



Evaluation of the Whooshh Fish Transport System

WBS: 3.1.0.604

Hydropower Program

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Project Overview

Project Summary

PNNL supported Whooshh Innovations Inc. through a DOE Small Business Voucher. Through this project we accomplished two main tasks:

- 1) Defined limits for evaluation criteria of new fish passage technologies
- 2) Designed and executed a field evaluation of the scanning & sorting capabilities of the volitional entry Whooshh Fish Transport System

Project Objective & Impact

The objective was to clarify the regulatory process for an innovative fish passage technology deployment, and conduct rigorous scientific evaluation of the Whooshh Fish Transport System's sorting effectiveness and tube-transportation effects on salmon. Hydropower owners need cost-effective fish passage options that are safe, timely, and effective. Outcomes included a peer-reviewed publication of the system's performance that documented its safety when transporting fish, and a draft Decision Tree to help Whooshh and other innovators navigate the regulatory review process for new fish passage technologies. This work furthered Whooshh's commercialization goals by improving communication with regulators charged with evaluating their technology for use at hydropower projects.

Project Information

Project Principal Investigator(s)

Alison Colotelo, Brian Bellgraph

WPTO Lead

Tim Welch, Dana McCoskey

Project Partners/Subs

Whooshh Innovations, Inc.;
Washington Department of Fish &
Wildlife

Project Duration

- Project Start Date: October 1, 2017
- Project End Date: December 31, 2018

Hydropower Program Strategic Priorities

Environmental R&D and Hydrologic Systems Science

Big-Data Access and Analysis

Technology R&D for
Low-Impact
Hydropower Growth

R&D to Support
Modernization,
Upgrades and Security
for Existing Hydropower
Fleet

Understand, Enable,
and Improve
Hydropower's
Contributions to Grid
Reliability, Resilience,
and Integration

Environmental R&D and Hydrologic Systems Science

- Develop better monitoring technologies to evaluate environmental impacts
- **Develop technologies and strategies that avoid, minimize, or mitigate ecological impacts**
- Support development of metrics for better evaluating environmental sustainability for new hydropower developments
- Assess potential impacts of long-term hydrologic variations to hydropower generation and flexibility
- Improve abilities to assess potential methane emissions from reservoirs
- Better identify opportunities and weigh potential trade-offs across multiple objectives at basin-scales

The Whooshh Fish Transportation System is an innovative technology that could avoid, minimize, and/or mitigate the ecological impacts and regulatory constraints of a hydropower dam by providing a more cost-effective and adaptable option for fish passage than conventional options such as fish ladders and trap-and-haul.

Technology R&D for Low-Impact Hydropower Growth

- Enable the design and development of new Standard Modular Hydropower (SMH) technologies for both existing water infrastructure and new stream-reach development. This new approach to systems design for hydropower projects incorporates ecological and social objectives for river systems earlier in design processes
- Leverage new advancements in manufacturing and materials to dramatically lower costs of SMH components and systems designs
- Support development of necessary testing infrastructure for new technologies

The Whooshh Fish Transportation System provides a modular fish passage option for both existing and new stream reach development. An effective fish-scanning/ identification/ sorting capability could provide automated data acquisition capabilities to small modular hydropower developers that may be required for environmental permitting/licensing.

- Cost share included design, fabrication, and installation of the test system by Whooshh Innovations

Total Project Budget – Award Information		
DOE	Cost-share	Total
\$300k	\$75k	\$375k

FY17	FY18	FY19 (Q1 & Q2 Only)	Total Actual Costs FY17–FY19 Q1 & Q2 (October 2016 – March 2019)
Costed	Costed	Costed	Total
\$172k	\$128k	\$0k	\$300k

