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USGS Ohio-Kentucky-Indiana Water Science Center

Update:
Lower Ohio River Basin Super Gages

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

Talk Outline

- Super gages and their benefits
- Background
- Site locations
- Provisional results
  - Total nitrogen
  - Total phosphorus
- Recent publication

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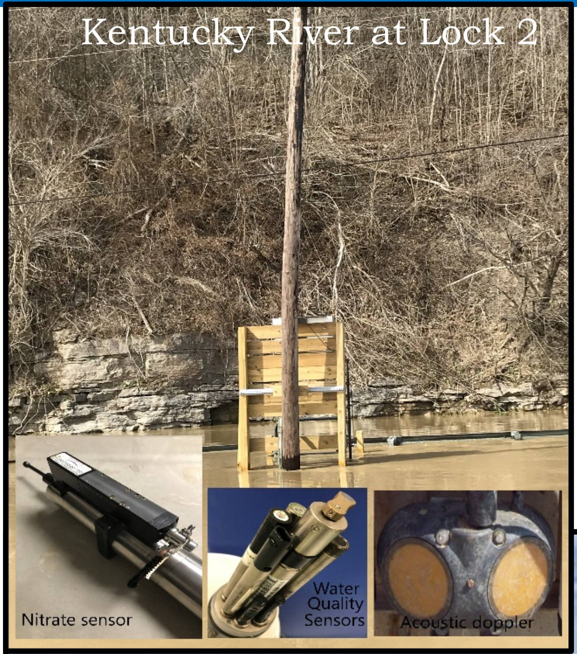
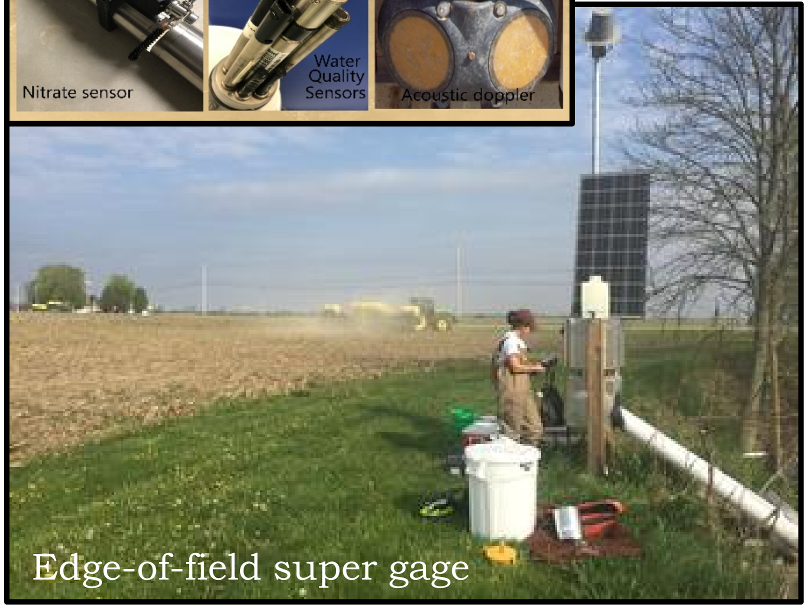
Super Gage Benefits

- **What is a Super Gage?**
- **What are their benefits?**
  - Enhance ability to model nutrients and their surrogates
  - Assessment of conservation practices
  - Provide early warning for water supply
  - Nutrient reduction strategy
  - Groundwater/surface water interaction





