Icicle Creek Instream Flow Sub Committee Report to the Icicle Work Group

May 16, 2014

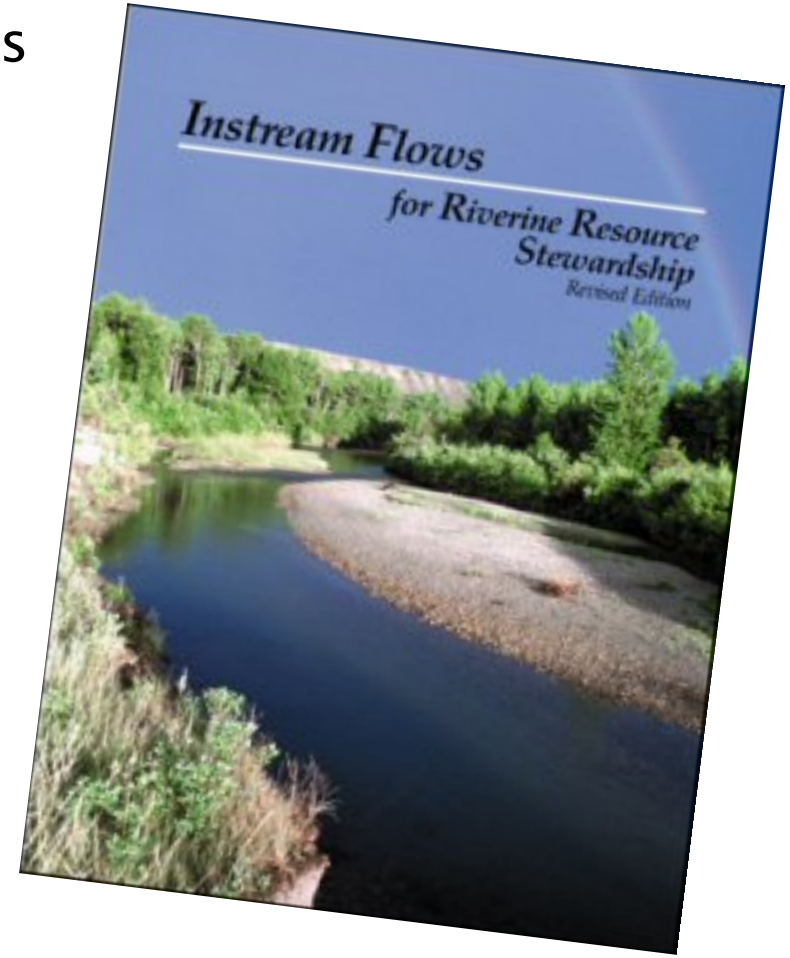
IFC did:

- Made flow recommendations based on the protection and perpetuation of fish life.
- Used best available science
- Assessed and applied modeling based on fish focal species and life stages.
- Used common fish-flow-habitat models and passage requirements for each reach.
- Applied Instream Flow Council methodology – see next slide.

Science Provides Best Information

- Basic Instream Flow Science
  - Eight Ecosystem Components

1. Hydrology
2. Geomorphology
3. Biology
4. Water Quality
5. Connectivity
6. Public Involvement
7. Legal
8. Institutional



IFC did NOT…..

- Address public involvement
- Address institutional needs
- Address water right validity, unless relevant
- Address screening violations
- Address recovery actions

Target Reaches

- **Reach 1-** Upstream of Icicle & Peshastin ID POD; RM 5.8 to headwaters.
  - Committee added a reach between 5.7 to 5.8 due to flow differences; no separate assessment though.
- **Reach 2** – IPID POD to LNFH POD; RM 5.7 to 4.5
- **Reach 3** – LNFH POD to Structure 2; RM 4.5 to 3.9
- **Reach 4** – Historic channel; RM 3.9 to 2.7
- **Reach 5** – Downstream of LNFH outflow to the Wenatchee River confluence; RM 2.7 to 0.0

Focal Fish Species by Reach

Reach	River Mile	Species	Life History & Life Stage
1	Headwaters to 5.8 (5.7)	Steelhead, Rainbow trout, bull trout, cutthroat trout	SH – Passage, Spawning, Rearing RB – S, R CT – R BT – P, S, R
2	5.7 to 4.5	SH, BT	SH – P, R BT – P
3	4.5 to 3.9	SH, BT	SH – P, R BT – P
4	3.9 to 2.7	SH, BT, Lamprey	ST – P, R, S BT – P L – P
5	2.7 to 0.0	SH, BT, Lamprey	SH – S, R BT – P L – P

