DETROIT TEMPERATURE CONTROL AND DOWNSTREAM PASSAGE

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February 2018

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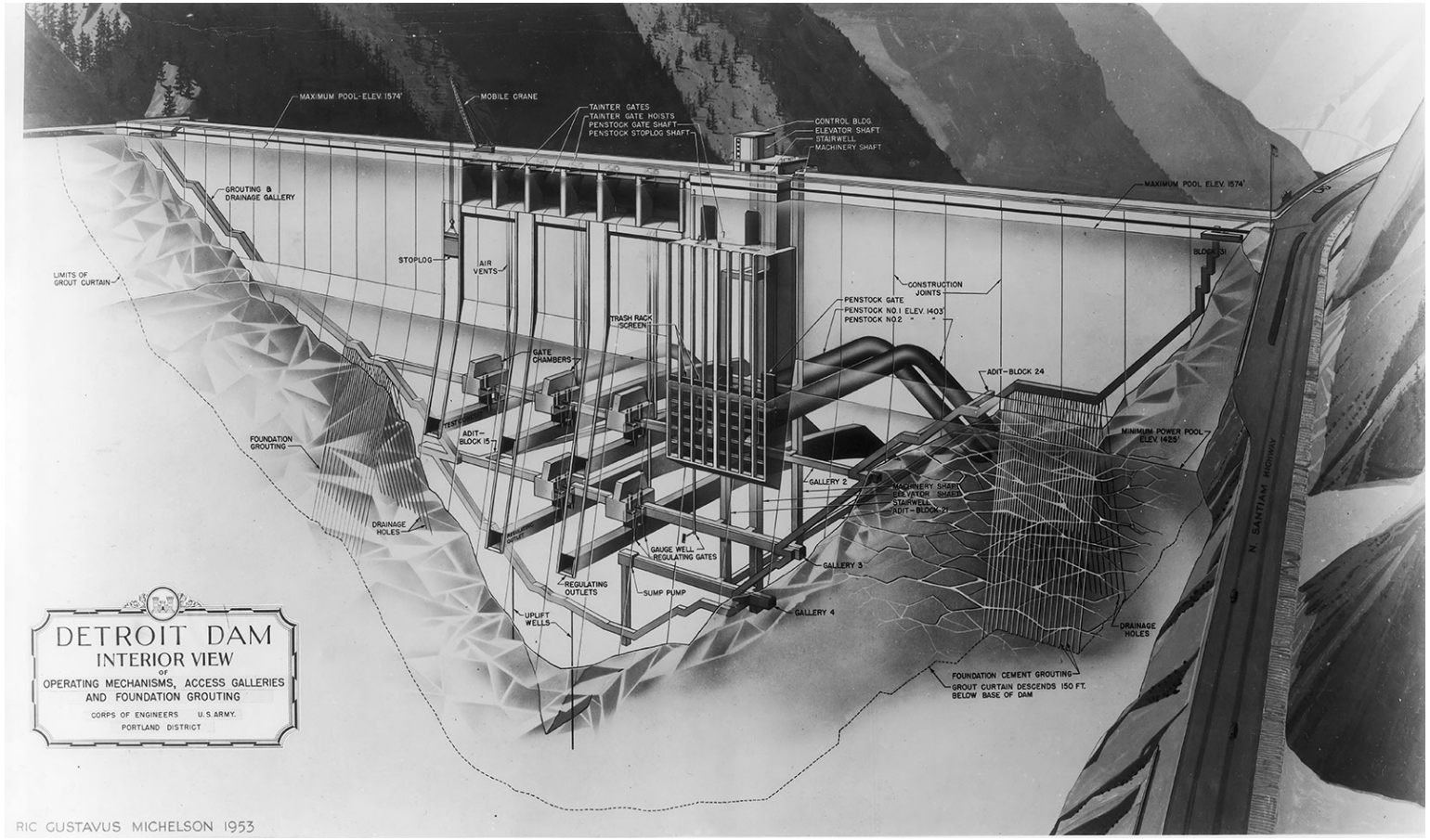
AGENDA

Project Background

Evolution of Design

- Biological Focus

Next Steps



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Detroit Dam

Authorized Purposes:
Flood Control
Hydropower
Navigation
Irrigation
Fish & Wildlife
Recreation
Water Quality
Municipal & Industrial

Built without accounting for:

