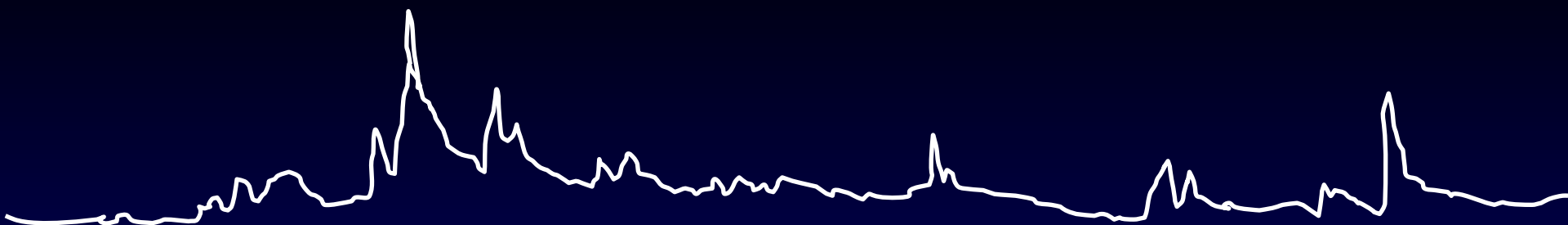




Continuous Monitoring for Nutrients at Super Gages



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KASMC Executive Meeting, Louisville, Kentucky

December 9, 2015

U.S. Department of the Interior
U.S. Geological Survey

Nutrient Monitoring at Super Gages

Presentation Outline

- Super gage overview
- Valuable information to be gained from continuous nutrient monitoring
- Expanded applications
- Comparison of discrete concentrations and yields at different sites in the Midwest

What is a USGS Super Gage?

- Conventional streamflow gage supplemented with:
 1. Continuous water-quality monitors
 2. Representative sampling
 3. Surrogate modeling
- Designed to answer specific questions on a:
 - Watershed scale
 - Regional scale and/or
 - National scale



Representative Sampling

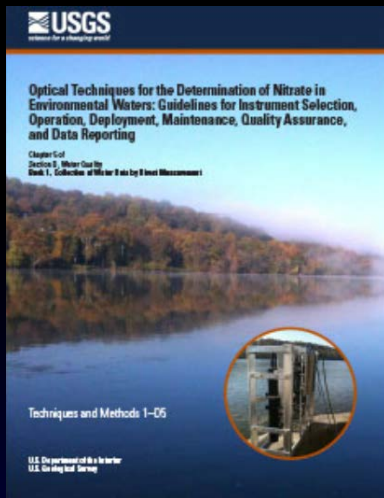


Stream-width and depth-integrated water samples for laboratory analysis to verify super gage sensor data and for development of surrogate models.

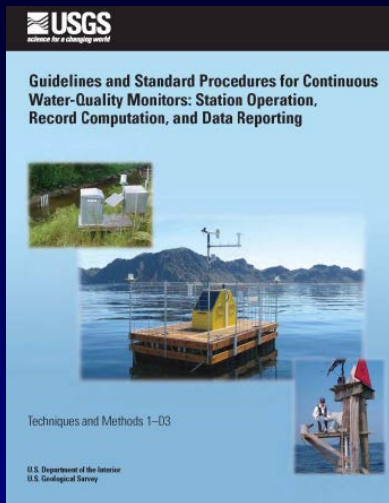
 USGS

 USGS

Protocols and Guidelines



Pellerin, B.A., Bergamaschi, B.A., Downing, B.D., Sacaceno, J.F., Garrett, J.A., and Olsen, L.D., 2013, **Optical techniques for the determination of nitrate in environmental waters: Guidelines for instrument selection, operation, deployments, maintenance, quality assurance, and data reporting**: USGS Techniques and Methods 1-D5, 37p.



Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, **Guidelines and standard procedures for continuous water-quality monitors--Station operation, record computation, and data reporting**: USGS Techniques and Methods 1-D3, 51p. + 8 attachments

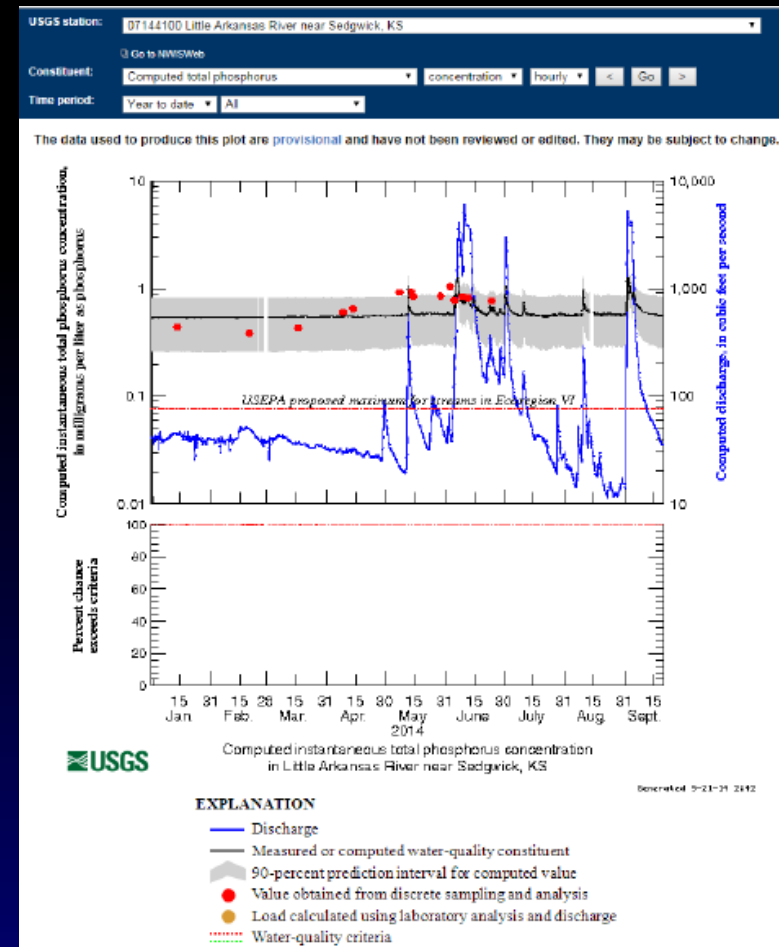
<http://pubs.er.usgs.gov>

Surrogate Models

- What are they?
 - Continuous in-stream sensor measurements used to compute or estimate a concentration of a constituent of greater interest
- How are they developed?
 - In-stream values compared to discrete values
 - Develop regression model

