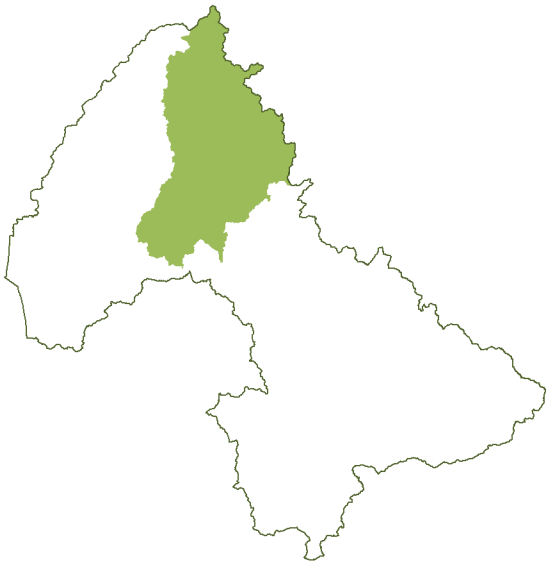
5.8 Olympic Mountains Ecological Region

5.8.1 Overview

The Olympic Mountains Ecological Region encompasses the northern part of the Chehalis Basin, including the Satsop and Wynoochee rivers and their tributaries (Figure 5-15). This region encompasses 496 square miles (greater than 317,000 acres) and represents approximately 18% of the overall Chehalis Basin. The Satsop and Wynoochee rivers arise in the Olympic Mountains. The highest point in this ecological region is Capitol Peak (different from the Black Hills Capitol Peak) at 5,054 feet. The Satsop River arises in three forks in distinctly different areas: the East Fork Satsop River arises in and flows through a series of wetlands and lakes in the low (approximately 110 feet in elevation) glacial moraine deposits west of Shelton; the Middle Fork Satsop River arises in the southern hills of the Olympic Mountains at approximately 2,000 feet in elevation; and the West Fork Satsop River arises in the higher elevations within the Olympic National Forest at Satsop Lakes near Chapel Peak at approximately 3,000 feet in elevation. The Wynoochee River arises in Olympic National Park near Wynoochee Point at approximately 4,000 feet in elevation.

The Olympic Mountains geology is predominantly volcanic and marine sedimentary rocks, including sandstone and siltstone, claystone, shale, mudstone, and locally derived conglomerates and breccias (WDNR 2010). Alpine glaciation from the Olympic Mountains advanced into the Chehalis Basin on multiple occasions (at least four times) with the deposition of glacial till and outwash across the northwestern portion of the Chehalis Basin (Gendaszek 2011).

Precipitation in the Olympic Mountains Ecological Region is dominated by rainfall, with higher



