ASRP PROJECT SCIENCE GUIDANCE

Background and Definitions

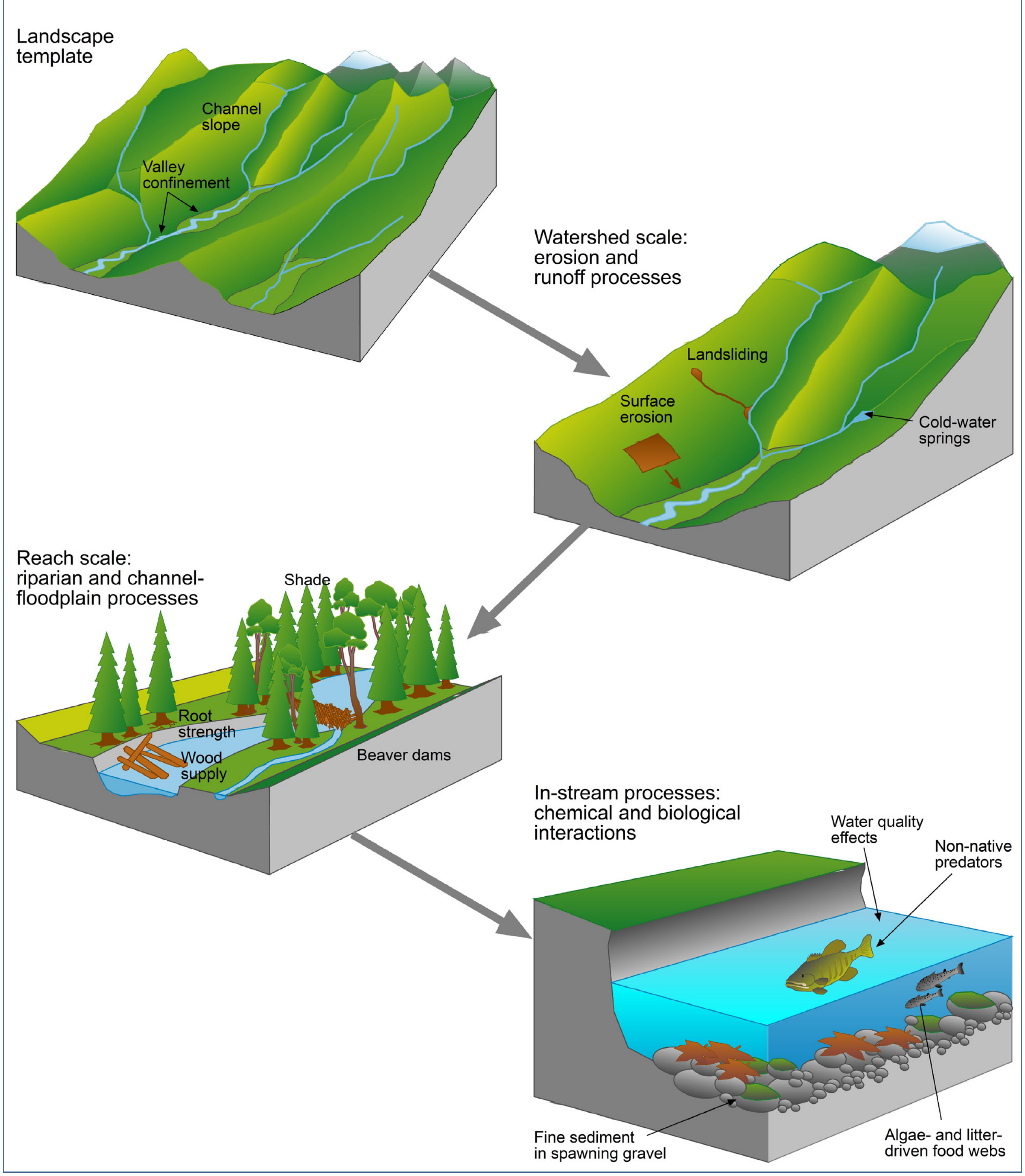
The *Aquatic Species Restoration Plan* (ASRP) has been developed on a foundation of the best available science relative to habitat restoration and the climatic, geomorphic, habitat, vegetation community, and aquatic species conditions within the Chehalis Basin. This guidance is provided as a bridge from the Scientific Foundation for the ASRP (Appendix A of ASRPSC 2019) to the actual development and implementation of projects. The Scientific Foundation and the memorandum titled “A Prioritization and Sequencing Plan to Guide Implementation of the ASRP” (ASRPSRT 2021) are the primary guiding documents for how the Science and Technical Review Team (SRT) believes process-based protection and restoration should be strategically implemented for the ASRP to maximize benefits to habitats and species.

The ASRP is based on protection, restoration, and management actions that work in harmony with—and support the restoration of—watershed processes. When planning a restoration project, it is important to consider the relevant processes operating on the project site, the river reach, and within the larger watershed context.

Figure 1 illustrates an example of watershed processes at the scales of the landscape, the watershed, a reach, and a site. Definitions of key watershed processes follow Figure 1.

> The term ***watershed process*** generally refers to movements of landscape or ecosystem components into and through river systems, which are typically measured as rates (Roni and Beechie 2012). Within the umbrella of watershed processes, there are several categories or processes that work together at different scales to create the ecology of a river system (Figure 1).

Figure 1
Example of Watershed Processes at Landscape, Watershed, Reach, and Site Scales



Note: Figure modified from Roni and Beechie 2012.

ASRP Definitions of Key Watershed Processes

- **Hydrologic processes –** Hydrologic (water) processes vary based on the climate conditions (precipitation and temperature) and are a driving process in a river or stream system, but they also interact with other processes in a watershed. Hydrologic processes that determine how water gets to a stream and the volume of water in the streamflow include canopy interception, snow accumulation and melt, surface runoff, subsurface flow, and groundwater flow. Hydrologic processes related to how water moves through or is stored within the drainage network include routing and flood storage. The magnitude, frequency, duration, timing, and rate of change of flow influence all of the other watershed processes.
- **Sediment processes –** Similar to hydrologic processes, sediment processes are both a driving process and actively interrelated with hydrologic, floodplain, riparian, large wood, and biological processes. The type and quantity of sediment that can be delivered to a river system is determined by the underlying geology. Sediment is supplied to streams through surface erosion, mass wasting, and soil creep and is transported by streams as bed, suspended, or dissolved sediment load. Sediment may be stored within the channel or as floodplain deposits; there is usually interaction with floodplain, riparian, and large wood processes that affect how sediment is transported or stored.
- **Floodplain processes –** Floodplain processes include the combined hydrologic, sediment, riparian, and biological processes that dynamically create and shape the floodplain environment. Channel migration recycles old floodplain and creates new floodplain. Oxbow ponds are created from cutoff meanders, and floodplain wetlands are created from frequent overbank flooding and a high groundwater table. Both will naturally evolve into nutrient-rich habitats for many aquatic and semi-aquatic species that may be seasonally connected to the active channel. Overbank flows also bring fresh sediment deposition accompanied by seeds from upstream vegetation, reinforcing riparian processes.
- **Riparian processes –** Riparian processes function primarily at a reach scale and provide shading, root reinforcement of stream banks, wood supply, sediment retention, nutrient delivery through leaf fall, and support for the stream food web through addition of terrestrial invertebrates. Riparian plants such as willows and cottonwoods are adapted to quickly colonize and thrive on bare alluvial surfaces such as bars within a dynamic river corridor and can quickly stabilize islands and riparian zones. In stable areas, early colonizers eventually give way to successional tree species that will ultimately provide large wood to the river system. Riparian processes interact with sediment and hydrologic processes by stabilizing banks and trapping sediment both in bars and on the floodplain.
- **Large wood processes –** Large wood processes encompass the role that large wood plays in creating in-channel complexity and stability that creates habitats such as pools, traps sediment, and diffuses energy from high flows (hydrologic processes). In a natural or restored state, large wood is naturally provided to the stream through erosion of riparian forests during channel migration (floodplain process). Wood also supports biological processes as a stable nutrient source for the aquatic food web and colonization surface for some invertebrate species.
- **Biological processes –** Biological processes are largely driven by the hydrologic, sediment, floodplain, large wood, and riparian processes that create the habitat conditions and food resources for instream and floodplain aquatic and semi-aquatic species. A diversity of conditions/habitats will support a more diverse biological community assemblage. Riparian and floodplain conditions influence the dominant food web based on terrestrial insect and leaf inputs, or the primary production of algae, mosses, and rooted aquatic and emergent plants.

