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Fish Guidance and Diversion Screening Session

Evolution of the Fish Sorting and Debris Handling System at the Swift Hydroelectric Project Floating Surface Collector (FSC) for Juvenile Salmonids

Dana Postlewait, P.E.,
R2 Resource Consultants, Inc.
(December 11, 2018, 11:40 AM – 12:40 PM)



FISH PASSAGE 2018 - INTERNATIONAL CONFERENCE ON RIVER CONNECTIVITY
INCORPORATING THE FIRST SYMPOSIUM ON HYDROPOWER AND FISH MANAGEMENT
DECEMBER 10-14, 2018 | ALBURY, NEW SOUTH WALES (AUSTRALIA)



Presentation Overview

- FSC Overview
- Debris Issue, and Interrelationship with Fish Collection and Sorting
- Options to Address
- Selected Alternative
- Update on Construction
- Expected Results
- Conclusions & Next Steps

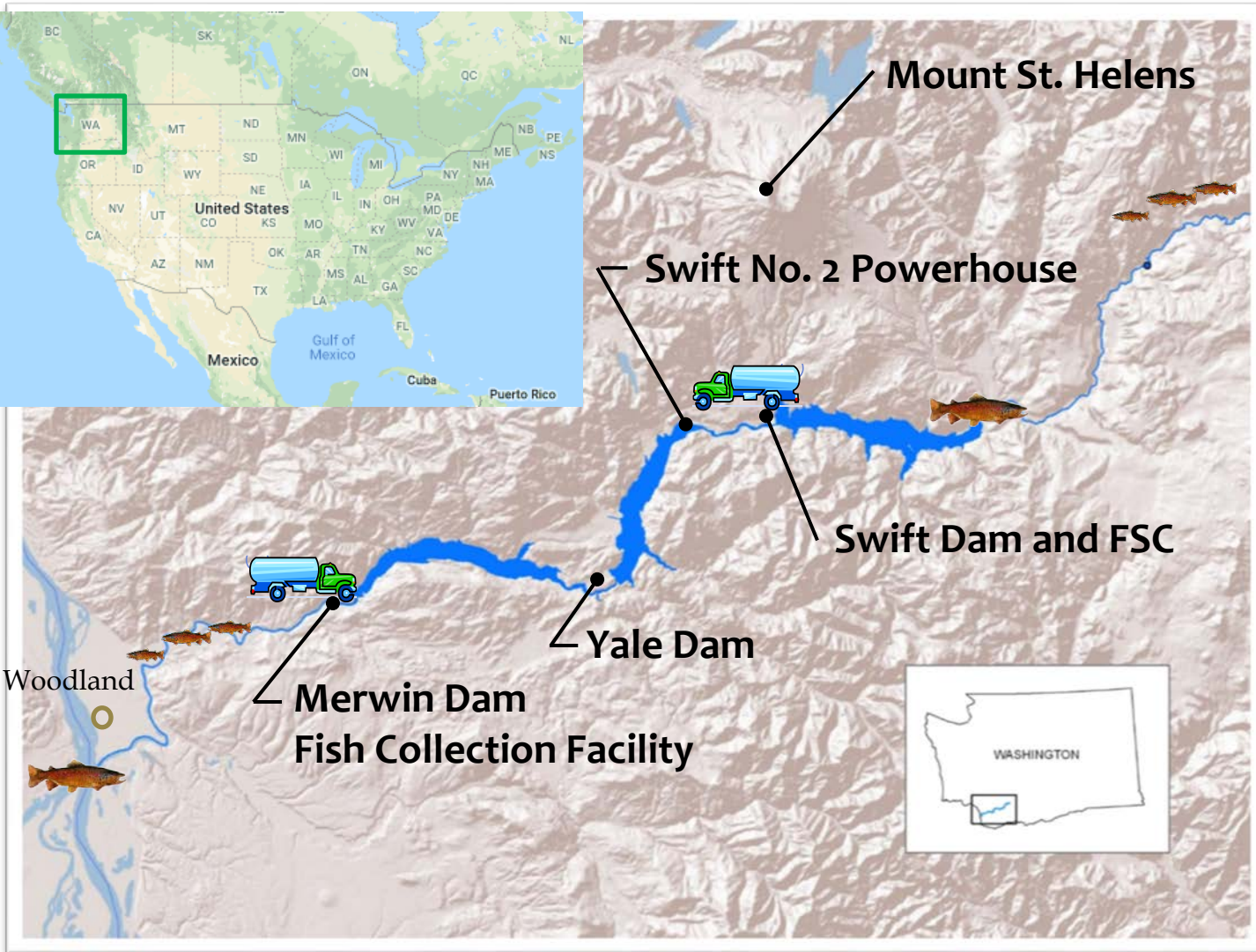


What is an FSC?



- **Floating Surface Collector**
 - Collects downstream migrating fish at dams, and provides safe, efficient downstream passage
 - Avoids hazards of dams
 - Turbines, sluices, spillway routes, etc.
 - Emulates a lake exit
 - Large screened funnel to attract fish with pumped flow
 - Swift
 - Collect • Sort
 - Hold • Transport
 - Nets, exclusion

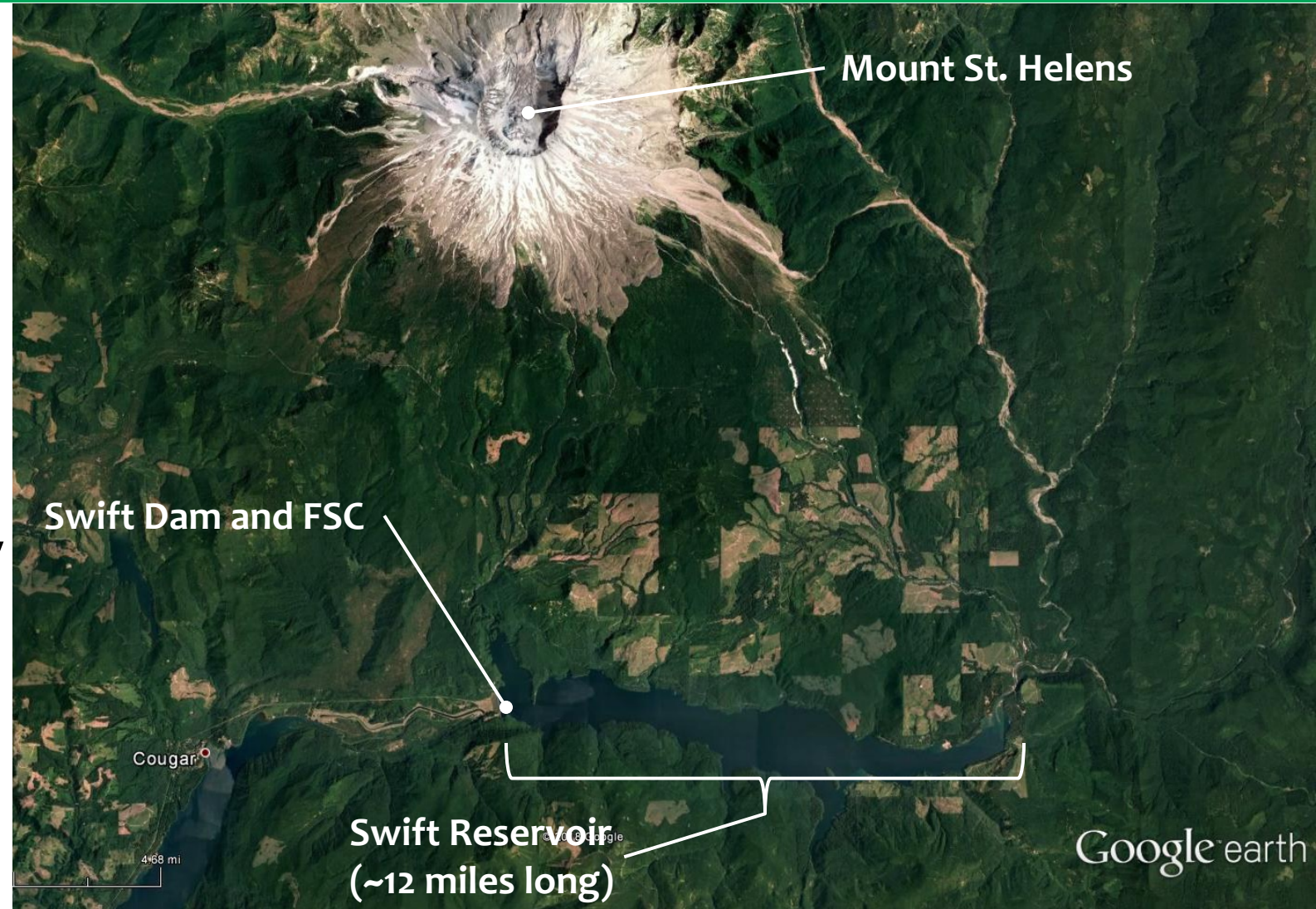
FSC at Lewis River Hydroelectric Project



