sediment	Filtration is widely variable depending on slope and soils.
Nutrients	Subsurface flow: not dependent on buffer width Surface flow: 15-131 m (49-430 feet)	In addition to buffer width, the rate of nutrient removal is dependent on infiltration, soil composition, and climate. Filtration capacity decreases with increasing loads, so best management practices that reduce nutrient loading will improve riparian function.
Metals	NA- Appropriate buffer width not established	Stormwater system improvements to slow and infiltrate runoff could help reduce metals entering aquatic systems.
Pathogens	NA- Appropriate buffer width not established	Minimizing the density of septic systems, maximizing the distance of septic systems from aquatic resource areas, and promoting pet waste management will help limit the transport of pathogens to aquatic systems.
Herbicides	6-18 m (20-59 feet)	Best management practices during application of herbicides and pesticides can help limit leeching to groundwater.

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Function	Range of Effective Buffer Widths	Notes on Function
Pharmaceuticals	NA- Appropriate buffer width not established	Best management practices for disposal of pharmaceuticals may limit potential impacts.
Bank Stabilization	10-30 m (33-98 feet)	Beyond 98 feet from the stream, buffers have little effect on bank stability.
Stream Temperature	10-30 m (33-98 feet)	Percent areal cover is more closely related to stream temperature than buffer width.
Microclimate	(10-45 m) 33-150 feet	Most microclimate changes occur within 10-45 m (33 to 150 feet) from the edge, but microclimate effects extend over 240 m (790 feet) from the forest edge.
Invertebrates and Detritus	30 m (98 feet)	Areas with 10 m (33 feet) buffers exhibit changes in invertebrate community composition.
Wildlife Habitat	100 to 600 feet	Minimum width for supporting habitat varies among taxa, guides, and species. Functions include both corridor (travel and migration) and support of lifecycle stages, including breeding.
In-stream Habitat (large woody debris – LWD)	18-50 m (59 to 164 feet)	Most LWD is recruited from the area within one tree-height width from the stream, however, tree-fall from beyond that area may still affect LWD loading.

The review of science acknowledges several limitations of applying the results of primary scientific literature to policy decisions. In particular, it is important to recognize the setting of scientific investigations, as management recommendations differ between undeveloped forested environments and highly developed urban areas. For example, in more developed areas, it is important to account for the presence of engineering and public works projects, such as surface-water detention facilities that may alter hydraulic conditions and sediment transport, or stormwater routing, which may cause runoff to bypass riparian areas altogether. Another consideration when evaluating primary literature is that scientific references commonly evaluate the effects of a single set of conditions, or in some cases several specific conditions. Depending on the specific conditions and function tested, outcomes may vary. Thus, although stream and riparian conservation measures should be based in BAS, some level of policy interpretation must be made by each local jurisdiction based on local conditions.

To achieve improved water quality in the County’s streams, riparian buffer areas should be utilized effectively to provide both biofiltration of stormwater runoff and protection from adjacent land uses. Both of these goals can be achieved by providing dense, well-rooted vegetated buffer areas, and by protecting hydrologic source areas, including slope and depressional wetlands. Hydrologic source areas may also be protected by allowing for buffer averaging, where wider buffer areas apply in areas where surface water is likely to collect.

In addition to riparian buffers, the literature points to a range of recommended management measures to help maintain stream functions for fish and wildlife. Effective methods to reduce impacts from urbanization and associated runoff can include the following:

- Limiting development densities and impervious surface coverage
- Limiting vegetation clearing and retaining forest cover
- Concentrating impact activities, particularly roads, parking lots, and pollutant sources, away from watercourses
- Limiting the total area of roads and parking lots and requiring joint use of new access roads
- Protecting vegetation and limiting development on or near hydrologic source areas
- Low impact development (LID)
- Municipal stormwater treatment
- Public education
- Removal of fish passage barriers
- Daylighting of streams
- Removal or replacement of culverts to support passage of flood flows

Biofiltration swales, created wetlands, and infiltration opportunities for specific stormwater runoff discharges can be particularly effective to intercept runoff before it reaches stream channels. Stormwater runoff that is conveyed through stream buffers in pipes or ditch-like channels and discharged directly to stream channels “short circuits” or bypasses buffer areas and receives little water quality treatment via biofiltration. In areas where stormwater flows untreated through riparian buffer areas, the buffer is underutilized and is prevented from providing the intended or potential biofiltration function. Actions that increase filtration, including LID and targeted stormwater retrofits provide important opportunities to improve water quality and moderate the effects of development on flow conditions.

