



moffatt & nichol

Luther Aadland, Ph.D.



# Fishway Planning/Design Lock and Dams 2 & 3

Status Update  
October 30, 2023



# Original Intent of Project

- Develop a comprehensive watershed-based strategy to improve the resilience of anadromous fish populations through the construction of natural rock rapids fishways at both Lock and Dams 2 and 3
- Provide free flowing access to historic spawning grounds, without compromising congressionally authorized purposes of navigation or affecting water supply users with intakes upstream of each the dams
- Bladen County is the lead governmental entity and was awarded the following funds:
  - NC Port of Wilmington - \$750,000
  - NC Division of Water Resources - \$1.59 M
  - National Fish and Wildlife Foundation (Duke Energy Settlement) - \$840,000

## Goals of Project

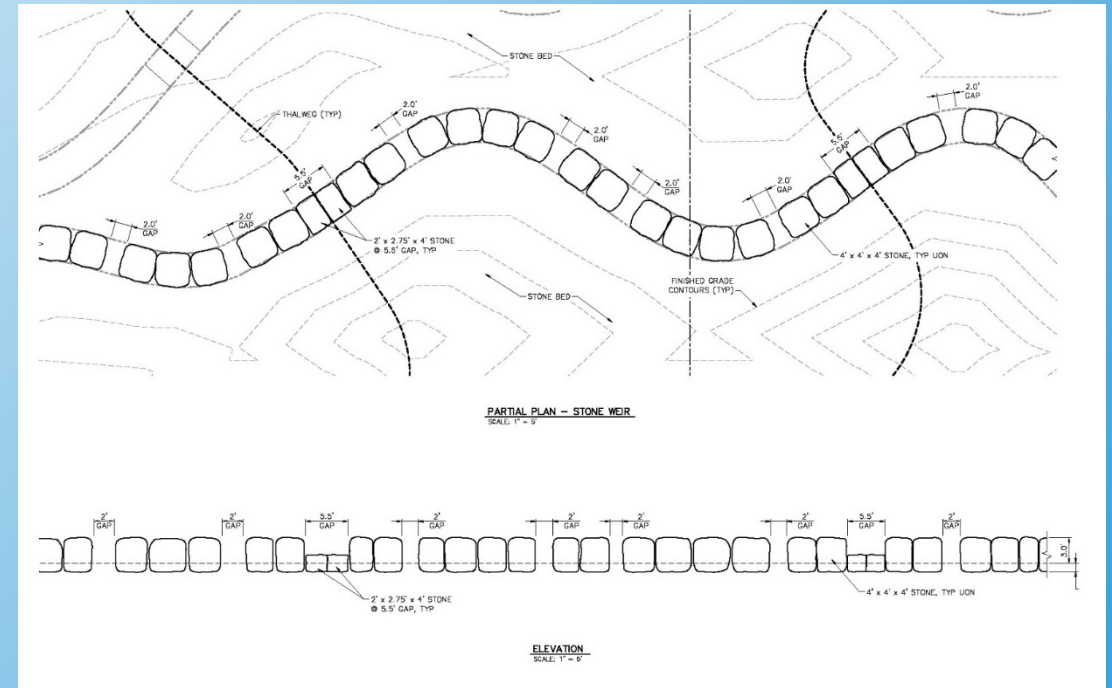
- Develop nature-like fishways at Lock and Dam 2 and 3 similar to the structure completed at Lock and Dam 1
- Incorporate modifications to the design to minimize structural improvements to the lock structure
- Stabilize the scoured riverbed downstream of the dams as required
- Incorporate the latest federal fish passage design guidelines

# Overview of Scope

- Data Collection and Field Investigations
- Biological Monitoring
- Stakeholder Input Session and Outreach/Education
- Alternatives Analysis
- Preliminary Design and Recommendation of Preferred Alternative
- Advanced Hydraulic Modeling
- Dam Removal Assessment
- Environmental Assessment/Biological Assessment
- USACE Section 408 Review and Permit Applications
- Final Design and Preparation of Construction Documents

# Status of Tasks

- Basis of Design Completed
- Hydrologic and Hydraulic studies completed
- Preliminary Engineering Completed
  - Major and minor flow paths
  - Weir elevations and gap widths
  - Pool depths
  - Lock/Dam Modifications
- Alternatives Developed
  - Upstream and Downstream
  - Bypass
  - Interior Locking
  - Dam Removal
  - No Action
- 408 Permit Package
  - Under development





# Concurrent Efforts by Partners

- Section 216 Disposition Study (on hold)
- Lock and Dam 1 Fish Passage Improvement (completed November 2021)
- Fish Stock Assessments and Monitoring (Clemson/UNCW/WRC/DMF)
- NC Division of Water Resources Grant Contract Renewal
- Experimental Flow Releases by Sustainable Rivers Program (TNC/USACE)





# Alternatives Evaluated

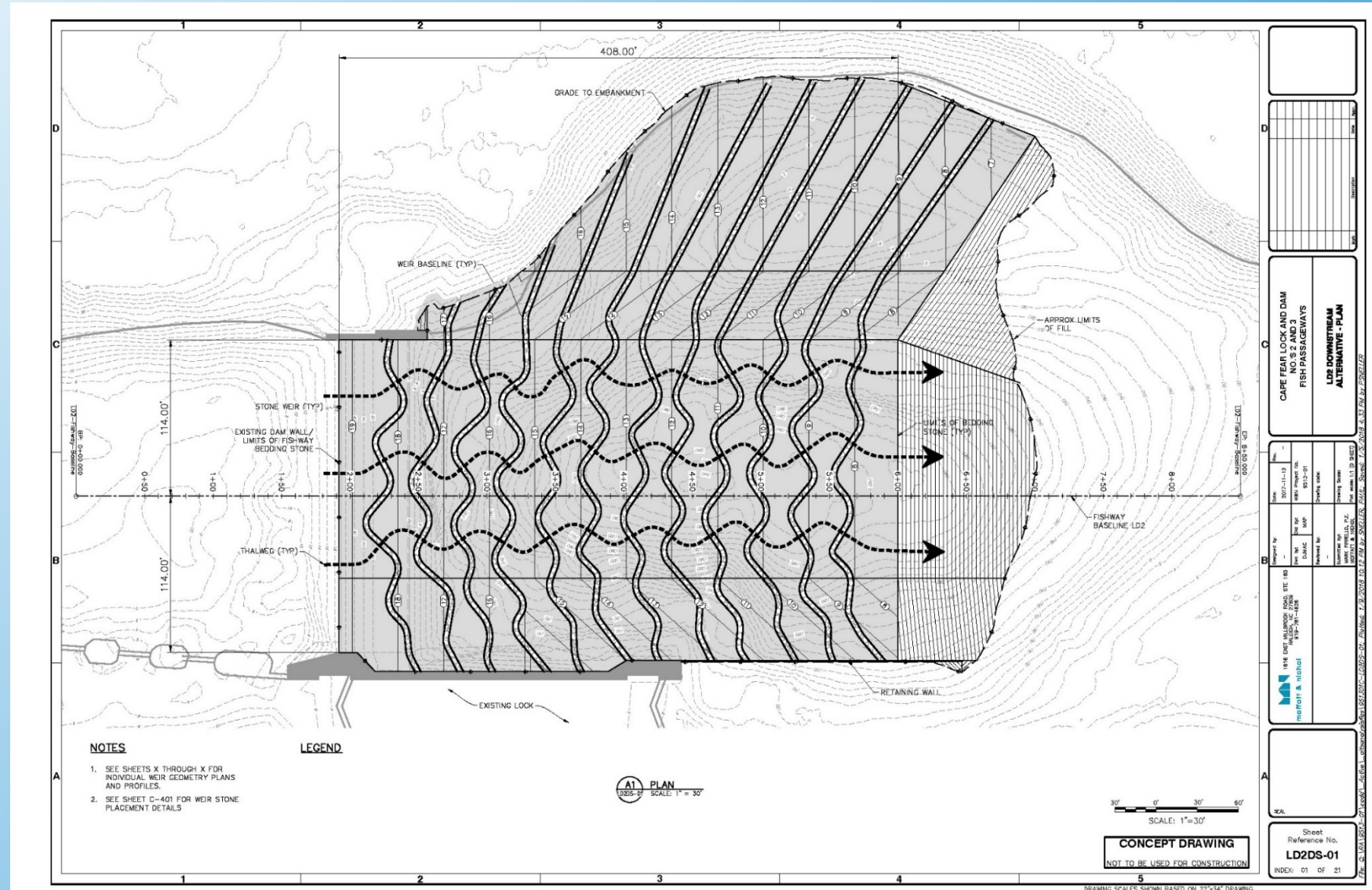
- Nature-like rock arch fishway – Downstream
- Nature-like rock arch fishway – Upstream
- Bypass System – Rock Arch Fishway
- Lock Chamber – Rock Arch Fishway
- Dam Lowering
- Dam Removal – Lock and Dam 2 only
- No Action – Continued Locking

