STRATEGY

FISH PASSAGE PROJECT PRIORITIZATION IN THE UPPER COLUMBIA

The Upper Columbia Regional Technical Team

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Introduction

The Upper Columbia region is over 6,500 square miles (16,835 square kilometers) and has over 2,000 miles (3,200 km) of salmon, steelhead, and bull trout habitat. Since 1999, partners working in the region have addressed over 135 fish passage barriers, opening almost 250 miles (402 km) of habitat for fish. Previous barrier assessments in the region identified numerous high priority fish passage barriers but as well-known high priority barriers were addressed, partners in the region identified the need to assess and prioritize remaining barriers.

Between 2016 and 2019 the Cascade Columbia Fisheries Enhancement Group was awarded funding from Washington's Recreation and Conservation Office to complete a comprehensive assessment of potential fish passage barriers in the four anadromous subbasins of the Upper Columbia. As part of that project they completed a prioritization of barriers based on recovery-based criteria. The purpose of this report is to describe the strategy that was developed and used to prioritize fish passage projects in the Upper Columbia. We define prioritization as the process of ranking fish passage projects to determine their relative biological priority for funding and implementation.

Prioritization is a critical component of the Regional Technical Team's (RTT's) *Biological Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region*, which was last updated in 2017. The objective of the Fish Passage Prioritization Strategy is to provide a consistent, repeatable, systematic, and well-documented approach for prioritizing fish passage projects. This intent is to provide a transparent prioritization process that will assist restoration practitioners and managers with making decisions. We will revise this strategy periodically as new information becomes available or the need for revisions arises. Because the prioritization strategy has been built by Aspect Consulting, Inc. into an ArcGIS tool, changes can be made to the underlying metrics, weightings, or scoring systems and the tool can be rerun with new barrier datasets at any time.

To develop the prioritization strategy, the Upper Columbia Salmon Recovery Board (UCSRB) convened a technical working group to provide input and review. The group reviewed several existing fish passage prioritization and scoring approaches including Washington Dept. of Fish and Wildlife's Priority Index (PI) approach (WDFW 2009), the Brian Abbott Washington Fish Passage Removal Board scoring criteria, the RTT's 2008 barrier prioritization strategy, as well as several other approaches described in the literature (Branco et al. 2014; Diebel et al. 2015; Kemp and O'Hanley 2010; King and O'Hanley 2016; King et al. 2017; Neeson et al. 2015; Peterson et al. 2013) . Based on a review of the potential metrics the technical work group decided to use three categories of indicators to prioritize fish passage projects – species indicators, habitat indicators, and barrier indicators.

What follows is a description of the prioritization process. It is important to note that although this is a CCFEG and UCSRB product, the hope is that it will be adopted and used by other partners and funders to support prioritization process and that the tool will continue to evolve and be built upon through a collaborative process with regional partners developing and implementing fish passage

projects. The RTT adopted the following prioritization approach in 2018 for use across the region. The results of the regional prioritization indicate that based on the criteria used in this analysis that most of the highest priority projects for listed species have been implemented; however, there remain a handful of fish passage projects with the potential to benefit at least one or more listed species.

Prioritization Approach

The general approach used to prioritize fish passage projects is a scoring and ranking strategy. This approach was used not only because it is simple, repeatable, systematic, and transparent, but because it is consistent with the RTT's broader prioritization approach for the region. The Fish Passage Prioritization technical work group selected metrics and weightings for the strategy, the integration of the scoring and ranking process into an ArcGIS tool allows for the capability to change various aspects of the prioritization approach as needed (e.g. metrics and weightings) and re-run the prioritization tool as information changes or becomes available.

The list of metrics used to prioritize fish passage projects was developed from existing scoring (FBRB) and prioritization criteria (RTT, WDFW based on their ability to distinguish fish passage projects that would contribute the most to recovery of ESA-listed spring Chinook, steelhead, and bull trout. The metrics chosen to prioritize projects can be grouped into three categories: recovery/species indicators, habitat indicators, and barrier-specific indicators. Although cost is an important part of prioritizing projects for implementation, the lack of information about potential costs prohibited use from including this type of metric at the scale at which this strategy was employed. It is assumed that cost effectiveness will be considered as a primary metric for prioritizing among high priority projects or groups of projects. Other indicators that were considered but not used due to a lack of data or information include watershed impairment, life stages benefiting, and exotic/invasive species. These metrics could be incorporated later if, and when, the data become available.

