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Understanding fecal coliform removal by river networks

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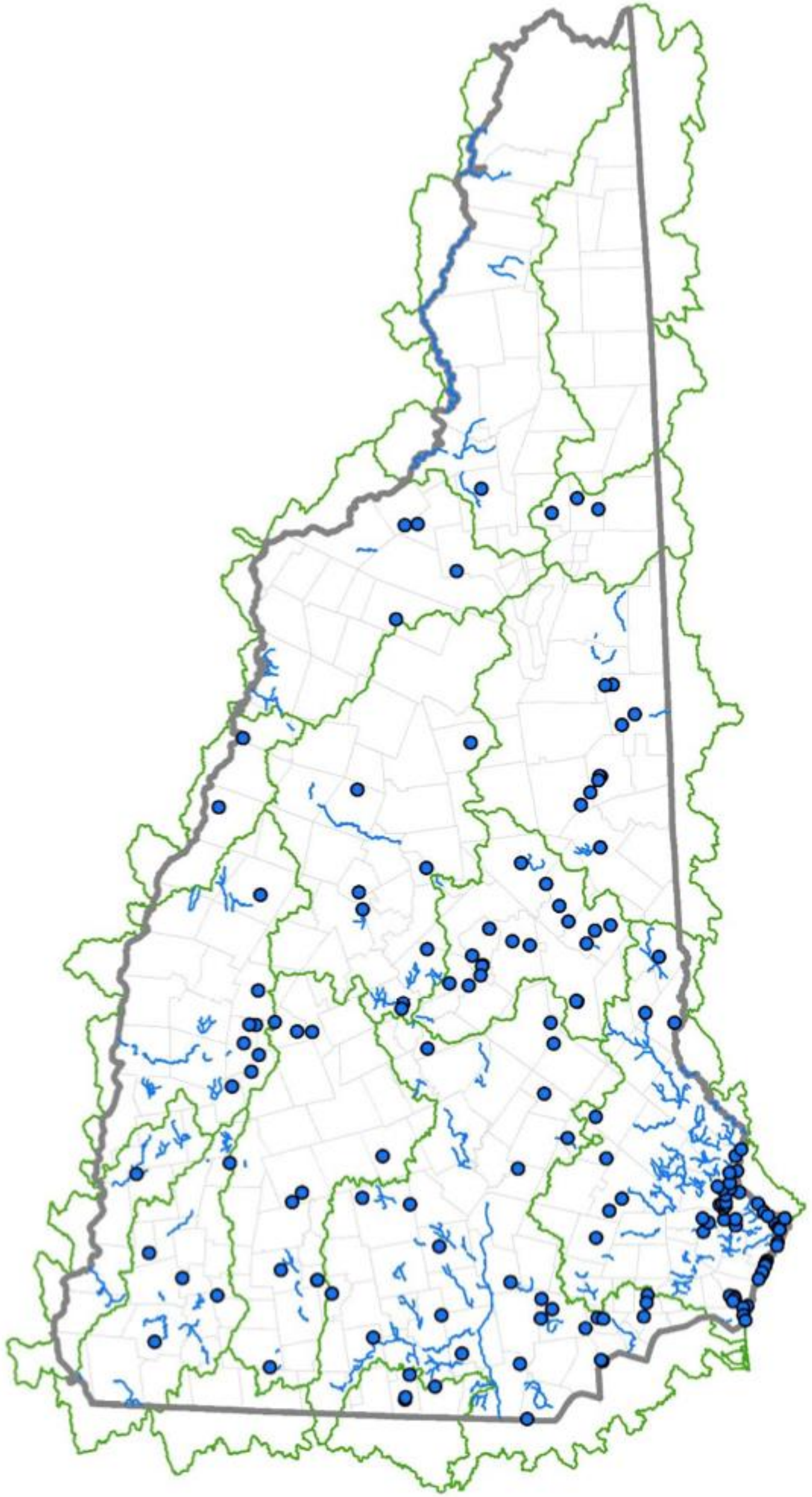
NEW HAMPSHIRE EPSCoR

Water Systems Analysis Group

Background

- Pathogens are a top cause of water quality impairment in the United States (Li and Migliaccio, 2010).

- Understanding factors controlling delivery of pathogens is critical.



NH DES, 2010

Current understanding

Landscape characteristics control fecal coliform at the baseflow conditions (Verhougstraete et al. 2015).

Hydrologic variability controls the delivery of fecal coliform from land (Geldreich et al. 1968, Liao et al. 2015).

Watershed models used to estimate spatially and temporally varying fecal coliform loads (Benham et al. 2006, Zhu et al. 2011).

Knowledge gap

The role of river systems in regulating or attenuating **fecal coliform loads delivered to critical water bodies** is still very limited.

Research question

Are stream networks important regulators of fecal coliform transfer from source areas to critical water bodies?

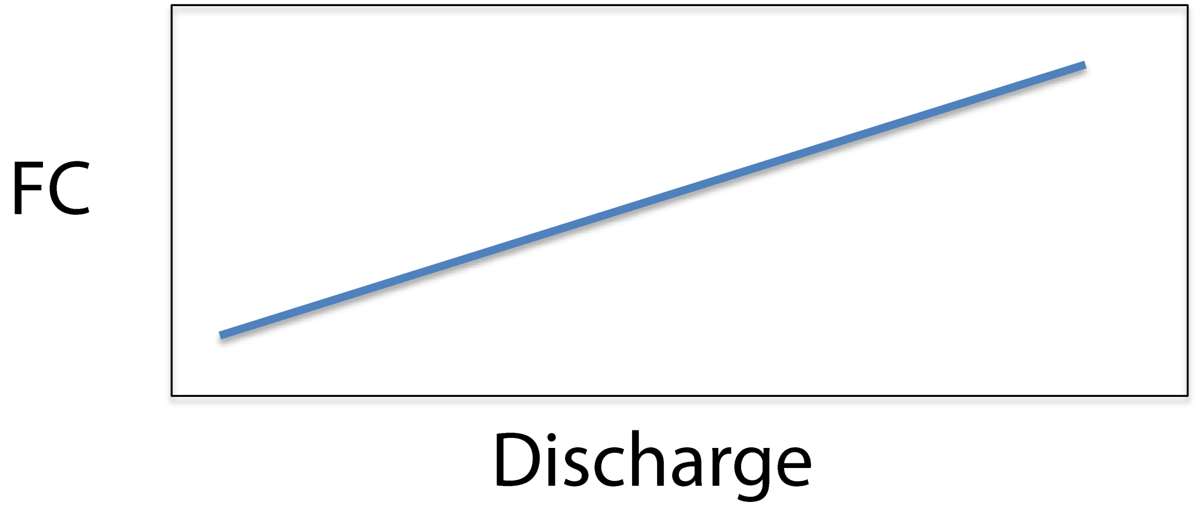
Hypothesis

The fecal coliform removal by river systems is important under low to moderate flows because of longer residence time.