- Reservoir induced temperature changes
- Downstream fish passage

Spillway is currently being used for interim operational temperature control

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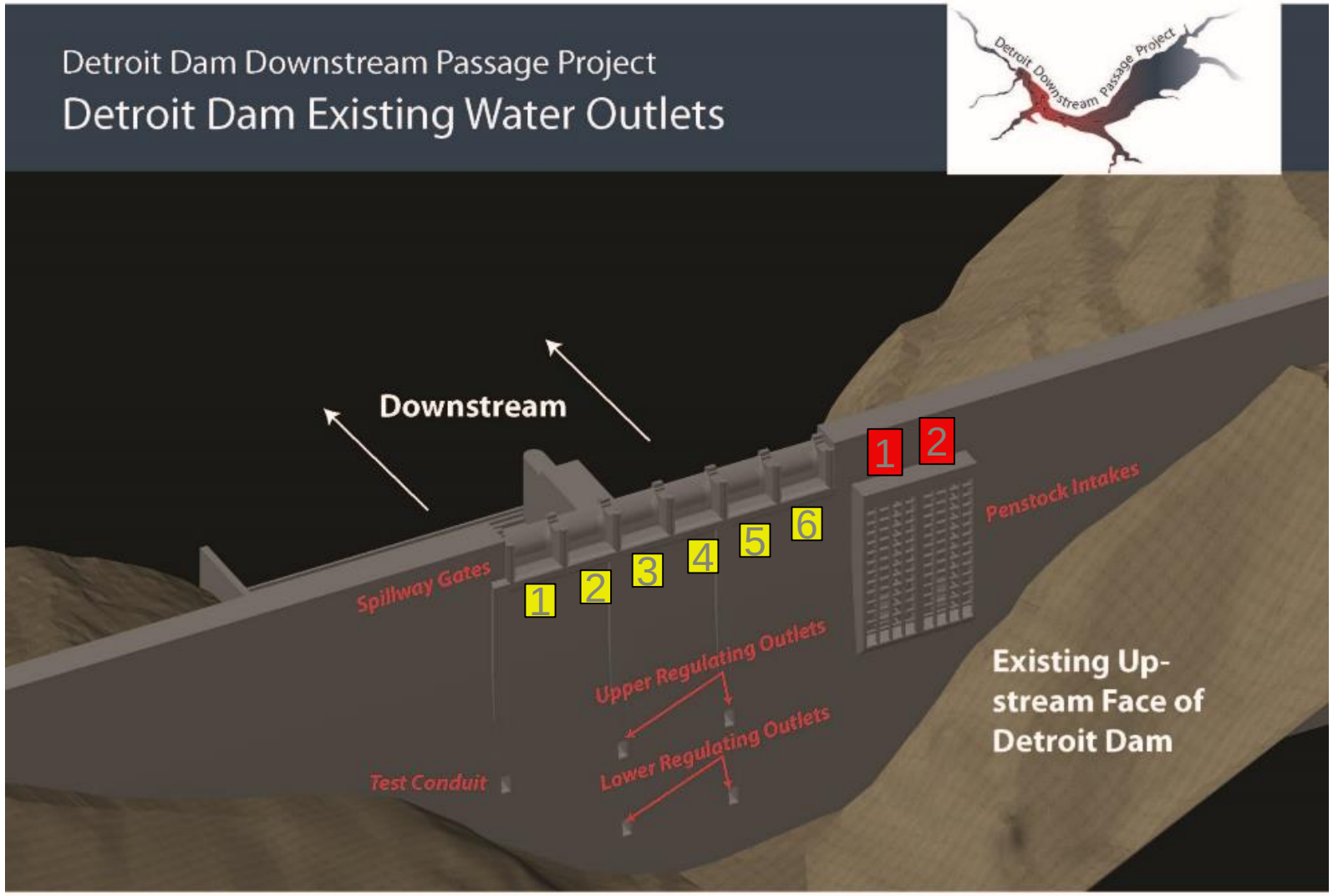
PROJECT BACKGROUND



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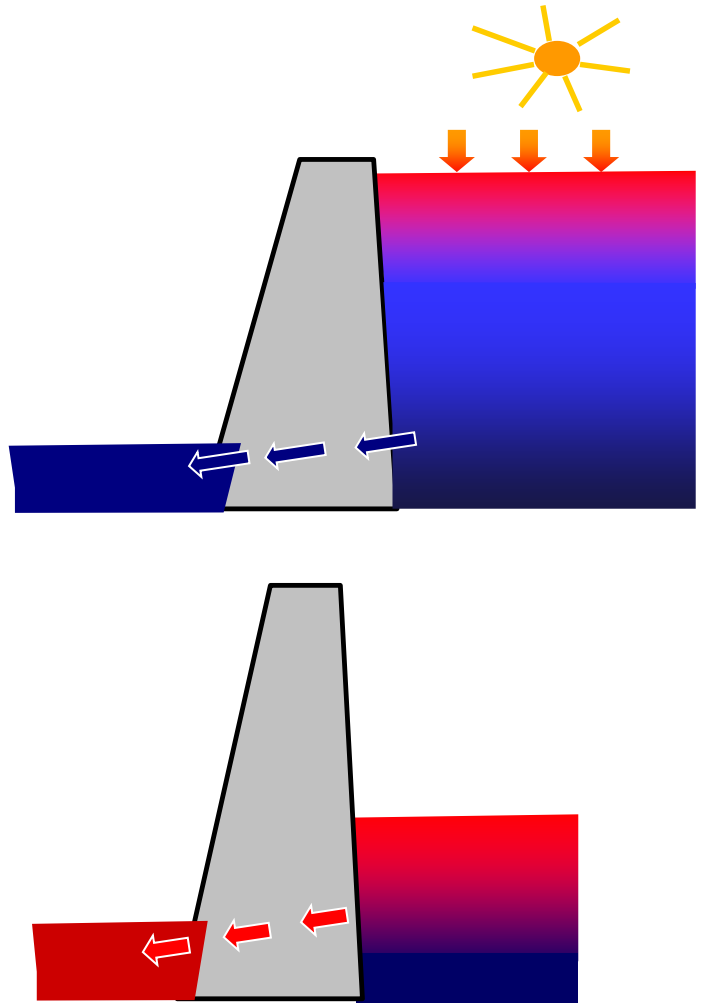
PROJECT BACKGROUND

National Marine Fisheries Service 2008 Biological Opinion

RPA Measure 5.2: requires the Action Agencies to minimize water quality effects (Temperature and Total Dissolved Gas) associated with operations of Detroit and Big Cliff dams by making structure modifications or major operational changes

RPA Measure 4.12.3: requires downstream fish passage at Detroit Dam

ESA listed stream type chinook and winter steelhead



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EVOLUTION OF DESIGN – ENGINEERING PROCESS

Project Goals –

- High survival downstream passage
- Downstream temperature control
- Minimize operations impacts

<u>Biological Considerations</u>

- ➢ What does the fish behavior suggest?
- ➢ How does this inform design?

Regional lessons learned
RM&E - Detroit forebay studies

- PNNL – Hydroacoustics
- USGS – Acoustic telemetry

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EVOLUTION OF DESIGN – NORTHWEST REGION LESSONS LEARNED

Entrance location and configuration - Highly important for success!

- Location - Position based on fish concentration and behavior.
- Entrance - Hydraulic performance and configuration.

