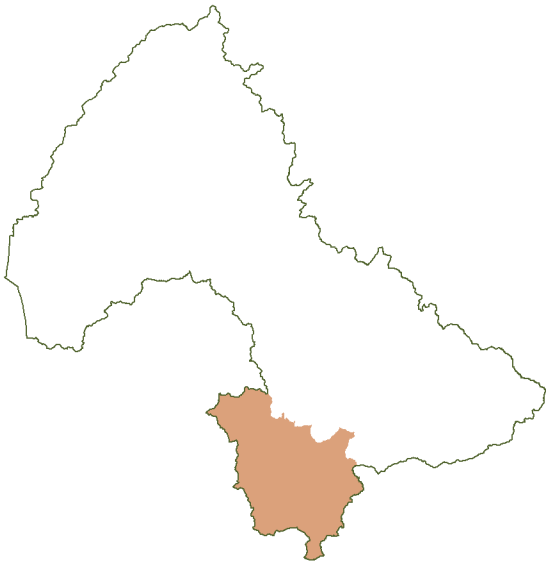
# 5.1 Willapa Hills Ecological Region

## 5.1.1 Overview



The Willapa Hills Ecological Region encompasses the upper Chehalis River (above Rainbow Falls) and tributaries, including East Fork and West Fork Chehalis rivers, Elk Creek, and the South Fork Chehalis River and its tributaries (Figure 5-1). This ecological region encompasses 316 square miles (greater than 200,000 acres) and represents approximately 12% of the overall Chehalis Basin. The maximum elevation in the watershed is 3,113 feet at Boistfort Peak (also called Bawfaw). The Chehalis River arises in the East Fork and West Fork, and primary tributaries to the upper Chehalis River include Thrash, Crim, Rock, and Elk creeks and the South Fork Chehalis River. Primary tributaries to the South Fork Chehalis River include Stillman and Lake creeks.

### Important Features and Functions

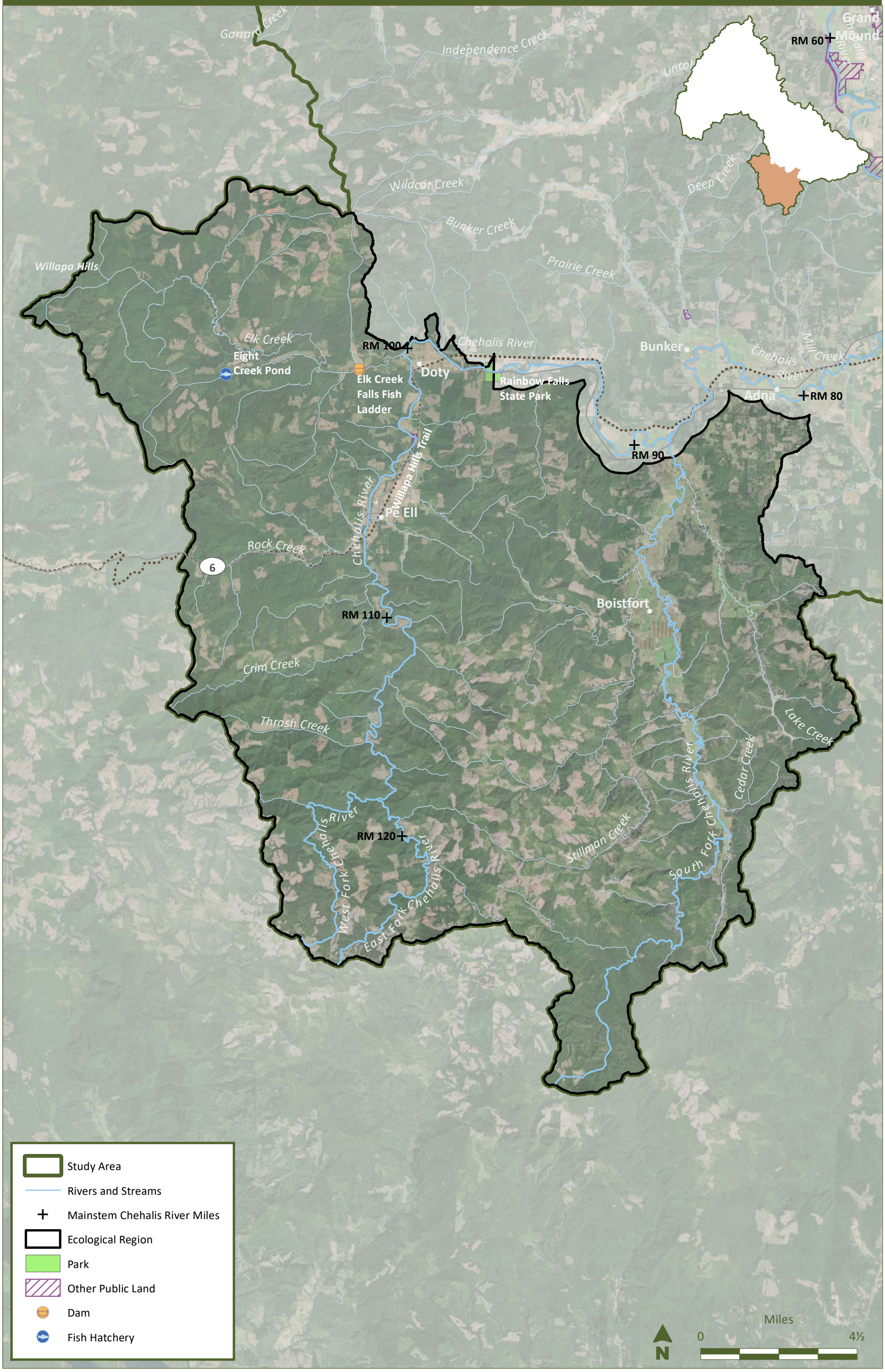
- Willapa Hills was a former stronghold of spring-run Chinook salmon, but species occurrence has been highly variable and notably decreasing in recent years, leading to concerns about local extirpation.
- The upper Chehalis River supports a relatively large number of wild winter-run steelhead (Ashcraft et al. 2017).
- This ecological region anchors the location in the watershed where anadromous fish life histories have the longest distance in their migrations upstream of the estuary (promoting substantial life history diversity).
- The greatest diversity of amphibians is in this ecological region. It is the only region with Dunn's salamander, has the highest densities of Western toad in the basin, and is an important area for both coastal tailed frog and Van Dyke's salamander.

