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THE COMPLETE WATER MAGAZINE

Vegetation for Bank Erosion Protection and Natural Channel Design

Dr. Bahar SM *P.Geo.(Ltd), P Eng*

AHYDTECH GEOMORPHIC
ADVANCED HYDROLOGY HYDRAULIC GEOMORPHOLOGY

2

Topics

- **Definition of Fluvial Geomorphology**

- **Vegetation for Bank Erosion Protection & NCD**

- **Innovative Technique for NCD**

- **Hydraulics in Aquatic Habitat**

Fluvial Geomorphology

"Fluvial"

↓

Fluviālis, Fluere

↓

River/Stream, Flow

↓

Hydrology, Hydraulic & Sediment Transport

"Geomorphology"

↓

Physical Geography: the study of the characteristics, origins, and development of land forms

Channel Shear Stress

Total Shear Stress = Skin Resistance + Drag/Form Resistance
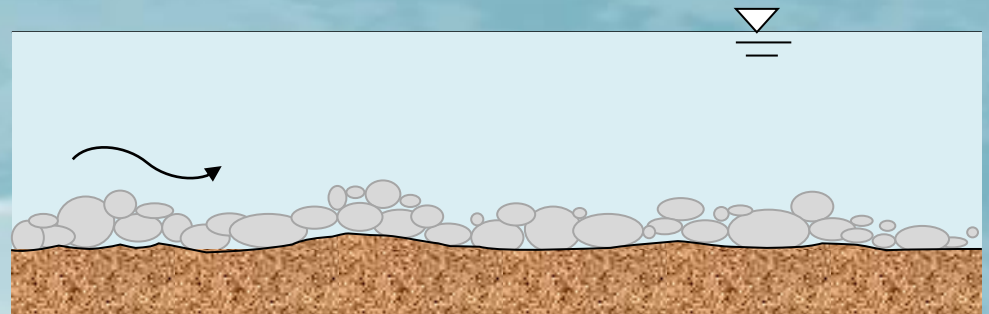
Total Shear Stress = Skin Resistance + Drag/Form Resistance
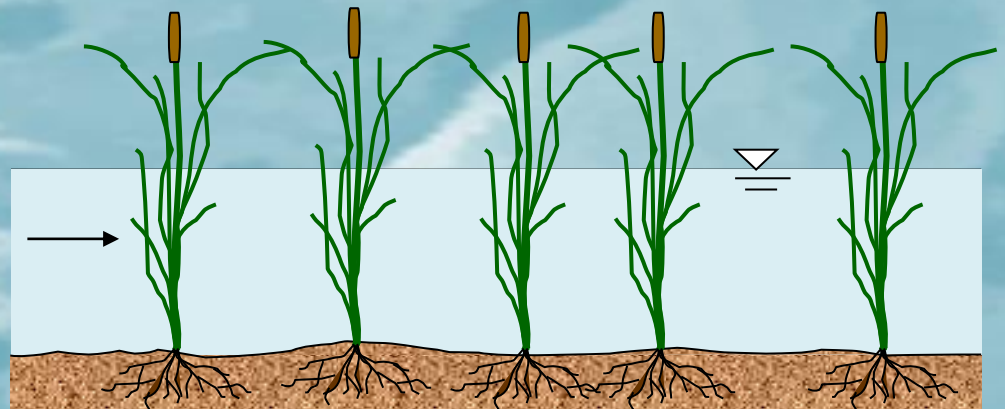
Total Shear Stress = Skin Resistance + Drag/Form Resistance

Vegetation Shear Resistance

$$\begin{pmatrix} \tau_{bx} \\ \tau_{by} \end{pmatrix} = \rho C_f \begin{pmatrix} U \\ V \end{pmatrix} \sqrt{U^2 + V^2} ; \qquad C_f = \frac{gn^2}{h^{1/3}}$$
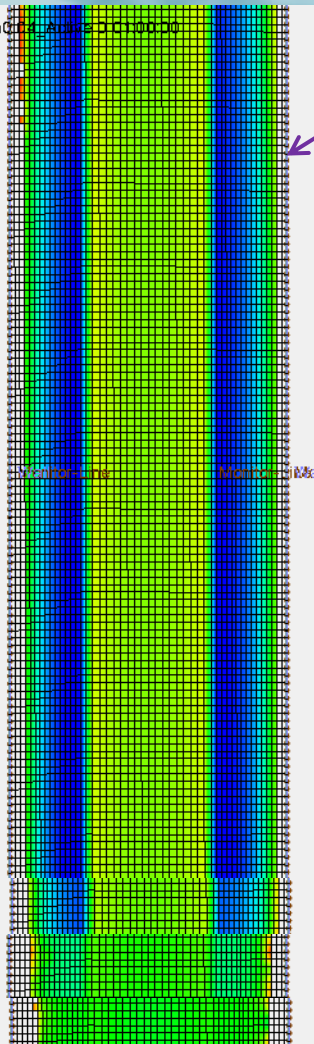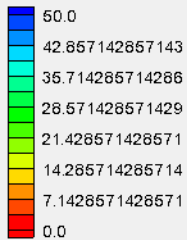
Dense Veg.

Medium Veg.

Sparse Veg.

No Vegetation

Mesh Module B_Stress_n0

- 50.0
- 42.857142857143
- 35.714285714266
- 28.571428571429
- 21.428571428571
- 14.285714285714
- 7.1428571426571
- 0.0

60 m

5.5m

Bed Shear Stress (N/m2)

Cross Section (m)

— Manning'n 0.021 — Bank Manning'n 0.025 — Bank Manning'n 0.035
— Bank Manning'n 0.04 — τ = ρgSH

τ = ρgSH

Bed Shear Stress (N/m2)

Cross Section (m)

Boundary Shear Stress

— τ = ρgSH
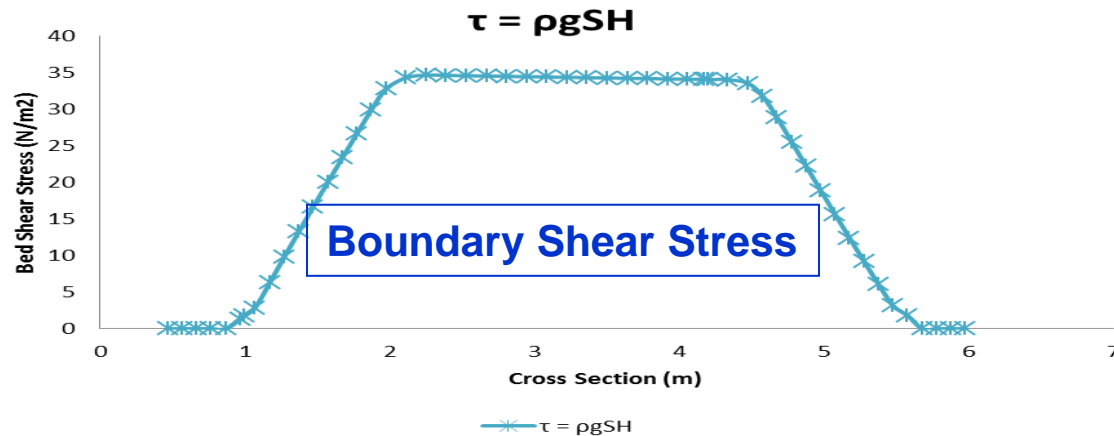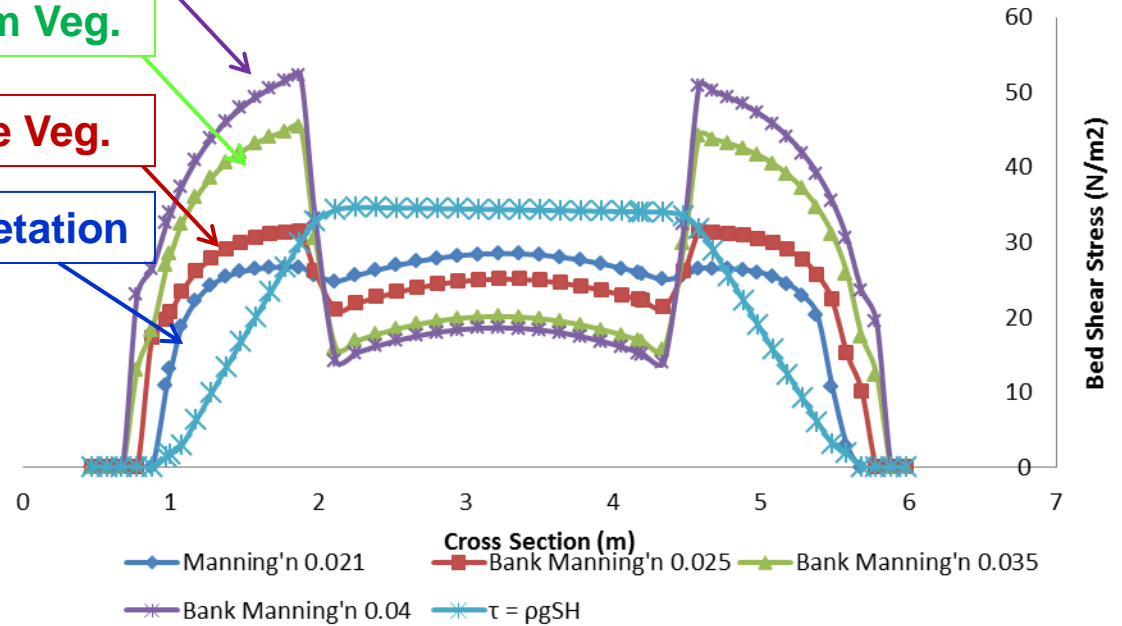
Boundary Shear Stress Vs Shear Resistance
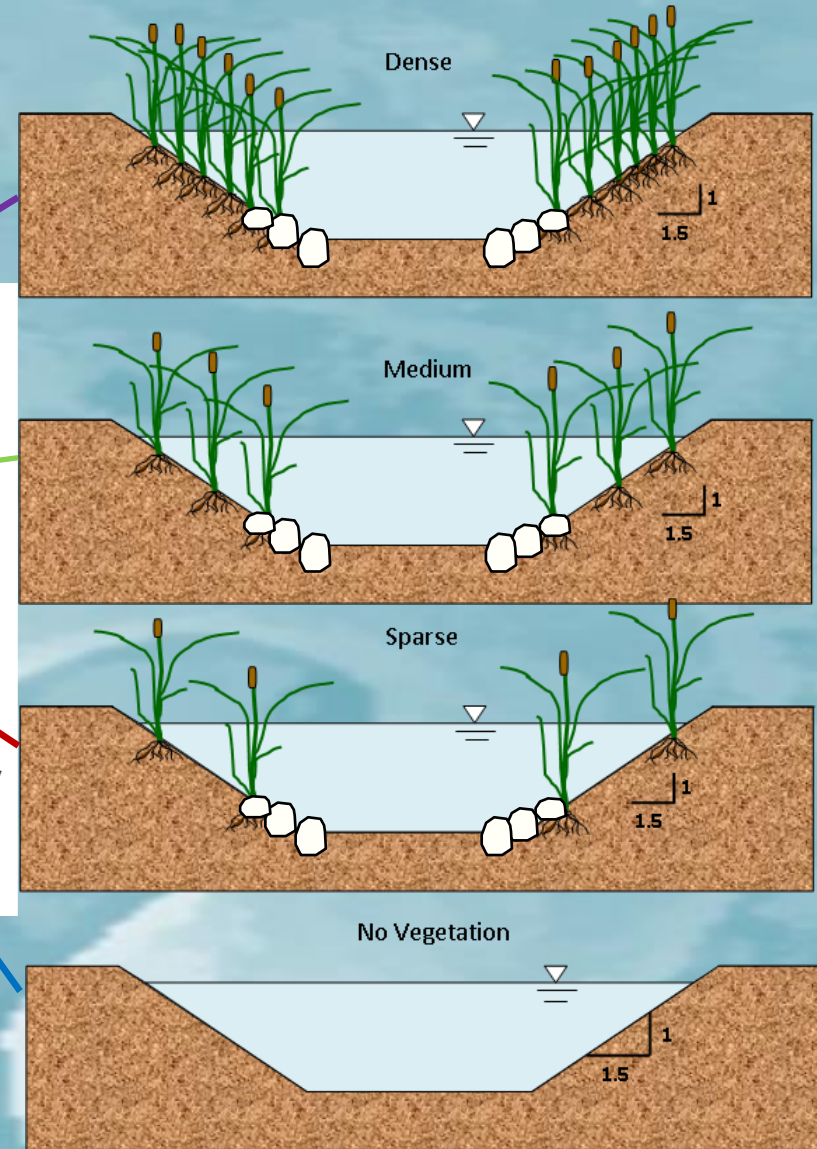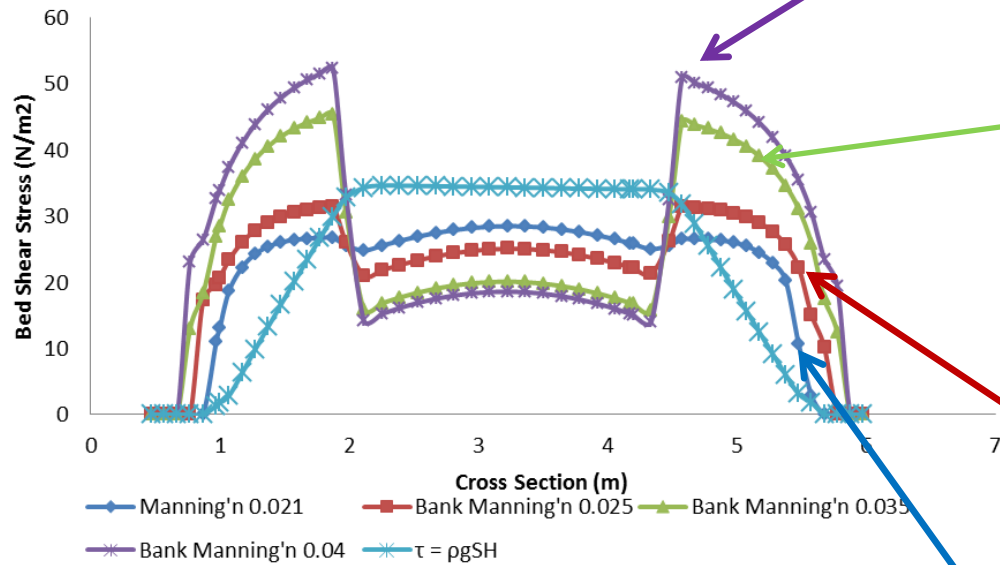
Fluvial Geomorphology: Why Qualified Professional
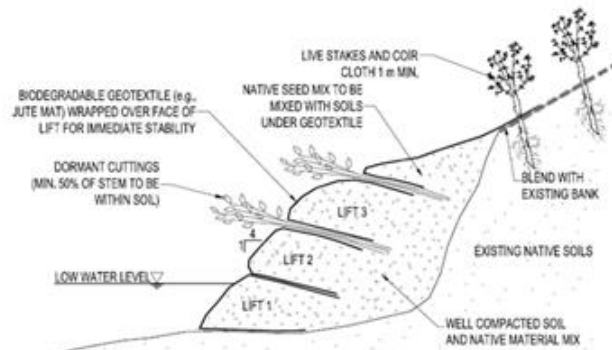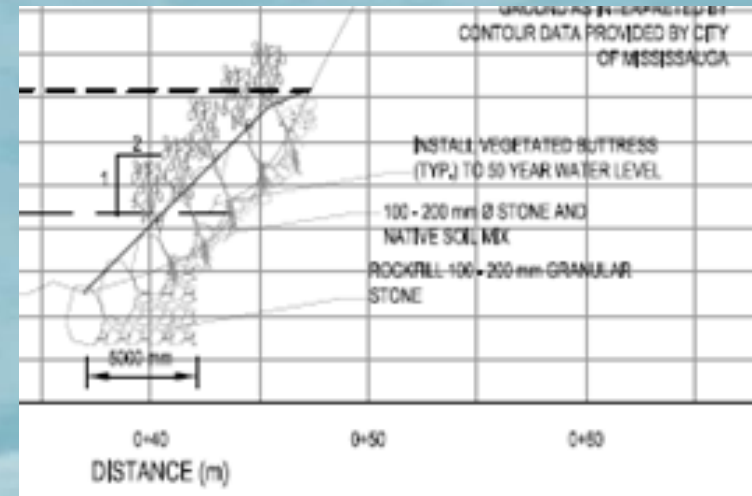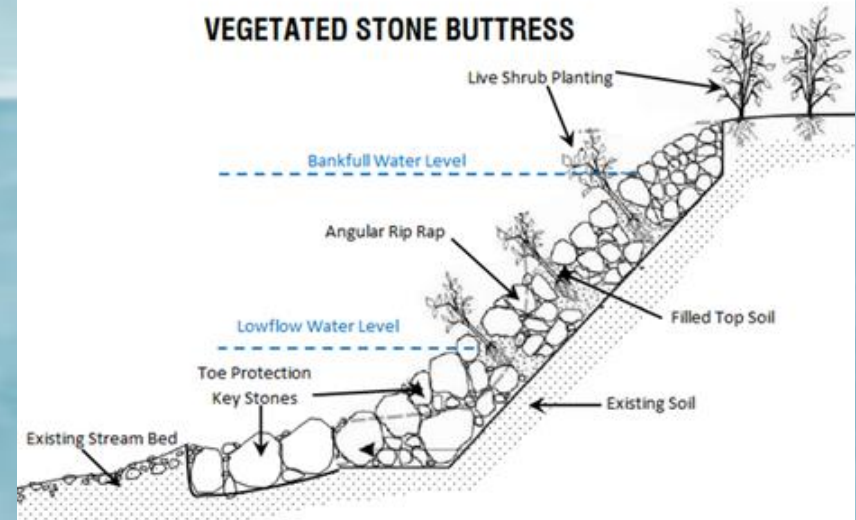
Fluvial Geomorphology: Why Qualified Professional