Factors	Description	Rating System	Weighting
Performance	Ability for target species related to attraction (guidance), maneuverability, and average and peak velocities.	1. Significant Positive Benefit 2. Positive Benefit 3. Neutral 4. Negative Benefit 5. Significant Negative Benefit	35
Water Supply	Impacts to regional utilities and commercial operations		20
Construction Cost	Construction of the fishways, demolition of the dam and locks, and restoration of river geometry		15
Recreational	Recreational use of the river including fishing and boating		10
Navigation	Maintain commercial and recreational navigation		10
Operation and Maintenance Costs	Cost associated with operation and maintenance of the system		5
Water quality	Impacts to regional utilities and commercial operations		5



# Downstream Alternative @ CFLD2

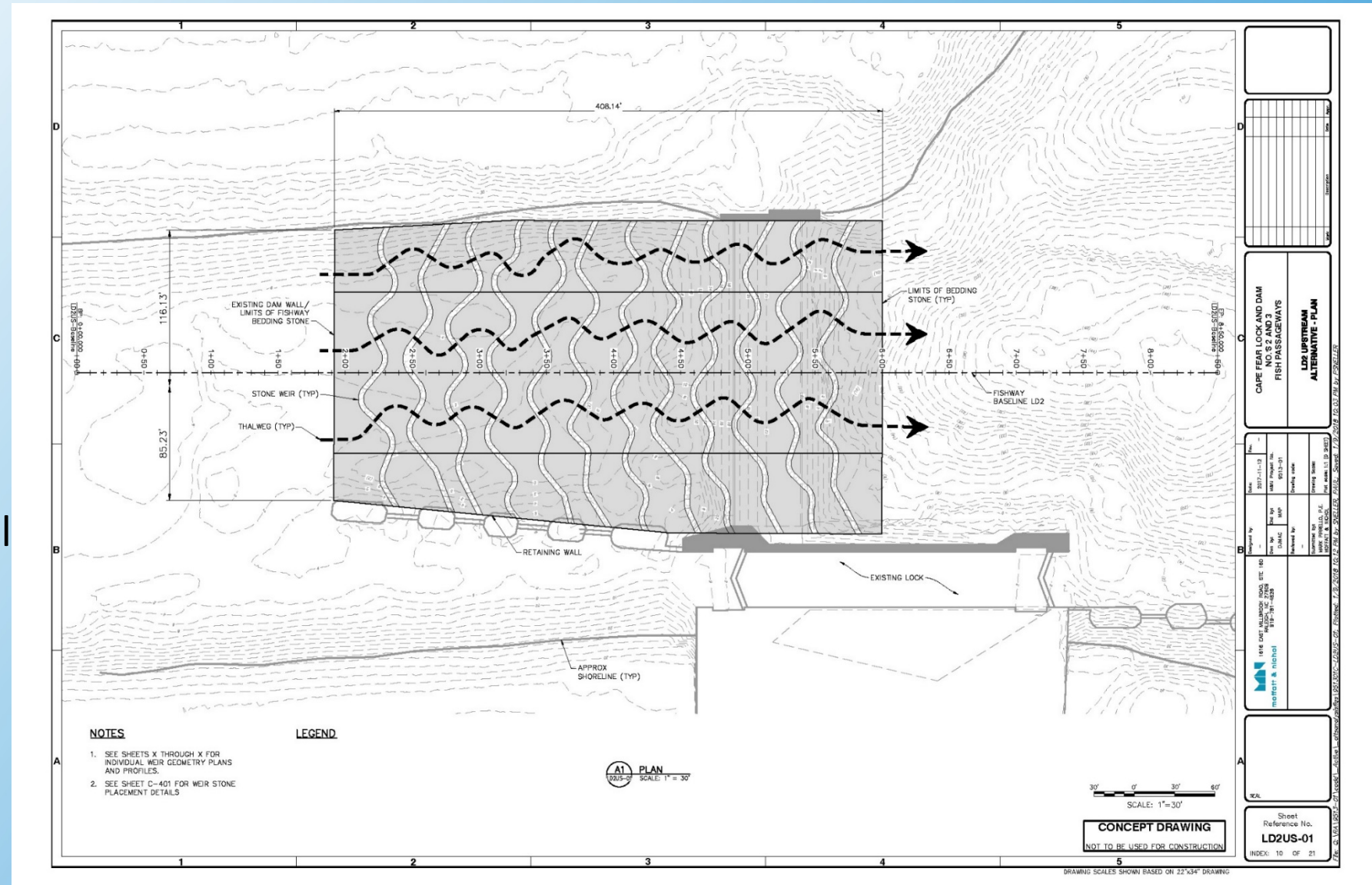
- Overall Dimensions
  - 500 LF including transition
  - 228 LF width
  - 2,900 LF Weir
- Total Volume
  - ~190,000 Tons
- Structural Improvements
  - 220 LF Retaining Wall
  - No lock wall improvements
- Construction Cost
  - ~\$22.5M
  - ~7M savings USACE scour hole project





