
USGS
science for a changing world
New York Water
Science Center
L. Champlain NYCAC, December 2023
U.S. Department of the Interior
U.S. Geological Survey

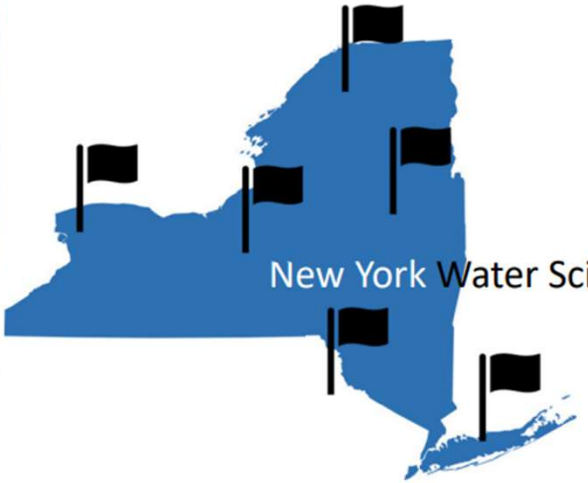
Outline

- USGS Intro.
- Surface and Ground Water Monitoring Network
- Streamgage Data Uses
- Opportunities for Improvement
- Questions

Who We Are

Department of the Interior

Geological Survey



Mission Areas

Water
Core Science Systems
Ecosystems
Energy and Minerals
Environmental Health
Land Resources
Natural Hazards

Regions

Region 1: North Atlantic-Appalachian
Region 2: South Atlantic-Gulf
(Includes Puerto Rico and the U.S. Virgin Islands)
Region 3: Great Lakes
Region 4: Mississippi Basin
Region 5: Missouri Basin
Region 6: Arkansas-Rio Grande-Texas-Gulf
Region 7: Upper Colorado Basin
Region 8: Lower Colorado Basin
Region 9: Columbia-Pacific Northwest
Region 10: California-Great Basin
Region 11: Alaska
Region 12: Pacific Islands

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Who We Are

- 6 Offices –Main office in Troy
- ~150 Scientists, Technicians, Support Staff
- Backed by the World's Foremost Experts in Earth System Science (8000+ Strong)
- Mostly non-federal funding (Matching Funds) –adapt our science to meet customer's needs
- ~100 Customers at any one time

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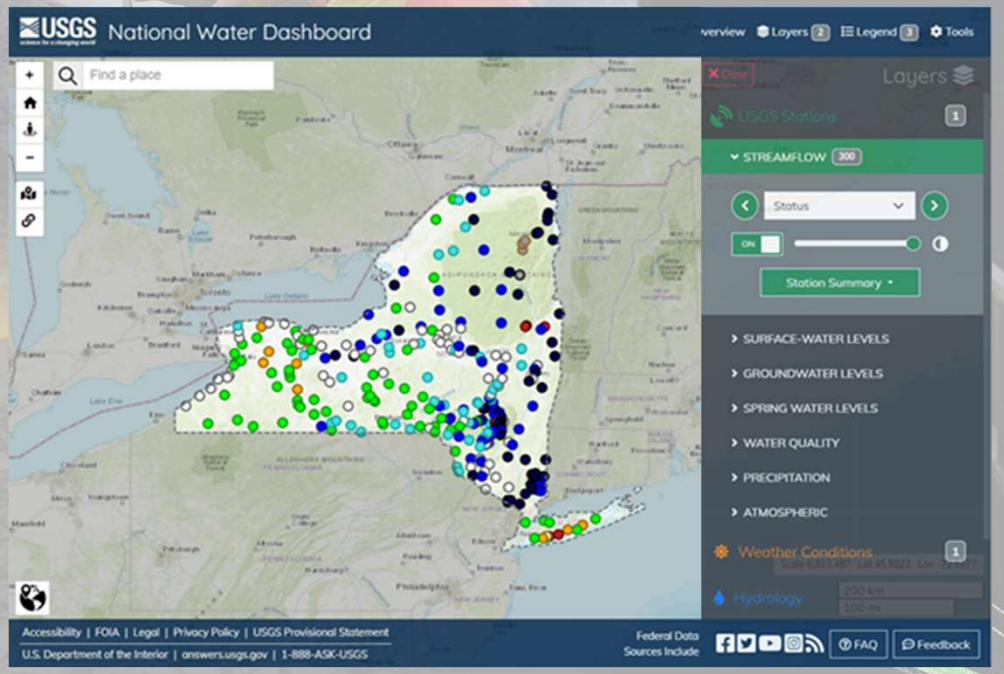
Who We Are

- Experienced, Permanent staff
- Infrastructure (satellite, redundant servers)
- Nationally Consistent Methods
- Free, Publicly available information
- Data stored in perpetuity



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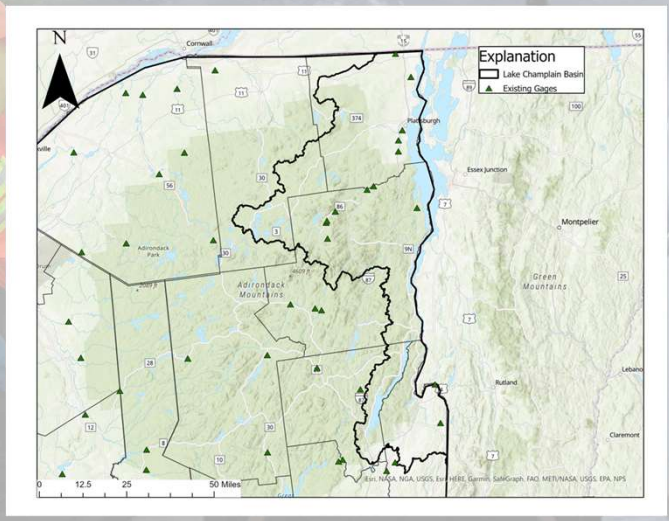
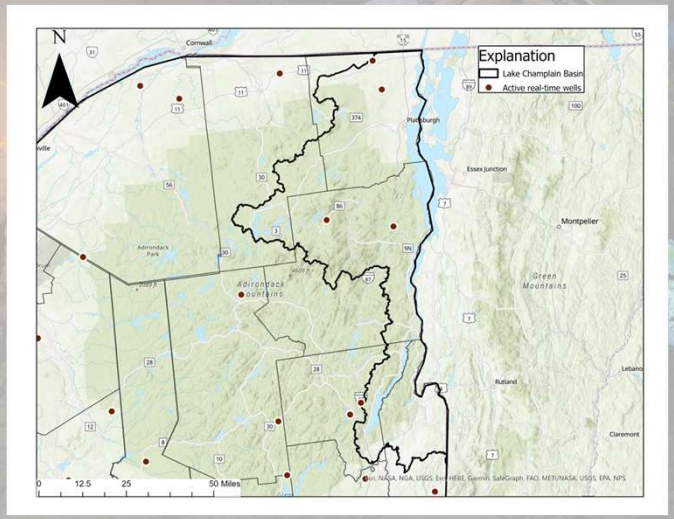
What We Do