Table 1 shows each of the indicators and their weights, definition, relevance, and data sources. Scoring rules for each indicator are presented in Attachment 1. The scoring rules for bull trout are slightly different from those for steelhead and spring Chinook based on some species-specific criteria for temperature and colonizing potential. Weights were based on a ranking survey of technical team members about what metrics were most important to consider. The highest weights were assigned to habitat quantity upstream (based on Intrinsic Potential area upstream), habitat quality upstream, and barrier severity. This list of important metrics is consistent with other fish passage prioritization strategies being used. Other metrics have lower weights and therefore contribute less to the overall score.

The tool was developed so that weightings, metrics, and scoring rules could easily be changed based on user-specific preferences. Individual scores for each species are calculated based on the sum of the individual scores times their weighting factor. The total score was the sum of the three

scores for each species (spring Chinook, steelhead, and bull trout). This allows users to evaluate barriers on a species-by-species basis as well as across all three listed species.

Table 1. Passage project prioritization indicators and their weights, definitions, relevance, and data sources.

Indicator	Definition	Relevance	Data Source
Species Indicators			
Core population area designation *(weighting factor = 2.4; 12%)*	Barrier is within a major (MaSA) or minor (MiSA) spawning area (salmon/steelhead) or within designated types of critical habitat (bull trout)	For broad-scale analysis, it is important to consider the role of barrier removal in the viability and recovery of populations. Projects in MaSA or MiSA or bull trout spawning and rearing habitat (SR) will have a greater likelihood of contributing to VSP.	Maps of salmon and steelhead MaSA and MiSA (NOAA) and bull trout critical habitat (USFWS)
Colonization Potential *(weighting factor = 2.6, 13%)*	Distance from known fish use by target species.	The closer a barrier is to spawning and rearing habitat already being used, the higher the likelihood that the habitat upstream will be colonized quickly.	Fish Distribution (USFS)
Species Benefitting *(weighting factor = 1.6, 8%)*	Number of species expected to use habitat upstream of the barrier.	The more listed species that benefit from the action, the greater the overall benefit to recovery.	"Habitat Potential" tool outputs
Habitat Indicators			
Habitat Potential: Habitat Quantity *(weighting factor = 2.0, 20%)*	Area (m^2) of potential habitat upstream of the barrier up to the end of potential habitat or to a fully impassable barrier.	The amount of habitat upstream of a barrier is an indicator of the potential capacity and/or production that could be added if the barrier is addressed.	NOAA Intrinsic Potential Maps- area attribute, USFS bull trout climate shield, bull trout critical habitat (USFWS)
Habitat Potential: Habitat Quality *(weighting factor = 3.0; 15%)*	Habitat quality for various life stages and species. Habitat quality is based on 4 Cs: Clean (water quality), Connected (barriers and flows), Cold (temperature), and Complex (riparian/floodplain condition).	Habitat quality above the barrier is directly related to its potential to support and produce fish that contribute to recovery.	NorWeST (canopy cover, temperature), USFS Roads Layer, DOE 303d list, DNR (intermittent or perennial flow)
Future Habitat Quality: Resistance/Resilience to Climate Change *(weighting factor = 1.2; 6%)*	Areas sensitive to climate change will experience changes in hydrologic regimes (snow-dominated to transitional or transitional to rain-dominated), increased exposure to flood events, increased mean August temperatures, and reduced summer water availability (based on climate model projections for 2040).	Climate change is likely to threaten listed fish because of warmer water temperatures, changes in peak flows, and increased frequency and intensity of disturbances such as flood and wildfires.	NorWeST Database, VIC