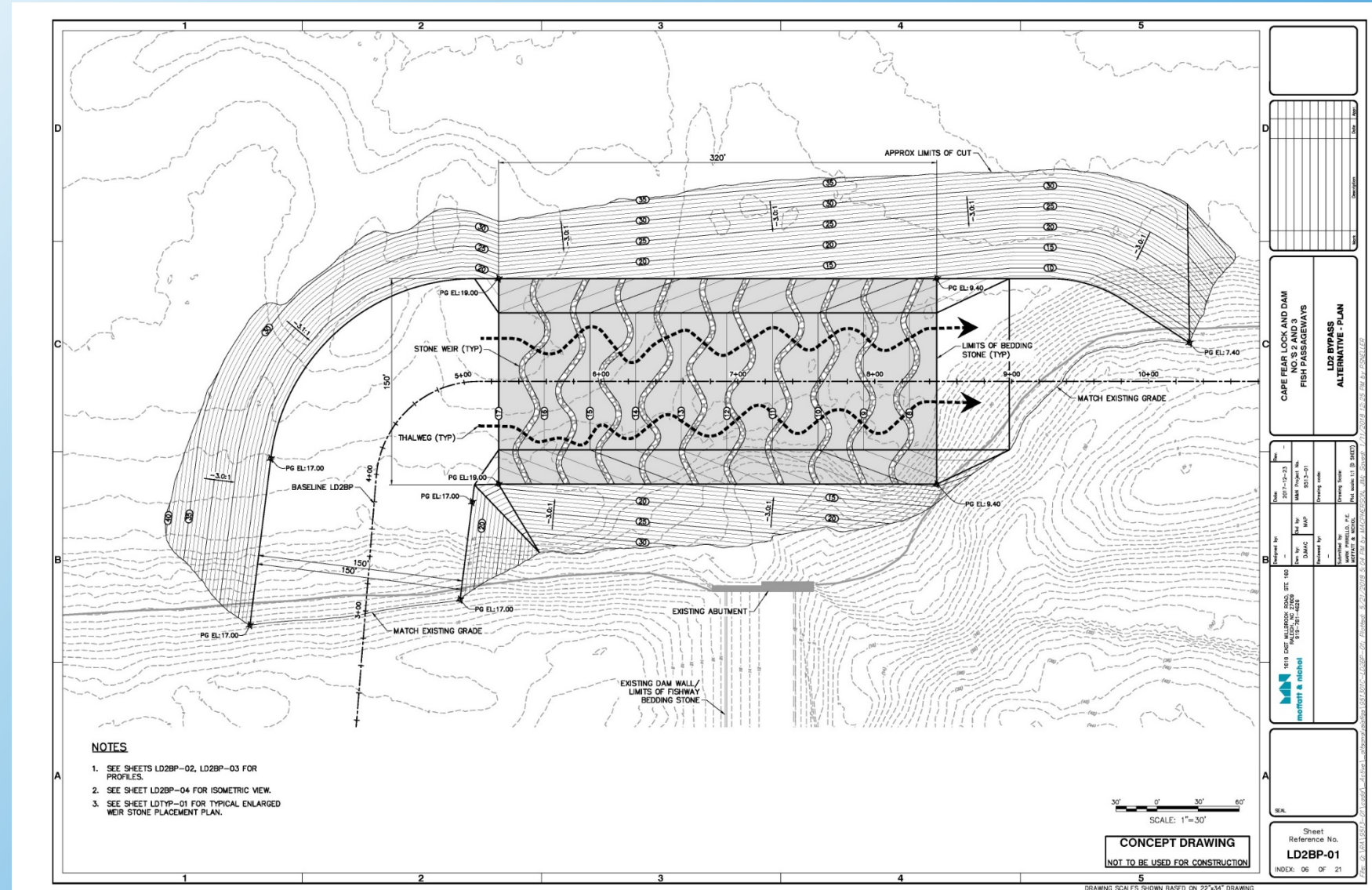
# Upstream Alternative @ CFLD2

- Overall Dimensions
  - 450 LF including transition
  - 200 LF width
  - 1,800 LF Weir
- Total Volume
  - ~70,000 Tons
- Structural Improvements
  - 500 LF Retaining Wall
  - No lock wall improvements
  - Dam Removal
- Construction Cost
  - ~\$15M



# Bypass Alternative@ CFLD2

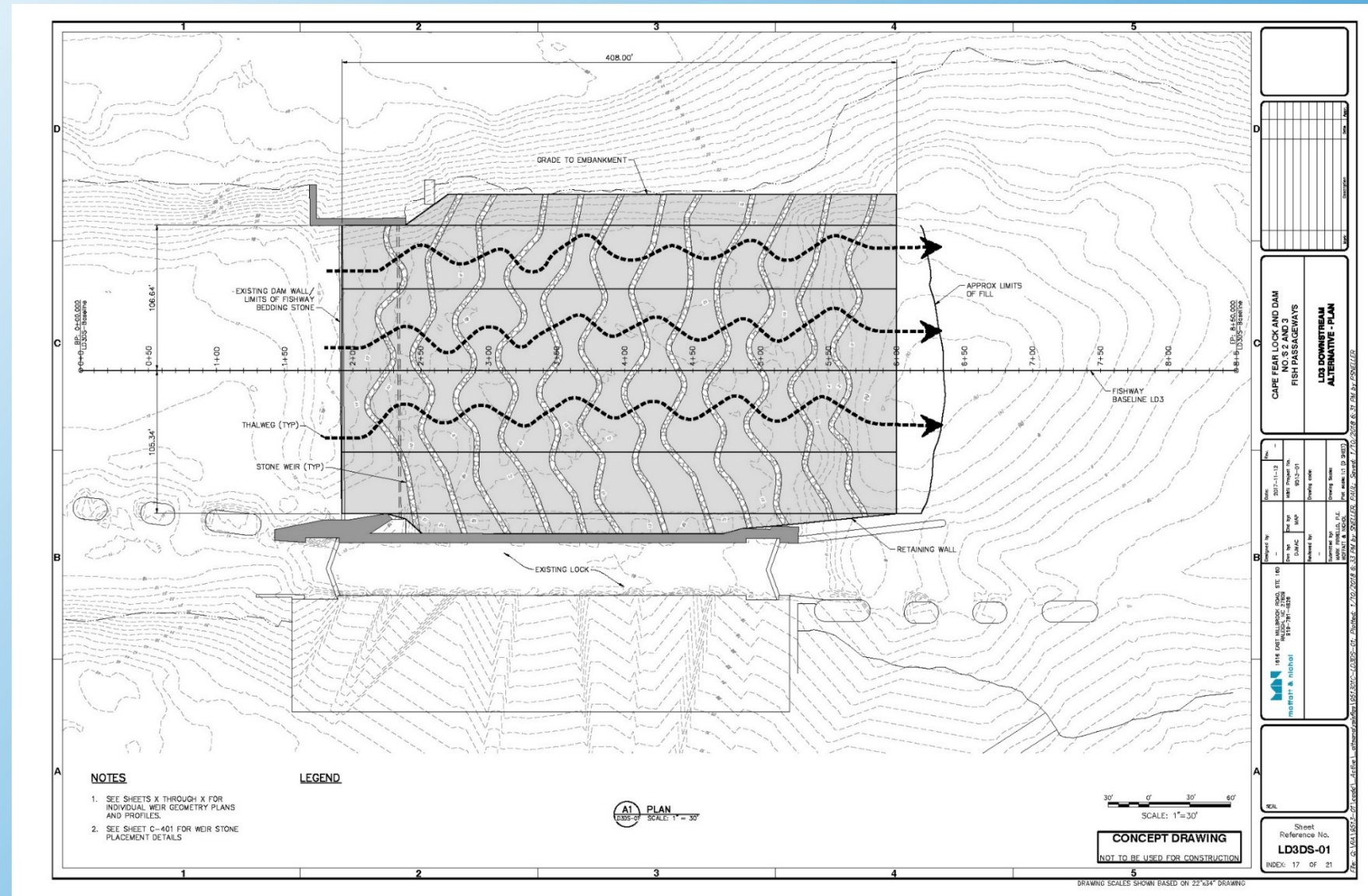
- Overall Dimensions
  - 400 LF including transition
  - 150 LF width
  - 1,200 LF Weir
- Total Volume
  - ~80,000 Tons
- Structural Improvements
  - 300 LF Weir Wall
  - Bank Stabilization
- Construction Cost
  - ~\$12M
  - Excludes Property Acquisition