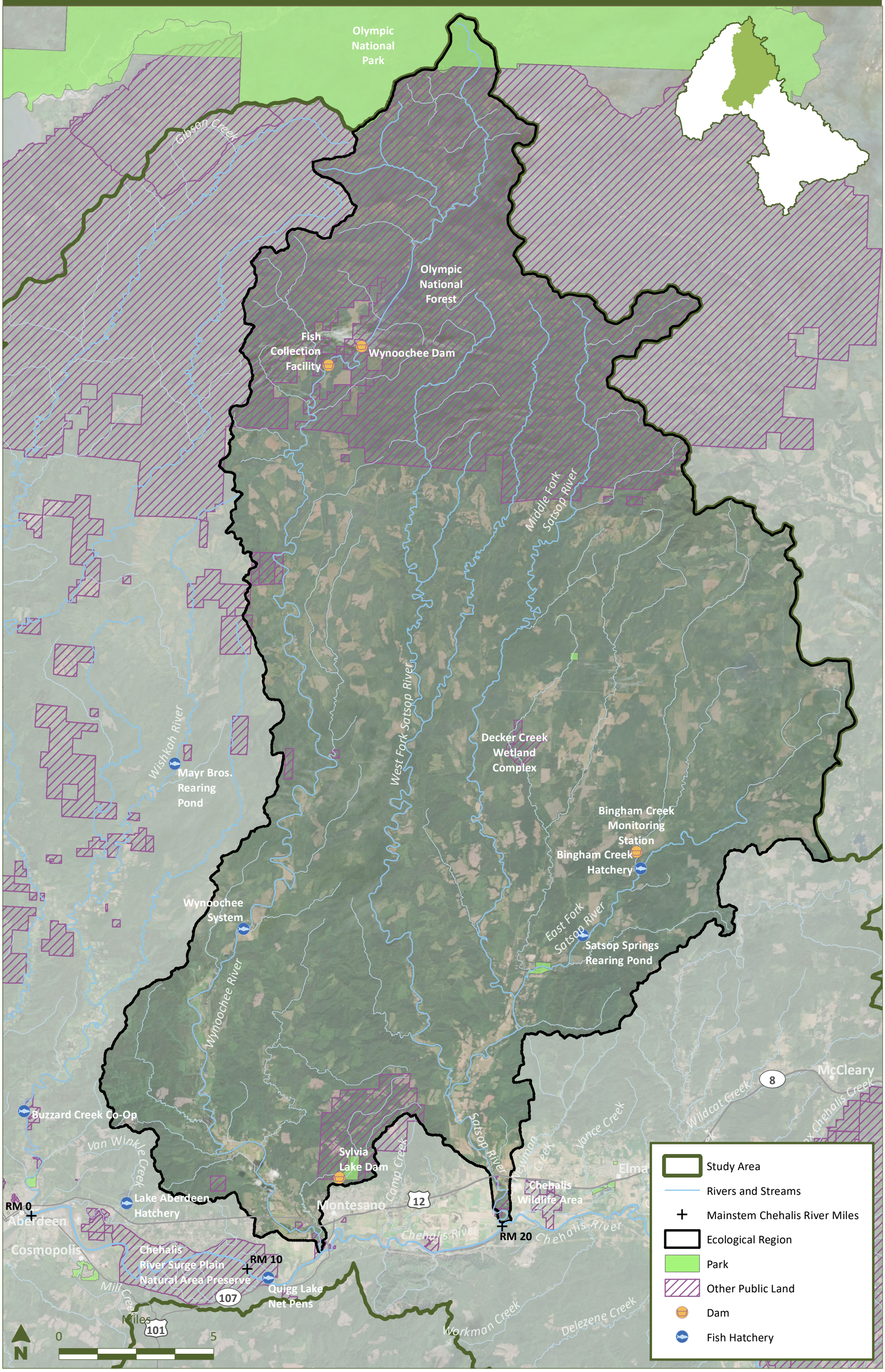
Important Features and Functions

- This ecological region is very productive for multiple salmonid species (steelhead and chum, coho, and fall-run Chinook salmon) and Pacific lamprey. The East Fork Satsop River is particularly productive for chum and coho salmon. Native char have been documented in both the Satsop and Wynoochee rivers.
- Glacial outwash gravel deposits with a large network of groundwater-fed streams in the East Fork Satsop River and tributaries are unique among all the ecological regions.
- Seasonally dry channels have extensive seasonal spawning use.
- This is one of only two ecological regions that still has significant old-growth forest.
- The West Fork Satsop and Wynoochee river systems have higher-elevation headwaters with rainfall-dominated hydrology and high sediment supply, characterized by active channel migration, major avulsions, and a lack of stable logjams.
- There are significant hatchery influences on wild fish that may include competition, genetics, predation, disease, and fish passage.
- There is more habitat for stream- and riparian-associated amphibians than any other ecological region.

elevations receiving snow. Average annual precipitation is 100 to 200 inches and can be as high as 250 inches in the upper mountain areas. Generally, this part of the Chehalis Basin receives the most precipitation out of all the ecological regions.