Indicator	Definition	Relevance	Data Source
Barrier Indicators			
Barrier Severity *(weighting factor = 3.2; 16%)*	The severity (passability) of the barrier represents the likelihood that fish can pass upstream (this rating is based on WDFW passability criteria for the CCFEG assessment).	Removal of total or near-total barriers will have a greater benefit than removing or replacing a barrier that is already somewhat passable.	WDFW barrier inventory
Downstream Barriers *(weighting factor = 2.0; 10%)*	Connectivity up to the barrier in question.	The ability of fish to reach the barrier in question will influence the likelihood that fish benefit from the project.	WDFW barrier inventory

This prioritization strategy is strictly based on biological criteria, and the assumption is that high priority projects will be vetted by the RTT, funders, and partners according to various feasibility criteria such as those listed below and in the RTT's prioritization strategy (RTT 2018).

- Landowner Willingness – Landowner willingness may preclude the implementation of certain projects.
- Cost Effectiveness – The cost of an action relative to its benefit may reduce the ranking of an action type (Box 4.1 on pages 113-114 in ISAB (2018) provides a simplified framework for evaluating cost effectiveness).
- Probability of Success – The complexity of an action type may preclude its implementation.
- Regulatory Constraints – Regulatory issues such as permitting may make some actions more difficult to implement than others.

Methods

The purpose of the tool is to identify the relative biological value of fixing each fish passage barrier. This includes considerations for recovery/species indicators, habitat indicators, and barrier-specific indicators. To determine a quantitative representation of the relative biological benefit for each potential barrier removal, a score was calculated based on the available indicator data. Indicators were assigned weights based on their assumed importance in prioritizing barriers (Table 1). The final score for each barrier was computed by summing the product of each indicator score by its weight. The total scores were then ranked from highest to lowest, with the highest scores indicating the barriers that would provide the greatest biological benefit if fixed. Importantly, several indicators could have a value of "0," which means that fixing the passage impediment would have no biological benefit. For example, if there is no intrinsic potential upstream from a given barrier, that barrier would receive a score of "0" and would fall to the bottom of the priority list. In addition, for obvious reasons, barriers upstream from complete barriers would receive a score of "0" as would barriers that are downstream from toxic or lethal habitat conditions (e.g., toxic conditions, lethal water temperatures, or dewatered). Scores of "0" for any of these indicators result in a final or total score of "0."

The fish passage barrier removal priority ranking tool utilizes ArcGIS model builder to run a variety of spatial analysis tools, including flow-enabled network tracing and spatial joins. A flow-enabled network was established using the National Hydrography Dataset (NHD) and fish passage barrier locations from WDFW. Where possible, barrier locations were adjusted to connect to the stream network GIS layer. Barriers located on unmapped tributaries (e.g. not mapped on the NHD layer) are not connected to the flow network and therefore were excluded from related calculations. These barriers were flagged in the analysis for further investigation. By tracing the stream connections from each barrier, the scores for upstream connectivity, downstream barrier passability, and upstream habitat quantity are calculated. Similarly, scores for the additional

indicators were calculated using spatial joins and summary statistics of surrounding data to represent each indicator piece of the biological benefit puzzle.

Each of the indicators is scored individually according to specific scoring rules (Attachment 1). Some metrics are a composite score (mean) of sub-categories of data (e.g. habitat quality). Total scores for each species are calculated based on individual scores multiplied by the weighting factors. A total score for each potential barrier is generated by summing the individual scores for each species.

The barrier prioritization results reflect certain assumptions about barriers, species, and habitat. The model assumes that barriers are mapped to the appropriate stream in the NHD network layer and were accurately assessed for passability criteria. It also assumes that barriers with unknown passability are 100% passable. This assumption played into the metric on downstream barriers and passability to the barrier in question. Ideally, the status of these downstream barriers would be surveyed prior to funding the upstream barrier. Broadly speaking, this tool provides a suite of data that can be used to further investigate specific barriers that show the greatest potential for benefits to ESA-listed fish species. The tool does not provide the full suite of information that should be used to evaluate potential fish passage projects for funding and implementation. Project and site-specific information should be used alongside he information provided in this analysis of barriers.