Discovery, entry, capture

- Detroit Dam - Juvenile chinook and winter steelhead as well as steelhead kelt.
- Design Features – Entrance, screens, flumes, debris, holding, etc…
  - Design Criteria - NMFS 2011, Bell, Clay, Senn, Piper, ODEQ, etc…

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PNNL DETROIT RESERVOIR STUDIES

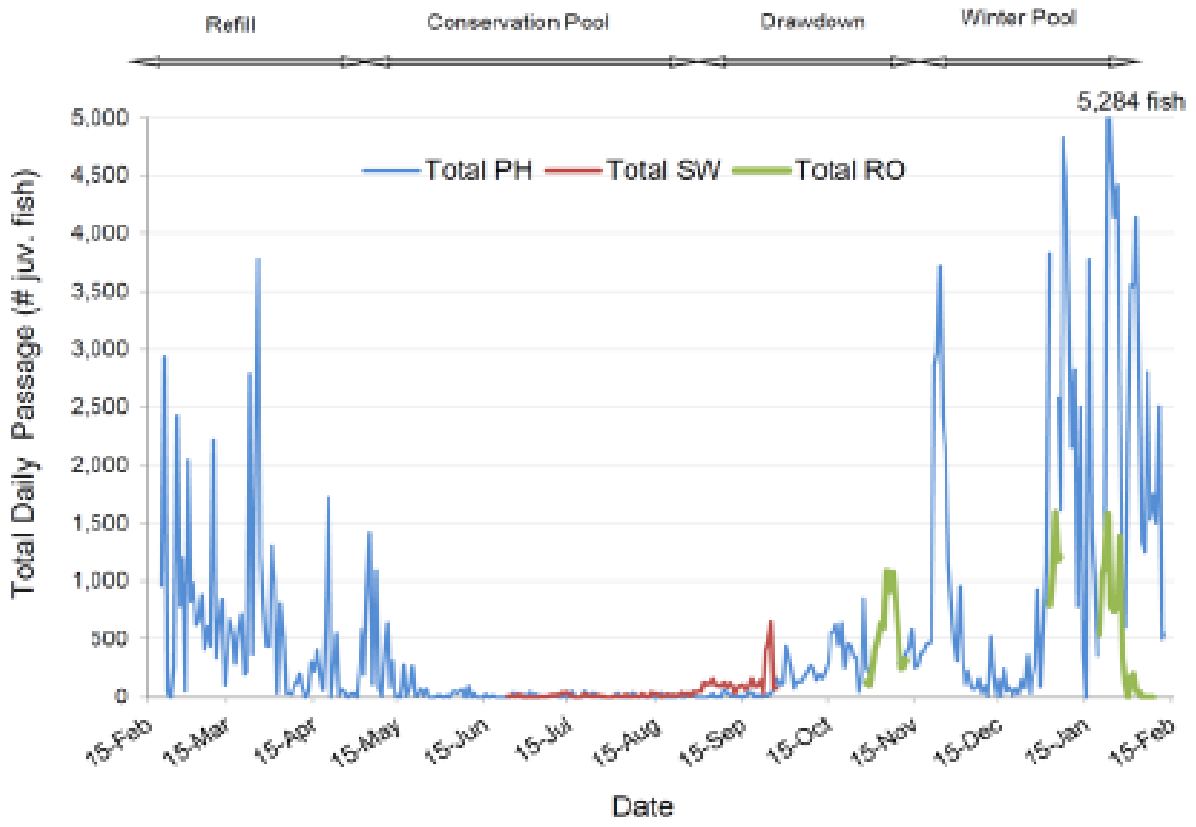
Hydroacoustics Feb. 2011 - Feb. 2012

Smolt-size fish passage and distribution

- Powerhouse, spillway, regulating outlet

Passage proportions

- Turbine Unit 2 > Unit 1
- Spillbay 4 = Spillbay 5
- Spillway > Turbines
- Vertical distribution throughout water column



(Fig. 3.7, Khan et al. 2012)

- Surface route may be effective for passage
- Temp. control cold water intake at low elevation
- Exclude poor survival turbine route

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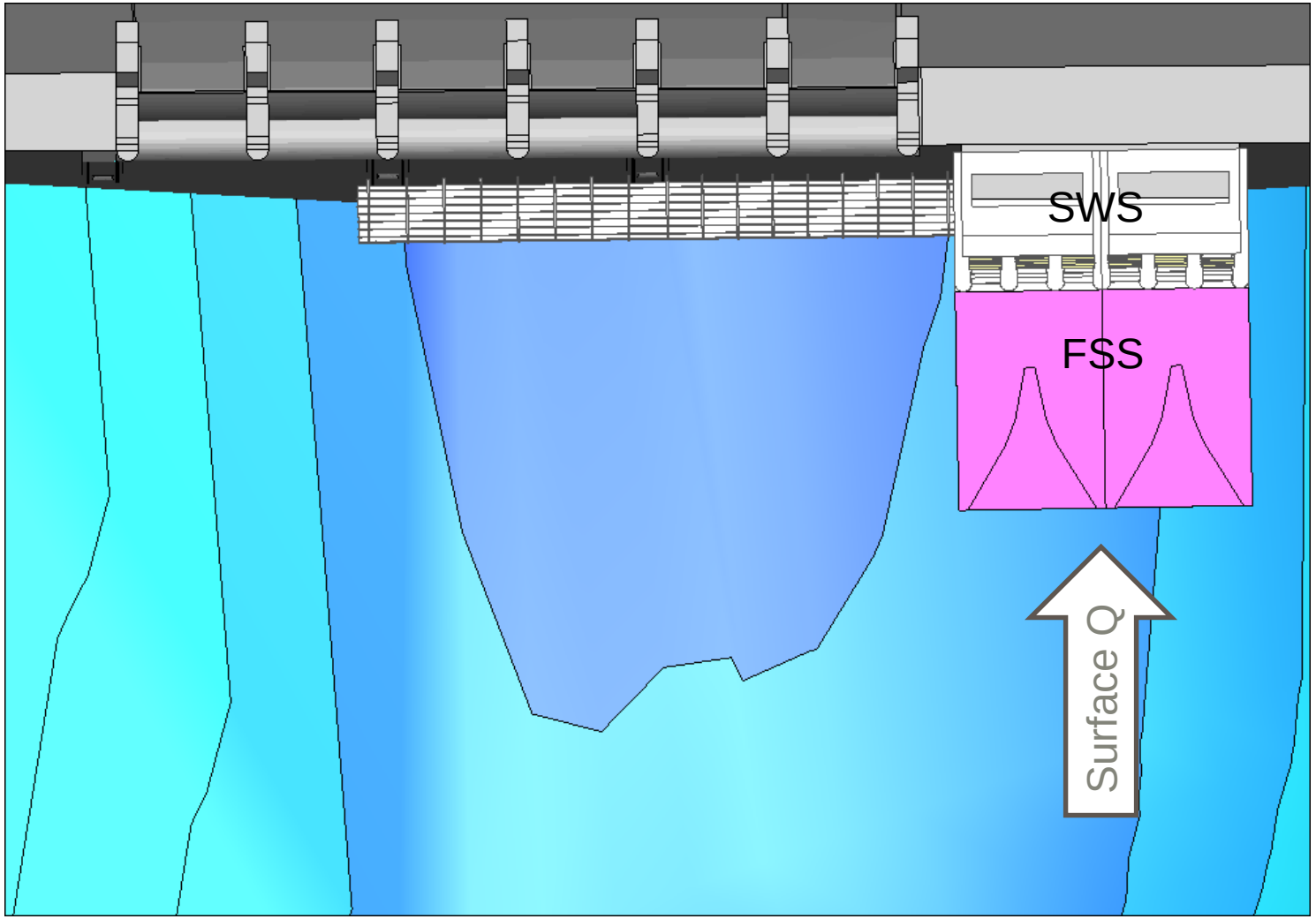
EVOLUTION OF DESIGN- PLAN VIEW COLLECTOR AND TOWER LOCATION



