

Jun 22nd, 9:30 AM - 9:45 AM

Stream Crossings I: Experiments on Box Culvert Design for Fish Passage

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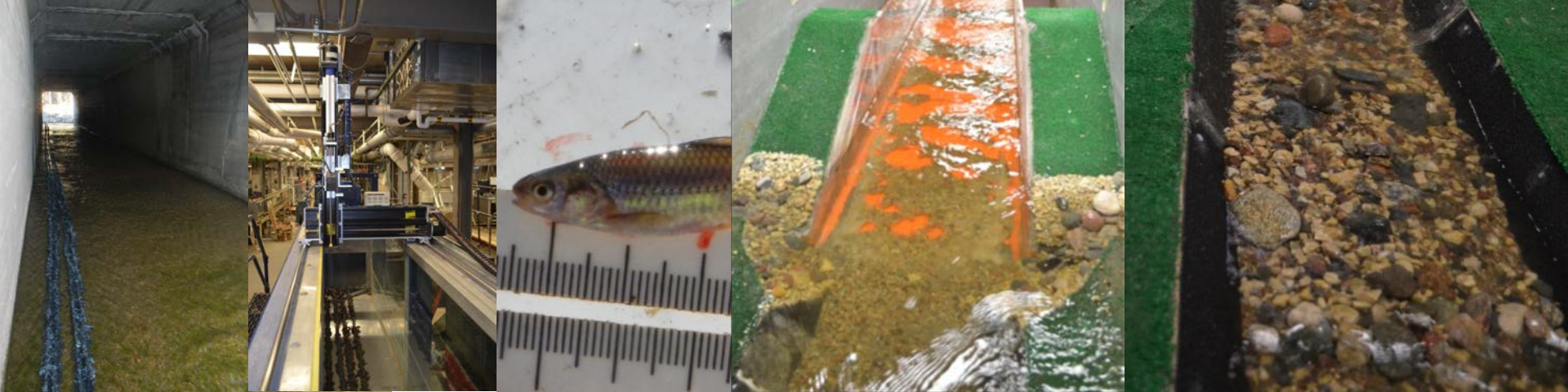
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