Note: Definitions summarized and modified from Roni and Beechie 2012.

Actions to Address Limiting Factors

Habitat modeling of future conditions with climate change has been conducted through the ASRP development, using both Ecosystem Diagnosis and Treatment (EDT) model and the National Oceanic and Atmospheric Administration (NOAA) Northwest Fisheries Science Center salmonid life-cycle model (NOAA model). The results from this modeling identified the following key limiting factors on salmonid abundance and productivity outlined in Table 1, along with restoration actions to address the limiting factors.

Table 1
Limiting Factors and Actions Proposed for the ASRP to Address Limiting Factors

EDT LIMITING FACTORS	NOAA MODEL HABITAT FACTORS	ACTIONS TO ADDRESS FACTORS
Key habitat –proportion of channel area in stream habitat types (e.g., pools, riffles, glides, side channels)	Bank armor in large rivers Changes in beaver pond abundance Floodplain habitats reduced	• Remove bank armor and other geomorphic impediments to habitat formation • Restore riparian and wetland habitats to support beavers • Install beaver dam analogs • Restore and reconnect floodplain and off-channel habitats
Habitat diversity –habitat structure and diversity, primarily related to large wood quantity and riparian condition	Wood abundance Shade reduced from historic conditions	• Install wood and wood structures in rivers • Restore riparian forest cover
Obstructions – fish passage barriers	Fish migration barriers	• Remove fish passage barriers
Temperature – number of days at daily maximum temperatures relative to suitability for salmon	Shade reduced from historic conditions Floodplain habitats reduced (related to hyporheic exchange and temperature)	• Protect key upland forested habitats that support natural hydrology and groundwater infiltration • Restore riparian forest cover • Restore and reconnect floodplain habitats • Install wood and wood structures in rivers (including beaver dam analogs)
Flow – estimated change from historical condition of peak and low flows	N/A	

EDT LIMITING FACTORS	NOAA MODEL HABITAT FACTORS	ACTIONS TO ADDRESS FACTORS
Channel length – estimated reduced length from historical condition relative to salmonid life stage capacity	Large river channel straightening	• Remove bank armor and other geomorphic impediments to habitat formation • Restore and reconnect floodplain and off-channel habitats • Install wood and wood structures in rivers
Channel stability – estimated change from historical condition, primarily related to bed scour	N/A	
Sediment load – fine sediment in riffles and suspended sediment load	Fine sediment in spawning gravels	• Restore riparian areas • Install wood and wood structures in rivers (including beaver dam analogs) • Protect and restore upland forested habitats that moderate sediment loading
Predation – conditions that favor predators or known presence of predators	N/A	• Restore riparian forest cover • Provide seasonal connectivity to off-channel areas

The ASRP priorities and sequencing plan have been developed to focus effort in the following three time periods:

- **Near-term (Years 1 to 10)** includes a focus on actions that support one or more of the following elements:
  1. Provide rapid benefits to three at-risk species—spring-run Chinook salmon (*Oncorhynchus tshawytscha*), Oregon spotted frog (*Rana pretiosa*), and coastal tailed frog (*Ascaphus truei*)—with a focus on the upper basin and the Black River Ecological Region
  2. Promote ecological resiliency by protecting and enhancing unique and high-quality habitat areas such as glacial deposit wetland and cold-water areas of the Olympic Mountains
  3. Increase stream flows and the suitability of habitat for spring-run Chinook salmon in the South Fork Chehalis River sub-basin.
  4. Enhance core habitats for multiple species
  5. Restore riparian areas that take a long time to mature in key areas of highest benefit for shading
  6. Are targeted learning experiments to inform restoration actions in future time periods
- **Mid-term (Years 11 to 20)** includes a focus on actions that support one or more of the following elements:
  1. Provide benefits to multiple species, including a focus on the Estuary Ecological Region
  2. Continue restoration of riparian areas that take a long time to mature

3. Restore access to high-quality habitats throughout the basin
4. Have been developed and shown to have substantial benefits through targeted learning experiments in the near-term time period

- **Long-term (Years 21 to 30)** includes a focus on actions that support one or more of the following elements:
  1. Broaden spatial distribution for multiple species
  2. Restore lateral and longitudinal connectivity
  3. Continue building resilience to climate change

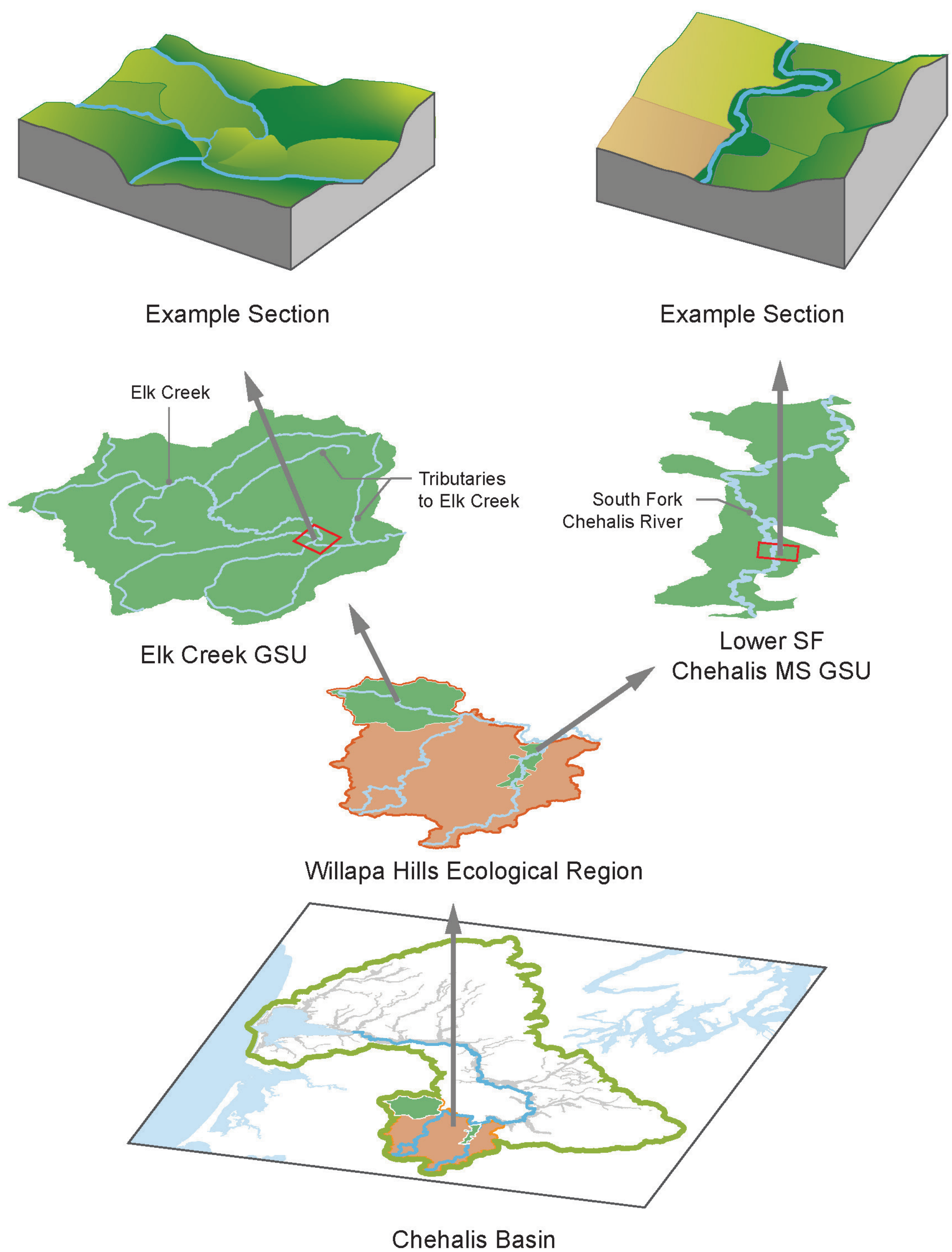
Near-Term, Mid-Term, and Long-Term Priority Actions

The sets of figures and tables on the following pages outline the areas, restoration actions, and focus species and habitat types for each 10-year increment that will be most effective to address the limiting factors identified in the ASRP. To support the prioritization process, the ASRP includes the organization of the basin into 10 ecological regions that are further subdivided into 93 sub-basins containing 180 geospatial units (GSUs) to facilitate identifying and prioritizing areas for restoration.