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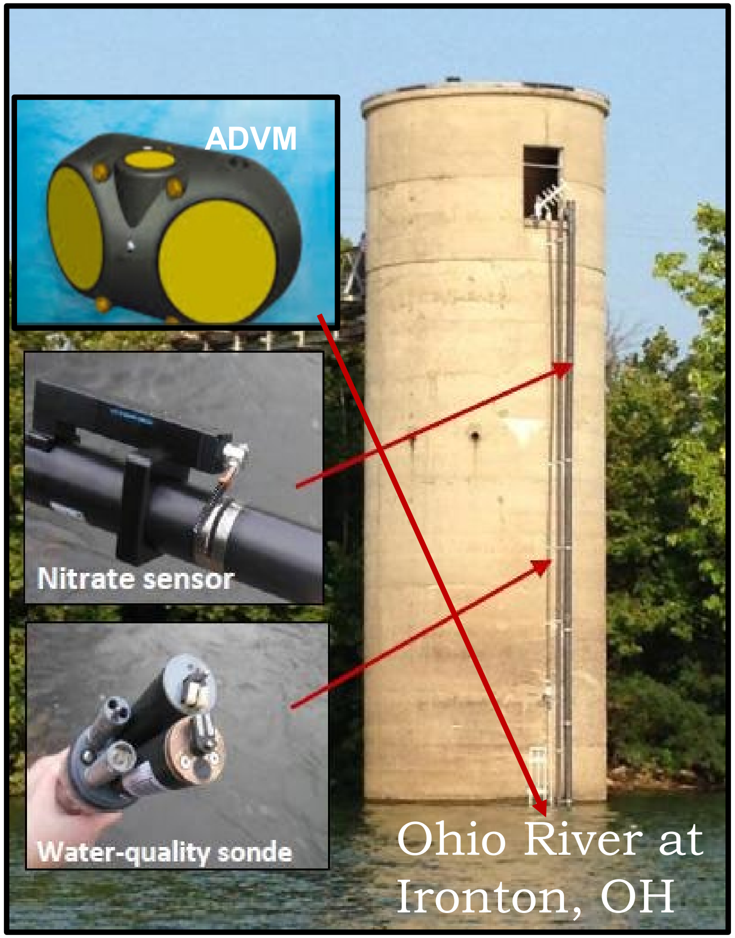
Timeline of Large River Super Gages

- **2013**
  - Green River at Spottsville, KY
  - Ohio River at Olmsted, IL (outlet)
- **2015**
  - Ohio River at Ironton, OH (inlet)
- **2018**
  - Kentucky River at Lock 2, KY
  - Licking River near Alexandria, KY
  - Wabash River at New Harmony, IN



