



# Status of USGS Super Gages Network

**Nutrient Monitoring Council**

**September 16, 2015**

**Springfield, IL**

**Doug Yeskis**

# USGS Nutrient Monitoring in Illinois

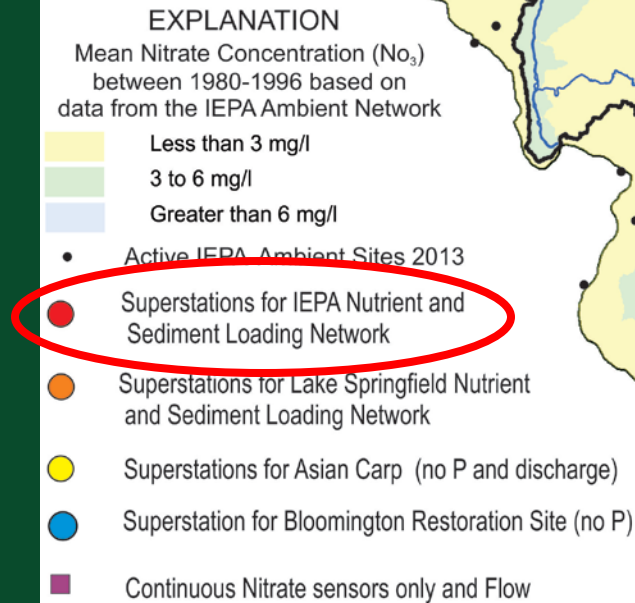
## Presentation Outline

- Brief Review of Plan
- Status of Activities
- Future Plans

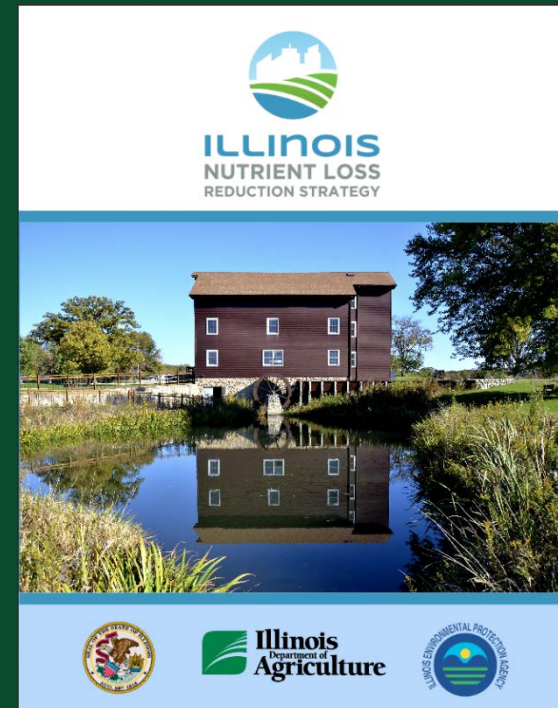
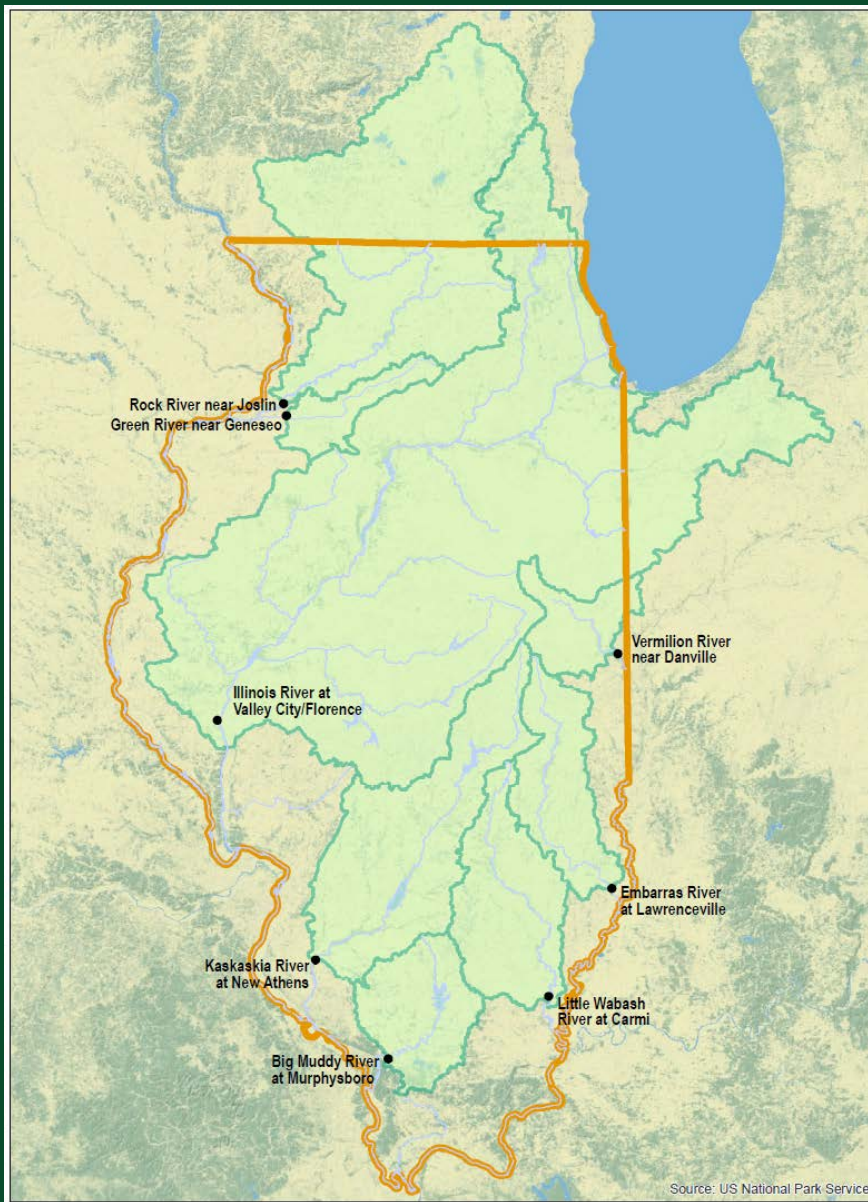
# The Plan

- Basins covering almost 75% of area of the State
  - Rock River
  - Green River
  - Illinois River
  - Kaskaskia River
  - Big Muddy
  - Little Wabash
  - Embarras River
  - Vermilion River
- Current USGS gaging station (flow)
- Current IEPA Ambient site/Historical Data

Illinois Real-Time  
Nutrient and Sediment  
Surface-Water-Quality  
and Discharge  
Monitoring Stations  
(Super Gages)  
Operated by the  
USGS



# Basins cover almost 75% of the land area in the State



# Status of Activities

- **Construction is Proceeding**
  - Infrastructure for all sites, but one, is completed
  - Equipment is deployed and being transmitted publically for 3 stations
- **All stations should be completed and transmitting internally by October 2**
- **Some station(s) will need re-evaluation**