- **Fish Passage Goal**
 - Genetically viable, self-sustaining, naturally reproducing, harvestable populations of anadromous fish upstream of Merwin Dam
 - Spring Chinook Salmon
 - Coho Salmon
 - Winter Steelhead
 - Most habitat upstream of Swift Dam
 - Collect adults at Merwin Dam
 - Collect out-migrating smolts at Swift Dam
- **510 MW Hydro Project (total)**

Swift Reservoir

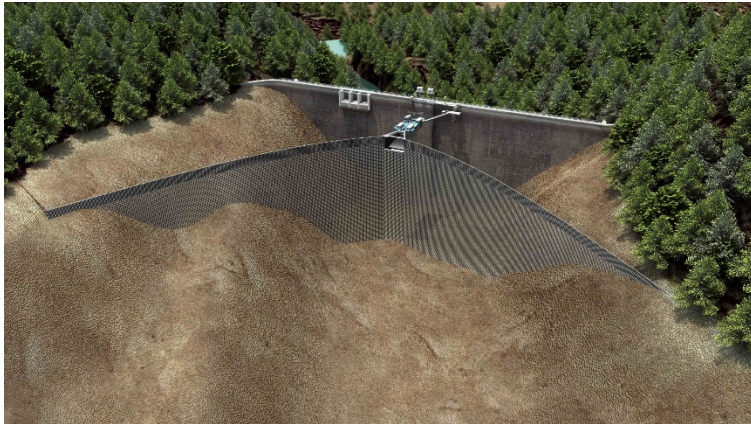
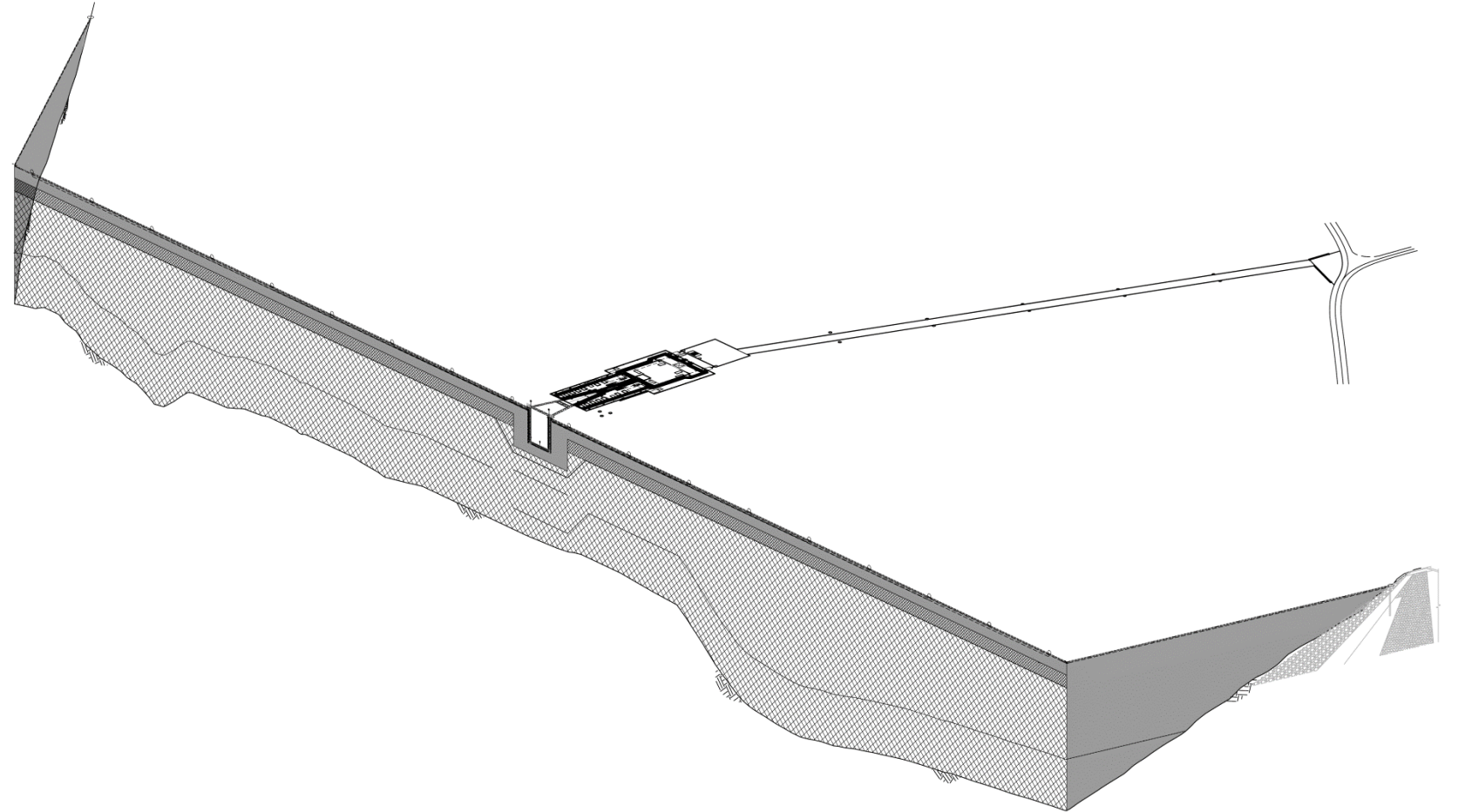
- Level Fluctuates ~100 Feet
- Unregulated River
- Base of Mt. St. Helens
- Forested Landscape
- Heavy Debris Load!
- Flows
 - 9,400 cfs, powerhouse capacity
 - ~5,000 cfs, mean annual
 - >100,000 cfs, 100-year flood
- Swift Dam 240 MW