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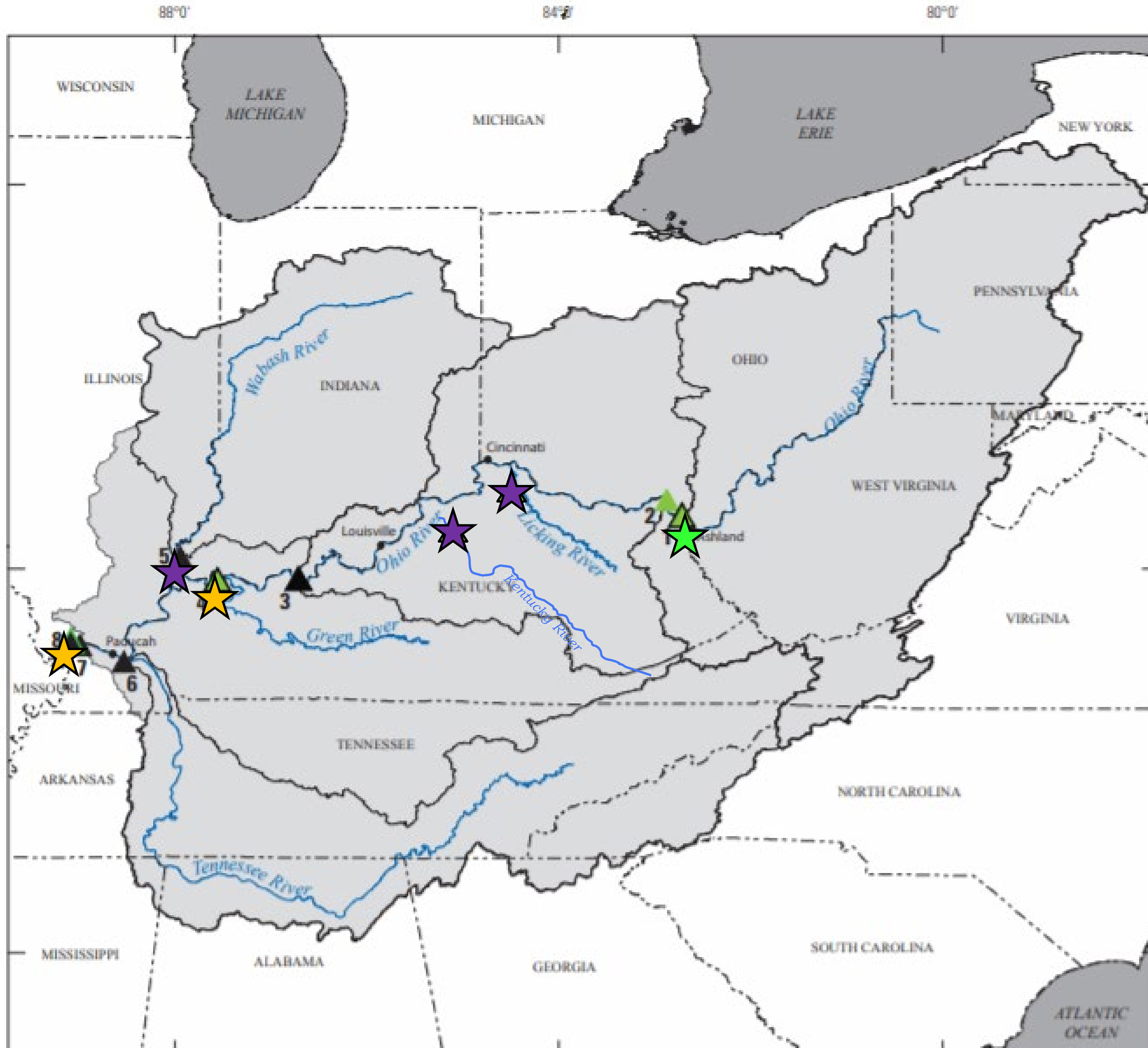
Super Gage Locations

EXPLANATION

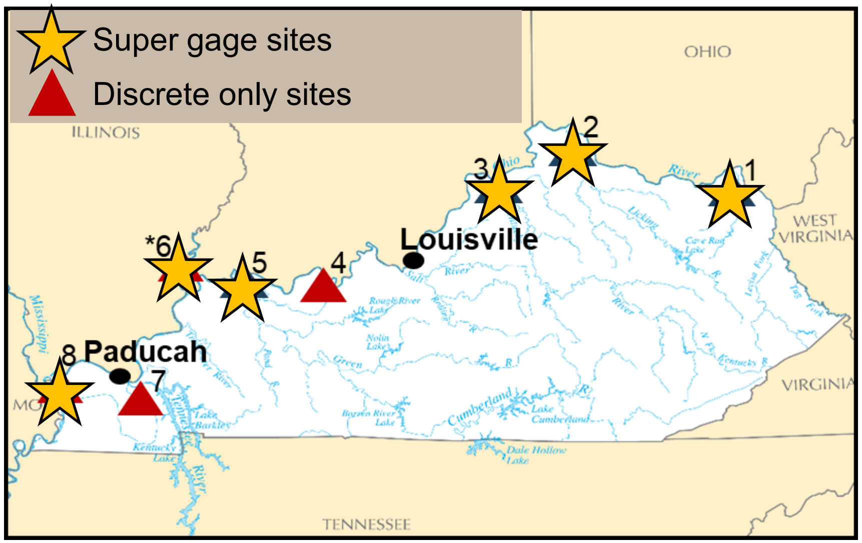
- 2013 installation
- 2015 installation
- 2018 installation



