



Water Monitoring Activities in Kentucky: Progress and Needs

Kentucky Farm Bureau

January 28, 2016

Surface-water quality



Current USGS Site Locations –

“What’s coming in and what’s going out?”

Incoming



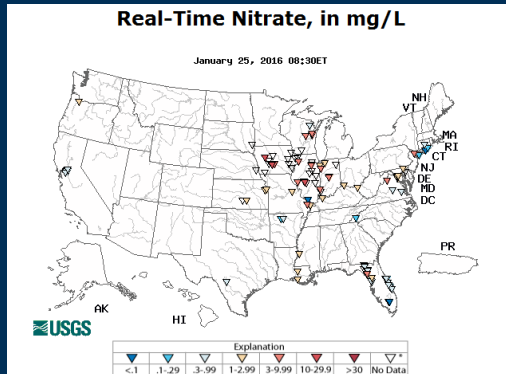
Outgoing



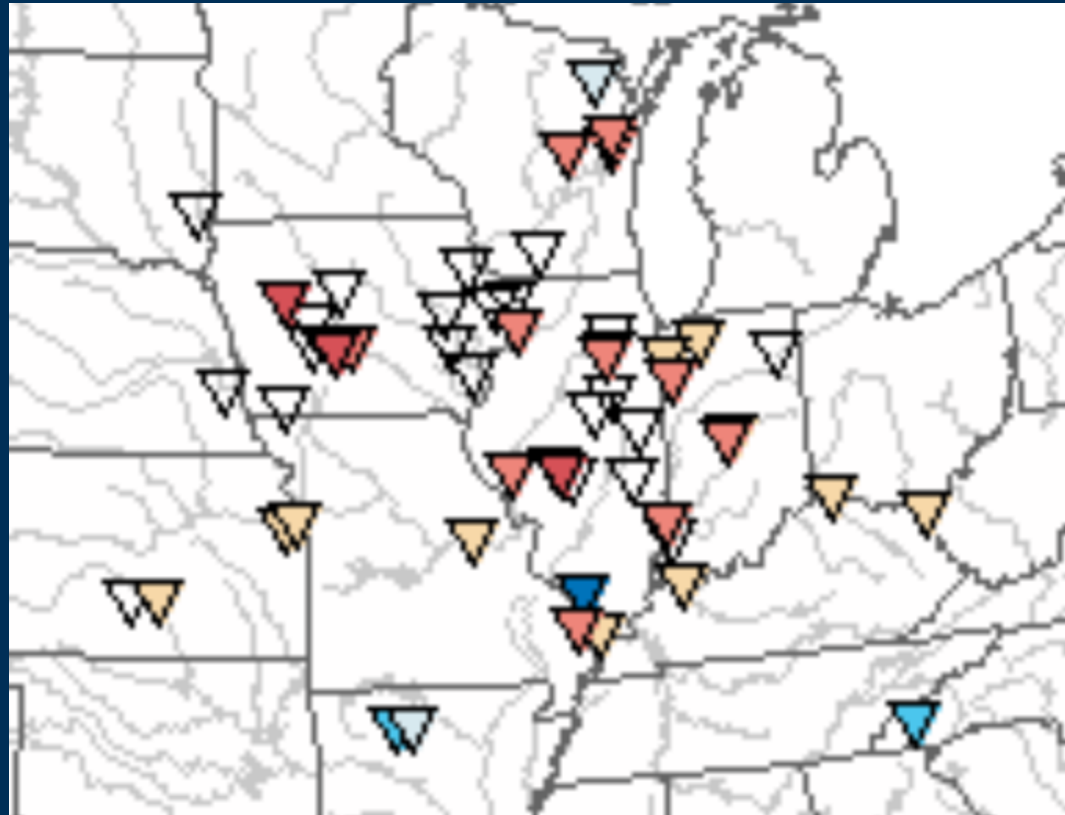
Yellow – Real-time USGS Super Gage
Red – USGS NAWQA sampling site

National Perspective

KY sites currently ~ 1 mg/L

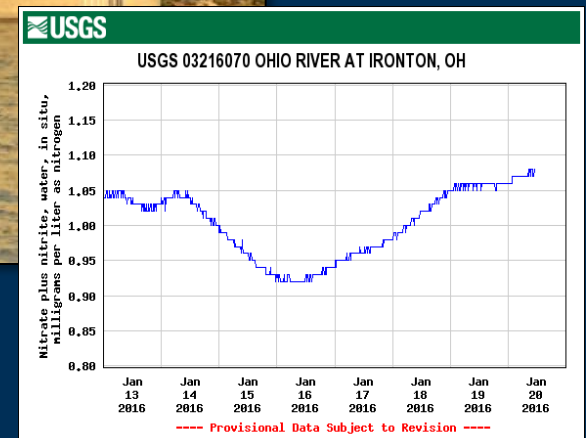
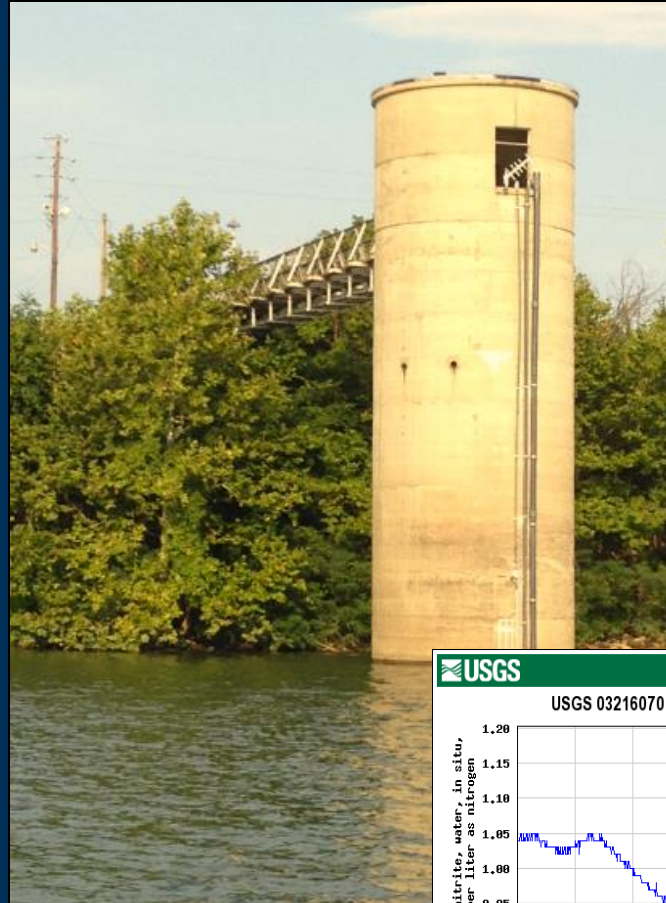


