

# Wabash River Continuous Monitor

Agenda Item 7c

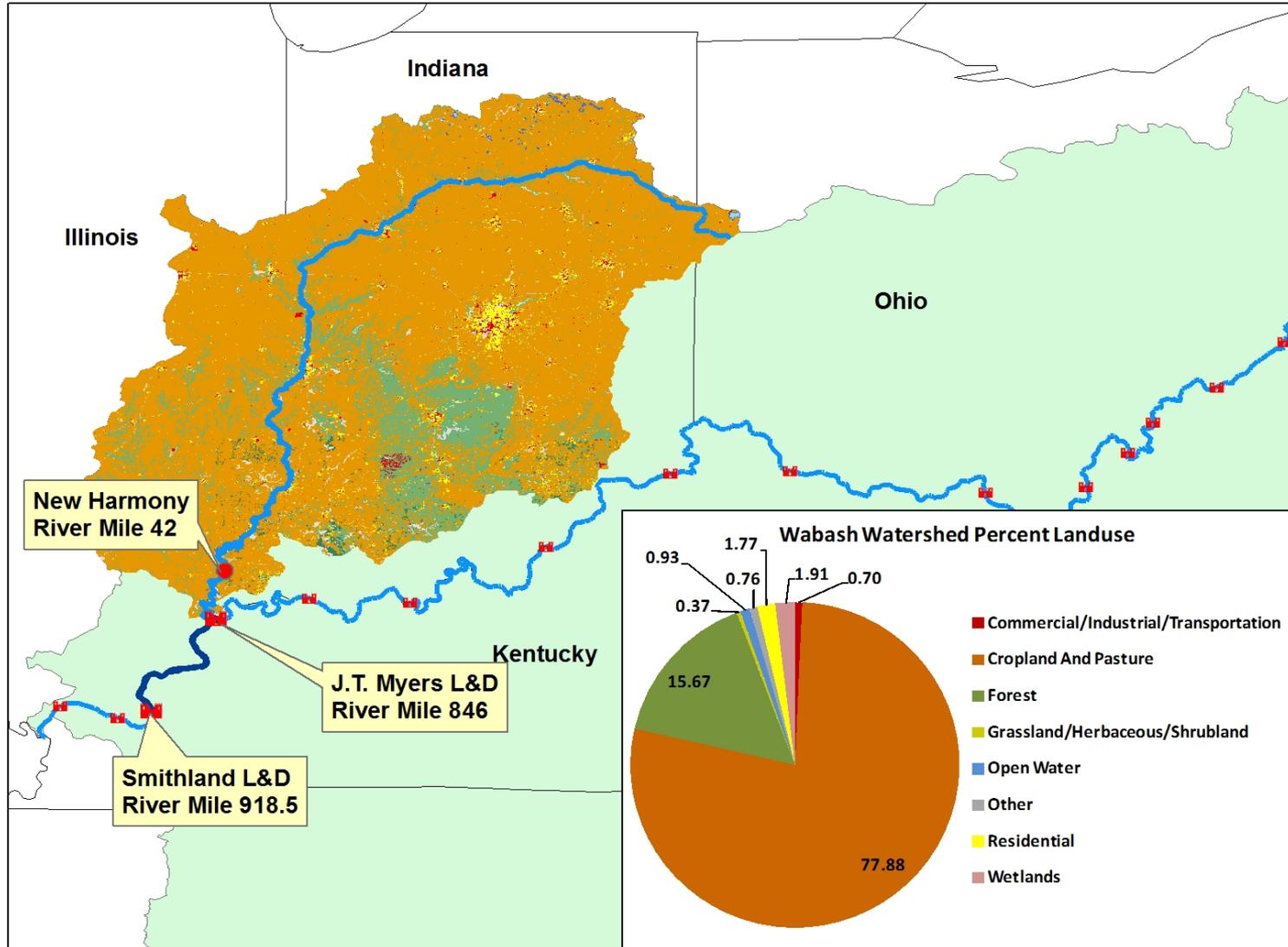


# Project Goals

- 1 year project. Budget of \$98,000. Data collected from 7/1/2010 to 9/30/2011.
- Determine annual load of nutrients from Wabash River and at JT Myers on the Ohio River.
- Evaluate the Wabash River as a possible cause of low dissolved oxygen in the Smithland Pool.



# Project Location



# Parameters

- Continuous monitor data downloaded 3/day
  - pH, conductivity, temp, turbidity, dissolved oxygen, chlorophyll a
- Nutrients collected every 2 weeks
  - Ammonia, TKN, Nitrate/Nitrite, Total Phosphorus, BOD, TSS, Algae, Chlorophyll
  - Ohio River samples collected during summer months
- Data available on website

### Wabash River Project

#### NUTRIENTS AND CONTINUOUS MONITORING PROGRAM

The Wabash River has been identified as one of the largest contributors of nitrogen to the Gulf of Mexico and the zone of hypoxia. In addition, the Wabash River enters the Ohio River at the upstream end of the Smithland Pool. The Smithland Pool has experienced lower dissolved oxygen levels in recent years and has been designated as impaired in ORSANCO's 2008 Assessment of Water Quality Conditions, and previous sampling in the Smithland Pool indicates the Wabash River may be a significant contributor to the problem.