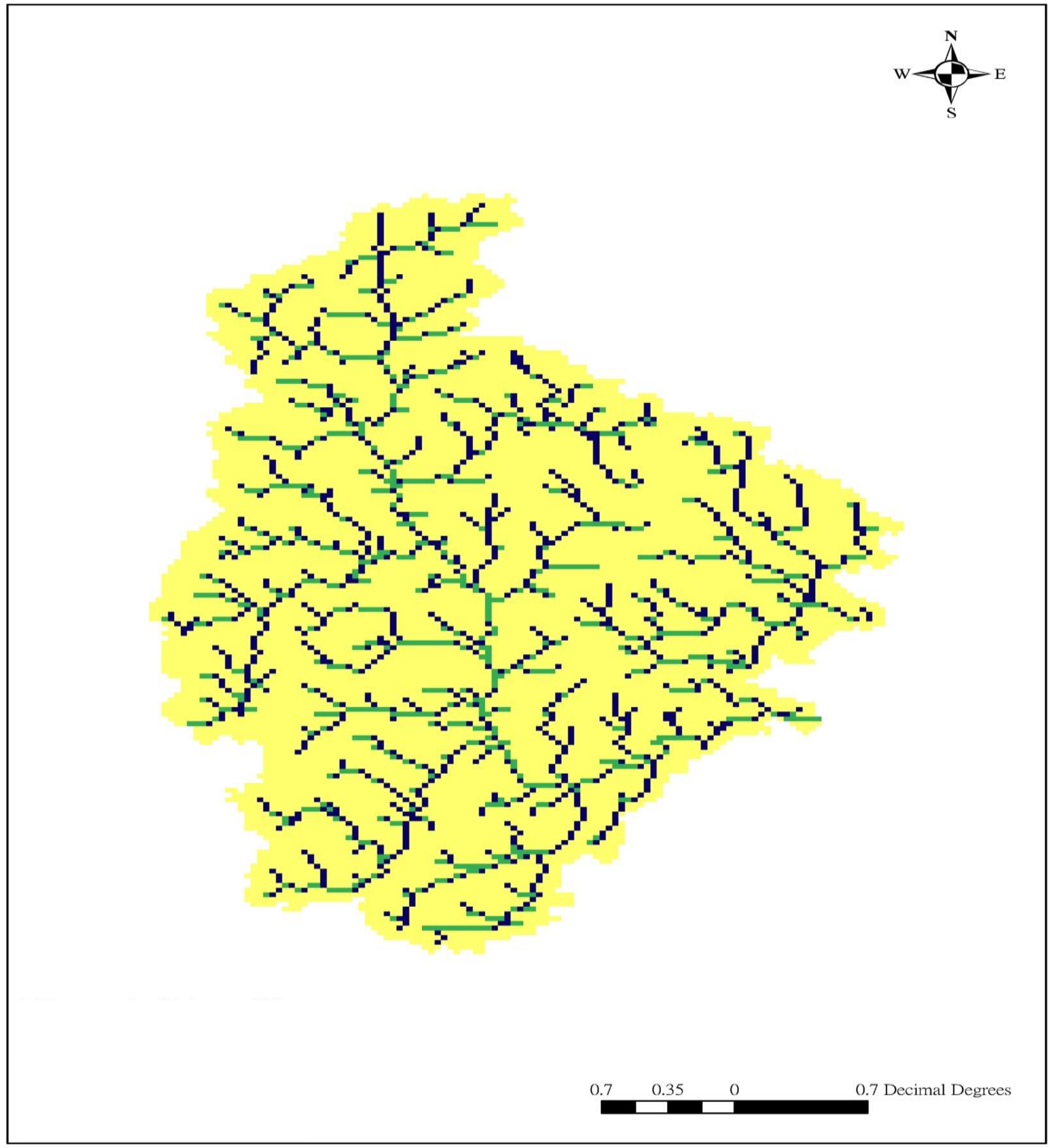
Method

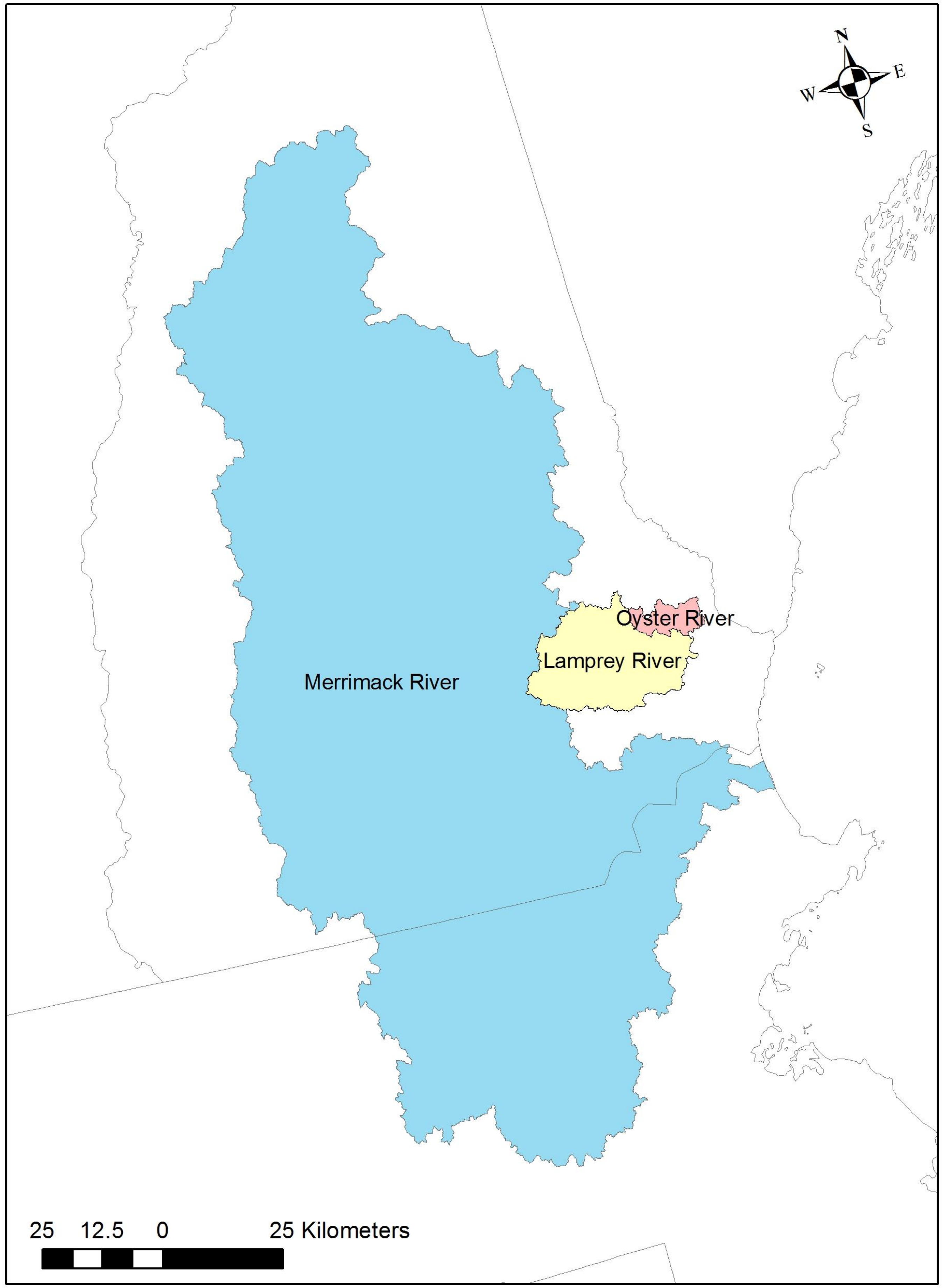
Step 1: FC sampling of baseflow and storm conditions

Step 2: Develop loading relationships for various land uses



Step 3: Apply the spatially distributed model and route through the river system





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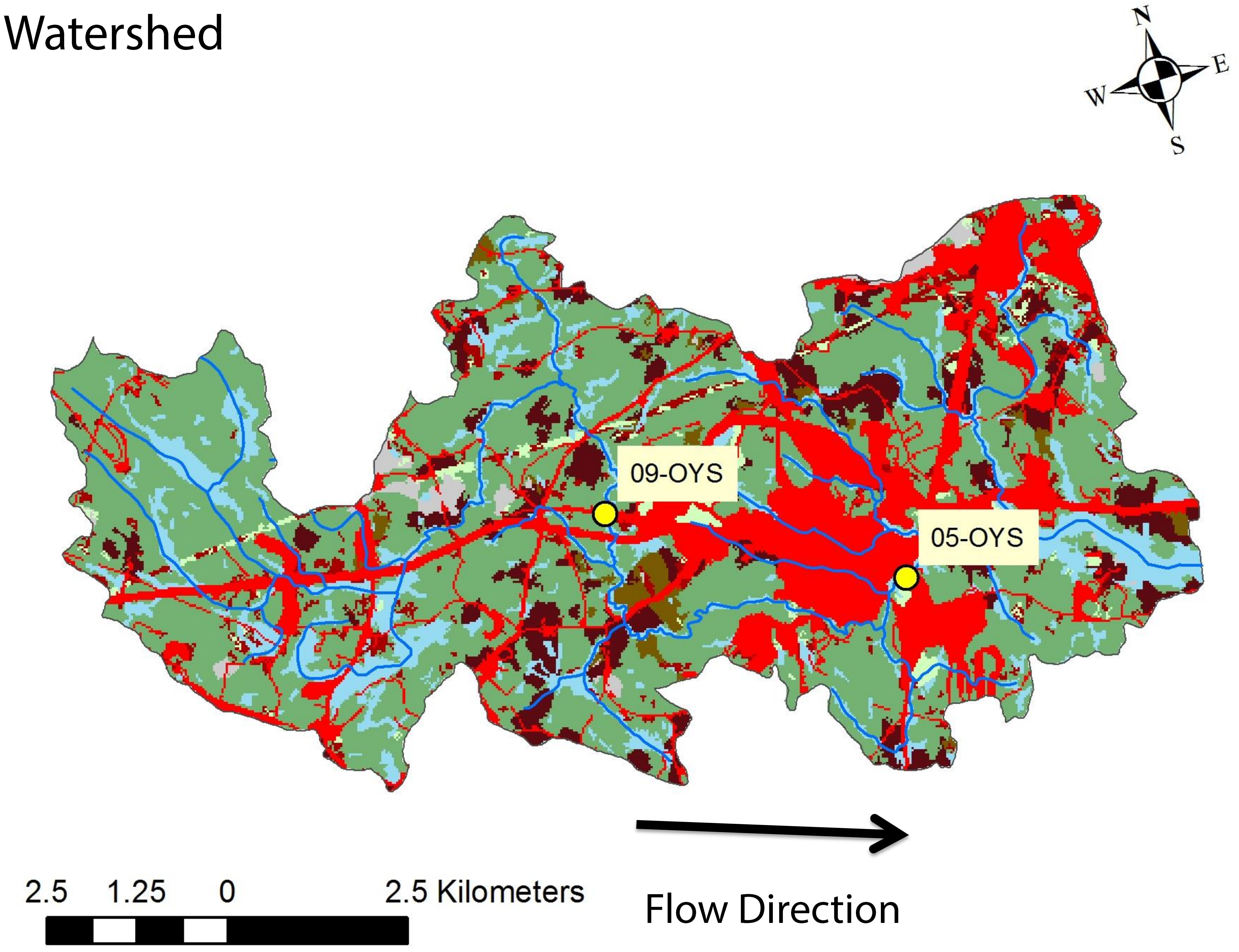
Oyster River Watershed



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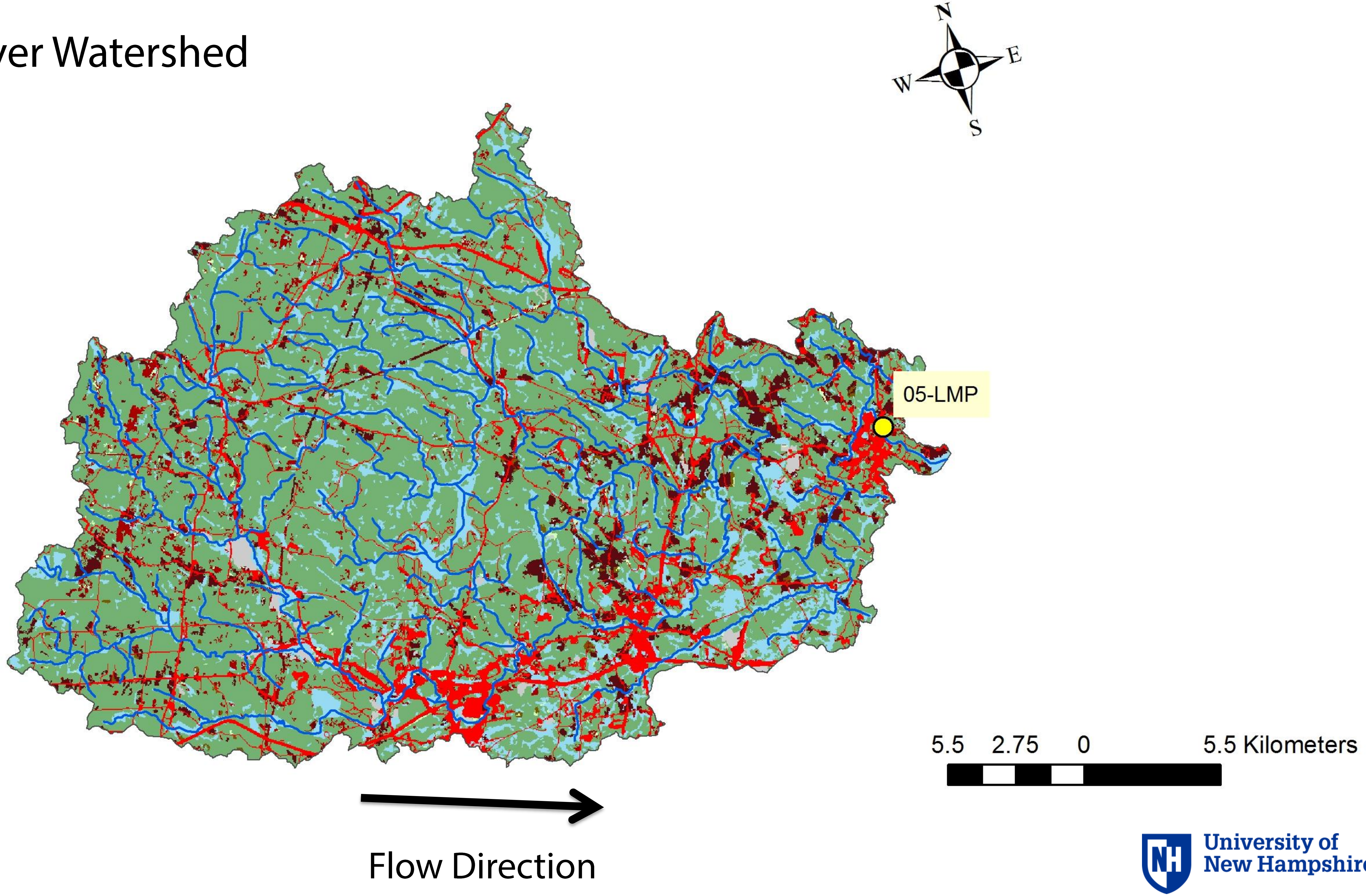
Lamprey River Watershed