Fish Collection

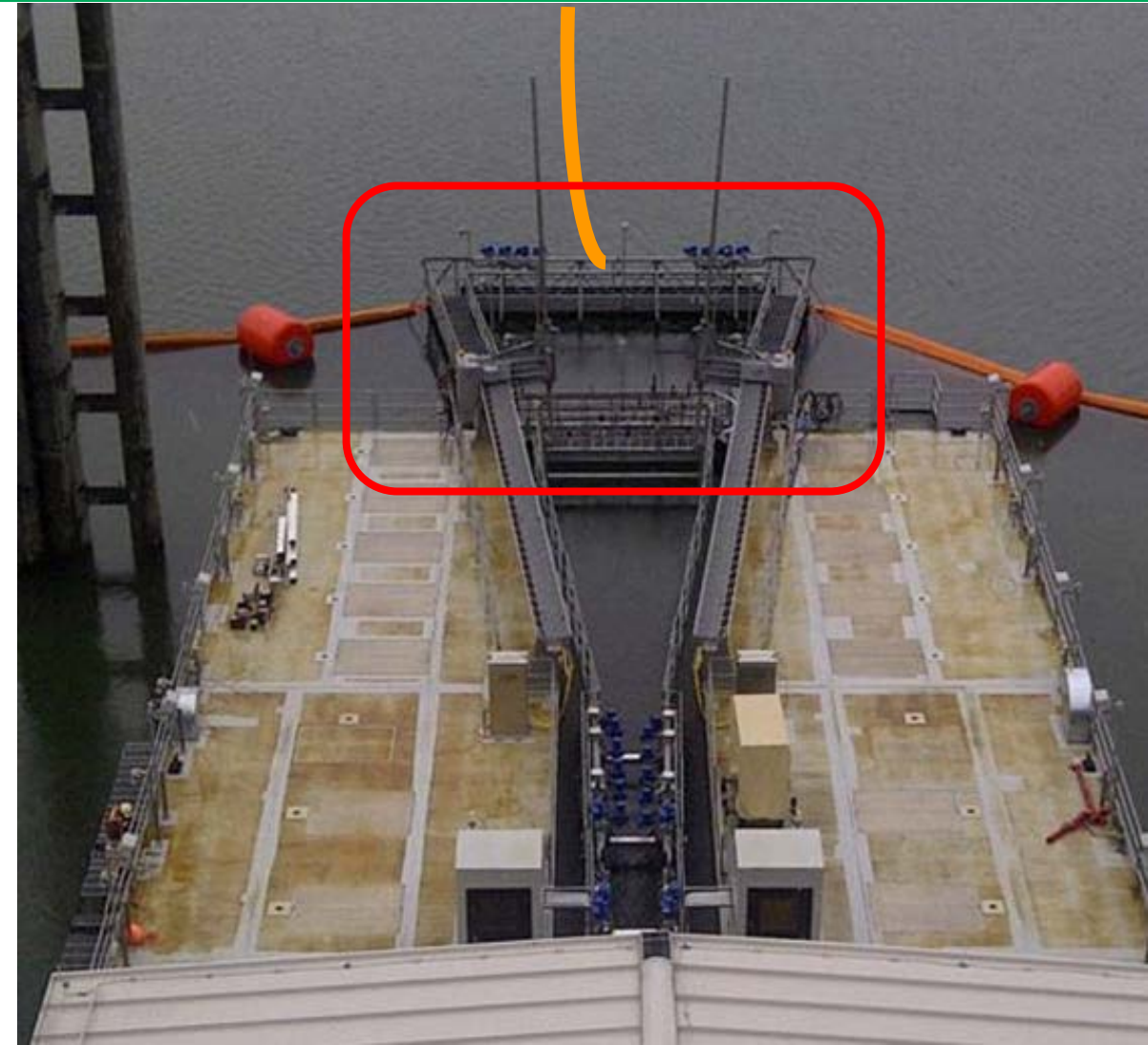
- Exclusion Nets

- Prevents fish from entering turbines
- Lowers to pass floating debris via spillway
- Accommodates ~100 foot reservoir fluctuation



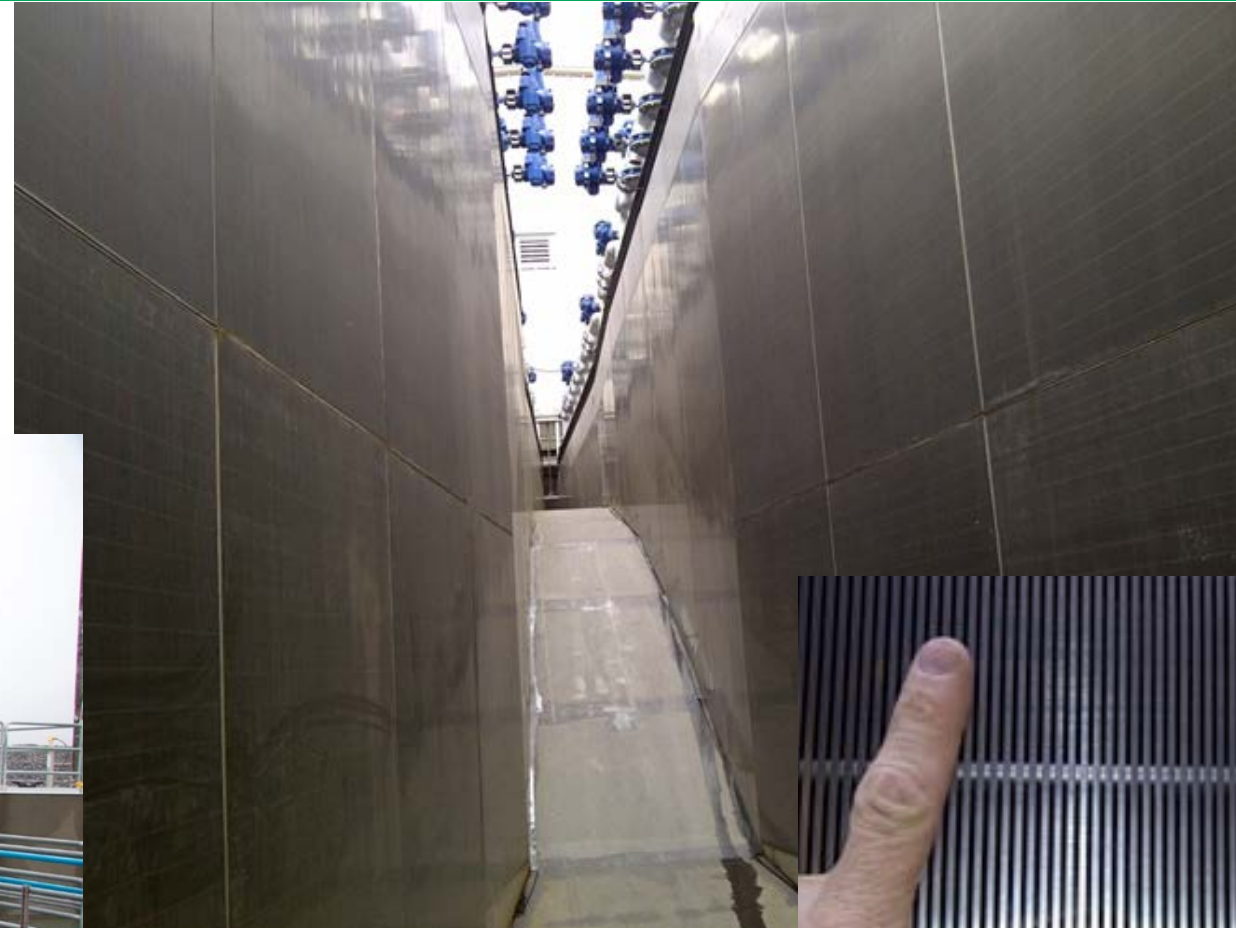
Fish Collection

- Net Transition Structure (NTS)

