Two-Dimensional (2D) Hydrodynamic Flood Models in Stream Restoration

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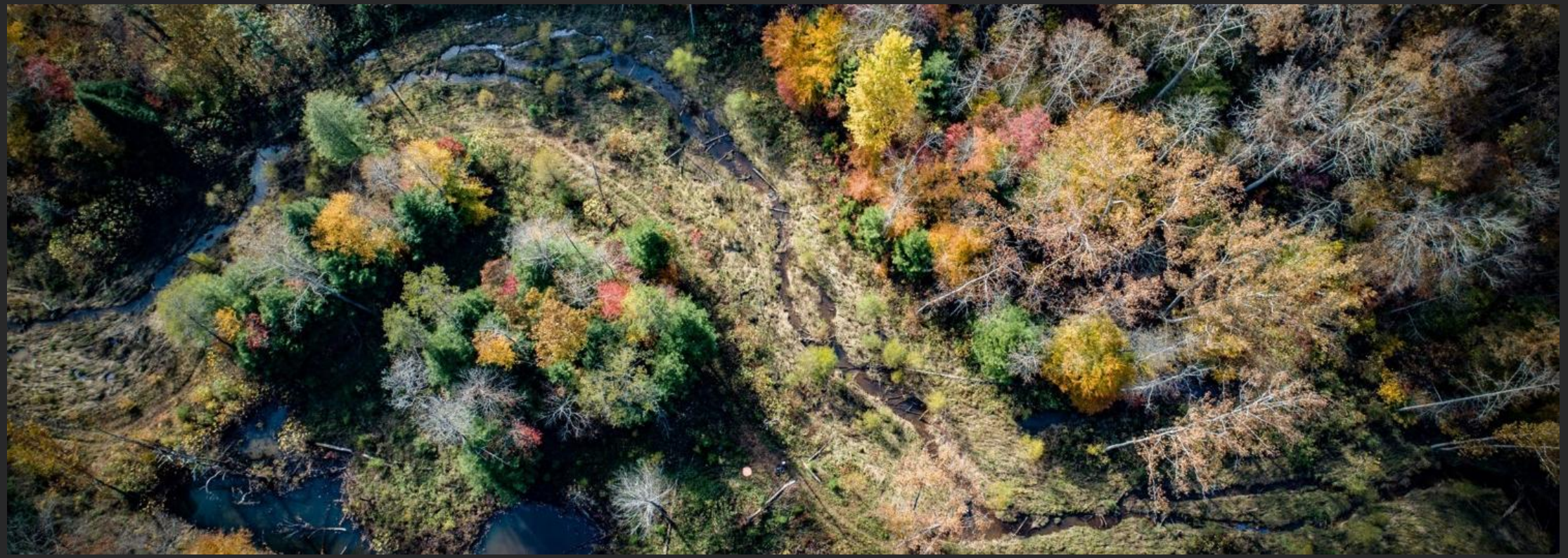
Restore High Functioning, Robust, Stream and Wetland Systems



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Barren Fork (Marsh Creek)
McCreary Co. 2 June 2006

Low Bed Stress -Stable epifaunal substrate

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Low Stress: Organic Carbon Retention

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2D Models and Restoration Design

- **Flood Vulnerability -** Design to remove **Vulnerabilities** or Provide Protection
  - Beyond bankfull – model flows up to 100 yr recurrence interval flow
  - Modify design topography to remove high velocity or provide protection

- **Habitat** – the **floodplain and channel system** velocities determine habitat

- **Design Processes Efficiency** – develop iterative design processes with fast and accurate modeling

- **Creativity** – understanding the **floodplain and channel system** leads to new restoration solutions

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2D hydrodynamic models – identify vulnerabilities of floodplain and channel system

