Appendix 26
Qualitative Habitat Assessment (QHA): Stream and Lake Files

This appendix presents the results of our Qualitative Habitat Assessment (QHA) of all the watersheds in the subbasin at the HUC-6 scale and our Lacustrine QHA (LQHA) analysis of selected lakes. A brief primer follows, but for more detailed information on QHA, readers are encouraged to see Appendix 62.

The QHA files are Excel spreadsheets. To open one, click on the file below that you are interested in.

Flathead Subbasin Stream QHA

Bull Trout QHA File (5.5mb)

Westslope Cutthroat Trout QHA File (5.5mb)

Flathead Subbasin Lake QHA

Bull Trout LQHA File (7.3mb)

Westslope Cutthroat Trout LQHA File (7.5mb)

Short Primer

Each Excel file contains a series of worksheets that can be viewed by clicking the appropriate tab at the bottom of the page. To view how our Technical Team scored the **current condition** of individual HUC-6 watersheds or selected lakes, click on the Current tab. You will see a table like this, except with many more reaches:

| | | Attribute Confidence | 1 | 1 | 2 | 2 | 1 | 1.5 | 2 | 2 | 2 | 1.5 | 2 |
| | | Attribute Toggle | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
HUC 5	HUC 6	Reach Name	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions	Reach Confidence
1701020604	170102060404	Big Creek 1	1.5	2.0	2.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	3.5	1.0
1701020604	170102060405	Big Creek 2	1.5	2.0	2.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	1.0
1701020604	170102060406	Canyon Creek	2.0	2.0	2.5	3.0	3.0	3.0	4.0	4.0	4.0	4.0	1.0	0.5
1701020603	170102060305	Coal Creek 1	2.5	3.0	3.0	3.0	4.0	2.0	4.0	4.0	3.0	4.0	2.5	1.0
1701020603	170102060308	Coal Creek 2	1.5	2.0	2.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	1.0
1701020603	170102060307	Cyclone Creek	1.5	1.5	2.0	1.0	3.0	2.0	4.0	4.0	4.0	4.0	4.0	1.0
1701020604	170102060403	Hallowat Creek	3.0	3.0	3.5	3.0	3.5	4.0	4.0	4.0	4.0	4.0	3.5	1.0
1701020603	170102060301	Hay Creek	3.0	2.0	2.0	3.0	3.0	2.0	4.0	4.0	4.0	4.0	3.0	1.0

Our Technical Team[1] scored the eleven attributes (riparian condition through obstructions) on a scale of 0 to 4, where 0 = 0% of normative; 1 = 25% of normative; 2 = 50% of normative; 3 = 75% of normative; and 4 = 100% of normative. Normative conditions are defined as ideal conditions for a similar stream in this ecological province. Note that this is more from a geomorphic perspective than a biological perspective. Attribute and reach confidence were scored on a scale of 0 to 2, where 0 = Unknown; 1 = Expert Opinion; and 2 = Well Documented. (Note: the attributes in LQHA are different than in the stream version shown here, because the habitats important to salmonids in lakes are different.)

As part of our QHA analysis, the technical team also scored the reference condition. The instructions were: Describe the normative condition for this stream with regard to the physical conditions relative to an optimal condition for similar streams in this ecological province. The default rating for the reference condition is 4, however, ratings less than 4 inherent "limitations" of streams and reaches caused by geology, topography or other factors. To view how our technical team scored the reference condition, click on the Reference tab. You will see a table like this:

Attribute Confidence		0.5	0.5	1.0	1.0	0.5	1.0	1.0	1.0	1.0	0.5	1.0	
Attribute Toggle		1	1	1	1	1	1	1	1	1	1	1	
Reach Name	Not Rated	Riparian Condition	Channel stability	Habitat Diversity	Fine sediment	High Flow	Low Flow	Oxygen	Low Temperature	High Temperature	Pollutants	Obstructions	Reach Confidence
Big Creek 1	0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.5
Big Creek 2	0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.5
Canyon Creek	0	4.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0	0.5
Coal Creek 1	0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.5
Coal Creek 2	0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.5
Cyclone Creek	0	4.0	3.0	4.0	4.0	4.0	2.5	4.0	4.0	3.0	4.0	2.5	0.5
Hallowat Creek	0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	0.5
Hay Creek	0	4.0	3.0	4.0	4.0	4.0	2.0	4.0	4.0	4.0	4.0	3.0	0.5

This table is similar to the one that appears when you click the Current tab except that it represents likely stream conditions prior to European settlement. Again, the attributes in LQHA are different, because the habitats important to salmonids in lakes are different.

To view the Technical Team's hypothesis about how the stream or lake habitat would be used by a focal species (in this case bull trout), click on the Hypothesis tab. The hypothesis is the "lens" through which physical conditions in the stream are viewed. The hypothesis consists of weights that are assigned to life stages and attributes, as well as a description of how reaches are used by different life stages. These result in a composite weight that is applied to a physical habitat score in each reach. Note, the life stages used in LQHA are slightly different from those in the stream version, shown on the facing page.