The Olympic Mountains Ecological Region is primarily within Grays Harbor County (204,387 acres, or 64%) and Mason County (111,656 acres, or 35%), and it is just touching the edge of Jefferson County (1,235 acres, or <1%). Cities and towns within this ecological region include Elma and Montesano.

Figure 5-15
Olympic Mountains Ecological Region Map



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

5.8.2 Historical Conditions and Changes

Historical records for the pre-Euro-American settlement conditions are not available, but available historical records and maps indicate that the Olympic Mountains Ecological Region was dominated by old-growth Western hemlock forest, including other important species such as Douglas-fir and Western red cedar. Several wetlands were present in the glacial deposits on the east and southeast side of the mountains. GLO maps show numerous and large wetlands associated with the upper East Fork Satsop River, Lake Nahwatzel, the Middle Fork Satsop River, and some wetlands along the West Fork Satsop River. Several major flow splits with side channels are shown for the lower to middle Wynoochee River, and a complex multithreaded channel with sloughs is shown on the lower 3 to 4 miles of the Wynoochee River.

Key changes that occurred in the Olympic Mountains Ecological Region following Euro-American settlement were extensive timber harvest and agricultural and residential development in the lower floodplains of the mainstem Satsop and Wynoochee rivers. Agricultural development as well as road, railroad, bridge, and gravel removal likely also incrementally moved and straightened many of the rivers and creeks in the Olympic Mountains Ecological Region over time.

Historical changes to the Satsop River included construction of the water diversion and hatchery facilities at Bingham Creek, construction of chum salmon spawning channels and hatchery facilities at Satsop Springs (RM 14.8), construction of small dams on several tributaries, and increased fine sediment delivery to the West Fork Satsop River and numerous tributaries. Additionally, the Middle Fork Satsop River was noted as going dry in the summer as early as the 1960s (WDF 1975).

Historical changes to the Wynoochee River included a water diversion at RM 8.1 that occasionally diverted fish into Lake Aberdeen (WDF 1975), the construction of Wynoochee Dam in 1972 that eliminated approximately 9 miles of mainstem spawning habitat (including spawning habitat for the remnant spring-run Chinook salmon that were nearly extirpated from the river by the 1970s), and numerous areas of gravel mining in the middle and lower river and floodplain. Coho salmon and steelhead are now trapped at a fish collection dam downstream of Wynoochee Dam and hauled upstream past Wynoochee Dam, and smolts travel downstream during the 77 days when

This structure on Bingham Creek has a fish ladder and smolt trap that have provided approximately 40 years of wild coho salmon life-cycle monitoring information.

Wynoochee Dam is a fish passage barrier and affects gravel and wood loading downstream.

hydropower operations are suspended to allow passage through the dam (Tacoma Power 2018). Chinook salmon are not transported upstream of Wynoochee Dam.

To support the ASRP analysis and EDT modeling, 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 remnant channels and other floodplain features. Rivers in the Olympic Mountains Ecological Region are unconfined to partly confined and low gradient within narrow valleys in the upper areas and large wide alluvial valleys in the lower extents. Compared to historical conditions, the stream channel lengths do not appear to be significantly reduced, but side channels would have historically been far more prevalent, particularly on the lower Satsop River; the rivers could have had 4 times or greater the area of frequently connected floodplain. Large wood has been removed from the channels throughout this region.

5.8.3 Current Conditions

Current conditions reflect ongoing forest management, agricultural land uses, and residential and commercial development. Land cover is 48% coniferous forest, 25% shrub, 8% grassland, 4% developed, 4% wetland, 4% bare ground, and small percentages of other cover[27] (Figure 5-16). Approximately one-third of this region is within the Olympic National Forest.

An assessment of riparian conditions and functions by NOAA (Beechie 2018) indicates that the majority of the riparian areas in the Olympic Mountains Ecological Region are either moderately impaired or impaired for wood recruitment, with only about 21% of reaches functional. These are substantially better conditions than most regions of the basin, but they are still impaired. Shading conditions are also only moderately changed from historical conditions, except in the lower reaches of both the Satsop and Wynoochee rivers.