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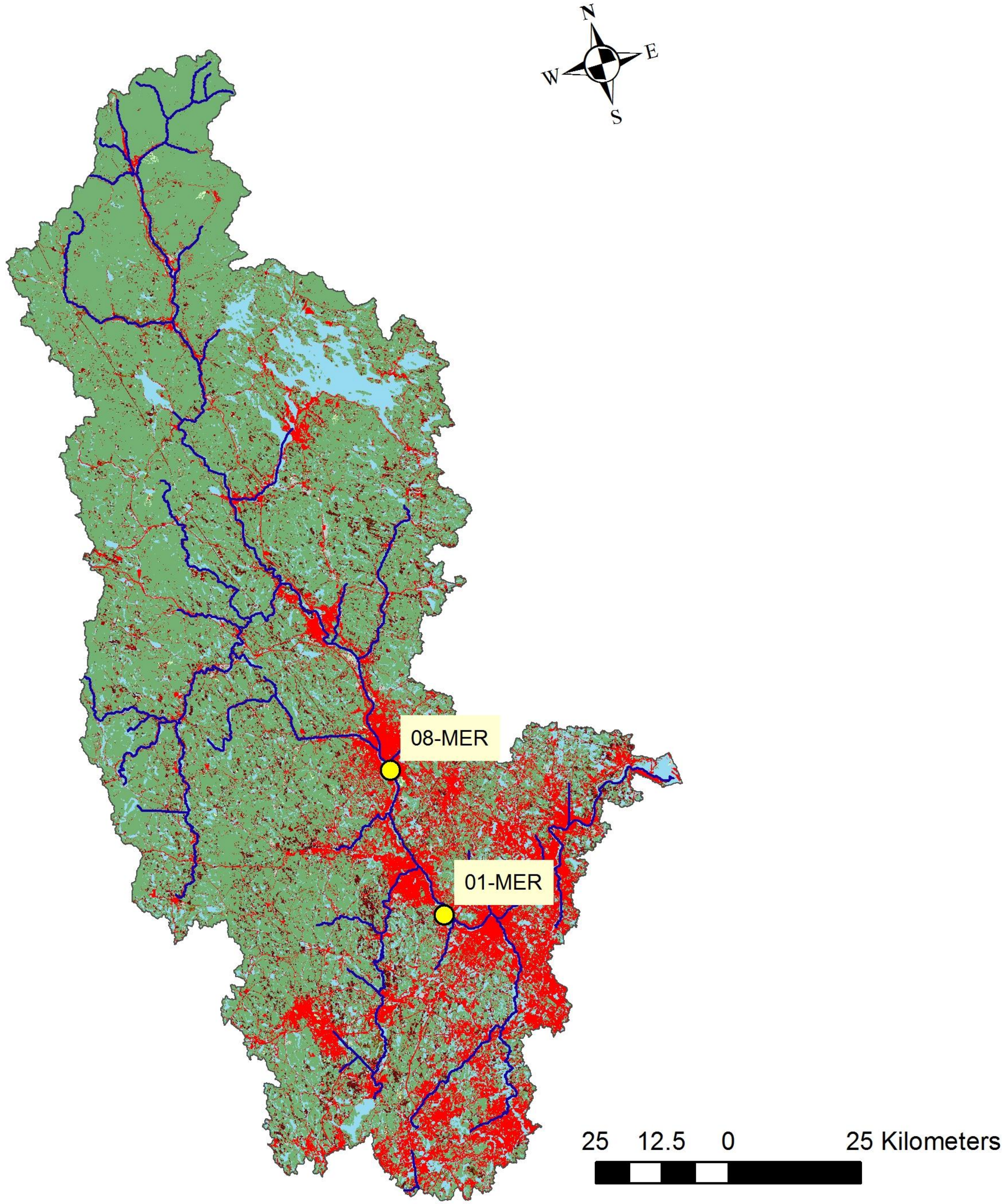
Merrimack River Watershed

Flow Direction



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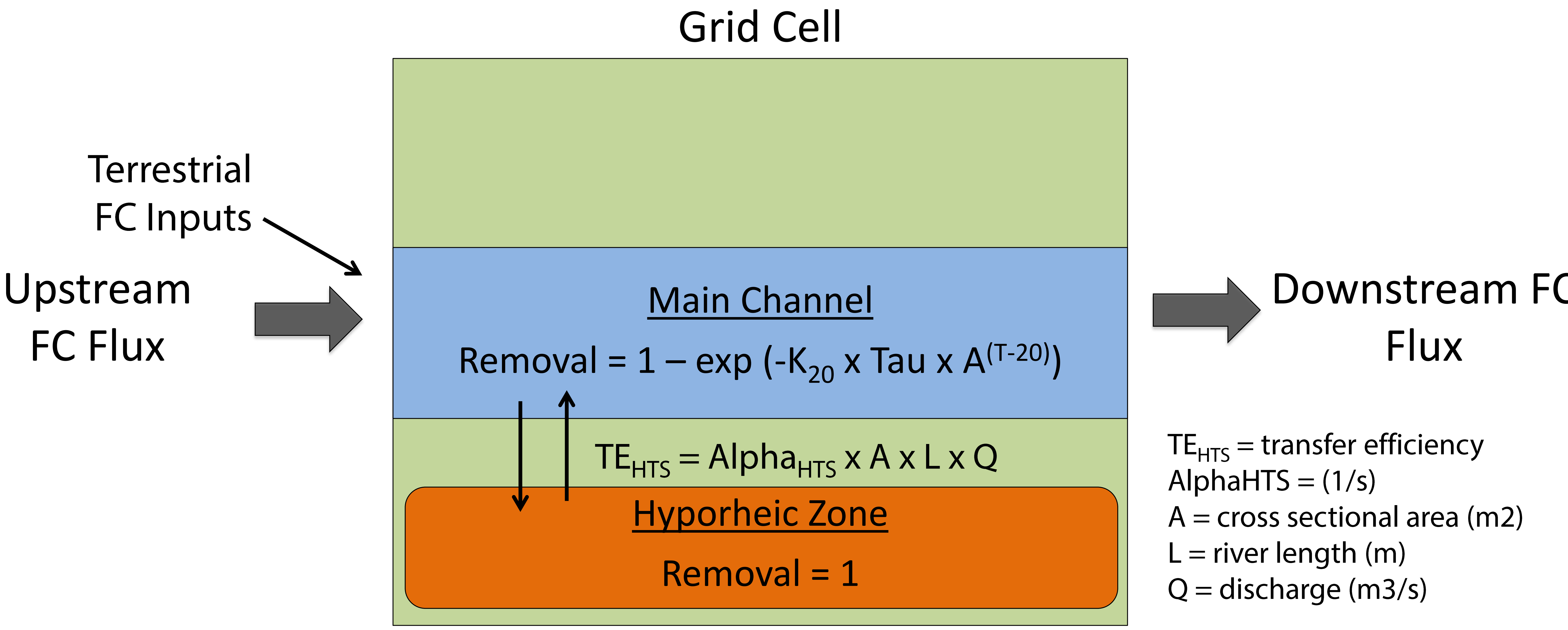
In-stream Fecal Coliform Removal



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Estimation of terrestrial inputs

In this study, we focused on Escherichia coli (E. coli) because it is the fecal contamination indicator for freshwater.

Small watershed approach can provide information about terrestrial input (Bormann and Likens et al. 1967).

We used multiple linear regression to predict the variation of environmental factors effects on E. coli concentration.

$$\log(E.coli) = 1.8 + 0.044 * rainfall * 0.027 * impervious\%$$

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Model results

- Validation
- Effective discharge
- Application

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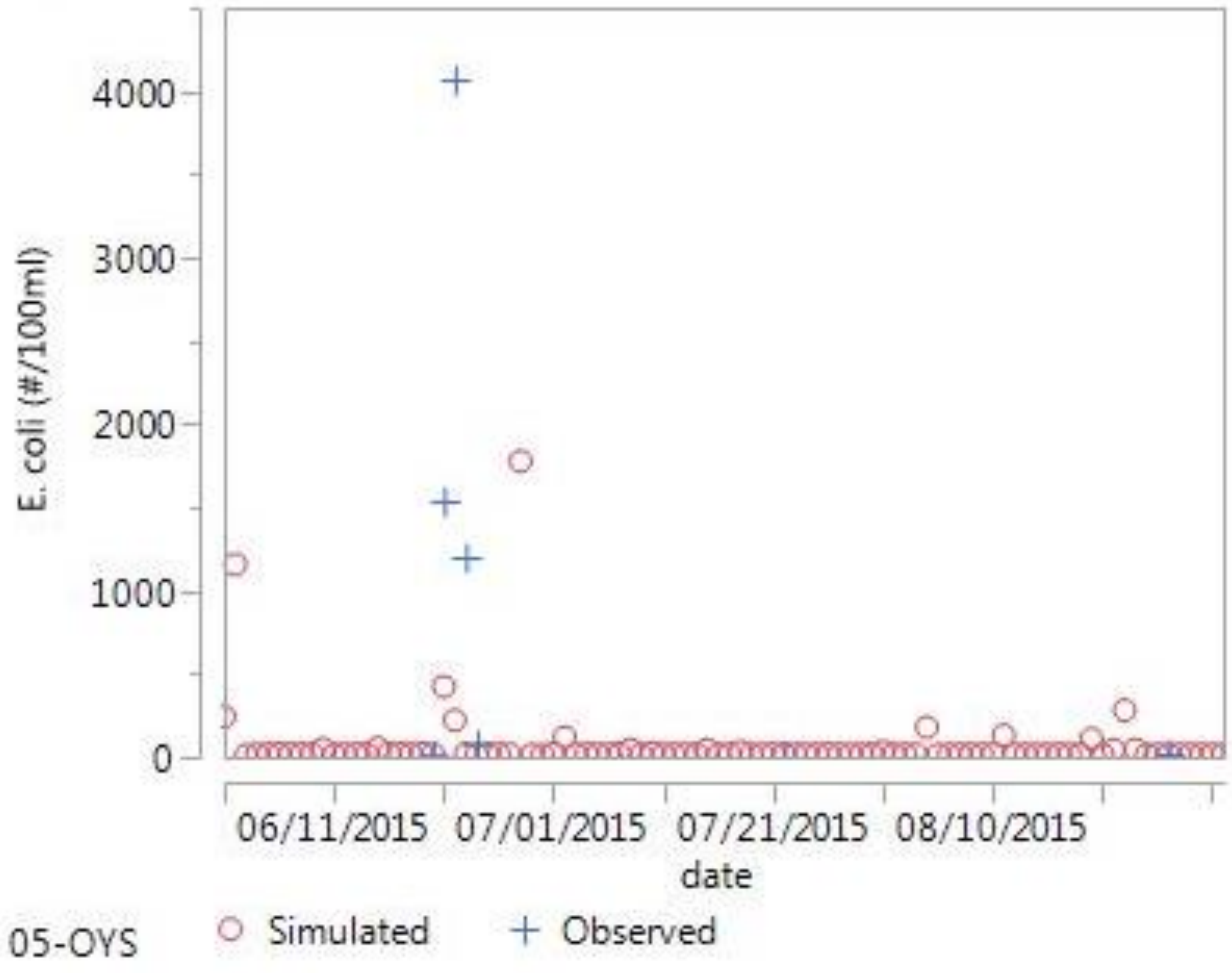
Oyster River