Wabash River	Ohio River @ J.T. Myers	Ohio River @ Smithland
<a href="#">-Datasonde</a>	<a href="#">-Datasonde</a>	<a href="#">-Datasonde</a>
<a href="#">-Algae</a>	<a href="#">-Algae</a>	<a href="#">-Algae</a>
<a href="#">-Nutrients</a>	<a href="#">-Nutrients</a>	<a href="#">-Nutrients</a>

The United States Geological Survey (USGS) maintains a gaging station on the Wabash River at New Harmony, Indiana. [Click here](#) to see the current river level and for historic data.

The National Weather Service provides predictive stream height using the USGS data. [Click here](#) to view this data.



The map displays the Wabash River basin in green, with the river itself shown in blue. Key features include Interstate 24 crossing the river, the town of New Harmony, and the J.T. Myers Lock and Dam. A scale bar is located at the bottom right of the map.

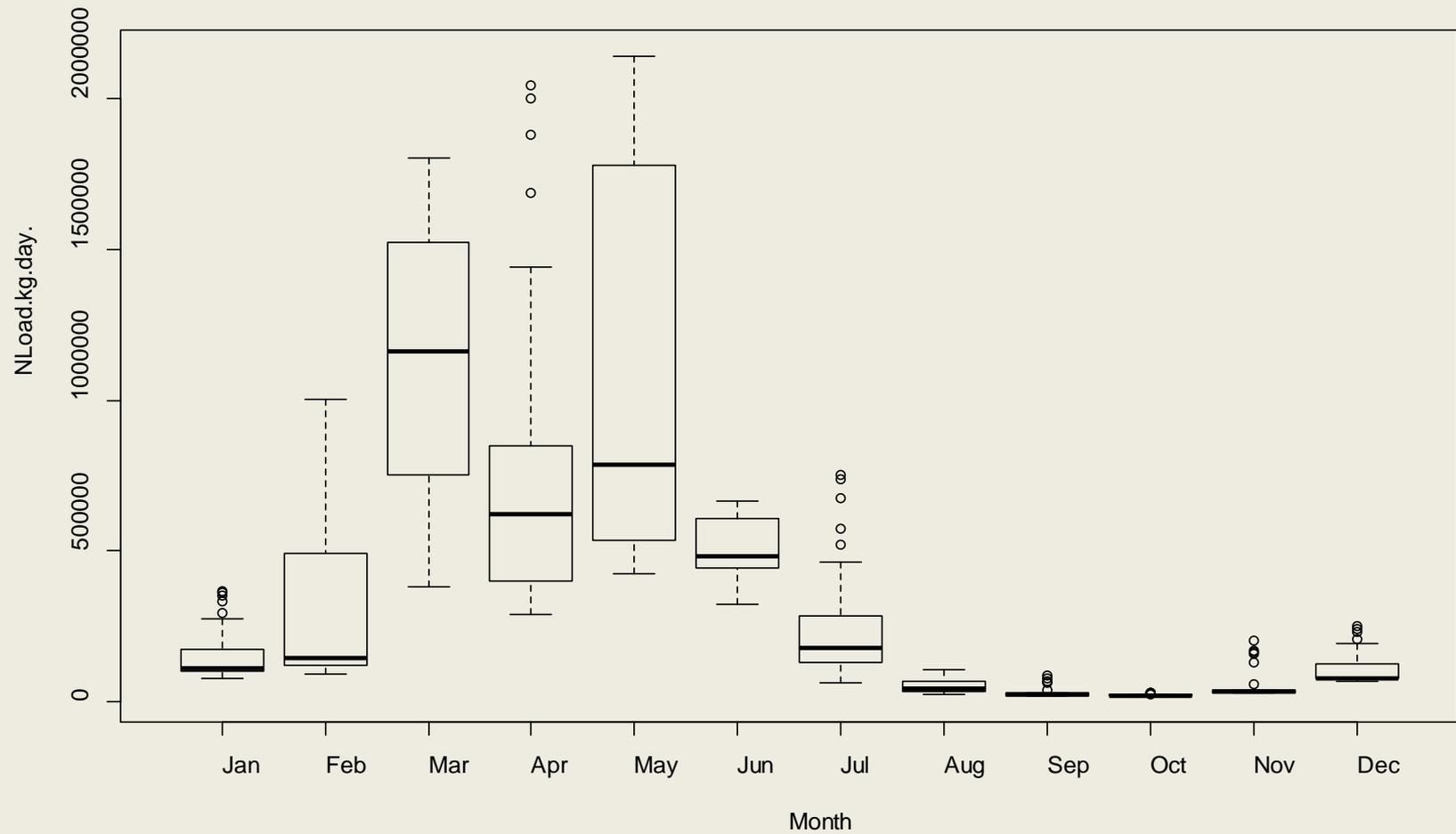
# Goal 1: Load Calculation

- USGS LOADEST
  - FORTRAN program for estimating loads
- Uses a time series of streamflow and constituent concentration data.
- Develops a regression model of the constituent load.
- This model is then used to estimate loads over the specified time interval.

