High Head Bypass Study – Direct Fish Injury and Survival Green Peter Dam, Oregon, 2016

Paul Heisey, Joanne Phipps, and Adam Slowik*

*Presenter

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

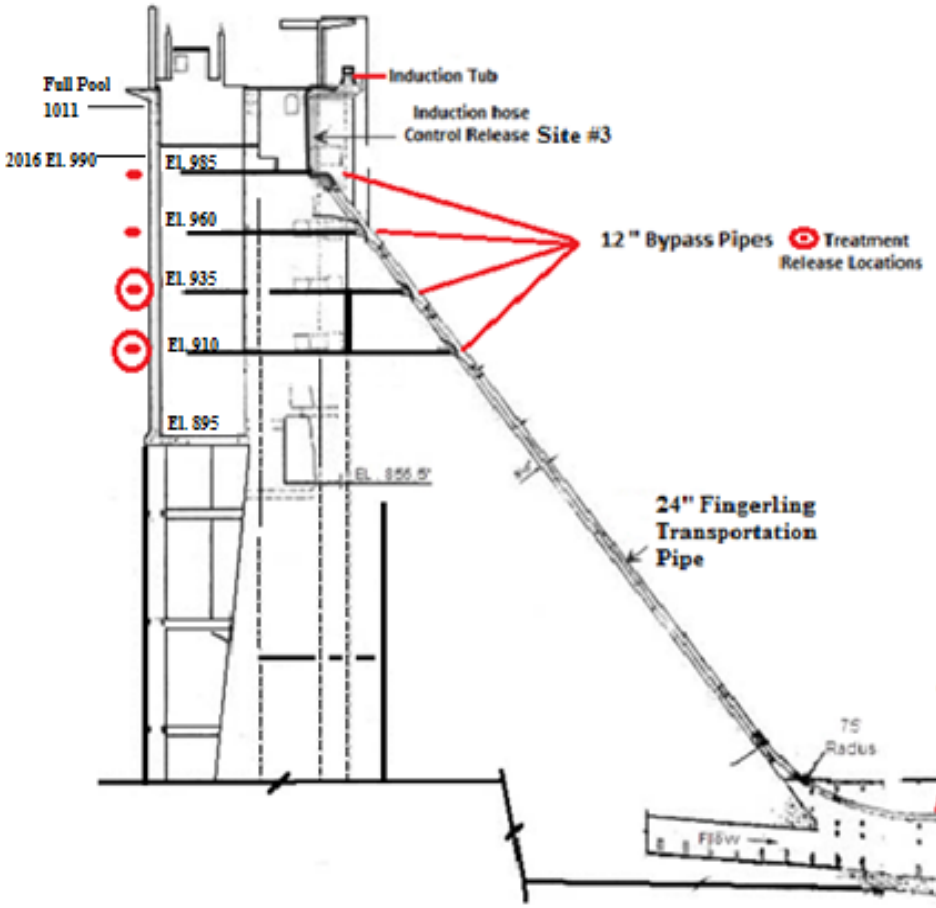
US Army Corps of Engineers®

Background

- Study conducted to provide the Corps with direct survival/injury information for consideration when designing fish bypass systems at high head dams.
- Study (year 2) was conducted at an abandoned fish bypass system at Green Peter Dam, Oregon.
- Remaining bypass system consists of four pressurized/partially pressurized 12-in bypass pipes that discharge into a non-pressurized 24-in bypass pipe which empties into fish evaluator.