Real-time data as of
1/25/2016



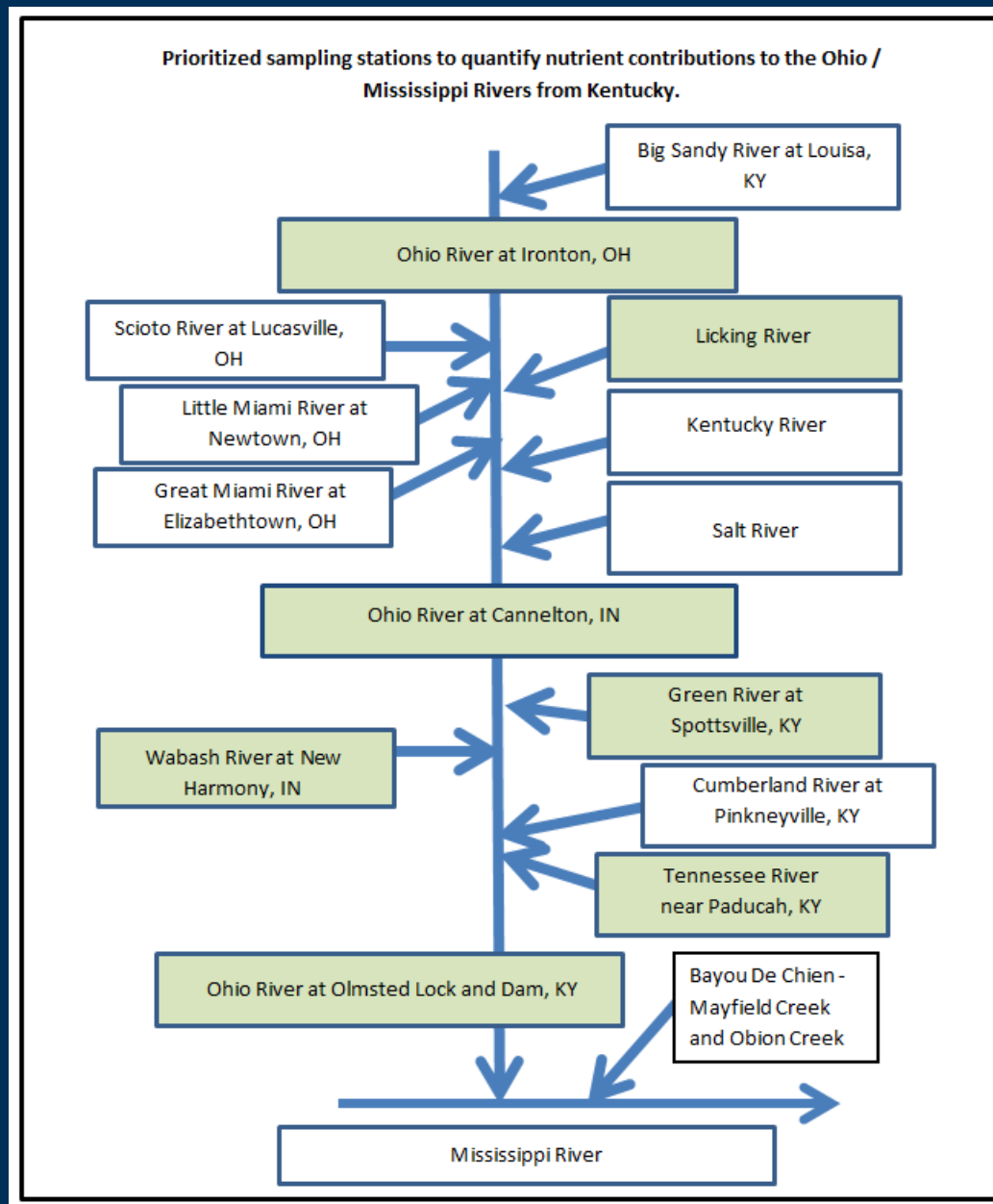
<http://waterwatch.usgs.gov/wqwatch/>

Ohio River at Ironton, OH



Future needs

- * Shaded sites are operational (super gage or can compute defensible loads).
- * Sites on all major river basins is ideal.
- * Need to work with partners on other side of the river.
- * Sustainable funding required; 3 sites are scheduled to lose funding in 2018 and will be shut down.



Future needs – estimated costs (1-2016)

Component	Required
ONE-TIME Construction of <u>new station</u> and first year operation for streamflow – assuming a large river and the use of acoustic sensors for real-time velocity data.	\$40,000
ONE-TIME Cost of 5-parameter water-quality sonde and installation	\$18,500
ONE-TIME Cost of nitrate sonde and installation	\$29,000
ONE-TIME Cost of phosphate sonde and installation	\$28,000
ANNUAL Operation and Maintenance of surface-water gage – using acoustic sensors for real-time velocity data	\$24,000 (year 1&2) \$14,000 (year 3+)
ANNUAL Operation and Maintenance of 5-parameter water-quality sonde	\$27,000
ANNUAL Operation and Maintenance of nitrate sonde	\$12,000
ANNUAL Operation and Maintenance of phosphate sonde	\$14,000
ANNUAL Collection of other discrete water-quality samples (if desired – see above for examples)	TBD – site specific
ANNUAL Laboratory fees for discrete water-quality analyses (if desired – see above for examples)	TBD – site specific

Harmful Algal Blooms (HABs)

This is a BRIEF description of current monitoring as it relates to, and works in coordination with, existing agricultural-monitoring projects.

Note that there are many concurrent activities and responsible agencies - references will be provided for relevant sources of information.

Harmful Algal Blooms (HABs)

The screenshot shows the EPA website's 'Nutrient Pollution' section. The main heading is 'Harmful Algal Blooms'. Below it, a breadcrumb trail reads 'You are here: EPA Home » Nutrient Pollution » Harmful Algal Blooms'. The page content begins with the text: 'Harmful algal blooms are a major environmental problem. They are caused by green algae or cyanobacteria that grow in large numbers and can be harmful to people and ecosystems.' A sidebar on the left lists navigation options: 'Nutrient Pollution', 'The Problem', 'Sources and Solutions', 'The Effects', 'Where This Occurs', 'What You Can Do', and 'Policy and Data'. At the top, there are links for 'Learn the Issues', 'Science & Technology', 'Laws & Regulations', and 'About EPA', along with a search bar and language options (Español, 中文: 繁體版, 中文: 简体版, Tiếng Việt, 한국어).

What causes harmful algal blooms?

Harmful algal blooms need:

- Sunlight
- Slow-moving water
- Nutrients (nitrogen and phosphorus)

Nutrient pollution from human activities makes the problem worse, leading to more severe blooms that occur more often.

[Learn where nutrient pollution comes from.](#)

Did you know?
Climate change might lead to stronger and more frequent algal blooms.

Nutrient Pollution

- Nutrient Pollution
- The Problem
- Sources and Solutions
- The Effects
- Where This Occurs
- What You Can Do
- Policy and Data

Sources and Solutions

You are here: EPA Home » Nutrient Pollution » Sources and Solutions

Excessive nitrogen and phosphorus that washes into water bodies and is released into the air are often the direct result of human activities. The primary sources of nutrient pollution are:

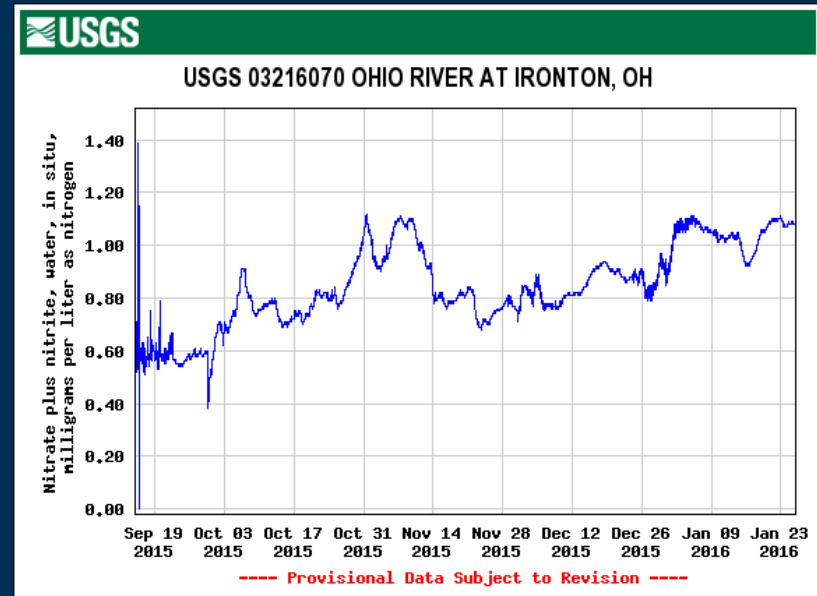
- **Agriculture:** Animal manure, excess fertilizer applied to crops and fields, and soil erosion make agriculture one of the largest sources of nitrogen and phosphorus pollution in the country.
- **Stormwater:** When precipitation falls on our cities and towns, it runs across hard surfaces - like rooftops, sidewalks and roads - and carries pollutants, including



<http://www.epa.gov/nutrientpollution/harmful-algal-blooms>

Harmful Algal Blooms (HABs)

9-2015 Ohio River at Ironton, OH

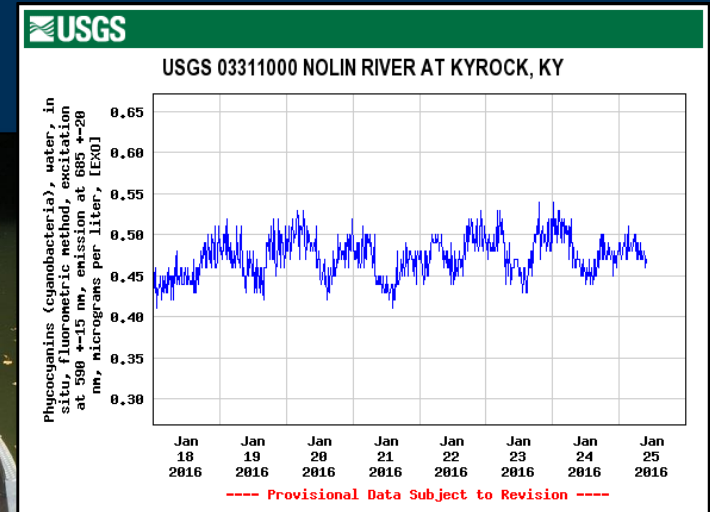
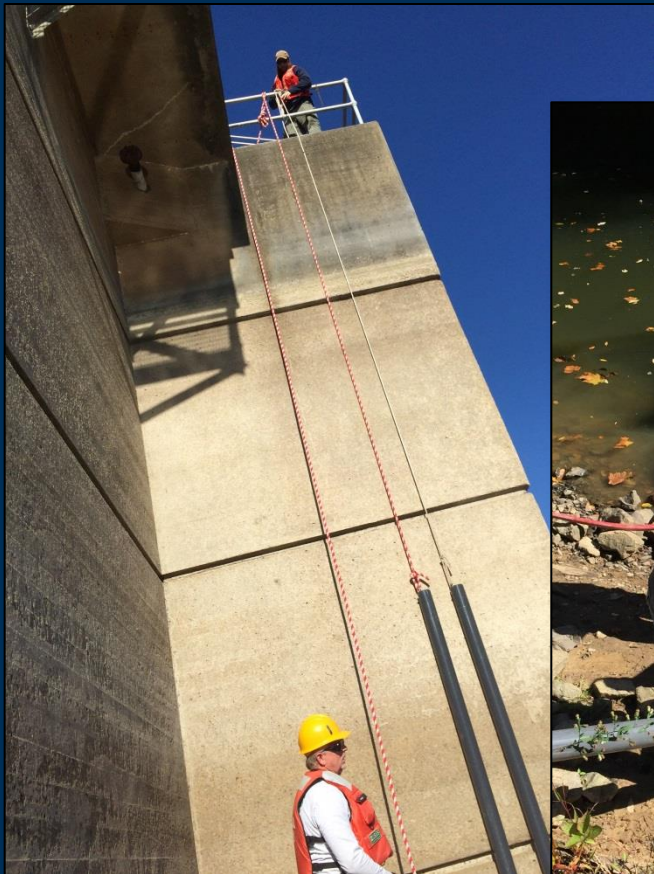