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USGS DETROIT RESERVOIR STUDIES

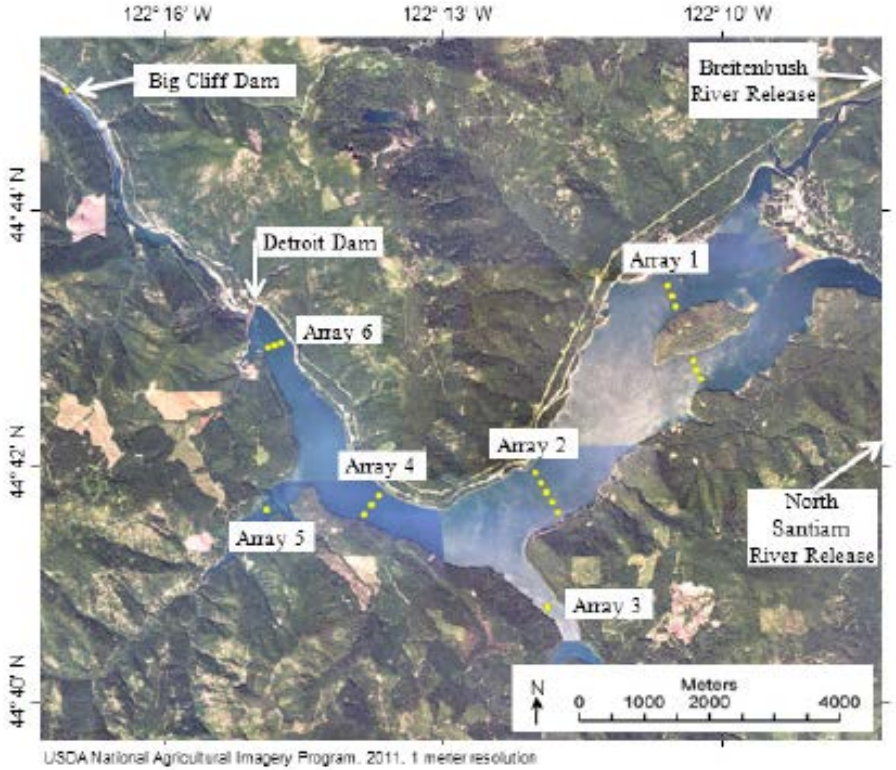
USGS Acoustic Telemetry

- Two year study - 2012 to 2014

Tributary Releases Acoustic Tagged Fish

	2012		2013	
	Spring	Fall	Spring	Fall
Chinook (n)	468	514	394	606
Steelhead (n)	200	NA	229/*125	271

***125 released downstream Piety Island**



(Fig. 3, Beeman et al., 2014)

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USGS DETROIT RESERVOIR STUDIES

Tributary Releases – Reservoir Passage Efficiency (SE)

	2012		2013	
	Spring	Fall	Spring	Fall
Chinook	0.925 (0.013)	0.821 (0.018)	0.883 (0.018)	0.850 (0.015)
Steelhead	0.870 (0.030)	NA	0.855 (0.042)	0.286 (0.054)

- High probability of fish reaching the dam once in the reservoir.
- Directional persistence

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USGS DETROIT RESERVOIR STUDIES