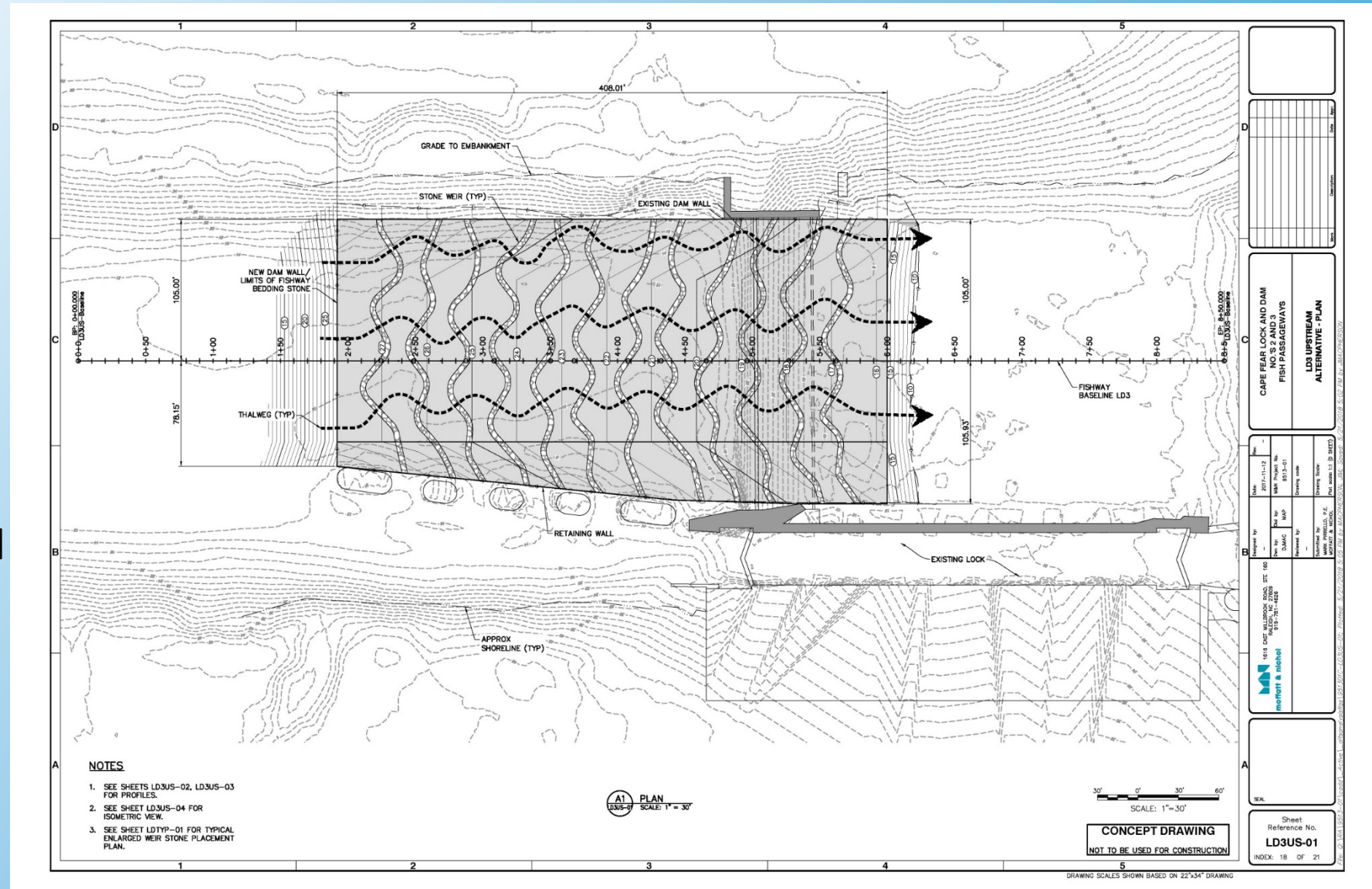
# Downstream Alternative @ CFLD3

- Overall Dimensions
  - 475 LF including transition
  - 1210 LF width
  - 1,930 LF Weir
- Total Volume
  - ~100,000 Tons
- Structural Improvements
  - 125 LF Retaining Wall
- Construction Cost
  - ~\$13M



# Upstream Alternative @ CFLD3

- Overall Dimensions
  - 430 LF including transition
  - 185 LF width
  - 1,650 LF Weir
- Total Volume
  - ~70,000 Tons
- Structural Improvements
  - 550 LF Retaining Wall
  - No lock wall improvements
  - Dam Removal
- Construction Cost
  - ~\$15M





# Lock and Dam 3 – Flow 3D Modeling

Lock and Dam 3  
3500 cfs

depth averaged velocity ( $\text{ft s}^{-1}$ )