- USGS capabilities
  - Monitoring (e.g., Flow, Water-level, WQ, WWTP, etc.)
  - Modeling (e.g., Watershed (SWAT), Groundwater/Water Quality, Flood Inundation/Hydrodynamic, etc.)
  - Science and research capabilities (e.g., HABS, Microplastics, Habitat/Round Goby, etc.)
  - Hydrogeologic capabilities (e.g., Geophysical Applications, Karst Hydrogeology, etc.)

Gage Network in L. Champlain, NY

- **Continuous, free, accessible water data for:**
  - Streamflow (n = 11)
  - Groundwater levels (n = 4)
  - Precipitation (n = 1)
  - Temperature (n = 1)





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Gage Network in L. Champlain, NY

Gage No.	Location	Parameters
04271500	GREAT CHAZY RIVER AT PERRY MILLS NY	Stage, Discharge
04271815	LITTLE CHAZY RIVER NEAR CHAZY NY	Stage, Discharge
04273500	SARANAC RIVER AT PLATTSBURGH NY	Stage, Discharge
04273700	SALMON RIVER AT SOUTH PLATTSBURGH NY	Stage, Discharge
04273800	LITTLE AUSABLE RIVER NEAR VALCOUR NY	Stage, Discharge
04274185	WHITE BROOK NEAR WILMINGTON NY	Stage, Discharge, Temp
04275000	EAST BRANCH AUSABLE RIVER AT AU SABLE FORKS NY	Stage, Discharge
04275500	AUSABLE RIVER NEAR AU SABLE FORKS NY	Stage, Discharge
04276500	BOQUET RIVER AT WILLSBORO NY	Stage, Discharge
04280000	POULTNEY RIVER BELOW FAIR HAVEN, VT	Stage, Discharge
04280450	METTAWEE RIVER NEAR MIDDLE GRANVILLE NY	Stage, Discharge

Well No.	Location
441644073315101	Local number, Ex-157, near Lewis NY
441834073545601	Local number, Ex-261, near Lake Placid NY
445052073350201	Local number, Cl-145, SUNY Plattsburgh NY
445805073380501	Local number, Cl-242, at Mooers Forks NY

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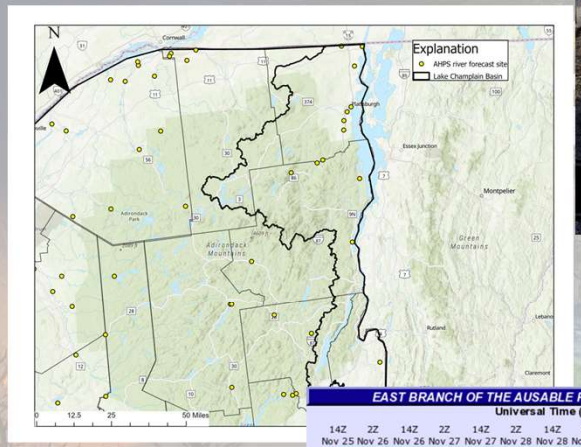
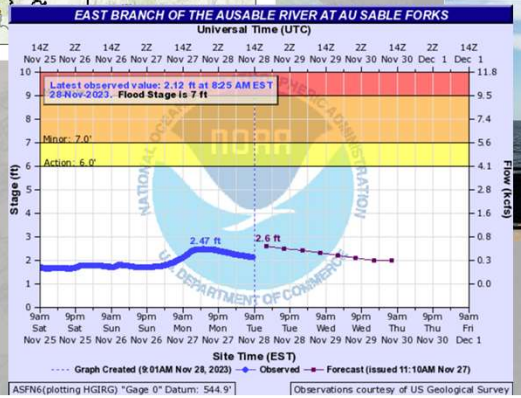
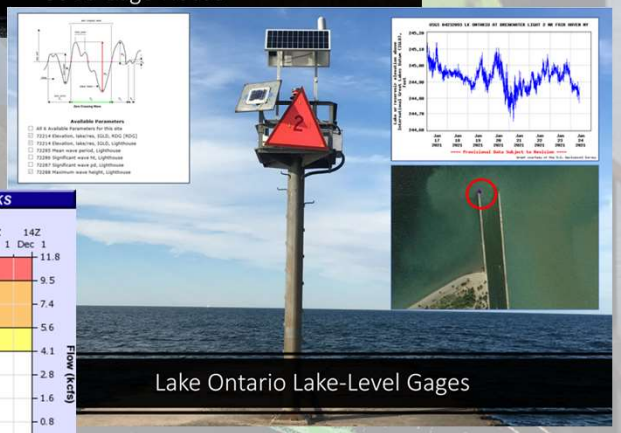
Gage Data Uses

- Permit decisions
- Flood forecasting
- Project siting
- Academic research
- Bridge design
- Water recreation







Water Data . . . by the Numbers

- **Flood loss reduction**
  - NYS HMP: Annualized (1996-2018) Loss from Flooding is $129.9M [1].
  - One hour notice can save up to 10-percent of flood damages. [2]
- **Protecting NY's infrastructure**
  - Current research shows that for every $1 spent on mitigation, an average $6 is saved. [1]
- **Water economic activity**
  - Boating/Fishing provided $1.48B in economic activity in NY for 2020. [3]

