Successful downstream passage of juvenile salmonids at a run-of-river hydro project in the Pacific Northwest

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Successful downstream passage of juvenile salmonids at a run-of-river hydro project in the Pacific Northwest

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Fish Metrics Inc.
Brian Pyper

International Conference on Engineering and Ecohydrology for Fish Passage
June 19-21, Corvallis, Oregon
PGE Clackamas Hydro Project
River Miles 22.3 – 31.7
Clackamas River Hydro Project

Run-of-River Project
127 MW Capacity

3 Dam Complex

Built 1906 – 1958

Mean Daily flow = 1,454 cfs or 41 cubic meter/s (cms)
FERC License
Issued in 2010

Major Downstream Passage Improvements Include:

North Fork Floating Collector

North Fork Spillway Exclusion Net

River Mill Collector

Extension of Downstream Migrant Pipeline/Sampling Facility
250 cfs collector (7cms)
Installed with dam in 1958

Spillway exclusion net
Installed 2013
North Fork surface collector commissioned in 2015
1,000 cfs attraction flow (28 cms)
North Fork Fish Guidance Evaluation
## North Fork Fish Guidance Evaluation

<table>
<thead>
<tr>
<th>Species</th>
<th>Release Groups</th>
<th>Released</th>
<th>Collected</th>
<th>FGE</th>
<th>95% CI</th>
<th>% FSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1</td>
<td>55</td>
<td>48</td>
<td>0.87</td>
<td>0.76 – 0.94</td>
<td>92%</td>
</tr>
<tr>
<td>Coho</td>
<td>5</td>
<td>455</td>
<td>429</td>
<td>0.94</td>
<td>0.92 – 0.96</td>
<td>75%</td>
</tr>
<tr>
<td>Steelhead</td>
<td>3</td>
<td>266</td>
<td>249</td>
<td>0.94</td>
<td>0.90 – 0.96</td>
<td>60%</td>
</tr>
</tbody>
</table>

**Notes:**
- <sup>1</sup> Chinook bone is not included in this evaluation.

**Graph:**
- Chinook
- Coho
- Steelhead

**Legend:**
- Species: ch - Chinook, co - Coho, s - Steelhead
Juvenile Migrant Pipeline

Pipeline Length: 7.1 miles
Diameter: 18 inches
Flow: 7 cfs
Water Travel Time: ~ 90 min.
Juvenile Migrant Sampling Facility

Timer based sampling
Daily enumeration by species and life stage
Collection of fish for evaluations
PIT detection array
# Juvenile Pipeline Evaluation - 2016

<table>
<thead>
<tr>
<th>Species</th>
<th>N</th>
<th>Injury</th>
<th>Mortality</th>
<th>Median Travel Time (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coho</td>
<td>137</td>
<td>0.7%</td>
<td>0.0%</td>
<td>2.6 - 4.7</td>
</tr>
<tr>
<td>Steelhead</td>
<td>195</td>
<td>0.5%</td>
<td>0.0%</td>
<td>1.9 – 2.0</td>
</tr>
</tbody>
</table>
River Mill surface collector
Commissioned in 2012
500 cfs attraction flow tied to PH
River Mill Fish Guidance Evaluation

Release site
River Mill Fish Guidance Evaluation

98.3%  98.9%  97.5%

species

chimook  coho  steelhead
Project-Wide Passage (2016)

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<tr>
<td>Coho</td>
<td>382</td>
<td>95.3%</td>
<td>92.7-97.0%</td>
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<tr>
<td>Steelhead</td>
<td>254</td>
<td>95.5%</td>
<td>92.3-97.4%</td>
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</tbody>
</table>
Conclusions

North Fork
High guidance (>85%) all flows tested for coho & steelhead
Chinook guidance high at low flows, moderate at high/spill flows
Further testing planned

River Mill
High guidance under all conditions for all species

Very low injury and mortality rates in both bypass systems
Acknowledgements

Sean Flak - PGE Engineer
Peter Christensen - R2 Resource Consultants
Doug Cramer - Retired PGE Biologist
John Esler – PGE License Manager
Resource Agencies
Countless other design engineers, vendors, and construction contractors
## North Fork Fish Guidance Evaluation - 2016

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¹ Chinook includes only one release group.