DECEMBER 2019

Upper Cowlitz & Cispus Habitat Strategy

Upper Cowlitz and Cispus Rivers, Washington

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Upper Cowlitz and Cispus Rivers, Washington

Prepared for:

Lower Columbia Fish Recovery Board
11018 NE 51st Circle
Vancouver, WA 98682

Prepared by:

Inter-Fluve, Cramer Fish Sciences, and Lower Columbia Fish Recovery Board in collaboration with the Upper Cowlitz Cispus Work Group

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1 Executive Summary

1.1 Importance of Upper Cowlitz Cispus Basin to Regional Recovery

The Upper Cowlitz and Cispus watersheds support salmon and steelhead that are key to species-scale recovery in the Lower Columbia region (Figure 1). This is because these watersheds support six high priority populations for recovery (Table 1). Two of these high priority populations are spring Chinook (Upper Cowlitz and Cispus), which happen to be two of the three high priority spring Chinook populations in the region. These populations are also designated as historical "core" and "genetic legacy" populations, which increases their importance to recovery of the species. These attributes make the Upper Cowlitz and Cispus watersheds a very important focal area for recovery efforts in the Lower Columbia River region. Results from the most recent status review by NOAA also indicate that habitat improvements are still necessary in order to achieve recovery targets: Lower Columbia River Chinook are considered to have very high or high extinction risks for most populations, while coho and steelhead have moderate risks of extinction at the regional scale (NMFS 2016).

Table 1. The six salmon and steelhead populations that rely on the Upper Cowlitz and Cispus watersheds. These populations all have the highest recovery designation in the Lower Columbia River region (Primary), with viability targets for recovery from high (coho salmon and winter steelhead) to very high (spring Chinook salmon). Species-scale extinction risk was assessed by NOAA as part of their 2016 Status Review, which are represented by the viabilities listed in the "2016 Species-Scale Viability" column.

Watershed	Population	Recovery Priority	2016 Species-Scale Viability	Recovery Viability Target
Upper Cowlitz	Spring Chinook[1, 2]	Primary	Very Low – Low	Very High
	Coho	Primary	Moderate	High
	Winter Steelhead[1, 2]	Primary	Moderate	High
Cispus	Spring Chinook[1, 2]	Primary	Very Low – Low	Very High
	Coho	Primary	Moderate	High
	Winter Steelhead[1, 2]	Primary	Moderate	High

[1] Historical core population [2] Genetic legacy population

1.2 Importance of Salmon Habitat in the Basin

Recovery relies on two main components: threat reductions and viability improvements to salmon and steelhead species (see definitions, text box). Seven different threat categories are identified in the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (Recovery Plan) based on impacts fish experience while completing their freshwater, tidal, and marine-based lives. The Recovery Plan relies on a balanced, integrated approach to threat reductions because no single threat category addresses all the impacts that limit salmon and steelhead achieving viability targets. One common theme across the region is the importance of protecting and restoring freshwater habitat conditions. This is an essential piece of the recovery puzzle, and the Recovery Plan relies on gains in habitat quality and quantity to leverage viability improvements from reduced impacts in other threat categories, such as blocked passage in watersheds with hydropower systems, and hatchery and harvest management. This multifaceted approach is referred to as "All-H" (LCFRB, 2010).

In the case of the Upper Cowlitz and Cispus watersheds, the Recovery Plan identifies the need for increased habitat connectivity, diversity, riparian and floodplain function, and improved sediment processes and stream temperatures (LCFRB 2010, Volume 2, Chapter F). However, site-scale habitat actions are not identified in the Recovery Plan, and new information from salmon and habitat monitoring are available since the Recovery Plan was developed. As other threat reduction efforts are already underway in the basin, the LCFRB decided to develop a watershed-scale habitat assessment effort to address this habitat data gap in order to support more efficient and effective salmon recovery in the Upper Cowlitz and Cispus watersheds. While benefits from some habitat improvements are immediate, such as fish passage corrections, other efforts may take decades to be fully realized, such as riparian restoration projects. This delay in habitat benefits increases the importance of identifying the most important fish habitat needs today.

Viability

Viability is the chance that a population or species may persist over a 100-year period. Viability is estimated by assessing population abundance, growth, spatial distribution, and genetic and life history diversity.

Threats

Threats are factors that limit populations and species ability to achieve viability goals. These are based on what salmon and steelhead experience during their lives in streams, rivers, the estuary, and ocean.

1.3 What is the Habitat Strategy?

The Habitat Strategy, described in this report, was developed in close coordination with a work group led by the Lower Columbia Fish Recovery Board that includes representatives from: Tacoma Power, Cowlitz Indian Tribe, Yakama Nation, Lewis County Public Utility District, Lewis County Public Works, US Forest Service (USFS), National Marine Fisheries Services (NMFS), Washington Department of Fish and Wildlife (WDFW), Forterra, Washington State Department of Ecology, Pinchot Partners, Lewis Conservation District and local citizens. Inter-Fluve and Cramer Fish Sciences (CFS) supported the development of the Habitat Strategy. The work group met monthly to review and discuss the development of the Habitat Strategy. Two community meetings were scheduled to gain feedback and information from people living and working in the Upper Cowlitz and Cispus watersheds.

The strategy utilized a process domain approach, whereby areas of the basin were grouped into 12 landscape units (LU) based on similar biophysical conditions (Figure 2). Ecological processes were described and evaluated within each landscape unit. Habitat actions, including over 100 potential restoration and protection measures, were identified, described, and mapped. Actions were grouped into categories according to a hierarchical framework, including: (1) Protection, (2) Strategic Restoration, (3) Reconnect and Restore, and (4) Enhance and Create. A select number of "focal" landscape units were identified as high priority in consideration of existing and potential fish use and the potential opportunity for ecological uplift. However, there are opportunities throughout the basin that have important benefits, and many individual actions, even within non-focal LUs, could be considered high priority actions based on their specific benefits or the specific context of the site.

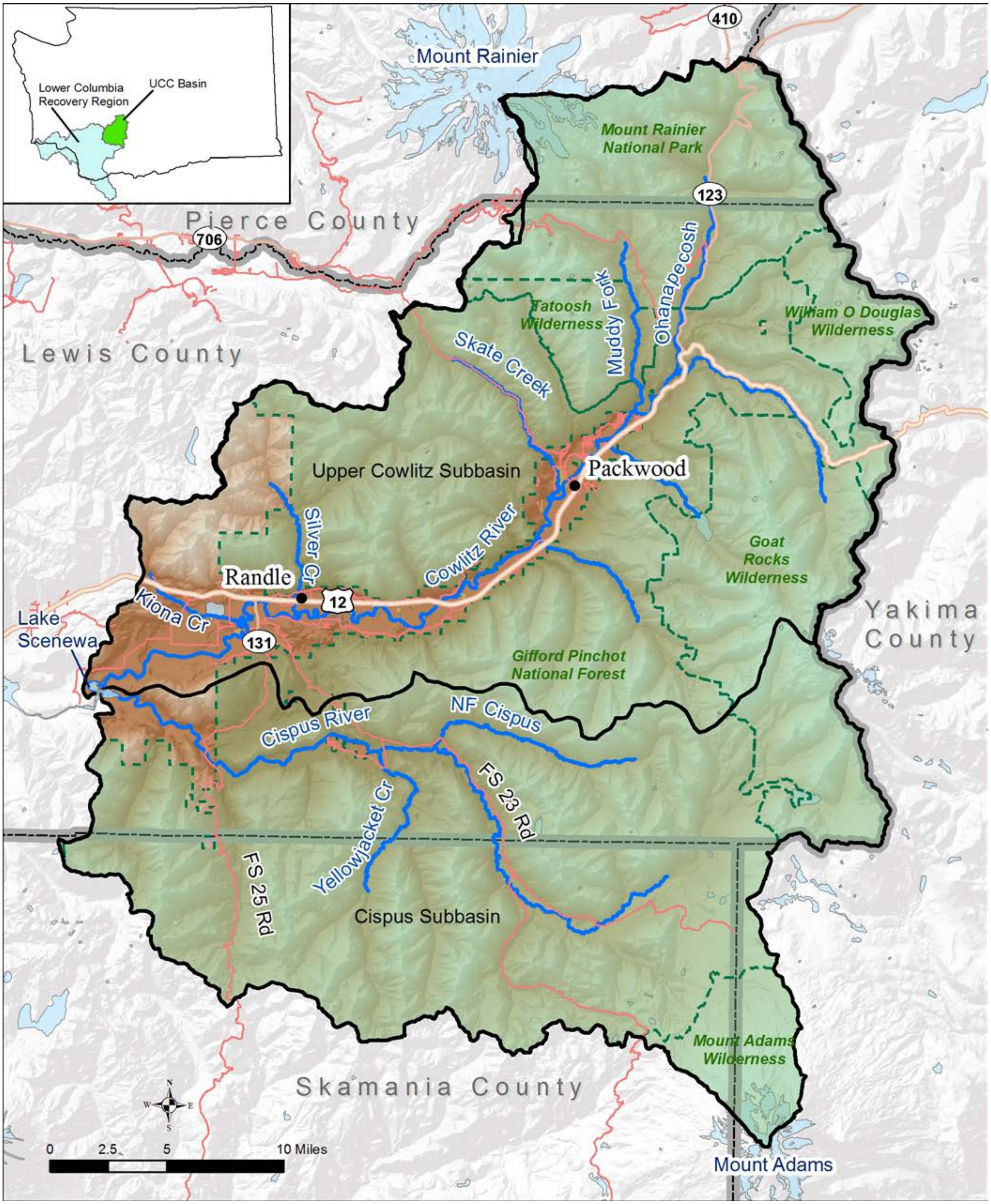


Figure 1. Overview map of the Lower Columbia River Recovery Region, the Upper Cowlitz Cispus Basin, and study area for this effort.

1.4 Strategy Summaries by Landscape Unit

One-page summaries for each landscape unit are provided in this Executive Summary. These include an overview of the unit and brief descriptions of fish use, habitat stressors, objectives, and actions and strategies. Additional details are provided in the body of the report.

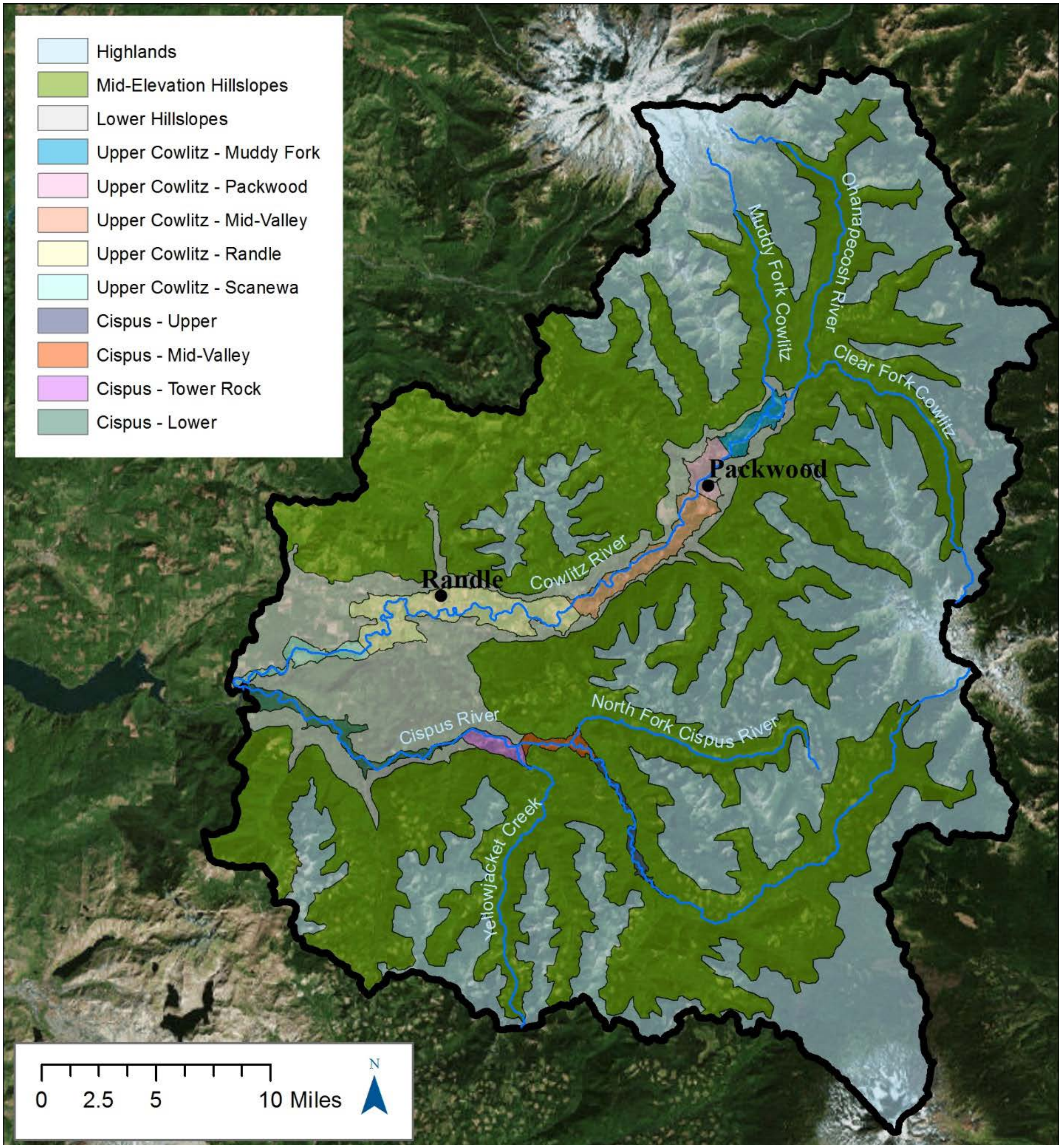


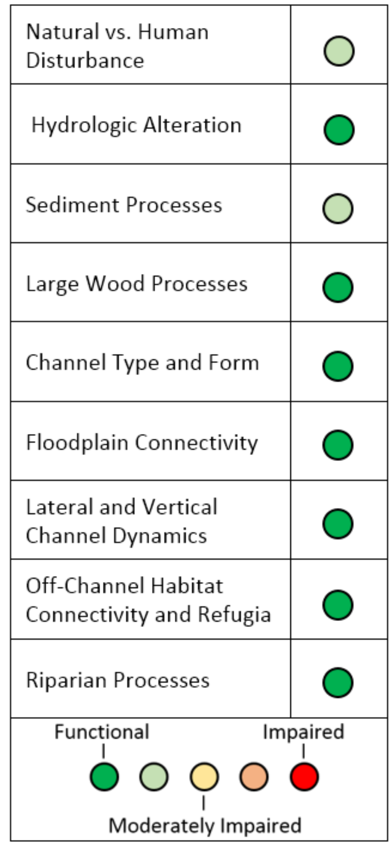
Figure 2. Twelve landscape units (LUs) in the project area that were defined based on similar biophysical conditions.

Highlands

Overview

The Highlands LU contains high elevation zones (1,200 meters and above) where snow is dominant during the winter and rain-on-snow events are less likely. This area corresponds with the Washington Department of Natural Resources (WA DNR) highlands zone. This zone covers the slopes of the high peaks located within the basin, including portions of Mount Rainier, Goat Rocks, and Mount Adams. The Highlands LU is almost entirely within federal forest lands (Gifford Pinchot National Forest and Mount Rainier National Park), and management is governed primarily by forest practice regulations and plans. Northwest Forest Plan (NWFP) land use allocations comprise the following areas: Congressional Reserves / Administratively Withdrawn (CR/AW) (little-to-no timber harvest) is 65%; Late Successional Reserves (LSR) (very limited harvest) is 7%; and matrix (greater harvest) comprises 28%. Conditions within the LU are generally improving, and existing protections, including public ownership and riparian buffer protections, are generally believed to be adequate for protection in this LU.

Ecological Indicators



Fish Use

Largely not accessible to target salmon and steelhead species in the basin, and are not designated critical habitat for salmon or steelhead.

Stressors

The primary existing stressor in the Highlands LU is fine sediment loading from forest roads.

Objectives

1. Continuing aspects of the current forest management scheme that are working well; and,
2. Decommissioning un-necessary roads.

Summary of Action Types and Strategies

This LU is largely already protected by existing federal forest management law and policy. There are, however, opportunities to address watershed process impairments affecting downstream areas with high fish use.

Primary Emphasis = Reconnect and Restore action types.

- Reconnect and Restore – Reduce hydrologic impairment and fine sediment delivery to streams, particularly on private timberland and on USFS matrix lands, via road improvements/removals and timber harvest planning. Evaluate and address fish passage barriers.

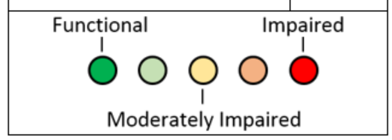
Mid-Elevation Hillslopes

Overview

The Mid-Elevation Hillslopes LU contains the "peak rain-on-snow" and "snow dominated" zones from the WA DNR rain-on-snow mapping and correspond to elevations between 500 and 1200-1300 meters. Lands within this LU are almost entirely (94%) within federal forest lands (Gifford Pinchot National Forest), and the NWFP land use allocations comprise the following areas: CR/AW (little-to-no timber harvest) is 16%; LSR (very limited harvest) is 24%; and matrix (greater harvest) comprises 54%. Matrix lands are generally improving and upland riparian forests in this LU are recovering from past harvest. Stream habitat conditions are likely on an improving trend, particularly with respect to wood loading and stream shade, but opportunities for enhancement likely exist.

Ecological Indicators

Natural vs. Human Disturbance	● (light green)
Hydrologic Alteration	● (light green)
Sediment Processes	● (light green)
Large Wood Processes	● (light green)
Channel Type and Form	● (dark green)
Floodplain Connectivity	● (dark green)
Lateral and Vertical Channel Dynamics	● (dark green)
Off-Channel Habitat Connectivity and Refugia	● (dark green)
Riparian Processes	● (light green)



Fish Use

Streams in this LU have the potential to provide important refuge habitat as they tend to be in better condition than those located downstream that are more heavily affected by human impacts. Chinook critical habitat is located in the lower elevation zones of this LU, particularly up Yellowjacket Creek and the North Fork Cispus River. Coho Salmon and steelhead critical habitat is nearly identical in this LU, and is located at lower elevation areas, including Yellowjacket Creek, North Fork Cispus River, and Skate Creek.

Stressors

Stressors include fine sediment loading from forest roads and logging operations, potential passage barriers, and stream degradation from past logging activities (e.g., erosion from a lack of large wood supply).

Objectives

1. Continuing aspects of the current forest management scheme that are working well;
2. Decommissioning un-necessary roads;
3. Evaluation and replacement of culverts that are blocking passage; and,
4. Habitat creation and enhancement where pockets of floodplain exist.

Summary of Action Types and Strategies

Primary Emphasis = Reconnect and Restore and Enhance and Create action types.

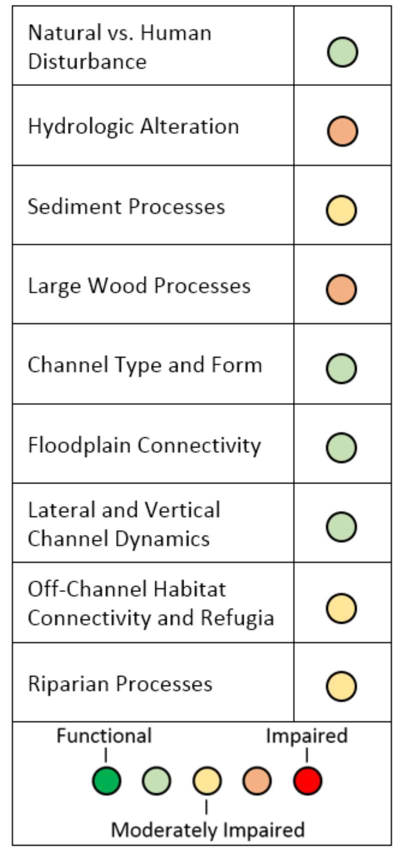
- Reconnect and Restore – Reduce hydrologic impairment and fine sediment delivery to streams, particularly on private timberland and on USFS matrix lands, via road removals and upgrades as well as timber harvest planning. Evaluate and address fish passage barriers.
- Enhance and Create – Enhance habitat complexity and availability in anadromous fish bearing streams.

Lower Hillslopes

Overview

The Lower Hillslopes LU contains the "rain dominated" zone from the WA DNR rain-on-snow mapping and corresponds to elevations below 500 meters. Lands within this LU are approximately half within federal forest lands (Gifford Pinchot National Forest). The remaining half is private land. Restoration, protection, and management of the federal and private timberlands presents an opportunity to improve ecological processes that directly impact tributary habitats and indirectly impact the mainstem rivers.

Ecological Indicators



Fish Use

Streams in this LU contain a large portion of fish-bearing tributary habitat, and have the potential to provide important rearing, refuge, and spawning habitat.

Stressors

Stressors include fine sediment loading from forest roads and logging operations, potential passage barriers, riparian forest clearing, and stream degradation from past logging activities (e.g., erosion from a lack of large wood supply and standing riparian plants).

Objectives

1. Continuing aspects of the current forest management scheme that are working well;
2. Acquisition and/or easement of properties (with willing sellers/landowners) with high functioning and/or riparian forests;
3. Decommissioning un-necessary roads;
4. Evaluation and replacement of culverts that are blocking passage;
5. Restoration and/or protection actions to improve conditions in fish-bearing tributaries; and,
6. Restoring degraded riparian areas in rural residential and/or agricultural areas.

Summary of Action Types and Strategies

Primary Emphasis = Protection, Reconnect and Restore, and Enhance and Create action types.

- Protection – Work with County and willing landowners on protection and restoration within rural residential zone, especially along major tributaries. Address forest practices that can alter properly functioning habitat processes downstream. Work with willing agricultural owners on riparian and floodplain protections and restoration. In some areas, private timber land may be susceptible to land use changes, including rural residential development; work with County to enact zoning or other changes to limit conversion to more impactful land uses in critical areas (e.g., riparian zones, floodplains, and channel migration zones [CMZs]).
- Reconnect and Restore – Evaluate and address fish passage barriers. Work with landowners on riparian restoration. Identify and decommission unnecessary and problem roads.
- Enhance and Create – Enhance habitat complexity and availability in anadromous fish bearing streams.

Upper Cowlitz - Muddy Fork

Overview

The Upper Cowlitz River Valley – Muddy Fork LU encompasses the confluence with the Muddy and Clear Fork Cowlitz Rivers and is located at the transition from steep headwater streams to much flatter valley bottom areas. This area has likely always been dynamic with past mass wasting events as the primary sources of disturbance. This LU is still affected by the high bedload generated from the 2006 Muddy Creek avulsion, exhibiting a braided channel pattern and is a significant source of sediment to downstream LUs. Encroachment into the floodplain has exposed properties to frequent flooding and bank erosion via sediment deposition, channel widening, and migration.

Fish Use

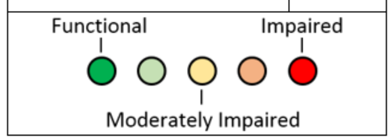
Within this LU, the mainstem Cowlitz is primarily used for spawning and rearing by target populations. However, spawning is likely limited by rapid and frequent bed adjustments. To the extent that spawning gravels accumulate, tributaries are used by Coho and Steelhead for spawning and rearing.

Stressors

Stressors include development in the floodplain, bank armoring, and rapid channel bed fluctuations.

Ecological Indicators

Natural vs. Human Disturbance	
Hydrologic Alteration	
Sediment Processes	
Large Wood Processes	
Channel Type and Form	
Floodplain Connectivity	
Lateral and Vertical Channel Dynamics	
Off-Channel Habitat Connectivity and Refugia	
Riparian Processes	



Objectives

1. Removing impediments to channel migration (e.g., bank armoring, infrastructure and assets) to provide the river with adequate width as it adjusts to the 2006 avulsion (and potential future avulsions);
2. Managing forests for the production of trees that are large enough to produce wood that can self-stabilize in the channel;
3. Protecting riparian areas that are functioning well; and,
4. Enhancing tributary habitats (e.g., wood jam installation).

Summary of Action Types and Strategies

The Cowlitz Muddy Fork LU is still adjusting to flood, debris-flow, and channel avulsion impacts, and will likely continue to do so in response to future flood events. It is a dynamic place to work, with challenges for implementation and uncertainties with outcomes.

Primary Emphasis = Protection and Strategic action types.

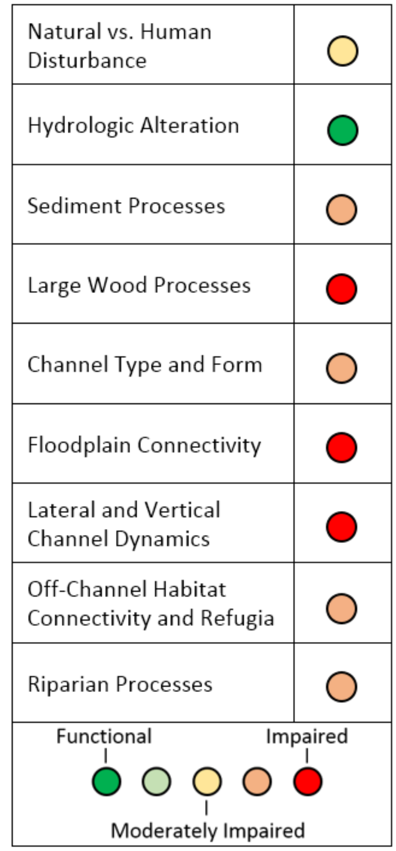
- Protection –protect some of the few remaining undeveloped areas within the floodplain and CMZ to maintain channel migration and floodplain functions.
- Strategic– Work with willing landowners and neighborhoods to address properties at risk of future flooding and to also improve long-term ecological function by restoration of the CMZ and the resiliency of the river to respond to flood and sediment related disturbance.

Upper Cowlitz - Packwood

Overview

The Upper Cowlitz River Valley - Packwood LU marks a reduction in gradient and increase in valley width compared with the upstream Muddy Fork LU. Development within the floodplain is prevalent and has a confining influence on the channel. The active channel zone within this LU is dynamic, responding to sediment loading from the Muddy Fork avulsion. Development in the floodplain, bank armoring, and the Cora Bridge have a confining influence on the evolution of channel, reduce floodplain connection, and are contributing to channel incision.

Ecological Indicators



Fish Use

This LU contains high flow refuge and rearing habitats, though in a degraded condition. Tributaries such as Butter Creek, Skate Creek and the upper reaches of Hall Creek within this LU historically supported steelhead and coho salmon spawning and rearing.

Stressors

Stressors include development in the floodplain, bank armoring, and rapid channel bed fluctuations.

Objectives

1. Removing impediments to channel migration (e.g., bank armoring, infrastructure) and reconnecting the channel to its floodplain (e.g., selective grading to lower and revegetate floodplain surfaces);
2. Kick starting the re-establishment of an island braided channel pattern with the construction of mainstem large wood jams;
3. Managing riparian forests for the production of trees that are large enough to produce wood that can self-stabilize in the channel;
4. Protecting riparian areas that are functioning well; and,
5. Enhancing tributary habitats (e.g., riparian revegetation).

Summary of Action Types and Strategies

This LU will continue to adjust as material from past debris flows continues to move downstream. Some of the floodplain surfaces with houses and roads are very low, signaling future potential issues. There is nearby infrastructure in several places, which makes it challenging to work.

Primary Emphasis = Protection, Strategic, Reconnect and Restore, and Enhance and Create action types.

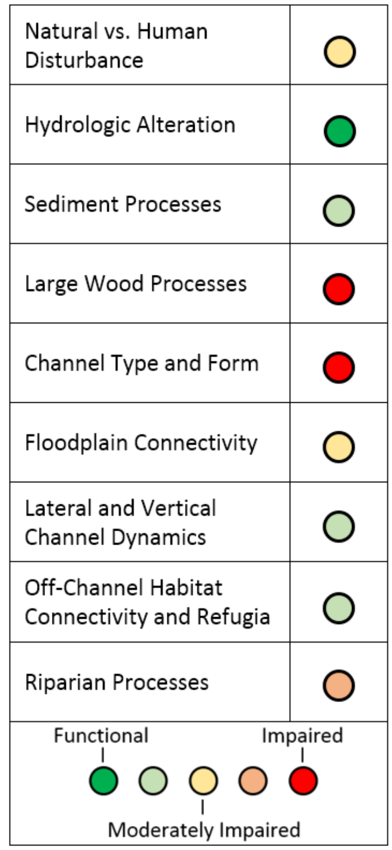
- Protection – Protect existing undeveloped areas in the CMZ and floodplain.
- Strategic – Work with willing landowners to address flood risk to properties while improving ecological functions and the ability of the system to respond to disturbances.
- Reconnect and Restore – Work to restore an island-braided channel type using large instream structures and targeted secondary channel connections.
- Enhance and Create – There is the potential for backwater, side-channel, and margin enhancements.

Upper Cowlitz - Mid-Valley

Overview

The Upper Cowlitz River Valley – Mid Valley LU encompasses a broad alluvial valley that is sparsely populated, though contains artificial, laterally confining features (e.g., structures, roads, bank armoring). Channel migration was historically the primary disturbance in this LU, with substantial upstream sediment delivery from tributaries and the mainstem reforming the active channel. Currently, the mainstem Cowlitz in this LU is very dynamic, with the active channel configuration shifting frequently. The LU has the potential to provide important ecological linkages between upstream and downstream LUs.

Ecological Indicators



Fish Use

Chinook critical habitat in this LU is contained in the mainstem Cowlitz River. Coho salmon and steelhead critical habitat is contained in the mainstem Cowlitz River, and several tributaries such as Hall Creek, Johnson Creek, Smith Creek, Willame Creek, and Burton Creek.

Stressors

Stressors include development in, and conversion of, the floodplain and riparian areas (e.g., logging and clearing for agriculture, rural residential use), bank armoring, and artificial confinement.

Objectives

1. Protect existing, high-functioning areas;
2. Restore connectivity to the floodplain and side channels/co-dominant channels (e.g., encourage flow through former channel scars via construction of log jams);
3. Remove impediments to channel migration zone processes (e.g., bank armoring);
4. Initiate the formation of stable islands (e.g., through the construction of mainstem wood jams); and,
5. Enhance spawning and rearing habitats for all targeted species: spring Chinook, coho, and winter steelhead (e.g., construction of wood jams that create scour pools and provide complex cover).