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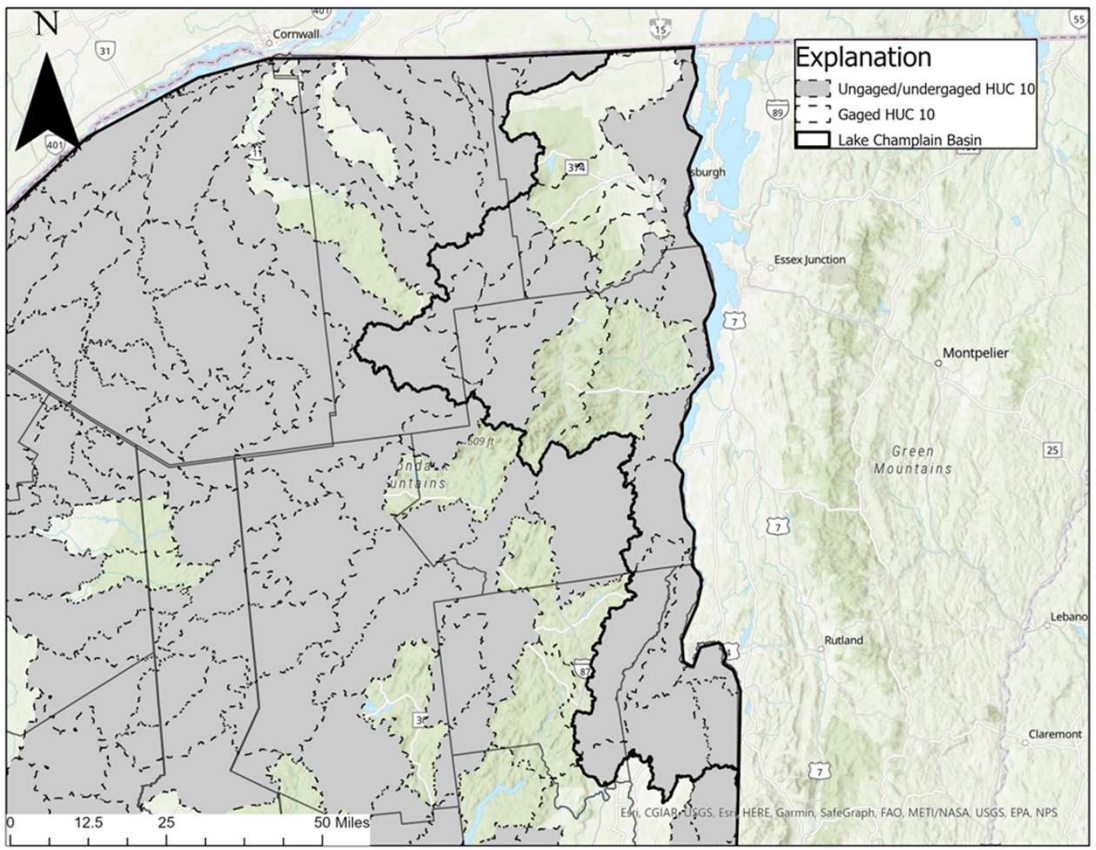
How Much HydroNet Benefits

- **References**

1. MITIGATE NY (availabs.org)
2. TM10.pdf (weather.gov)
3. The Economic Impact of the Great Outdoors - June 2022 (state.ny.us)

Opportunities for Improvement



Opportunities for Improvement

- Rain Gages
- Water-Temperature
- Specific Conductance
- Water Quality Sensor: Supergages at critical locations 
- Climate Indicators: Measurement of climate change indicators, including Albedo (vegetation cover), soil moisture, snowmelt, groundwater level/temp/specific conductance, ET, lake levels.
- LSPIV cameras 

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Opportunities for Improvement

Item	Approx. Capital Cost per Site	Approx. Annual O&M per site
Stream Gage	$30,000	$22,500
Rain Gage	$13,000	$2,800
Water Temperature	$5,000	$3,300
Specific Conductance	$24,000	$6,000
Super Gage	$85,000	$60,400
WQ Sensor (T, SC, pH, DO, Turbidity)	$32,000	$29,000
Climate Indicators	$25,000	$26,000
Real-Time GW Well	$18,000	$5,700
LSPIV Camera	$10,000	$4,000
Lake Elevation	$30,000	$11,000

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Questions?