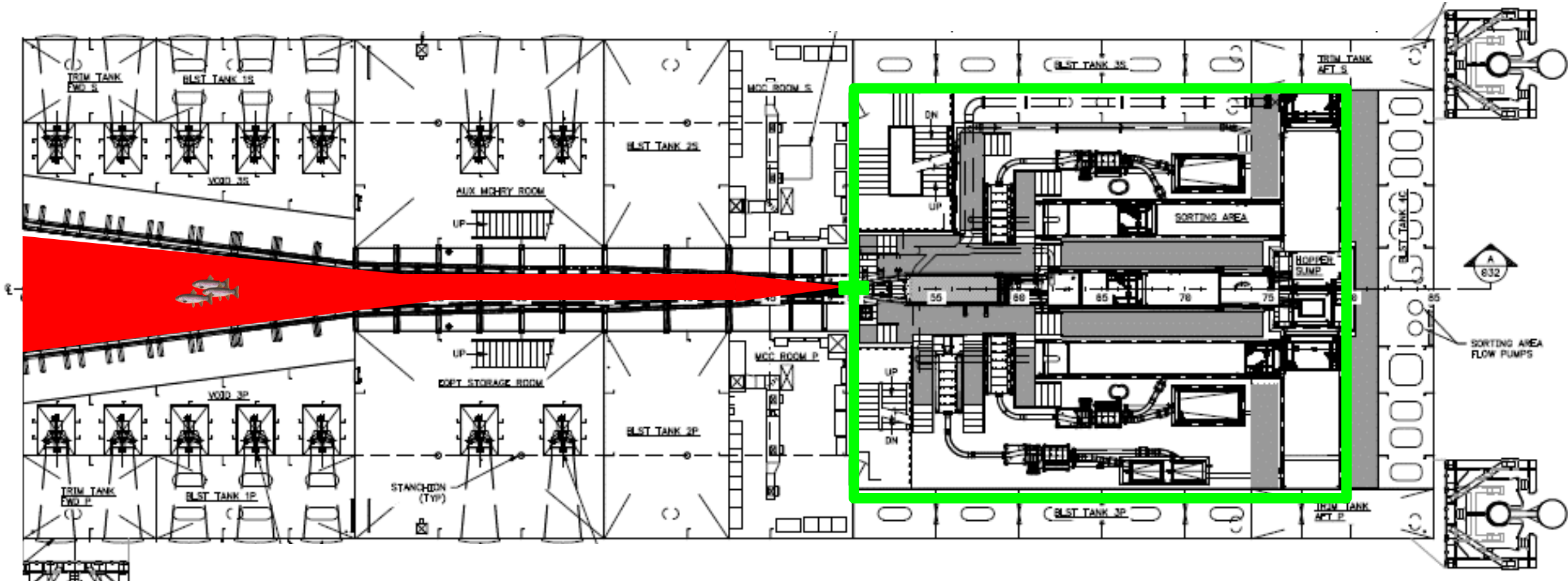


Fish Collection

- Entrance Channel
- Profile Bar Fish Screens
 - Primary screen chamber
 - Secondary screen chamber