# LOADEST Inputs

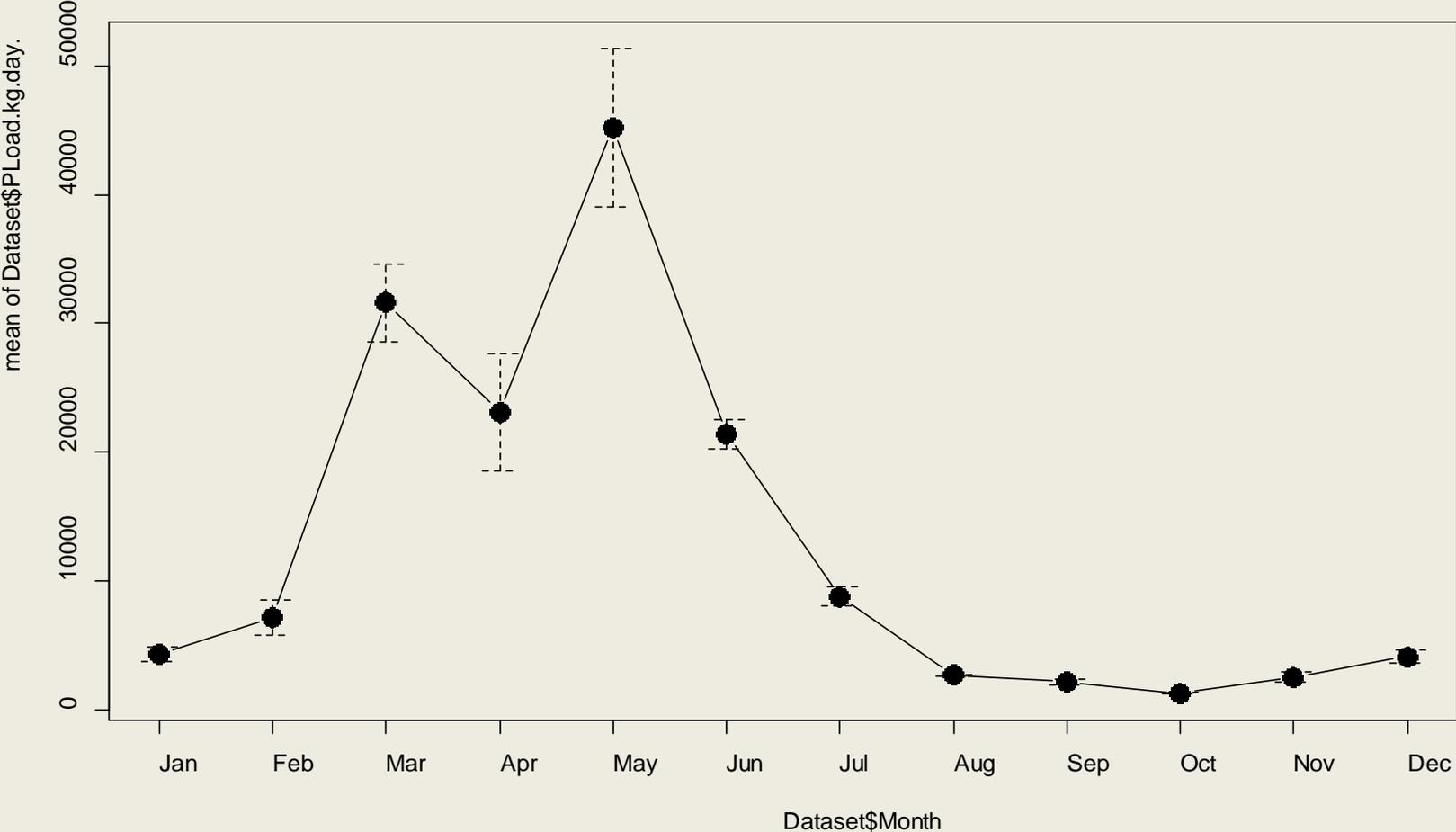
- Wabash River
  - 30 nutrients samples
  - TN calculated by adding TKN and Nitrate/Nitrite
  - Flow data from USGS gauge at Mt. Carmel, IL
    - Mt. Carmel 28,635 sq mi (86.5% of watershed)
    - New Harmony 29,234 sq mi (88% of watershed)
    - 599 sq mi = 2%
- Ohio River at JT Myers
  - 20 Nutrients Samples
    - Project only collects summer time data. Additional data provided by Bi-monthly Program
  - TN calculated by adding TKN and Nitrate/Nitrite
  - Flow data from COE Cascade

# Nitrogen Load - Wabash River



# Phosphorus Load - Wabash River

Plot of Means



# Load Calculations

## Wabash River

- 1 Year load 7/1/2010 to 6/30/2011
  - Flow for model year – 15,187,190 cfs
  - Flow for previous 10 years
    - 10,207,480 cfs – 17,737,490 cfs
    - 2<sup>nd</sup> highest flow year since 2001
- **138,976** metric tons TN
- **4,646** metric tons TP

## Ohio River at JT Myers

- 1 Year load 7/1/2010 to 6/30/2011
  - Flow for model year – 83,036,200 cfs
  - Flow for previous 10 years
    - 50,373,500 cfs – 87,999,200 cfs
    - 3<sup>rd</sup> highest flow year since 2001
- **427,788** Metric tons TN
- **39,337** metric tons TP

# Wabash River Load Comparison

Report	TN (metric tons)	TP (metric tons)
<b>LOADEST 2011</b> (adjusted for area)	<b>160,646</b>	<b>5,370</b>
<b>ORSANCO 2003 Report</b> (1998-1999 data)	<b>127,414</b>	<b>5,432</b>
<b>SPARROW (2002)</b>	<b>194,767</b>	<b>7,120</b>

# Goal 2: Causes of DO Impairment

- Evaluation of DO data
- Evaluation of nutrient concentrations
- BOD as a source of DO impairment
- Algae as a source of DO impairment

# Dissolved Oxygen

Station	Max Flux	# days >6mg/L Flux	# days <5 mg/L average	# days <4 mg/L instant
Wabash R.	<b>10.94</b>	<b>21</b>	<b>0</b>	<b>13</b>
JT Myers L&D	<b>7.25</b>	<b>2</b>	<b>0</b>	<b>12</b>
Smithland L&D	<b>7.03</b>	<b>2</b>	<b>25</b>	<b>7</b>

