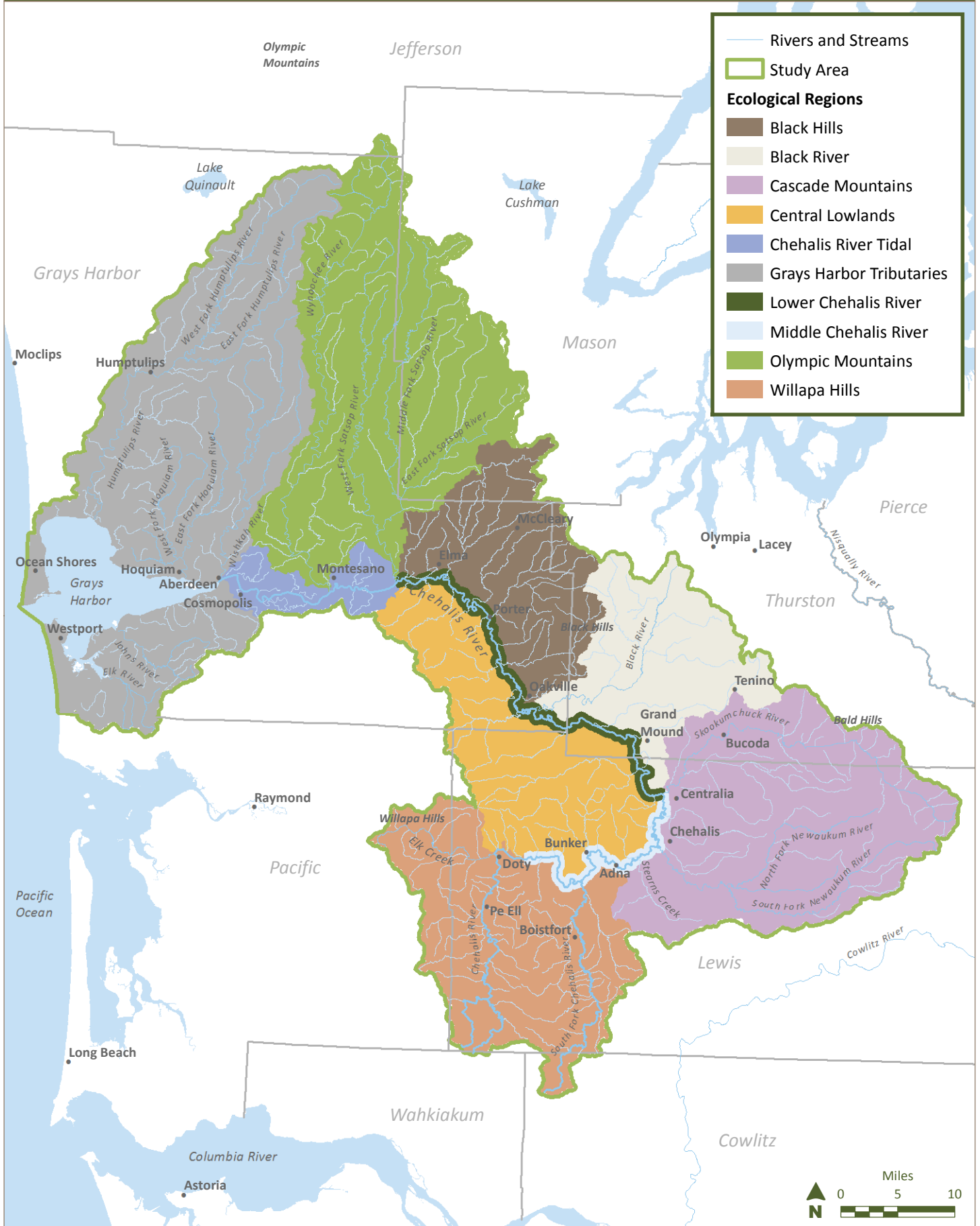
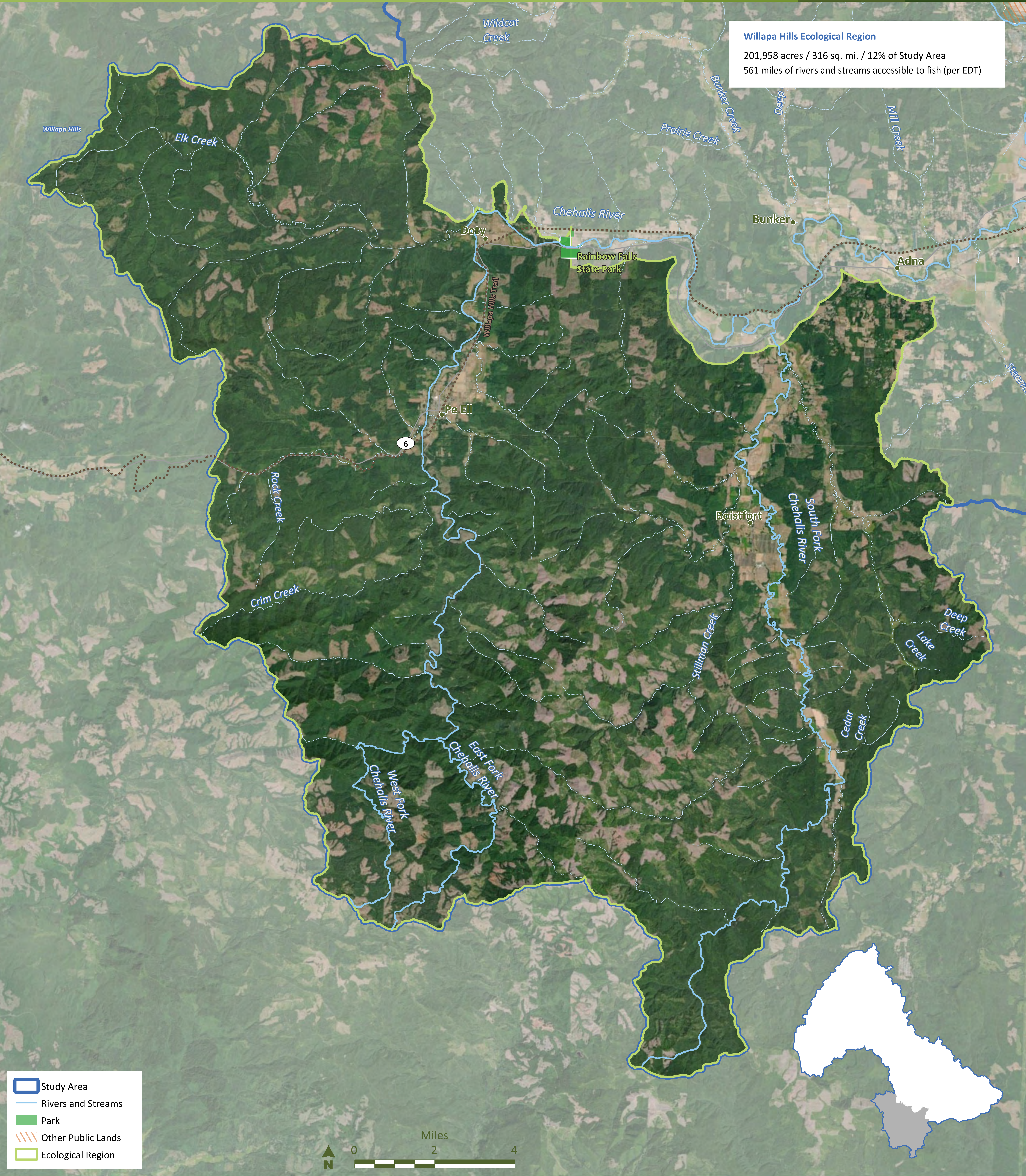


## Ecological Regions





# Willapa Hills Ecological Region Map





# Willapa Hills Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- Willapa Hills was a former stronghold of spring Chinook salmon, but the species appears to be headed towards regional extirpation.
- 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 in these spawning aggregates).
- The most diversity of amphibians is in this Ecological Region. It is the only one with Dunn's salamander and has the highest densities of Western toad in the Basin and the second greatest distribution of Van Dyke's salamander. It also has long distances of low gradient, coarse clast/bedrock, large river habitat.