Results

The result of the barrier prioritization process is a list and associated map of scored and ranked fish passage projects. These outputs are intended to guide the regional experts, sponsors, funders, and partners toward the highest priority fish passage projects with the greatest potential to benefit listed species, based on compiled information and assigned scores. A list of identified fish passage barriers, the resulting score for each species, a composite score, and associated scores and data for each of the indicators can be found online the https://www.ucsrb.org/fish-passage/ website. Results are updated periodically as new barriers are identified or priorities are updated. Associated GIS data can be found on the UCSRB data portal- https://data-ucsrb.opendata.arcgis.com/.

Flags for each barrier are also provided, which highlight potential issues that warrant further investigation. Minor flags were assigned to barriers with missing data and major flags were assigned to barriers with no ESA-listed fish habitat upstream (based on IP), toxic water quality, unknown passability, and downstream impassable barriers. Some of these issues resulted in a score of "0" for that barrier based on scoring rules. These flagged barriers could be either removed from a final priority list for the region or put on a separate list of data gaps for further investigation.

The RTT approved this Fish Passage Prioritization Strategy on August 8, 2018 and the next step in the process was a review of the results and subsequent ranking/tiering by the RTT to develop a final list of high priority fish passage project for the Wenatchee subbasin. Scores were sorted from from highest to lowest and used to inform the binning of projects into tiers as described below. This

tiering method was developed and adopted by the RTT in November 2018. The table and Webmap indicated above include the following tiering results for barriers in the Wenatchee.

Tier 1. High priority barrier for restoration, high biological benefit, and no sequencing issues with other barriers or other restoration needs. Individual species scores over 90 and/or total score over 203 or specific circumstances as identified in this list or other information considered by the RTT.

Tier 2. Moderate biological benefit. May have some sequencing issues to consider such as other partial barriers (perhaps 1 or 2 partial barriers up or downstream) or other habitat degradation affecting overall success, such as road management, water quantity, or habitat quality. Individual species scores over 76-90 and/or total scores over 171 or specific circumstances as identified in this list or other information considered by the RTT.

Tier 3. Low biological benefit. May have some sequencing issues to consider such as other barriers (3 or more up or downstream) or other habitat restoration projects affecting overall success such as road management, water quantity, or habitat quality. It is generally not a priority compared to other restoration priorities but may be worthwhile particularly if the financial investment is reasonable. There may be other (non-fish passage) considerations such as sediment risk or wood recruitment that make this barrier worth fixing. Individual species scores over 50-75 and/or total scores over 113 or specific circumstances as identified in this list or other information considered by the RTT.

Tier 4. Not a priority at this time due to very little habitat potential upstream, major sequencing issues such as many downstream or upstream complete barriers or extremely poor habitat conditions. Individual species scores <50 and/or total scores <113 or specific circumstances as identified in this list or other information considered by the RTT.

Need More Information. Missing critical information (passability, location missing). Barriers could not be scored because of a lack of information.

Not a priority. Projects that have little to no intrinsic potential or toxic habitat upstream are not tiered because they have no known benefit to listed species and therefore should not be implemented for the purpose of benefitting ESA-listed fish. If other information is available to verify the potential for ESA-listed fish use upstream (beyond IP) then these projects could be tiered by the RTT based on that information.

Proceed only as a complex. In many cases it does not make sense to implement a barrier restoration project unless it is done in conjunction with upstream or downstream barriers. Generally, it is recommended that the most downstream barrier be included in the barrier restoration complex. Likewise, if a barrier is nearby upstream it should be included in the restoration complex so that the net gain in habitat achieves a worthwhile biological benefit. Sequencing issues may dictate deviating from the downstream to upstream approach; however, if there is not an apparent future opportunity to implement the most beneficial barrier fixes in the complex, then we recommend holding off on implementing the available projects.

It is expected that this scoring strategy will be regularly updated and applied in the Upper Columbia to future barrier assessment data such as those proposed or underway in the Methow and Entiat. This strategy and the tools and data it provides could be adopted more broadly across the state to inform decisions in other areas.