In an analysis of riparian zone ordinances, Wenger and Fowler (2000) support using approaches that allow some flexibility in how policies are implemented on a parcel scale. Variable-width buffer policies (i.e. policies that may vary depending on slope, soil type, and land use intensity) provide greater adaptability to address site-specific conditions; however, fixed buffer widths are more easily established, require a lesser degree of scientific knowledge to implement, and generally require less time and money to administer (Castelle and Johnson 1998).

Updates to critical area regulations within some other jurisdictions (e.g. Clark County, Thurston County, City of Redmond) have utilized a variable width approach in which stream buffers may be larger/smaller depending upon connectivity to special aquatic areas such as Puget Sound or other Shorelines of the State. Buffer averaging provides another example of flexibility, where limited reductions in riparian zone width are allowed so long as they are offset by wider riparian zones in adjacent areas. This type of approach is particularly effective if implemented such that the wider buffer areas are located in areas that protect specific functions. For example, research into water quality functions has found that source areas (areas where surface runoff first becomes channelized) are most important to protect to infiltration functions. Therefore, to

maintain water quality functions, the buffer might be expanded to an area where surface runoff is likely to become channelized, such as existing depressions or swales. Another example would be to expand the buffer width in an area where it will contribute to habitat corridor connectivity.

If fixed-width buffers are implemented, conservative (larger) buffer widths are recommended in order to ensure that riparian buffers are effective under a range of variable conditions (Haberstock et al. 2000).

General Terrestrial Habitat Management

Cowlitz County includes habitat types that are known to be used or could potentially be used by vulnerable species, including sensitive, threatened, or endangered species, or other species identified by the State of Washington. WDFW has developed management recommendations for many priority species and habitats (Rodrick and Milner eds. 1991, Knutson and Naef 1997, Larsen ed. 1997, Hays et al. 1999, Watson and Rodrick 2000, Azerrad ed. 2004, Larsen et al. eds. 2004, Azerrad 2012). WDFW species-specific recommendations are often referenced in local jurisdictions' critical areas regulations. In addition to these species-specific recommendations, general recommendations for terrestrial habitat are listed below.

- Generally, plan development to minimize fragmentation of native habitat, particularly large, intact habitat areas. Where large forest stands exist, manage for sensitive species and avoid fragmentation (Donnelly and Marzluff 2004, Diffendorfer et al. 1995, Mason et al. 2007, Orrock and Danielson 2005, Pardini et al. 2005 and others).
- Control invasive species where needed on a site- and species-specific basis. Address invasive species on a landscape scale, particularly focusing on areas where environmental conditions tend to promote infestation, including created edges, roadways, and riparian zones where they are contiguous with developed areas that may act as a seed source (Olden et al. 2004, Pimentel et al. 2005, McKinney 2002 and others).
- Maintain or provide habitat connectivity with vegetated corridors between habitat patches (Schaefer 2003, Clair 2008, Gilbert-Norton et al. 2010 and others).
- Protect, maintain, and promote habitat features such as snags and downed wood (Blewett and Marzluff 2005).
- Manage for increase native vegetative cover in landscaping and discourage lawns (Nelson and Nelson 2001).
- Plan habitat areas away from roads (Fahrig et al. 1995, Lehtinen et al. 1999).
- Promote buffers of adequate width to support wildlife guilds in adjacent habitat (Semlitsch and Bodie 2003, Crawford and Semlitsch 2007).
- Preserve habitat patches of at least moderate size 35 ha (86 ac) within developed areas (Kissling and Garton 2008).

6 FREQUENTLY FLOODED AREAS

6.1 Existing Conditions

FEMA mapped 100-year floodplains exist throughout Cowlitz County. The majority of the floodplains in Cowlitz County lie adjacent to the Columbia River. Major floodway areas are concentrated along the Columbia River, the North Fork Toutle River, and Silver Lake. Most of the large rivers in Cowlitz County have some limited floodplains directly adjacent to their banks, including the Coweeman River, the South Fork Toutle, the Green River, the Kalama River and others.