## What is working? What is broken?

- Substantial channel length lacks stable gravel and wood.
- Severe disturbance via storm events in the Willapa Hills has had a large impact on stream conditions. Recolonization of salmonids and Western toad appears to be rapid (less than 10 years). The recolonization rate currently observed show high densities of juvenile salmonids that apparently contradict observed habitat conditions (i.e., warm temperatures, lack of wood, prevalence of bedrock) and the conditions typically considered important for salmonids. Despite this rebound, habitat conditions continue to be in a degraded condition.
- The relatively intact wetland complex in the Elk Creek watershed is probably a good example of what many of the valleys now dominated by agriculture originally looked like. It holds fish through numerous life stages, an example of "sticky" habitat.
- Severe incision, and poor riparian and floodplain habitat conditions, are found in the South Fork Chehalis River.
- A key issue in this Ecological Region is the overall warmer temperatures in the Upper Chehalis River and South Fork Chehalis River geographic spatial units compared to sub-basins with similar high-elevation headwaters.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Install functional wood structures in the Upper Chehalis River to trap sediment, creating spawning and incubation habitat and cool water pools.
- Consider a salmon refuge preserve such as the wetland complex in the upper valley portion of Elk Creek.
- Test small stream wetland restoration at Lake Creek, which has high coho salmon production potential, including encouraging beavers or using beaver dam analogs. Stillwater amphibians also need beaver dams, and need close proximity reconnection to forested habitat for amphibian movement.
- Continue monitoring Stillman Creek relative to recovery from the 2007 storm event.
- Raise the stream bed in the South Fork Chehalis River through instream wood placement. This could have symbiotic groundwater storage benefits that will also benefit instream flows.
- 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.
- Prioritize buffer length over width on the South Fork Chehalis River to promote shading and cover along its length.



*The upper watershed was historically a stronghold for spring Chinook salmon. These areas also provide habitat for beaver, amphibians, and other indicator species. First-order headwater streams with forested land could be identified for protection to reduce future degradation of aquatic habitats.*



*On the West Fork Chehalis River, 6 or 7 miles of coho and steelhead habitat could be opened by reconnecting an oxbow channel and bypassing the falls.*



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



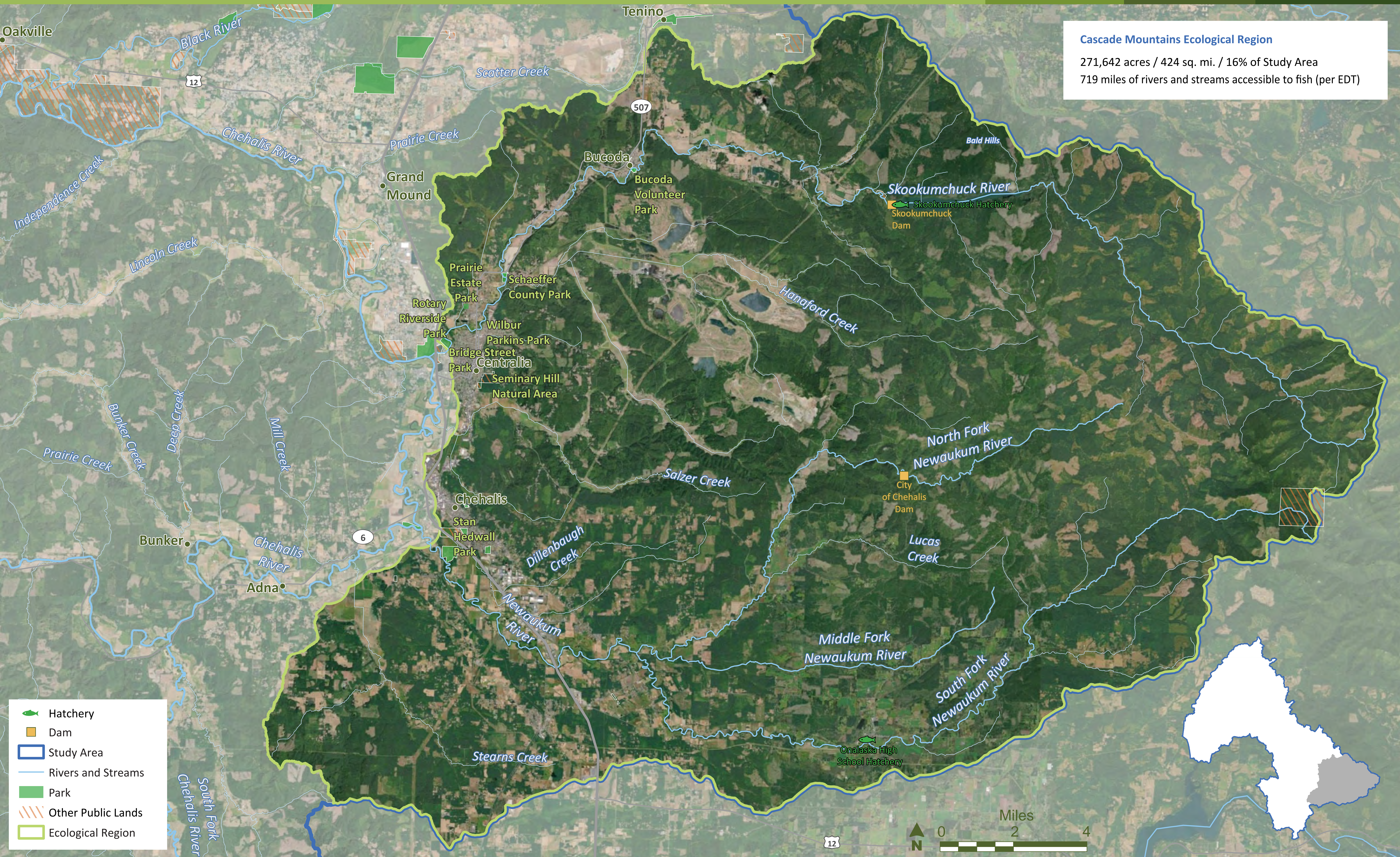
*Lower Stillman Creek has opportunities for floodplain reconnection in the Willapa Hills Ecological Region.*



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



# Cascade Mountains Ecological Region Map





# Cascade Mountains Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- The Newaukum and Skookumchuck rivers support the majority of the spring Chinook salmon population in the Chehalis Basin. Improving conditions for this population, especially enhancing summer holding habitat, is a key consideration for restoration in these watersheds.
- Diverse channel gradient, confinement, and size is a natural condition of the landscape that affects the potential for channel complexity and water storage.
- Deep-seated landslides—a source of episodic sediment to downstream reaches—have been documented in the upper watershed.
- Hanaford Creek has extensive floodplain wetlands, though channelization and industrial land use impacts are also prominent.
- Nonnative fish species (bass, sunfish) are observed in the mainstem river that connects geographic spatial units in this Ecological Region, in lower reaches of the Newaukum forks, and in the mainstem Newaukum River below the forks. Presence in the Skookumchuck River is unknown.
- There are significant hatchery influences on wild fish genetics.
- This Ecological Region supports multiple salmon species and Pacific lamprey.

## What is working? What is broken?

- There is a lack of wood, channel incision, poor riparian conditions, and disconnected floodplains.
- Lower reaches of the Newaukum and Skookumchuck rivers have large potential for improved stream temperatures. There is a strong upstream-downstream temperature gradient, and downstream extents are undoubtedly influenced by the land use and lack of riparian buffers.
- Many landowners farm or mow grasses to the channel edge, which has significant effects on shading (temperature), food inputs (terrestrial insects), and other stream characteristics. WDFW snorkel and PIT-tag studies showed that juvenile coho salmon and steelhead are present in the lower South Fork Newaukum River in May and June, but some combination of mortality and upstream migration in July results in limited use for summer rearing habitat.
- There are invasive exotic plant species including reed canarygrass.
- Substantial channel length lacks stable gravel. The lower extents of the Newaukum and Skookumchuck sub-basins are heavily silted. Siltation (affected by the lack of riparian buffer and cattle access to streams) reduces survival of incubating eggs and affects the availability of benthic food resources.
- Spring Chinook salmon reach summer holding areas by late June and remain there throughout the summer until spawning begins in September. During this holding period, they are highly vulnerable to illegal harvest, which is known to occur within this Ecological Region.
- Skookumchuck Dam disconnected the upper and lower watershed and disrupted physical and biotic processes.
- Salzer, China, Coal, and Dillenbaugh creeks all have visible urban creek impacts.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Protect and restore this Ecological Region at a high intensity because of its critical function as a spring Chinook salmon core area, the impacted habitat condition, and its high vulnerability to increasing development.
- Evaluate removal of Skookumchuck Dam or operational changes to benefit aquatic species.
- Increase community involvement in protecting spring Chinook salmon in summer holding areas.
- Increase enforcement against poaching.
- Strategically restore wet marsh habitats, such as in Stearns Creek and Hanaford Creek.
- Restore the lower reaches of the Newaukum and Skookumchuck rivers, specifically riparian buffers and instream wood for channel complexity and floodplain connectivity, to improve summer rearing and holding habitat for salmonids.
- The Skookumchuck and Newaukum rivers have significant hatchery activities; any restoration actions will have to consider these activities. Hatchery steelhead programs likely could also be improved to minimize impacts on wild populations.



