Explanation for the SRT Prioritization and Sequencing Workbook

The Science and Technical Review Team (SRT) was charged with providing a science-based prioritization and sequencing (P&S) of actions to build upon the three cumulative restoration scenarios from the Aquatic Species Restoration Plan (ASRP) Phase I document. The SRT's P&S conclusions are described in the SRT's P&S technical memorandum[1] and are summarized in the P&S Excel workbook. This memorandum explains the workbook and provides the rationale for the SRT's recommendations.

The P&S workbook contains two spreadsheet tabs. The "P&S" tab is the main spreadsheet that contains the conclusions of the SRT and will be described herein. Information from the P&S spreadsheet is summarized and graphed on the "Summary" tab.

Science-based recommendations from the SRT are presented in the P&S spreadsheet in two major areas: first, P&S of restoration actions in columns A through T, and second, habitat-limiting factors to target and recommended types of restoration in each geospatial unit (GSU) in columns U through AW.

Prioritization and Sequencing of Actions by GSU (Columns A–T)

The P&S spreadsheet is a refinement of the ASRP Phase I scenarios to sequence actions across the Chehalis Basin into near-, mid-, and long-term periods. This sequencing reflects the guiding principles and strategies developed by the SRT and described in its memorandum.[1] In the P&S spreadsheet, rows (numbered) describe each of the 178 GSUs that are organized by nine ecological regions.[2] The columns (letters) provide criteria used to make decisions in columns S through AV. The SRT defines habitat attributes and spatial domain by the needs and distribution of species, as indicated in the species present in each GSU shown in columns AI through AV.

The conclusions of the SRT regarding priorities and sequencing of restoration action by GSU are shown for near-, mid-, and long-term periods in the yellow highlighted columns K through M. These conclusions derive from reasoning summarized in columns D through J based on the information in columns T through AW. In columns D through J, each GSU was assigned a priority rating of 1 to 3, with a 1

[1] ASRP 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.
[2] The SRT has delineated 10 ecological regions across the Chehalis Basin. In the spreadsheet, the Lower and Middle Chehalis River mainstem reaches are combined to make nine regions.

indicating a high, near-term priority and a 3 indicating a lower, longer-term priority. Blanks in these cells indicate GSUs that were not included in the SRT's P&S.

The prioritization of restoration actions by GSU in columns D through J was based on the following five factors:

- **At-Risk Species (Spp.) Habitat (Columns D through F).** Habitat for at-risk species was prioritized to reflect their acute restoration needs and likelihood of extirpation in the near term. The SRT delineated the following three at-risk species to prioritize habitat restoration:
  - Spring-run Chinook salmon
  - Oregon spotted frog
  - Coastal tailed frog
- **High-Priority Core Habitats (Column G).** These habitats are contained in GSUs the SRT believes should receive a high priority (1 or 2) for restoration actions that are not captured by the at-risk species criterion. The starting point for identifying these GSUs was Scenario 1 (Column S), which prioritized GSUs in Phase I based on habitat potential for key salmonid species from the Ecosystem Diagnosis and Treatment (EDT) modeling. For P&S, the SRT used that information plus additional information from the National Oceanic and Atmospheric Administration (NOAA) habitat modeling and the SRT's experience and knowledge of the Chehalis Basin to assign GSUs to priority 1 or 2. The SRT also included additional GSUs in this category that were not in Scenario 1 that it felt should be prioritized due to the needs of other species or proximity to ongoing restoration projects.
- **Additional Core Habitats (Column H).** These are GSUs not captured by the other factors that were included in Scenario 3. The SRT believes restoration of these GSUs is important but have assigned them a lower priority (2 or 3) relative to the other factors. The starting point for identifying these GSUs is those that were added in ASRP Scenarios 2 and 3.
- **Unique At-Risk Habitats (Column I).** These are environments that provide unique and essential habitats for key aquatic species that need to be protected from degradation; these GSUs were assigned a priority of 1. This is not to say that these GSUs are pristine and only require protection. They all suffer from some degree of degradation due to human action. However, they retain unique qualities that are essential to the current biological potential of the basin.
- **Early Riparian Restoration (Column J).** Some actions that have long lead times need to be initiated in the near-term period to provide benefits in the long-term and beyond. This especially includes planting of riparian trees that will only provide full benefit to aquatic habitats more than 75 years after planting. The SRT assigned a priority of 1 to GSUs with a high potential for riparian restoration based on NOAA habitat modeling where it is believed tree plantings and other actions to enhance riparian conditions need to commence immediately to provide benefits later this century.