Summary of Action Types and Strategies

Primary Emphasis = Protection, Strategic, and Reconnect and Restore action types.

- Protection – Work with willing landowners to protect undeveloped private parcels within the floodplain and CMZ that are at risk of development.
- Strategic– Work with willing landowners on efforts that remove infrastructure from flood risk areas and that help to restore ecological function.
- Reconnect and Restore – Use early-action Reconnect and Restore projects with high feasibility as demonstration projects to leverage support for future work. These include in-channel work to encourage the development of an island-braided channel and also the removal of the obsolete armoring.

Upper Cowlitz - Randle

Overview

The Upper Cowlitz River Valley - Randle LU encompasses a transition to a lower gradient and wider alluvial valley. The active channel zone within the LU marks a departure from the characteristics of those upstream: lower channel gradient, reduced valley confinement, and increased discharge have caused the channel to take more of a meandering channel pattern. The channel and floodplain in this LU have undergone dramatic change as a result of land cover conversion and floodplain encroachment. Widespread agricultural development, bank armoring, bridges, instream wood removal, riparian clearing, and flood protection have all simplified instream habitat and disconnected the channel from its floodplain.

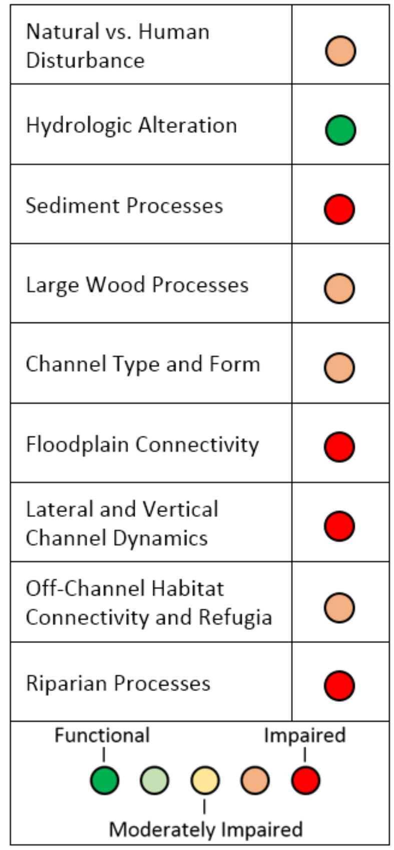
Fish Use

This LU would have historically provided abundant high-flow refugia areas in off-channel wetland, oxbows, and side channels. It is likely still utilized by juvenile salmonids; however, the capacity is greatly reduced from historical conditions. Numerous tributaries may have contained important—if small—pockets of habitat.

Stressors

Stressors in the Upper Cowlitz River Valley - Randle LU include floodplain encroachment, floodplain disconnection, and land cover conversions.

Ecological Indicators



Objectives

1. Protecting and/or restoring riparian forests and vegetation;
2. Removing barriers to channel migration processes and reconnecting the channel to floodplains and side channels where possible; and,
3. Enhancing mainstem and tributary habitats.

Summary of Action Types and Strategies

Primary Emphasis = Protection, Strategic, and Reconnect and Restore action types.

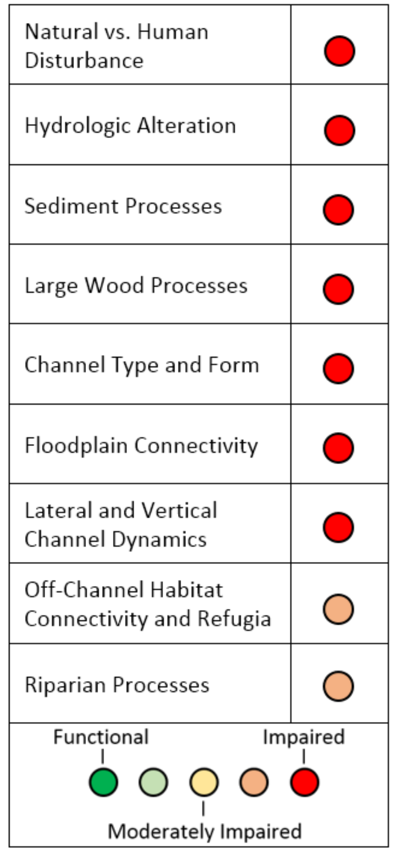
- Protection – Work with willing landowners to protect undeveloped private parcels within the floodplain and CMZ that are at risk of development and future damage from erosion and flooding.
- Strategic– Work with willing landowners to implement widespread riparian and floodplain planting, which will complement future large-scale channel and floodplain restoration. Work with willing landowners on efforts that remove infrastructure from flood risk areas and that help to restore ecological function.
- Reconnect and Restore – Particular focus areas include working with willing landowners to address properties located in flood risk areas associated with existing side-channels or side-channels that could be reconnected in the future.

Upper Cowlitz - Scanewa

Overview

The Upper Cowlitz River Valley - Scanewa LU is defined by the backwater influence of Lake Scanewa and is partially confined by glacial terraces and landslide deposits. The former pool-riffle channel and associated habitats have been inundated by the lake. The backwater effect also reduces the energy gradient, impacting sediment dynamics through the reach. Land use change and land cover conversion for agricultural and timber extraction purposes have impacted the floodplain and riparian zone.

Ecological Indicators



Fish Use

Fish use is predominantly migration. Salmon and steelhead released upstream of Cowlitz Falls Dam as part of the truck-and-haul program pass through this LU on their way upstream, and return through this reach during their juvenile outmigration. Some inundated, off-channel areas may provide good potential foraging habitat for juvenile salmonids and holding habitat for migrating adults.

Stressors

The primary stressor in the Upper Cowlitz River Valley – Scanewa LU is the Cowlitz River hydrosystem. Other stressors include conversion of floodplain for agricultural purposes.

Objectives

1. Protecting and/or restoring riparian forests and vegetation; and,
2. Creating margin habitat.

Summary of Action Types and Strategies

This LU is impounded by Cowlitz Falls Dam and so restoration and protection options are somewhat limited. However there are a few opportunities that may address degraded migration and transient rearing/holding habitats.

Primary Emphasis = Create and Enhance action types.

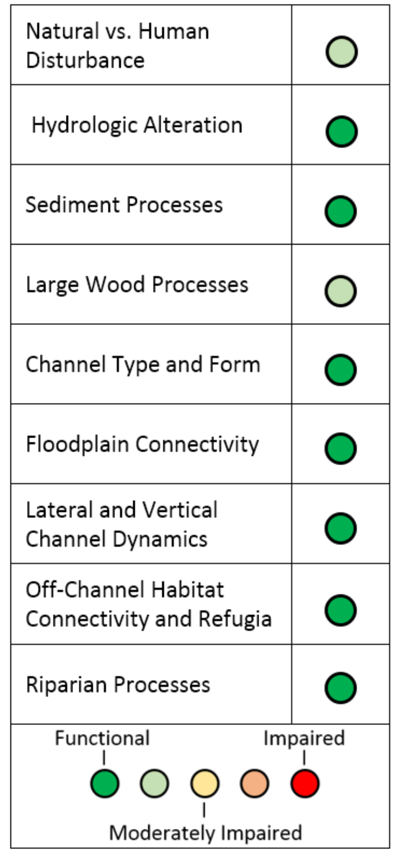
- Enhance and Create – Look for opportunities to enhance habitat cover and complexity for migrating adults and juveniles.

Cispus - Upper

Overview

The Cispus River Valley – Upper LU is the most upstream valley bottom LU on the Cispus (RM 21.7 - 30.7). The active channel sits in a relatively narrow alluvial valley and confinement ranges from confined to partly confined. Islands containing mature forest are present and there is abundant large wood in the active channel. Historically, conditions may have been similar, with the key differences being late seral stage riparian stands and the presence of large, old growth trees adding stability to jams and creating an island braided planform.

Ecological Indicators



Fish Use

This LU supports all life stages of target species, although rearing habitat may have been limited as a result of the steeper gradient (relative to downstream reaches).

Stressors

Stressors in this LU are primarily the legacy effects of forest practices (e.g., timber harvest and road building) and include increased fine sediment delivery, reduction in wood sizes and numbers, and riparian impacts.

Objectives

1. Continuing to manage for the recovery of ecological processes;
2. Increasing connectivity to the floodplain (e.g., use wood jams to force more frequent inundation of side channel habitat);
3. Initiating and supporting the formation of stable islands; and,
4. Enhancing spawning and rearing habitats for all targeted species: spring Chinook, coho, and winter steelhead (e.g., wood jam construction).

Summary of Action Types and Strategies

Primary Emphasis = Strategic, Reconnect and Restore, and Create and Enhance action types.

- Strategic– There is one Strategic habitat action opportunity associated with addressing the floodplain/CMZ impacts of the FS 23 Road.
- Reconnect and Restore – There are multiple opportunities to support the further development of an island-braided system via log jam installation and side-channel connections.
- Enhance and Create – More confined areas can be enhanced with habitat cover and complexity additions.

Cispus – Mid-Valley

Overview

The Cispus River Valley – Mid-Valley LU is located at the transition from a more confined valley setting to reduced confinement. The LU includes the lower North Fork Cispus River. The active channel zone within the LU is highly dynamic, exhibiting a braided channel pattern in some locations and island braided in others. Large wood loading is substantial and habitats are complex. The LU is largely functioning on a positive trajectory. At the downstream end, the Cispus Road bridge impinges upon the floodplain and is causing the channel to incise.

Fish Use

This LU supports all life stages of target species. Between the North Fork Cispus and Cispus, this LU contains high quality mainstem, tributary, and off-channel habitat for spawning, refuge, and rearing. Camp Creek provides habitat for Coho and Steelhead.

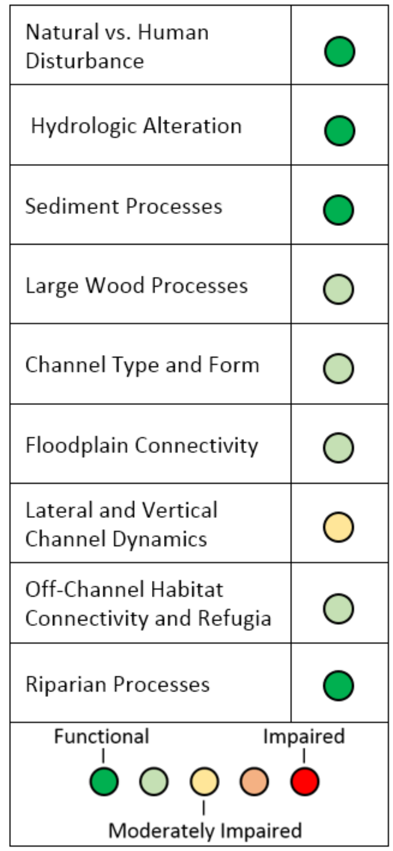
Stressors

The primary stressor in this LU include floodplain encroaching structures and the legacy effects of past forest land management (e.g., smaller riparian trees and instream wood).

Objectives

1. Remove barriers to channel migration processes and floodplain connectivity.

Ecological Indicators



Summary of Action Types and Strategies

Primary Emphasis = Strategic and Reconnect and Restore action types.

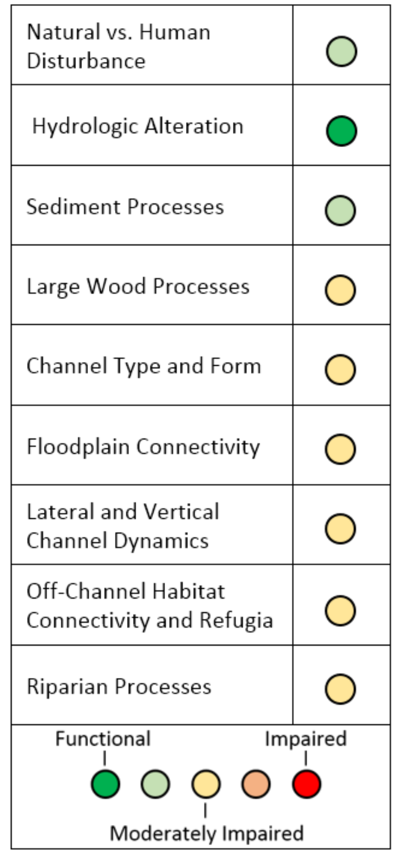
- Strategic– Collaborate with the US Forest Service, with special focus on the two Strategic actions: one associated with a section of failing riprap armoring and the Cispus River road, and one more complex action associated with the downstream bridge crossing.
- Reconnect and Restore – Collaborate with the US Forest Service, with special focus on more straightforward Reconnect and Restore actions include addressing the push-up levee on the lower North Fork Cispus and the push up berm at the highway revetment.

Cispus – Tower Rock

Overview

The transition downstream to the Cispus River Valley – Tower Rock LU further decreases the valley confinement, with the active channel set into a broad alluvial valley. The LU encompasses the confluence with Yellowjacket Creek. The LU is relatively dynamic, exhibiting a braided and island braided channel pattern that has lower sinuosity when compared with historical conditions. Floodplain connection is impaired from anthropogenic confinement and Yellowjacket Creek has incised in response to the Cispus Road bridge. Similar to the upstream LU, historical conditions would have had an island braided planform controlled by large wood jams.

Ecological Indicators



Fish Use

This LU supports all life stages of target species and historically contained the best spawning habitat in the Cispus subbasin. Additionally, Yellowjacket Creek contains relatively good habitats for spawning, rearing, and migration for all target species.

Stressors

Stressors in the LU include encroachment in the floodplain (e.g., development, infrastructure), channelization, and bank armoring.

Objectives

1. Restoring connectivity to the floodplain throughout the LU (e.g., targeted acquisitions from willing landowners and levee/riprap removal);
2. Removing impediments to channel migration zone processes (e.g., berm removal);
3. Initiating the formation of stable islands (e.g., use wood jams to deflect flows and sort and deposit sediment); and,
4. Enhancing spawning and rearing habitats for all targeted species (e.g., wood jam construction): spring Chinook, coho, and winter steelhead.

Summary of Action Types and Strategies

Primary Emphasis = Strategic and Reconnect and Restore action types.

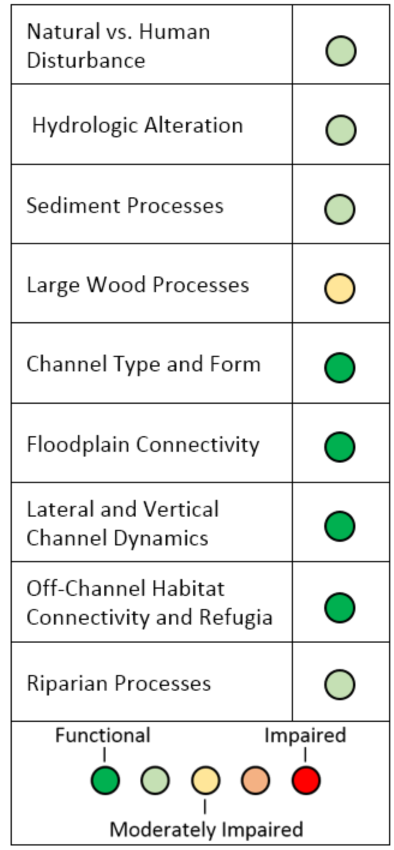
- Strategic – Collaborate with landowners, with special focus on Strategic actions associated with the Yellowjacket Creek bridge and upper fan, a section of armoring and floodplain development mid-reach, and the developed and flood-vulnerable floodplain area at the downstream end.
- Reconnect and Restore – There are several Reconnect and Restore actions that support restoration of the fan processes in lower Yellowjacket Creek, island-braided channel formation in the mainstem, and connectivity to potential off-channel habitat.

Cispus – Lower

Overview

The Cispus River Valley – Lower LU marks a transition into a setting with increased valley confinement and an active channel inset into glacial terraces. Portions of the reach behave as a transport reach, with a relatively steep gradient; in other areas confinement reduces to form small depositional zones with greater habitat complexity. Much of the forest cover is at least second growth, in-channel wood is lacking, and there is a high road density in the reach. The downstream end of the LU is controlled by Lake Scanewa backwater.

Ecological Indicators



Fish Use

As a result of the relatively lower gradient, this LU contains suitable spawning gravels for all species, though floodplain and off-channel habitats are limited by natural valley confinement. Fish use in the tributaries likely occurs, but is limited by barrier falls and/or flow.

Stressors

Stressors in this LU are primarily the legacy effects of forest practices (e.g., timber harvest and road building) and include increased fine sediment delivery, reduction in wood sizes and numbers, and riparian impacts.

Objectives

1. Increasing sediment storage and lateral connectivity (e.g., use wood jams to deflect flows and sort and deposit sediment); and
2. Improving rearing and holding habitats in the mainstem and tributaries for all targeted species (e.g., wood jam construction): spring Chinook, coho, and winter steelhead.

Summary of Action Types and Strategies

Primary Emphasis = Reconnect and Restore and Create and Enhance action types.

- Reconnect and Restore – There are Reconnect and Restore opportunities in the pockets of wider floodplains and lower tributary fans, where island-braided channel formation could be encouraged through wood placements.
- Enhance and Create – Confined or partially confined areas, and lower Wood Creek, could be enhanced by adding habitat cover and complexity.

1.5 Next Steps

Implementation of this habitat strategy is fully voluntary, and thus relies on a collaborative and supportive network of community members, tribal representatives, and natural resource managers to implement identified actions. The habitat strategy report is a planning tool for voluntary implementation, and serves as a resource that:

1. synthesizes surveys and analyses;
2. centralizes data and information in the study area;
3. uses existing data, information and analysis results to identify impairments and stressors to salmon habitat, and actions to address them; and
4. reflects local stakeholder expertise in salmon, watershed health and community needs.

This habitat strategy can help project sponsors understand where the highest priority habitat protection and restoration needs are. This provides a foundation for reaching out to property owners to further identify opportunities for on the ground work. In addition to the written materials produced through the strategy process, work group members and the LCFRB staff are important contacts for learning more about the strategy process, landowner outreach results, and potential grant programs and project sponsorship opportunities. Contact details for individuals and organizations are included in the Next Steps section of the report (Section 8). Resources collected and synthesized during the strategy development process are also identified in Appendix A, with access details included.

Recommended next steps for project sponsors interested in implementing the strategy are:

1. review the prioritized recommendations for landscape units and habitat actions;
2. contact Tacoma Power to ensure the latest salmon monitoring information is incorporated into habitat action selection and project design;
3. discuss collaboration with potential grant funders, project sponsors, and permitting agencies in developing habitat action opportunities into projects with willing landowners;
4. reach out to and work with willing landowners to develop grant applications; and
5. apply for funding to implement high priority habitat projects to support salmon recovery in the basin.

1.6 How to Use this Document

This habitat strategy describes physical and habitat characteristics of the Upper Cowlitz Cispus basin in the context of salmon recovery. This report summarizes the work completed during this effort, including methodology for assessing habitat conditions, and for identifying potential actions. The authors and contributors recognize that different people will use this report for different purposes. The main body of the report is a synthesis of the strategy assessments and recommendations. The appendices include supporting information and additional detail. The following table provides a brief guide for where to find different types of information in this report.

I want to learn more about…	
Why was the strategy developed, and what are the goals?	Section 2.2 (Recovery Planning Context) explains how the habitat strategy supports broader recovery goals for Chinook, coho, and steelhead in the Lower Columbia River. Section 2.4 (Habitat Strategy) defines the goals and vision.
Who was involved in the strategy?	Table 3 in Section 2.3 (Development of the Habitat Strategy) lists the work group members and their affiliations. These individuals, along with Lower Columbia Fish Recovery Board, Inter-Fluve, and Cramer Fish Sciences staff, provided information, reviewed, and drafted materials for the strategy.
What landscape areas, or units, are described?	Section 3.2 (Landscape Unit Framework) identifies 12 unique landscape units that encompass the hillslope and valley bottom areas of the Upper Cowlitz and Cispus watersheds. Landscape unit locations are in the Figure 5 map. Landscape Unit boundaries can also be downloaded for your own mapping efforts: see Appendix A.
What was learned about watershed processes and fish needs in the landscape units?	Section 5.2 (Landscape Unit Descriptions) describes the level of impairment for watershed processes in each landscape unit. More details on Landscape Unit results can be found in Appendix D (Landscape Unit Conditions). Causal stressors for impaired watershed processes are described in Section 1.4 (Strategy Summaries by Landscape Unit).
What was learned about fish habitat use and needs?	Salmon and steelhead populations are described in detail in Section 4.4 (Salmon & Steelhead Populations). Section 5.2 (Landscape Unit Descriptions) describes how landscape units may support salmon and steelhead.
What resources were considered?	Section 9 (References) includes information cited in the main report. Tabular data sources as well as links to geospatial data for request and/or download are included in Appendix A.
What habitat actions are identified?	Section 6 (Habitat Actions) describes what habitat actions were identified for the strategy. Maps and tables with more details on individual actions can be found in Appendix E (Habitat Actions). Actions can also be downloaded for your own mapping efforts, see Appendix A.
What are the top priorities for habitat conservation and improvements?	Section 7 (Action Priority Areas) describes the top priorities for salmon habitat conservation and restoration in the strategy area.
What happens next?	Section 8 (Next Steps) identifies existing data gaps to be filled as well as who to talk to while planning implementation of habitat projects based on the strategy habitat actions.
I just want a concise summary of the project.	Section 1 (Executive Summary) provides a summary of all of the above questions, and is a good first stop in reviewing the strategy.

2 Introduction

2.1 Overview

This habitat strategy describes physical and habitat characteristics of the Upper Cowlitz Cispus basin in the context of salmon recovery and provides a strategy for restoration and protection of aquatic habitat and associated ecological processes. The Upper Cowlitz Cispus basin is identified by various groups as important to supporting several populations of Endangered Species Act (ESA)-listed salmon and steelhead. Increasing viability of these populations is of high importance for meeting regional salmon and steelhead recovery goals. The Habitat Strategy has been developed in close coordination with a work group led by the Lower Columbia Fish Recovery Board (LCFRB) that includes representatives from multiple entities that are listed in Section 2.3. The project area for the Habitat Strategy is the area draining to Lake Scanewa and includes the upper mainstem Cowlitz subbasin and the Cispus subbasin (Figure 3). The Cowlitz River below the study area flows west and south to its confluence with the Columbia River near Kelso, Washington.

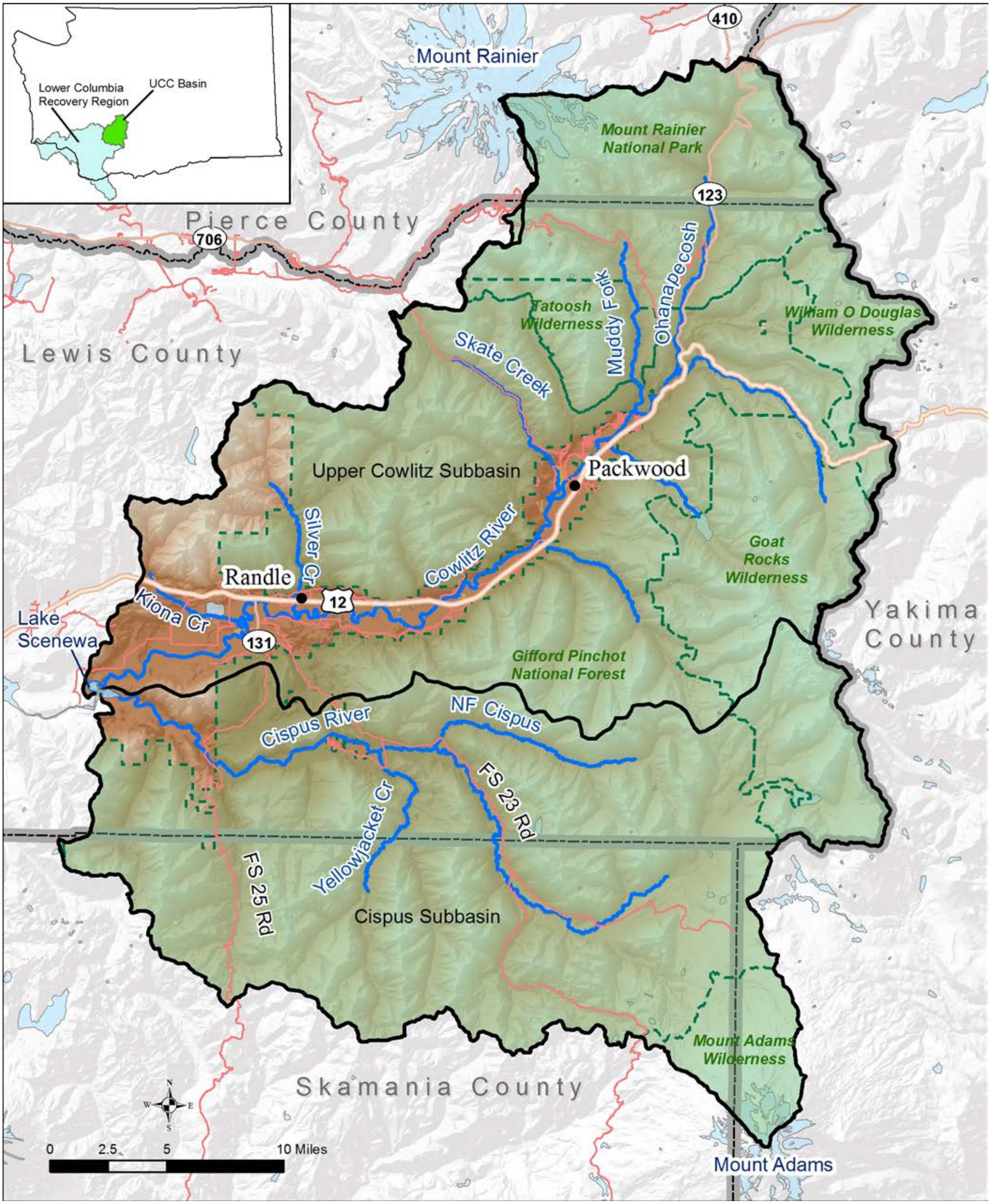


Figure 3. Overview map of the Lower Columbia River Recovery Region, the Upper Cowlitz Cispus Basin, and study area for this effort.

2.2 Recovery Planning Context

The Washington Lower Columbia River recovery region spans seventeen major watersheds, termed "subbasins", and supports 74 Endangered Species Act (ESA) listed populations of salmon, steelhead, and bull trout in southwest Washington (Figure 3). Salmon and steelhead were first listed under the ESA by the National Oceanic and Atmospheric Association's (NOAA) National Marine Fisheries Service (NMFS) in 1998 and 1999, and the LCFRB and its partners developed a Recovery Plan to support ESA delisting and long-term recovery of these fish in the region in 2004. The Recovery Plan was ultimately updated in 2010 and incorporated into NMFS's domain plan for the entire Lower Columbia River region in 2013 (LCFRB 2010).

The Recovery Plan details a recovery scenario, which identifies viability goals for salmon and steelhead, threats to populations and species that must be addressed to achieve those goals. Viability is assessed at individual population scales, but goals are based on regional, or species-scale needs for ESA delisting. Viability indicates the probability a population or species may go extinct, and is based on the assessment of four Viable Salmonid Population (VSP) parameters: abundance, productivity, spatial structure, and diversity. Populations are assigned a recovery designation indicating their viability goal for ESA delisting: Primary (high or very high viability), Contributing (low to medium viability), or Stabilizing (very low or low viability). "All-H" threats encompass seven impact categories based on what salmon and steelhead experience while completing their freshwater, tidal, and marine-based life histories: stream habitat, estuary habitat, harvest, hatcheries, hydropower, ocean and climate conditions, and ecological interactions. Threats to salmon and steelhead vary depending on their life histories and the land use and management of the watersheds they rely on for spawning and rearing. However, degraded and limited stream habitat is identified as a high priority threat for all salmon and steelhead populations in the region.

The Upper Cowlitz and Cispus watersheds support salmon and steelhead that are key to species-scale recovery in the Lower Columbia region. This is because these watersheds support six high priority populations for recovery (Table 2). Two of these high priority populations are spring Chinook (Upper Cowlitz population and Cispus population), which happen to be two of the three high priority spring Chinook populations in the region. These populations are also designated as historical "core" and "genetic legacy" populations, which increases their importance to recovery of the species. These attributes make the upper Cowlitz and Cispus watersheds a very important focal area for recovery efforts in the Lower Columbia River region. Results from the most recent status review by NOAA also indicate that improvements are still necessary in order to achieve recovery targets: Lower Columbia River Chinook are considered to have very high or high extinction risks for most populations, whereas coho and steelhead have moderate risks of extinction at the regional scale (NMFS 2016).

Table 2. The six salmon and steelhead populations that rely on the Upper Cowlitz and Cispus watersheds. These populations all have the highest recovery designation in the Lower Columbia River region (Primary), with viability targets for recovery from high (coho salmon and winter steelhead) to very high (spring Chinook salmon). Species-scale extinction risk was assessed by NOAA as part of their 2016 Status Review, which are represented by the viabilities listed in the "2016 Species-Scale Viability" column.

Watershed	Population	Recovery Priority	2016 Species-Scale Viability	Recovery Viability Target
Upper Cowlitz	Spring Chinook[1, 2]	Primary	Very Low – Low	Very High
	Coho	Primary	Moderate	High
	Winter Steelhead[1, 2]	Primary	Moderate	High
Cispus	Spring Chinook[1, 2]	Primary	Very Low – Low	Very High
	Coho	Primary	Moderate	High
	Winter Steelhead[1, 2]	Primary	Moderate	High

[1] Historical core population [2] Genetic legacy population

Reintroduction of spring Chinook, coho, and winter steelhead into the Upper Cowlitz and Cispus watersheds is underway to support achieving recovery goals for these populations. The recovery plan identifies separate spring Chinook, coho, and winter steelhead populations for the Upper Cowlitz and Cispus watersheds based on historical patterns (Myers et al. 2006). However, past management practices (e.g., hatchery operations, no mass-marking of fish until 1995, and only sporadic fish transport into the Upper Basin from about the mid-1970s to the mid-1990s) and current reintroduction program methods (only identifying fish as originating in the Upper Cowlitz basin, versus the Upper Cowlitz or Cispus watershed) do not support identification of fish unique to the Upper Cowlitz or Cispus watershed. In the future, facilities or genetic tools may become available for segregating fish from these two watersheds. Until then, managers combine the recovery abundance goals and other viability metrics for these two populations into a single goal for the Upper Cowlitz basin. From a recovery perspective, it is important to support salmon and steelhead habitat in both watersheds today.