Diurnal flux is caused by algal respiration

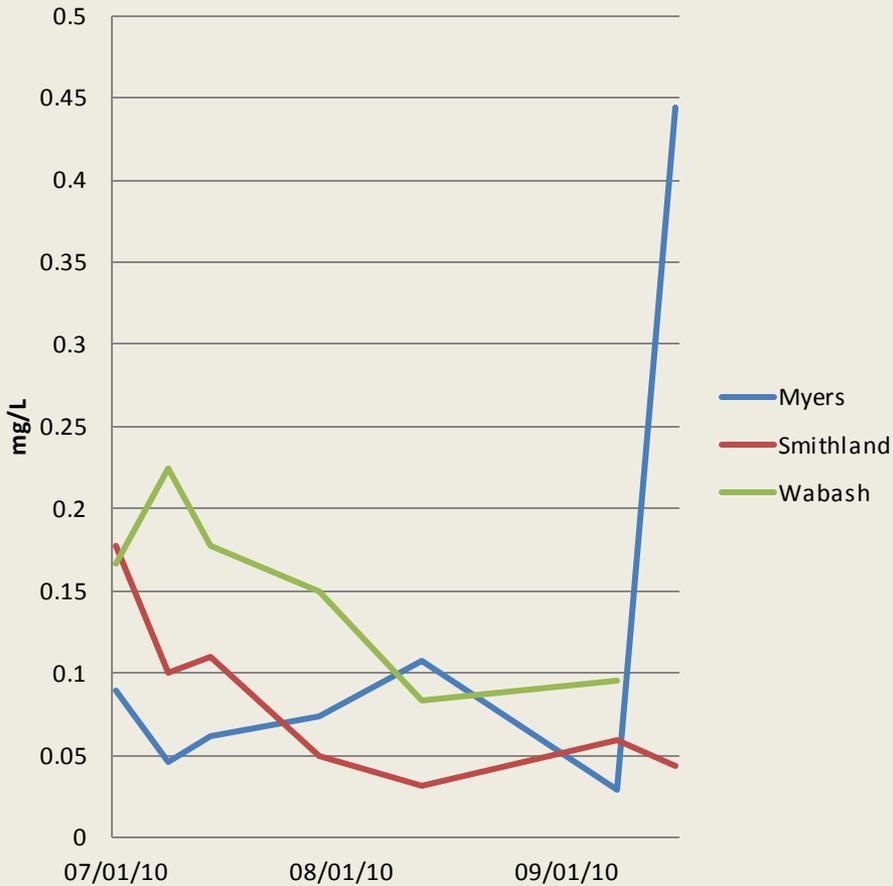
Wabash R. low DO associated with large diurnal flux

JT Myers/Smithland low DO associated with minimal diurnal flux

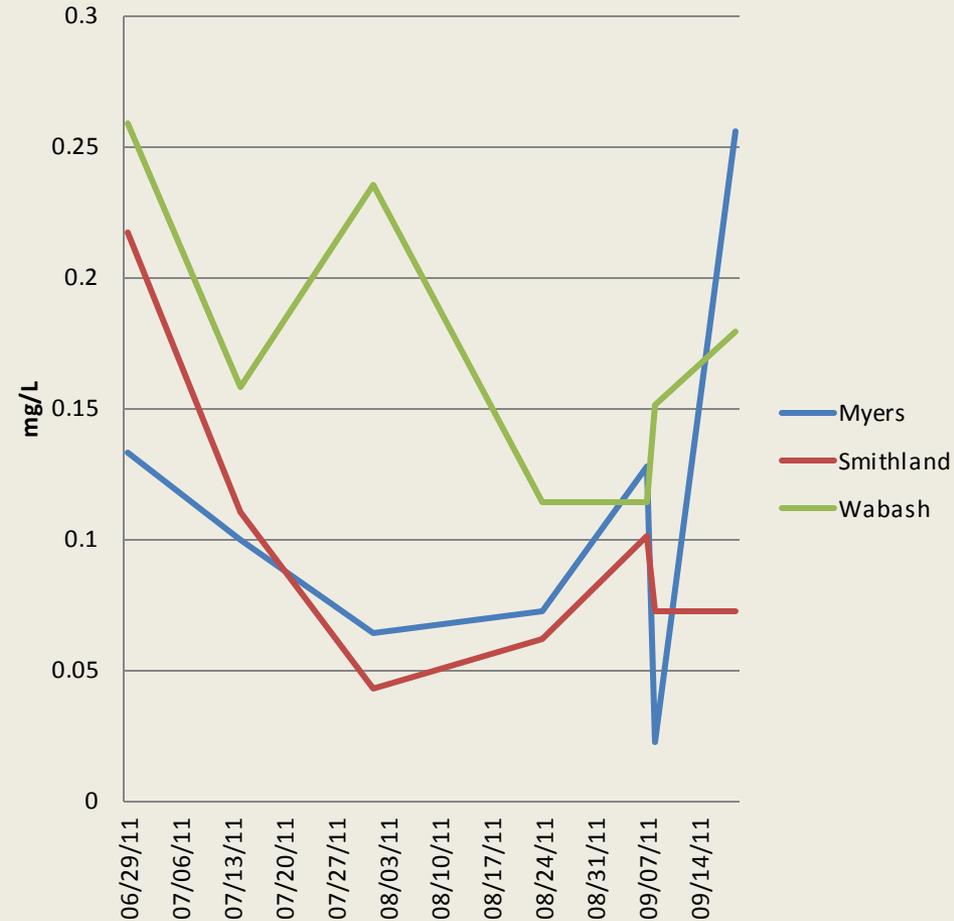
Period: 7/1/2010 to 9/30/2011 (2 summers)