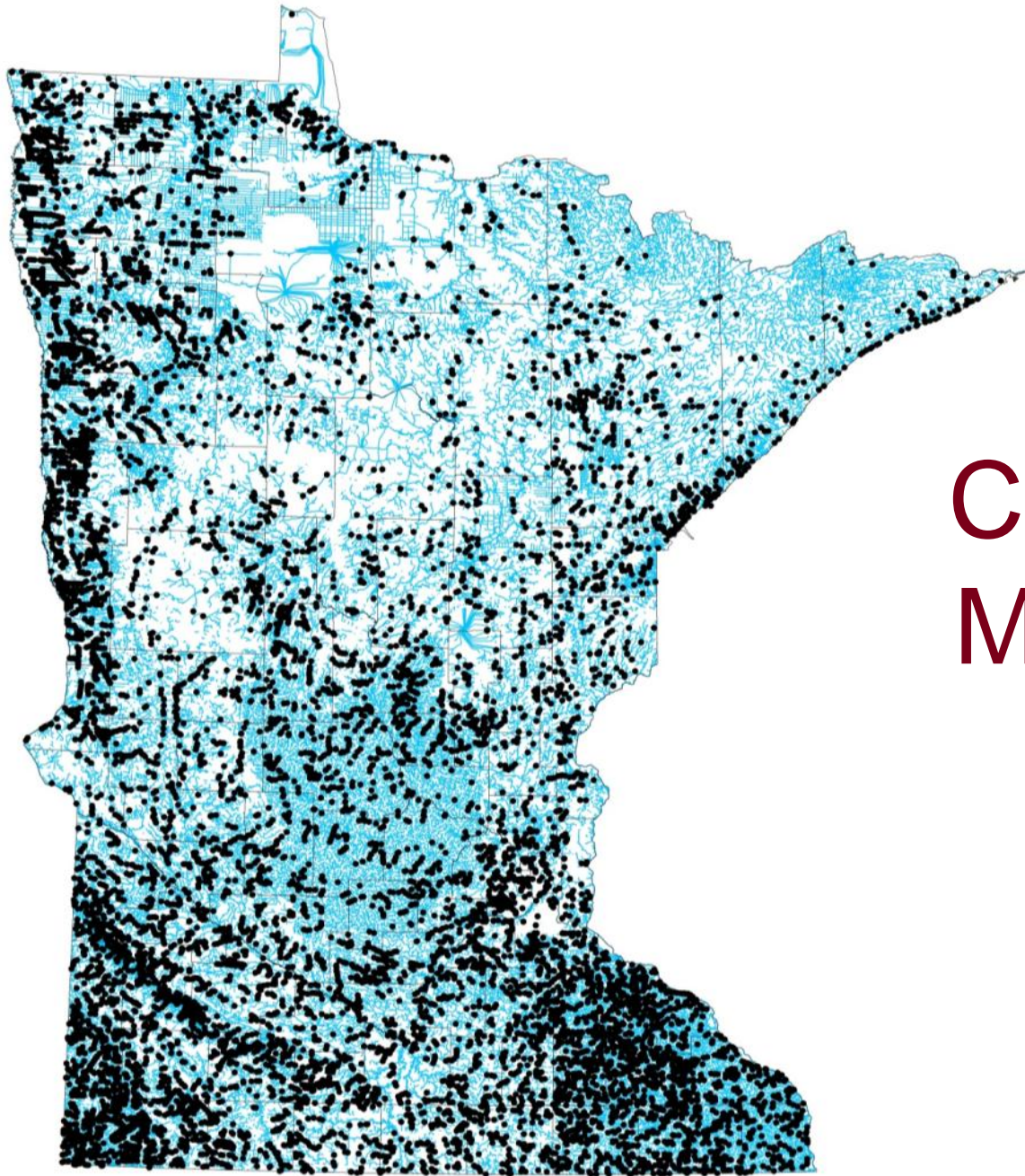
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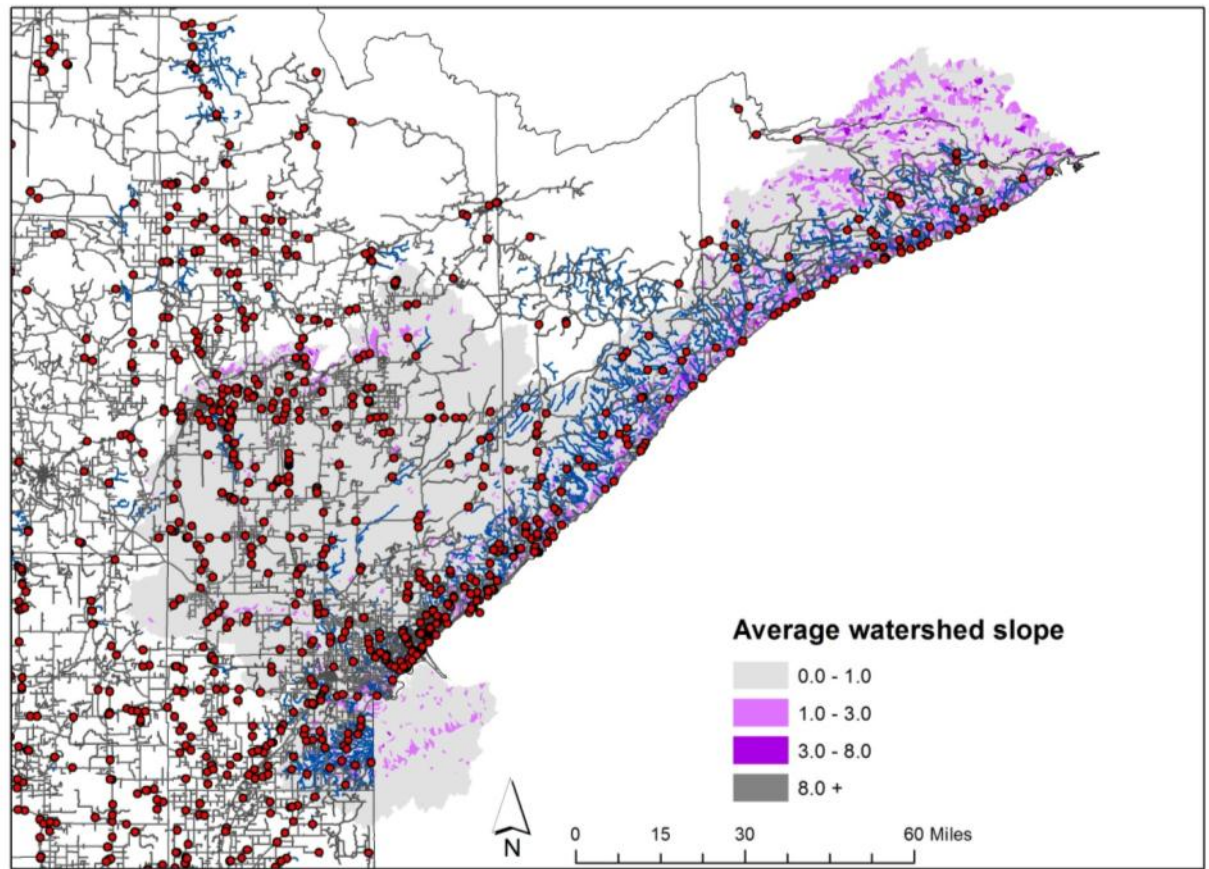
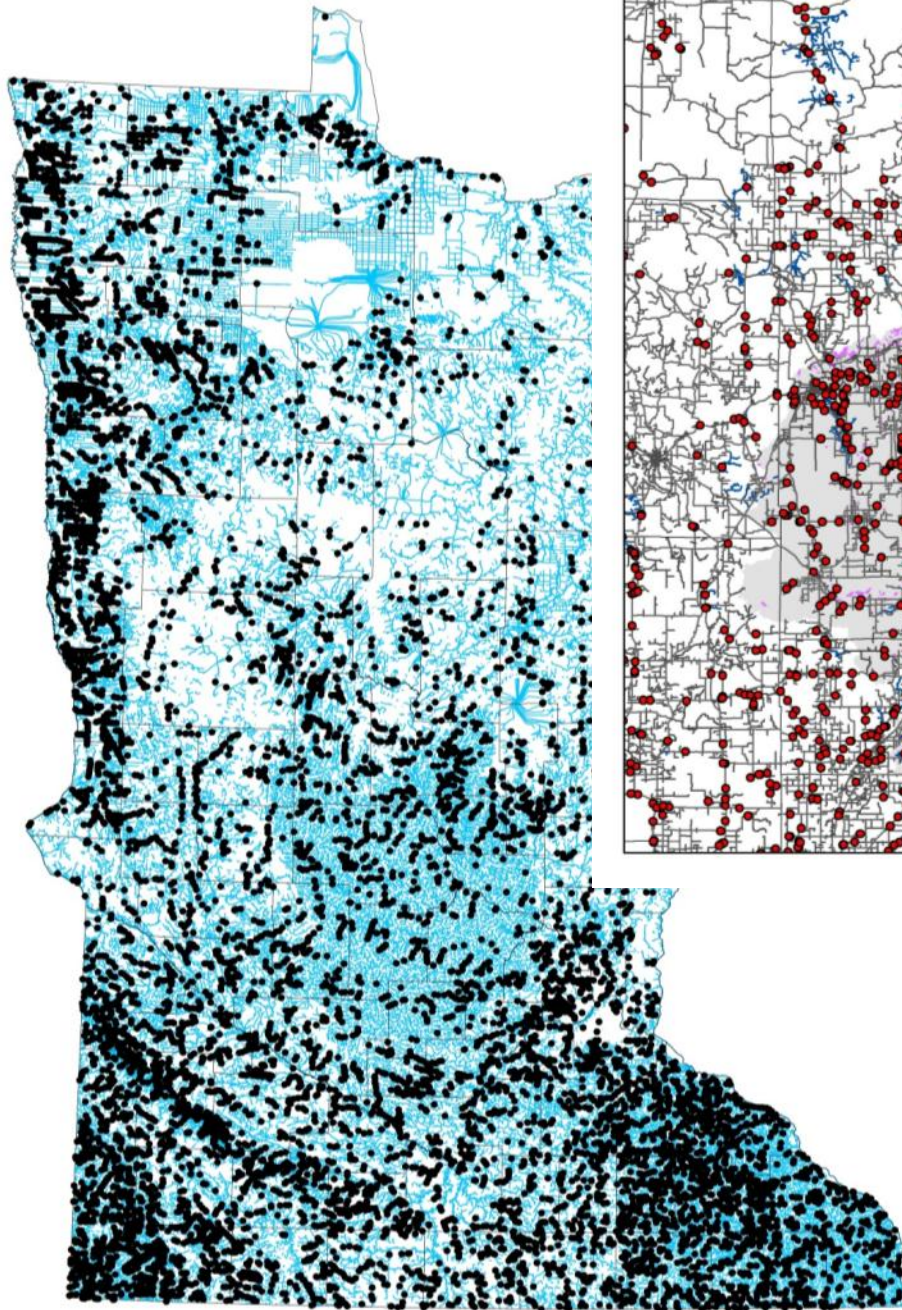
Experiments on Box Culvert Design for Fish Passage