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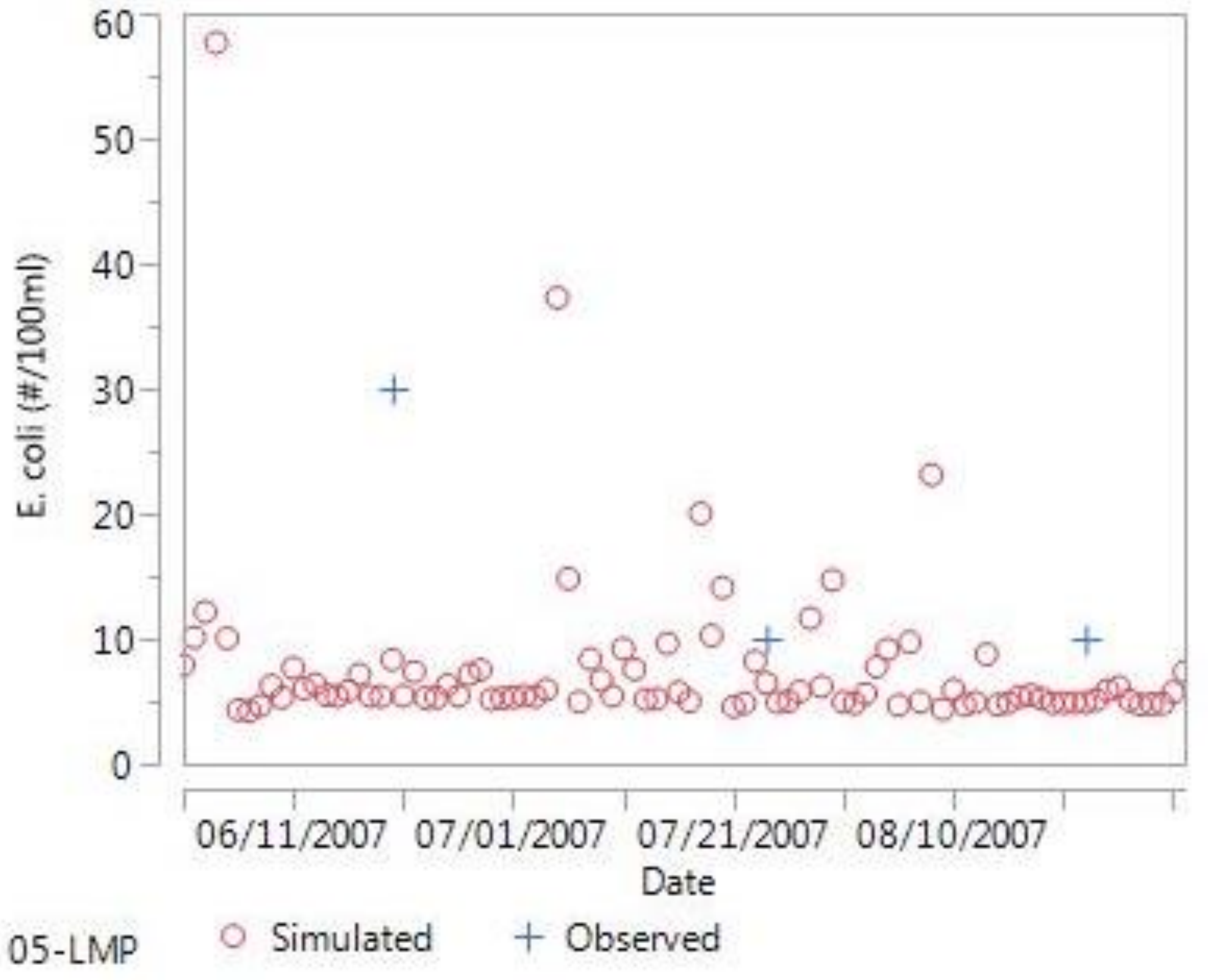
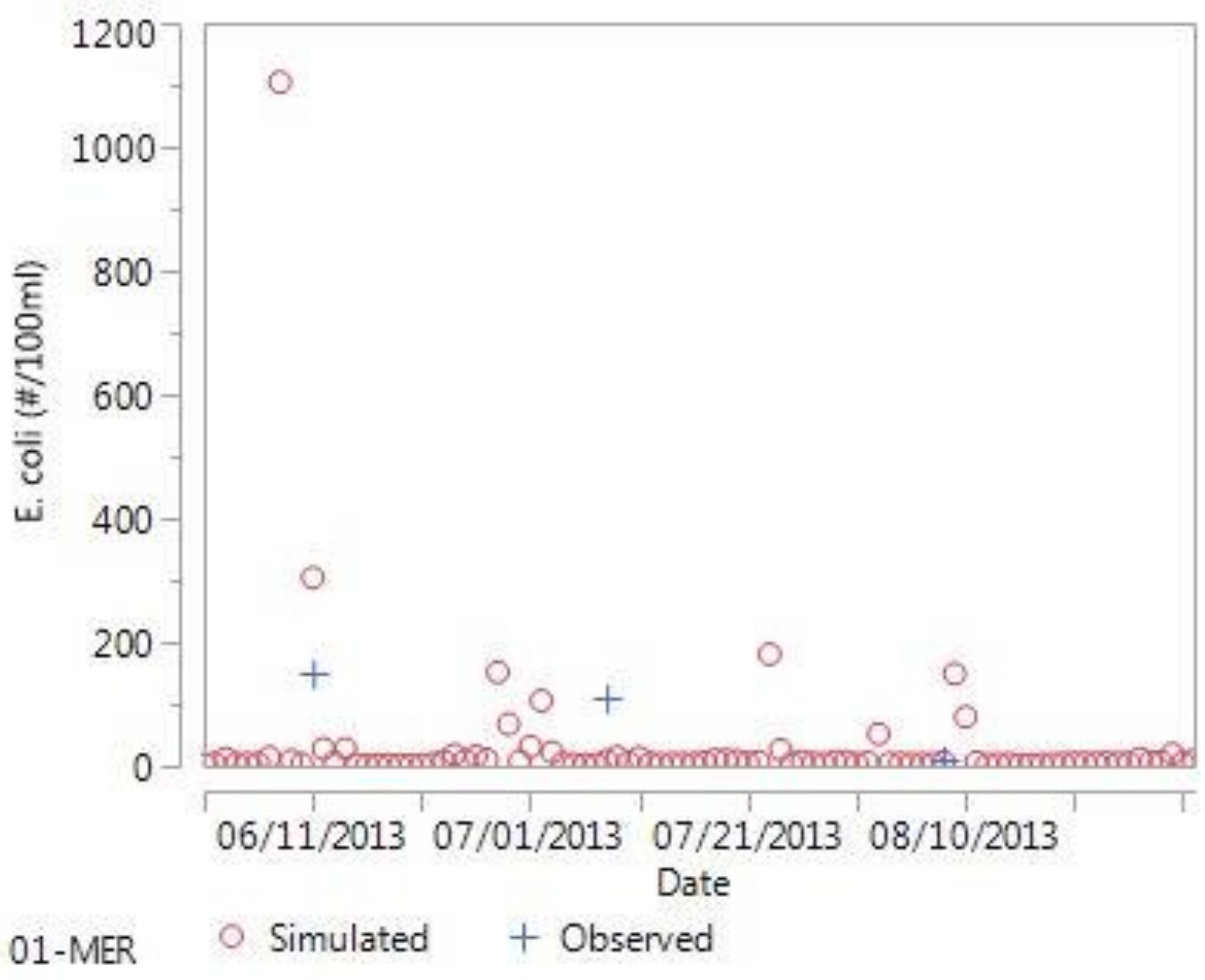
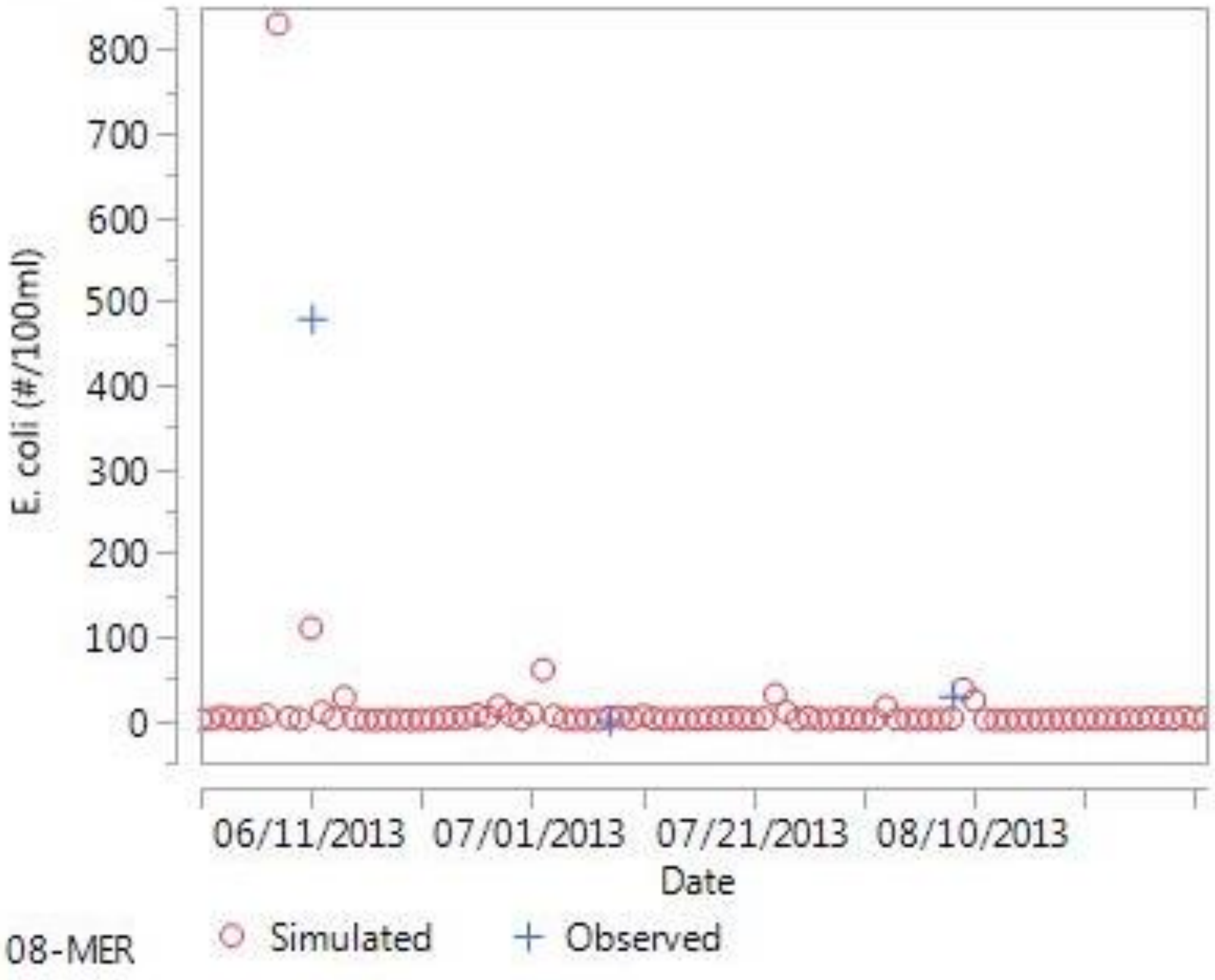
Lamprey River