The Upper Cowlitz subbasin chapter of the Recovery Plan (LCFRB 2010, Vol 2, Ch F) identifies eight key priorities for salmon and steelhead recovery in the Tilton, Upper Cowlitz, and Cispus watersheds:

1. Provide passage through the Cowlitz Basin Hydrosystem;
2. Protect intact forests in the basin headwaters;
3. Manage forest lands to protect and restore watershed processes;
4. Manage growth and development to protect watershed processes and habitat conditions;
5. Restore valley floodplain function and stream habitat diversity;
6. Maintain consistency between conservation objectives and hatchery priorities;
7. Manage fishery impacts so they do not impede progress towards recovery; and

8. Reduce out-of-basin impacts to salmon and steelhead so that the benefits of in-basin actions can be realized

This Upper Cowlitz Cispus Habitat Strategy primarily supports priority 5, but considers priorities 2 – 4 in terms of identifying and informing conservation, restoration and land use programs that are necessary to support and improve watershed health. Priorities related to fisheries and hatchery management are being addressed through other processes within the basin, including forums related to implementation of the Federal Energy Regulatory Commission's (FERC) licenses, the FERC license Settlement Agreement, the Lower Columbia Conservation and Sustainable Fisheries Plan (CSFP) (WDFW, 2017), and the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (LCFRB 2010).

2.3 Development of the Habitat Strategy

The LCFRB applied for a Salmon Recovery Funding Board (SRFB) grant in 2017 with financial support from Tacoma Public to assess salmon and steelhead habitat needs in the Upper Cowlitz and Cispus watersheds, and was awarded funds in 2018. This assessment, the Upper Cowlitz Cispus Habitat Strategy, began in January 2018 and ended in December 2019. The strategy project included assessment of watershed processes and salmon habitat needs in the Upper Cowlitz and Cispus watersheds, identification of habitat actions to support conservation and restoration gaps based on the assessment, and completion of a conceptual design based on one of the habitat actions in the strategy.

The following components were part of the Habitat Strategy development process:

1. Collect and review existing information;
2. Outline vision and goals for restoring and protecting salmon and steelhead habitat, and identify limiting factor priorities to be addressed by this project;
3. Perform and describe additional information from desktop analyses of habitat limiting factors and watershed biophysical processes;
4. Complete field reconnaissance to further refine understanding of the watersheds and possible restoration or protection opportunities;
5. Draft a list of habitat restoration and protection opportunities based on the findings;
6. Rank opportunities and present in prioritized summary; and
7. Compile information into a final Habitat Strategy document.

To support development of the habitat strategy, the LCFRB formed a work group consisting of local stakeholder representing natural resources, citizen, and tribal perspectives. The work group was essential to developing a strong habitat strategy, rooted in scientific information and local knowledge, with an emphasis on identifying and addressing the root watershed process stressors that limit watershed health and salmon habitat in the project area. This collaborative group is also key to implementing the habitat strategy in the future because of their familiarity with the watershed and the strategy process. Implementation of the strategy is fully voluntary, and thus relies on a collaborative and supportive work group with ties to the local community to implement actions identified in the strategy. Work group members included those listed in Table 3.

Table 3. Work group members

Work group Member	Affiliation
Bob Amrine	Lewis Conservation District
Scott Anderson	National Marine Fisheries Service
Eli Asher	Cowlitz Indian Tribe
Sherry Brown	Resident
Scott Brummer	Washington Department of Fish and Wildlife
Amy Kocourek	National Marine Fisheries Service
Florian Leischner	Tacoma Power
David Lindley	Yakama Nation Fisheries
Hazelanna McMahan	Resident
Zach Meyer	Washington State Department of Ecology
Jordan Rash	Forterra
Rudy Salakory	Cowlitz Indian Tribe
Melora Shelton	Tacoma Power
John Squires	Pinchot Partners
Ruth Tracy	United States Forest Service
Kelly Verd	Lewis Conservation District
Ann Weckback	Lewis County Public Work
Ken Wieman	United States Forest Service
Laura Wolfe	Lewis County Public Utilities District

The work group met monthly from April 2018 through December 2019, with occasional gaps when holidays and strategy products were in development. Meetings were public and held primarily in Morton, Washington. Notes were drafted by LCFRB staff for each meeting, and were subsequently reviewed and approved by work group members. Technical Memorandums were also developed to show interim progress with support from the work group, including incorporation of feedback and approval of materials. The following memorandums were used to guide the habitat strategy development, and are synthesized in this strategy report:

Technical Memorandum 1: Background and Existing Data

Technical Memorandum 2: Project Vision and Goals

Technical Memorandum 3: Strategy Methods

Technical Memorandum 4: Landscape Characterization of Upper Cowiltz-Cispus Basin

Technical Memorandum 5: Habitat Action Identification

Technical Memorandum 6: Habitat Action Prioritization

Meeting materials can be requested by contacting the Lower Columbia Fish Recovery Board (info@lcfrb.gen.wa.us).

2.4 Habitat Strategy Vision and Goals

The Upper Cowlitz Cispus Habitat Strategy aims to describe (a) the habitat needs of viable focal fish populations, (b) the current condition of the watershed processes as they impact these populations, and (c) begin to identify and prioritize actions that can be taken to support viability improvements in the short and long term. The intention for the strategy is that it considers solutions at multiple spatial and temporal scales to support the focal fish populations, that it works for the people living and working in the basins, and that tangible next steps to support habitat restoration and protection are identified.

In order to implement the Upper Cowlitz Cispus Habitat Strategy vision, the following goals were identified:

1. Describe what fish need: describe habitat and lifecycle needs of focal salmon and steelhead populations in the Upper Cowlitz and Cispus basins.

Rationale: *It is important to understand the current salmon and steelhead population viability and patterns, watershed processes, and habitat conditions. Just as important is understanding where we came from (historical patterns and conditions) and where we aim to go (population viability and habitat improvement targets for recovery). These perspectives are essential to developing a habitat strategy that supports short and long-term population recovery and watershed health goals.*

2. Describe watershed conditions: Describe the biophysical processes in the basins that impact habitat conditions for focal populations.

Rationale*: Physical and biological processes in the basins drive habitat conditions for focal species. Historical and current conditions and potential drivers (e.g., climate, geology, and land use) will be described to help identify spatially-and temporally specific habitat and watershed process deficiencies. This information will further help identify opportunities to create and sustain key habitat and support viable salmon and steelhead populations.*

3. Identify the habitat needs most important for the success of salmon and steelhead.

Rationale*: Critical life stages (eg juvenile, winter rearing), and corresponding habitat factors (eg channel stability, or habitat diversity) are identified for the salmon and steelhead populations in the basin in previous studies. This habitat information can help guide the identification of habitat opportunities that will be most important to support overall population viability improvements.*

4. Identify data gaps that can be bridged with this current effort and possible future work.

Rationale*: Understanding data limitations can be just as important as identifying what is known when synthesizing and building upon existing information. This effort will help clarify what gaps may be addressed through this strategy as well as what gaps are outside the current scope, but are still valuable to supporting the vision.*

5. Work with landowners to identify opportunities for and constraints to restoration and protection projects within the basin.

Rationale: *Providing field data collection access and implementing restoration and protection actions is fully voluntary. These efforts thus rely on willing landowners. Landowner opportunities and constraint information will inform feasibility and prioritization of restoration or protection opportunities.*

6. Recommend opportunities within the project area that address priority limiting factors for focal populations.

Rationale: *An essential part of this Habitat Strategy is to recommend opportunities that will support the vision. Opportunities include site-scale restoration and protection work as well as spatially-defined assessments to fill outstanding data gaps that are important to implementing the Habitat Strategy vision and goals. These opportunities will build upon current understanding of population bottlenecks, watershed and reach-scale processes, habitat limiting factors, landowner opportunities and constraints, and other identified variables.*

7. Prioritize opportunities based on the developed framework.

Rationale: *A framework for prioritizing opportunities will be developed during this process to support the Habitat Strategy vision and goals by prioritizing recommended opportunities based on how well they address primary habitat limiting factors and population bottlenecks for the focal populations.*

8. Incorporate local input and knowledge throughout the process.

Rationale: *Input and knowledge from people living and working in the basin will inform the Habitat Strategy, with observations of the watersheds and fish populations, as well as provide feedback about how the strategy may impact the community.*

9. Respect and incorporate the local culture, economic interests, property rights, community values, and Tribal interests

Rational: *Viable salmon and steelhead populations are fundamental to Tribal interests and cultural identity. Further, salmon and steelhead restoration is important to communities for a multitude of socioeconomic and cultural reasons.*

3 Approach and Methods

3.1 Ecosystem Process-Based Approach

This Habitat Strategy takes an ecosystem process-based approach to address salmon and steelhead recovery, consistent with the regional Recovery Plan (LCFRB 2010). Inherent in this approach is an understanding of the controls and drivers of ecological processes that can affect aquatic habitat conditions that salmon and steelhead rely on during their life cycles. These controls and processes, and their relationships to fish and habitat, are displayed conceptually in Figure 4. To the extent practicable within the scope of this effort, this Habitat Strategy characterizes these relationships in the Upper Cowlitz Cispus basin. The condition of habitat necessary to support salmon migration, spawning, rearing, and holding in the basin is identified as well as the impaired process drivers that can contribute to degradation. Through this lens, recommended restoration and protection actions are identified.

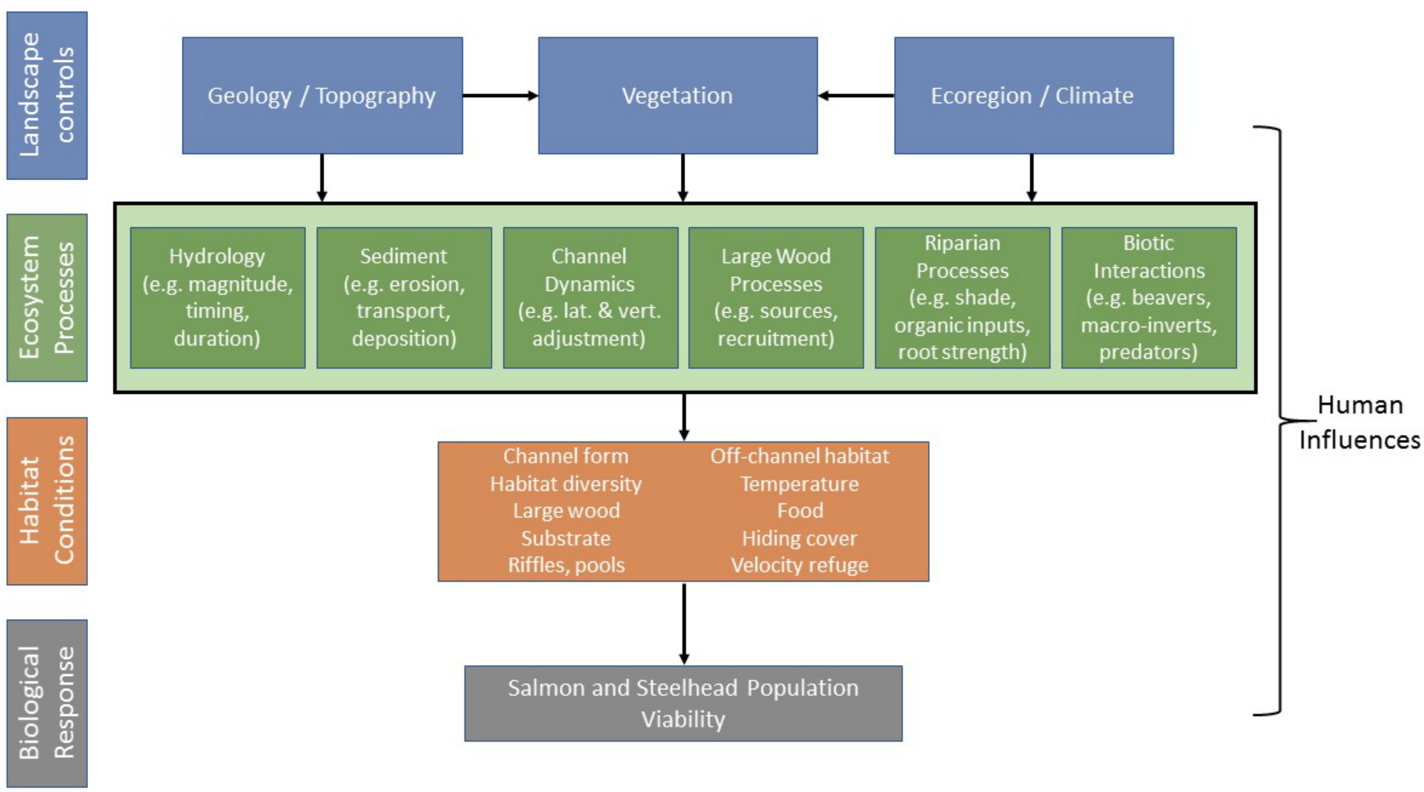


Figure 4. Linkages among landscape controls, ecosystem processes, habitat conditions, and biological response (adapted from Beechie and Bolton 1999, Beechie et al. 2010).

This Habitat Strategy incorporates concepts and methods from well-established approaches for developing watershed-scale restoration strategies. In particular, we have incorporated principles from the River Styles Framework (Brierley and Fryirs 2005), Beechie et al. (2008), Roni et al. (2002, 2013, 2018), and Montgomery (1999) with respect to how to assess watershed conditions and identify and prioritize restoration and protection actions. Our overall approach also closely follows a process-based philosophy (e.g., Beechie and Bolton 1999, Beechie et al. 2010), which prioritizes actions that address scale-appropriate key drivers of watershed process impairments that focus on root causes of problems rather than symptom or form-based approaches. This is not to say that site-scale habitat enhancement or creation[1] actions are not be identified, as oftentimes this is the only reasonable alternative in a highly altered and developed area. However, the focus is on first targeting the most important process-impairments that address root causes, and being explicit about expected outcomes and ecosystem recovery potential.

3.2 Landscape Unit Framework

3.2.1 Landscape Unit Conceptual Framework

This strategy uses a landscape unit framework for describing ecological conditions and for identifying and prioritizing restoration actions. Landscape units follow a "process domain" approach, such as described by Montgomery (1999). This approach groups areas of the basin into spatially identifiable units that represent distinct suites of geomorphic processes, habitat, climate, and land use. This approach is similar in concept to stream reaches, except that landscape units occur at a larger spatial scale than typical stream reaches and also encompass broader valley bottom as well as hillslope (i.e., upland) areas. Using this approach allows us to break up a physiographically diverse watershed into understandable units that are governed by similar ecosystem processes and that can be characterized and compared among one another. This provides a useful framework for understanding impairments and for identifying and prioritizing restoration and protection measures.

3.2.2 Landscape Unit Delineation

Landscape units were delineated by identifying geomorphic provinces with distinct topography, climate, disturbance processes, and aquatic habitat types. Delineation and characterization of landscape units was completed first in the office using remotely sensed data and then verified and amended by field reconnaissance (see Section 3.5).

Two broad categories of landscape units were identified: 1) valley bottoms and 2) hillslopes (Table 4). The valley bottom landscape units were delineated to include the broad valley floors of the Cowlitz and lower Cispus rivers. They extend from Lake Scanewa at the downstream end to just above the Muddy Fork confluence on the Cowlitz and up to the Canyon Creek confluence on the Cispus. The valley bottom landscape units generally contain the Tier 1 and 2 (i.e., high priority) stream reaches from the Recovery Plan (LCFRB 2010), representing some of the most important habitat for ESA-listed salmon and steelhead in the basin. The Hillslopes include the land areas above the broad mainstem valley bottoms. These areas influence salmon and steelhead habitat within valley bottom landscape units via their contributing processes,

[1] In this context, 'enhancement' and 'creation' actions are distinguished from true 'restoration'. True 'restoration' entails returning a site and ecosystem processes to a pre-existing (e.g., historical) condition or as close to that condition as possible. 'Enhancement' is the improvement of selected processes or habitat conditions where full restoration is not possible; and 'creation' is more form-based, creating new features that may or may not have existed historically and where processes needed to create and sustain them are not addressed.

including sediment delivery, hydrology, and wood inputs. These processes are impacted by land use practices, such as timber harvest, as well as by natural processes, such as glacial melt and landslides.

3.2.2.1 *Valley bottom landscape unit delineation*

Individual valley bottom landscape units were delineated based primarily on breaks in geomorphic channel type and the primary processes governing channel form and function. These processes are influenced by local valley gradients, sediment processes, confinement, underlying geology, and land use history. Characterization of the valley bottom units used existing geologic and hydrologic data, presence of infrastructure and other structures, aerial photographs, and observations from field reconnaissance. Existing channel type and form was also compared to predicted types from Beechie and Imaki (2014), which are based on slope, discharge, valley confinement, and sediment.

3.2.2.2 *Hillslope landscape unit delineation*

The three hillslope landscape units are Highlands, Mid-Elevation Hillslopes, and Lower Hillslopes. Individual hillslope units were delineated using the Washington State Department of Natural Resources Rain-on-Snow (ROS) zones (WDNR, 2018). The ROS mapping was performed by WDNR to provide an index map based on the understanding of the process controls governing the magnitude and frequency of water inputs associated with ROS events (WDNR, 2018). The ROS zones were delineated by the WDNR based on several factors, including climate, elevation, latitude, and vegetation conditions. This dataset was selected because it captures one of the primary disturbance processes (i.e., flooding and associated erosion and wood loading) affecting downstream channel habitats. The delineation factors are expected to correlate well with other landscape-scale forms and processes including forest types, temperature regimes, channel types, aquatic habitat types, and to some degree, land management practices. During the delineation, the hillslope units mapping was generalized by lumping smaller non-contiguous areas less than 4,000 acres with the surrounding hillslope LU type.

Table 4. Landscape units used in this study and their location.

	Landscape Unit	Location
Hillslope Units	Highlands	High elevation, snow-dominated terrain draining the high peaks and ridgelines.
	Mid-Elevation Hillslopes	Mid-elevation rain-on-snow zone ranging from approximately 500 to 12-1300 meters elevation.
	Lower Hillslopes	Low elevation rain-dominated zone below approximately 500 meters elevation.
Valley Bottom Units	Upper Cowlitz– Muddy Fork Avulsion Affected	Cowlitz River Valley Bottom RM 132.5 – 128.2; previous (pre-2006) Muddy Fork confluence to grade break near Butter Creek confluence.
	Upper Cowlitz– Packwood	Cowlitz River Valley Bottom RM 128.2 – 125.5; grade break near Butter Creek confluence to Skate Creek.
	Upper Cowlitz– Mid-Valley	Cowlitz River Valley Bottom RM 125.5 – 116.4; Skate Creek to Cora Bridge (Hwy 12).
	Upper Cowlitz– Randle	Cowlitz River Valley Bottom RM 116.4 – 97.7; Cora Bridge (Hwy 12) to Scanewa Backwater.
	Upper Cowlitz– Scanewa	Cowlitz River Valley Bottom RM 97.7 -90; Scanewa Backwater to Lake Scanewa.
	Cispus - Upper	Cispus River Valley Bottom RM 30.7 to 21.7; Canyon Creek confluence to valley widening near RM 21.7.
	Cispus– Mid-Valley	Cispus River Valley Bottom RM 21.7 – 17.5; Valley widening near RM 21.7 to Cispus Road Bridge.
	Cispus– Tower Rock	Cispus River Valley Bottom RM 17.5 – 13.5; Cispus Road Bridge to start of channel confinement.
	Cispus – Lower	Cispus River Valley Bottom RM 13.5; Start of channel confinement to Lake Scanewa.

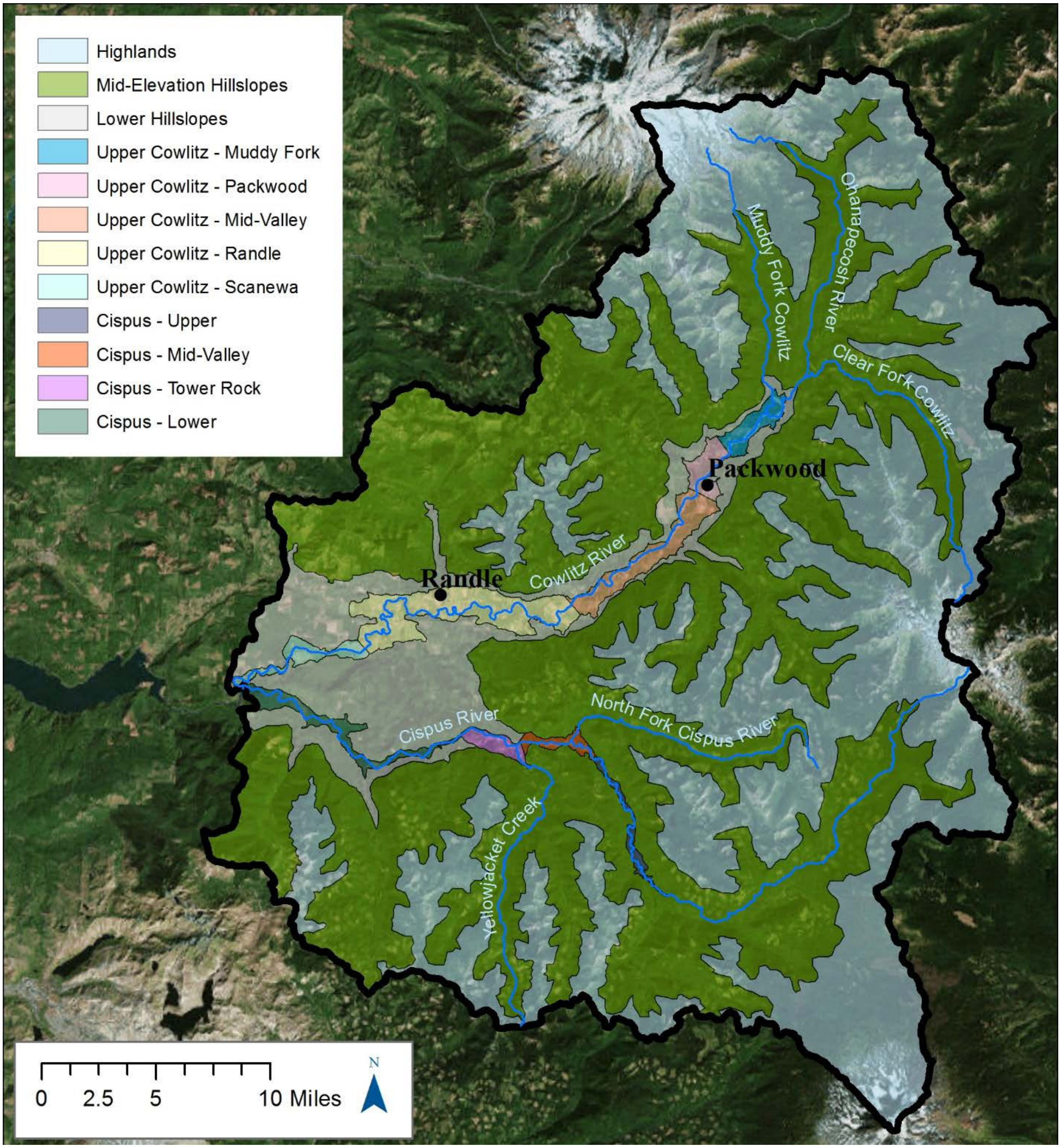


Figure 5. Landscape units in the Upper Cowlitz Cispus Basin project area for the purpose of the basin habitat strategy.

3.2.3 Landscape Unit Characterization & Ecological Indicators

Once the landscape units were delineated, the conditions within the landscape units were described. The Upper Cowlitz Cispus basin is large, and various efforts have been completed in the past and are currently ongoing. In describing landscape units, the intention was to avoid repeating existing analyses, and to compile and report other efforts within the context of project goals.

At the core of the landscape unit characterization is the assessment of the process-based ecological indicators. The nine ecological indicators represent the primary ecological process drivers affecting river function and salmon and steelhead habitat, and that have been affected by land-use and management to various degrees depending on the setting. These ecological indicators are listed in Table 5. Ecological indicators were assigned a designation ranging from "impaired" to "functional" in each landscape unit. Evaluating landscape units using these indicators helps to explicitly describe and document conditions, which allows conditions to be compared across the landscape. The indicator rankings also provide context and information that is used in the development of restoration and protection strategies. The definitions of the Ecological Indicators and the criteria for their condition ratings are provided in Appendix C.

In addition to the ecological indicator ratings, other attributes of landscape units were also described – these are listed at the bottom of Table 5.

Table 5. List and description of ecological indicators and other attributes used to characterize landscape units.

Ecological Indicator	Description
Natural vs. Human Disturbance	The condition of natural versus human-related disturbances, including floods, mass wasting, wildfire, icing, channel avulsion, wind storms, volcanic-related events, and forest stand disease. Have natural disturbances been altered and have new human disturbances been introduced?
Hydrologic Alteration	The condition of hydrologic processes within the basin with respect to human effects on the Magnitude, timing, duration, and frequency of stream flows.
Sediment Processes	The degree to which sediment processes have changed in response to land use, including channel bedload flux (aggradation or incision), hillslope sediment contributions (e.g., mass wasting), and fine sediment in spawning gravels.
Large Wood Processes	The condition of large wood processes and how they have been altered. Processes considered include sources (e.g., riparian zones), recruitment (e.g., channel migration), and retention (e.g., key piece size and channel complexity). Wood piece and jam counts are considered if available.
Channel Type and Form	The degree to which channel type and form have been altered, including changes to channel type, profile, planform, and cross-section patterns. Pool frequency and quality metrics are considered if available.
Floodplain Connectivity	The degree to which surface water access to the floodplain (magnitude, frequency, timing, or duration) has been altered, typically via artificial confinement, floodplain filling, or incision.

Lateral and Vertical Channel Dynamics	The degree to which vertical and lateral channel adjustment processes have been impeded (e.g., bank or bed armoring) or exacerbated (e.g., removal of bank vegetation that is providing root strength).
Off-Channel Habitat Connectivity and Refugia	The degree to which off-channel habitats (side-channels, alcoves, floodplain wetlands) have been disconnected from the channel or made inaccessible to fish, or have otherwise been degraded.
Riparian Function	The condition of riparian vegetation along streams with respect to riparian disturbance (e.g., clearing), stand structure (e.g., tree sizes), and canopy cover (stream shading).
Other Attributes	*These attributes were described for each landscape unit, but were not given functional ratings like the above Ecological Indicators*
Historical Conditions	The historical condition and function of landscape units, intended to provide context for understanding ecosystem processes and habitat recovery potential; with the acknowledgment that in many cases it will be impossible or imprudent to attempt to restore to historical conditions.
Contributing Process Drivers	The interactions among landscape units, such as influences on the unit from upstream, downstream, or adjacent hillslopes. This information affects sequencing and prioritization of restoration and protection actions. For example, attempting to restore an incised channel in a lowland valley may be futile if the incision is caused by a sediment imbalance or hydrologic impairment in an upstream contributing subwatershed.
Fish Use	The current and future potential salmon and steelhead use within the landscape unit. See sources for fish information below.
Habitat Patch Connectivity	Patch connectivity reflects the idea that species and ecosystem function may benefit most from recovering areas that are well-connected to existing functioning habitats. Such areas may be highlighted as strategic restoration or protection areas that receive a higher priority for action.
Management Plans, Past Studies, Projects	Includes existing management plans, policies, conventions, or laws that have an effect on current or future function or ecosystem recovery potential. This is performed at a coarse-scale, since a detailed analysis of policies and plans is outside the scope of this current effort.

3.3 Action Identification

3.3.1 Approach to Identifying Actions

Restoration and protection actions were identified throughout the study area. Action identification focuses on restoring root causes and process-related impairments. For example, in unconfined valley bottoms, actions are identified that restore lateral connectivity that has been lost through confinement and floodplain development. In addition to full process restoration actions, potential habitat enhancement or creation actions are also identified where there is uncertainty in the socio-political acceptance or feasibility of a more process-oriented action. Most landscape units include a combination of potential approaches given the early stage of project planning (e.g., landowner communication and feasibility analysis have not yet occurred).

The scale and types of actions vary depending on the landscape unit and the specific needs and opportunities. In many cases, the actions are not specific actions but instead *types* of actions. For example, 'restoring floodplain connectivity through purchase of conservation easements and levee set-backs' might be a priority action for an area in an unconfined valley bottom. In other cases, site-specific features are included in the action where it is clear a certain feature needs to be addressed. For all of the valley bottom landscape units, the action areas were mapped as polygons in a GIS and maps are provided later in this report.

Recommended actions were identified with the following guidelines in mind:

- Identify impairments (and ecosystem recovery actions) at the appropriate scales at which they operate;
- Identify actions that address root causes of impairments rather than symptom or form-based approaches;
- Identify actions that restore linkages to intact habitats;
- Identify land use, social, and economic constraints associated with specific actions and be explicit about their potential influence on the action;
- Identify the expected benefits to target fish populations; and
- Identify actions that provide both short-term and long-term ecological and habitat benefits

Identification of actions occurred as part of office analyses and field surveys. Field surveys occurred along the mainstem Upper Cowlitz River, mainstem Cispus River, and in primary tributaries that had known watershed process impairments and high fish use or potential use. A description of the field effort is provided in Section 3.5. The following spatial and field-generated data sources were utilized along with professional judgment. It is recognized that there could be different ways to identify and categorize actions given that this is a complex landscape and many actions exist and overlap with one another.

The primary datasets that were used to identify actions remotely include:

- Terrain (LiDAR and surface derivatives, e.g., Relative Elevation Model);
- Aerial photography, including historical images;
- Channel Migration Zone delineations;
- Flood hazard areas identified in past studies;
- Previously defined protection areas;
- Fish use and barrier information;
- Spatial datasets, including levees, roads, parcel boundaries and ownership, FEMA flood layers;
- 2019 Hydraulic modeling for the Upper Cowlitz basin from river mile 91 to 124 (performed by Tacoma Power); and
- 2019 geomorphic characterization of the project area (performed by Tacoma Power)

Once identified, actions were placed within the prioritized hierarchical framework presented in Figure 6. The framework borrows heavily from concepts described in Brierley and Fryirs (2005) and Roni et al. (2002, 2013) and is consistent with the Recovery Plan's 'Specific Reach and Subwatershed Priorities' identified for the Upper Cowlitz Subbasin (LCFRB 2010, Volume 2, Chapter F).

