Icicle Creek Instream Flow Sub Committee

Of the Icicle Work Group

April 29, 2014

Caveats…..

- This is a working presentation. The IFC will discuss technical issues in relation to the slide content.

- Outcome (after 2nd IFC meeting): Flow levels & recommendations for the benefit of fish life.

IFC will 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

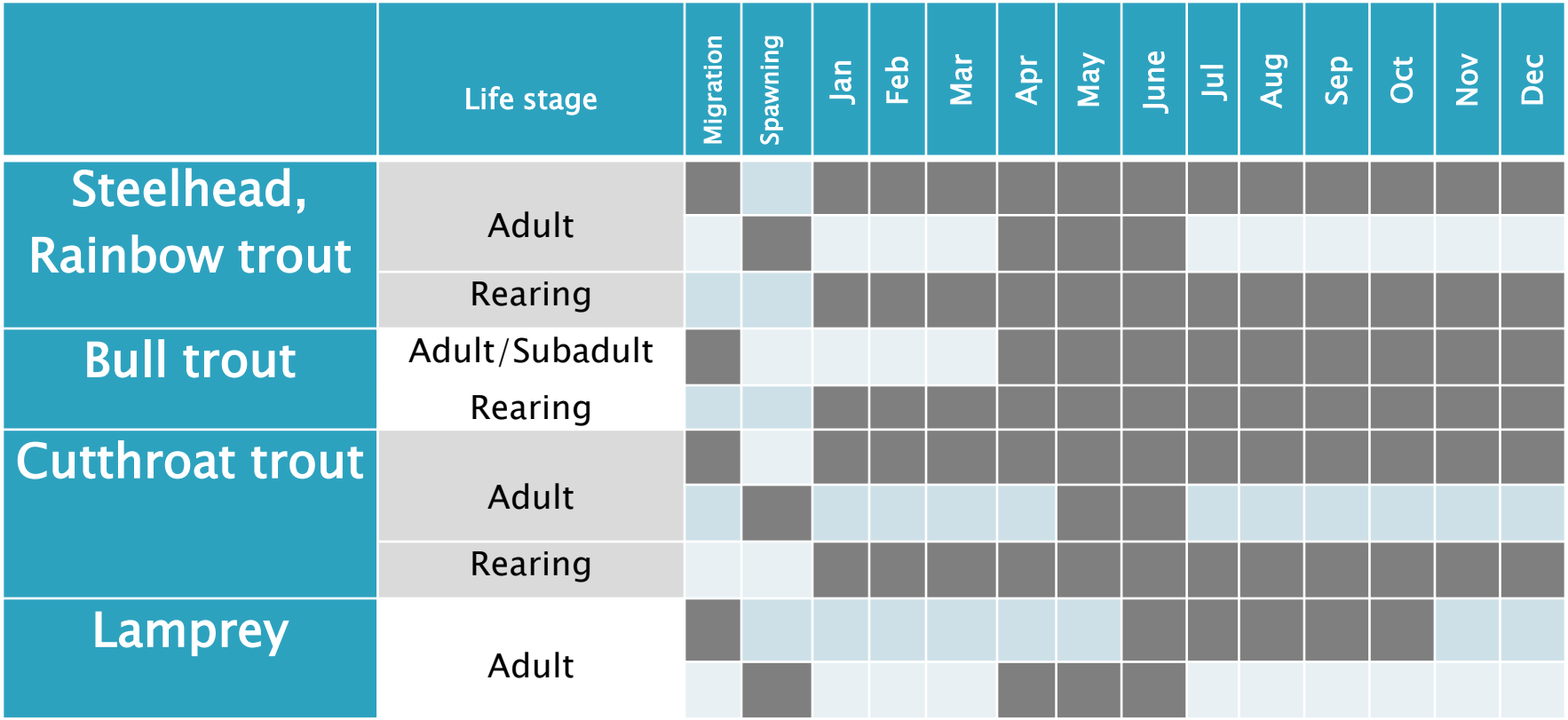
Focal Fish Species by Reach

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



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

Flow and Fish Passage Relationships

Fish Passage Depth Concerns– for focal fish species

- Structure 2 upstream passage – gates open
  - S2 – minimum 64 cfs – rainbow, lamprey, subadult BT
  - S2 – minimum 132 cfs – fluvial bull trout
  - S2 – minimum 181 cfs – steelhead & salmon
- LNFH POD weir – see upcoming slide
- Natural channel flows
  - below 30 to 40 cfs – juvenile salmonids limited
  - below 120 cfs – mid size fish limited (SH)
  - below 200 cfs – fluvial BT