Olympic Mountains Current Snapshot

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

Restoration Potential: High

Protection Potential: High

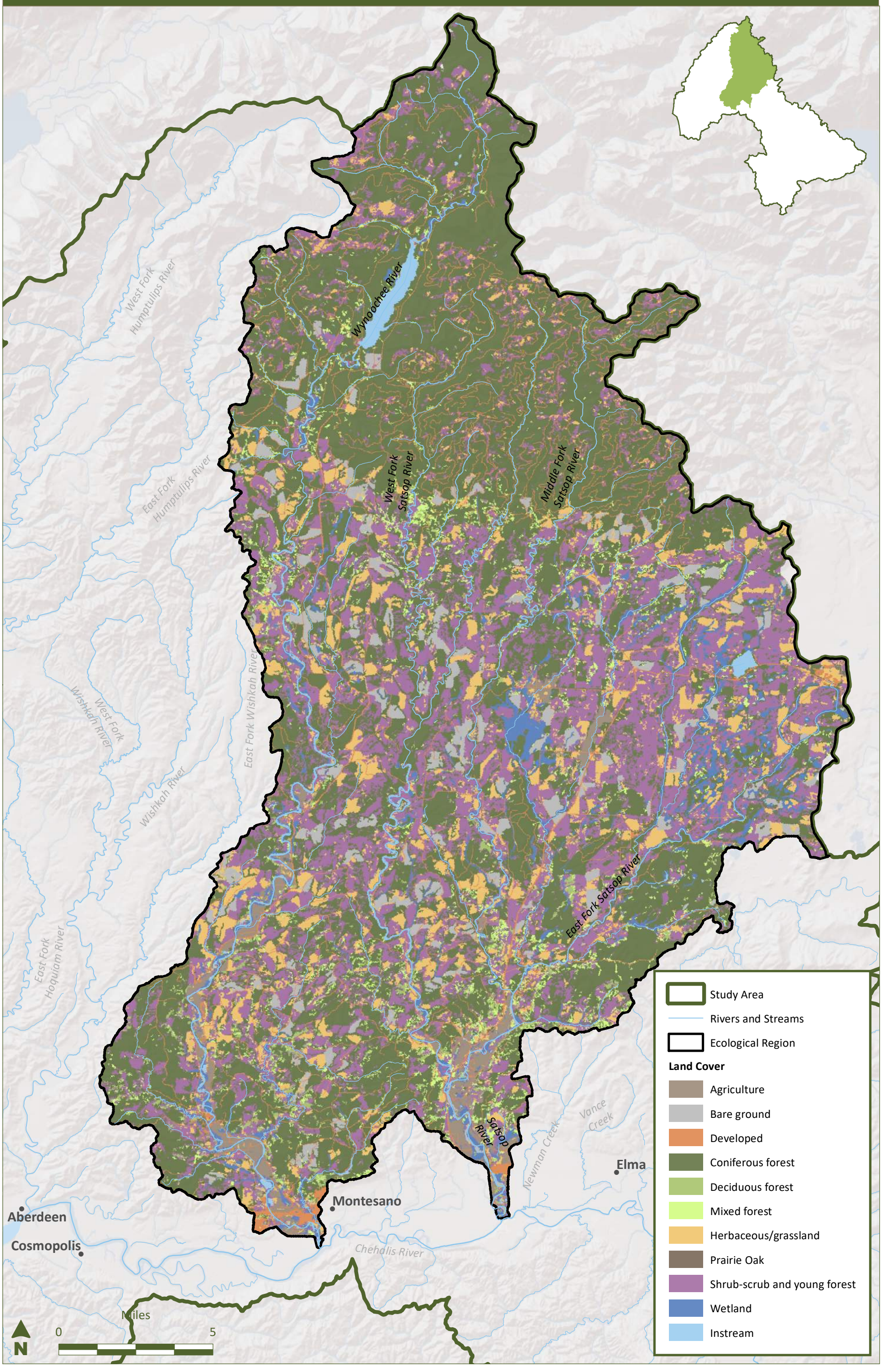
Geographic Spatial Units: East Fork Satsop River, Middle Fork Satsop River, West Fork Satsop River, Lower Satsop River, Lower Wynoochee River, and Middle Wynoochee River