Jessica L. Kozarek

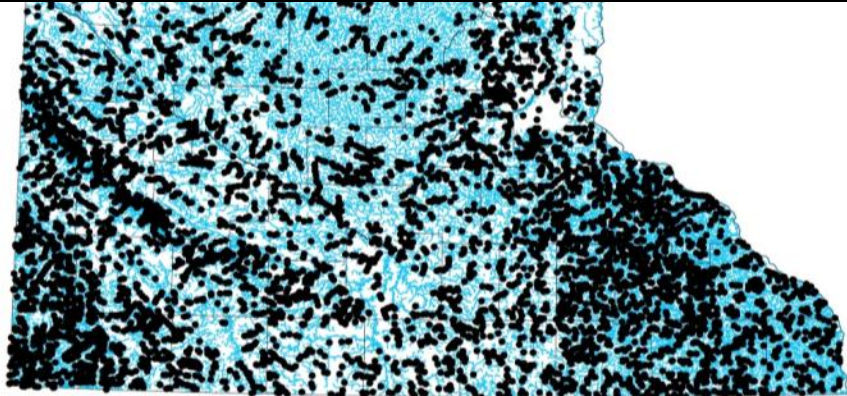
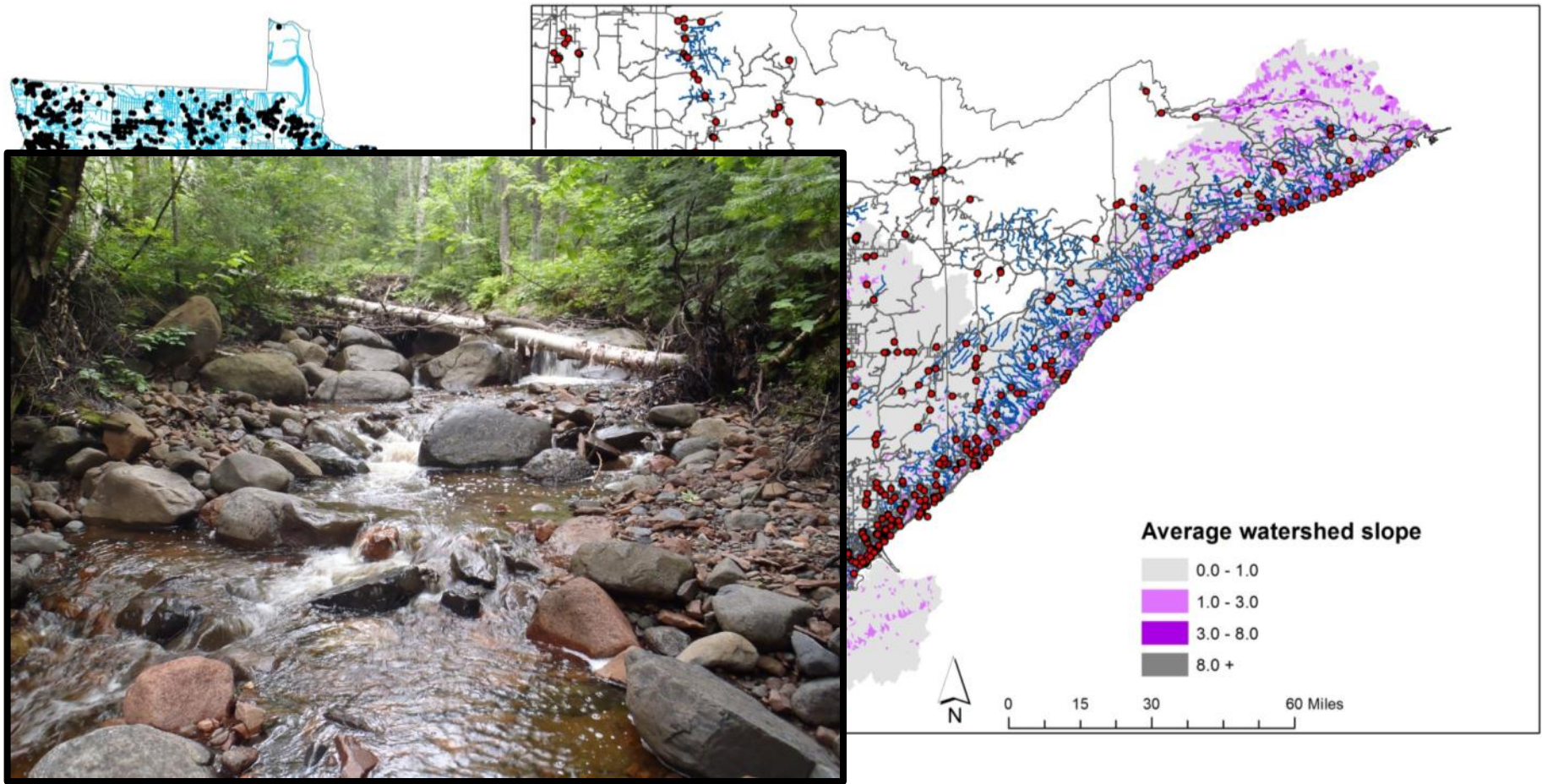
S. Mielke, M. Hernick, B. Mosey, and J.
Hatch