A GSU is typically a major segment of a river or may be an entire small tributary sub-basin (Figure 2). For example, the Lower South Fork Chehalis River is a GSU, encompassing the lower mainstem river and its floodplain to the confluence with the Chehalis River. Another example of a GSU is Elk Creek, which encompasses the entire small sub-basin (Elk Creek and its tributaries). The actions in the sets of figures and tables for each time period are focused at the GSU scale and are intended to provide measurable benefits to aquatic species and habitats within each GSU.

The GSUs that encompass only mainstem river segments and their associated floodplains provide particularly important habitat for spring- and fall-run Chinook salmon as well as being core habitats for other species such as chum and coho salmon and steelhead or Western toad. The scale of restoration proposed in each GSU is based on a percentage of restoration or protection of the named river miles within a GSU (e.g., number of miles of the Lower South Fork Chehalis River or number of miles of Elk Creek), not counting its tributaries. Tributaries not specifically identified in the prioritization and sequencing are of lesser emphasis and should be primarily considered for fish barrier removals, riparian restoration, groundwater storage, or protection actions.

Figure 2
Example Geospatial Units

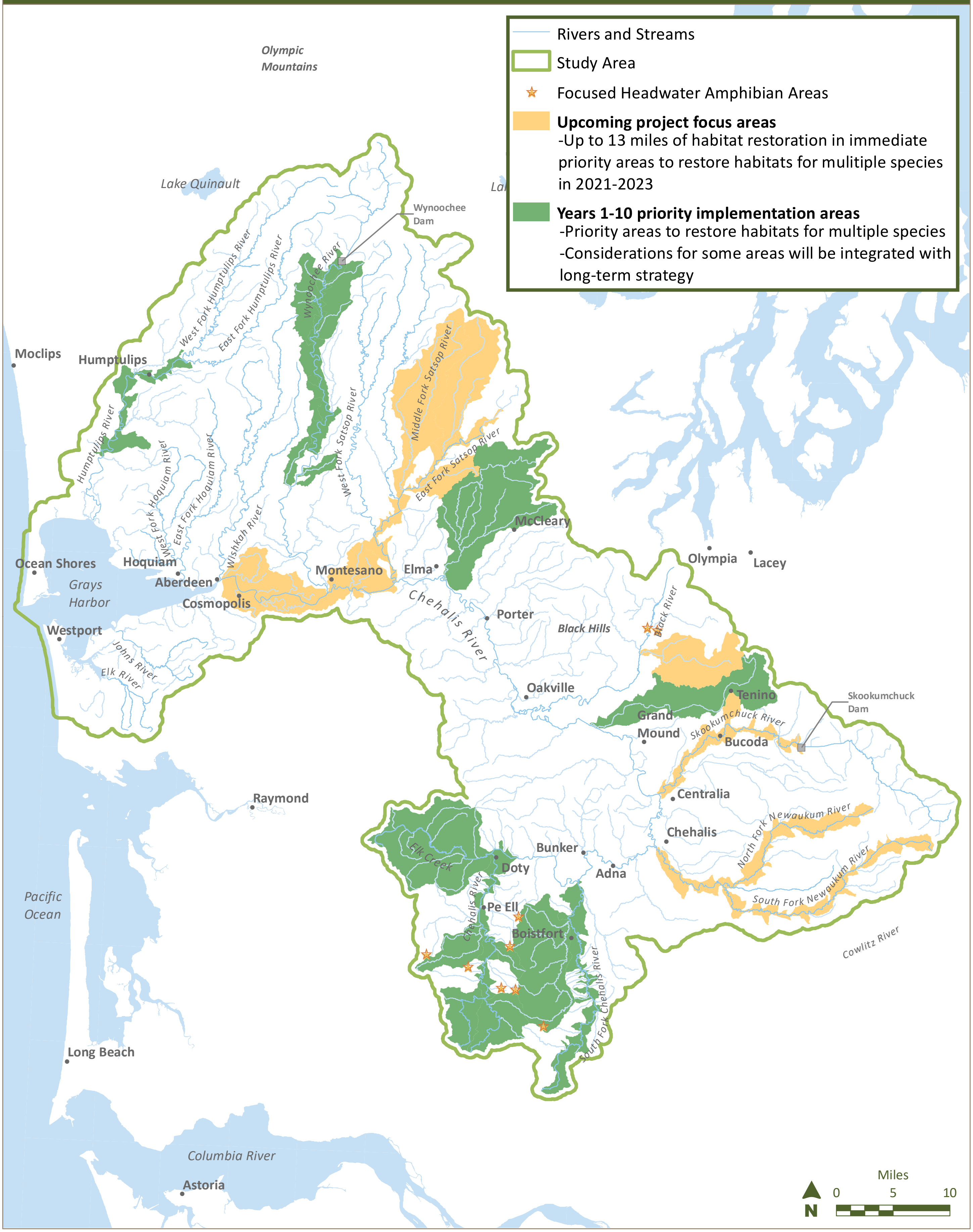


The stream mileage proposed for restoration and protection in the near term is larger and more intensive than in the mid- and long-term time periods due to the importance of addressing the most at-risk species quickly and developing greater resilience in the basin to resist negative effects from climate change and population growth. Restoration and protection are also focused in the upper watershed in the near term that will more effectively translate to downstream benefits in flow and temperature. In the near-term time period, 235 miles of stream and estuary habitats are proposed for restoration and protection. In the mid-term time period, 198 miles of stream and estuary habitats are proposed for restoration and protection, and in the long-term time period, 121 miles of stream habitats are proposed for restoration and protection.

The limiting factors discussed in the prior section were simplified to the following list, for use in the tables:

- **Channel length:** Change in channel length relative to historic condition (change in habitat quantity/capacity)
- **Channel stability:** Change in channel stability relative to historic condition such as increased bed scour
- **Flow:** Change in flow regime relative to historic condition such as changes to peak or low flow conditions
- **Habitat diversity:** Habitat structure and diversity primarily related to presence of large wood and riparian conditions
- **Key habitat:** Proportion of stream habitat in various unit types (e.g. riffles, pools, glides)
- **Obstructions:** Artificial obstructions such as culverts or dams
- **Predation:** Change in conditions favoring predators (e.g., warm water)
- **Sediment load:** Fine sediment presence in riffles (spawning) and fine sediment load
- **Temperature:** Days of daily maximum temperature compared to optimum temperatures for fish

