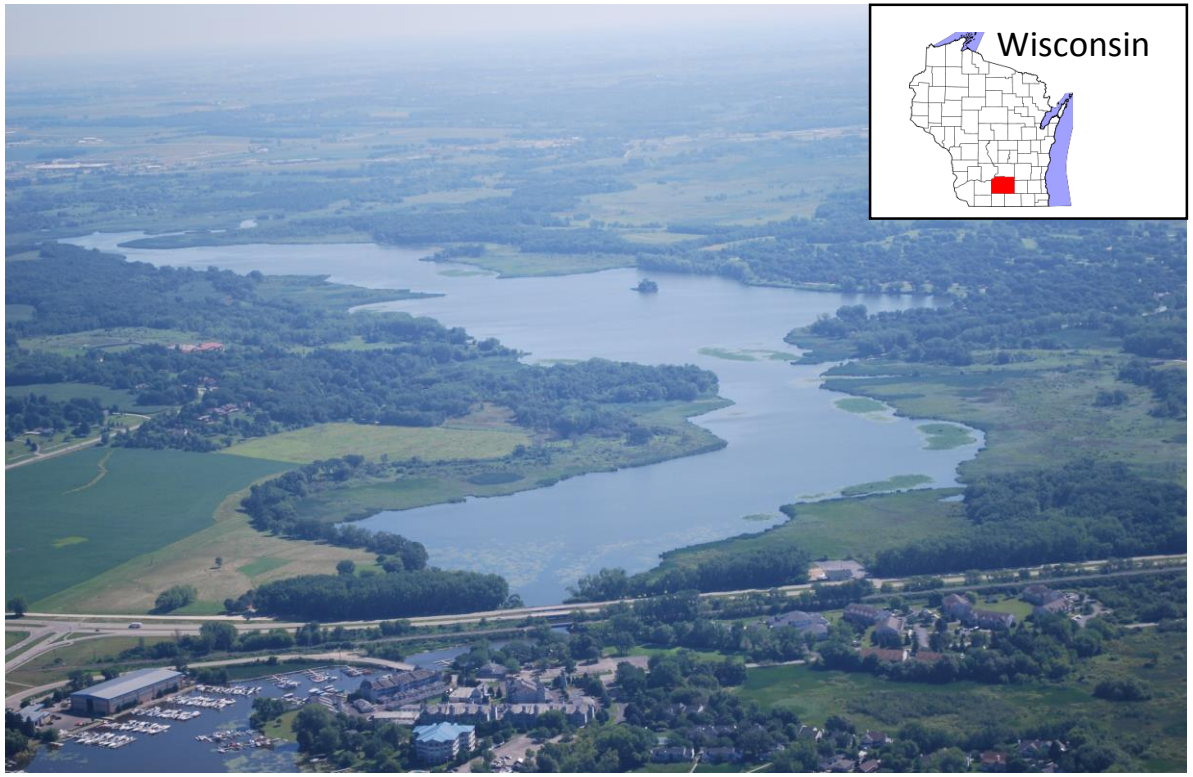
Effectiveness of Braided-Island Rehabilitation in Cherokee Marsh, Wisconsin



AWRA Wisconsin, 42nd Meeting, March 8, 2018

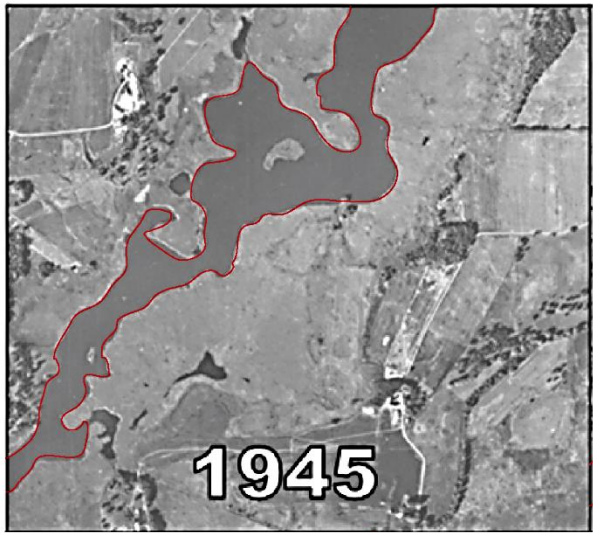
Peter Torma , John R. Reimer , Chin H. Wu

University of Wisconsin–Madison

Budapest University of Technology and Economics, Hungary

MŰEGYETEM 1782

Motivations



640 acres lost **~ 1 square mile**

Cherokee Marsh *is* *disappearing*!

Rehabilitation Alternatives

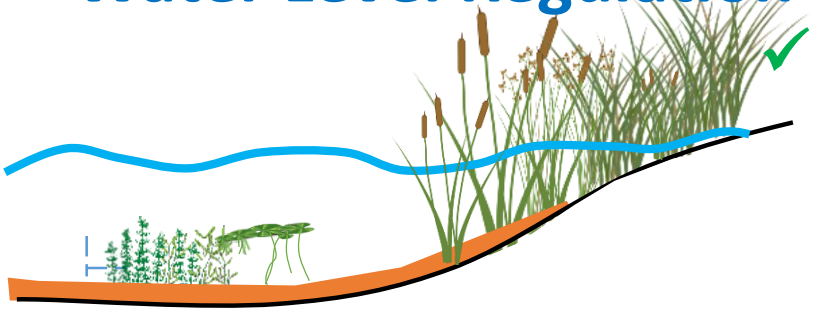
- **Floating Bog Interceptors (FBIs)**

✓ Stabilize shoreline

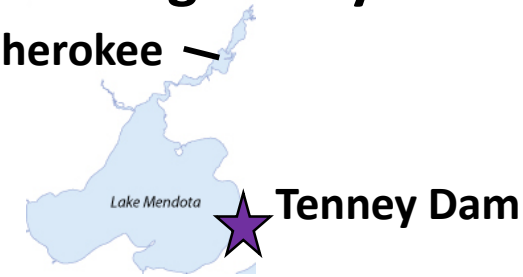
✓ Improve biodiversity

✘ Local Solution

- **Water Level Regulation**



✓ Restore globally



✘ Public Interest

- **Braided Islands Rehabilitation**

✓ Rehabilitate regionally

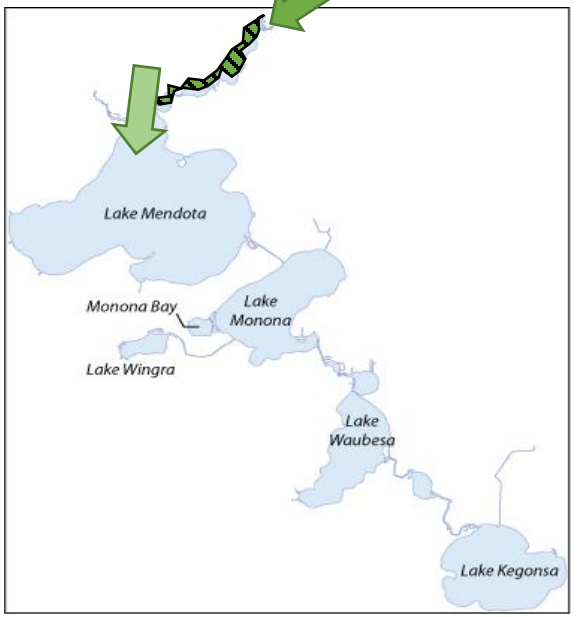
✓ Provide diversities

? Effectiveness

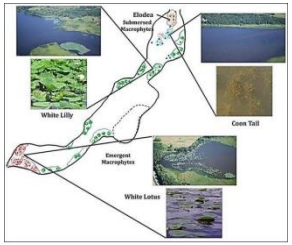
Research Objective

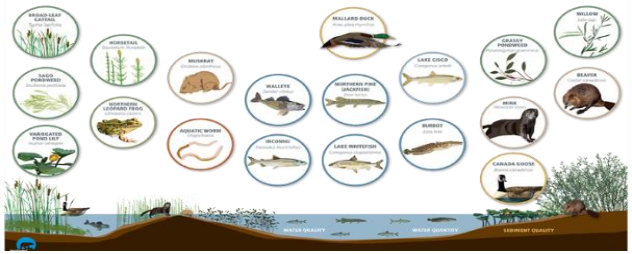
Assess effectiveness of braided islands rehabilitation in Cherokee Marsh, Wisconsin

- Reduce sediment/nutrient loading



- Promote diversified habitat and improve biodiversity



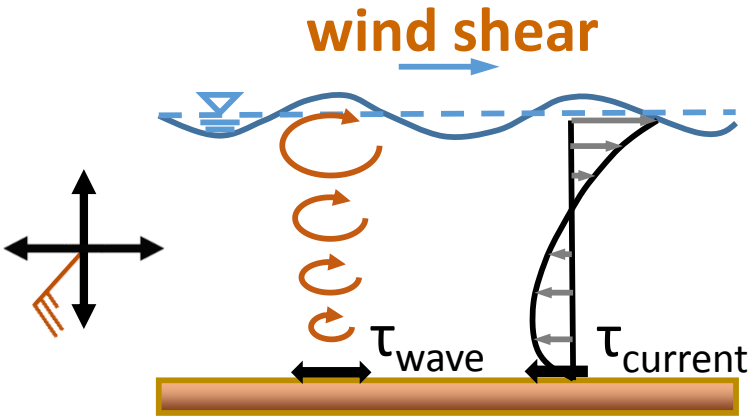


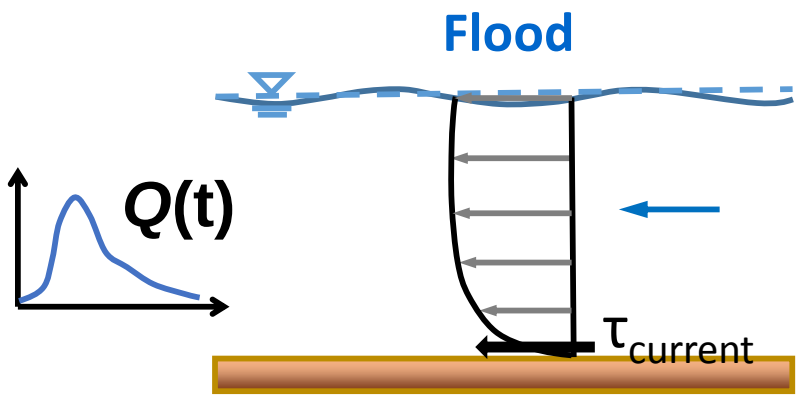
Vegetation Fish Wildlife

Assessment Framework

Statistics

Return Period
1
10
50
100
500
1000

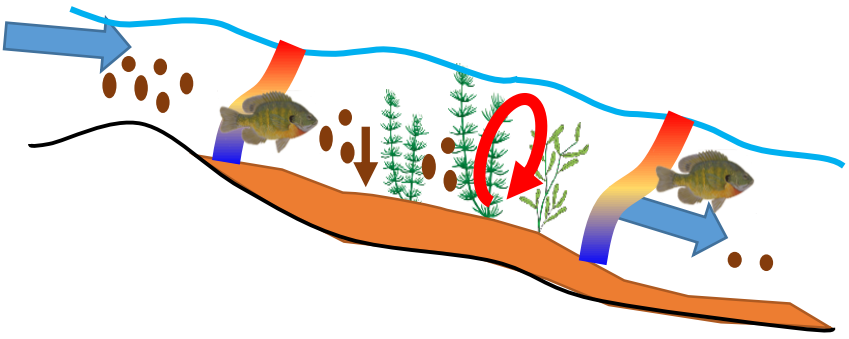




S-S Assessment Framework

Sensitivity

Water Level	Temperature
High (Flood Level)	**Hot** (Summer)
Normal (Summer)	**Medium** (Spring)
Low (Winter)	**Cold** (Winter)