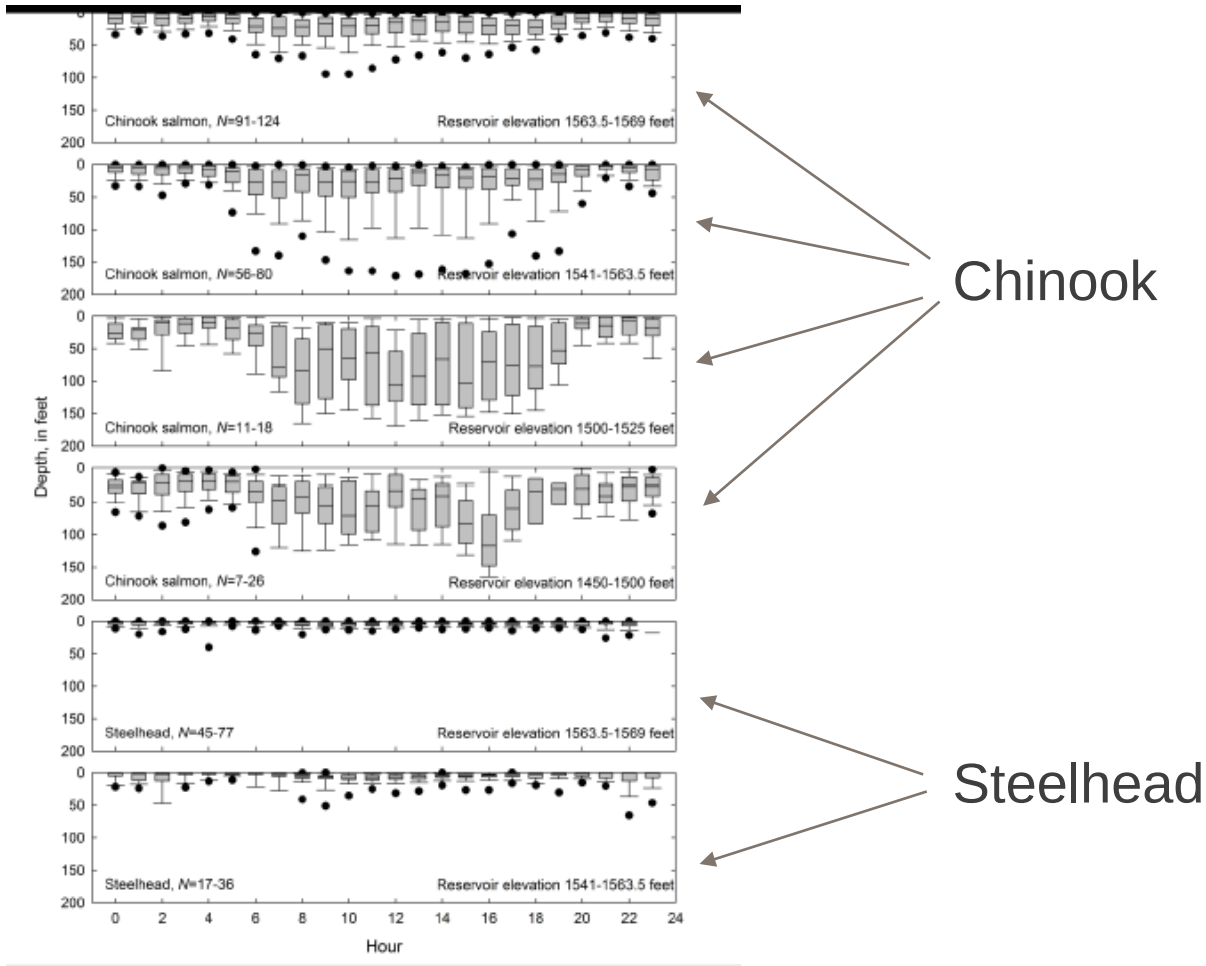
Vertical distribution

Steelhead shallower and less variable than chinook

Chinook deeper during day than night

Both frequently at shallow depths

- Surface route will be effective



(Fig. 1-28, Beeman and Adams, 2015)

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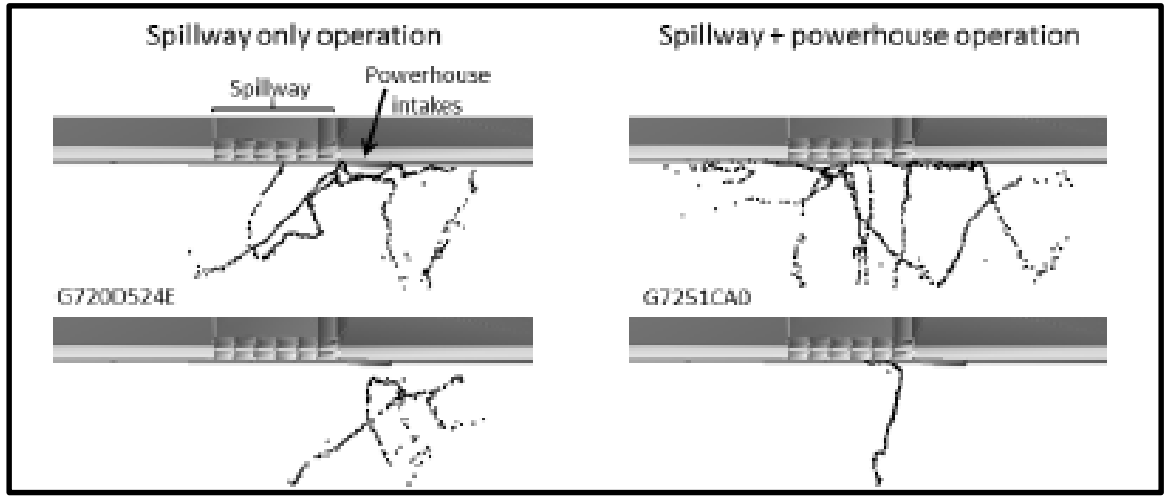
USGS DETROIT RESERVOIR STUDIES

