



Leavenworth National Fish Hatchery Tribal Fishery Analysis



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Project Background

- Current and proposed changes to Hatchery Channel operation have impacted the timing and frequency of discharges over the Hatchery Channel Spillway
- Concerns that changes to flow regime at Hatchery Channel Spillway and in Historic Channel will impact:
 - Sediment transport, deposition, and scour in pool at bottom of Hatchery Channel Spillway
 - Timing and duration of spills that create turbulence to help attract and keep fish in pool
 - The number of fish available for harvest

Icicle Creek at Leavenworth National Fish Hatchery

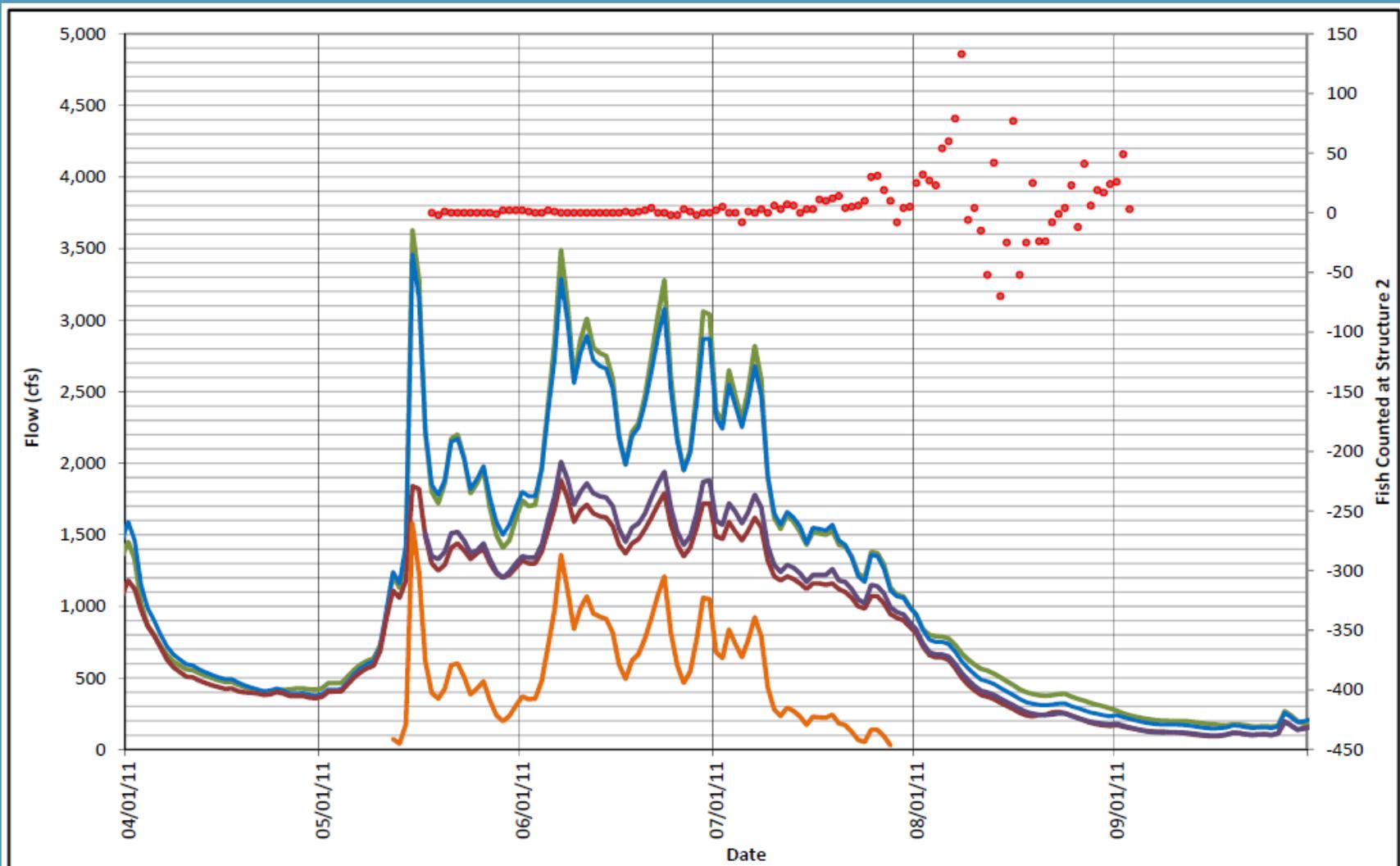


Scope of Work

- Meet with LNFH personnel to review operation of Hatchery Channel and Control Structures
- Evaluate and characterize flow conditions in Hatchery Channel and Historic Channel
- Evaluate the hydraulic conditions that induce scour, turbulence, and sediment deposition and transport in pool at the bottom of the Hatchery Channel

Flow Characterization

- With both gates open at Structure 2
 - Flow backs up into the Hatchery Channel when flow upstream is approximately 300 cfs
 - Flow spills over the Hatchery Channel Spillway when flow upstream is approximately 990 cfs
- Actuators recently installed at Structure 2 allow independent operation of gates
- With only one gate open at Structure 2
 - Flow would back up into the Hatchery Channel when flow upstream is approximately 150 cfs
 - Flow would spill over the Hatchery Channel Spillway when flow upstream is approximately 495 cfs