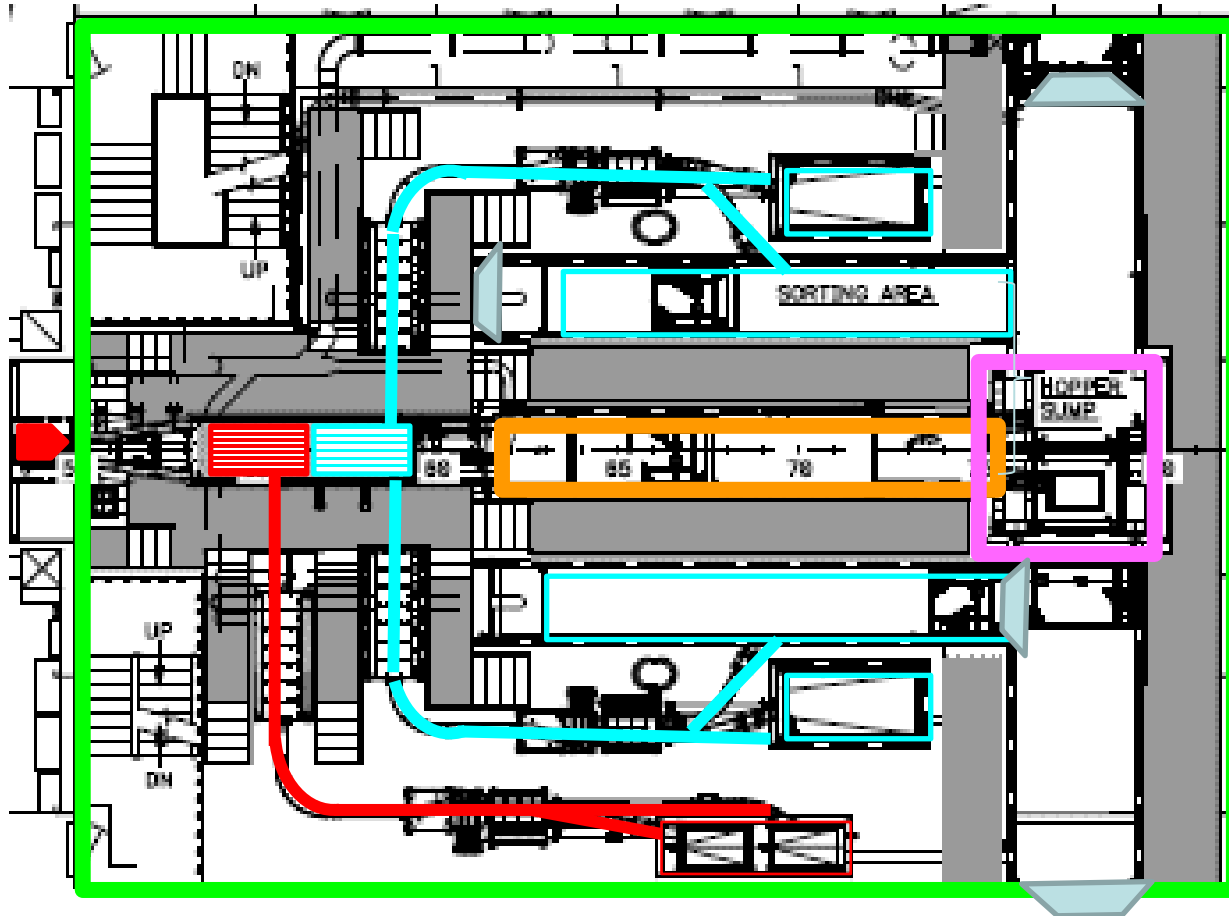


FSC Layout and Fish Capture



Plan View of FSC

FSC Layout and Fish Capture



Fry



Smolt



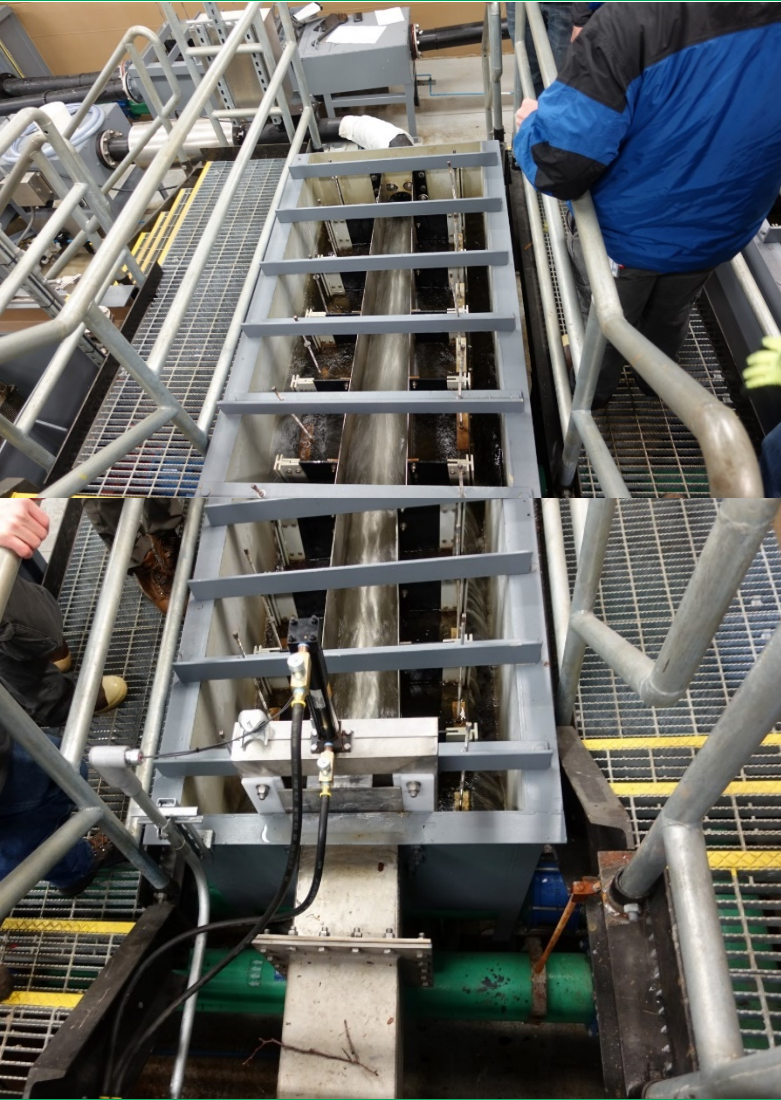
Adult

Plan View of FSC Sorting and Holding Area

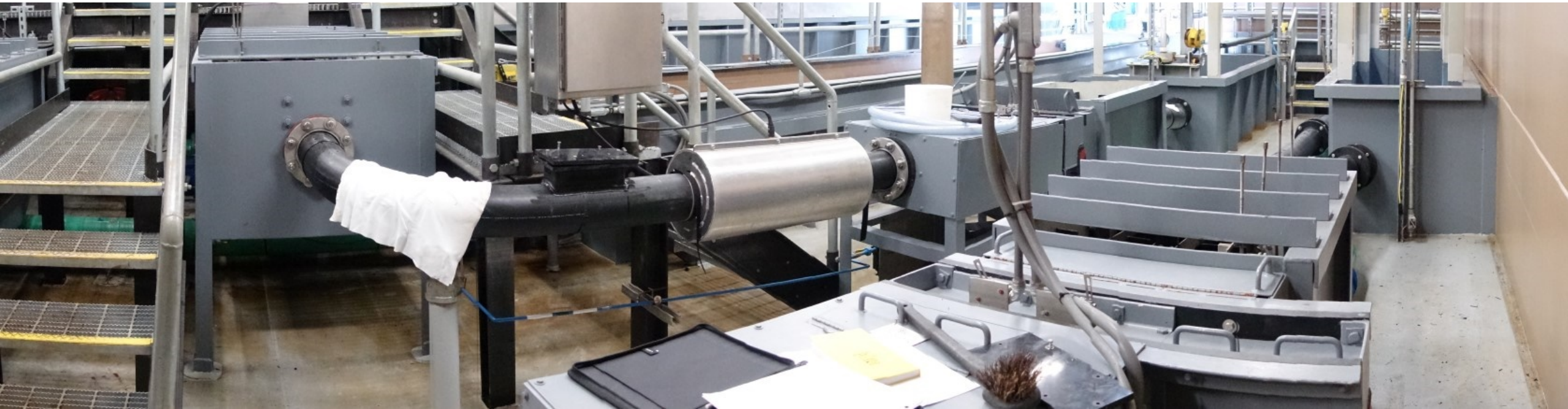
Fish Sorting



Fish Sorting



Fish Holding and Transport Area



Debris Issue



- Large and Small Debris
- Inhibits Fish Attraction and Collection
- Operational Challenges



Swift Debris - Believed to Be Worst in Region of New FSCs

1 st Yr Operation	Project Name	Flow (cfs)	Nets, or other
2008	Upper Baker FSC	500 or 1,000	Guide, exclusion, lead
2009	Round Butte Dam Surface Collector	0 – 6,000	None
2012	Swift FSC	600	Exclusion initial, Lead added in 2016
2012	River Mill Fixed Surface Collector	600	None
2013	Lower Baker FSC	500 or 1,000	Guide, exclusion, lead
2014	Cougar Dam FSC	63 or 122	None
2015	North Fork Dam FSC	1,000	Partial exclusion
2015	Cushman	250	Exclusion
2017	Cowlitz Falls North Shore Collector	500	None, BGS

First year of operation and flow (compiled from Tobias Kock, June 19, 2017 Corvallis Fish Passage Class)

Swift Debris - Believed to Be Worst in Region of New FSCs



Debris

- Piles Up at Entrance, Detracts from Collection
- All Sizes Enter FSC Sorting Area
- Smaller Debris Falls through Bars
 - Interferes with fish collection and sorting



Debris

- >90% injury/mortality associated with debris
- Injury / mortality standard:
 - <2% fry
 - <0.5% smolt