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Attachment 1: Scoring Rules for Fish Passage Barriers by Species

STEELHEAD AND SPRING CHINOOK		
Indicator	**Scoring Rules**	**Data Source**
Core population area designation *(weighting factor = 2.4; 12%)*	5 = Barrier within MaSA 3 = Barrier within MiSA 1 = Barrier within the distribution of steelhead or spring Chinook but not within MaSA or MiSA	Maps of MaSA and MiSA
Colonization Potential *(weighting factor = 2.6, 13%)*	5 = Colonizers are within 50 m of the barrier 4 = Colonizers are within 50 to 200 m of the barrier 3 = Colonizers are within 200 to 500 m of the barrier 2 = Colonizers are within 500 to 1,000 km of the barrier 1 = Colonizers are greater than 1,000 m from the barrier	Fish Distribution (FS)
Species Benefitting *(weighting factor = 1.6, 8%)*	5 = All listed species will benefit from the action 3 = Two of the three listed species will benefit from the action 1 = One of the three listed species will benefit from the action 0 = No listed species will benefit from the action	IP
Habitat Potential: Habitat Quantity *(weighting factor = 2.0, 20%)*	10 = IP >50,000 sq m 9 = IP 41,000 - 50,000 sq m 8 = IP 24,000 - 41,000 sq m 7 = IP 19,000 - 24,000 sq m 6 = IP 15,000 - 19,000 sq m 5 = IP 13,000 - 15,000 sq m 4 = IP 8,000 - 13,000 sq m 3 = IP 5,000 - 8,000 sq m 2 = IP 2,000 - 5,000 sq m 1 = IP >0 - 2,000 sq m **Flagged and assigned an overall score of "0"** 0 = Barrier with no IP upstream	Intrinsic Potential Maps- area attribute WDFW barrier inventory
Habitat Potential: Habitat Quality *(weighting factor = 3.0; 15%)*	**Water Quality:** 5 = No impairment to water quality (303d listing) and temperatures are suitable for spawning and rearing (<13 deg) 4 = No impairment to water quality (303d listing) and temperatures are optimal for rearing but not spawning (13-15 deg)	NorWeST (canopy cover, temperature),USFS Roads Layer, DOE 303d list, DNR (intermittent or perennial flow), WDFW barrier inventory

STEELHEAD AND SPRING CHINOOK		
Indicator	**Scoring Rules**	**Data Source**
	3 = No impairment to water quality (303d listing) but temperatures are suboptimal for rearing (15-20 deg) 2 = Water quality is poor (303d listing) but water temperature is <15 degrees 1 = Water quality is poor (303d listing) and temperatures are suboptimal for rearing (15-21 deg) 0 = Water is toxic to fish (>21 deg) [FLAGGED] **Temperature (NoRWeST 2002-2011 mean August temp)- thresholds based on this paper* **Roads (sediment and complexity):** 5 = Road density within 300' of the stream network <0.5 mi/sq mi 4 = Road density within 300' of the stream network 0.5-2 mi/sq mi 3 = Road density within 300' of the stream network 2-5 mi/sq mi 2 = Road density within 300' of the stream network 5-10 mi/sq mi 1 = Road density within 300' of the stream network >10 mi/sq mi **Connectivity:** 5 = There are no man-made passage impediments upstream from the barrier of interest and flow is perennial 3 = One or more partial man-made or flow passage impediments upstream but flow is perennial 1 = There are partial or complete man-made and flow passage impediments upstream **Riparian (NorWeST Canopy metric):** 5 = >80% of riparian zone is forested 4 = 61-80% of riparian zone is forested 3 = 41-60% of riparian zone is forested 2 = 21-40% of riparian zone is forested 1 = 0-20% of riparian zone is forested **Overall Score:** Geomean (Water Quality, Connectivity, Temperature, Complexity) **Flagged and/or assigned an overall score of "0"** **Water Quality:**	