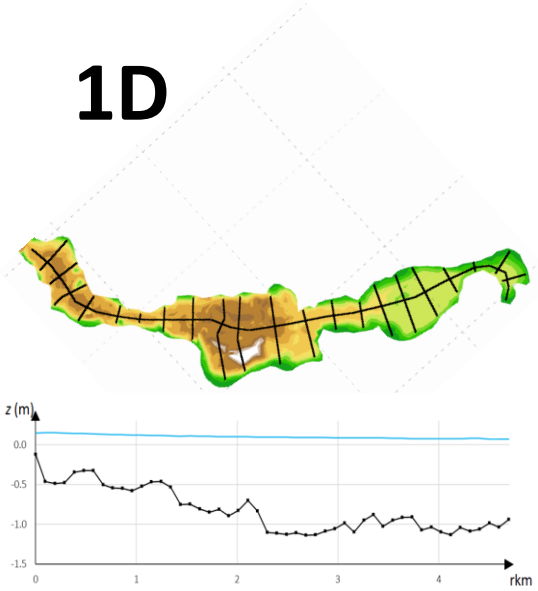
Velocity ⇔ Vegetation

Shear stress ⇔ Sedimentation

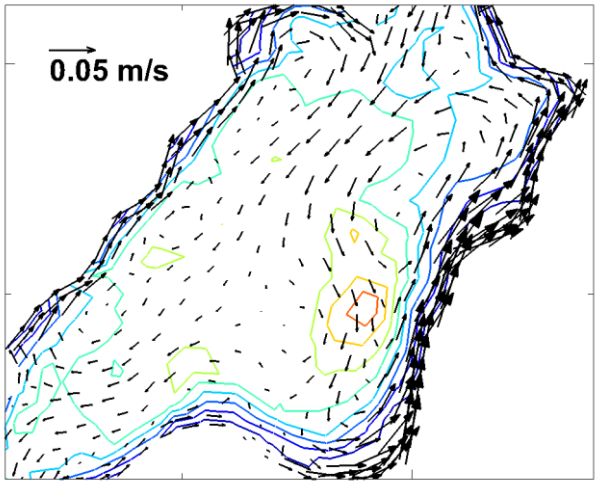
Temperature ⇔ Habitat

Modeling Approach

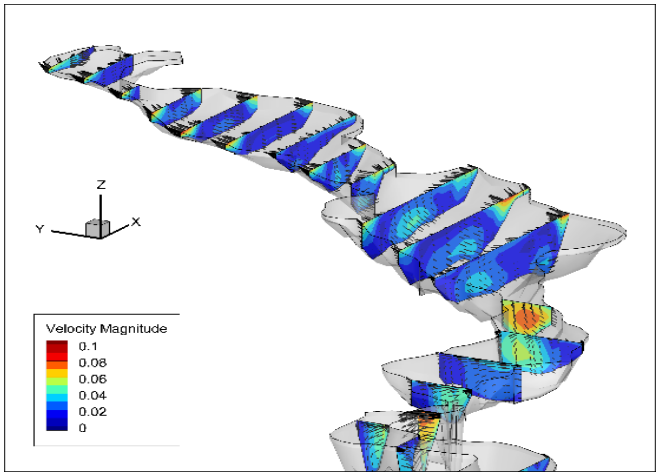
1D



2D



3D



Longitudinal profiles
- ✓ Water level
- ✓ Flow

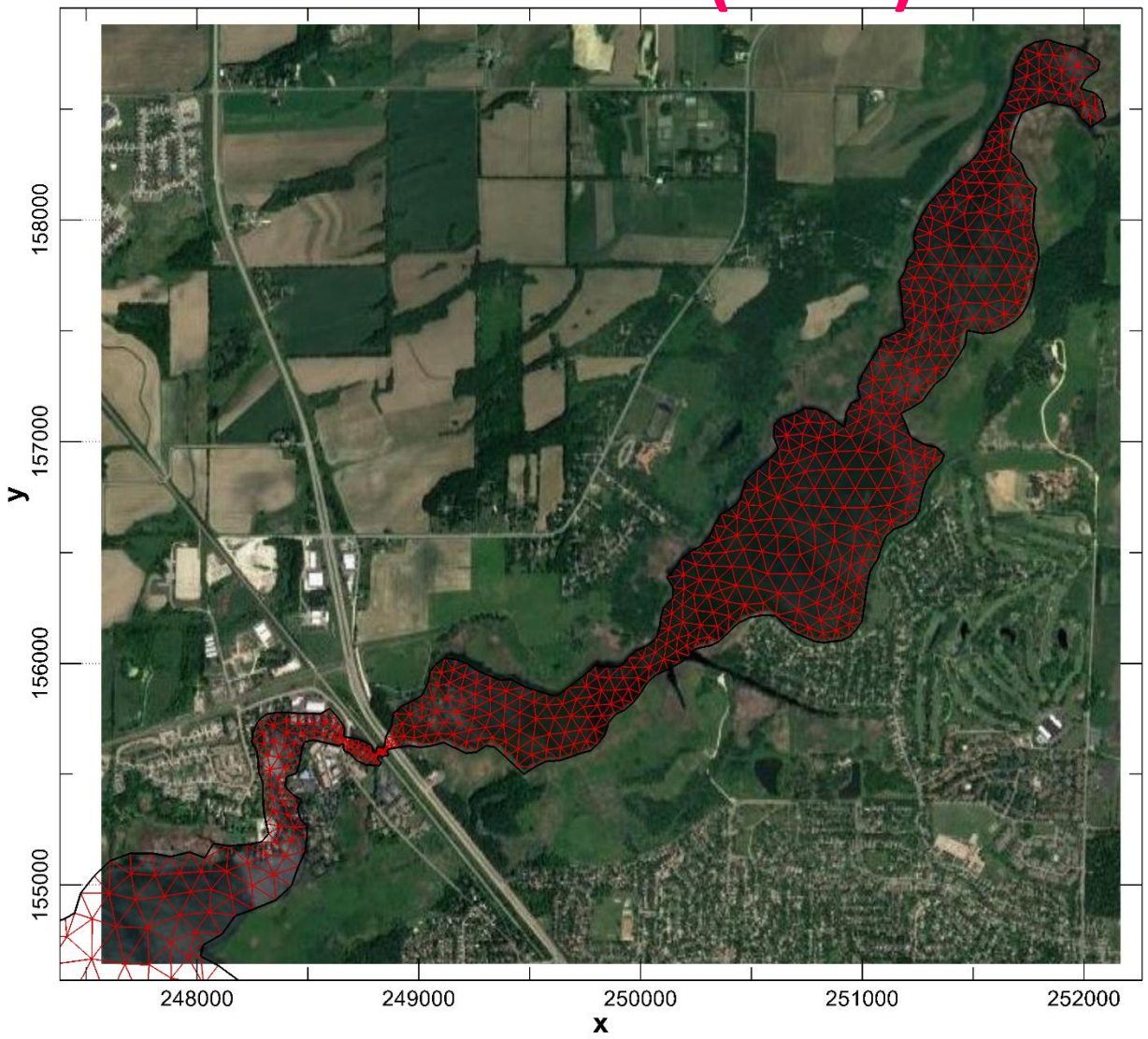
Wind induced
- ✓ Horizontal variations
- ✓ Wave motion

Vertical variations
- ✓ Thermal structure
- ✓ Wave-Current inter.

Waves - Hydrodynamics

Computational Mesh

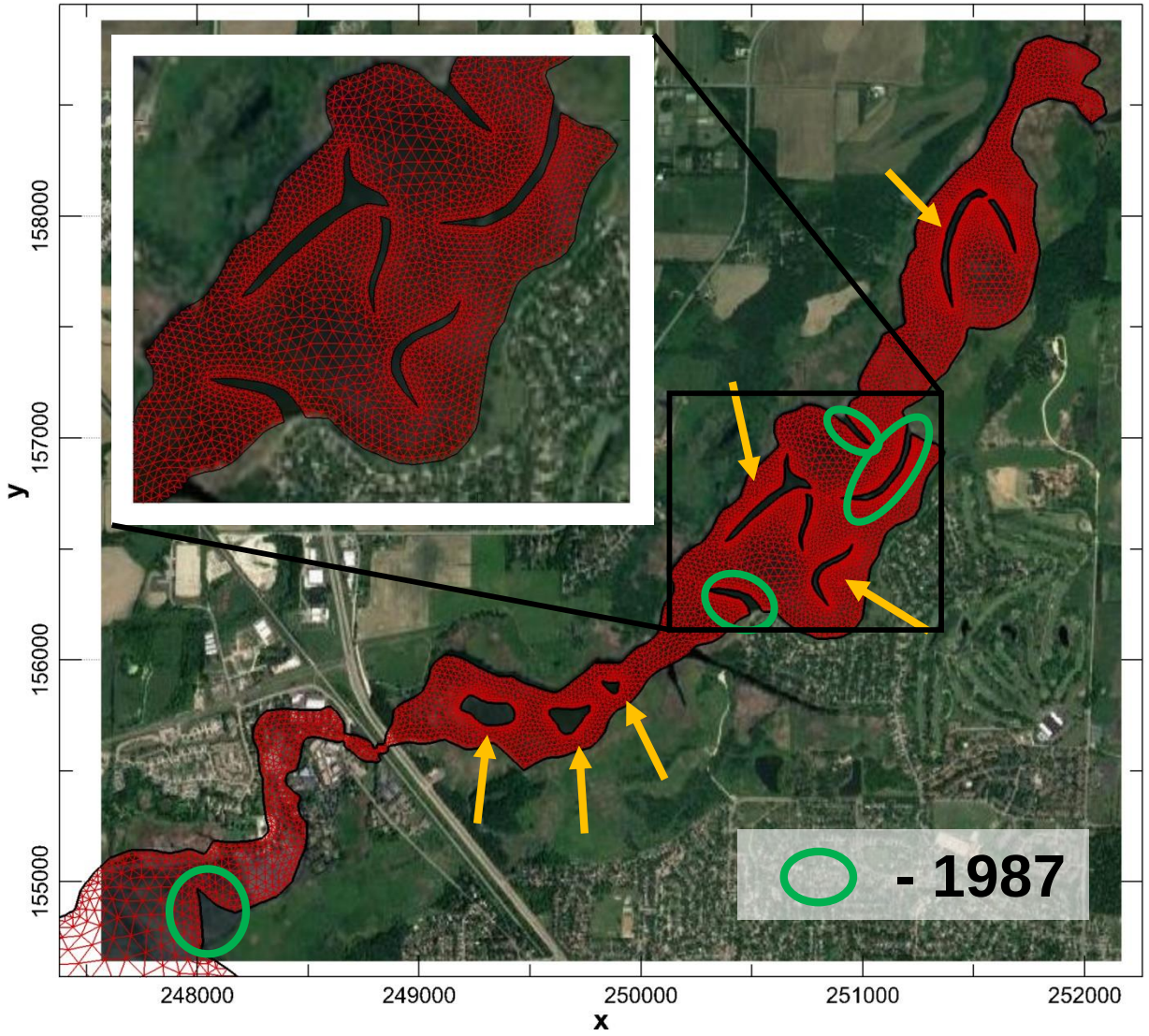
Present State (2017)