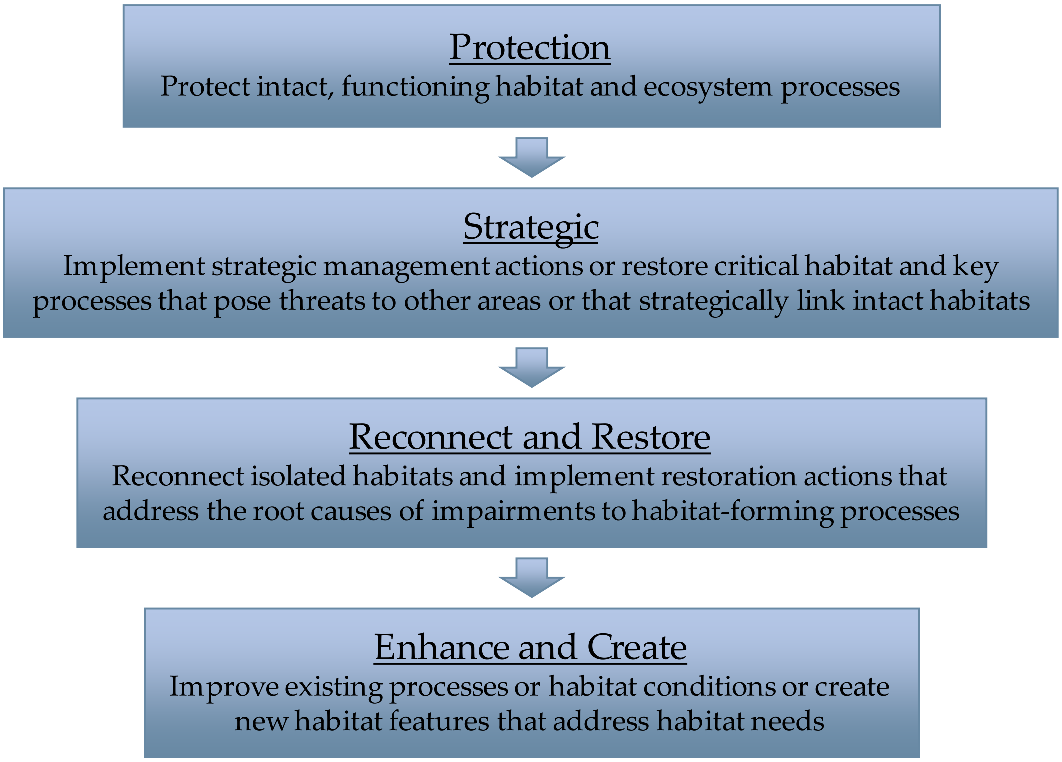


Figure 6. Hierarchical prioritization framework for identifying and prioritizing actions.

Actions were assigned a category from Figure 6 based on the primary emphasis for the habitat action area. It is important to note that although individual areas are assigned a primary action type, they may include elements from the other action types. For example, areas identified for Protection may also benefit from targeted Enhance and Create projects. Considered inversely, projects implemented within a particular action area may not necessarily be exemplary of that action type. An example is where a Strategic action is identified to reconfigure a bridge, but where habitat improvement projects may be implemented in that area and still be effective, prior to addressing issues caused by the bridge. Lastly, many of the identified actions include private lands, thus willing landowners must be involved to implement specific projects that fall within each action type.

More emphasis has been placed on identifying action areas within the valley bottom LUs compared with the hillslope LUs. This is a recognized data gap of this Habitat Strategy, and while effort was made to identify types of actions in the hillslope LUs, less spatial specificity is available for those actions. Additionally, some valley bottom locations within the project area are not marked for action. Generally, these locations are:

- Highly functioning and already protected (e.g., public land, or within Ordinary High Water, [OHW]);
- Outside of floodplain or Channel Migration Zone (CMZ);
- Already identified as habitat mitigation areas (e.g., Packwood Lake Hydroelectric Project);
- Developed and outside of flood hazard areas; or,

- Highly constrained to the degree that the work group does not anticipate addressing in the foreseeable future (e.g., affected by Cowlitz Falls Dam impoundment).

Notably, while existing public land management regulations serve as a protection to many highly functioning areas in the basin, these land use rules must stay in place for the benefits of those protections to be realized. If, for example, the rules governing forest land or shorelines change in the future, these areas will need additional protection to maintain high ecological function.

3.3.2 Description of Action Types

3.3.2.1 *Protection*

Areas identified for Protection currently have moderate to high ecosystem function but may be at risk of future impairment (e.g., from development or other action). Typically, these locations have little to no existing human development or structures. They may have additional restoration potential, and frequently exhibit Strategic or Reconnect and Restore potential, often in combination with adjacent areas. In most cases, areas identified for protection include private lands, which would require willing landowners and associated agreements, easements, or acquisition. Areas that are currently functioning, but are on a degrading trajectory based on ecosystem processes (e.g., forested islands that are eroding due to current river conditions), are addressed as Strategic or Reconnect and Restore actions.

Example project type:

- Partner with a willing landowner to purchase a conservation easement on private, developable forest land within the flood hazard zone by a conservation land trust.

  Result = preserves this land for present and future floodplain, channel migration, and off-channel habitat; and prevents development in flood risk areas.

3.3.2.2 *Strategic actions to restore watershed process*

Strategic actions typically meet at least one of the following conditions:

1. Actions that address impairments that have a broad-scale negative impact on ecological processes or habitat, such as impacts that propagate up- or downstream into high priority areas or across the valley floor. An example of this type of broad-scale negative impact is roads or levees impinging the floodplain. These actions are Reconnect and Restore actions that affect a larger spatial scale, or have a larger impact on the ecosystem.
2. Actions that must occur, such as infrastructure acquisition, before the restoration of ecological processes or habitat can occur. These provide a combination of ecological and societal benefits that will ultimately result in a larger ecological uplift. For example, addressing development within flood hazard zones as identified from previous studies (e.g., GeoEngineers, 2009) where acquisition/relocation would help with human flood protection as well as allow for the restoration of ecological function.

Strategic opportunities are mostly situated on private lands but may also include public lands with infrastructure causing process impairments and/or exhibiting the potential to create future impairments. As such, these locations typically require willing landowners and associated agreements, easements, or acquisition.

Example project types:

- Removal of a levee and relocation of a roadway away from the stream channel to address reach-scale channel confinement and incision.

  Result = allows for renewed meandering and sediment storage in the reach and a reduction in floodplain disconnection over the entire reach.

- Partner with willing landowner(s) to purchase properties within the flood hazard zone, and restore riparian and floodplain forests on those lands.

  Result = allows for restoration of natural floodplain inundation patterns, and resumption of channel migration processes necessary for creating and maintaining aquatic habitats over time. Also reduces flood hazard to properties and structures.

- Partner with willing landowner(s) to purchase conservation easements and relocate of structures away from a prominent mainstem side channel targeted for reconnection and enhancement.

  Result = allows for reconnection of the side channel to the mainstem for salmon and steelhead spawning and rearing.

3.3.2.3 *Reconnect and Restore actions*

Reconnect and Restore actions remove watershed process barriers and/or otherwise work to restore underlying watershed/river processes (e.g., floodplain inundation, channel migration, large wood recruitment). Examples include removing levees and armoring, replanting riparian zones, and reconnecting side channels to more frequent inundation. These actions may be located on private or public lands, frequently requiring willing landowners and associated agreements, easements, or acquisition.

Example project types:

- Removal of bank armoring (e.g., riprap) that is no longer providing structure protection and replacing it with large wood jams and riparian plantings.

  Result = restores channel margin habitat, riparian conditions, and long-term channel migration.

- Setting back a levee closer to the neighborhood it is intended to protect.

  Result = widens the floodplain and channel migration zone to allow for off-channel habitat creation, more natural flood inundation patterns, and a decrease in downstream flooding.

- Installation of large log jams in the mainstem river to create sediment deposition zones where vegetation can establish, and to elevate water surface elevations to enhance flow in side-channels.

  Result = initiate re-establishment of an "island braided" channel type that provides abundant habitat availability and complexity.

- Replanting a pasture in the floodplain with native floodplain forest vegetation.

  Result = provides hydraulic roughness (which is important for flood dampening and habitat complexity) and a source of large wood recruitment when the river floods or migrates into that area over time.

3.3.2.4 *Enhance and Create*

Enhance and Create actions improve habitat for targeted salmon and steelhead species, but do not necessarily improve underlying causative factors. These actions typically provide benefits on shorter time scales or smaller spatial scales, but benefits may be short lived if current watershed process regimes cannot maintain the habitat. When paired with Reconnect and Restore and Strategic actions, they have the potential to quickly jumpstart recovery. They may also be used to enhance areas marked for protection. Enhance and Create actions may be located on private and public lands, and as such, may require willing landowners and associated agreements, easements, or acquisition.

Example project types:

- Adding large wood to stream channel margins, or side channels.

  Result = enhances hydraulic complexity, sediment sorting, pool scour, and habitat cover for juvenile salmonid rearing and adult holding.

- Excavating a backwater alcove connected to the mainstem.

  Result = enhances availably of off-channel rearing and flood refuge for juvenile salmonids.

3.4 Data Sources & Literature Review

An important early step in developing the Habitat Strategy involved compiling and summarizing available fish population biology, life history, ecology, and physical habitat data. This information identifies and predicts salmon and steelhead presence and patterns as well as watershed processes that contribute to habitat conditions required for population viability. The fish biology data are important because they describe viability requirements associated with recovering focal populations. The bio-physical characteristics and trajectories of the basins are important in understanding areas and reasons for key habitat degradation or improvement. Limiting factors to focal salmon and steelhead help guide the identification of actions. The Habitat Strategy builds on this body of information to inform the prioritization of future actions in support of key habitat. Additionally, restoration efforts have been occurring in the Upper Cowlitz and Cispus basins and that work is important to incorporate and learn from in the development of the Habitat Strategy.

Literature, historical data, and previous reports and projects were reviewed within the following categories:

- Fish Population Information
- Physical Habitat Information
- Limiting Factors to Focal Populations
- Past Projects in the Basin

Summaries of the results of this review can be found in the background references and data sources described in Appendix A. Note that the literature review in Appendix A was developed at the beginning of the Habitat Strategy effort, and thus does not reflect all resources considered during the project. Additional resources can be found in the Existing Guidance (Section 3.4.1) and Reference (Section 9) sections of this report.

3.4.1 Existing Guidance Documents & Studies

Natural resource management plans, past studies, and/or past projects within the LUs are referenced in this document. The intention is not to repeat the extensive work included in these documents. However, where relevant, specific policies, plans or recommendations from these works are called out as they relate to the habitat trajectory of various LUs. Key management plans relevant to the project area include:

- US Forest Service Northwest Forest Plan (USFS and BLM, 1994)
- US Forest Service Late-Successional Reserve Assessment (e.g., USFS, 1997)
- US Forest Service Gifford Pinchot Land Management Plan and Amendment 11 (USFS 1990, 1995)
- WA DNR Forest Practices Act, RCW 76.09; Forest Practices Rules, Title 222 WAC
- WA State Owned Aquatic Lands, RCW 79.105.020
- Grays-Elochoman & Cowlitz Detailed Implementation Plan WRIA 25 and 26 (Manlow and Andrews, 2008)
- Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, Vol.2, Ch. F: Upper Cowlitz Subbasin (LCFRB, 2010)
- Upper Cowlitz River Basin Reach Characterization Project – Identifying River Reaches Suitable for Protection (Cardno, 2014)
- Report: Geomorphic Evaluation and Channel Migration Zone (CMZ) Analysis for the Upper Cowlitz River (GeoEngineers, 2003 and 2009)
- Reach Analysis and Erosion Hazard Management Plan: Cispus River from River Mile 12.3 (Greenhorn Creek) to River Mile 17.6) Cispus Road Bridge (Herrera, 2004)
- Upper Cowlitz River: Final Flood Hazard Risk Assessment Report, Lewis County, WA (NRCS, 2009)

3.4.2 Data Sources for Physical Watershed & River Processes

Physical processes from watershed to site scales drive watershed function and consequently current and potential fish habitat. This Habitat Strategy relies on identifying areas of the basin that are “functional” and “impaired” with respect to key physical processes. In particular, this effort used existing data sources to evaluate disturbance regimes, geology, sediment processes, landscape and reach-scale geomorphic trends, hydrology, wood inputs, and floodplain connectivity/disconnection. Topographic and bathymetric data derived from LiDAR assisted in understanding river and hillslope characteristics. Various LiDAR flights were used, ranging from 2007 to 2018 (see geospatial data sources in Appendix A). A regional data set that predicts channel type and form based on slope, discharge, valley confinement, and sediment (Beechie and Imaki, 2014) was used as a reference for geomorphic interpretations.

The Integrated Watershed Assessment (IWA) from the Recovery Plan (LCFRB, 2010; although IWA was last updated in 2004) was used, along with other referenced information, in the characterization of the LUs. The IWA was a GIS-based analysis that identified hillslope process impairment at the 7th Field HUC scale (termed "subwatersheds" in the Recovery Plan) with respect to three processes; hydrology, sediment delivery, and riparian function. Each subwatershed was given a rating of 'functional', 'moderately impaired', or 'impaired' for the three indicators. The IWA results for the hillslope LUs are presented in the description of Ecological Indicators, and they are also presented in the valley bottom LUs based on the contributing subwatershed conditions.

Additional information about river form and function was developed by Tacoma Power during development of the Habitat Strategy. Specifically, an office-based geomorphology assessment (prepared by Natural Systems Design, Inc.) and a two-dimensional hydraulic model (in preparation by Anchor QEA). Links to information from these projects are included in Appendix A.

3.4.3 Data sources for Fish Distribution, Habitat, & Restoration/Protection Efforts

Current or potential habitat quality for target fish species and life stages are characterized by assembling a single database of existing data sets including EDT output, critical habitat designations (NMFS, 2016), a comprehensive series of physical habitat and biological surveys conducted 1934-42 (McIntosh et al., 1990), a set of spawning surveys covering years 1943-2017 that was recently compiled by WDFW, a spatial dataset describing potential fish passage barriers throughout the basin compiled by WDFW, a spatial dataset describing anadromous fish distributions that was compiled for SWIFD (State-Wide Integrated Fish Distribution) as part of a collaboration between WDFW and the Northwest Indian Fisheries Commission (NWIFC), and surveyor inference based on physical habitat characteristics observed during the development of this Habitat Strategy project. The EDT output has limitations, and concerns have been raised regarding the use of it in this process. In acknowledgment of those limitations, the dataset is considered as one line of evidence amongst others, such as those listed above. A discussion of the EDT model and its applicability to this habitat strategy is provided in Appendix B.

The variety of time periods, methods, and project foci lead to data spatial extents ranging from comprehensive to patchy; however, this compilation of existing data can provide guidance regarding current and potential future habitat for target fish populations in the Upper Cowlitz and Cispus basins. Section 5 and Appendix D include descriptions of target fish use, habitat conditions, and maps for each LU. In several locations, either mapped fish distributions or critical habitat do not overlap with priority EDT reaches. At this time, the most comprehensive dataset highlighting areas of potential fish performance is EDT, the use of which is described in more detail in Appendix B. The other data sets provide additional lines of evidence for fish use.

3.5 Field Surveys

Field surveys of the valley bottoms were performed October 24, 25, and 26, 2018 by Inter-Fluve and Cramer Fish Sciences staff. The emphasis of the survey was to observe physical characteristics of the Cowlitz and Cispus Rivers and major tributaries as they relate to historical, current, and potential future salmon and steelhead habitat; as well as to validate the office-based analysis. Indicators of watershed processes, based on those listed in Table 5, were evaluated.

The survey was targeted at areas of channel complexity, where salmon and steelhead habitat might be most impacted by future human development or restoration and protection actions. In general, that meant lower slope valley bottoms of the Cowlitz and Cispus Rivers, upstream of the Lake Scanewa backwater impacts, as well as tributaries in areas passable to salmon and steelhead. The survey extent was limited in part by landowner willingness and field time limitations; however, the survey was extensive and representative of a majority of the landscape units. As shown in Figure 7, the survey was completed using a boat (inflatable kayak) to float mainstem stretches, by walking segments of the channel, and by driving roads adjacent to the river and stopping intermittently to observe the river. In areas where field surveys did not occur, the results of our assessment are based on the available literature/data, or use inference from other similar areas.

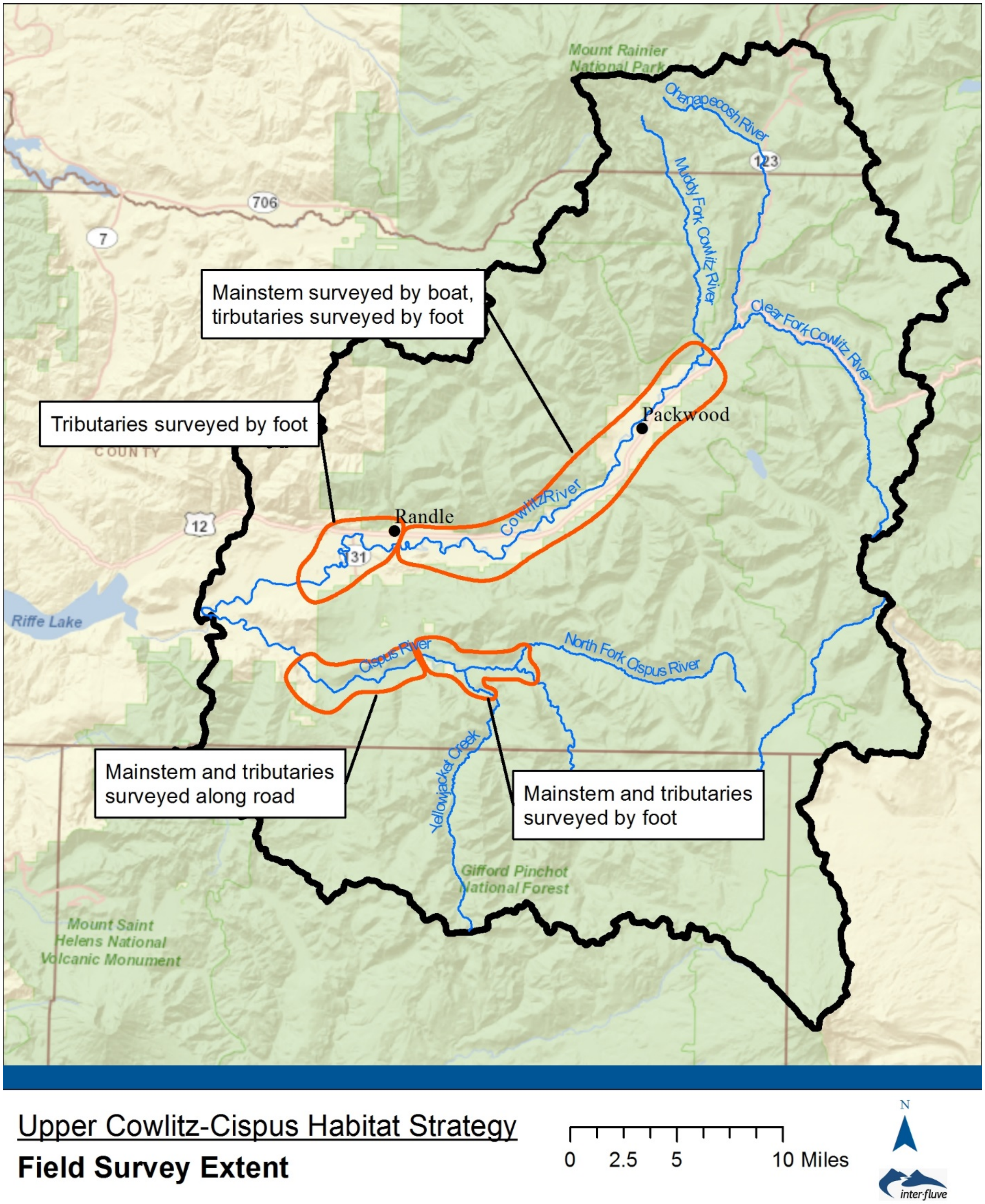


Figure 7. Extent and method of field investigation within the project area. Boxes indicate general survey location and method, and do not necessarily mean all parcel locations were visited.

3.6 Coordination with Ongoing Monitoring & Assessment Efforts in the Basin

Tacoma Power conducted two additional habitat assessments in the upper Cowlitz basin concurrent with the development of this strategy: a geomorphic assessment of the upper Cowlitz and Cispus Rivers (with Natural Systems Design, Inc.) and hydraulic modelling of the upper Cowlitz River between river miles 91 and 124 (with Anchor QEA). Draft work products for these assessments were provided to Inter-Fluve as they became available to facilitate information sharing and also to ensure that the developing technical information was aligned among the different analyses as much as possible. Both habitat assessments were finalized in December 2019.

In addition to regular participation by Tacoma Power's habitat program, Tacoma Power's Cowlitz monitoring and evaluation program participated in the Upper Cowlitz Cispus work group on an ad hoc basis to share information on the developing fish monitoring program in the basin. This coordination was important as current, publicly-available data products and reporting related to fish monitoring were limited.

Tacoma Power hosted a workshop on June 6, 2019 where the technical experts from all four consultants (Inter-Fluve, Cramer Fish Sciences, Natural Systems Design, Anchor QEA), as well as representatives from the Lower Columbia Fish Recovery Board and Tacoma Power habitat and Cowlitz fisheries programs, shared and discussed all of their efforts. The goal of the workshop was to capture as much developing information as possible into the strategy. Coordination and data sharing continued throughout the development of the habitat strategy.

Coordination with the US Forest Service was also key to developing the Habitat Strategy as they are major land manager in the strategy area, as well as a monitoring and restoration partner in the Cispus River watershed. At the June 2018 work group meeting, the US Forest Service presented on their monitoring program and restoration priorities in the strategy area. The US Forest Service continued to provide habitat and fish monitoring information as well as priority watershed and harvest management details throughout the development of the strategy.

4 Environmental Setting

4.1 Physical Setting

4.1.1 Basin Overview

The study basin is the drainage area contributing to Cowlitz Falls Dam and includes the upper mainstem Cowlitz River, the mainstem Cispus River, and associated tributary basins (Figure 3). The total basin area is 1,026 square miles. The eastern boundary of the basin follows the crest of the Cascades and includes Mount Rainier, Mount Adams, and the craggy peaks of the Goat Rocks Wilderness. The Nisqually drainage lies to the north and the upper Lewis River drainage lies to the east. The mainstem Cispus and upper Cowlitz Rivers converge at Lake Scanewa, the reservoir created by the Cowlitz Falls Dam on the Cowlitz River at approximately river mile (RM) 88.5. The Cowlitz Falls Dam is owned and operated by Lewis County Public Utility District No. 1. It was constructed in 1994 and creates a narrow 11-mile long reservoir, with backwater effects that extend a considerable distance upstream on the low gradient mainstem Cowlitz. Backwater effects do not extend as far up the Cispus. The mainstem upper Cowlitz River valley consists of a broad alluvial valley that extends from Lake Scanewa up to just beyond the confluence of the Muddy and Clear Forks of the Cowlitz (RM 132), just upstream of the town of Packwood, Washington. This is an agricultural and rural residential valley. The Cispus River valley is located south and east from the confluence, in the direction of Mount Adams. The Cispus River valley is more confined, more forested than the Upper Cowlitz, and is dominated by forestry land-uses.

4.1.2 Geology

The study basin ranges in elevation from 792 ft to 14,410 ft. It is composed of steep terrain, with 64% of the basin having a slope over 30% (Washington StreamStats, 2019). High points include the volcanic peaks of Mount Rainier (14,410 ft) and Mount Adams (12,280 ft); as well as the Goat Rocks Wilderness (Gilbert Peak 8,184 ft). Mount Rainier, in its modern form, began to form around 500,000 years ago (Pringle 2008 as cited in Riedel and Dorsch 2016). The surficial bedrock geology that overlies most of the basin, above the broad alluvial river valleys, is volcanic sedimentary deposits and andesite and basalt flows (WA DGER 2016, Crandall and Miller 1974) (Figure 8).

Glacial action has had a dominant impact on the formation of the broad river valleys and on the floodplain and terrace deposits within them. The effects of glaciation are more pronounced in the upper Cowlitz than the Cispus, with multiple instances of glaciers extending from Mount Rainier down the Cowlitz River valley. Late Pleistocene glaciation included several glacial advances including the Wingate Hill (300,000-600,000 years ago), Hayden Creek (130,000-320,000 years ago), and Evans Creek glaciations (13,000-70,000 years ago) (Crandall and Miller 1974, Dethier 1988). During these episodes, an icecap was believed to be centered on Mount Rainier, with glacial lobes extending down the river valleys (Crandall and Miller 1974). One of the longest of these lobes was the Cowlitz River glacier within the Cowlitz River valley. It is estimated that glaciers during the Wingate Hill and Hayden Creek periods extended 105 km (65 mi) from Mount Rainier, to near Silver Creek, Washington west of Mossyrock. The more recent Evans Creek glacier extended down to near present-day Cowlitz Falls Dam (Crandall and Miller 1974). An end moraine crossed the valley approximately 1.5 miles southwest of Randle, with remnant till deposits present there today (Crandall and Miller 1974, WA DGER 2016). The Cispus River valley bottom is primarily composed of Quaternary alluvium and basalt flows, with some Evans Creek drift along the valley walls in the lower portion in the Tower Rock area (WA DGER 2016).

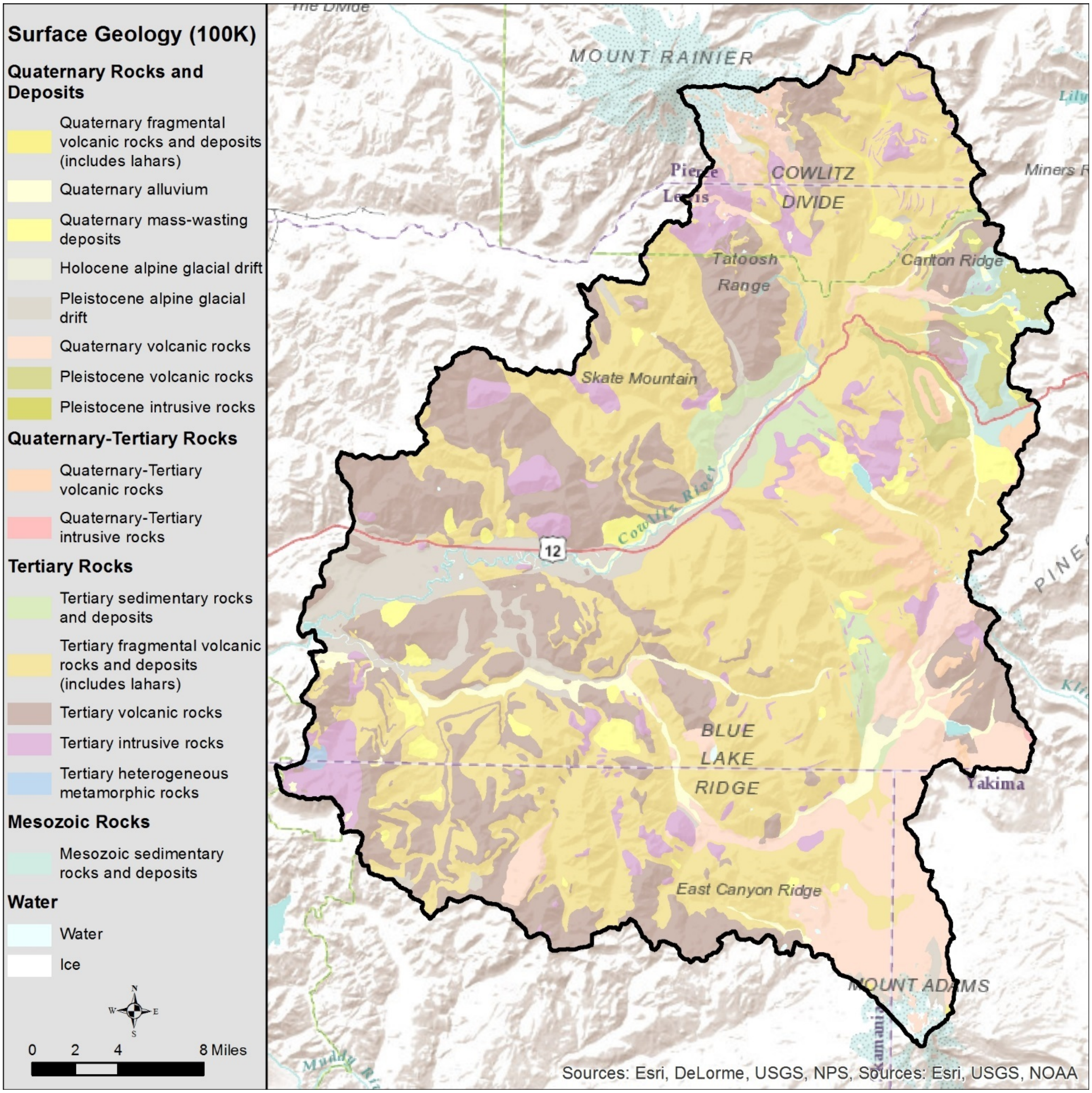


Figure 8. Surface geology map of Upper Cowlitz and Cispus basins. Source: Washington Division of Geology and Earth Resources (2016).

4.1.3 Climate

The climate of the basin is typical of the Western Cascades, with cool and moist conditions in the fall, winter, and spring, and warm and dry conditions in the summer. Most precipitation is orographic, resulting from the prevailing west winds bringing moisture-laden air from the Pacific Ocean that rises as it hits the Cascade Mountains. Precipitation increases dramatically with elevation (Crandall and Miller 1974). Mean monthly temperatures in Packwood range from 36.3 F in December to 65.9 F in August (WRCC 1981-2010 normals). Average annual precipitation is 56.0 inches in Packwood (WRCC 2019), with a basin-wide mean of 85.9 inches (Washington StreamStats). Mean monthly precipitation in Packwood ranges from 0.87 inches in August to 9.95 inches in November (WRCC 1981-2010 normals).