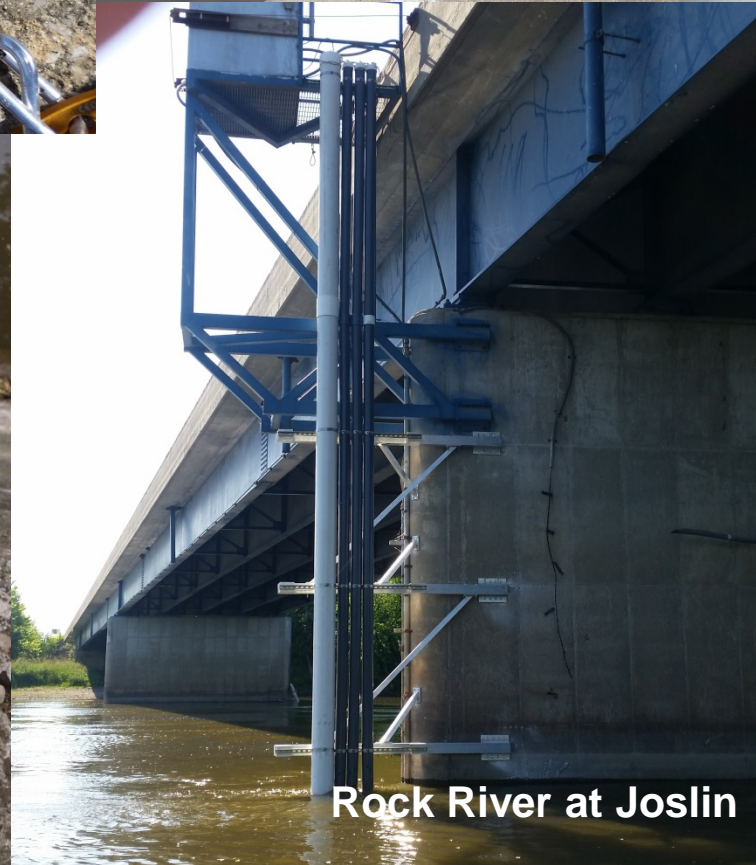
Kaskaskia at New Athens



Little Wabash  
at Carmi



Green River at Geneseo

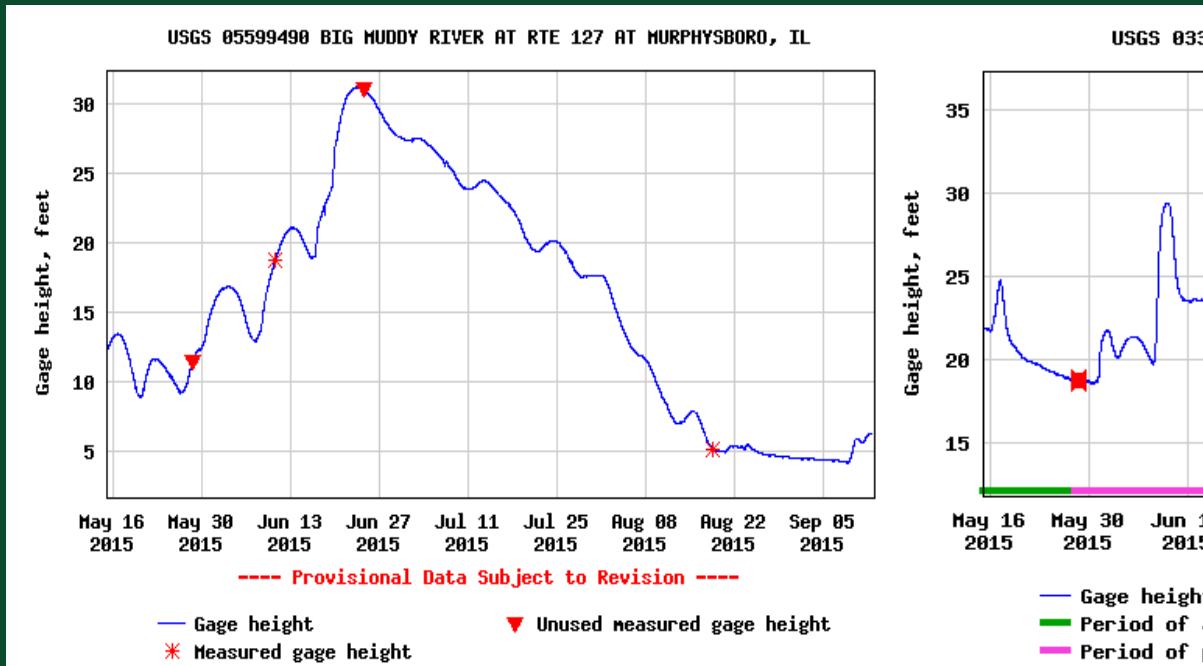


Rock River at Joslin



# Schedule Impacts

- Agreement April 1
- Weather

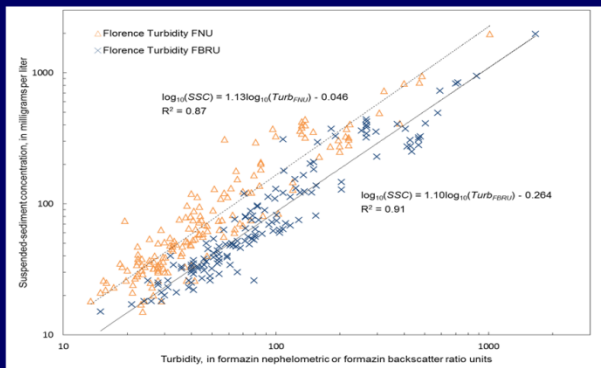


# Future Plans

- Finish rest of installations (end of Sept.)
- Re-engineer where needed (Oct.)
- Build record for surrogates (2015-2016)
- Report w/ surrogate relationships (2016-2017)

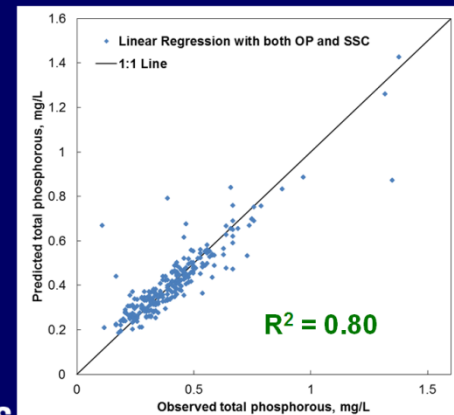
## Turbidity and SSC at the Illinois River at Florence

To measure suspended sediment concentration, USGS uses Turbidity as a surrogate



## Total Phosphorus Predicted with Orthophosphorus and Suspended Sediment (IL River Valley City 1991 – 2013)

$$TP = 0.109 + 1.1 OP + 0.00063 SSC$$





# USGS Continuous NO<sub>3</sub> and PO<sub>4</sub> in the Illinois River



Prepared in cooperation with the Illinois Environmental Protection Agency

## Continuous Monitoring of Sediment and Nutrients in the Illinois River at Florence, Illinois, 2012–13



Scientific Investigations Report 2015–5040

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

Terrio, P.J., Straub, T.D., Domanski, M.M., and Siudyla, N.A., 2015, Continuous monitoring of sediment and nutrients in the Illinois River at Florence, Illinois, 2012–13: U.S. Geological Survey Scientific Investigations Report 2015–5040, 61 p., <http://dx.doi.org/10.3133/sir20155040>.  
<http://pubs.usgs.gov/sir/2015/5040/pdf/sir2015-5040.pdf>.



### Real-Time Continuous Nitrate Monitoring in Illinois in 2013

Many sources contribute to the nitrogen found in surface water in Illinois. Illinois is located in the most productive agricultural area in the country, and nitrogen fertilizer is commonly used to maximize corn production in this area. Additionally, septic/wastewater systems, industrial emissions, and lawn fertilizer are common sources of nitrogen in urban areas of Illinois. In agricultural areas, the use of fertilizer has increased grain production to meet the needs of a growing population, but also has resulted in increases in nitrogen concentrations in many streams and aquifers (Schweizer and others, 2010). The urban sources can increase nitrogen concentrations, too. The Federal limit for nitrate nitrogen in water that is safe to drink is 10 milligrams per liter (mg/L) (<http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm>, accessed