Merrimack River



Merrimack River



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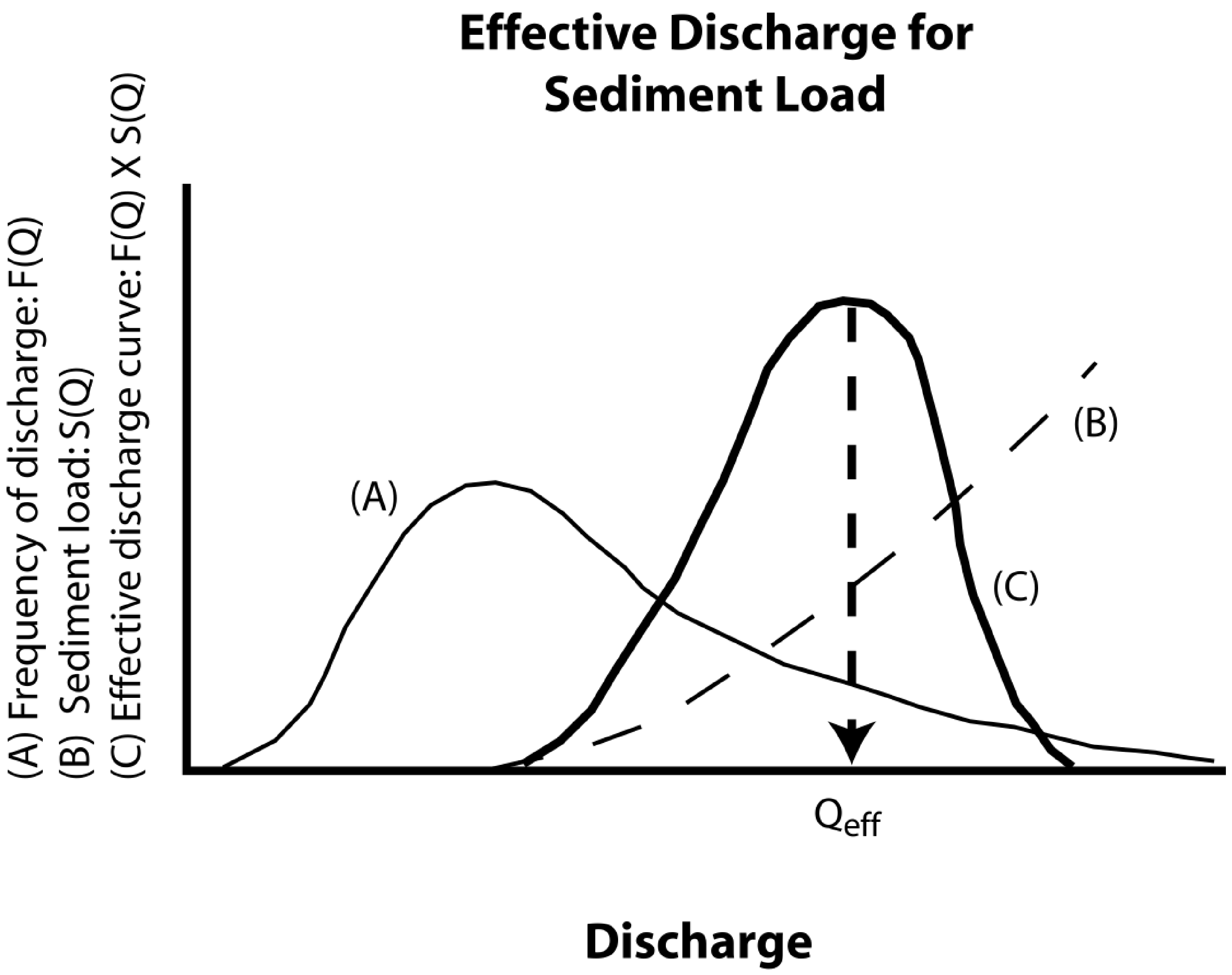
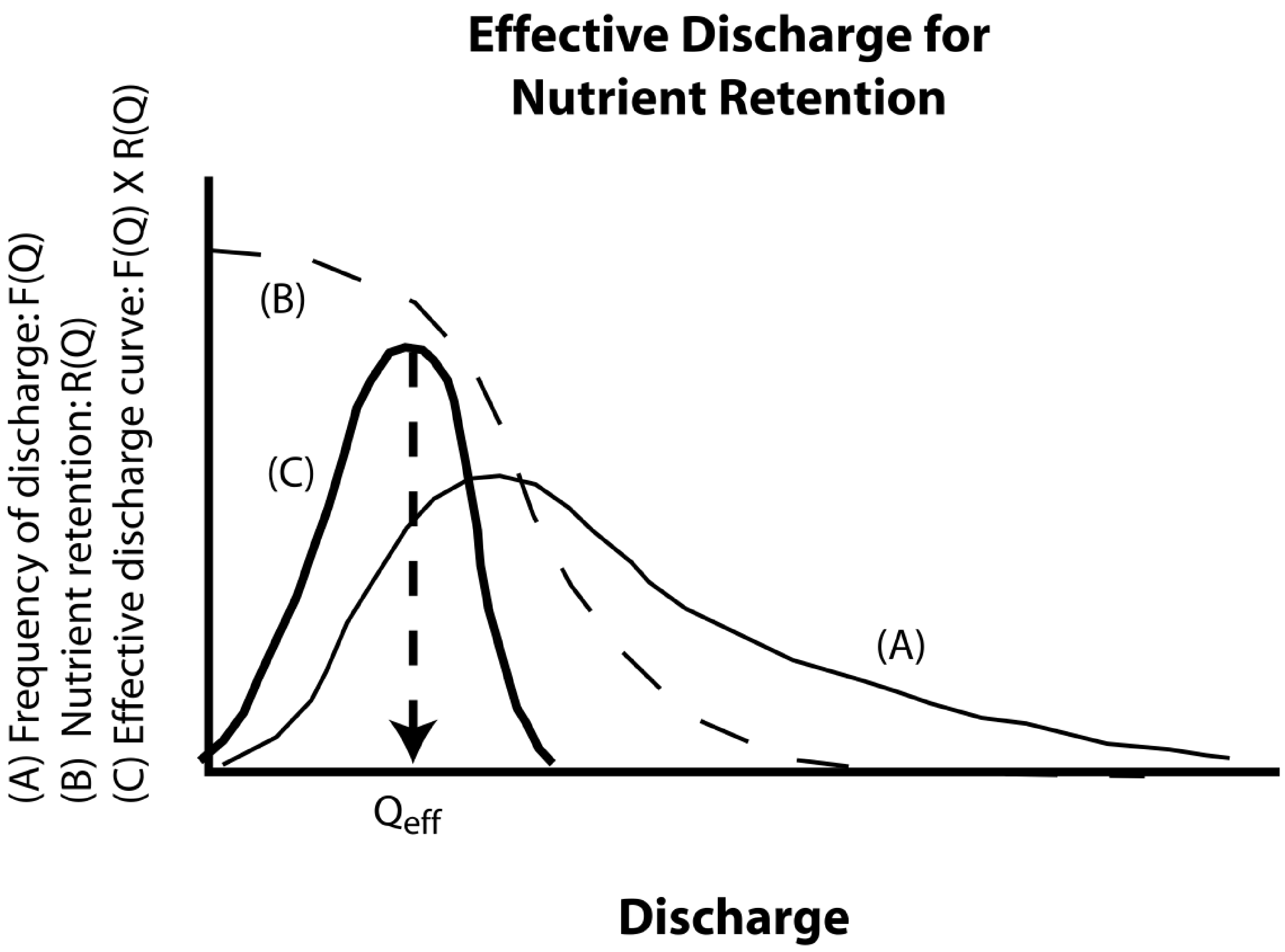
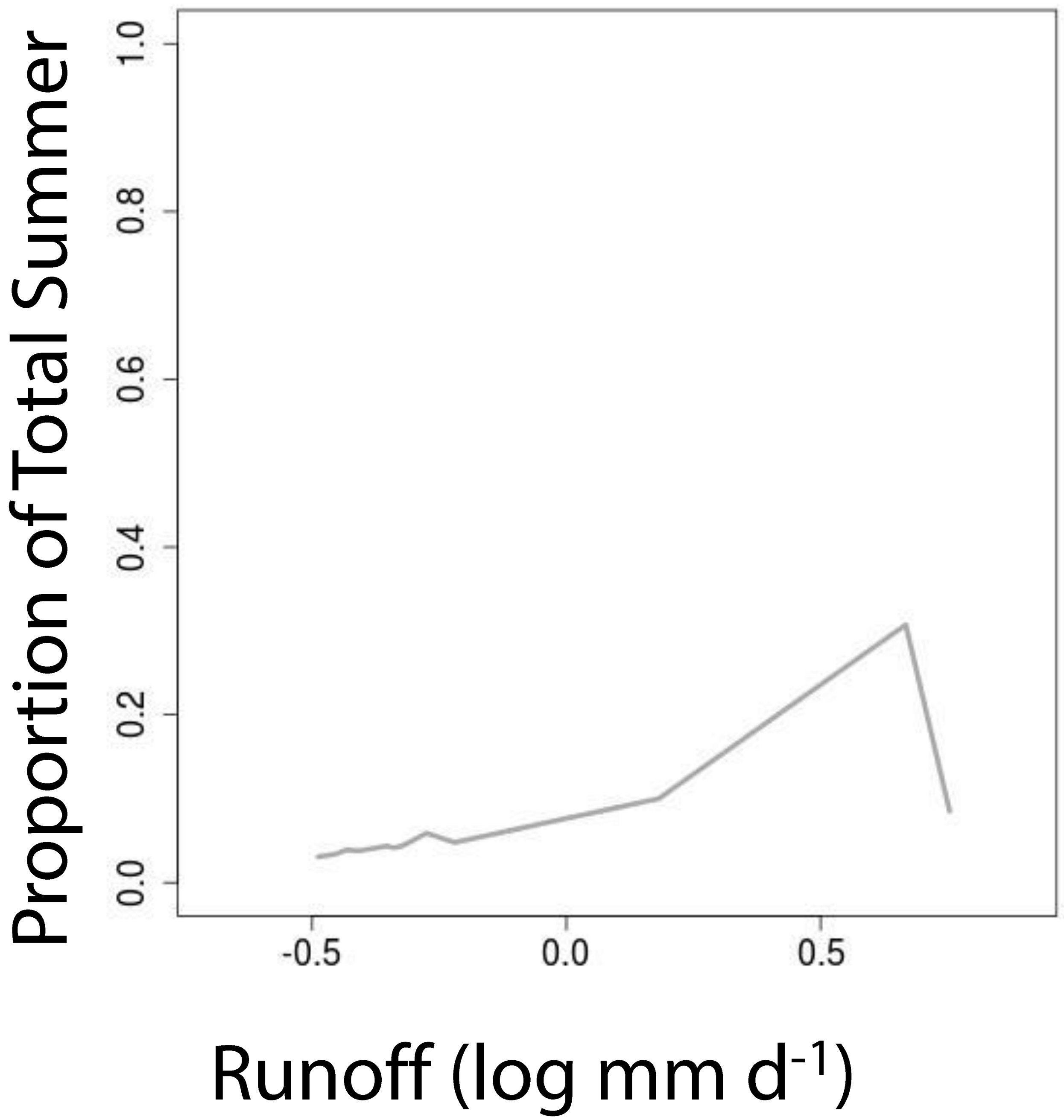
Effective discharge