Years 1 - 10 Near-term Priorities for ASRP Implementation



NEAR-TERM ASRP PRIORITY AREAS AND ACTIONS

		Restoration Actions							Geospatial Unit Information					
Ecological Region	Geospatial Unit	Place Large Wood	Remove Fish Barriers	Reconnect/ Restore Floodplain	Riparian Restoration	Beaver Ponds/ BDAs	Wetland Restoration	Acres of OSF* Habitat Protection/ Restoration	Total Number of Barriers	Length of Primary River (miles)	Percent of Primary River Length Proposed for Restoration	Proposed Protection/ Restoration (miles)	Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
Grays Harbor Tributaries	Middle Humptulips MS GSU	High		Medium	High				0	22.8	50%	11	(H) High Priority Core Habitats (R) Early Riparian Restoration	**Key Habitat, Temperature, Sediment Load,** Habitat Diversity, Flow, Channel Length, Channel Stability, Predation
Olympic Mountains	Lower Satsop MS GSU	High		Medium	High				0	6.6	50%	3	(H) High Priority Core Habitats (R) Early Riparian Restoration	**Key Habitat, Temperature, Habitat Diversity,** Channel Length, Channel Stability, Predation, Flow, Sediment Load
	Lower EF Satsop MS GSU	Medium		Medium	High				0	11.4	50%	6	(H) High Priority Core Habitats (R) Early Riparian Restoration	**Temperature, Key Habitat, Habitat Diversity,** Predation, Channel Stability, Flow, Sediment Load
	Decker GSU	High	Medium	High	○	Medium			16	15.8	50%	8	(U) Unique At-Risk Habitat (protection)	**Key Habitat, Temperature, Habitat Diversity,** Obstructions/ Barriers, Sediment Load, Predation, Channel Stability, Flow, Channel Length
	Bingham GSU	High	High	High	○	Medium			13	13.8	50%	7	(U) Unique At-Risk Habitat (protection)	**Obstructions/Barriers, Key Habitat, Habitat Diversity,** Channel Stability, Sediment Load, Predation, Flow, Temperature, Channel Length
	Dry Run GSU	Medium	High		○	High			1	6	50%	3	(U) Unique At-Risk Habitat (protection)	**Obstructions/Barriers, Key Habitat,** Channel Stability, Habitat Diversity, Sediment Load, Flow, Temperature, Predation, Channel Length
	Upper EF Satsop MS GSU	Medium	High	Medium	○				1	8.4	75%	6	(U) Unique At-Risk Habitat (protection)	**Obstructions/Barriers, Key Habitat, Temperature,** Predation, Habitat Diversity, Sediment Load, Channel Stability, Flow, Channel Length
	Middle Wynoochee MS GSU	Medium	Low	Medium	Medium				2	29.4	50%	15	(H) High Priority Core Habitats	**Key Habitat, Obstructions/Barriers, Temperature,** Habitat Diversity, Predation, Sediment Load, Flow, Channel Stability, Channel Length
	Middle Wynoochee Tribs GSU (Anderson and Helm Creeks)	Medium	High	Medium	Medium	Medium			29	8	50%	4	(H) High Priority Core Habitats	**Obstructions/Barriers, Sediment Load,** Habitat Diversity, Channel Stability, Temperature, Flow, Key Habitat, Predation, Channel Length
Black Hills	Cloquallum GSU	High	High	Medium	High	Medium			62	20.4	50%	10	(H) High Priority Core Habitats	**Obstructions/Barriers, Temperature, Key Habitat,** Predation, Habitat Diversity, Sediment Load, Channel Stability, Flow, Channel Length
Black River	Scatter GSU	High	Low	High	High	High	High		7	20.6	33%	7	(H) High Priority Core Habitats (R) Early Riparian Restoration	**Temperature, Key Habitat, Habitat Diversity,** Predation, Channel Stability, Sediment Load, Flow, Obstructions/Barriers, Channel Length
	Beaver GSU	Medium	High	High	High	High	High	19	11	11.4	50%	6	(H) High Priority Core Habitats (R) Early Riparian Restoration (O) Oregon Spotted Frog	**Key Habitat, Obstructions/Barriers, Sediment Load,** Habitat Diversity, Temperature, Predation, Channel Stability, Flow, Channel Length
Cascade Mountains	Lower Skookumchuck MS GSU	High		High	High				0	22.2	75%	17	(R) Early Riparian Restoration (S) Spring Chinook	**Channel Length, Temperature, Key Habitat,** Habitat Diversity, Predation, Sediment Load, Channel Stability, Flow
	Lower Newaukum MS GSU	Medium		High	High				0	10.5	75%	8	(R) Early Riparian Restoration (S) Spring Chinook	**Temperature, Habitat Diversity, Channel Length,** Key Habitat, Sediment Load, Predation, Channel Stability, Flow
	SF Newaukum MS GSU	High		High	High				0	22	75%	17	(R) Early Riparian Restoration (S) Spring Chinook	**Habitat Diversity, Temperature, Key Habitat,** Channel Stability, Flow, Sediment Load, Predation
	NF Newaukum MS GSU	High	Low	Medium	High				1	20	75%	15	(R) Early Riparian Restoration (S) Spring Chinook	**Temperature, Habitat Diversity, Key Habitat,** Channel Stability, Predation, Sediment Load, Flow, Channel Length

High = High Priority   Medium = Medium Priority   Low = Low Priority   ○ Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian)   *Oregon Spotted Frog

NEAR-TERM ASRP PRIORITY AREAS AND ACTIONS (CONT.)

Ecological Region	Geospatial Unit	Restoration Actions: Place Large Wood	Restoration Actions: Remove Fish Barriers	Restoration Actions: Reconnect/ Restore Floodplain	Restoration Actions: Riparian Restoration	Restoration Actions: Beaver Ponds/ BDAs	Restoration Actions: Wetland Restoration	Restoration Actions: Acres of OSF* Habitat Protection/ Restoration	Geospatial Unit Information: Total Number of Barriers	Geospatial Unit Information: Length of Primary River (miles)	Geospatial Unit Information: Percent of Primary River Length Proposed for Restoration	Geospatial Unit Information: Proposed Protection/ Restoration (miles)	Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
Willapa Hills	Elk Cr GSU	Medium	High	Medium	○	Medium			2	15.8	75%	12	High Priority Core Habitats Spring Chinook	**Key Habitat, Habitat Diversity, Temperature,** Sediment Load, Channel Stability, Predation, Flow, Obstructions/ Barriers, Channel Length
	Chehalis Abv Crim MS GSU	High			○				0	10.8	75%	8	Spring Chinook Coastal Tailed Frog	**Temperature, Habitat Diversity, Key Habitat,** Predation, Channel Stability, Sediment Load, Flow
	Chehalis RB Falls to Crim MS GSU	High		Medium	Medium				1	12.6	75%	9	Early Riparian Restoration Spring Chinook	**Habitat Diversity, Temperature, Key Habitat,** Predation, Channel Stability, Sediment Load, Flow, Channel Length
	EF Chehalis MS GSU	Medium			○				0	18	75%	14	Spring Chinook Coastal Tailed Frog	**Habitat Diversity, Key Habitat, Temperature,** Channel Stability, Flow, Sediment Load, Predation
	WF Chehalis MS GSU	Medium			○				0	9.6	75%	7	Spring Chinook Coastal Tailed Frog	**Key Habitat, Habitat Diversity, Temperature,** Sediment Load, Channel Stability, Flow, Predation
	Crim GSU	Medium			○				0	8.4	25%	2	High Priority Core Habitats Coastal Tailed Frog	**Key Habitat, Habitat Diversity, Temperature,** Sediment Load, Flow, Channel Stability, Predation
	Big (WH) GSU	Medium			○				0	3	25%	1	High Priority Core Habitats Coastal Tailed Frog	**Key Habitat, Sediment Load, Channel Stability**
	Rock GSU	Medium							5		N/A	2	Coastal Tailed Frog	**Key Habitat, Habitat Diversity, Obstructions/Barriers,** Temperature, Channel Stability, Flow, Sediment Load, Predation, Channel Length
	Roger GSU	Medium							1		N/A	2	Coastal Tailed Frog	**Key Habitat, Sediment Load, Channel Stability,** Channel Length
	Alder GSU	Medium							0		N/A	1	Coastal Tailed Frog	**Key Habitat, Sediment Load,** Channel Stability
	Mack GSU	Medium							0		N/A	2	Coastal Tailed Frog	**Key Habitat, Channel Stability, Sediment Load,** Habitat Diversity, Flow
	Stowe GSU	Medium							2		N/A	2	Coastal Tailed Frog	**Obstructions/Barriers, Key Habitat, Temperature,** Habitat Diversity, Predation, Sediment Load, Flow, Channel Stability, Channel Length
	Willapa Hills Tribs GSU	Medium							0		N/A	2	Coastal Tailed Frog	**Key Habitat, Temperature, Habitat Diversity,** Sediment Load, Channel Stability, Predation, Flow
	Stillman GSU	High	Low	Medium	Medium	Medium			4	14.9	50%	7	Early Riparian Restoration Spring Chinook Coastal Tailed Frog	**Temperature, Key Habitat, Habitat Diversity,** Channel Length, Obstructions/Barriers, Sediment Load, Channel Stability, Flow, Predation
	Lower SF Chehalis MS GSU	High		High	High				0	13.8	50%	7	Early Riparian Restoration Spring Chinook	**Temperature, Key Habitat, Habitat Diversity,** Predation, Channel Length, Channel Stability, Sediment Load, Flow
	Upper SF Chehalis MS GSU	High		Medium	○	Medium			0	18	50%	9	Spring Chinook	**Temperature, Key Habitat, Habitat Diversity,** Predation, Channel Stability, Flow, Sediment Load
Estuary	Tidal Zone GSU	Medium	Medium	Medium	Medium				72	19.8	33%	7	Early Riparian Restoration Unique At-Risk Habitat (protection)	**Habitat Diversity, Flow, Channel Stability,** Key Habitat, Predation, Sediment Load, Temperature, Obstructions/ Barriers, Channel Length