Mark Klotz
USGS
mklotz@usgs.gov

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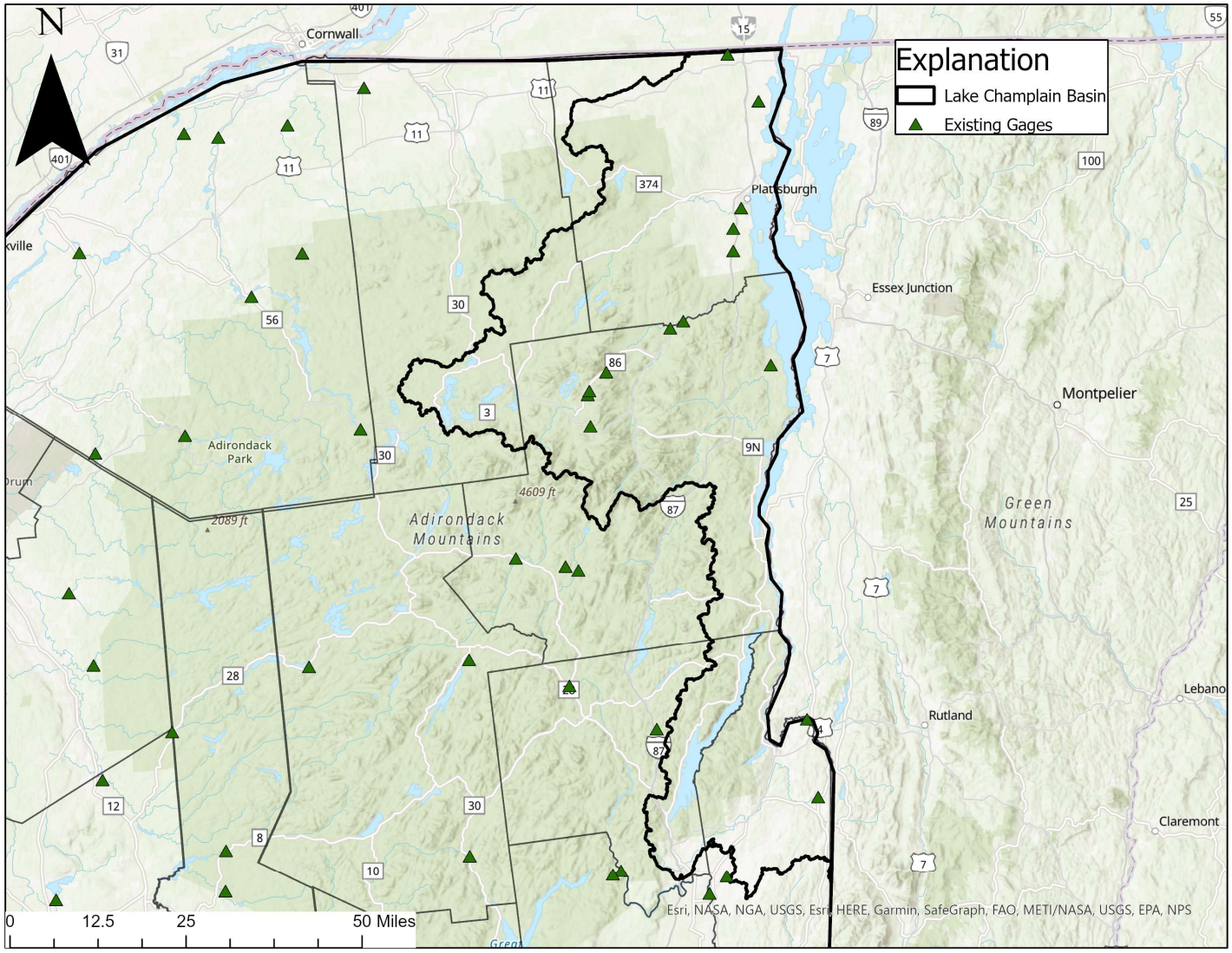