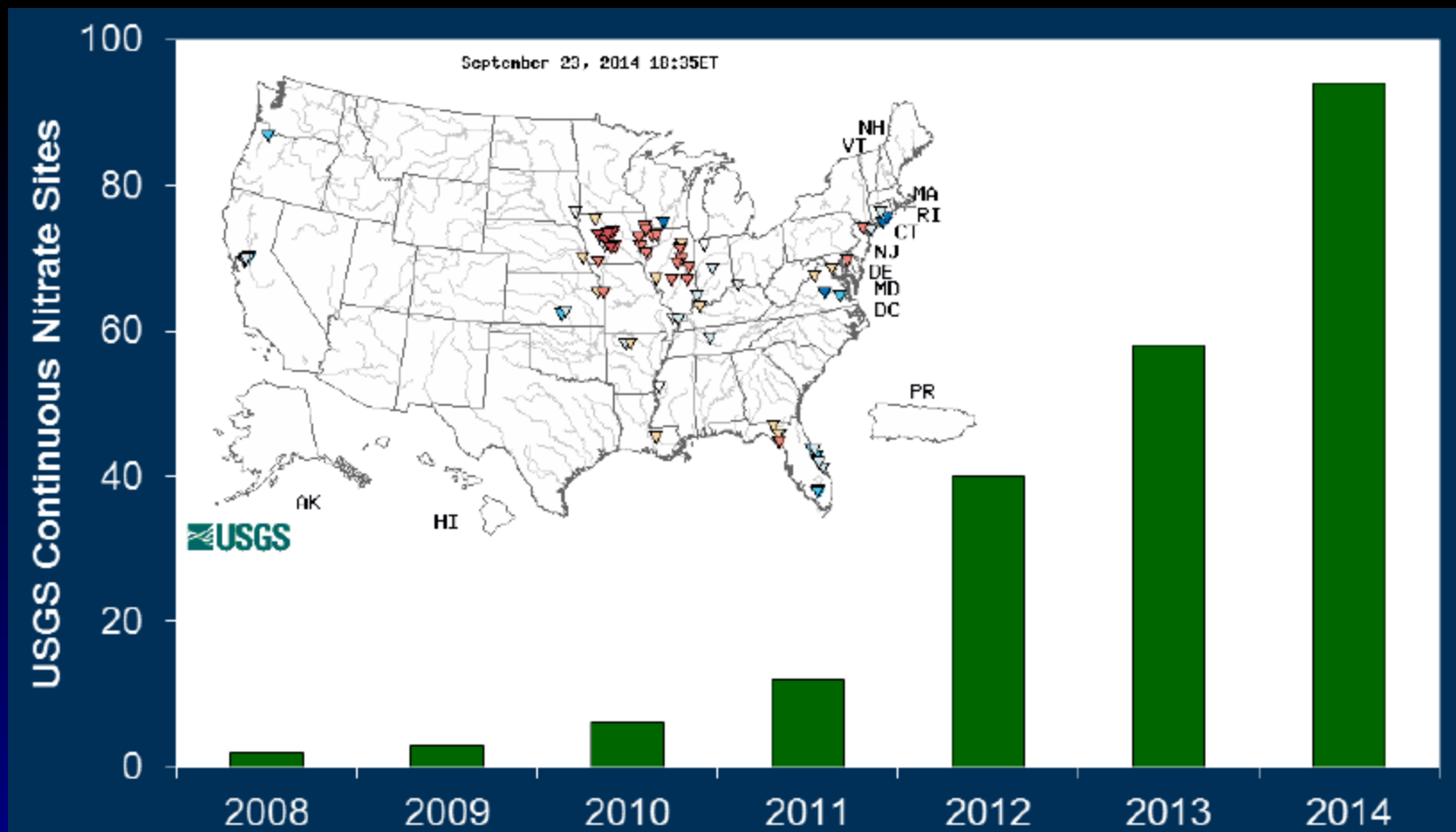
Guidelines and Procedures for Computing Time Series Suspended-Sediment Concentrations and Loads from In-Stream Turbidity-Sensor and Streamflow Data

Rasmussen and others, 2009



How many Nitrate Super Gages in the Nation?

In 2014, 96 nitrate monitoring site Nationwide (operated in 24 States)



How many USGS Super Gages in KY?