Salmon Use and Potential: Fall-run Chinook salmon, chum salmon, coho salmon, and steelhead; spring-run Chinook salmon historically present

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, speckled dace, common goldeneye, great blue heron, and wood duck

[27] Land cover data from Multi-Resolution Land Characteristics Consortium, National Land Cover Database 2011.

Figure 5-16
Olympic Mountains Ecological Region Land Cover



Water quality is impaired in multiple reaches of the Olympic Mountains Ecological Region, primarily for temperature, low dissolved oxygen, and bacteria (Ecology 2018). Recent temperature monitoring in the East Fork (RMs 10.8, 17.7, 22.5) and West Fork (RM 0 and 15) Satsop rivers by WDFW (2015 data) indicates that the East Fork Satsop River is substantially cooler than the West Fork Satsop River, although temperatures do occasionally exceed water quality standards (16°C [61°F] core summer salmonid habitat) in July and August (Ecology 2016). The West Fork Satsop River regularly exceeds water temperature standards and typically exceeds 20°C (68°F) in July and August.

WDFW's Thermalscape model indicates that from 2013 to 2018, many stream reaches of the Olympic Mountains Ecological Region (ranging from 25% [2018] to 46% [2014 to 2015] of reaches) had mean August temperatures equal to or exceeding 16°C (61°F) and are projected to increase to 59% and 77% 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) by 2080 (Beechie 2018).

Existing mapping of wetlands (Ecology 2011b) shows large wetland areas, including the Decker Creek wetland complex, and significant areas of wetlands in the upper East Fork Satsop River area and along Bingham Creek. There are also several wetlands along both the lower Satsop and Wynoochee rivers and Sylvia and Black creeks (tributaries to the lower Wynoochee River).

Historical and current areas of floodplain marsh and beaver pond habitats were documented by NOAA using GLO mapping (Beechie 2018). They found the Satsop River sub-basin has lost 20% of its historical marsh habitat and the Wynoochee River sub-basin has lost about 50%; however, the existing marshes have been modified. The Satsop River sub-basin has lost about 55% of its historical beaver pond habitat, and the Wynoochee River sub-basin has lost about 80%. Approximately 160 fish passage barriers were incorporated into the EDT model[28] for the Olympic Mountains Ecological Region, with a significant

These early action reaches on the Satsop and Wynoochee rivers have substantial channel migration and bank erosion occurring.

[28] Fish passage barrier data from WDFW processed through EDT model.

number on tributaries to the Wynoochee River (Wynoochee Dam is the primary barrier on the mainstem rivers).

Several streams in this ecological region have highly porous glacial sediments and go dry or have very low flows in summer, including Dry Run, Dry Bed, and Decker creeks. This may mostly reflect natural conditions, but it creates a potential future risk for further dewatering from water withdrawals or loss of forest canopy and groundwater infiltration.

The percentage of fine sediment in streams was modeled by NOAA based on the density of roads and land uses; this modeling indicated about 16% fines in the Satsop River and 15 to 18% fines in the Wynoochee River, which is a substantial increase from modeled historical conditions (Beechie 2018) of 11% to 14% fines.

The salmonid species present in the Olympic Mountains Ecological Region include fall-run Chinook salmon, chum salmon, coho salmon, and steelhead. Spring-run Chinook salmon used and were historically present in the upper Wynoochee River but were nearly extirpated by the early 1970s from the river (WDF 1975). Non-salmon indicator species include 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. The bird indicator species present include common goldeneye, great blue heron, and wood duck.