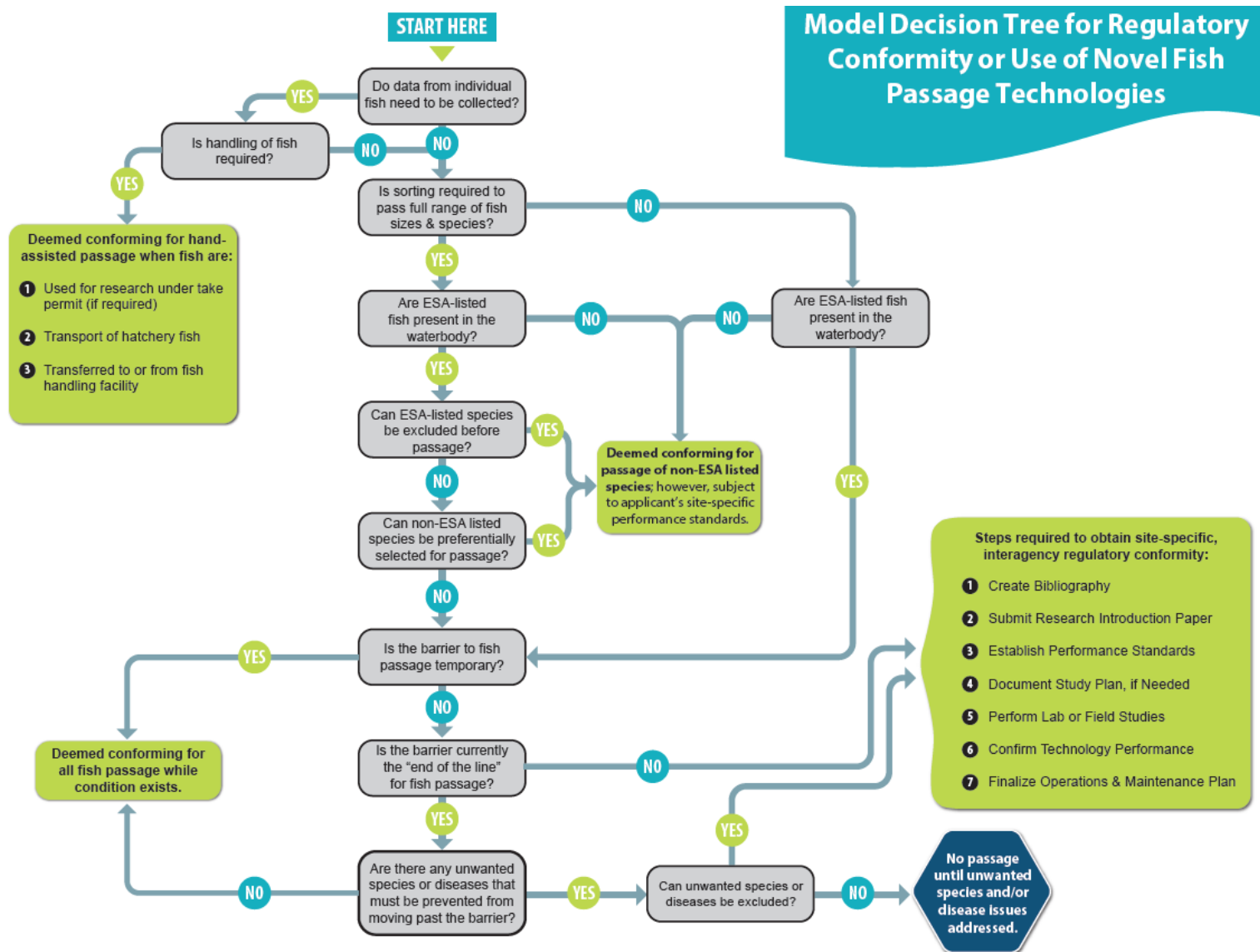
Management Approach – Milestones & Deliverables

	FY2017	FY2018	FY2019
Quarter One	Engaged with National Marine Fisheries Service (NMFS) Portland Office on the study plan for evaluation of the Whooshh Fish Transport System (WFTS)	Field evaluation of the sorting capability of the WFTS concluded Solicited feedback from hydropower community on flow chart roadmap	No key milestones or accomplishments
Quarter Two	Identified study site for field evaluation	Delivered final memo on flow chart roadmap feedback to DOE	Peer-reviewed manuscript published in Fisheries Research
Quarter Three	Finalized study design for field evaluation	Submitted manuscript for publication in Fisheries Research	N/a
Quarter Four	Field evaluation of the sorting capability of the WFTS commenced	No key milestones or accomplishments	N/a

Technical Approach

- **Sought input on Decision Tree from owner/operators and regulators:**
 - Wisconsin DNR; Doug DeHart/Coffee Creek Consulting; Brookfield Renewables; U.S. Fish & Wildlife Service; U.S. Forest Service; NOAA Fisheries Oregon & Washington Coastal Office/Portland