Δx:
50 m
–
100 m

Computational Mesh

Rehabilitated Braided Islands



Δx:
8 m
–
40 m

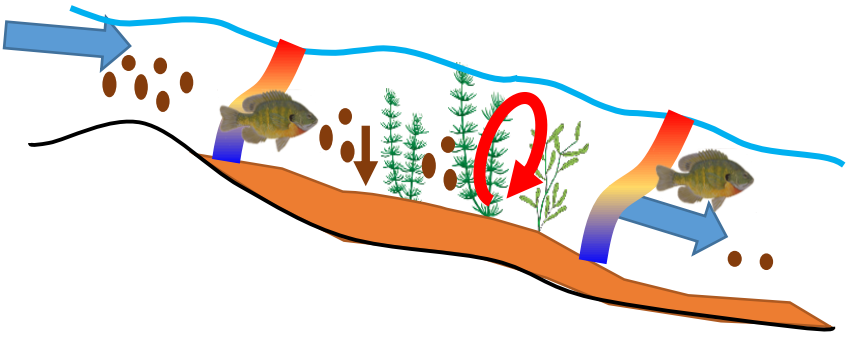
S-S Assessment Framework

Statistics

Return Period	Wind (m/s)	Flow (cfs)
1	21	102
10	31	207
50	38	642
100	41	995
500	48	2684
1000	51	4097

Sensitivity

Water Level	Temperature
High (Flood Level)	Hot (Summer)
Normal (Summer)	Medium (Spring)
Low (Winter)	Cold (Winter)