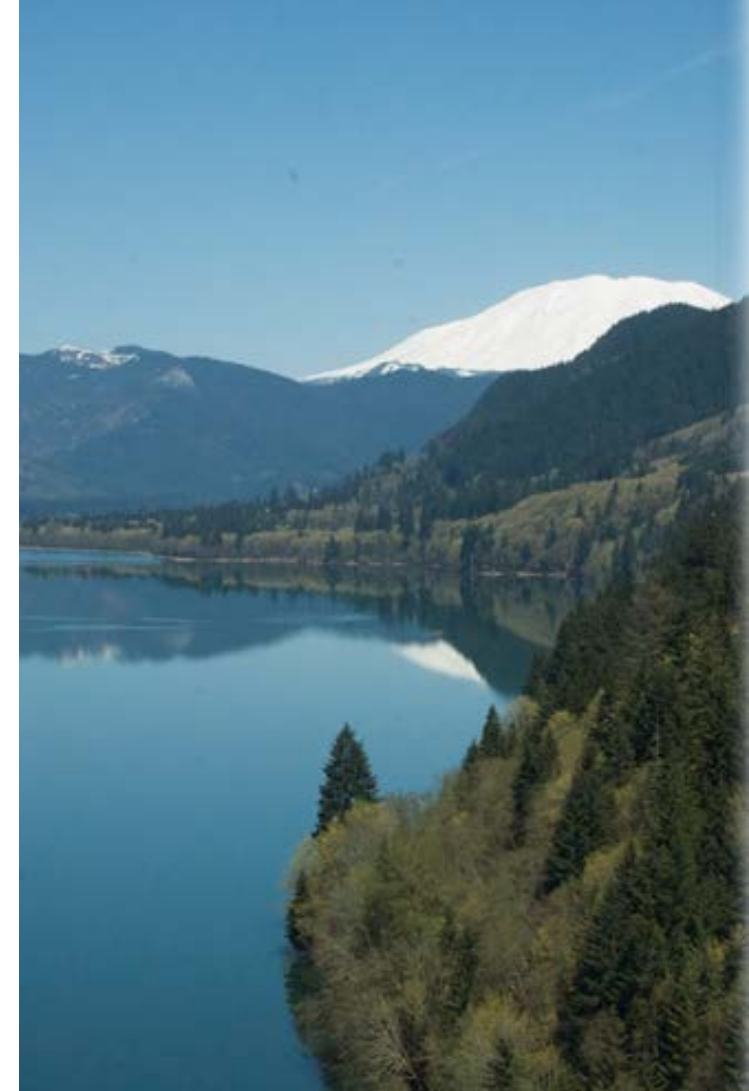


Debris Handling Options

- In Reservoir
 - Upstream of FSC
- At FSC
 - Entrance
 - At screens
 - At sorter bars
 - Fry holding area
 - Adult holding area



- Plan for All Seasons



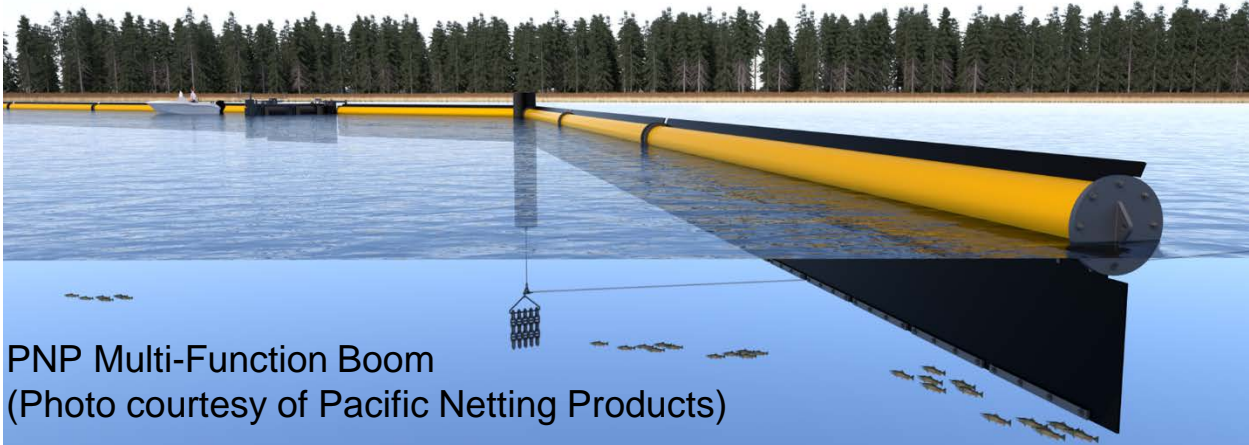
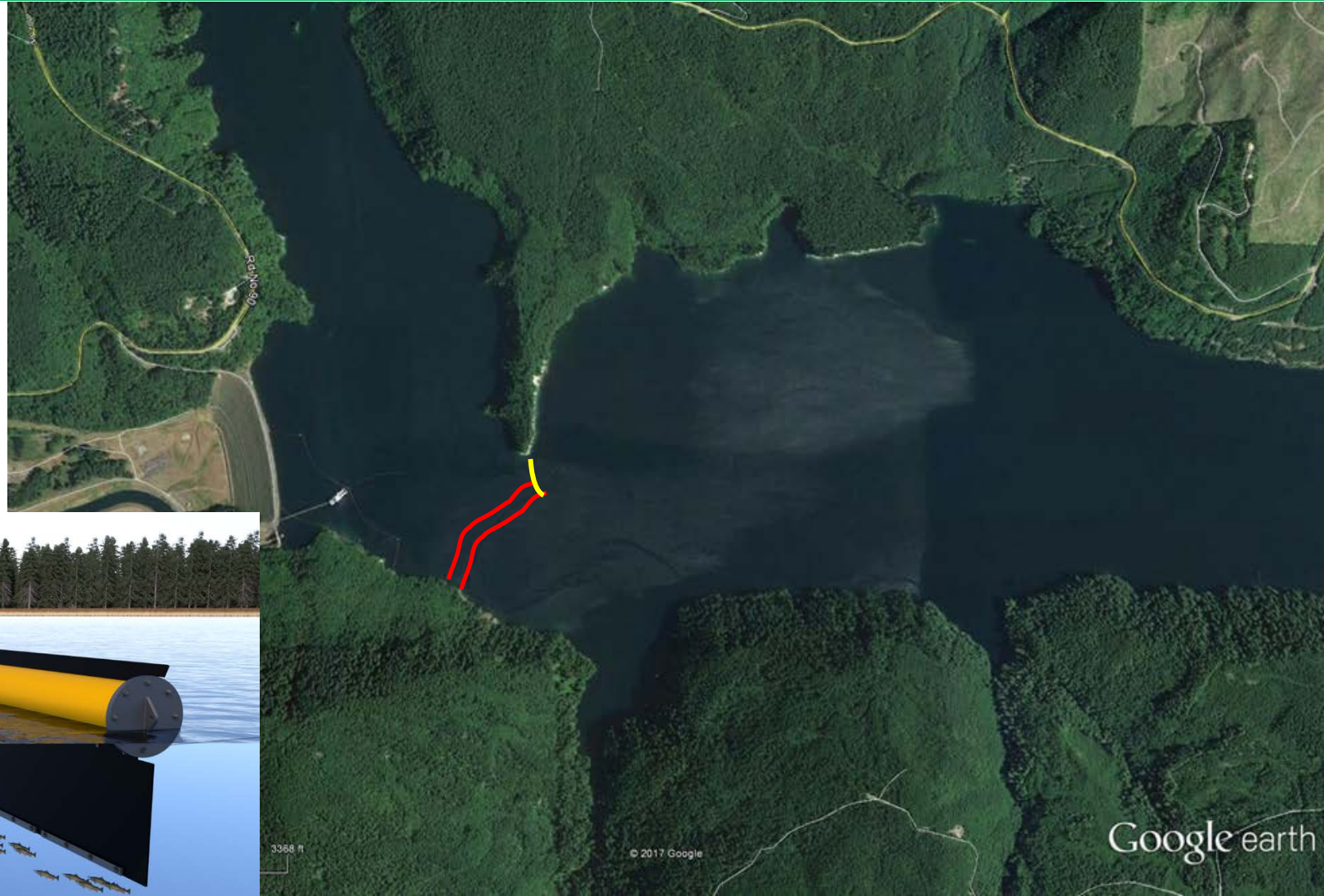
In Reservoir Debris Handling

- Two Existing Debris Booms
- Effective, But Could Be Improved
 - New locations
 - Double booms
 - Boom style
 - Boat gates