on May 24, 2013). In addition to the concern with nitrate nitrogen in drinking water, nitrate, along with phytoplankton, is an organic concern because it fuels the intensive growth of algae that are responsible for the hypoxic zone in the Gulf of Mexico. The largest nitrogen flux to the waters feeding the Gulf of Mexico is from Illinois (Alexander and others, 2005). Most studies of nitrogen in surface water and groundwater include samples for nitrate nitrogen collected weekly or monthly, but nitrate concentrations can change rapidly and these discrete samples may not capture rapid changes in nitrate concentrations that can affect human and aquatic health. Continuous monitoring for nitrate could inform scientists and water-resource managers of these changes and provide information on the transport of nitrate in surface water and groundwater.

#### What is continuous and real-time nitrate monitoring?

Continuous monitoring collected every 15 minutes) for nitrate provides continuous observations of nitrate concentration measured by a sensor placed directly in the body of water. Measurements are logged and stored by instrumentation at the field site. Real-time continuous nitrate data are first rinsed and then are transmitted to an office computer via satellite telemetry. The real-time data collected by the U.S. Geological Survey (USGS) in Illinois are uploaded from the computer to the Web site every hour (<http://waterdata.usgs.gov/illinois/cwrm/>). The real-time transmission eliminates the waiting time inherent in laboratory chemical analysis and allows scientists and water managers to make decisions based on rapid changes in water quality.



Instrumentation shelter and telemetry equipment are used for collecting, storing, and transmitting stream discharge and nitrate data at the U.S. Geological Survey (USGS) streamgauge near Florence, Illinois (photo by Nicholas Swartz, USGS).

A nitrate sensor operates on the principle that nitrate ions absorb ultraviolet (UV) light at wavelengths less than 220 nanometers (nm) (Cullen and others, 2013). The sensor is designed to correct optical absorption properties measured to a nitrate concentration by using laboratory calibrations and integrated algorithms to account for interferences from other absorbing ions and organic matter. This allows for real-time nitrate measurements without the need for chemical reagents. Suspended particles and highly colored water may affect the optical sensor, so consistently accounting for these factors is critical to the meaningful deployment and interpretation of results in different settings. The sensor has integrated or external auto-cleaning systems, but the USGS typically has to clean and calibrate a nitrate sensor monthly, or as needed to remove sediment, biological growth, and lime scale.

#### Where does the USGS measure nitrate continuously in Illinois?

The USGS deploys continuous nitrate sensors in a variety of stream types, sizes, and locations in Illinois to better characterize the behavior and transport of nitrogen. In partnership with various components and as part of the USGS Water Watch program on stream from coast to coast (fig. 1A), the USGS Illinois Water Science Center installed eleven nitrate sensors in multiple watersheds (Fox River, Illinois Creek, East Thomas Creek, Spoon River, Kickapoo Creek, and Malsbary River and upper Illinois River basins), and Illinois River (fig. 1B). These watersheds range in size from very small (3.8 square miles (mi<sup>2</sup>) to very large (26,870 mi<sup>2</sup>) (table 1).

The USGS is collecting and evaluating continuous nitrate data at a number of sites in the Midwest (fig. 1A). Evaluation of the accuracy, effectiveness, and reliability of different types of nitrate sensors in the field is underway at two test sites in Illinois in coordination with the USGS Hydrologic Instrumentation Facility. For example, two continuous nitrate sensors have been installed on the Illinois River at Florence (previously called Illinois River at Valley City), which is the most downstream streamgauge on the Illinois River prior to discharge to the Mississippi (fig. 2).

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

Fact Sheet 2015-008  
December 2015



# Questions?

**Doug Yeskis**

**[djyeskis@usgs.gov](mailto:djyeskis@usgs.gov)**

**217-328-9706**

**Kelly Warner**

**[klwarner@usgs.gov](mailto:klwarner@usgs.gov)**

**217-328-9727**