Innovative Technique for Natural Channel Design

- **A Technique for Natural Channel Design**

- **Estimate Riffle-Pool Sequence profile**

- **Estimate Channel Bed, Bank & Floodplain Elevations**

Innovative Technique for Natural Channel Design

Input Data:

- **Upstream & Downstream Channel Invert**

- **Channel Centre Line & Bank Toe Profiles**

- **Channel, Bank & Floodplain Slopes**

- **Output Grid Data Interval**

- **Riffle & Pool Slope**

- **RUN PROGRAM**

Innovative Tool for Natural Channel Design

Tool Creates:

RIFFLE
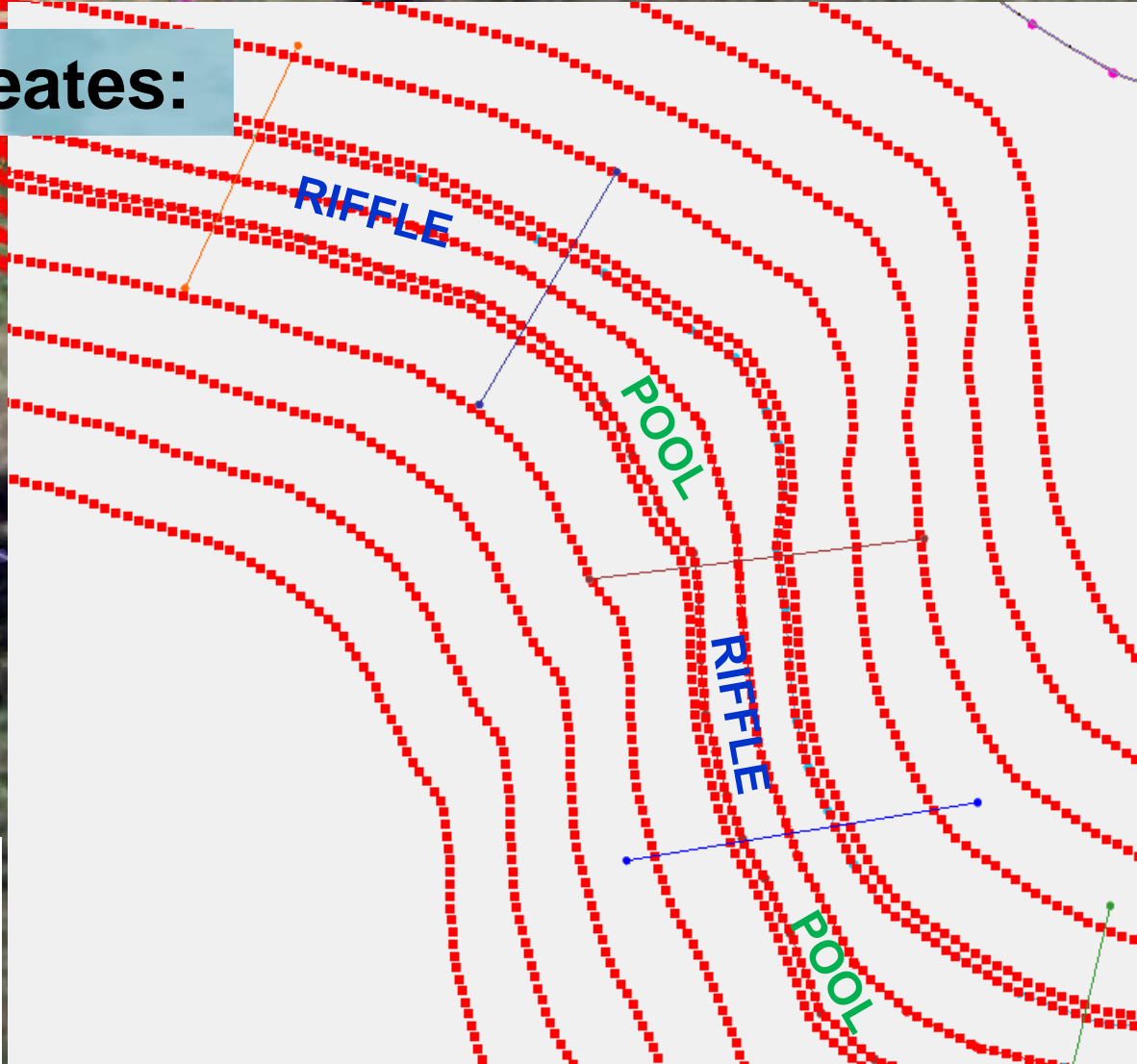
POOL

RIFFLE

POOL

ction

Innovative Tool for Natural Channel Design

Creates Riffle & Pool Sequence
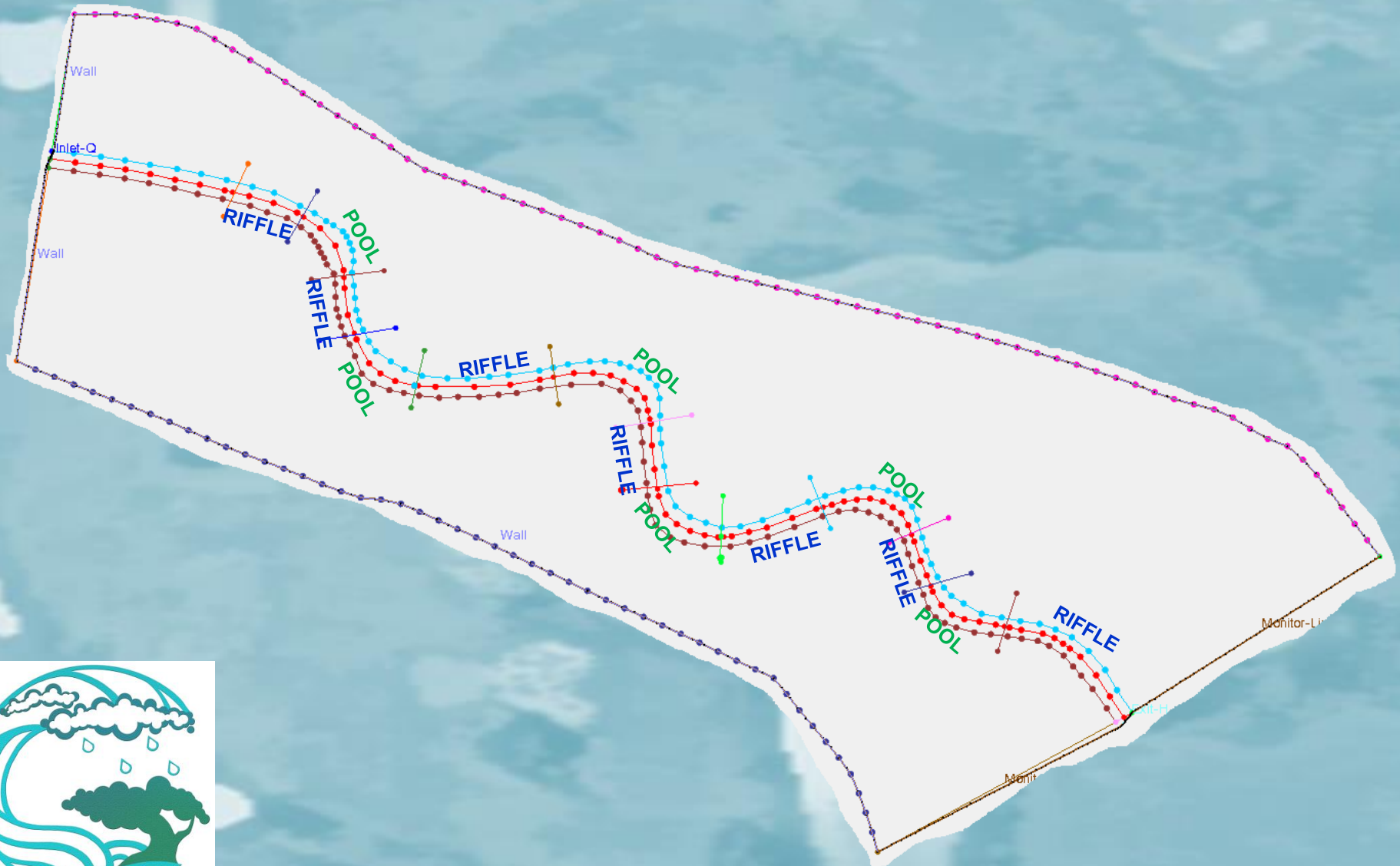
Innovative Tool for Natural Channel Design
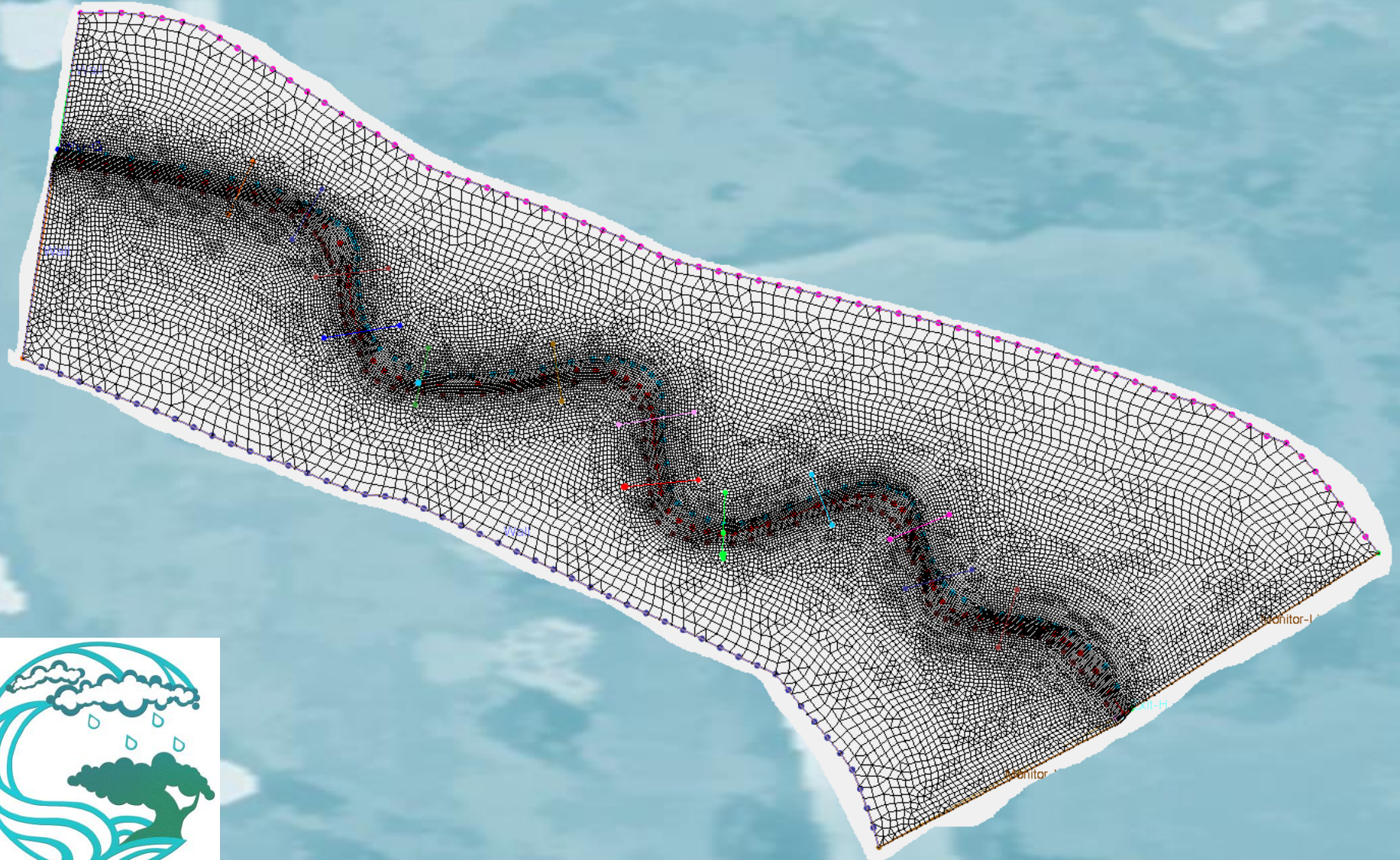
2 Dimensional Mesh