*The upper South Fork Newaukum River, including the Pigeon Springs area, is a key cold-water refuge for spring Chinook salmon and other indicator species that should be protected.*



*Skookumchuck Dam and its reservoir cause disconnection of the upper and lower watershed and of physical and biotic processes, though they also provide cold-water supplementation.*



*Stream conditions lacking wood and mature riparian areas are common throughout the Cascade Mountain Ecological Region.*



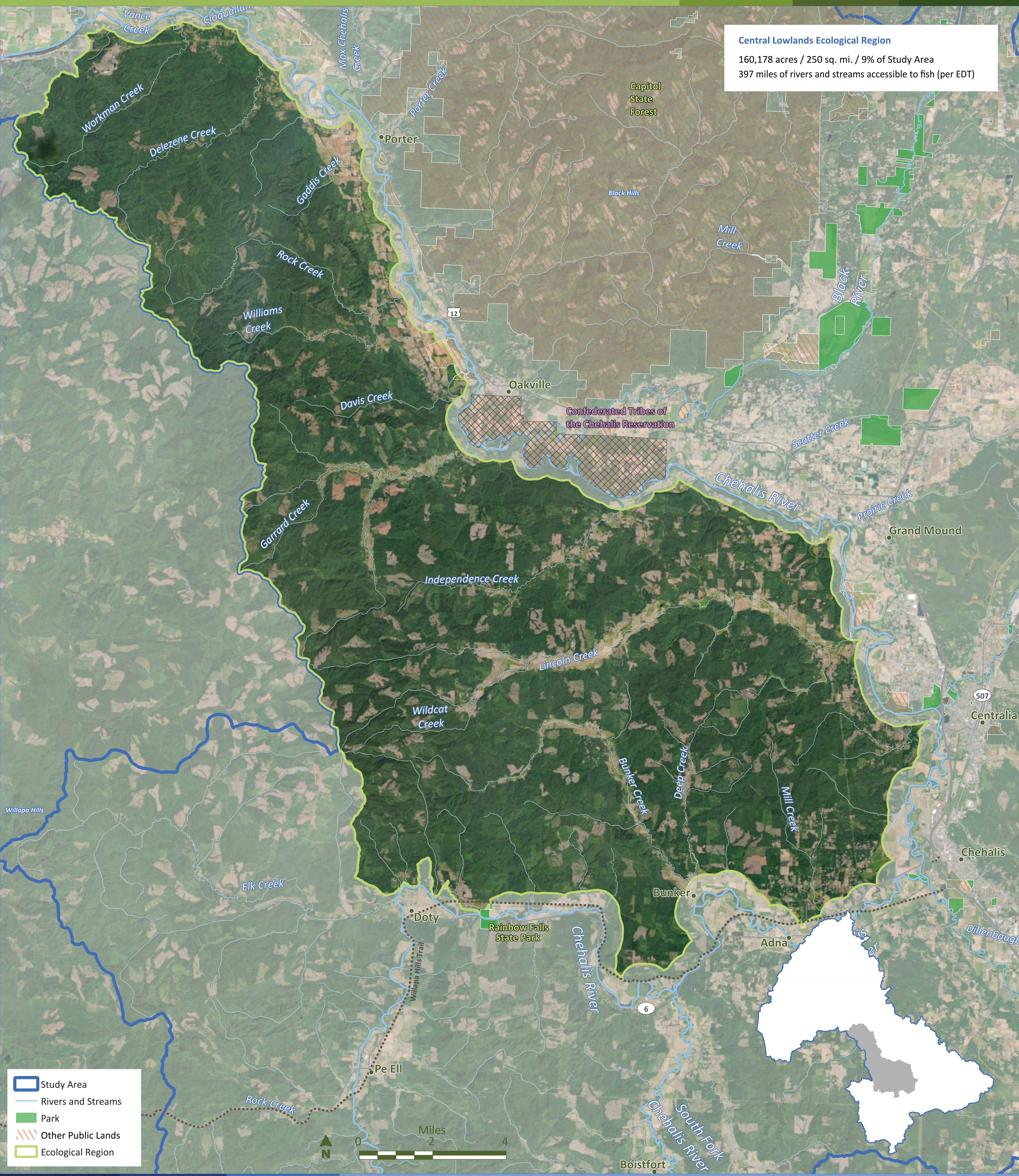
*Infrastructure in the floodplain has disrupted natural processes, as illustrated by this riprap embankment protecting a bridge crossing.*



*Stearns Creek is a priority for lowland marsh and prairie restoration. Like other creeks in the Cascade Mountain Ecological Region, much of Stearns Creek is restricted by fish passage barriers, channelization, poor riparian conditions, loss of floodplain habitats, and high water temperatures.*



# Central Lowlands Ecological Region Map





# Central Lowlands Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- Abundant wetlands and beavers were likely key components of historical conditions on the small, low-gradient streams.
- This Ecological Region has important spatial diversity areas for many species.
- There is a significant wood duck population along Lincoln Creek.
- Climate change will increase the frequency of high flows and low flows with associated bed/bank scour and drying of streams. Wood, wetlands, and riparian forest areas could moderate this effect, but may also increase flooding (i.e., water elevation).
- Restoring slough habitat with groundwater inputs may provide chum salmon spawning habitat, increasing the overall spatial footprint used by the Grays Harbor chum salmon population.
- Consideration may need to be given to identifying a subset of streams for restoration combined with protection. Such a strategy should be weighed against doing less intensive work over a larger number of streams.

## What is working? What is broken?

- Bunker, Lincoln, Independence, and Garrard creeks have extensive floodplains and wetlands (proportionately large for the streams). Floodplain functions are frequently compromised by agricultural practices.
- The Ecological Region is lacking wood and beavers.
- Poor riparian conditions or young trees exist in many locations.
- Floodplain development is relatively low.
- Substantial channel length lacks stable gravel.
- There are invasive exotic plant species including reed canarygrass.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Protect existing riparian forested areas.
- Install large wood; this Ecological Region has the advantage that small streams don't need as large of wood to be stable.
- Encourage beavers, restore willows and other food for them, and install beaver dam analogs.
- Examine opportunities for greenbelts (riparian areas) because development is minimal.
- Prioritize Bunker, Lincoln, and Garrard creeks for channel, floodplain, and riparian restoration
- (large wood, floodplain reconnection, invasive control, and riparian management).
- Restore confluence areas where creeks join the mainstem Chehalis River. Bunker Creek could be a cold-water holding area for spring Chinook salmon, and Deep Creek could also be considered.
- Focus on headwater streams (mostly first-order streams) for acquisition and protection because of their sensitivity to climate change.



*Bunker, Lincoln, and Garrard creeks are priorities for channel, floodplain, and riparian restoration. Existing riparian forested areas should be protected and beavers (or the use of beaver dam analogs) should be encouraged.*



*Larger streams in the Central Lowlands Ecological Region—such as Bunker, Lincoln, Independence, and Garrard creeks—have relatively extensive floodplains and wetlands that should be protected and enhanced.*



*Climate change will increase the frequency of high flows and low flows with associated bed/bank scour and drying of streams. Wood, wetlands, and riparian forest could moderate this effect.*



*More intensive residential or small farm development could harm instream flows as well as limiting options for restoration. There is a potential for riparian easements along the tributary streams; this could retain farming and provide an opportunity for greatly improved habitats.*

