



## Research To Inform Nutrient Thresholds & Targeting Actions: Plan for FY16-19

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## Research To Inform Nutrient Thresholds & Targeting Actions

### **PROJECT GOAL** (for FY16-19 Research):

Research to advance science needed for decisions to:

1. Prioritize watersheds and nutrient\* sources for nutrient management actions (e.g., load reductions)
2. Define appropriate nutrient levels (e.g., quantitative thresholds) for the nation's waters

*\*Nutrient(s) here = nitrogen and other pollutants typically associated with nitrogen, as outlined in EPA's Nitrogen & Co-Pollutant Roadmap for Research*





## Research To Inform Nutrient Thresholds & Targeting Actions

### Three Areas of Research

1. Improved Nutrient Indicator Development
2. Ecosystem Response and Recovery to Nutrients
3. Nutrient Sources and Relative Contributions to Impairment





## Research Area: Improved Nutrient Indicator Development

### Research to quantify indicators sensitive to nutrient exposures for a variety of water body types

Example research areas and goals:

1. Use of emerging technologies (genomics, bioinformatics) to characterize aquatic life and responses to nutrients
2. Evaluation of nutrient indicators for diverse ecosystems/water body types – across different spatial/temporal scales
3. Analyses of appropriate indicators associated with nutrient-enhanced coastal acidification
4. Use of innovative monitoring technologies for nutrient indicator development (e.g., remote sensing, drone, AUV based monitoring)





## Research Area: Ecosystem Response and Recovery

**Research that seeks to relate nutrient fate, transport, and exposures to nutrient-system endpoint responses for the development of nutrient management thresholds**

Example research areas and goals:

1. Improved simulation models and multi-media models to link nutrient sources, exposures and effects across watersheds and coastal marine systems – and to consider climate change effects
2. Assessments of aquatic life impact risk associated with nutrient pollution and acidification interactions in estuarine and coastal marine ecosystems





## Research Area: Nutrient Sources and Relative Contributions to Impairment

**Research to identify important nutrient sources for impairments of human and aquatic life uses of water**

Example research areas and goals:

1. Improved methods to analyze anthropogenic nutrient sources in coastal acidification processes
2. Broad-scale estimates of ambient air-to-deposition ratios for nutrients
3. Improved source attribution estimates for nutrients at regions and small watershed



*EW Boyer*



**Questions and discussions welcome:**

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## **Example Project: Thresholds in the Little Miami River Watershed - Present Research and Beyond**

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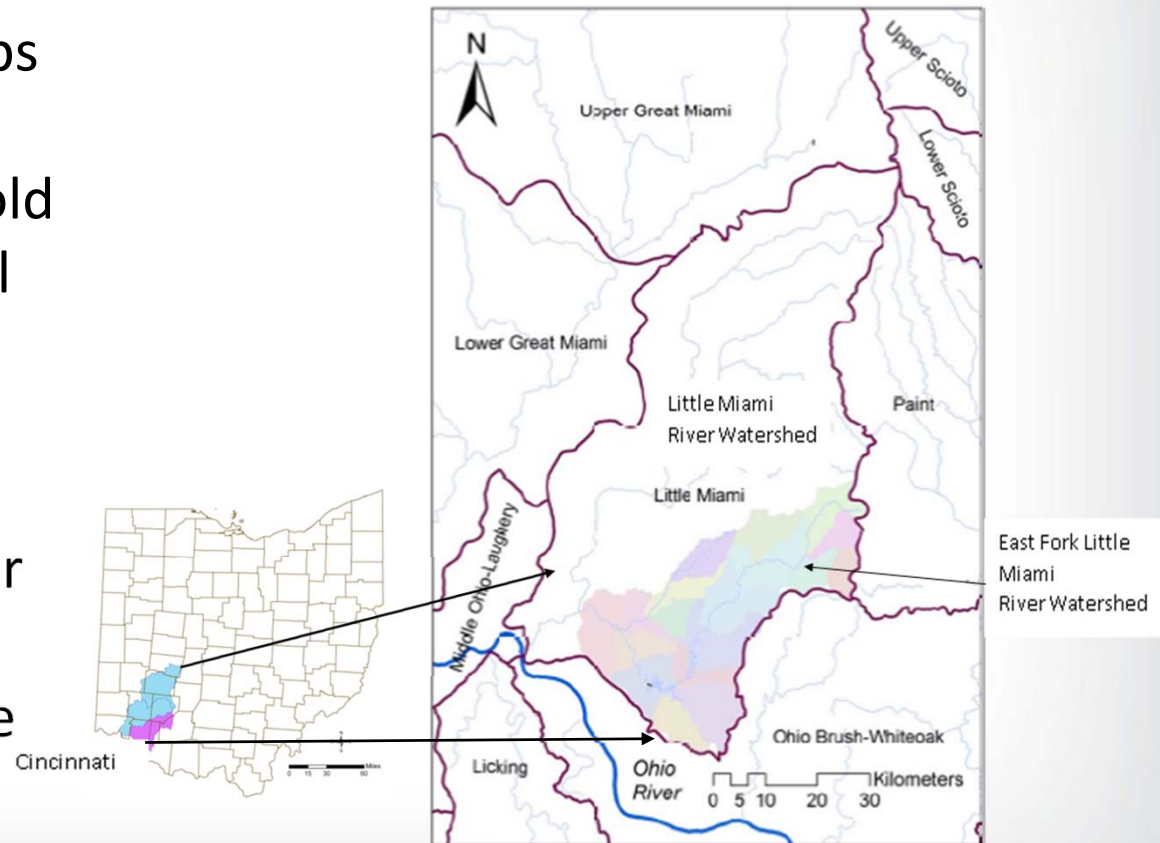
Collaborators (ORD): Chris Nietch, Ken Fritz, Michael McManus, Brent Johnson, Roy Martin, Erik Pilgrim, Joe Flotemersch