In columns K through M (yellow), the conclusions are collapsed into near-, mid-, and long-term actions for implementation. Miles and acres of restoration are shown in columns P through S. Restoration miles were computed by applying the "Percent of Primary River Length Proposed for Restoration" in column Q (also referred to as the intensity of restoration) to the "Primary Channel Length" in column P. Acres of habitat for Oregon spotted frog were assigned based on maps and photo interpretation.

Additional Considerations for GSU Prioritization and Sequencing

In making the conclusions in columns D through J, the SRT made a number of judgments that reflect its conclusions regarding the scientific basis for P&S of actions. These judgments are described in the following statements:

1. Only the 85 GSUs included in the refined Scenario 3 were included in the SRT's P&S (not all 178 GSUs across the basin).
2. Habitat defined by the needs and distribution of at-risk species received the top prioritization (1) for restoration in the near term with the following caveat: Coastal tailed frog is a widespread species across the Chehalis Basin but is currently at-risk. The SRT prioritized restoration of coastal tailed frog habitat in the Willapa Hills region to leverage synergisms with restoration of spring-run Chinook salmon habitat.
3. Oregon spotted frog inhabit warm, off-channel wetland areas that are largely separated from habitat for salmonids and coastal tailed frog. Oregon spotted frog habitat in the Chehalis Basin has been reduced to tributaries and upper reaches of the Black River. These GSUs received a priority 1 for restoration (and protection) based on the status of Oregon spotted frog (listed as threatened under the federal Endangered Species Act) and are highlighted in green in columns D and R. Because of the nature of these habitats, they are quantified as acres rather than miles in column R and are not included in the total restoration miles.
4. Unique at-risk habitats included the East Fork Satsop River, the Black River (Oregon spotted frog habitats), and the Chehalis River tidal surge plain. The East Fork Satsop River is characterized by abundant springs and groundwater inputs that result in markedly cooler water and high-quality habitats for salmonids and other fish and amphibian species. The unique features of the East Fork Satsop River could be lost due to groundwater extraction and other development activities, and for this reason it is designated a high-priority area for protection. The Chehalis Tidal Surge Plain below Porter Creek is a key habitat for all anadromous species originating from upriver areas. Much of the area is currently protected. However, sea level rise associated with climate change could move the tidal surge plain upstream, indicating additional priority for restoration and habitat development.

Results for the prioritization in columns D through J were used to assign GSUs to near-, mid-, and long-term periods in columns K through M. A GSU could have multiple species and priorities but the lowest numeric priority was used to assign GSUs to a time period. For example, the Middle Humptulips Mainstem GSU (row 5) was prioritized 3 for coastal tailed frog, 2 for high-priority core habitats, and 1 for

early riparian restoration. Therefore, this GSU was assigned to the near-term period based on the early riparian restoration priority.

The lengths of restoration in each GSU are shown in column R. These lengths were based on values of restoration intensity in column P that were applied to the primary channel length in column P. The intensity values were developed in Phase I and are the portion of a GSU that is expected to receive restoration. These values largely reflected conclusions of needed restoration for salmonids, which often overlapped with coastal tailed frog habitat. However, a number of GSUs are included based mainly on the needs of the two amphibian species. Those GSUs are designated with an "X" in column Q[3] while an estimate of the needed restoration miles for coastal tailed frog is included in column R. Restoration of Oregon spotted frog habitat is described by acreage in column S.

The P&S workbook prioritizes actions by GSU for the three time periods, provides guidance regarding limiting factors, and identifies needed restoration actions. The drop-down arrows in the header cells in row 3 can be used to sort and focus restoration actions. For example, clicking on the drop-down in cell K1 shows the content of this column; clicking off the box for "Blanks" will filter the information to only show the GSUs included for near-term actions (i.e., it will filter out the GSUs that are only applicable to the mid- and long-term periods) to identify priorities for implementation and guide funding. The SRT, for example, has used this tool to recommend funding priorities for the 2021–2023 biennium.

Summary of SRT Prioritization and Sequencing of GSUs

Results for the P&S are summarized in Table 1.

[3] The Grays Harbor Shoreline GSU has an X in cell Q167. This GSU was prioritized for anadromous salmonids and does not include either amphibian species. An X in cell Q167 shows the GSU is included in prioritization and allows the GSU to be captured when sorting.