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[1] *The Flathead Subbasin Technical Team members particiapating in the HUC-by-HUC assessment included fisheries biologists and hydrologists from Montana Fish, Wildlife & Parks, Montana Department of Environmental Quality, US Army Corps of Engineers, US Fish and Wildlife Service, the Flathead National Forest, two provincial Canadian ministries, the Confederated Salish and Kootenai Tribes, and a private consulting firm.*
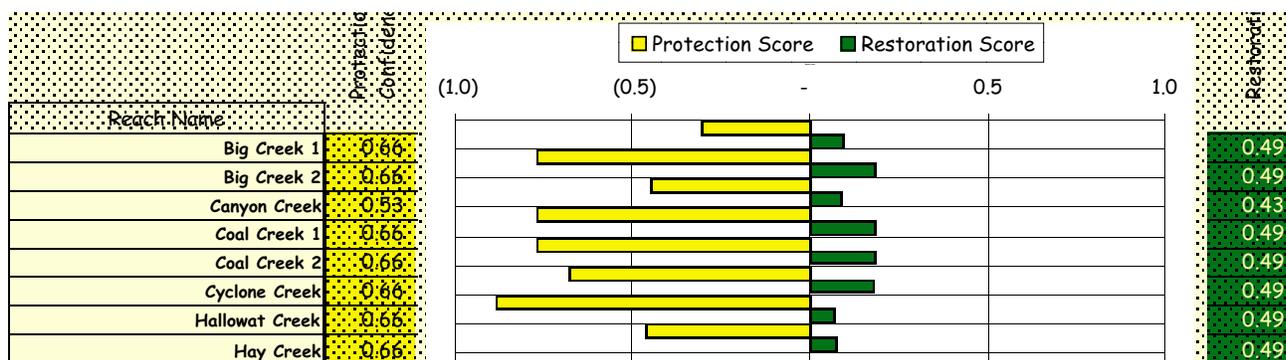
Species habitat hypothesis
Focal Species: Bull Trout in Flathead

	Spawning/incubation	Summer Rearing	Winter Rearing	Migration
Life Stage Rank (1-4)	3.0	3.0	0.0	2.0

Assign a weight to each attribute (0-2) relative to its importance to the life

Riparian Condition	1.0	2.0	2.0	0.5
Channel stability	2.0	2.0	2.0	0.5
Habitat Diversity	1.0	2.0	2.0	0.5
Fine sediment	2.0	2.0	2.0	0.5
High Flow	2.0	1.0	1.0	0.5
Low Flow	2.0	2.0	2.0	2.0
Oxygen	2.0	2.0	2.0	2.0
Low Temp	0.5	0.0	0.0	0.0
High Temp	2.0	2.0	2.0	2.0
Pollutants	2.0	2.0	2.0	2.0
Obstructions	0.0	1.0	1.0	2.0

To view the how the focal species uses each reach or HUC (or in the case of LQHA, each lake), click on the species range tab. You will see a table like the one below. A 1 means the species uses that reach for that particular life stage; a 0 means it does not.

Reach Name	Confidence	Current Range (0-1)				Reference Range (0-1)			
		Spawn and incubation	Summer rearing	Winter rearing	Migration	Spawn and incubation	Summer rearing	Winter rearing	Migration
Big Creek 1	0	0.0	1.0	1.0	0.0	0.0	1.0	1.0	0.0
Big Creek 2	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Canyon Creek	0	0.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0
Coal Creek 1	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Coal Creek 2	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cyclone Creek	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hallowat Creek	0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hay Creek	0	0.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0

Finally, to view the output, click on the tornado tab and you will see a summary chart that shows, for each HUC-6 or lake: (1) relative restoration ratings, (2) relative protection ratings, and (3) confidence ratings for each of these. This is called a tornado because it often looks like one. The purpose of this diagram is to allow planners to look at the system from a holistic perspective. The tornado diagram displays the reach scores for protection and restoration. These scores have no inherent meaning but do have relative

Reach Name	Protection Confidence		Protection Score / Restoration Score				Restoration
		(1.0)	(0.5)	-	0.5	1.0	
Big Creek 1	0.66						0.49
Big Creek 2	0.66						0.49
Canyon Creek	0.53						0.43
Coal Creek 1	0.66						0.49
Coal Creek 2	0.66						0.49
Cyclone Creek	0.66						0.49
Hallowat Creek	0.66						0.49
Hay Creek	0.66						0.49

value to compare protection and restoration values between reaches. To the left and right of the tornado diagram are a series of numbers between zero and one that summarize the confidence that planners have in these depictions, based on the confidence ratings described earlier.

The algorithm used in the spreadsheet for the restoration score (which determines the length of the tornado bar) is:

$$\text{Restoration Attribute Score}_{ij} = (\text{Reference}_{ij} - \text{Current}_{ij}) * \text{LSWeight}_{ijk}$$

Where the Restoration Attribute Score is for reach i for attribute j, Reference is the attribute score for the reach and attribute from the Reference tab, and Current is the attribute score for the reach and attribute from the Current tab. LSWeight is the weight assigned in the hypothesis table to the attribute (j) for the highest ranked life stage (k) using the reach (i). This equation results in a number that provides a relative indication of the effect of restoring conditions beyond the current condition. The reach score is the simple sum of the individual attribute scores.

The algorithm used in the protection rankings table is generated from information in the current conditions tables and the hypothesis tables:

$$\text{Protection Attribute Score}_{ij} = (0 - \text{Current}_{ij}) * \text{LSWeight}_{ijk}$$

This results in a negative number that indicates a potential loss to the focal species if conditions were degraded beyond the current condition.

We then used the restoration and protection scores to classify streams into five different classes (see the HUC/Unit Chapter of the Assessment).