Northwest **Power** and **Conservation** Council

August 7, 2018

MEMORANDUM

TO: **Council Members**

FROM: **Laura Robinson, Program Liaison Coordinator**

SUBJECT: **Briefing on Surface Collectors in the Pacific Northwest: Operating Characteristics and Collection Success**

BACKGROUND:

Presenter: Toby Kock, U.S. Geological Survey, Western Fisheries Research Center

Summary: Toby Kock is a research fish biologist with the U.S. Geological Survey. He has worked extensively on evaluations of downstream fish passage and survival at dams throughout the Pacific Northwest. His expertise includes the application of telemetry systems to monitor fish behavior and movement patterns, focusing on data collection that supports the decision-making process for resource managers responsible for protecting salmon and steelhead populations in the region. Toby has degrees from Pacific Lutheran University and the University of Idaho, where he studied the effects of sediment on white sturgeon embryo survival in the Kootenai River. He is currently working on studies on the Yakima, Klickitat and Willamette rivers.

Toby's presentation to the Council will provide a review of USGS's recent work on evaluating floating surface collectors in the Northwest that are used to capture downstream-migrating juvenile salmon and steelhead at high-head dams.

Relevance: The 2014 Fish and Wildlife Program's Emerging Priority: *investigate blocked area mitigation options through reintroduction, passage and habitat improvement, and implement if warranted*

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Workplan: 2017/2018 Fish and Wildlife Workplan: Reintroduction/High-head Dam Passage

Background: The construction of dams in the Pacific Northwest has severely affected many populations of Pacific salmon (*Oncorhynchus* spp.), resulting in depressed or extirpated populations throughout the region. Efforts to improve fish passage and survival have largely been successful at run-of-river dams such as those on the Columbia River. However, improvements at high-head dams have been more challenging and substantial room for improvement remains.

At several locations, floating forebay collectors have been developed to capture downstream-migrating juvenile salmon and steelhead. These devices have been very successful at some locations, yet perform poorly at others. In 2017, USGS conducted a thorough review of forebay collectors located at eight projects in Washington and Oregon. These included:

- Upper Baker Dam and Lower Baker Dam, Baker River, Washington
- Cushman Dam, Skokomish River, Washington
- Swift Dam, Lewis River, Washington
- North Fork Dam and River Mill Dam, Clackamas River, Oregon
- Round Butte Dam, Deschutes River, Oregon
- Cougar Dam, McKenzie River, Oregon

The goals of the review were to synthesize operating characteristics and conditions among projects, and to attempt to determine if there were factors that appeared to be affecting collection success. Forebay collectors are being considered at numerous locations throughout the region, and a need exists to better understand how operations can be established to increase the likelihood of achieving fish collection goals at each new project.

The review provides an overview of each project, comparisons of environmental, physical, and operating features among projects, and summaries of project-specific performance. Data collected during this review were analyzed and USGS identified factors that were found to be statistically important predictors of collection success. Through this review, USGS provided data that can be used by resource managers to improve the design and operation of dam-based forebay collection systems in the future.

More Info:

- Toby's presentation at the 2018 Lake Roosevelt Forum
- The Council's 2016 staff paper on high-head fish passage technologies

USGS
science for a changing world

Surface Collectors in the Pacific Northwest: Operating Characteristics and Collection Success

Tobias Kock[1], Russell Perry[1], John Beeman[1], Nicholas Verretto[2], Nicklaus Ackerman[3], Michael Garello[4], and Scott Fielding[5]

Northwest Power and Conservation Council Meeting
August 15, 2018

[1]U.S. Geological Survey
[2]Puget Sound Energy
[3]Portland General Electric
[4]HDR Inc.
[5]U.S. Army Corps of Engineers

U.S. Department of the Interior
U.S. Geological Survey

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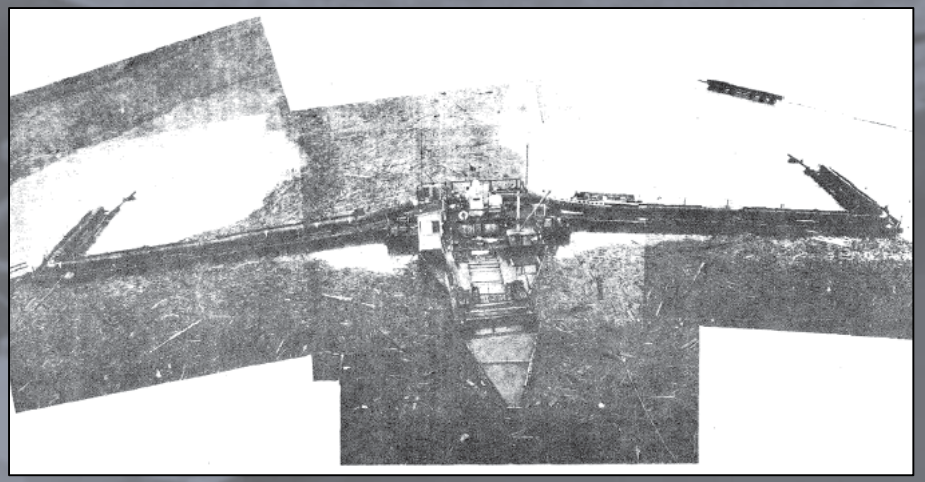
- Several entities provided data and information for their collection facilities including,
  - Puget Sound Energy, special thanks to Nick Verretto
  - Tacoma Power, special thanks to Matt Peter
  - PacifiCorp, Inc., special thanks to Frank Shrier
  - Portland General Electric, special thanks to Garth Wyatt, Nick Ackermann, Bob Spateholts, and Jim Bartlett
  - U.S. Army Corps of Engineers, special thanks to Scott Fielding

USGS

First Generation Forebay Collectors

- "Gulpers": 1950s and 1960s
  - <150 ft^3/sec
  - Brownlee Dam
  - Lookout Point Dam
  - Upper Baker Dam
  - Merwin Dam

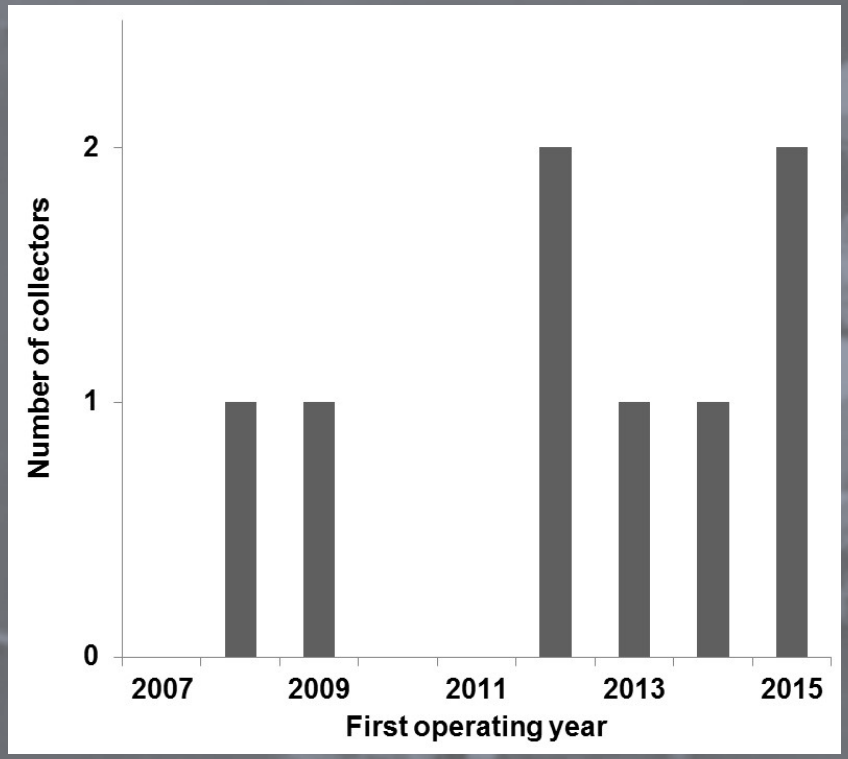


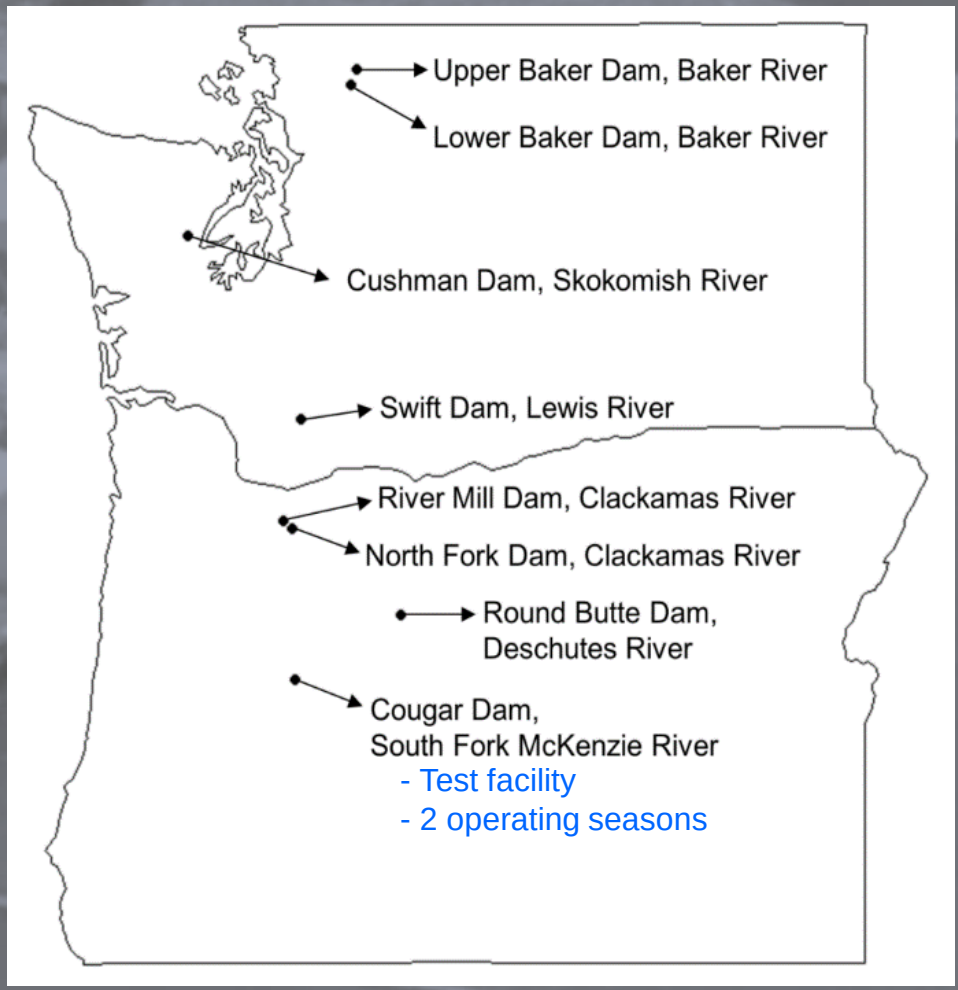
- Most abandoned within a few years

The conclusion of the study was that this artificial outlet did not attract or collect a satisfactory number of downstream-migrant salmon or steelhead trout. Insufficient volume of flow and poor entrance design of the device were thought to be the limiting factors. It was recommended that the development of a floating artificial outlet be continued using optimum volumes of attraction flow, as determined by spillway experiments, and entrance design criteria established through other studies. The device should also be tested at the head of a reservoir.

USGS

Second Generation Forebay Collectors





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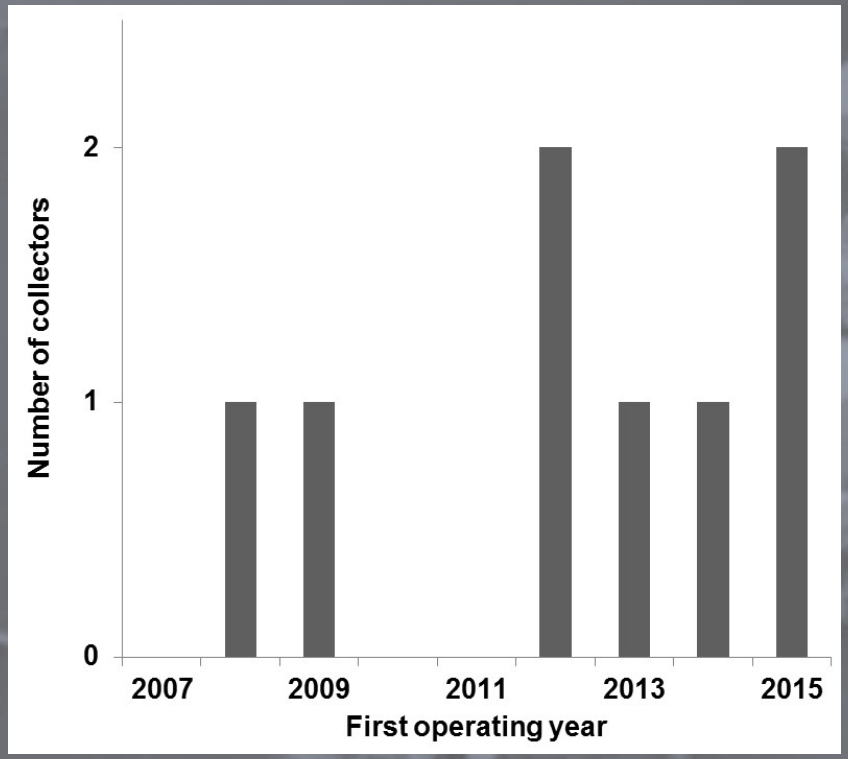
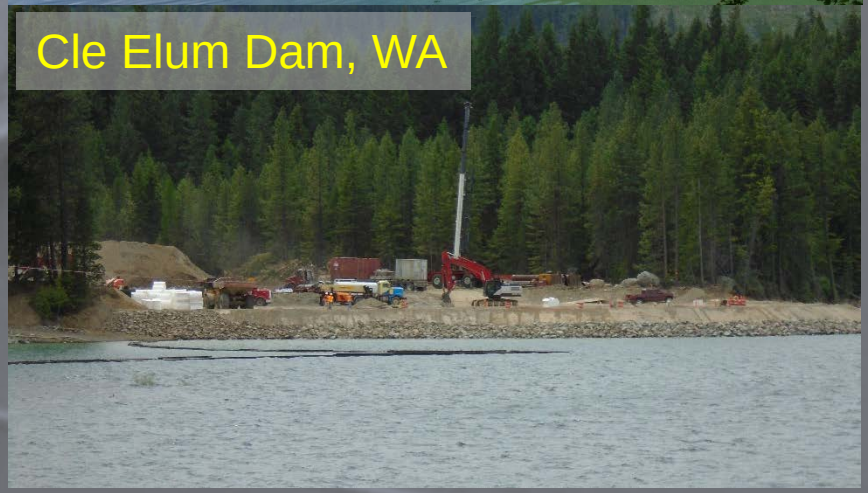
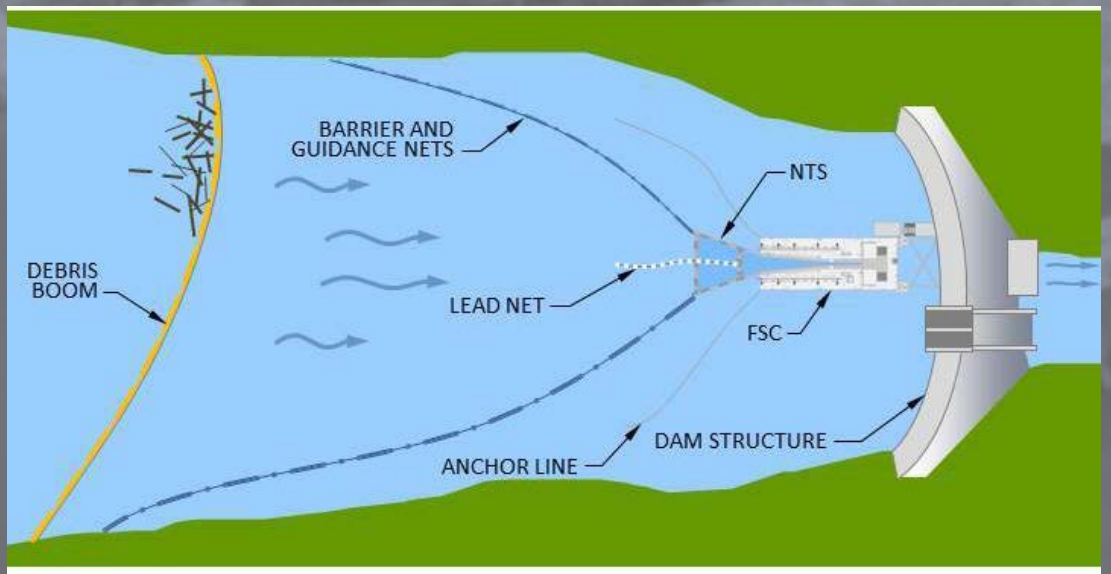
Second Generation Forebay Collectors



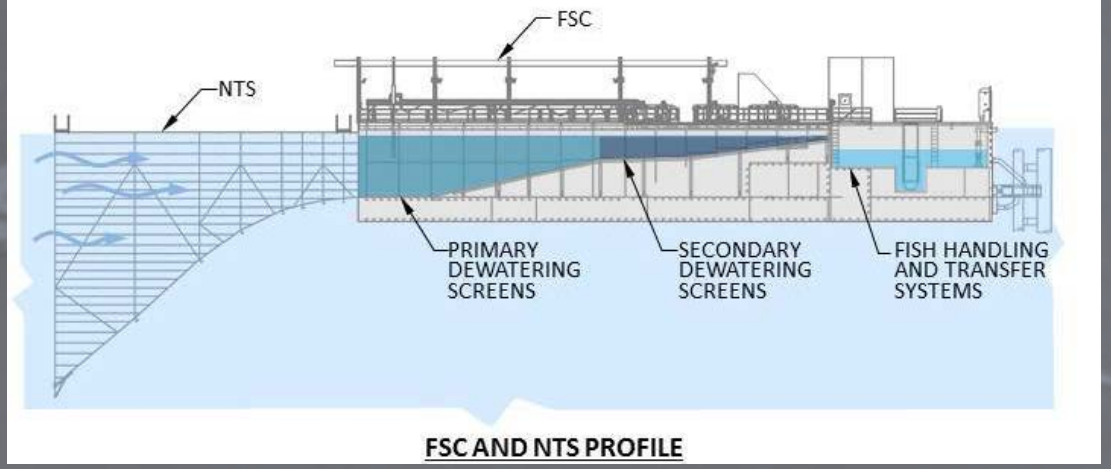


USGS

Second Generation Forebay Collectors



GENERAL ARRANGEMENT



FSC AND NTS PROFILE

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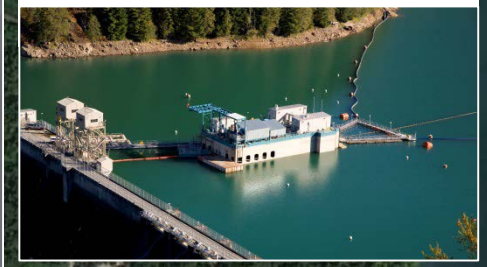
Upper Baker and Lower Baker Dams

Upper Baker Collector

First year of operation = 2008



Lower Baker Collector

First year of operation = 2013

- 500 and 1000 ft^3/sec inflow
- Guide, exclusion, and lead nets

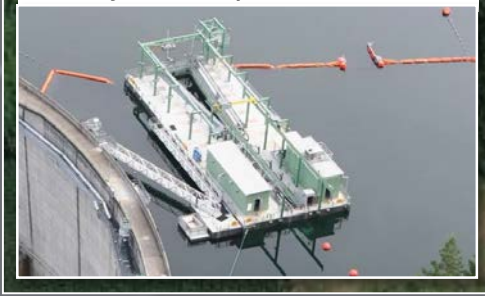
USGS

North Fork and River Mill Dams

- MC: 250 ft^3/sec inflow
- FSC: 1,000 ft^3/sec inflow
- Partial exclusion nets

North Fork Collector

First year of operation = 2015



- Uses turbine flows
- 500 ft^3/sec
- No nets

River Mill Collector

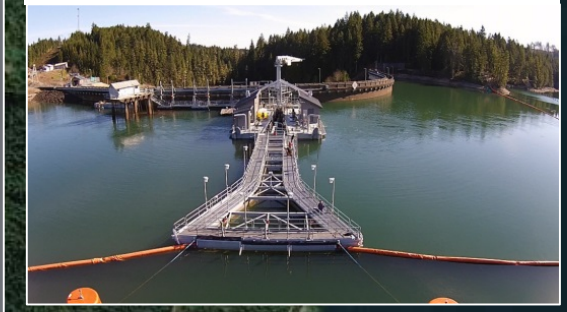
First year of operation = 2012

USGS

Cushman Dam

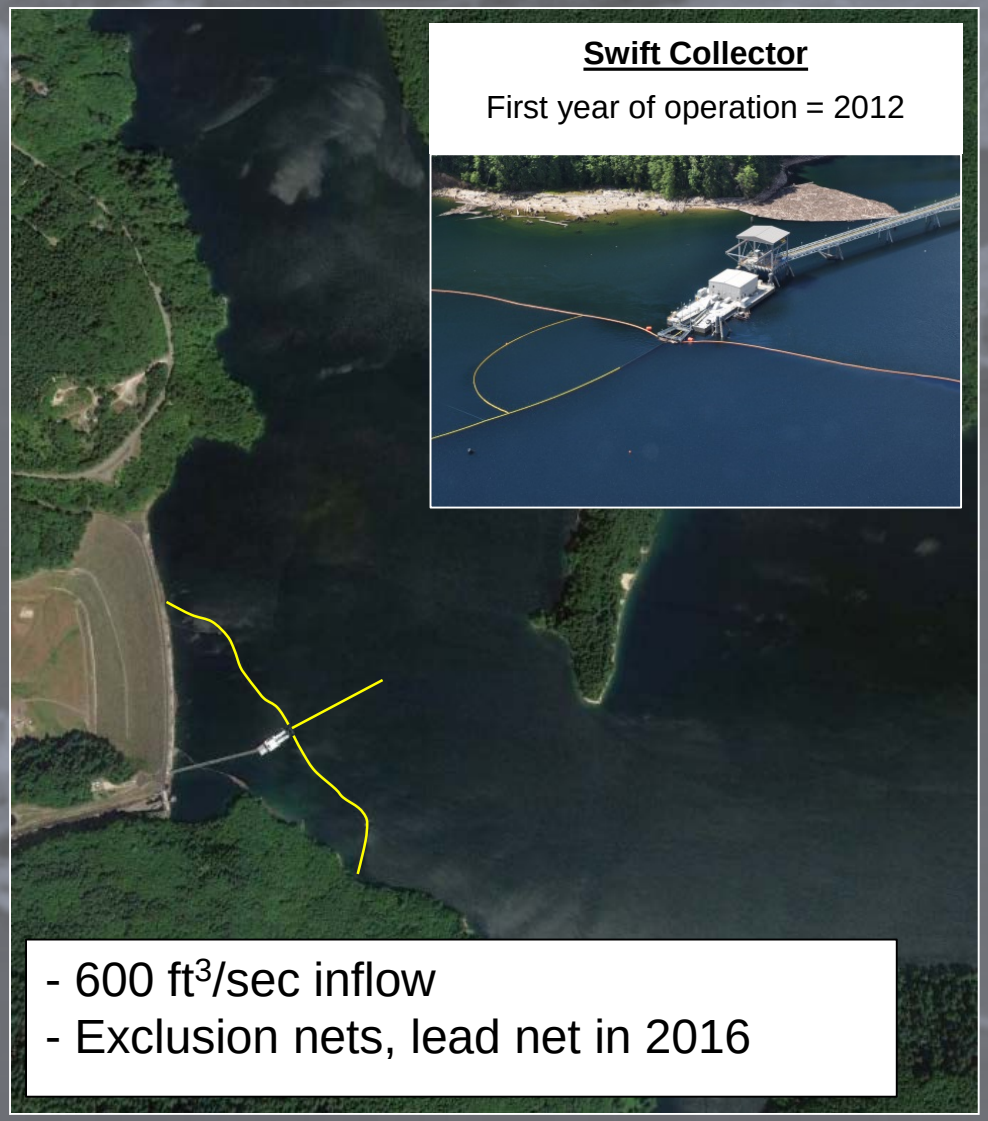
Cushman Collector

First year of operation = 2015



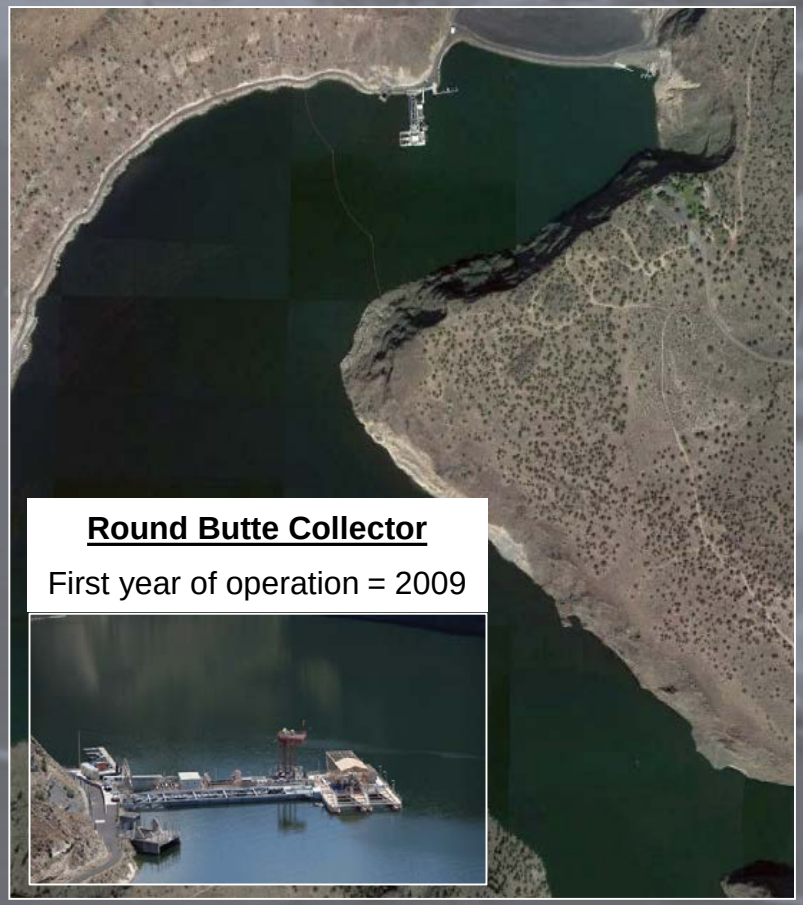
- 250 ft^3/sec inflow
- Exclusion nets
- No existing fish runs

Swift Dam



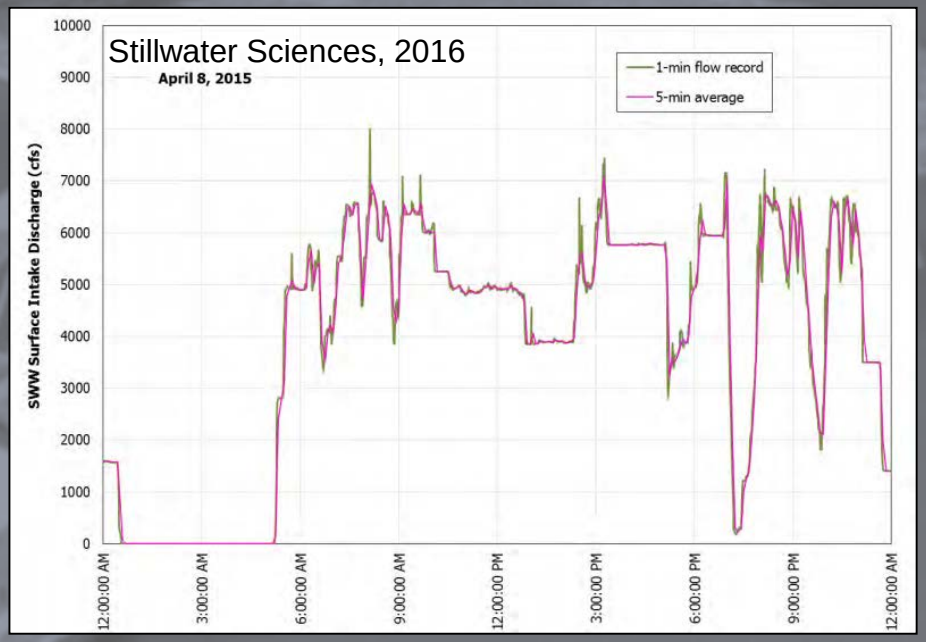
USGS

Round Butte Dam



Round Butte Collector

First year of operation = 2009



- 0-6,000 ft^3/sec
- No nets

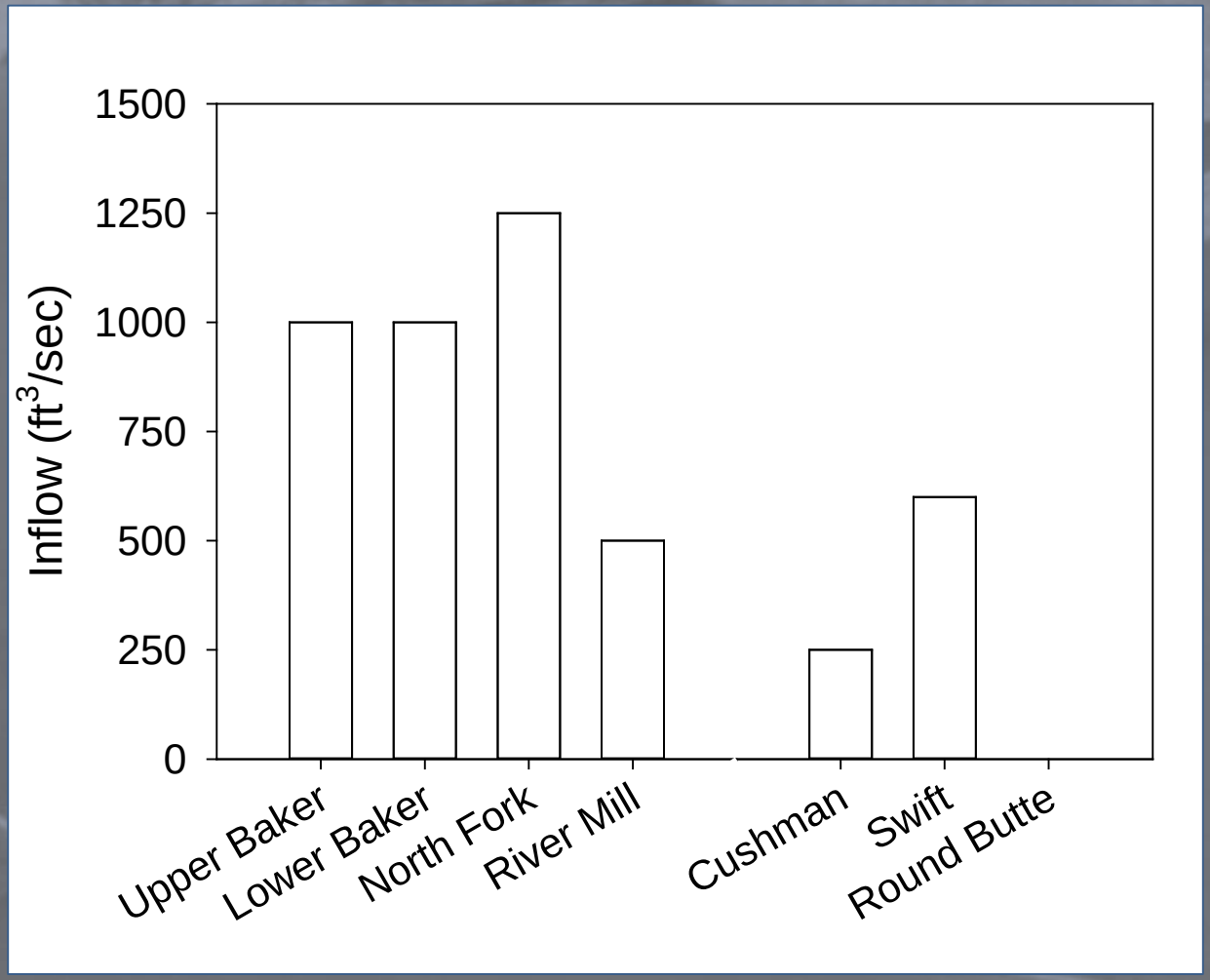
USGS

Fish Collection Efficiency

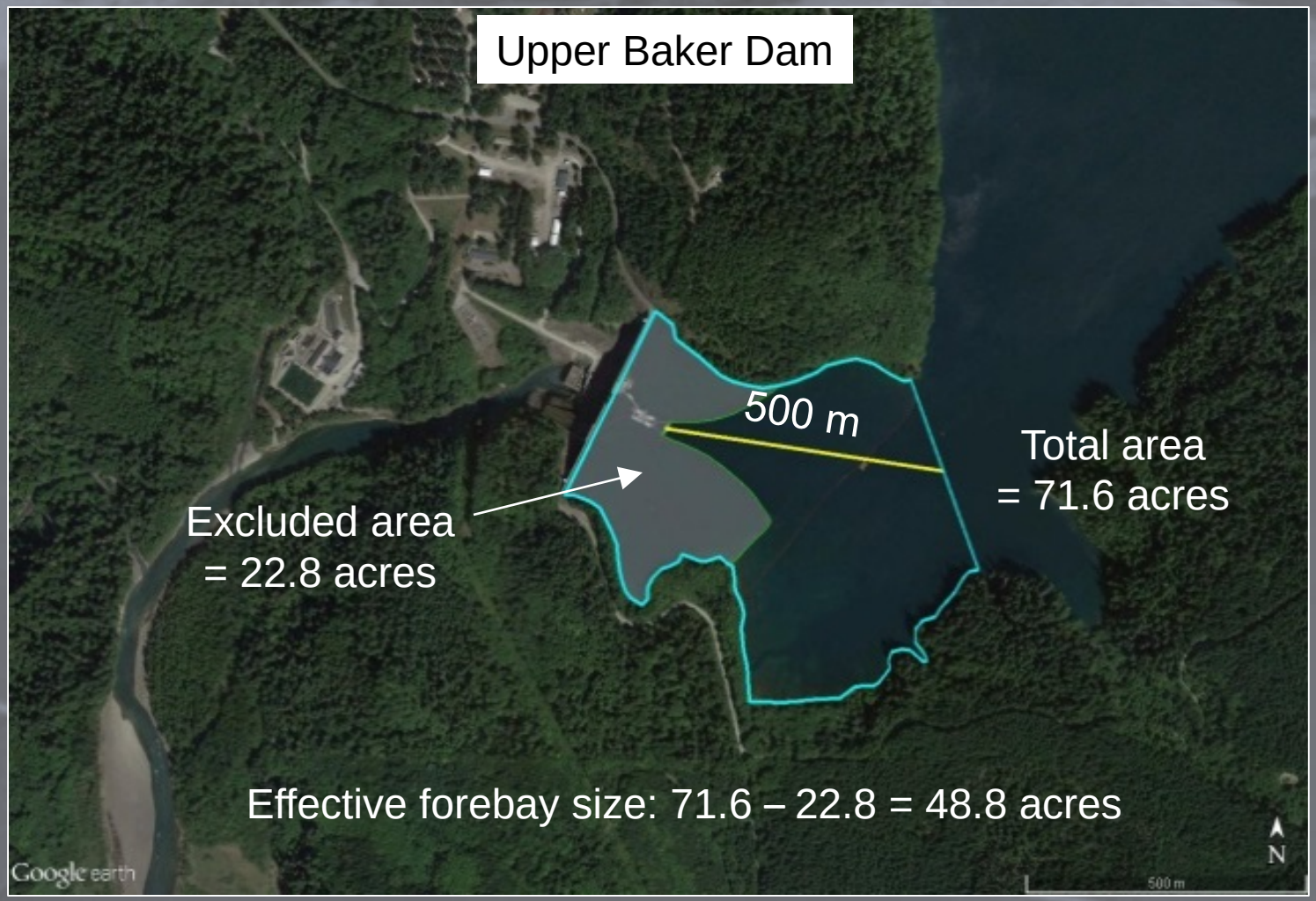
Project	Sockeye	Steelhead	Coho	Chinook
Upper Baker	88%		92%	
Lower Baker	87%		92%	
North Fork		98%	97%	90%
River Mill		97%	99%	98%
Cushman			23%	
Swift		11%	14%	2%
Round Butte		16%		32%

USGS

Collector Inflow



Effective Forebay Size



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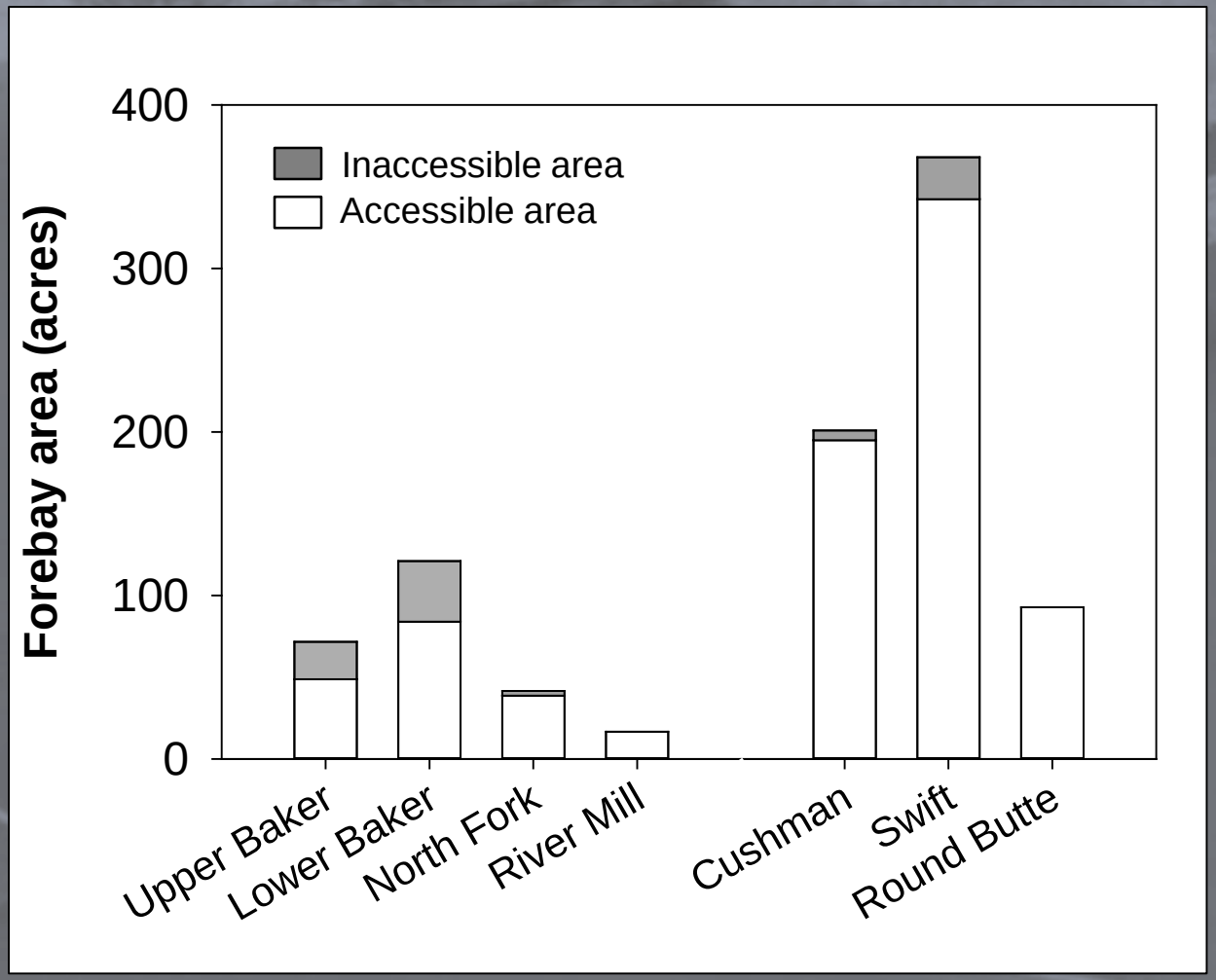
Effective Forebay Size



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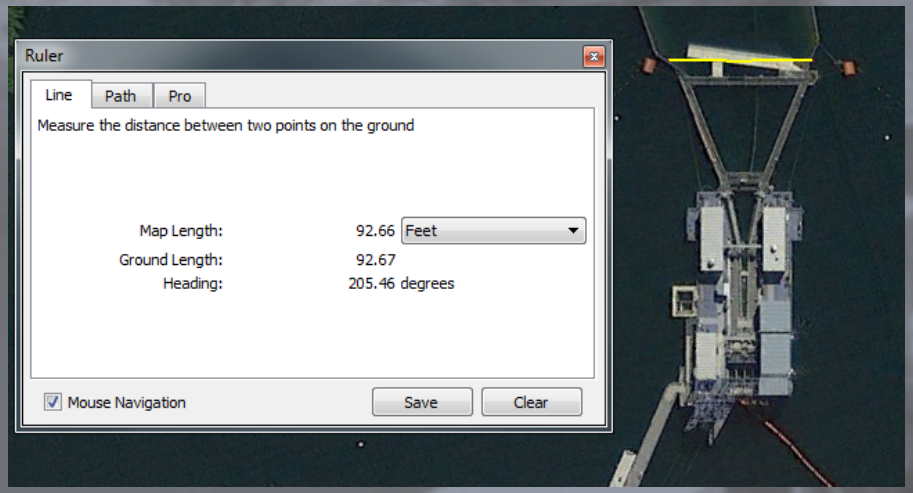
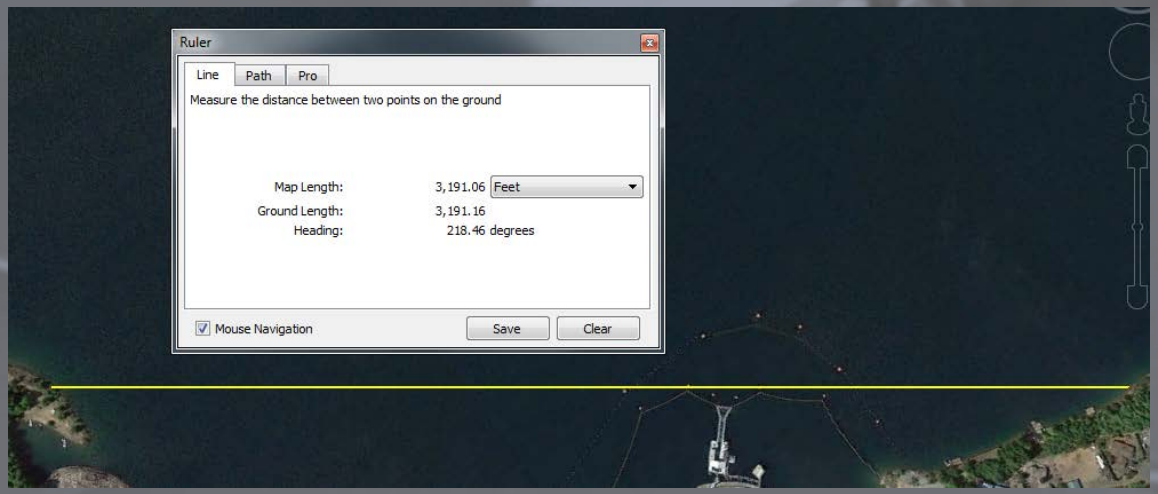
Confinement Distance



Upper Baker Dam



Cushman Dam

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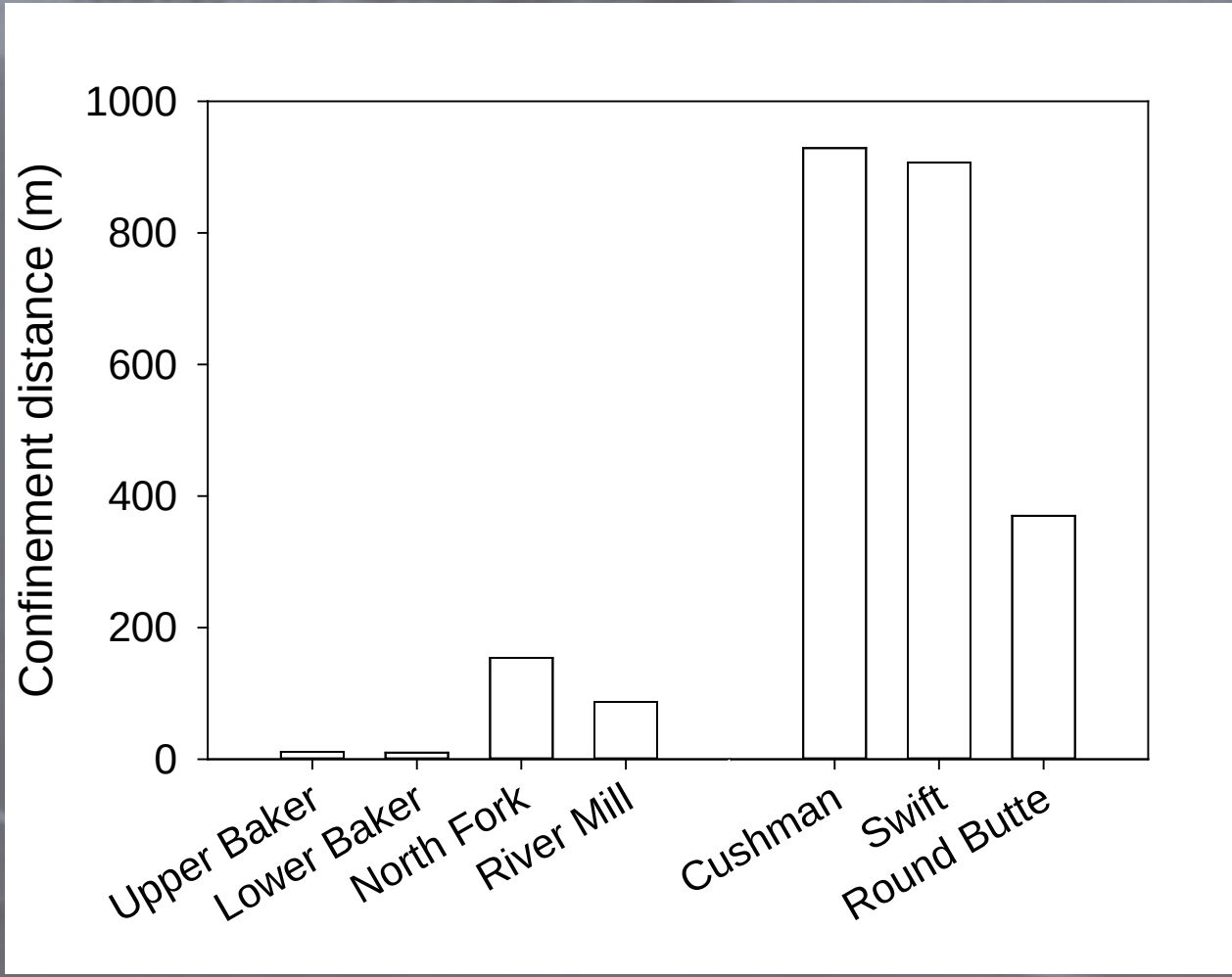
Confinement Distance



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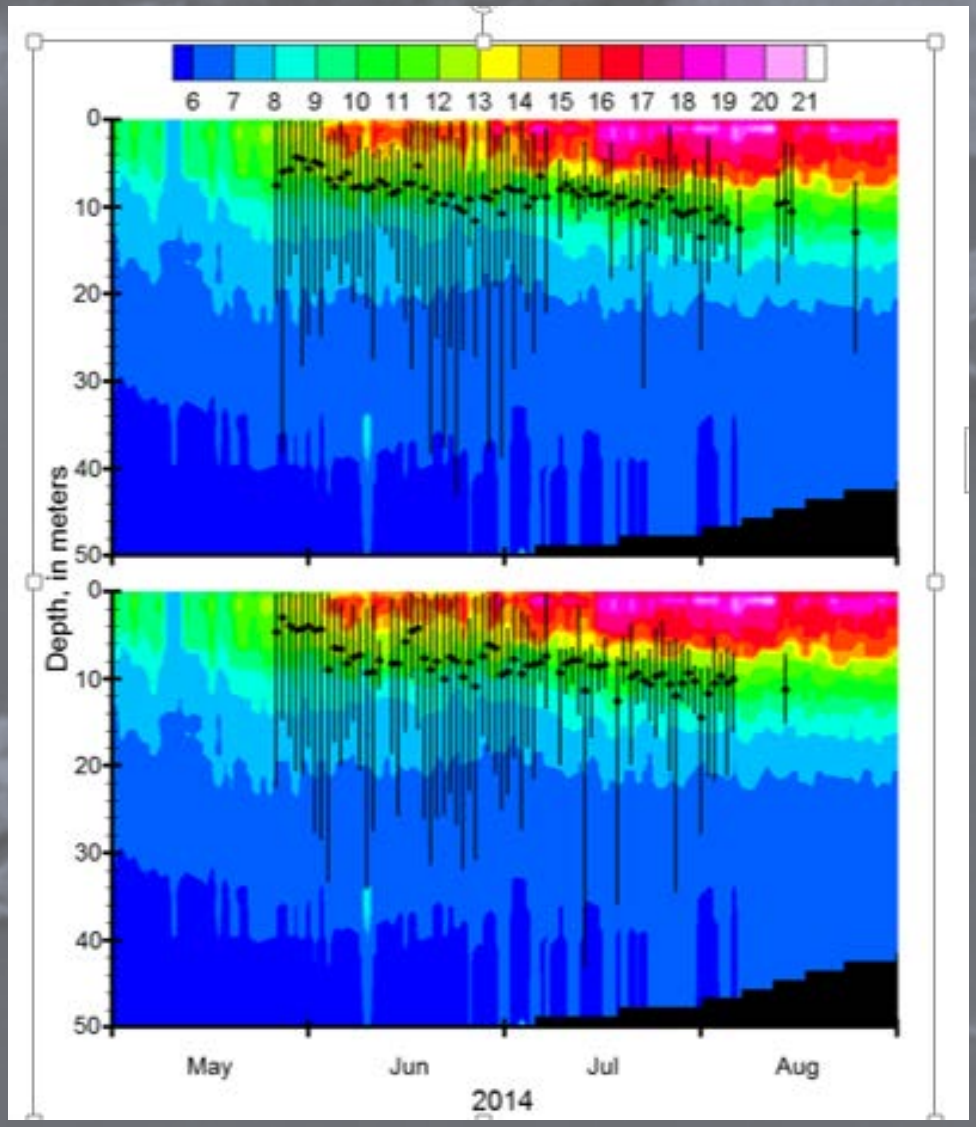
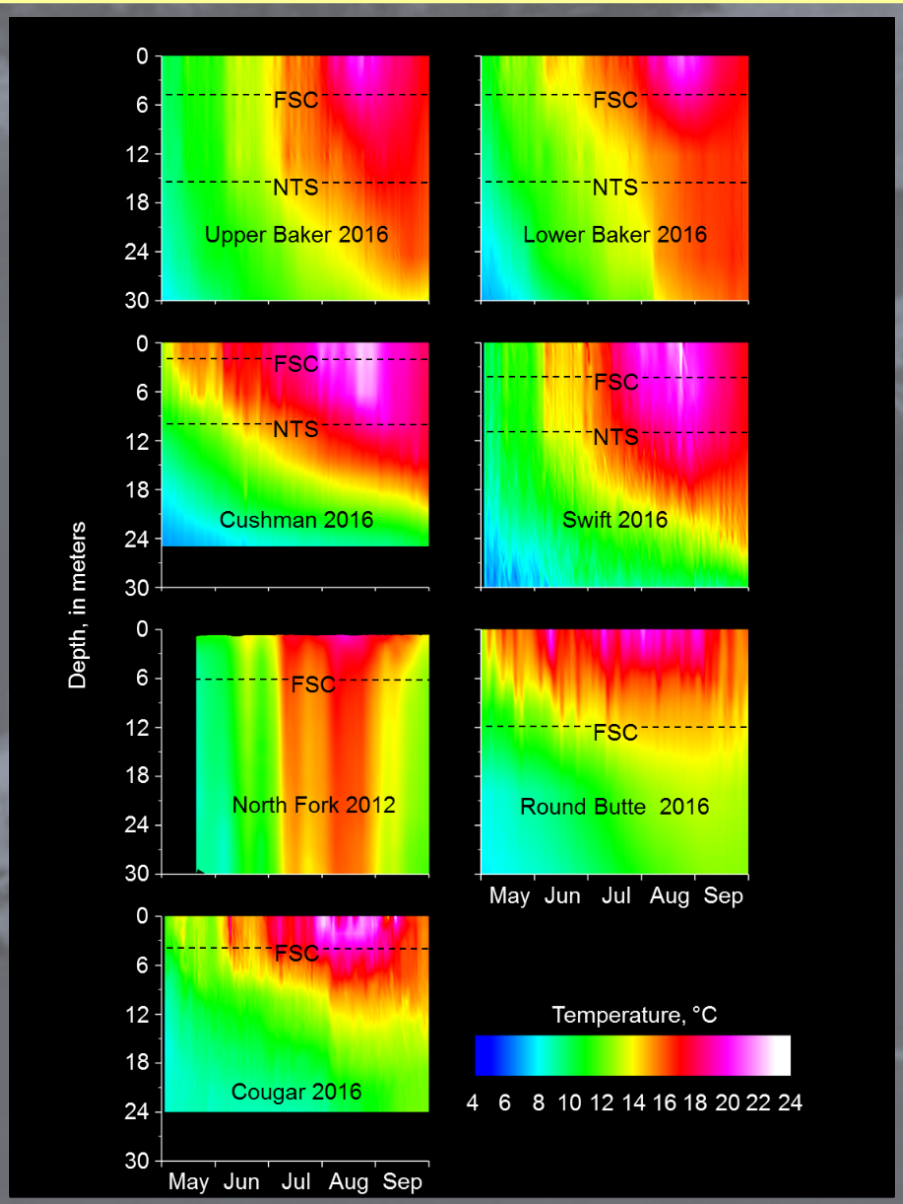
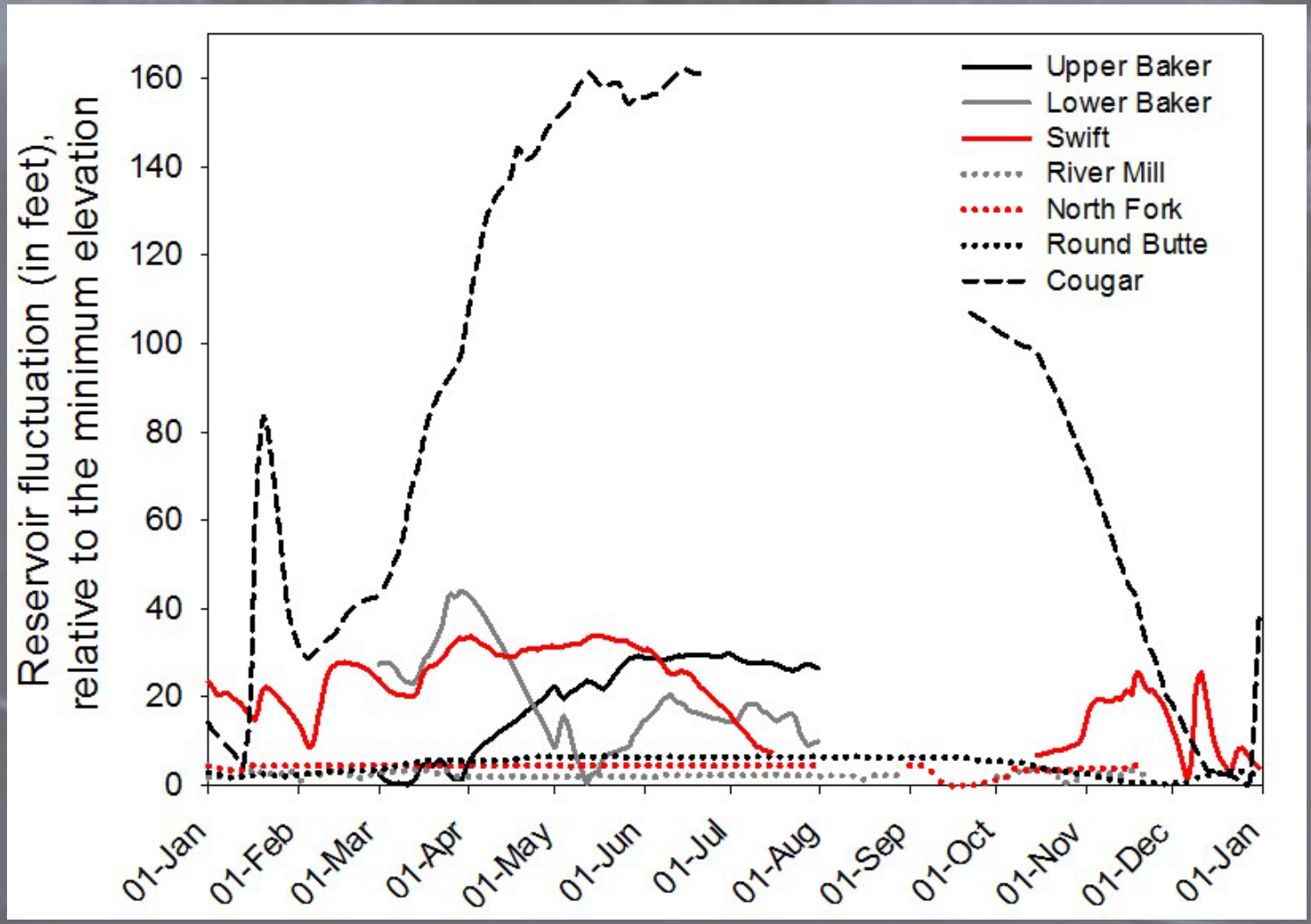
Chinook Salmon Temperature Use



Summer Water Temperature



Reservoir Fluctuations



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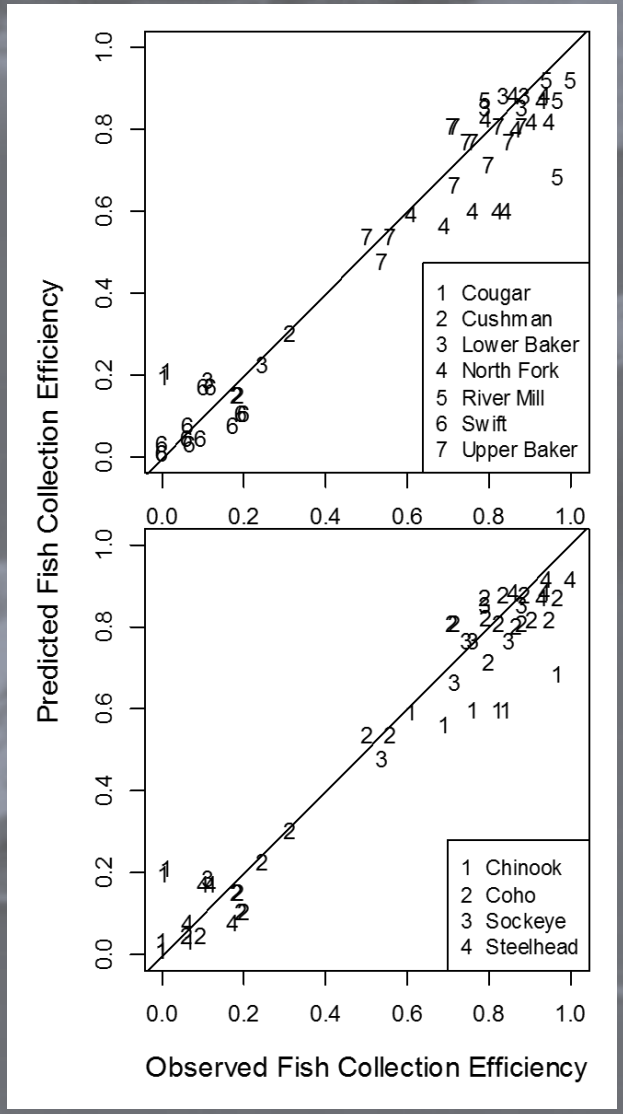
Analysis of Factors Affecting Performance

- The Data
  - 7 projects
  - 4 species
  - 52 FCE estimates
    - FCE = number collected / number released
- Predictor variables
  - Species
  - Inflow
  - Collector entrance area
  - Effective forebay area
  - Lead nets
  - Effective forebay area x collector entrance area
- Quasi-binomial regression model

USGS

Analysis of Factors Affecting Performance



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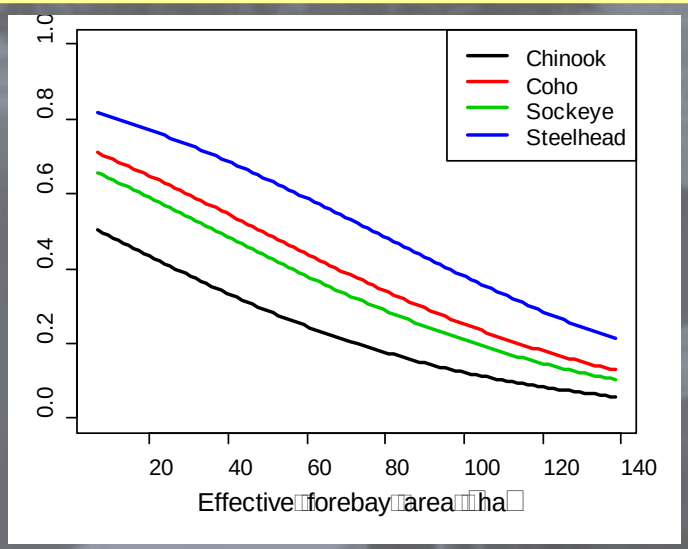
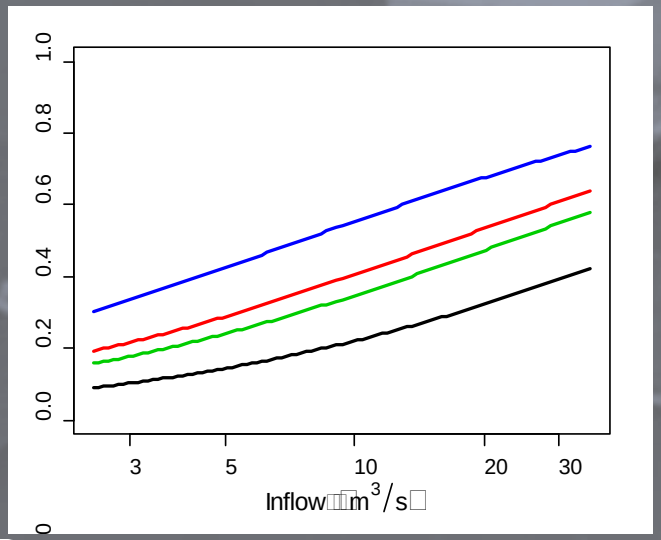
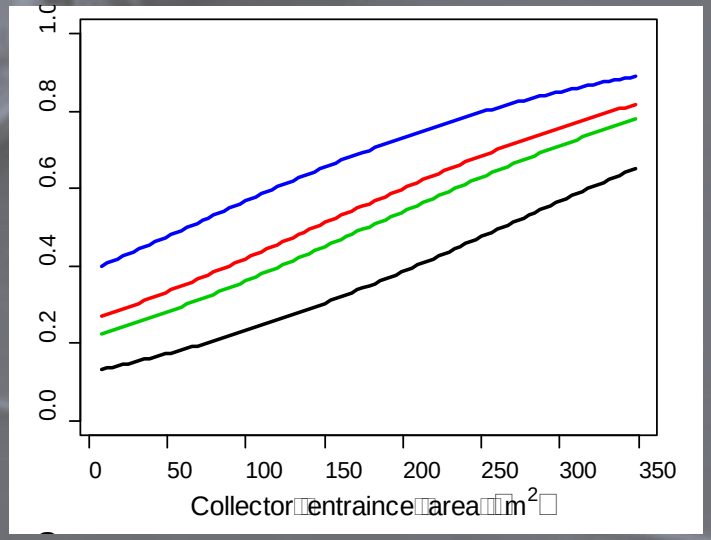
Analysis of Factors Affecting Performance







Lead net presence and effective forebay area x entrance area also significant

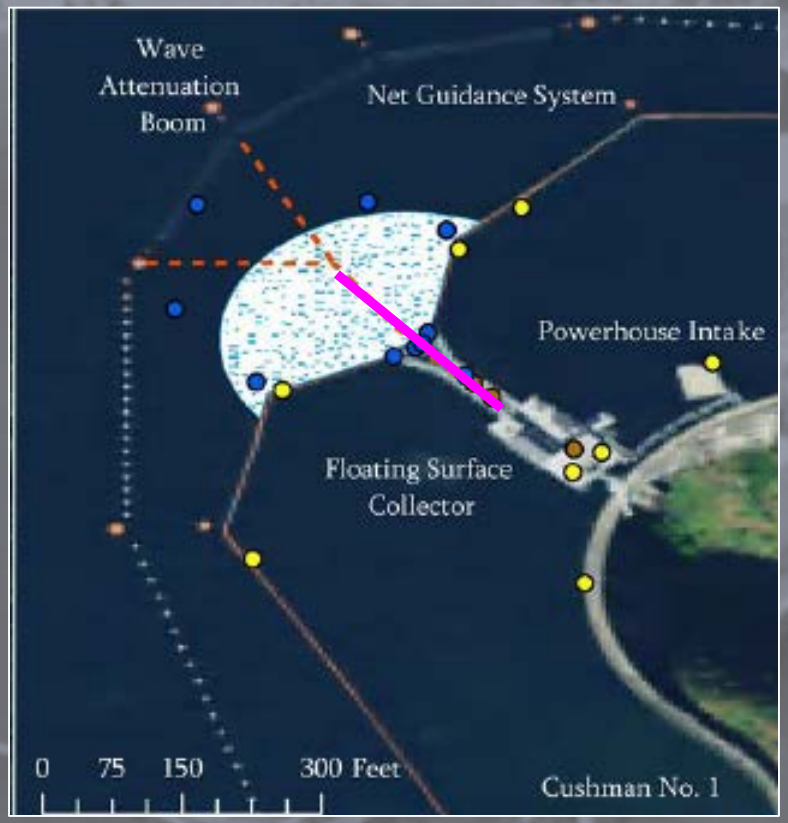
Lessons Learned

- Broad range of environmental conditions and collection success
- Significant predictors of collection success:
  - Inflow
  - Lead net presence
  - Entrance area
  - Effective forebay area
  - Entrance area x effective forebay area
- Emerging information
  - Modifications leading to increased collection

USGS

Modifications to Improve Collection

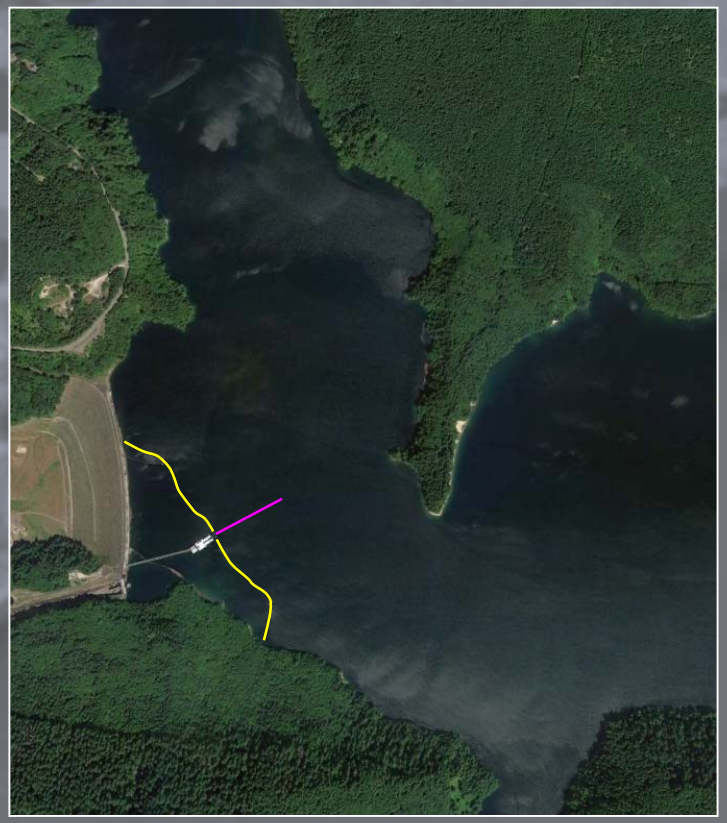
Cushman Dam



Increased FCE

Coho: 19% to 31%

Swift Dam



Increased FCE

Coho: 8% to 20%

Chinook: 0% to 7%

USGS

Questions