Super Gage Network

4 Green River at Spottsville, KY



Ohio River



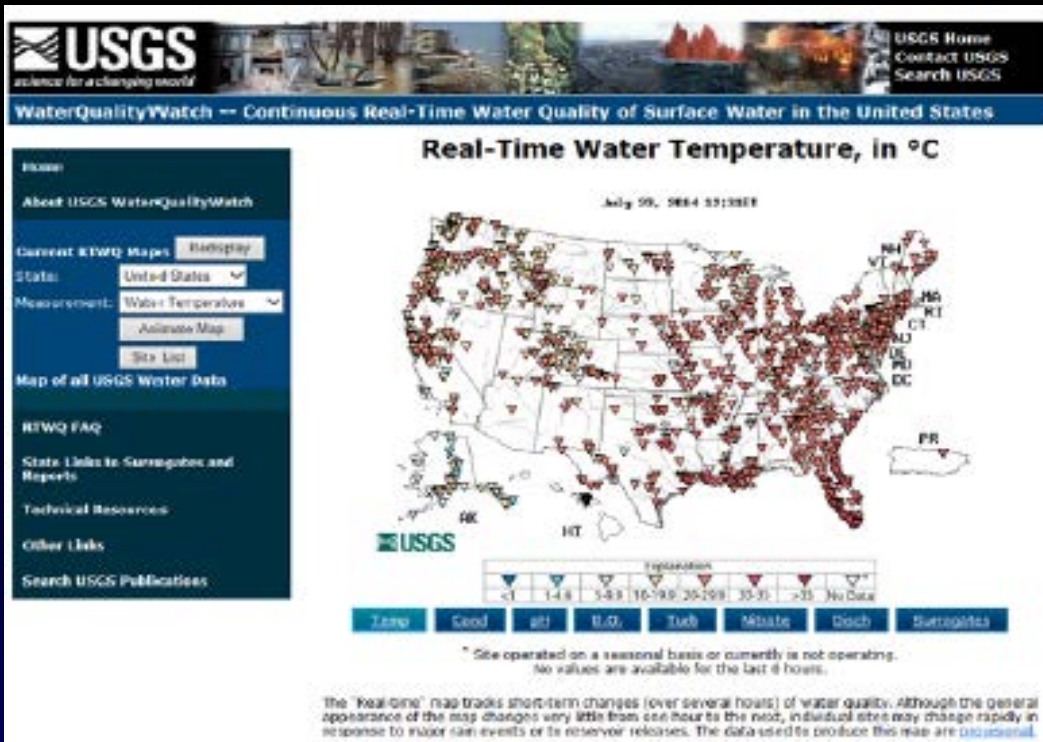
Licking River at
Alexandria, KY



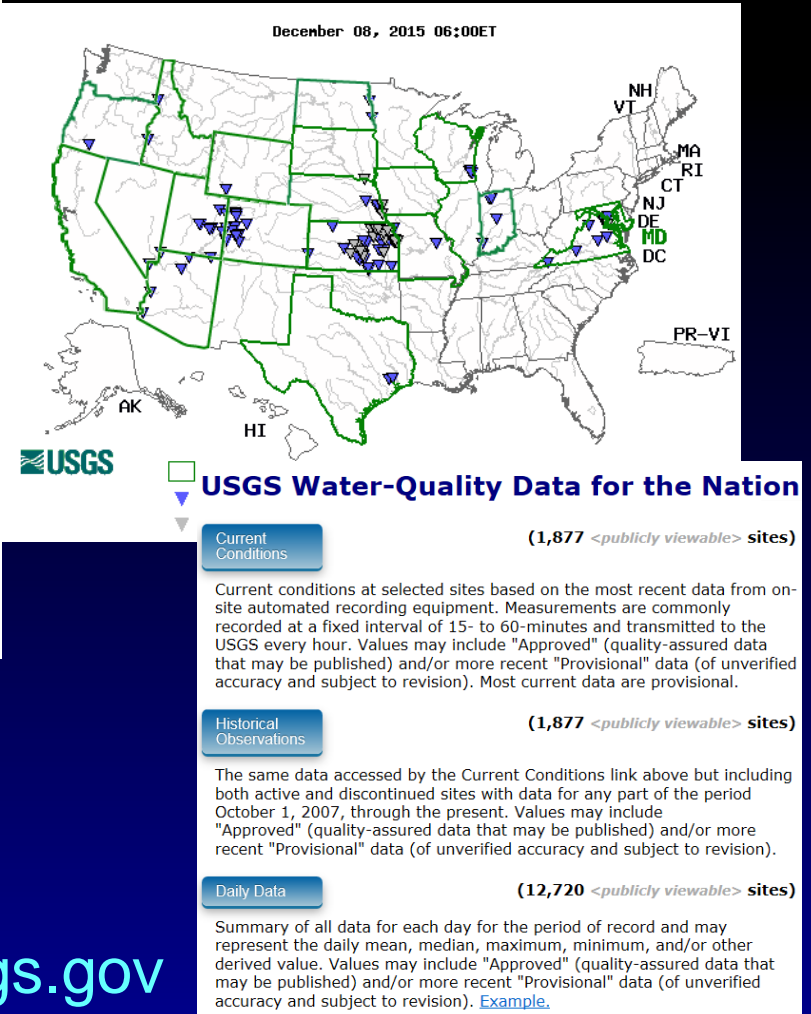
Ohio River at
Ironton, OH



Real-time data available on the Web



<http://nrtwq.usgs.gov>



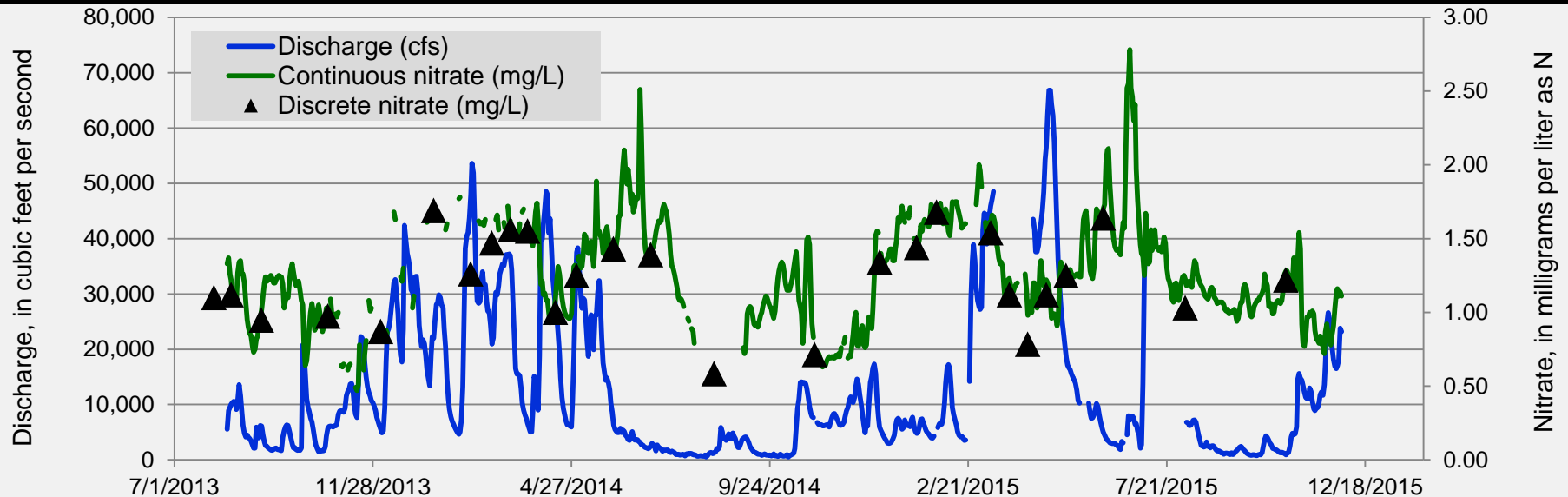
<http://waterwatch.usgs.gov/wqwatch>



<http://waterdata.usgs.gov>

Valuable Data

Green River at Spottsville, KY

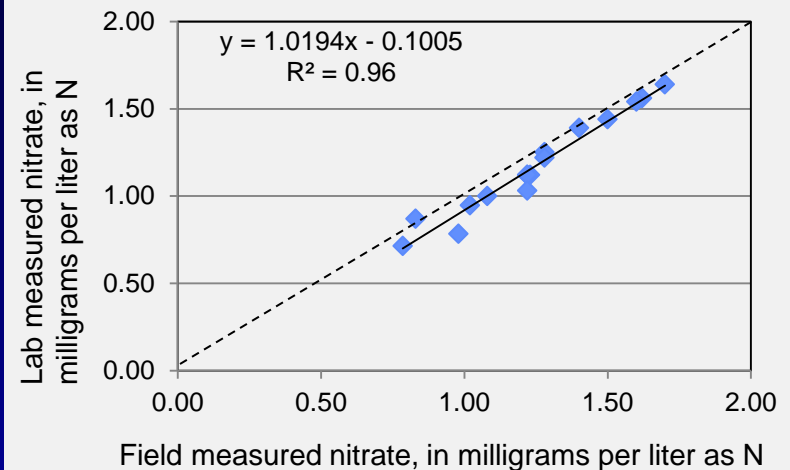


Provisional data

UV nitrate
sensor

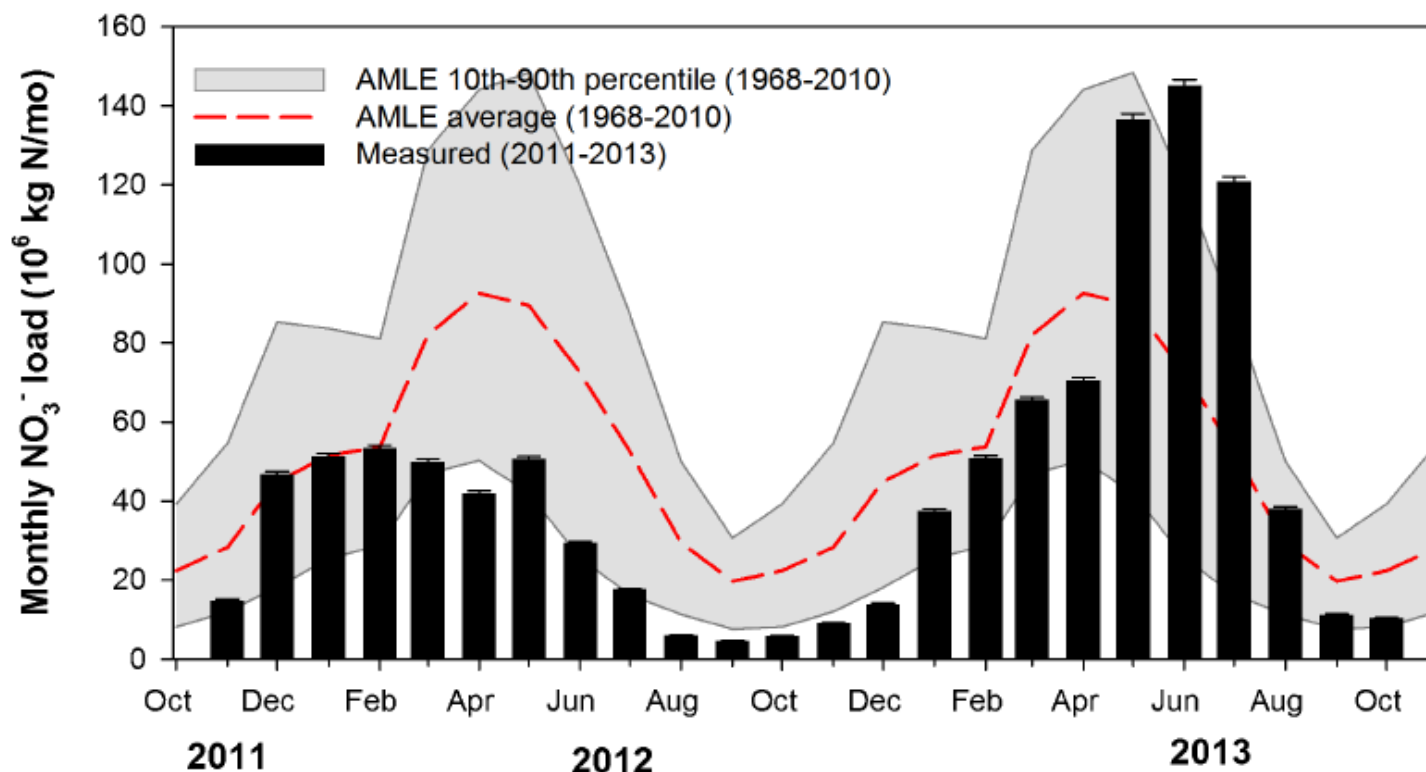