Assumptions:

- No spring Chinook assessment
- Assume steelhead production is present

Focal Fish Species and Relevant Life Stages Periodicity Within Icicle Work Group Study Reaches

	Life stage	Migration	Spawning	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead, Rainbow trout	Adult														
	Rearing														
Bull trout	Adult/Subadult														
	Rearing														
Cutthroat trout	Adult														
	Rearing														
Lamprey	Adult														

Source: USFWS 2013 draft

Complex Instream Flow & Habitat Studies

- **USFWS 2013**
  - IFIM, River 2D, fish passage; RM 2.7 to 3.9
- **USBOR, 2005**
  - PHABSIM; RM 0.2 to 2.4
- **Montgomery Water Group, Inc., 2004**
  - PHABSIM, Tennant, Hatfield & Bruce, and fish passage depth: RM 3.9 to 4.5
- **1985 USBOR study** – for hydro power feasibility
  - PHABSIM; RM 6.0 to 11.0, three study reaches
- **Wild Fish Conservancy 2007**
  - fish, fish passage, & habitat
- **Icicle Creek Boulder Field Fish Passage Assessment 2013**
  - HEC-RAS, River FLO 2D, & fish energetics model
    - RM 5.6

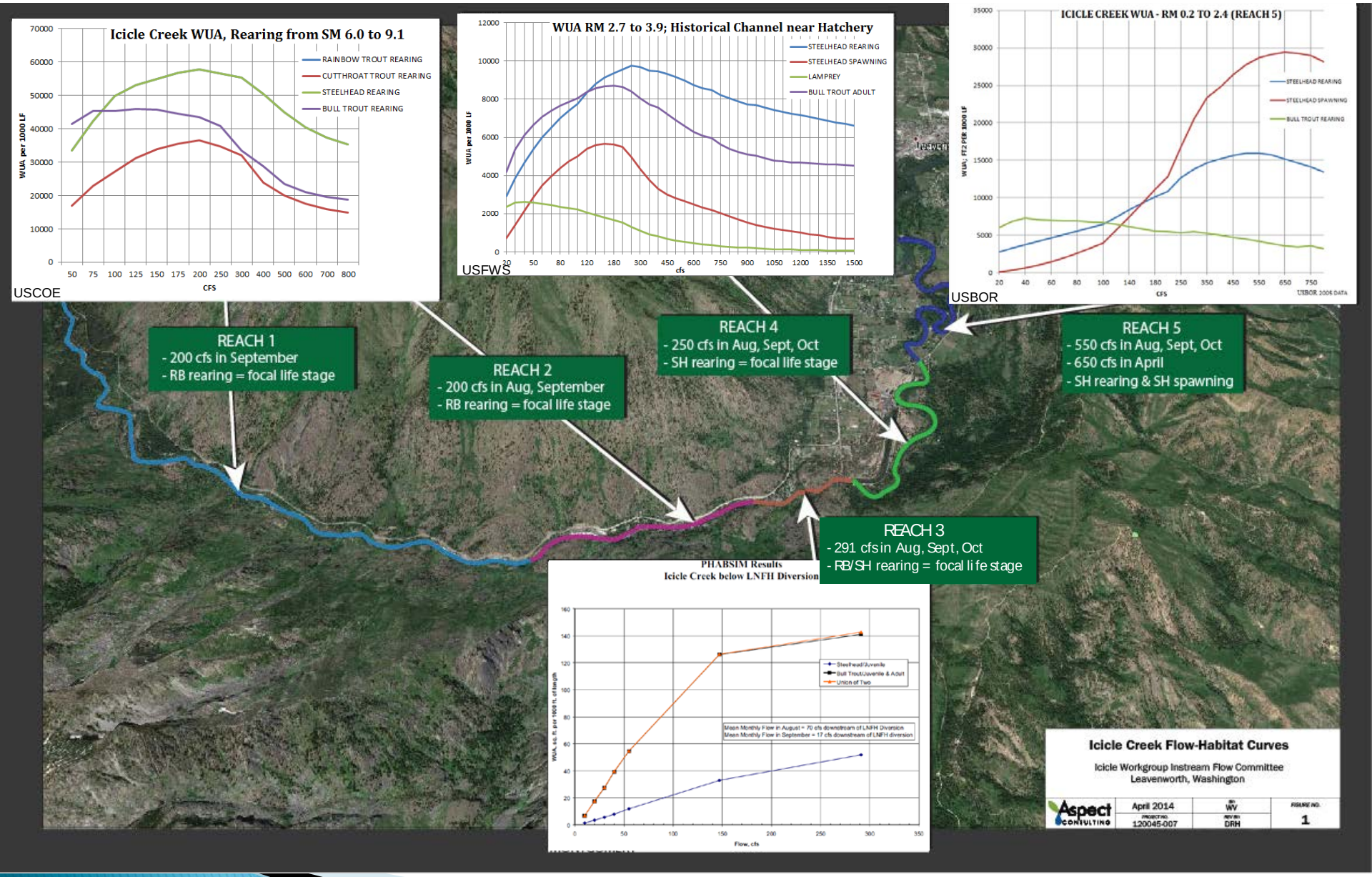
IFC Assessed WUA by Reach and Flow and Fish Passage Relationships