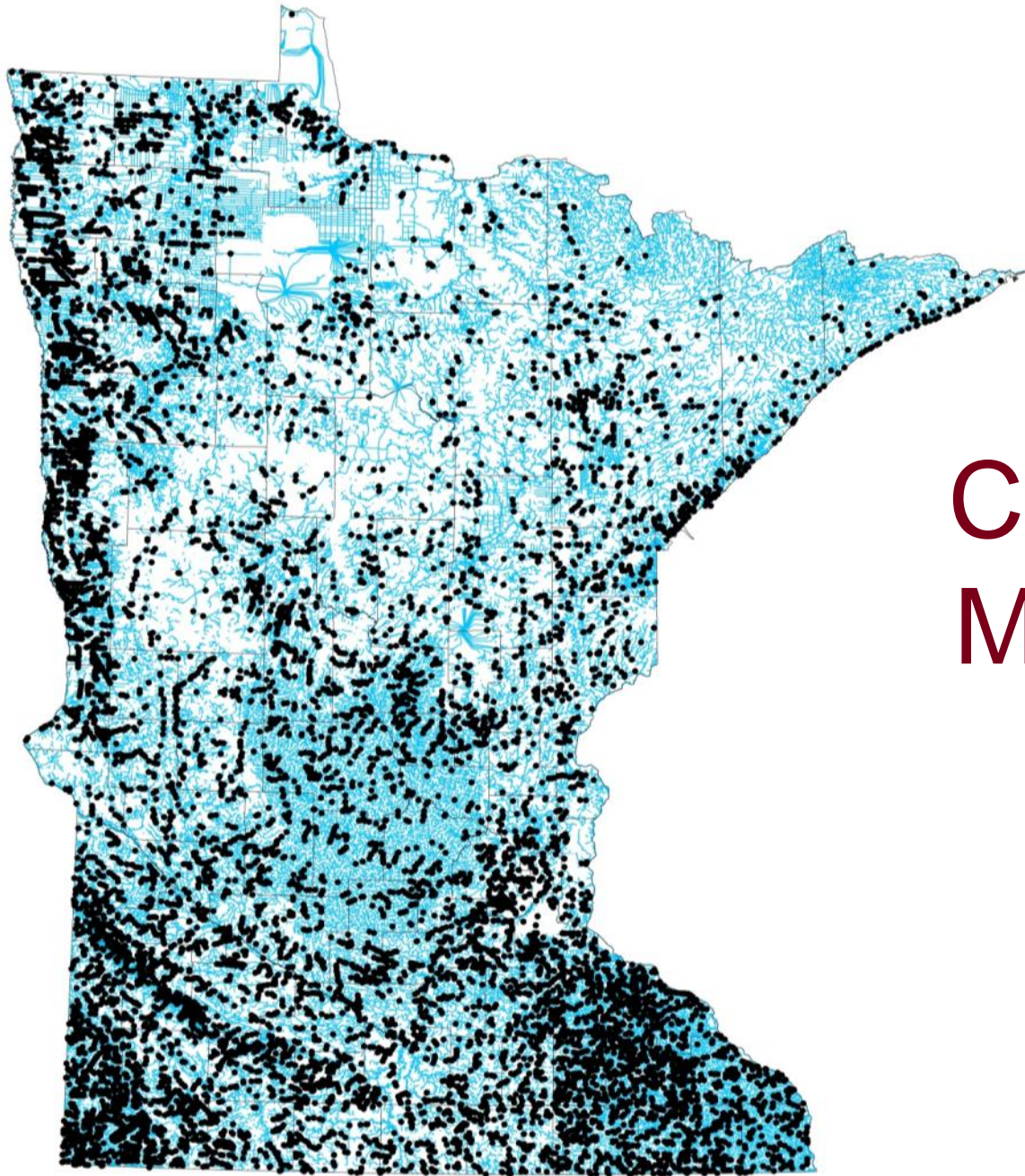
Culverts in Minnesota



Trout Streams

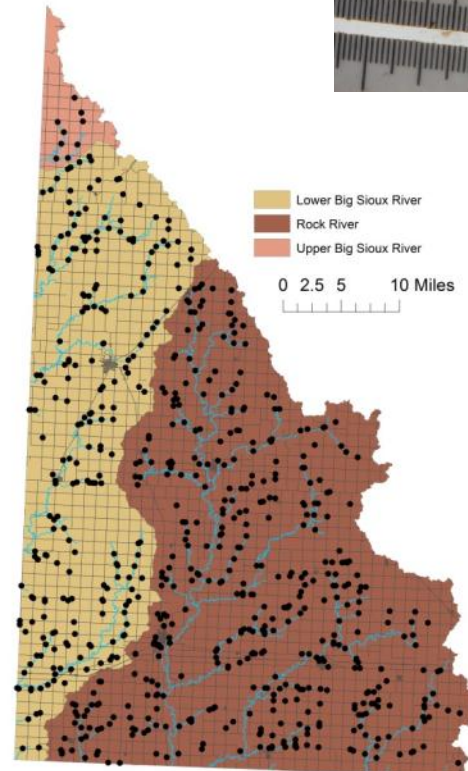
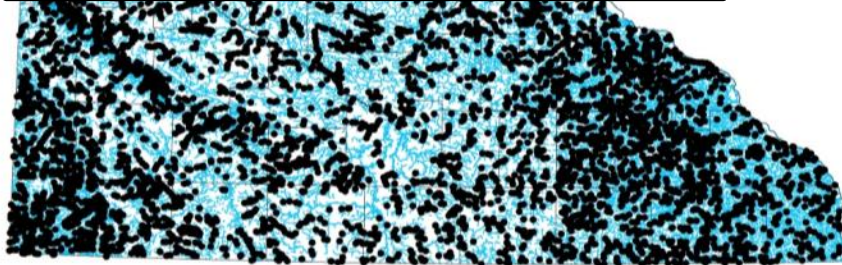
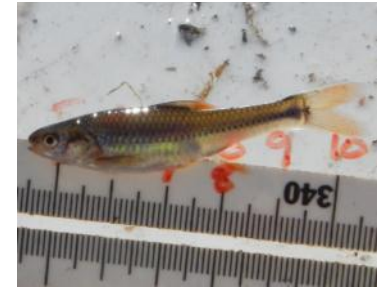
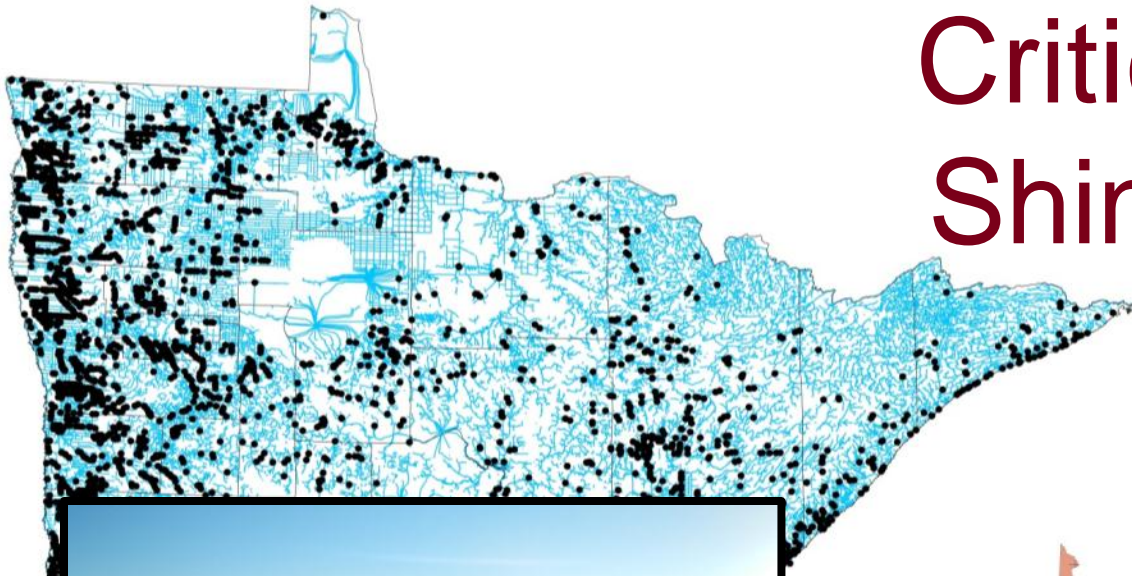


Trout Streams



Culverts in Minnesota

Critical Topeka Shiner Habitat



1. Evaluation of design considerations for recessed/embedded culverts



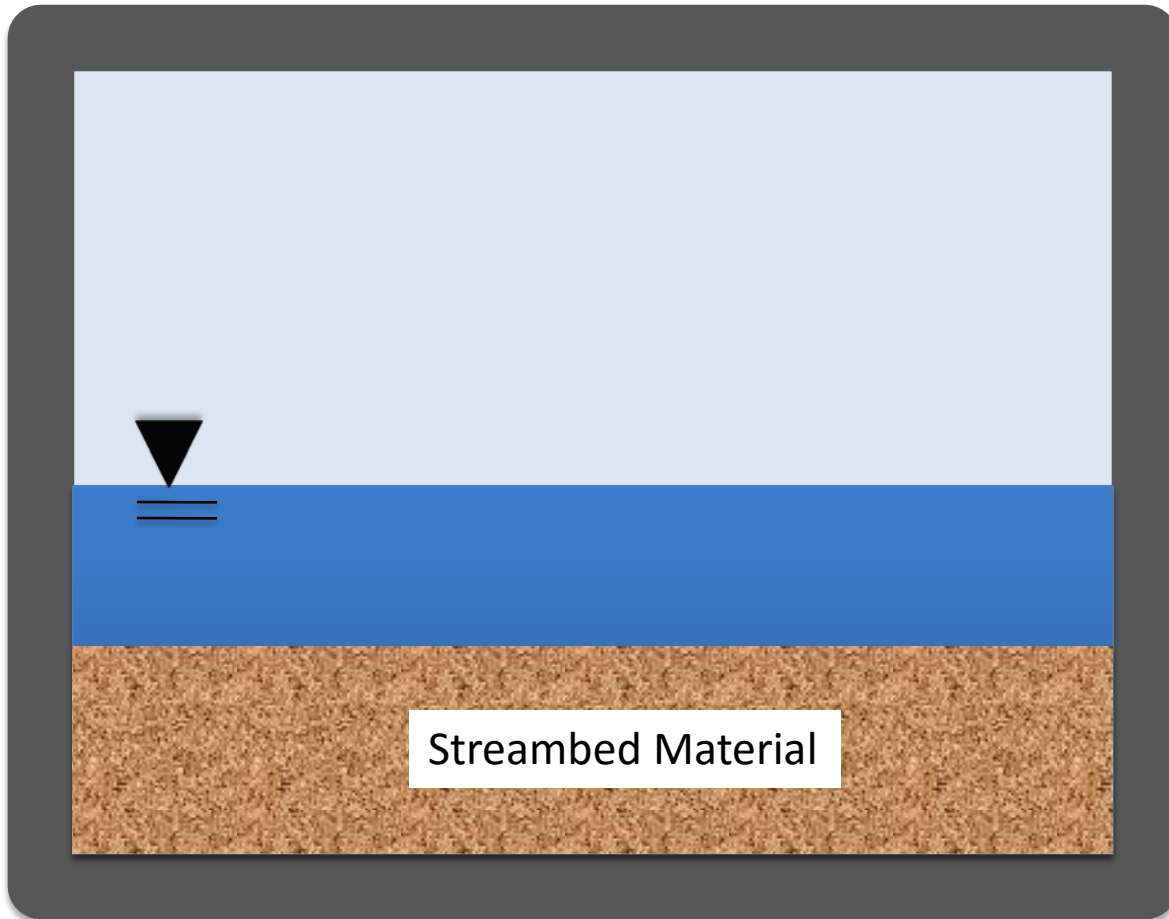
2. Novel boundary roughness retrofits



3. Evaluation of behavioral barriers in long dark culverts



Embedded (recessed) culverts



Goals:

- Natural streambed roughness
- Slower velocities than culvert set at streambed grade.

Flume Experiments:

What is the impact of filling
a recessed culvert

- streambed stability
- roughness in the culvert
- above the culvert?

How does this change with:

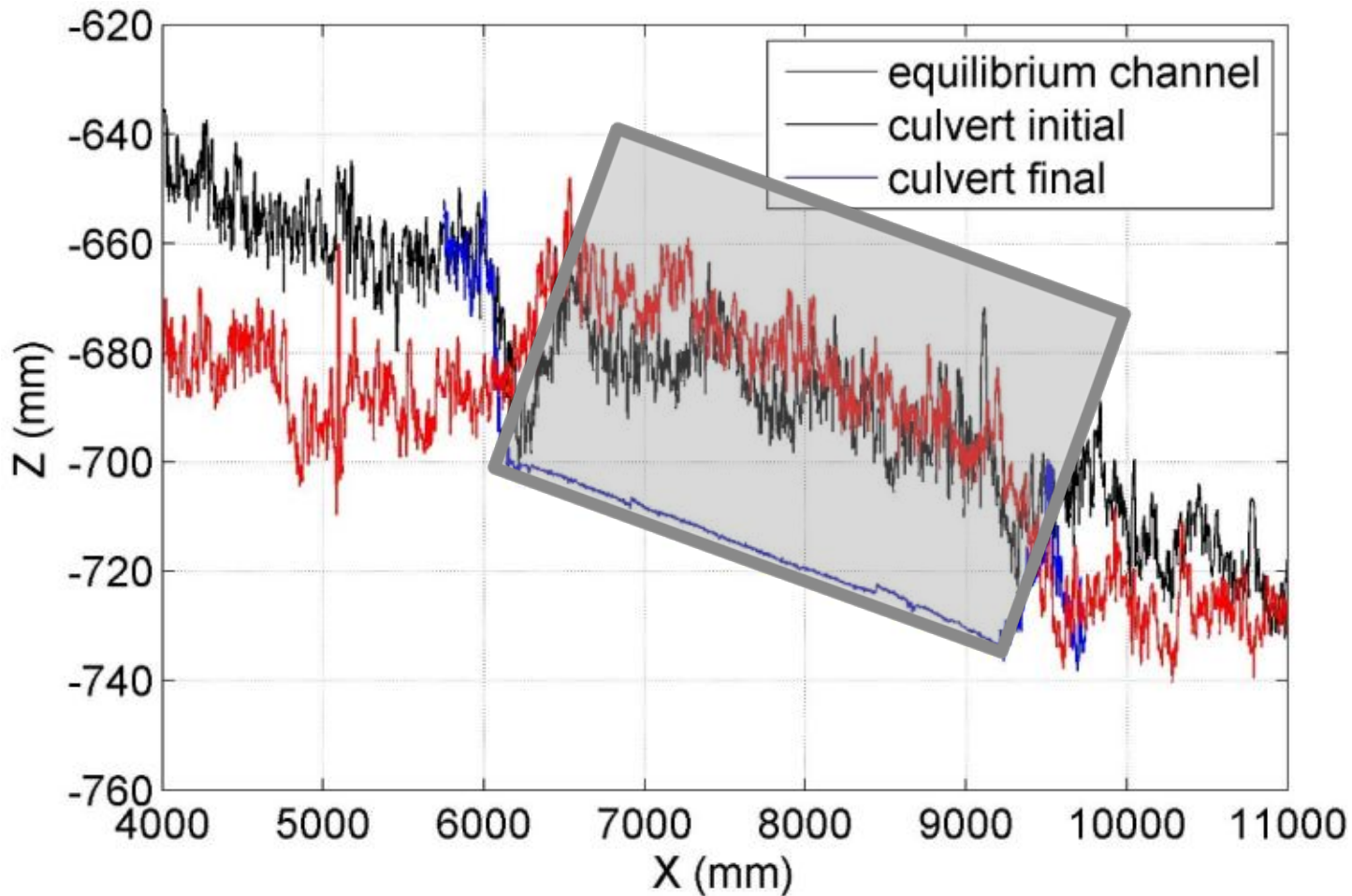
- flow rate
- slope
- grain size?



Embedded Culvert Summary

Filling:

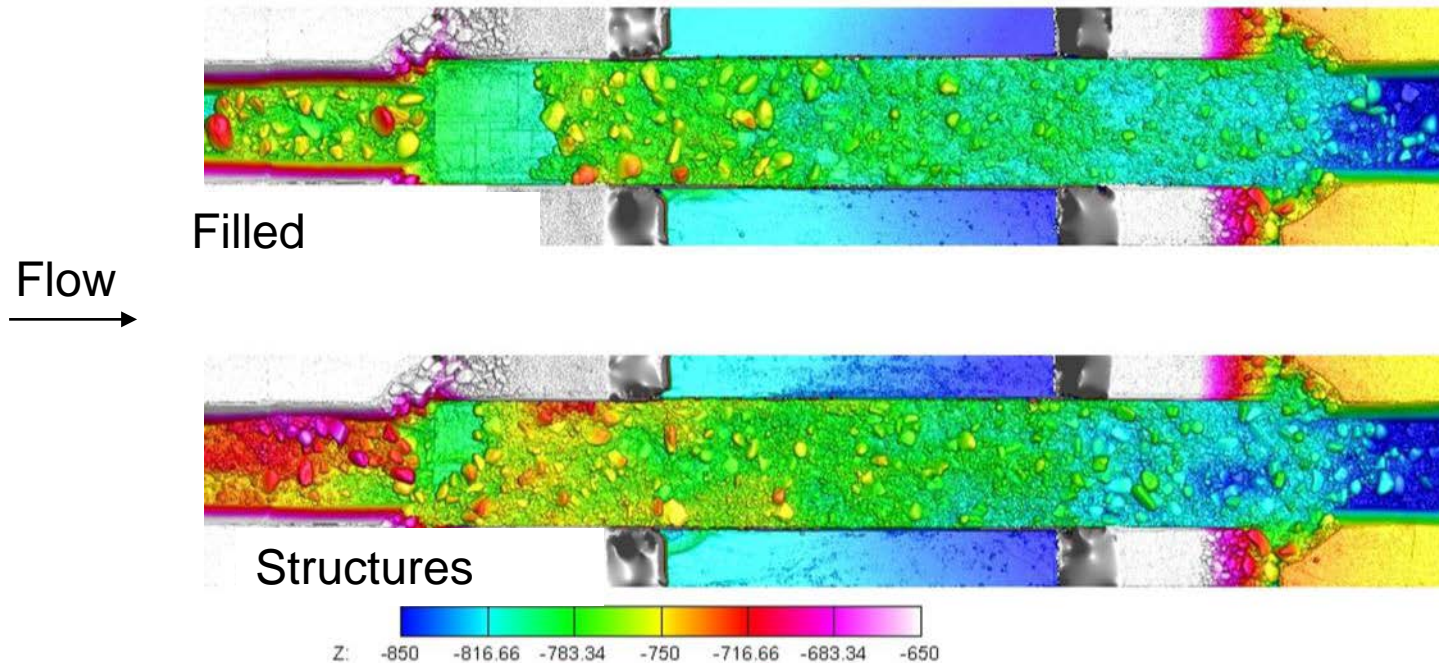
- less risk of upstream scour or headcuts



Embedded Culvert Summary

Structures:

- Sediment stability in culverts – less risk upstream
- Flow complexity, pools, and flow refugia
- Avoid near the culvert entrance





Differences between experiments and field observations:

- Vegetation!
- Extended low flows
- Grain size distribution and suspended load

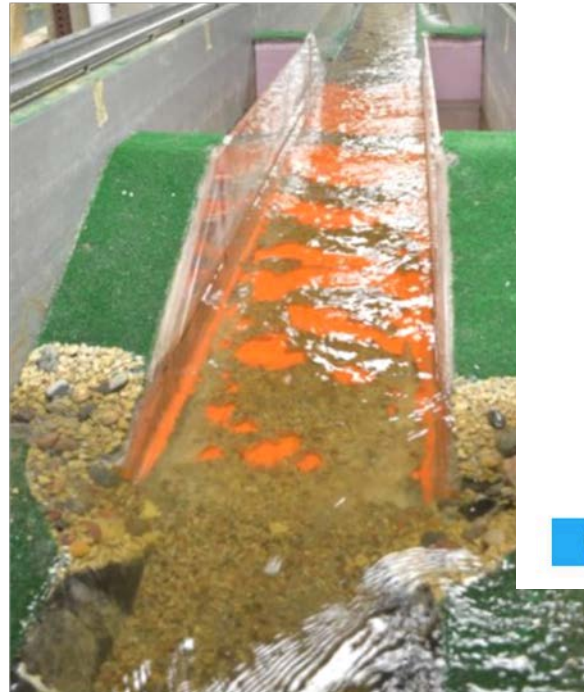


Experimental Limitations:

- Scaling Interpretation
- Single channel geometry and channel width to culvert width ratio.
- Single entrance condition

Site specific analysis of flow, shear stress estimates and mobility of the range of sediments is recommended

Differences between experiments and field observations:



Minnesota Department of Transportation

Sediment Transport through Recessed Culverts: Laboratory Experiments

RESEARCH SERVICES & LIBRARY

Office of Transportation System Management

Jessica Kozarek, Principal Investigator
St. Anthony Falls Laboratory
University of Minnesota