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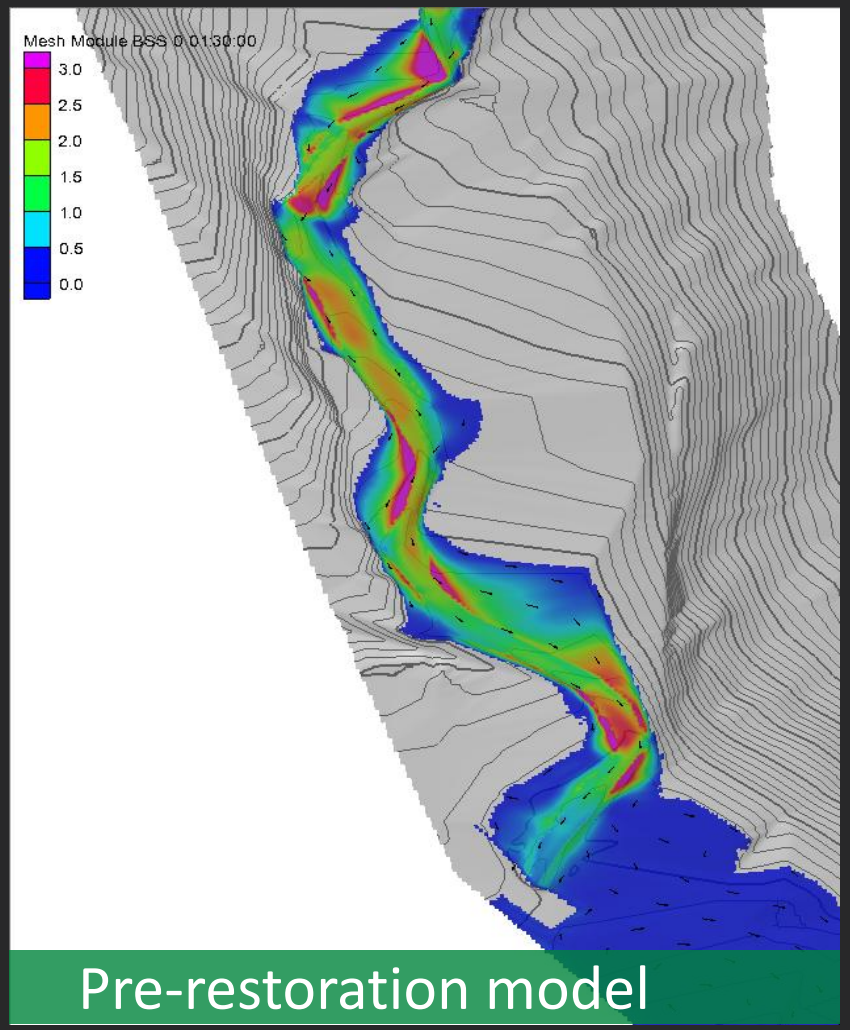
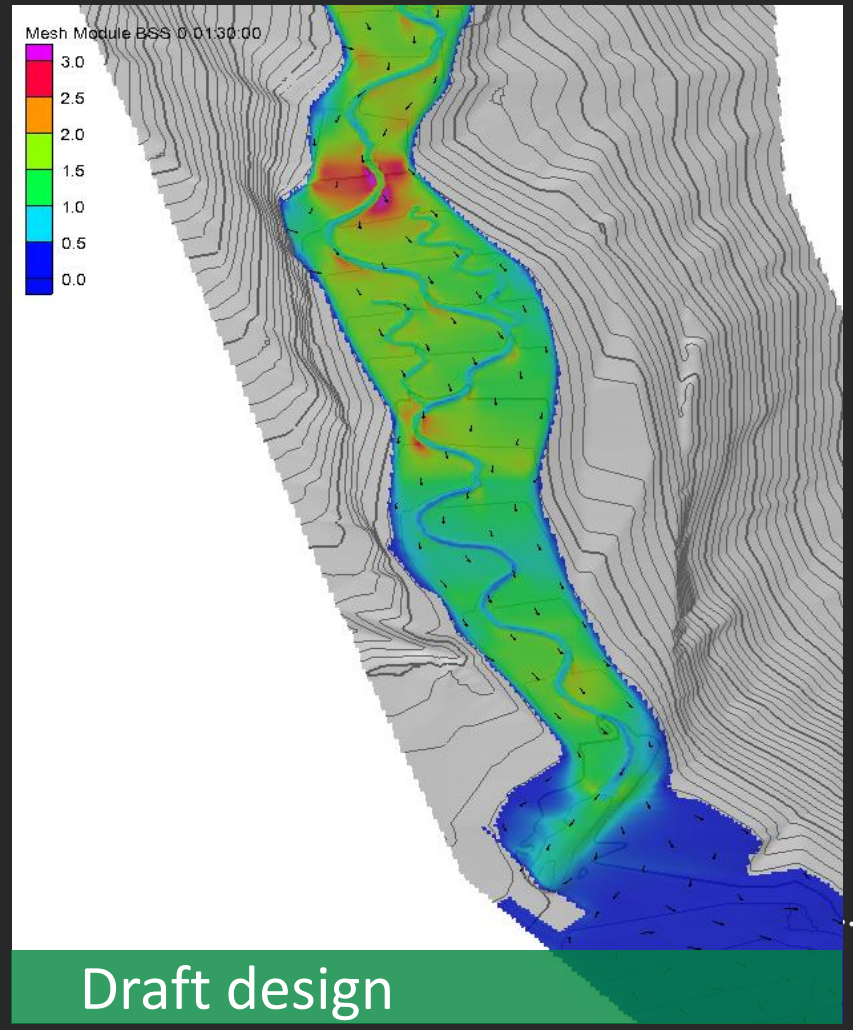
Model shear stress and velocity magnitude using flow up to Q100