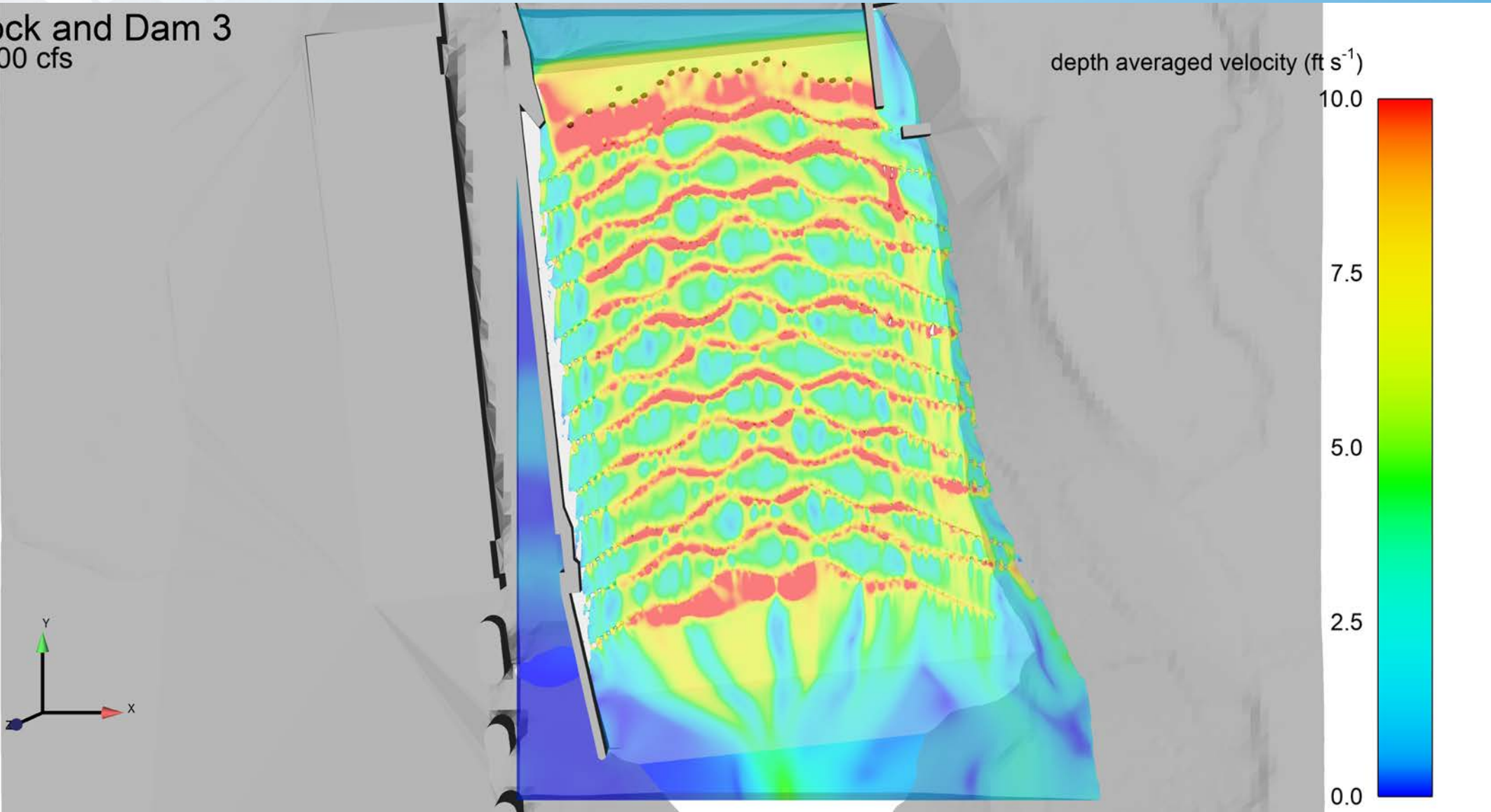
10.0

7.5

5.0

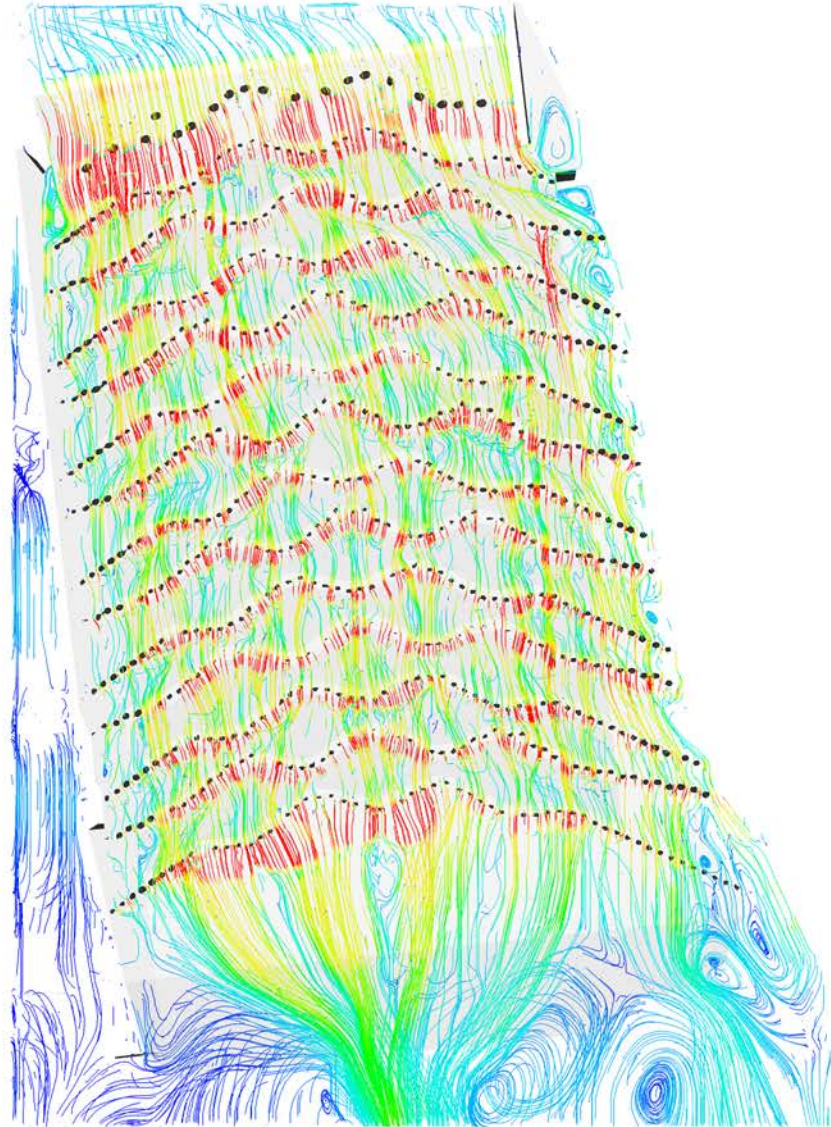
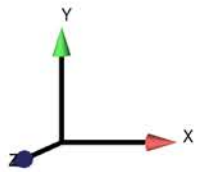
2.5

0.0

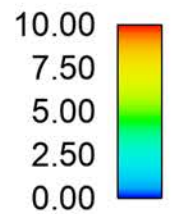


# Lock and Dam 3 – Flow 3D Modeling

Lock and Dam 3  
3500 cfs



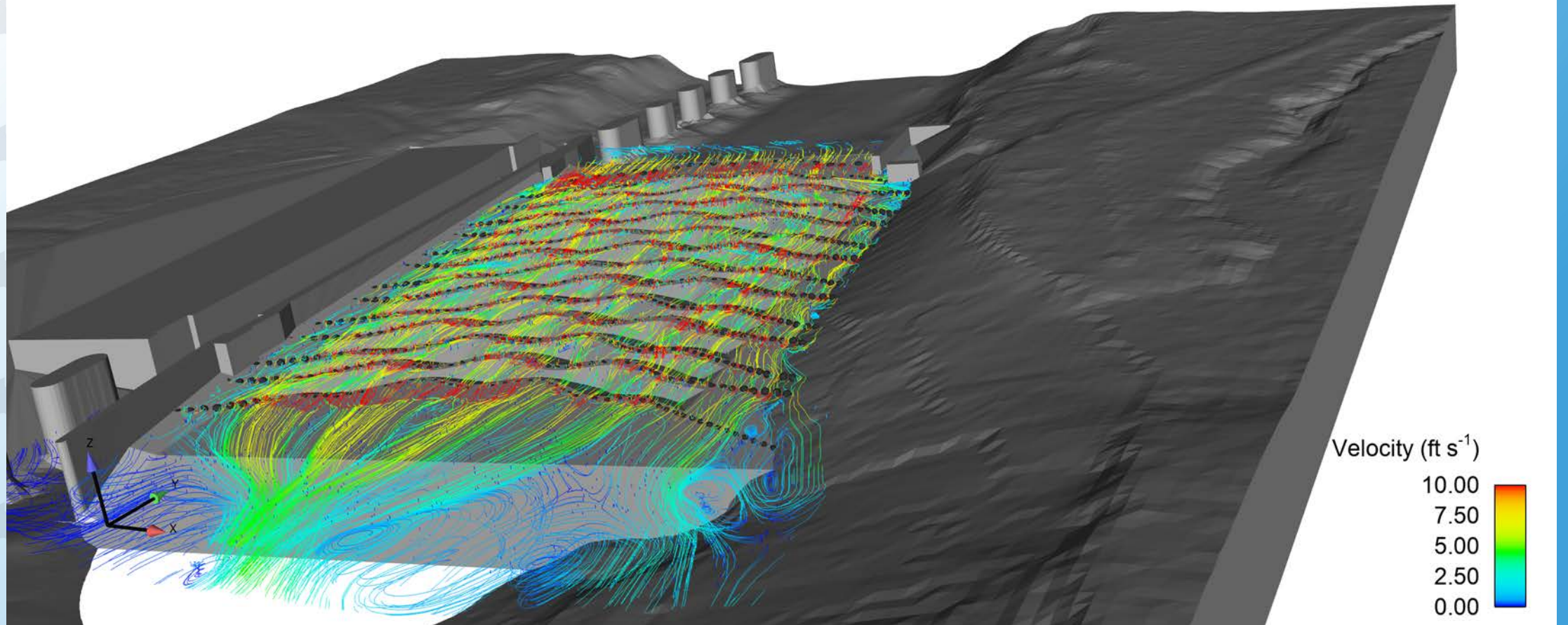
Velocity ( $\text{ft s}^{-1}$ )





# Lock and Dam 3 – Flow 3D Modeling

Lock and Dam 3  
3500 cfs



# Lock and Dam 3 – Flow 3D Modeling

Lock and Dam 3  
3500 cfs

depth averaged velocity ( $\text{ft s}^{-1}$ )

10.0

Flow Path 1

Flow Path 3

Flow Path 2

Flow Path 4

7.5

5.0

2.5

Velocity ( $\text{ft s}^{-1}$ )