Shear stress ⇔ Sedimentation

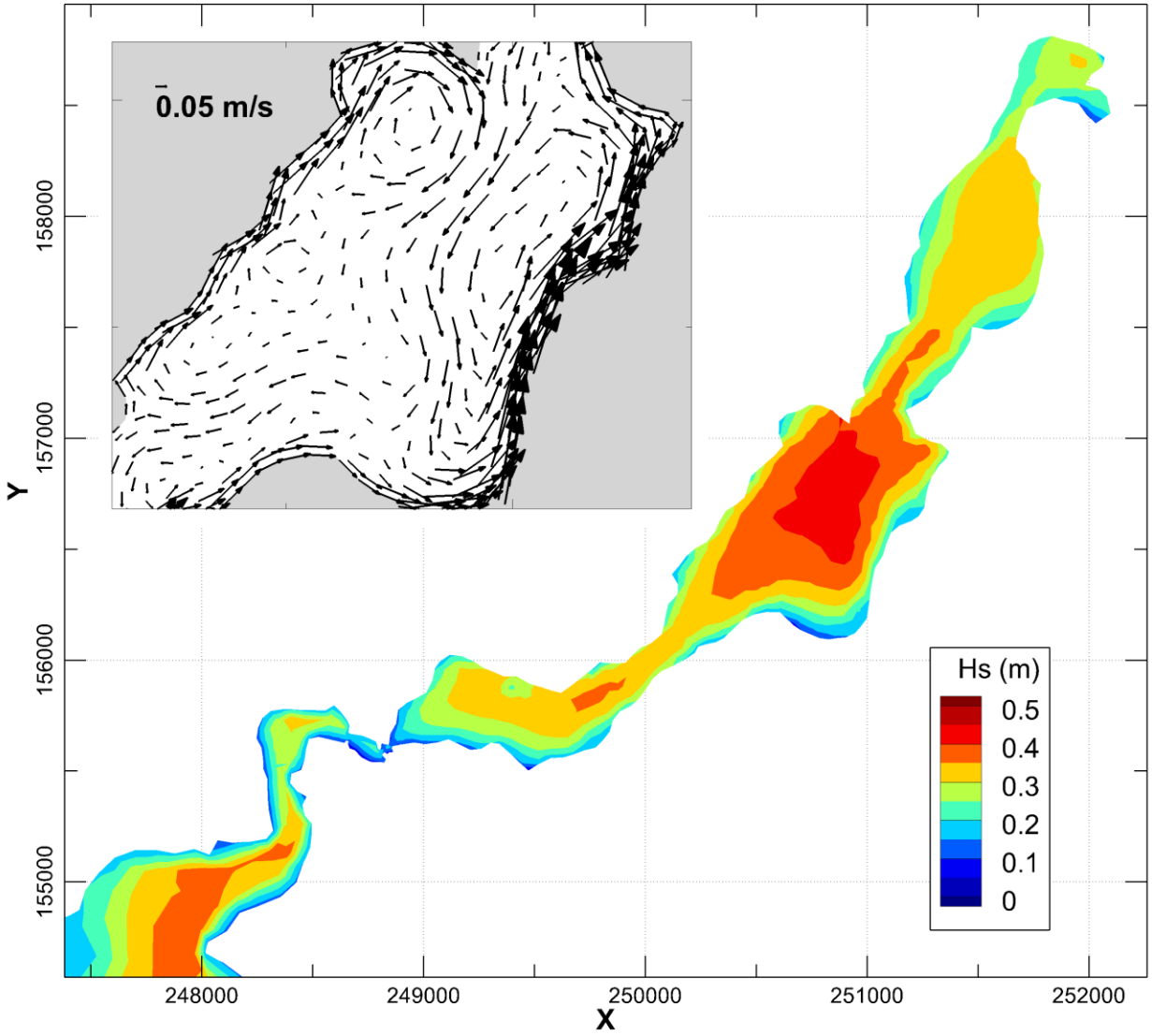
Velocity ⇔ Vegetation

Temperature ⇔ Habitat

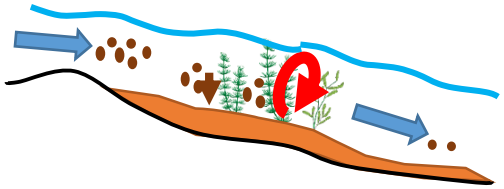
Present State

21 m/s

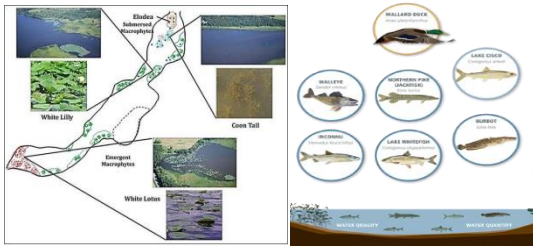
Wave Height



Reduce sediment loading



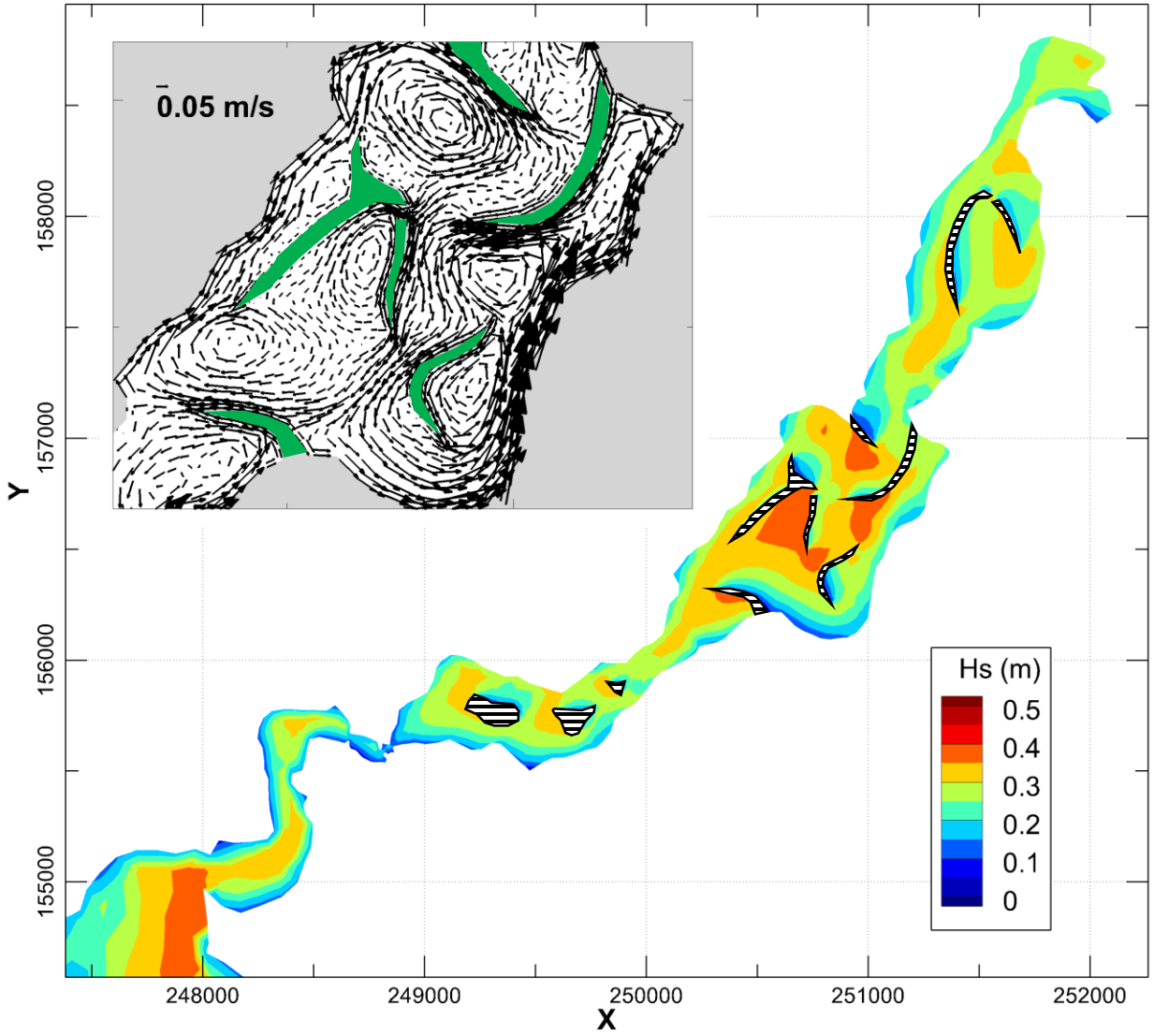
Provide diversified habitat



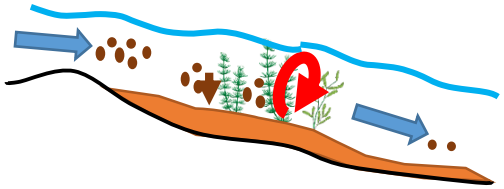
Rehabilitated Braided Islands

21 m/s

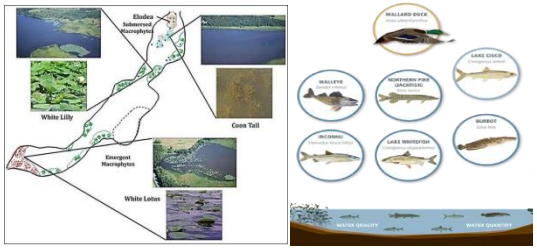
Wave Height



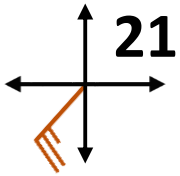
Reduce sediment loading



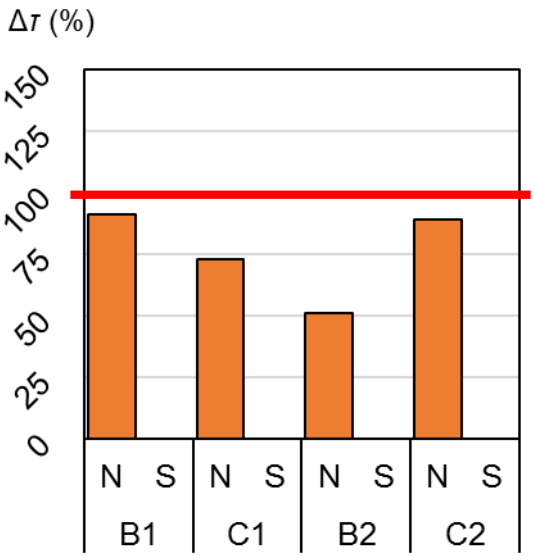
Provide diversified habitat



$$\text{Ratio} = \frac{\tau_b \text{ Rehabilitated Braided Islands}}{\tau_b \text{ Present State}}$$

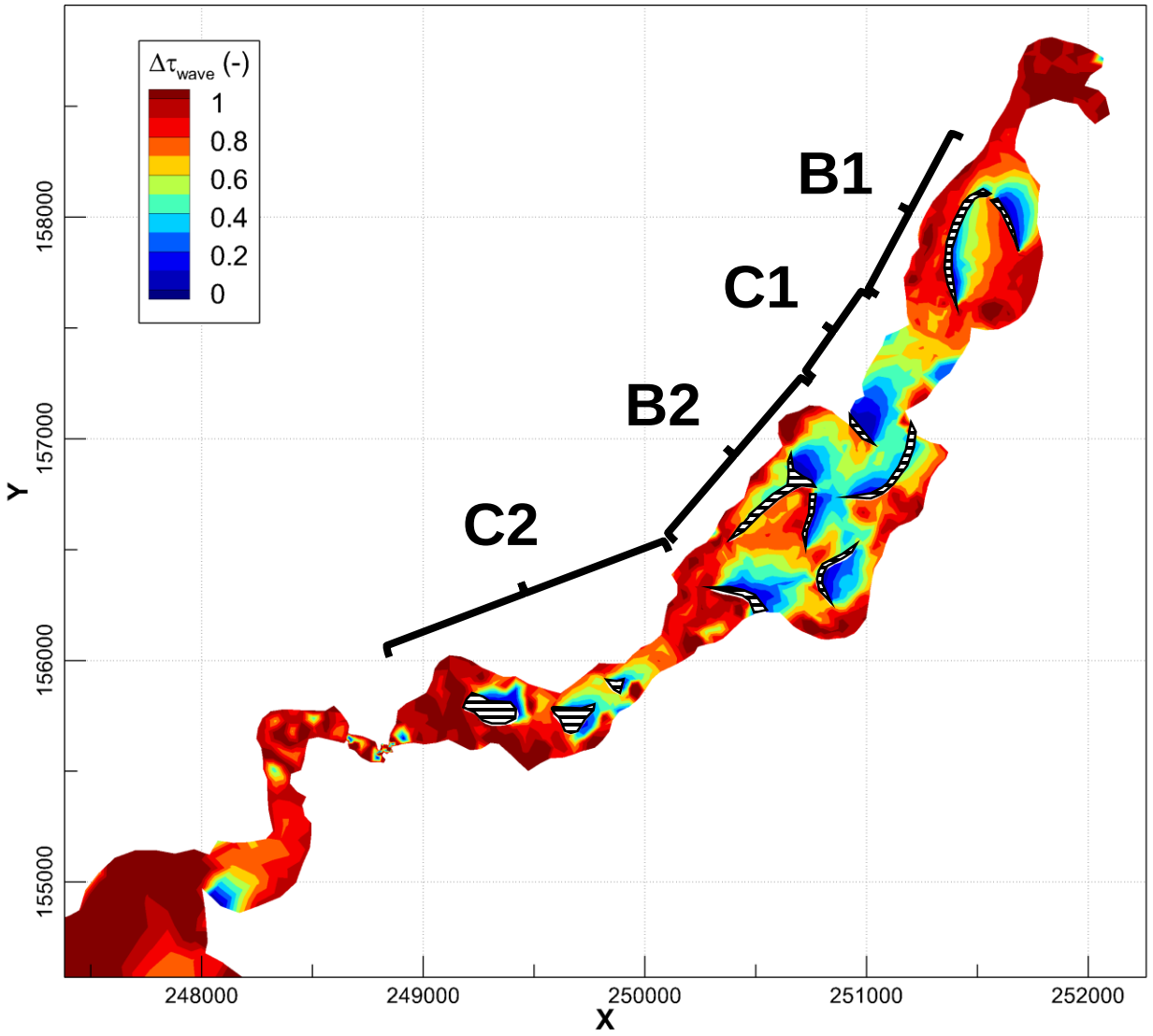


Wind

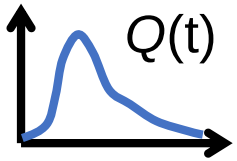


Average: 67%

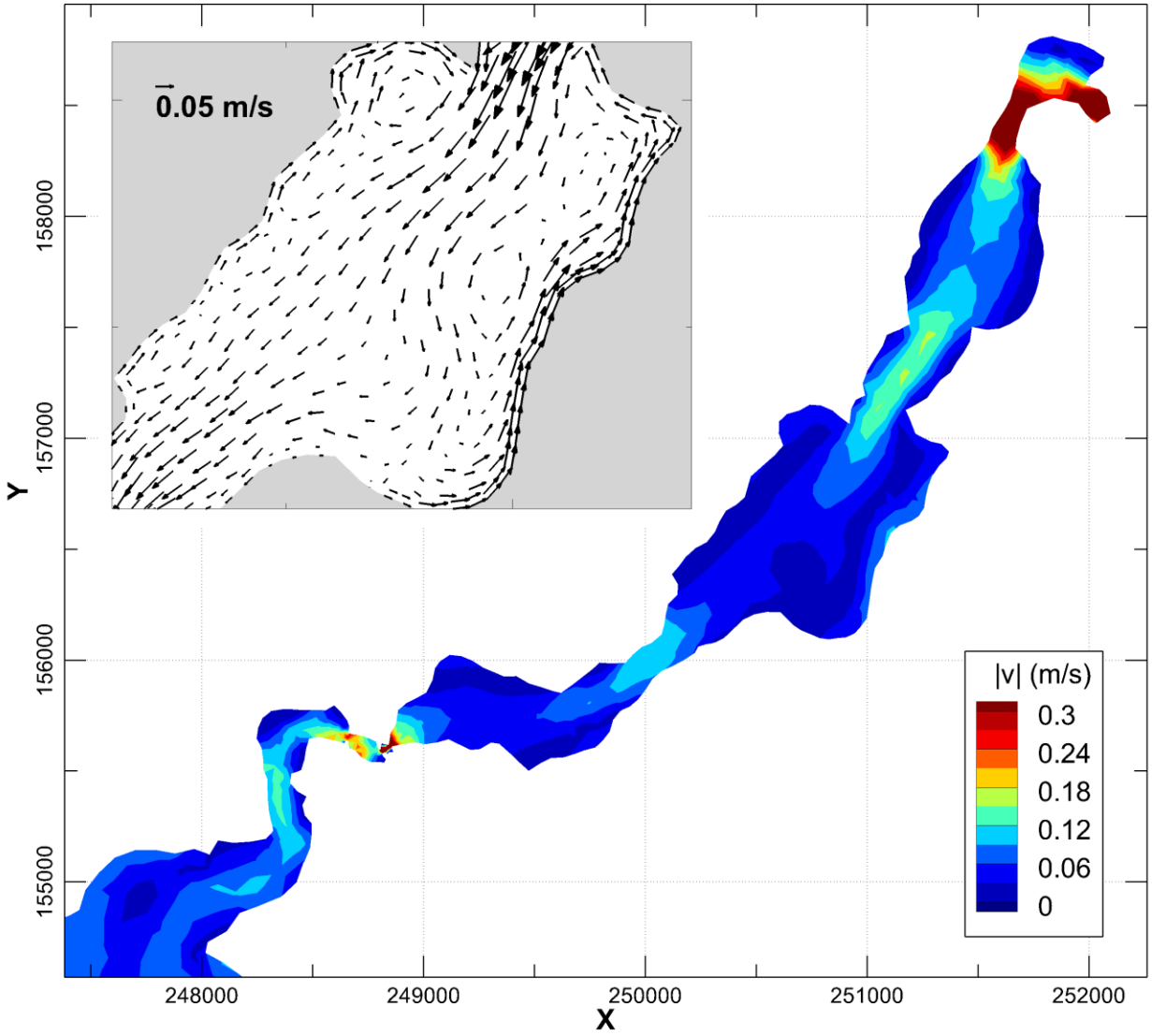
Ratio of Bottom Shear Stress



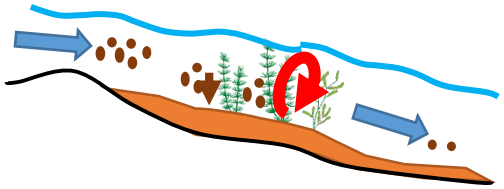
Present State



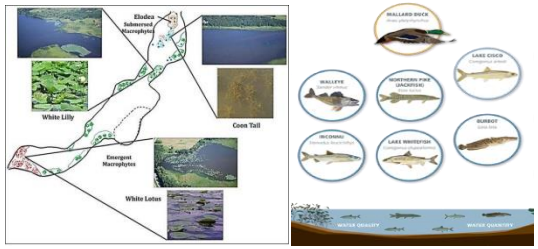
Flow Velocity



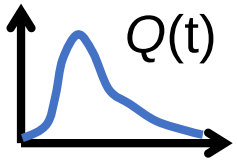
Reduce sediment loading



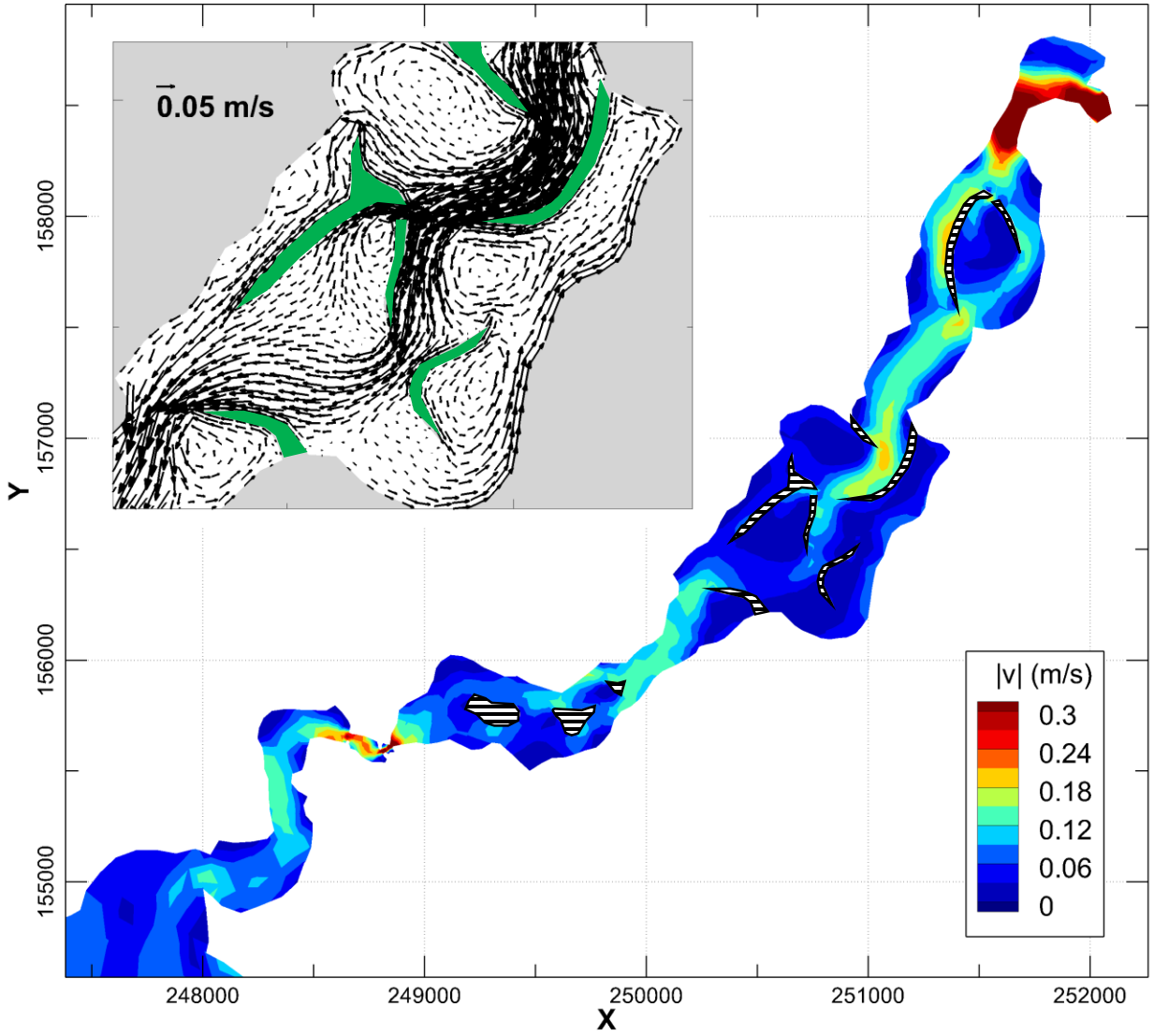
Provide diversified habitat



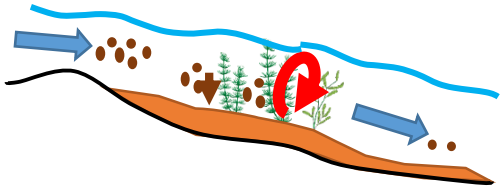
Rehabilitated Braided Islands



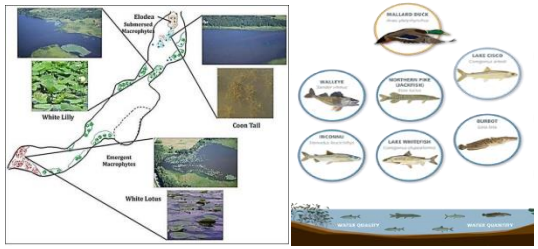
Flow Velocity



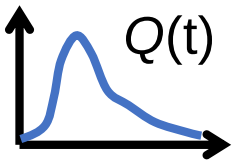
Reduce sediment loading



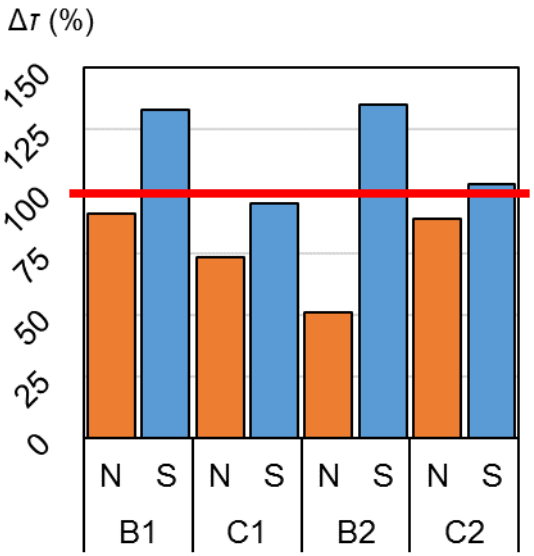
Provide diversified habitat



$$\text{Ratio} = \frac{\tau_b \text{ Rehabilitated Braided Islands}}{\tau_b \text{ Present State}}$$

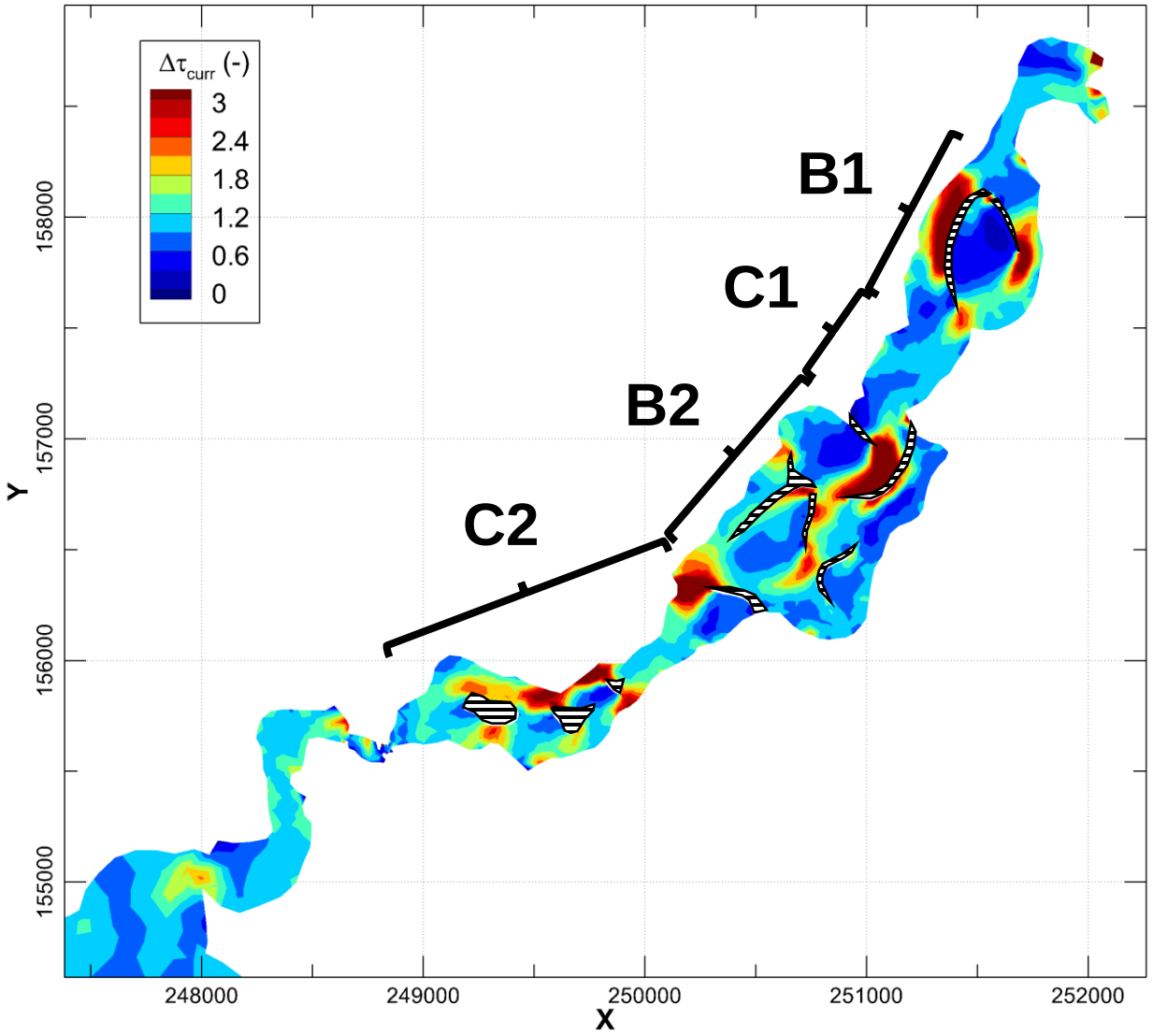


Flow

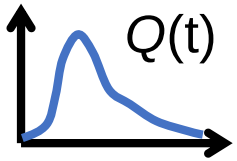


Average: 103%

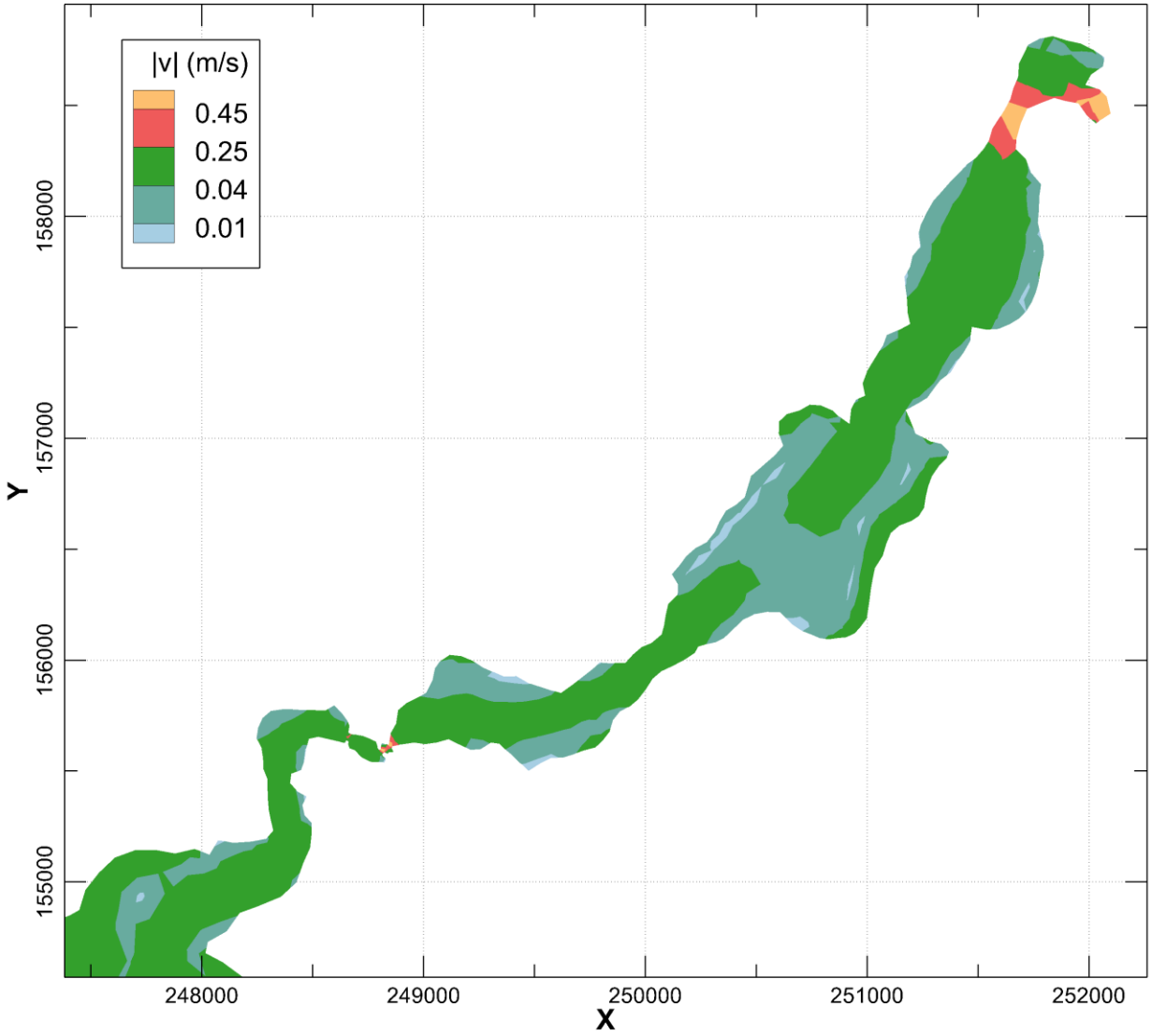
Ratio of Bottom Shear Stress



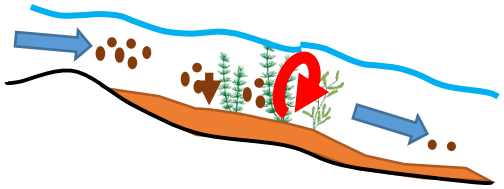
Present State



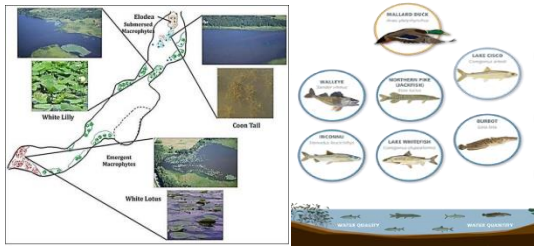
Flow Velocity



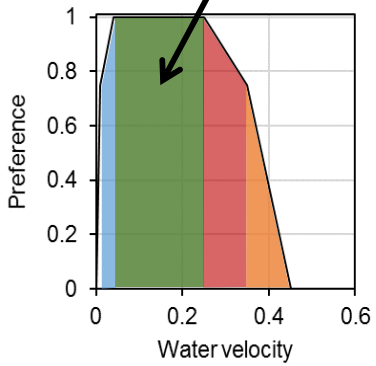
Reduce sediment loading



Provide diversified habitat

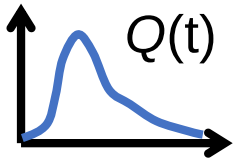


Pondweed

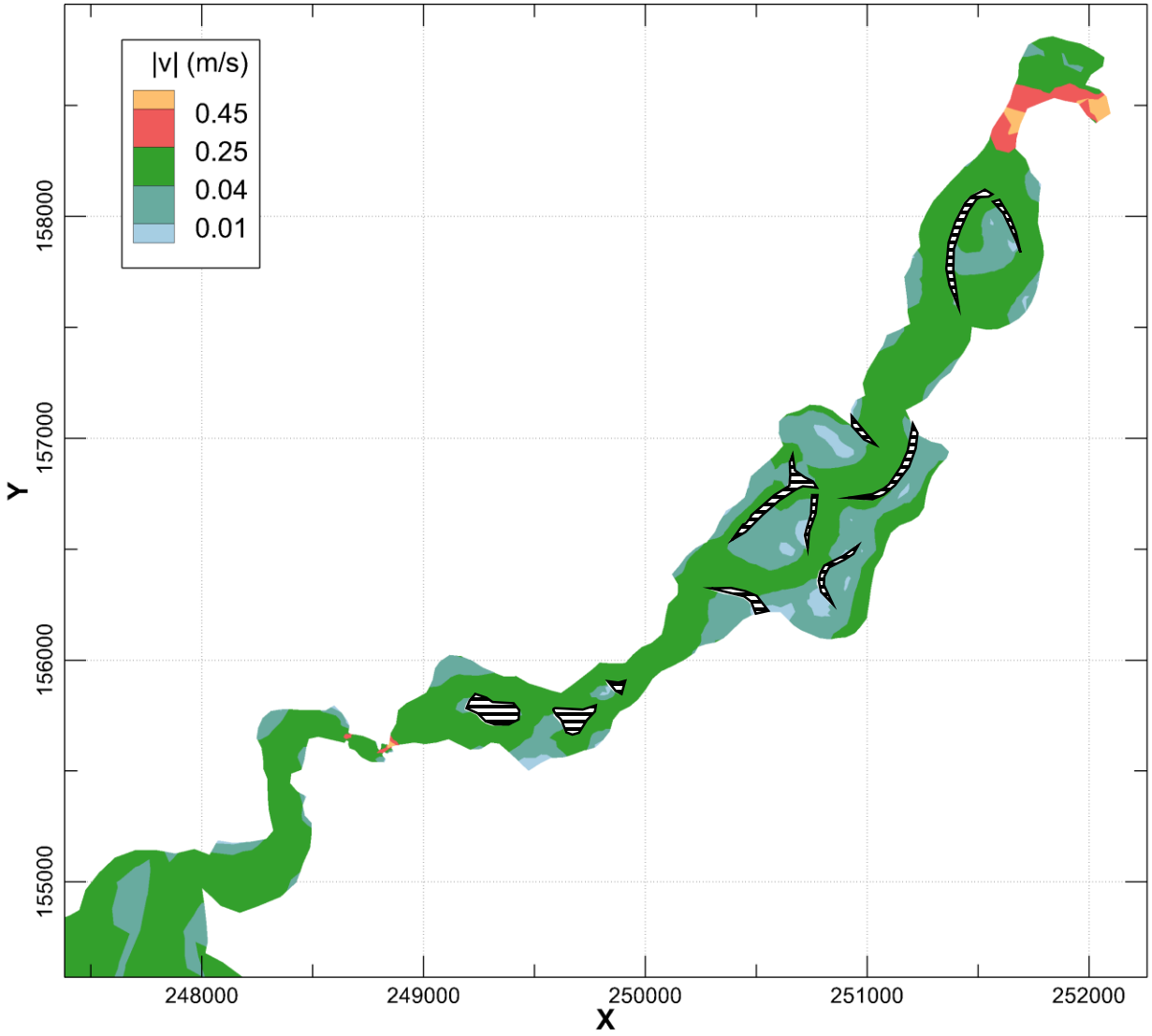


Riis & Biggs 2003, Kemp et al 2004

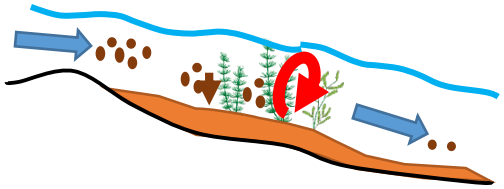
Rehabilitated Braided Islands



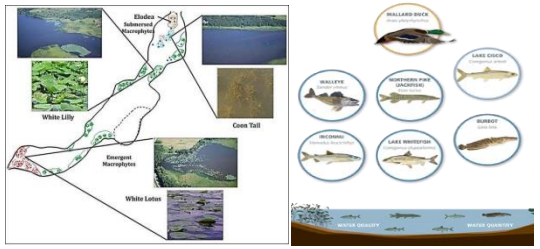
Flow Velocity



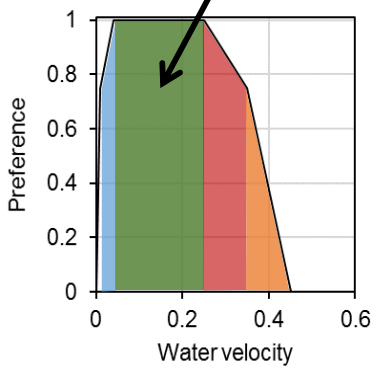
Reduce sediment loading



Provide diversified habitat



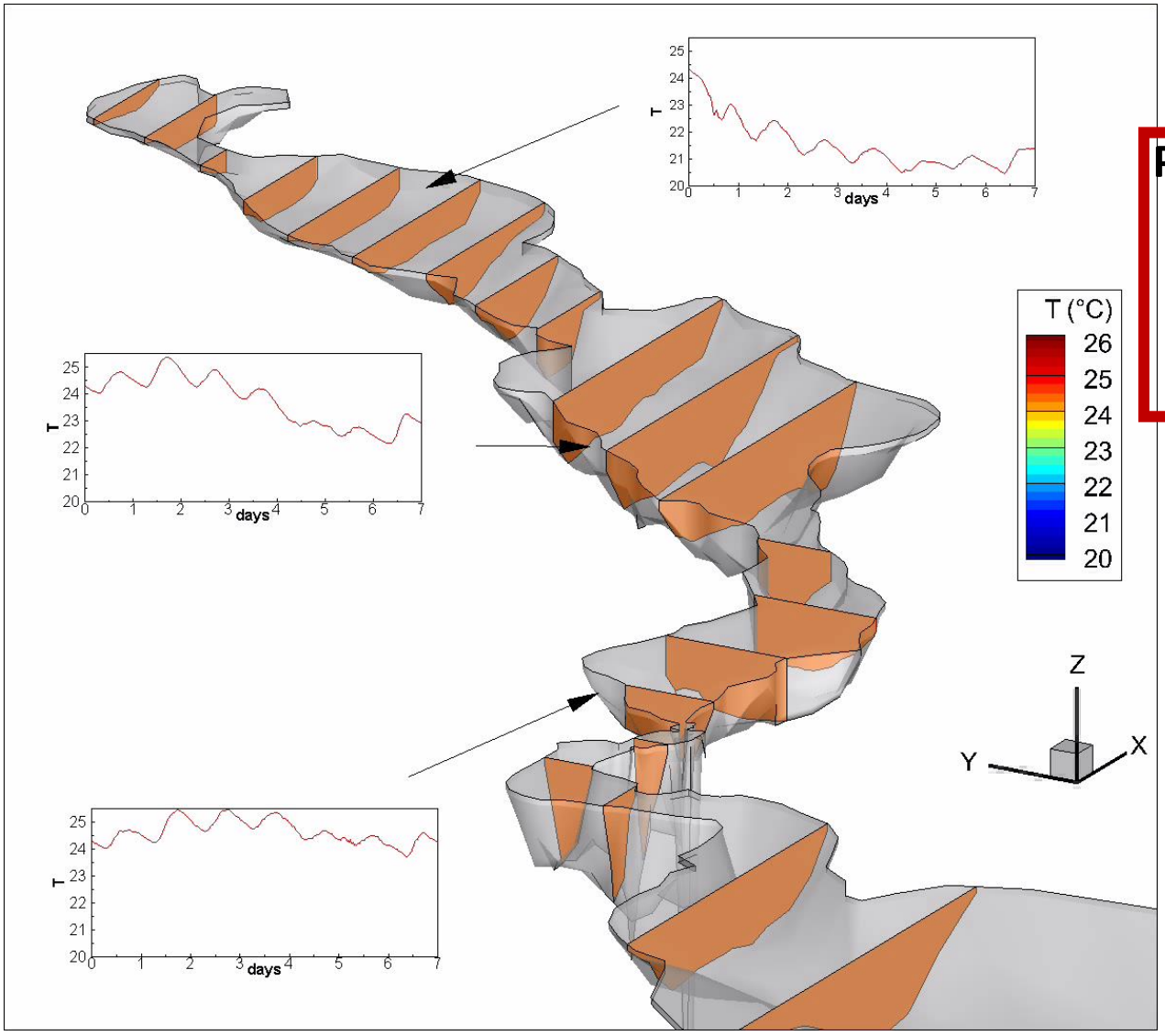
Pondweed



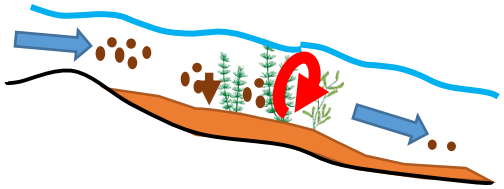
Riis & Biggs 2003, Kemp et al 2004

Present State