There are two hatchery facilities on the Satsop River; all programs are integrated broodstock, detailed as follows:

- The Satsop Spring facility is owned by WDFW but operated by the Chehalis Basin Task Force cooperative program. The annual production goals are 500,000 Chinook salmon, 450,000 normal-timed coho salmon, and 300,000 chum salmon released into the East Fork Satsop River. Chinook and coho salmon are all marked. The chum salmon are too small at release to clip the adipose fin, so they are unmarked. The Chinook and chum salmon programs are for supplementing the natural population and providing harvest opportunity, while coho salmon are for harvest.
- Bingham Creek Hatchery releases 150,000 each of normal and late-timed coho salmon and 55,000 winter-run steelhead into the East Fork Satsop River for harvest. All releases are marked. This hatchery also provides broodstock support for Satsop Springs when needed.

Lake Aberdeen Hatchery rears summer- and winter-run steelhead for release into the Wynoochee River to mitigate for lost harvest opportunity caused by Wynoochee Dam. Annual release goals are 60,000 summer and 170,000 winter-run steelhead that are all marked. The summer steelhead program is a segregated program, using hatchery-origin broodstock, while the winter-run steelhead program is integrated.

Additionally, there is one annual coho salmon fry release by Montesano Junior/Senior High School totaling about 275 fish. The size of these fish at release are less than 1 gram per fish. This program is too small to contribute to adult returns.

5.8.4 Limiting Factors

Limiting factors for salmonids have been identified in several assessments of the Chehalis Basin, including 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.

Diagnostic Snapshot

- The ecological region is lacking wood nearly everywhere.
- Substantial channel length lacks stable gravel.
- Steep slopes are at risk of landslides.
- The East Fork Satsop River is highly productive and includes cold water and better conditions than other areas.
- These big rivers have very active channel migration that creates substantial risk for agriculture and residential land uses.
- Invasive plant species, including reed canarygrass, are present. The lower Satsop River, in particular, has extensive areas of knotweed.
- Wynoochee Dam affects gravel and wood loading downstream of the dam and inundated areas that may have been highly productive Chinook salmon spawning habitat. Chinook salmon are not transported above the dam.
- Lower watersheds include poor riparian conditions, excessive channel widths, and a lack of shade.
- Tributary channels are affected by incision.

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 (primarily lower rivers)
- Low habitat diversity (lack of side channels, large wood, floodplain connectivity, and beaver ponds)
- Reduced quantity and quality of instream habitats
- Channel lengths and widths
- Sediment load (fine sediments)
- Fish passage barriers
- Predation (non-native fish species)
- Channel instability (bed scour and sediment transport)
- Flow (primarily low flows)

These 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 floodplain conditions, riparian conditions, water quality, sediment conditions, fish passage barriers, lack of large wood, channel stability, and water quantity. The ASRP assessment identified slightly different priorities focused on large wood, floodplain connectivity, beaver ponds, and riparian restoration.

Limiting factors and threats to non-salmon indicator species are not well understood but may 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]).

5.8.5 Strategies and Actions in the Ecological Region

5.8.5.1 Habitat and Process Protection

Many of the protection actions described in Section 4.2.1 are appropriate in the Olympic Mountains Ecological Region, particularly acquisitions and easements to protect high-quality riparian and floodplain wetland habitats. Based on existing conditions, the following areas and actions are recommended for a protection focus:

- Protect extensive wetland habitats and other aquifer recharge areas that support cold-water inputs in the upper East Fork and Middle Fork Satsop river sub-basins (including Dry Run and Dry Bed creeks).
- Protect estuary-adjacent areas at confluences with the Chehalis River to accommodate the processes by which sea level rise will cause estuary zones to shift upstream.
- Protect headwater lakes in the Wynoochee and West Fork Satsop river sub-basins for unique amphibian assemblages and species diversity.

The upper East Fork Satsop River includes headwater wetlands and cold water springs that are likely to be resilient to climate change effects on stream temperature, making this area a refuge and an important protection priority.

This seasonally dry channel, a tributary to the East Fork Satsop River, provides substantial chum and coho salmon habitat when wetted. Even ephemeral streams can add to the productivity of the system and should be protected.