Existing USGS supergages already monitor nutrients and can easily include HABs-related constituents.

At the time of the HAB event, the Ohio R. nitrate conc. was ~0.60 mg/L

Harmful Algal Bloom (HABs) super gages

Similar but with additional sensors



Future needs – estimated costs to add HABs parameters to a USGS supergauge (1-2016)

Component	Required
ONE-TIME	\$ 4,000
Cost of total algae (phycocyanin and chlorophyll) sonde and installation	
ANNUAL	\$ 14,000
Operation and Maintenance of total algae (phycocyanin and chlorophyll) sonde	

Resources for HABs information

Kentucky Division of Water:

<http://water.ky.gov/waterquality/pages/HABS.aspx>

Louisville US Army Corps of Engineers:

<http://www.lrl.usace.army.mil/Missions/CivilWorks/WaterInformation/HABs.aspx>

USGS resources:

- http://water.usgs.gov/coop/products/qw/cyanobacteria_habs.html
- <https://pubs.er.usgs.gov/publication/ofr20151164>



Surface-water availability



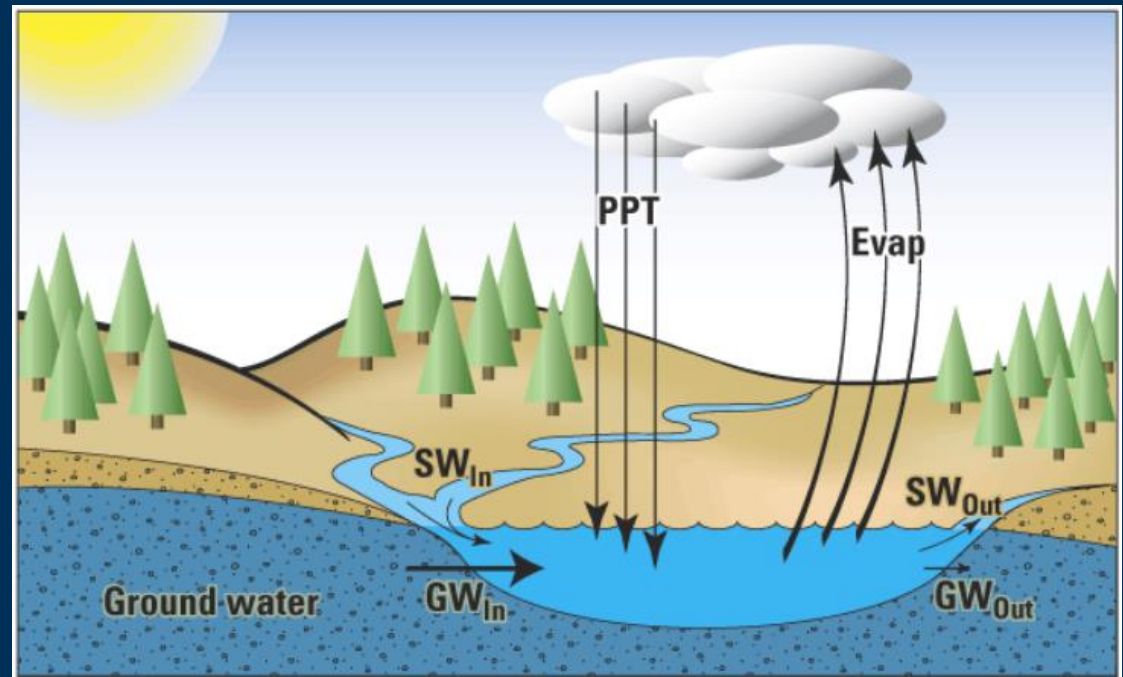
Surface-water availability

USGS gage data is a critical piece of the basic water budget:

$$\text{Precipitation} = \text{ET} + \text{Streamflow} + \Delta\text{GW} + \Delta\text{SM} + \Delta\text{RSV} \pm \text{Diversions}$$

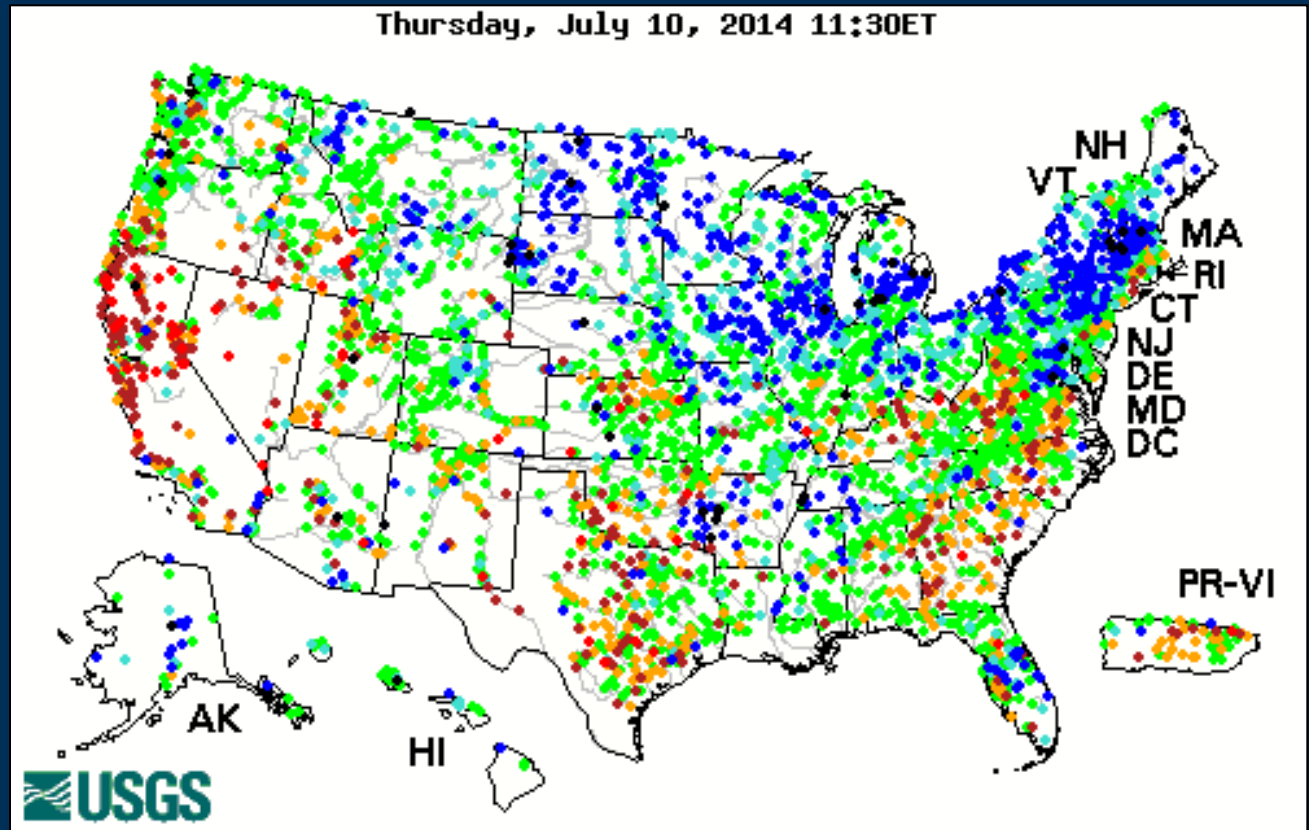
Where you want to quantify the hydrologic cycle, you need these pieces of information.