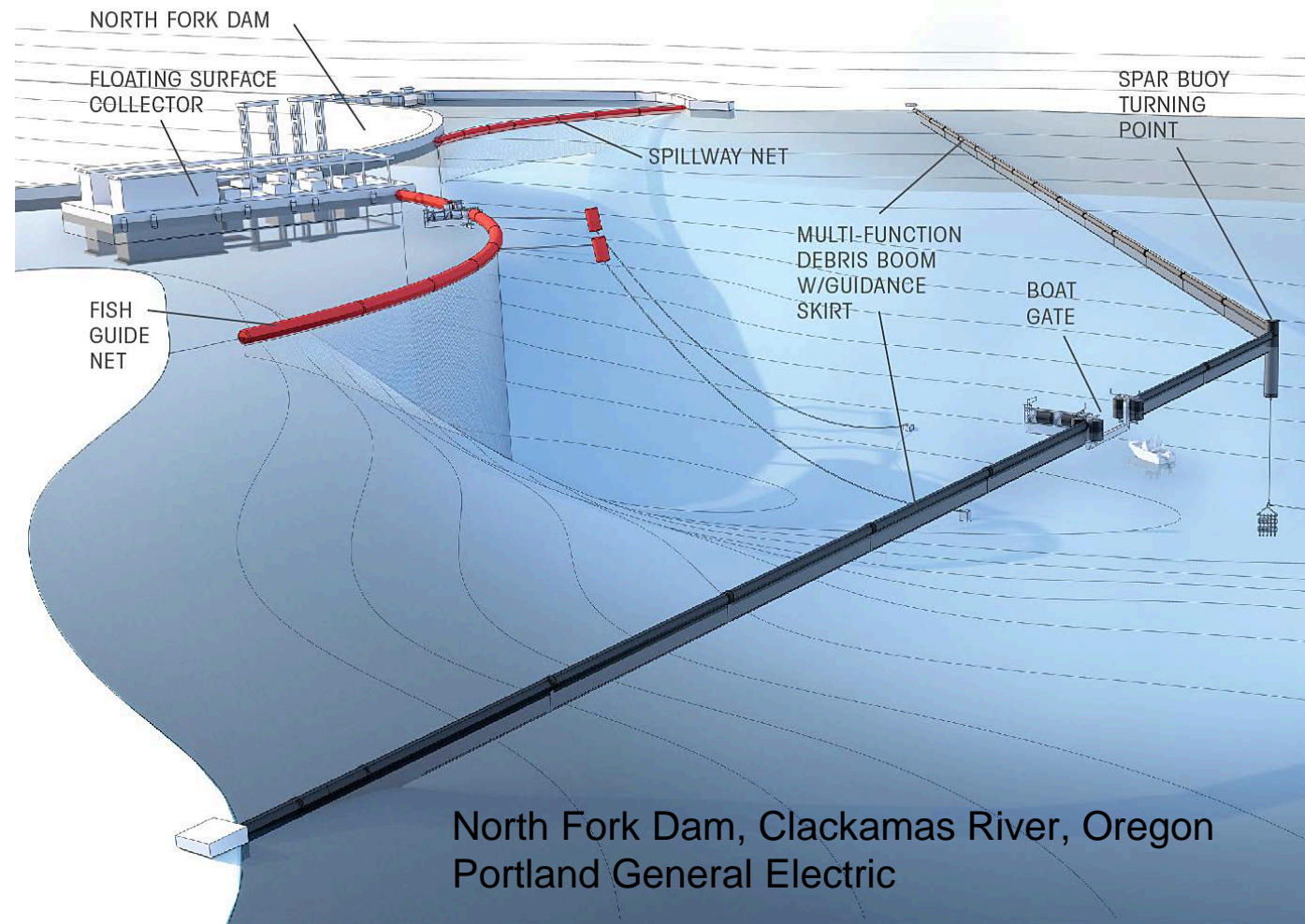
In Reservoir Debris Handling

- New Double Debris Booms
 - Locate upstream near Devil's Backbone
- Pacific Netting Products Style Boom
- Add Boat Gates



PNP Multi-Function Boom
(Photo courtesy of Pacific Netting Products)

In Reservoir Debris Handling



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IMAGE INCLUDES PATENT PENDING COMPONENTS

- Boom and Net Overview

- Boom
- Boat gate
- Exclusion/guide net
- FSC

In Reservoir Debris Handling

- Boom and Boat Gate Example



In Reservoir Debris Handling

- Active Debris Management

- Corral with work boats
- Skimmers

- Debris Removal

- Removal location
- Crane and trucks
- Boat ramp for debris removal access



Debris Handling at FSC Entrance

- Small Debris Boom at Entrance
- Trash Rack
- Trash Rack Cleaner
- Skimmer
- Smaller NTS
 - Velocity discussion



Debris Handling at FSC Entrance

- Traveling Peg Cleaner on Trash Rack

(Freeman Dam trash rack, CA, USA)



- Traveling Belt Skimmer above Trash Rack at Entrance, with Sluice
(Lower Baker FSC, WA, USA)

Debris Handling at FSC Screens



- Primary Screens
 - Atlas Polar Hydrobrush
 - Sweeps debris entire height



Debris Handling at FSC Screens

- Secondary Screens
 - Pressure water backwash system
 - Travels behind screen
 - Full coverage
- Both Systems Very Effective for Cleaning
- Dislodges Debris Flows into Sorting / Holding Area
- Vertical Traveling Screens?
 - May reduce debris load somewhat, but minimal
 - Cowlitz North Shore Collector, 2017 commissioning

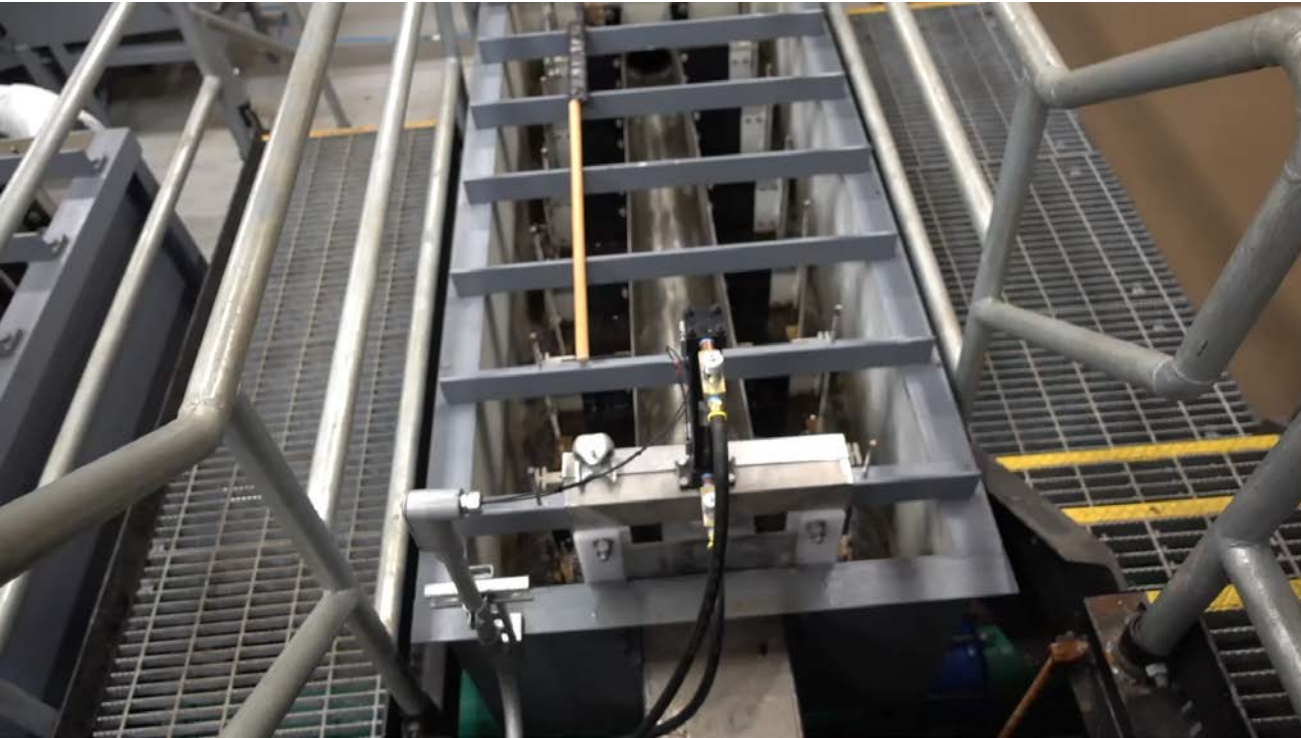


Debris Handling at Sorter Bars

- Flow Pulsing
 - Operational modification
 - Flow pulses to wash debris downstream into adult tank
 - Timed operation
 - Manual override