10.00

7.50

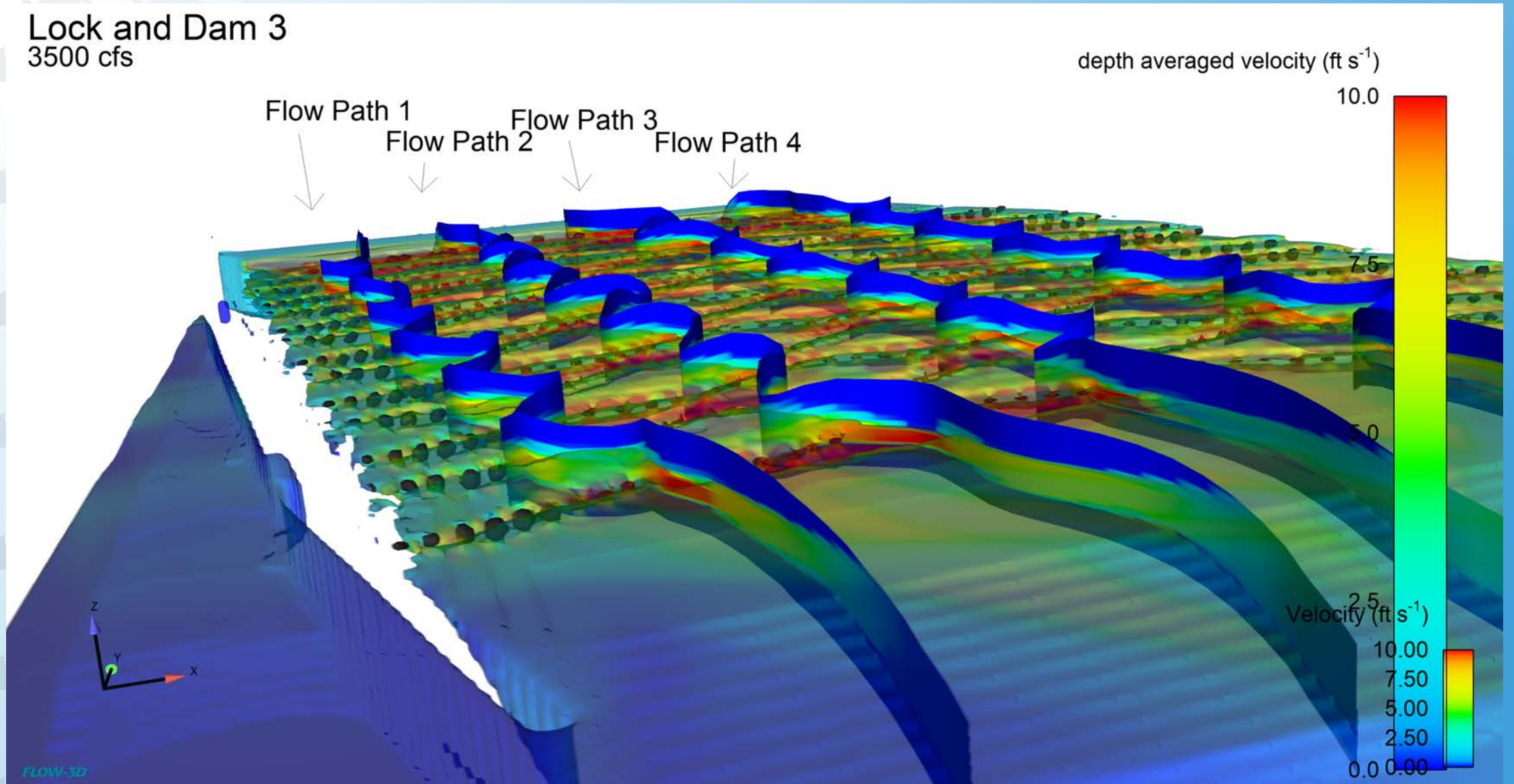
5.00

2.50

0.0 0.00



FLOW-3D





# USACE Section 408 Program Summary

- A mechanism to alter a federally authorized USACE Civil Works project
- Alterations cannot impair the usefulness of the project and cannot be injurious to the public interest. No dam removal allowed.
- USACE process scheduled to take 120 days after receipt of request
- Basic submittals include alteration description, technical analysis and design, environmental and cultural resources compliance, real estate requirements, & OMRR&R requirements.

# USACE Section 408 Program

- The Section 408 Program provides a mechanism for others, such as other federal agencies, a local government, company, tribe, or individual, to alter a federally authorized USACE Civil Works project without approval directly from Congress.
- Alterations cannot impair the usefulness of the project and cannot be injurious to the public interest.
- Section 408 permission will not be granted for a proposed alteration that would have an effect of deauthorizing a USACE project or eliminating an authorized project purpose.
- Proposed alterations that will result in substantial adverse changes in water surface profiles will not be approved.
- ***No dam removal allowed under Section 408 Program***



# USACE Section 408 Program Process

- USACE and Requester pre-application meetings
- Requester submits Section 408 request
- USACE Completeness Determination Review: 30 days
- USACE Final Review and Decision: 90 days
- USACE Final Decision Notification
- USACE Construction Oversight
- Future submittal guidance in 33 CFR Chapter II, Part 350 may replace and supersede EC 1165-2-220.

# Basic Requirements for a Complete Section 408 Request

- USACE Project and Alteration Description
  - Basic submittal requirements includes identification of the USACE project and a complete description of the proposed alteration(s) including necessary drawings, sketches, maps, and plans.
- Technical Analysis and Design
  - The requester is responsible for ensuring a proposed alteration meets current USACE design and construction standards.
  - The requester determines and displays H&H changes of proposed alteration.
  - Alteration requiring professional design services, must submit a certification of quality control.
  - A Safety Assurance Review (SAR) review plan is required for design and construction activities where potential hazards pose a significant threat to life safety.



# Basic Requirements for a Complete Section 408 Request

- Environmental and Cultural Resources Compliance
  - USACE ensures and conducts environmental and cultural resources compliance.
  - The requester is responsible for providing all supporting information and documentation that the district identifies as necessary to assess compliance. Requesters may, but are not required to, draft the NEPA environmental assessment.
  - USACE is encouraged to adopt by reference any NEPA documentation that may already exist.
  - Proposed alteration also requires Section 10/103/404.
  - A decision on a Section 408 request is a federal action subject to NEPA and other federal environmental and cultural resources compliance requirements, such as Section 7 of the Endangered Species Act (ESA), Section 106 of the NHPA, essential fish habitat (EFH) consultation, tribal consultation, etc.

# Basic Requirements for a Complete Section 408 Request

- Real Estate Requirements
  - A description of the real property required to support the proposed alteration must be provided.
- Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R)
  - The requestor must identify any projected requirements for O&MRR&R needed throughout the life of the proposed alteration and the responsible entity to assume responsibility for that change at no cost to the Federal government.
- The proposed alteration must meet all legal and policy requirements.



# USACE Section 408 Review and Decision Process

- The USACE District is expected to provide a written completeness determination within 30 days of receipt of the information for a complete Section 408 request. If the USACE District determines a submittal is not complete, the 30-day timeline for a completeness determination is restarted upon any subsequent submittals of information.
- The 90-day review and decision step will be initiated when: (1) the proposed alteration appears to meet the conditions of an established categorical permission; (2) a milestone is met in the multi-phase review approach; or (3) basic requirements are met for a single-phase review. Categorical permissions expedite and streamline the review and decisions of Section 408 requests that are similar in nature and that have similar impacts to the USACE project and environment. For categorical permission, the Section 408 request can be granted with a simplified validation process.

# Next Steps

- Stakeholder Meeting to review alternatives
- Submit preliminary design to the US Army Corps of Engineers
- Complete Alternative Analysis
- 408 Package Submittal
- Environmental Assessment
- Section 408/404/10/401/7 Consultation and Permitting
- Identify Implementation Funding with Partners



# Technical Rationale in Fish Passage





# Fish passage effectiveness and considerations

## Dam Removal



- Most complete restoration
- Eliminates dam function(s)
- Sediment accumulation may require significant restoration

## Full-width Rock Arch Rapids



- Slope dependent (flatter is better)
- Natural river width
- No attraction issues
- Practical limits for dam height
- Allow room for large-bodied fish
- Potential spawning habitat for rheophilic spawners

## Partial-width By-pass Fishway



- Slope dependent (flatter is better)
- Size dependent (bigger is better)
- Attraction critical (entrance near dam best)
- High dams require long fishway/land
- Small fishways can be bottleneck for large numbers of fish and large-bodied fish
- Habitat is size-dependent