There has been a net loss of approximately 30% of the glacial area on Mount Rainier since the early 1900s (Nylen 2002 as cited in Riedel and Dorsch 2016). Glacial mass balance monitoring on the Emmons and Nisqually glaciers from 2003 to 2010 indicated large losses of glacial volume for all years except for one (Riedel and Dorsch 2016).

4.1.4 Geomorphology

4.1.4.1 *Channel Type, Channel Form, and Geomorphic Processes*

Channel type, channel form, and geomorphic processes vary throughout the basin depending on topography/slope, valley width, contributing basin size, hydrologic processes, underlying geology, and glacial history. Although there is considerable variation across this large and diverse basin, some general patterns can be identified. A comprehensive source for channel type information is the modeling performed by Beechie and Imaki (2014) for streams throughout the Columbia River Basin. This work used a suite of variables to predict the "natural" channel types that would be expected in the absence of land use impacts. The predictor variables included slope, discharge, valley confinement, and surrogates for sediment information. The data for the Upper Cowlitz Cispus basin is shown in Figure 9 with definitions of the geomorphic channel patterns in Table 6. Although these are modeled data, they correlate well with our field observations, with only a few exceptions.

Table 6. Definitions of channel patterns. Modified from Beechie and Imaki (2014).

Channel Pattern	Definition
Confined	Valley floor width divided by channel width <4
Straight	Primarily single thread channel, sinuosity <1.5
Meandering	Primarily single thread channel, sinuosity >1.5
Island-Braided / Anabranching	Multiple channels, >50% of channels separated by vegetated islands
Braided	Multiple channels, >50% of channels separated by unvegetated gravel bars

The Beechie and Imaki (2014) dataset only includes channels that are greater than 8 meters wide since those are the only ones capable of forming the alluvial channel patterns that were the focus of the study. For this reason, there are few modeled streams in the Highlands region. However, some modeling has been done on the smaller streams using primarily gradient to predict channel types based on Montgomery and Buffington (1997); these data suggest that the Highlands LU contains primarily cascade and step-pool channel types. Portions of the smaller mainstem tributaries that lie within the valley-bottom LUs tend to be comprised of pool-riffle channels. The larger tributaries, which lie within the lower and middle hillslope LUs and that can be seen in Figure 9, are dominated by “straight” and “confined” channel types. The mainstem upper Cowlitz and Cispus rivers within the valley-bottom LUs contain three geomorphic channel types: island-braided, meandering, and confined. Examples of these in the Upper Cowlitz Cispus basin are given in Figure 10.

The Muddy Fork and Packwood LUs are predicted to be island-braided channel types (Beechie and Imaki, 2014), it is possible that from time-to-time these areas would also naturally exhibit a braided channel form. This would occur due to the slightly steeper gradient than the downstream reaches and also in response to periodic large sediment inputs from the Muddy Fork, which originates from the southeast slopes of Mount Rainier. Currently, the Muddy Fork LU appears to be in a transition from braided to island-braided as it continues to adjust and stabilize in response to the 2006 Muddy Fork avulsion (see discussion in Section 4.1.4.2). Figure 10A shows an example of a braided segment of the upper Cowlitz in the Muddy Fork LU. The presence of braided channel conditions where the predicted “natural” channel type is island-braided may also be due to loss of older-aged riparian forests and channel confinement and simplification from past land uses. A loss of forested islands and an increase in channel width was documented for various sample reaches in a recent geomorphic study of the upper Cowlitz conducted for Tacoma Power (Natural Systems Design 2019). The study measured conditions from aerial photos and maps dating to the early 1900s.

Island-braided channel types dominate the other valley-bottom LUs, and often are predicted in areas where the Habitat Strategy has identified potential habitat restoration potential. An example of island-braided channel form is shown in Figure 10.

Island braided channel type is predicted for the upstream portion of the Randle LU, with meandering channel type in the downstream portion (Beechie and Imaki, 2014); however, field observations suggest that the entire LU is better characterized as meandering (Figure 10C). This broad, low-gradient valley is underlain by fluvially deposited sediments of glacial origin. The broad and flat topography was likely formed, in part, by the latest Evans glaciation, with a terminal moraine located downstream of Randle as described previously in Section 4.1.2. The mainstem Cowlitz river exhibits a highly sinuous planform through this LU, and there are abundant channel scars in the floodplain that give evidence to the tortuous meandering and regular cut-off channels creating abandoned oxbows that are common in meandering reaches. Field observations and LiDAR topographic data suggests that the channel in the Randle LU has likely incised several feet from pre-Euro-American settlement conditions. This is evidenced by current channel bottom elevations that are several feet lower than those in abandoned oxbow channels.

The confined channels are found primarily in the Cispus basin; both in the Upper Cispus LU and the Lower Cispus LU (Figure 10D). Each of these contain short sections of island-braided channels, which correspond to areas of good habitat restoration potential described in this strategy.

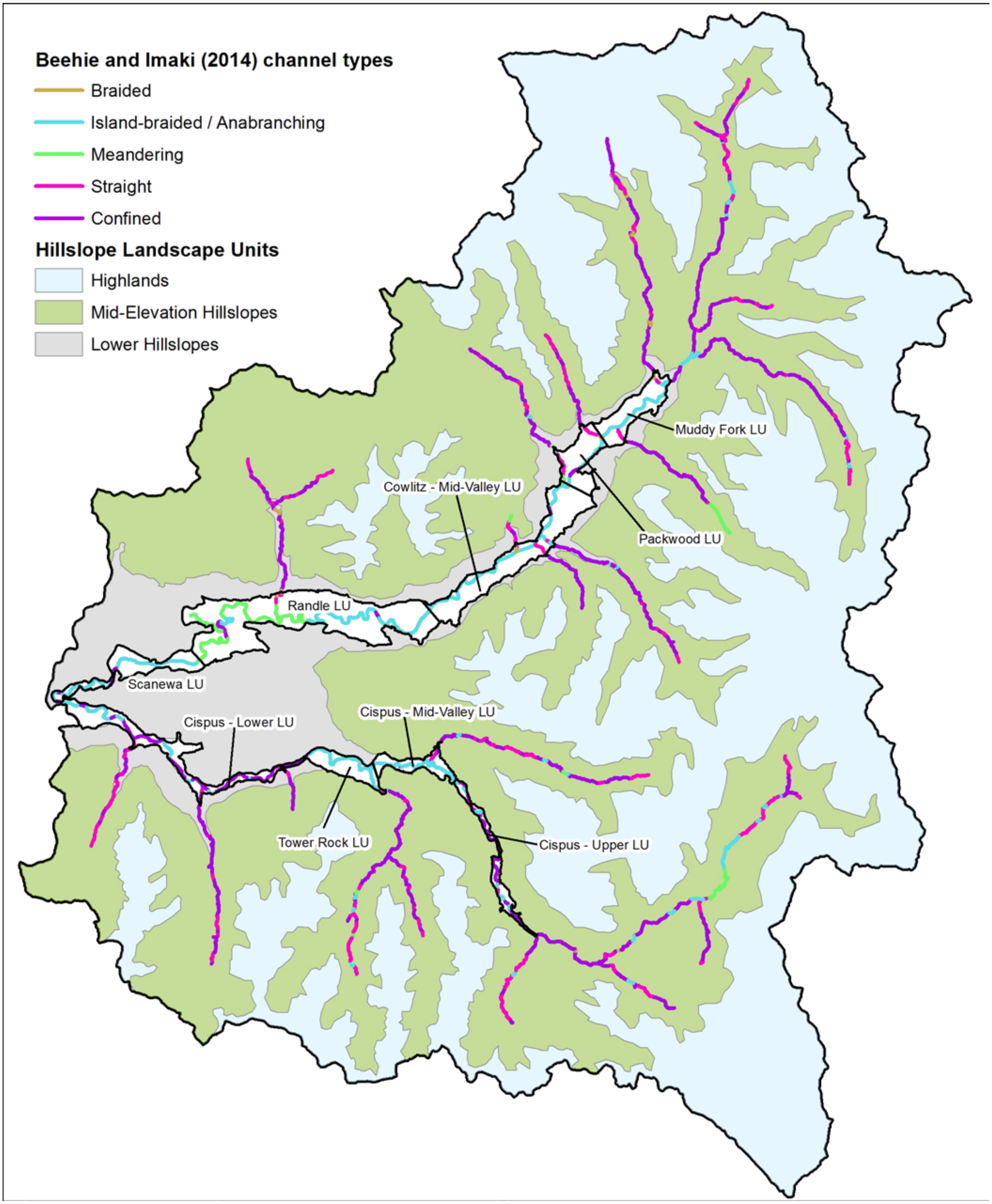


Figure 9. Predicted channel types based on modeling described in Beechie and Imaki (2014).

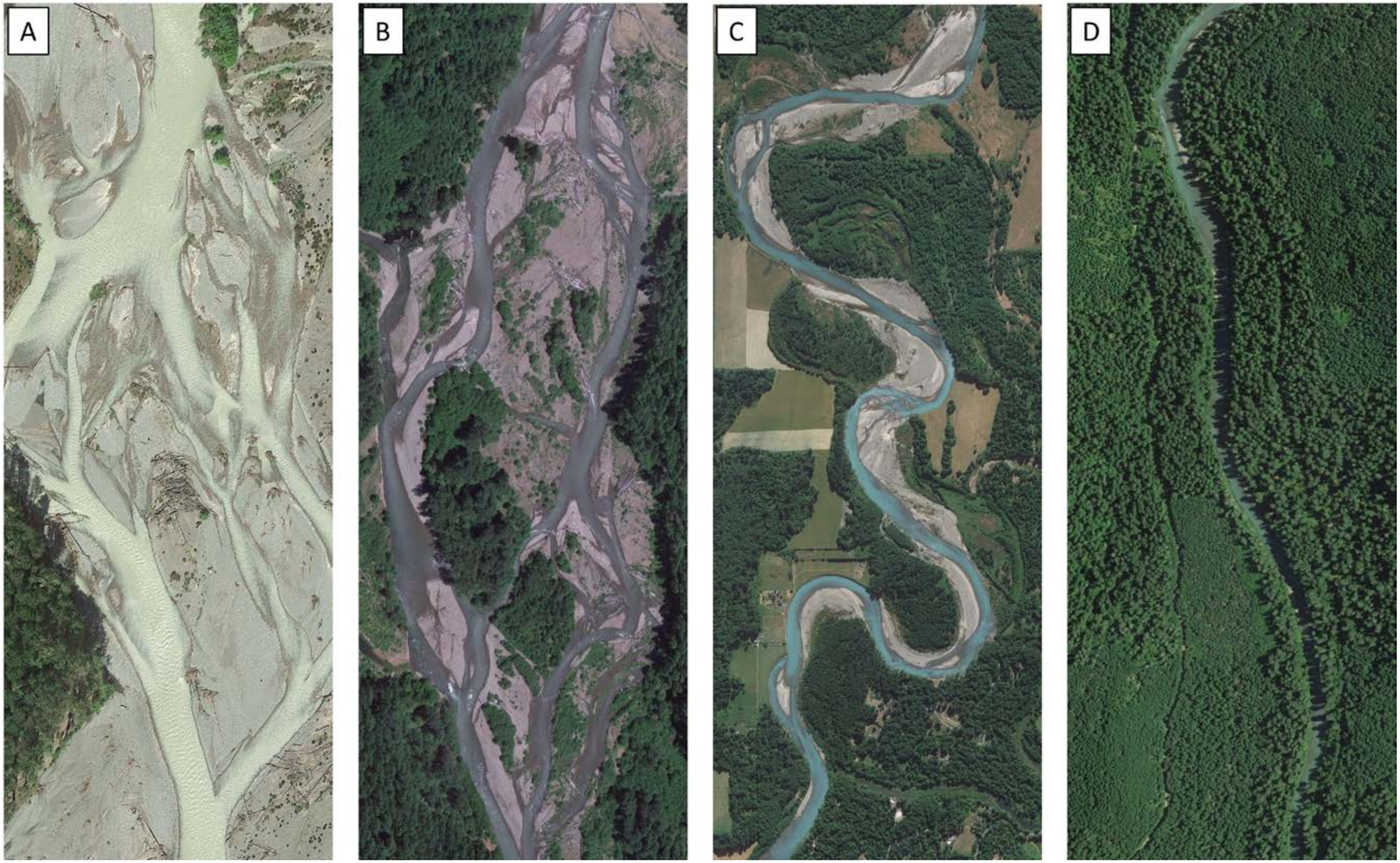


Figure 10. Examples of channel types on the mainstem upper Cowlitz and Cispus Rivers: A) braided channel segment on the mainstem Cowlitz in the Muddy Fork LU; B) Island-braided / anastomosing channel on the Cispus River in the Cispus Mid-Valley LU; C) Meandering channel type on the mainstem Cowlitz in the Randle LU; and D) Confined channel type on the mainstem Cispus in the Cispus Lower LU. Google Earth photos.

4.1.4.2 *Muddy Fork Flooding and Sediment Transport Dynamics*

Flooding and sediment transport events originating from the Muddy Fork Cowlitz River have had a strong influence on channel geomorphology in the upper mainstem Cowlitz River. These processes primarily affect the Muddy Fork and Packwood LUs. The highly dynamic nature of these processes affects the fish use and aquatic habitat restoration potential of these LUs. These processes are discussed in greater detail for these LUs in Section 5.2 and Appendix D.

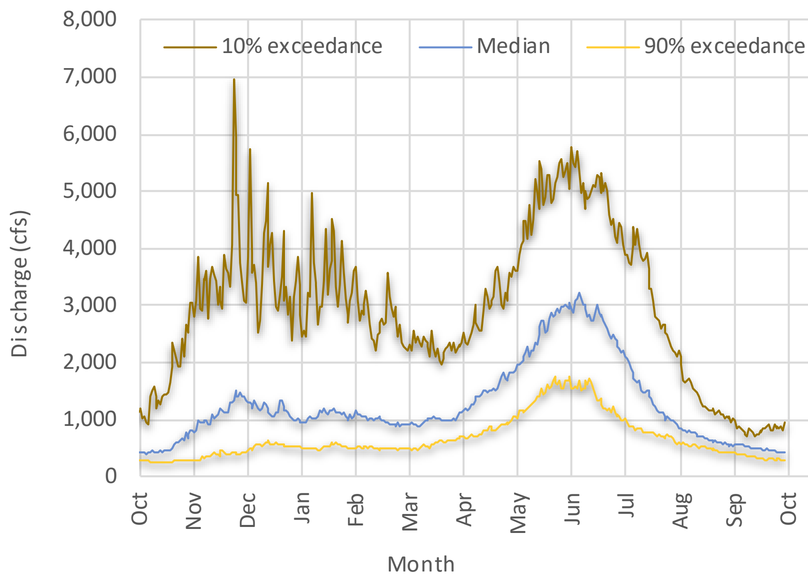
The Muddy Fork originates on the southern glaciated slopes of Mount Rainier and regularly carries large volumes of meltwater and sediment down through an upper canyon before emptying out at a broad alluvial fan as it enters the Clear Fork of the Cowlitz River upstream of Packwood. One of the largest recent events was the November 2006 flood (42,100 cfs on the USGS Packwood Gage #14226500). During this event, large quantities of sediment and debris flow material were transported through the canyon and deposited in the lower Muddy Fork channel at the alluvial fan, causing an avulsion (an abrupt shift in channel position). Up to 8 feet of deposited alluvium was measured (GeoEngineers 2007). The lower half-mile of the Muddy Fork shifted from its former southeast flow path into a longer (approximately 0.9 mi) south-southwest path, entering the mainstem near the Timberline community near RM 131 (Figure 11). The river incised approximately 8 feet along the new channel path (GeoEngineers 2007). The subsequent deposition of sediment downstream caused lateral channel erosion, damaging homes and property.

There have been fairly extensive geomorphic investigations related to the 2006 avulsion and subsequent channel dynamics in the river (NRCS 2009, GeoEngineers 2007, GeoEngineers 2009). These focus primarily on the area between the 2006 avulsion site (near the confluence of the Muddy and Clear Forks) and the highly affected neighborhoods located nearby or just downstream, including the Timberline and High Valley neighborhoods. Some of this analysis has also extended downstream to Lake Scanewa, but with less detail. These studies have described channel dynamics that occur as a result of flooding and associated sediment transport processes, and the related risks to property and infrastructure. There has also been a Channel Migration Zone (CMZ) delineation and analysis, first completed in 2003 (GeoEngineers 2003) and then updated in 2009 (GeoEngineers 2009) due to changes that resulted from the 2006 avulsion. The CMZ analysis resulted in the delineation of severe, moderate, and low hazard CMZs along the mainstem Cowlitz from the Muddy Fork to Lake Scanewa. These hazard zones were used in this Habitat Strategy to help identify and describe restoration and protection actions.

Figure 11. Muddy Fork avulsion (November 2006) area. 2017 Google Earth image.

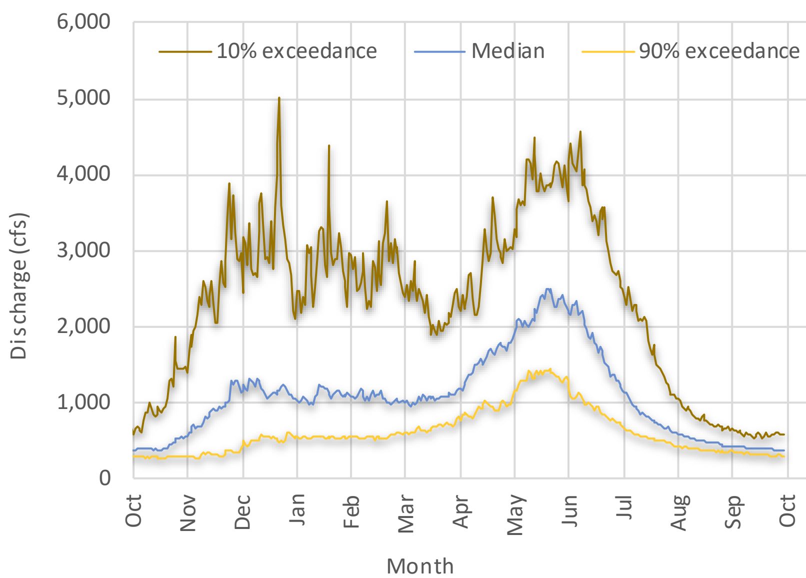
4.1.5 Hydrology

The drainage area of the study basin is 1,026 square miles. Sixty percent of the basin is within the rain-on-snow zone, including the WDNR snow-dominated zone, peak rain-on-snow zone, and the rain-dominated zone (WDNR 2018). Both the mainstem upper Cowlitz and Cispus rivers experience a two-phase runoff regime, with winter peaks from rain and rain-on-snow events and a spring snowmelt peak. The winter peaks tend to be storm-related, with rapid flow spikes and recession, whereas the snowmelt runoff is much steadier and less variable. The winter events occur November through mid-March and the snowmelt peaks typically occur in May or June (Figure 12 and Figure 13). In most years, snowmelt results in the greatest seasonal streamflow; however, 85% of the annual peaks from the Packwood Gage (1912-2019) occurred during the fall or winter, many of the larger ones likely resulting from rain-on-snow events.



Recurrence Interval (Years)	Discharge (cfs)
2	14,200
5	21,400
10	26,400
25	33,000
50	38,100
100	43,400
200	48,800
500	56,300

Figure 12. Left: daily flow exceedance plot for USGS Gage #14226500, Cowlitz River at Packwood, WA, 1930-2019. Right: Flood recurrence intervals from Mastin (2016).



Recurrence Interval (Years)	Discharge (cfs)
2	8,300
5	12,700
10	15,900
25	20,200
50	23,600
100	27,100
200	30,800
500	36,000

Figure 13. Left: daily flow exceedance plot for USGS Gage #14232500, Cispus River near Randle, WA, 1911-1996. Right: Flood recurrence intervals from Mastin (2016).

4.2 Land Use & Ownership

Current land ownership types, land uses, and road densities were determined with available Lewis County parcel and WDNR roads GIS data (see Appendix A). This information is used to infer potential watershed process impacts at LU-scales and to discuss feasibility of restoration and protection habitat actions. These data are discussed for individual LUs below, and summarized here in Table 7-Table 8.

Table 7. Road density and land ownership by landscape unit. Water or unclassified areas were assumed to be Public.

	Landscape Unit	Road Density (mi/mi^2)	Private (%)	Public (%)
Hillslopes	Highlands	0.8	0.1	99.9
	Mid-Elevation Hillslopes	2.6	6.3	93.7
	Lower Hillslopes	5.1	48.4	51.6
Upper Cowlitz	Upper Cowlitz - Muddy Fork	6.6	46.3	53.7
	Upper Cowlitz - Packwood	7.2	67.3	32.7
	Upper Cowlitz - Mid-Valley	3.9	76.6	23.4
	Upper Cowlitz - Randle	4.8	86.4	13.6
	Upper Cowlitz - Scanewa	3.0	86.9	13.2
Cispus	Cispus - Upper	5.6	0.0	100
	Cispus - Mid-Valley	6.4	0.0	100
	Cispus - Tower Rock	7.3	43.0	57.1
	Cispus - Lower	7.4	64.1	35.9

Table 8. Land use designation (%) by landscape unit. Category abbreviations: M/F = Mining/Forestry, Ag = Agriculture, SR = Single Residential, U/V= Undeveloped/Vacant, W = Water, P/Q-P = Public/Quasi-Public, C/R= Commercial Retail, M-R = Multi-Residential, T/U = Trans/Utility, C/I = Commercial Industrial, Unk = Unknown.

	Landscape Unit	M/F	Ag	SR	U/V	W	P/Q-P	CR	M-R	T/U	CI	Unk
Hillslopes	Highlands	7.3			53.4							**39.3**
	Mid-Elevation Hillslopes	33.2			39.9		0.1					**26.7**
	Lower Hillslopes	69.6	0.5	4.8	22.7		0.9					**1.3**
Upper Cowlitz	Upper Cowlitz - Muddy Fork	31.6		23.5	24.2	13.9	1.1	0.3	0.2	0.1		**5.1**
	Upper Cowlitz - Packwood	31.1	1.8	28.6	14.9	8.2	4.2	1.0	0.9	1.5		**7.8**
	Upper Cowlitz - Mid-Valley	35.0	8.0	24.5	12.6	6.4	1.0	0.5	0.4	1.1	0.6	**10.0**
	Upper Cowlitz - Randle	12.6	36.9	17.0	20.7	4.6	1.5	0.1	0.3	0.2	0.1	**6.0**
	Upper Cowlitz - Scanewa	40.0	12.6	1.2	32.9	12.5	0.3					**0.7**
Cispus	Cispus - Upper	36.9			10.0							**53.2**
	Cispus - Mid-Valley	99.9										**0.1**
	Cispus - Tower Rock	68.2		17.5	2.8		3.5					**7.9**
	Cispus - Lower	89.2			5.1	5.6						**0.1**
	Valley Bottom - Overall Average	***15.6***	***0.1***	***0.2***	***37.9***	***0.3***	***1.3***	***14.8***	***0.3***	***16.1***	***2.3***	***11.1***

4.3 Hillslope & Forest Conditions

Forest management activities and conservation are dominant in the upper sections of the basin. While the focus of the Habitat Strategy is on target fish populations and habitat within the valley bottoms, the upper watersheds drive key processes that impact habitat. The following information on the upper watershed areas summarizes the key management guidance and watershed trajectories. This information is used to infer LU ecological indicator ratings (Section 5).

Federal Forest Lands

A recent Status and Trends evaluation of Watershed Conditions covered the first 20 years of the Aquatic and Riparian Effectiveness Monitoring Program (AREMP), 1994 - 2013, which monitors and scores the effectiveness of forest management within lands covered by the Northwest Forest Plan (NWFP) region (Miller et al., 2017). For the purposes of this analysis, the Upper Cowlitz Cispus basin is included within the West Cascades Aquatic Province (WCAP). This assessment indicated that, across the WCAP as well as specifically within the Upper Cowlitz Cispus watersheds, overall upslope conditions are generally at or above the regional average and have remained static or have marginally increased since 1993. Most of this positive change was attributed to areas that were heavily managed (i.e., harvest and roaded areas) prior to adoption of the NWFP (Miller et al. 2017).

Within the WCAP, scores were relatively high and remained essentially unchanged over the 20 years of monitoring across most of the process indicators that inform upslope conditions. Sediment scores within the WCAP were generally high, with most areas within the WCAP scoring at the maximum (100). Wood scores were moderate, with slight positive trends over time. Riparian scores were low to moderate, with very slight positive trends. Hydrology scores for the WCAP, although relatively high compared to other process indicators, were among the lowest in the region, with a moderate positive trend. Fish Passage scores within the WCAP were among the lowest in the region and unchanged.

Federal forests in the region are managed according to the Land Use Allocations in the NWFP (https://www.fs.fed.us/r6/reo/landuse). These include the following allocations:

- **Congressionally Reserved Areas (CR)** - Lands reserved by the U.S. Congress such as wilderness areas, wild and scenic rivers, and national parks and monuments.
- **Late-Successional Reserves (LSR)** - Lands reserved for the protection and restoration of LSOG forest ecosystems and habitat for associated species; including marbled murrelet reserves (LSR3) and northern spotted owl activity core reserves (LSR4).
- **Managed Late-Successional Areas (MLSR)-** Areas for the restoration and maintenance of optimum levels of LSOG stands on a landscape scale, where regular and frequent wildfires occur. Silvicultural and fire hazard reduction treatments are allowed to help prevent older forest losses from large wildfires or disease and insect epidemics.
- **Administrative Withdrawn Areas (AW)** - Areas identified in local forest and district plans; they include recreation and visual areas, back country, and other areas where management emphasis does not include scheduled timber harvest.

- **Adaptive Management Areas–reserved (AMR)** - Identified to develop and test innovative management to integrate and achieve ecological, economic, and other social and community objectives. Emphasis on restoration of late-successional forests and managed as an LSR.
- **Adaptive Management Areas–nonreserved (AMA)** - Identified to develop and test innovative management to integrate and achieve ecological, economic, and other social and community objectives. Some commercial timber harvest was expected to occur in these areas, but with ecological objectives.
- **Riparian Reserves (RR)-** Protective buffers along streams, lakes, and wetlands designed to enhance habitat for riparian-dependent organisms, provide good water-quality dispersal corridors for terrestrial species, and provide connectivity within watersheds.
- **Matrix** - Federal lands outside of reserved allocations where most timber harvest and silvicultural activities were expected to occur.

In general, these allocations are typically grouped into fewer categories regarding the amount of timber harvest that occurs within them, with CR/AW/RR having little-to-no timber harvest; LSR/MLSR/AMR having limited harvest; and Matrix/AMA having the greatest amount of harvest. In the Upper Cowlitz Cispus basin, there is some non-production harvest that might occur in the AW areas; for example, some harvest occurs in these allocations in the upper Cispus River basin to support huckleberry habitat (Ken Wieman, USFS, personal communication 2019). In the LSR, harvest is allowed in stands less than 80 years old to support old growth forest development unless it is determined there is risk of large-scale disturbances (USFS 1995). Right now, harvest in the form of thinning is an ongoing management activity in the Upper Cowlitz Cispus basin for LSR allocations, as these forest stands are still relatively young from historical harvest and fires (Ken Wieman, USFS, personal communication 2019).

Regarding scoring breakdown by land use allocation, Congressional Reserve (CR) areas scored high regarding status, but appear to be trending slightly downward, while Matrix areas appeared to be trending upward the strongest. This apparent effect is likely the product of an elevated status within the CR zones and more degraded status within Matrix zones at the outset of monitoring efforts (Miller et al., 2017).

In general, AREMP model output supports continued protection of riparian buffers, to reduce the loss of riparian vegetation and road density, with the net effect of improving sediment processes and fish passage (Miller et al., 2017). Positive habitat changes in NW Forest Service land harvest management are also supported by the positive process indicator score trend observed in Matrix zones.

4.3.1 State & Private Forest Lands

The WA Forest Practice Act was passed in 1974 (RCW 76.09), establishing the Washington Department of Natural Resources (DNR) as the agency responsible for administering the statute, implementing Forest Practice Rules (TITLE 222 WAC), as well as adaptive management. The listing of salmon, steelhead, and bull trout under the federal Endangered Species Act (ESA) beginning in the late 1990s led to the development of the Washington State Forest Practice Habitat Conservation Plan (HCP), in 2006. Annual reporting for the HCP indicates that, between 2001 and mid-2018, over 28,000 miles of forest roads have been improved and that over 7,000 fish passage barriers have been corrected, providing access to over 4,000 miles of additional fish habitat across the state (Forest Practices HCP Annual Report, 2018). Road maintenance and Abandonment Plan (RMAP) projects were originally planned to be completed across the state by 2016, but extensions were provided for some participants in the RMAP program through 2021.

Forest Practices effects on riparian and aquatic habitats, as well as status and trends of riparian habitat, are monitored throughout the state as part of the HCP reporting requirements. A pilot study for western Washington riparian status and trends monitoring is ongoing, as is an evaluation of effects of riparian harvest prescriptions on stand condition and habitat trajectory for fish-bearing streams. Both of these reports are currently in review (Forest Practices HCP Annual Report, 2018). A study on watershed-scale effects of RMAP implementation is in progress (Dubé et al., 2010), and a study on the effectiveness of riparian harvest prescriptions on stand condition and habitat trajectory for perennial non fish-bearing streams is already completed (Schuett-Hames et al., 2012).

Forest Practice rule changes in 2001 were developed to reduce road-related landslides, erosion, and fish passage barriers. RMAP implementation of these rules is expected to reduce sediment runoff into streams and improve hydrologic functions and connectivity across watersheds. Initial results of RMAP implementation indicate these improved watershed functions are occurring: a significant negative relationship between the number of forest roads meeting Forest Practice standards and sediment delivery were found (Dubé et al., 2010). The same study found that 11% of forest roads across the state still deliver sediment to streams and wetlands, 62% of monitored roads meet hydrology improvement targets, and 88% meet sediment improvement targets.