Range 0.007 to 28 mg/L



Can we improve load estimates?

- Differences in modeled vs. sensor loads of up to 30% in the spring (sensor > model)
- Order of magnitude lower uncertainty in the sensor vs. model loads
- Loads below the 10th and above the 90th percentiles during this period



(Pellerin et al., in review)

Expanding Super Gage Applications

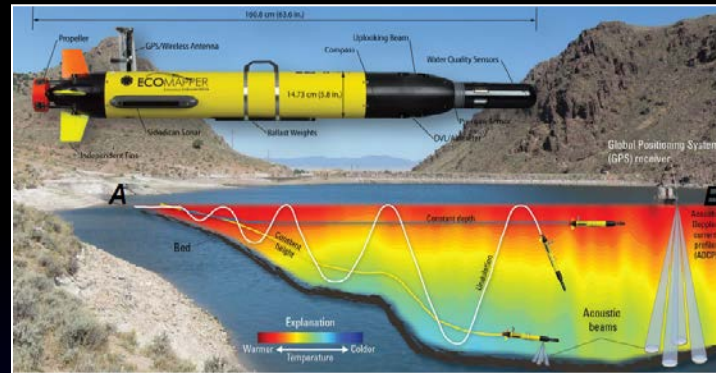
- **Surface water**

- Assess biological conditions

- **Groundwater**

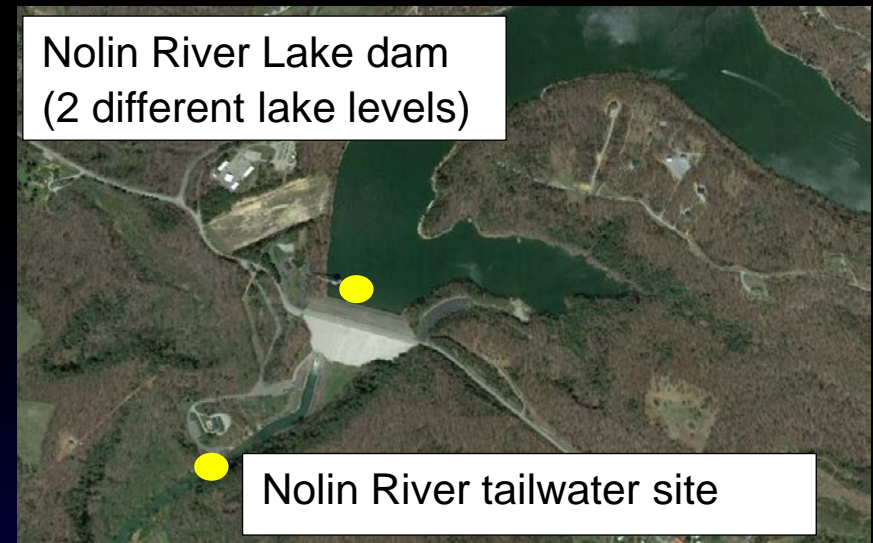
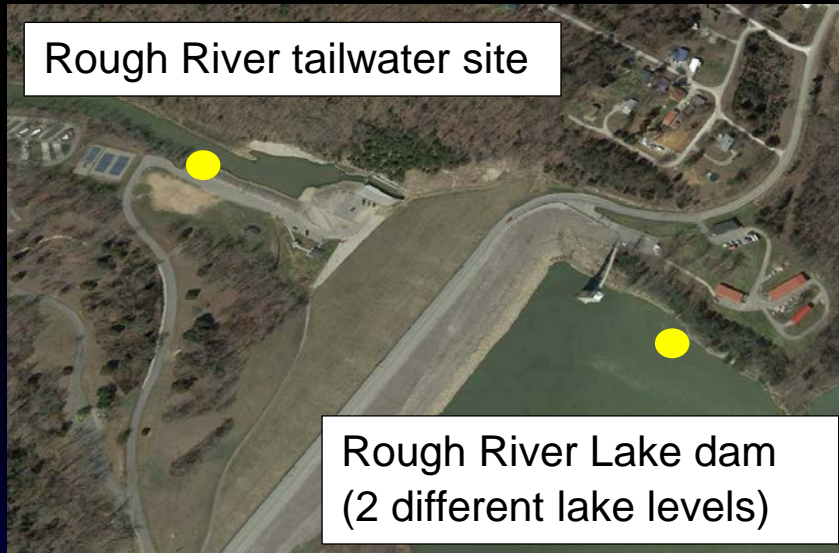
- **Edge-of-field**