No Need of Coupling 1D and 2D Models

2 Dimensional Mesh
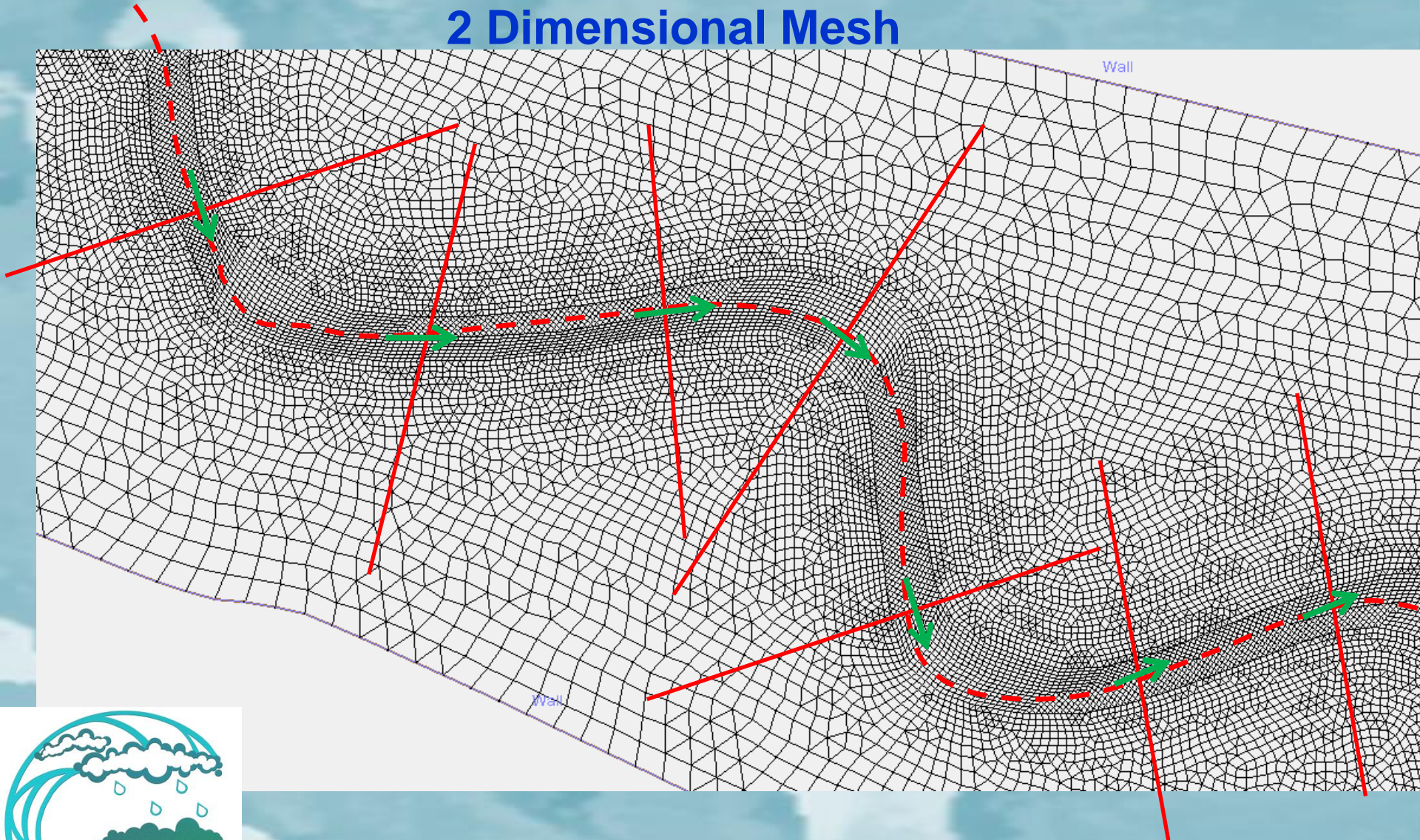
Innovative Tool for Natural Channel Design
2 Dimensional Mesh
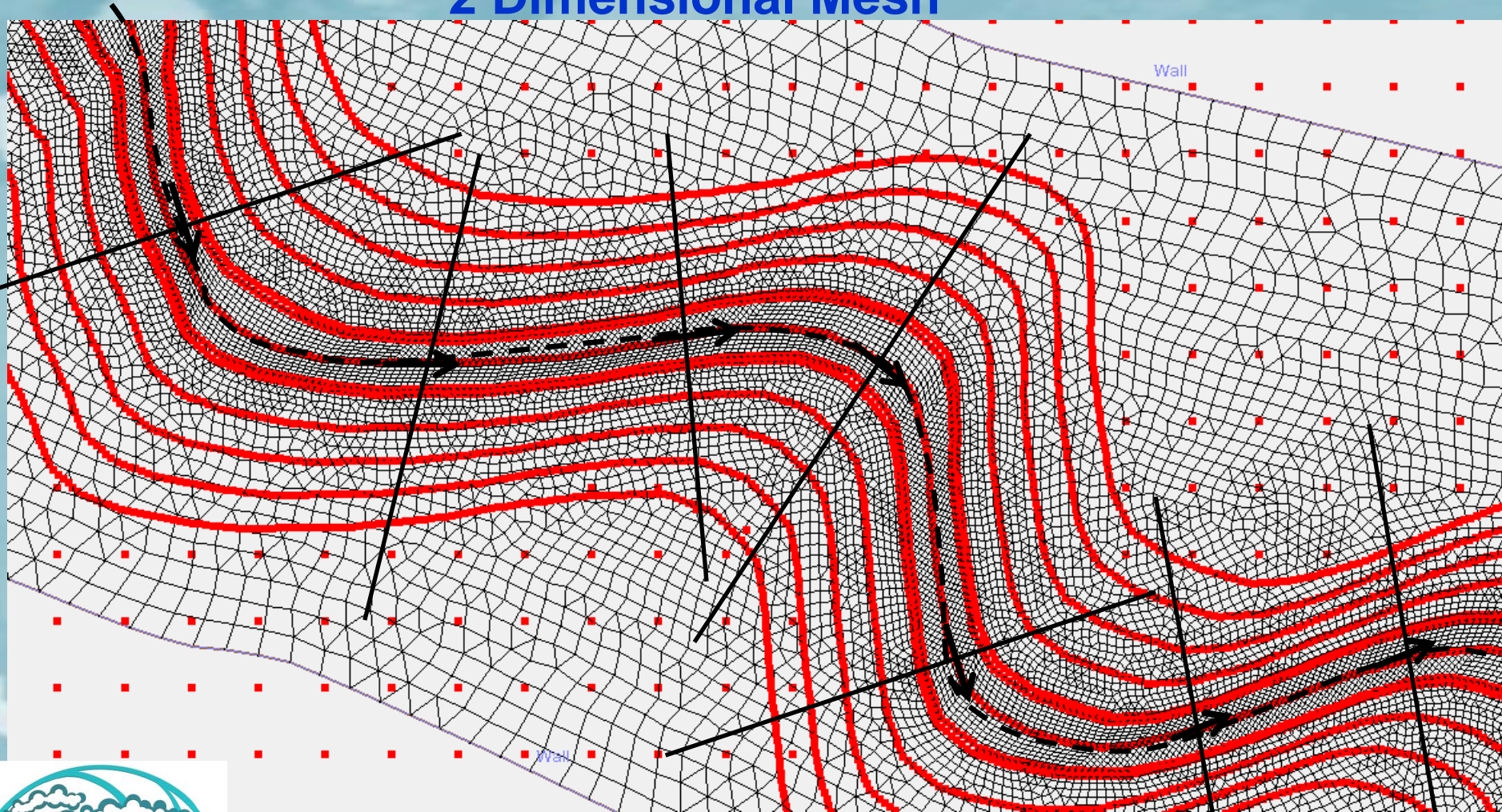
AHYDTECH GEOMORPHIC
ADVANCED HYDROLOGY HYDRAULIC GEOMORPHOLOGY

Innovative Tool for Natural Channel Design

Creates Channel & Floodplain Topography

Mesh Module elevation
- 221.4
- 220.35
- 219.3
- 218.25
- 217.2
- 216.15
- 215.1
- 214.05
- 213.0
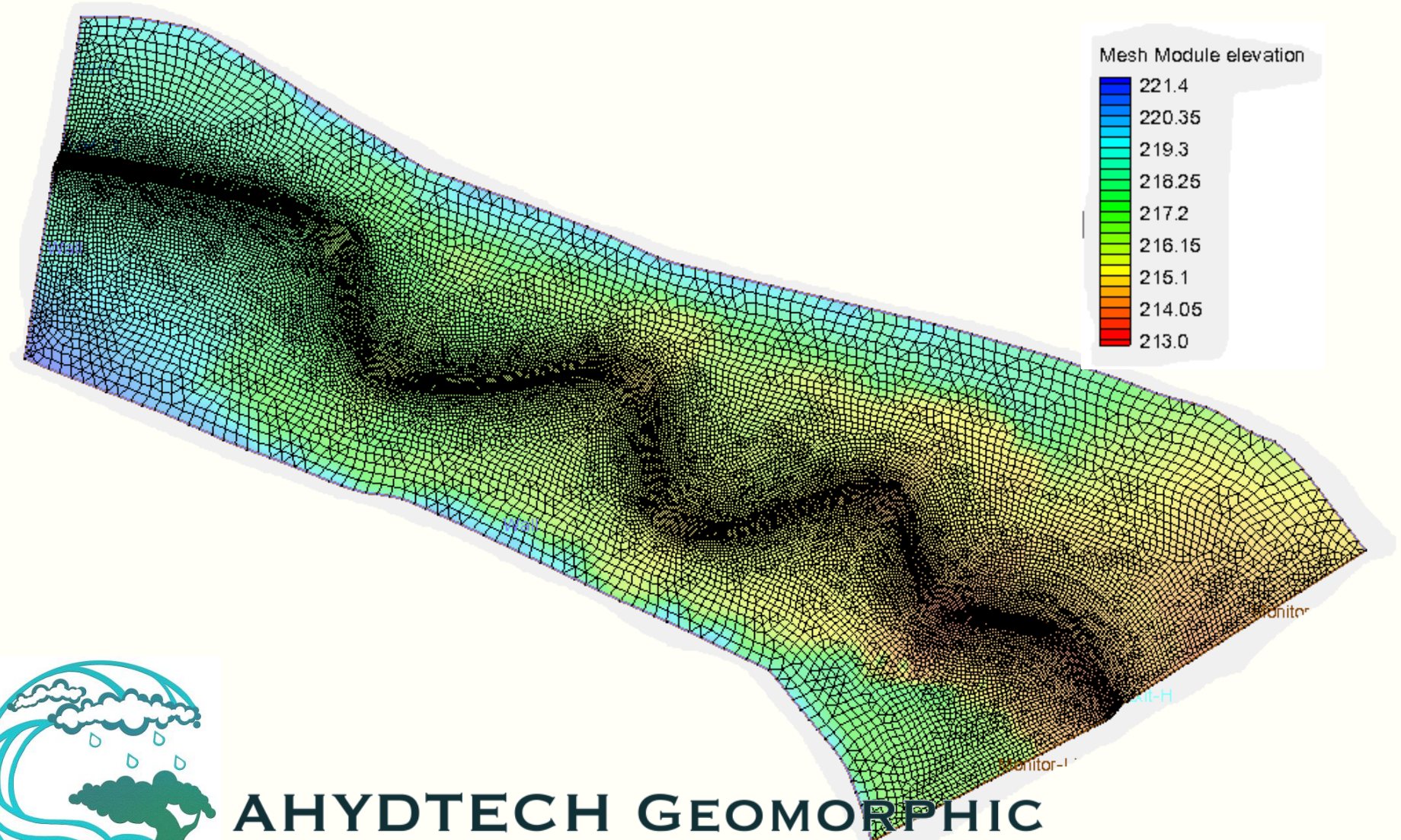
AHYDTECH GEOMORPHIC
ADVANCED HYDROLOGY HYDRAULIC GEOMORPHOLOGY