Preliminary results on harvest management changes indicate differences in riparian condition as well as stream shading and wood and sediment delivery in perennial, non-fish bearing streams. Over five years post-harvest, researchers monitored riparian plant composition, tree regeneration and mortality, large wood recruitment, stream channel woody material loading, stream shade, and soil disturbance in clear cut, harvest-buffered, and non-harvested riparian stands of perennial non-fish bearing drainages (Schuett-Hames et al., 2012). Clear cut stands were found to exhibit the greatest direct effects of harvest on riparian and stream habitat, with large decreases in canopy coverage, high small debris (slash) stream inputs, and harvest equipment soil disturbance immediately post-harvest. Minimal opportunities for large wood recruitment are expected in clear cut stands because of the short (40 – 60 year) harvest cycles, and small stream debris inputs were also minimal by year five of the study. Compared to clear cut stands, buffered riparian stands had much lower soil and small debris run-off impacts to streams. While stream shade was lower than in reference, unharvested stands, buffered stands were still found to support 61 – 80% stream cover five years post-harvest. These buffered stands also supplied large wood to streams, with inputs concentrated in the first three years post-harvest. Harvest-buffered stands were found to have greater tree mortality rates and more episodic large wood recruitment cycles than reference stands. These are primarily related to greater exposure of harvest-buffered stands than non-harvested stands, which led to increased mortality, tree fall rates, soil run-off, stream shade and wood recruitment in buffered stands during moderate wind events (Schuett-Hames et al., 2012).

Habitat trajectories are likely poor for clear cut areas outside of small, low gradient streams where slash can provide habitat immediately after harvest. Harvest-buffered stands likely provide some habitat benefits in the long-term, with initial large wood recruitment pulses post-harvest, but habitat outcomes are dependent on frequency of moderate wind disturbance events. Sediment delivery and hydrologic connectivity are also likely improving as RMAP implementation nears completion.

4.3.2 National Watershed Condition Assessment

Within the last decade, the USFS NRM conducted a National Watershed Condition Assessment. One product of this effort was the Watershed Classification and Assessment Tracking Tool (WCATT) (Potyondy & Greier, 2011). The WCATT provides a high-level assessment of physical and biological processes associated with aquatic and terrestrial habitats, based on 12 indicator metrics. Watersheds are scored by WCATT according to their function in relation to five characteristics associated with properly functioning systems: biotic integrity, resilience to disturbance, connectivity (lateral, vertical, longitudinal), ecosystem services provided, and maintenance of soil productivity. WCATT scores indicate that the most impaired regions in the subbasin tend to be located primarily within the lower valley, and that processes in the Cispus drainage appear to be more impaired than in the Upper Cowlitz drainage. North-Central uplands appear moderately impaired, but there is also evidence of substantial restoration activity that has already been completed within this zone, which may be addressing or already have addressed these impairments.

4.4 Salmon & Steelhead Populations

4.4.1 Fish Distribution & Life History Timing

The Upper Cowlitz Cispus basin has historically supported winter steelhead, fall Chinook salmon, spring Chinook salmon, and coho salmon (LCFRB 2010). Salmon and steelhead life history timing and use periods are presented in Figure 14. Species distribution is depicted in Figure 15.

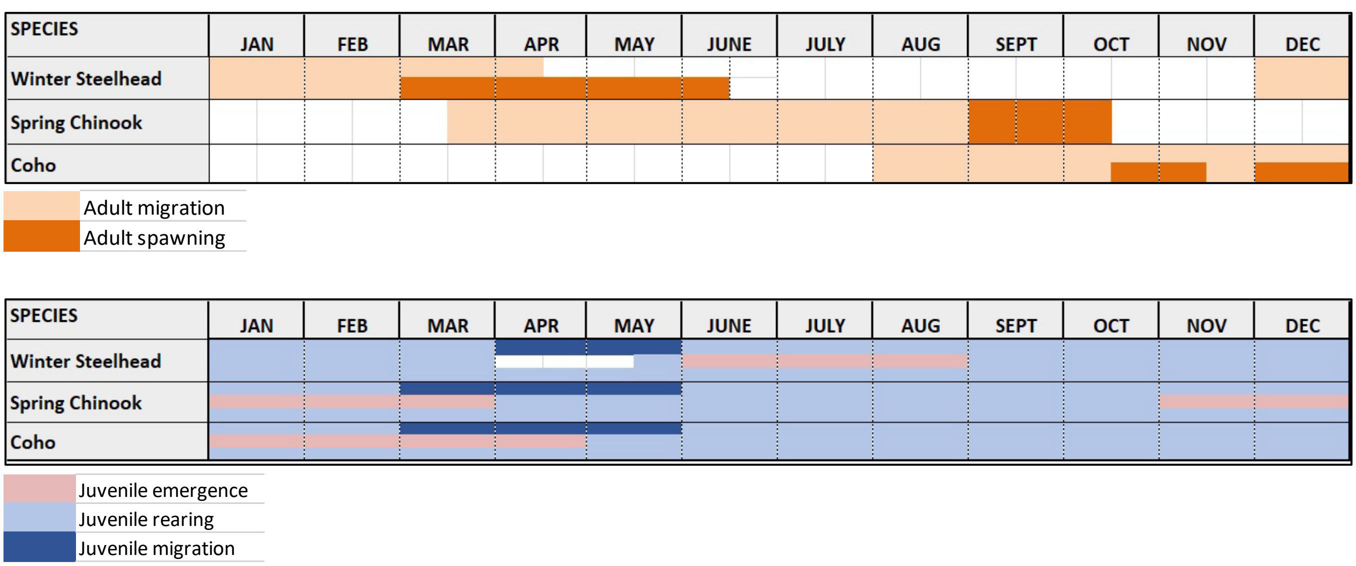


Figure 14. Life history timing summary (data adapted from LCFRB 2010). Although fall Chinook are not currently transported into the Upper Cowlitz Cispus basin, they have been transported there during various times in the past, and are likely to be in the future, and their life history timing is included here for reference.

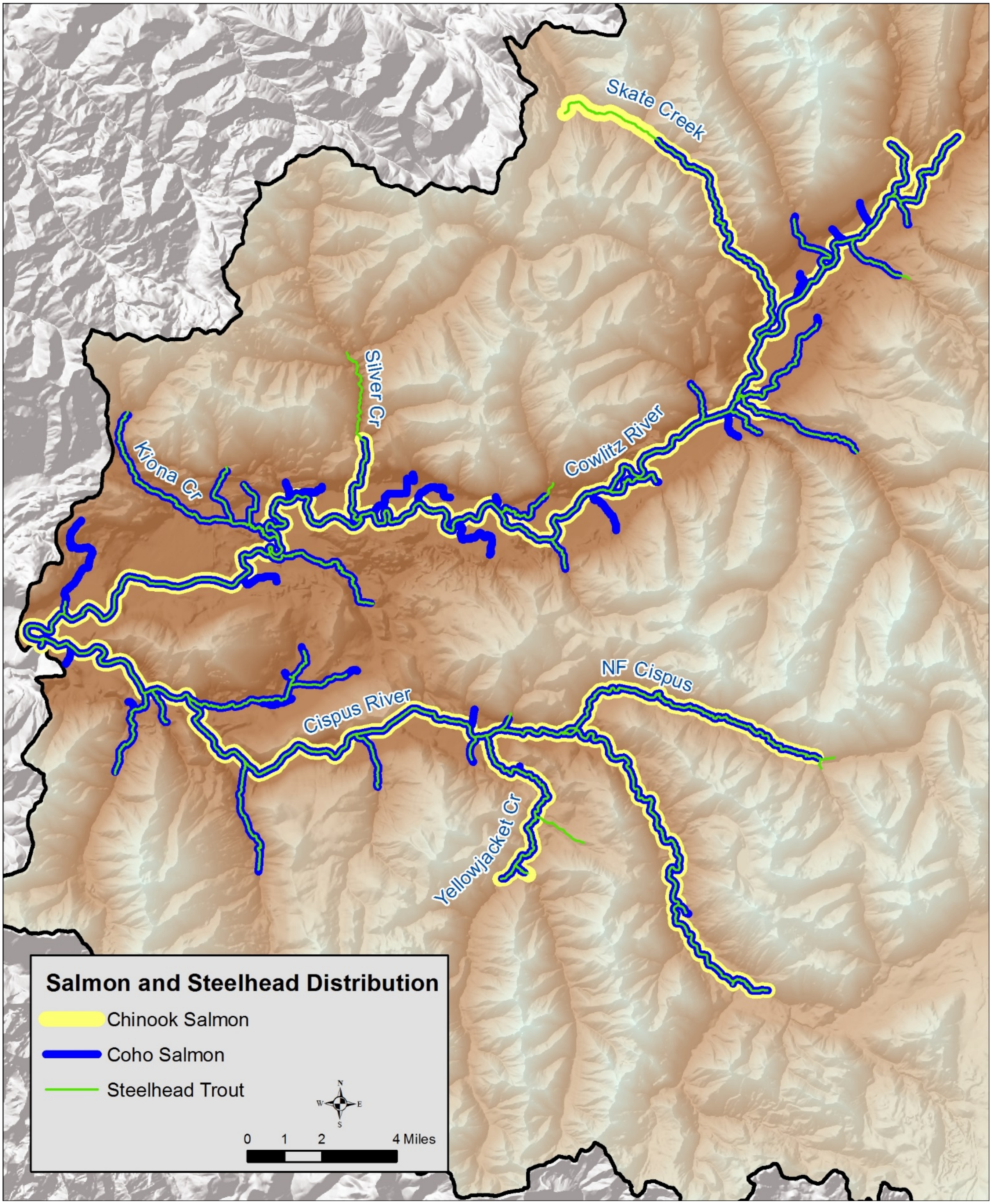


Figure 15. Salmon and steelhead distribution in the Upper Cowlitz and Cispus. Data is from the Statewide Washington Integrated Fish Distribution (SWIFD) database for anadromous salmonid fish species.

4.4.2 Fish Management & Hydrosystem History

4.4.2.1 *Upper basin populations and population management*

The Recovery Plan (LCFRB 2010) identifies ESA-listed populations of spring Chinook, fall Chinook, winter steelhead, and coho originating from the Upper Cowlitz basin. As a part of the recovery strategy, reintroduction of these populations is underway with the goal of increasing abundance in the Upper Cowlitz basin during the early phases of the program to support overall viability needs of these populations. Reintroduction of fall Chinook Salmon is currently limited to the Tilton River subbasin. This is to prevent interference with the recovery of spring Chinook Salmon in the Upper Cowlitz Basin.

The population designations in the Recovery Plan (LCFRB 2010) reflect historically-distinct populations with basin and subbasin associations that vary by species. This is based on descriptions of historically separate populations of spring Chinook, coho, and steelhead in the Upper Cowlitz and Cispus Rivers (Myers et al. 2006). However, because of past management practices (e.g., hatchery operations, no mass-marking of fish until 1995, and only sporadic fish transport into the Upper Basin over the last 20 years), all fish currently transported above Cowlitz Falls are assumed to be aggregated populations originating from both above and below the hydropower facilities.

Current management is for a single Upper Cowlitz subbasin population of spring Chinook, coho, and winter steelhead, comprised of the Cispus River and the Upper Cowlitz River and their tributaries above Lake Scanewa. Smolts are collected from these watersheds at the Cowlitz Falls Fish Facility, and marked only as Upper Cowlitz basin fish because no existing infrastructure is in place that would allow managers to capture and associate them with just the Upper Cowlitz or Cispus watershed. Subsequently, when mature salmon return, managers can only identify them as having originated in the Upper Cowlitz basin. Upper Cowlitz basin fish are transported into either the Upper Cowlitz or Cispus river, or into Lake Scanewa, from which they can select their preferred watershed. In the future, facilities or genetic tools may become available for segregating fish from these two watersheds. Until then, managers combine the recovery abundance goals and other viability metrics for these two populations into a single goal for the Upper Cowlitz basin.

While the Habitat Strategy follows the Recovery Plan population framework, it is necessary to recognize the context of the upper basin populations being in the early phases of reintroduction, as well as current management limitations on separating Upper Cowlitz and Cispus watershed fish. Tacoma Power's Fish and Hatchery Management Plan (Tacoma Power *in prep*) is a source of more information, and can be found on the Cowlitz Fisheries Technical Committee website (mytpu.org/cowlitzftc).

4.4.2.2 *Hydrosystem history*

There are three major hydropower facilities on the Cowlitz River. At the upper end of the basin is the Cowlitz Falls Dam (RM 88), owned and operated by Lewis County Public Utility District (PUD). It was completed in 1994, forming Lake Scanewa. Downstream from Cowlitz Falls, Tacoma Power's Cowlitz River Hydroelectic Project is comprised of two dams. The Mossyrock Dam (RM 65), completed in 1968, impounds the Cowlitz River below Cowlitz Falls Dam forming Riffe Lake. The Mayfield Dam (RM 52), completed in 1963, impounds the lower reaches of the Tilton River as well as the Cowlitz River below Mossyrock Dam to form Mayfield Lake. Mayfield Dam is operated to regulate inflows and outflows while Mossyrock Dam is operated for seasonal storage of water in Riffe Lake and to provide flood relief downstream.

Tacoma Power has developed fish hatcheries as well as fish collection and transport programs as part of the hydropower facilities on the Cowlitz River. Tacoma Power's Hatchery Complex includes the Cowlitz Salmon Hatchery and Cowlitz Trout Hatchery, both of which are located downstream of Mayfield Dam. The hatcheries were constructed by Tacoma Power and began operation in 1967 and 1968, respectively, after the Mossyrock Dam was completed. These hatcheries currently include three integrated hatchery programs contributing to the recovery of fish populations upstream of Cowlitz Falls: Upper Cowlitz subbasin spring Chinook, Upper Cowlitz subbasin coho, and Upper Cowlitz subbasin winter steelhead. The current hatchery program for Upper Cowlitz subbasin fall Chinook contributes to fish populations in the Tilton River, but could eventually support fall Chinook recovery upstream of Cowlitz Falls.

The Cowlitz River Hydroelectric project blocked fish passage for anadromous salmonids at Mayfield Dam in 1963. During the 1960s, fish were passed over the dam (first by mechanical transfer, then by volitional passage by way of a fish ladder, elevator, and adult passage flume) where they had access to the upper basin until the completion of Mossyrock Dam in 1968. Also in 1968, the Barrier Dam adjacent to the Cowlitz Salmon Hatchery began facilitating adult fish collection for trap-and-haul operations at RM 49; at which time the fish passage facilities at Mayfield Dam were abandoned. By the early 1970s, the adult trap-and-haul program was focused on the Tilton basin with downstream juvenile fish collection at the Mayfield Dam and only sporadic adult fish transport upstream of Mossyrock Dam to support recreational fisheries. There were two years in the early 1980s when coho were not transported anywhere upstream of Mayfield Dam (Stober 1986). There were also a number of years where Chinook were not transported upstream (Stober 1986).

After completion of the Cowlitz Falls project in 1994, the trap-and-haul program was restored to transport adult salmonids to Upper Cowlitz and Cispus rivers and to collect juvenile outmigrants at the Cowlitz Falls Fish Facility (completed in 1996). Juvenile hatchery fish were transported and released into the upper basin at this time as well, and artificial redds using hatchery produced eggs were created in an attempt to boost initial upper basin juvenile production. A new juvenile outmigrant collection facility, the Cowlitz Falls North Shore Collector, was completed in 2017 to improve downstream fish collection. Today, all adult salmonids hauled to the upper Cowlitz Basin are stopped at the Barrier Dam and diverted into the Cowlitz Sorting Facility, where they are sorted for disposition. All juvenile salmonids hauled downstream from the upper Cowlitz Basin are collected at Cowlitz Falls, hauled downstream to Cowlitz Salmon Hatchery for acclimation, and then volitionally released into the lower Cowlitz River below Barrier Dam.

Juvenile collection efficiencies at Cowlitz Falls are lower than desired for all species since the first facility was completed in 1996. This is particularly true for Chinook: juvenile Chinook salmon collection efficiencies were typically very poor (<10%) prior to installation of the Cowlitz Falls North Shore Collector, although collection efficiencies improved substantially (>70%) after the Cowlitz Falls North Shore Collector was installed and commissioned. Additional efforts are underway to continue improvements for all species, while concurrently working to determine if collection efficiency remains a limiting factor for recovery of those populations.

4.4.3 Focal Species Life History

This section includes life history information and general habitat requirements for the focal species in the Upper Cowlitz Cispus watersheds. This information is relevant for identifying habitat limitations and enhancement approaches in the basin to improve habitat and population viability.

4.4.3.1 *Coho salmon*

Coho parr observed in a Chehalis River side channel.

Coho in the Upper Cowlitz Cispus basin are separated into two different stocks, an early run and a late run. Early run fish enter the Columbia River from mid-August through September, and spawn in the basin in late October. Late run fish enter the Columbia River from late September through October, and spawn in December (LCFRB 2010). Juvenile coho are present in freshwater year-round, and therefore rear during both summer low flow and winter high flow conditions are important. Juvenile coho are poor swimmers relative to other salmonids, and respond to increased water velocities during high flow periods by moving to the nearest available low-velocity habitat (Beecher et al. 2016, McMahon and Hartman 1989). Coho heavily utilize slow water floodplain habitats such as beaver ponds and off-channel alcoves during winter high flows (MacMahon and Hartman 1989, Swales and Levings 1989, Bustard and Narver 1975, and Bryant 1984). Coho in the Upper Cowlitz Cispus basin typically emigrate from the river as yearling smolts in the spring (LCFRB 2010).

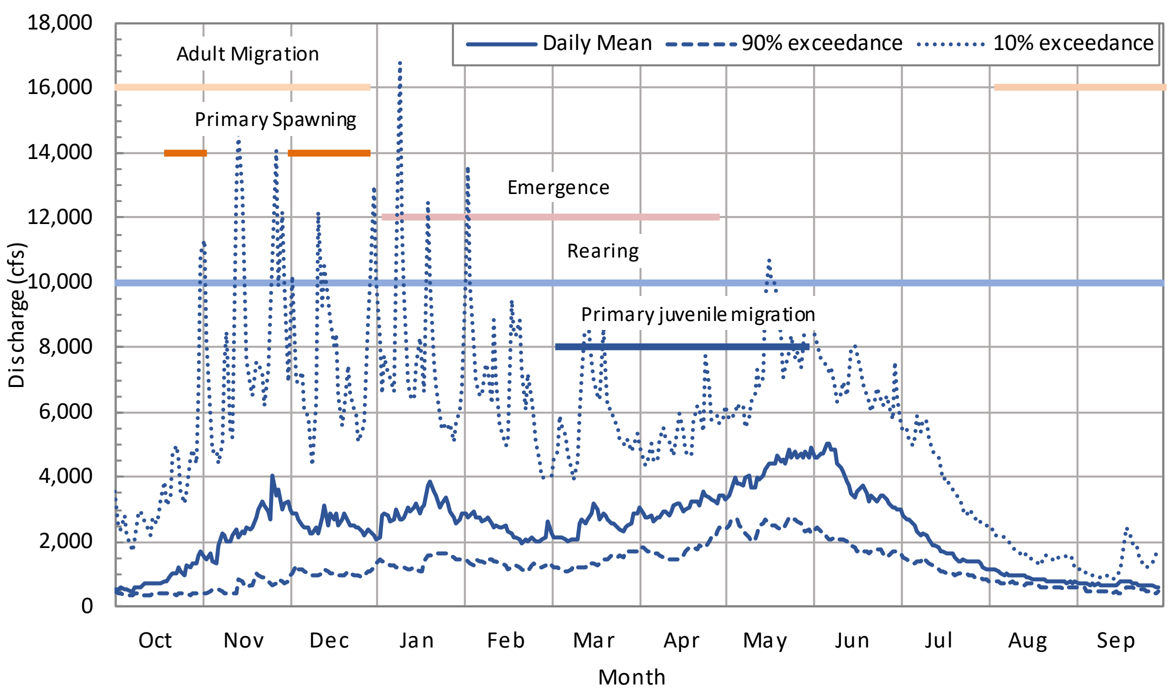
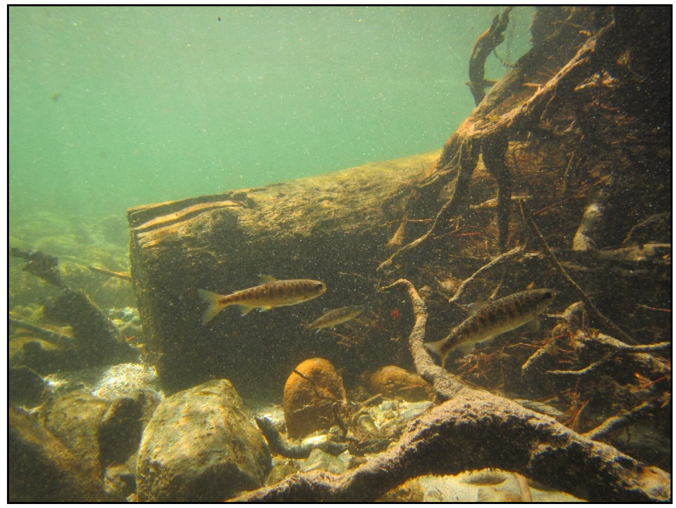


Figure 16. Coho life history timing and hydrology for the Upper Cowlitz Cispus basin. Life history timing based on the 2010 Subbasin Plan, and discharge based on the USGS gage at Randle from 1994-2018 (#14231000).

4.4.3.2 *Spring Chinook*



Yearling Chinook Salmon resting behind a constructed log jam in the upper Columbia.

Spring Chinook enter the Cowlitz River from February through June, with spawning occurring between late August and October. Incubating eggs are very sensitive to changes in oxygen levels and percolation, both of which are affected by sediment deposition and siltation in the redd (Quinn 2005). Juvenile Chinook emerge from the gravel from November through March, and post emergent fry seek out backwater or margin areas with lower velocities, dense cover, and abundant food (Quinn 2005). As they increase in size, juveniles begin to select for deeper and faster moving water, particularly areas with overhanging cover (Moyle et al. 2002). These areas provide more holding and feeding habitat area for the larger juveniles to occupy. Juvenile Chinook rear in freshwater for 1 year prior to out-migrating the following spring (LCFRB 2010).

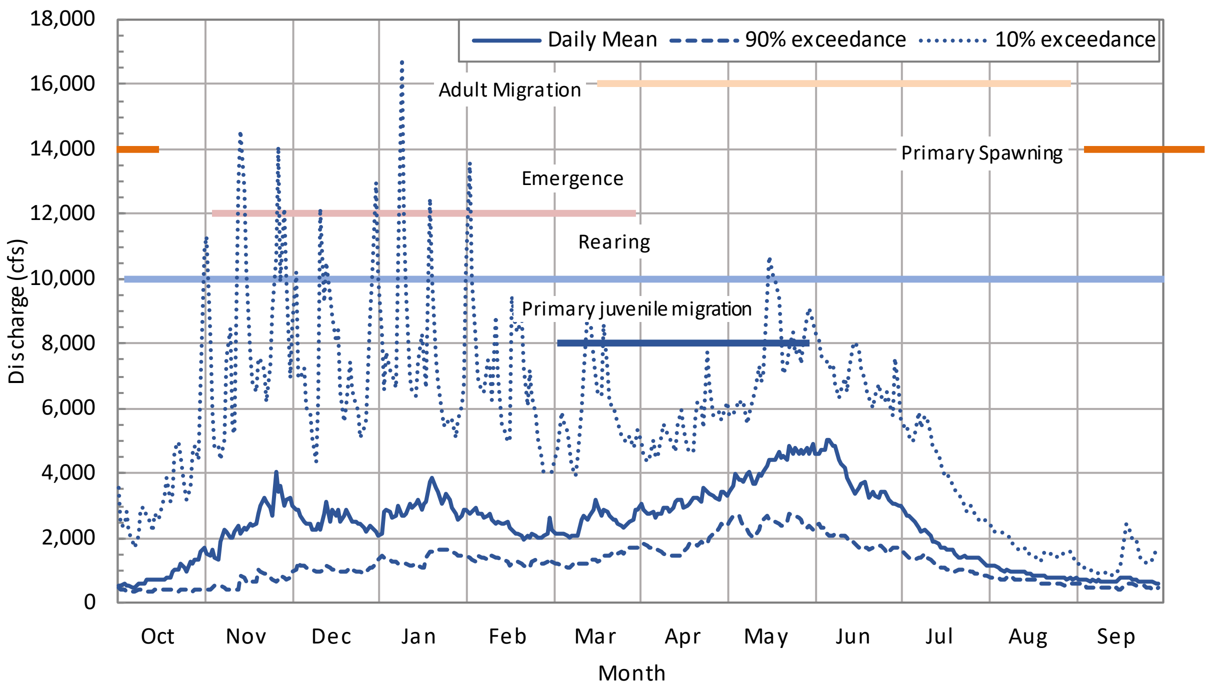


Figure 17. Spring Chinook life history timing and hydrology for the Upper Cowlitz Cispus basin. Life history timing based on the 2010 Subbasin Plan, and discharge based on the USGS gage at Randle from 1994-2018 (#14231000).

4.4.3.3 Steelhead

Steelhead parr holding position in a South Fork Chehalis riffle in June.

Steelhead enter the Upper Cowlitz Cispus basin in the winter and hold until spawning takes place from early-March to early June. Egg survival is highly sensitive to intra-gravel flow and temperature (Quinn 2005) and is particularly sensitive to siltation earlier in the incubation period. Fry emerge between June and August, during the receding limb of the hydrograph. Post emergent steelhead fry primarily utilize margin habitat and riffles (Wydoski and Whitney 2003), and transition to using swifter and deeper water as they grow over the summer months (Everest and Chapman 1972). Juvenile steelhead select for habitats with large substrates, while older fish prefer deeper water with and large wood (Bustard and Narver 1975). Juvenile steelhead rear for 1-4 years (typically 2 years) in freshwater before outmigrating as smolts in the spring (LCFRB 2010). Steelhead are known to be iteroparous, meaning they can return to their natal stream to spawn multiple times throughout their life.

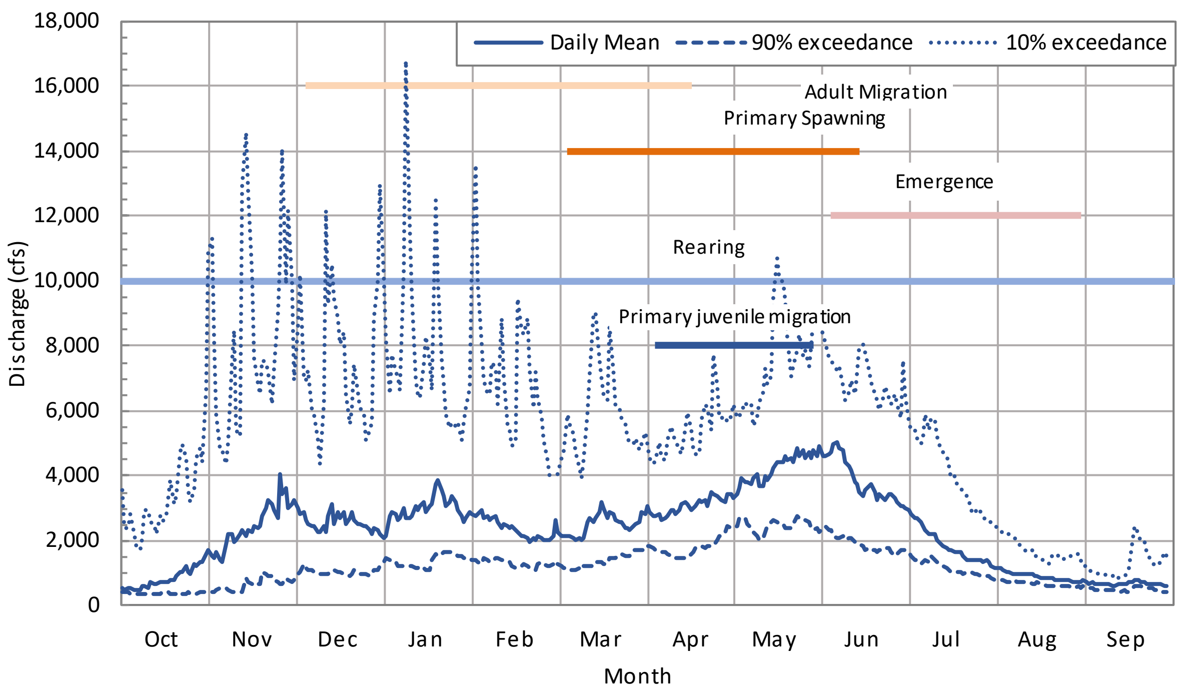


Figure 18. Steelhead life history timing and hydrology for the Upper Cowlitz Cispus basin. Life history timing based on the 2010 subbasin plan, and discharge based on the USGS gage at Randle from 1994-2018 (#14231000).

5 Landscape Unit Conditions

5.1 Overview

Ecological process conditions are described in this section by landscape unit. More detailed information on process conditions, including rationale for the ecological indicator ranks, as well as overview maps and fish use maps, are included in Appendix D.

5.1.1 Hillslope Landscape Units

Hillslopes are defined to include the land above the mainstem valley bottoms of the Cowlitz and Cispus Rivers. These are primarily supply and transport reaches that influence salmon and steelhead habitat within valley bottom LUs by defining the frequency, duration, and magnitude of the supply of water, sediment and wood. In some cases, particularly in the lower and middle hillslope LUs, stream segments used by fish may be present. The hillslope LUs have been primarily impacted by timber harvest and to some extent rural residential land uses. They also have relatively active disturbance regimes that include mass wasting (debris flows, lahars), wildfire, snow avalanches, and forest disease.

5.1.2 Valley Bottom Landscape Units

Valley bottom LUs include the broad, fluvially-formed floodplains of the Cowlitz and Cispus rivers and contain the Tier 1 and 2 stream reaches from the Recovery Plan, representing some of the most important habitat for ESA-listed salmon and steelhead. These are depositional "response" reaches, underlain by river alluvium and fluvially-worked glacial sediments, that vary based on valley gradient, confinement, and sediment supply.

5.1.3 Summary of Ecological Indicator Ranks

Table 9 below summarizes the ecological indicator rankings for all landscape units in the study basin. These are further discussed in the following landscape unit-specific sections and in the more detailed presentation of landscape unit results in Appendix D.

Table 9. Ecological indicator ratings for all landscape units. See Appendix D for additional information.