Management and Technical Approach (continued)



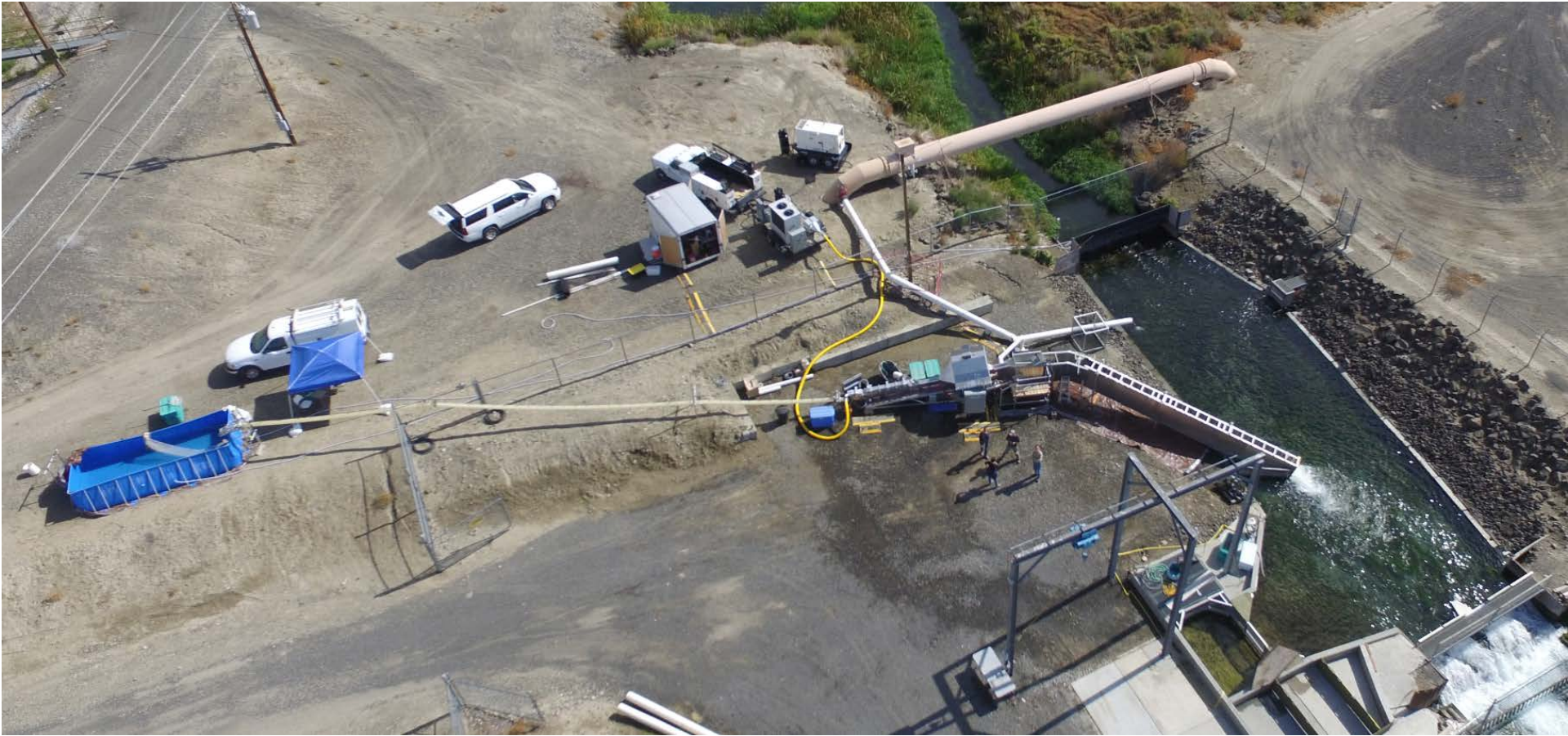
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- **Performed field evaluation with wild adult salmon**

Management and Technical Approach (continued)