2 Dimensional Grid Elevation
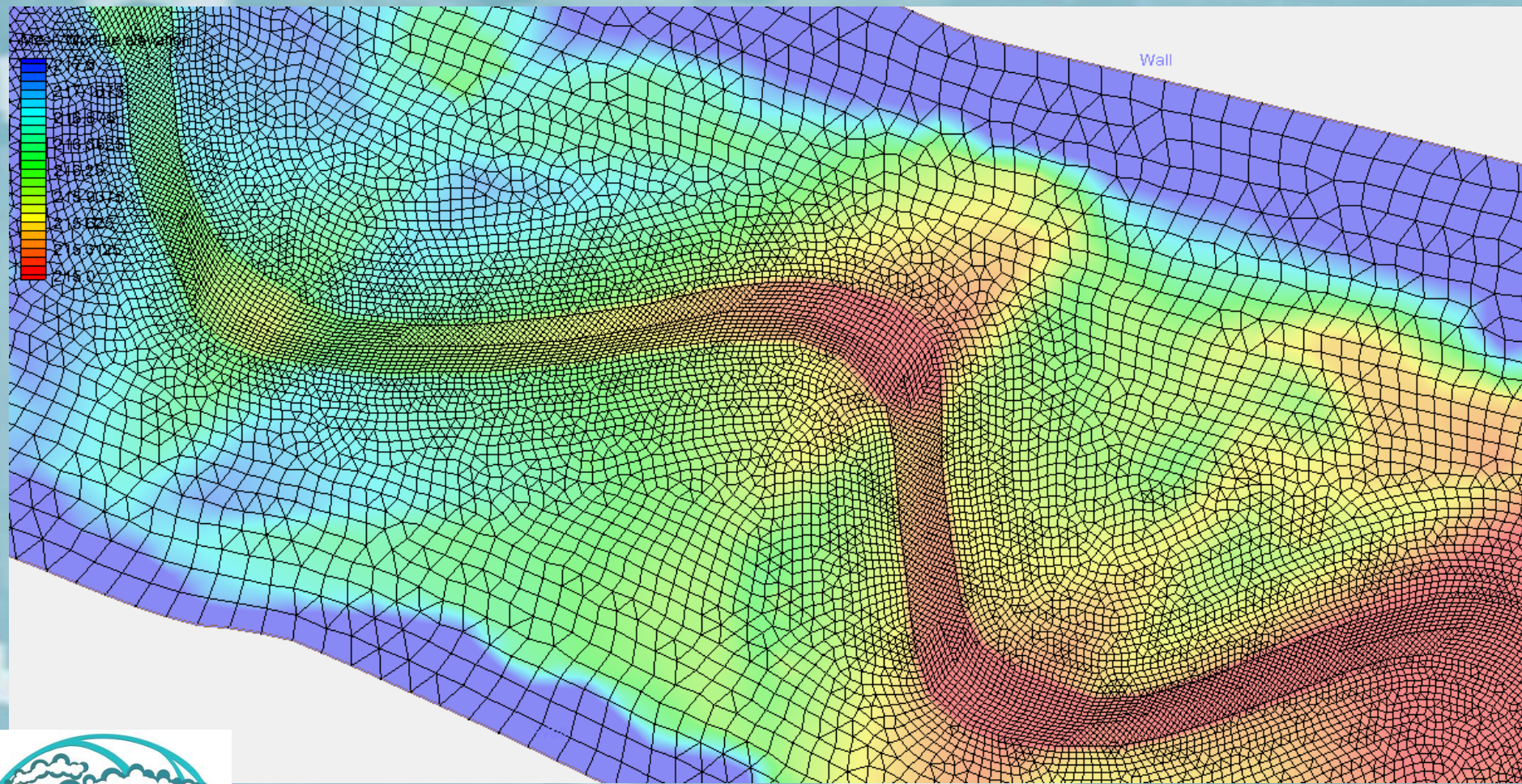
Innovative Tool for Natural Channel Design
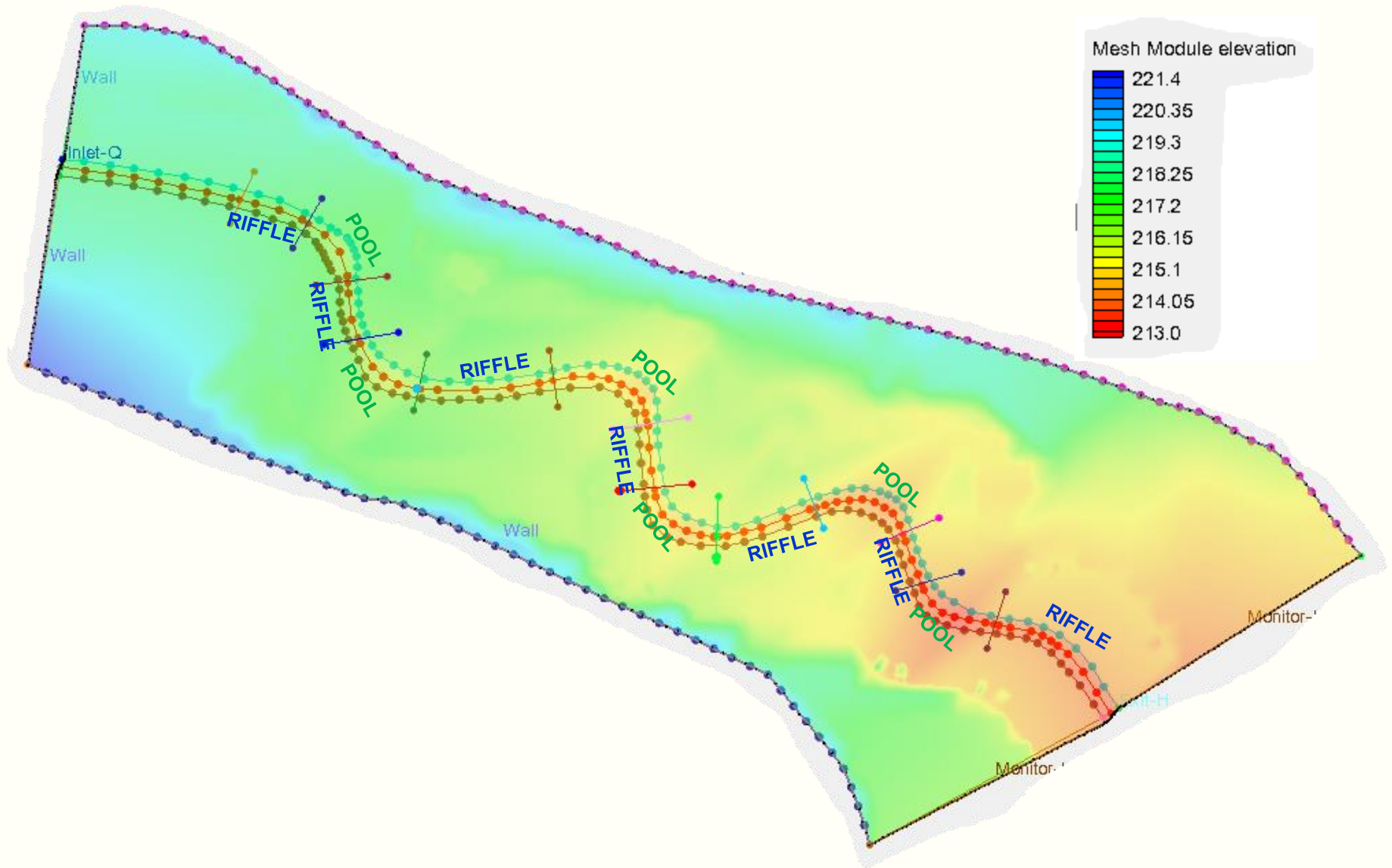
Creates Channel & Floodplain Topography

Innovative Tool for Natural Channel Design

Creates Channel & Floodplain Topography
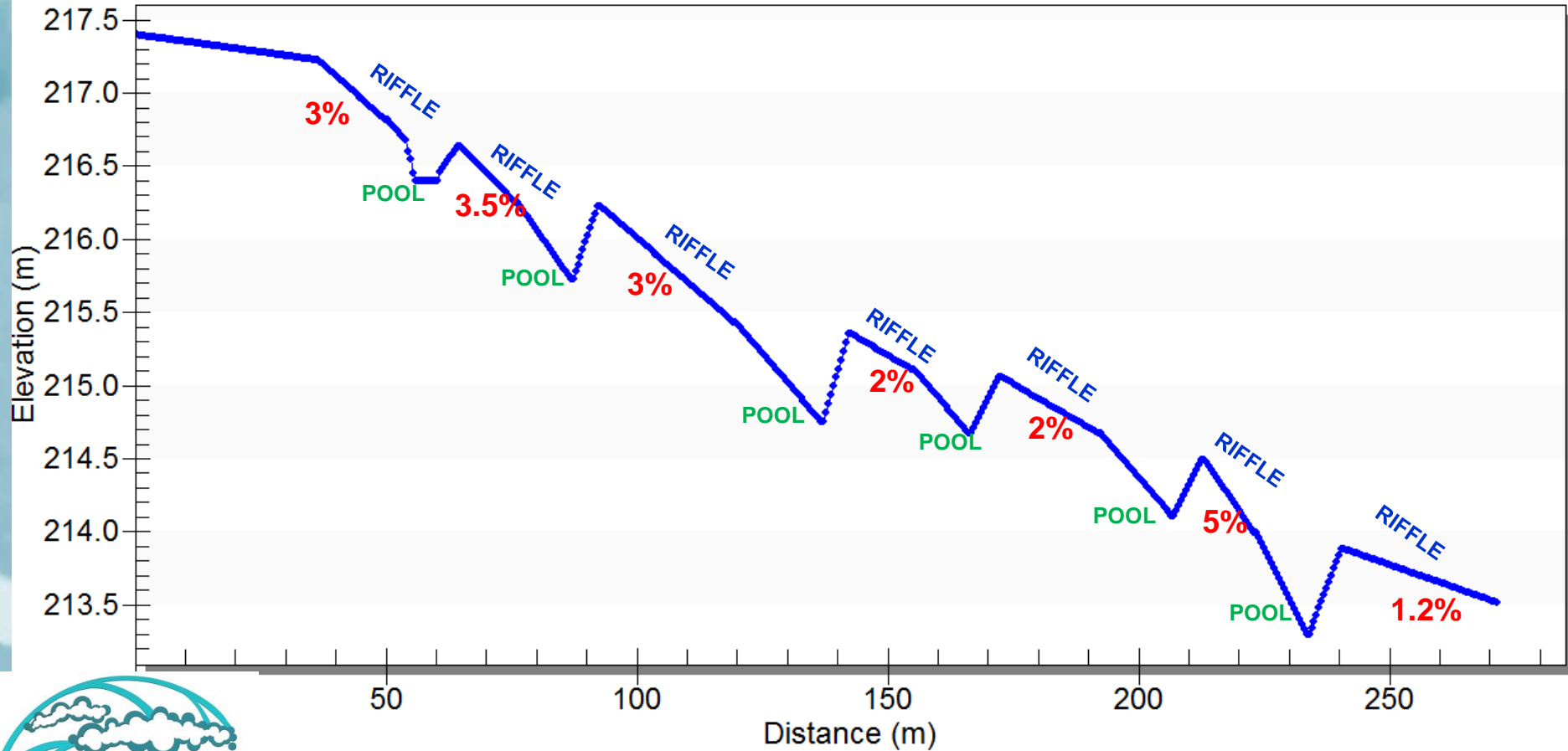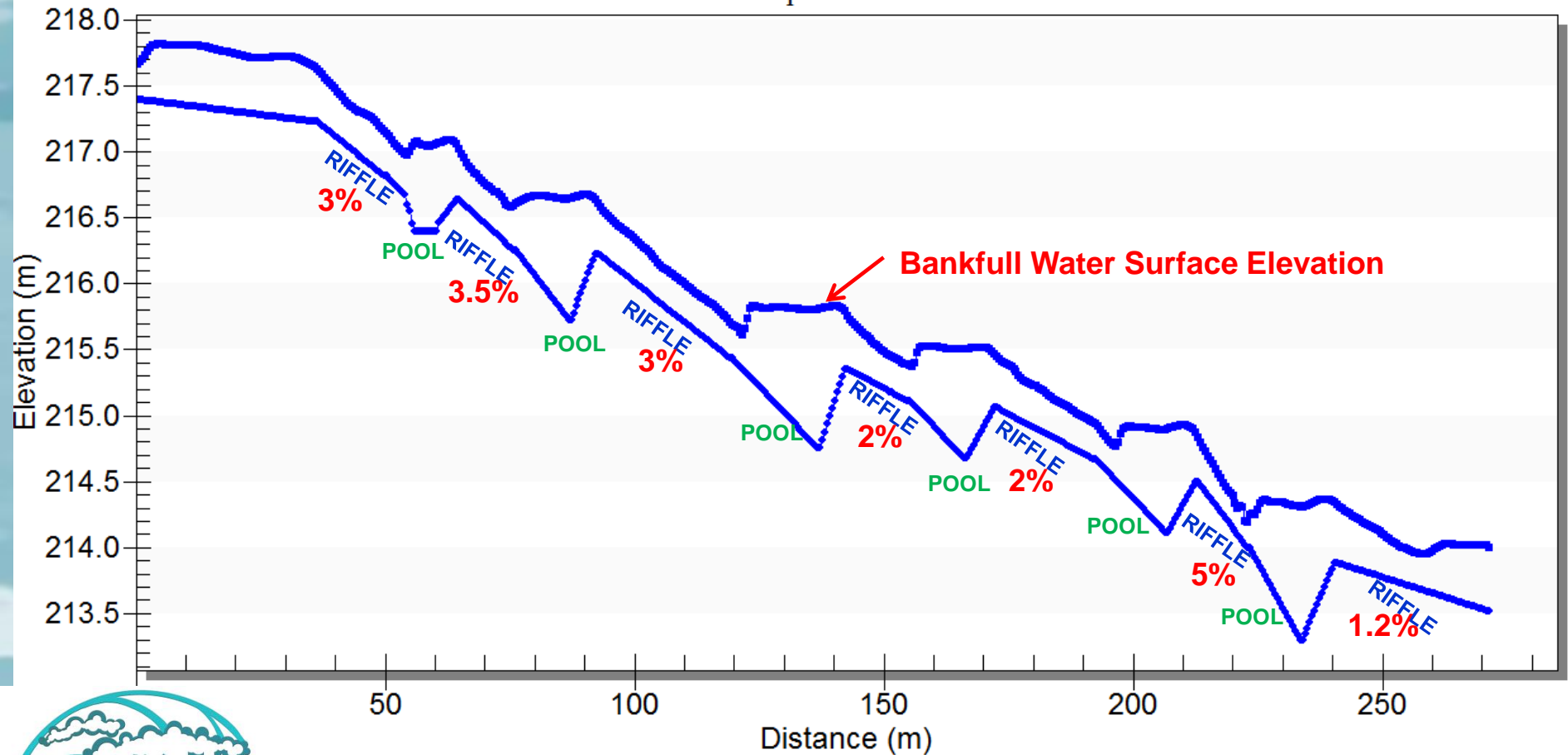
Innovative Tool for Natural Channel Design
Check Water Surface Elevation & Knick-Point