Pre-restoration model



Draft design

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Wide valley, low velocity and stress

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Vertical controls—low stress

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Narrow valley—high stress

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Vertical controls—very high stress

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2D Modeling and Transition Design

- Incised upstream channels
- Bridges and culverts
- Constructed riffles
- Downstream incised channels

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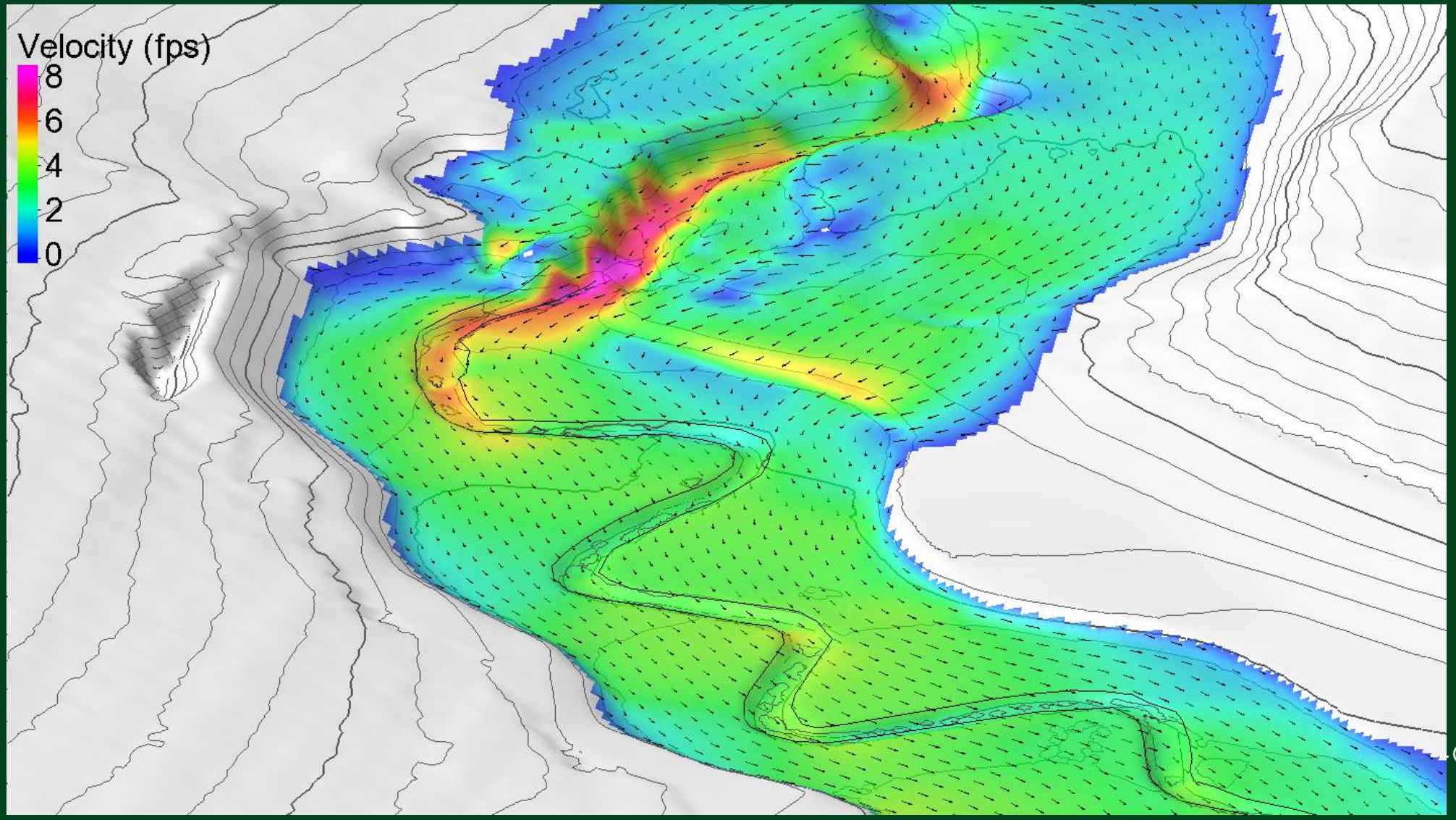
Flow Velocity in Feet Per Second (fps)