High Priority — Medium Priority — Low Priority — ○ Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian)

*Oregon Spotted Frog

Years 11 - 20 Mid-term Priorities for ASRP Implementation

MID-TERM ASRP PRIORITY AREAS AND ACTIONS

Ecological Region	Geospatial Unit	Restoration Actions: Place Large Wood	Remove Fish Barriers	Reconnect/ Restore Floodplain	Riparian Restoration	Beaver Ponds/ BDAs	Wetland Restoration	Acres of OSF* Habitat Protection/ Restoration	Geospatial Unit Information: Total Number of Barriers (passage < 1)	Length of Primary River (miles)	Percent of Primary River Length Proposed for Restoration	Proposed Protection/ Restoration (miles)	Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
Grays Harbor Tributaries	Lower Humptulips MS GSU	Medium		Medium	Medium				0	9	50%	5	(H) High Priority Core Habitats (R) Early Riparian Restoration (C) Coastal Tailed Frog	**Habitat Diversity, Key Habitat, Sediment Load,** Temperature, Flow, Channel Stability, Predation, Channel Length
	EF Humptulips MS GSU	High			○				0	28.8	50%	14	(H) High Priority Core Habitats (R) Early Riparian Restoration (C) Coastal Tailed Frog	**Habitat Diversity, Sediment Load, Temperature,** Key Habitat, Channel Stability, Flow, Predation
	WF Humptulips MS GSU	Medium	Low		○				1	24.6	50%	12	(H) High Priority Core Habitats (C) Coastal Tailed Frog	**Temperature, Sediment Load, Habitat Diversity,** Key Habitat, Channel Length, Channel Stability, Predation, Flow
	Big (Hump) GSU	High	Medium	Low	○	High			16	11.5	50%	6	(R) Early Riparian Restoration (C) Coastal Tailed Frog	**Temperature, Sediment Load, Key Habitat,** Habitat Diversity, Channel Stability, Obstructions/Barriers, Flow, Predation, Channel Length
	Upper Wishkah MS GSU	High	Low	Medium	Medium				2	16.2	50%	8	(R) Early Riparian Restoration (A) Additional Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Sediment Load, Flow, Channel Stability, Predation, Channel Length
	EF Wishkah MS GSU	High	Low	Low	Medium				1	15	50%	8	(H) High Priority Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Channel Stability, Flow, Predation, Sediment Load, Obstructions/ Barriers, Channel Length
Olympic Mountains	Lower MF Satsop MS GSU	Medium		Medium	Medium				0	21	50%	11	(R) Early Riparian Restoration (A) Additional Core Habitats	**Temperature, Habitat Diversity, Key Habitat,** Predation, Sediment Load, Channel Stability, Flow
	Lower WF Satsop MS GSU	High		Medium	Medium				0	18.6	50%	9	(R) Early Riparian Restoration (A) Additional Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Channel Length, Sediment Load, Predation, Channel Stability, Flow
	Upper WF Satsop MS GSU	High	Medium		○				1	21	50%	11	(H) High Priority Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Sediment Load, Predation, Channel Stability, Flow
	Upper MF Satsop MS GSU	High		Medium	○				0	11.4	50%	6	(H) High Priority Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Predation, Flow, Channel Stability, Sediment Load
	Lower WF Satsop Tribs GSU	Medium	High		○	High			6	11.4	50%	6	(H) High Priority Core Habitats (C) Coastal Tailed Frog	**Key Habitat, Obstructions/Barriers, Sediment Load,** Habitat Diversity, Temperature, Channel Stability, Flow, Predation, Channel Length
	Lower Wynoochee MS GSU	Medium			○	High			0	20.4	50%	10	(R) Early Riparian Restoration (A) Additional Core Habitats	**Habitat Diversity, Temperature, Key Habitat,** Predation, Flow, Channel Length, Channel Stability, Sediment Load
Black Hills	Mox Chehalis GSU	Medium	Medium	Medium	High	Medium			4	15	50%	8	(H) High Priority Core Habitats	**Temperature, Key Habitat, Habitat Diversity,** Predation, Sediment Load, Channel Stability, Flow, Obstructions/Barriers, Channel Length
	Porter GSU	High	Medium		○				5	11.8	50%	6	(H) High Priority Core Habitats	**Key Habitat, Habitat Diversity, Temperature,** Predation, Sediment Load, Channel Stability, Obstructions/Barriers, Flow
	Cedar GSU	Medium	Medium	Low	○				4	17.4	50%	9	(H) High Priority Core Habitats	**Habitat Diversity, Key Habitat, Temperature,** Predation, Sediment Load, Channel Stability, Flow

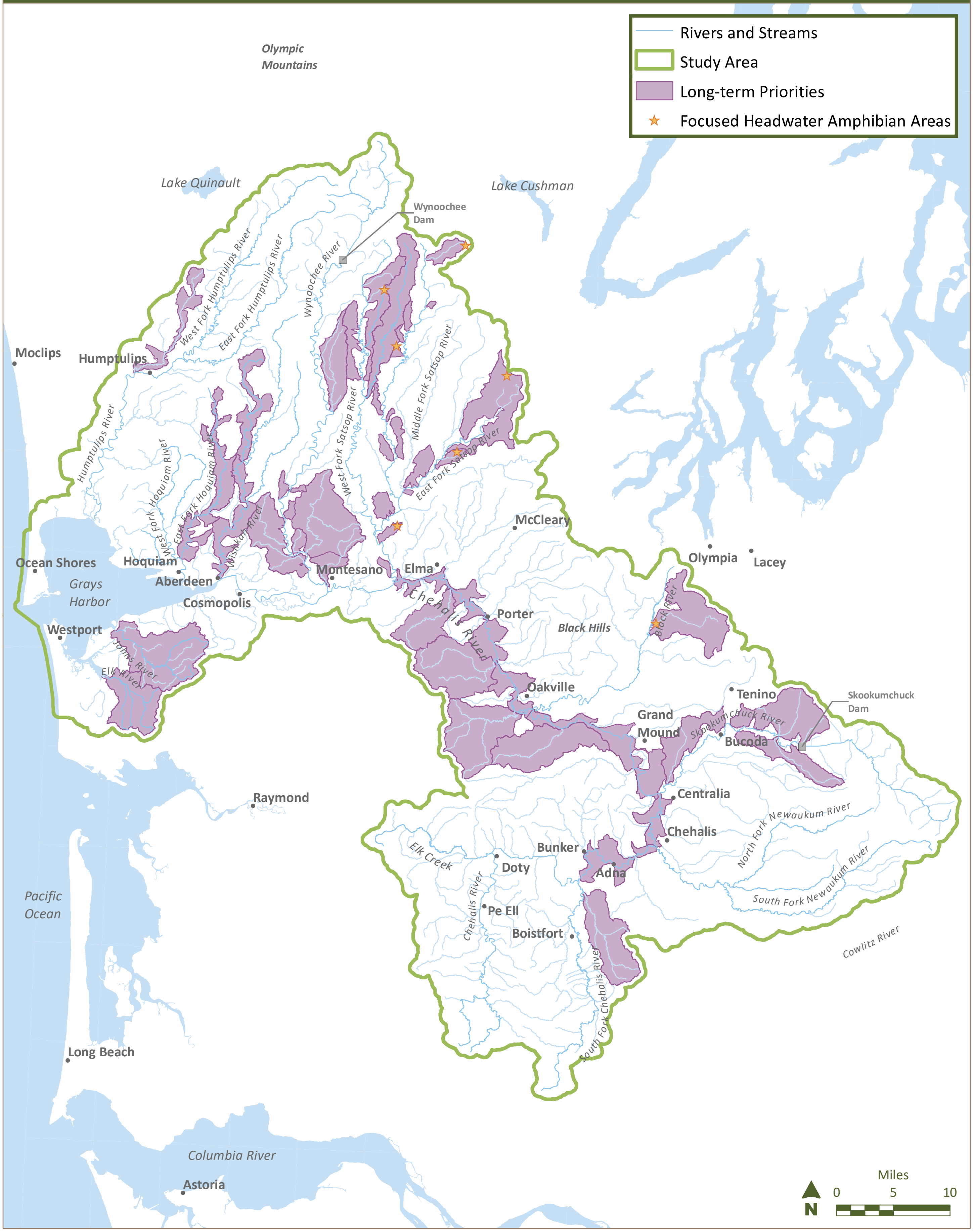
High Priority · Medium Priority · Low Priority · ○ Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian) · *Oregon Spotted Frog