# Total Phosphorus Concentrations

## 2010 TP

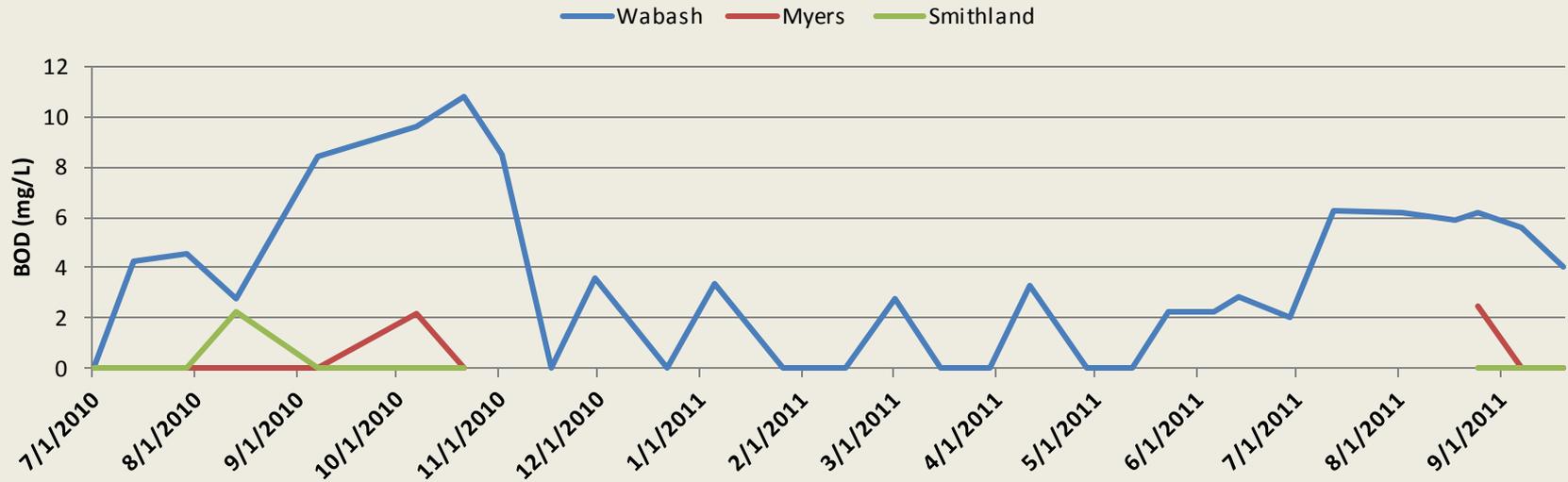


## 2011 TP



# BOD

## BOD July 2010-Sep 2011



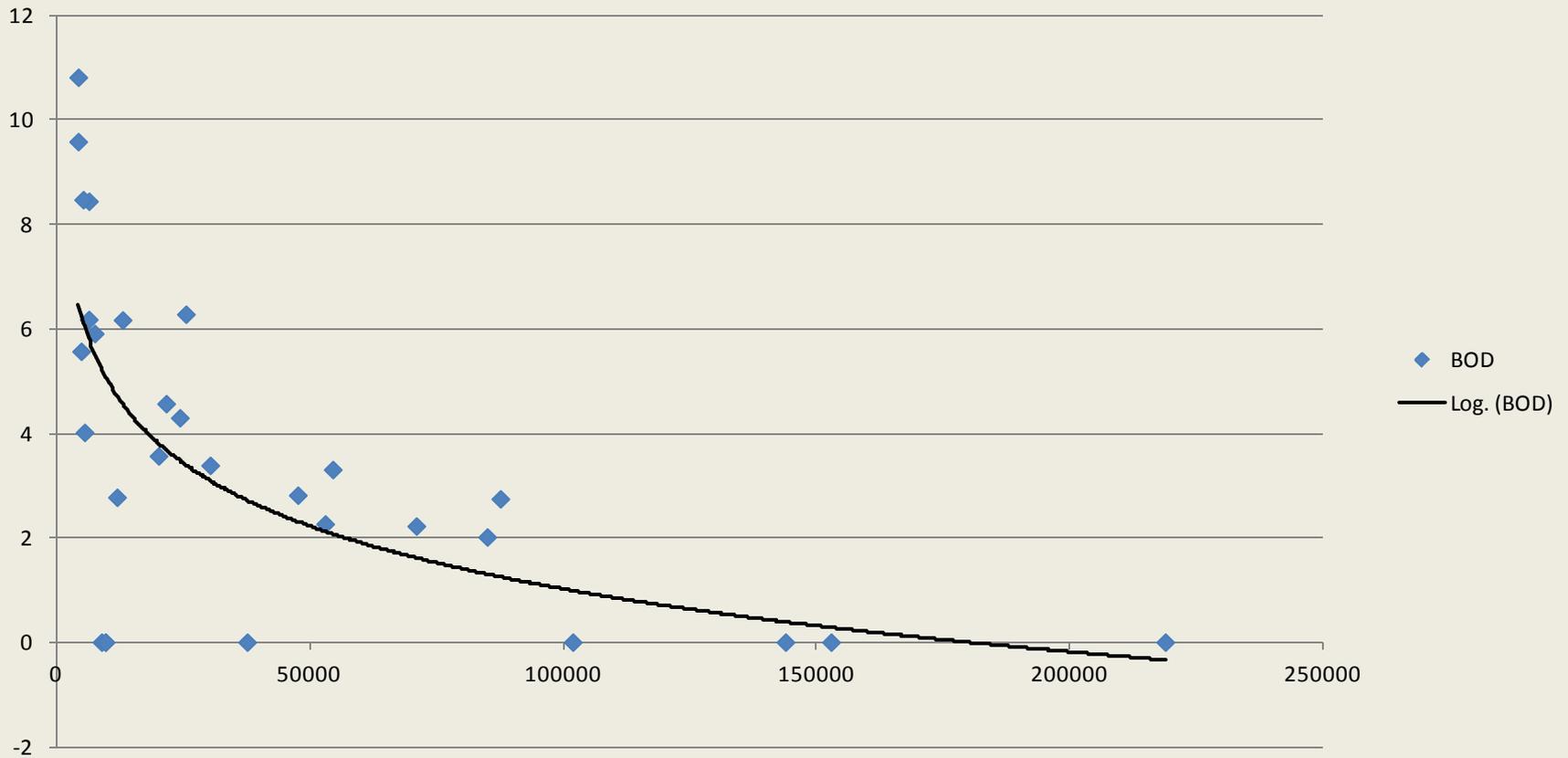
Max BOD Wabash River = 10.8 mg/L

Max BOD JT Myers = 2.51

Max BOD Smithland = 2.27

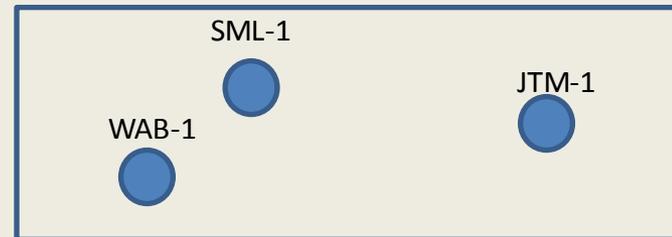
# Effect of Flow on BOD

## Wabash River BOD vs Flow



# Algae Community

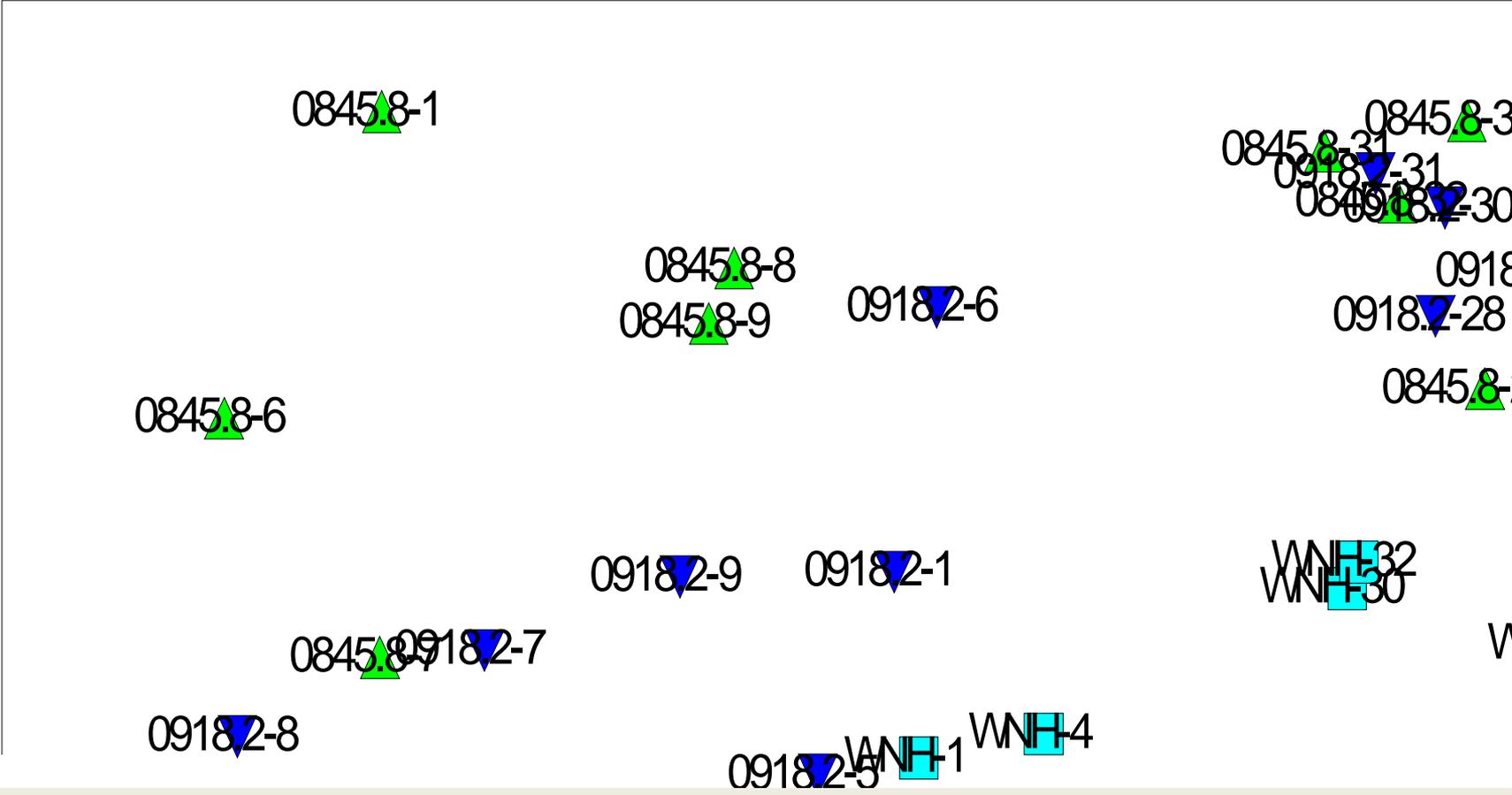
- Analyses performed using Primer (v5.2.9)
- Performed standardized Bray-Curtis Similarity (with no data transformation) to create a sample-similarity matrix
  - Bray Curtis disproportionately emphasizes more common species
- Performed a Two-way nested Analysis of Similarity (ANOSIM) using 'Location' (JTM, SML, WAB) and Visit (1-32) as factors using 9999 permutations
  - 2-way nested performed because you want to know the relative similarity of 'location' within each visit
  - e.g. The analyses looks at the relative distance between samples within each round
    - SML-1 and WAB-1 are most similar
    - SML-1 and JTM-1 are medially similar
    - WAB-1 and JTM-1 are least similar