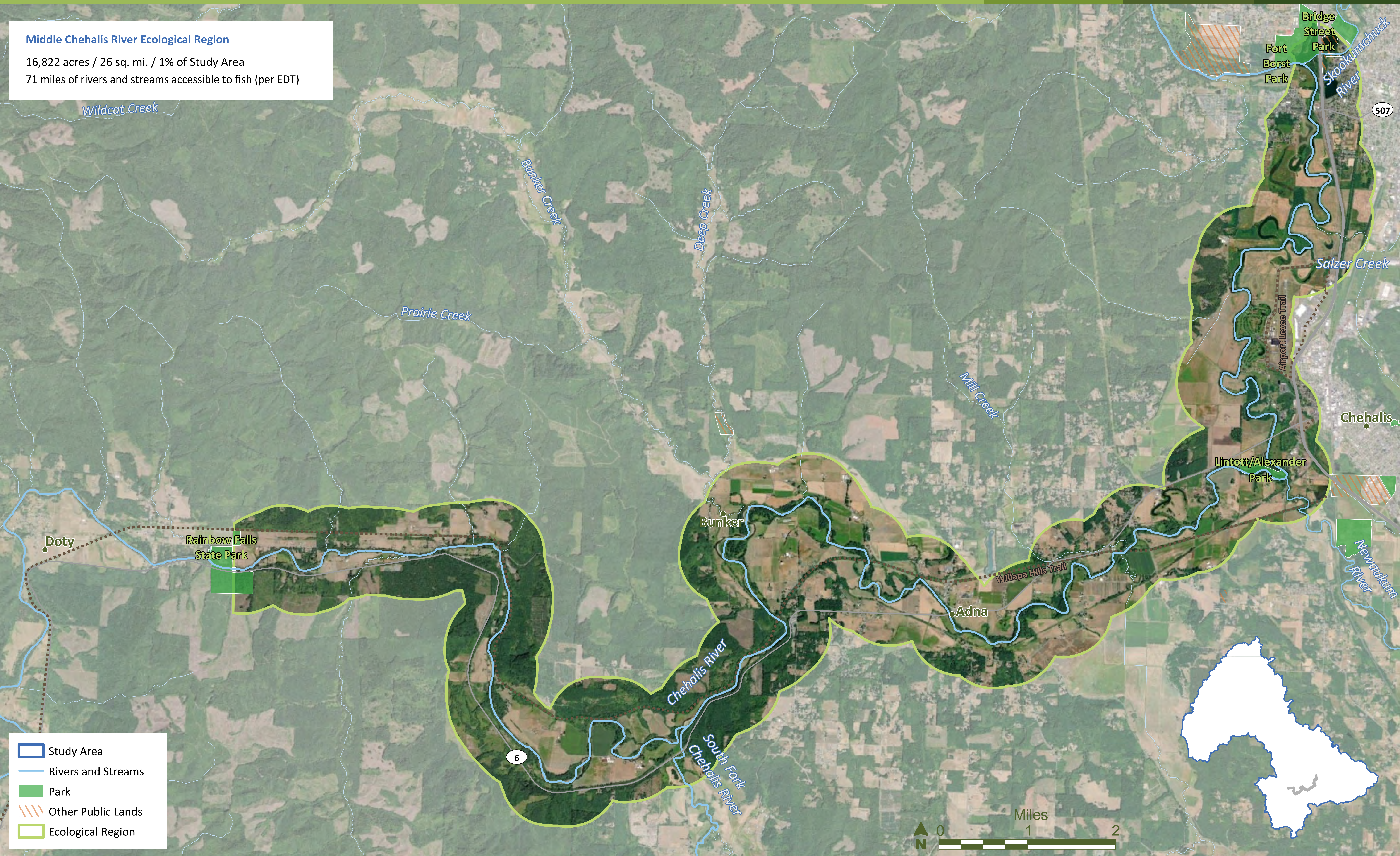


*There is a significant contrast between stream reaches with only limited riparian zone and areas with riparian forested habitat. Riparian cover also tends to support more spawning than areas with less cover.*



# Middle Chehalis River Ecological Region Map

**Middle Chehalis River Ecological Region**  
16,822 acres / 26 sq. mi. / 1% of Study Area  
71 miles of rivers and streams accessible to fish (per EDT)





# Middle Chehalis River Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- Migratory fish from all sub-basins in the upper Chehalis Basin pass through this region, making its ecological function more impactful to large areas.
- The Ecological Region is unique in that it includes a large and deep river channel as well as a series of off-channel habitats created by old river channels in various stages of succession.
- High exotic loading is found in off-channel habitats and substantial exotic fishes live in the mainstem Chehalis River.
- Numerous disconnected oxbows are present on the floodplain. The reach likely once held substantial off-channel rearing areas in the form of old oxbows and other features.

## What is working? What is broken?

- The Ecological Region is lacking wood nearly everywhere.
- Substantial channel length lacks stable gravel.
- Channel migration and channel-forming processes have degraded over time. Over multiple decades, the banks of the mainstem have been artificially stabilized (e.g., riprap) by landowners desiring to protect property from the river. Artificial stabilization has resulted in less migration of the mainstem and creation of few off-channel areas, and now the existing off-channel areas are undergoing succession (i.e., disconnecting) and newer off-channel areas are not being created.
- Exotic fish species and bullfrogs are widespread in this Ecological Region.
- The main channel is largely disconnected from its floodplain. Riparian zones are narrow to non-existent in much of the reach. Very little wood exists in the Middle Chehalis River, and moderate lengths of riprap and channel control are found throughout the reach.
- High water temperatures are a significant issue. Pockets of cooler water near the Chehalis River confluences with the Skookumchuck and Newaukum rivers may be critical to providing refuges during the summer months, especially for adult spring Chinook salmon and Olympic mudminnow.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Restore instream structure and pool frequency with large wood installations.
- Consider spacing off-channel habitat restoration, using a node concept to increase fish access along the length of the reach. Restoration of channel-forming process and floodplain connection will be somewhat constrained by land uses.
- Protect existing riparian forest.
- Protect existing wet prairie.
- Test restoration of floodplain wetlands that dry out in the summer.
- Protect cool-water inputs.



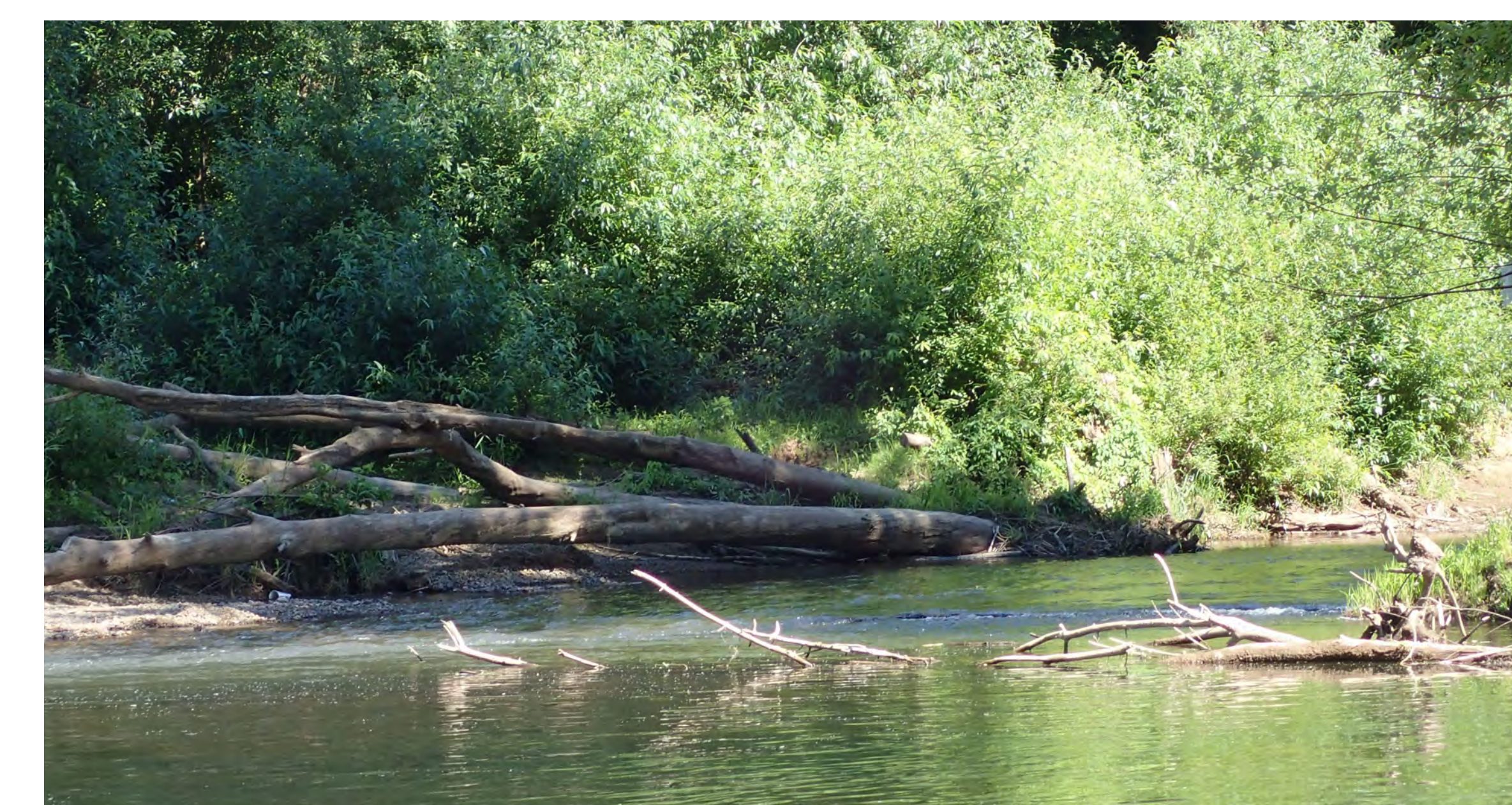
*The Middle Chehalis River Ecological Region is limited by infrequent instream pools and inadequate riparian conditions. In this area upstream of the confluence with the Newaukum River, the Chehalis River shows channel incision, an eroding bank, and a lack of functioning riparian vegetation and wood.*



*Stearns Creek, an important small tributary, historically included wetland and prairie habitat at the confluence with the Chehalis River. Current conditions at the creek mouth, viewed from the Willapa Hills Trail, illustrate sediment deposition.*



*This glide habitat near Chehalis River river mile 78 shows the need for wood and structural habitat elements, and the potential for floodplain reconnection.*



*Tributaries influence conditions in the mainstem Chehalis River, and the effectiveness of actions in other ecological regions will be influenced by conditions in the mainstem. This image shows an important confluence with the Newaukum River, which can deliver inputs of wood and gravel and can provide a cooling influence on water temperatures.*



# Lower Chehalis River Ecological Region Map





# Lower Chehalis River Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- The Chehalis River has the highest densities of coho salmon per area of watershed, which is related to the abundance of overwintering habitat naturally provided in the wide and meandering floodplain. It also has the highest densities of native stillwater-breeding amphibians and native non-salmonid fish.
- Migratory fish from all sub-basins above the tidal areas pass through this region, making its ecological function more impactful to large areas.
- The floodplain is extensive along the river's mainstem through the Lower Chehalis River Ecological Region, which could present numerous opportunities for floodplain reconnection.
- This area has the largest amount of diverse off-channel habitats of all the Ecological Regions.