Note groundwater, soil moisture, and other parameters that are also included here!



Real-Time Streamgages

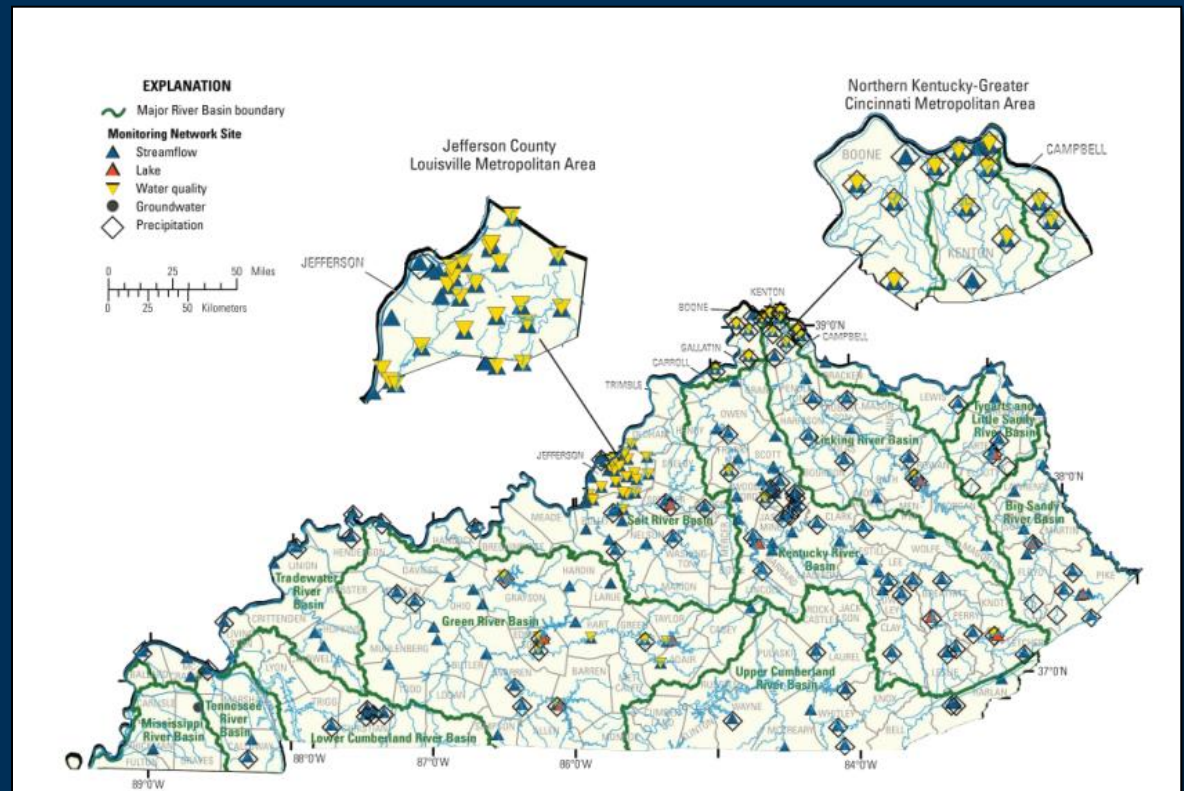
USGS operates approximately **14,800** sites nationally with real-time streamflow data. This national network allows local data to be quickly scaled-up to a regional or national context to assess conditions – but it may NOT be locally optimized for specific uses.



USGS IN-KY WSC has over 200 sites with real-time data in Kentucky

USGS continually assesses the statistical strength of the network; we already see a loss of statistical strength in rural areas as static funding is shifted to urban areas to address changing priorities.

Notably, gaps exist in the Western KY and the Cumberland River Basins.



Future needs – current costs for a BASIC USGS streamgage (1-2016)

Component	Required
ONE-TIME	\$ 26,000
Cost of installation and first year's O&M for a basic (non-acoustic) streamgage	
ANNUAL	\$ 14,000
Operation and Maintenance for year 2+	

KGS Progress Toward Improved Statewide Groundwater Monitoring and Research



Re-Establishing a Groundwater-Level Observation Network

Status of KGS Observation Well Sites As Of November 15, 2015



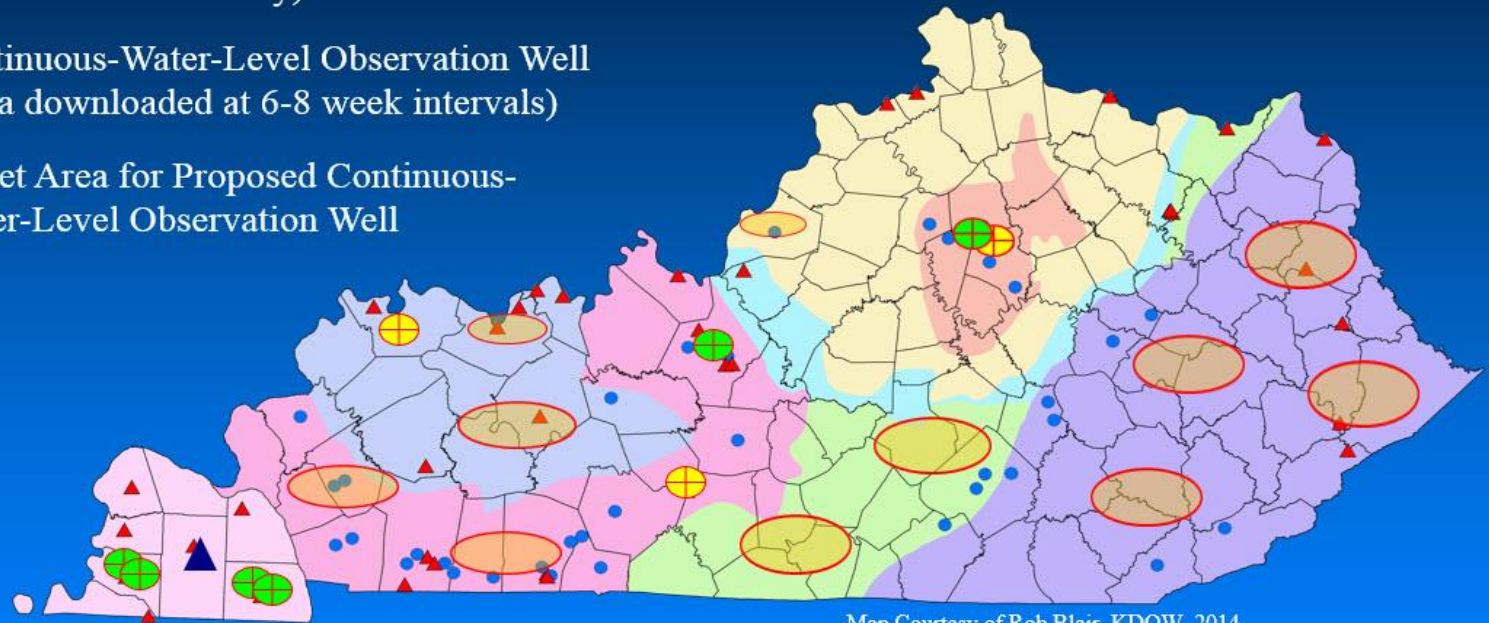
Continuous-Water-Level Observation Well
(Data downloaded daily)



Continuous-Water-Level Observation Well
(Data downloaded at 6-8 week intervals)



Target Area for Proposed Continuous-Water-Level Observation Well



Map Courtesy of Rob Blair, KDOW, 2014

Groundwater Monitoring Sites
Maintained By Other Agencies:



KDOW-ITAC Groundwater-Quality Sampling Sites



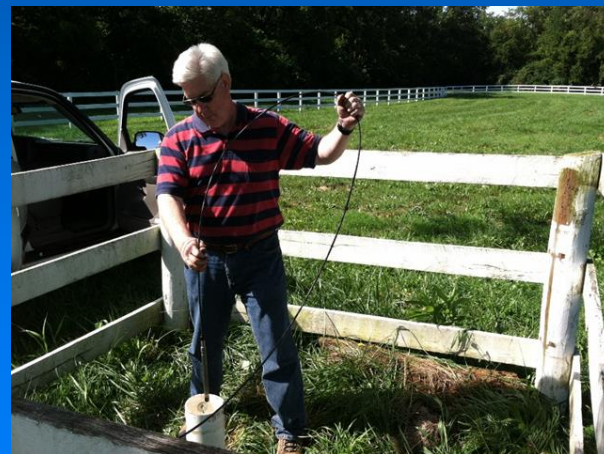
USGS National Climate-Response Network Well