IFC evaluated flow relationship with depth, velocity, and physical structures

- Structure 2 upstream passage – gates open
- LNFH POD weir – see upcoming slide
- Natural channel flows
- Structure 5
- LNFH & Cascade IC POD
- Boulder field at RM 5.6

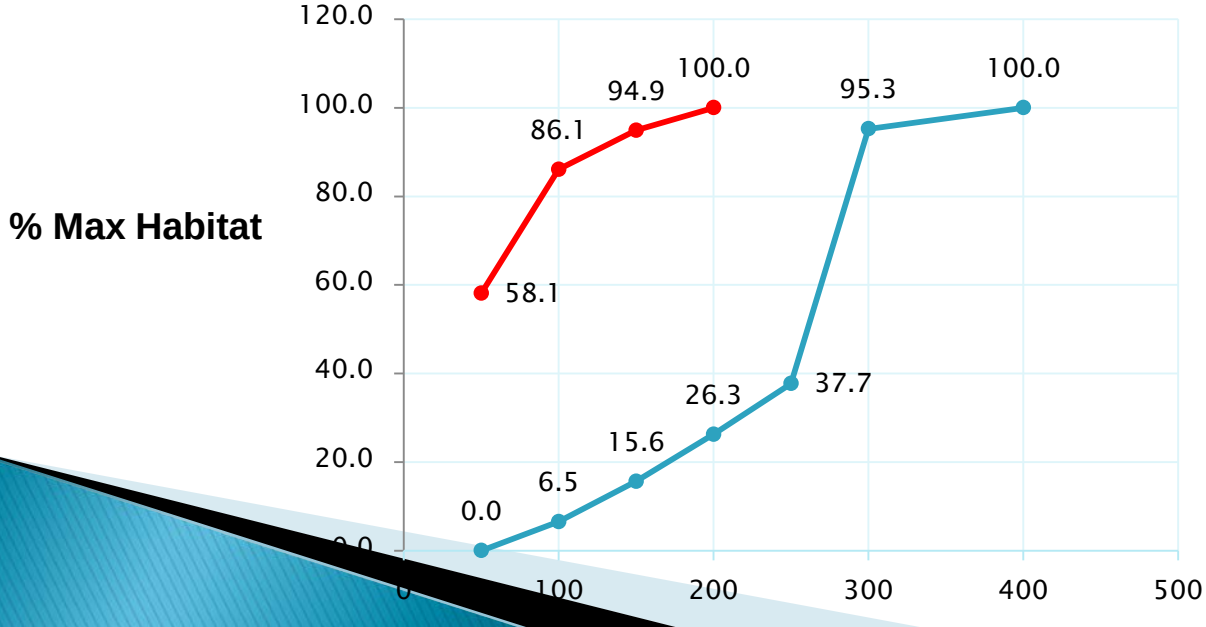
Handouts

Percent Maximum Habitat by Reach
Hydrographs
Flow Recommendations


Icicle Creek WUA, Rearing from SM 6.0 to 9.1
RAINBOW TROUT REARING
CUTTHROAT TROUT REARING
STEELHEAD REARING
BULL TROUT REARING
WUA per 1000 LF
CFS
USCOE
WUA RM 2.7 to 3.9; Historical Channel near Hatchery
STEELHEAD REARING
STEELHEAD SPAWNING
LAMPREY
BULL TROUT ADULT
WUA per 1000 LF
cfs
USFWS
ICICLE CREEK WUA - RM 0.2 TO 2.4 (REACH 5)
STEELHEAD REARING
STEELHEAD SPAWNING
BULL TROUT REARING
WUA, FT2 PER 1000 LF
CFS
USBOR 2006 DATA
USBOR
REACH 1
- 200 cfs in September
- RB rearing = focal life stage
REACH 2
- 200 cfs in Aug, September
- RB rearing = focal life stage
REACH 4
- 250 cfs in Aug, Sept, Oct
- SH rearing = focal life stage
REACH 5
- 550 cfs in Aug, Sept, Oct
- 650 cfs in April
- SH rearing & SH spawning
REACH 3
- 291 cfs in Aug, Sept, Oct
- RB/SH rearing = focal life stage
PHABSIM Results
Icicle Creek below LNFH Diversion
Steelhead/Juvenile
Bull Trout/Juvenile & Adult
Union of Two
Mean Monthly Flow in August = 70 cfs downstream of LNFH Diversion
Mean Monthly Flow in September = 17 cfs downstream of LNFH diversion
Flow, cfs
Icicle Creek Flow-Habitat Curves
Icicle Workgroup Instream Flow Committee
Leavenworth, Washington
Aspect CONSULTING
April 2014
120045-007
WV
DRH
1

Reach 1 Flow Recommendation

Month	Gage Q	Focal Species & Life Stage WUA	Flow Rule (cfs)	Q Deficit	Flow Recommendation
April	661	Rainbow Rearing; 200 cfs		No	
May	1,690			No	
June	1,890			No	
July	874			No	
Aug	264		400	No	
Sept	161		275	(–) 39 cfs	200 cfs
Oct	235		267	No	