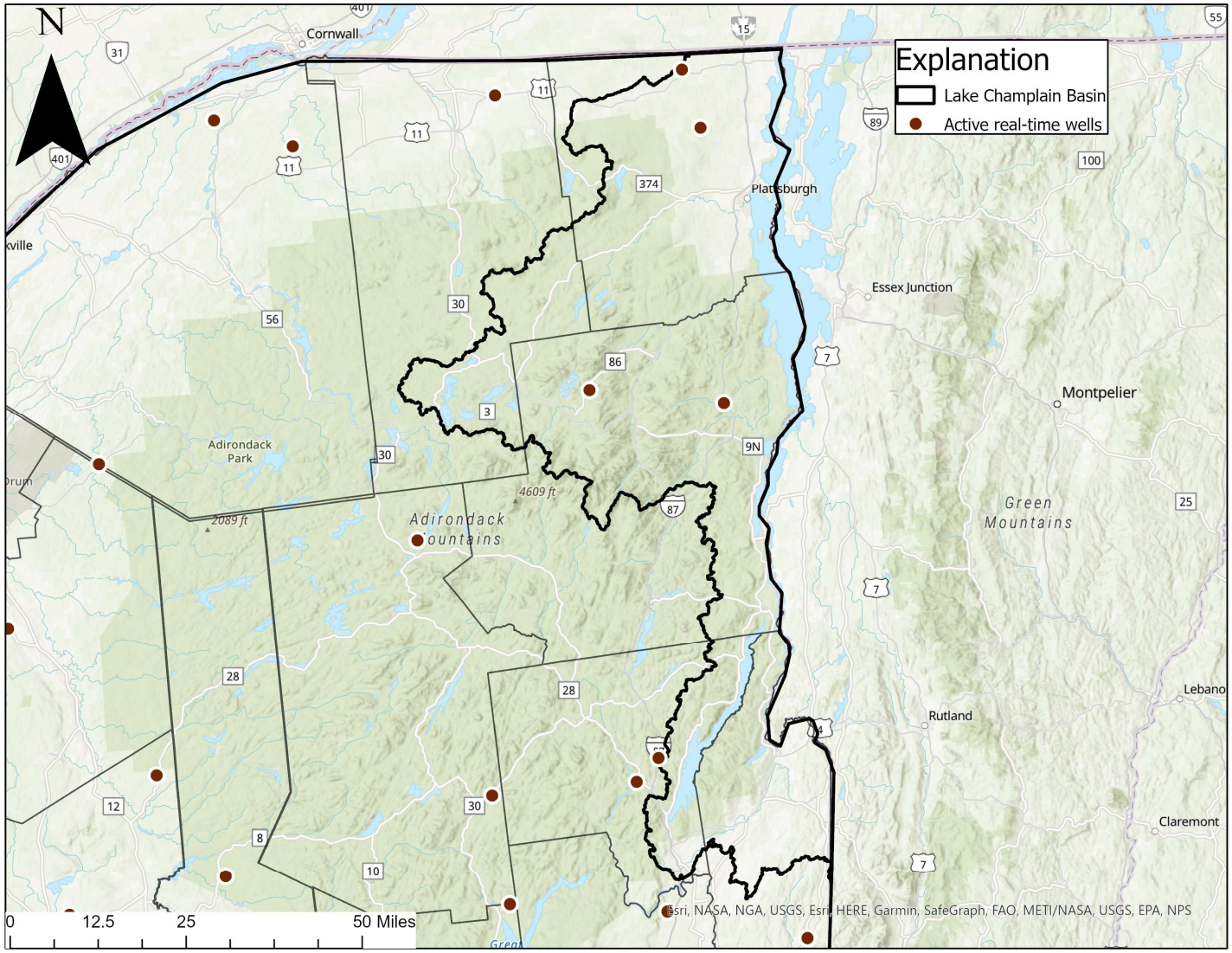
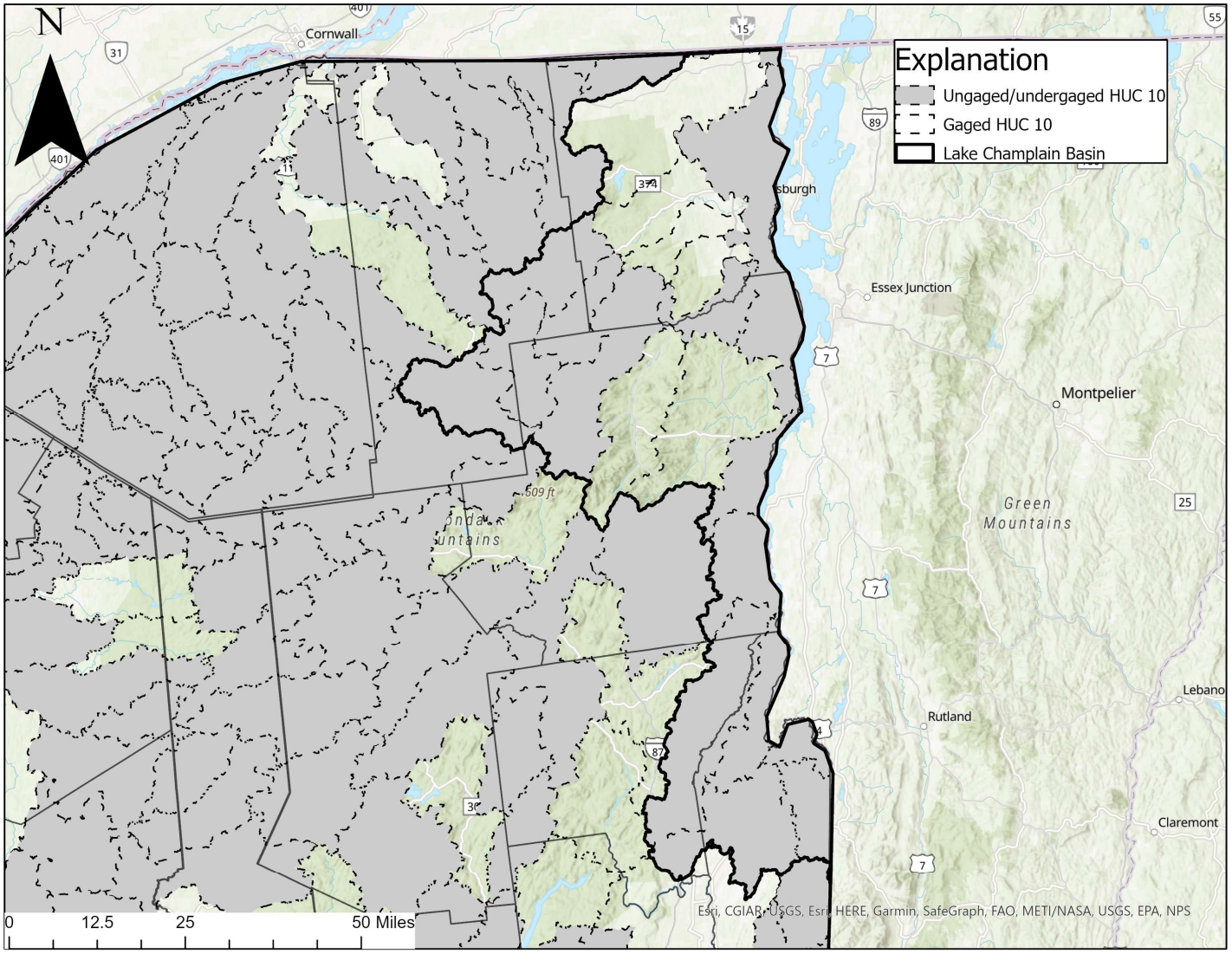