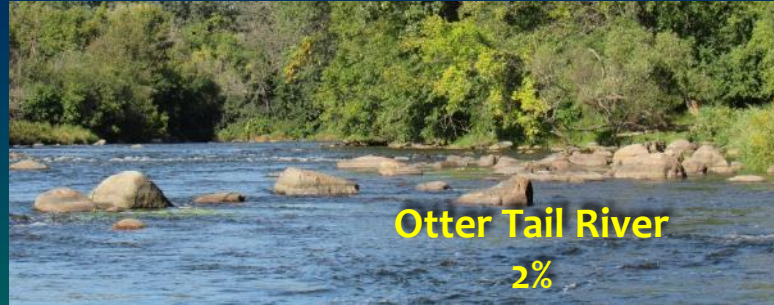


# Natural Rapids Reference Reaches

Red Lake River  
1%



Otter Tail River  
2%



Kettle River  
2.5%

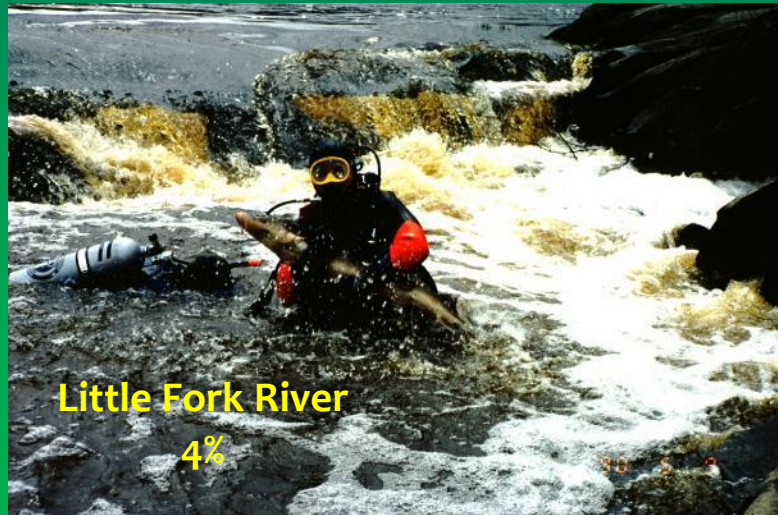


Lower Velocity -  
Most Passable

Minnesota River  
3%

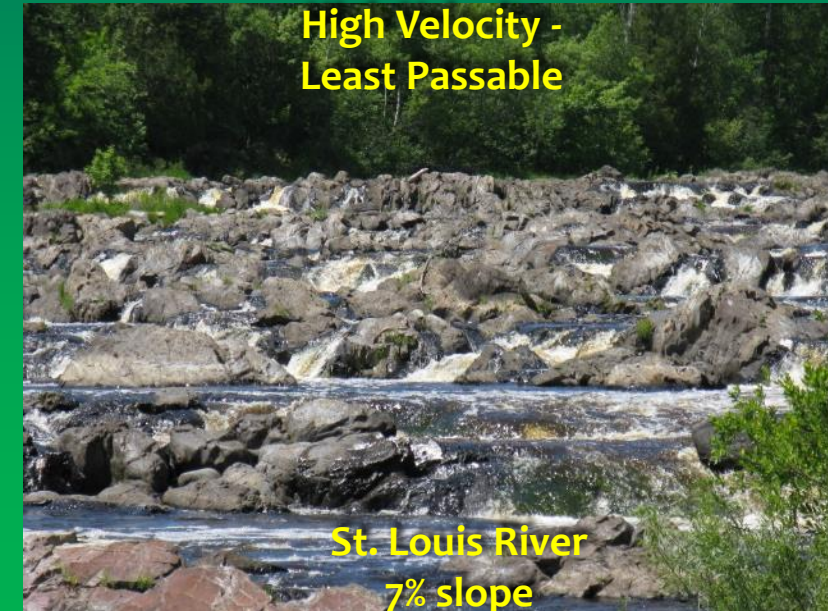


Little Fork River  
4%



High Velocity -  
Least Passable

St. Louis River  
7% slope





# Centerline Slope (near-bank slopes are 1-2% lower)

Slopes over 3% should be avoided and result in:

- High shear stress
- Pools that are short for fish passage and energy dissipation
- Excessive head-loss over weirs
- Lower initial cost may be lost in long-term stability and maintenance
- Site hydrology and geology affect slope efficacy





## Dunton Locks Fishway

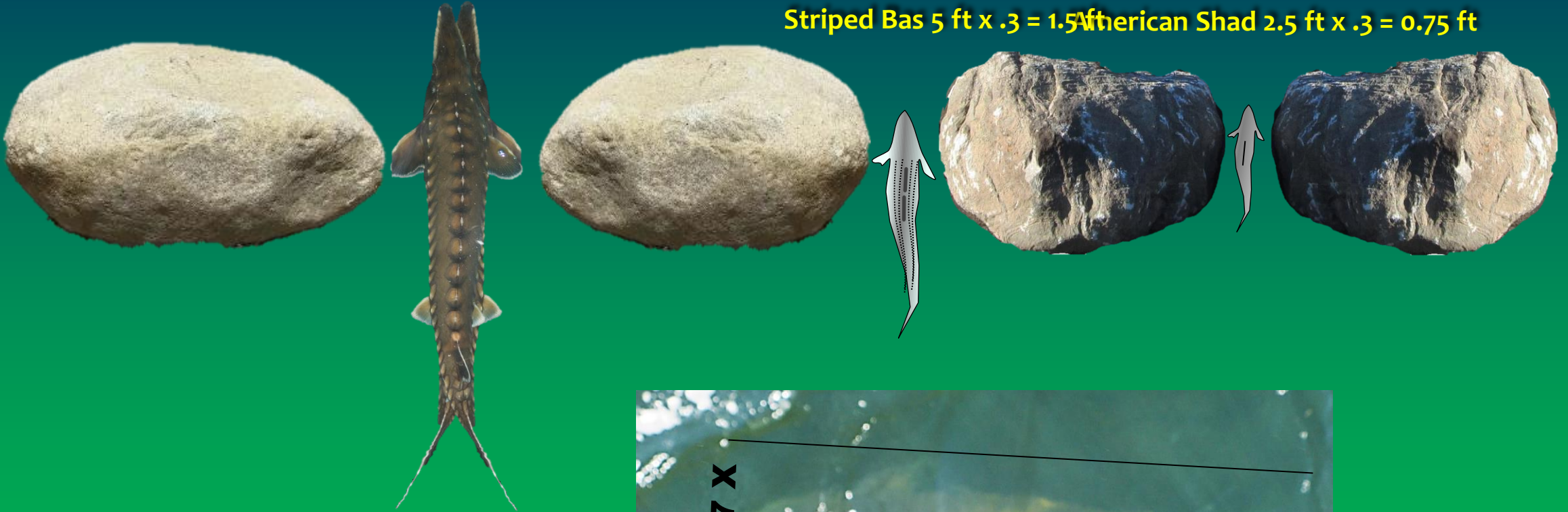
6% initial slope (too steep)