Methods

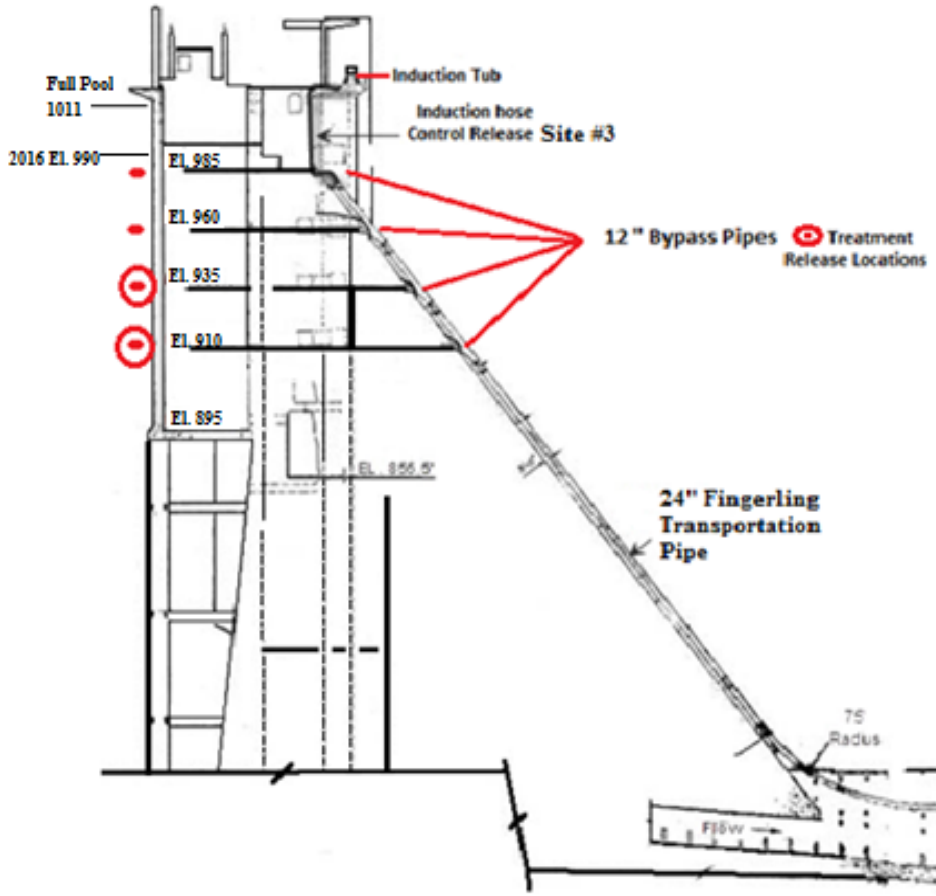
Schematic of Migrant Bypass Pipe



- Juvenile Chinook Salmon and Steelhead and young-of-year (YOY) Steelhead released through 12-in pipes at elevations 910 and 935 fmsl
- Two higher pipes at 960 and 985 fmsl not tested. Head pond ≈21 ft below full pond
- Evaluator elevation 715 fmsl; maximum head tested approx. 225ft

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Schematic of Migrant Bypass Pipe



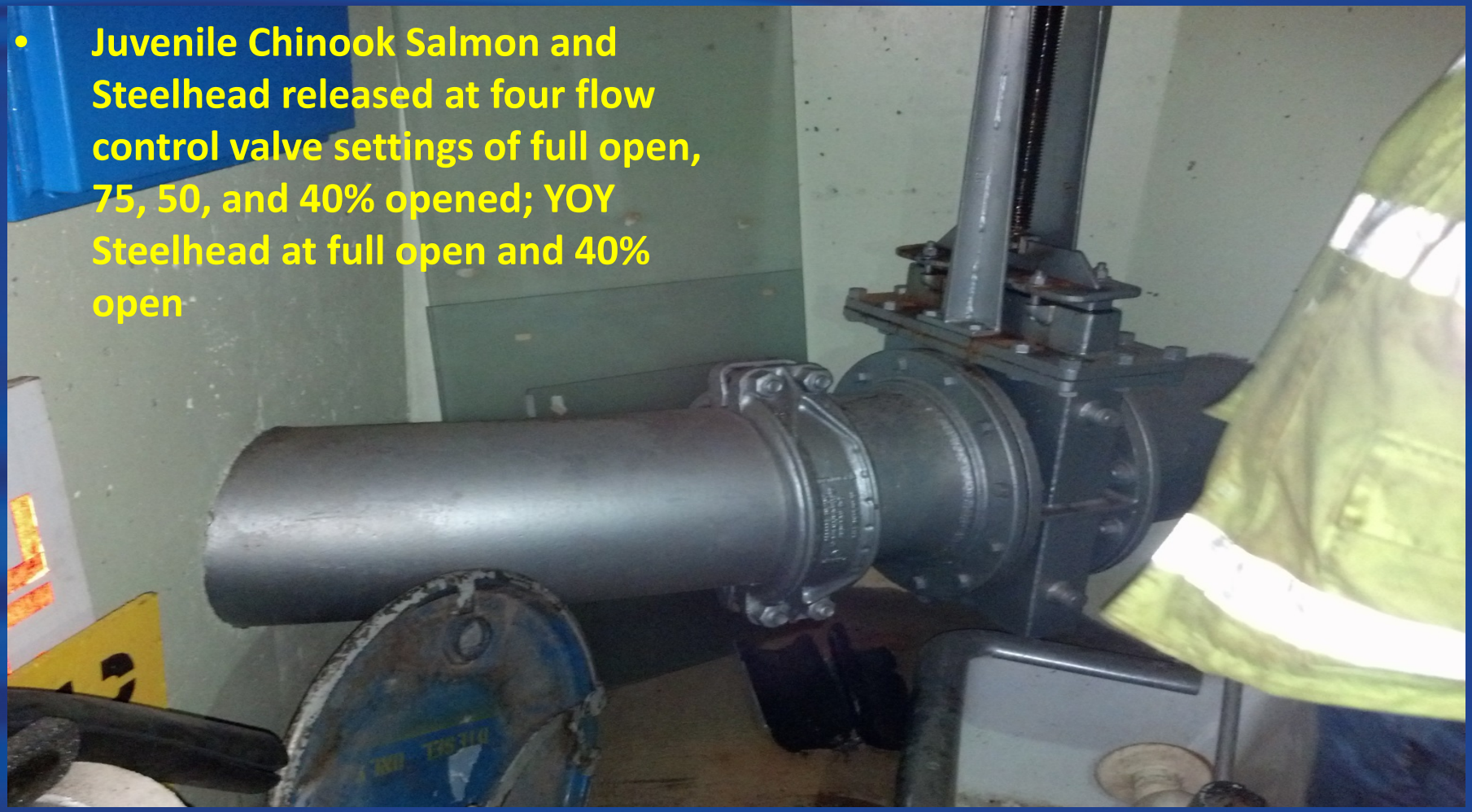
- Control juveniles released at end (site 1) and top (site 3) of 24-in bypass pipe; YOY released only at site 3
- Site 3 releases designed to assess the effects of the 24 inch bypass pipe passage