6.2 Best Available Science for Protection of Functions and Values

Frequently flooded areas are generally regulated to manage potential risks to public safety. Given the ecological role of floodplains in moderating flows, providing a source of organic material, and providing off-channel refuge for fish during high flows, the protection of floodplain functions is also important for maintaining ecological functions (The Watershed Company 2014).

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8 ACRONYMS AND ABBREVIATIONS

ac.....	acres
BAS.....	Best Available Science
CAO	Critical Areas Ordinance
CCC.....	Cowlitz County Code
cm	centimeters
Corps	U.S. Army Corps of Engineers
County	Cowlitz County
dbh	diameter at breast height
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEMA.....	Federal Emergency Management Agency
ft.....	feet
FFA.....	frequently flooded areas

Critical Areas
Review of Existing Conditions and Best Available Science

FWHCA.....Fish and Wildlife Habitat Conservation Areas
GMA.....Growth Management Act
hahectares
in.....inches
LID.....Low Impact Development
LWDLarge Woody Debris
m.....meter
NE.....Northeast
NFIPNational Flood Insurance Program
PHS.....Priority Habitats and Species
SEPAState Environmental Policy Act
State.....Washington State
WAC.....Washington Administrative Code
WDFWWashington Department of Fish and Wildlife

APPENDIX A: COWLITZ COUNTY WETLAND, HABITAT AND SPECIES MAPS

NWI WETLANDS

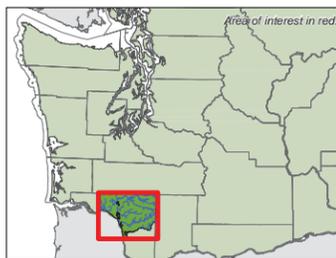
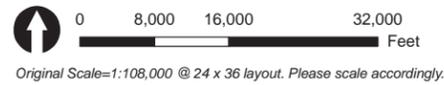