Innovative Tool for Natural Channel Design
Channel Velocity Distribution
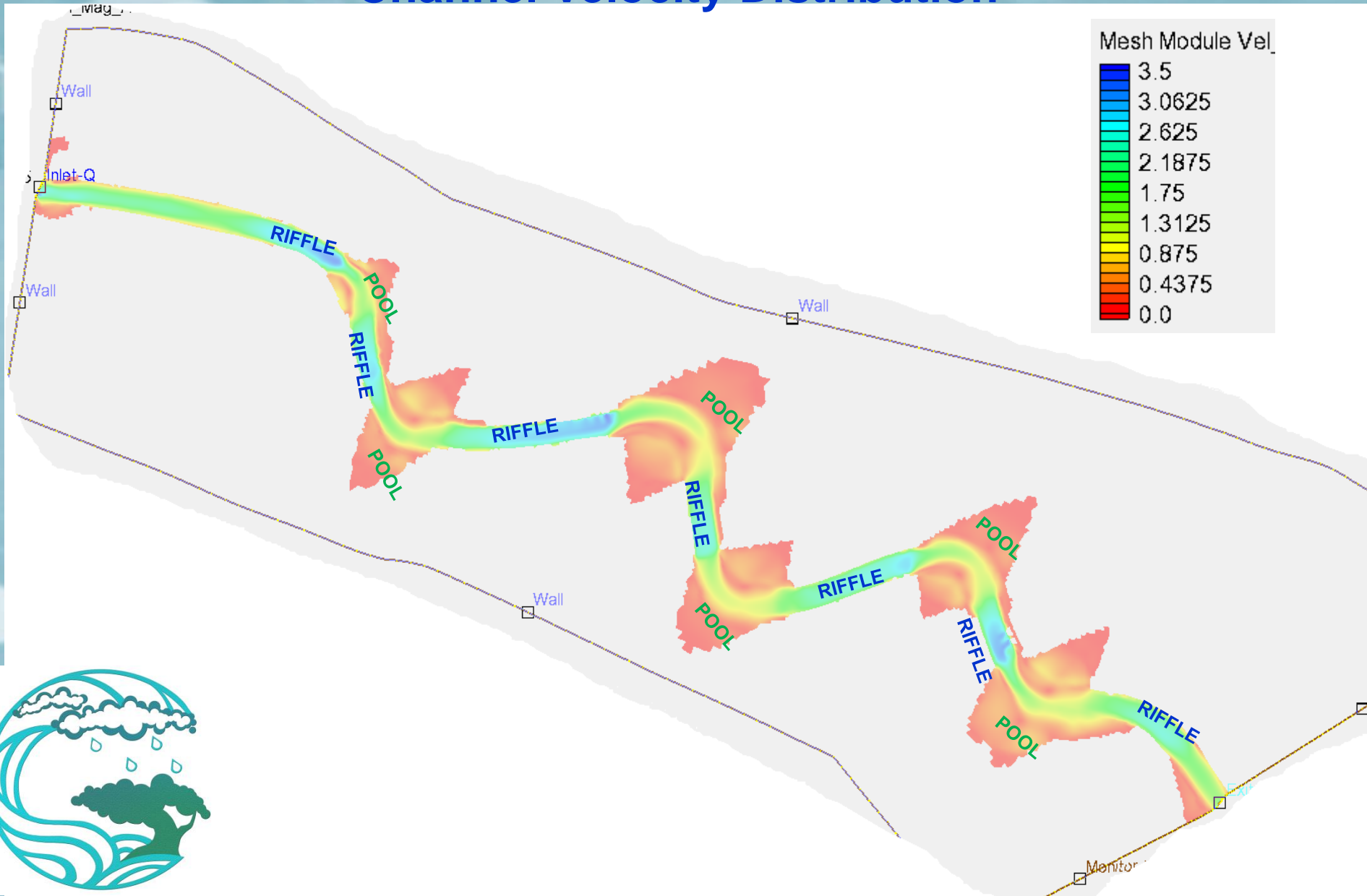
Innovative Tool for Natural Channel Design
Channel Velocity Distribution
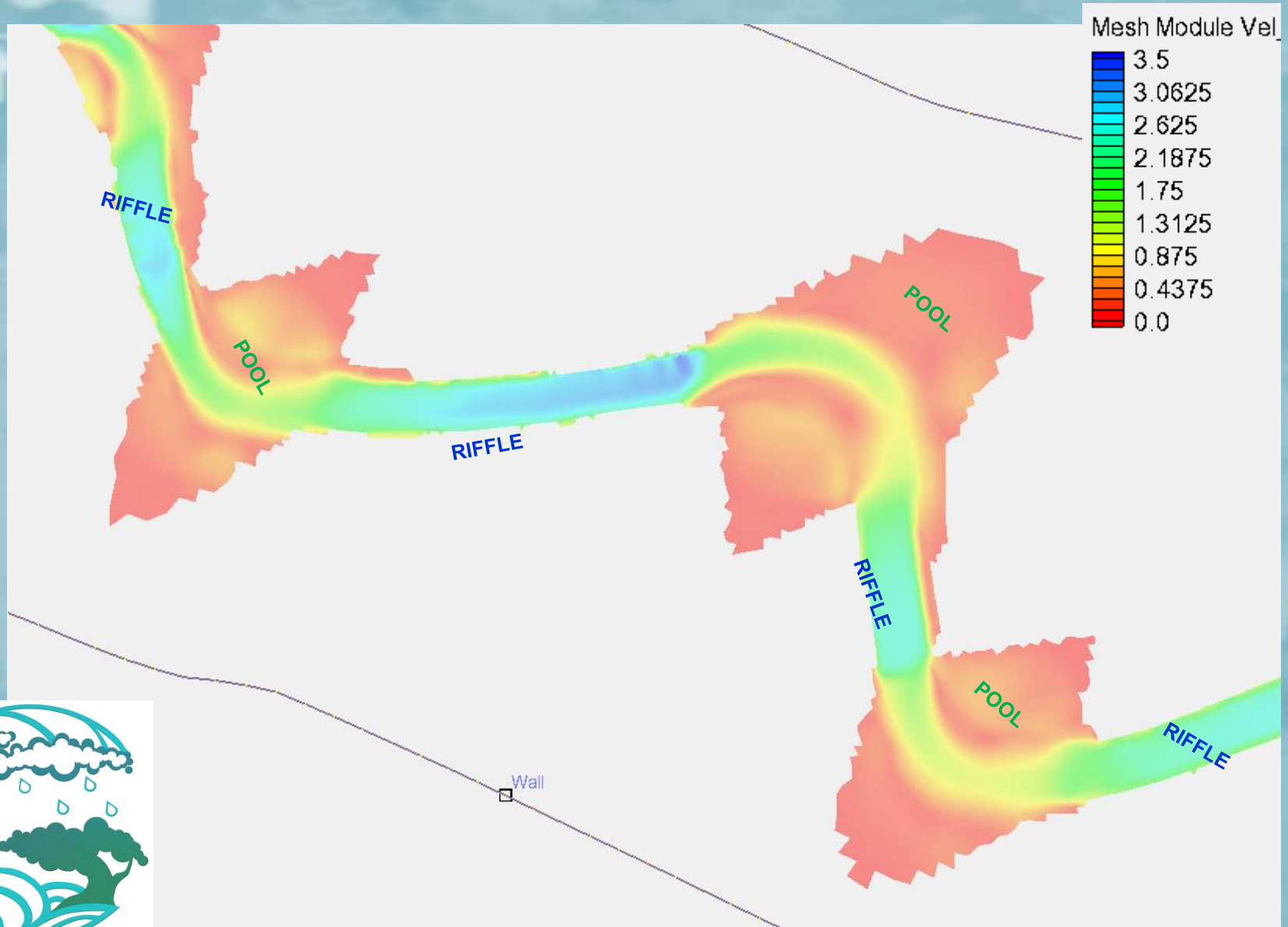
1D Model VS 2D Model

2 Dimensional Flow Trace
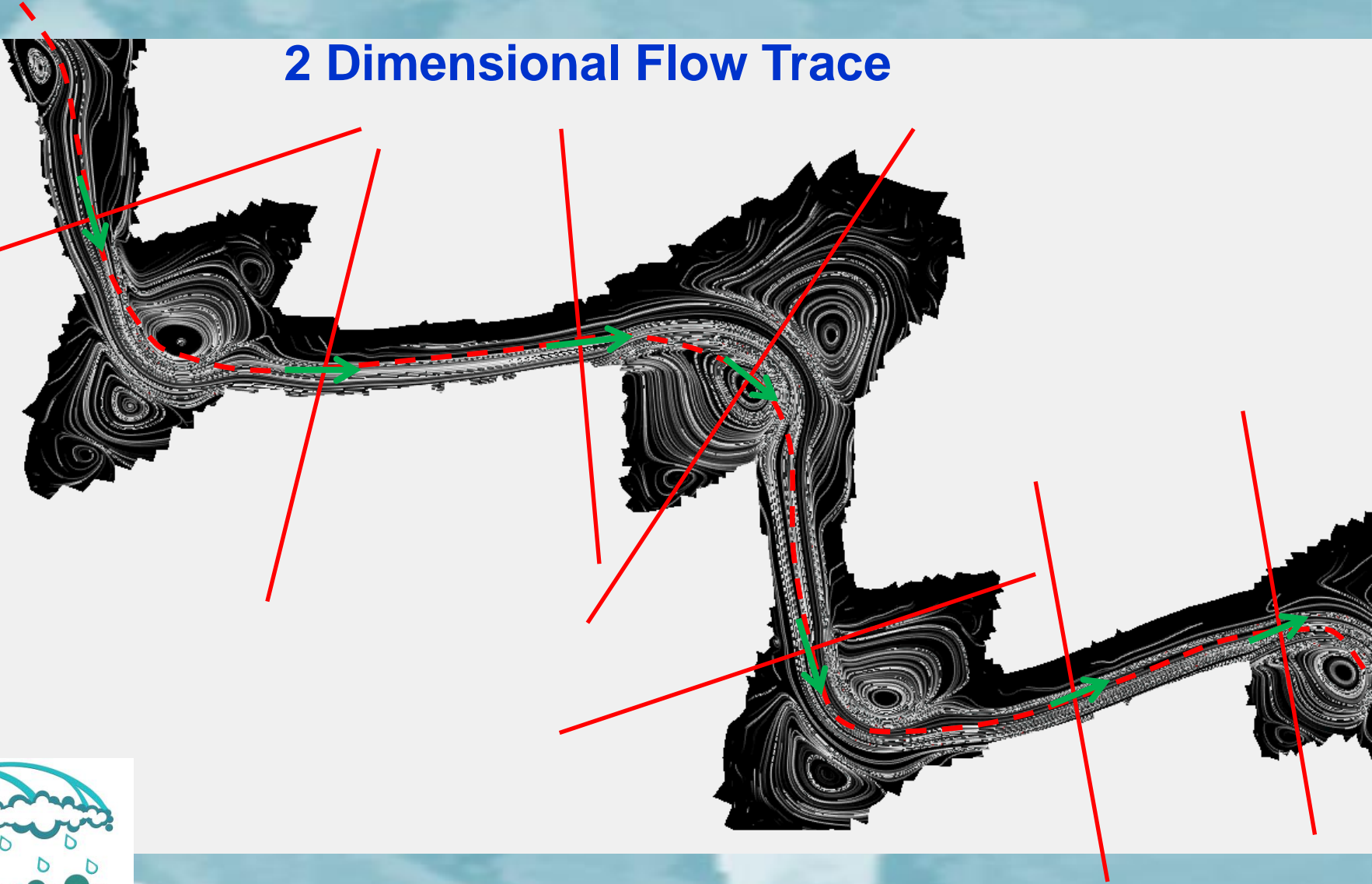
1D Model VS 2D Model
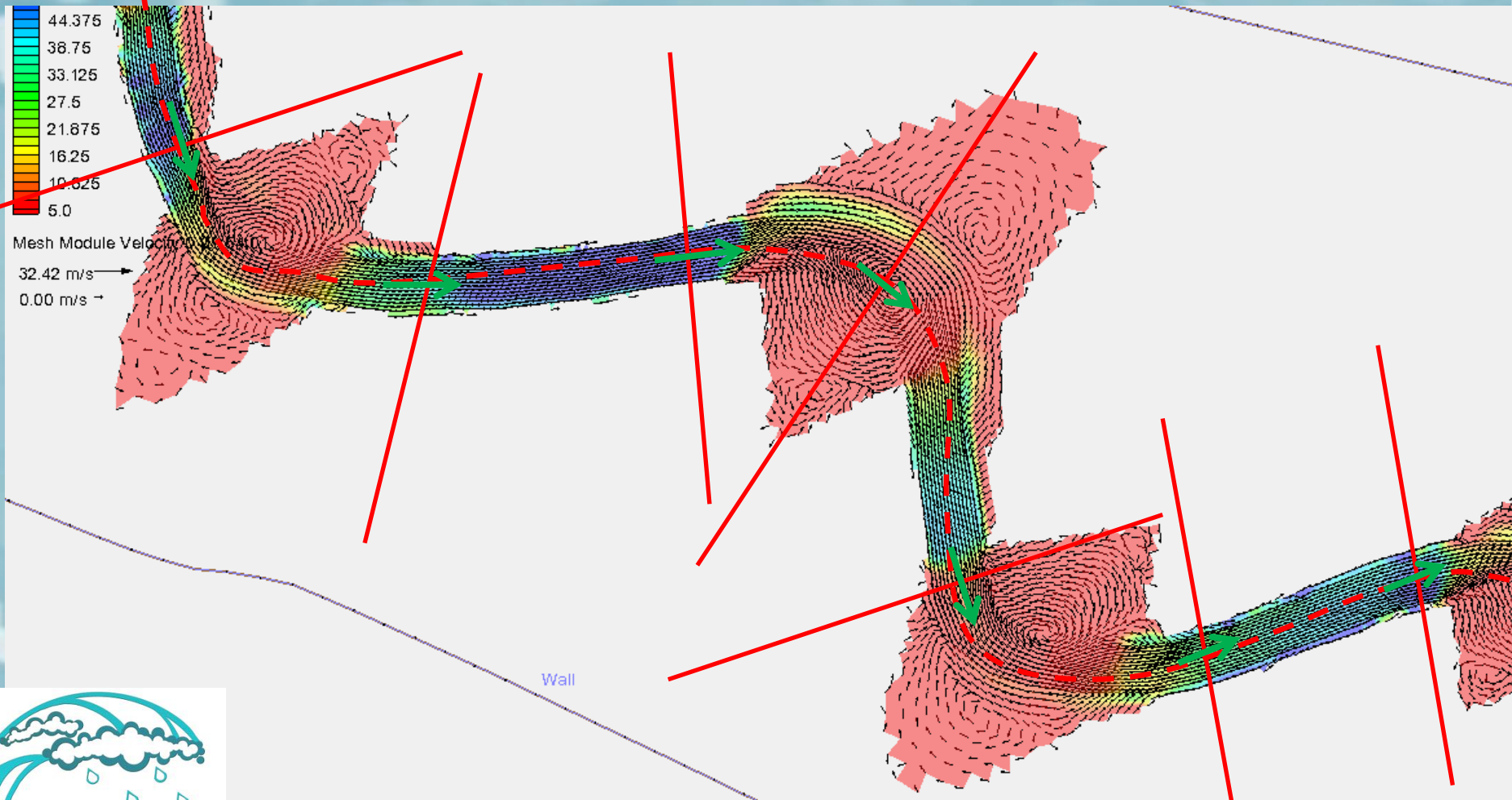
2 Dimensional Flow