The Willapa Hills geology is predominantly Tertiary volcanic and marine-derived sedimentary rocks. The sedimentary McIntosh Formation is composed of siltstone, shale, and sandstone with interbeds of basalt flows and basaltic sandstone. Coal seams are found within these units. Columbia River basalts overlie these rocks in some areas. Uplift of the volcanic and sedimentary rocks resulted in the higher elevation of the Willapa Hills. The Doty Fault Zone is an east-west trending fault zone that initiates along the northern boundary of the Willapa Hills Ecological Region, about 3 miles northwest of Doty, and extends east. It is the only fault zone suspected of being active in the Chehalis Basin (HDR and Shannon & Wilson 2015). Upland slopes can be quite steep and susceptible to landslides in many areas.

Precipitation in the Willapa Hills Ecological Region is dominated by rainfall, with higher elevations occasionally receiving snow. Average annual precipitation is 120 inches or higher in the upper watershed (WSE 2014) and 58 inches near Doty.

The Willapa Hills Ecological Region is primarily within Lewis County (159,622 acres, or 79%), with a small portion in Pacific County (36,873 acres, or 18%) and an even smaller portion in Cowlitz County (5,427 acres, or 3%), and it is just touching the edge of Wahkiakum County (5,427 acres, or <1%). Towns within this ecological region include Doty, Pe Ell, and Boistfort.

**Figure 5-1**
**Willapa Hills Ecological Region Map**




Aerial Photo Source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

### 5.1.2 Historical Conditions and Changes

Historical records for the pre-Euro-American settlement condition are not available, but available historical records and maps indicate that the Willapa Hills Ecological Region was dominated by old-growth Western hemlock and Western red cedar forest, including other important species such as Douglas-fir. Smith and Wenger (2001) indicated that a large fire burned the Stillman Creek watershed around 1800, resulting in a nearly uniform stand of Douglas-fir. Prairies were noted by early settlers, including Pe Ell and Boistfort prairies, many of which were typically inundated each spring (WNPS 1994), implying historical connectivity to rivers and streams. GLO maps noted that beaver swamps, hardhack (*Spirea douglasii*) swamps, and other wetlands were present in substantial areas along the South Fork Chehalis River and Lake Creek.

Key changes that occurred in the Willapa Hills Ecological Region following Euro-American settlement were extensive timber harvest and agricultural development in some areas, notably along the South Fork Chehalis River. Similar to other regions of the basin, splash dams were used to transport timber downstream (see the description in Section 2.1). At least nine splash dams were documented in the Willapa Hills Ecological Region, including some of the largest splash dams used in the basin; four were used on Elk Creek and its tributary, Nine Creek; three were on Rock Creek and other tributaries to the upper Chehalis River; and two were on the South Fork Chehalis River and its tributary Stillman Creek (Wendler and Deschamps 1955). Gravel mining also occurred in Stillman Creek. Agricultural development as well as road, bridge, and residential construction likely also incrementally moved and straightened many of the rivers and creeks and drained wetlands in the Willapa Hills Ecological Region over time. All of these actions contributed to wood removal, channel incision, and floodplain disconnection. Other historical changes to rivers include the disconnection of a meander on the West Fork Chehalis River for road construction that created the West Fork Falls fish barrier, provision of a fish ladder on Elk Creek Falls (RM 1.5 on Elk Creek) in 1972 to pass coho salmon and steelhead, and reduction of the Fisk Falls barrier on the upper Chehalis River in 1970 to improve fish passage (WDF 1975). Chum salmon were noted to have been present in the South Fork Chehalis River in the 1930s (Royal 1931).

To support the ASRP analysis and EDT modeling efforts, the SRT developed assumptions of the channel lengths and areas of floodplain habitat that were likely to be present in historical conditions. These assumptions were based on the GLO mapping from the late 1800s, more recent historical aerial photographs, and interpretation of current LiDAR data that show many remnant channels and other floodplain features across the basin. For the Willapa Hills, the upper Chehalis River is generally confined within a narrow valley, so historical conditions would not likely have included any significant differences in main channel and side channel length or floodplain area. However, large wood has been removed from the channel, and the historical use of splash dams caused channel incision to bedrock in many locations. The East Fork and West Fork Chehalis rivers and major tributaries such as Crim Creek are partly confined in slightly wider valleys and may historically have had more sinuous channels, with side channels in some locations, and 2 to 3 times the area of connected floodplain. Elk Creek, the South Fork

Chehalis River, lower Stillman Creek, and Lake Creek have wide valleys that do not confine the streams, with many remnant floodplain features visible in LiDAR data. Channels and side channels were interpreted to have been nearly double the length that currently exists, with 3 or more times the connected floodplain area. In all of the streams and rivers of the Willapa Hills Ecological Region, large wood has been removed from channels and channel incision has occurred to some extent.

### 5.1.3 Current Conditions

Current conditions reflect ongoing forest management, agricultural land uses, and residential and commercial development. Land cover is 48% coniferous forest, 23% shrub, 8% grassland, 4% agriculture, 5% developed, and small percentages of other cover[4] (Figure 5-2). Much of the upper areas of the Willapa Hills Ecological Region are commercially managed timber forest.

An assessment of riparian conditions and functions by NOAA (Beechie 2018) indicates that the majority of the riparian areas in the Willapa Hills Ecological Region are impaired or moderately impaired[5] for wood recruitment due to the young age of trees present within riparian areas and/or the width of riparian buffers. The major flood event in 2007 caused numerous landslides that recruited and then transported substantial quantities of wood downstream that was generally removed from the ecological region after the flooding; this led to even lower current potential rates of wood recruitment. In areas of agricultural and residential development (e.g., South Fork Chehalis River and Chehalis River between Rainbow Falls and Crim Creek), fewer than 5% of the reaches have larger trees in the riparian zone. The lack of trees also affects cover and provides low levels of shading.

#### Willapa Hills Current Snapshot

**Condition of Watershed Processes:**
Hydrology – moderately impaired
Floodplain connectivity – impaired
Riparian condition – impaired
Water quality – impaired

**Restoration Potential**: High

**Protection Potential:** Moderate

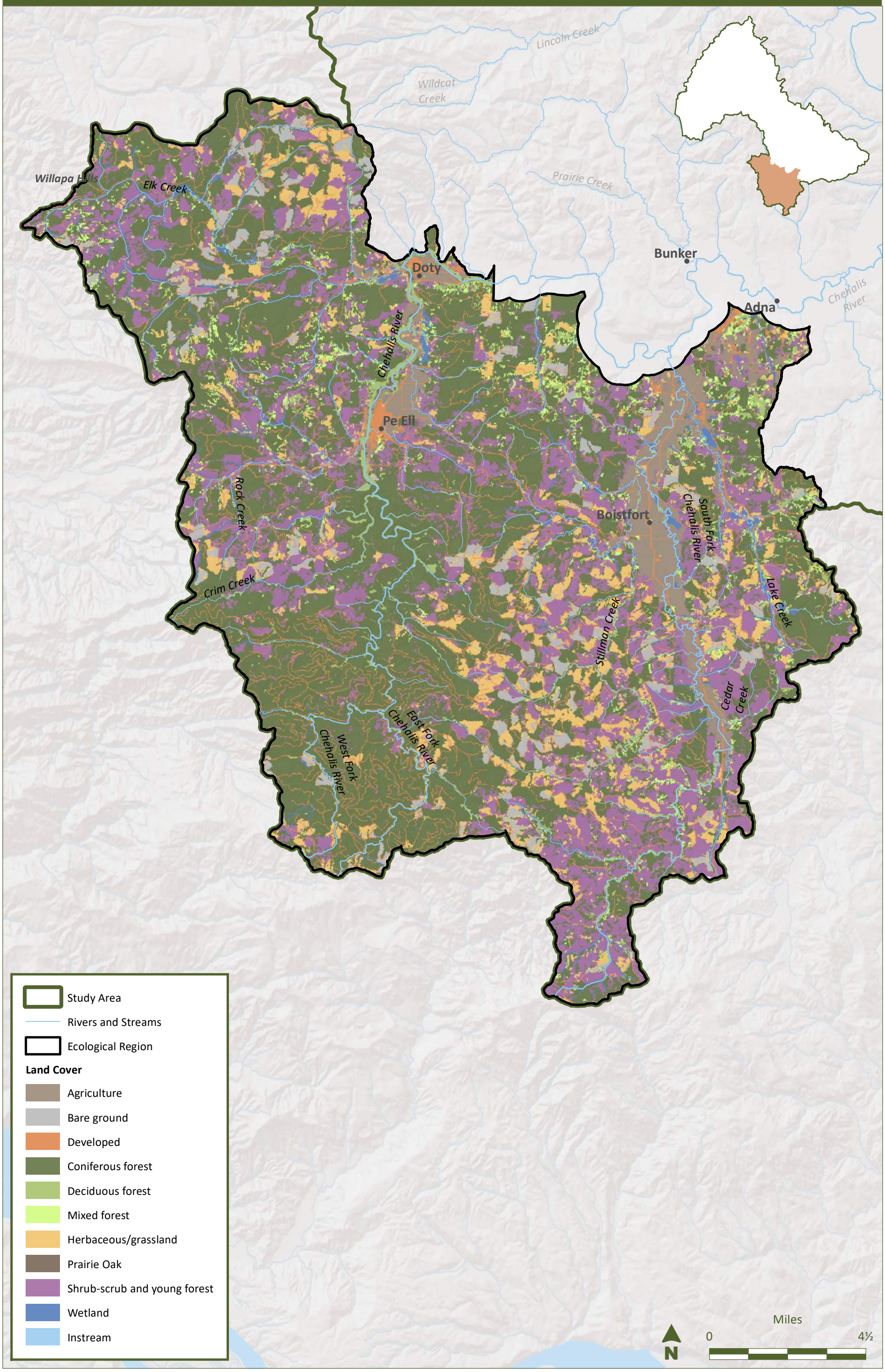
**Geographic Spatial Units**: Upper Chehalis River, East Fork Chehalis River, West Fork Chehalis River, Crim Creek, Elk Creek, South Fork Chehalis River, Stillman Creek, and Lake Creek

**Salmon Use and Potential**: High for spring-run Chinook salmon, fall-run Chinook salmon, coho salmon, and steelhead

**Non-Salmon Use and Potential:** Western toad, coastal tailed frog, Van Dyke's salamander, northern red-legged frog, North American beaver, Olympic mudminnow, largescale sucker, mountain whitefish, Pacific lamprey, riffle and reticulate sculpin, and speckled dace

[4] Land cover data from Multi-Resolution Land Characteristics Consortium, National Land Cover Database 2011, augmented by WDFW Habitat Guild 2015 floodplain data where available.
[5] Condition of watershed processes categorized based on procedures in Beechie et al. 2003.