The majority of the Olympic Mountains Ecological Region is within Grays Harbor County, which has regulations and policies in place to protect wetlands, floodplains, riparian areas, and fish and wildlife habitat conservation areas from degradation and development and manage invasive species. Grays Harbor County's draft SMP that is currently in final review with Ecology contains regulations to protect channel migration zones and riparian vegetation, along with general development regulations related to shoreline areas in the County (Grays Harbor County 2018).

The eastern portion of the ecological region is in Mason County, which has regulations and policies in place to restore shoreline ecological functions and floodplain connectivity, improve habitat for salmon populations, and protect wetlands and groundwater. They also have objectives to coordinate with nearby counties on conservation plans and programs to ensure that protection measures occur at the watershed scale.

As part of the community planning strategy (see Section 5.8.5.3), funding support to align the counties' regulations with the ASRP and conduct enforcement will be considered.

General protection priorities for Grays Harbor and Mason counties in the Olympic Mountains Ecological Region are as follows:

- Protect and increase forest cover.
- Protect wetlands from development and surface and groundwater withdrawals and minimize impervious surfaces.
- Protect spawning gravel sources and retain spawning gravels (protect/allow channel migration and improve wood recruitment).
- Protect key functioning floodplain and riparian areas from development and promote groundwater recharge.

5.8.5.2 Restoration

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

- Restore riparian areas in the lower rivers to maintain cooler water temperatures and slow unnaturally high channel migration rates.
- Place extensive stable instream wood to improve channel stability, trap alluvium (finer gravel), increase variations in bed textures, increase the number of pools and cover, raise streambeds, and increase floodplain and wetland connectivity and promote groundwater recharge.
- Address fish passage barriers, particularly those associated with fish hatcheries and fish collection facilities.

A key Chinook salmon spawning reach is downstream of Wynoochee Dam in managed forest. No Chinook salmon are passed upstream of the dam, though areas upstream historically may have provided highly productive spawning habitat. The dam has effects on substrate and wood loading downstream (lack of gravels downstream of dam); this area could be restored and enhanced.

- Reconnect floodplains to restore and increase off-channel habitats that are particularly important for juvenile coho and Chinook salmon.
- Target estuary-adjacent areas at confluences with the Chehalis River for restoration to accommodate the processes by which sea level rise will cause estuary zones to shift upstream.
- Implement and monitor the early action restoration projects on the Wynoochee and East Fork Satsop rivers to evaluate the effectiveness of restoration techniques and identify opportunities for additional restoration projects.

Priority areas for restoration in the Olympic Mountains Ecological Region include the mainstem Satsop River and all forks; key tributaries such as Decker, Bingham, and Dry Run creeks; the lower and middle Wynoochee River; and Canyon River.

5.8.5.3 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 Olympic Mountains Ecological Region include the following:

- WDFW could investigate the potential effects of hatchery fish on wild fish.
- Explore opportunities for Wynoochee Dam operational modifications that mimic natural flow patterns to benefit fish spawning and rearing in downstream reaches and improve fish transport and passage above the fish collection weir and dam.
- Discuss with Grays Harbor and Mason counties additional planning measures that could promote and protect the following:
  - Surface and groundwater supplies through reduction of withdrawals
  - Minimization of impervious surfaces
  - Riparian maturation and wood recruitment for retention of spawning gravel and sources
  - Natural channel migration
- 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).

5.8.5.4 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 Olympic Mountains 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:

- Seize on educational opportunities at the numerous public access recreation and fishing sites. Signage and/or community events at the access sites would present opportunities for communication and education regarding river restoration activities and connections to the fisheries that are supported by these activities.
- Continue outreach, engagement, and involvement processes to incorporate landowner expertise into ASRP planning and local implementation efforts, particularly timber landowners.
- Partner with and support the efforts of existing local organizations (see Appendix E for a list of potential partner organizations).

5.8.5.5 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 Olympic Mountains 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).