Equipment Installation At the Network's 1st Observation Well

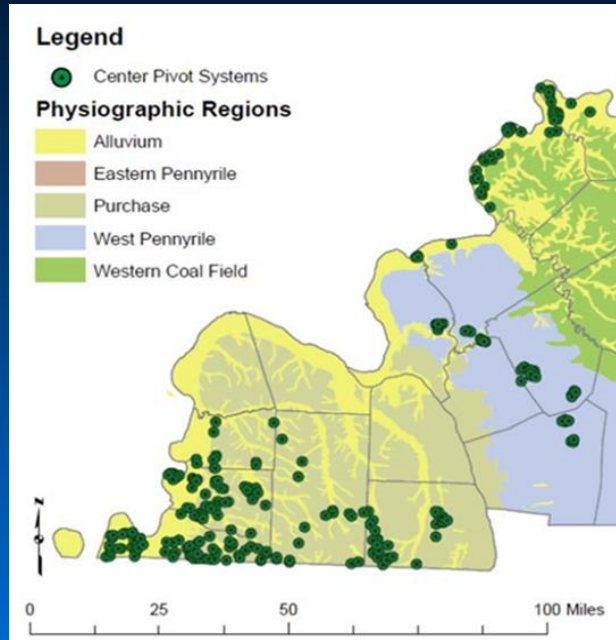
Monitoring a fractured-karstic limestone aquifer at Kentucky Horse Park, Scott Co.

Clockwise from upper left:

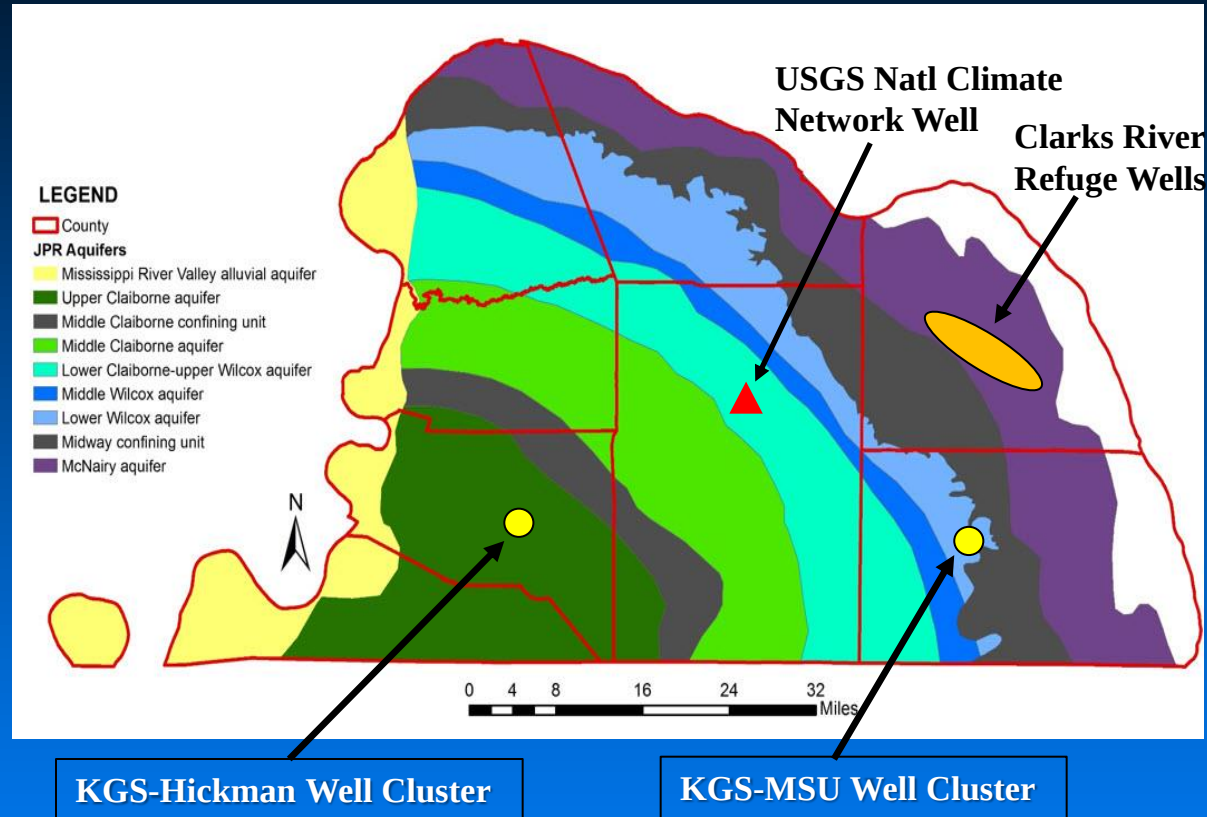
1. Preparation of anchor point (datum) for pressure transducer.
2. Measuring out transducer data cable length.
3. Inserting transducer and cable into well.
4. Final field check of transducer and telemetry equipment.
5. Well integrity must also be quantified on regular intervals.



KGS Research & Monitoring Activity in the Purchase Area



Center Pivot Wells Inventoried by KDOW & KGS in 2014



- ✓ KGS Drilled and Instrumented Two New Observation Well Clusters.
- ✓ Collecting Natural Gamma Logs, and other Geophysical Data, to Improve Identification of Subsurface Aquifer Boundaries and Confining Units.
- ✓ Collected Additional GWL Measurements and Water Well Data, and Conducted Specific Capacity Tests of Irrigation Wells at Clarks River Wildlife Refuge.

KGS Hickman Co. Observation Well Cluster

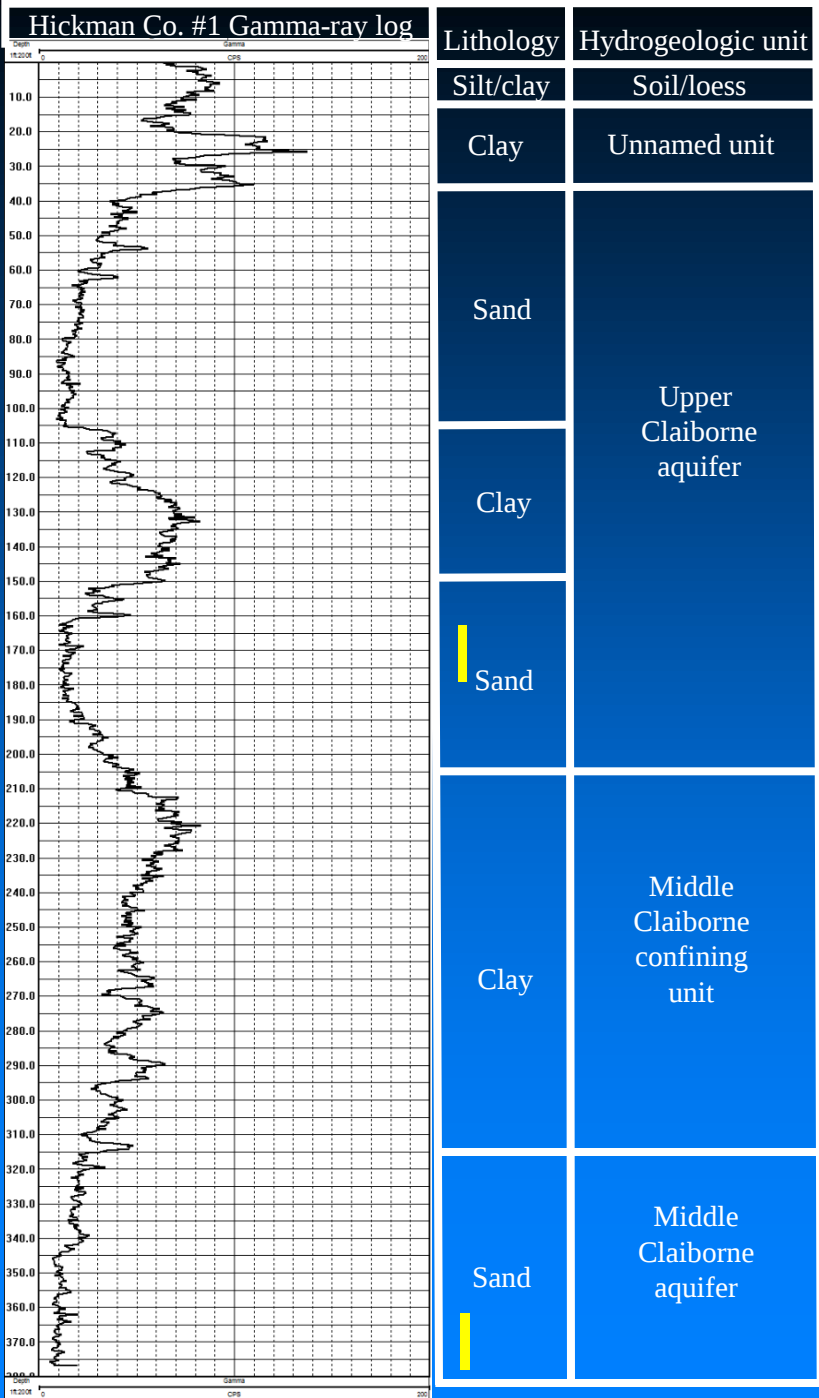
near Clinton, KY



SWL/TD:

HICKMAN #2 81/180 FBLS

HICKMAN #1 84/380 FBLS

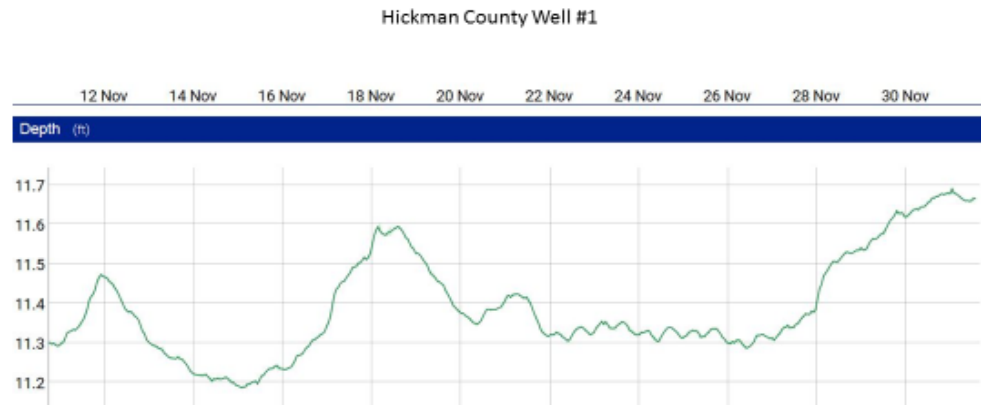
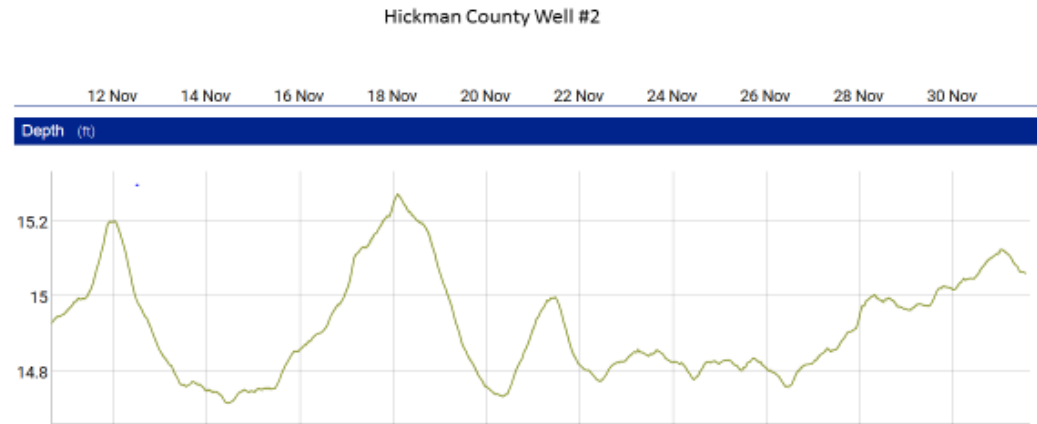


Location of the Hickman Observation Cluster Relative to Some High-Yield Water Wells



First Hydrographs for Hickman Co. Observation Wells #1 and #2

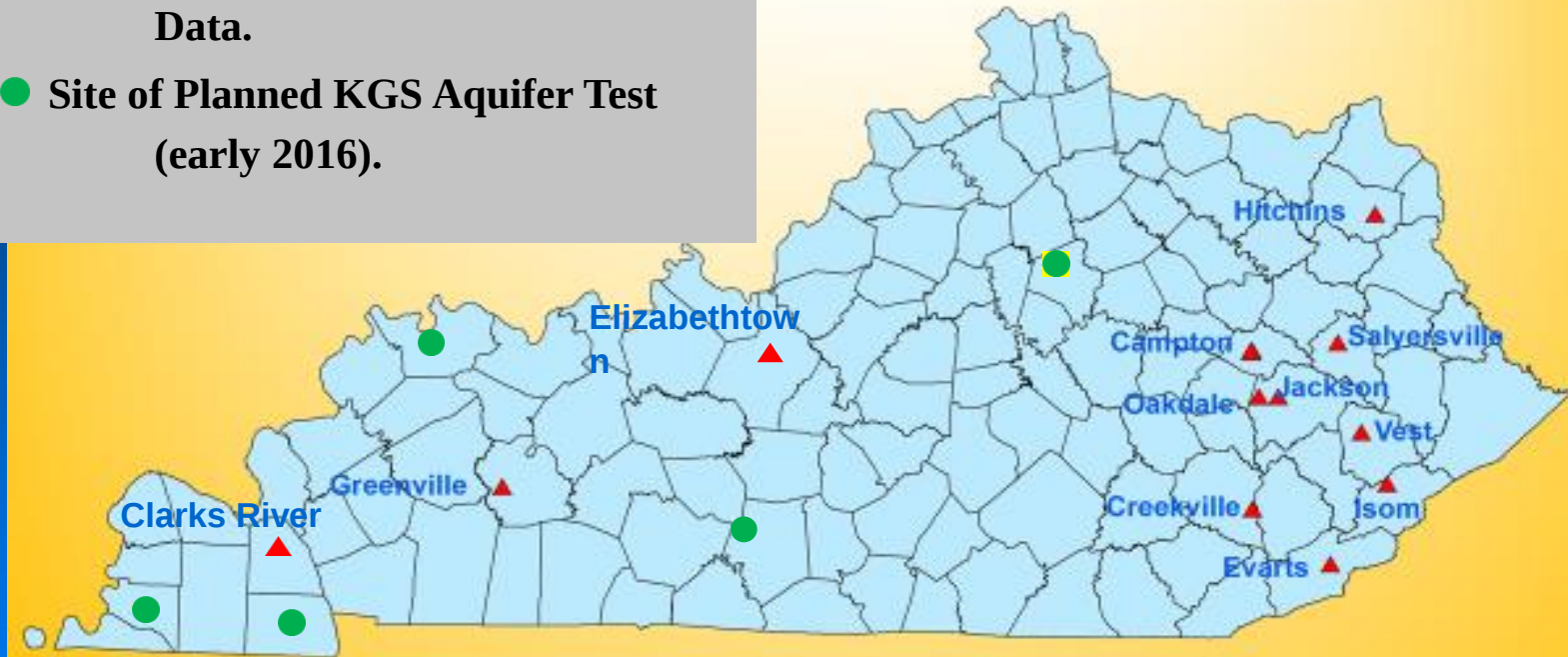
(Raw data, feet above
transducer)



Creating a Public Aquifer Test Archive and Webpage

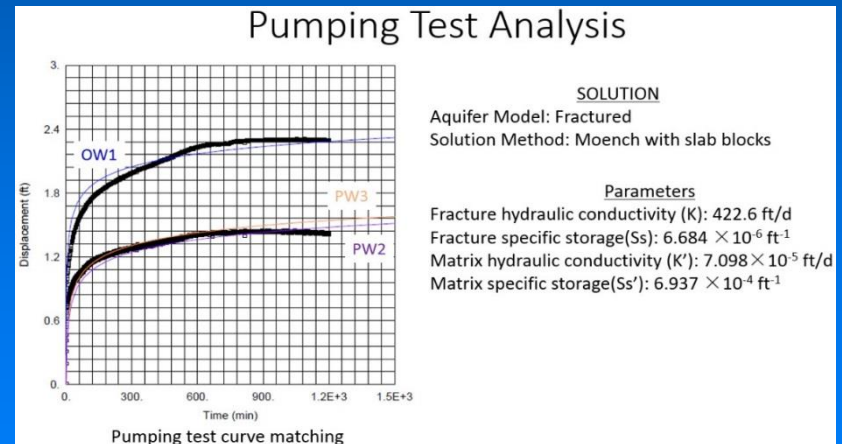
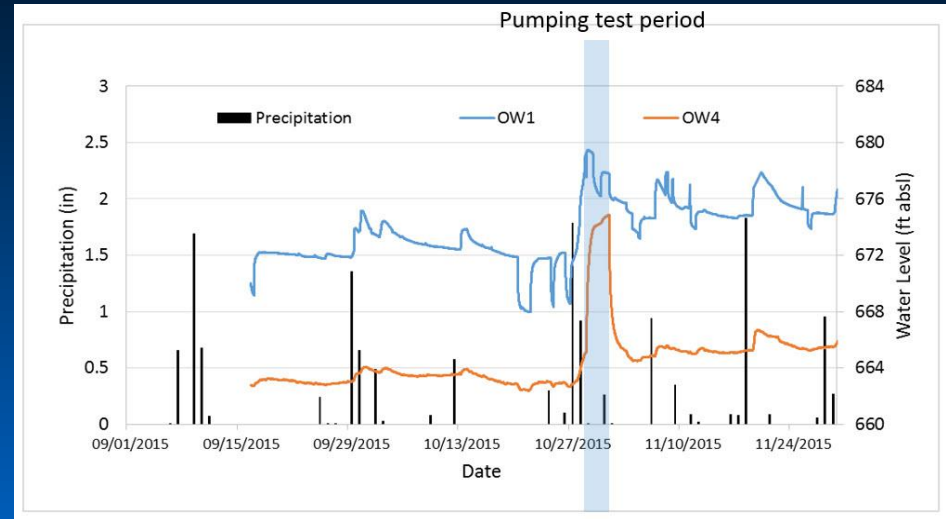
Aquifer Test Data Compiled by KGS

- ▲ Site of Existing KGS Aquifer Test Data.
- Site of Planned KGS Aquifer Test (early 2016).