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Infrastructure integrated into design

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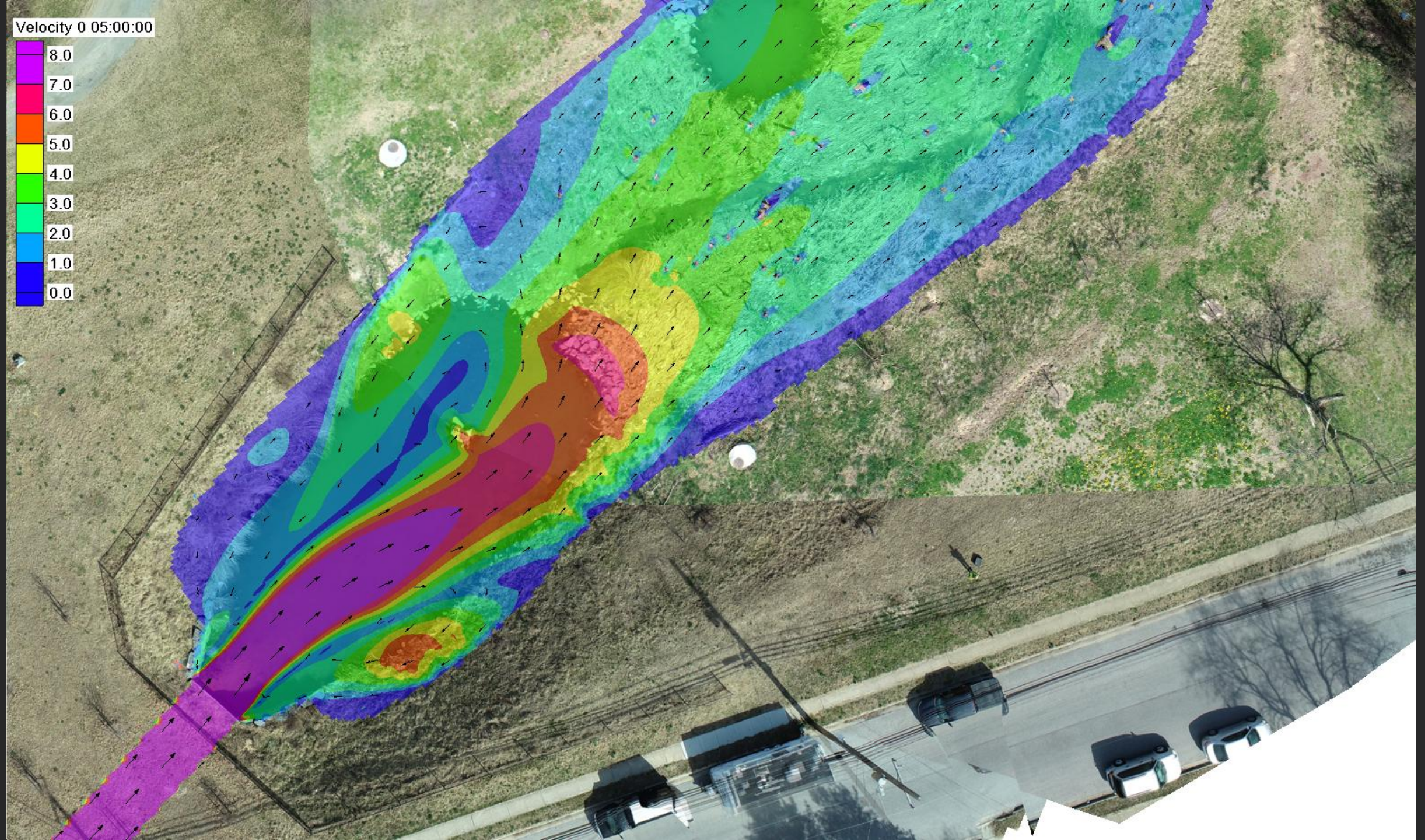
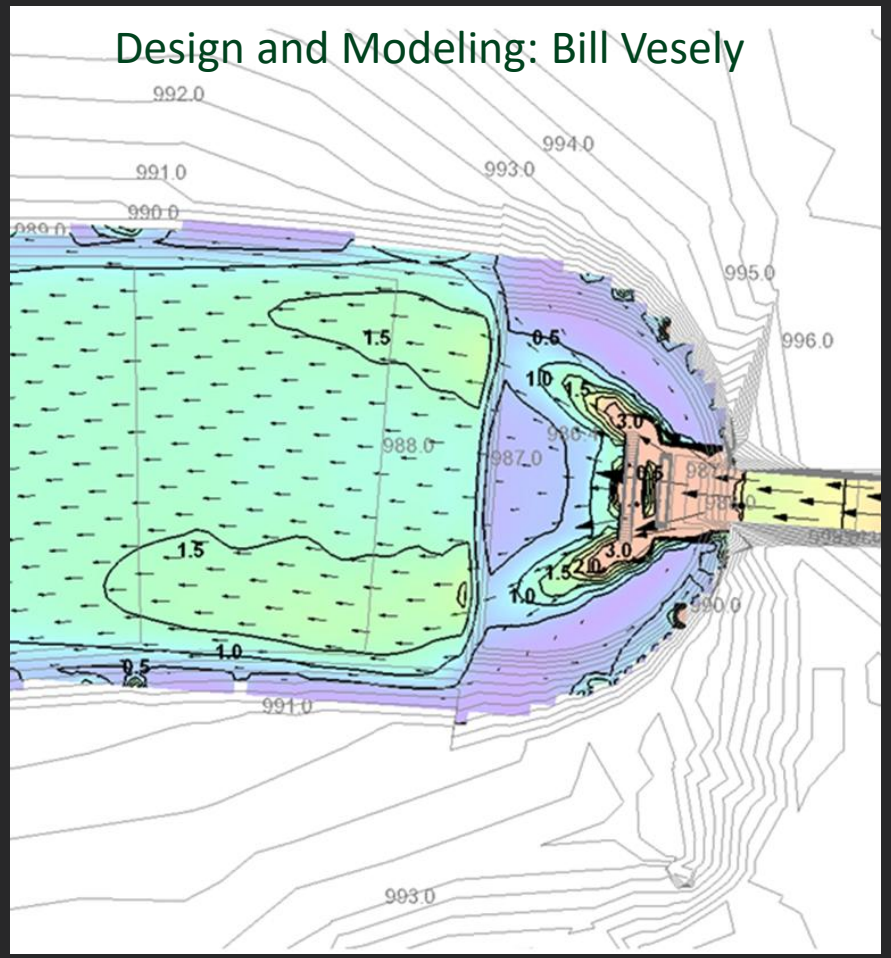