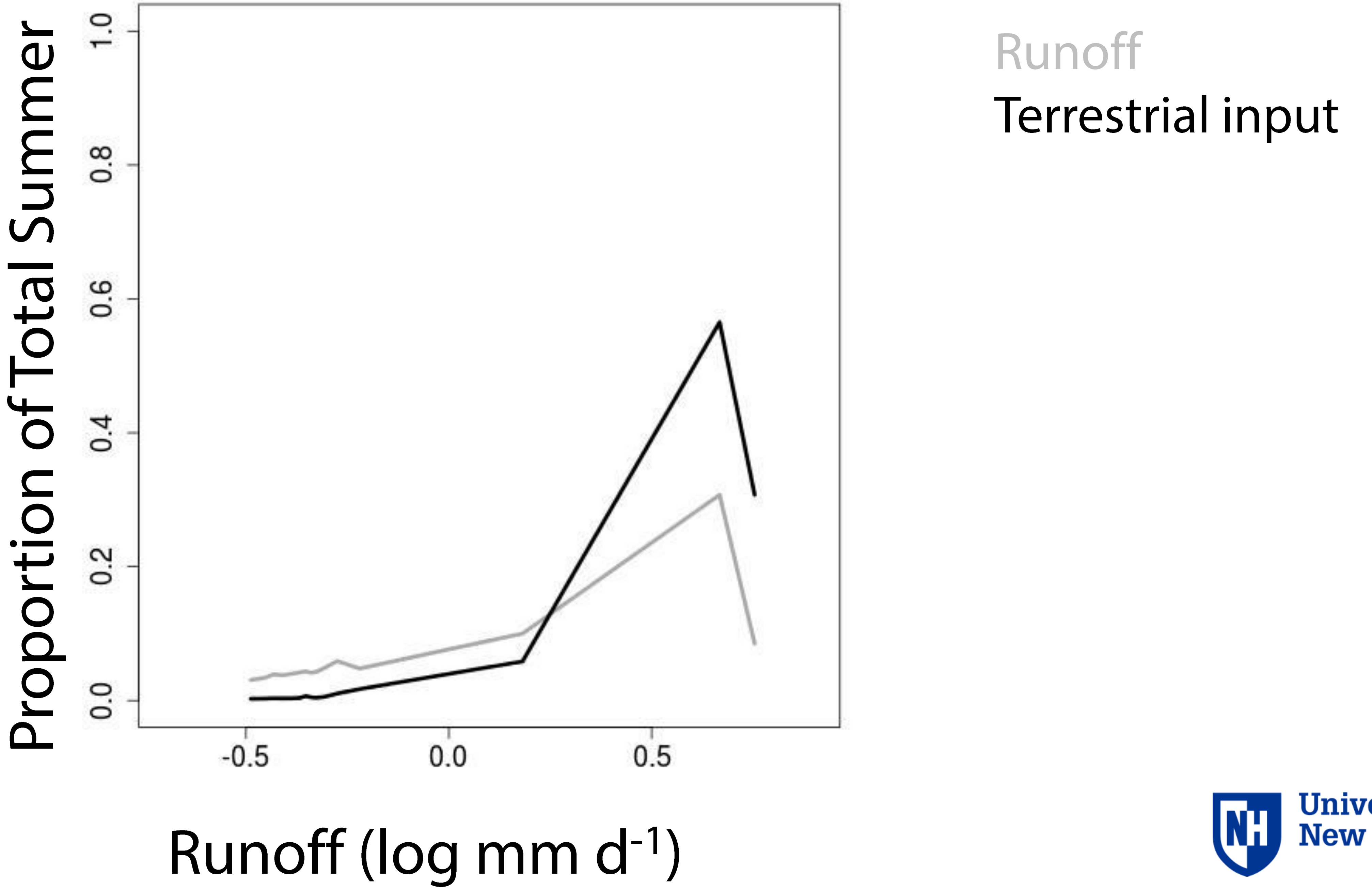
(Doyle, 2005)