- Get out of the stream and on the landscape where runoff is directly affected by field practices
- Reduce influences of 'in-stream' processes
- Information on BMPs



GLRI Priority Watersheds
(Matt Komiskey, USGS, WI)

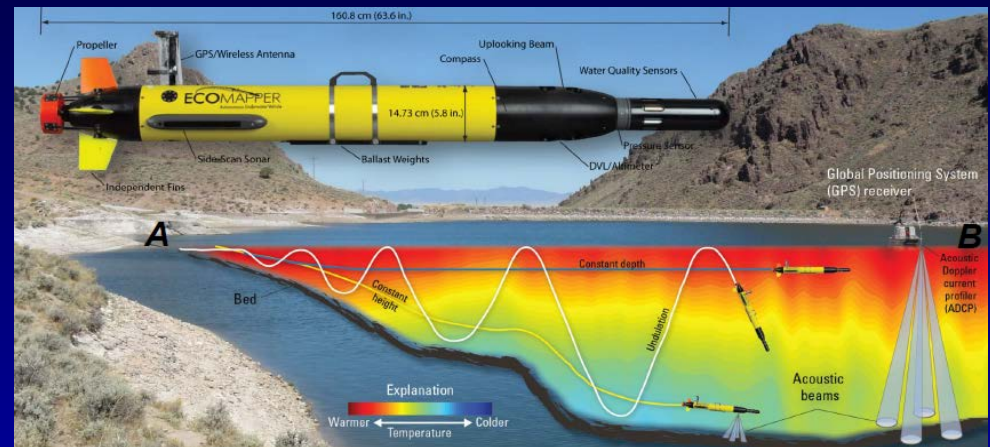
Harmful Algal Blooms



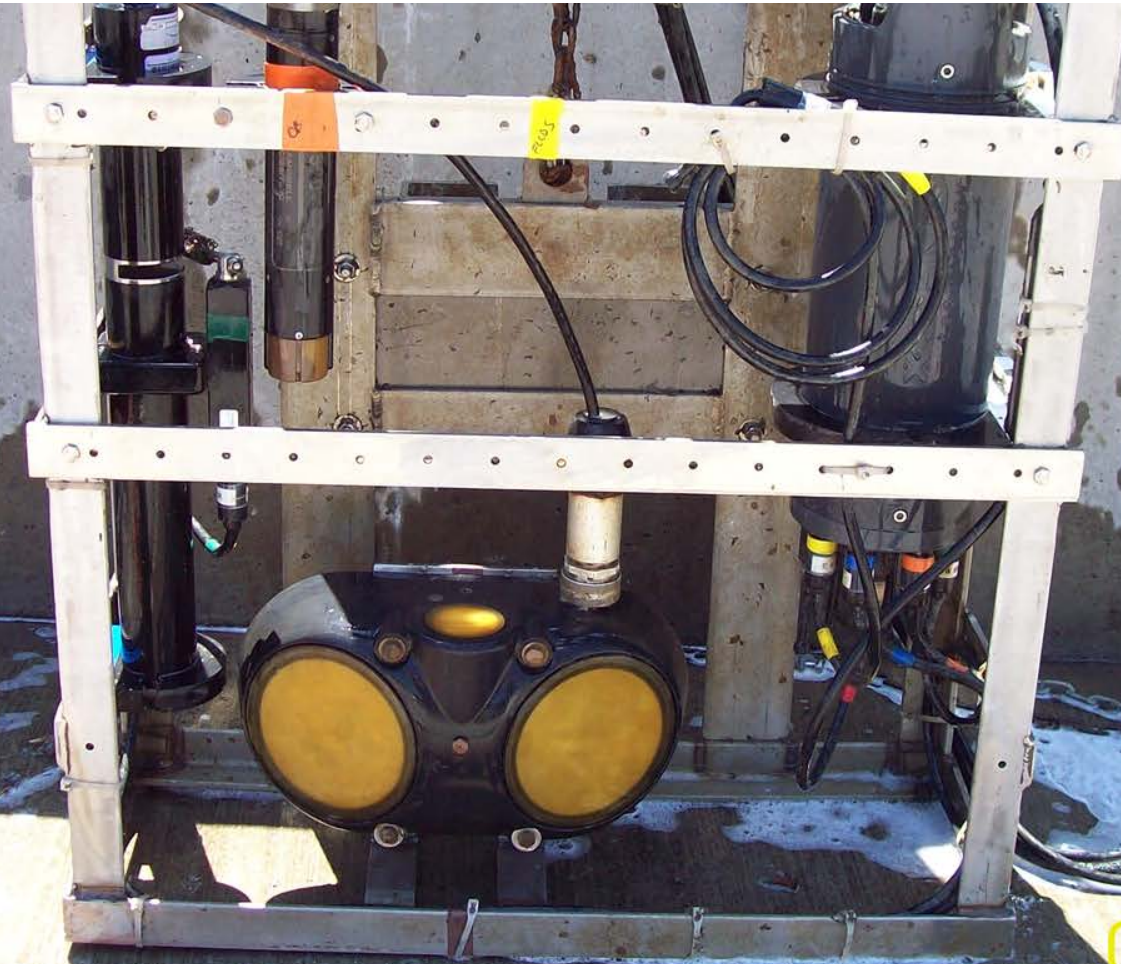
- **USACE (cooperator)**
- **1-year study**
 - Real-time chlorophyll and phycocyanin
 - Real-time nitrate