**Figure 5-2**
**Willapa Hills Ecological Region Land Cover**



Water quality is impaired in many areas of the Willapa Hills Ecological Region, primarily for temperature, low dissolved oxygen, and bacteria (Ecology 2018). Recent temperature monitoring in the upper Chehalis (RMs 98 and 117.7) and South Fork Chehalis (RMs 1.7 and 16.8) rivers by WDFW (2014 to 2015 data) indicates that water temperatures regularly exceed the 16°C (61°F) core summer salmonid habitat criterion from May through September,[6] and they typically exceed the 13°C (55°F) supplemental spawning incubation criterion (September 15 to July 1) in September and May to July (Ecology 2016, 2011a). The *Upper Chehalis River Basin Temperature Total Maximum Daily Load* (TMDL; Ecology 2001)[7] has designated a goal of 18°C (64°F) for the upper Chehalis River, with the primary goals of increasing shading along the Chehalis and South Fork Chehalis rivers and decreasing the width of the South Fork Chehalis River. It is also critical to prevent further reductions in flows and improve low flows if feasible.

WDFW's Thermalscape model indicates that from 2013 to 2018, the majority of stream reaches within the Willapa Hills Ecological Region (ranging from 46% [2018] to 76% [2015] of the reaches) equal or exceed a mean August temperature of 16°C (61°F) and are projected to increase to 91% and 100% of reaches in 2040 and 2080, respectively, without restoration actions (Winkowski and Zimmerman 2019).

The NOAA model that incorporates mature riparian conditions and anticipated climate change shows a likely future increase in summer water temperatures ranging from 1.5°C (2.7°F) to more than 2.5°C (4.5°F) in this region by 2080 (Beechie 2018). The South Fork Chehalis River was the only area where the model showed a lesser future temperature increase (because the current riparian condition is very poor on the South Fork Chehalis River).

The river channels are predominantly one primary channel with varying levels of incision. Abbe et al. (2016) estimated potential levels of channel incision in several locations, ranging from 15 to 30 feet on the Chehalis River, 17 feet on Crim Creek, 2 to 4 feet on Elk Creek, 2 to 11 feet on the South Fork Chehalis River, 0 to 4 feet on Lake Creek, and 0 to 8 feet on Stillman Creek.

Existing mapping of wetlands (Ecology 2011b) shows large wetland areas adjacent to Jones Creek, Elk Creek, the South Fork Chehalis River, Lake Creek, Lost Creek, and in some areas along the upper Chehalis River below Pe Ell. Historical and current areas of floodplain marsh and pond habitats were documented by NOAA using GLO mapping (Beechie 2018). They found the South Fork Chehalis River floodplain has lost about half of the historical marsh habitat (remaining marsh is heavily modified) and nearly all of the historical beaver pond habitat. Elk Creek still retains much of its historical beaver pond habitat. Fish passage barriers do not generally block mainstem reaches in the Willapa Hills Ecological Region—although the human-caused West Fork Falls fish barrier blocks all upstream fish passage. Barriers impede passage into many small tributaries, including Rock and Lake creeks. Approximately 50 fish passage barriers were incorporated into the EDT model[8] for the Willapa Hills Ecological Region.

[6] 7-day average daily maximum temperatures reached more than 25°C (77°F) in the South Fork Chehalis River and more than 23°C (73°F) in the upper Chehalis River.
[7] The *Upper Chehalis River Basin Temperature TMDL* (Ecology 2001) covers the basin upstream of Porter.
[8] Fish passage barrier data from WDFW processed through EDT model.

Landslides following heavy precipitation are a common occurrence in this region due to the unstable soils and steep slopes. Multiple authors (Turner et al. 2010; Whittaker and McShane 2012) documented more than 2,500 landslides in the Upper Chehalis Basin associated with the 2007 storm event, where 12 to 26 inches of rain fell in a 4-day period in parts of the Chehalis Basin (WSE 2014). These landslides occurred most frequently in young stands of trees (less than 10 years), on steep slopes, and where rainfall intensities far exceeded the threshold for precipitation that would be considered a 100-year event.