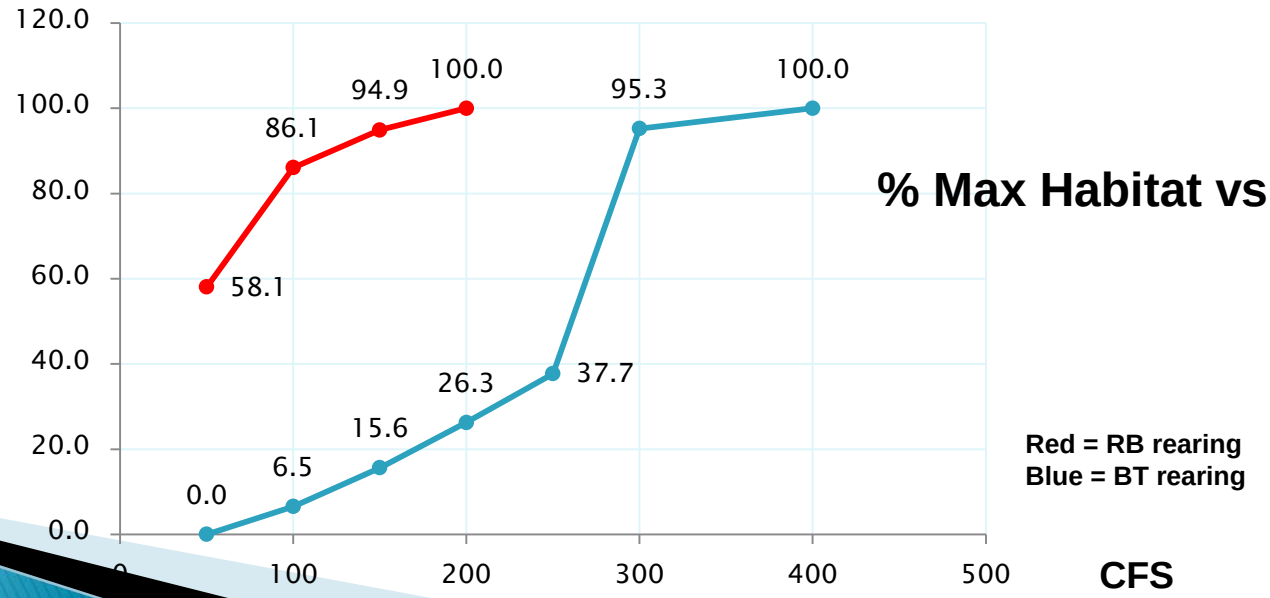


Red = SH/RB rearing; Sept
Blue = SH spawning; April

% Max Habitat vs Flow

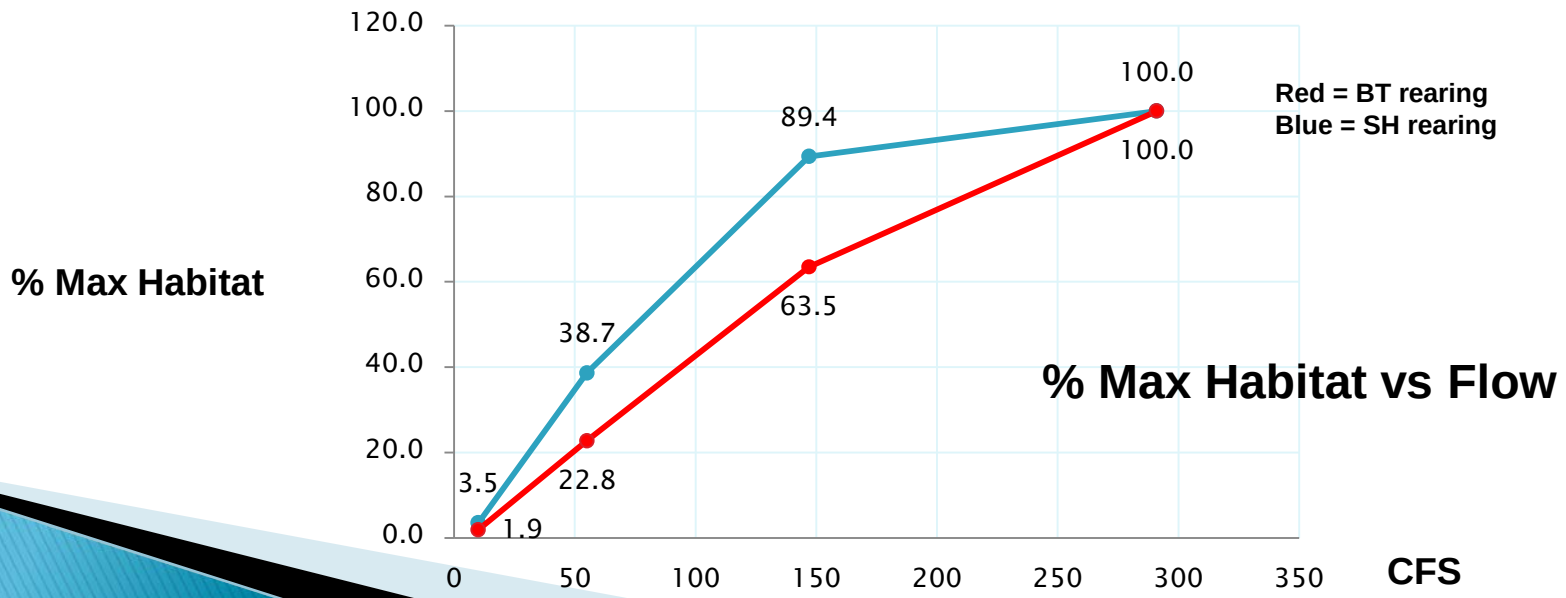
Reach 2 Flow Recommendation

Month	Gage Q	Snow Cr +	W/D (-)	Focal Species & Life Stage WUA	Reach Q	Flow Rule (cfs)	Q Deficit	Recommended Flow
April	661	24	75	Rainbow Rearing; 200 cfs	610		No	
May	1,690	56	100		1,646		No	
June	1,890	30	100		1,820		No	
July	874	44	110		808		No	
Aug	264	37	110		191	400	(–) 9 cfs	200 cfs
Sept	161	43	85		119	275	(–) 81 cfs	200 cfs
Oct	235	33	5		265	267	No	



Reach 3 Flow Recommendation

Month	Gage Q	+ Snow Cr	(-) W/D	Focal Species & Life Stage WUA	Reach Q	Flow Rule (cfs)	Q Deficit	Recommended Flow
April	661	24	127	Steelhead Rearing; 291 cfs	558		No	
May	1,690	56	152		1,594		No	
June	1,890	30	155		1,765		No	
July	874	44	170		748		No	
Aug	264	37	170		131	400	(–) 160 cfs	291 cfs
Sept	161	43	141		63	275	(–) 228 cfs	291 cfs
Oct	235	33	59		209	267	(–) 82 cfs	291 cfs