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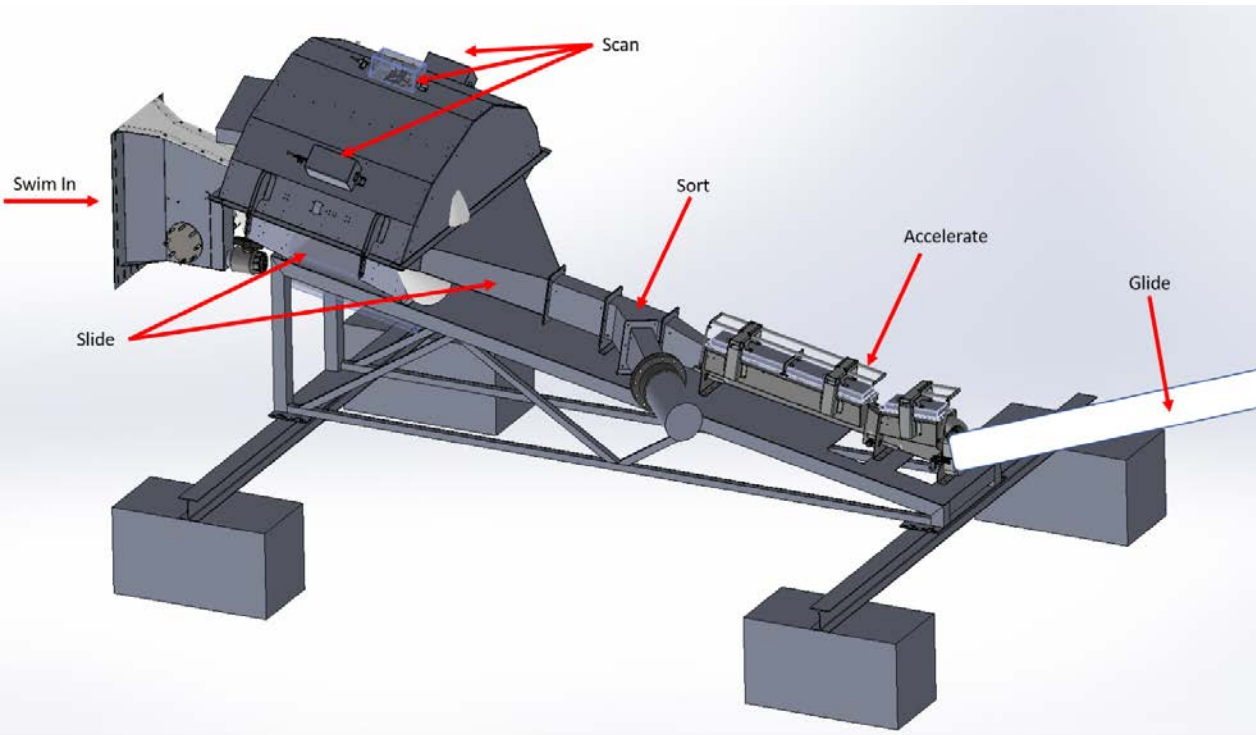
Energy Efficiency &
Renewable Energy



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- **Performed field evaluation with wild adult salmon**
 - Swim, Scan, Slide, Sort, Glide

Management and Technical Approach (continued)



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 - Assessed Fish Health

Management and Technical Approach (continued)

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ENERGY

Energy Efficiency &
Renewable Energy



Technical Approach

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- **Performed field evaluation with wild adult salmon**
 - Swim, Scan, Slide, Sort, Glide
 - Assessed Fish Health
- **Critical Success Factors & Key Challenges Solved**
 - Improved communication with regulatory agencies
 - Successfully integrated volitional entry of fish
 - Re-affirmed safety of tube for fish transport

- Hydropower owner/operators will benefit by having cost-effective fish passage options that are safe, timely, and effective
- Results continue to inform how to improve environmental outcomes of hydropower
- Published study in scientific journal reaffirms safety of the Whooshh Fish Transport System and moving the needle toward regulatory acceptance
- Study results featured heavily in recent media:
 - Wired, CNN, USA Today, The Guardian, numerous local media outlets

- **Improved understanding of fish passage regulatory requirements resulting in Whooshh's improved communication with regulatory agencies**
 - Clear understanding of expectations helps to guide future testing efforts
- **Confirmed, again, that the Whooshh Fish Transport System is safe for fish**
 - Scientific community 'warming up' to safety of system
- **Made significant advancements toward a volitional entry system with effective sorting capability**
 - A key component toward eventual hydropower dam installation