The percentage of fine sediment in streams was modeled by NOAA based on the density of roads and channel gradient; this modeling indicated that 15% to 20% fines are likely to be present throughout the ecological region, compared to 9% to 14% fines as modeled for historical conditions (Beechie 2018). The upper Chehalis River (above Crim Creek) naturally has lower levels of fine sediment than the South Fork Chehalis River sub-basin.

The Willapa Hills Ecological Region is one of the few spawning areas for spring-run Chinook salmon, and it also has runs of fall-run Chinook salmon, coho salmon, and steelhead. The upper Chehalis River supports a relatively large number of wild winter-run steelhead (Ashcraft et al. 2017). The Willapa Hills Ecological Region is one of only two key strongholds for Van Dyke's salamander, a riparian-dwelling amphibian that is a state candidate species. Populations of this species in the Willapa Hills, potentially the amphibian most vulnerable to climate change, are typically surface active at temperatures ≤13.8 C (≤57 F). Poor riparian habitat conditions are a key limiting factor for this species. Other non-salmon indicator species present in this region include Western toad, coastal tailed frog, northern red-legged frog, North American beaver, Olympic mudminnow, largescale sucker, mountain whitefish, Pacific lamprey, riffle and reticulate sculpin, and speckled dace. Each year, hatchery-raised juvenile coho salmon (approximately 100,000 fish) and steelhead (approximately 32,000 fish) from Skookumchuck Hatchery are released into Eight Creek Pond (a tributary to Elk Creek) as part of the mitigation for Skookumchuck Dam (Cascade Mountains Ecological Region). It is not known to what extent these hatchery-origin fish affect wild fish production in Elk Creek and in the mainstem Chehalis River in the vicinity and downstream of Elk Creek.

### 5.1.4 Limiting Factors

Limiting factors for salmonids have been identified in several assessments of the Chehalis Basin, including the EDT (ICF 2019) and NOAA modeling (Beechie 2018) conducted for the ASRP and earlier studies (GHLE 2011; Smith and Wenger 2001). Additional limiting factors and a diagnosis of what is working and what is broken in the ecological region were determined by the SRT, drawing on local basin knowledge and reconnaissance conducted within the region.

The combined results of these assessments indicate that the major issues for salmonids in the region are as follows (in relative order of importance):

- High water temperatures
- Reduced quantity and quality of instream habitats
- Low habitat diversity (lack of side channels, large wood, floodplain habitats, and beaver ponds)
- Flows (both low and high flows)
- Channel instability and bed scour
- Sediment conditions (fine sediment and bedrock)
- Poor riparian conditions
- Fish passage barriers

#### Diagnostic Snapshot

- Substantial parts of all rivers and streams in the Willapa Hills have been historically severely scoured, and they lack wood.
- Severe disturbance via past storm events in the Willapa Hills had a large impact on stream conditions. Recolonization after flood events of salmonids and Western toad appears to be rapid on the upper Chehalis River and Stillman Creek (less than 10 years). Despite this rebound, habitat conditions continue to be in a degraded condition.
- The relatively intact wetland and beaver pond complex in the Elk Creek watershed is an example of what many of the valleys now dominated by agriculture may have historically looked like.
- Severe incision and poor riparian and floodplain habitat conditions are found in the South Fork Chehalis River.
- A key issue in this region is the overall warmer temperatures in the upper Chehalis and South Fork Chehalis rivers compared to other regions with similar-elevation headwaters that may be related to numerous areas of exposed bedrock.

The identified issues for salmonids are generally consistent with earlier findings from Smith and Wenger (2001) and the Chehalis Basin Lead Entity (GHLE 2011), which indicated that the key limiting factors in this ecological region include fish passage barriers, riparian conditions, sediment conditions, channel incision and loss of floodplain connectivity, and high water temperatures. ASRP results indicate different priorities; water temperature and lack of large wood are the most substantial limiting factors, along with a lack of beaver ponds and floodplain connectivity, particularly in the South Fork Chehalis River sub-basin. Fish passage barriers are relatively lower priority because they primarily occur on smaller streams in this ecological region and timber landowners are actively addressing many barriers on forest roads. Addressing two key fish passage barriers (West Fork Falls and the waterfall and fish ladder on lower Elk Creek) and some of the numerous fish passage barriers in the South Fork Chehalis River sub-basin could also provide substantial benefits to salmon and steelhead. Non-native predator species such as

smallmouth bass also have the potential to limit native aquatic species, particularly with continued warming temperatures with climate change. This issue is continuing to be studied.