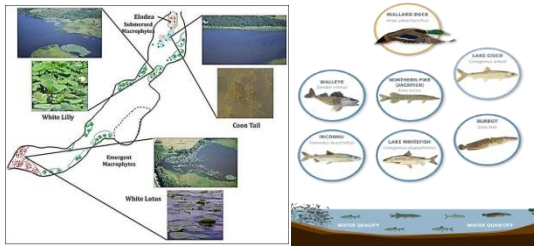
3D Thermal Structure



Reduce sediment loading

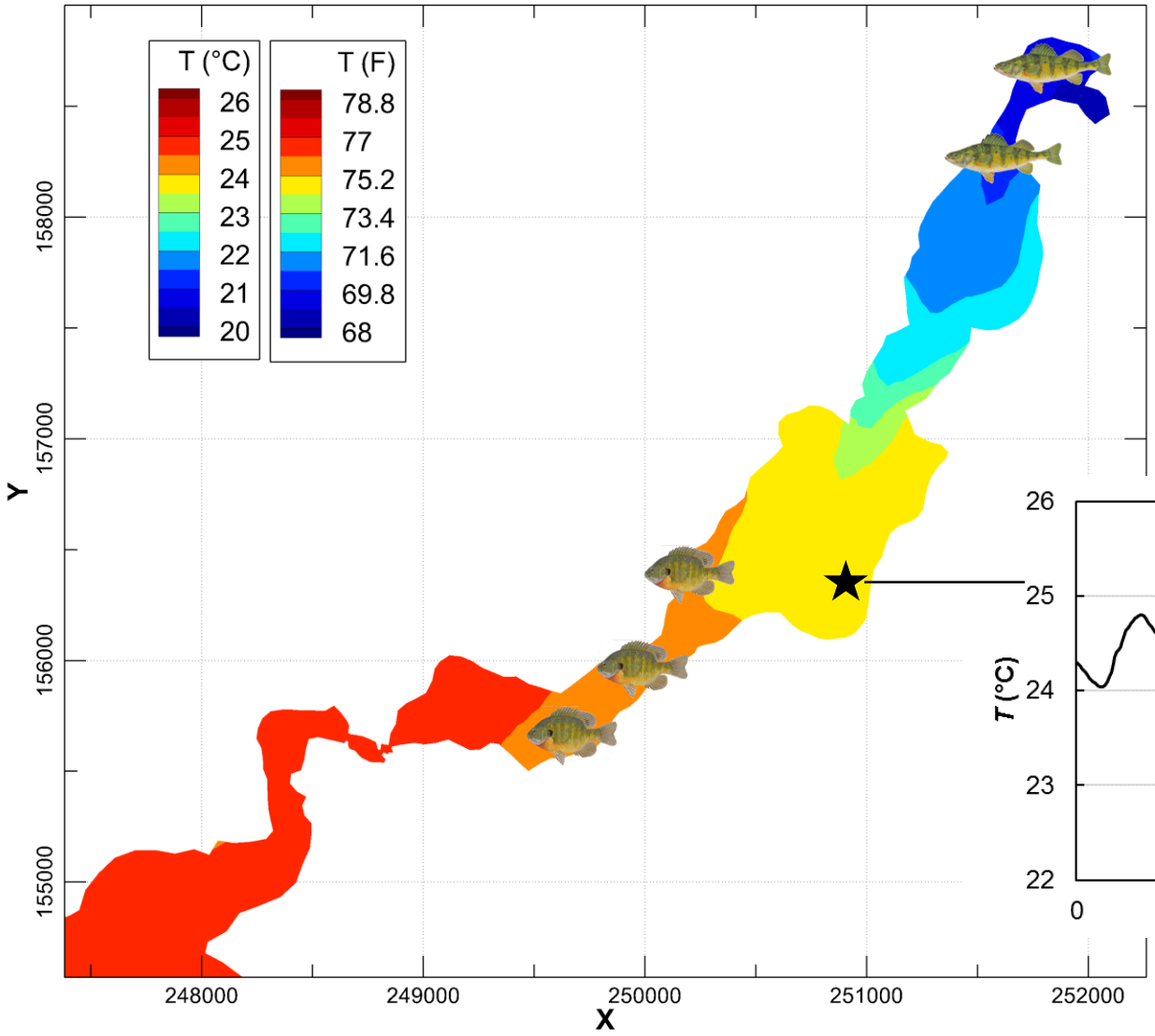


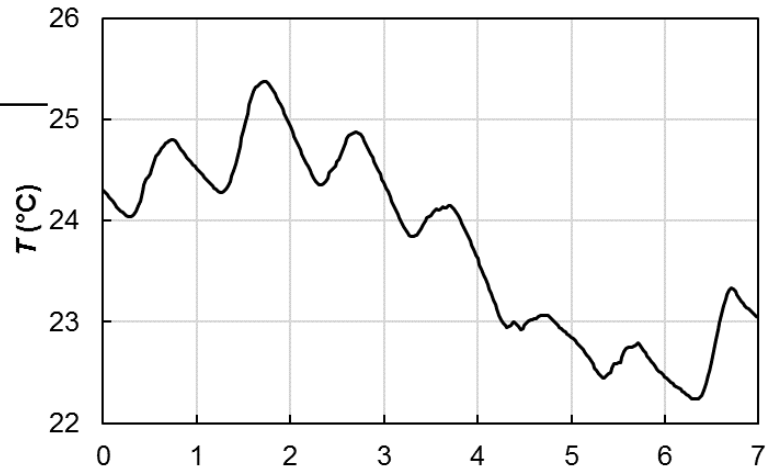
Provide diversified habitat



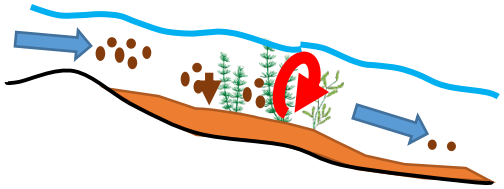
Present State

Temperature

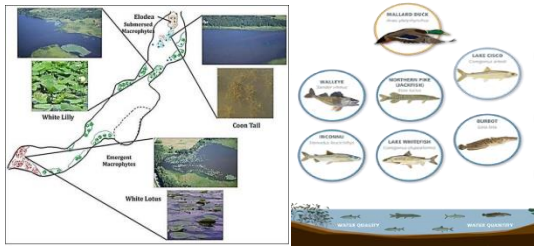




Reduce sediment loading

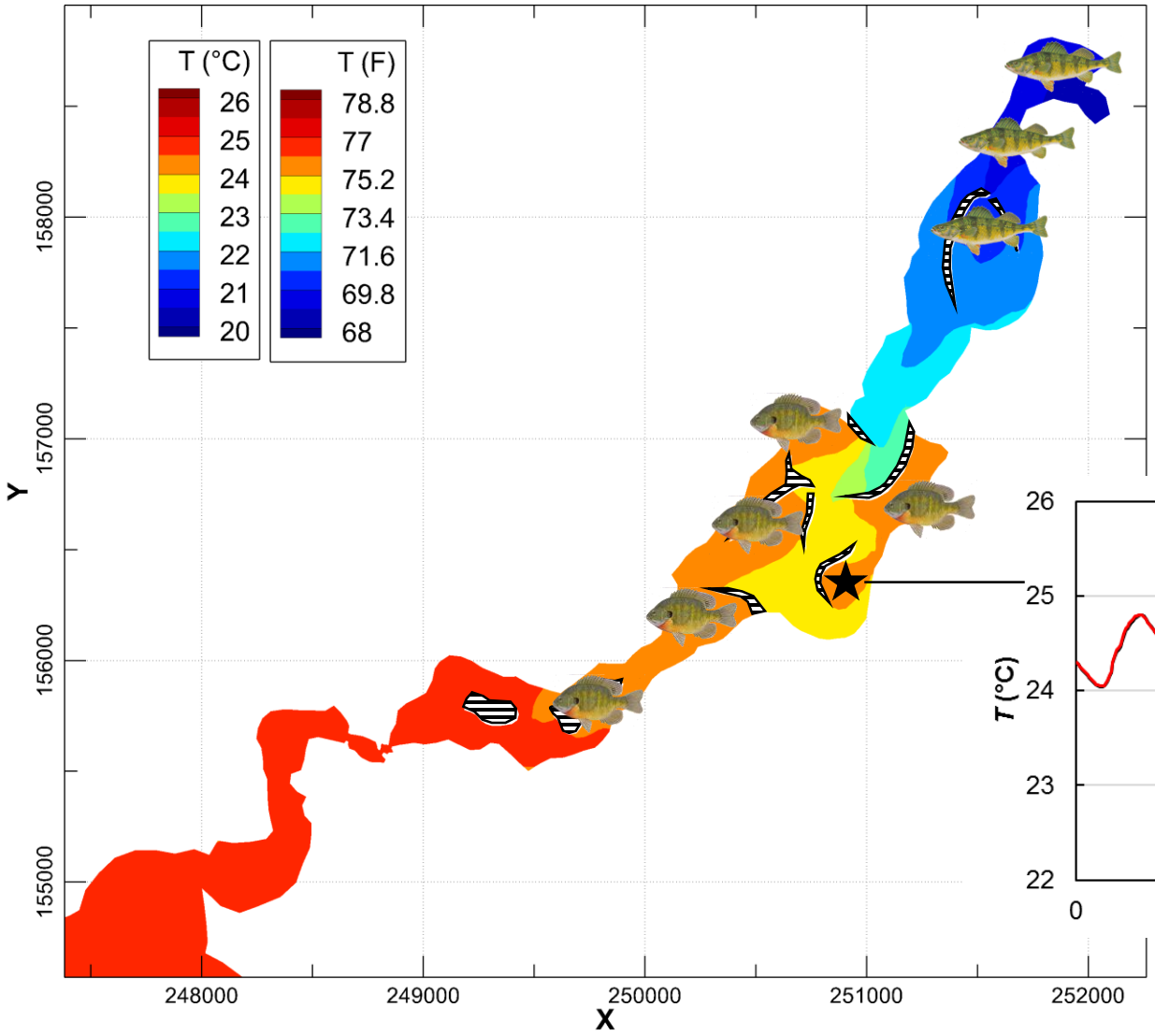


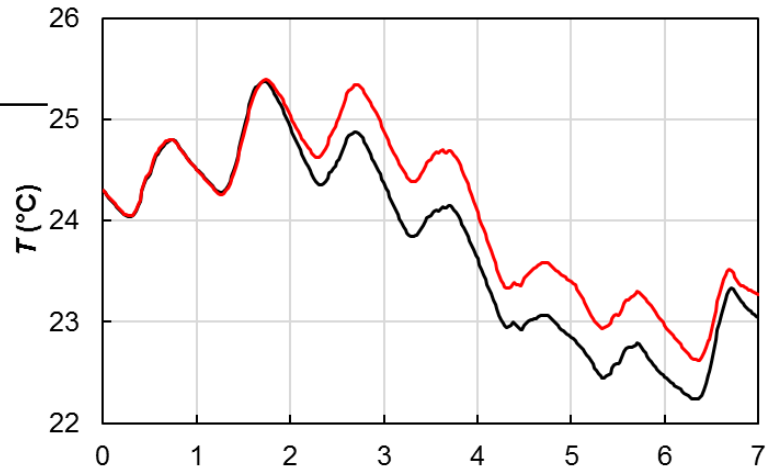
Provide diversified habitat



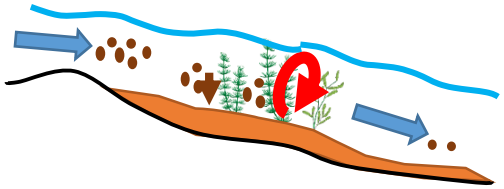
Rehabilitated Braided Islands

Temperature

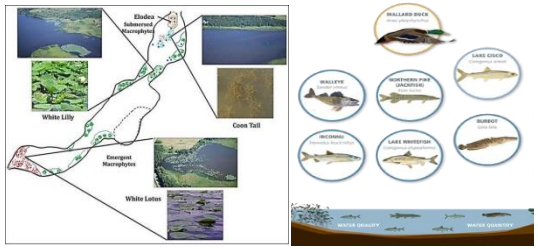




Reduce sediment loading



Provide diversified habitat



Summary

Assess effectiveness of braided islands rehabilitation in Cherokee Marsh

S-S Assessment Framework

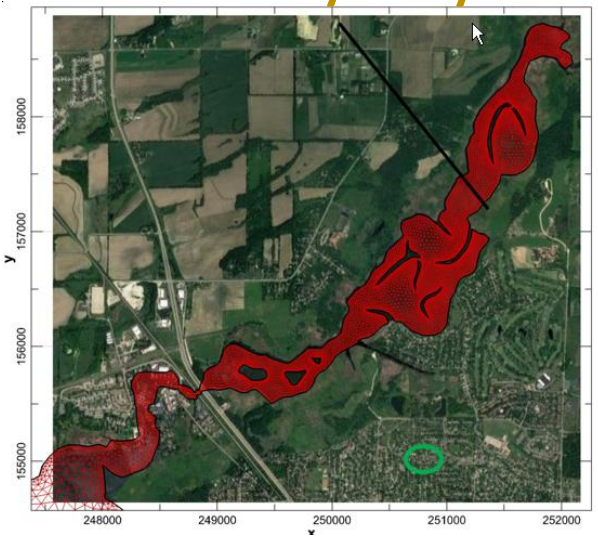
Statistics

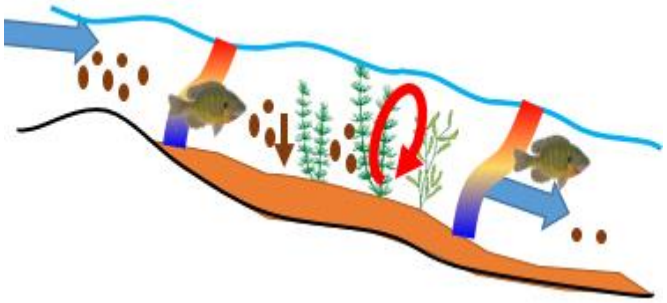
Return Period	Wind (m/s)	Flow (cfs)
1	21	102
10	31	207
50	38	642
100	41	995