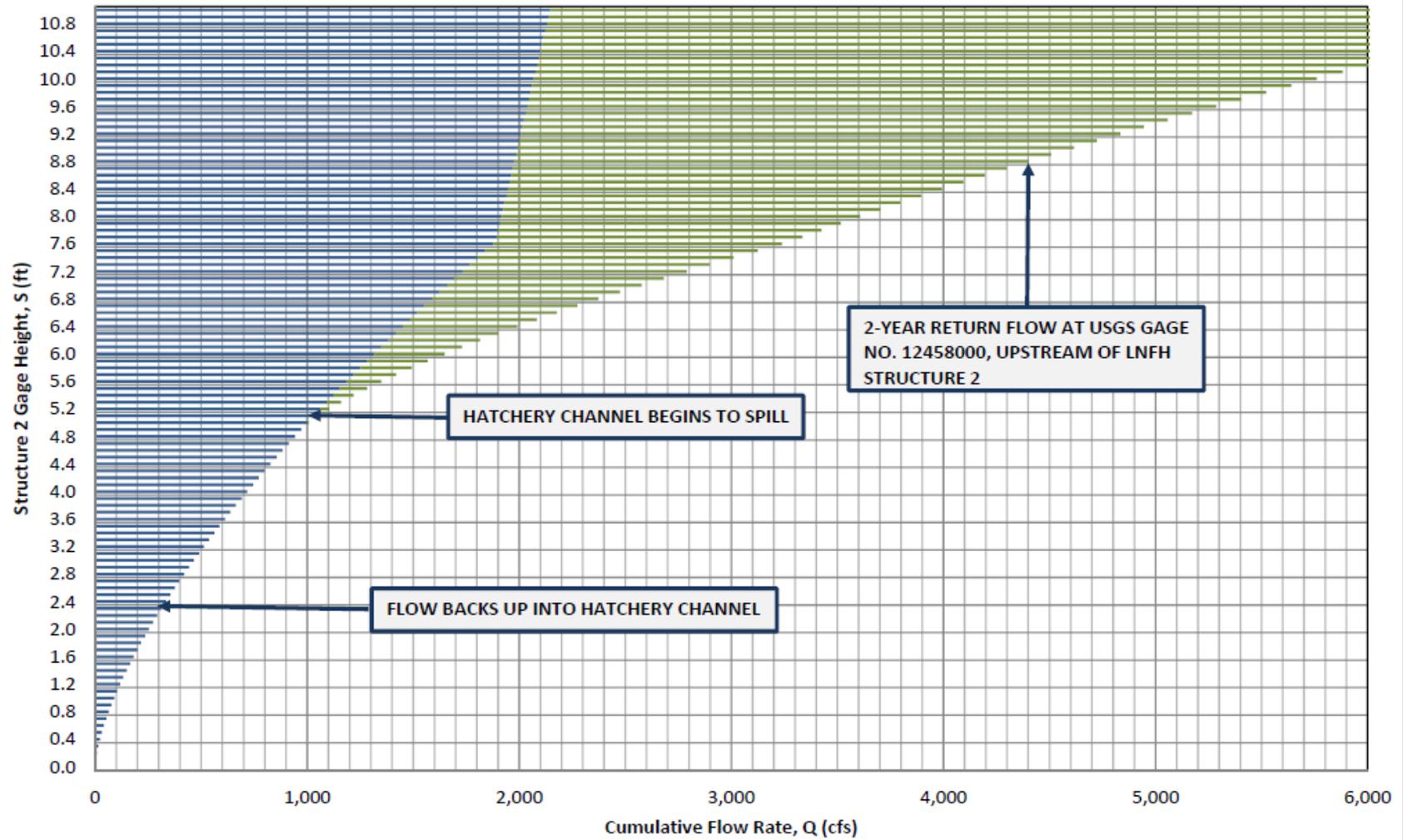


Legend:

- USGS Gage No. 12458000
- Ecology Gage 45B070
- LNFH - Structure 2
- LNFH - Structure 5
- LNFH - Spillway
- Fish Counted at Structure 2

Figure 3
Icicle Creek Flows and Fish Counts
Water Year 2011
LNFH Tribal Fishery Analysis





Legend:

- Flow Through Structure 2
- Flow Over Hatchery Channel Spillway

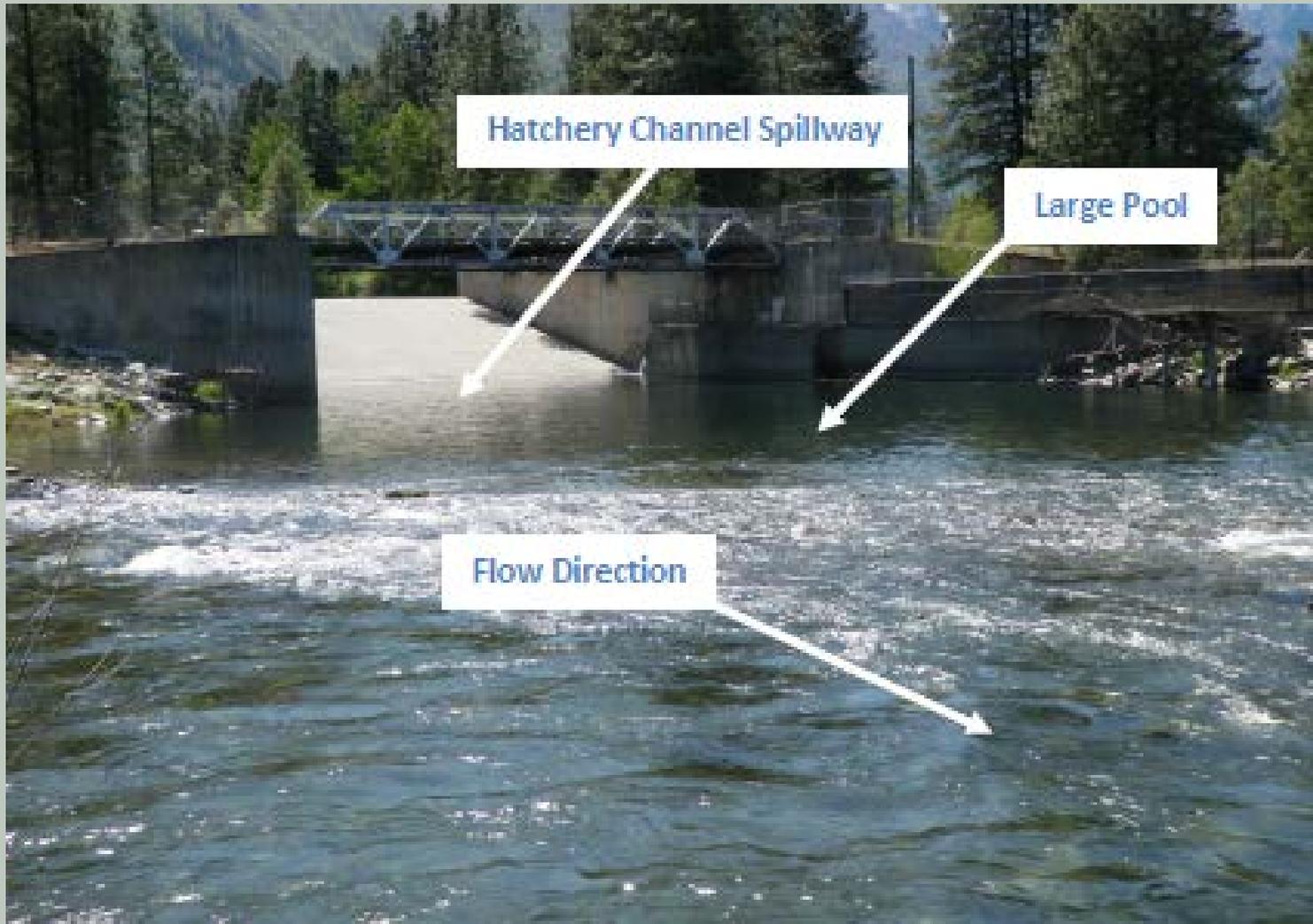
Figure 8
Estimated Structure 2 + Hatchery Channel Flows
Both Gates Fully Open
LNFH Tribal Fishery Analysis



Estimated Peak Flows

Return Period (years)	Flow at USGS Gage No. 12458000 (cfs)	Estimated Flow at Hatchery Channel Spillway (cfs)
2	4,400	2,400
10	8,373	6,100
100	16,507	14,200
Peak	19,800	17,500

Hatchery Channel Spillway and Scour Pool



Scour Conditions

- Initial analysis indicates that scour is initiated during peak flow events (2-year flows or higher)
- Restrictions on Structure 2 primarily limit flows to Hatchery Channel during low flow periods
- Peak flows and corresponding scour conditions are not likely impacted by the current restrictions on gate operation at Structure 2

Sediment Transport

- Observations and initial analysis indicate that sand is likely transported at flows in excess of 500 cfs
- Bedload sediment (based on gravel bar sample with D_{50} of 11.5 mm) likely to be transported at flows in excess of the 10-year flow
- Coarser gravel and boulders would be transported at higher flow rates
- Peak flows and corresponding sediment transport conditions are not likely impacted by the current restrictions on gate operation at Structure 2

Turbulence

- No observations could be made during Spring 2015 because spills were limited
- Preliminary analysis estimates that spillway flows in excess of 500 cfs provide largest fluctuation in water surface and air entrainment
- Options of inducing air entrainment and turbulence
 - Divert flow around spillway and discharge to create turbulence and air entrainment
 - Use mechanical device to create bubble curtain
 - Discharge effluent or pump-back water at head of spillway
 - Use sprinklers or spray jets to induce turbulence

Next Steps

- Further evaluate impact of increased flow in historic channel on sediment delivery to scour pools downstream of spillway
- Continue to observe spillway conditions through coming critical high flow periods and document occurrence of turbulence
- Further evaluate potential methods for reducing sediment deposition, maintaining scour, and inducing turbulence and air entrainment

Questions/Discussion