Velocity 0 05:00:00
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

2D Model Design: Transition from Culverts to Restoration

Outfall Transitions

Design and Modeling: Bill Vesely



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Outfall Rock Diffuser

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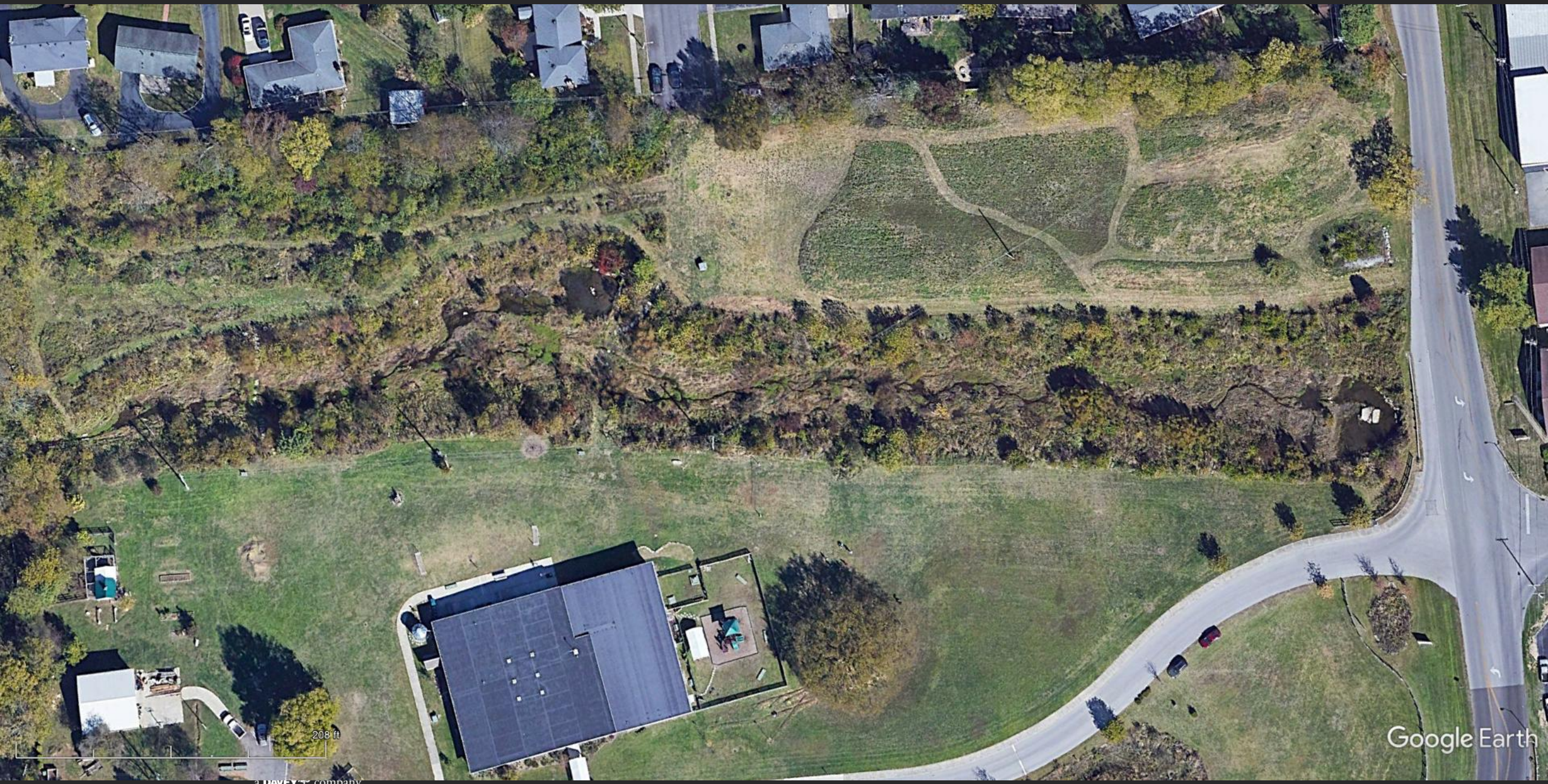
208 ft
Google Earth


224 ft
Google Earth

2D Modeling Flood Flow Intensity and Habitat

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CATEGORY 1

Stable and Retentive

Very retentive of organic (OM) matter and sediment

Vegetation type and density not impacted by flood stress

CATEGORY 2

Stable & Mostly Retentive

Retentive of OM and sediment, likely in a patchy distribution.

Vegetation type and density modestly influenced by flood stress.

CATEGORY 3

Locally eroding & Un-stable

Retention of (OM) matter and sediment only by trapping at obstacles.

Vegetation type and density influenced by flood stress. Sensitive species absent.