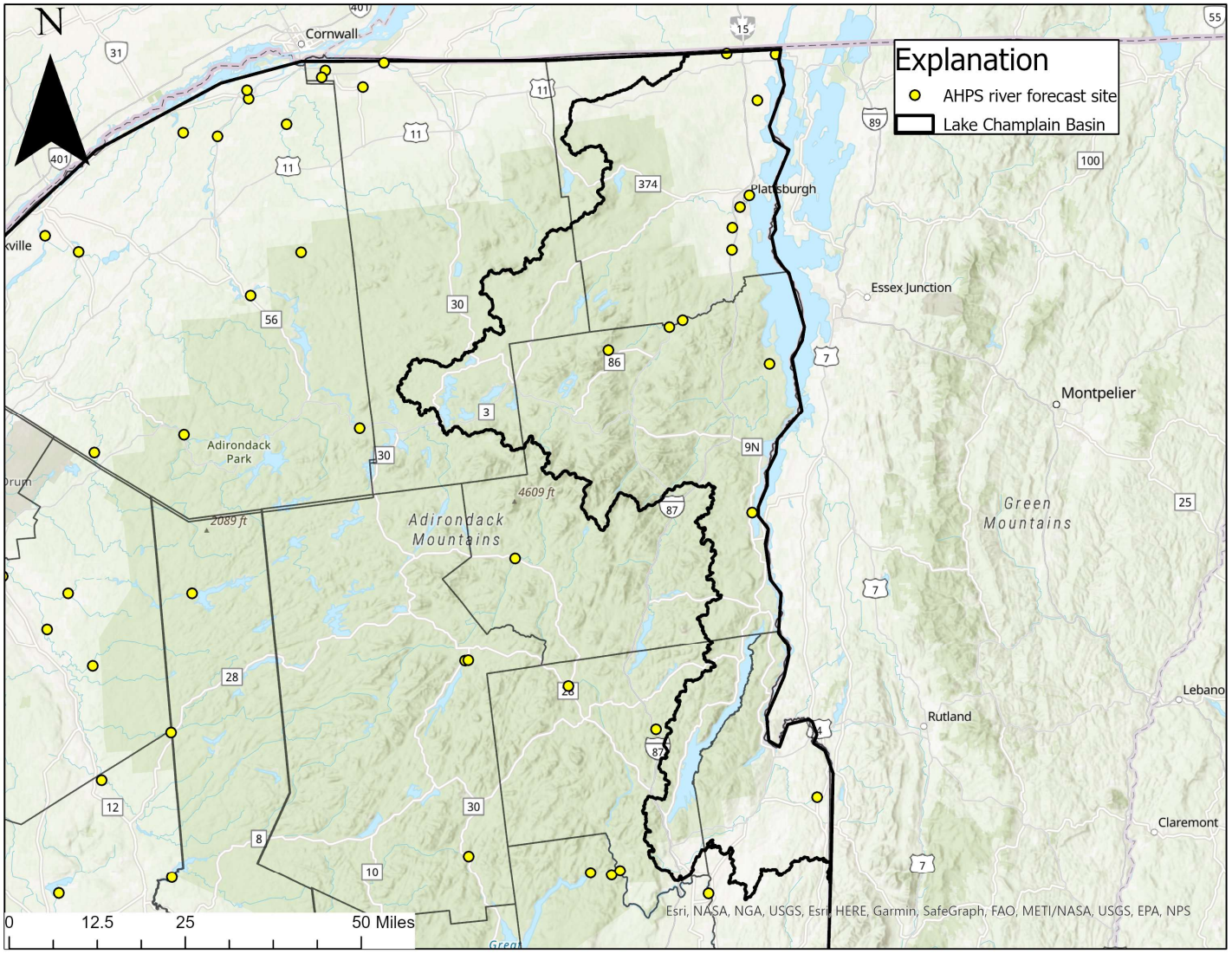
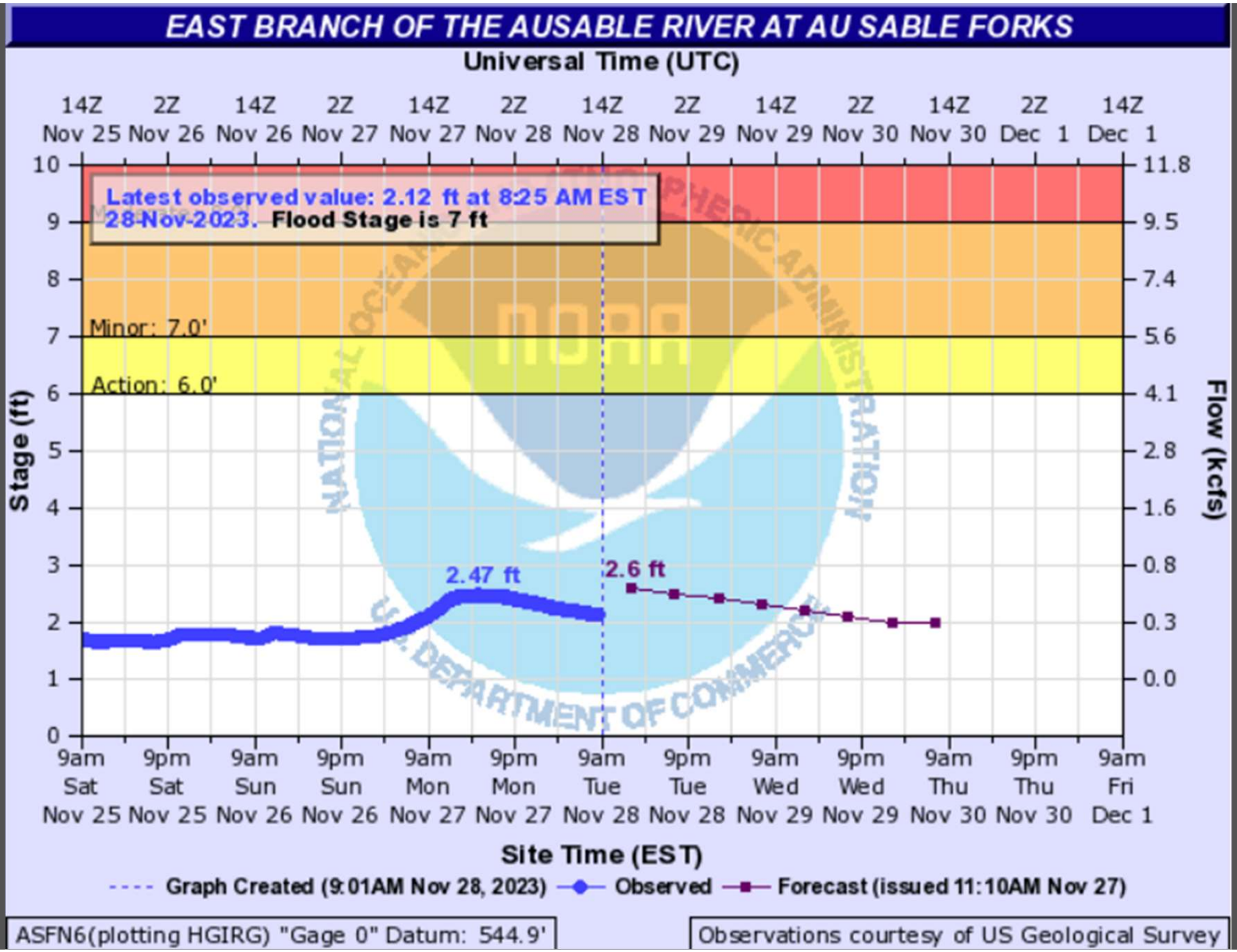
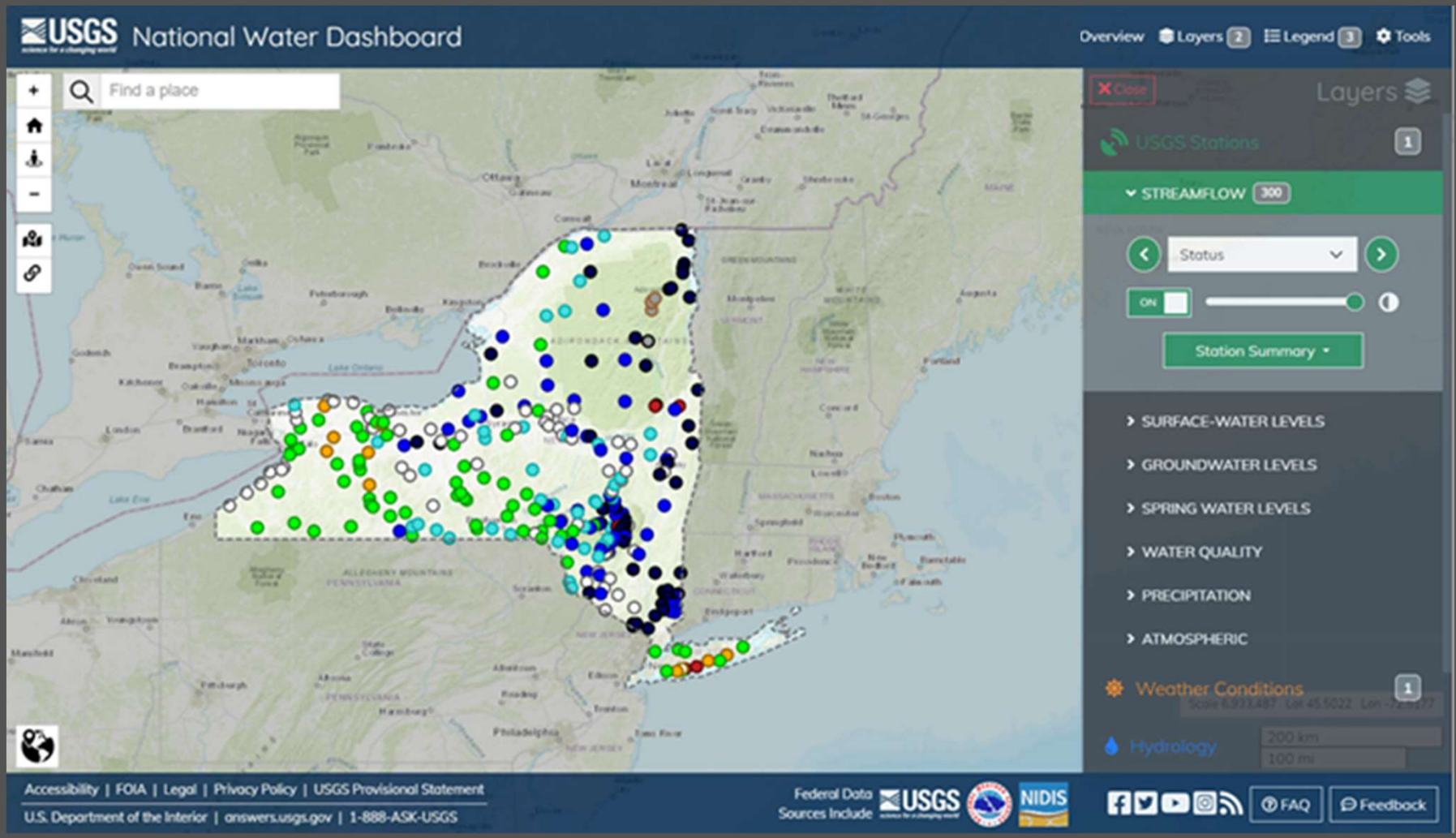

N
Explanation
Lake Champlain Basin
Existing Gages
Cornwall
Plattsburgh
Essex Junction
Montpelier
Rutland
Claremont
Lebano
Adirondack Park
Adirondack Mountains
Green Mountains
4609 ft
2089 ft
0 12.5 25 50 Miles
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS


N
Explanation
Lake Champlain Basin
Active real-time wells
Cornwall
Plattsburgh
Essex Junction
Montpelier
Adirondack Park
Adirondack Mountains
Green Mountains
Rutland
Lebano
Claremont
4609 ft
2089 ft
0 12.5 25 50 Miles
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

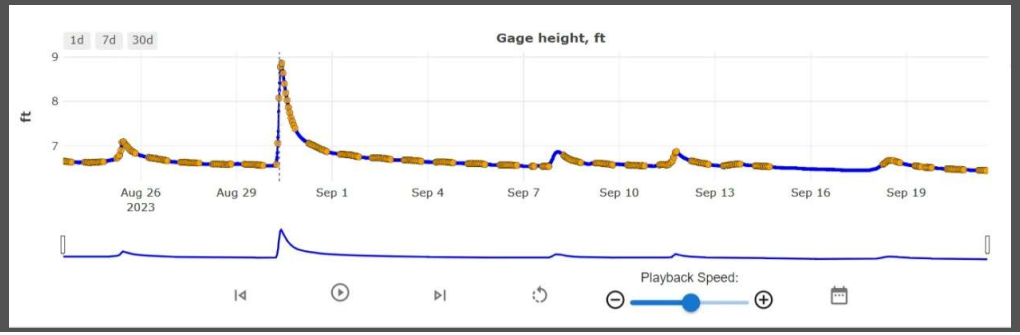

N
Explanation
Ungaged/undergaged HUC 10
Gaged HUC 10
Lake Champlain Basin
Cornwall
Essex Junction
Montpelier
Green Mountains
Rutland
Lebano
Claremont
0
12.5
25
50 Miles
Esri, CGIAR, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

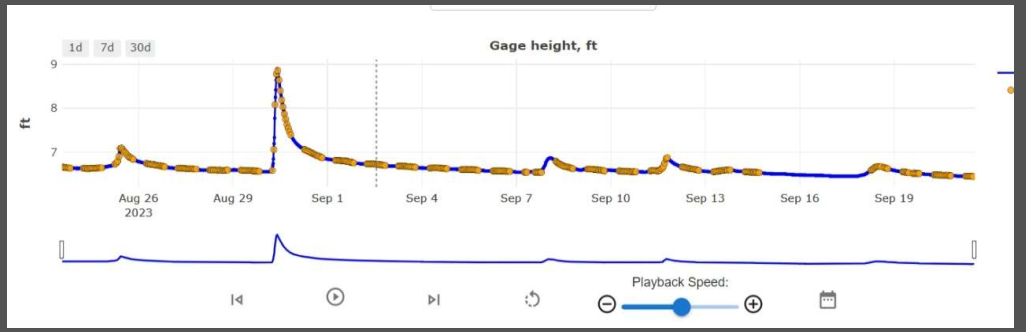

N
Explanation
AHPS river forecast site
Lake Champlain Basin
Cornwall
Plattsburgh
Essex Junction
Montpelier
Rutland
Claremont
Adirondack Park
Adirondack Mountains
Green Mountains
2089 ft
4609 ft
0 12.5 25 50 Miles
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS


EAST BRANCH OF THE AUSABLE RIVER AT AU SABLE FORKS
Universal Time (UTC)
14Z Nov 25
2Z Nov 26
14Z Nov 26
2Z Nov 27
14Z Nov 27
2Z Nov 28
14Z Nov 28
2Z Nov 29
14Z Nov 29
2Z Nov 30
14Z Nov 30
2Z Dec 1
14Z Dec 1
Latest observed value: 2.12 ft at 8:25 AM EST 28-Nov-2023. Flood Stage is 7 ft
Minor: 7.0'
Action: 6.0'
Stage (ft)
Flow (kcfs)
10
9
8
7
6
5
4
3
2
1
0
11.8
9.5
7.4
5.6
4.1
2.8
1.6
0.8
0.3
0.0
2.47 ft
2.6 ft
9am Sat Nov 25
9pm Sat Nov 25
9am Sun Nov 26
9pm Sun Nov 26
9am Mon Nov 27
9pm Mon Nov 27
9am Tue Nov 28
9pm Tue Nov 28
9am Wed Nov 29
9pm Wed Nov 29
9am Thu Nov 30
9pm Thu Nov 30
9am Fri Dec 1
Site Time (EST)
Graph Created (9:01AM Nov 28, 2023)
Observed
Forecast (issued 11:10AM Nov 27)
ASFN6(plotting HGIRG) "Gage 0" Datum: 544.9'
Observations courtesy of US Geological Survey


USGS National Water Dashboard
Overview
Layers 2
Legend 3
Tools
Find a place
Layers
USGS Stations 1
STREAMFLOW 300
Status
ON
Station Summary
SURFACE-WATER LEVELS
GROUNDWATER LEVELS
SPRING WATER LEVELS
WATER QUALITY
PRECIPITATION
ATMOSPHERIC
Weather Conditions 1
Hydrology
Accessibility | FOIA | Legal | Privacy Policy | USGS Provisional Statement
U.S. Department of the Interior | answers.usgs.gov | 1-888-ASK-USGS
Federal Data Sources Include
FAQ
Feedback