COWLITZ COUNTY

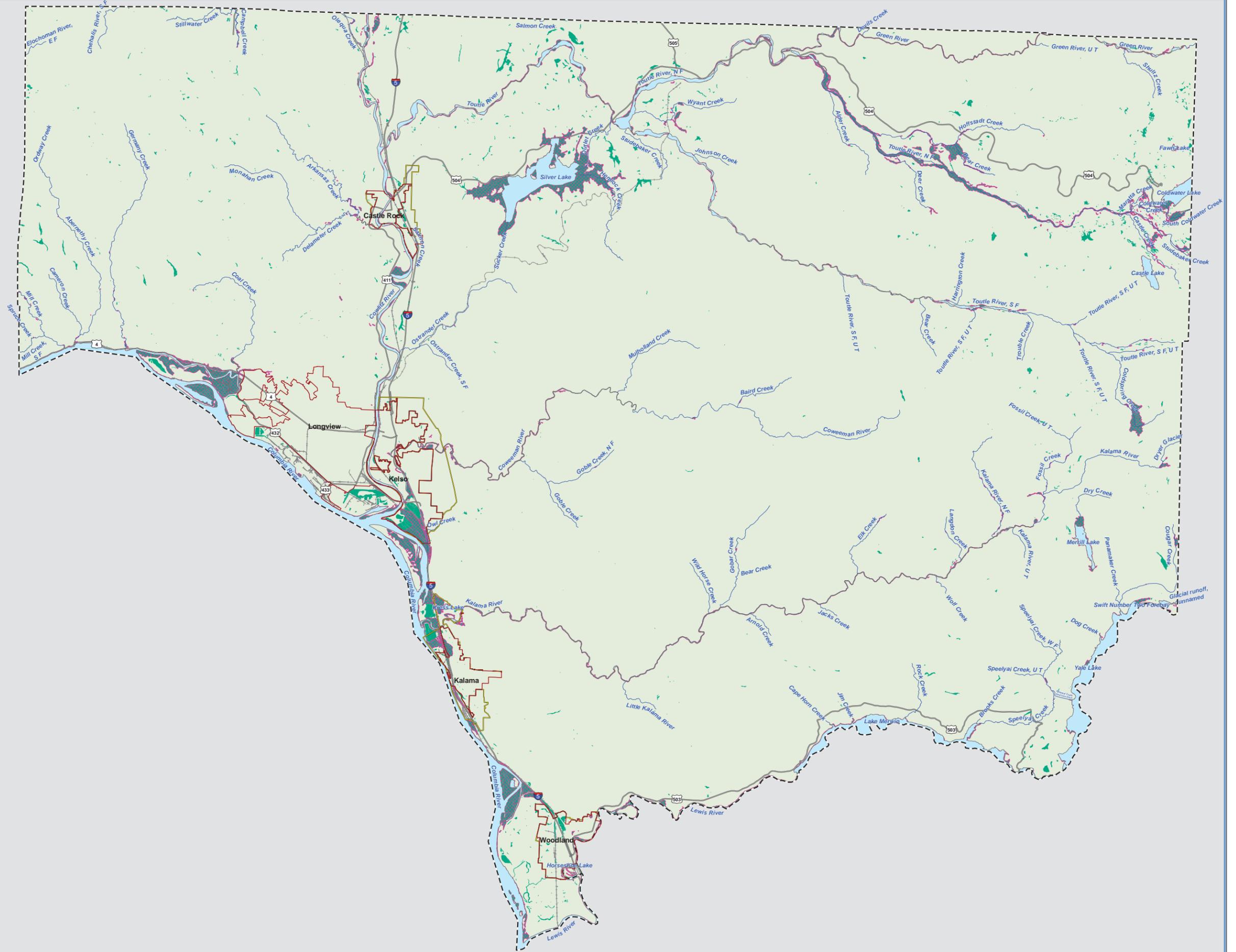
DRAFT

- NWI Wetland
- Stream
- Waterbody
- Potentially Associated Wetland
- City Boundary
- UGA/UGB/PAB
- County Boundary

Date: 3/7/2016
 Name: BAS_NWL_Wetlands
 Data sources:
 Cowlitz County, US Fish and Wildlife, Department of Ecology, The Watershed Company.



All features depicted on this map are approximate. They have not been formally delineated or surveyed and are intended for planning purposes only. Additional site-specific evaluation may be needed to confirm/verify information shown on this map.