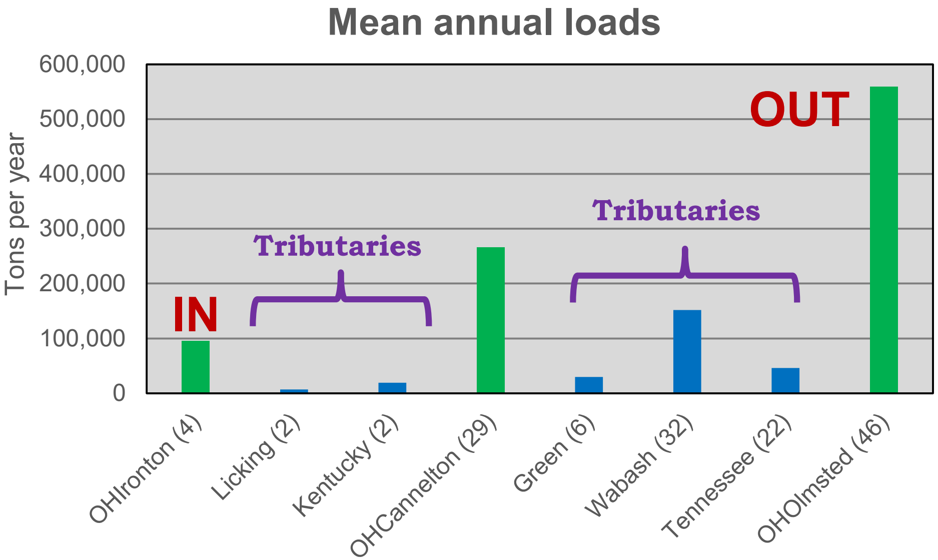
Preliminary Information-Subject to Revision. Not for Citation or Distribution

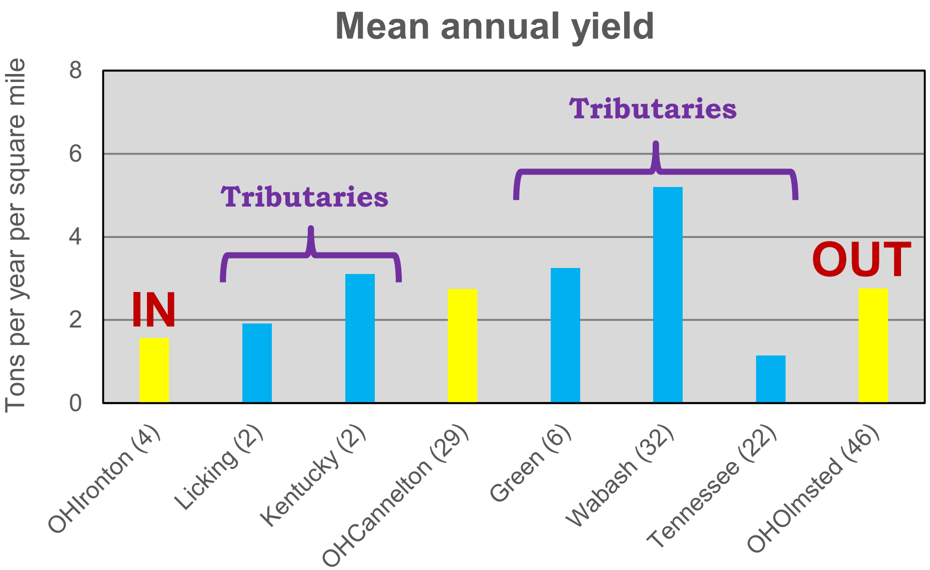
Total Nitrogen

What's coming in & going out?