Fish Passage Velocity Concerns– for focal fish species

- Structure 2 upstream passage – gates open
  - S2 – no passage – juvenile salmonids
  - S2 – maximum 64 cfs – rainbow, subadult BT, lamprey
  - S2 – maximum 512 cfs – steelhead, salmon, fluvial BT

- LNFH POD weir – see upcoming slide

Source: USFWS 2013 draft

Fish Passage Physical Concerns– for focal fish species

- Structure 5 upstream passage – gates open
  - S5 – pickets– 0.125 ft openings
    - Passes only small fish & juveniles
    - Operates mid May through June
- LNFH & Cascade Orchard IC POD weir
  - fish ladder
    - Pool velocities marginal
    - Weir notches 0.34 ft @ 121 cfs (typical late summer flows) – limits most all salmonid passage

Source: USFWS 2013 draft

Fish Passage Physical Concerns–continued

- LNFH & Cascade Orchard IC POD weir
  - POD screening
    - 0.125 ft to 0.5 ft bar spacing
    - 5,200 ft pipeline to hatchery
  - Cross weir/slots – depth problems for fluvial BT
- Boulder Field – velocity & structural?

Source: USFWS 2013 draft

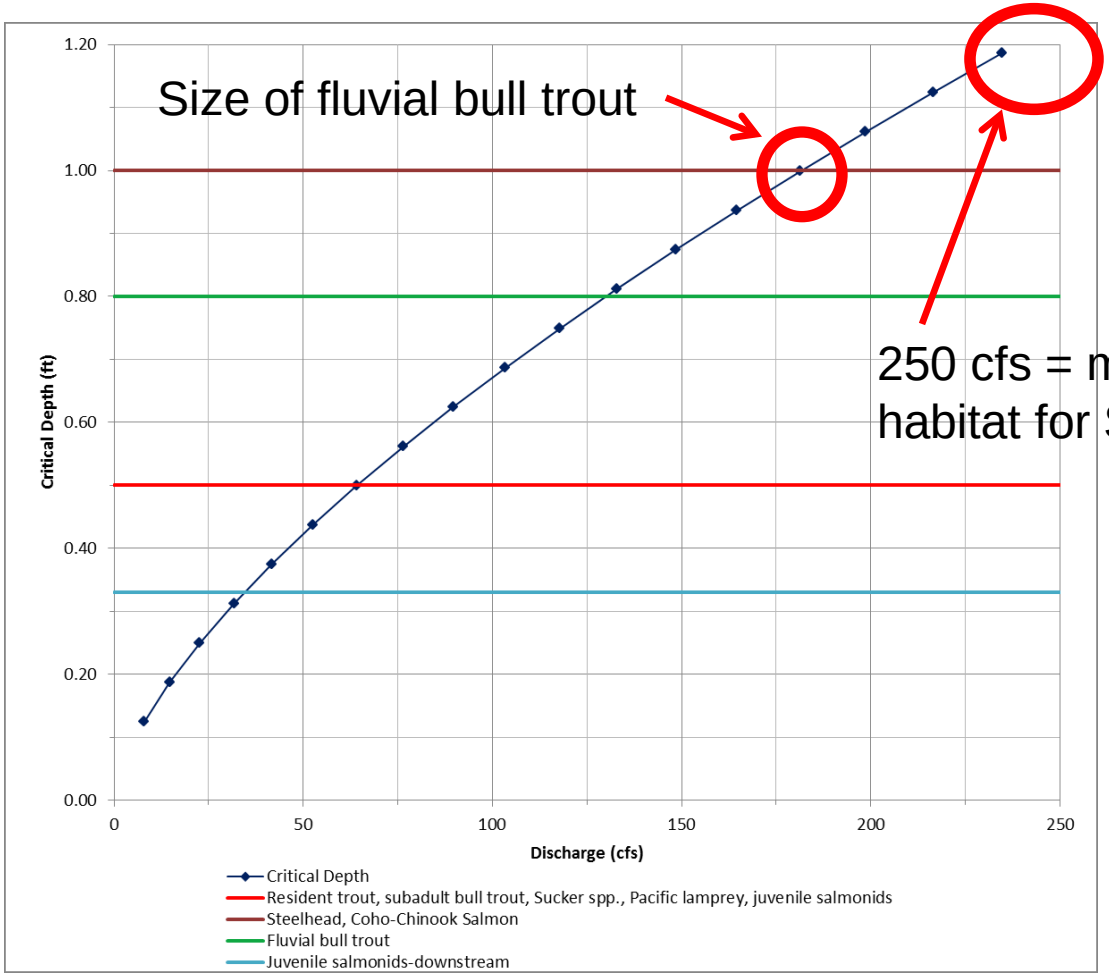
S2 Results – Velocity vs. Discharge

Reach 4

USFWS 2013 draft

S2 Results – Depth vs. Discharge

Reach 4



USFWS 2013 draft

Handouts

WUA by Reach
Hydrograph by Reach

Reach 1 Hydrology & Flow Recommendations Based on WUA

Month	Gage Qi	Focal Species & Life Stage WUA	Flow Rule (cfs)	Qi 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	

Flow Rule applies at RM 1.5

Deficit measured at RM 1.5

Qi = USGS Snow Creek gage

Reach 2 Hydrology & Flow Recommendations Based on WUA