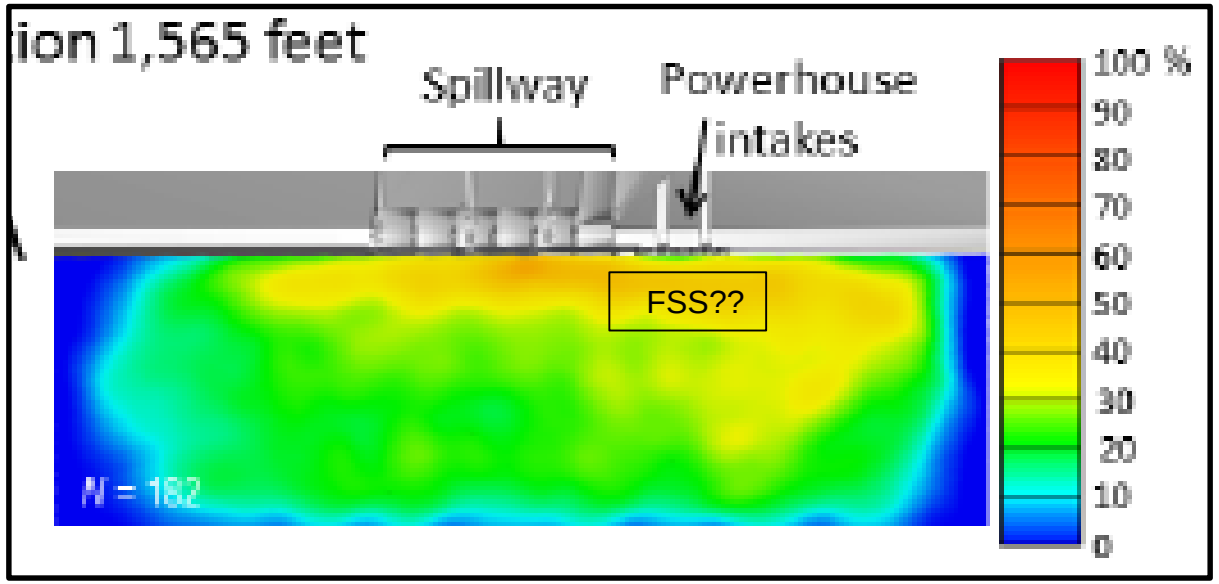
Fish densities – close to the dam during spill

Passage rate increased as spillway discharge increased.

Spill test passage rate –

weir flow > normal flow





Entrance

- Position entrance close to the dam
- Use dam as a guidance feature
- Shape a surface entrance with free flow and a hydraulic drop.

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EVOLUTION OF DESIGN – FISH COLLECTION KEY CONSIDERATIONS

- Utilize fish behavior in design features.
- Maximize the surface flow hydraulic signature in the forebay.
- Position entrance close to the dam. Utilize the dam as a guidance feature.
- Minimize competing flow or confusing flows.
- Exclude fish from areas that would limit their ability to find the entrance.
- Debris management critical for survival and O&M.
- Shape the entrance to optimize hydraulic conditions to maximize collection efficiency.

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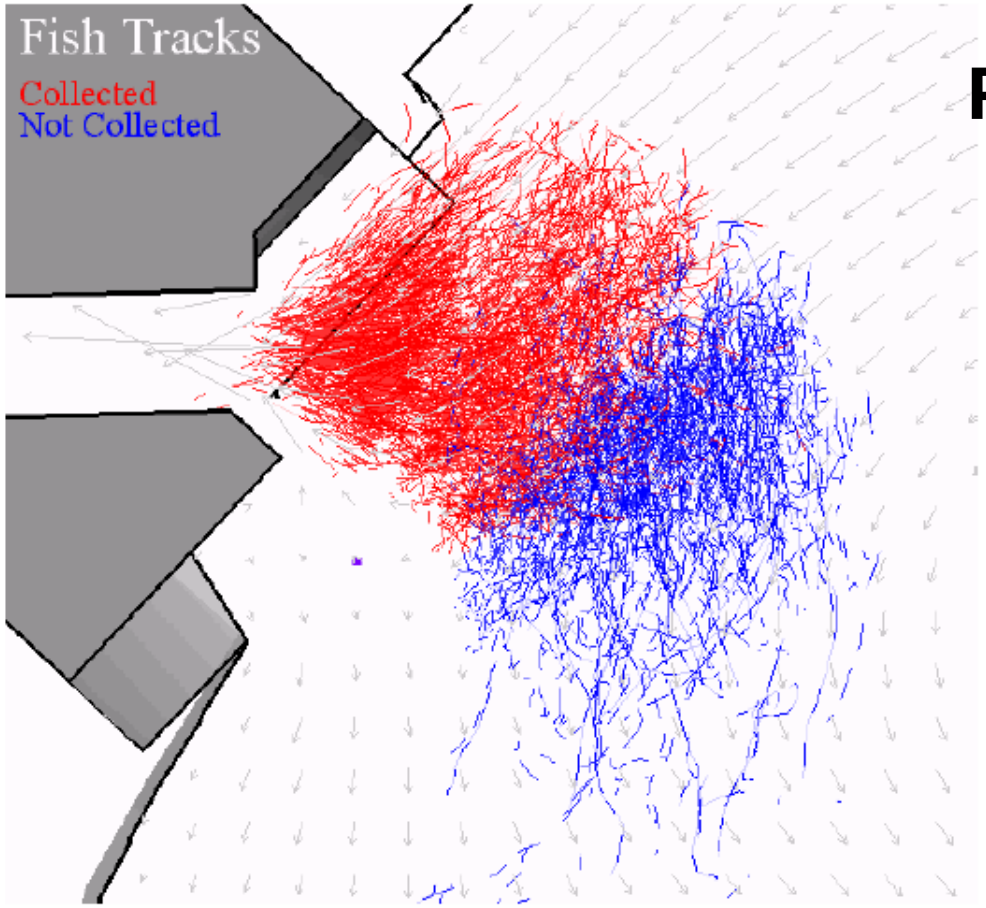
BONNEVILLE DAM B2 CORNER COLLECTOR



Fish follow flow

(Ploskey et al., 2005)