Autonomous Underwater Vehicle Lakes and Reservoirs (Ryan Jackson, USGS, IL)



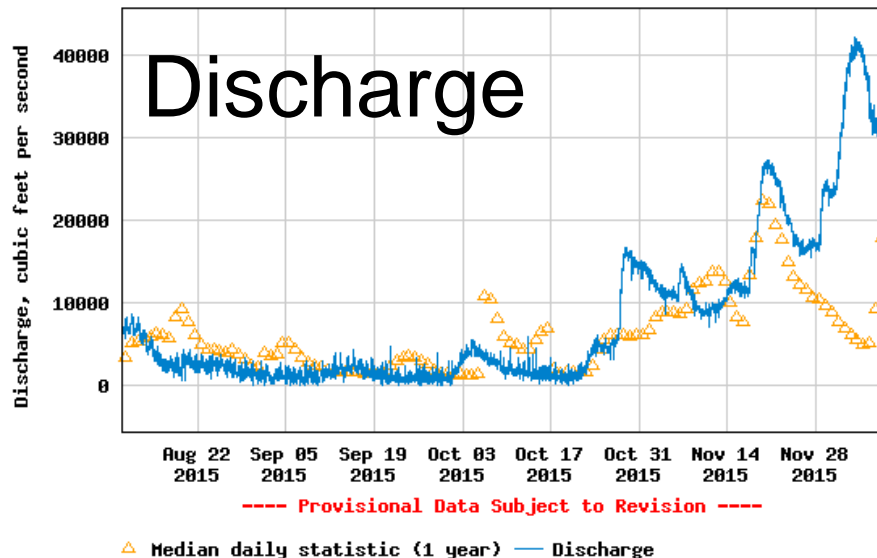
**Where will time-dense continuous nutrient data
change what you know or what you do about
water quality?**



Continuous Nitrate at Kentucky Site



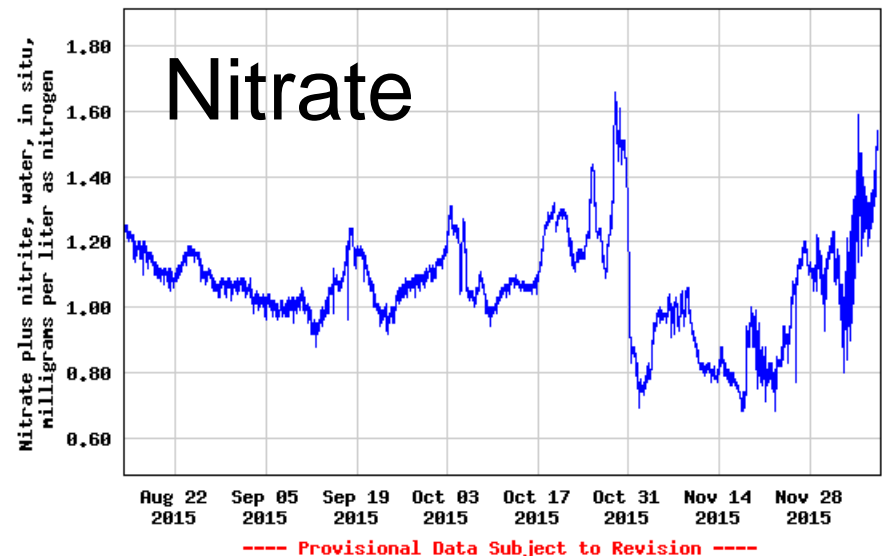
USGS 03321500 GREEN RIVER AT LOCK 1 AT SPOTTSVILLE, KY



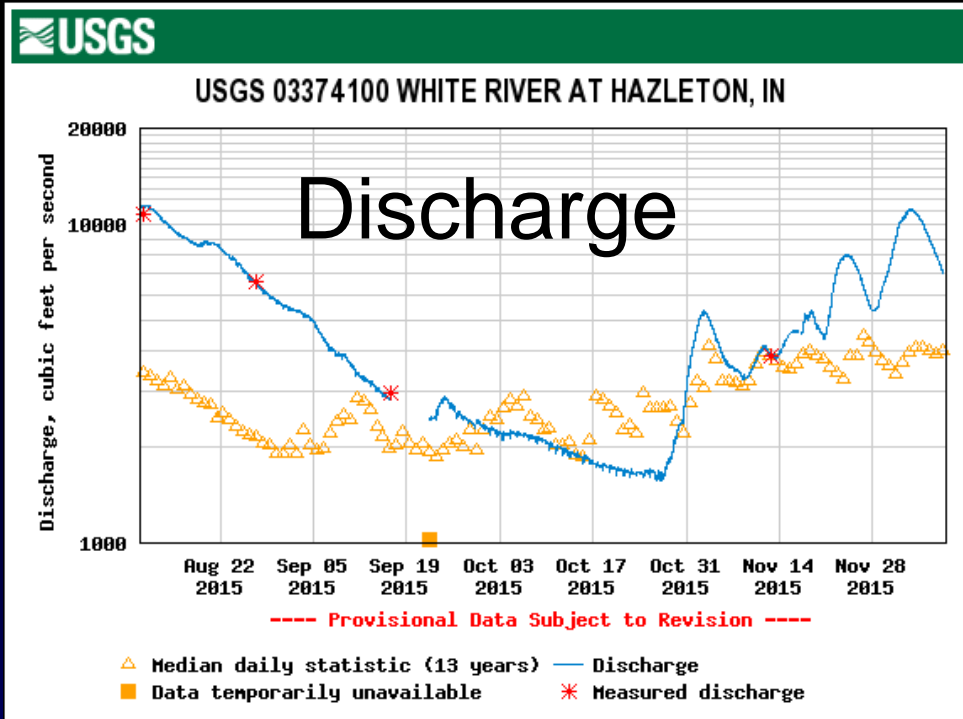
Most recent instantaneous value
1.55 mg/L
12-08-2015 14:15 CST