## Thresholds in the Little Miami River Watershed

**Goal:** To quantify the relationships between landscape indicators of watershed condition and threshold responses of in-stream ecological endpoints (e.g., IBIs) to identify mechanisms by which potential land use changes, best management practices, and other anthropogenic stressors affect water body condition, aquatic life uses, and watershed integrity.





## Thresholds in the Little Miami River Watershed

**Approach** to develop threshold relationships between watershed condition and measures or indicators of ecological condition

- 1. Development of models relating landscape and chemical stressors to changes in ecological condition at multiple spatial scales**
- 2. Identification of thresholds to bridge between mechanistic representations of pollutant loading management and ecological response**





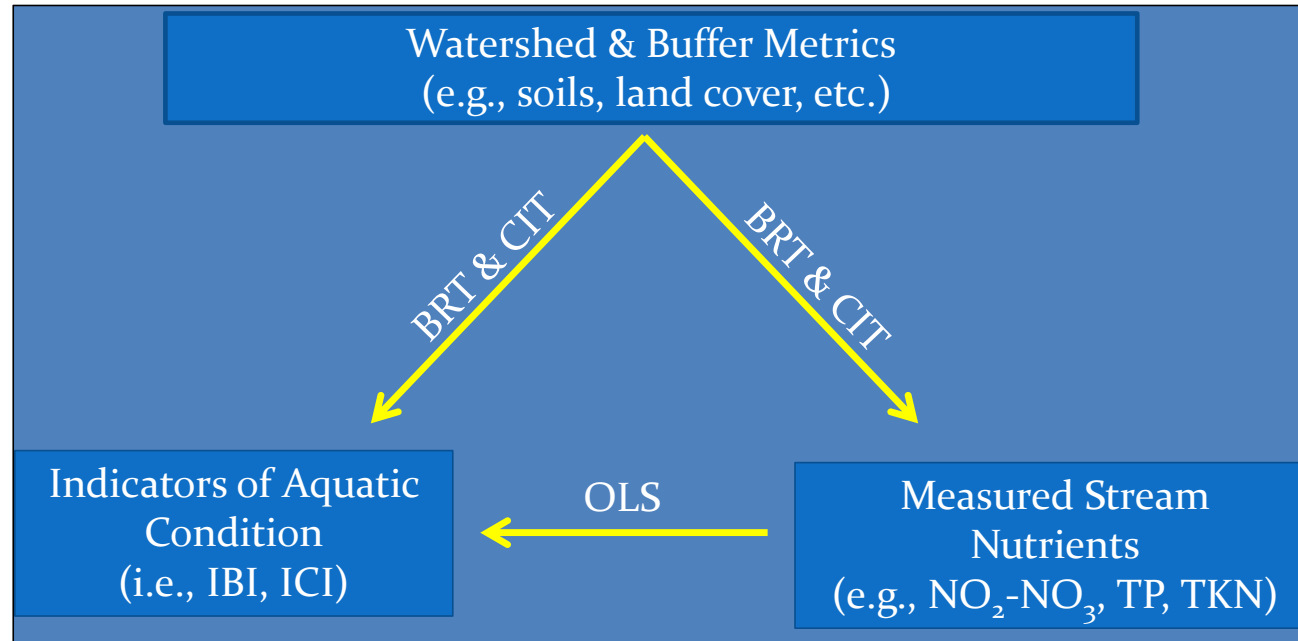
## Thresholds in the Little Miami River Watershed

- Multiple projects within project area
- Nutrient-related project:

**What are the potential thresholds in aquatic biological condition and nutrient concentrations based on a gradient of diffuse (watershed) and local (buffer, in-stream) sources of nutrient impairment in a Midwestern mixed land cover watershed?**