Month	Gage Qi	Snow Cr (+)	W/D (-)	Focal Species & Life Stage WUA	Reach Q i	Flow Rule (cfs)	Qi 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	

Flow Rule applies at RM 1.5

Qi = USGS gage

Deficit measured at RM 1.5

Reach 3 Hydrology & Flow Recommendations Based on WUA

Month	Gage Qi	+ Snow Cr	(-) W/D	Focal Species & Life Stage WUA	Reach Q i	Flow Rule (cfs)	Qi 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

Flow Rule applies at RM 1.5

Qi = USGS gage

Deficit measured at RM 1.5

Reach 4 Hydrology & Flow Recommendations Based on WUA

Month	Gage Qi	+ Snow Cr	(-) W/D	Focal Species & Life Stage WUA	Reach Q i	Flow Rule (cfs)	Qi 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
					63	275	(-) 187 cfs	250 cfs
Sept	161	43	141		209	267	(-) 41cfs	250 cfs
Oct	235	33	59					

Flow Rule applies at RM 1.5

Qi = USGS gage

Deficit measured at RM 1.5

Reach 5 Hydrology & Flow Recommendations Based on WUA

Month	Gage Qi	Snow Cr +	W/D (-)	Hatchery Return	Focal Species & Life Stage WUA	Reach Qi	Flow Rule (cfs)	Qi 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	400 cfs
Sept	161	43	141	40		103	275	(-) 447 cfs	275 cfs
Oct	235	33	59	40		249	267	(-) 301cfs	267 cfs

Qi = USGS Snow Creek gage

Flow Rule applies at RM 1.5

Deficit measured at RM 1.5

Icicle Creek Instream Flow Rule 2008 And Historical Flows Upstream at RM 5.8

Month/Day	Rule cfs, RM 1.5	Monthly Mean at RM 5.8*
January 1	267	303
Feb 1	267	293
Feb 15	566	
March 1	518	299
April 1	650	661
May 1	650	1,690
June 1	650	1,890
June 15	550	
July 1	550	874
Aug 1	400	264
Aug 15	343	
Sept 1	275	161
Oct 1	267	235
Nov 1	267	402
Dec 1	267	341