- Non-metric, multidimensional scaling (NMDS) ordination plot generated to visually observe a 2-dimensional representation of samples

# NMDS Results By Location

*Wabash Algae*



# Two-Way ANOSIM Results

- TESTS FOR DIFFERENCES BETWEEN Visit GROUPS

- (averaged across all Location groups)

- Groups too small

- TESTS FOR DIFFERENCES BETWEEN Location GROUPS

- (using Visit groups as samples)

- Global Test

- Sample statistic (Global R): 0.034

- Significance level of sample statistic: 17.6%

- Number of permutations: 9999 (Random sample from a large number)

- Number of permuted statistics greater than or equal to Global R: 1761

- Pairwise Tests

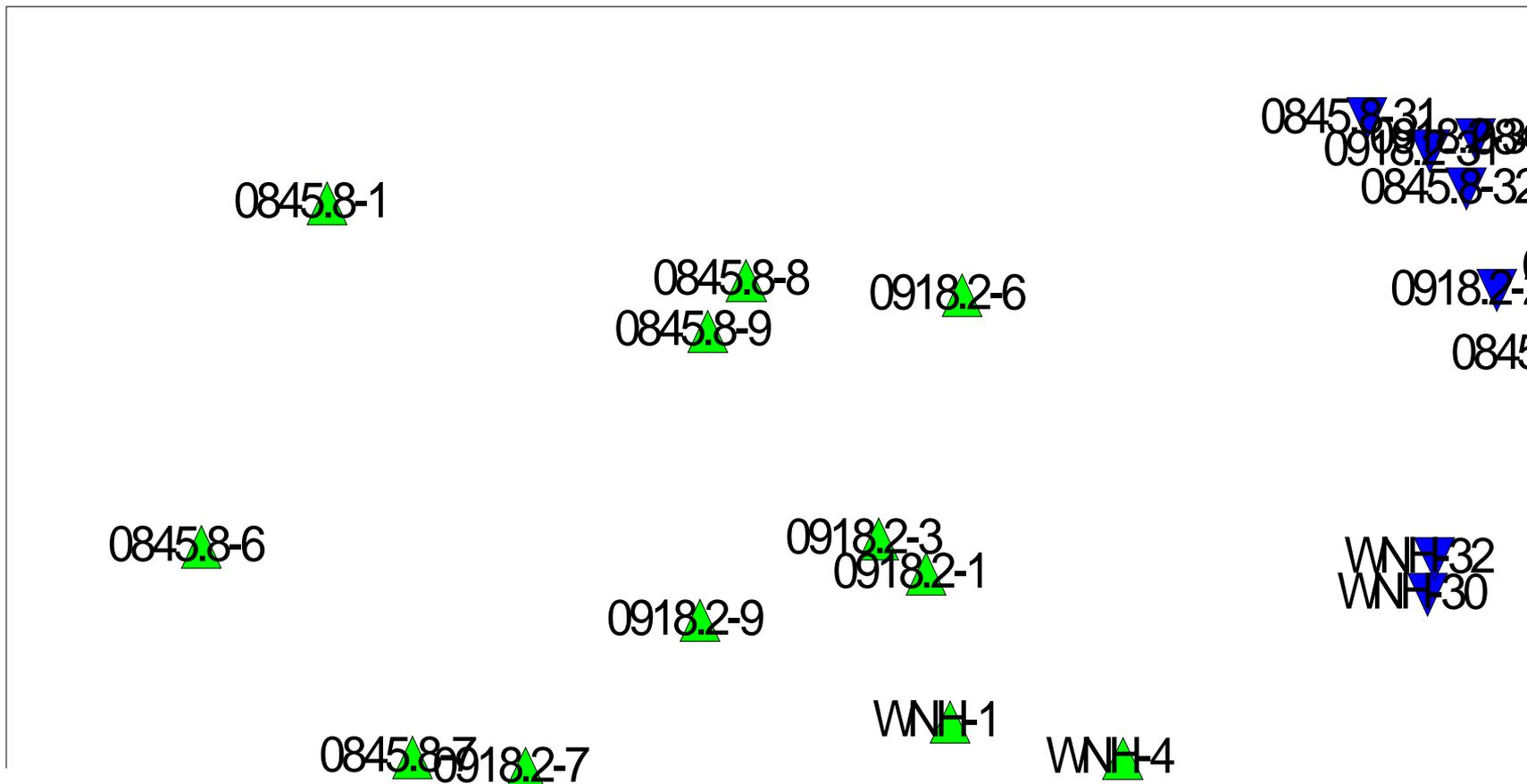
•	R	Significance	Possible	Actual	Number >=
•Groups	Statistic	Level %	Permutations	Permutations	Observed
•JT Meyers, Smithland	-0.058	87.5	5200300	9999	8749
•JT Meyers, Wabash River	0.111	4.8	5200300	9999	474
•Smithland, Wabash River	0.056	14.9	5200300	9999	1484