## Statistical Approach



BRT = Boosted Regression Tree analysis

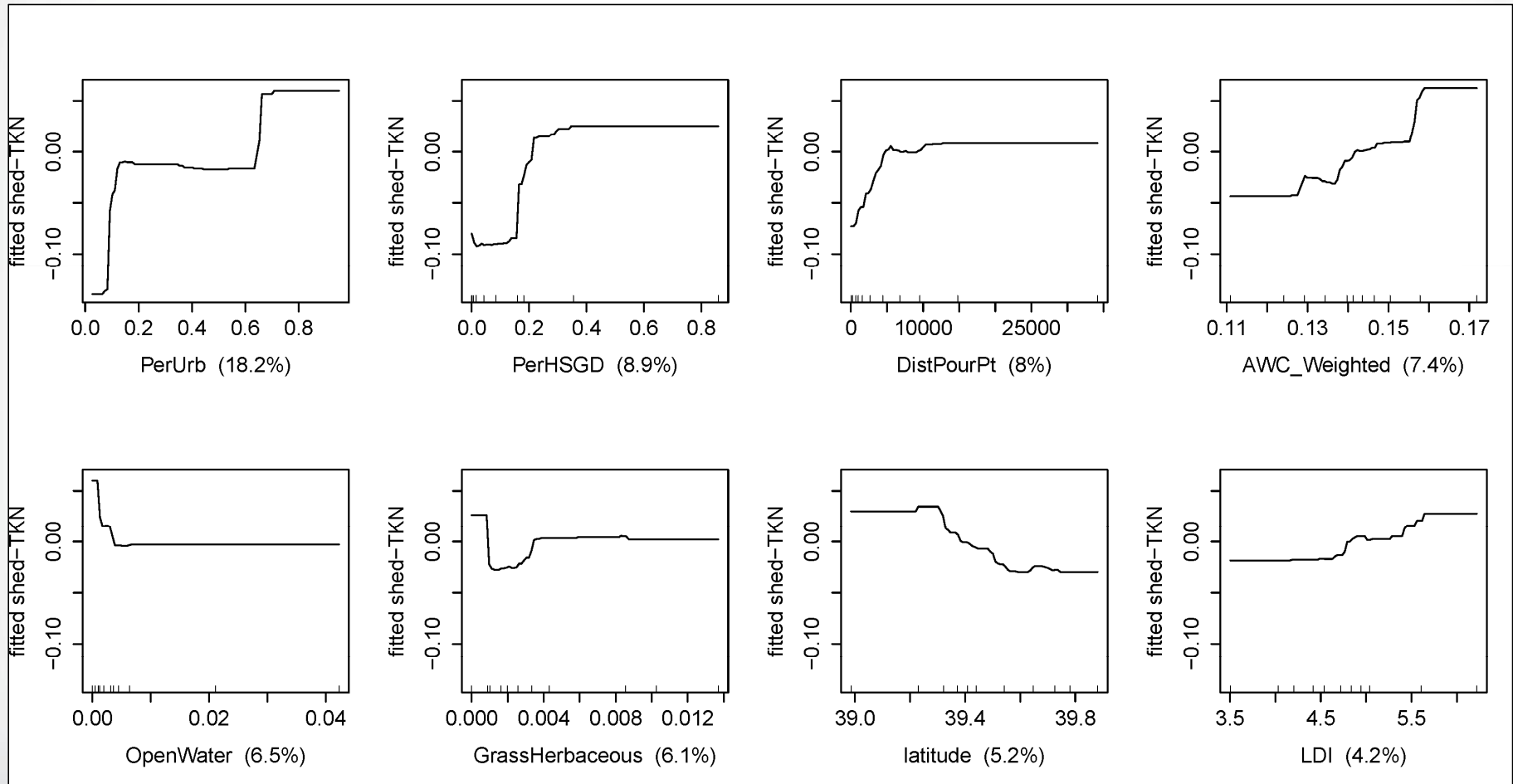
CIT = Conditional Inference Tree analysis

OLS = Ordinary Least Squared Regression

Additional: Bayesian Hierarchical Analyses

# Example analyses – TKN and Watershed Factors

## BRT Partial Dependence Plots





## Thresholds in the Little Miami River Watershed

### Project Impact

OW and local, state, and regional clients = improved understanding of chemical, physical, and biological thresholds to anthropogenic watershed stressors and the ability to identify areas of state-change in aquatic ecosystems at a watershed scale.

### Next Steps

- Develop and simulate mechanistic relationships between watershed nutrient loading and periphyton response in an agricultural watershed
- Project benthic responses under climate change
- Comparative mesocosm studies to validate/verify responses
- Expansion of current work to other watersheds





**Questions and discussions welcome:**

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