STEELHEAD AND SPRING CHINOOK		
Indicator	**Scoring Rules**	**Data Source**
	0 = Water is toxic to fish (>21 deg); flag= complete barrier upstream	
Future Habitat Quality: Resistance/Resilience to Climate Change *(weighting factor = 1.2; 6%)*	**Hydrologic Regime Shift (CFM)** 5 = Small hydrologic regime shift within the watershed (change in CFM<14 days±) 3 = Moderate hydrologic regime shift within the watershed (change in CFM 14-30 days±) 1 = Large hydrologic regime shift within the watershed (>30 days±) **Flood Events (Q1.5)** 5 = Small change in flood events (change Q1.5<10%) 3 = Moderate change in flood events (change Q1.5 [10-25%]) 1 = Large change in flood events (Q1.5>25%) **Temperature (mean August temp)** 5 = 2040 mean August temperatures are suitable for spawning and rearing (<13 deg) 3 = 2040 mean August temperatures are optimal for rearing but not spawning (13-15 deg) 1 = 2040 mean August temperatures are suboptimal for spawning and rearing (15-21 deg) 0 = 2040 Mean August Temp >21 deg **Summer Low Flow (MS)** 5= Small change in summer flow (change Q1.5<10%) 3 = Moderate change in flood events (change Q1.5 [10-25%]) 1 = Large change in flood events (>25%) **Overall Score:** Geomean (Hydrologic Regime, Flood Events, Temperature, Summer Low Flow)	NorWeST Database, VIC
Barrier Severity *(weighting factor = 3.2; 16%)*	5 = 0% passability 3 = 33% passability 1 = 67% passability **Flagged and assigned an overall score of "0"** 0 = Barrier with unknown passability	WDFW barrier inventory
Downstream Barriers *(weighting factor = 2.0; 10%)*	5 = No partial or full fish passage barriers downstream (100% connectivity) 4 = One barrier downstream that is 67% passable 3 = One barrier downstream that is 33% passable or two 67% passable barriers	WDFW barrier inventory

STEELHEAD AND SPRING CHINOOK		
Indicator	**Scoring Rules**	**Data Source**
	1 = 10-30% passability to the barrier **Flagged and assigned an overall score of "0"** 0 = Complete barriers to fish passage downstream from barrier, <10% passability to the barrier, OR more than 3 barriers	

BULL TROUT		
Indicator	**Scoring Rules**	**Data Source**
Core population area designation *(weighting factor = 2.4; 12%)*	5 = Spawning/rearing (SR) habitat 3 = Barrier within bull trout foraging, migration, overwintering (FMO) habitat 1 = Barrier not within bull trout SR/FMO	Maps of bull trout critical habitat
Colonization Potential *(weighting factor = 2.6, 13%)*	5 = Colonizers are within 500 m of the barrier 3 = Colonizers are within 500-1,000 m of the barrier 1 = Colonizers are greater than 1,000 m from the barrier	Fish Distribution (FS)
Species Benefitting *(weighting factor = 1.6, 8%)*	5 = All listed species will benefit from the action 3 = Two of the three listed species will benefit from the action 1 = One of the three listed species will benefit from the action 0 = No listed species will benefit from the action	IP
Habitat Potential: Habitat Quantity *(weighting factor = 2.0, 20%)*	10 = IP >50,000 sq m 9 = IP 41,000 - 50,000 sq m 8 = IP 24,000 - 41,000 sq m 7 = IP 19,000 - 24,000 sq m 6 = IP 15,000 - 19,000 sq m 5 = IP 13,000 - 15,000 sq m 4 = IP 8,000 - 13,000 sq m 3 = IP 5,000 - 8,000 sq m 2 = IP 2,000 - 5,000 sq m 1 = IP >0 - 2,000 sq m **Flagged and assigned an overall score of "0"** 0 = Barrier with no IP upstream	RTT generated map of bull trout intrinsic potential (based on critical habitat and climate shield), and WDFW barrier inventory
Habitat Potential: Habitat Quality *(weighting factor = 3.0; 15%)*	**Water Quality:** 5 = No impairment to water quality (303d listing) and temperatures are suitable for spawning and rearing (<12 deg) 4 = No impairment to water quality (303d listing) and temperatures are optimal for FMO (12-14 deg) 3 = No impairment to water quality (303d listing) but temperatures are suboptimal for SR and FMO (15-16 deg) 2 = Water quality is poor (303d listing) but water temperature is <12 degrees 1 = Water quality is poor (303d listing) and temperatures are suboptimal for rearing (>14 deg) 0 = Water is toxic to fish (>21 deg) [FLAGGED]	NorWeST (canopy cover, temperature),USFS Roads Layer, DOE 303d list, DNR (intermittent or perennial flow), WDFW barrier inventory