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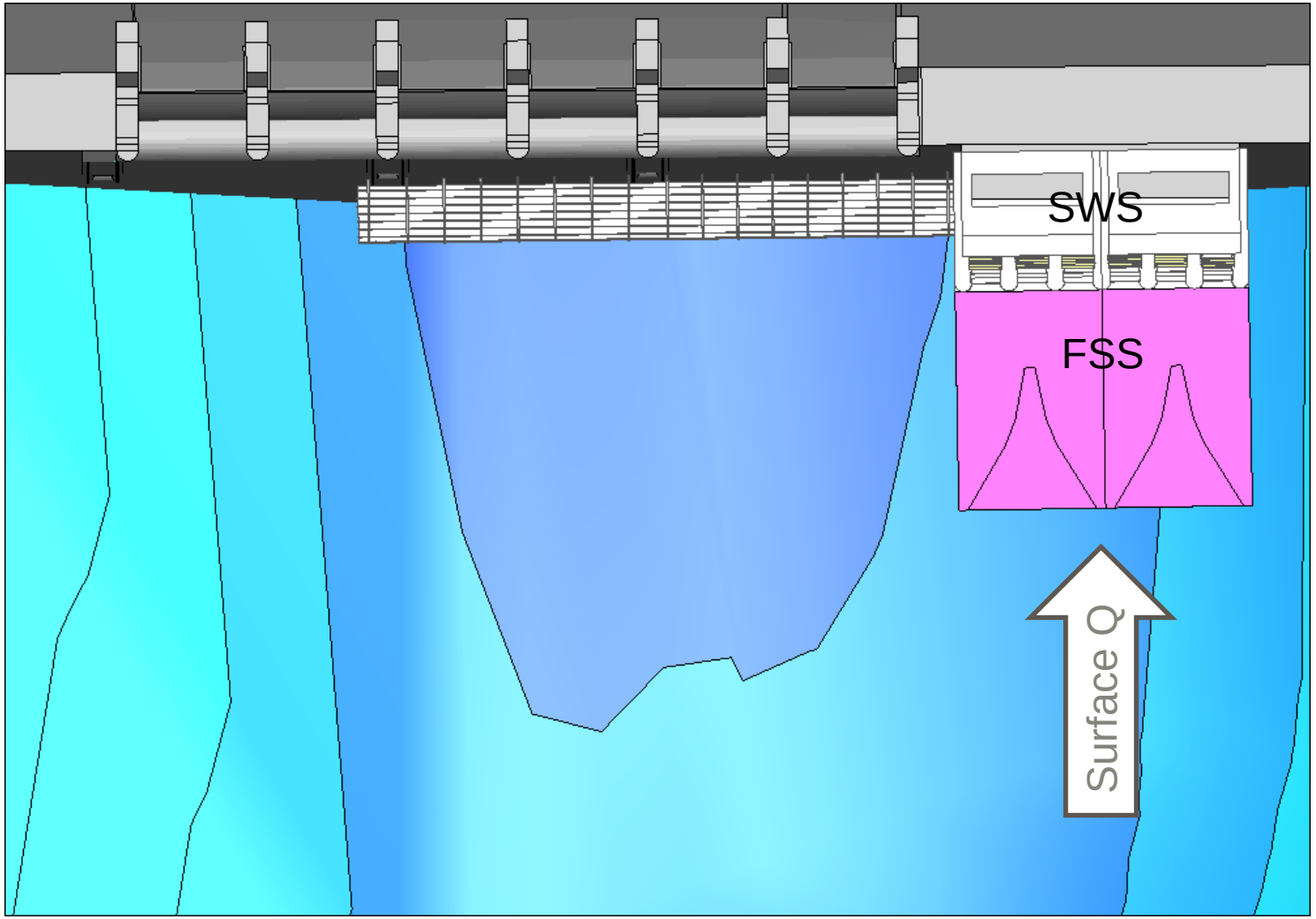
EVOLUTION OF DESIGN- PLAN VIEW COLLECTOR AND TOWER LOCATION



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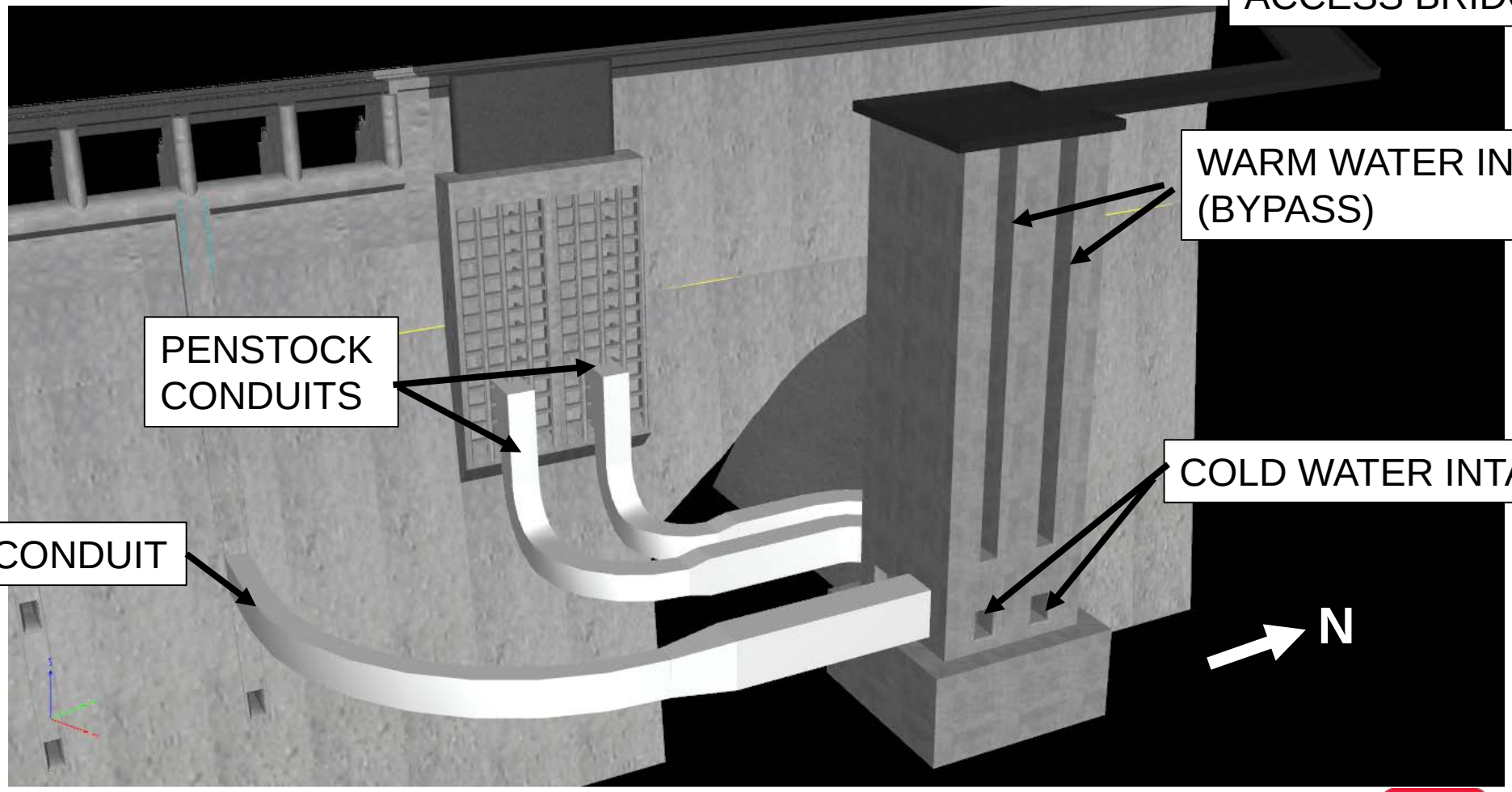
CONCEPT SELECTIVE WITHDRAWAL STRUCTURE



