

# **Reservoir Management for Harmful Algal Blooms (HABs)**

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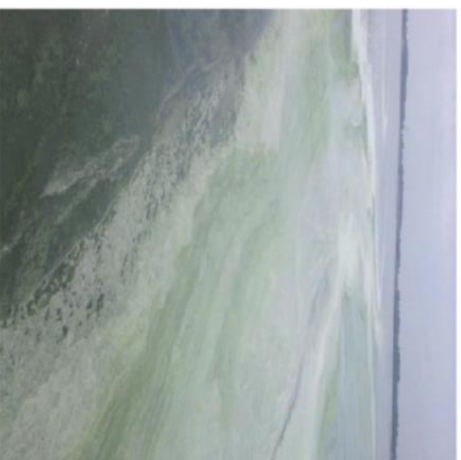


# Overview

- Background information on HABs
- Types of in-lake management controls
  - Physical
  - Chemical
  - Biological
- Regulatory requirements
- Under development

# Defining HABs

- **Harmful** – posing threat to ecosystem, animal and human health; *cyanotoxins* are a primary concern for drinking water and recreation
- **Algae** – photosynthetic aquatic organisms lacking true roots and stems; *cyanobacteria* are primary concern in freshwater systems
- **Bloom** – excessive biomass, occurs when conditions (e.g., nutrients, light, temperature) support high growth rates



# Adverse Impacts

- **Cyanotoxin production** - dermal toxins, neurotoxins, and hepatotoxins
  - Symptoms of exposure include nausea, skin rashes, gastrointestinal distress, disorientation, numbness, and fatigue.
  - Ohio has received reports of human illness and dog deaths associated with recreational exposure to cyanotoxins.
- **Taste and odor problems**
  - Methylisoborneol (MIB) & Geosmin (earthy/musty odor)
- **Dissolved oxygen dips**
- **Nuisance** - visual and olfactory effects can be significant
- **Costs to communities**
  - Economic impacts from loss of recreation based tourism
  - Increased costs for production of drinking water