March 2015

Research Project
Final Report 2015-08

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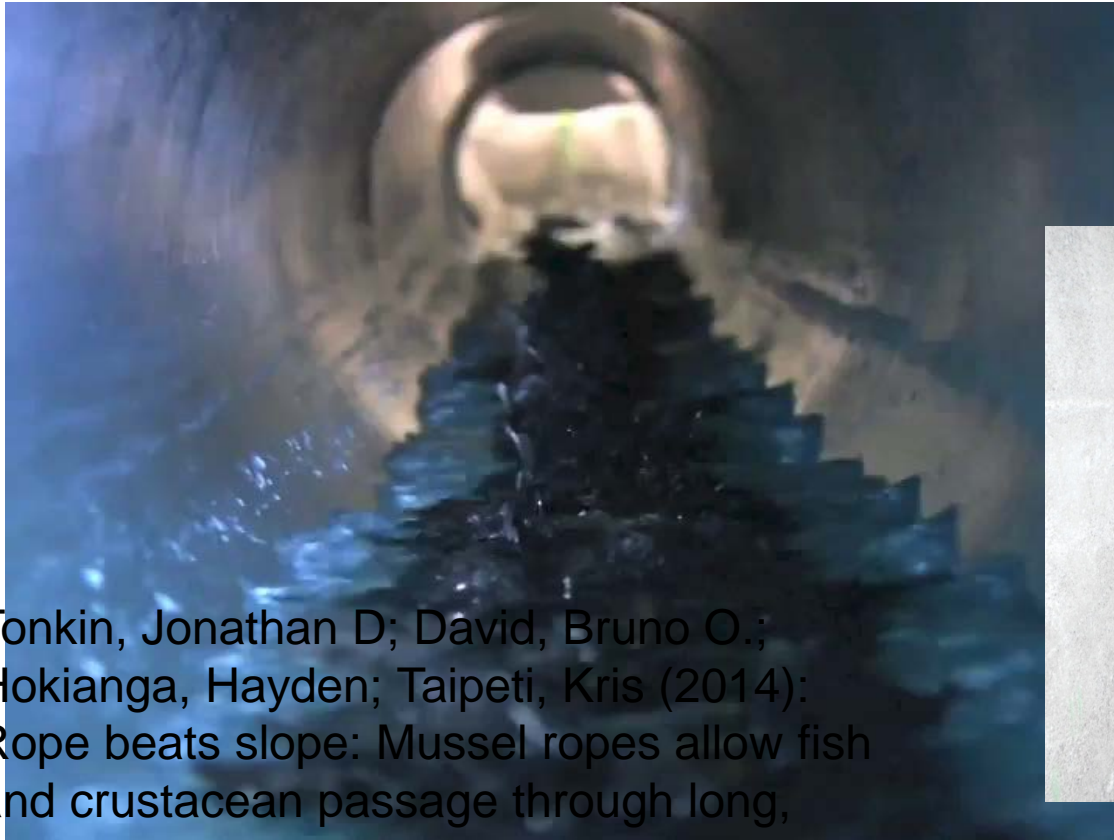
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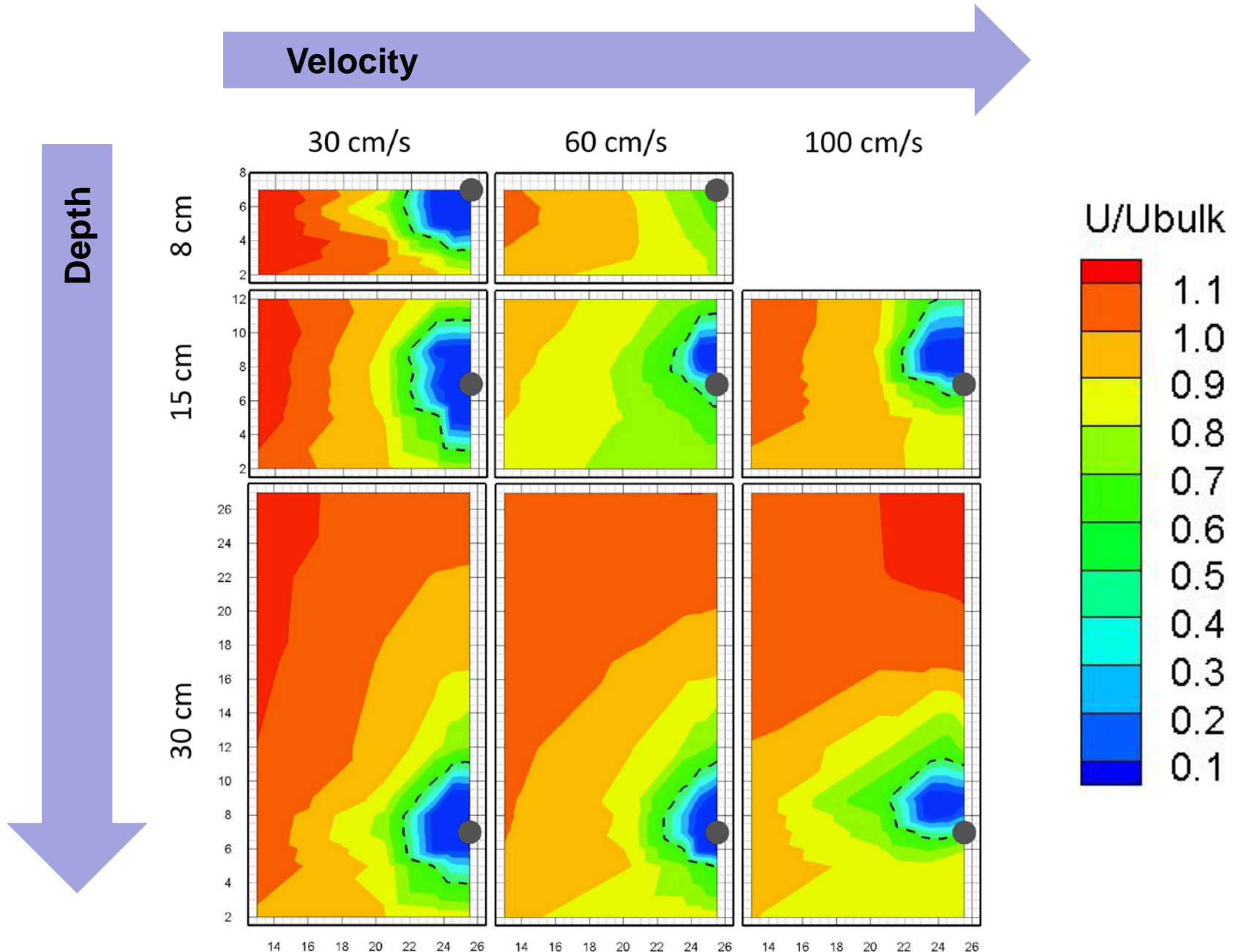
range of sediments is recommended

Novel boundary roughness retrofits: Will furry rope work in the Midwest?