MID-TERM ASRP PRIORITY AREAS AND ACTIONS (CONT.)

Ecological Region	Geospatial Unit	Restoration Actions							Geospatial Unit Information				Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
		Place Large Wood	Remove Fish Barriers	Reconnect/ Restore Floodplain	Riparian Restoration	Beaver Ponds/ BDAs	Wetland Restoration	Acres of OSF* Habitat Protection/ Restoration	Total Number of Barriers (passage < 1)	Length of Primary River (miles)	Percent of Primary River Length Proposed for Restoration	Proposed Protection/ Restoration (miles)		
Black River	Lower Black MS GSU	Medium		Medium	Medium	Medium		4	0	18.6	50%	9	(H) High Priority Core Habitats (R) Early Riparian Restoration (O) Oregon Spotted Frog	**Temperature, Predation, Key Habitat,** Habitat Diversity, Sediment Load, Channel Stability, Flow
	Upper Black MS GSU	Medium		Medium	Medium	High	High	4	0	10.2	33%	3	(R) Early Riparian Restoration (O) Oregon Spotted Frog (A) Additional Core Habitats	**Key Habitat, Temperature, Predation,** Sediment Load, Habitat Diversity, Channel Stability, Flow
	Lower Black Tribs GSU (Mima Creek)	Medium	Low	Medium	Medium	High	High	8	9	6	25%	2	(R) Early Riparian Restoration (O) Oregon Spotted Frog (A) Additional Core Habitats	**Key Habitat, Sediment Load, Obstructions/Barriers,** Habitat Diversity, Channel Stability, Predation, Flow, Channel Length
	Dempsey GSU	Medium	Medium	High	Medium	High	High	13	5	2.4	33%	1	(H) High Priority Core Habitats (R) Early Riparian Restoration (O) Oregon Spotted Frog	**Obstructions, Channel Width, Sediment Load,** Habitat Diversity, Channel Stability, Predation
	Waddell GSU	High	Low		○	Medium		4	2	10.4	50%	5	(H) High Priority Core Habitats (O) Oregon Spotted Frog	**Sediment Load, Habitat Diversity, Key Habitat,** Temperature, Predation, Obstructions/Barriers, Channel Stability, Flow
Central Lowlands	Lincoln GSU	High	Medium	High	Medium	Medium	High		14	17.1	50%	9	(H) High Priority Core Habitats	**Key Habitat, Temperature, Obstructions/Barriers,** Predation, Habitat Diversity, Sediment Load, Channel Stability, Flow, Channel Length
	Bunker GSU	Medium	High	Medium	Medium	High	High		6	12.8	50%	6	(H) High Priority Core Habitats	**Obstructions/Barriers, Temperature, Habitat Diversity,** Key Habitat, Channel Stability, Flow, Sediment Load, Predation, Channel Length
Cascade Mountains	Hanaford GSU	Medium	High	High	High	High			15	16.4	50%	8	(H) High Priority Core Habitats	**Habitat Diversity, Obstructions/Barriers, Key Habitat,** Sediment Load, Temperature, Channel Stability, Flow, Predation, Channel Length
	SF Newaukum Tribs GSU (Kearney, Beaver, Bernier Creeks)	Medium	Medium	Medium	High	High			56	12	50%	6	(C) Coastal Tailed Frog (A) Additional Core Habitats	**Obstructions/Barriers, Key Habitat,** Sediment Load, Habitat Diversity, Channel Stability, Temperature, Channel Length
	Stearns GSU	High	High	High		High			24	10	50%	5	(H) High Priority Core Habitats	**Habitat Diversity, Obstructions/Barriers,** Sediment Load, Channel Stability, Flow, Predation, Channel Length
Willapa Hills	Thrash GSU	Medium			○				1	4.2	25%	1	(H) High Priority Core Habitats (C) Coastal Tailed Frog	**Key Habitat, Habitat Diversity, Sediment Load,** Channel Stability, Flow
Estuary	Grays Harbor Shoreline GSU								Unknown			14	(A) Additional Core Habitats	Not applicable
Middle Chehalis River	Middle Chehalis: SF to Rainbow Falls GSU	Medium		Medium	Medium		High		0	9.6	20%	2	(S) Spring Chinook	**Temperature, Key Habitat, Habitat Diversity,** Predation, Sediment Load, Channel Length, Channel Stability

● High Priority ● Medium Priority • Low Priority ○ Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian) *Oregon Spotted Frog