500	48	2684
1000	51	4097

Sensitivity

Water Level	Temperature
High (Flood Level)	Hot (Summer)
Normal (Summer)	Medium (Spring)
Low (Winter)	Cold (Winter)

3D Waves -Hydrodynamics





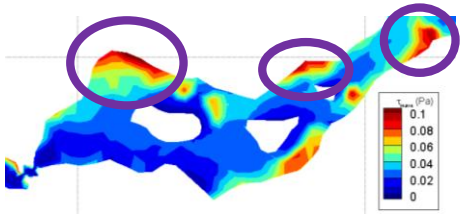
Shear stress ⇔ Sedimentation

Velocity ⇔ Vegetation

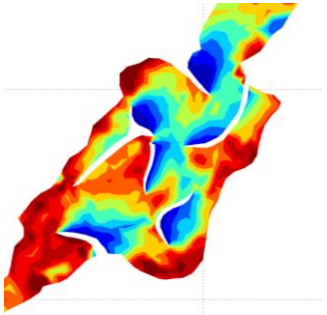
Temperature ⇔ Habitat

Summary

(i) Reduce sediment/nutrient loading

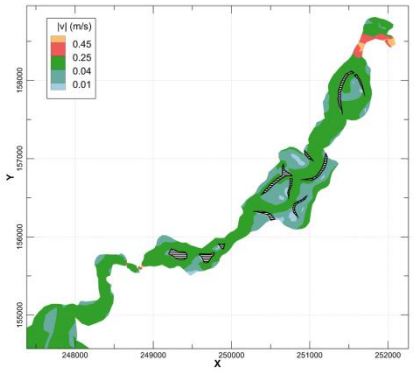


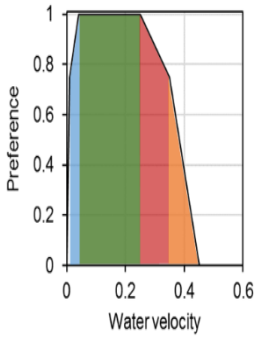
Reduce
wave impacts



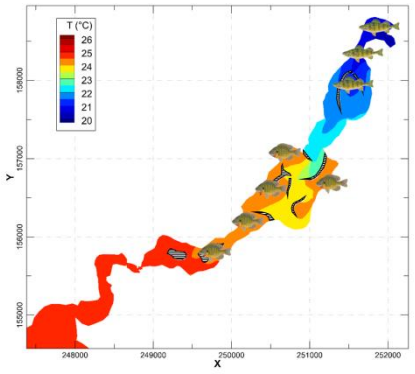
Reduce
Bottom shear stress

(ii) Provide diversified habitat





Shelter for vegetation



Fish spawning areas

Vision for REHAB Cherokee Marsh:

Restore Ecological Health of Aquatic Bio-diversity

Goals

- Decrease phosphorus loading
- Increase sediment trapping
- Rehabilitate marshland/wetland
- Restore fishery & wildlife habitat
- Promote public access & recreation