## What is working? What is broken?

- This Ecological Region is lacking wood nearly everywhere.
- There is limited spawning habitat (identified between Oakville and Porter) and summer temperatures are too high to support juvenile salmonid rearing.
- Non-native species such as bull frogs and bass (smallmouth and largemouth) are prevalent throughout this Ecological Region. The timing of introduction of these species is unknown, but they are all major piscivores that are known to or likely to have negative interactions with native fishes.
- There are invasive exotic plant species including reed canarygrass.
- This Ecological Region has experienced the greatest loss of floodplain wetland habitats.
- The main channel is more connected to its floodplain in this Ecological Region than in the Middle Chehalis River Ecological Region. Riparian zones are narrow to non-existent, there is very little wood, and moderate lengths of riprap and channel control are found in much of the reach.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Protect cold water inputs, and attempt to better understand these areas for protection.
- Protect existing riparian forest.
- Protect and restore existing wet prairie habitats.
- Restore depressional-intermediate hydroperiod wetlands.
- Restore instream structures and pool frequency with large wood installations.
- Test restoration of floodplain wetlands that dry out in the summer.



*Lower mainstem habitats are limited in diversity and could be enhanced by wood, riparian restoration, and off-channel reconnection actions.*



*Gravel bars are prevalent in the Lower Chehalis River near river mile 35. Both in-channel and floodplain habitats could be enhanced with wood and riparian restoration.*



*Several floodplain areas in the Lower Chehalis River Ecological Region are owned by Washington State or the Chehalis Tribe. This site is seasonal floodplain habitat protected by the Chehalis Tribe, which could be an important location to experiment and learn from restoration techniques.*



*Lower mainstem habitats have degraded riparian conditions, as shown here across from a boat launch near Porter. Substantial recreational river use and sport fishing occur throughout the Lower Chehalis River Ecological Region.*



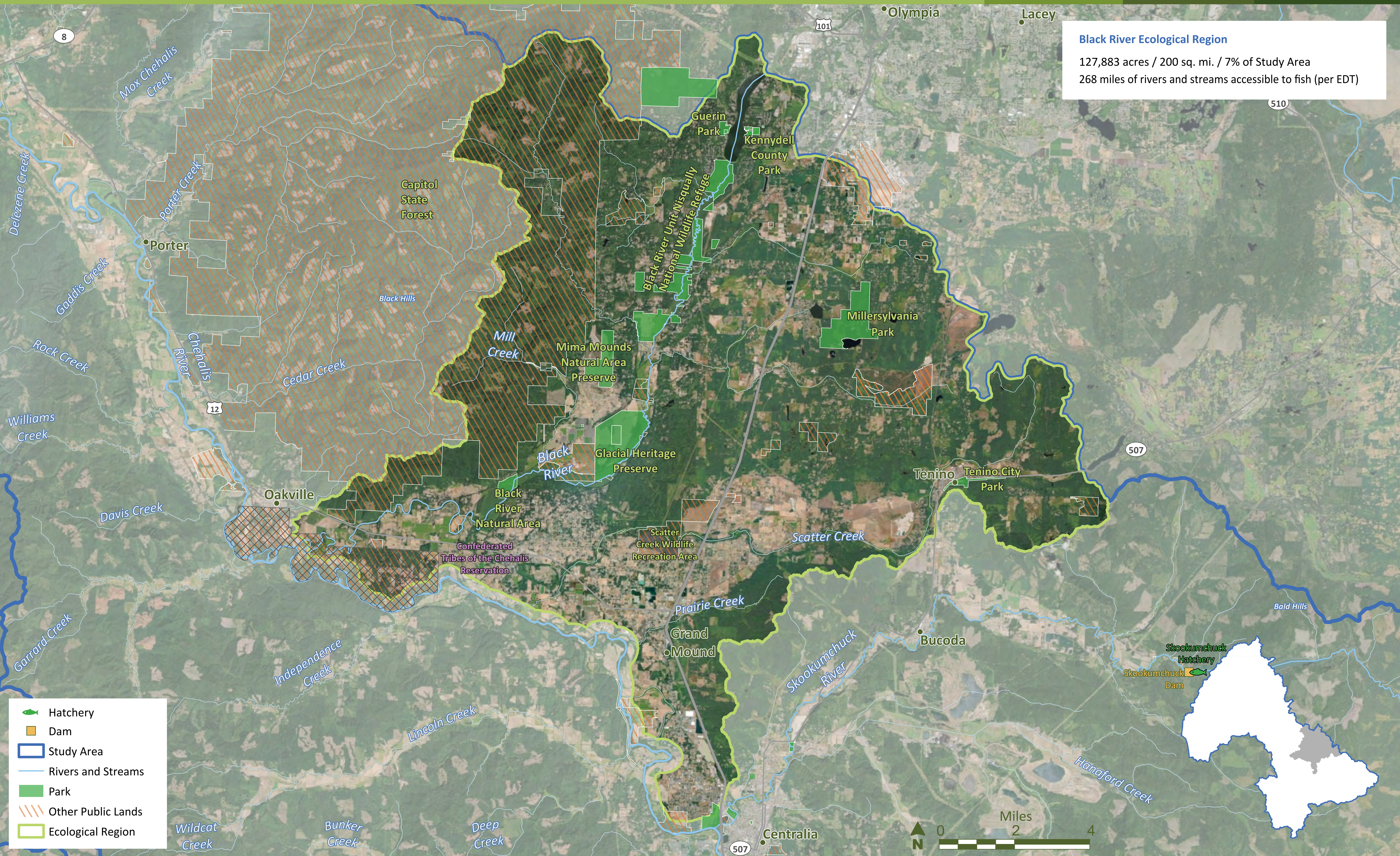
*Hoxit Pond, which is already protected, is an example of off-channel conditions that could be enhanced or restored in other locations to provide important habitat for amphibians.*



*Backwaters and remaining side-channels along the mainstem Chehalis River provide opportunities for restoration.*



# Black River Ecological Region Map



## Black River Ecological Region

127,883 acres / 200 sq. mi. / 7% of Study Area  
268 miles of rivers and streams accessible to fish (per EDT)

- Hatchery
- Dam
- Study Area
- Rivers and Streams
- Park
- Other Public Lands
- Ecological Region

0 2 4  
Miles



# Black River Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- Extensive low-gradient wetland complexes found in the Black River Ecological Region are currently unique in the Chehalis Basin (some may have historically existed in the Skookumchuck River area). Springs and groundwater inputs may be occurring.
- State wildlife lands and extensive marsh systems limit land development in much of this Ecological Region, which offers important protections to aquatic species.
- The presence of Oregon spotted frog is unique to this Ecological Region. Olympic mudminnow is also widespread and has frequent co-occurrence with Oregon spotted frog.
- West Rocky Prairie is a unique area with several types of headwater prairie habitats that support multiple threatened species.
- Stream temperature is not well understood but may be particularly important to summer habitat for juvenile coho salmon and summer holding habitat for adult spring Chinook salmon (note adult spring Chinook salmon have been reported in the Black River by landowners but not recently confirmed). Temperatures in the lower mainstem are quite warm during the summer, but there has been minimal spatial coverage to document temperatures or identify coho salmon summer rearing areas.