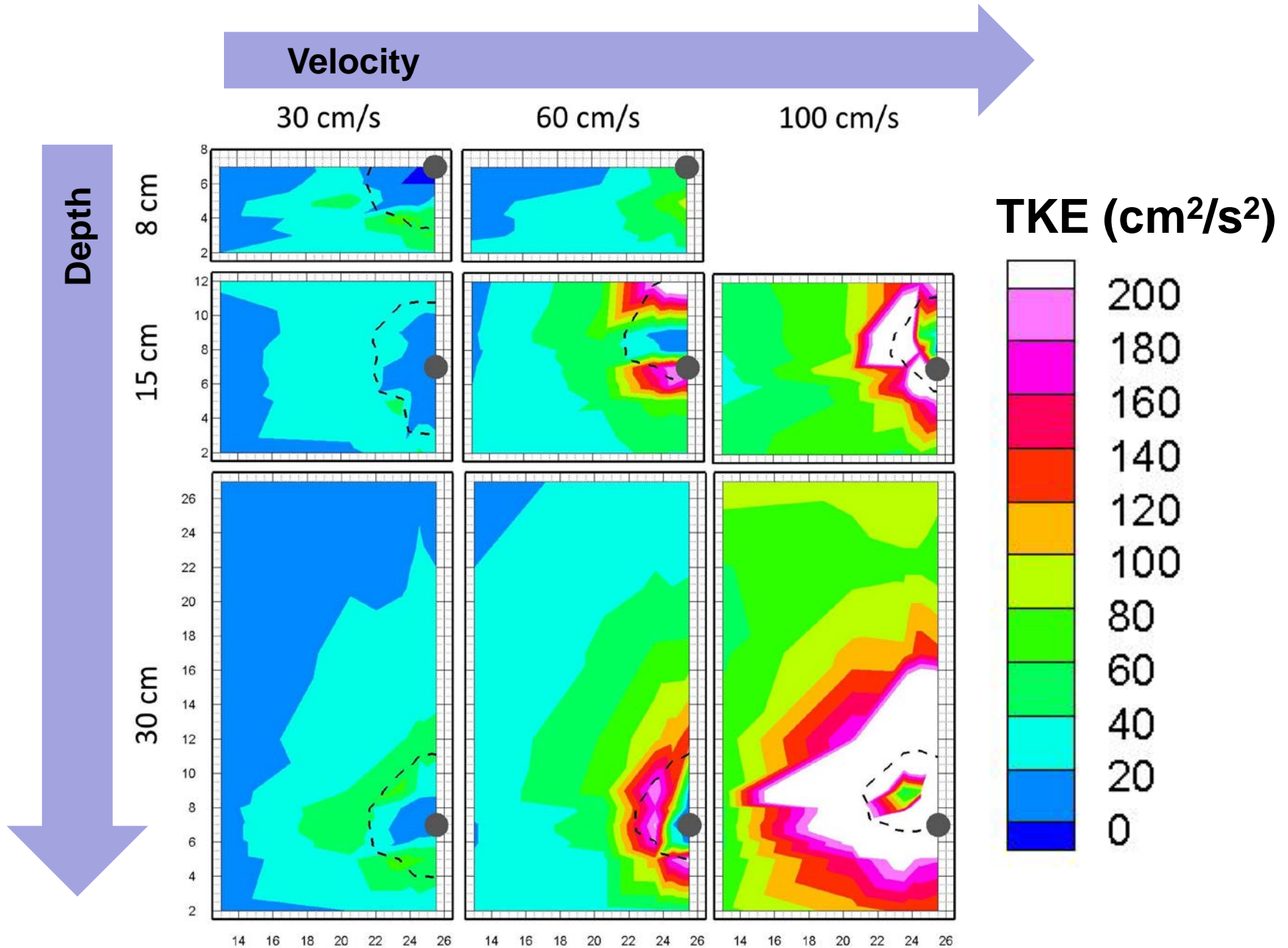


Tonkin, Jonathan D; David, Bruno O.;
Hokianga, Hayden; Taipeti, Kris (2014):
Rope beats slope: Mussel ropes allow fish
and crustacean passage through long,
steep culverts. figshare.

Hydrodynamics of Furry Rope

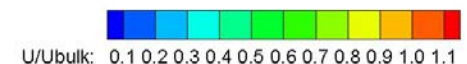
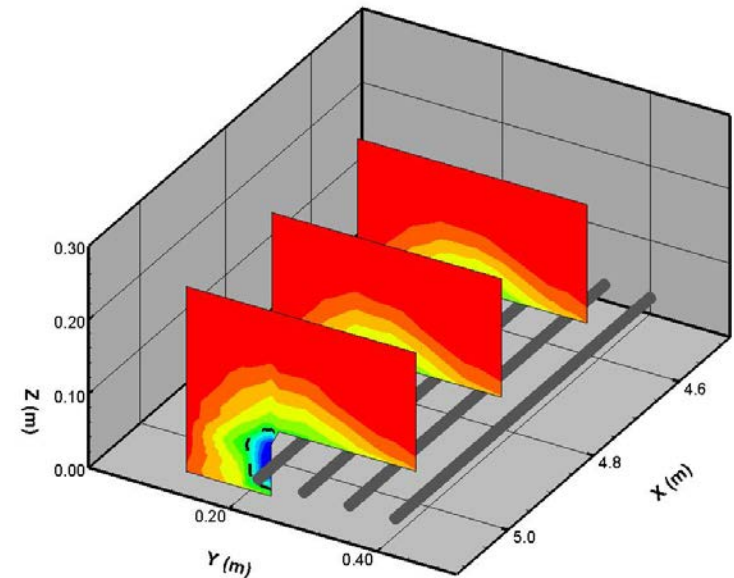
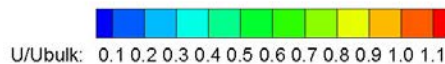
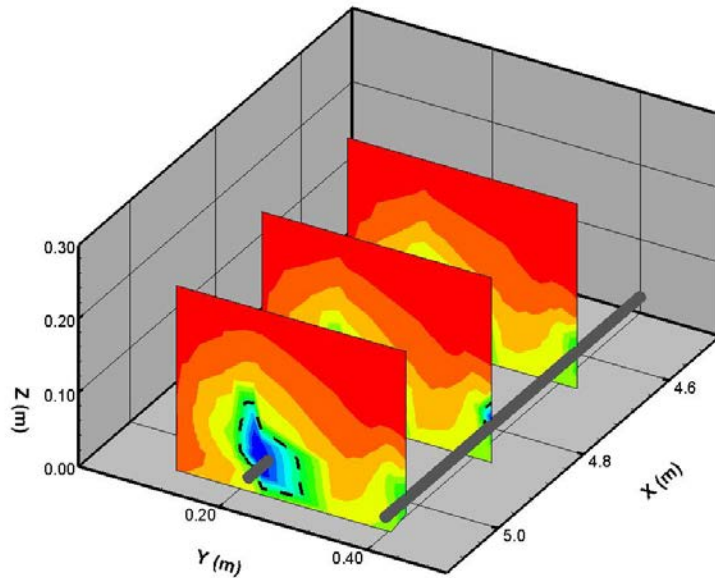
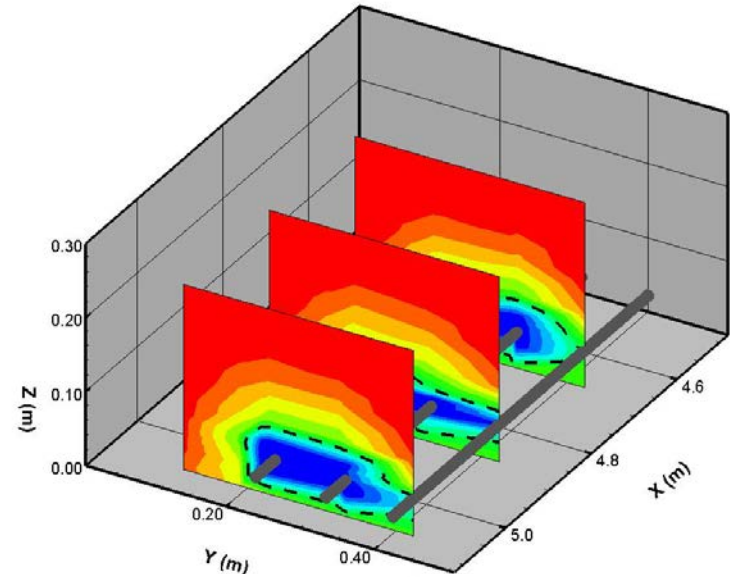