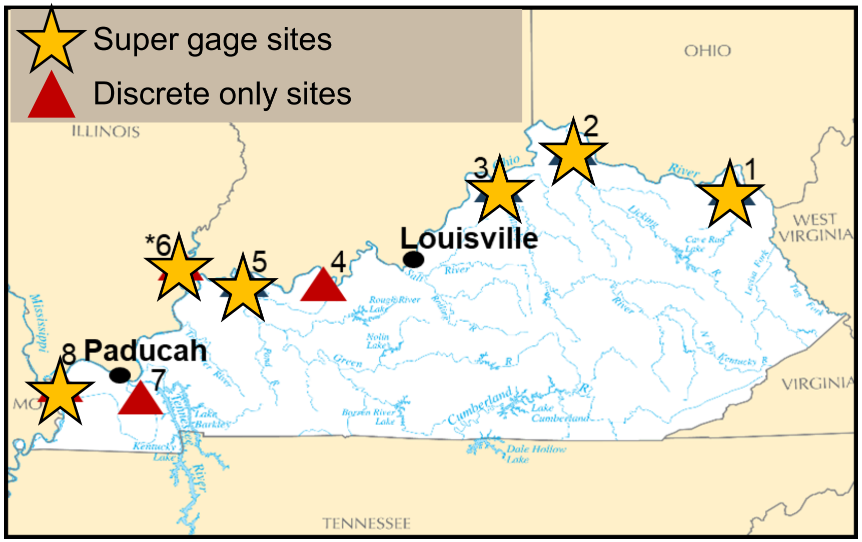
Long-term fixed sites are required to compute loads, yields, climate response, etc.

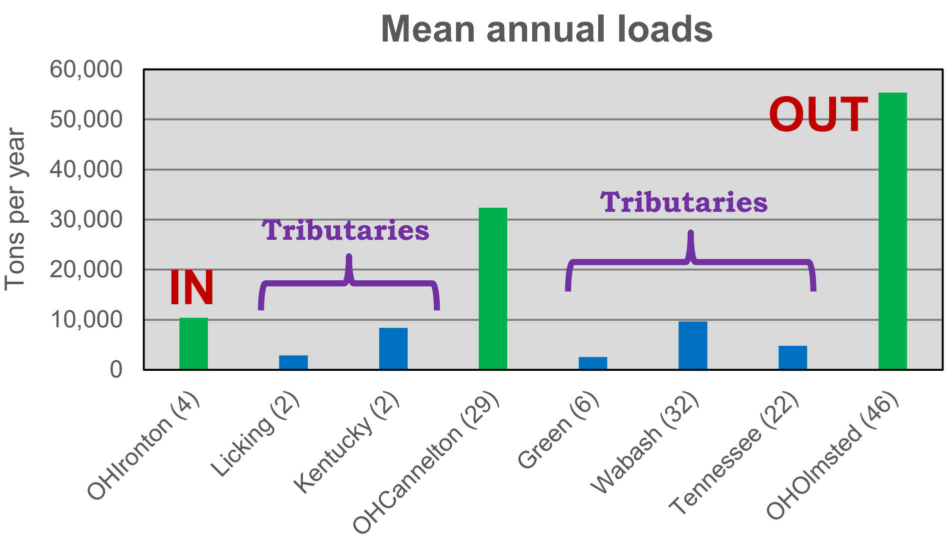


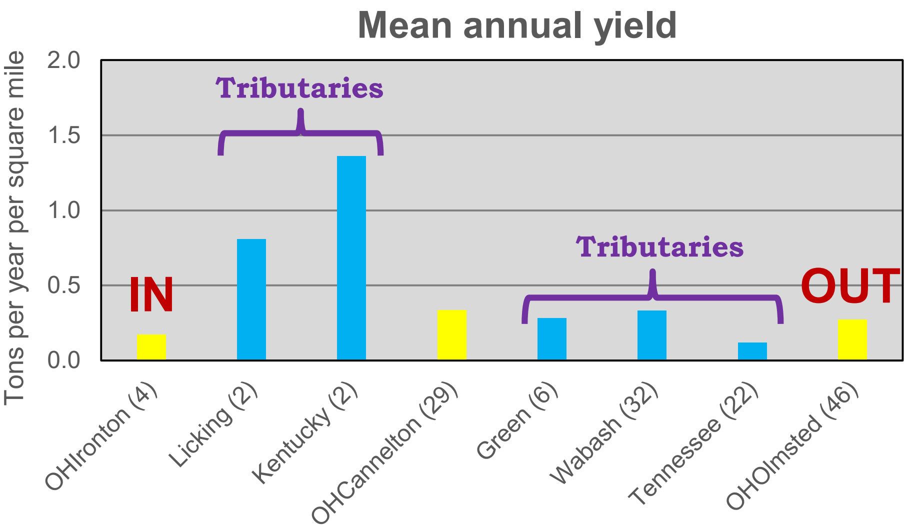


Total Phosphorus

What's coming in & going out?