## What is working? What is broken?

- The Ecological Region is lacking wood nearly everywhere.
- Substantial channel length lacks stable gravel.
- There are invasive exotic plant species including reed canarygrass.
- The extensive, relatively intact marsh habitat and lakes are high protection priorities.
- The upper Black River is vulnerable to development impacts from the greater Olympia area.
- The Black River has been channelized and widened, and possible impacts of those modifications have not been evaluated.
- Scatter Creek instream flows may be impacted by groundwater pumping and the historical diversion of one of its headwater tributaries outside of the Basin.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Ensure continued protection and restoration/management of Oregon spotted frog habitat.
- Identify and protect areas with cool-water inputs.
- Reduce or prevent surface or groundwater withdrawals that could decrease instream flows, including reconnecting diverted tributaries, particularly in systems like Scatter Creek.
- Identify effects of channelization in the Black River and other systems and restore if needed and possible, with the objective of restoring anabranching channel patterns where appropriate. Add instream structure to increase the number of pools and promote anabranching/island formation.
- Protect functioning wet prairie, floodplain, and marsh habitats, especially in the Allen Creek area.



*The low-gradient and meandering Black River, along with Scatter and Prairie creeks, formerly supported significant runs of chum and coho salmon but these populations are reduced now.*



*A mosaic of riparian areas and palustrine forested, scrub-shrub, and emergent wetlands in the ecological region represent one of the largest remaining relatively undisturbed freshwater wetland systems in the Puget Sound region. The extensive associated wetland system should be further protected and enhanced.*



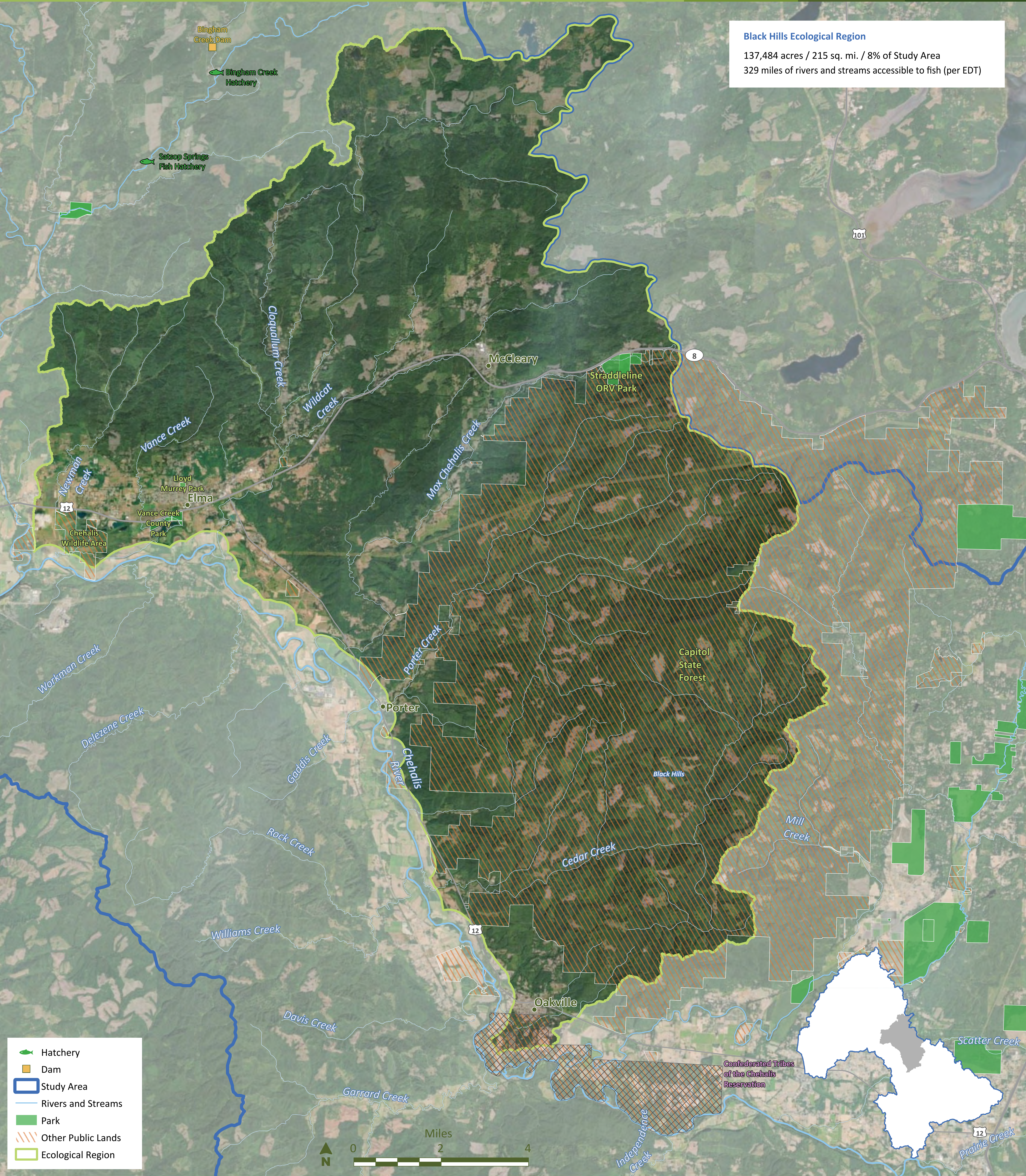
*The Black River Ecological Region is the only known occurrence of Oregon spotted frog in the Chehalis Basin, and one of only six known locations in Washington. West Rocky Prairie, a known Oregon spotted frog-occupied site, is an example of glacial pond habitats that should be targeted for protection and restoration.*



*Scatter Creek was an important historical habitat for salmon and other indicator species. This area is currently threatened by impaired riparian function, loss of floodplain habitats, and low flows. Scatter Creek could be enhanced by protection of flows and restoration of beaver habitat and wood.*



# Black Hills Ecological Region Map





# Black Hills Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- This Ecological Region is composed of relatively short, woodland tributaries flowing south from the Black Hills into the Chehalis River. The lower section (less than half a mile) of these tributaries is often slough-like with low gradient, slow/no flow habitat that contrasts with the riffle/pool or plane bed habitat observed throughout much of the rest of the streams.
- Several of the streams (such as Porter and Cedar creeks) are within the Capitol State Forest managed by WDNR, which offers protection of stream and riparian habitat. Habitat Conservation Plans developed for the managed forests retain riparian buffers that are essential for shading and wood delivery to stream channels.
- Underlying glacial geology can supply spawning gravel, and these creeks are an important cold-water inflow to the Chehalis River.
- Management considerations include the planting of inland trout (exotic to Washington trout genetics) into headwater lakes. In many cases, WDFW removed fish screens that blocked passage into these lakes in the early 1990s, but some fish screens remain. The screens retain inland trout within the lake for fishing, reduce interactions with rainbow trout/steelhead, and block access to habitat for anadromous fishes (i.e., coho salmon) that use headwater streams for spawning and rearing.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Continue to enlarge culverts to increase anadromous fish access to habitat.
- Identify potential lake areas where genetic mixing issues may occur between resident trout releases and wild steelhead, and reduce the risks. Evaluate impacts and management needs.
- Add wood to improve instream habitat with respect to channel diversity, gravel recruitment, and cover. The urbanized landscape in some lowland reaches is a constraining factor that may limit the benefits of instream wood in some areas; this constraint should be considered when investing in restoration projects.
- Place extensive stable instream wood to capture alluvium (finer gravel), increase variations in bed textures, increase the number of pools and cover, raise streambeds, and increase floodplain connectivity. Large-scale loss of gravel in many Black Hills channels is a substantial restoration opportunity.
- Quickly restore Porter, Cedar, and Sherman creeks with large wood augmentation. These actions could be completed through a rapid-action projects category.

## What is working? What is broken?

- Widespread loss of stable instream wood has resulted in extensive conversion of pool-riffle channels to plane bed channels. This has resulted in loss of many miles of spawning habitat and hundreds of pools, as well as floodplain disconnection and loss of floodplain habitat-forming processes.
- Several of the streams (such as Vance, Newman, and McDonald creeks) are urbanized and have been heavily impacted by anthropogenic factors. A substantial investment in restoration at McDonald Creek generated a lot of community excitement, but has been impacted by the development of a hospital immediately adjacent to the stream channel.
- The existing riparian canopy provides good shading for smaller tributaries, and riparian forest within WDNR lands is better than most—species composition leans heavily to red alder, but does provide shade.
- The lower portions of Cedar, Mox Chehalis, and Coquallum creeks provide temperature refugia for spring Chinook salmon. The source of this cooler water is not understood.
- Substantial channel length lacks stable gravel.
- There are invasive exotic plant species including reed canarygrass.