	Hillslopes			Cowlitz River Valley Bottom					Cispus River Valley Bottom			
	Highlands	**Mid-Elevation Hillslopes**	**Lower Hillslopes**	**Muddy Fork**	**Packwood**	**Mid-Valley**	**Randle**	**Scanewa**	**Upper**	**Mid-Valley**	**Tower Rock**	**Lower**
Natural vs. Human Disturbance	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired to Impaired	Impaired	Functional to Moderately Impaired	Functional	Functional to Moderately Impaired	Functional to Moderately Impaired
Hydrologic Alteration	Functional	Functional to Moderately Impaired	Moderately Impaired to Impaired	Functional to Moderately Impaired	Functional	Functional	Functional	Impaired	Functional	Functional	Functional	Functional to Moderately Impaired
Sediment Processes	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired to Impaired	Functional to Moderately Impaired	Impaired	Impaired	Functional	Functional	Functional to Moderately Impaired	Functional to Moderately Impaired
Large Wood Processes	Functional	Functional to Moderately Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired	Impaired	Impaired	Moderately Impaired to Impaired	Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired
Channel Type and Form	Functional	Functional	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired to Impaired	Impaired	Moderately Impaired to Impaired	Impaired	Functional	Functional to Moderately Impaired	Moderately Impaired	Functional
Floodplain Connectivity	Functional	Functional	Functional to Moderately Impaired	Moderately Impaired	Impaired	Moderately Impaired	Impaired	Impaired	Functional	Functional to Moderately Impaired	Moderately Impaired	Functional
Lateral and Vertical Channel Dynamics	Functional	Functional	Functional to Moderately Impaired	Moderately Impaired	Impaired	Functional to Moderately Impaired	Impaired	Impaired	Functional	Moderately Impaired	Moderately Impaired	Functional
Off-Channel Habitat Connectivity and Refugia	Functional	Functional	Moderately Impaired	Moderately Impaired	Moderately Impaired to Impaired	Functional to Moderately Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired	Functional	Functional to Moderately Impaired	Moderately Impaired	Functional
Riparian Processes	Functional	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired	Impaired	Moderately Impaired to Impaired	Functional	Functional	Moderately Impaired	Functional to Moderately Impaired

5.2 Landscape Unit Descriptions

5.2.1 Highlands

The Highlands LU contains high elevation zones (1,200 meters and above) where rain-on-snow events are less likely, corresponding with WA DNR highlands zone. This zone covers the slopes of the high peaks located within the basin, including portions of Mount Rainier, Goat Rocks, and Mount Adams. The primary sources of disturbance in this LU include ground saturation and resulting slope failure, avalanches, and volcano- and glacier-associated mass wasting (e.g., lahars).

5.2.1.1 *Fish use*

These areas are not accessible to target salmon and steelhead species in the basin, and are not designated critical habitat for salmon or steelhead.

5.2.1.2 *Process considerations*

The Highlands LU contains the important source zones for the downslope transport of water, sediment, and wood. Headwater zones, including alpine and subalpine meadows, regulate hydrology and are sources for cold, clean water in downstream channels. Channels in this LU consist of colluvial source channels and high gradient, confined source channels. Logging was the primary human disturbance in the LU and is the driver of excess sediment loading and impacts to some channels. Climate change continues to alter hydrologic conditions within this LU. Historical conditions would have been similar to current conditions, with the exception that late seral stage forests would historically cover hillslopes not exposed to recent disturbances, supporting healthier sediment, flow, and large wood processes. Watershed processes continue to improve under the current management regime. The overall function of this LU remains relatively intact and this is reflected in the ecological indicator rankings (Table 10).

Table 10. Summary of Ecological Indicator rankings for the Highlands LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional	Functional to Moderately Impaired	Functional	Functional	Functional	Functional	Functional	Functional

5.2.2 Mid-Elevation Hillslopes

The Mid-Elevation Hillslopes LU contains the “peak rain-on-snow” and “snow dominated” zones from the WA DNR rain-on-snow mapping and corresponds to elevations between 500 and 1200-1300 meters. Primary sources of disturbance in this LU consist of debris flow and flooding, though the LU also has potential for high-intensity wildfires resulting from a legacy of fire suppression.

5.2.2.1 *Fish use*

Streams in this LU have the potential to provide important refuge habitat as they tend to be in better condition than those located downstream that are more heavily affected by human impacts. Chinook salmon critical habitat is located in the lower elevation zones of this LU, particularly up Yellowjacket Creek and the North Fork Cispus River. Coho and steelhead critical habitat is nearly identical in this LU, and is located at lower elevation areas, including Yellowjacket Creek, North Fork Cispus River, and Skate Creek.

5.2.2.2 *Process considerations*

Similar to the Highlands LU, the Mid-Elevation Hillslopes also contain the important source zones for the downslope transport of water, sediment, and wood. Channels within this LU consist primarily of confined source and transport channels, although pockets of more alluvial channels are present. Primary impacts to the LU stem from timber extraction and include elevated quantities of fine sediments and hydrologic impairment. Historically, forests within this LU would have consisted of late-successional and late seral stage forests. Large, old growth trees would have had a substantial impact on streams, with channels containing high habitat complexity, especially where localized reductions in valley confinement allow pockets of floodplain to form. The current departure from historical conditions, primarily from timber extraction, are reflected in the ecological indicator rankings (Table 11).

Table 11. Summary of Ecological Indicator rankings for the Mid-Elevation Hillslopes LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional	Functional	Functional	Functional	Functional to Moderately Impaired

5.2.3 Lower Hillslopes

The Lower Hillslopes LU contains the "rain dominated" zone from the WA DNR rain-on-snow mapping and corresponds to elevations below 500 meters. Channels in this LU behave mostly as sediment source or response reaches, and the primary sources of disturbance in this LU consist of debris flows, flooding, and channel migration. The LU also has potential for high-intensity wildfires resulting from a legacy of fire suppression.

5.2.3.1 *Fish use*

Streams in this LU contain a large portion of the fish-bearing tributary habitat and have the potential to provide important rearing, refuge, and spawning habitat. Coho and steelhead critical habitat is more widespread, including larger portions of tributaries such as Kiona Creek, Silver Creek, Johnson Creek, Skate Creek, and Muddy Fork in the Upper Cowlitz basin, and Quartz Creek, Iron Creek, and Woods Creek in the Cispus basin. There are small amounts of Chinook salmon critical habitat in Silver Creek, Muddy Fork, and the mainstem Cowlitz River upstream of the Muddy Fork.

5.2.3.2 *Process considerations*

The Lower Hillslopes LU contains some of the larger tributary channels contributing to the mainstem Cowlitz and Cispus rivers. A larger proportion of these channels are transport and response reaches compared to the higher elevation LUs. Primary impacts to the LU stem from a greater amount of human activity and development – road density is relatively high (5.1 mi/mi^2) and while the eastern portion of the LU is federal forest lands, the western portion is private land with agricultural, rural residential, and forestry land uses. These activities increase sediment delivery from hillslopes to channels, increase the flashiness of runoff, and alter wood supply. Historically, these areas would have consisted of late-successional and late seral stage forests. Old-growth forests would have supplied the streams with large trees that would have driven the development of highly complex habitats and high lateral connectivity in locations where valley confinement was reduced and floodplains could form. The current departure from historical conditions, primarily from timber extraction, are reflected in the ecological indicator rankings (Table 12).

Table 12. Summary of Ecological Indicator rankings for the Lower Hillslopes LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Moderately Impaired to Impaired	Moderately Impaired	Moderately Impaired to Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired

5.2.4 Upper Cowlitz – Muddy Fork Avulsion-Affected

The Upper Cowlitz River Valley – Muddy Fork LU encompasses the confluence with the Muddy and Clear Fork Cowlitz Rivers and is located at the transition from steep headwater streams to much flatter valley bottom areas. This area has likely always been dynamic with past lahars and other large mass wasting events as the primary sources of disturbance in the LU.

5.2.4.1 *Fish use*

Within this LU, the mainstem Cowlitz is primarily used for spawning and rearing by target populations. However, spawning is likely limited by rapid and frequent bed adjustments. To the extent that spawning gravels accumulate, tributaries are used by coho and steelhead for spawning and rearing.

5.2.4.2 *Process considerations*

This LU is still affected by the high bedload generated from the 2006 Muddy Creek avulsion, exhibiting a braided channel pattern and is a significant source of sediment to downstream LUs. Encroachment into the floodplain has exposed properties to frequent flooding and bank erosion via sediment deposition, channel widening, and migration. Large wood loading is prevalent, but much of the wood is too small to self-stabilize and has deposited higher up on bars and along the channel margin providing limited, if any, habitat benefits. Historically, conditions in this LU likely have been closely linked to the timing and frequency of mass wasting events from Mt. Rainier. Channel pattern likely oscillated between braided, in closer temporal proximity to mass wasting/disturbance events, and island braided in the intervening time periods where adjacent forests could mature to later seral stages, supplying the channel with wood large enough to provide a stabilizing effect. The ecological indicator scores are thus primarily a function of floodplain encroachments (e.g., development, bank armoring) and a lack of late seral stage vegetation (Table 13).

Table 13. Summary of Ecological Indicator rankings for the Upper Cowlitz – Muddy Fork Avulsion-Affected LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired to Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired to Impaired

5.2.5 Upper Cowlitz – Packwood

The Upper Cowlitz River Valley - Packwood LU marks a reduction in gradient and increase in valley width compared with the upstream Muddy Fork LU. Development within the floodplain is prevalent and has a confining influence on the channel. Channel migration in response to increased sediment storage was likely the primary source of disturbance in the LU.

5.2.5.1 *Fish use*

This LU appears to contain important high flow refuge and rearing habitats, though in degraded condition. Tributaries such as Butter Creek, Skate Creek and the upper reaches of Hall Creek within this LU historically supported steelhead and coho spawning and rearing.

5.2.5.2 *Process considerations*

The active channel zone within this LU is dynamic, responding to sediment loading from the Muddy Fork avulsion. Development in the floodplain, bank armoring, and the Cora Bridge have a confining influence on the evolution of channel, reduce floodplain connection, and are contributing to channel incision. Similar to the Muddy Fork LU, large wood is present within the active channel, but has been deposited above the active channel being too small to self-stabilize. Historically, a supply of large wood would have had a stabilizing influence on the reach and led to the development of an island braided channel pattern. Multiple, co-dominant side channels would have fed a well-connected floodplain containing oxbows and wetlands. Multiple age classes of riparian vegetation, ranging from recently established to late seral, would have occupied the floodplain and supplied the channel with late seral trees. These conditions would have moderated the reach response to disturbances. The departure from historical conditions is largely a product of past logging practices and floodplain encroachment. This is reflected in the ecological indicator rankings which show corresponding impaired scores for related fields (Table 14).

Table 14. Summary of Ecological Indicator rankings for the Upper Cowlitz - Packwood LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Moderately Impaired	Functional	Moderately Impaired to Impaired	Impaired	Moderately Impaired to Impaired	Impaired	Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired

5.2.6 Upper Cowlitz – Mid Valley

The Upper Cowlitz River Valley – Mid Valley LU encompasses a broad alluvial valley that is sparsely populated, though contains artificial, laterally confining features (e.g., structures, roads, bank armoring). Channel migration, avulsions and flooding were historically the primary disturbances in this LU, with the active channel responding to tributary and upstream loads of sediment and wood.

5.2.6.1 *Fish use*

Historically, this geomorphically complex LU would have generated substantial and diverse habitat supporting all life stages of target species. Chinook salmon critical habitat in this LU is contained in the mainstem Cowlitz River. Coho and steelhead critical habitat is contained in the mainstem Cowlitz River, and several tributaries such as Hall Creek, Johnson Creek, Smith Creek, Willame Creek, and Burton Creek.

5.2.6.2 *Process considerations*

Currently, the portion of the mainstem Cowlitz in this LU appears to be very dynamic, with the active channel configuration shifting frequently. The LU has the potential to provide important ecological linkages between upstream and downstream LUs. Historically exhibiting a 'wandering' configuration, islands created from large, old growth trees would have divided multiple co-dominant channels. As a result of the artificially confining features and lack of old growth wood supply, the lowest ecological indicator ratings for this LU are in Natural vs Human Disturbance, Large Wood Processes, Channel Type and Form, and Riparian Processes (Table 15).

Table 15. Summary of Ecological Indicator rankings for the Upper Cowlitz - Mid Valley LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Moderately Impaired	Functional	Functional to Moderately Impaired	Impaired	Impaired	Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired to Impaired

5.2.7 Upper Cowlitz – Randle

The Upper Cowlitz River Valley - Randle LU encompasses a transition to a lower gradient and wider alluvial valley. Floodplain encroachment and land cover conversion have been the driving influence over channel incision and widening. Channel migration and the formation of cutoff channels in response to flooding was likely the primary source of disturbance in the LU.

5.2.7.1 *Fish use*

This LU would have historically provided abundant high-flow refugia in off-channel wetland, oxbows, and side channels. It is likely still utilized by juvenile salmonids; however, the capacity is greatly reduced from historical conditions. Numerous tributaries may have contained important—if small—pockets of spawning and rearing habitat.

5.2.7.2 *Process considerations*

The active channel zone within the LU marks a departure from the characteristics of those upstream: lower channel gradient, reduced valley confinement, and increased discharge have caused the channel to take more of a meandering channel pattern. The channel and floodplain in this LU have undergone dramatic change as a result of land cover conversion and floodplain encroachment: widespread agricultural development, bank armoring, bridges, instream wood removal, riparian clearing, and flood protection have all simplified instream habitat and disconnected the channel from its floodplain. The channel has greatly simplified, losing sinuosity through the development of meander cutoffs. In some locations, the channel is rapidly eroding through tall, erodible banks where agricultural development has cleared riparian forests. This is a substantial departure from historical conditions where a complex and diverse floodplain would have been well-connected to the channel and inundated for large portions of the year. The channel planform would have had large, complex meanders, with split flow paths, oxbows, back and side channels, and large wetlands. Multiple age classes of riparian vegetation, ranging from recently established to late seral, would have occupied the floodplain and supplied the channel with late seral trees. This wood loading would have had structural effect on the channel, moderating reach response to disturbances. Diverse assemblages of substrate and hydraulic conditions would have produced ample high-quality rearing habitat. The departure from historical conditions is reflected in the ecological indicators (Table 16), where nearly every indicator shows some level of impairment.

Table 16. Summary of Ecological Indicator rankings for the Upper Cowlitz - Randle LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Moderately Impaired to Impaired	Functional	Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired	Impaired	Impaired	Moderately Impaired to Impaired	Impaired

5.2.8 Upper Cowlitz– Scanewa

The Upper Cowlitz River Valley - Scanewa LU was defined by the backwater influence of Lake Scanewa and is partially confined by glacial terraces and landslide deposits. Natural disturbance processes have been largely eliminated in this LU by the backwater influence of Lake Scanewa.

5.2.8.1 *Fish use*

Fish use in this LU is predominantly adult and juvenile migration. Salmon and steelhead released upstream of Cowlitz Falls Dam as part of the trap-and-haul program need to pass through this LU on the way to spawning grounds in the Upper Cowlitz River. Some inundated, off-channel areas may provide good potential adult holding and juvenile foraging habitat for target salmon and steelhead populations. All juveniles produced in the basin must pass through this reach during outmigration.

5.2.8.2 *Process considerations*

From a channel evolution point of view, the active channel zone within the Upper Cowlitz River Valley - Scanewa LU has stalled out. The backwater effect from the lake reduces the energy gradient, impacting sediment dynamics through the reach. This causes a reduction in bedload transport, and deposition of the coarse fraction of the bedload. Large wood from upstream floats through and either eventually sinks in the lake or is removed from the dam forebay. Land use change and land cover conversion for agricultural and timber extraction purposes have impacted the floodplain and riparian zone. There are some areas where high flows inundate old channel scars and create floodplain wetlands, but the quality and function of these areas is unknown. This is the furthest upstream extent of the Cowlitz River hydrosystem which is a significant impediment to stream processes. Historically, this LU would have acted primarily like a transport reach and been subject to channel migration processes. The severe impacts of the hydrosystem and land use change are reflected in the ecological indicator scores where nearly every indicator is impaired (Table 17).

Table 17. Summary of Ecological Indicator rankings for the Upper Cowlitz– Scanewa LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Impaired	Impaired	Impaired	Impaired	Impaired	Impaired	Impaired	Moderately Impaired to Impaired	Moderately Impaired to Impaired

5.2.9 Cispus – Upper

The Cispus River Valley – Upper LU is the most upstream valley bottom LU on the Cispus (RM 21.7 - 30.7). The active channel sits in a relatively narrow alluvial valley and confinement ranges from confined to partly confined. In various locations, the active channel is directly coupled to the hillslope, with the cross-valley position of the active channel primarily controlled by lateral sediment inputs (e.g., alluvial fans, landslides) which are the primary sources of disturbance in the LU.

5.2.9.1 *Fish use*

This LU supports all life stages of target species, although rearing habitat may have been limited as a result of the steeper gradient (relative to downstream reaches).

5.2.9.2 *Process considerations*

Currently, islands containing mature forest are present and there is abundant large wood in the active channel. Historically, conditions may have been similar, with the key differences being late seral stage riparian stands and the presence of large, old growth trees adding stability to jams and creating an island braided planform; however, the reach would have also been subject to, and possibly adjusting to, disturbance cycles, and therefore planform may have been highly variable. As a result, the ecological indicator rankings are largely functional with functional to moderately impaired ratings for those categories that suffer from the lack of old-growth sized trees (Table 18).

Table 18. Summary of Ecological Indicator rankings for the Cispus– Upper LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional	Functional	Functional to Moderately Impaired	Functional	Functional

5.2.10 Cispus – Mid-Valley

The Cispus River Valley – Mid-Valley LU encompasses the confluence with the North Fork Cispus River and is located at the transition from a more confined valley setting to reduced confinement. Channel migration in response to increased sediment storage was likely the primary source of disturbance in the LU.

5.2.10.1 *Fish use*

Between the North Fork Cispus and Cispus, this LU contains high quality off-channel habitat that would have been valuable for refuge and rearing. Additionally, Camp Creek provides habitat for coho and steelhead.

5.2.10.2 *Process considerations*

The active channel zone within the LU is highly dynamic, exhibiting a braided channel pattern in some locations and island braided in others. Large wood loading is substantial and habitats are complex. At the downstream end, the Cispus Road bridge impinges upon the floodplain and is causing the channel to incise. Historically, the channel planform would have been controlled by the supply of sediment and large wood jams. Multiple, co-dominant side channels would have fed a well-connected floodplain containing oxbows and wetlands. Multiple age classes of riparian vegetation, ranging from recently established to late seral, would have occupied the floodplain and supplied the channel with late seral trees. This would have moderated the reach response to disturbances. Some of these processes are still occurring, but are affected by younger riparian forest stands and smaller instream wood than would have existing historically. The ecological indicators scoring less than 'functional' are largely related to the lack of late seral vegetation and floodplain encroachment in the LU (Table 19).

Table 19. Summary of Ecological Indicator rankings for the Cispus – Mid-Valley LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional	Functional	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Functional to Moderately Impaired	Functional

5.2.11 Cispus – Tower Rock

The transition downstream to the Cispus– Tower Rock LU is marked by a further reduction in valley confinement, with the active channel set into a broad alluvial valley. The LU encompasses the confluence with Yellowjacket Creek, and channel migration in response to increased sediment storage was likely the primary source of disturbance in the LU.

5.2.11.1 *Fish use*

Historically, this LU contained the best spawning habitat in the Cispus subbasin. Additionally, Yellowjacket Creek contains relatively good habitats for spawning, rearing, and migration for all three target species.

5.2.11.2 *Process considerations*

The LU is relatively dynamic, exhibiting a braided and island braided channel pattern that has lower sinuosity when compared with historical conditions. Floodplain connection is impaired from anthropogenic confinement and Yellowjacket Creek has incised in response to the Cispus Road bridge. Similar to the upstream LU, historical conditions would have had an island braided planform controlled by large wood jams. Again, key, old-growth pieces would have helped to moderate reach response to disturbance. A well-connected floodplain would have contained multiple age classes of riparian vegetation, including oxbows and wetlands. As a result of the lack of large, late seral trees and the anthropogenic confinement, ecological indicator scores show a moderately impaired reach (Table 20).

Table 20. Summary of Ecological Indicator rankings for the Cispus – Tower Rock LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional	Functional to Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired	Moderately Impaired

5.2.12 Cispus – Lower

The Cispus – Lower LU is marked by a transition into a setting with increased valley confinement and an active channel inset into glacial terraces. Being coupled to the valley and terrace walls for much of its length, primary disturbance would have been from lateral sediment inputs from lateral erosion into the glacial terraces and/or hillslope processes.

5.2.12.1 *Fish use*

As a result of the relatively lower gradient, this LU contains suitable spawning gravels for all species, though floodplain and off-channel habitats are limited by natural valley confinement. Fish use in the tributaries likely occurs, but is limited by barrier falls and/or flow.

5.2.12.2 *Process considerations*

Currently, the reach behaves as a transport reach, with a relatively steep gradient. Much of the forest cover is second growth (or more recent), in-channel wood is lacking, and there is a high road density in the LU. The downstream end of the LU is controlled by Lake Scanewa backwater. Historically, late seral stage riparian vegetation would have supplied large wood to the channel, contributing to the formation of some larger jams; bank jams would have provided margin habitat. Valley confinement may have limited the persistence of recruited and supplied large wood. As a result, 'Large Wood Processes' ecological indicator is identified as moderately impaired (Table 21).

Table 21. Summary of Ecological Indicator rankings for the Cispus – Lower LU.

Natural vs. Human Disturbance	Hydrologic Alteration	Sediment Processes	Large Wood Processes	Channel Type and Form	Floodplain Connectivity	Lateral and Vertical Channel Dynamics	Off-Channel Habitat Connectivity and Refugia	Riparian Processes
Functional to Moderately Impaired	Functional to Moderately Impaired	Functional to Moderately Impaired	Moderately Impaired	Functional to Moderately Impaired	Functional	Functional	Functional	Functional to Moderately Impaired

6 Habitat Actions

6.1 Overview

This section summarizes the linkages between LU stressors and identified actions, as well as identifies focus areas for implementation. The identification of actions and focus areas is set within the context of the following three key assumptions:

1. Continued operation of the Cowlitz Basin hydropower system, including fish transport, according to the terms of the FERC License(s) and other private-public agreements.
2. Continued management and protection of public forest lands according to current policy.
3. Any action implementation involves voluntary cooperation with willing landowners and associated agreements.

For these reasons, this Habitat Strategy does not identify actions to address hydrosystem or related fish transport/passage operations. Because the Habitat Strategy also assumes continued management regimes for public forests, it does not identify these areas as focus areas for protection; and instead assumes they are already adequately protected through current law or policy for the foreseeable future.

6.1.1 Hillslope Actions Summary

Primary actions for the hillslope LUs involve protection; changes to timber harvest type and location; forest road maintenance and abandonment; and to a lesser degree, aquatic habitat enhancement in fish bearing streams. There are also fish passage improvement opportunities.

6.1.2 Valley Bottom Actions Summary

Restoration and protection actions in these LUs consist of a broad suite of activities that vary depending on the location, biophysical setting, type/degree of human use, and landownership. The proportion of the various action types in the entire valley bottom LU area is displayed in Figure 19. The proportion of action types by LU is provided in Table 22. Refer to Section 3.3.2 for definitions of the action types. A total of 112 individual actions were identified, covering approximately 50% of the land area within the valley bottom LUs. Reconnect and Restore and Strategic action types were the most frequently identified, followed by Protect and then Enhance and Create action types; however, the proportion of action types varies considerably by LU (Table 22).

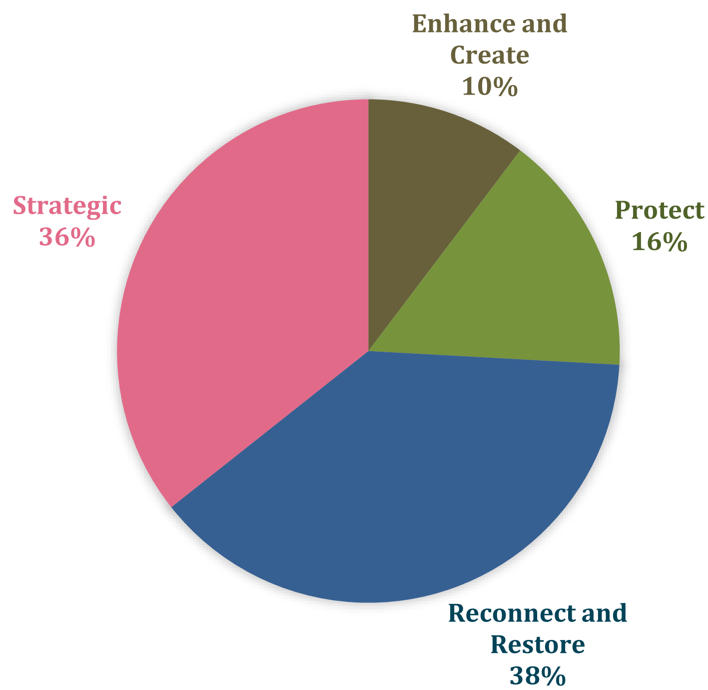


Figure 19. Proportion of land area within identified Action Types in all of the valley bottom LUs combined. Refer to Section 3.3.2 for definitions of action types.

Table 22. Proportion of Action Types within LUs, by area.

	Landscape Unit	Total LU Acreage	Proportion of LU with Actions Identified	Proportion of Action Types within LU			
				Protect	Strategic	Reconnect and Restore	Enhance and Create
Upper Cowlitz	Muddy Fork	2,001	30%	13%	84%	0%	3%
	Packwood	1,789	56%	8%	38%	45%	8%
	Mid-Valley	4,521	74%	17%	45%	34%	4%
	Randle	9,630	62%	23%	30%	40%	8%
	Scanewa	2,120	18%	0%	0%	23%	77%
Cispus	Upper	1,148	41%	0%	2%	73%	25%
	Mid-Valley	1,142	25%	0%	74%	26%	0%
	Tower Rock	1,385	61%	0%	46%	54%	0%
	Lower	3,204	16%	0%	0%	44%	56%

6.2 Landscape Unit Actions

The sections below include summaries of primary stressors, restoration and protection objectives, and actions. The specific actions within the landscape units are presented in Appendix E.

6.2.1 Highlands

The primary existing stressor in the Highlands LU is fine sediment loading from forest roads. Land within the LU is almost entirely within federal forest lands (Gifford Pinchot National Forest and Mount Rainier National Park), and management is governed primarily by forest practice regulations and plans. NWFP land use allocations comprise the following areas: CR/AW (non-production timber harvest) is 65%; LSR (very limited harvest to support old growth establishment) is 7%; and matrix (greater harvest) is 28%. Conditions within the LU are generally improving, and existing protections, including public ownership and riparian buffer protections, are generally believed to be adequate for protection in this LU. Therefore, objectives include:

1. Continuing aspects of the current forest management scheme that are working well; and,
2. Decommissioning unnecessary roads.

6.2.2 Mid-Elevation Hillslopes

Existing stressors in the Mid-Elevation Hillslopes LU include fine sediment loading from forest roads and logging operations, potential passage barriers, and stream degradation from past logging activities (e.g., erosion from a lack of large wood supply). Lands within this LU are almost entirely (94%) within federal forest lands (Gifford Pinchot National Forest and Mount Rainier National Park), and the NWFP land use allocations comprise the following areas: CR/AW (non-projection timber harvest) is 16%; LSR (very limited harvest to support old growth establishment) is 24%; and matrix (greater harvest) is 54%. Matrix lands are generally improving and upland riparian forests in this LU are recovering from past harvest. Stream habitat conditions are trending towards improvement, particularly with respect to wood loading and stream shade, but opportunities for enhancement likely exist. Therefore, objectives include:

1. Continuing aspects of the current forest management scheme that are working well;
2. Decommissioning unnecessary roads;
3. Evaluation and replacement of culverts that are blocking passage; and,
4. Habitat creation and enhancement where pockets of floodplain exist.

The primary mechanisms for accomplishing these objectives include replacing culverts with aquatic organism passable (AOP) structures and removing culverts that can be decommissioned along with the adjacent roads. Habitat creation and enhancement in floodplain pockets will primarily consist of wood loading (e.g., helicopter transport and placement of large wood).

6.2.3 Lower Hillslopes

Existing stressors in the Lower Hillslopes LU include fine sediment loading from forest roads and logging operations, potential passage barriers, riparian forest clearing, and stream degradation from past logging activities (e.g., erosion from a lack of large wood supply and standing riparian plants). Lands within this LU are approximately half within federal forest lands (Gifford Pinchot National Forest) and the NWFP land use allocations comprise the following areas: CR/AW (non-production timber harvest) is 0%; LSR (very limited harvest to support old growth establishment) is 35%; and matrix (greater harvest) is 13%. The remaining half is private land. Restoration, protection, and management of the federal and private timberlands presents an opportunity to improve ecological processes that directly impact tributary habitats and indirectly impact the mainstem rivers. Therefore, objectives include:

1. Continuing aspects of the current forest management scheme that are working well;
2. Acquisition and/or easement of properties (with willing sellers/landowners) with high functioning and/or riparian forests;
3. Decommissioning unnecessary roads;
4. Evaluation and replacement of culverts that are blocking passage;
5. Restoration and/or protection actions to improve and maintain conditions in fish-bearing tributaries (e.g., large wood placements); and,
6. Restoring degraded riparian areas in rural residential and/or agricultural areas.

The primary mechanisms for accomplishing these objectives include collaborative work with willing landowners to acquire private timberlands, and the replacement of culverts with AOP crossings and removing culverts that can be decommissioned along with the adjacent roads. Reconnect and Restore and/or habitat creation and enhancement in the tributaries will primarily consist of riparian restoration and wood loading.

6.2.4 Upper Cowlitz – Muddy Fork Avulsion-Affected

Habitat action strategies for this LU stem from the dynamic nature of the unit and the lack of wood large enough to self-stabilize. Existing stressors include development in the floodplain, bank armoring, and rapid channel bed fluctuations. Objectives include:

1. Removing impediments to channel migration (e.g., bank armoring, infrastructure and assets) to provide the river with adequate width as it adjusts to the 2006 avulsion (and future avulsions);
2. Managing forests for the production of trees that are large enough to produce wood that can self-stabilize in the channel;
3. Protecting riparian areas that are functioning well; and,
4. Enhancing tributary habitats (e.g., wood jam installation).