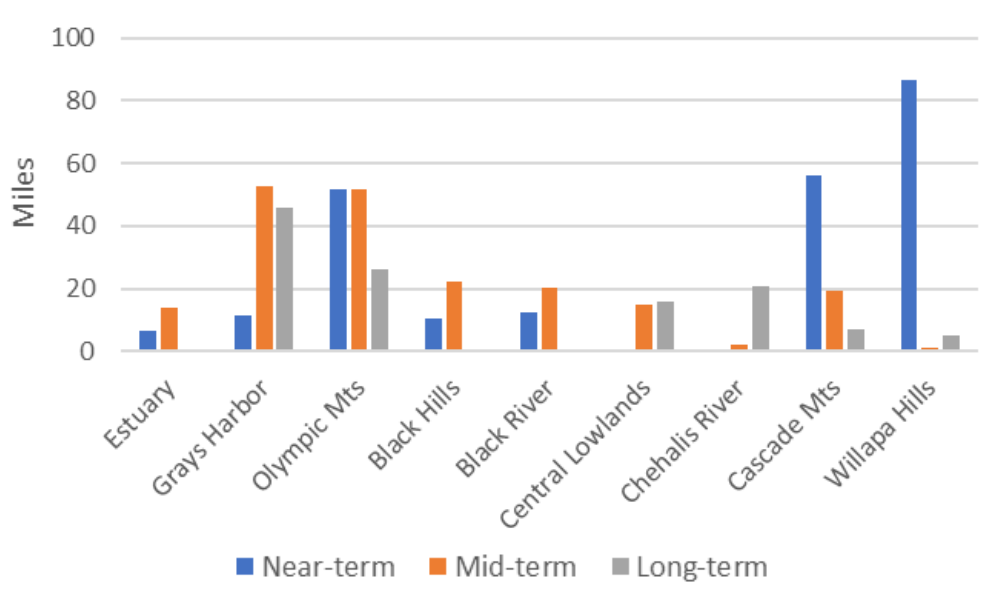
Table 1

Miles of Riverine Habitat Restored in Near-, Mid-, and Long-Term Time Periods in the Chehalis Basin by Ecological Region

ECOLOGICAL REGION	MILES RESTORED			
	NEAR-TERM	MID-TERM	LONG-TERM	TOTAL
Estuary	6.5	14.0	0.0	20.5
Grays Harbor	11.4	52.6	46.0	109.9
Olympic Mountains	51.8	51.9	26.1	129.8
Black Hills	10.2	22.1	0.0	32.3
Black River	12.5	20.2	0.0	32.7
Central Lowlands	0.0	15.0	16.0	31.0
Chehalis River	0.0	1.9	20.7	22.6
Cascade Mountains	56.0	19.2	7.0	82.2
Willapa Hills	86.8	1.1	4.9	92.8
Total	**235.3**	**197.8**	**120.6**	**553.7**
Distribution	**42%**	**36%**	**22%**	**100%**

In the near term, restoration is prioritized in the Cascade Mountains and Willapa Hills ecological regions, reflecting the distribution of spring-run Chinook salmon (Figure 1). Restoration in the Olympic Mountains Ecological Region in the near term was based on protection of unique habitats in the East Fork Satsop River as well as early riparian restoration. Restoration in the mid- and long-term periods shifts downstream due to other priorities.

Figure 1
Distribution of Restoration Miles Across Ecological Regions in the Three Time Periods



Note the Chehalis River includes both the Lower Chehalis and Middle Chehalis ecological regions.

Habitat-Limiting Factors and Recommended Actions (Columns U–AW)

The restoration actions found in columns AD through AI are recommendations from the SRT regarding types of actions to be applied in each prioritized GSU. The actions are defined along with relevant information sources in Tables 2 and 3. Table 3 also includes information for the SRT recommendation that came from a variety of sources. The SRT reviewed limiting habitat factors for salmonids from the EDT modeling. In columns U through AC, EDT limiting factors are ranked based on the effect of restoration in each GSU on sub-basin salmon abundance (1 being the largest effect, with the top three factors highlighted in green). EDT limiting factors are defined in Table 4. These factors assess the effect of a change in the current condition relative to the historic template on life stage productivity or capacity. The SRT also reviewed the impacts of culverts on salmonids in the EDT model (column N) and their distribution within sub-basins using the EDT Webmap. Results of NOAA habitat analysis informed the SRT regarding the potential to moderate water temperature through restoration of riparian conditions and the potential for reconnection of riverine and floodplain environments. NOAA also constructed a Beaver Intrinsic Potential (BIP) model that was used to recommend actions to promote beaver occupancy and indicate the possible value of beaver dam analogs (BDAs) to provide ponds and other features provided by beaver. The SRT also used Google Earth and the EDT Webmap to examine habitat features along stream courses. The SRT reviewed actions from the perspective of amphibians and other non-salmonid species as well as salmonids. Finally, the SRT members provided their own expertise and experience in species biology, aquatic habitat restoration, and knowledge of the Chehalis Basin when recommending restoration actions.