Limiting factors and threats to non-salmon indicator species are not well understood, but they potentially include high water temperatures, migration barriers, changes in flow conditions and water level variations, fine sediments, riparian conditions, and non-native predator species (as identified for Pacific lamprey by Clemens et al. [2017]). Limited riparian shading and warmer water temperatures benefit Western toad, in contrast to most other native aquatic species; however, improvements in natural processes of channel migration and riparian turnover would help maintain a variety of habitats, including the kinds of recently disturbed habitats that support Western toad.

## 5.1.5 Strategies and Actions in the Ecological Region

### *5.1.5.1 Habitat and Process Protection*

The protection actions described in Section 4.2.1 are all appropriate in the Willapa Hills Ecological Region, including acquisitions or easements in areas of high-quality habitat. Based on existing conditions, the following areas and actions are recommended for a protection focus:

Upper reaches of Elk Creek should be protected and enhanced within the managed forest context for salmonid refuge.

- Protect existing high-quality habitats such as the wetland and beaver pond complex in the upper valley portion of Elk Creek to provide coho salmon and steelhead overwintering habitat and support diverse life histories for multiple salmon species.
- Protect several headwater stream areas (small tributaries to the upper Chehalis River and Stillman Creek) to maintain a high diversity of amphibian species and promote shading and water temperature moderation along with protecting and enhancing summer low flows.
- Protect the upper Chehalis River (above Pe Ell), including the East Fork and West Fork Chehalis rivers, which are core spawning and rearing habitat for several salmonid species.
- Investigate the potential for water conservation in the South Fork Chehalis River sub-basin to reduce surface and/or groundwater withdrawals to address low-flow conditions.
- Protect and enhance cool-water tributary confluences with the Chehalis River for spring-run Chinook salmon holding.

The majority of the Willapa Hills Ecological Region is within Lewis County, which has regulations and policies in place to maintain forest cover, increase riparian canopy, protect streams from development, and protect surface and groundwater and reduce withdrawals. The Lewis County SMP identifies priority

habitat as those habitat types with unique or significant value to one or more species, including fish spawning habitat, and contains regulations that new development should not interfere with the process of channel migration (Lewis County 2017). The County has a policy to support projects from the Lewis County Shoreline Restoration Plan (Lewis County 2016), the ASRP, and the lead entities for salmon recovery. As part of community planning strategies (Section 5.1.5.3), funding support to align regulations with the ASRP and conduct enforcement will be considered.

The upper watershed was historically a stronghold for spring-run Chinook salmon. These areas also provide habitat for North American beaver, amphibians, and other indicator species. First-order headwater streams within forested lands could be further protected to reduce downstream degradation of aquatic habitats.

Streams show channel incision to bedrock in many locations.

General protection priorities for Lewis County in the Willapa Hills Ecological Region are as follows:

- Protect spawning gravel sources and retain spawning gravels (protect channel migration and improve wood recruitment).
- Protect and reduce water temperatures by maintaining or increasing forest cover, riparian canopy, and floodplain connectivity.
- Protect from development.
- Protect headwater streams by maintaining and increasing forest cover.
- Protect the floodplain, channel migration zone, riparian zone, and beaver ponds.

### *5.1.5.2 Restoration*

The restoration actions described in Section 4.2.2 are all appropriate in the Willapa Hills Ecological Region. Based on existing conditions, the following areas and actions are recommended for a restoration focus:

- Install functional stable wood structures and beaver dam analogs throughout the upper Chehalis and upper South Fork Chehalis rivers to trap sediment and smaller wood, creating stable spawning and incubation habitat and cool-water pools. This action could be implemented rapidly in areas managed by one landowner (e.g., timber landowners).
- Address water temperature problems through combinations of beaver dam analogs, beaver dams, floodplain reconnection, and riparian restoration and experimental approaches such as pre-filled sediment wedges.
- Test restoration of wetland prairie habitat at Lake Creek, including encouraging beavers or using beaver dam analogs. Coho salmon and stillwater-breeding amphibians could particularly benefit

from beaver dams (and close proximity to forested habitat for amphibian movement). Wetland prairie areas were historically a significant component of the Chehalis Basin.