Debris Handling at Fry Tank



- Re-Purpose Fry Holding Tank to a “Debris Vacuum”
- Fry Handling with Dip-net vs. Prior Flow-through
 - Experience shows few fry collected
- Larger Tank with Inclined Traveling Screen
- Debris Disposal via:
 - Debris flume to tank
 - Chopper pump (comminutor)

Debris Handling at Fry Tank

- Construction Just Completed
 - November 30, 2018
- Testing This Season with Fish Collection



Debris Handling at Adult Tank

- Existing
 - Manual flush debris into tank
 - Manual lift, hoist reconfigure to lift to upper deck
- Fish Facts
 - ~100 adults handled each season
 - Netted and moved to hopper, hoisted up
 - Steelhead kelts
- Debris Facts
 - Most troublesome when reservoir filling
 - Most prominent in spring
 - Peak: fill/transport hopper every day
 - Take off site and burn

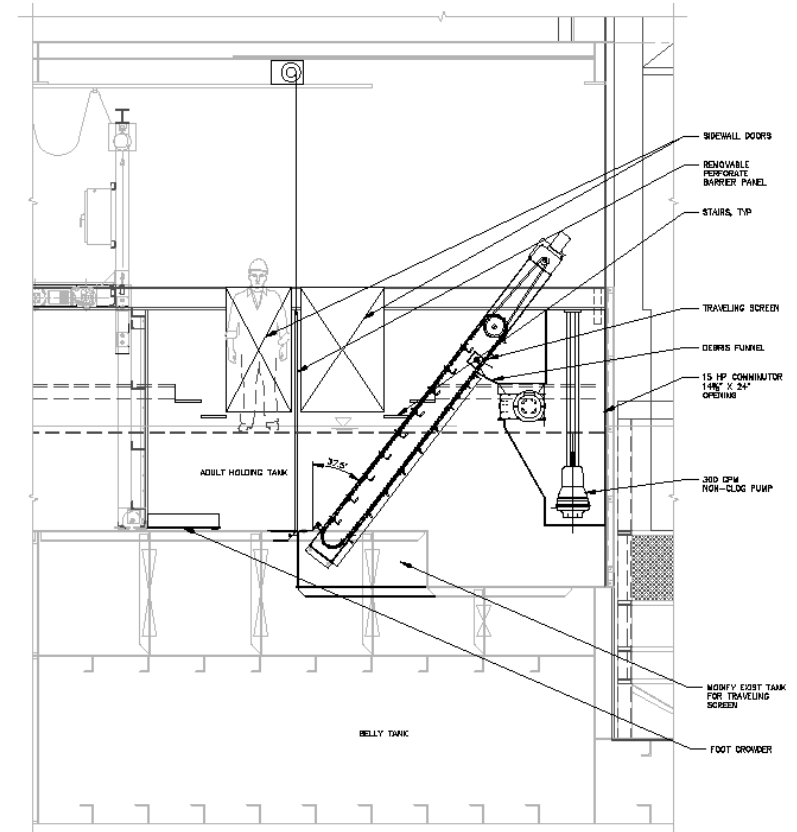
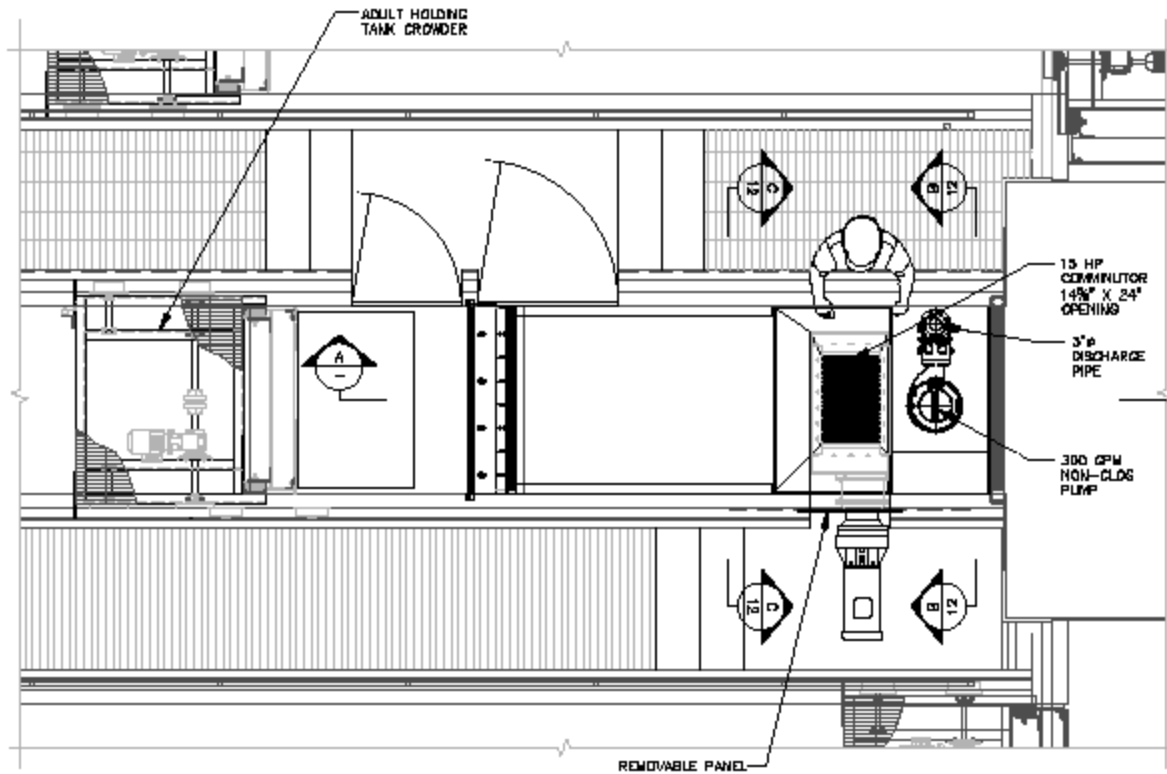


Debris Handling at Adult Tank

- Future Potential Modifications

- Modify tank size
- Modify adult crowder

- Inclined traveling screen



Conclusions and Next Steps

- Debris Is Very Site Specific
- Plan for Debris and Handling
 - Influence on fish collection and injury
 - Affects on operations: safety, reliability
 - Adaptive management is key



Conclusions and Next Steps

- Swift Is a Good Case Study for Large FSCs
 - Extreme debris
 - 6 years' operating experience
 - Fry debris testing this season
 - Comminutor new idea
 - Adult debris handling next



Thank You

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