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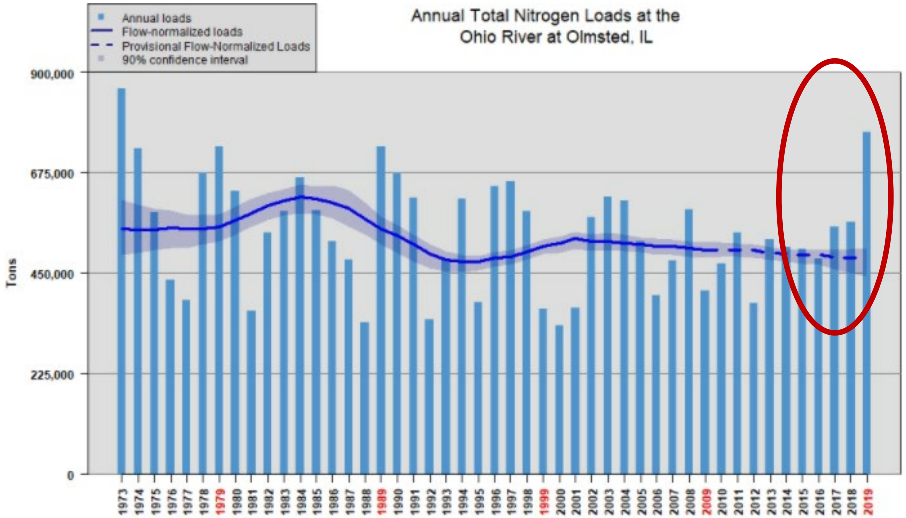
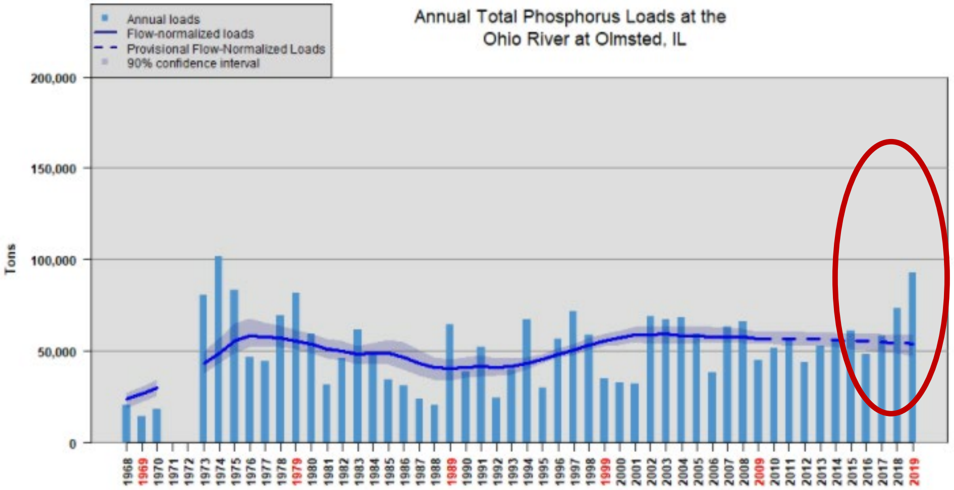
Annual Loads



Trend start year	Trend end year	Trend, in percent change	Lower 90% confidence interval	Upper 90% confidence interval	Trend attributed to changes in streamflow	Trend attributed to other changes in the watershed
1979	2019	-13%	-23%	-3%	-3%	-10%
1989	2019	-12%	-23%	-4%	3%	-15%
1999	2019	-5%	-16%	1%	3%	-8%
2009	2019	-4%	-16%	3%	0%	-4%