BULL TROUT		
Indicator	**Scoring Rules**	**Data Source**
	Temperature (NoRWeST 2002-2011 mean August temp)- thresholds from USFWS (pers. comm)* **Roads (sediment and complexity): 5= Road density within 300' of the stream network <0.5 mi/sq mi 4= Road density within 300' of the stream network 0.5-2 mi/sq mi 3= Road density within 300' of the stream network 2-5 mi/sq mi 2= Road density within 300' of the stream network 5-8 mi/sq mi 1= Road density within 300' of the stream network >8 mi/sq mi 1 = Road density within 300' of the stream network >10 mi/sq mi NOTES: May need to adjust these down to reflect effect better (e.g. 0.5-1) **Connectivity:** 5 = There are no man-made passage impediments upstream from the barrier of interest and flow is perennial 3 = One or more partial man-made or flow passage impediments upstream but flow is perennial 1 = There are partial man-made and flow passage impediments upstream **Riparian (NorWeST Canopy metric):** 5 = >80% of riparian zone is forested 4 = 61-80% of riparian zone is forested and 3 = 41-60% of riparian zone is forested 2 = 21-40% of riparian zone is forested 1 = 0-20% of riparian zone is forested **Overall Score:** Geomean (Water Quality, Connectivity, Temperature, Complexity) **Flagged and assigned an overall score of "0"** 0 = water is toxic to fish (>20 deg)	

BULL TROUT		
Indicator	**Scoring Rules**	**Data Source**
Future Habitat Quality: Resistance/Resilience to Climate Change *(weighting factor = 1.2; 6%)*	**Hydrologic Regime Shift (CFM)** 5 = Small hydrologic regime shift within the watershed (change in CFM<14 days±) 3 = Moderate hydrologic regime shift within the watershed (change in CFM 14-30 days±) 1 = Large hydrologic regime shift within the watershed (>30 days±) **Flood Events (Q1.5)** 5= Small change in flood events (change Q1.5<10%) 3 = Moderate change in flood events (change Q1.5 [10-25%]) 1 = Large change in flood events (Q1.5>25%) **Temperature (mean August temp)** 5 = 2040 mean August temperatures are suitable for spawning and rearing (<12 deg) 3 = 2040 mean August temperatures are optimal for FMO but not spawning or rearing (12-14 deg) 1 = 2040 mean August temperatures are suboptimal for SR and FMO (14-16) 0 = 2040 Mean August Temp >16 deg **Summer Low Flow (MS)** 5 = Small change in summer flow (change Q1.5<10%) 3 = Moderate change in flood events (change Q1.5 [10-25%]) 1 = Large change in flood events (>25%) **Overall Score:** Geomean (Hydrologic Regime, Flood Events, Temperature, Summer Low Flow)	NorWeST Database, VIC
Barrier Severity *(weighting factor = 2.0; 10%)*	5 = 0% passability 3 = 33% passability 1 = 67% passability **Flagged and assigned an overall score of "0"** 0 = Barrier with unknown passability	WDFW barrier inventory
Downstream Barriers *(weighting factor = 3.2; 16%)*	5 = No partial or full fish passage barriers downstream (100% connectivity) 4 = One barrier downstream that is 67% passable 3 = One barrier downstream that is 33% passable or two 67% passable barriers 1 = 10-30% passability to the barrier	WDFW barrier inventory

BULL TROUT		
Indicator	**Scoring Rules**	**Data Source**
	Flagged and assigned an overall score of "0" 0 = Complete barriers to fish passage downstream from barrier, <10% passability to the barrier, OR more than 3 barriers	

Attachment 2: Resulting outputs of Wenatchee Barrier Prioritization Tool (updated regularly)

Link to map of results

Link to table of results and data

All documents, maps, and results can also be found through the http://data-ucsrb.opendata.arcgis.com/