*Larger streams such as Porter and Cedar creeks—with areas of forested riparian and relatively intact habitat—could be easily enhanced with wood and conifer plantings to increase habitat potential.*



*Streams within the Capitol State Forest could be easily restored by adding wood.*



*Mox Chehalis Creek arises in the Black Hills and is one of several low-gradient streams with abundant spawning gravel and forested areas. The lower reaches potentially provide temperature refugia for spring Chinook salmon and overwintering habitat for coho salmon that could be protected and enhanced.*



*Mox Chehalis Creek and other Black Hills streams could be enhanced for off-channel and beaver pond habitat for coho salmon.*



# Olympic Mountains Ecological Region Map





# Olympic Mountains Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- This Ecological Region is very productive for multiple salmonid species (steelhead and chum, coho, and fall Chinook salmon) and lamprey. The East Fork Satsop River is particularly productive for chum and coho salmon.
- Glacial outwash gravel deposits with a large network of groundwater-fed streams in the East Fork Satsop River and tributaries is unique among all the Ecological Regions.
- Seasonally dry channels have extensive seasonal spawning use.
- This is one of only two Ecological Regions that has significant old growth forest.
- The West Fork Satsop and Wynoochee 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, competition, genetics, predation, disease, and fish passage.
- There is more habitat for stream- and riparian-associated amphibians than any other Ecological Region.
- There are significant areas of managed forest.

## What is working? What is broken?

- The Ecological Region is lacking wood nearly everywhere.
- Substantial channel length lacks stable gravel.
- The East Fork Satsop River is highly productive and includes cold water and better conditions than other areas.
- Big rivers have very active channel migration that creates substantial risk for agriculture and residential land uses.
- There are invasive exotic plant species including reed canarygrass. The lower Satsop River, in particular, has extensive areas of knotweed.
- Wynoochee Dam affects substrate (lack of gravels) 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.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Protect East Fork Satsop River headwater wetlands and springs, which are likely to be resilient to climate change effects on stream temperature, making this area a refuge.
- Develop a strategy to address knotweed.
- Protect intact riparian areas and restore degraded riparian areas.
- Protect the highly productive spawning reach above 7400 bridge on the Wynoochee River.
- The Satsop River has significant harvest and hatchery activities; any restoration actions will have to consider these activities.
- Install stable large wood on mainstem rivers and tributaries. Promote formation of stable forested islands.
- Explore removal of Wynoochee Dam or changed operations to maximize natural processes.
- Introduce sediment and wood downstream of Wynoochee Dam.
- Protect and restore channel migration areas on lower rivers. Provide incentives to landowners to move structures out of the floodplain.
- Conduct demonstration projects for landowners to show the stability of engineered log jams and the role of wood and riparian forest in limiting wood deposition on farm fields.



*These potential Early Action reaches on the Satsop and Wynoochee Rivers have substantial channel migration and bank erosion occurring.*



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



*This fish barrier on Bingham Creek is impassable has a fish ladder and smolt trap that has provided approximately 40 years of wild coho life cycle monitoring information.*



*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.*



*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.*



# Grays Harbor Tributaries Ecological Region Map

Grays Harbor Tributaries Ecological Region

384,775 acres / 601 sq. mi. / 22% of Study Area  
1,216 miles of rivers and streams accessible to fish (per EDT)





# Grays Harbor Tributaries Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- The amount of tidally influenced freshwater wetland with Sitka forest is unique in the Chehalis Basin, and much different from the deciduous-dominated forest in the Chehalis River Tidal Ecological Region.
- The maritime climate provides a year-round buffer to air temperatures.
- The Humptulips Basin characteristics are important and unique: smaller percentage of the total length in tidewater, substantial spawning gravel, and close proximity to the ocean. Old-growth forest in the upper Humptulips has no duplicate in the Chehalis Basin except in small portions of the upper Wynoochee and Satsop.
- This Ecological Region supports multiple salmon species and lamprey.
- This Ecological Region is characterized by several species that are either not seen or rarely seen elsewhere in the Basin, including bull trout and eulachon, both of which are federally listed as threatened under the Endangered Species Act.
- Stillwater-breeding amphibian habitats seem limited at all elevations. This Ecological Region may be the only place in the Basin where the Cascade frog occurs. Some of the best stream-breeding and stream-associated amphibian habitats also occur in the headwaters of the Humptulips.
- Treed tidal slough areas of this Ecological Region are important habitat for the bird indicator species—great blue heron, barrow’s goldeneye, and wood duck.

## What is working? What is broken?

- This Ecological Region is lacking wood and stable gravel. River habitat conditions are influenced by a legacy of logging, including splash dams that fundamentally altered instream habitat. In addition, local extraction of river resources (e.g., wood debris, gravel) appears to be prevalent. This has resulted in many reaches that lack complexity.
- The lower end of the tidal reach of the Humptulips is in very good condition, except for invasive plant infestations. The condition of the delta of this watershed is an unusual feature; there has been essentially no agricultural conversion and little development. The availability of this feature could help magnify any fish benefits associated with habitat improvements in freshwater habitat.
- Lower tidal reaches of the Hoquiam and Wishkah rivers are within Aberdeen and Hoquiam and have been heavily modified.
- Sea level rise will significantly alter the lower reaches of these systems.
- Municipal and industrial water supply dams are on the Hoquiam (West Fork, Davis Creek) and Wishkah (Malinosky Dam) rivers. Fish passage and water quality issues are believed to exist, and owners have limited resources to address issues.
- There are invasive exotic plant species including reed canarygrass.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- Protect areas, including stream lengths with properly functioning riparian areas and remaining old-growth, especially in the Humptulips Basin. These areas provide critical summer rearing habitat for juvenile salmon and steelhead currently as well as under future climate change scenarios.
- Protect intact tidal marsh habitats.
- Add wood throughout the instream areas above tidal influence.
- Restore wider riparian buffers, especially in the Humptulips Basin.
- Develop a strategy to integrate hatchery and natural production, which could help accelerate recovery of wild populations.
- Correct dam issues on the Hoquiam and Wishkah rivers.
- Develop a strategy for addressing knotweed.
- Develop demonstration projects for key restoration actions that can also address the importance of educating local populations. Key projects would include land acquisition/easements in the ecological corridor, instream wood and logjams, floodplain and riparian reforestation, and urban creek restoration.
- The Humptulips River has significant harvest and hatchery activities; any restoration actions will have to consider these activities.
- Research the remnant run of spring-run Chinook salmon in the Humptulips River and protect important holding areas.



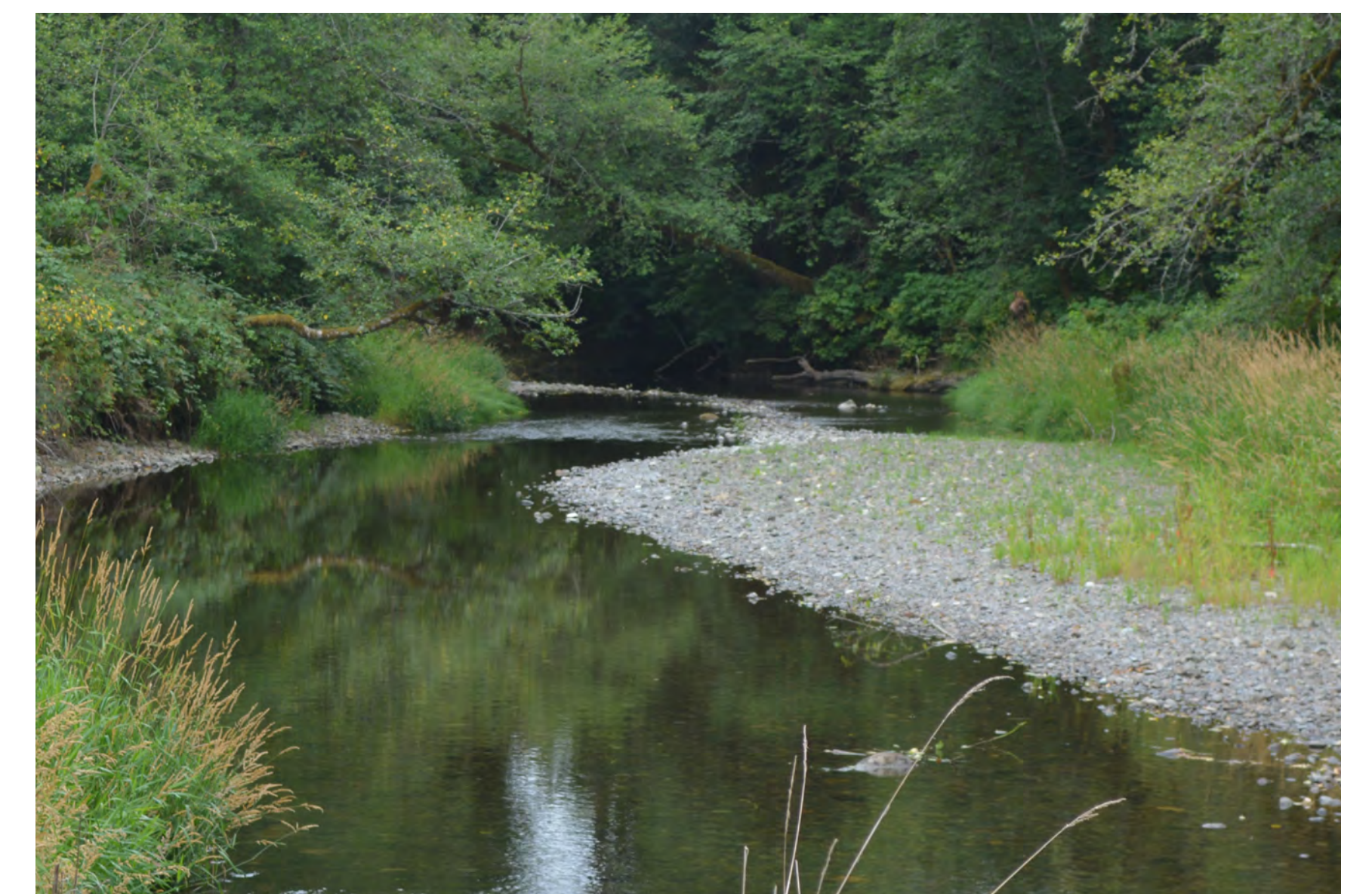
*The lower tidal reach of the Humptulips River is in relatively good condition, except for significant invasive species issues. The Humptulips estuary should be protected and restoration should be conducted to address invasive species.*