Hydrodynamics of Furry Rope



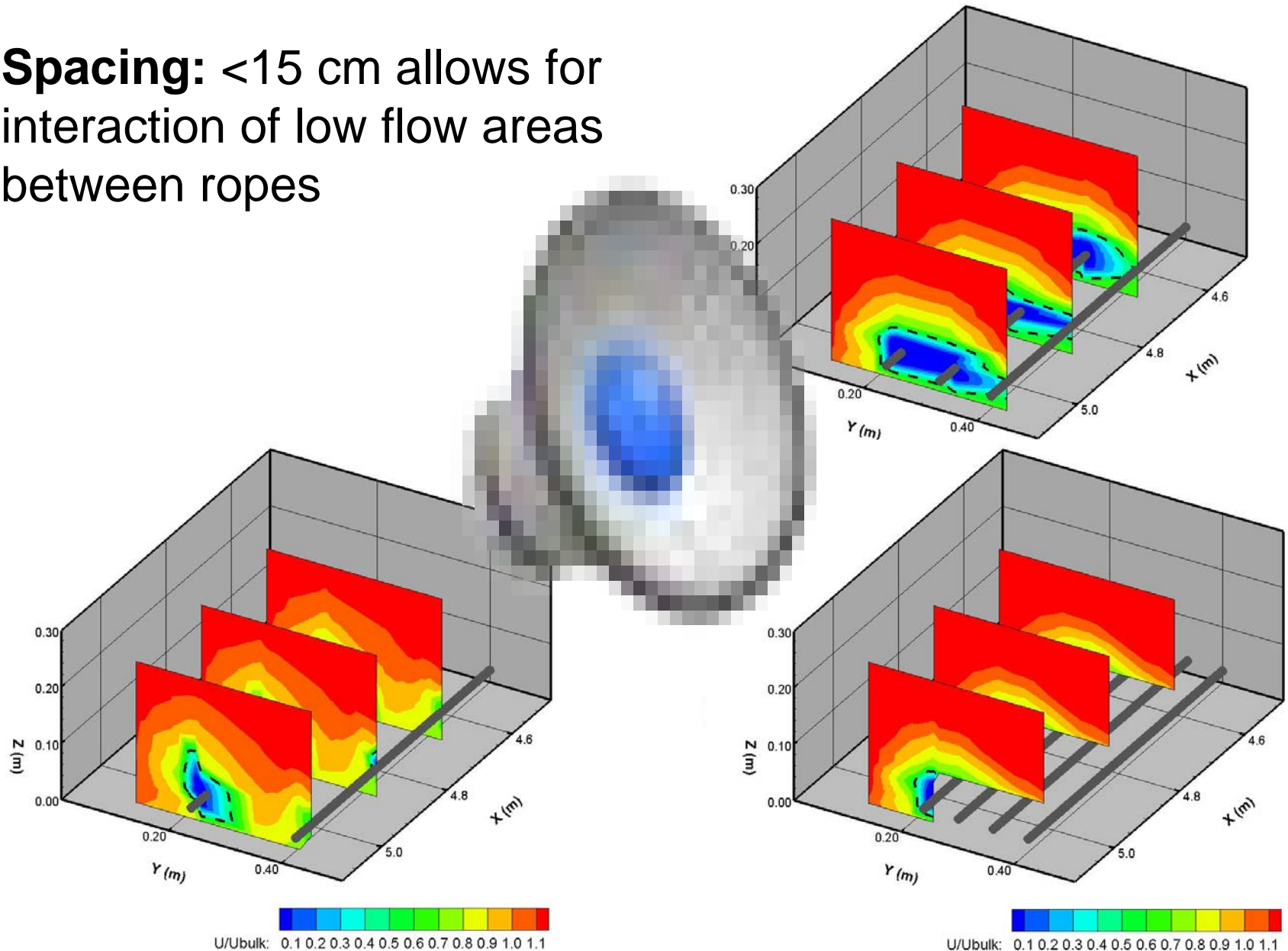
Hydrodynamics of Furry Rope

Spacing: <15 cm allows for interaction of low flow areas between ropes



Hydrodynamics of Furry Rope

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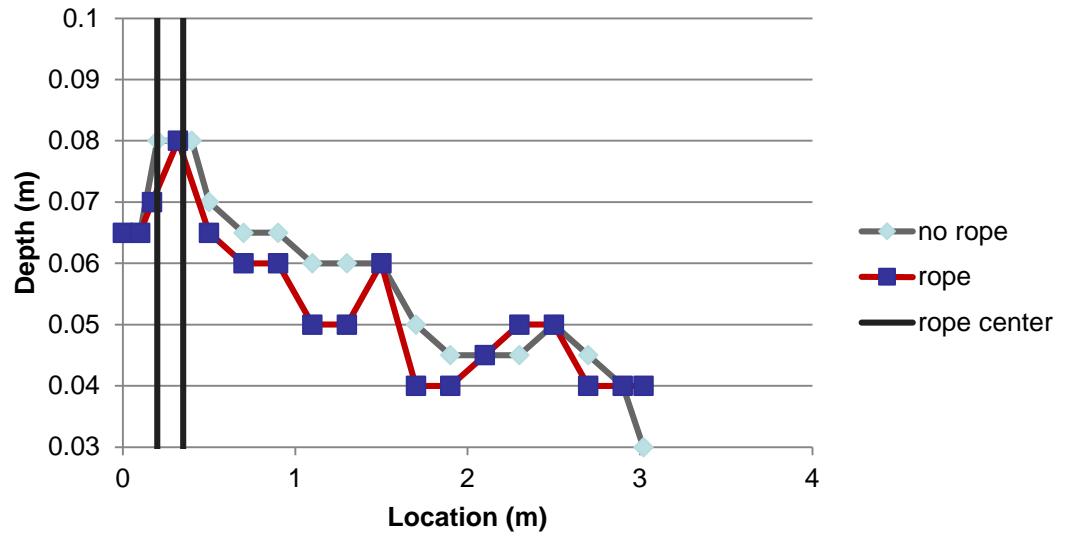


Field Investigations

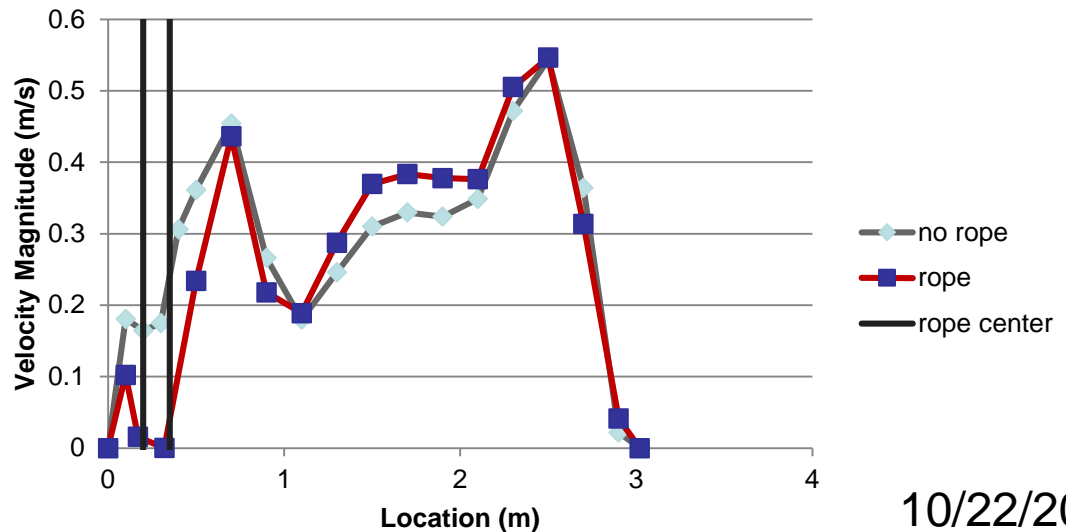


Silver Creek Mid-culvert Cross Section

Water Depth
(flow is out of page)



Velocity Magnitude
From ADV



Key Observations

- Ice
 - Ice seemed to form on ropes first
- Sediment
 - Sediment deposition under ropes
- Debris
 - Collected some debris, mostly small, will continue to monitor
- Installation
 - Attached end or free? Installation in deep water?
- Fish use – To the Lab!



Culvert Design for Aquatic Connectivity in Minnesota



Questions?

Researchers:

Sara Mielke
Britney Mosey
Jay Hatch
Matt Hernick
Numerous Undergraduate Researchers, SAFL
SAFL technical staff

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Advisory: MnDOT TAP members – Petra DeWall, Shirlee Sherkow, Brian Walter, Nicole Danielson-Bartelt, Jon Bergstrand, Peter Leete, Joe Nietfeld, Scott Morgan
Bob Gubernick, Kelly Hughes