Oyster River

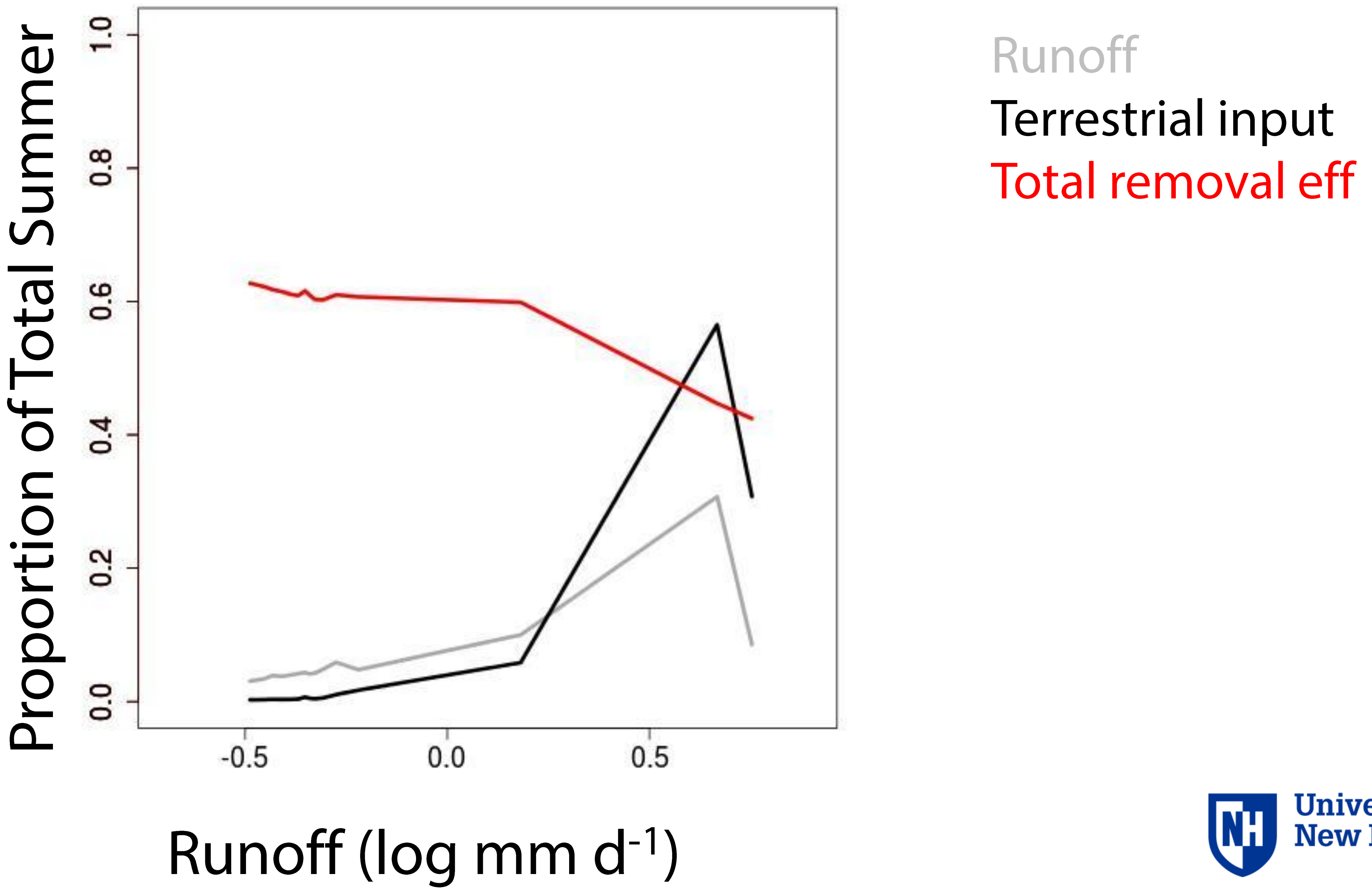


Runoff

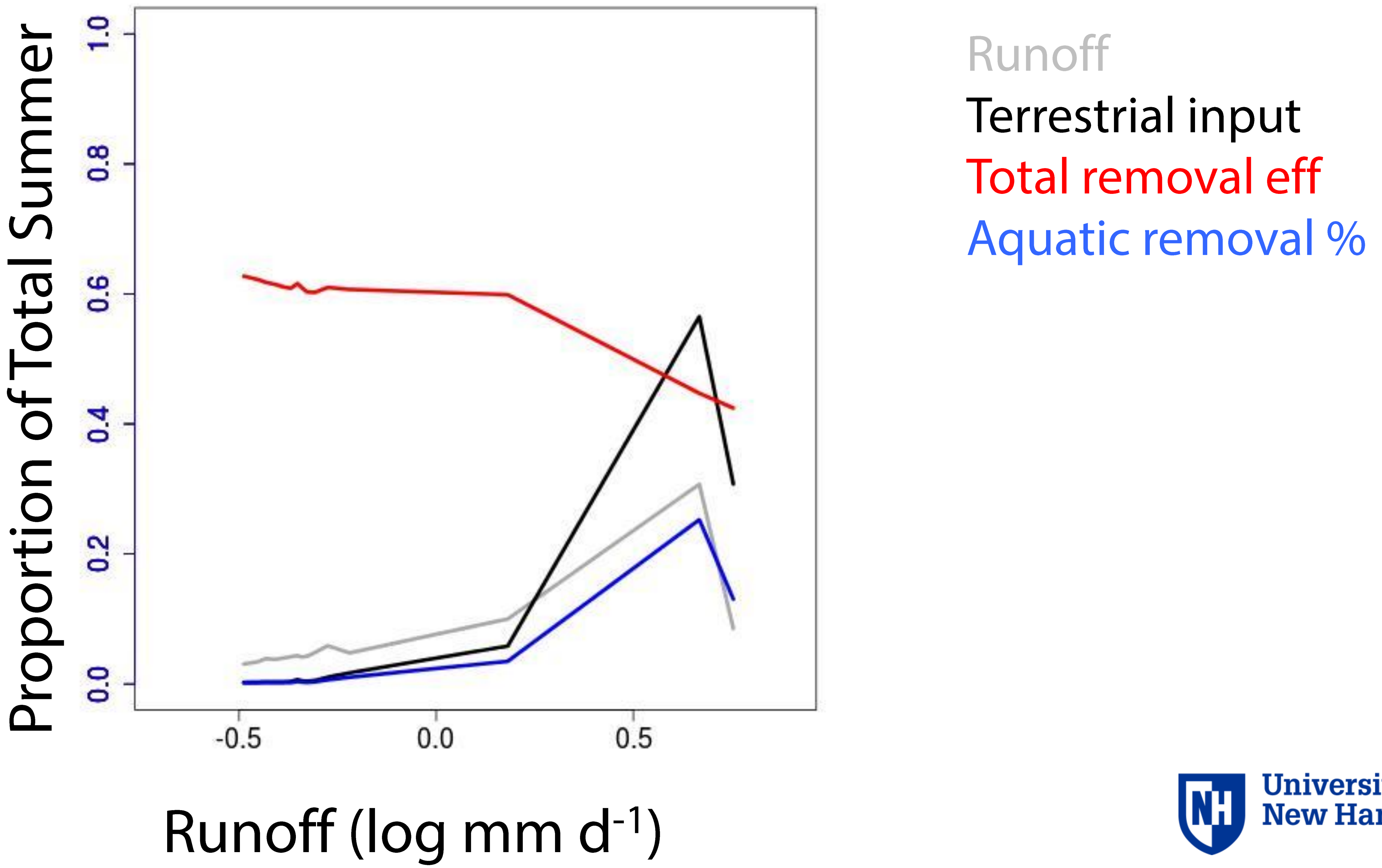
Oyster River



Oyster River



Oyster River



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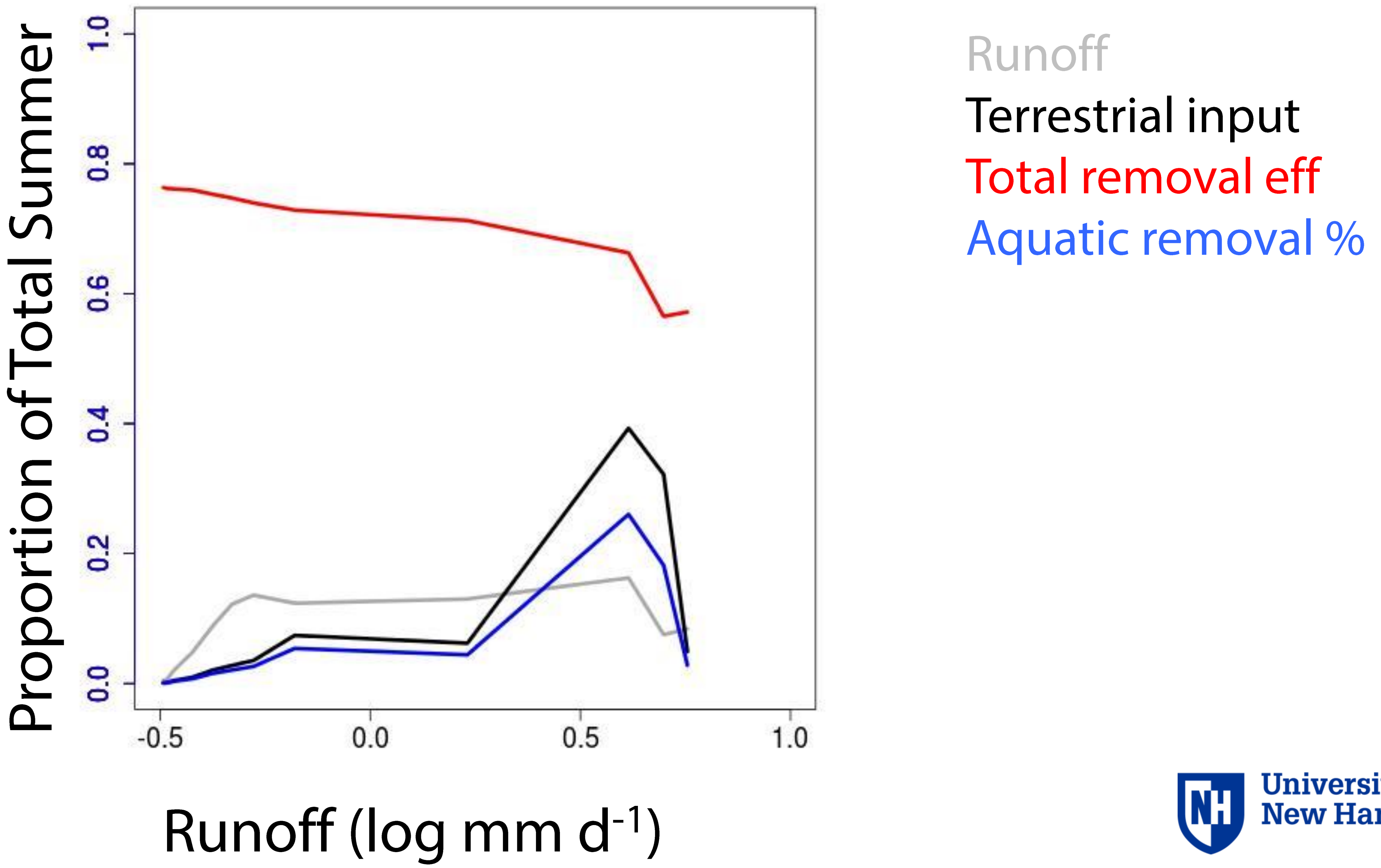
Lamprey River



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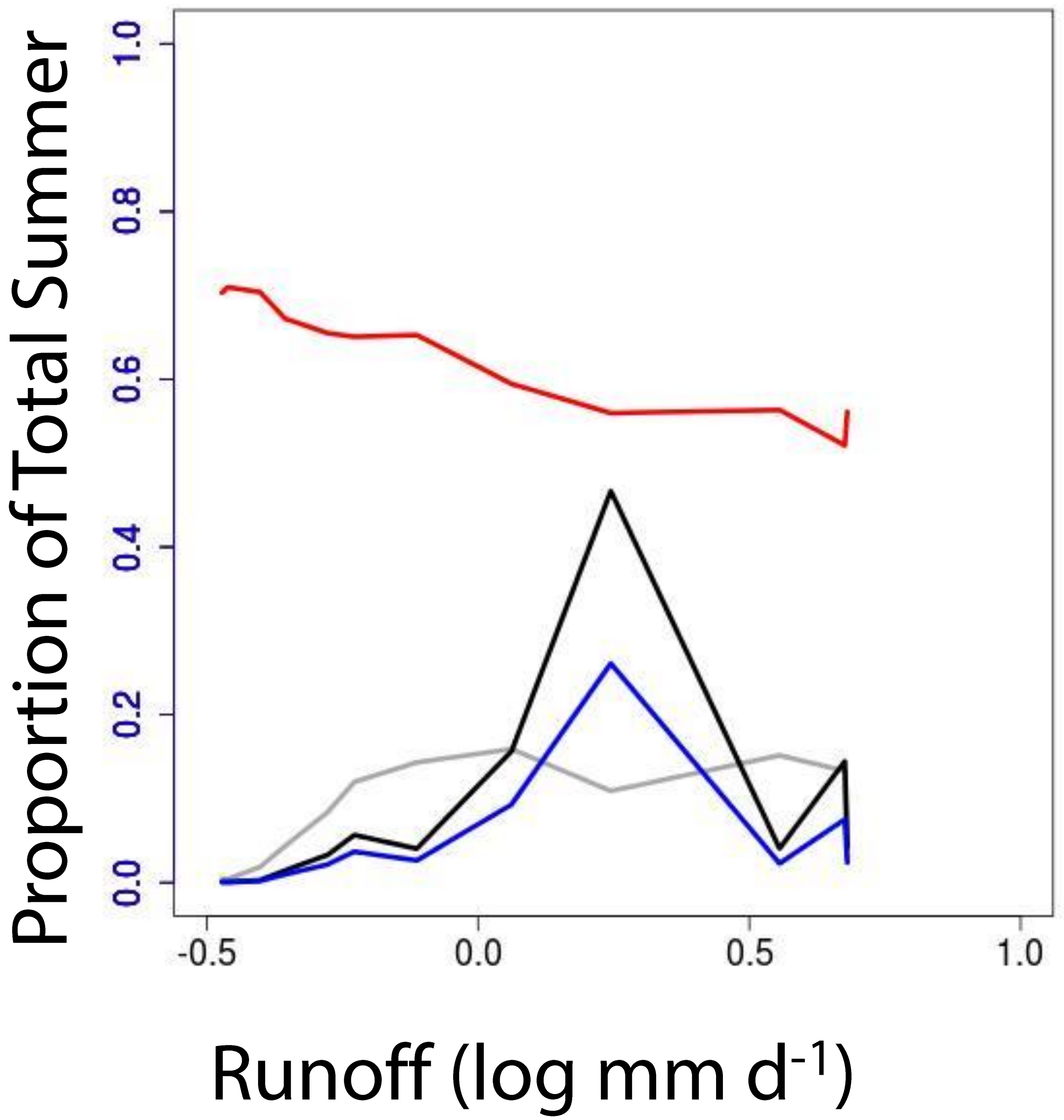
Merrimack River



Runoff
Terrestrial input
Total removal eff
Aquatic removal %

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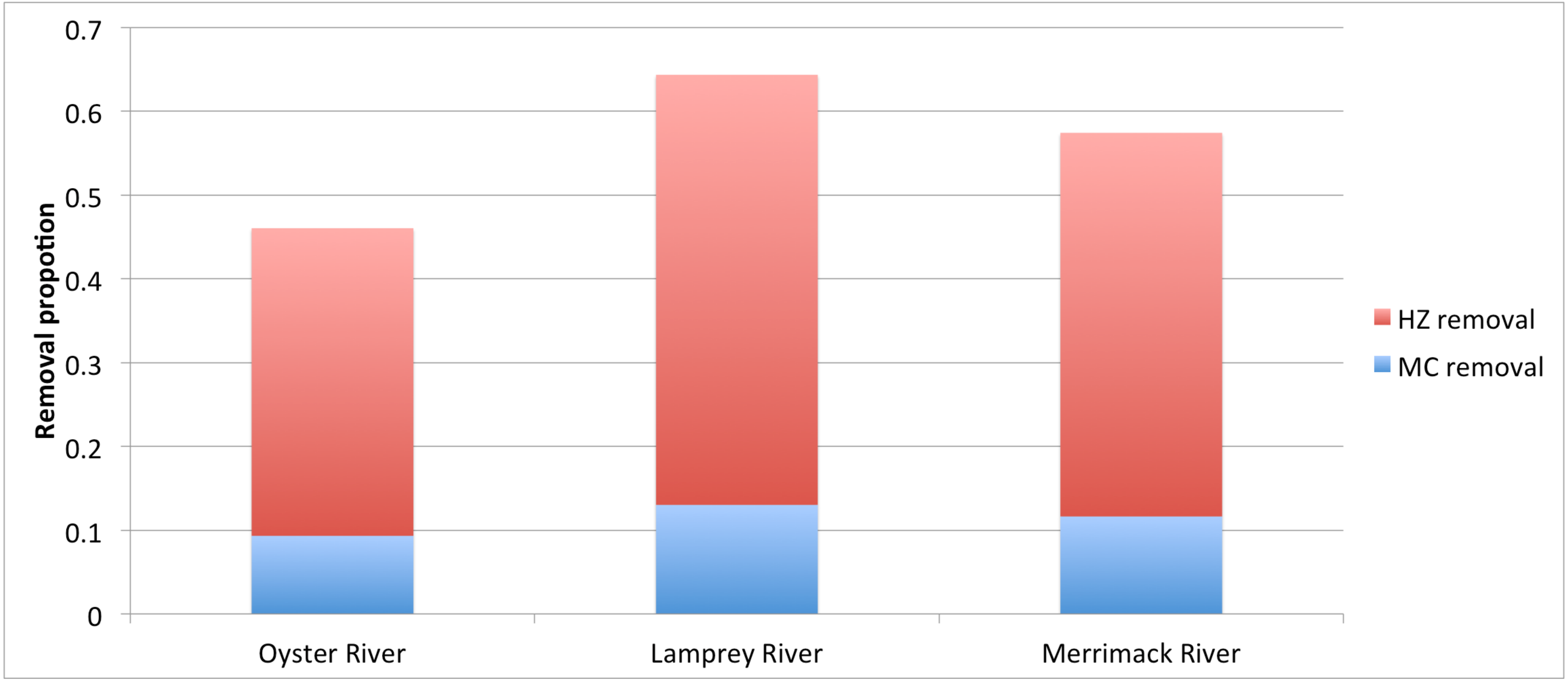