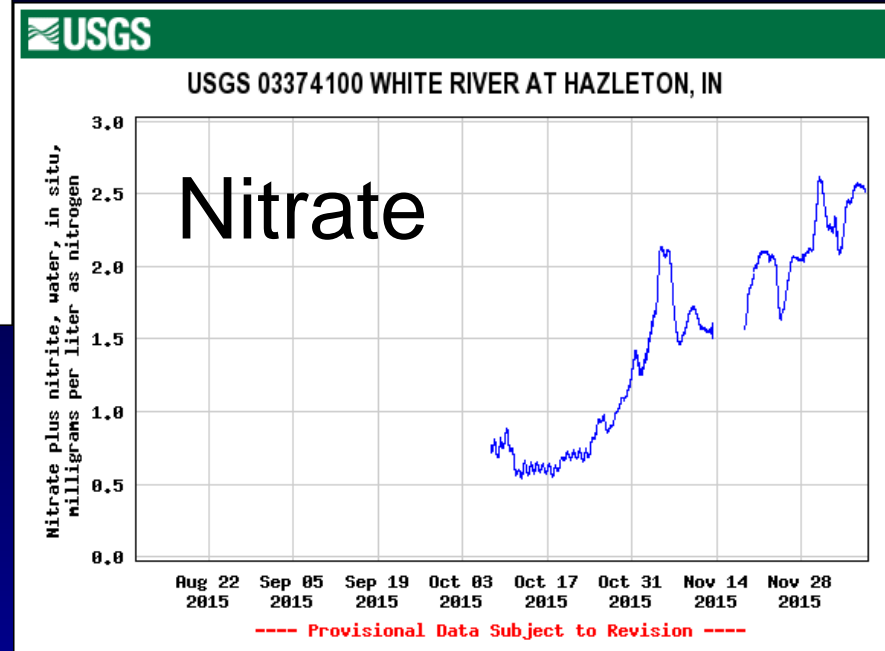
USGS 03321500 GREEN RIVER AT LOCK 1 AT SPOTTSVILLE, KY



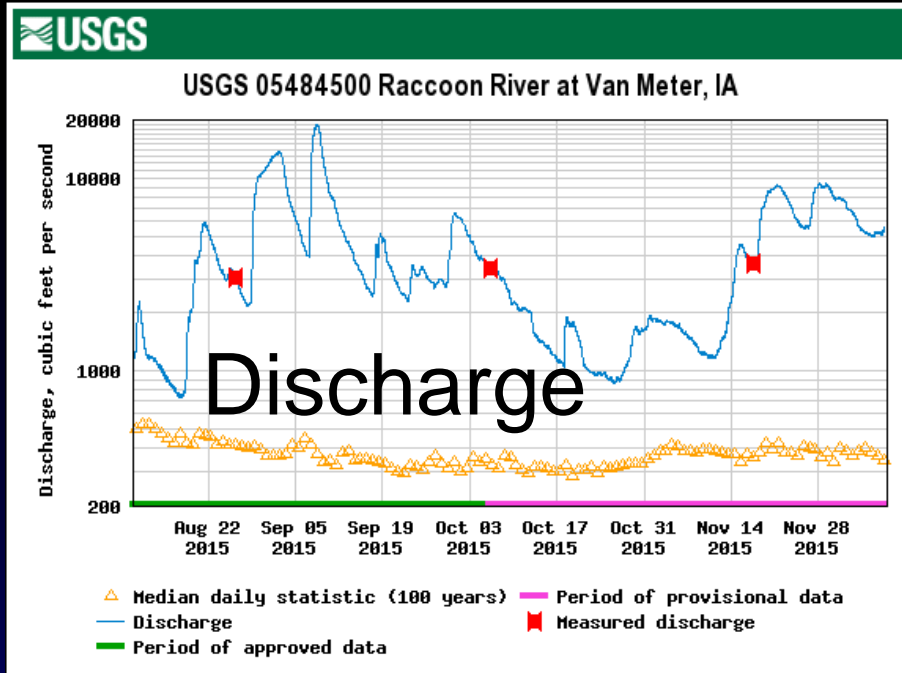
Continuous Nitrate at Indiana site



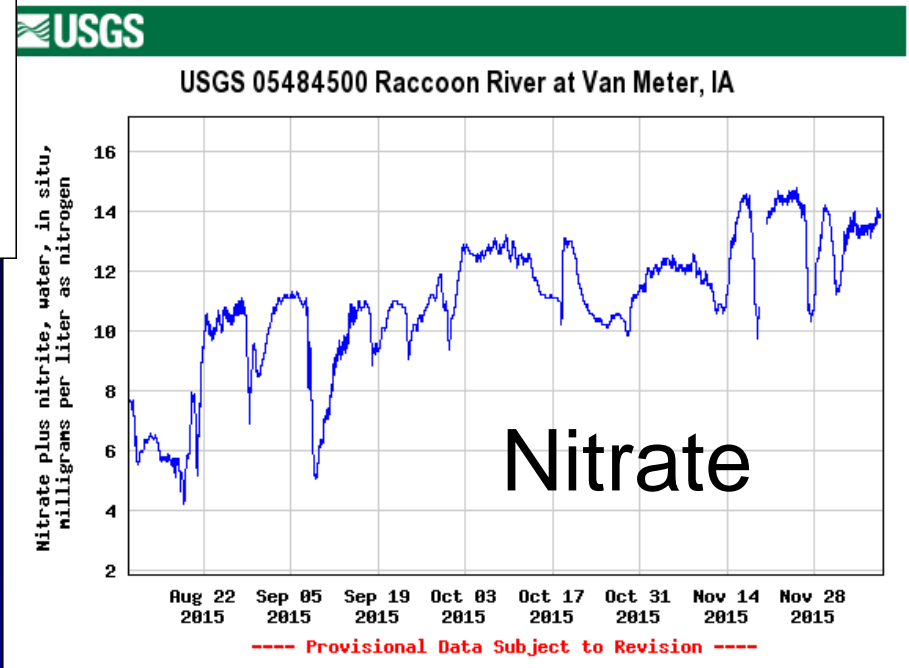
Most recent instantaneous nitrate value
2.50 mg/L
12-08-2015 15:45 EST