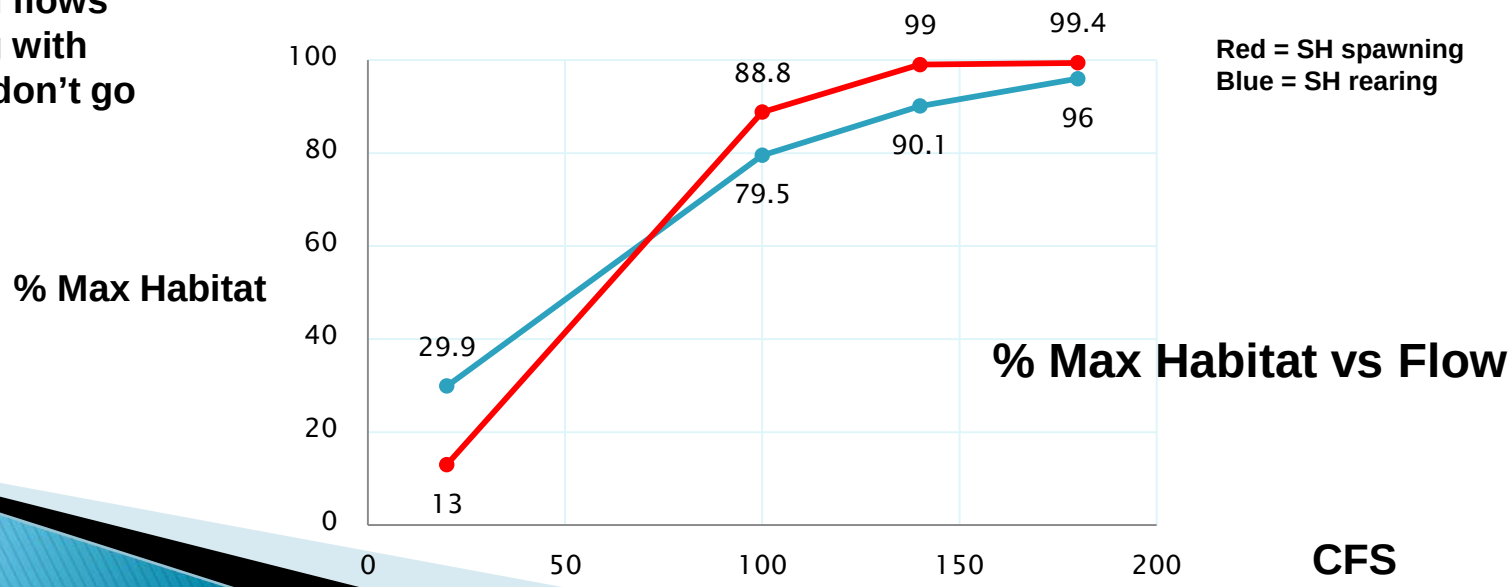


Reach 4 Flow Recommendation

? - Maximum habitat steelhead spawning & rearing flows are far below actual Q in historic channel.

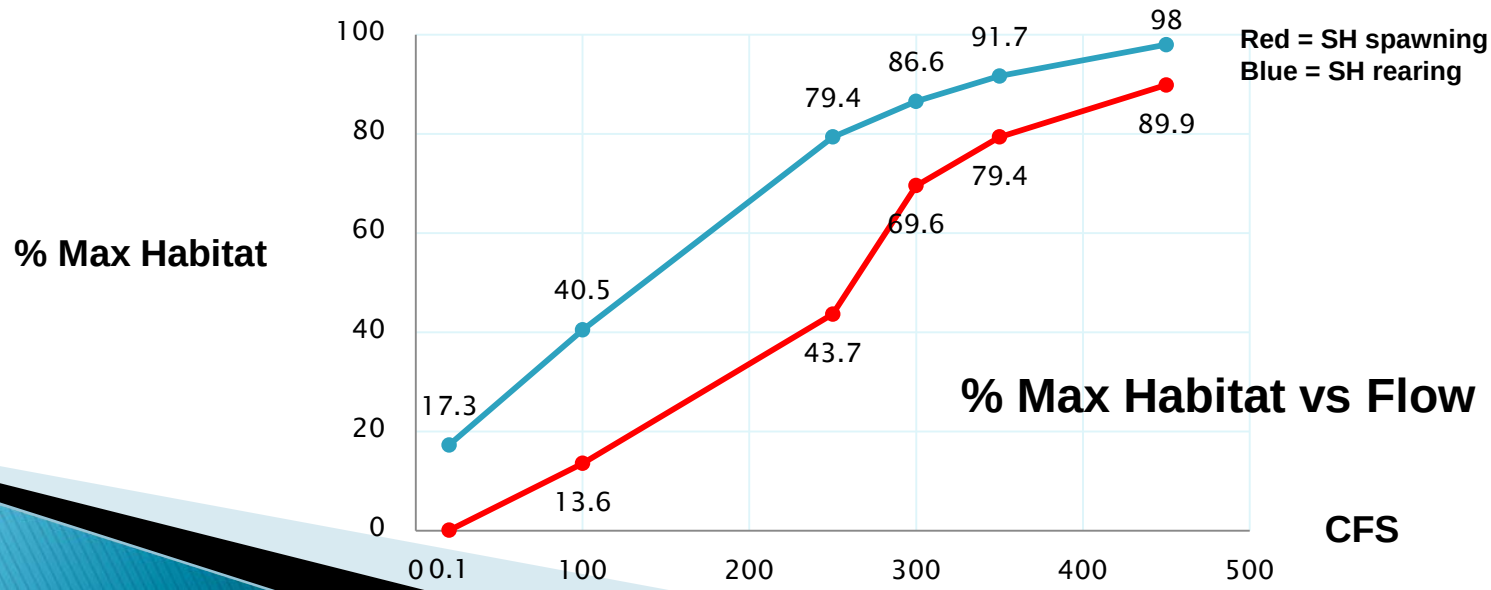
<u>Idea</u>: Supplement hatchery channel flows during the spring with excess Q? Just don't go below 250 cfs.