# Weir Gap Width Rationale

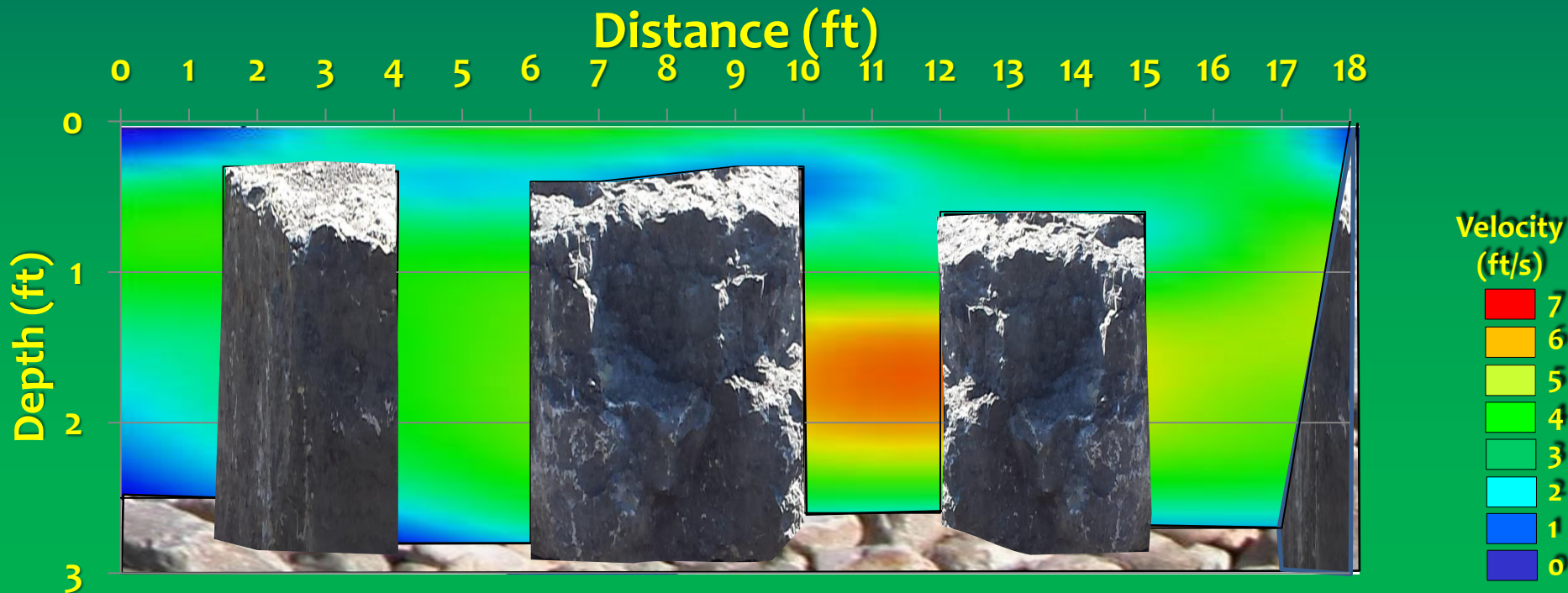
Hydrodynamic:  
Minimum width of swimming path  
Example: Atlantic sturgeon = 14 ft x 0.27 = 3.8 ft

Striped Bas 5 ft x .3 = 1.5 ft    American Shad 2.5 ft x .3 = 0.75 ft

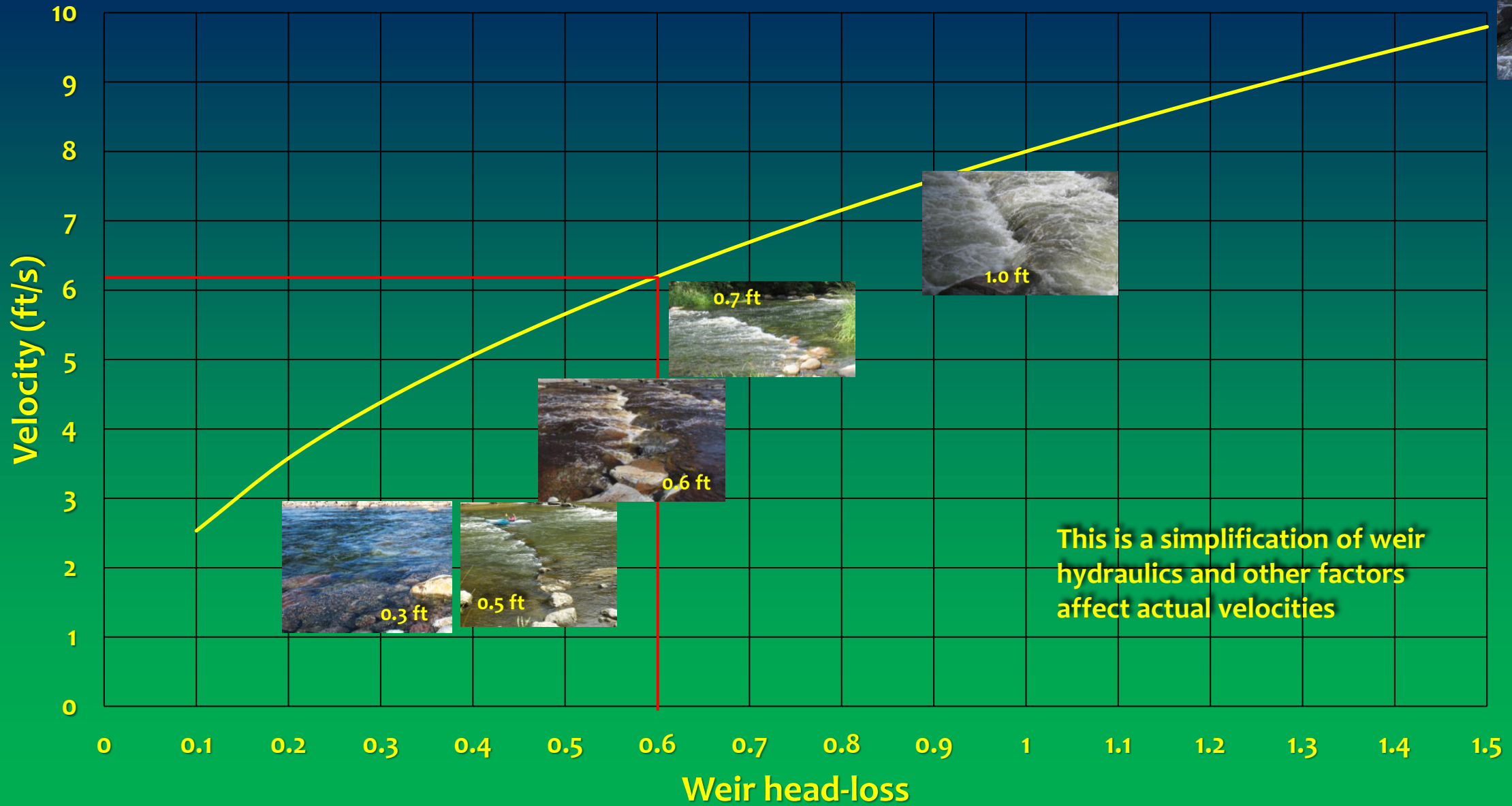




St. Louis River Rock Arch Rapids  
3% slope  
Built to provide sturgeon spawning habitat



# Velocity Versus Weir Height (based on gravitational acceleration)









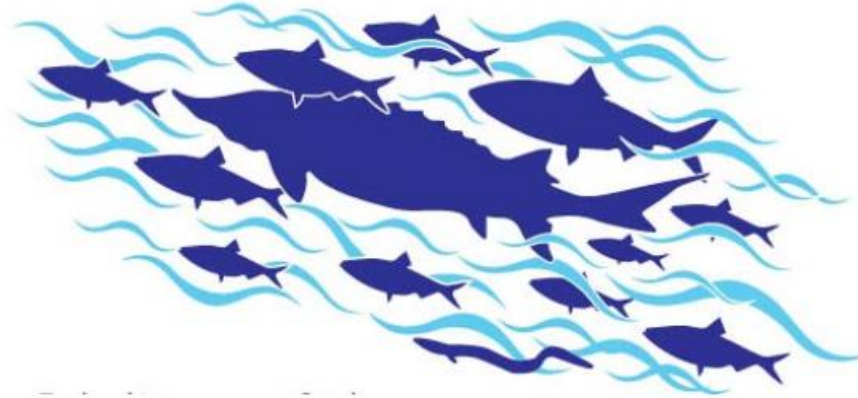
**Drayton Fishway**  
**Red River of the North**  
**3% slope**





## Technical Memorandum

### Federal Interagency Nature-like Fishway Passage Design Guidelines for Atlantic Coast Diadromous Fishes



May 2016