- Implement and monitor early action restoration work on lower Stillman Creek to learn about the effectiveness of restoration techniques, particularly for coho and spring-run Chinook salmon.
- Continue monitoring upper Stillman Creek relative to recovery from the 2007 storm event and identify where engineered logjams or anchoring of existing wood would best promote longer-term habitat stability and function.
- Reconnect floodplains in targeted areas of the South Fork Chehalis River using a "node" concept, wherein refuge areas would be spaced along the channel length and available to fish as they travel throughout the system. Associated with nodes, locally raise the stream bed and increase floodplain connectivity through instream stable wood placement. This could have symbiotic groundwater storage benefits that will also benefit instream flows.

Fish passage barriers block access to many miles of upstream habitat.

Lower Stillman Creek has opportunities for floodplain reconnection in the Willapa Hills Ecological Region.

- Test enhancement of first- and second-order headwater streams in upper Stillman Creek and/or upper Chehalis River tributaries with wood installation and improvement of long-term canopy cover to test increased groundwater recharge and low-flow support. These small headwater streams are likely to be particularly vulnerable to climate change flow changes.
- Prioritize buffer length over width on the South Fork Chehalis River to promote shading and cover along its length.
- Remove or address key fish passage barriers including West Fork Falls, Elk Creek Falls and fish ladder, and multiple barriers on tributaries to the upper Chehalis and South Fork Chehalis rivers. Individual fish passage barrier replacements have not been prioritized or ranked in this phase of the ASRP.

Priority restoration areas in the Willapa Hills Ecological Region include the mainstem Chehalis River above Rainbow Falls; East Fork and West Fork Chehalis rivers; upper South Fork Chehalis River; and Stillman, Lake, Big, Crim, Thrash, and Elk creeks.


Weyerhaeuser has been monitoring post-flood conditions on Stillman Creek for more than 10 years (Weyerhaeuser 2018); these data may support further research and controlled studies on passive recovery or supplemental restoration.

### *5.1.5.3 Community Planning*

As noted in Section 4.2.3, community planning actions would be coordinated with state and local governments, landowners, and other stakeholders to ensure the long-term success of the ASRP. Focus programs and policies that could be developed or investigated in the Willapa Hills Ecological Region include the following:

- WDFW could investigate potential hatchery fish effects on wild fish production in Elk Creek.
- Discuss with Lewis County additional planning measures that could effectively promote and protect the following:
  - Riparian maturation and wood recruitment for retention of spawning gravel and sources
  - Water temperatures and floodplain connectivity
  - Beaver ponds
- As the Chehalis Basin Strategy becomes more integrated, coordinate the ASRP with the CFAR Program to build habitat restoration and protection actions into community flood risk reduction efforts (such as restoring areas where structures and people have been relocated from floodplains).

### *5.1.5.4 Community Involvement*

As noted in Section 4.2.4, community involvement and voluntary landowner participation are essential to the success of the ASRP, and the actions described in that section will be further evaluated for the Willapa Hills Ecological Region in Phases 2 and 3 based on the restoration and protection scenario selected. Based on the specific issues in this area, the following actions are recommended for focused community involvement:

- Continue outreach, engagement, and involvement processes to incorporate landowner expertise into ASRP planning and local implementation efforts.
- Continue to share with the community about early action restoration work on Stillman Creek and discuss results of the experimental actions.
- Partner with and support the efforts of existing local organizations (see Appendix E for a list of potential partner organizations).

### *5.1.5.5 Institutional Capacity*

The institutional capacity strategy is intended to build on and support the work of existing organizations, as well as support creativity in how local organizations approach working toward the goals of the ASRP. The actions described in Section 4.2.5 will be further evaluated for the Willapa Hills Ecological Region in Phases 2 and 3 based on the restoration and protection scenario selected. Based on the specific issues in this area, the following focused institutional capacity actions are recommended:

- Provide technical training on process-based restoration practices and principles.
- Provide funding for groups and individuals interested in restoration projects.
- Build on and support the work of existing organizations with missions that overlap with the ASRP vision (see Appendix E for a list of potential groups).