## Summary of Results:

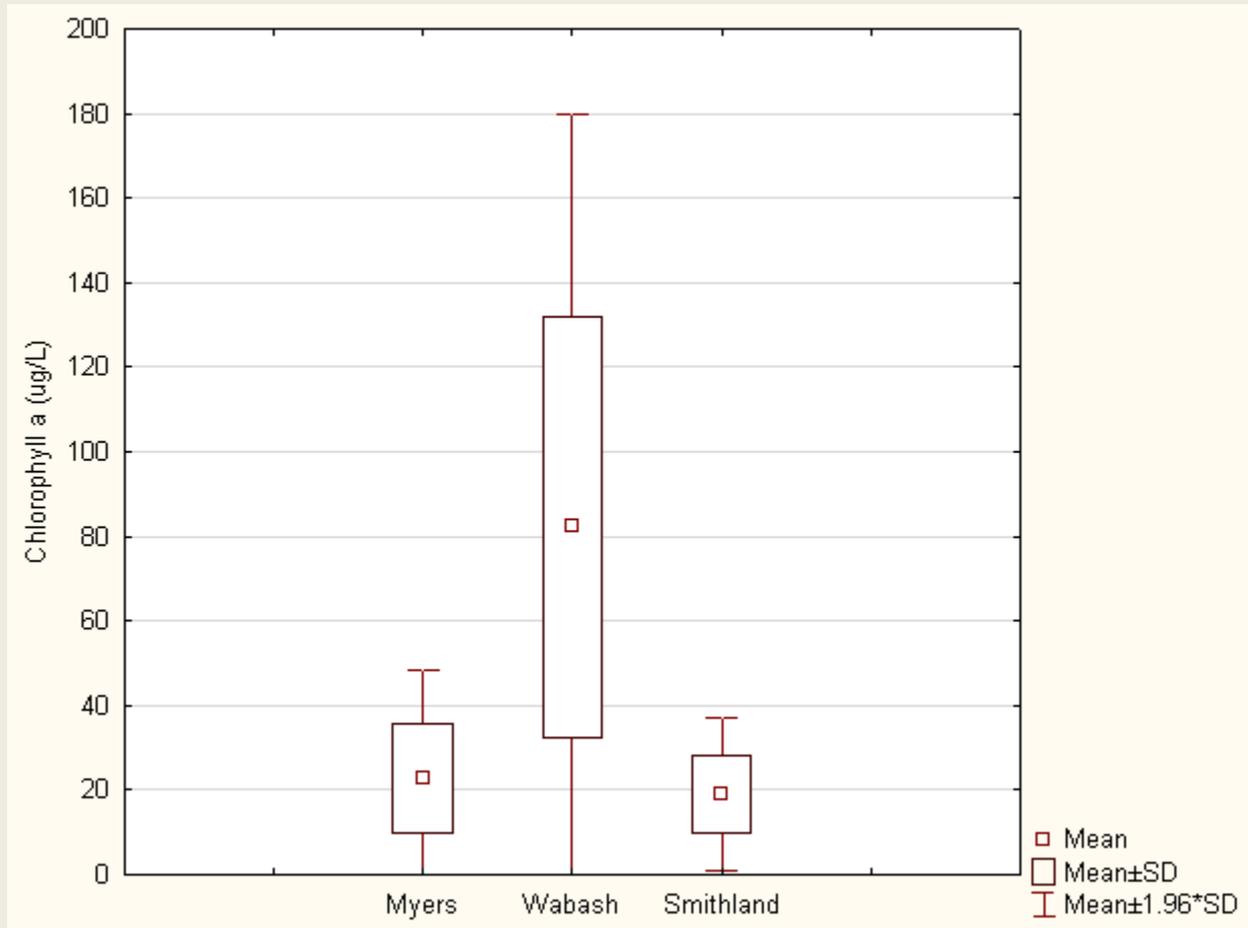
- Very little variance is accounted for in this 2-way ANOSIM – Global R= -0.034
- No sig diff between 3 Locations  $p < 0.176$
- Not enough power to test for differences between visits
- Significant pairwise difference exhibited b/w JTM & Wabash ( $p < 0.048$ )
  - The relative magnitude of pairwise p-values indicate there is a marginal influence of the Wabash Algae assemblage to the Ohio River

# NMDS Results By Year

*Wabash Alg*



# Chlorophyll *a*



# Conclusions

- Wabash River continues to be a major source of nutrients.
  - For study period Wabash River was 23% of N load, 12% of P load
- DO pattern indicates Ohio River low DO not caused by algae
- Algae Community shows effect of Wabash River on Smithland Pool
- Algae concentration does not show effect of Wabash River on Smithland Pool
- High water year on the Wabash River. Low problem year for DO on the Ohio River
- Wabash River is a source of BOD to Ohio River.
  - Appears to be a point source issue

# Next Steps

- Grant ends April 2, 2012
- Discuss this presentation with IDEM staff and potentially USGS. Incorporate suggestions into final report.
- 3 more years on Wabash River