CATEGORY 4

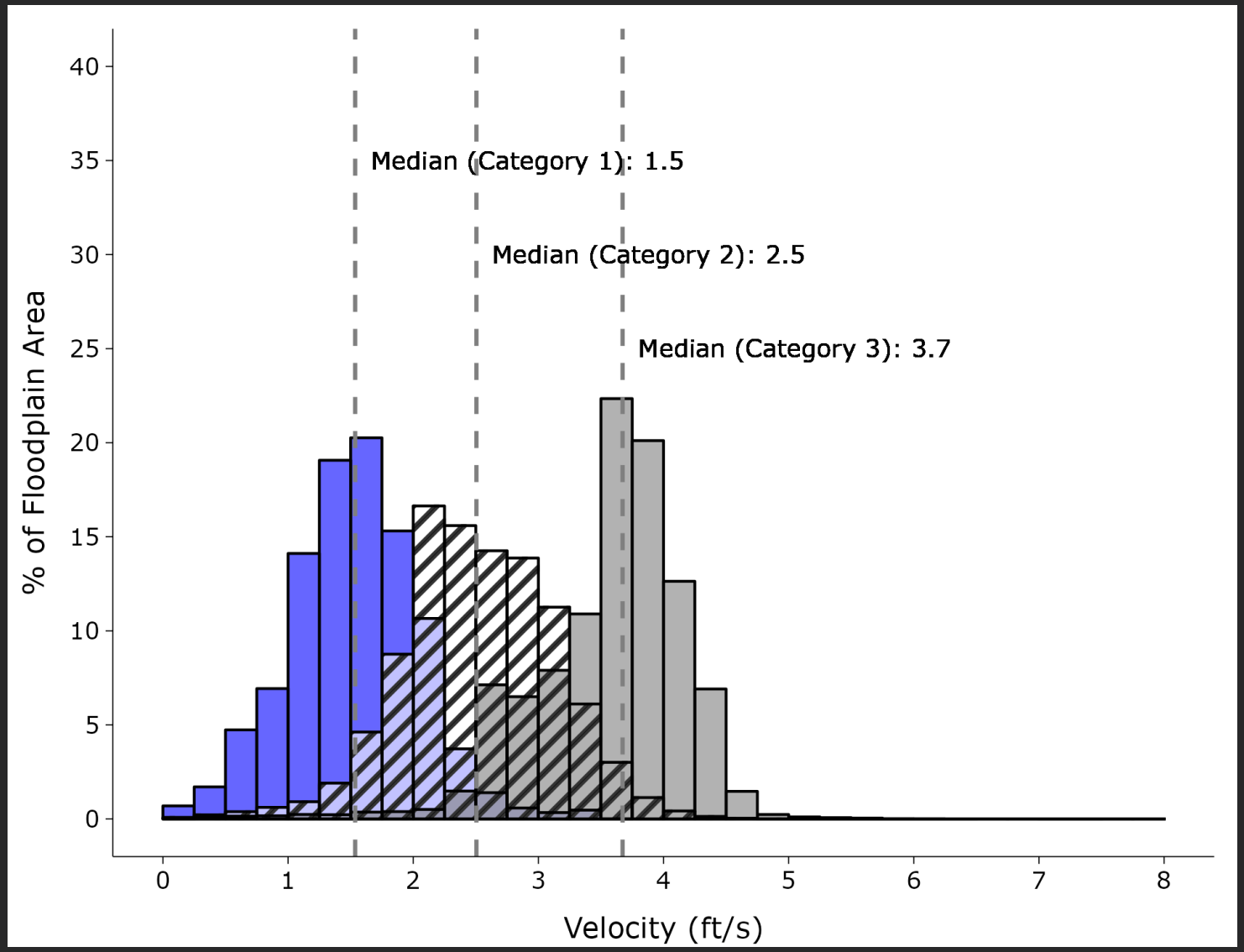
Widespread erosion & very Un-stable

Not retentive of OM and sediment- both are transient

Vegetation type and density heavily impacted by flood stresses.

2D Modeling in Site Assessment

Changes in flood disturbance intensity described in categories are associated with different distributions of 2D model velocities.



Summary

- 2D Models help identify vulnerabilities and consider solutions from site assessment to final design
- Iterative design with 2D Models allow us to efficiently develop restoration design that is resilient and high-functioning

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