Years 21 - 30 Long-term Priorities for ASRP Implementation



LONG-TERM ASRP PRIORITY AREAS AND ACTIONS

Ecological Region	Geospatial Unit	Restoration Actions						Geospatial Unit Information				Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
		Place Large Wood	Remove Fish Barriers	Reconnect/ Restore Floodplain	Riparian Restoration	Beaver Ponds/ BDAs	Wetland Restoration	Total Number of Barriers (passage < 1)	Length of Primary River (miles)	Percent of Primary River Length Proposed for Restoration	Proposed Protection/ Restoration (miles)		
Grays Harbor Tributaries	Stevens GSU	Medium	Medium	Low	Medium			1	13.7	50%	7	Ⓒ Coastal Tailed Frog	**Temperature, Key Habitat, Habitat Diversity,** Flow, Channel Stability, Sediment Load, Predation, Obstructions/ Barriers, Channel Length
	Elk R GSU	Medium	Low	Low	○	High		2	20	50%	10	Ⓒ Coastal Tailed Frog Ⓐ Additional Core Habitats	**Sediment Load, Temperature, Habitat Diversity,** Flow, Obstructions/Barriers, Channel Stability, Predation, Key Habitat, Channel Length
	Johns GSU	High	High	Low	○	Medium		5	13.6	50%	7	Ⓒ Coastal Tailed Frog Ⓐ Additional Core Habitats	**Temperature, Habitat Diversity, Sediment Load,** Key Habitat, Channel Stability, Flow, Predation, Obstructions/ Barriers
	EF Hoquiam MS GSU	High		Low	Low			0	22.2	33%	7	Ⓐ Additional Core Habitats	**Habitat Diversity, Channel Stability, Flow,** Sediment Load, Predation, Temperature
	Lower Wishkah MS GSU	High		High	Medium			0	18	50%	9	Ⓐ Additional Core Habitats	**Habitat Diversity, Key Habitat, Temperature,** Channel Stability, Predation, Flow, Channel Length, Sediment Load
	WF Wishkah MS GSU	Medium	Medium	Low	Medium			2	12	50%	6	Ⓐ Additional Core Habitats	**Obstructions/Barriers, Key Habitat, Habitat Diversity,** Channel Stability, Flow, Predation, Temperature, Sediment Load, Channel Length
Olympic Mountains	Upper MF Satsop Tribs GSU	Medium						1		N/A	2	Ⓒ Coastal Tailed Frog	**Key Habitat, Habitat Diversity,** Sediment Load
	Upper WF Satsop Tribs GSU	Medium						1		N/A	1	Ⓒ Coastal Tailed Frog	**Key Habitat, Habitat Diversity, Temperature,** Sediment Load, Predation, Channel Stability, Flow
	Upper EF Satsop Tribs GSU	Medium	High					12		N/A	2	Ⓒ Coastal Tailed Frog	**Obstructions/Barriers, Key Habitat, Sediment Load,** Channel Stability, Temperature, Predation, Flow, Channel Length
	Canyon R GSU	Medium	Low		○			1	14.4	50%	7	Ⓒ Coastal Tailed Frog Ⓐ Additional Core Habitats	**Temperature, Habitat Diversity, Predation,** Flow, Sediment Load, Channel Stability
	Lower Wynoochee Tribs GSU (Wedekind, Mooney Creeks)	High	Medium	Medium	○			19	9	50%	5	Ⓐ Additional Core Habitats	**Obstructions/Barriers, Sediment Load,** Habitat Diversity, Temperature, Channel Stability, Flow, Predation, Channel Length
	Black (Wyn) GSU	Medium		Medium	Medium	High		0	10.3	50%	5	Ⓐ Additional Core Habitats	**Temperature, Sediment Load, Habitat Diversity,** Predation, Channel Stability, Flow
	Shaffer GSU	Medium	Medium	Medium	Medium	High		7	8	50%	4	Ⓐ Additional Core Habitats	**Temperature, Obsructions/Barriers, Habitat Diversity,** Predation, Channel Stability, Flow

High = High Priority; Medium = Medium Priority; Low = Low Priority; ○ = Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian)

LONG-TERM ASRP PRIORITY AREAS AND ACTIONS (CONT.)

Ecological Region	Geospatial Unit	Restoration Actions: Place Large Wood	Remove Fish Barriers	Reconnect/ Restore Floodplain	Riparian Restoration	Beaver Ponds/ BDAs	Wetland Restoration	Geospatial Unit Information: Total Number of Barriers (passage < 1)	Length of Primary River (miles)	Percent of Primary River Length Proposed for Restoration	Proposed Protection/ Restoration (miles)	Priority Species or Habitat Focus	Limiting Factors From Highest Priority to Lowest
Central Lowlands	Garrard GSU	Medium	High	Medium	Medium	Medium	High	6	10.3	50%	5	Additional Core Habitats	**Key Habitat, Obstructions/Barriers, Temperature,** Habitat Diversity, Predation, Channel Stability, Sediment Load, Flow, Channel Length
	Rock (CL) GSU	Medium		Medium	Medium	Medium		0	10.7	50%	5	Additional Core Habitats	**Key Habitat, Temperature, Habitat Diversity,** Predation, Channel Stability, Sediment Load, Flow
	Delzene GSU	Medium	Low	Medium	Medium	Medium		2	6	25%	2	Additional Core Habitats	**Key Habitat, Habitat Diversity, Temperature,** Sediment Load, Predation, Channel Stability, Obstructions/Barriers, Flow, Channel Length
	Independence GSU	Medium	Low	High	Medium	High	High	12	8	50%	4	Additional Core Habitats	**Temperature, Key Habitat, Sediment Load,** Habitat Diversity, Predation, Channel Stability, Flow, Channel Length
Cascade Mountains	Skookumchuck Tribs GSU (Johnson and Thompson Creeks)	Medium	High	High	High	High		22	14	50%	7	Additional Core Habitats	**Obstructions/Barriers, Key Habitat,** Sediment Load, Channel Stability, Habitat Diversity, Temperature, Flow, Predation, Channel Length
Willapa Hills	Lake GSU	Medium	Medium	Medium	Medium	High		6	9.8	50%	5	Additional Core Habitats	**Key Habitat, Temperature, Habitat Diversity,** Sediment Load, Channel Stability, Flow, Predation
Middle Chehalis River	Middle Chehalis: Newaukum to SF GSU	Medium	Low	Medium	Medium		High	5*	13.2	20%	3	Additional Core Habitats	**Temperature, Habitat Diversity, Key Habitat,** Predation, Sediment Load, Channel Length, Channel Stability, Flow, Obstructions/Barriers
	Middle Chehalis: Skook to Newaukum GSU	Medium		High	Medium		High	0	8.4	33%	3	Additional Core Habitats	**Habitat Diversity, Temperature, Key Habitat,** Predation, Sediment Load, Channel Length, Channel Stability
Lower Chehalis River	Lower Chehalis: Satsop to Porter GSU	Medium		High	Medium		High	0	13.2	33%	4	Additional Core Habitats	**Habitat Diversity, Predation, Key Habitat,** Temperature, Sediment Load, Channel Stability, Flow, Channel Length
	Lower Chehalis: Porter to Black GSU	Medium		High	Medium		High	0	13	33%	4	Additional Core Habitats	**Predation, Habitat Diversity, Key Habitat,** Temperature, Channel Stability, Flow, Sediment Load, Channel Length
	Lower Chehalis: Black to Skook GSU	Medium		High	Medium		High	0	19.8	33%	7	Additional Core Habitats	**Key Habitat, Habitat Diversity, Temperature,** Predation, Channel Length, Channel Stability, Flow, Seidment Load

High Priority · Medium Priority · Low Priority · Restoration is supplemental as-needed (GSU is primarily managed forest with protected riparian)

* Barriers not located on mainstem river but on small unnamed tributaries

Considerations for Project Planning and Design

The ASRP-recommended approach is to restore natural watershed processes, as feasible, at any restoration project reach or site. The following sections provide important items to consider when developing and designing projects to meet both ASRP and landowner goals.

Context from Prioritization and Sequencing

Following the priorities and sequencing described previously is intended to most successfully improve habitat conditions for the aquatic species of interest, particularly at-risk species. However, implementation of projects will require balancing of species and landowner needs to be successful. The restoration actions recommended and emphasized are of greatest importance, but additional and innovative restoration actions may be appropriate at any given site. The following items are intended to provide additional context for the prioritization and sequencing plan.

- Implementation Teams should locate near-term riparian efforts where the restoration (planting) will not be removed in the future due to in-channel or other work. Riparian restoration emphasized in the near-term period should be considered as the primary restoration element because it was identified as the most important action in specific GSUs; however, as appropriate, riparian restoration can be integrated with other restoration elements, including in-channel elements, if that is the most efficient and effective restoration design approach for a specific location.
- The memorandum titled "A Prioritization and Sequencing Plan to Guide Implementation of the ASRP" (ASRPSRT 2021) identified specific GSUs for restoration and proposed the mileage of restoration in each, but it did not identify specific areas within a GSU that should be restored. Locations are best determined by the Implementation Teams working with individual landowners. For each GSU, when developing projects, it will be important to consider which reaches/areas can be restored most effectively to restore natural watershed processes (such as floodplain connectivity) and achieve the ASRP goals.
- The ASRP does not promote creation of habitats where they would be unlikely to naturally form. However, there may be instances where created habitats would be beneficial. For example, excavation of seasonal floodplain wetlands may be a good approach to support amphibian species and discourage invasive amphibian or fish species that require permanent water. The installation of large wood structures is not considered a created habitat, but an effective method to form in-channel habitats in the short term until riparian forest can mature and naturally contribute large wood to the system.