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Application to water quality standard

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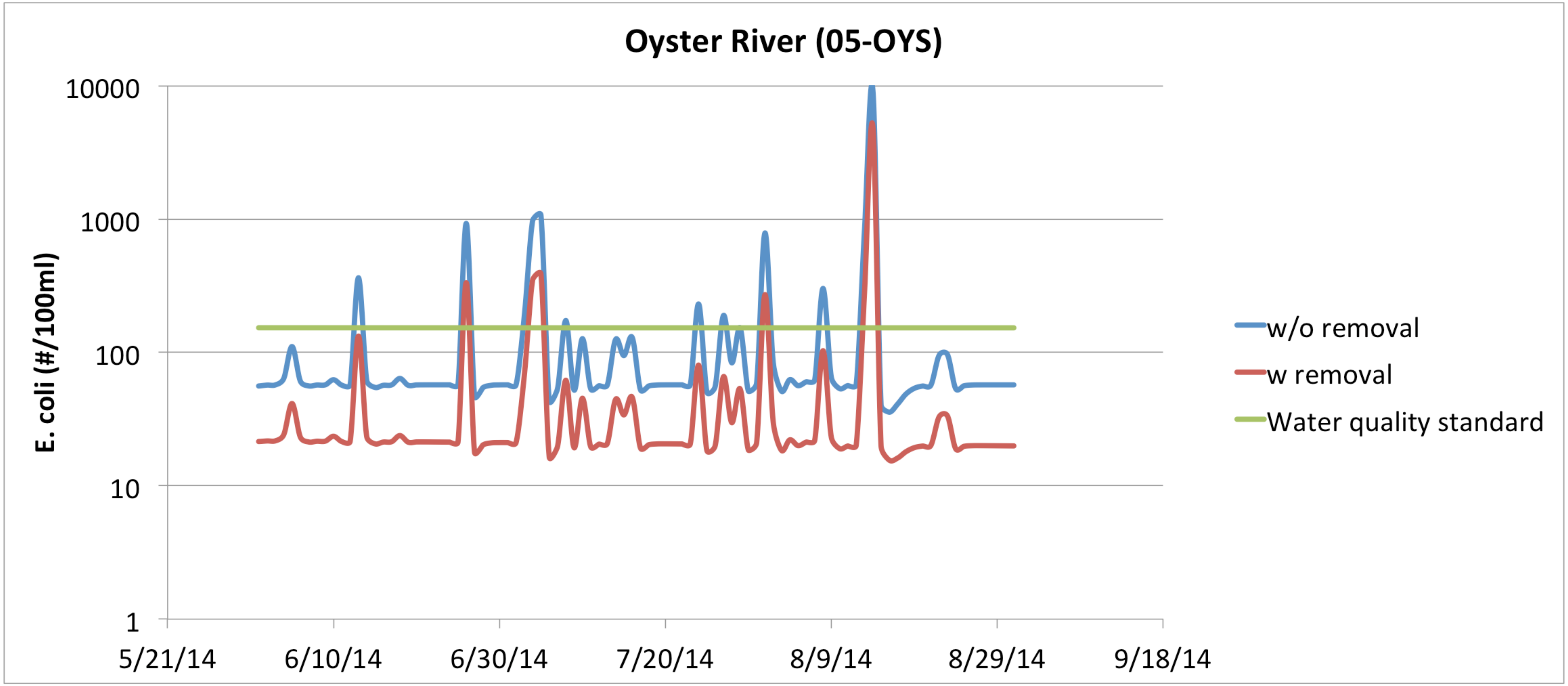

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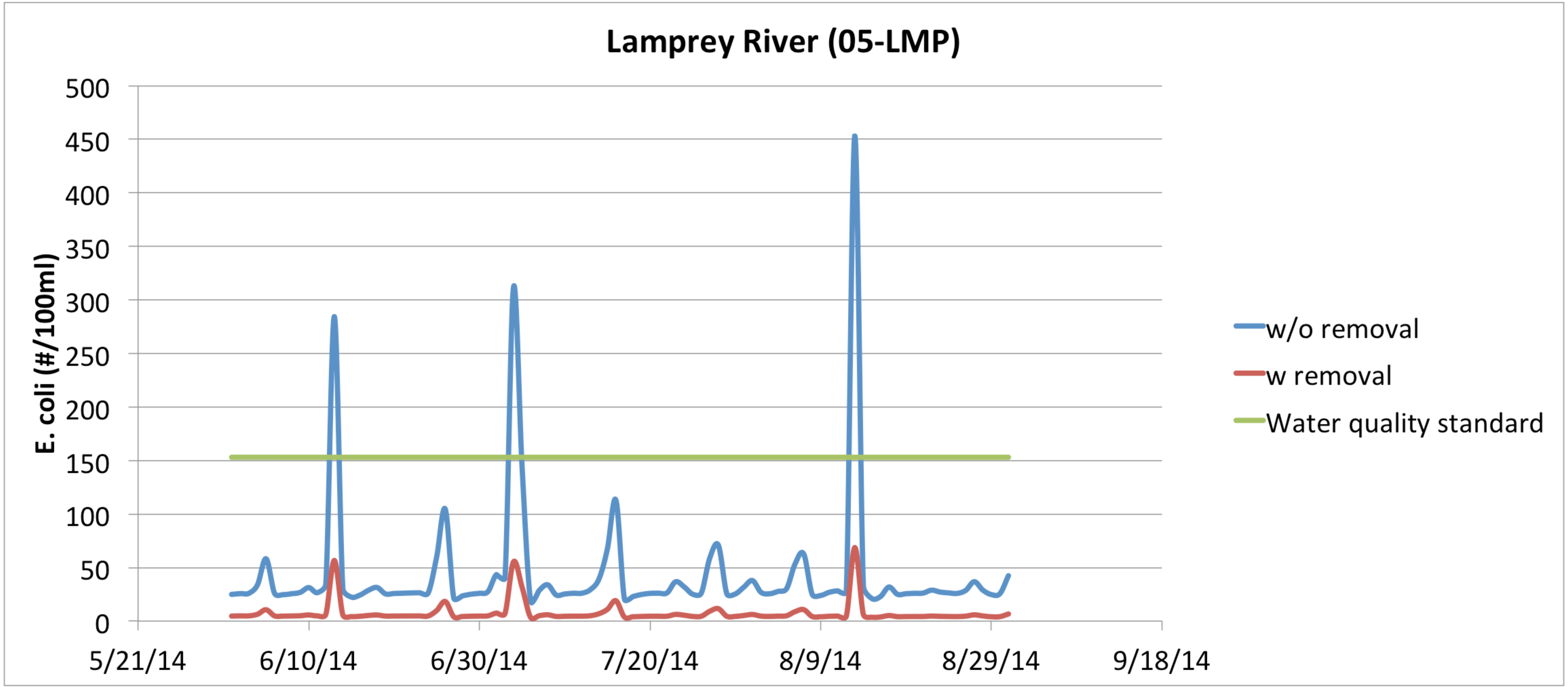

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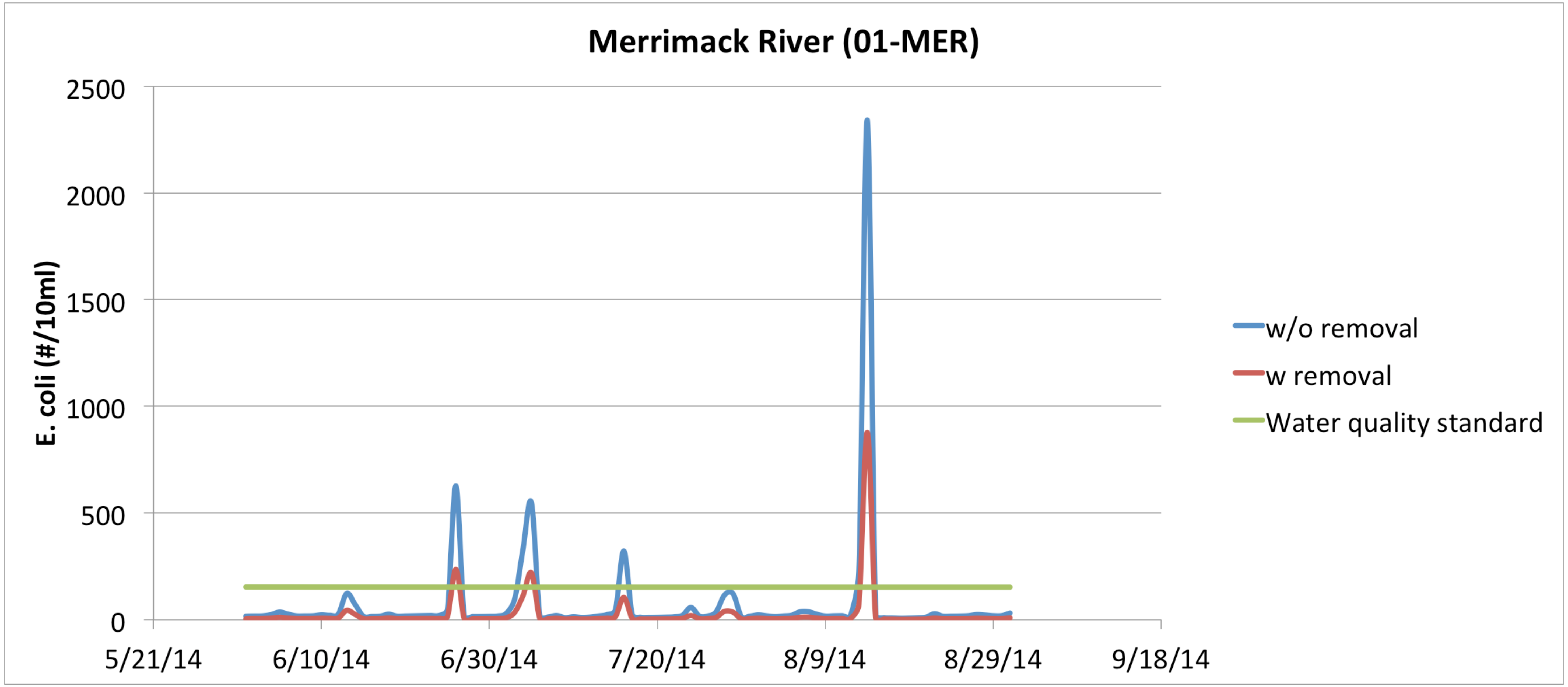

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Conclusions

River networks have the ability to remove fecal coliform.

In this study, HTS removed more FC than MC.

The capacity of river networks to remove fecal coliform inputs reduced in high flow conditions.

Questions?

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