Innovative Tool for Natural Channel Design

2 Dimensional Flow Field
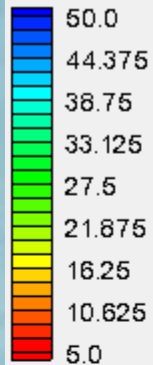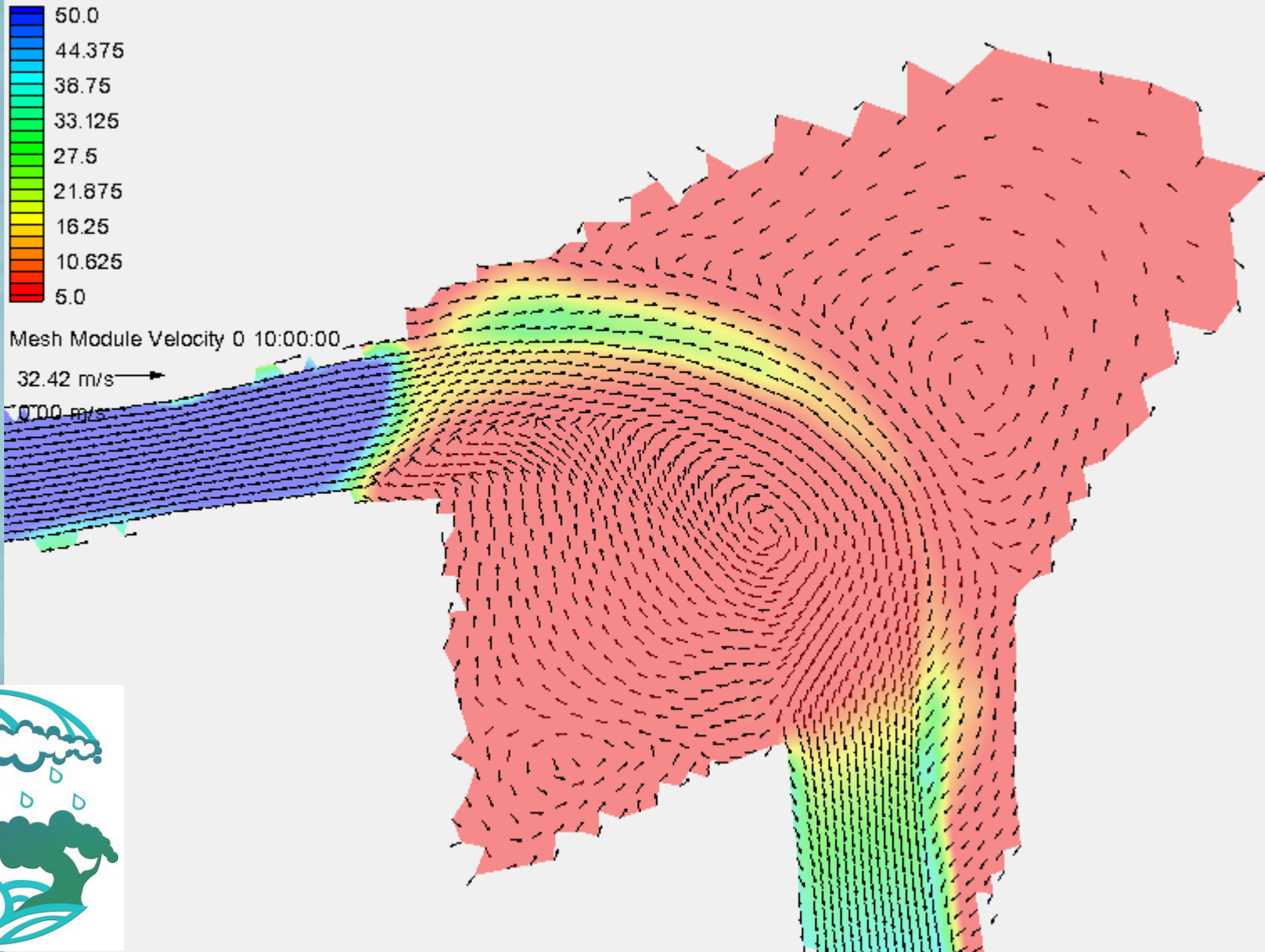
Innovative Tool for Natural Channel Design
Check Water Surface Elevation & Knick-Point

Innovative Technique for Natural Channel Design
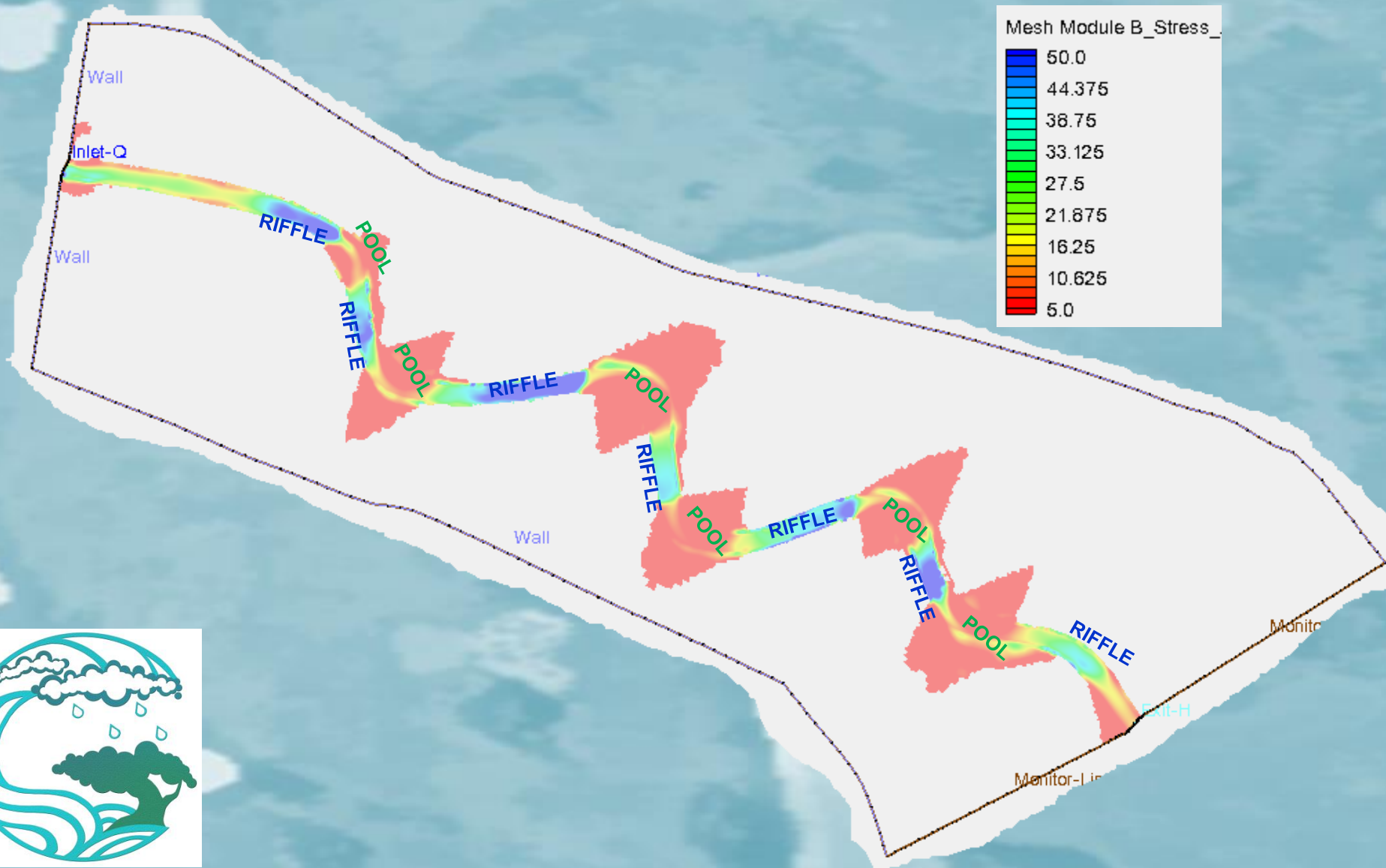
Bed Shear Stress