The result of this effort is a synthesis of diverse information that led to the recommended actions in columns AD through AI. The recommendations are types of actions that could be used in a GSU to address limiting factors and other issues. The Implementation Team should use the recommendations but will also need to take into account issues such as land ownership, availability of willing participants, feasibility, and on-the-ground conditions that will direct if, when, and where restoration actions will be implemented.

Table 2
Legend for Restoration Actions (Columns AD–AI)

RESTORATION ACTIONS THAT WILL BE IMPLEMENTED FOR EACH UNIT	
X	Action with high potential for biological benefit as indicated by EDT and NOAA modeling
x	Action will be implemented in the short term; large wood and floodplain provide short-term benefits, while floodplain and riparian provide long-term benefits
x	No restoration action needed but will result from natural regrowth of the riparian zone in managed forests in the long term
x	Restoration action de-emphasized based on limiting factors review (for barriers based on review of the number, percent blockage, and location of barriers in the GSU)

Table 3

Definitions of Restoration Actions Including Information Sources and Rationale for Conclusions

RESTORATION ACTION	INFORMATION SOURCES AND RATIONALE
Place Large Wood	Addition of large wood including engineered logjams. Emphasized wood placement in specific GSUs based on EDT habitat diversity rankings and limiting factors where potential retention of spawning gravel area was high based on NOAA habitat analysis.
Remove Fish Passage Barriers	Removal or correction of artificial barriers to passage of species life stages. Evaluated obstructions in specific GSUs based on EDT limiting factors analysis, total number of culverts in the GSU, and a review of the location and percent obstruction of each barrier on the EDT Webmap. Based on this, the SRT emphasized or de-emphasized correction as appropriate.
Reconnect/Restore Floodplain	Emphasized floodplain reconnection/restoration to specific GSUs where floodplain habitat potential was high based on NOAA habitat analysis and visual interpretation of Google Maps imagery; reduced emphasis in GSUs that had low floodplain habitat potential based on NOAA habitat modeling.
Riparian Restoration	Emphasized restoration of riparian forest for specific GSUs where EDT and NOAA habitat analysis indicated temperature reduction is needed, temperature reduction potential due to shading was high based on NOAA habitat analysis, and based on visual interpretation of opportunities using Google Maps.
Beaver Ponds/BDAs	Assumed increase in beaver population and/or use of BDAs to mimic effect of beaver dams. Added beaver ponds to specific GSUs where BIP was high based on NOAA habitat analysis. BIP for bolded "**X**" is >6 and BIP for non-bolded "x" is 4.5 to 6 in the NOAA habitat analysis results.
Wetland Restoration	Restoration/reconnection of wetlands. GSUs with significant wetland potential identified with bold "**X**"; note there is overlap with large wood, beaver ponds, and floodplain reconnection actions.

Table 4

Definitions of Salmonid Habitat Limiting Factors Used in the EDT Model

EDT SALMONID LIMITING FACTOR	DEFINITION	EFFECT OF CHANGE RELATIVE TO HISTORIC TEMPLATE CONDITION	
		LIFE STAGE CAPACITY	LIFE STAGE PRODUCTIVITY
Channel Length	Primary channel length (stream reach area)	x	
Channel Stability	Channel condition, especially bed scour		x
Flow	Peak and/or minimum flow (stream reach area)	x	x
Habitat Diversity	Habitat structure and diversity, primarily large wood elements and riparian condition		x
Key Habitat	Proportion of reach area as key habitat types (e.g., pools, riffles, glides) for life stages	x	
Obstructions	Obstructions, primarily artificial such as culverts and dams		x
Predation	Conditions increasing predation		x
Sediment Load	Fine sediment in spawning gravels and suspended sediment		x
Temperature	Days of daily maximum (and minimum) temperature, moderated by temperature refugia		x