Considerations for Addressing Watershed Processes

The process-based approach to restoration is intended to result in the long-term sustainability of habitats and habitat functions over time. If a restoration site must rely on ongoing human intervention or maintenance, it is not sustainable and does not function within ongoing watershed processes. If a project reach has so many constraints that natural processes cannot be restored, then alternate reaches should be considered a higher priority for restoration. For example, one goal of the ASRP is to promote frequent connectivity between the stream and its floodplain to allow aquatic species access to wetland, off-channel, or other habitat types and to allow for the long-term maintenance and formation of aquatic habitats. If connectivity to the floodplain cannot be achieved, or would result in adverse on-site or off-site impacts (such as flooding of numerous structures that cannot be relocated), other locations in the reach may be more feasible for restoration. Key questions to consider during project planning and design include the following:

- What activities may have historically occurred (or may still be ongoing) in the watershed that have degraded habitat and watershed processes? Could human activities have included the following:
  - Removal of large wood leading to increased water velocities and shear stresses on the channel bed and banks, causing channel incision and widening that secondarily may also have reduced connectivity to the floodplain?
  - Forestry that removed large trees and may have reduced water infiltration into the soil or increased runoff of water and sediment into the system?
  - Elimination of beavers and their ponds and habitats?
  - Removal of riparian vegetation?
- Will watershed conditions continue to affect habitats and processes in the project reach?
- Can restoration actions ameliorate the problem and function sustainably within the ongoing watershed condition context?
- Are there existing human-caused features within or adjacent to the project reach that inhibit or previously changed geomorphic processes? Could these features include the following:
  - Bank armoring intended to prevent channel migration?
  - Fill or structures that prevent flooding of portions of the floodplain?
  - Removal of vegetation that may have accelerated bank erosion and channel migration?
- Can these features be removed or modified to promote more natural geomorphic processes?
- Are there opportunities to promote more frequent connectivity to the floodplain and off-channel habitats that can be sustained, such as with natural recruitment of large wood over time and deposition of sediment to re-aggrade an incised channel?
- If native riparian habitats are restored, will short- to mid-term conditions allow for trees to mature and eventually naturally erode to provide large wood to the river system?
- If in-stream habitats or side-channels are restored, will flood events and natural rates of channel migration be able to connect, form, and reshape the restored habitats for a dynamic equilibrium of habitats over time?

Considerations for Cooperating with Landowners

Working and cooperating with landowners is essential for the success of the ASRP. To that end, the ASRP was developed with the understanding that there is not one prescribed way of implementing any restoration action and there will need to be a give and take between habitat protection or restoration and ongoing landowner uses. For example, the ASRP does not state that riparian restoration must be of a specific width along a stream, but the intent is to restore a naturally functioning riparian zone that can contribute large wood to the stream over time. Projects that restore very narrow riparian corridors that are not accessible to the river over time may not meet ASRP goals. The following considerations are commonly followed for many restoration projects but have been found to be particularly useful and important for implementing the ASRP:

- It is important to discuss with the landowner their concerns, needs, and interests for their property and opportunities for restoration from the very beginning.
- It is important to graphically convey areas of erosion hazard and flooding risk and hear about a landowner's past experiences with these events. This may open up opportunities to consider restoration or protection of areas with the highest risk and possibly the lowest land use value.
- If a landowner has ongoing erosion or flooding concerns, then identifying ways to slow erosion or opportunities to minimize flood damages should be discussed. The ASRP and Chehalis Basin Strategy more broadly can fund relocation of structures and/or larger reach-scale projects that simultaneously slow erosion while also providing substantial habitat benefits.
- The ASRP can fund ancillary features such as structure relocations, livestock fencing, livestock bridges, rerouted farm roads, or other features that could protect riparian plantings or minimize livestock access into sensitive aquatic habitats.
- Unique and innovative actions such as silvopasture and riparian hedgerows can be considered in the context of providing long-term shading, cover, wood recruitment, and other functions to stream habitats.
- Riparian and floodplain restoration expansion should be explored in areas where a landowner may have limited use already and may need to be narrowed in areas where it is important to maintain an existing structure or land use. The intent is to provide a cohesive project that allows for floodplain connectivity and natural channel migration where these processes are most beneficial and capable of being restored, while also providing mutual benefits to the landowner.
- If a reach-scale project involves multiple landowners, there can be varying scales of restoration on any individual property, but the entire project should be cohesive and process-based.

Scale Considerations for Project Planning at the GSU Level

It is important to recognize that the GSUs differ in size and some GSUs include only segments of the larger mainstem river channels and their floodplains, whereas other GSUs encompass small tributaries. Thus, projects will significantly differ in size depending on the GSU for which a project is designed.

Implementation Team planning within a GSU should be guided by addressing a set of questions, starting with the following—these are meant to form the basis of a "diagnosis" for the GSU, from which the actions should be developed:

- For GSUs with a species focus, what are the identified limiting factors to the focal species in the GSU? If not explicitly identified, what can be inferred about these factors from other information? Considering the level of risk that a species is currently faced with, would actions help stabilize the species performance within the needed time frame?

- What is the root cause of the limiting factors and where in the GSU are these causes occurring?
- What potential solutions exist to address these factors, and which, if any, are feasible to be implemented within the GSU?
- What is the scale of the problem that affects these factors in the GSU—and can the scale of the solution address the scale of the problem?
- What life stages or life histories of the species of concern need to be considered and what types of actions will be needed to address the relevant habitat features?
- What are the characteristics of the GSU that need to be considered in the solutions? These may include the following:
  - Size and complexity of the GSU
  - Landowner patterns and land uses
  - Opportunities for providing the scale of changes needed to address the limiting factors
  - Potential constraints that need to be addressed with regard to existing land uses, adjacent landowners, or issues related to other species (biological conflicts; an example would include how riparian restoration may reduce the suitability of a reach for Western toad that prefer warmer habitats)

Sequencing and Other Considerations

- Sequencing individual projects within a watershed may be important—for example, reducing reach-scale incision prior to correcting fish passage barriers.
- Consider if specific actions should be sequenced to start higher or lower in the GSU (longitudinally along the stream network). For example, protecting and restoring riparian habitats may make sense to sequence from higher in the GSU to lower, whereas removing fish passage barriers likely should be sequenced from lower in the GSU to higher.
- Consider concentrating actions within a GSU to focus on the highest priority habitats and species and produce measurable benefits for the species.
- Consider the potential synergy of a project with other projects previously built or planned in the future for the GSU. Also consider the potential for conflict with previous or future projects.
- Consider how a proposed project may integrate or align with actions in adjoining GSUs to produce better results that achieve ASRP goals.

Design Your Project for "Failure"

- Don't assume a project will be static over time; anticipate the future trajectories that the project could evolve into and work to collaborate together on what the definition of "success" is. Success may mean the eventual erosion of restored riparian areas and recruitment of wood to the river. Success may mean that a hay pasture floods more frequently and is modified to seasonal silvopasture.

- Consider the potential future trajectory of a project 10 to 20 (or more) years in the future and 1 mile or more upstream and downstream to identify potential risks associated with future channel migration, erosion, deposition, or other results that could affect the benefit of the project or affect landowners both upstream and downstream of the project site.
- Consider the consequences of a major flood occurring within the first couple of years following construction, whether the project could withstand such a major process in the near term, and what might change as a result.
- Consider the potential for failure of any individual element within a proposed project and whether that could cause failure of the whole.
- Consider the consequences of a drought within the first years following construction and whether the vegetation is likely to be resistant to drought conditions.

References

ASRPSC (Aquatic Species Restoration Plan Steering Committee), 2019. *Chehalis Basin Strategy: Aquatic Species Restoration Plan – Phase I*. Office of the Chehalis Basin. Publication #19-06-009. November 2019.

ASRPSRT (Aquatic Species Restoration Plan Science and Technical Review Team), 2021. Memorandum to: ASRP Steering Committee. Regarding: A Prioritization and Sequencing Plan to Guide Implementation of the ASRP. March 18, 2021.

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