WDFW PRIORITY HABITAT REGIONS

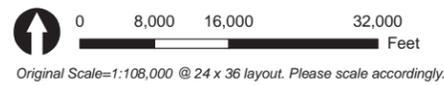


COWLITZ COUNTY

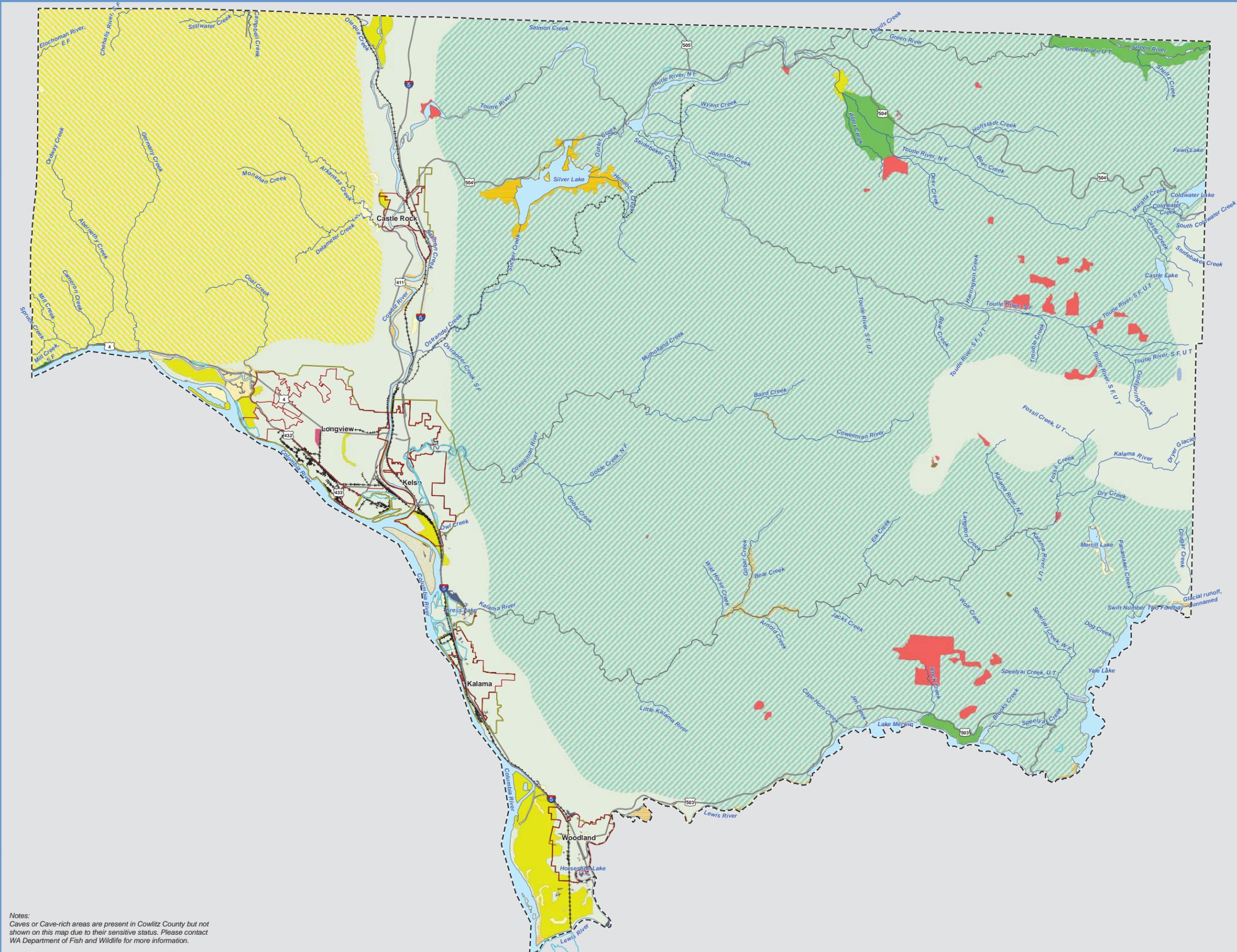
DRAFT

- Biodiversity Areas And Corridor
- Bald Eagle
- Cavity-nesting Ducks
- Cliffs/bluffs
- Great Blue Heron
- Herbaceous Bald
- Mule And Black-tailed Deer
- Oak Woodland
- Shepard's Parnassian
- Shorebird Concentrations
- Snag-rich Areas
- Talus Slopes
- Waterfowl Concentrations
- Roosevelt Elk
- Elk
- Stream
- Waterbody
- City Boundary
- UGA/UGB/PAB
- County Boundary

Date: 3/7/2016
 Name: BAS_PHS_regions
 Data sources:
 Cowlitz County, Washington Department of Fish and Wildlife, Department of Ecology, The Watershed Company.



All features depicted on this map are approximate. They have not been formally delineated or surveyed and are intended for planning purposes only. Additional site-specific evaluation may be needed to confirm/verify information shown on this map.



Notes:
 Caves or Cave-rich areas are present in Cowlitz County but not shown on this map due to their sensitive status. Please contact WA Department of Fish and Wildlife for more information.