Innovative Tool for Natural Channel Design

Bed Shear Stress

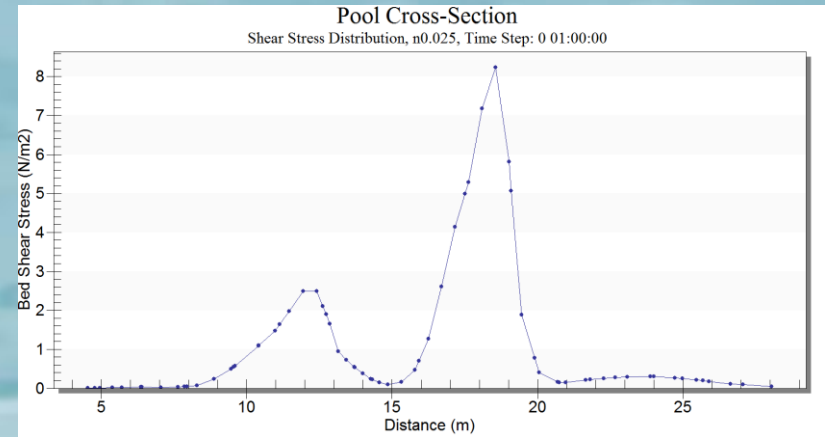Longitudinal Bed Shear
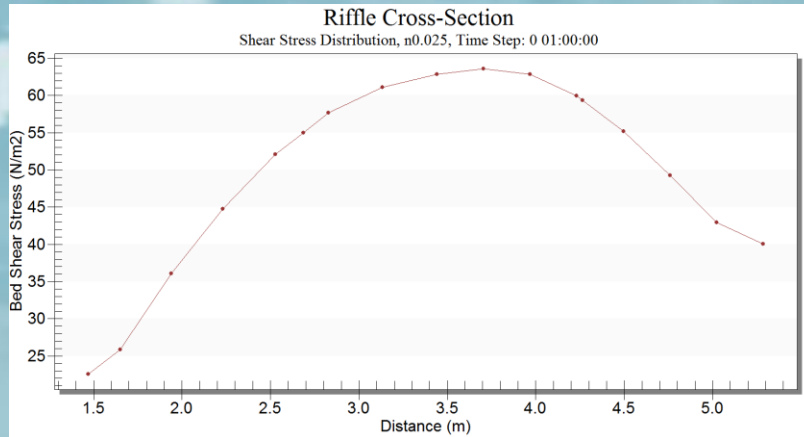B_Stress_Active, Time Step: 0 01:00:00
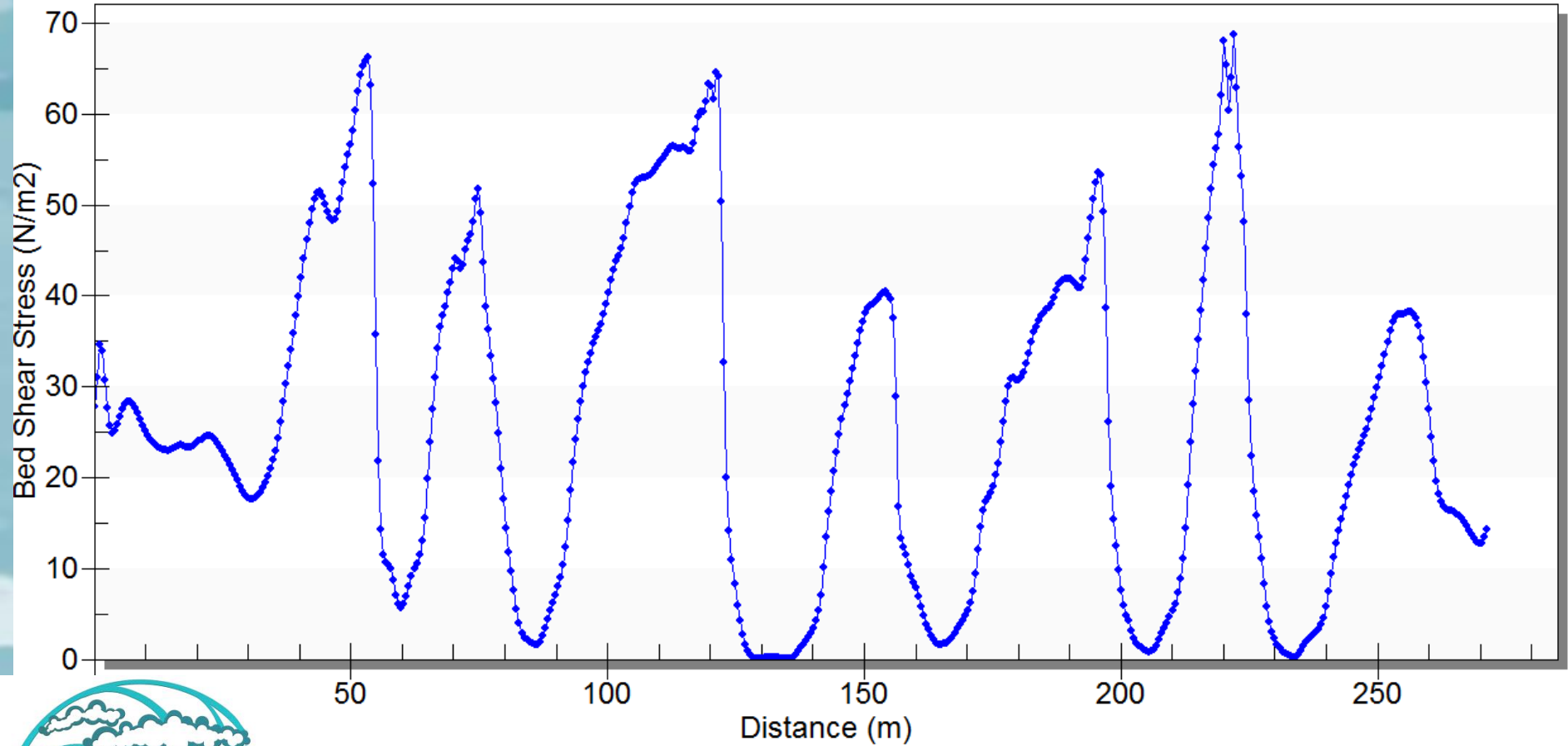
Fish Habitat Flow Field
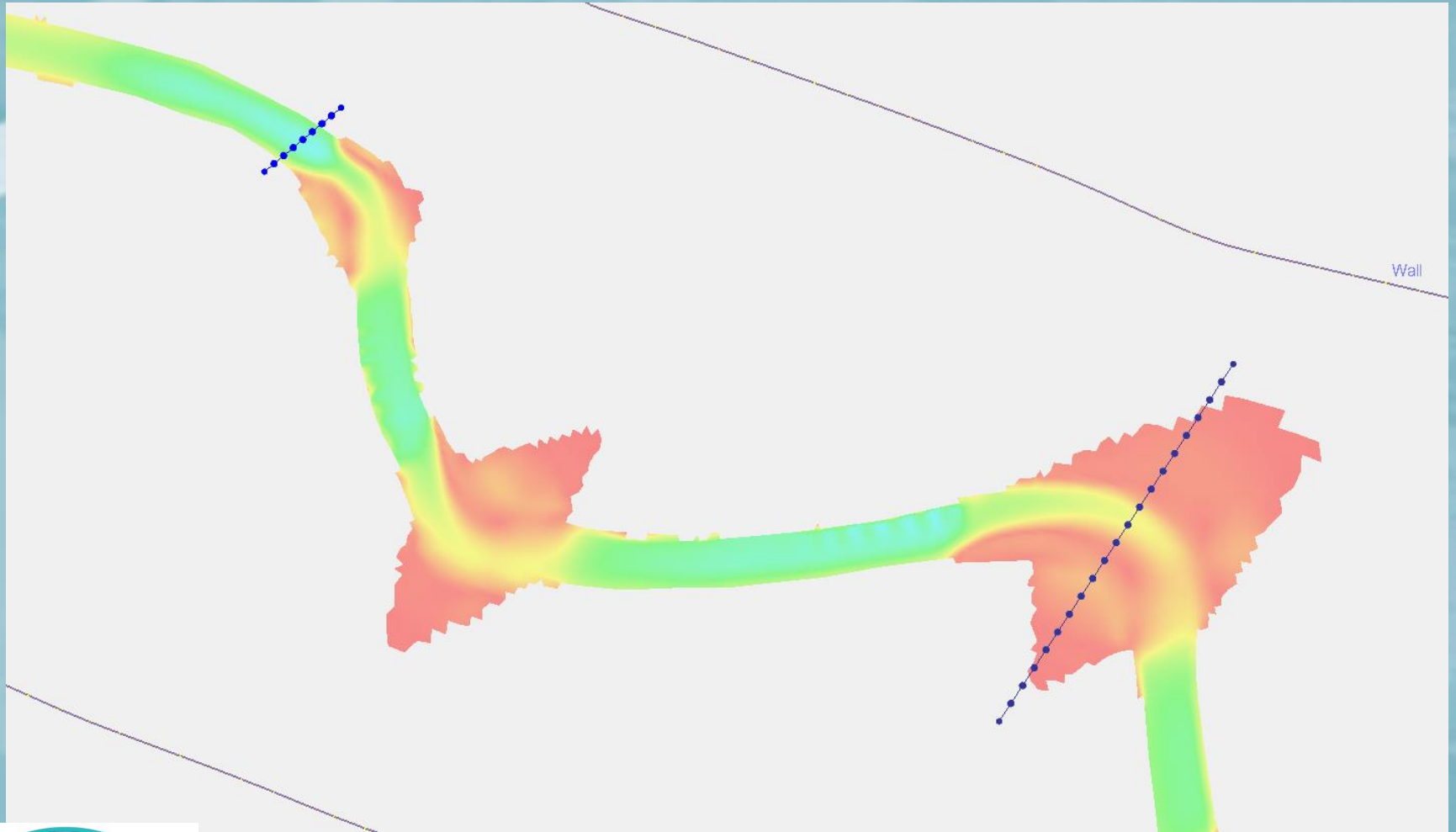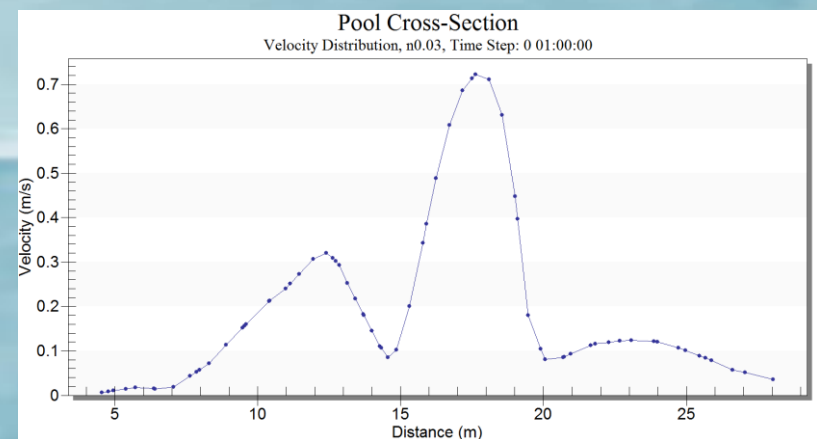
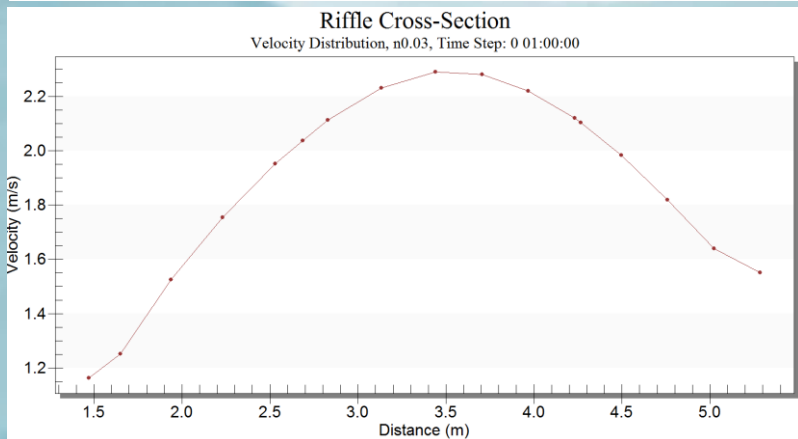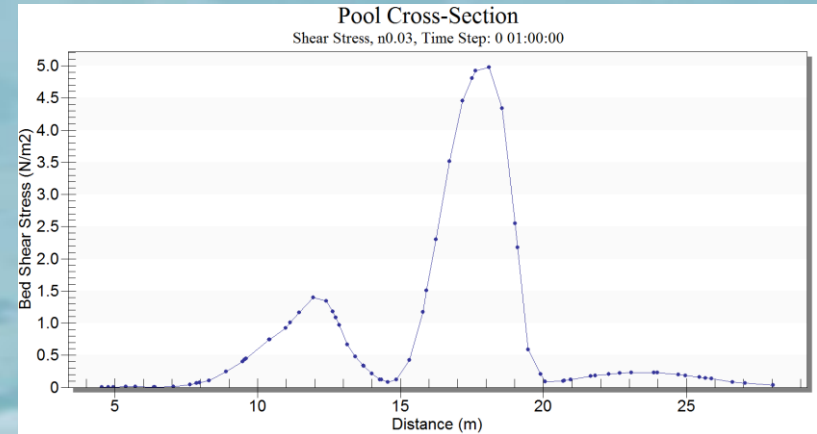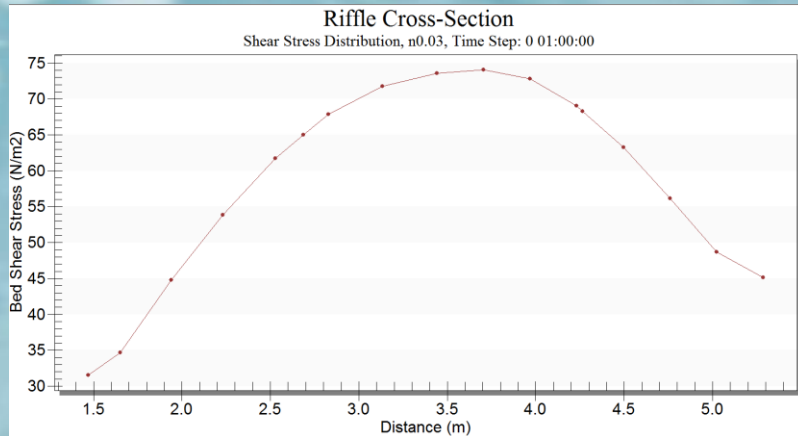# Fish Habitat Flow Field
NO Vegetation, Manning's n 0.021
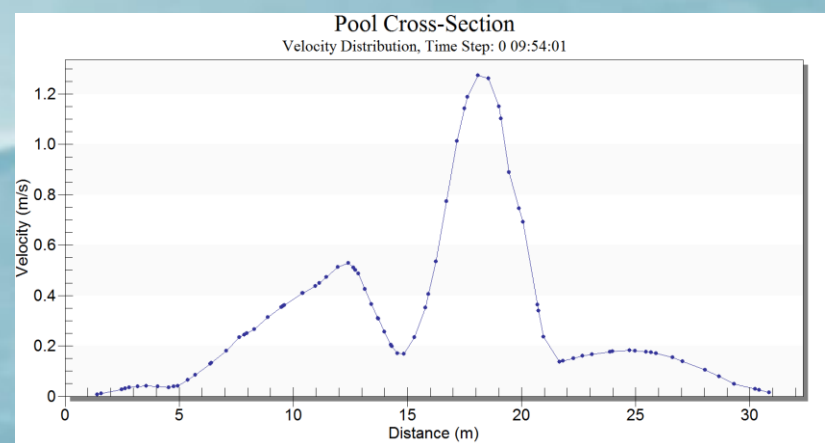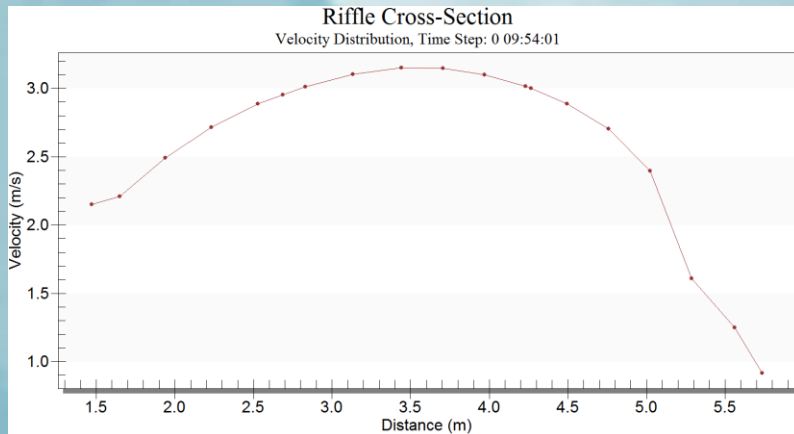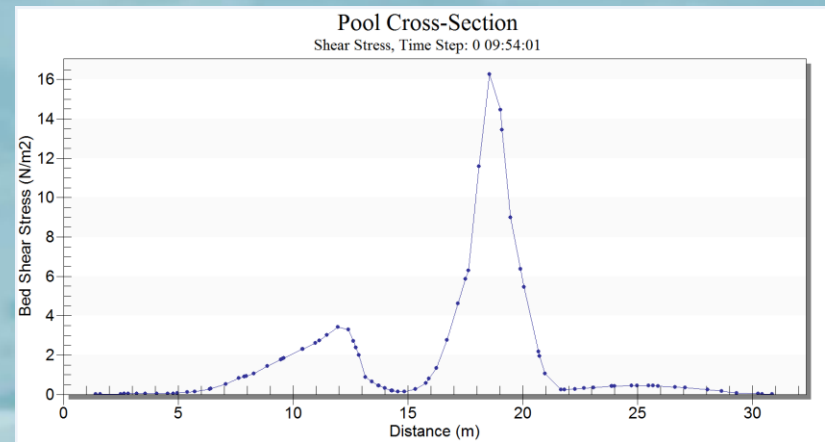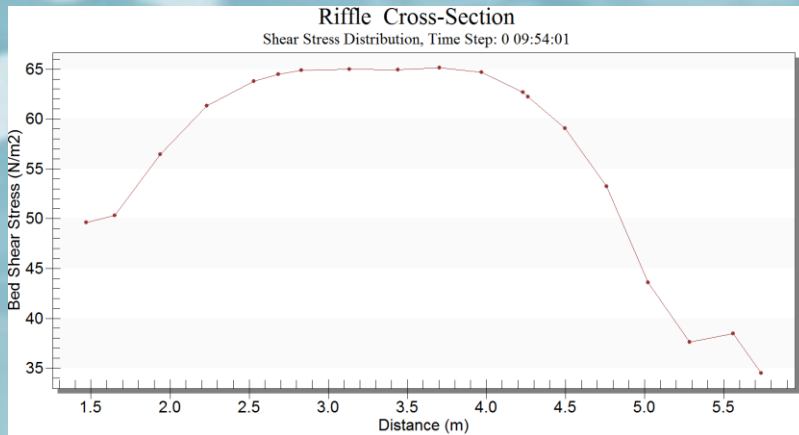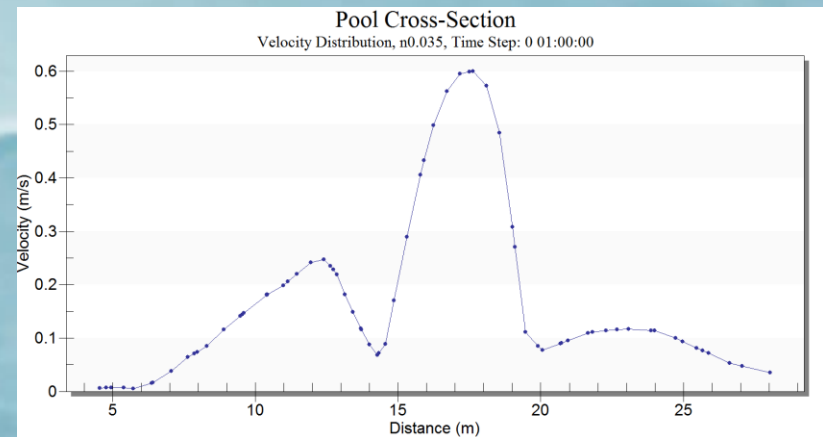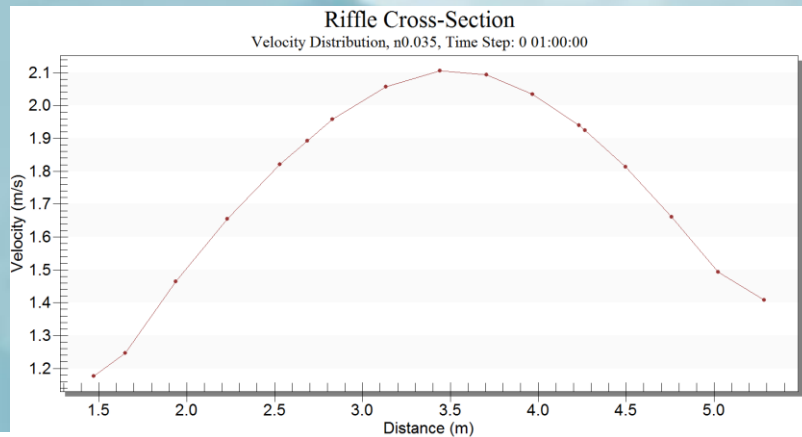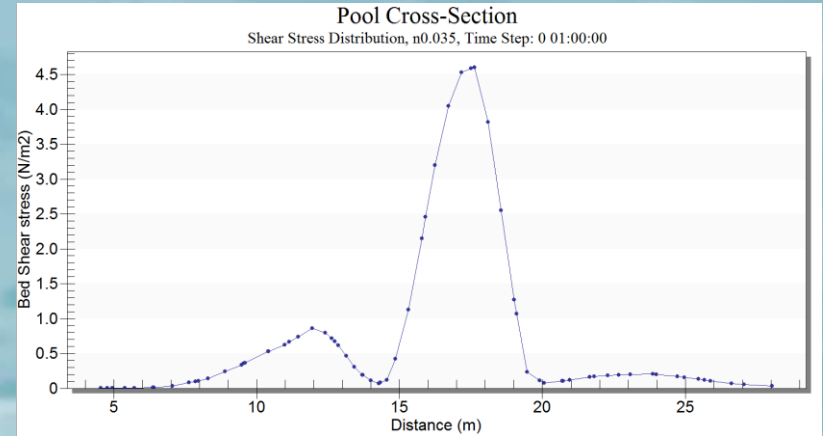
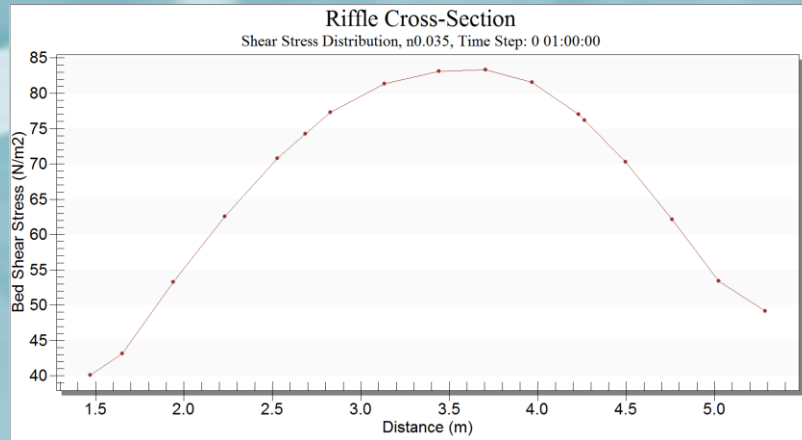# Fish Habitat Flow Field
Low Vegetation, Manning's n 0.025
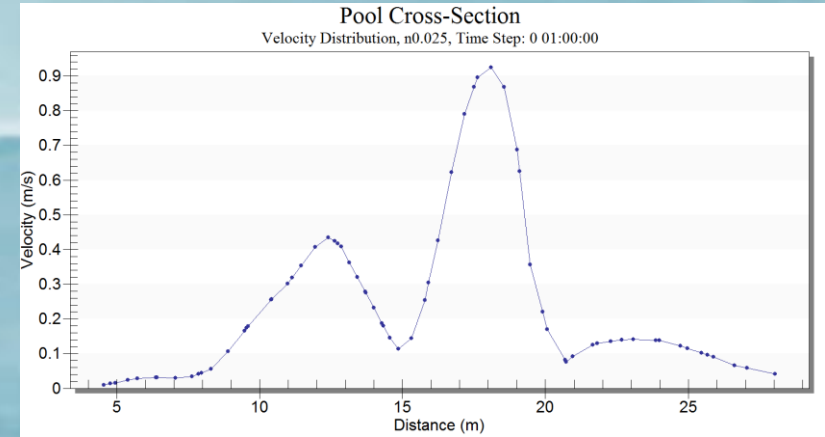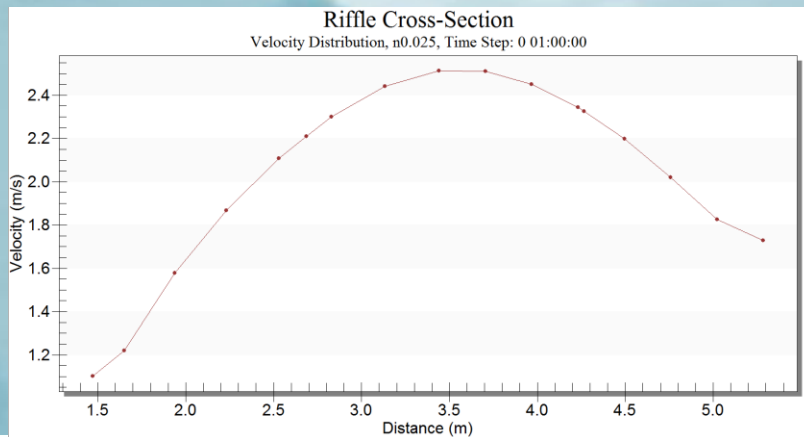
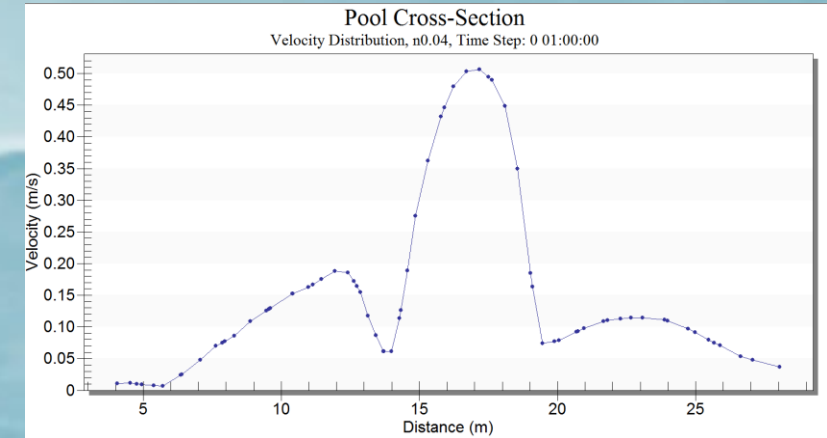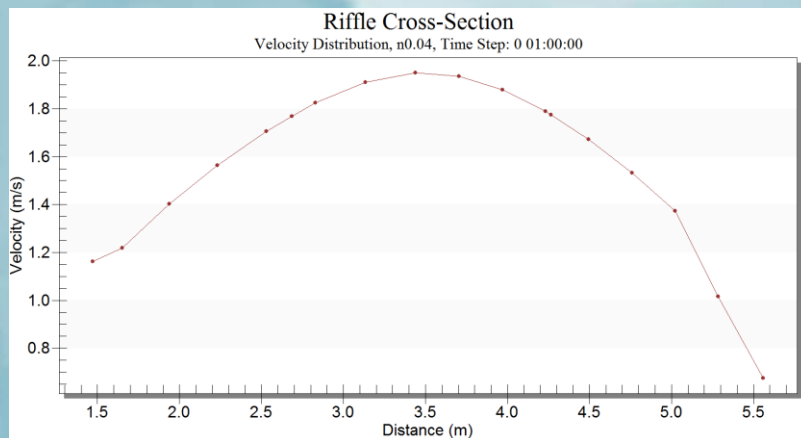# Fish Habitat Flow Field
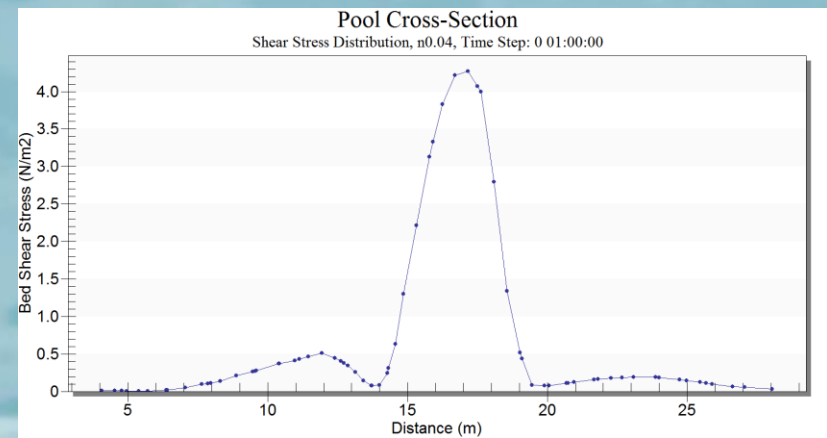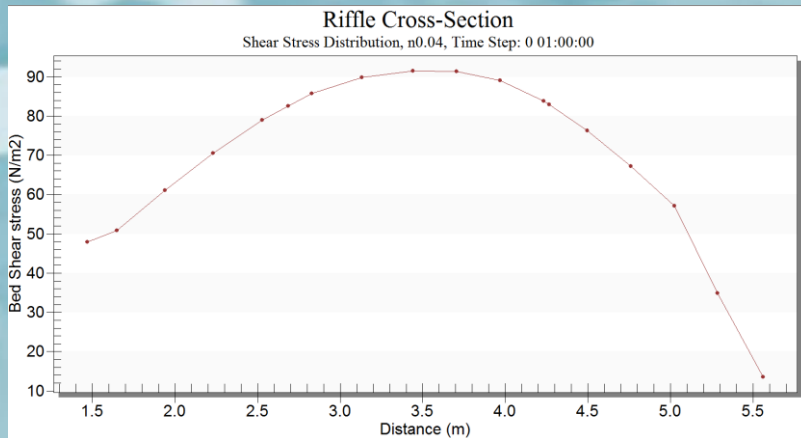## Sparse Vegetation, Manning's n 0.03