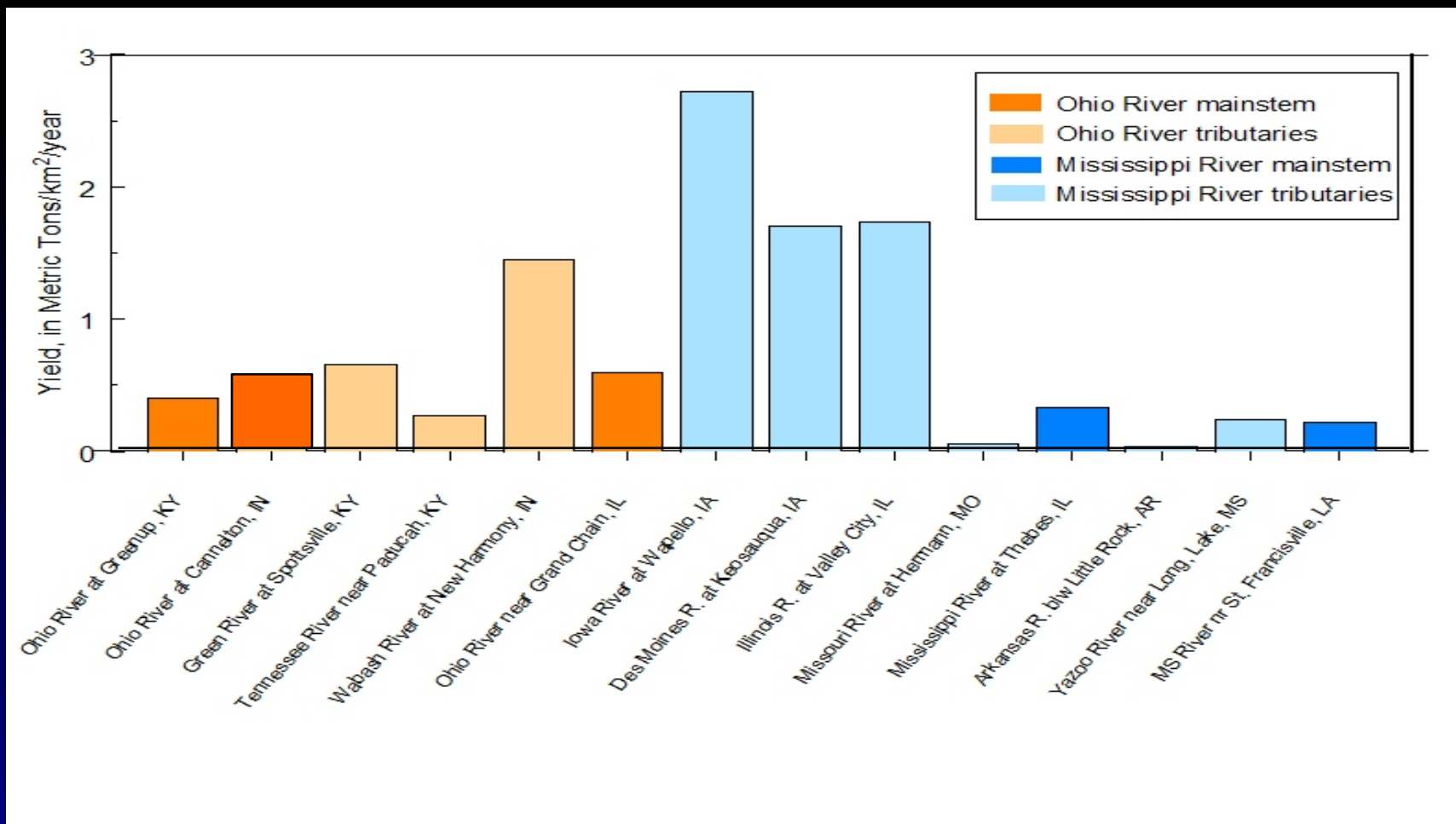
Continuous Nitrate at Iowa site



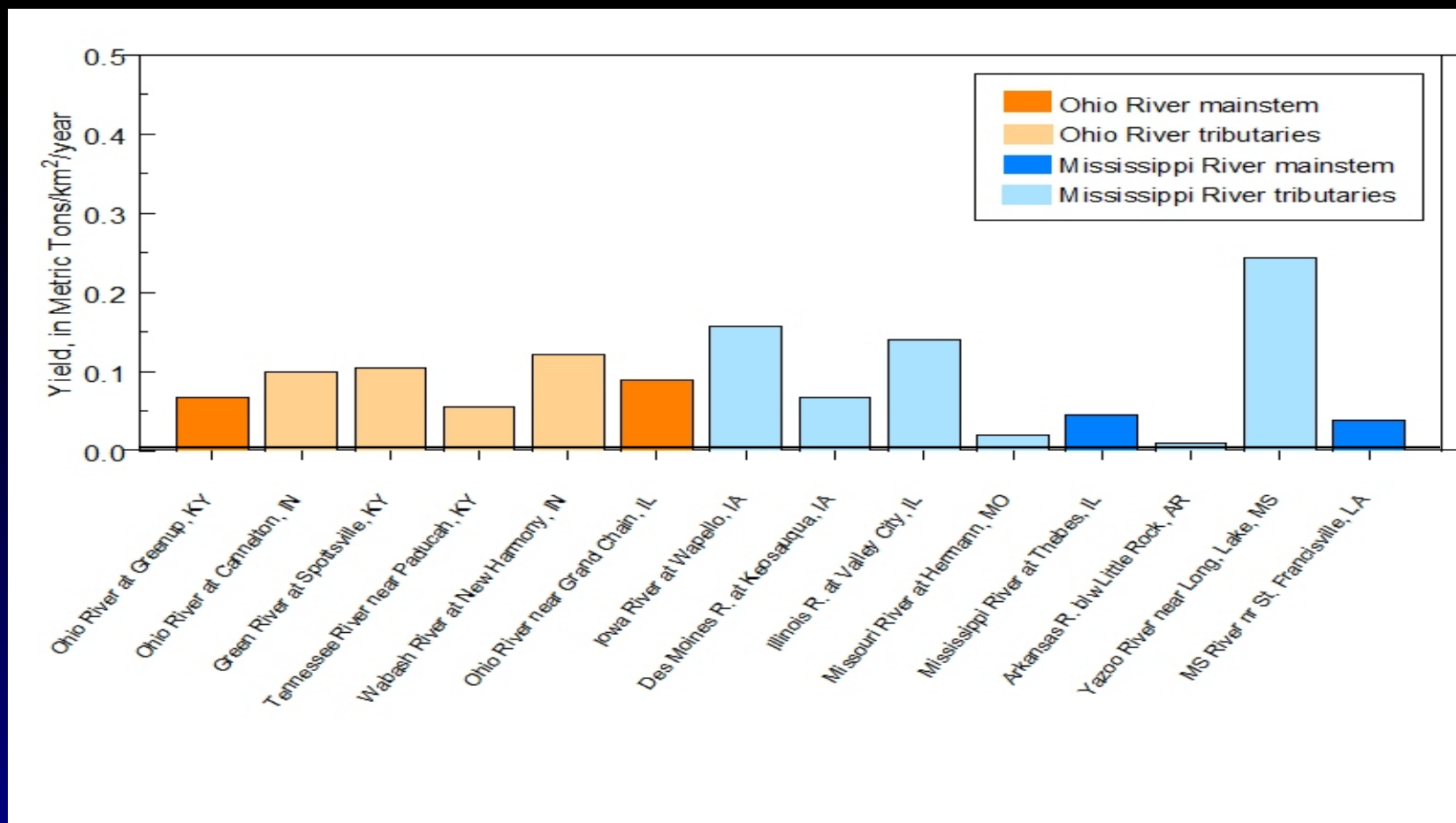
Most recent instantaneous nitrate value
13.9 mg/L
12-08-2015 14:00 CST



Nitrite Plus Nitrate Yields



Total Phosphorus Yields



Tracking Water-Quality in the Nation