NY_Neversink_Claryville_VISIBLE





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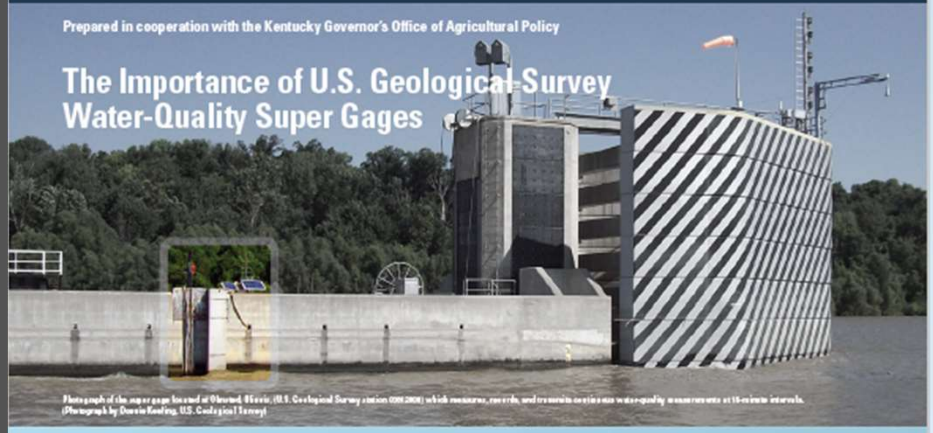
Prepared in cooperation with the Kentucky Governor's Office of Agricultural Policy

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



Photograph of the super gage located at Olmsted, Illinois (U.S. Geological Survey station 03612600) which measures, records, and transmits continuous water-quality measurements at 15-minute intervals. (Photograph by Dennis Keeling, U.S. Geological Survey)

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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Fact Sheet 2020–3019
April 2020

Provides Early Warning for Water Supply and Recreational Activities

Data from super gages can help protect the public by assisting water managers in developing real-time notification systems of changing water-quality conditions that may affect drinking-water treatment and [or] recreational waters. For example, when a fire caused the runoff of thousands of barrels of bourbon into the Kentucky River in July 2019 (**Tobin and Kobin, 2019**), the super gage data at the Kentucky River at Lockport, Kentucky, documented the effect of that runoff in 15-minute intervals and identified when the river recovered.

Nutrient Reduction Strategy

Super gages improve the estimation of nutrient loads through high-frequency measurements which can be beneficial for targeting and assessing nutrient reduction strategies in a basin. In Kentucky, the USGS super gage data played a key role in developing the Commonwealth's nutrient reduction strategy and documenting the nutrient loads entering and leaving the Commonwealth's major river basins.

Groundwater/Surface Water Interaction

Super gages that have colocated wells equipped to monitor continuous water-quality parameters allow for the assessment of groundwater contributions to streams and rivers. For example, understanding the contribution of legacy nitrate in groundwater to streams is largely unmonitored. This is particularly important in the karst areas of Kennucky and has important management implications because conservation practices cannot affect legacy nitrogen in groundwater.

Why Does My State Need a Super Gage Network?

The lack of enough data for river systems is one of the biggest obstacles to providing the science-based information needed to effectively manage the Nation's rivers and streams (National Research Council, 2007). Since that 2007 report, many nationally funded monitoring networks have either been reduced or eliminated altogether.

Strong partnerships between the USGS and state and local governments are needed to build and tailor monitoring networks that address specific water resource needs important to each state. Strategically placed super gages are one of the most cost-effective measures for addressing threats to water resources; whether it be monitoring impaired streams to ensure compliance with mandated total maximum daily loads of constituents in streams, protecting groundwater resources by continuously monitoring vulnerable areas, or improving understanding of the sources, pathways, and timing of nonpoint source pollutants in the state's rivers, streams, and groundwater.

References

National Research Council, 2007, River science at the U.S. Geological Survey: Washington, DC: The National Academies Press. [Also available at https://doi.org/10.17226/11773.]

Tobin, B., and Kobin, B., 2019, Jim Beam bourbon warehouse crumbles as runoff from fire spills into Kentucky River: The Courier Journal, July 3, 2019, accessed March 2020, at https://www.courier-journal.com/story/news/2019/07/03/jim-beam-bourbon-barrel-warehouses-burn-kentucky/1637073001.

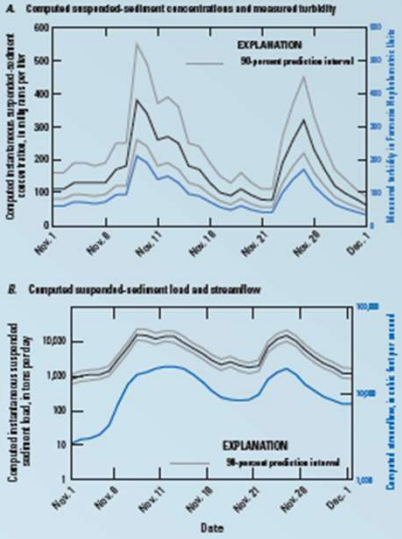

Figure 1. Graph showing, *A*, computed suspended-sediment concentration and measured turbidity and, *B*, computed suspended-sediment load and streamflow at the White River at Hazleton, Indiana.

How do you Access the Data?

USGS continuous water-quality data and surrogate models are located on the USGS National Real-Time Water Quality website, http://nrtwq.usgs.gov. The website features:

- interactive maps of states with real-time, continuous water-quality monitoring data;
- links to super gages that have surrogate models used to predict water-quality constituent concentrations important to environmental managers; and
- available surrogate model data with plots and tables at https://waterwatch.usgs.gov/wqwatch/?pcode=99999.

By Angela S. Crain

Downstream view of the Kentucky River near the super gage located at Lockport, Kentucky (U.S. Geological Survey station 03290500). (Photograph by Faye Peters, U.S. Geological Survey)

For more information, please contact:

Director, Ohio-Kentucky-Indiana Water Science Center
U.S. Geological Survey
9818 Bluegrass Parkway
Louisville, Kentucky 40299

Or visit the Ohio-Kentucky-Indiana Water Science Center super gage website
https://www.usgs.gov/centers/oki-water

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