Fish Habitat Flow Field
Medium Vegetation, Manning's n 0.035

Fish Habitat Flow Field
Dense Vegetation, Manning's n 0.04

Riffle Cross-Section — Shear Stress Distribution, n0.04, Time Step: 0 01:00:00

Pool Cross-Section — Shear Stress Distribution, n0.04, Time Step: 0 01:00:00

Riffle Cross-Section — Velocity Distribution, n0.04, Time Step: 0 01:00:00

Pool Cross-Section — Velocity Distribution, n0.04, Time Step: 0 01:00:00

Fish Habitat Flow Field
Effect of Roughness & Vegetation

Fish Habitat Flow Field
Effect of Roughness & Vegetation
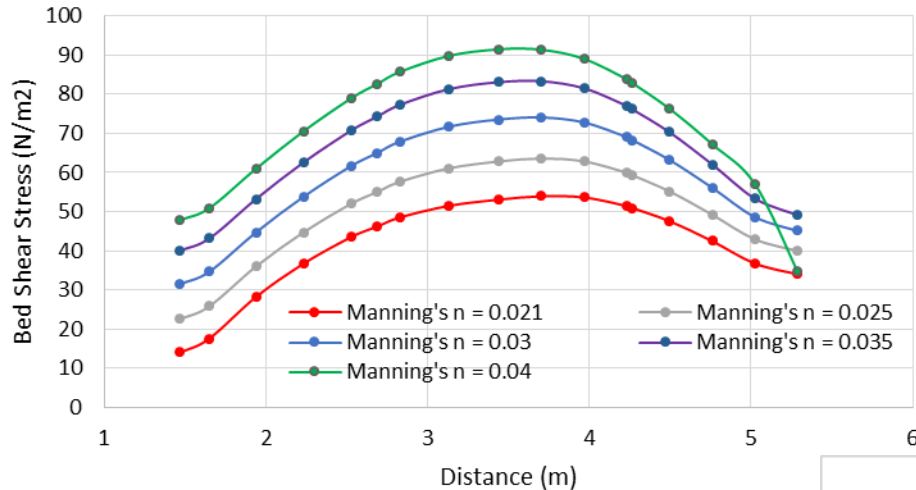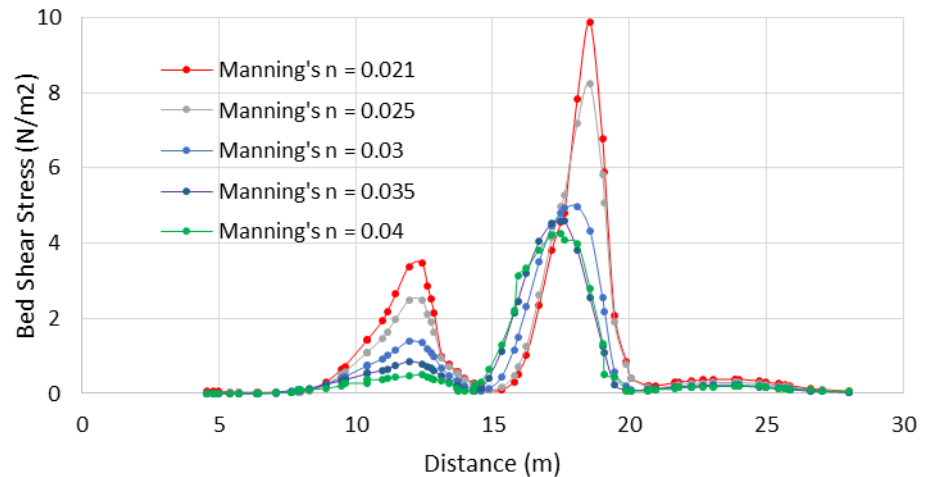
Application of the Innovative Technique

- **Natural Channel Design, Channel Restoration & Stabilization**

- **Compute Precise Shear Stress**

- **Determine Substrate Material for Channel Stability**

- **Maximize Application of Vegetation**

- **Check Potential Fish Barrier Knickpoint**

- **Check Wetland and Floodplain Function**

- **Hydraulics for Fish Habitat Analysis**

- **Generate Bathymetry Data from 1D Model XS**

Thank You !

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Phone: 519-400-0264, Email: bahar@ahydtech.ca