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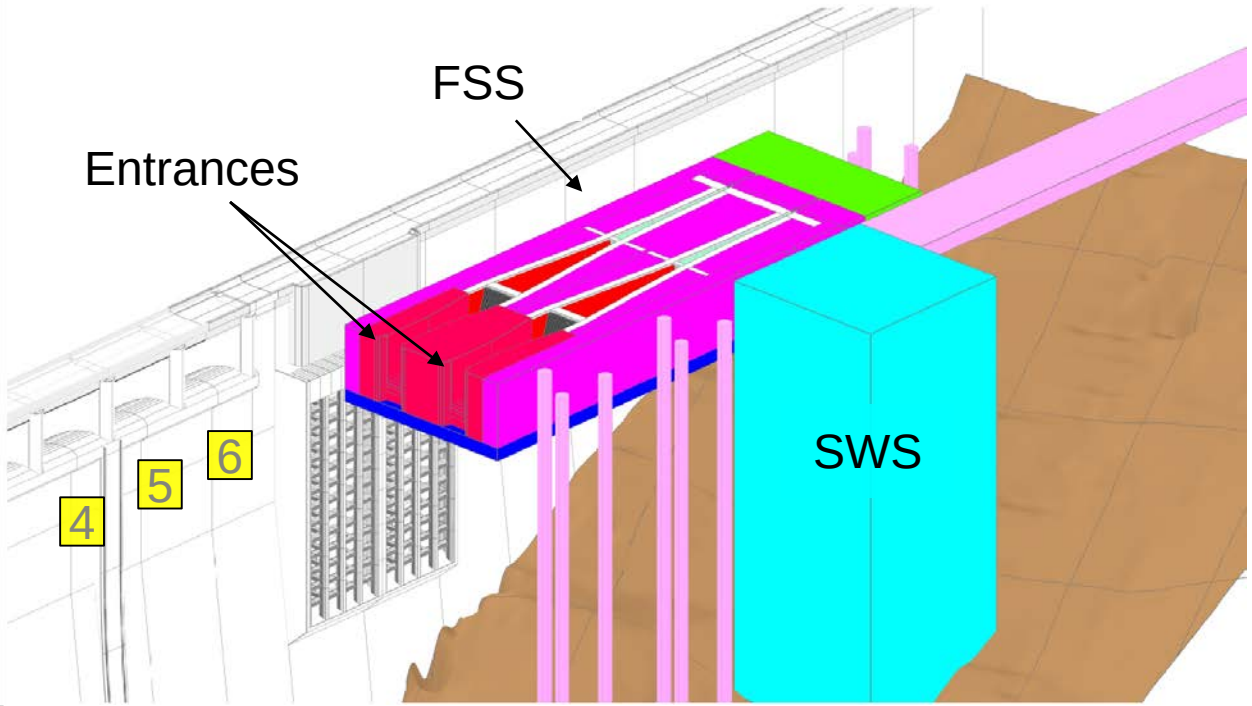
AE CONCEPT COLLECTOR AND TOWER LOCATION



Utilize fish behavior in design features.

Maximize the surface flow hydraulic signature in the forebay.

Position entrance close to the dam. Utilize the dam as a guidance feature.

Minimize competing flow or confusing flows.

Exclude fish from areas that would limit their ability to find the entrance.

Shape the entrance to optimize hydraulic conditions to maximize collection efficiency.

Art Anderson Associates
Value Beyond Engineering
R2
HDR
Alden
CES

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NEXT STEPS

Engineering and biological analysis continue - Final decisions have not been made yet.

- National Environmental Policy Act (NEPA)
- Value Engineering (VE) study
- Regional fish design coordination

Identify data gaps and additional RM&E

- Hydraulic modeling

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QUESTIONS?

Google Maps 2018

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USGS DETROIT RESERVOIR STUDIES

Tributary Releases - Cumulative Probability at Dam (SE)

	2012		2013	
	Spring	Fall	Spring	Fall
Chinook	0.767 (0.020)	0.710 (0.020)	0.685 (0.023)	0.721 (0.023)
Steelhead	0.535 (0.035)	NA	0.567 (0.049)/ *0.416 (0.044)	Low

***Released downstream Piety Island**

- High probability of fish in the reservoir reaching the dam
- Directional persistence

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