*Natural large wood is only present in a few protected locations in the upper West Fork Humptulips River. In the majority of the Grays Harbor Tributaries Ecological Region, the old growth was logged and splash dams were used extensively on the East and West Fork Humptulips rivers, the Wishkah River, and Newskah Creek to facilitate moving timber to markets.*



*Extensive gravel is present on the Humptulips River, but substrate stability is an issue because the system is lacking in-channel wood to hold gravels in place.*



*Spawning habitat for fall Chinook, coho, and chum salmon is present in the middle reaches of the Wishkah River. Increasing in-channel structure would retain and sort river gravels.*



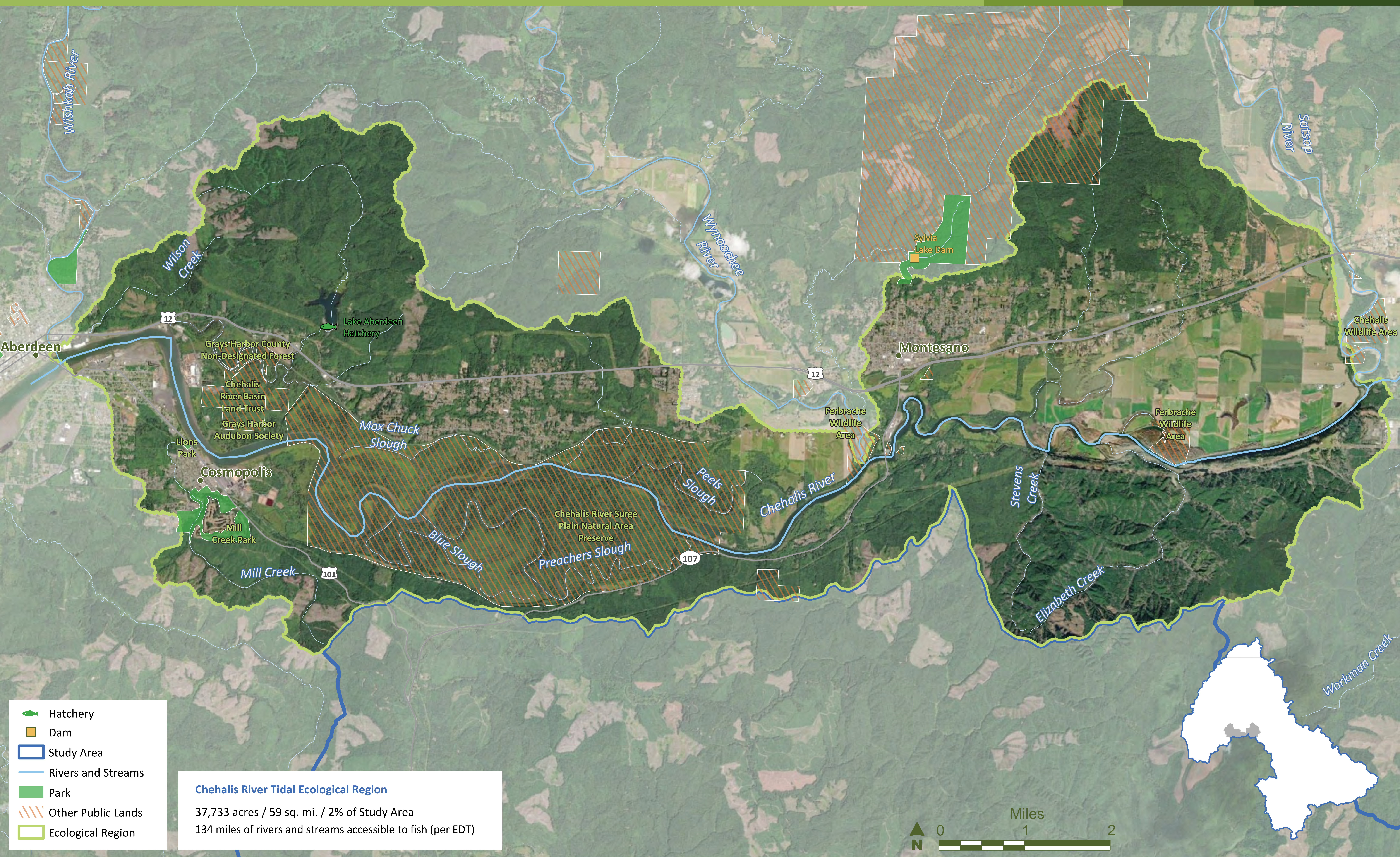
*This pond on a tributary to the Humptulips River is an example of high-quality ponded habitat for multiple species, including coho salmon, amphibian, and bird indicator species.*



*Extensive tidal surge plain and swamp habitat is present along the lower Hoquiam River.*



# Chehalis River Tidal Ecological Region Map





# Chehalis River Tidal Ecological Region Overview

## What are important/unique features and functions within this Ecological Region?

- All Chehalis Basin salmonids use or pass through this Ecological Region, making its function essential to their viability.
- The WDNR Surge Plain Natural Area Preserve provides protection for 5,500 acres of intact surge plain that includes expansive sloughs, mudflat, marsh, scrub-shrub, and forested wetlands. WDNR is working to acquire the remaining privately owned parcels surrounded by the preserve.

## What is working? What is broken?

- The Ecological Region is lacking wood nearly everywhere.
- Substantial channel length lacks stable gravel.
- There are invasive exotic plant species including reed canarygrass.
- The lower 3-miles of the Chehalis River channel is dredged and largely industrial. Current pollution effects on aquatic species are not understood.
- The surge plain appears to be largely intact, including both the channel and floodplain upstream to the Wynoochee River.
- Above the Wynoochee River, floodplain alterations and land uses have reduced in-channel and floodplain habitats.
- Very little is known about aquatic species use in this Ecological Region. In addition to salmonids, there is also believed to be use by other native fish, amphibians, and water fowl.

## What are your thoughts about some of the protection and restoration strategies and actions we feel are important for this Ecological Region?

- ASRP efforts should target estuary-adjacent areas for protection and restoration to accommodate the processes by which sea level rise will cause estuary zones to shift upstream.
- Conduct barrier removals to restore tidal channel connectivity, including tide gates.
- Identify any remaining water and sediment quality problems from industrial pollution that are affecting aquatic species.
- Opportunistically restore industrial portions of the estuary.
- Seize on education opportunities at the numerous public access recreation and fishing sites. Signage and/or community events at the access sites would present opportunities for communication/education regarding up-river restoration activities and connections to the fisheries that are supported by these activities.
- Develop partnering opportunities with Grays Harbor College to understand fish use patterns and natural processes within the tidally influenced area.



*Low-gradient freshwater tidal habitat could be enhanced by reconnecting forested and shrub-dominated sloughs and wetlands, such as through removal of tide gates and crossings.*



*Gravel ponds are prevalent in disturbed areas of the Chehalis River Tidal Ecological Region floodplain, which could be reconnected or restored.*



*Blue Slough is part of the Chehalis River Surge Plain Natural Area Preserve. It is not known to what extent historical piles affect habitat and natural processes.*



*In a portion of the surge plain habitat that is protected by WDNR, a barrier was replaced with a bridge to reconnect tidal channels. Additional similar restoration opportunities should be identified, and additional surge plain protection could be provided through acquisition of remaining private lands.*



*Preachers Slough is a lengthy slough providing diverse tidal slough and swamp habitat. Recent removal of barriers has reconnected more of this habitat.*



# Chehalis Basin

## Ecological Regions