Month	Gage Q	Snow Cr +	W/D (-)	Focal Species & Life Stage WUA	Reach Q	Flow Rule (cfs)	Q Deficit	Recommended Flow
April	661	24	127	Steelhead Rearing 250 cfs Fluvial Bull Trout Passage; 1.0-ft depth requirement 180 cfs	558		No	?
May	1,690	56	152		1,594		No	
June	1,890	30	155		1,765		No	
July	874	44	170		748		No	
Aug	264	37	170		131	400	(-) 119 cfs	250 cfs
Sept	161	43	141		63	275	(-) 187 cfs	250 cfs
					209	267	(-) 41cfs	250 cfs
Oct	235	33	59					



Reach 5 Flow Recommendation

Month	Gage Q	+ Snow Cr	W/D (-)	Hatchery Return	Focal Species & Life Stage WUA	Reach Q	Flow Rule (cfs)	Q Deficit	Recommended Flow
April	661	24	127	Est.40	Steelhead & Rainbow Rearing 550 cfs Steelhead spawning (April) 650 cfs	598		(–) 52 cfs	650
May	1,690	56	152	40		1,634		No	
June	1,890	30	155	40		1,805		No	
July	874	44	170	40		788		No	
Aug	264	37	170	40		171	400	(–) 379 cfs	550 cfs
Sept	161	43	141	40		103	275	(–) 447 cfs	550 cfs
Oct	235	33	59	40		249	267	(–) 301cfs	550 cfs



Flow Recommendations (cfs) Based On WUA Results And Studies

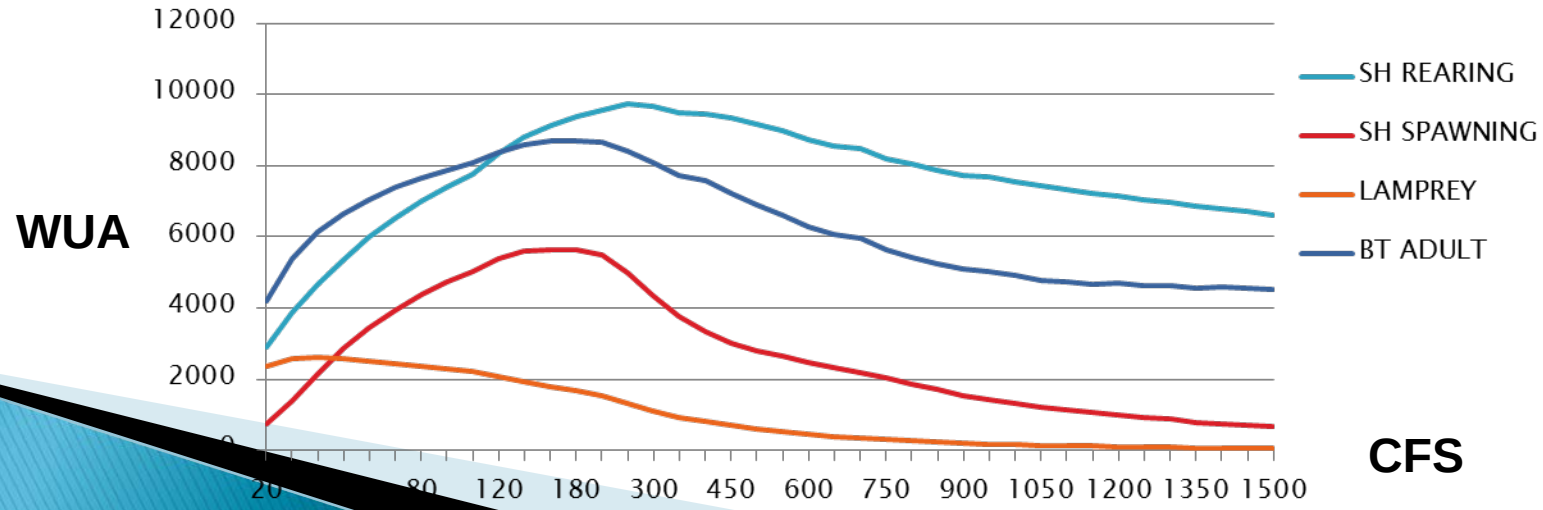
*Flow deficit equals reach focal species WUA minus reach Qi

