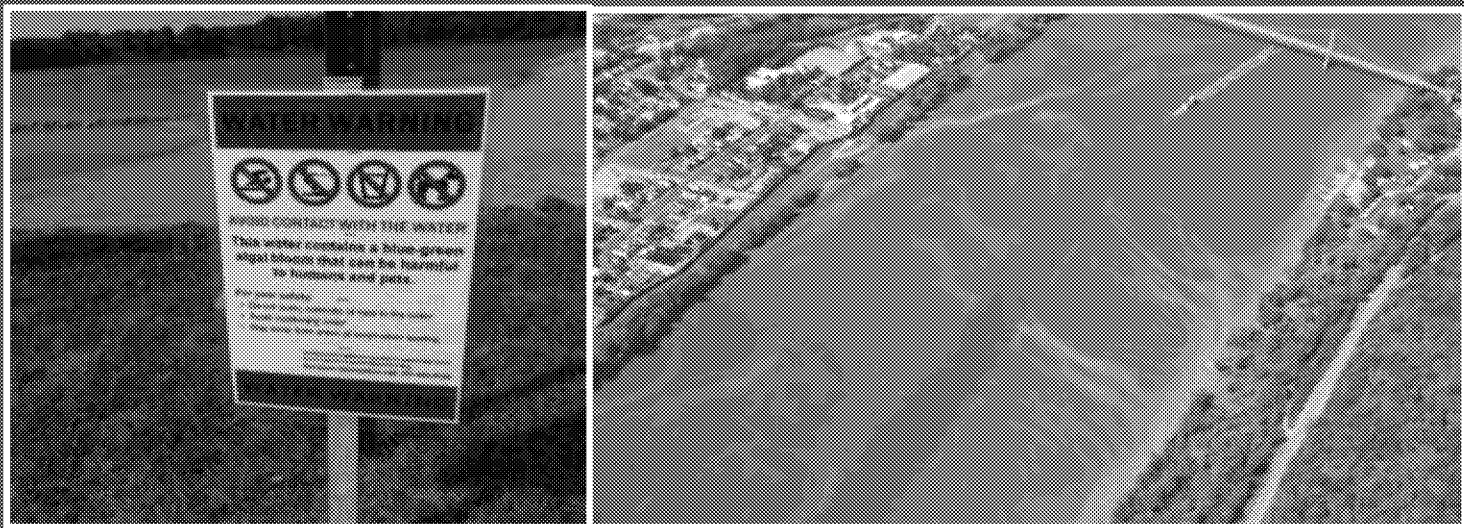


# Harmful Algal Blooms (HABs): *Responding to State and Regional Needs*



**Nicholas Dugan**

*US EPA ORD National Risk Management Research Laboratory*

**Region 5 and Neighboring States' Visit