WDFW PRIORITY SPECIES

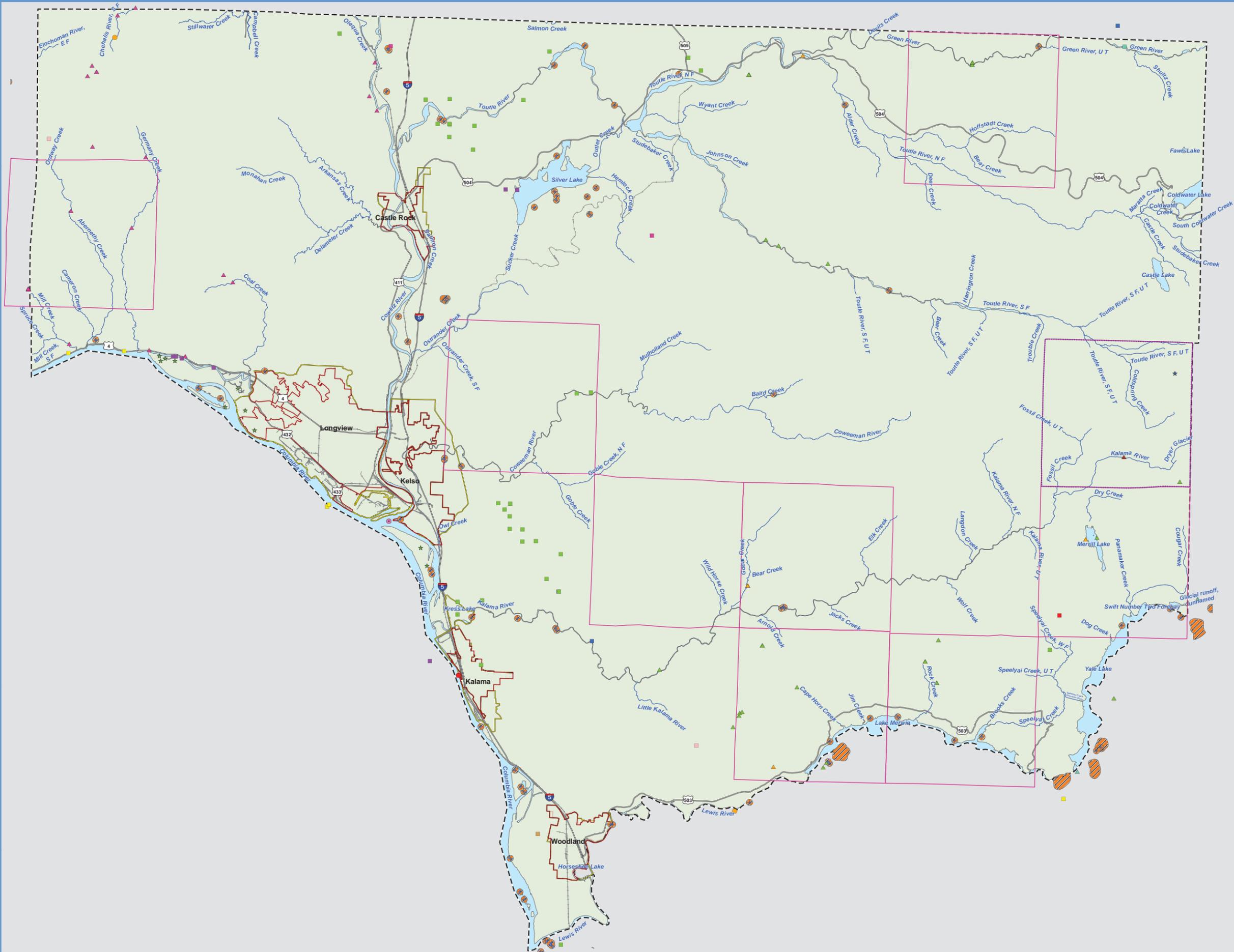
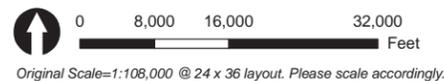


COWLITZ COUNTY

DRAFT

- WDFW Species**
- + Bald eagle
 - Eastern wild turkey
 - Harlequin duck
 - Marbled murrelet
 - Mountain quail
 - Northern goshawk
 - Peregrine falcon
 - Pileated woodpecker
 - Purple martin
 - Sandhill crane
 - California sea lion
 - Harbor seal
 - ▲ Western toad
 - ▲ Cascade torrent salamander
 - ▲ Dunn's salamander
 - ▲ Larch mountain salamander
 - ▲ Van dyke's salamander
 - Leopard dace
 - Mountain sucker
 - Pacific lamprey
 - ★ Columbian white-tailed deer
 - ★ Shepard's parnassian
 - ▨ Bald Eagle Nest Buffer
 - ▨ Townsend's Big Eared Bat Presence
 - ▨ Spotted Owl Presence

Date: 3/7/2016
 Name: BAS_PHS_species
 Data sources:
 Cowlitz County, Washington Department of Fish and Wildlife, Department of Ecology, The Watershed Company.



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