KGS intends to collaborate with USGS, among others, to obtain and compile additional existing aquifer test data.

Recent KGS Aquifer Test—Elizabethtown well field



Municipal supply wells completed in a karstic limestone aquifer

Summary: KGS Activities to Improve GW Monitoring

- ✓ Began re-establishing statewide network of long-term water-level observation sites.
- ✓ Conducting focused groundwater research to better characterize the aquifer system in the Jackson Purchase Area.
- ✓ Conducting aquifer tests to enable better assessment of groundwater availability.
- ✓ Creating new webpages needed to enhance public access to groundwater data.
- ✓ Conducting targeted sub-regional groundwater-quality assessments.



Campton, Wolfe Co.
New Plant Well (Brewer Trail Road)
December 19, 2009

BACKGROUND
The City of Campton had been looking for an additional groundwater supply well to supplement water production drawn from nearby Campton Lake. KGS was asked in 2006 to assist in performing aquifer tests on three wells: one by the old water plant, one at the city's lift station on Swift Road, and one at the location where the new water plant is now located on Brewer Trail Road.

Site of well near location of proposed Campton Water Plant.

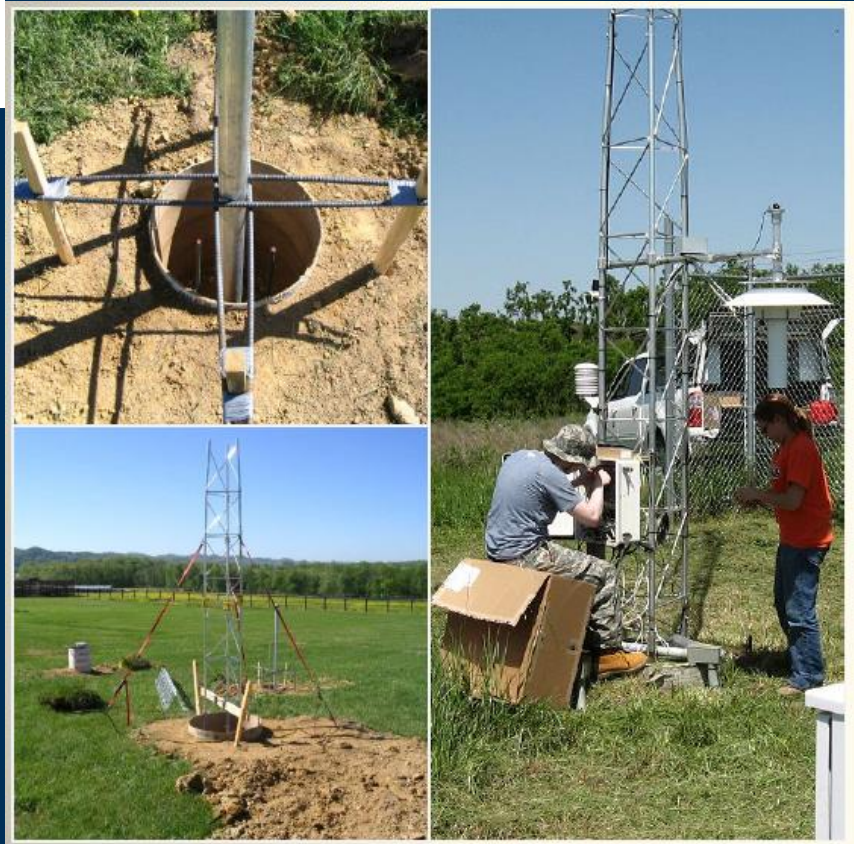
Well sites on a 7.5-minute topograph base of the Campton quadrangle.

Flow is determined by a gallon counter and discharged to a nearby creek.

Aquifer test setup conducted using drill rig.

Page 1

Climate and soil-moisture data

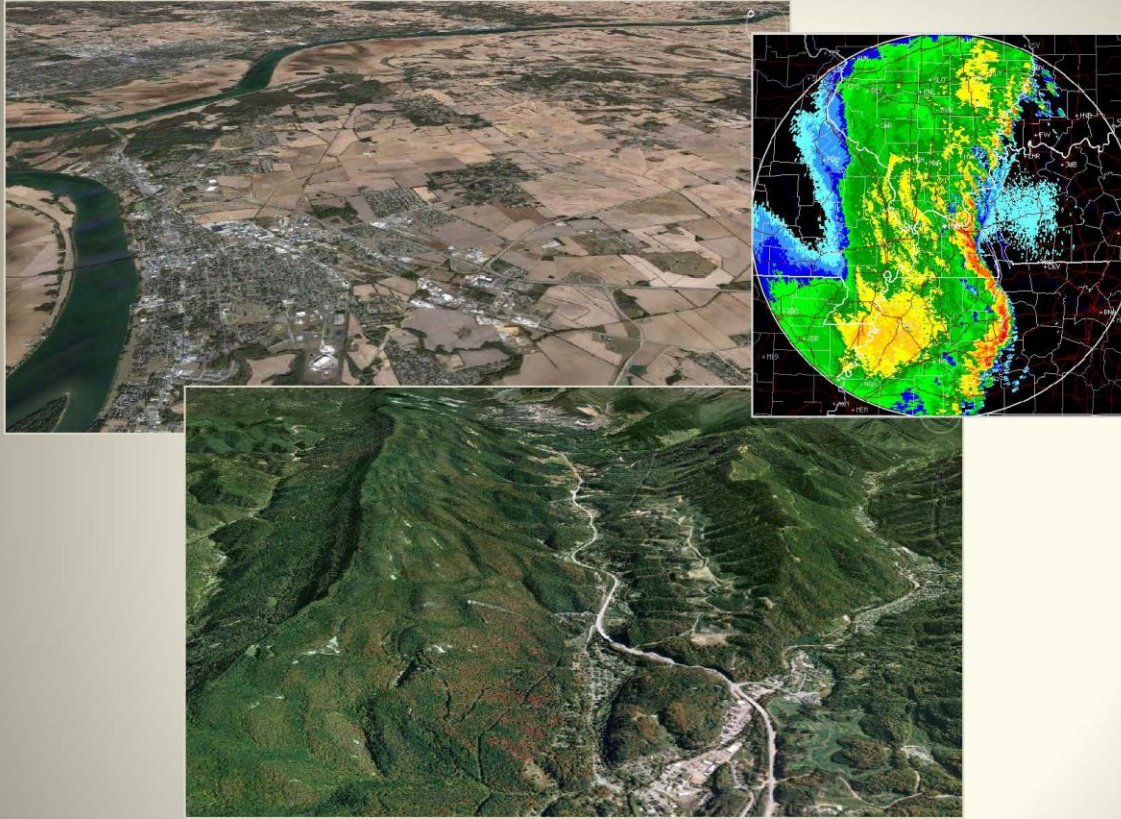


Climate and soil-moisture data



“First, we recently launched our 66th station. This one is located in Butler County and was funded through local partnerships and the KADF. It also includes a commitment for annual operating support. Second, we are in the process of developing a proposal for KADF funds to replace modems and relative humidity probes across our network and to replace some of our precipitation gauges. We hope to submit by the end of January.”