Reach	1	2	3	4	5
April	–	–	–	–	650
Flow Deficit*	–	–	–	–	(–)52
% of Maximum Habitat					99.1%
August	–	200	291	250	550
Flow Deficit*	–	(–)9	(–)160	(–)119	(–)379
% of Maximum Habitat		99.3%	~78.0%	87.2%	63.1%
September	200	200	291	250	550
Flow Deficit*	(–)39	(–)81	(–)228	(–)187	(–)447
% of Maximum Habitat	96.3%	90.6%	45.4%	63.0%	41.4%
October	–	–	291	250	550
Flow Deficit*	–	–	(–)82	(–)41	(–)301
% of Maximum Habitat			95.7%	98.3%	79.4%

Reach 4 & Hatchery Channel Flow Options (cfs) Based On WUA

*Flow surplus equals the difference between reach focal species WUA and reach Qi

Reach 4 – Maximum WUA = 250 cfs for Rearing; 160 cfs for spawning						
Rearing Flows	May 1,594	April 558	500	400	300	250
Flow Surplus*	+1,344	+308	+250	+150	+50	0
% of Maximum Habitat	~67.0%	91.9%	93.8%	97.0%	99.1%	100%
Spawning Flows	1,594	558	500	400	300	250
Flow Surplus*	+1,434	+398	+340	+240	+140	+90
% of Maximum Habitat	11.5%	46.7%	49.7%	58.7%	76.9%	88.2%



Conclusions & Comments

- Projects that provide instream flow that reduce the flow deficits significantly in critical low flow reaches during critical low flow periods for focal fish species are preferred.
- Instream flow represents one conservation component that must be complemented with other instream or riparian habitat projects in order to achieve maximum fish life value.
- If the hatchery channel has significant ecological value, such as but not limited to, side channel values for fish life, it's worth exploring future projects.

Data Slides

Snow Creek Monthly Mean Flow

Month	Mean Flow (cfs)	Qa
Oct	33.5	2,060
Nov	3.9	232
Dec	9.0	553
Jan	9.0	553
Feb	32.3	1,794
Mar	21.6	1,328
Apr	23.7	1,410
May	56.0	3,443
June	29.6	1,761
July	43.5	2,675
Aug	36.6	2,250
Sept	43.3	2,577

-1994 to 2002
- At confluence

Upper Snow Lake capacity = 12,450 AF of storage

Water Rights

Water Right	Source	Date	Qi (cfs) or Qa	POD (RM)
Icicle ID	Icicle Creek	1910	83.3	5.7
	Eightmile Lake	1926	2,500 AF 25 CFS	9.1
	Colchuck Lake	1926	2,500 AF 50 CFS	9.1
	Square Lake	1930's	2,500 AF, 10 cfs	27.93
	Kionaqua Lake	1926	2,500 AF, 25 cfs	21.75
	Snow Lake	1926	750 AF, 25 CFS	
Peshastin ID	Icicle Creek	1926	34.4	5.7
Cascade Orchard IC		1905	12.0	4.5
LNFH	Icicle Creek	1942	42	4.5
	Snow Lakes	1942	16,000 AF	Upper Snow LK
	Wells	1939 – 1980	14.9	Upland near RM 2.8 to 3.8
City of Leavenworth	Icicle Creek	1912	Surface = 275 AF GW = 926 AF	5.5
Icicle Creek Reservation	Icicle Creek	2008	0.1 cfs; additional 0.4 cfs – depends on projects benefits	Var.
Others	Icicle Creek & groundwater	Var.	Surface = 986 AF GW = 106 AF	Var.

Questions?

Icicle Creek Work Group
Instream Flow Subcommittee
Contact:

- Mary Jo Sanborn – Chelan County Natural Resource Department
- Paul LaRiviere – WDFW
- Dan Haller – Aspect Consulting