Trend start year	Trend end year	Trend, in percent change	Lower 90% confidence interval	Upper 90% confidence interval	Trend attributed to changes in streamflow	Trend attributed to other changes in the watershed
1969	2019	101%	63%	136%	4%	97%
1979	2019	-2%	-25%	14%	2%	-4%
1989	2019	33%	2%	58%	5%	28%
1999	2019	-2%	-22%	11%	5%	-7%
2009	2019	-5%	-22%	7%	0%	-5%

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Publication

[USGS Fact Sheet](https://pubs.er.usgs.gov/publication/fs20203019)

https://pubs.er.usgs.gov/publication/fs20203019

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Prepared in cooperation with the Kentucky Governor's Office of Agricultural Policy

The Importance of U.S. Geological Survey Water-Quality Super Gages

What is a U.S. Geological Survey (USGS) Super Gage?

Super gages are an important tool providing real-time, continuous water-quality data at streamgages or groundwater wells. They are designed to address specific water-resource threats such as water-related human health issues including harmful algal blooms, floods, droughts, and hazardous substance spills. In addition, super gages improve our understanding of the effects land-use practices have on critical water resources.

Before the development of super gages, scientists relied on discrete sample collection with subsequent laboratory analysis of the sample to monitor water quality—often requiring days or weeks to obtain results and potentially missing critical peak measurements. A super gage incorporates real-time streamflow or groundwater levels and continuous water-quality measurements with in-stream or groundwater well sample collection for laboratory analysis to ensure accuracy of the real-time data.

What can be Measured at a Super Gage?

Super gages always measure stream stage or measure water levels in groundwater wells. Additional continuous sensors depend upon the type of super gage. There are five types of super gages.

Standard sensors (5)
water temperature
specific conductance (SC)
pH
dissolved oxygen
turbidity

Sediment super gage
turbidity

***E.coli* super gage**
specific conductance
water temperature
turbidity

Nutrient super gage
standard sensors (5)
nitrate plus nitrite
orthophosphate

Harmful Algal Bloom super gage
standard sensors (5)
nutrient sensors
chlorophyll
phycocyanin

What are the Benefits of USGS Super Gage Data?

USGS super gages provide the hydrologic and water-quality information needed to aid in defining, using, and managing our country's invaluable water resources. Super gages provide an immediate, continuous source of well-archived, well-documented, and unbiased water-quality data useful to public and private entities. Some of the ways water-quality data from a USGS super gage network benefits all of us are presented here.

Enhances Ability to Model Nutrient and Sediment Surrogates

Data measured at super gages highlight the usefulness of surrogate regression model techniques in assessing parameters more difficult to measure using typical sampling strategies. A surrogate is a continuous in-stream sensor measurement used to estimate something of greater interest to environmental managers. Super gage data allow the development of surrogates to be modeled and reported in near real-time concentrations and loads (fig.1). Surrogates frequently developed include:

Measured parameter(s)	Surrogate
turbidity	suspended sediment
nitrate plus nitrite	total nitrogen
turbidity and SC	total phosphorus
water temperature, SC, and turbidity	*E. coli*

Assessment of Conservation Practices

Nutrient super gages (those equipped with nitrogen and phosphorus sensors and analyzers) can show both immediate and cumulative effects of conservation practices on water quality in watersheds. Edge-of-field water-quality monitoring helps scientists to understand nutrient pathways from field to stream and nutrient migration response to precipitation. Because there is immediate access to the data (including by the public), farmers can better estimate favorable conditions for applying fertilizers and pesticides so that the products remain on the field and prevent costly losses to runoff.

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

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Thank you!

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KENTUCKY ENERGY & ENVIRONMENT CABINET

Managing Northern Kentucky's Wastewater and Storm Water • SD1

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INDIANA
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QUESTIONS?
USGS
Kentucky River at Lock 2