to US EPA Cincinnati  
February 2, 2018**

Office of Research and Development

# HABs: Overall Problems

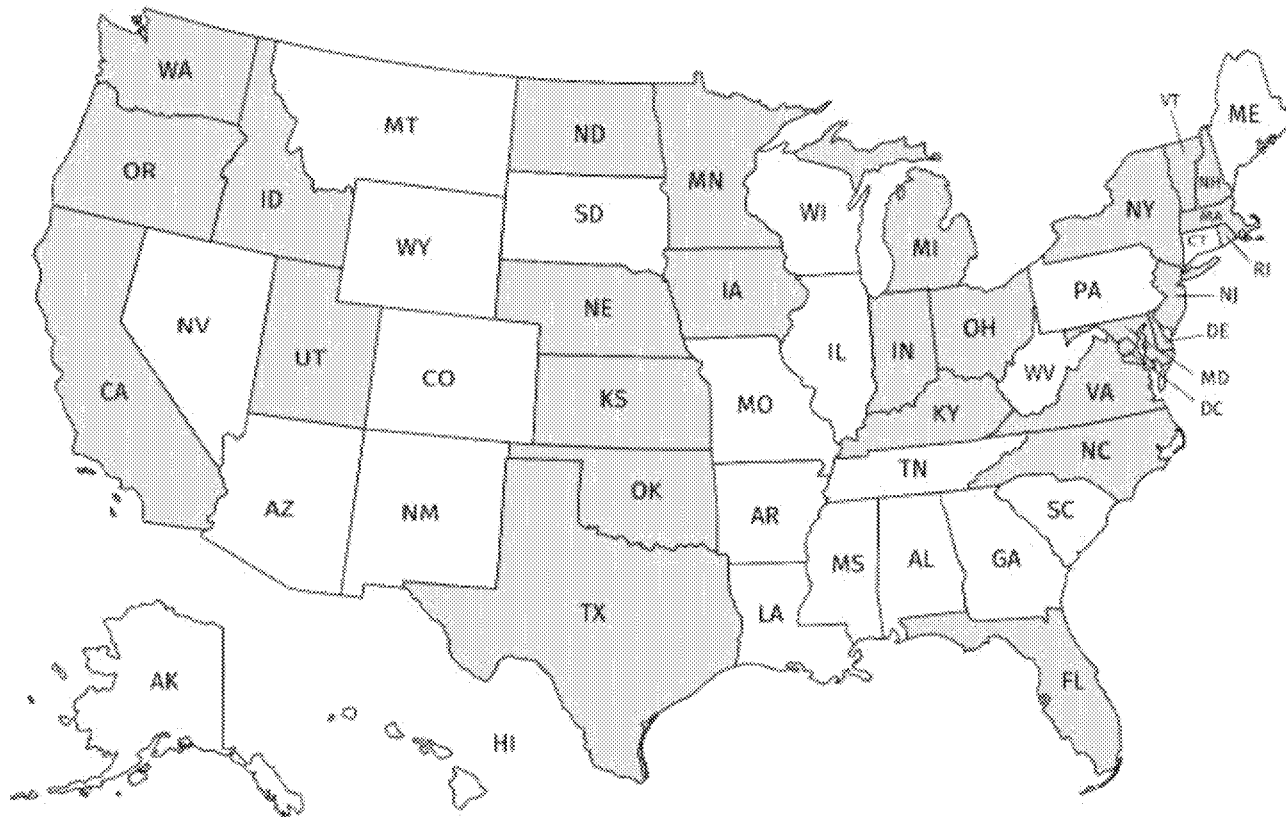
**HABs have the potential to generate adverse health, ecosystem and economic impacts.**



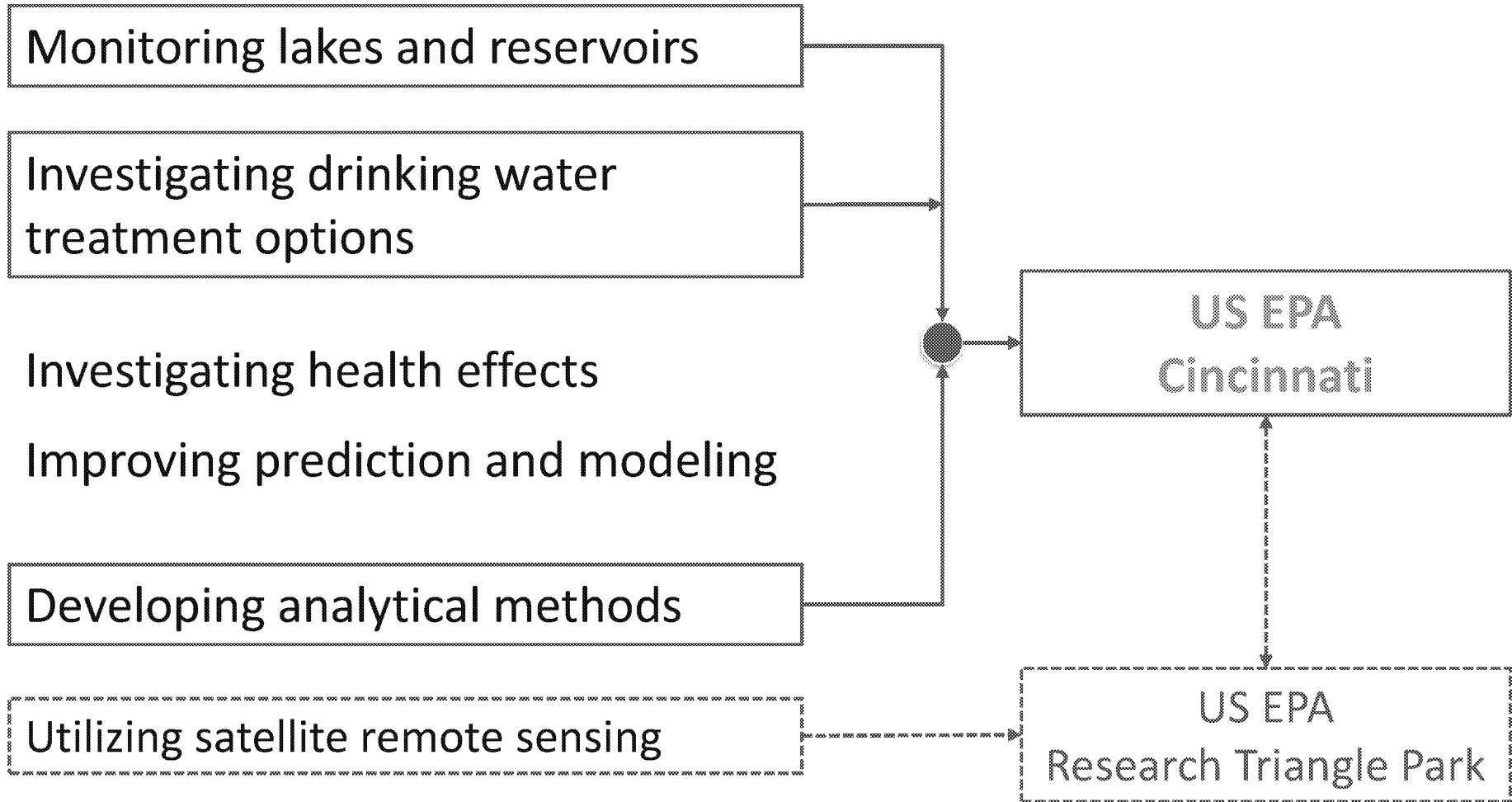
- Many different types of toxins
  - Pure toxins in laboratory studies exert toxic effects on liver and nervous system
  - Exposure through ingestion
  - Exposure through recreational activity body contact—associated with gastrointestinal effects, breathing difficulty, skin irritation, and animal deaths
- 
- Water treatment facilities may need to alter operational practices and/or invest in new equipment → economic burden
  - Health effects → beach closures → loss of recreational/aesthetic value → economic burden
  - Large blooms upset water chemistry (pH, dissolved oxygen) and limit the penetration of sunlight → declines in fish populations → loss of recreational/aesthetic value → economic burden, long term ecosystem damage
  - Large blooms are odorous and unsightly → reluctance to swim → economic burden

# HABs: Overall Problems

**During the 2017 bloom season, US EPA was aware of blooms, beach closures and/or health advisories in 27 states and DC.**



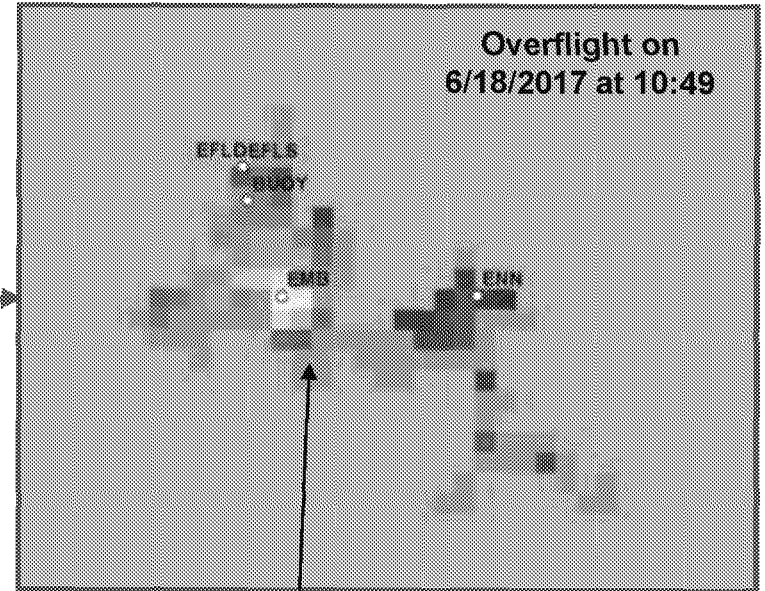
# Actions: Research Approach






# Actions: Monitoring and Remote Sensing



Overlay Satellite  
Data

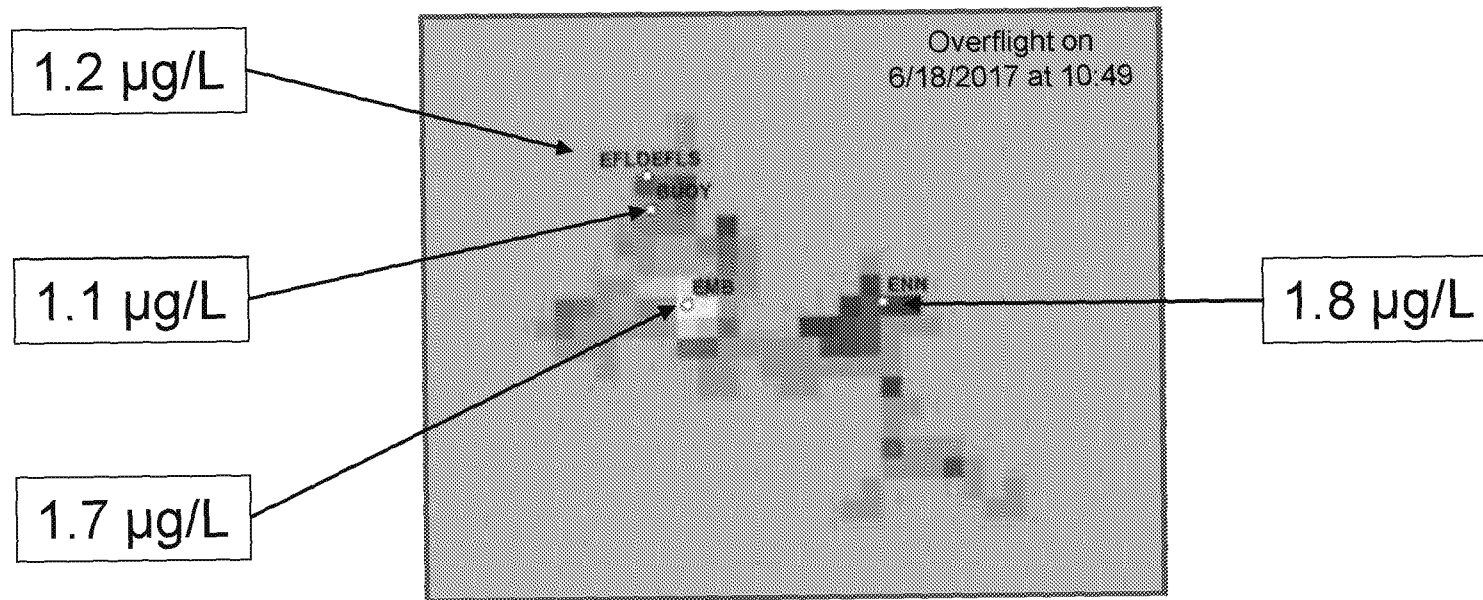


Optical signature of cyanobacterial pigments:

-  = Low Concentration
-  = High Concentration
-  = No Data

# Actions: Monitoring and Remote Sensing

Integrate satellite data with “on the lake” sampling results for toxins (microcystins)



EPA health advisory concentration =  
0.3 µg/L for pre-school aged children

# Impact: Monitoring and Remote Sensing

## Monitoring and Remote Sensing

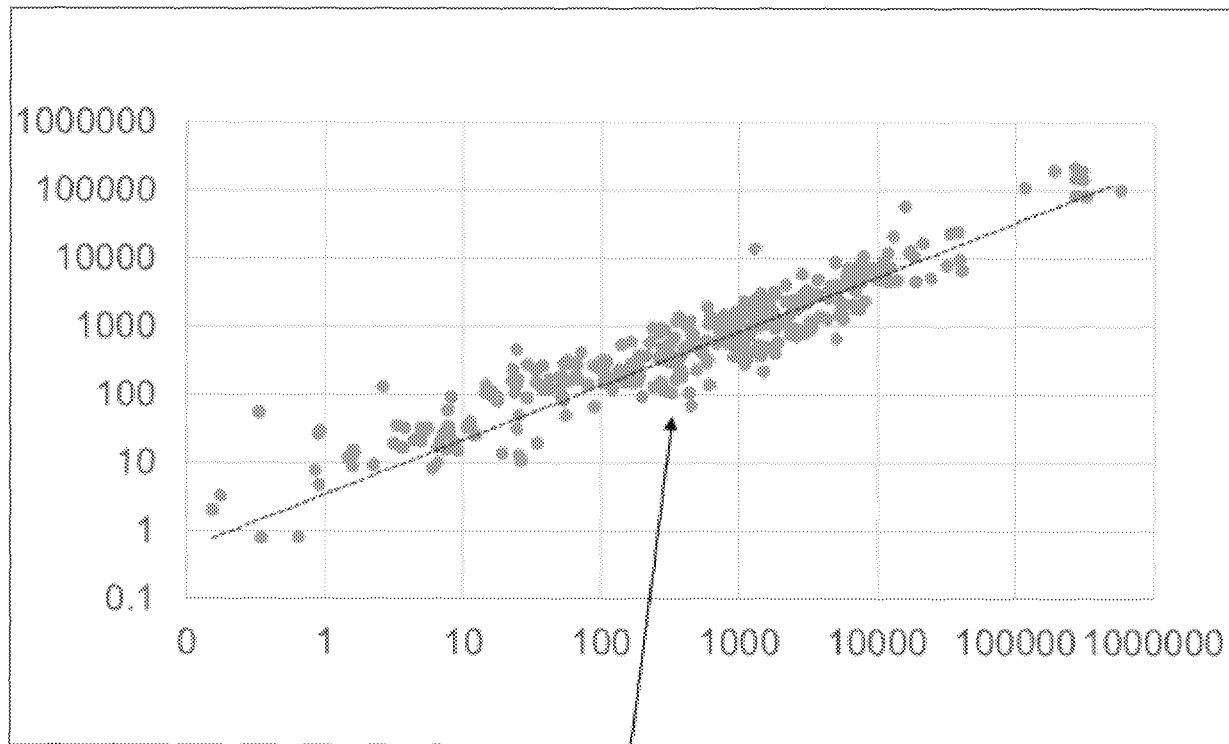
Ultimate goal is to combine satellite, buoy-deployed sensor and grab sampling data for pigments, nutrients, toxins, microbial species, water quality and weather

## Better Guidance Information

- Beach closure decisions
- Forecasting bloom peaks and toxin production
- Response to reports of human and animal illnesses

# Actions: Analytical Methods

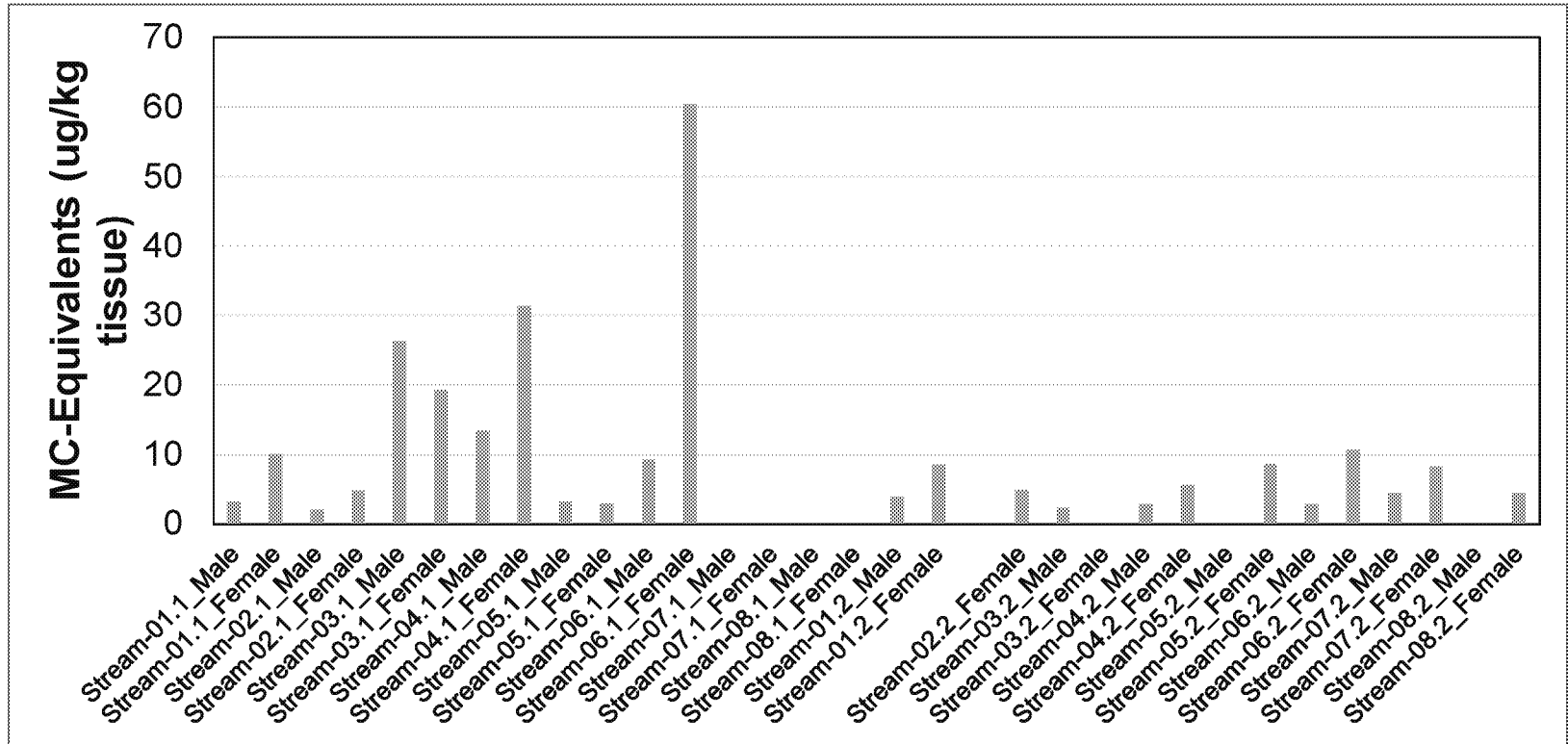
Collaboration with Ohio EPA to validate quantitative PCR method  
(Rapid detection of genetic material from toxin-producing cyanobacteria)



Agreement for samples split between  
Ohio and federal EPA laboratories

# Actions: Analytical Methods

## Toxin Analysis in Fish Tissues



Fathead minnows exposed to toxins in artificial streams  
 → toxins successfully recovered from whole-fish tissue samples

# Impact: Analytical Methods

Analytical Methods



Feeds back to the monitoring component



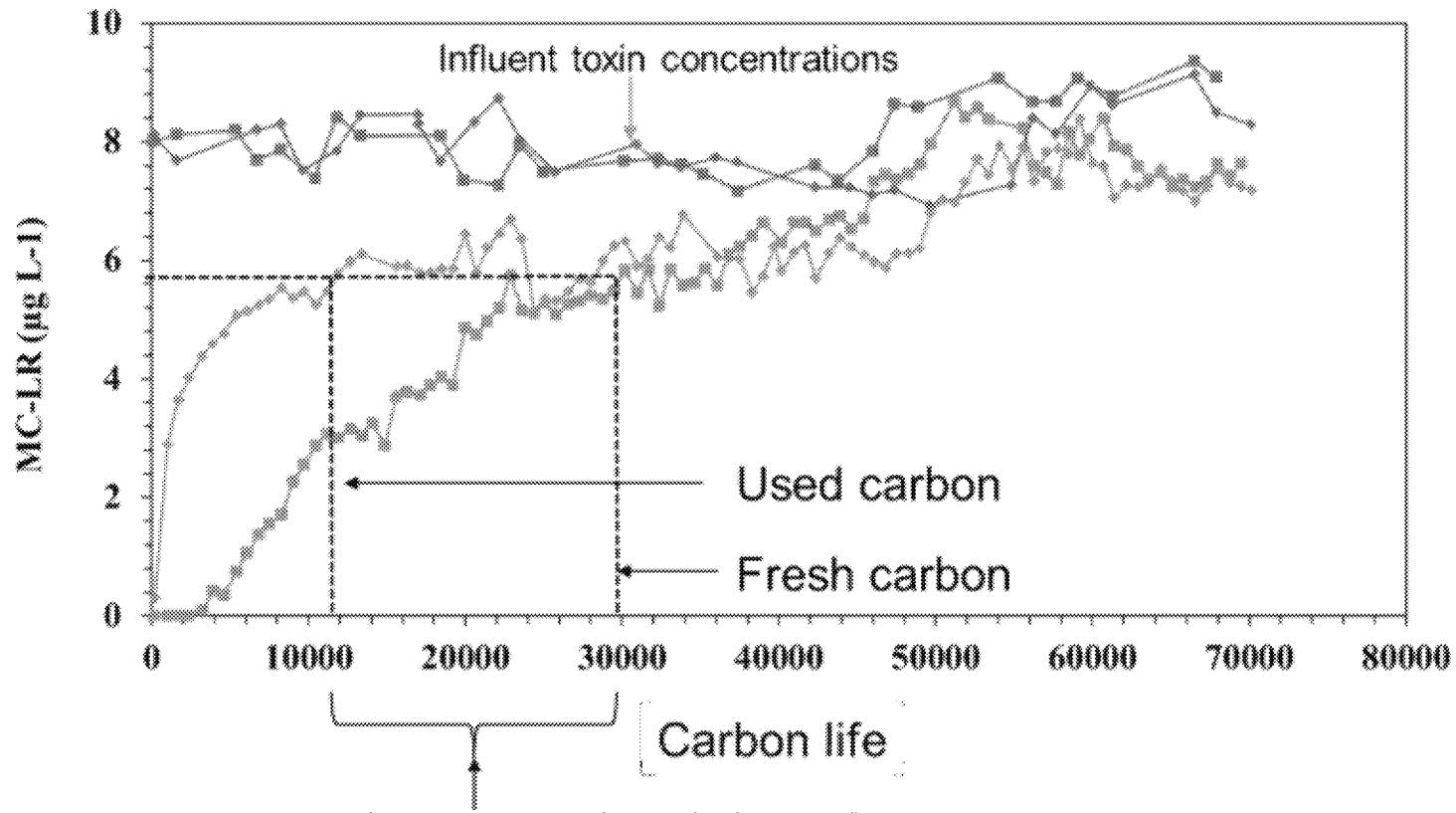
Better Guidance Information



- Beach closure decisions
- Forecasting bloom peaks and toxin production
- Response to reports of human and animal illnesses
- Response to concerns from fishermen

# Actions: Drinking Water Treatment

## Toxin Removal through Granular Activated Carbon (GAC) Impact of prior GAC use



Prior use decreases the ability of GAC to remove toxins

# Impact: Drinking Water Treatment

Drinking Water Treatment

Better Guidance Information

- Day-to-day treatment plant operation decisions (chemical dosing)
- Medium-term treatment plant operation decisions (timing carbon replacement)
- Long-term capital spending decisions

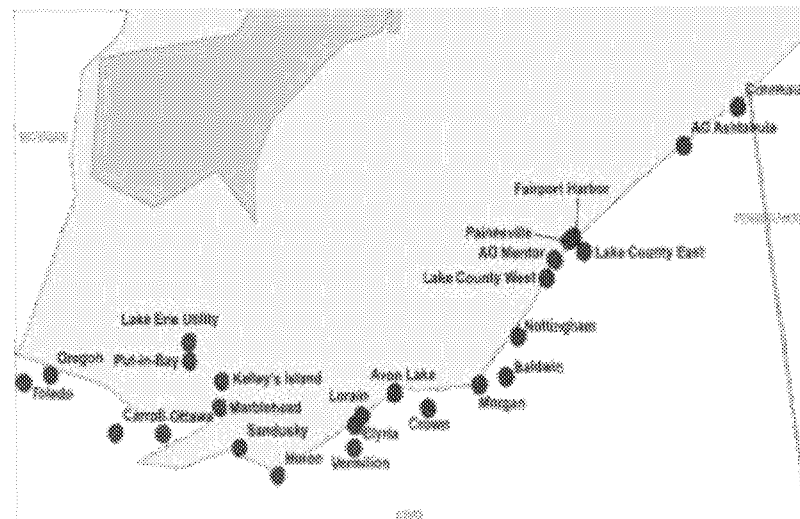
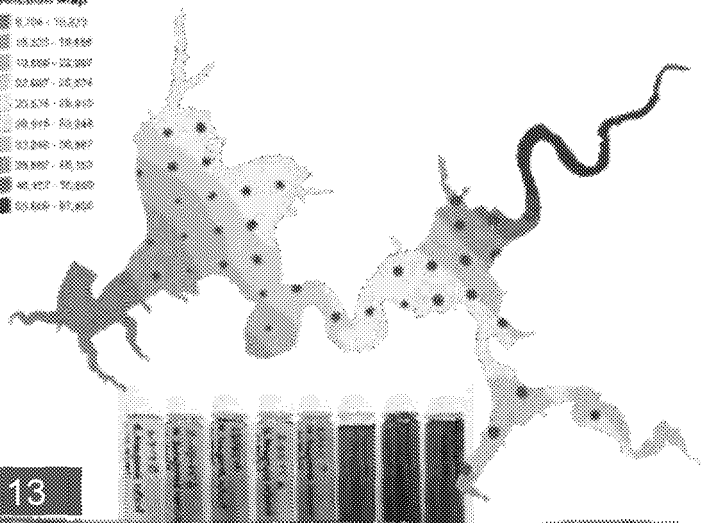
# Actions and Impact: Ohio Lakes

## Providing Technical Assistance to States

### Lake Erie

- Monitoring cyanobacteria toxins through multiple years in numerous treatment plants
- Conducting bench- and pilot-testing
- Satellite monitoring program

BGA-PC (cells/mL)  
Prediction Map



### Harsha Lake

- Nutrient and HAB bloom dynamics
- Treatment performance at local water utility
- Nutrient trading program: reduce nutrient loadings at lowest cost by expanding the number of participants that have incentives to purchase credits

# Actions and Impact: Toledo, OH

## Providing Technical Assistance to States

### Do Not Drink Advisory Issued by the State

In August 2014, Ohio EPA requested ORD's technical assistance to analyze drinking water for the presence of cyanobacterial toxins resulting in a harmful algal bloom.

### ORD Technical Assistance

- Samples flown directly to Cincinnati on numerous occasions
- Performed multiple analyses around the clock until the crisis was resolved
- Provided technical assistance to the city and state 24/7:
  - Confirmed extent of problem the potential for resolution, via treatment
  - Resolved sample handling and analytical procedures
  - Helped brief Ohio EPA Administrator, Mayor of Toledo, Governor and Members of Congress at various times during the event



***“Your efforts were instrumental in restoring safe drinking water to over ½ million Ohioans and exemplifies a great example of how local, state and federal agencies are able to work together, mobilize essential resources and address critical issues.”***

***—Governor John R. Kasich  
(in a letter to US EPA staff)***

# Contact

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