The primary mechanisms to accomplish these objectives include acquisition and/or easement of properties within the CMZ, forest management, protection, and tributary habitat enhancements including large wood placements. Actions, summarized by action type, are listed in Table 23. Protection and Strategic actions focus on providing space for the river to adjust. Reconnect and Restore actions at the downstream end of the LU are focused on influencing sediment dynamics to re-establish an island braided channel pattern. Enhance and Create actions are focused on increasing channel complexity in the tributaries.

Table 23. Strategy summaries by action type for the Upper Cowlitz – Muddy Fork LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	Protect undeveloped land within the CMZ.	Maintain existing functions for all species and life stages
Strategic	Acquire property and/or easements from willing landowners and remove/relocate infrastructure out of the CMZ. Actions would also reduce flood hazard to communities.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	At the downstream end of LU, initiate formation of island braided planform and reconnect side channels.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	Enhance spawning and rearing habitats in tributaries.	Provide short-term spawning and rearing habitat for coho and steelhead.

6.2.5 Upper Cowlitz – Packwood

Existing stressors include development in the floodplain, bank armoring, and rapid channel bed fluctuations. The Upper Cowlitz River Valley - Packwood LU, when combined with the downstream Mid-Valley LU, presents substantial opportunities to re-establish an island braided channel pattern which will diversify in-channel habitats and help reconnect the mainstem to side channels and floodplain habitats. Objectives include:

1. Removing impediments to channel migration (e.g., bank armoring, infrastructure and assets) and reconnecting the channel to its floodplain (e.g., selective grading to lower and revegetate floodplain surfaces);
2. Kick starting the re-establishment of an island braided channel pattern with the construction of mainstem large wood jams;
3. Managing riparian forests for the production of trees that are large enough to produce wood that can self-stabilize in the channel;
4. Protecting riparian areas that are functioning well; and,
5. Enhancing tributary habitats (e.g., riparian revegetation).

The primary mechanisms to accomplish these objectives include acquisition and/or easement of properties within the CMZ, main channel wood jam construction, and large wood loading and habitat enhancement in the tributaries. Actions, summarized by action type, are listed in. Protection and Strategic actions focus on providing space for the river to adjust and reconnecting floodplain habitats. Reconnect and Restore actions are focused on influencing sediment dynamics to re-establish an island braided channel pattern. Enhance and Create actions are focused on side channel habitat enhancements.

Table 24. Strategy summaries by action type for the Upper Cowlitz - Packwood LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	Protection of undeveloped riparian areas.	Maintain existing functions for all species and life stages
Strategic	Acquire property and/or easements from willing landowners and remove/relocate infrastructure out of the CMZ. Actions would also reduce flood hazard to communities.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	Facilitate sediment storage and the re-establishment of an island braided channel pattern with the implementation of side channel reconnections and mainstem large wood jams.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	Enhance floodplain, side channel, and tributary habitats.	Provide short-term spawning and rearing habitat for coho and steelhead.

6.2.6 Upper Cowlitz – Mid-Valley

Existing stressors in the Cowlitz Mid Valley LU include development in, and conversion of, the floodplain (e.g., logging and clearing for agriculture), bank armoring, and rapid channel bed fluctuations. Based on the assessment of the LU, including the ecological indicator ranks described in Table 15, the following key strategies are identified. The primary strategy for this LU is to increase lateral sediment exchange (e.g., sediment storage and sorting) across the floodplain, creating complex in-channel and floodplain habitats. Thus, reach objectives are to:

1. Protect existing, high-functioning areas;
2. Restore connectivity to the floodplain and side channels/co-dominant channels (e.g., encourage flow through former channel scars via construction of log jams);
3. Remove impediments to channel migration zone processes (e.g., bank armoring);
4. Initiate the formation of stable islands (e.g., through the construction of mainstem wood jams); and,
5. Enhance spawning and rearing habitats for all targeted species: spring Chinook, coho, and winter steelhead (e.g., construction of wood jams that create scour pools and provide complex cover).

The primary mechanisms to accomplish these objectives include targeted acquisitions that would provide relief to flood and erosion-vulnerable properties while enabling channel migration processes, reconnection of large portions of floodplain, and facilitating the creation of stable islands with mainstem log jams. There are also good opportunities for protection due to large parcels, some owned by timber companies,that may enable large acquisitions or other willing landowner agreements that would allow for large-scale protection/restoration.

Actions, summarized by action type in Table 25, include protection of undeveloped lands within the floodplain and CMZ. Strategic actions include targeted acquisitions, which are identified as strategic because they require action prior to the implementation of process improvements and their potential to provide relief to flood and erosion-vulnerable properties while enabling the restoration of floodplain and channel migration processes. Reconnect and Restore actions include levee removals and re-establishment of an island braided channel type. Enhance and Create actions are identified to provide habitat features (e.g., pools, cover) on a smaller scale that is not likely to drive changes to watershed processes.

Table 25. Strategy summaries by action type for the Upper Cowlitz– Mid Valley LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	Protect functioning and undeveloped or mostly undeveloped timber and rural residential land within the floodplain and CMZ. Multiple opportunities, some with large parcels that may be at risk of division and development.	Maintain existing functions for all species and life stages
Strategic	Restore large areas of floodplain and CMZ that are also within flood hazard zones. Targeted infrastructure relocation could be combined with modifications to levees and armoring to achieve large-scale process restoration with multiple benefits. There are some smaller	Restore the habitat-forming processes that will benefit all life-stages

	areas where structures are located in hazard zones but are currently protected by flood control facilities; addressing these areas may not be cost-effective.	of all ESA-listed salmonids.
Reconnect and Restore	One of the primary actions is the restoration of an anastomosing (e.g., co-dominant channels separated by vegetated islands) channel type throughout most of this LU. There is also opportunity to reconnect a large mainstem side-channel and opportunity to address confinement of the lower Hall Creek tributary.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	Portions of Hall Creek and Johnson Creek are identified for this category. In addition, habitat enhancement and creation actions (e.g., wood jam implementation) can be incorporated into most areas of this LU as appropriate for local habitat uplift.	Provide short-term spawning and rearing habitat for coho and steelhead.

6.2.7 Upper Cowlitz – Randle

Stressors in the Upper Cowlitz - Randle LU include floodplain encroachment, floodplain disconnection, and land cover conversions. Restoration and protection strategies seek to buffer the influence of these stressors through the following objectives:

1. Protecting and/or restoring riparian forests and vegetation;
2. Removing barriers to channel migration processes and reconnecting the channel to floodplains and side channels where possible; and,
3. Enhancing mainstem and tributary habitats.

The primary mechanisms to accomplish these objectives include acquisition and/or conservation easements for regularly flooded areas and existing high-quality riparian forest. There may also be opportunities to work with willing landowners to convert agricultural lands currently subject to high magnitude and/or frequent hazard back to riparian forests. The re-establishment of riparian forests is the primary strategy for mediating channel migration and avulsion. Main channel wood jams may be able to elevate and divert flows into abandoned meander scars and cutoffs to connect off-channel habitats; however, reconnections may require excavation as the channel has incised. Actions, summarized by action type, are listed in Table 26. Protection and Strategic actions focus on providing space for the river to adjust and reconnecting floodplain habitats. Reconnect and Restore actions are focused on targeted off-channel and side channel reconnections and riparian vegetation restoration. Enhance and Create actions are focused on channel complexity and cover enhancements.

Table 26. Strategy summaries by action type for the Upper Cowlitz - Randle LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	Protect functioning and undeveloped or mostly undeveloped timber and rural residential land within the floodplain and CMZ.	Maintain existing functions for all species and life stages
Strategic	Enhance floodplain forest conditions, floodplain inundation, and side-channel connectivity to the mainstem in this heavily agriculturally developed area with many private parcels within the CMZ hazard zone (much of it within the high hazard zone). Achieve this via select relocation of structures and other features (e.g., roadways) out of flood hazard zone, removal of fill, reforestation, and reconnection of former side-channels.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	Enhance connectivity of mainstem and tributaries to side channel and floodplain habitats, including many wetlands. Additionally, the restoration of native riparian and floodplain woody vegetation communities will support long-term riparian and floodplain functions.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	Enhance and create habitat in the mainstem and tributaries.	Provide short-term refuge habitat for migrating fish in the mainstem and spawning, rearing, and refuge habitat in the tributaries.

6.2.8 Upper Cowlitz – Scanewa

The primary stressor in the Upper Cowlitz – Scanewa LU is the Cowlitz River hydrosystem. The other main stressor is the conversion of floodplain for agricultural purposes. Reversing the impacts of the hydrosystem would require removal of the dams and are thus not considered feasible at this stage. Therefore, restoration and protection strategies are focused on improving habitat for migrating fish through the following objectives:

1. Protecting and/or restoring riparian forests and vegetation; and,
2. Creating margin habitat.

The primary mechanisms to accomplish these objectives include establishing and revegetating a riparian buffer and installing bank jams. Main channel wood jams may be able to influence flows into abandoned meander scars and cutoffs to connect off-channel habitats. Actions, summarized by action type, are listed in Table 27.

Table 27. Strategy summaries by action type for the Upper Cowlitz - Scanewa LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	Protection actions have not been identified for this LU.	NA
Strategic	Strategic actions have not been identified for this LU.	NA
Reconnect and Restore	Reconnect and Restore actions consist of establishing a vegetative buffer along the channel.	Restore the riparian processes that will provide food and cover for all life-stages of all ESA-listed salmonids.
Enhance and Create	Actions consist of creating margin complexity and habitat.	Provide short-term cover habitat for migrating fish.

6.2.9 Cispus – Upper

Stressors in this LU are primarily the legacy effects of historical land management (e.g., timber harvest and associated development). Given the condition of the LU, the primary strategy is to continue management actions that promote the functioning of ecological processes that develop and sustain instream and floodplain habitats. Furthermore, opportunities to enhance the diversity of the existing channel and habitats exist and thus LU objectives include:

1. Continuing to manage for the recovery of ecological processes;
2. Increasing connectivity to the floodplain (e.g., use wood jams to force more frequent inundation of side channel habitat);
3. Initiating and supporting the formation of stable islands; and,
4. Enhancing spawning and rearing habitats for all targeted species: spring Chinook, coho, and winter steelhead (e.g., wood jam construction).

The primary mechanism by which to accomplish these objectives includes large wood loading and perhaps the targeted excavation of pilot channels to remove any blockages from side channel inlets as necessary. Table 28 provides an overview of actions identified for the reach by action type. The only strategic action identified for the LU is associated with the NF-23 crossing which inhibits channel migration processes upstream of RM 29.

Table 28. Strategy summaries by action type for the Cispus – Upper LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	No protection areas identified. The entire landscape unit is on National Forest land. The associated land use practices are assumed (from Miller et al., 2017) to be sufficient to protect existing high functioning areas and should be continued.	NA
Strategic	The only strategic action is to address floodplain and CMZ impacts from the 23 Road crossing.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	The primary action is the restoration of an island braided channel type throughout the broader valley-bottom areas along the mainstem upper Cispus.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	In the more confined sections, the actions are to enhance habitat complexity and local sediment storage by placing large key pieces of wood to form large log jams.	Provide short-term spawning and rearing habitat, primarily for coho and steelhead.

6.2.10 Cispus – Mid-Valley

The primary stressors in this LU include floodplain encroaching structures and the legacy effects of past land management. The LU is largely functioning or on a positive trajectory and thus the primary approach is to continue to implement management strategies that promote ecological processes and remove floodplain encroaching structures (e.g., berms and riprap) where possible. Therefore, the specific objective is to:

1. Remove barriers to channel migration processes and floodplain connectivity.

Table 29 summarizes strategies by action type.

Table 29. Strategy summaries by action type for the Cispus – Mid-Valley LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	No protection areas identified. The entire LU is on National Forest land. The associated land use practices are assumed (from Miller et al., 2017) to be sufficient to protect existing high functioning areas and should be continued.	NA
Strategic	There are two strategic restoration actions identified in this LU. One is to address floodplain and CMZ effects of a section of riprap armoring and the nearby 23 Road that lies within the floodplain and CMZ near the NF Cispus. The other is to address floodplain and CMZ impairment related to the 23 Road fill and bridge crossing at the downstream end of the landscape unit.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	There are two Reconnect and Restore actions identified. One is to address the effects on channel processes and margin habitat due to the riprap revetment and associated cobble berm along the 23 Road washout area, and the other is to address the confinement of the lower NF Cispus.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	There are no Enhance and Create actions identified for this landscape unit, however local Enhance and Create elements are likely to be a part of other action areas identified in this LU.	NA

6.2.11 Cispus – Tower Rock

Existing stressors in the LU include encroachment in the floodplain (e.g., development, infrastructure), channelization, and bank armoring. The primary strategy for this LU is to increase lateral sediment exchange (e.g., store and sort bedload sediments) across the floodplain, creating complex in-channel and floodplain habitats. Thus, reach objectives include:

1. Restoring connectivity to the floodplain throughout the LU (e.g., targeted acquisitions from willing landowners and levee/riprap removal));
2. Removing impediments to channel migration zone processes (e.g., berm removal);
3. Initiating the formation of stable islands (e.g., use wood jams to deflect flows and sort and deposit sediment); and,
4. Enhancing spawning and rearing habitats for all targeted species: spring Chinook, coho, and winter steelhead (e.g., wood jam construction).

The primary mechanisms to accomplish these objectives include working with willing landowners on targeted acquisitions that could allow the removal of structures from the CMZ to restore channel migration processes, reconnection of large portions of floodplain, and the creation of stable islands with mainstem log jams. Actions, summarized by action type in Table 30, include strategic actions that require acquisitions and/or willing landowner agreements before ecological processes can be restored. Reconnect and Restore actions address floodplain connectivity issues.

Table 30. Strategy summaries by action type for the Cispus – Tower Rock LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	No Protection areas identified. Much of the landscape unit is on National Forest land. The associated land use practices are assumed (from Miller et al., 2017) to be sufficient to protect existing high functioning areas and should be continued. The other portions are not believed to be at significant risk of further impairment or are already impaired/disconnected.	NA
Strategic	There is a Strategic restoration action associated with the floodplain and CMZ impacts from the bridge crossing lower Yellowjacket Creek. The two other Strategic actions are associated with floodplain fill, development, levees, and armoring that affect portion of the river-left floodplain at the downstream end of the landscape unit.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Reconnect and Restore	Reconnect and Restore actions are primarily associated with restoring an island-braided channel type in lower Yellowjacket Creek and along the mainstem Cispus throughout the middle portion of the landscape unit.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	There are no Enhance and Create actions identified for this landscape unit however local Enhance and Create elements are likely to be part of other action areas identified in this LU.	NA

6.2.12 Cispus – Lower

The primary stressor causing stream degradation in this LU is historical logging and a lack of large wood. The primary strategy for this LU is to increase channel complexity where valley width allows and to increase margin complexity. Objectives include:

1. Increasing sediment storage and lateral connectivity (e.g., use wood jams to deflect flows and sort and deposit sediment); and
2. Improving rearing and holding habitats in the mainstem and tributaries for all targeted species: spring Chinook, coho, and winter steelhead (e.g., wood jam construction).

The primary mechanisms to accomplish these objectives include forest management and large wood loading, including mainstem and tributary jams, as well as the installation of bank jams. Actions are summarized by type in Table 31. Reconnect and Restore actions are focused on increasing connectivity at tributary junctions and localized areas of reduced confinement. Enhance and Create actions are focused on increasing channel complexity in the mainstem and tributaries.

Table 31. Strategy summaries by action type for the Cispus – Lower LU.

Action Type	Strategy Summary	Summary of Fish Benefits
Protection	No Protection areas identified. The upstream portion of this landscape unit is on National Forest land. The associated land use practices are assumed (from Miller et al., 2017) to be sufficient to protect existing high functioning areas and should be continued. The downstream portion is private timber land but is relatively confined, with sometimes challenging access.	NA
Strategic	No Strategic actions identified.	NA
Reconnect and Restore	The primary action is the restoration of an island braided channel type throughout the pockets of broader valley-bottom areas along the mainstem Cispus. There is also the potential to reconnect portions of lower Iron Creek where it is entrenched and confined.	Restore the habitat-forming processes that will benefit all life-stages of all ESA-listed salmonids.
Enhance and Create	In the more confined Cispus River sections, and in the Woods Creek tributary, the actions are to enhance habitat complexity and local sediment storage by placing large key pieces of wood to form large log jams.	Provide short-term spawning and rearing habitat, primarily for coho and steelhead.

7 Action Priority Areas

Within landscape units, the hierarchical structure of Protection → Strategic → Reconnect and Restore → Enhance and Create provides the basis for action type prioritization. Identifying priorities ***across*** LUs is more complex, since many actions throughout the basin and across multiple LUs will be necessary to achieve recovery.

A LU prioritization does not imply that all actions within a focal LU are better than actions within other LUs. For example, a high priority action in a non-focus LU may actually be more beneficial than a low priority action in a focus LU. However, it is useful to identify key focus areas and actions that will provide unique benefits targeting major watershed process impairments in important salmon and steelhead use areas. To support greater understanding of watershed process and potential actions within the Upper Cowlitz Cispus Basin, a subset of LUs and actions are highlighted below as areas to focus implementation. Other LUs and actions are just as important / critical to supporting habitat improvements for salmon and steelhead in the basin, and should still be considered for implementation.

In general, these focus LUs:

1. have the potential to provide substantial watershed process benefits to support long-term salmon recovery in the basin; and
2. are a high priority area from both a salmon recovery and a community interest perspective.

These focus areas and actions are presented below, with the rationale included. They are listed in no significant order. Some example projects are listed in these discussions; the project numbers can be cross-referenced to the tables and maps in Appendix E.

Cowlitz Mid-Valley

This LU contains abundant existing and potential salmon and steelhead spawning and rearing habitat (Chinook, coho, and steelhead critical habitat, Tier 1 EDT reaches). It has many moderately impaired or impaired ecological indicators, but with good opportunities for ecological uplift due to sparse development, existing forested conditions, large parcels, and less infrastructure and risk constraints compared to areas upstream. There are several key large parcels within the floodplain and CMZ that are at risk of subdivision, clearing, and development; these should be targets for protection actions. There are multiple Strategic actions where flood risk to structures and ecological restoration could be combined. Reconnect and Restore actions could focus on transforming the channel type to an island-braided system (Project 18 and 33) and addressing relic hydromodifications that are no longer necessary (e.g., Project 24). Simpler enhance/create opportunities are plentiful, including in important tributary habitats such as Hall Creek (Project 25).

Cowlitz Randle

This LU contains abundant existing and potential salmon and steelhead spawning and rearing habitat, with all Tier 1 EDT reaches. Ecological indicators are mostly moderately impaired or impaired ecological indicators. There are good restoration opportunities as development is relatively sparse, but there is widespread clearing and floodplain disconnection that will take concerted and focused efforts to address. There are large undeveloped and forested parcels within the floodplain and CMZ that could be subject to division, clearing, and development (e.g., Project 43, 46, and 65). Strategic actions include removal of at-risk structures from the floodplain/CMZ, in some cases opening up opportunities for large mainstem side-channel reconnections (Project 39 and 50). Reconnect and Restore actions include the widespread replanting of floodplain forests (e.g., Project 56), which is critical for the long-term function of this reach and will complement future restoration actions.

Cispus Mid-Valley

This LU contains abundant existing and potential salmon and steelhead spawning and rearing habitat (Chinook, coho, and steelhead critical habitat, Tier 1 EDT reaches). This segment of the Cispus River includes wider floodplain areas than up and downstream. Many of the Ecological Indicators are either 'functional' or 'functional to moderately impaired'. The LU is entirely within the National Forest and conditions are generally good, or improving under current management, and already protected. However, there are a few locations where actions would restore valley bottom processes to a very high quality. These include removal of armoring and levees near the NF Cispus confluence (Project 97), and enhancement of floodplain connectivity at the downstream end near the Cispus Road Bridge (Project 98).

Cispus Tower Rock

This LU contains abundant existing and potential salmon and steelhead spawning and rearing habitat (Chinook, coho, and steelhead critical habitat, Tier 1 EDT reaches). This segment of the Cispus River includes wider floodplain areas than up and downstream. It is dominated by 'moderately impaired' ecological indicators. The LU is just over half National Forest land, with private recreational, forest, and rural residential making up the remainder. There is high potential for improvement of ecological processes in this LU, including along the mainstem as well as in lower Yellowjacket Creek. Riparian clearing, armoring, floodplain disconnections, and channel simplification have impacted habitat. Strategic actions include modification/removal of fill and armoring (Project 99 and 102), and Reconnect and Restore actions include work in the mainstem and lower Yellowjacket Creek to re-create an island-braided channel system (Project 100 and 101).

Lower Hillslopes

This LU contains important tributary habitat and has uplands that contribute directly to downslope important fish use areas. Land use and ownership is varied and so are the impacts, with stressors related to rural residential development, agriculture, and forest practices. Much of the area is privately owned and is potentially vulnerable to land use conversions that would have greater impacts to fish habitat and watershed processes. This includes conversion of forest to agriculture or residential and conversion of agriculture to residential. Protection actions are important to address potential impairments in sensitive areas including riparian areas and floodplains. There are also opportunities for Reconnect and Restore and Enhance and Create actions.

8 Next Steps

8.1 Data Gaps Identified in the Upper Cowlitz Cispus Habitat Strategy

To support habitat improvement for salmonid recovery in the basin, several gaps in information and understanding have been identified.

- **Fish presence, limiting factors data or modeling**: limited salmon and steelhead monitoring data were available during development of the strategy because reintroduction of salmon and steelhead into the Upper Cowlitz and Cispus watersheds is in the early phases. As Tacoma Power continues monitoring reintroduction, more information will be available on fish distribution, presence, and limiting habitat conditions.
- **More detailed information for hillslope landscape units**: although ecological indicator ratings are included in the hillslope LUs, no habitat actions are identified. This is because of limited data availability for these areas, including a lack of field surveys. Additional review of these LUs, and the many tributaries within them, may result in refined ecological indicator ratings as well as identification of additional habitat actions to benefit salmon and steelhead.
- **Site specific modeling**: this strategy primarily focuses on coarse-scale variables that affect salmon and steelhead habitat conditions at landscape unit–scales. Modeling of finer-scale site conditions will need to occur when habitat actions are adapted for habitat project design, conservation and restoration.
- **An understanding of landowner willingness**: although outreach to riverside landowners and the general community occurred to support site surveys and public workshops, landowner willingness to support habitat protection and restoration actions is not well understood at this point across the strategy area. Potential habitat project sponsors will need to conduct additional outreach to landowners to determine if and how habitat actions may lead to site-scale projects.
- **Repeatable information**: a clearer picture of watershed processes and salmon and steelhead habitat needs is often available when watershed and population data are collected in a consistent and ongoing manner. As the salmon and steelhead monitoring program continues, and additional watershed characteristics are monitored by local partners, including Tacoma Power and the U.S. Forest Service, there will be increased confidence in the top needs for salmon and steelhead recovery and healthy watershed processes and conditions.
- **Climate change**: this strategy relies on historical and current information to inform recommended habitat actions for salmon and steelhead recovery. Climate change is affecting, and will continue to affect, precipitation and temperature patterns, which in turn impact hydrologic regimes and water temperature, two key variables that influence the quantity and quality of available salmon and steelhead habitat. A more accurate picture of salmon and steelhead habitat needs will be provided if climate change effects are considered in modeling hydrology and temperature regimes in the Upper Cowlitz and Cispus watersheds.

Additionally, several factors would facilitate implementation of the Habitat Strategy

- **Willing project sponsors**: implementation of the Habitat Strategy relies on willing project sponsors to work with funders, landowners, and strategy information to develop protection and restoration projects to support salmon and steelhead recovery. Potential project sponsors were involved in strategy development and discussion of implementation needs.
- **Funding mechanisms for habitat work**: habitat project development and implementation relies on long-term, financial support. Potential funding sources are listed in this report, but ongoing outreach and collaboration is necessary to ensure diverse and consistent financial resources are available for habitat projects.
- **Ongoing engagement and collaboration with landowners and residents**: as noted in the data gaps section, additional landowner outreach is key to implementing the strategy. The large number of habitat actions identified, as well as the large spatial-scale of many individual actions, require ongoing outreach and partnership with the local community to find ways to implement habitat projects that support people and fish.

8.2 From Planning to Implementation

Implementation of the strategy is fully voluntary, and thus relies on a collaborative and supportive network of community members and natural resource managers to implement identified habitat actions. The habitat strategy report is a planning tool intended to support voluntary implementation, and serves as a resource that:

- synthesizes surveys and analyses;
- centralizes data and information in the study area;
- uses existing data, information and analysis results to identify impairments and stressors to salmon habitat, and actions to address them; and
- reflects local stakeholder expertise in salmon, watershed health and community needs.

This habitat strategy can help project sponsors understand where the highest priority habitat protection and restoration needs are. This provides a foundation for reaching out to property owners to further identify opportunities for on the ground work. In addition to the written materials produced through the strategy process, work group members and the LCFRB staff are important contacts for learning more about the strategy process, landowner outreach results, and potential grant programs and project sponsorship opportunities. The following tables include key contacts for applying the habitat strategy planning resources to project development and implementation. Additional details on data sources are found in the reference section, Appendix A.

In addition to grant, project sponsorship, and permitting contacts, the LCFRB can provide information on landowner and stakeholder outreach efforts conducted as part of the habitat strategy. Contact the LCFRB office (360-425-1555; info@lcfrb.gen.wa.us) if you would like to learn more about past outreach efforts in the project area.

Table 32. Potential grant resources to support strategy implementation.

Grant Resource	Program Contacts	Program Focus
Wetland Reserve Program (WRP)	USDA Chehalis Service Center (360-748-0083)	Annually available restoration, enhancement and protection funds available for privately-owned wetland habitat that are on agriculture-eligible lands. More information can be found online.
Environmental Quality Incentives Program (EQIP)	USDA Chehalis Service Center (360-748-0083)	Technical and financial support for farm, ranch, and forest landowners to develop and implement conservation practices to support improved habitat and agricultural operations. More information can be found online.
Salmon Recovery Funding Board (SRFB)	Lower Columbia Fish Recovery Board (360-425-1555; info@lcfrb.gen.wa.us)	The annual SRFB grant program funds habitat assessments, designs, acquisition, and restoration projects that support salmon and steelhead recovery in Washington State. The Upper Cowlitz and Cispus watersheds are within the LCFRB Lead Entity for this program. More information can be found on the LCFRB and statewide websites.
Water Quality Grants and Loans	Agency Grant and Loan Coordinator (360-407-7626)	Ecology provides a number of grants and loans focused on improving water quality. More information on the programs can be found on online, including contacts for specific programs.
Cowlitz Restoration & Recovery Program (CRR)	Tacoma Power (253-502-8600; cowlitz@cityoftacoma.org)	The $17 million CRR fund is available to support hatchery and habitat projects that protect and promote recovery of ESA-listed salmon species in the Upper Cowlitz basin. More information can be found on online.
Lewis County Public Utilities District Mitigation Funds	Lewis County PUD (800-562-5612)	Lewis County PUD may have funds available to support salmon habitat projects in the basin that support PUD mitigation needs. Funds are typically available annually, with requests needed by June.
U.S. Forest Service	Cowlitz Valley Ranger Station (360-497-1100)	There is no formal grants program available for habitat restoration in the USFS area of the basin, but funds are occasionally available through timber sale return receipts.

Table 33. Potential habitat project sponsoring organizations that are either already working in the area or have potential to expand.

Sponsoring Organization	Project Types
Cowlitz Indian Tribe	Restoration
Yakama Nation Fisheries	Restoration
U.S. Forest Service	Restoration and NEPA permitting
Washington Department of Fish and Wildlife	Restoration and HPA permitting
Tacoma Power	Restoration, Protection, Monitoring
Forterra	Protection
Lewis County Public Utilities District	Restoration, Protection, Monitoring
Lewis County	Restoration, focused on fish passage constraints at county culverts and bridges
Lewis Conservation District	Restoration, agricultural lands support
Cascade Forest Conservancy	Restoration, Monitoring

Table 34. Contacts for habitat project permits. Not all permits may apply to all projects.

Permit	Agency	Contact (General)	Background or Jurisdiction
Regulatory Assistance	Governor's Office for Regulatory Innovation and Assistance (ORIA)	Phone: 800-917-0043 Phone: 360-725-0628 Website: Link	ORIA helps people navigate Washington's environment regulatory systems.
Critical Areas Ordinance, Growth Management Act (GMA), other local permits	Lewis County Community Development	Phone: 360-740-1146 Website: Link	GMA requires all cities and counties to adopt development regulations that protect critical areas.
Shorelines, State Environmental Policy Act (SEPA), Floodplain, etc.	Local municipalities, including, but not limited to, Silver Creek, Mossyrock, Morton, Glenoma, Randle, and Packwood	Contact local planning departments	Washington State Department of Ecology (Ecology) must approve shoreline conditional use permits and variances.
Shorelines, State Environmental Policy Act (SEPA), Floodplains, etc.	Washington State Department of Ecology (Ecology)	Phone: 360-407-7469 Website (general): Link Website: Link	Ecology must approve shoreline conditional use permits and variances.
Forest Practices Application (FPA): includes logging, forest road construction, and water typing.	Washington Department of Natural Resources (WDNR)	Phone (Headquarters, Olympia, WA): 360-902-1400 Phone (Pacific Cascade Region, Castle Rock, WA): 360- 577-2025 Website: Link	WDNR establishes standards for forest practices such as timber harvest, pre-commercial thinning, road construction, fertilization, and forest chemical application.
Hydraulic Project Approval (HPA)	Washington Department of Fish and Wildlife (WDFW)	Phone (Regional): 360-696-6211 Phone (Headquarters): 360-902-2422 Website: Link	Permit required if a project will “use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state.”
Section 10 (Rivers and Harbors Act), Section 404	United States Army Corps of Engineers (USACE)	Phone: 503-808-4373 Website: Link	Under Section 10, a permit is required for work or structures in, over or under navigable waters of the United States. Under Section 404, a permit is required for the discharge of dredged or fill material into waters of the United State

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