Climate and soil-moisture data



Kentucky's diverse terrain creates distinct local vulnerabilities to weather and climate

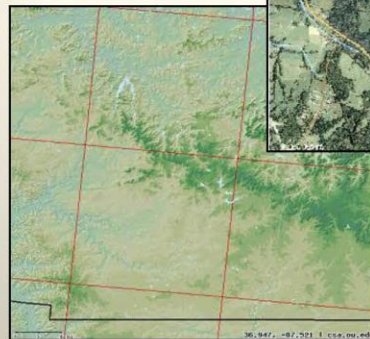


KENTUCKY
CLIMATE
CENTER

Climate and soil-moisture data

High-Quality Sites for High-Quality Data

- Work with local stakeholders to find the best available sites
- Sites are representative of their surrounding areas



Survey Scores

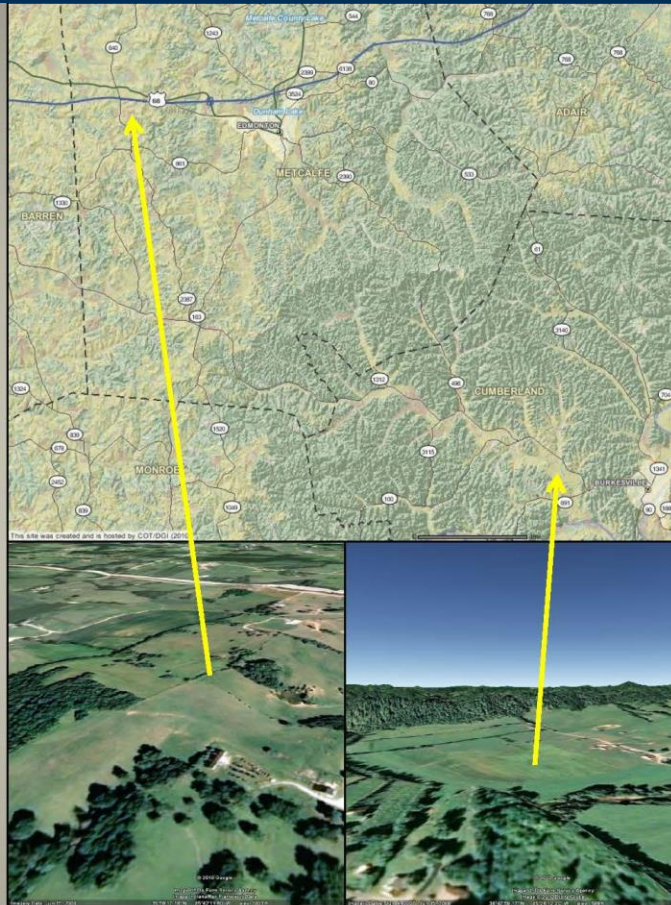
Temperature	40
Precipitation	30
Wind	12
Soil	15
Total	97

Climate and soil-moisture data



Paired-Sites

- Areas of complex topography cannot be well represented by a single site
- The most representative site may not be the nearest site
- An example is provided by the paired stations in Metcalfe County (plateau) and Cumberland County (valley)



Plateau , 1003'

Valley, 554'

Climate and soil-moisture data

Design Criteria Emphasize
Quality and Reliability



Temperature



Precipitation

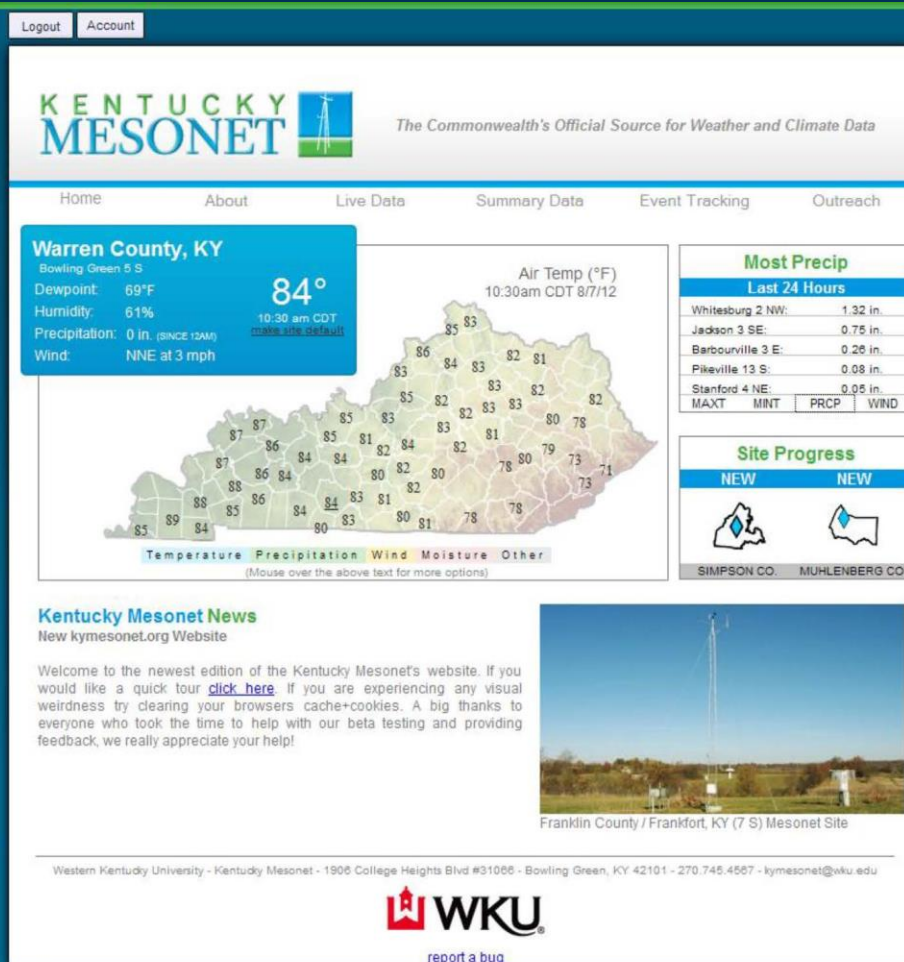
Sensor Package

- Air temperature
- Precipitation
- Solar radiation
- Relative humidity
- Wind speed & direction
- Soil moisture & temperature*

** selected sites*



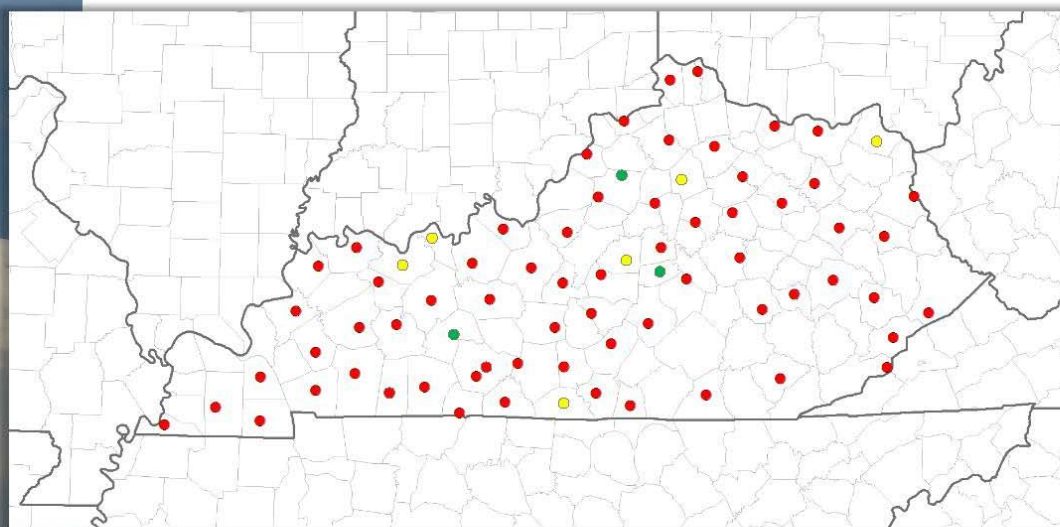
Climate and soil-moisture data – Mesonet database and web-based access. <http://www.kymesonet.org/>



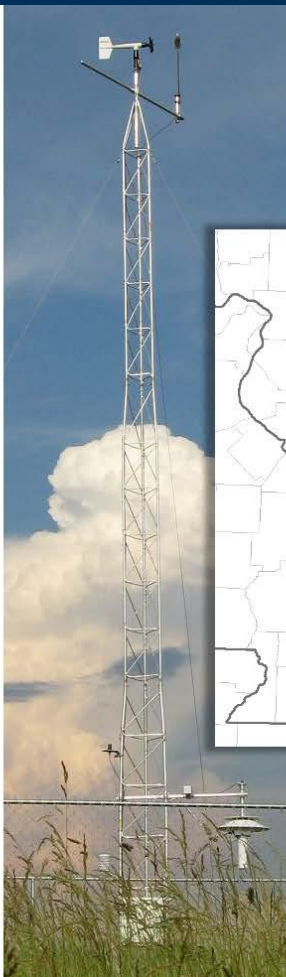
Climate and soil-moisture data



Kentucky Mesonet Coverage Map



- 65 - Existing stations in the Kentucky Mesonet
- 3 - Local governments have secured funding to acquire a new station
- 6 - Local governments are evaluating options to acquire a new station





Questions?

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