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Installation of fish release pipes

Flow Control Valve

- Juvenile Chinook Salmon and Steelhead released at four flow control valve settings of full open, 75, 50, and 40% opened; YOY Steelhead at full open and 40% open



- Fish recaptured in refurbished collection bin at end of 24-in bypass pipe.
- Fish examined for injuries and held 48 h for delayed effects of passage.
- Survival and Malady-Free (MF) estimates calculated by adjusting for control sites 1 & 3.
- MF: fish without loss of equilibrium, visible injury, and less than 20% scale loss per side.

Sample Size

- Fish from South Santiam Hatchery

	No. Treatment	No. Control	Length TL mm	
			Range	Mean
Chinook	852	200	161-260	214
Steelhead	800	200	141-290	222
YOY Steelhead	201	52	41-80	62

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Results

Chinook Salmon

- All fish recaptured.
- 48 h survival estimates for Chinook Salmon were 93.0 to 100.0%.
- Survival estimates were all 100.0% except 2 of the sixteen survival estimates.
- MF estimates were 90.0 to 100.0%.
- MF estimates were all ≥94.0% at thirteen of the sixteen estimates.
- Lowest survival and MF estimates were at a flow control valve opening of 40%.

Steelhead

- All fish recaptured.
- 48 h survival estimates for juvenile Steelhead all 100% except for 99.0% through pipe 910 at 75% valve opening.
- MF ranged from 91.6 to 100%.
- Lowest MF (91.6%) at pipe 910, opening of 40%.
- MF estimates ≥95.6% at fourteen of the sixteen estimates.

YOY Steelhead

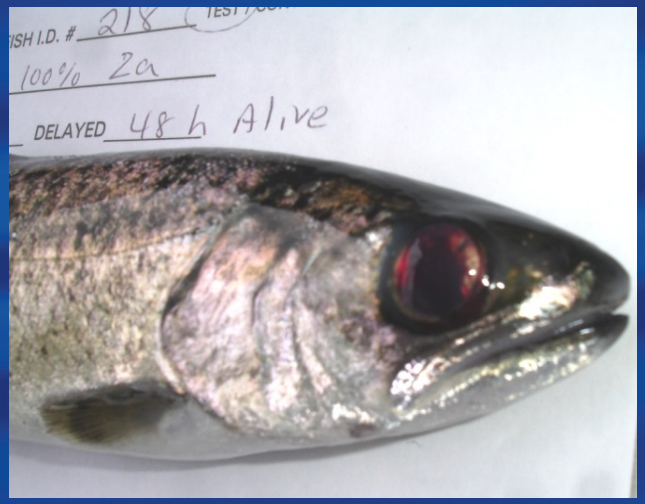
- All fish recaptured.
- YOY Steelhead 48 hour survival estimates 96.0% and 100%.
- MF ranged from 96.0 to 100%.
- No consistent trend for lower survival and MF at the 40% valve opening.

Injuries

(not adjusted for control fish)

- 4.7% of treatment Chinook visibly injured.
- 3.3% of treatment Steelhead visibly injured.
- 1.5% of YOY Steelhead visibly injured.
- Chinook primary injuries were eye damage (2.7%) and operculum damage (1.1%).
- Steelhead primary injuries were eye damage (1.9%) and operculum damage (0.8%).
- YOY Steelhead primary injuries were eye damage (1.0%).

Examples of Injuries



Examples of injuries to juvenile Chinook Salmon after passage through 12 and 24-in bypass pipes at 40-100% flow control valve opening.

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Examples of Injuries

Examples of injuries to juvenile Steelhead after passage through 12 and 24-in bypass pipes at 40-100% flow control valve opening.

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Conclusions

- Four studies conducted at the Green Peter Dam bypass system suggest the bypass pipes should be able to safely pass ≥96% of juvenile salmonids provided the flow control valves are ≥50% open.
- The 24 ft additional operating head in 2016 than in 2015 did not result in higher injury or mortality at valve openings ≥ 50%.
  - However, valve opening near 25% in 2016 inflicted considerably more injury and mortality than 25% valve opening in 2015.

Management Action

- The higher incident of injuries to Chinook salmon (4.7%) than Steelhead (3.3%) may warrant further investigation.

Acknowledgements/Questions

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS