# Cyanotoxin Risk Management for Drinking Water Systems

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EPA's Tools for Cyanobacteria and Cyanotoxins in Freshwater Systems
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# Presentation Overview

- Brief overview of harmful algal blooms (HABs) and drinking water impacts
- Discussion of key support tools for cyanotoxin risk management in drinking water systems

# Harmful Algal Blooms

- Naturally occurring cyanobacteria in surface water can rapidly form HABs
- Leading factors causing HABs:
  - Excess nutrient loadings and concentrations
  - Slow moving surface water
  - Elevated water temperature
- Some species of cyanobacteria produce toxic compounds, called algal toxins or cyanotoxins
- Significant impacts of HABs include:
  - Adverse human health effects
  - Adverse ecosystem impacts from toxins and hypoxia
  - Drinking and recreational water quality concerns
  - Economic losses

# HAB-related Drinking Water Challenges

- Drinking water quality
  - Taste and odor problems
  - Human health effects from ingesting toxins: gastroenteritis, liver and kidney damage
  - Potential development of disinfection byproducts
- Public water systems
  - Increasing operational costs
  - Additional research needed on how to prevent, predict, analyze, monitor and treat toxins
  - Developing and implementing cost effective methods to reduce HABs in source waters
  - Determining how to communicate risk to the public

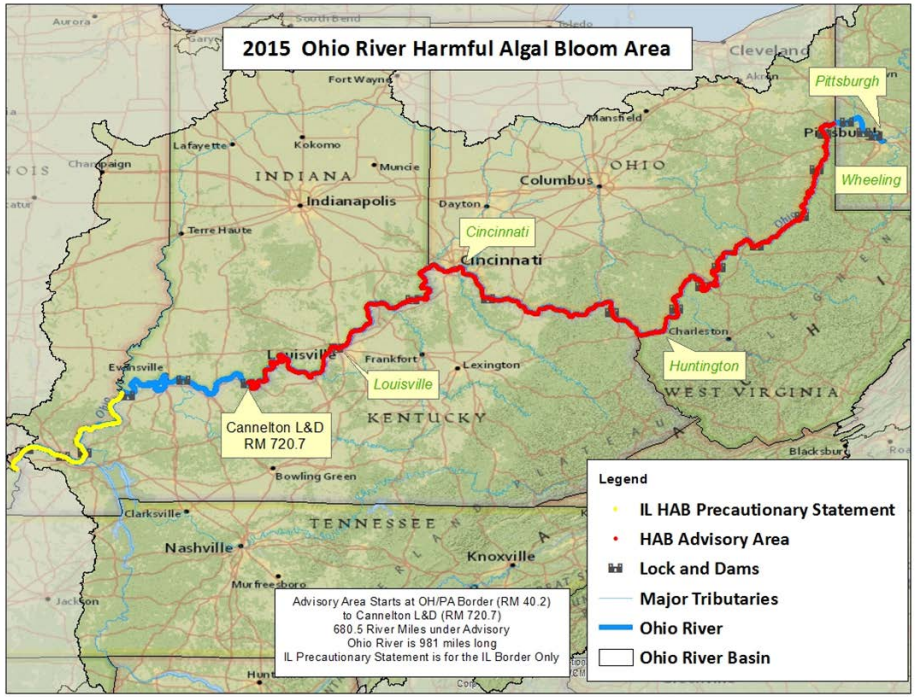
# Highlights from Recent Bloom Seasons

## Ohio River 2015

- Approximately 600 mile bloom
- Source of drinking water for over 5 million people

## Lake Erie 2015

- Most severe bloom of this century in Lake Erie




## Florida 2016

- Severe bloom impacted Lake Okeechobee, rivers, and estuaries

## Utah 2016

- Severe bloom on Utah Lake
- Recreational waters and secondary water systems impacted (i.e. irrigation, gardening, livestock)

## Recent Drinking Water Detects

- Ingleside, Texas (Jan./Feb. 2016)
  - Resulted in advisory
- Des Moines, Iowa (Aug 2016)
- Cayuga County, New York (Sept./Oct. 2016)
- Summit Lake (May 2017)

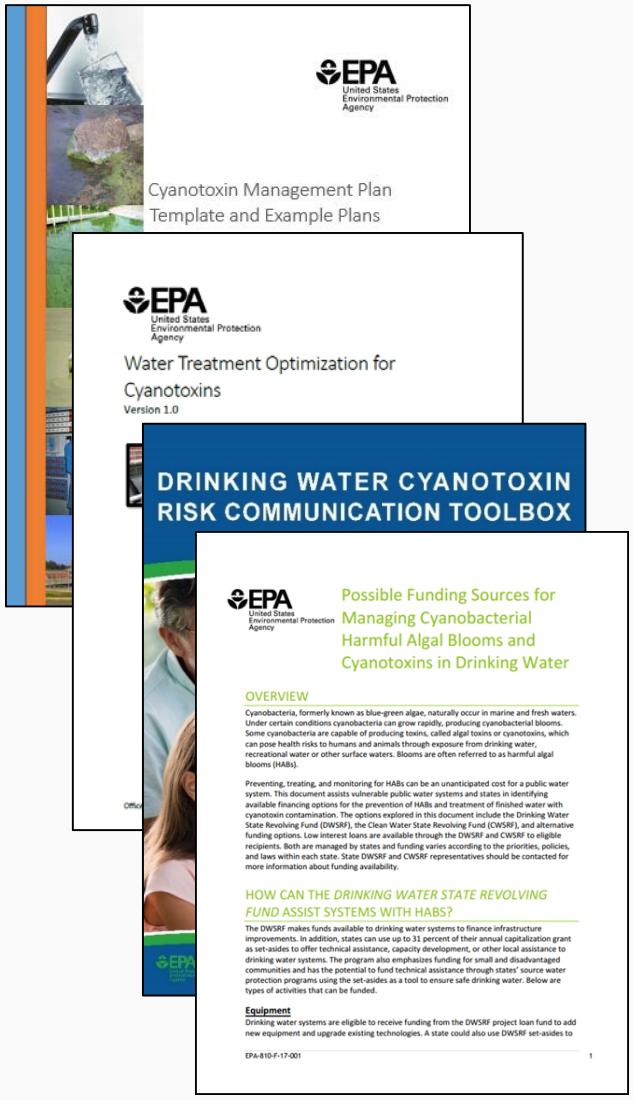


Citations:

Ohio River: Ohio River Valley Water Sanitation Commission www.orsanco.org

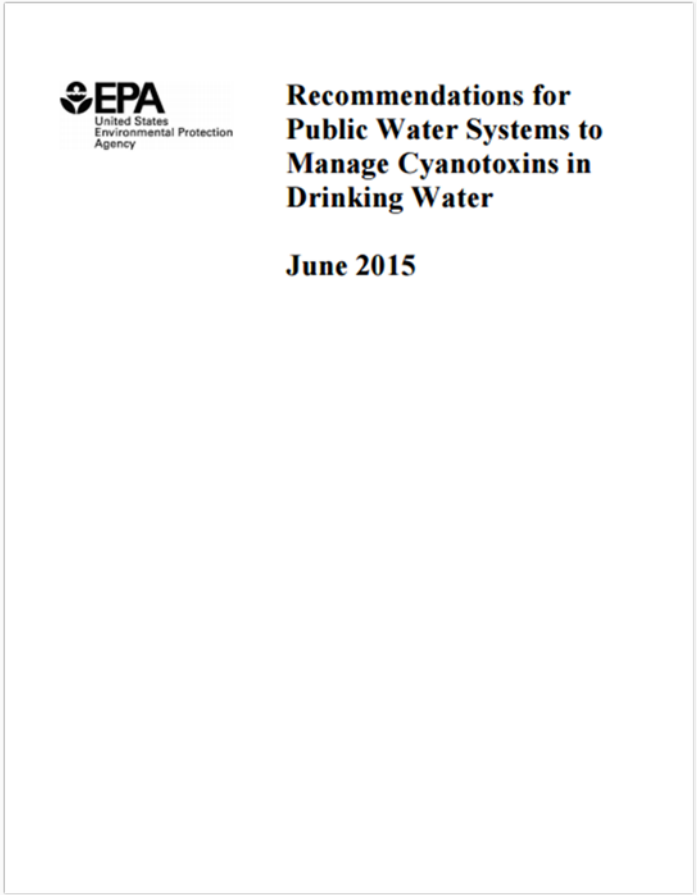
# EPA Cyanotoxin Risk Management Tools for Drinking Water

- Tools for developing a cyanotoxin risk management plan framework:
  - Recommendations documents released for public water systems to manage cyanotoxins in drinking water– 2015
  - Cyanotoxins Management Plan Template and Example Plans– 2016
- Tools and information sources to support development of specific areas within a management plan framework:
  - Drinking water Health Advisories and Health Effect Support Documents for cyanotoxins– 2015
  - Water Treatment Optimization for Cyanotoxins – 2016
  - Cyanotoxin Risk Communication Toolbox– 2016
  - HABs Funding Fact Sheet– 2017



# Managing Cyanotoxins in Drinking Water

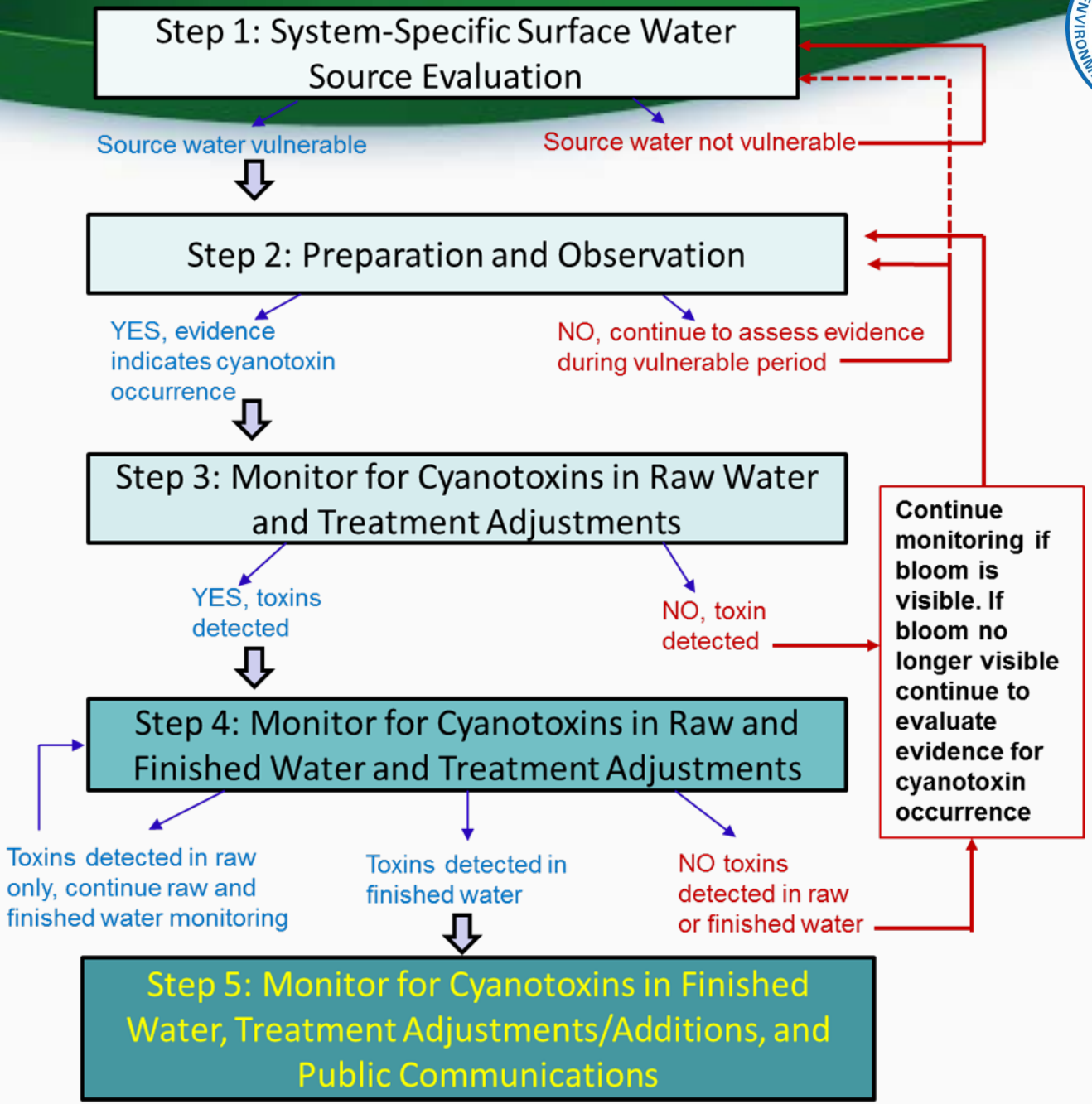
- In June 2015, EPA released a support document titled *Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water*
- The document is intended to assist interested states and utilities manage the risks from cyanobacterial toxins in drinking water, recognizing the most appropriate course of action will vary on a case by case basis


EPA United States Environmental Protection Agency

Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water

June 2015

# Potential Cyanotoxin Management Steps



# Step 1: System-Specific Surface Water Source Evaluation

- Key objective: Determine if source water is vulnerable to harmful algal blooms
- Potential information to consider when conducting a system-specific evaluation:
  - Evaluation of source waters at or near the intake:
    - Source Water Characteristics
    - Water Quality Parameters
    - Source Water Assessment Information
    - Climate and Weather Information
    - Land Use
    - Nutrient Levels

# Step 2: Preparation and Observation

## Preparation

- Potential actions to consider if a system is determined to be vulnerable in Step 1:
  - Determine when (e.g., which seasons) systems are most vulnerable to HABs
  - System Evaluation
    - Assess status of treatment plant prior to harmful algal bloom season
      - If source water is vulnerable and existing treatment is not sufficient to remove cyanotoxins from peak blooms, evaluate whether supplemental treatment (e.g., coagulant) might be needed during bloom season, or
      - If source water is vulnerable and existing treatment is frequently challenged by cyanotoxins, consider whether long-term treatment enhancements are needed

# Step 2: Preparation and Observation

## Preparation (Cont'd)

- Monitoring
  - Prepare for possible future cyanotoxin monitoring by ordering necessary lab materials for screening tests or setting up contracts with outside labs
- Communication
  - Establish partnerships with primacy agencies, state, and local public health officials

# Step 2: Preparation and Observation

## Observation

- Key observation objective: Identify potential cyanotoxin occurrence in source and raw water
- 3 Key Potential Observations:
  1. Visual: Visually confirm the presence of a bloom at intake structure or confirm public reports of blooms near raw water intake
  2. System effects: Track changes in treatment plant operations, water quality parameters, etc.
  3. Indicators: Indicator occurrence in source water and raw water at intake

# Step 2: Visible Observation of Blooms

- Potential actions to consider when assessing/collecting information on visible blooms (note, not all blooms are visible):
  - Location: Identify locations to monitor for presence of blooms and implications for the PWS (e.g., a bloom near a raw water intake vs. a bloom 50 meters away from an intake)
  - Evaluate whether the public can assist with collecting information on blooms

# Step 2: Observation of System Operation

- Potential actions to consider when assessing/collecting information on changes in system operations:
  - Examine raw water quality parameters (e.g., pH changes, turbidity)
  - Evaluate potential treatment changes (e.g., shortened filter run times, increased chlorine demand, etc.)
  - Investigate consumer complaints (e.g., taste and odor concerns)
  - Communicate with nearby/upstream systems (e.g., blooms in source water or cyanotoxin occurrence in their raw water)

# Step 2: Observation of HAB Indicators

- Information available on indicators of system vulnerability to HABs
  - Examine available data to determine if there has been an increase in nutrient concentrations (nitrogen or phosphorus) in source water
  - Examine other source water indicator data (pH, temperature, cyanobacterial cells, chlorophyll a levels, phycocyanin, phosphorus, nitrogen)
  - Participate/organize watershed monitoring programs collecting source water indicator data
  - Seek out secondary data on bloom occurrence in source water (e.g., satellite remote sensing, local or regional program surface water monitoring data) and information on intake characteristics

# Steps 3-5: Monitoring, Treatment Adjustments, and Communication

- Key objectives:
  - Determine if cyanotoxins have reached or are likely to reach the raw water
  - Determine the effectiveness of cyanotoxin removal via drinking water treatment operations
  - Adjust or consider additional treatment to reduce risks from cyanotoxins in drinking water (as appropriate)
  - Confirm whether cyanotoxins are detection in finished water (as appropriate)
  - Reduce risks from cyanotoxins in drinking water
  - Inform the public of the need to take actions to reduce their risks

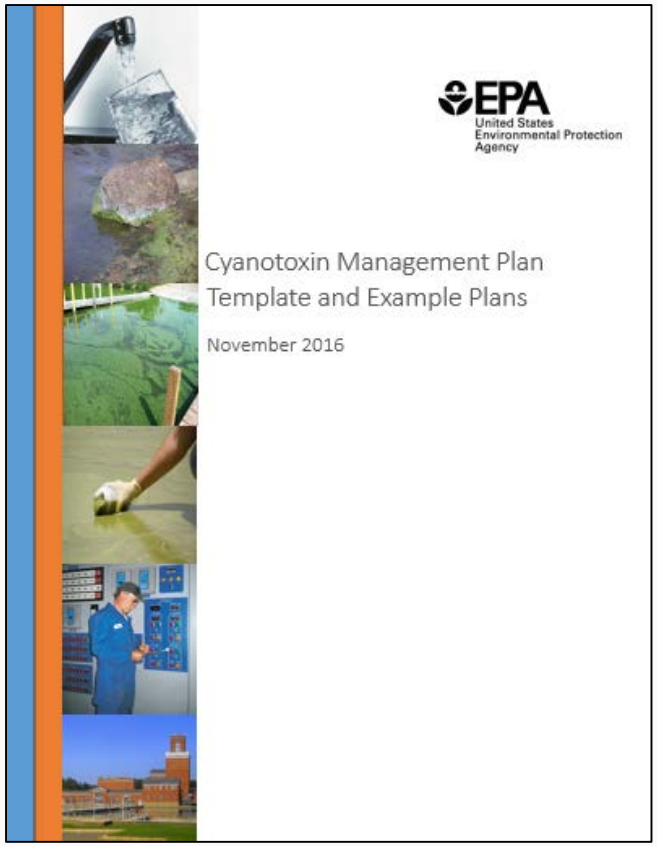
# Steps 3-5: Monitoring, Treatment Adjustments, and Communication

- Cyanobacterial blooms can cause water quality problems
  - Potentially producing cyanotoxins
  - Increasing solid loading
  - Increasing natural organic matter (NOM)
  - Producing unpleasant tastes and odors (T&O)
- Treatment strategies for cyanotoxins must also consider other treatment objectives
  - Turbidity removal
  - Disinfection
  - Disinfection by-products (DBPs) control
  - T&O control
  - Corrosion control

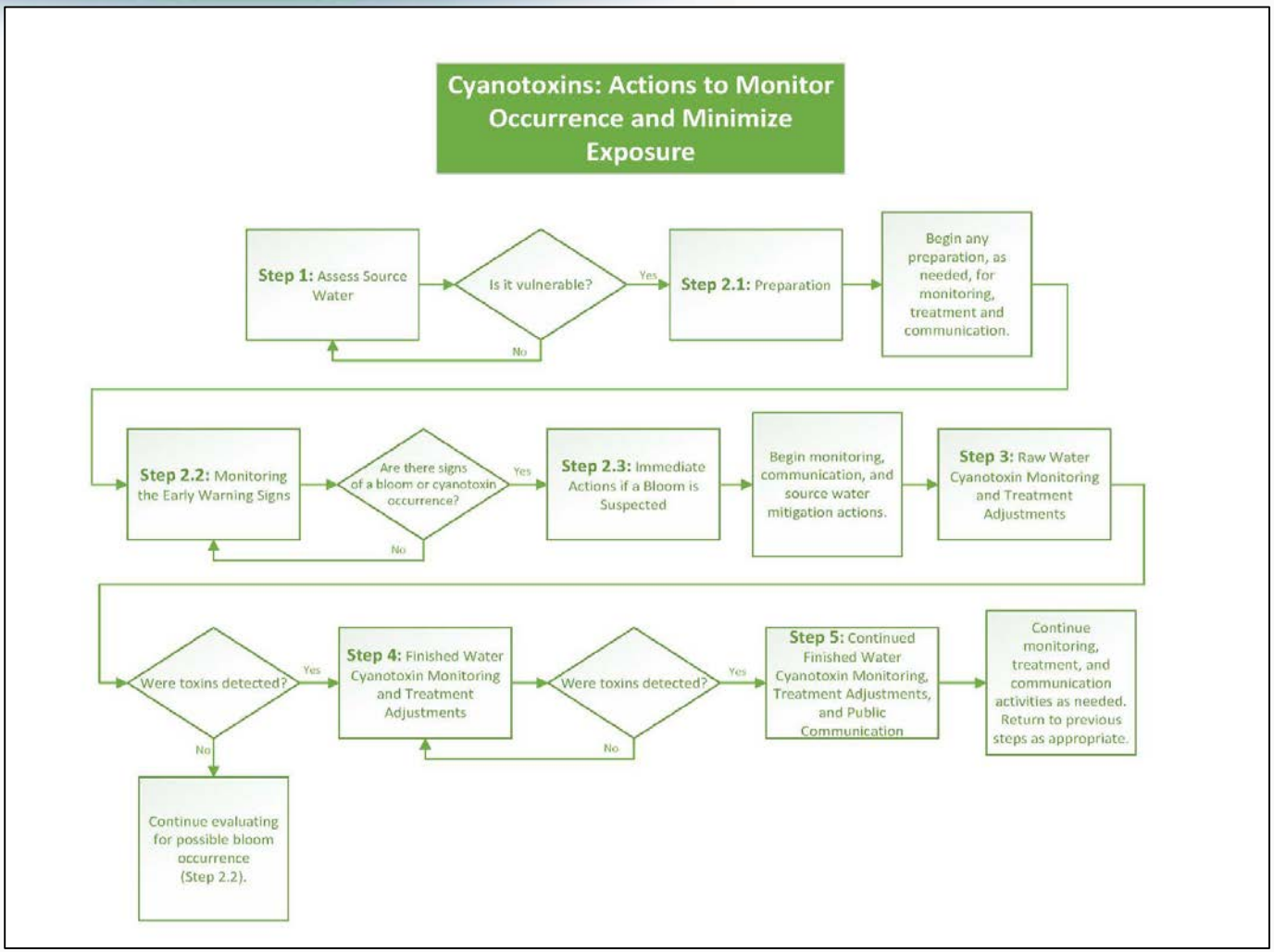
# Cyanotoxin Management Plans

Two parts:

1. Template
   - Framework for public water systems (PWSs) to inform the development of their own cyanotoxin management plans as they deem appropriate
2. Five example cyanotoxin management plans
   - Examples from five partner PWSs representing diversity in system characteristics and geography



# Cyanotoxin Management Plans: 5 Steps



# Cyanotoxin Management Plan Template Overview

- Executive Summary
  - A brief overview of the system and its source waters
- Five step process
  - Step 1: Assess Source Water
  - Step 2: Preparation, Monitoring for Early Warning Signs and Immediate Actions
  - Step 3: Raw Water Cyanotoxin Monitoring and Treatment Adjustments
  - Step 4: Finished Water Cyanotoxin Monitoring, Treatment Adjustments
  - Step 5: Continued Finished Water Cyanotoxin Monitoring, Treatment Adjustments and Public Communication
- Long-term activities to prevent and mitigate impacts of blooms and cyanotoxins on drinking water

# Cyanotoxin Management Plan Template-Example Plans

- In order to provide a broad range of example plans, we partnered with five PWS treatment plants in different systems. In identifying partners, we considered:
  - The previous history of harmful algal blooms in PWS source waters
  - Variety of system sizes
  - Variety of locations
    - Systems not using the same watershed
    - Different regions of the U.S.
  - Variety of source water types (i.e. lakes/reservoirs, rivers)
  - Variety of treatment (i.e. such as conventional treatment, GAC, capability of using PAC, pre-oxidation)

# EPA's Goals for Managing Risks of HABs in Drinking Water

- **Improving scientific understanding** of HABs and cyanotoxin production to better predict their occurrence;
- **Protecting human health** by identifying human health effects of current and emerging cyanotoxins;
- **Providing necessary technical assistance** to utilities so they can provide safe drinking water through effective HABs and cyanotoxin treatment in finished water;
- **Preventing HAB formation** with effective source water protection efforts and nutrient reduction strategies at the watershed scale.

# Contact Information

## Contacts

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CyanoHABs website:
https://www.epa.gov/cyanohabs

Cyanotoxins in Drinking Water website:
https://www.epa.gov/ground-water-and-drinking-water/cyanotoxins-drinking-water