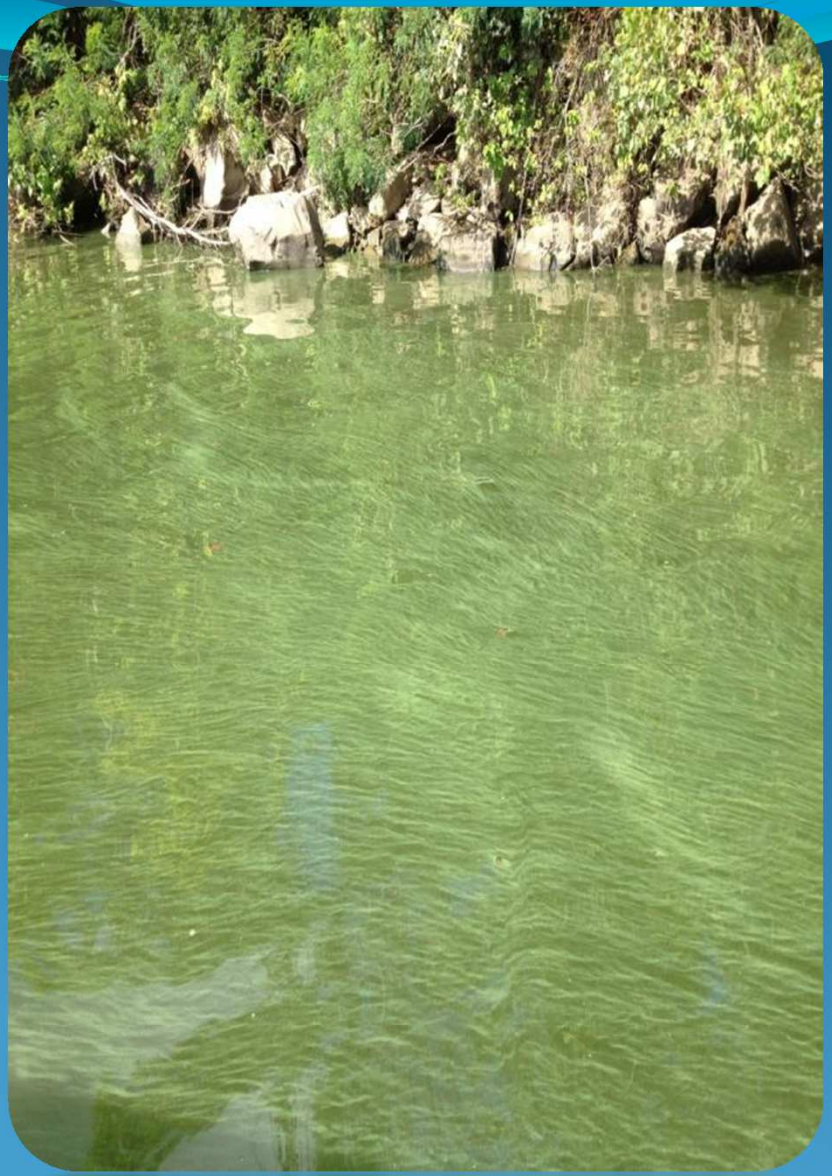
2015 Ohio River HAB Event



Sam Dinkins
Manager, Water Resources
ORSANCO

2015 Ohio River HAB Event

- Unprecedented event on a flowing river in the nation's recent history.
- Spanned approx. 700 miles and more than 2 months (Aug. 19 – Nov. 3).
- Advisories or precautionary statements for contact recreation issued by IL, IN, KY, OH, and WV.
- Microcystin concentrations ranged up to 1,900 ug/L.
- *Microcystis Aerugenosa* cell counts up to 31,000,000 cells/ml
- Multiple water utilities provided additional treatment or closed their intakes. No finished water microcystin detections.
- Estimated drinking water treatment costs of $2 million.

ORSANCO

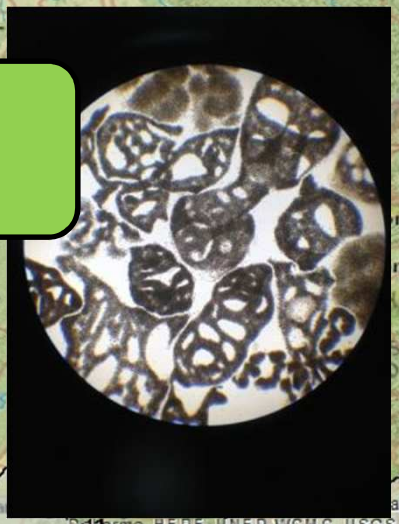
- The Ohio River Valley Water Sanitation Commission
  - Compact signed in 1948 (NY, PA, WV, VA, OH, KY, IN and IL)
  - Ohio River water quality monitoring
  - Develop Ohio River Pollution Control Standards
  - Regional Coordination
    - Organizing stakeholders and promoting communication
      - Water Utilities; POTWs, industry and NGO interests
    - Emergency Response: spill notification and tracking

AUG | SEP | OCT

19-AUG

Reported 'paint spill' at ORM 84

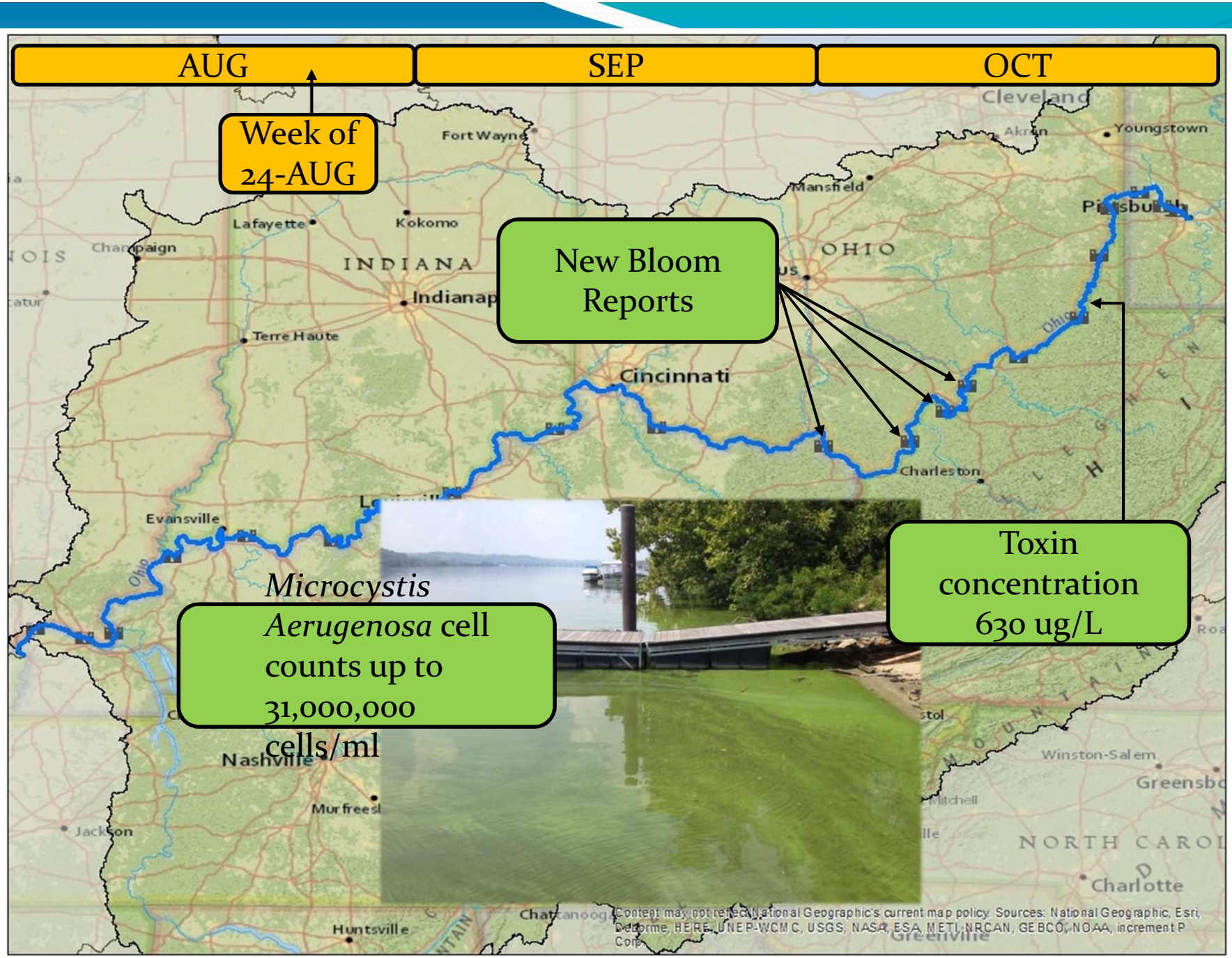
Identified as *Microcystis aerugenosa*



Toxin concentration 41 ug/L

Health Guidelines Overview

- US EPA published health advisory concentration guidelines for microcystin in June, 2015.
  - Drinking Water
    - 0.3 ug/L for children less than 6 years old
    - 1.6 ug/L for ages 6+
  - Recreation (Based upon World Health Organization Guidelines)
    - 10-20 ug/L Moderate Probability of Acute Health Effects
    - 20-2,000 ug/L High Probability of Acute Health Effects
    - > 2000 ug/L Very High Probability of Acute Health Effects
  - Ohio
    - 6 ug/L - swimming and wading not recommended.
    - 20 ug/L - No Contact Advisory (NCA).


AUG
SEP
OCT
Week of 24-AUG
New Bloom Reports
Toxin concentration 630 ug/L
Microcystis Aerugenosa cell counts up to 31,000,000 cells/ml
Cleveland
Akron
Youngstown
Fort Wayne
Mansfield
Lafayette
Kokomo
Champaign
INDIANA
OHIO
Indianapolis
Terre Haute
Cincinnati
Charleston
Evansville
Ohio
Nashville
Murfreesboro
Jackson
Huntsville
Chattanooga
Winston-Salem
Greensboro
Charlotte
NORTH CAROLINA
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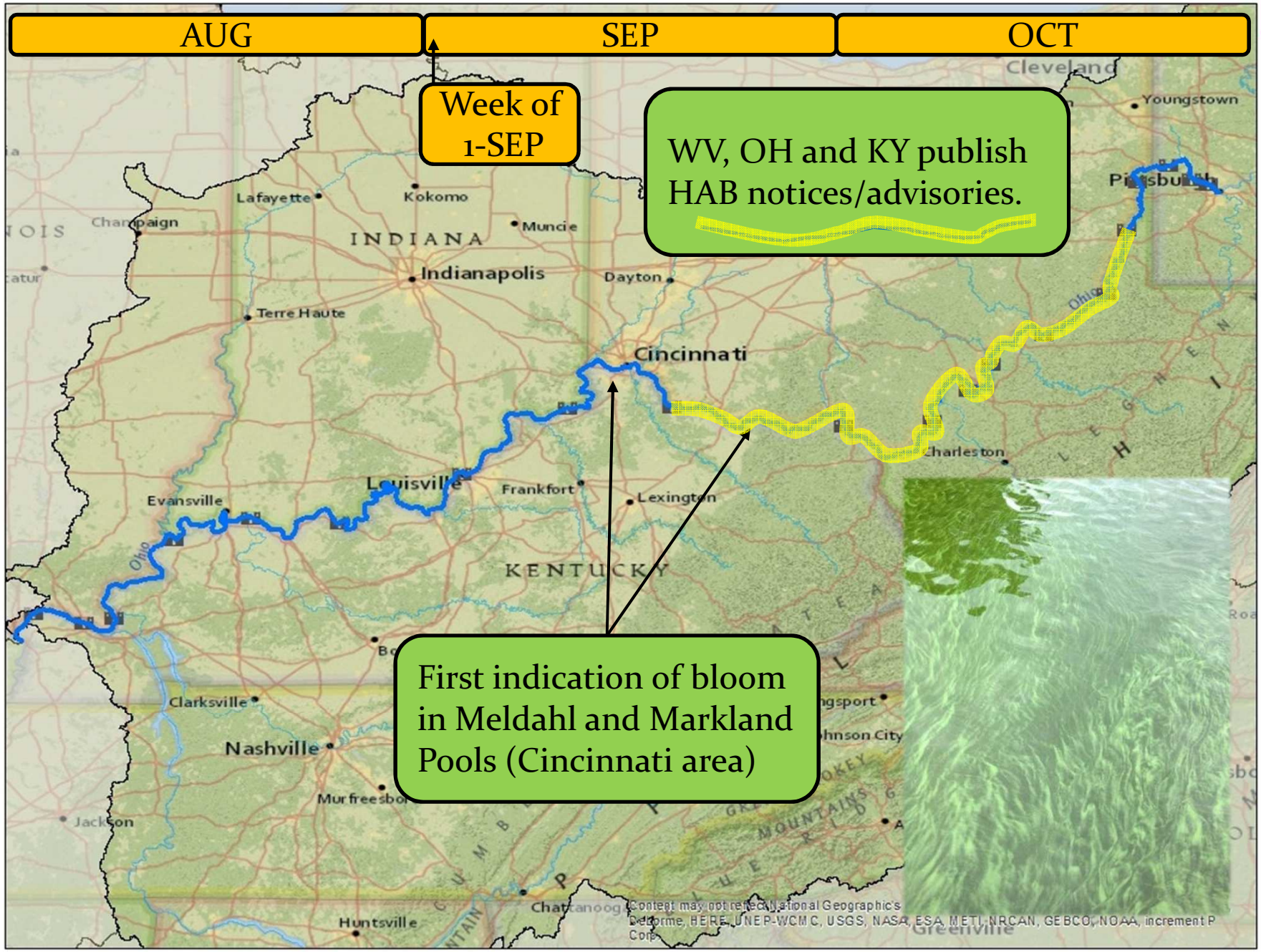
AUG
SEP
OCT
Week of 1-SEP
WV, OH and KY publish HAB notices/advisories.
First indication of bloom in Meldahl and Markland Pools (Cincinnati area)
Cleveland
Youngstown
Lafayette
Kokomo
Champaign
Muncie
INDIANA
Indianapolis
Dayton
Terre Haute
Cincinnati
Ohio
Charleston
Louisville
Frankfort
Lexington
Evansville
KENTUCKY
Clarksville
Nashville
Murfreesboro
Jackson
Huntsville
Chattanooga
Greenville
Johnson City
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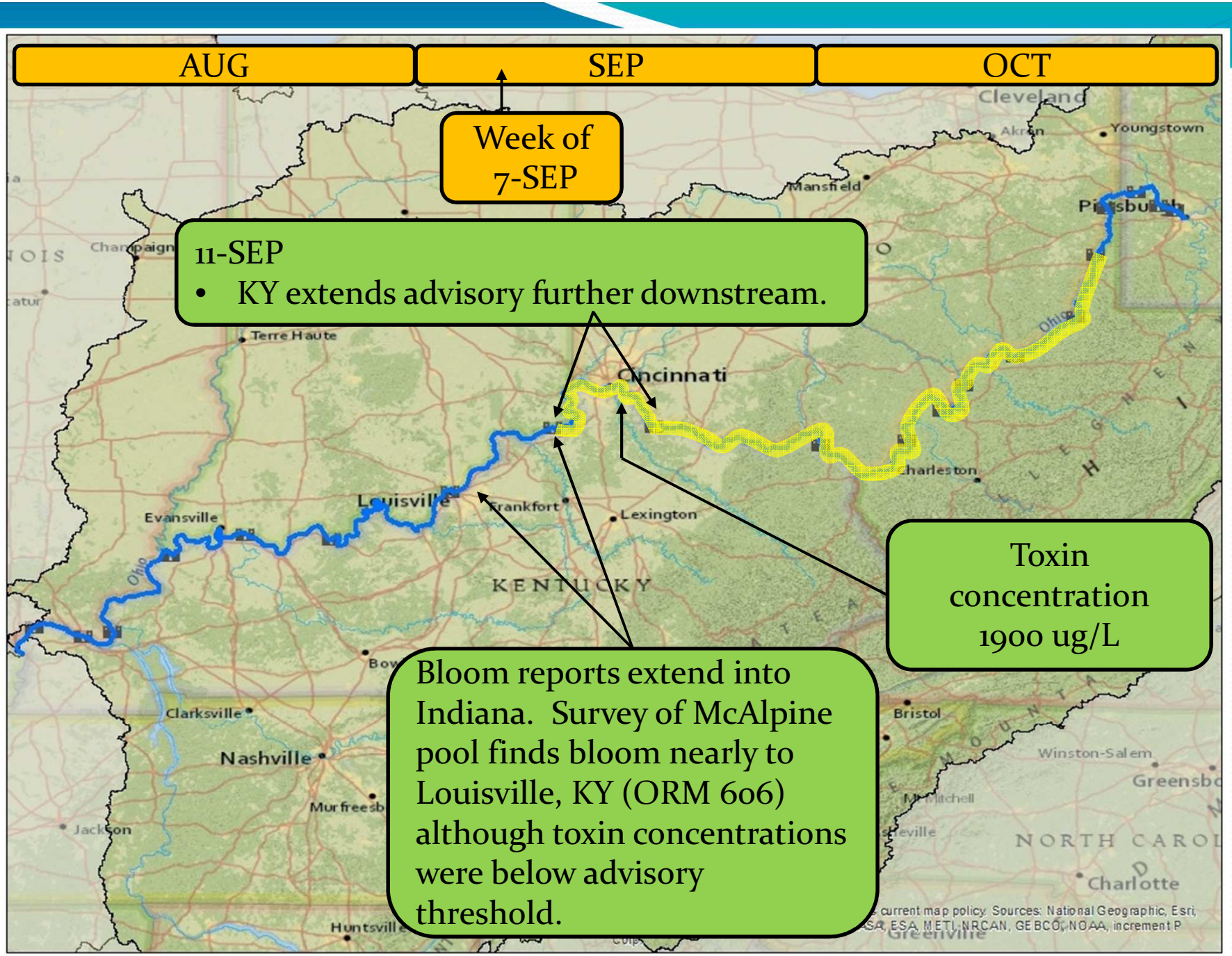
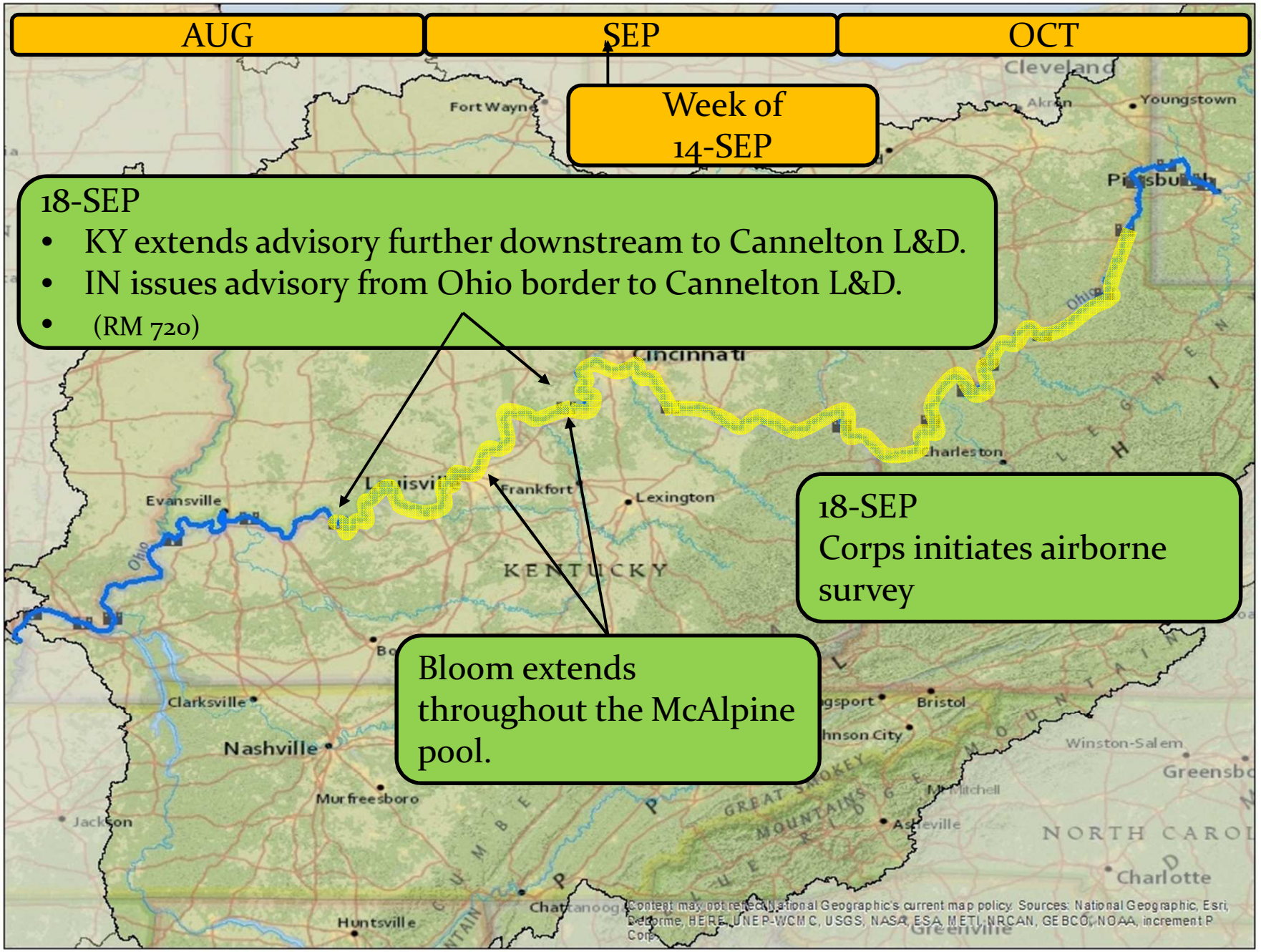
Corp.


AUG
SEP
OCT
Week of 7-SEP
11-SEP
• KY extends advisory further downstream.
Toxin concentration 1900 ug/L
Bloom reports extend into Indiana. Survey of McAlpine pool finds bloom nearly to Louisville, KY (ORM 606) although toxin concentrations were below advisory threshold.
Cleveland
Akron
Youngstown
Mansfield
Terre Haute
Cincinnati
Charleston
Louisville
Frankfort
Lexington
Evansville
KENTUCKY
Ohio
Clarksville
Nashville
Murfreesboro
Jackson
Huntsville
Bristol
Winston-Salem
Charlotte
NORTH CAROLINA
current map policy Sources: National Geographic, Esri, ESA, METI, NRCAN, GEBCO, NOAA, increment P


AUG
SEP
OCT
Week of 14-SEP
18-SEP
• KY extends advisory further downstream to Cannelton L&D.
• IN issues advisory from Ohio border to Cannelton L&D.
• (RM 720)
18-SEP
Corps initiates airborne survey
Bloom extends throughout the McAlpine pool.
Cleveland
Akron
Youngstown
Fort Wayne
Cincinnati
Charleston
Evansville
Frankfort
Lexington
KENTUCKY
Ohio
Clarksville
Nashville
Murfreesboro
Jackson
Huntsville
Bristol
Winston-Salem
Asheville
NORTH CAROLINA
Charlotte
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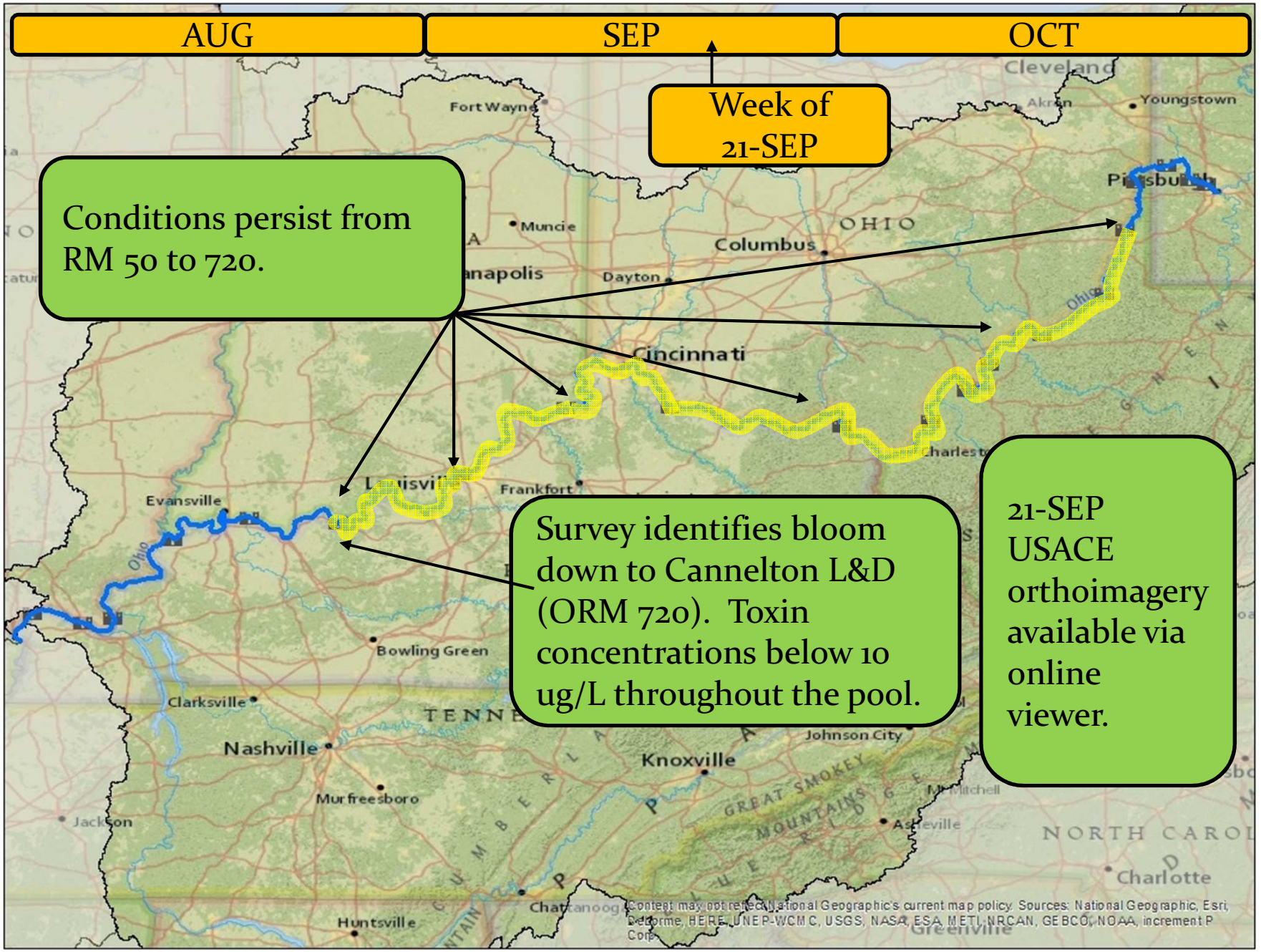
AUG
SEP
OCT
Week of 21-SEP
Conditions persist from RM 50 to 720.
Survey identifies bloom down to Cannelton L&D (ORM 720). Toxin concentrations below 10 ug/L throughout the pool.
21-SEP USACE orthoimagery available via online viewer.
Cleveland
Akron
Youngstown
Fort Wayne
Muncie
OHIO
Columbus
Dayton
Cincinnati
Ohio
Frankfort
Evansville
Bowling Green
Clarksville
Nashville
Murfreesboro
Jackson
Huntsville
Knoxville
Johnson City
Asheville
Charlotte
NORTH CAROL
GREAT SMOKY MOUNTAINS
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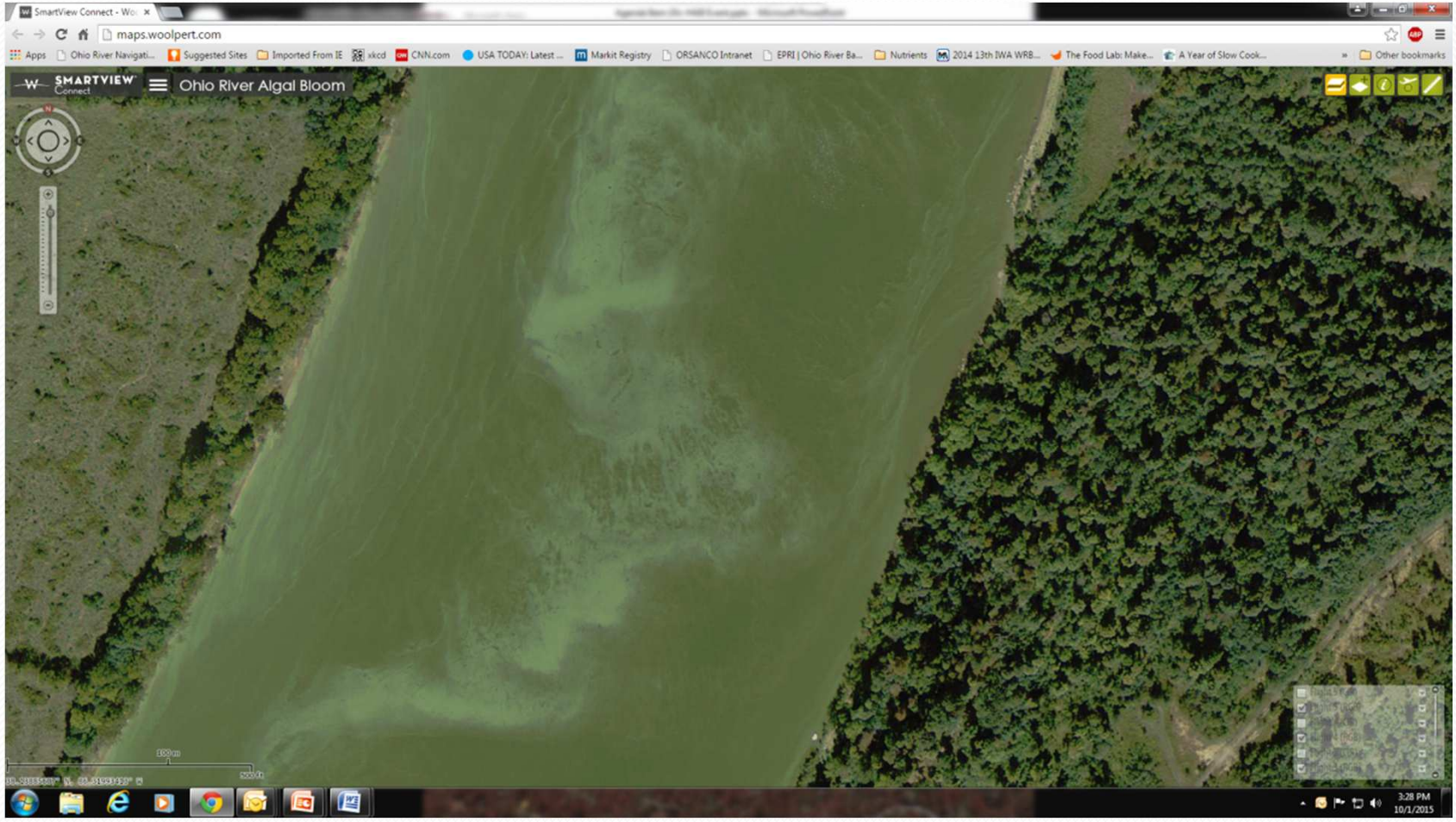
Airborne Survey Results

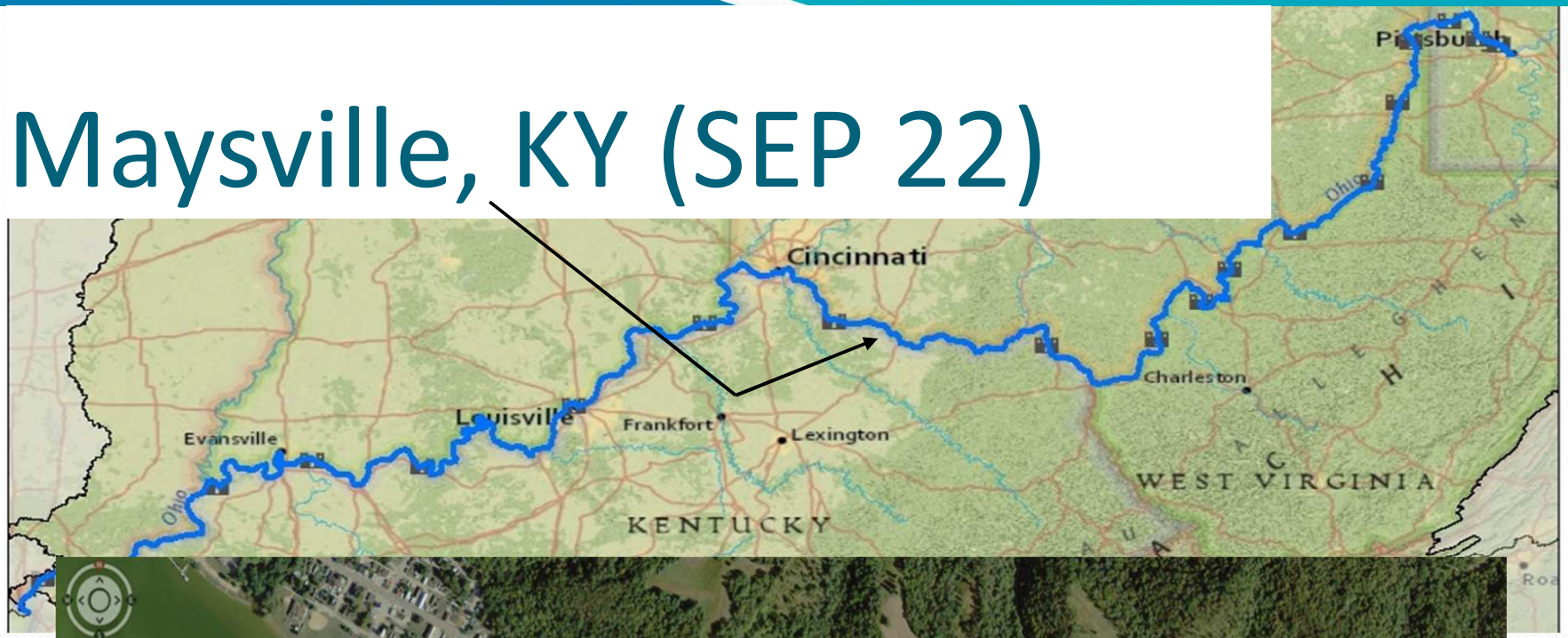


Wheeling, WV

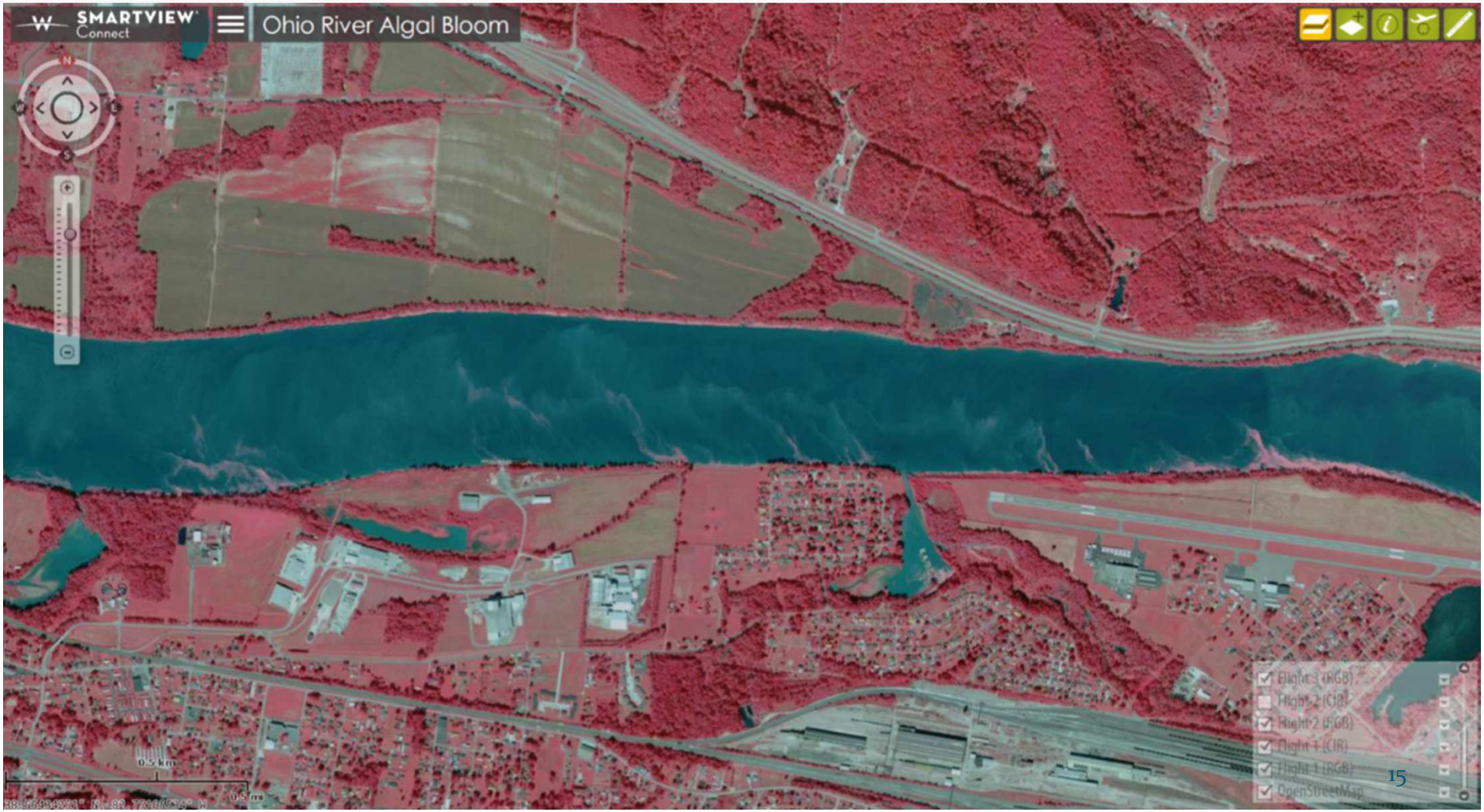

Mansfield
OHIO
Columbus
Ohio
Charleston
WEST VIRGINIA
Blacksburg

Maysville, KY (SEP 20)

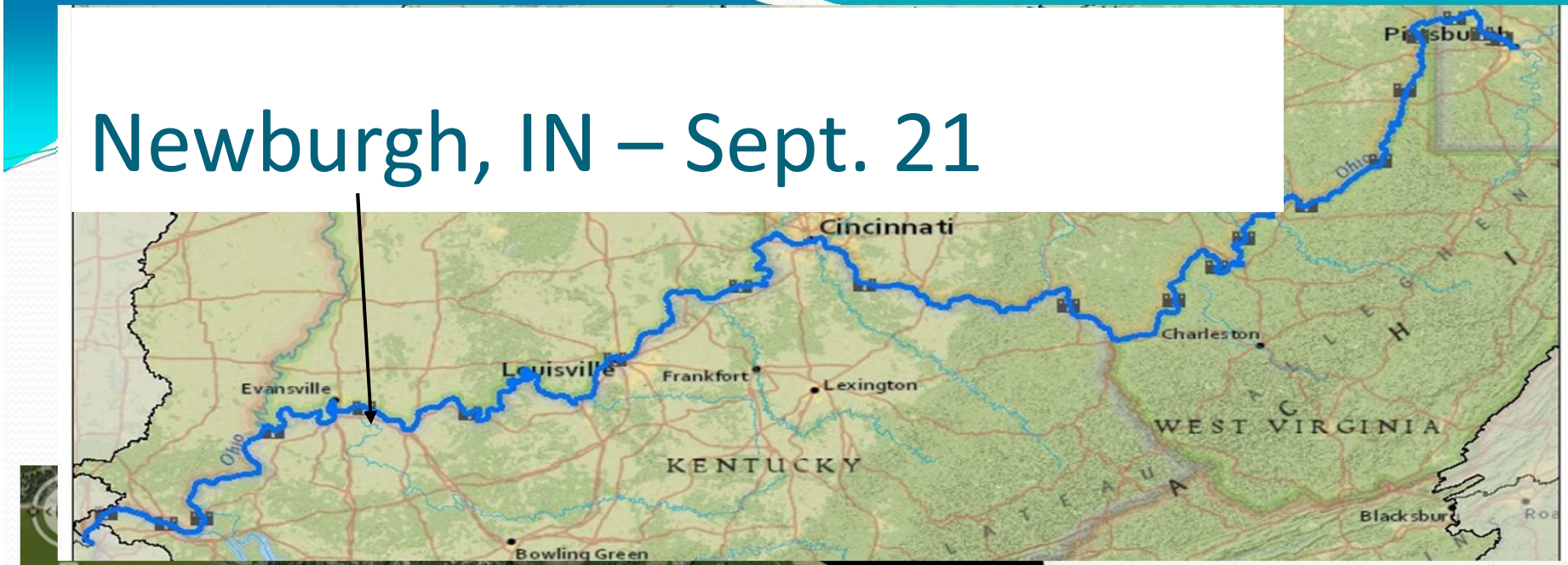
Maysville, KY (SEP 22)

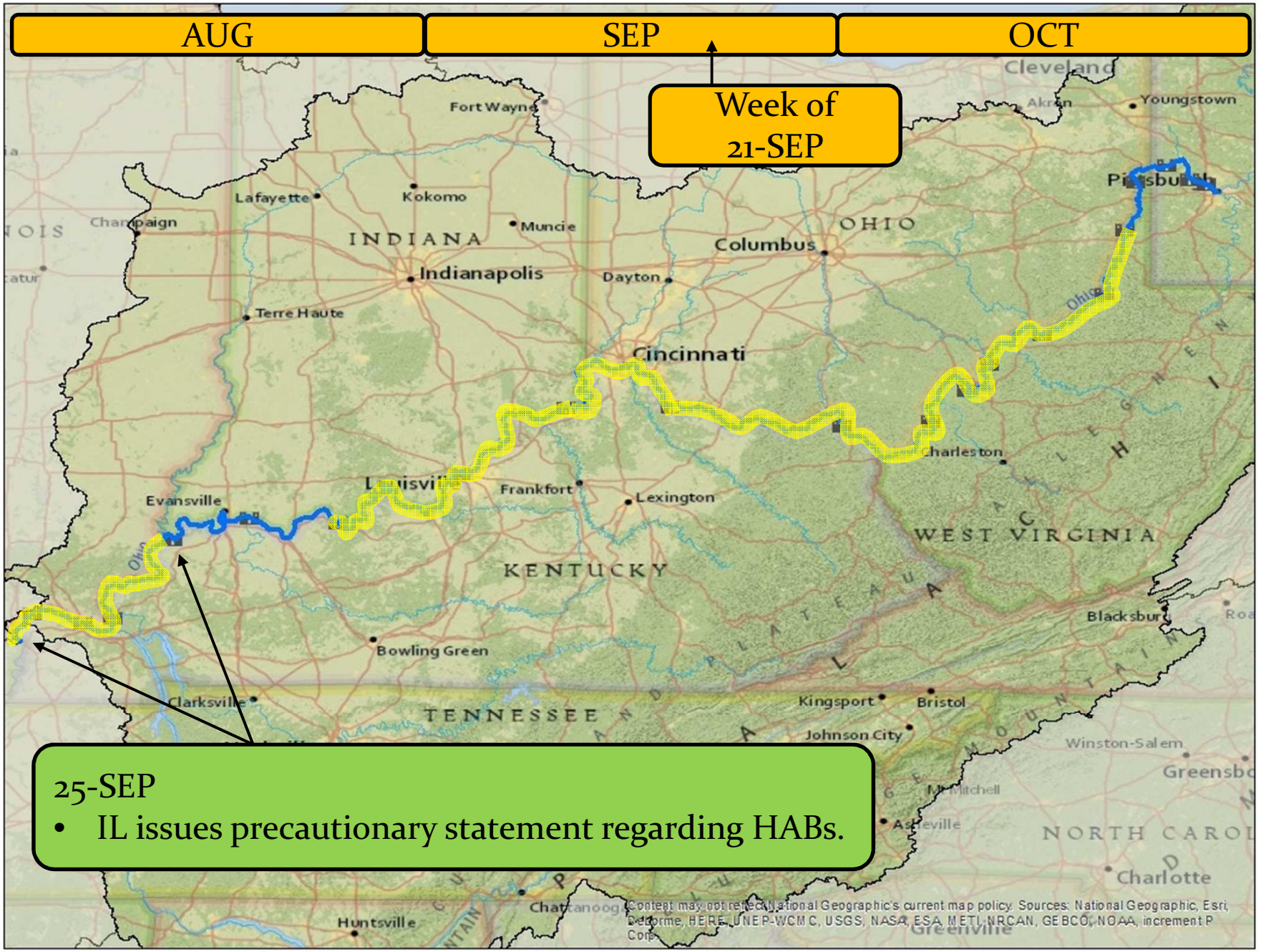


Infrared Image with Shoreline Productivity



Newburgh, IN – Sept. 21




AUG
SEP
OCT
Week of 21-SEP
Fort Wayne
Cleveland
Akron
Youngstown
Lafayette
Kokomo
Champaign
Muncie
INDIANA
OHIO
Columbus
Indianapolis
Dayton
Terre Haute
Cincinnati
Ohio
Charleston
Evansville
Frankfort
Lexington
KENTUCKY
WEST VIRGINIA
Bowling Green
Blacksburg
Clarksville
TENNESSEE
Kingsport
Bristol
Johnson City
Winston-Salem
Asheville
NORTH CAROL
Charlotte
Huntsville
Greenville
25-SEP
• IL issues precautionary statement regarding HABs.
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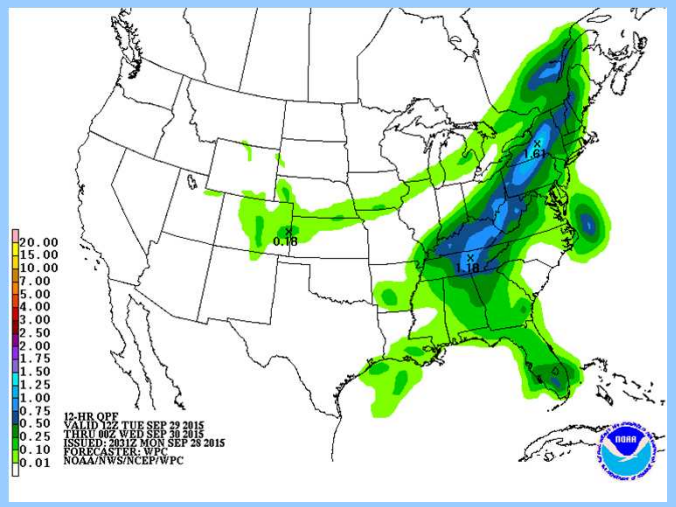
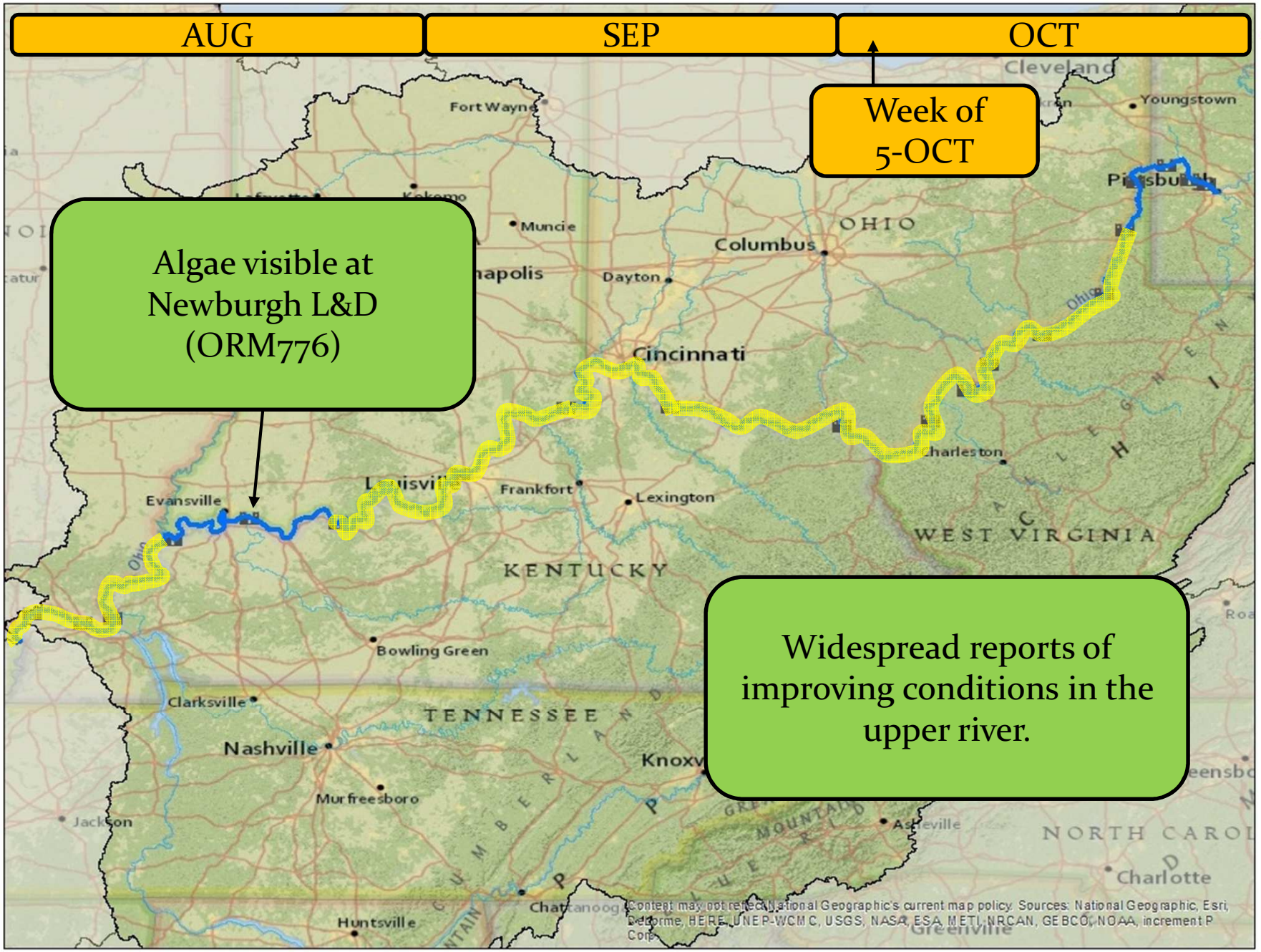
AUG | SEP | OCT

Week of 28-SEP

Report of localized algae near Evansville Water (ORM 791).

30-SEP RAIN!!!




AUG
SEP
OCT
Week of 5-OCT
Algae visible at Newburgh L&D (ORM776)
Widespread reports of improving conditions in the upper river.
Cleveland
Youngstown
Fort Wayne
Muncie
Columbus
OHIO
Dayton
Cincinnati
Charleston
Evansville
Frankfort
Lexington
WEST VIRGINIA
KENTUCKY
Bowling Green
Clarksville
TENNESSEE
Nashville
Murfreesboro
Jackson
Asheville
NORTH CAROLINA
Charlotte
Huntsville
Greenville
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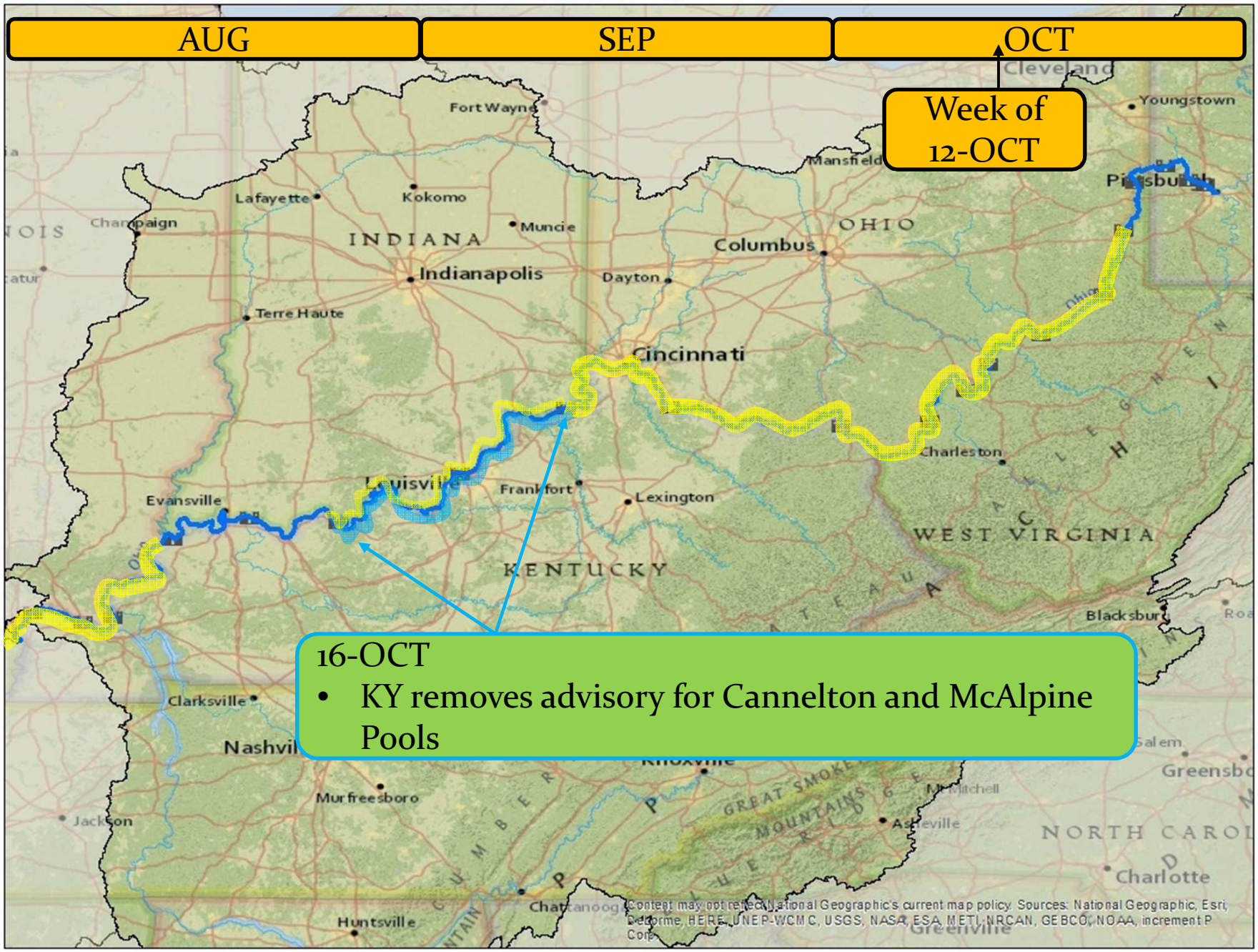
AUG
SEP
OCT
Week of 12-OCT
Fort Wayne
Youngstown
Lafayette
Kokomo
Muncie
INDIANA
OHIO
Columbus
Indianapolis
Dayton
Terre Haute
Cincinnati
Charleston
Evansville
Louisville
Frankfort
Lexington
KENTUCKY
WEST VIRGINIA
Blacksburg
16-OCT
• KY removes advisory for Cannelton and McAlpine Pools
Clarksville
Murfreesboro
Jackson
Huntsville
Asheville
Charlotte
Greensboro
NORTH CAROLINA
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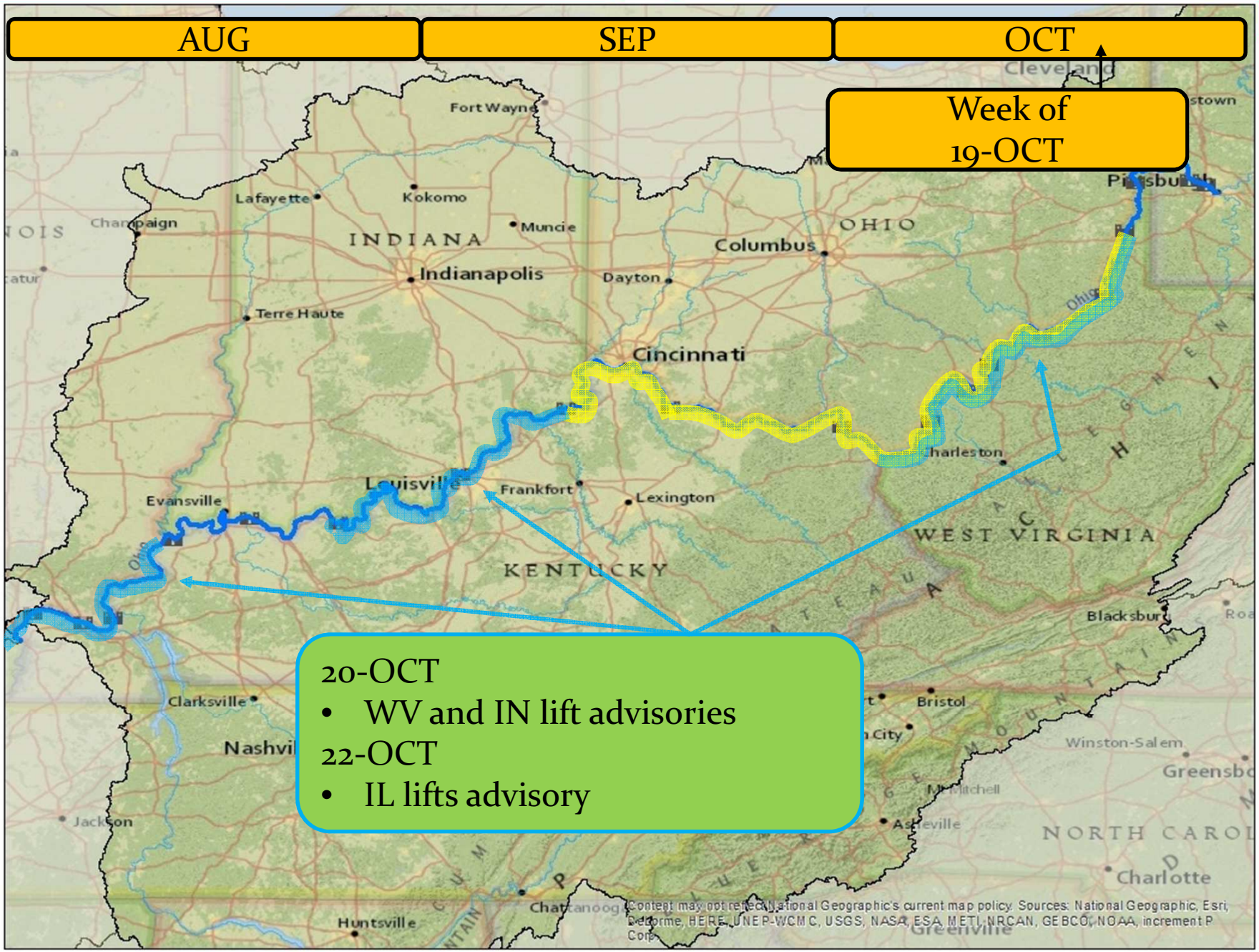
AUG
SEP
OCT
Week of
19-OCT
Fort Wayne
Lafayette
Kokomo
Champaign
INDIANA
Muncie
Indianapolis
Dayton
Columbus
OHIO
Terre Haute
Cincinnati
Evansville
Louisville
Frankfort
Lexington
KENTUCKY
WEST VIRGINIA
Clarksville
Nashvi
Bristol
Winston-Salem
Jackson
Asheville
NORTH CAROL
Charlotte
Huntsville
Greenville
20-OCT
• WV and IN lift advisories
22-OCT
• IL lifts advisory
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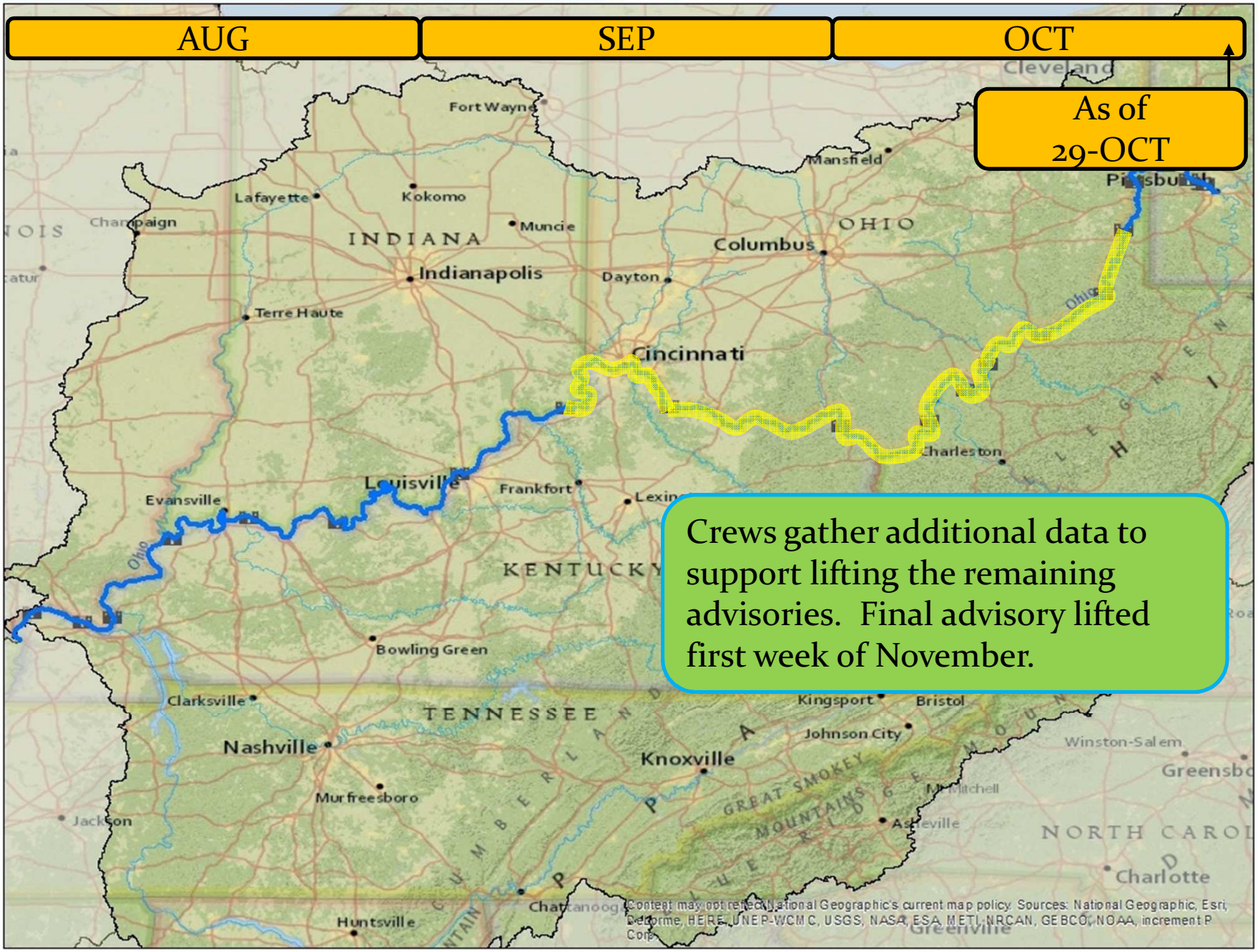
AUG
SEP
OCT
As of 29-OCT
Fort Wayne
Mansfield
Lafayette
Kokomo
Champaign
INDIANA
Muncie
OHIO
Columbus
Indianapolis
Dayton
Terre Haute
Cincinnati
Ohio
Charleston
Louisville
Frankfort
Evansville
KENTUCKY
Bowling Green
Clarksville
TENNESSEE
Kingsport
Bristol
Johnson City
Nashville
Knoxville
Winston-Salem
Murfreesboro
Jackson
Asheville
NORTH CAROL
Charlotte
Huntsville
Greenville
Crews gather additional data to support lifting the remaining advisories. Final advisory lifted first week of November.
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Sampling Efforts

- ORSANCO sampling crews conducted 21 surveys. Focus was on extent.
- Focus on microcystin.
- PA, WV, OH, KY, IL all had crews sampling sections of the river and their tributaries
- US EPA and Corps of Engineers provided sampling crews
- Aerial Surveys:
  - WV DEP – 2 from Huntington to Sistersville
  - OEPA – 1 survey from Cincinnati to Marietta
  - Corps of Engineers- 1 survey from river mile 50 to 850.
  - NASA – 2 localized surveys with hyperspectral imaging

Data

- Microcystin by Abraxis – Immunoassay method.

- 21 surveys; 180+ samples for microcystin; 43 nutrients.

Some of the Remaining Questions

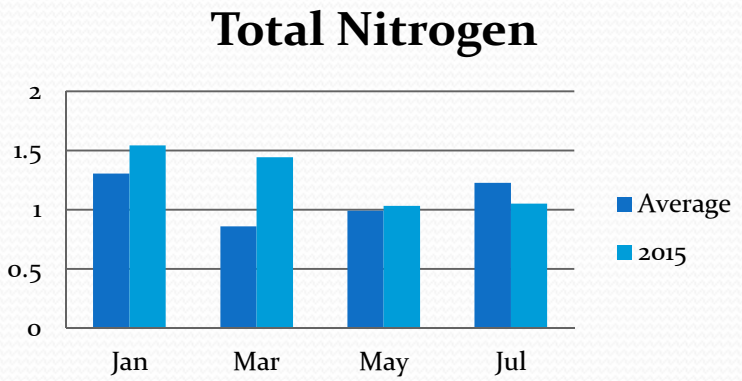
- What caused it?
- There are always enough nutrients, so why 2015?
- Why did it start where it started?
- Why did it progress downstream like a spill, but much faster than flows would indicate.

- Where sample?
- How best to analyze: Abraxis vs. LC-MS.

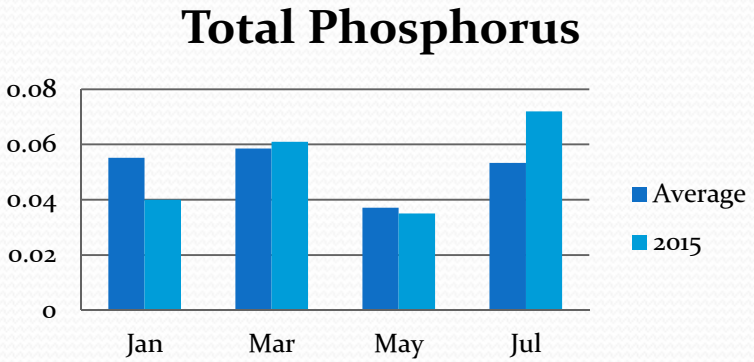
Where To Sample?

What were the causes?

- Precipitation?
- Flow?
- Clarity?
- Nutrients?
- Nutrient Ratios?
- Nutrient availability?
- Herbicides?
- Zebra mussels?



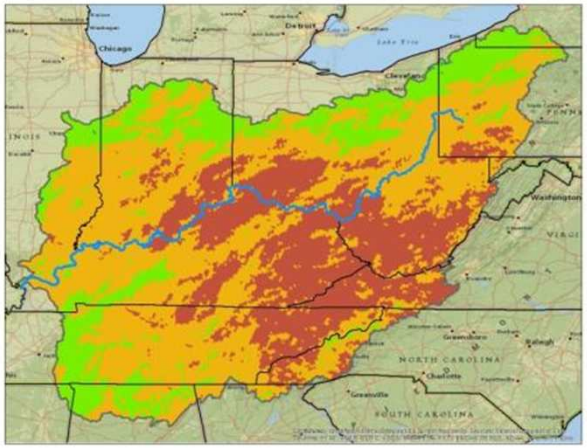
TN concentration 16% lower in 2015



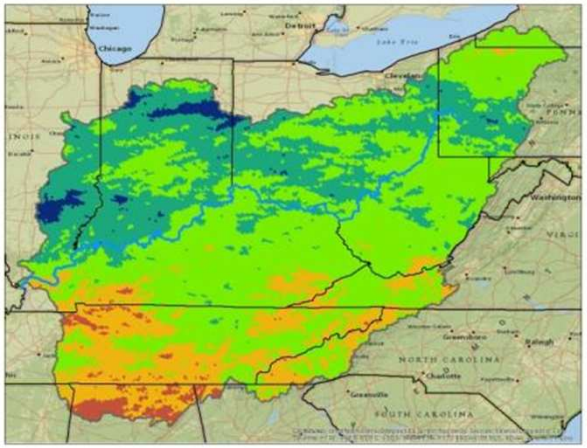
P concentration 36% higher in 2015

Summer 2015 Monthly Precipitation Relative to Normal

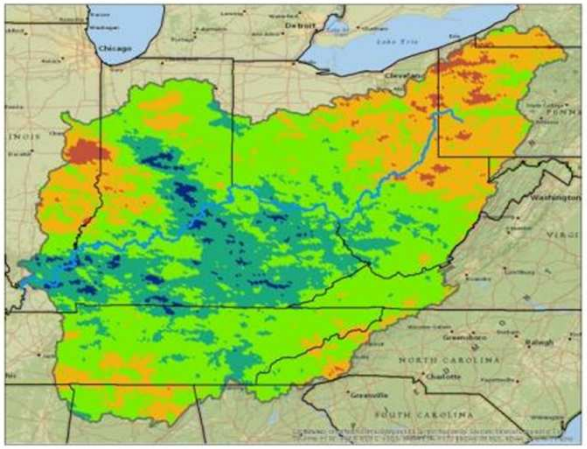
May



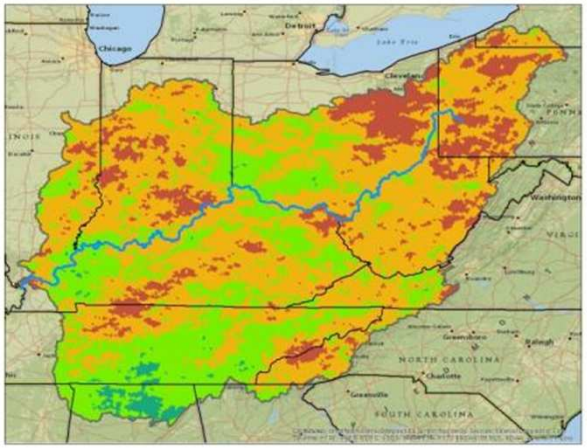
June



July



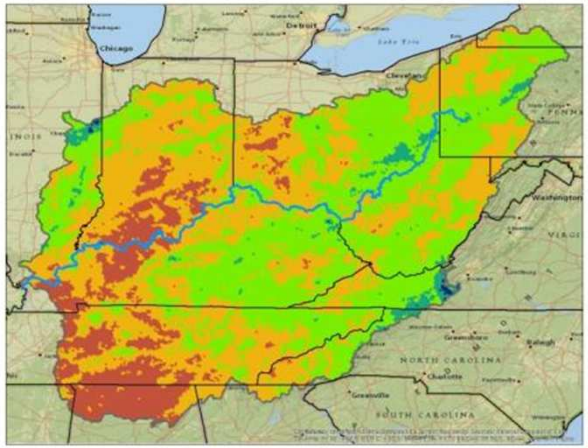
August



Percent of Normal Rainfal (2015)

- % 0.00 - 50.00
- % 50.01 - 100.00
- % 100.01 - 200.00
- % 200.01 - 300.00
- % 300.01 - 530.00

September



Post-HAB Efforts

1) Revise/Improve Ohio River HABs Response & Communications Plan
2) Data Analysis for determination of causes.
   - ORSANCO routine sampling
     - Bi-monthly nutrients
     - Continuous DO monitors
   - Water utilities
     - Temp
     - Turbidity
   - Event sampling
     - toxin, nutrients, species data from multiple States, Federal Agencies and ORSANCO
   - Satellite imagery
3) Proposed HABs Monitoring Network
   - Continuous monitors at Locks & Dams with telemetry.
   - Utilization of satellite imagery for early warning surveillance.

Questions ?

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