Flow rule control point = RM 1.5, within Reach 4

***Snow Creek USGS gage #12458000 (1936 to 2014)**

Flow Recommendations (cfs) Based On WUA Results And Studies

Reach	1	2	3	4	5
April	–	–	–	–	650
Flow Deficit*	–	–	–	–	(–)52
August	–	200	291	250	550
Flow Deficit*	–	(–)9	(–)160	(–)119	(–)379
September	200	200	291	250	550
Flow Deficit*	(–)39	(–)81	(–)228	(–)187	(–)447
October	–	–	291	250	550
Flow Deficit*	–	–	(–)82	(–)41	(–)301

*Flow deficit equals reach focal species WUA minus reach Qi

Conclusions

- 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.

- Upper Columbia River ESA status for steelhead and bull trout dictates that larger flow benefits results in larger gains towards stock sustainability and recovery.

Data Slides
HSI table
Snow Creek Hydrology

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

Data Reference: HSI Preferences – Spawning & Rearing

Species & Life Stage	Depth (ft)	Velocity (fps)	Notes
Bull trout – rearing	1.60 – 1.79	.40 – 0.49	> 35 ft width
Bull trout – spawning	.80 – .89	.70 – 0.89	
SH – rearing	2.80 – 2.89	1.40 – 1.49	> 35 ft width
SH – spawning	1.30 – 1.49	2.10 – 2.19	
Sp. Chin – rearing	2.20 – 2.29	.60 – 0.69	
Sp. Chin – spawning	1.0 – 1.09	1.90 – 2.29	
RB trout – rearing	2.80 – 2.89	1.40 – 1.49	
RB trout – spawning	.5–.59; .9–.99	1.60 – 1.89	
Whitefish – rearing	3.50 – 3.59	1.50 – 1.59	
Whitefish – adults	3.10 – 3.29	1.90 – 1.99	Combined spawning & holding

Instream Flow Study Guidelines, WDFW, Ecology 2013

Specific Projects and Potential Flow Benefits

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.

Alpine Lakes Study

- USFWS & IPID
- Automation, optimization, storage capacity
- Flow Benefit
  - ~14 cfs 75 days or 2,163 AF
  - small streams to confluence with Icicle Creek
  - Reaches 1- 4, Wenatchee River, and Col. River?

- Extra flow in Reach 1-4 if other efficiencies applied

IPID Pump Exchange

- Various alternatives
- Benefits range from 15 to 30 cfs
  - Piping projects savings estimates are often conservative
- Lengthy primary reach
  - to Peshastin Ck confluence
  - to Mission Ck confluence
- Largest potential for instream flow & habitat restoration

IPID Irrigation Efficiencies + Cascade Orchard IC

- Piping
  - High cost
  - New technology and efficient operations
- Benefits depend on amount of pipe!
  - IID est. = 5 cfs
  - PID est. = 3.3 cfs
  - COIC est. = 1.6 cfs
- Lengthy primary reach
  - to Peshastin Ck confluence
  - to Mission Ck confluence

Eightmile Lake

- Range of alternatives depend on:
  - IWG consensus
  - regulatory approval – state & federal
- Flow benefits – see chart
  - place of use doesn't change?
- Complete project for mutual benefit
  - Downstream users
  - Benefit reaches 1to 4

Icicle & Peshastin ID Diversion Rate

Month	2003	2004	2005	Average
Apr	58.8	52.1	60.2	57
May	74.5	76	77.3	75.9
June	97.4	90.5	96.5	94.8
July	100.9	96.8	102.7	100.1
August	102	94.5	105.4	100.6
Sept	82.6	78.7	76.9	79.4
Total AF	31,267	29,604	31,449	30,766

LNFH Groundwater Study

- Quantity of savings?
  - further study (estimate of 10 to 20 cfs?)
- Beneficial reach – non consumptive savings for Reaches 2 & 3
- Healthy winter/high flows as important for fish life as improving other base flows
  - in historical channel
  - Reach 4

Sediment Transport & Hydrologic Modeling

- Mostly physical instream/channel improvements
- Flow and habitat benefits?
- Flushing flow benefits to instream habitat

Other Projects or Studies?

Questions?

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