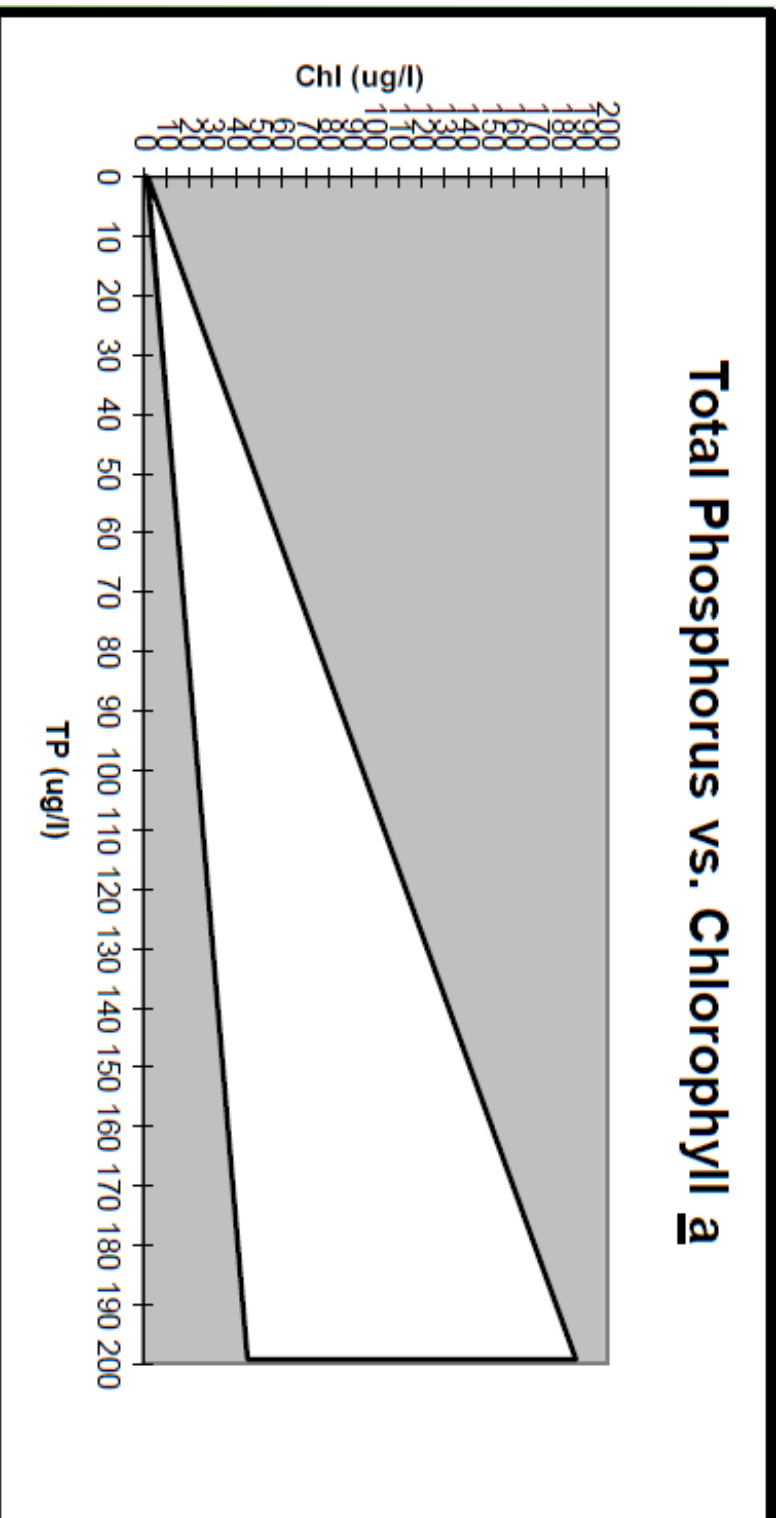


# Benefits from Reducing HABs

- Protect human health and appealing lake
- Cost saving to water system
  - Reduced cyanotoxins and HAB monitoring
  - Reduced taste & odor compounds
  - Reduced turbidity
  - Reduce filter clogging
  - Reduced organic carbon, reduced THMs
  - Reduce treatment chemical requirements

# Factors Affecting (Promoting) HABs

- Nutrients: Phosphorus (bloom) and Nitrogen (microcystins)



# Factors Affecting (Promoting) HABs

- Nutrients: Phosphorus and Nitrogen
- Light
- Temperature
- Water movement (stratification) and residence time
- Micronutrients
- Algal seasonal dynamics and history

# Source Water Management Strategies

## Watershed Management

- Control external loading of nutrients
  - Reduce sources or nutrient trapping
- Component of successful long-term management plan to reduce HABs
- High cost per area to achieve goal

## Avoidance Strategies

- Multiple source waters (isolate and treat)
- Multiple intake depths



# In-Lake Management Strategies

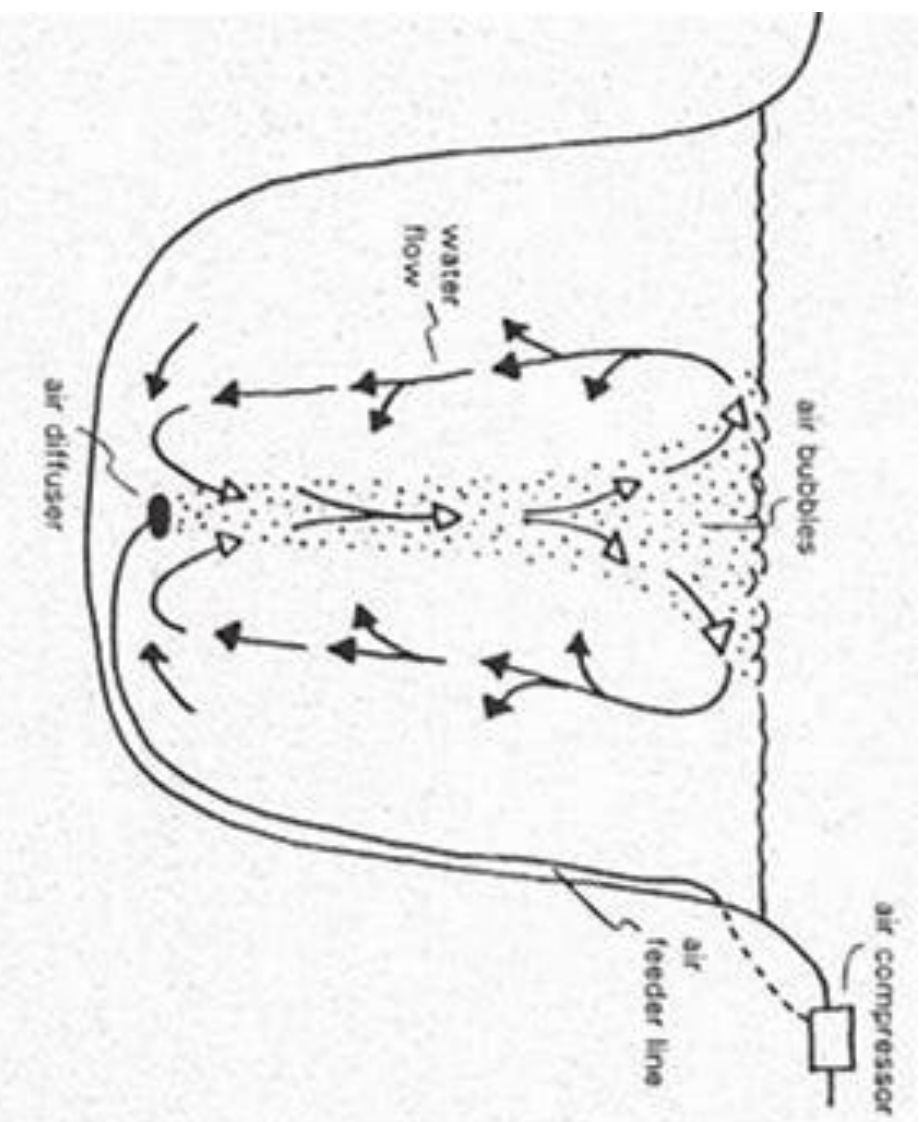
## Physical control

- Dredging to remove nutrient laden sediment or benthic mats
- Harvest/skim scums or mats
- Hydrologic manipulation (flushing, selective withdrawal)
- Aeration, hypolimnetic oxygenation (nanobubbles)
- Artificial mixing
- Sonication, ultrasound

# Case Study Examples

## Lake Carmi, VT

- Large, shallow with high internal P
- Impaired for nutrients (TMDL) and history of recreational HABs
- Evaluation aeration versus circulation system to address internal P

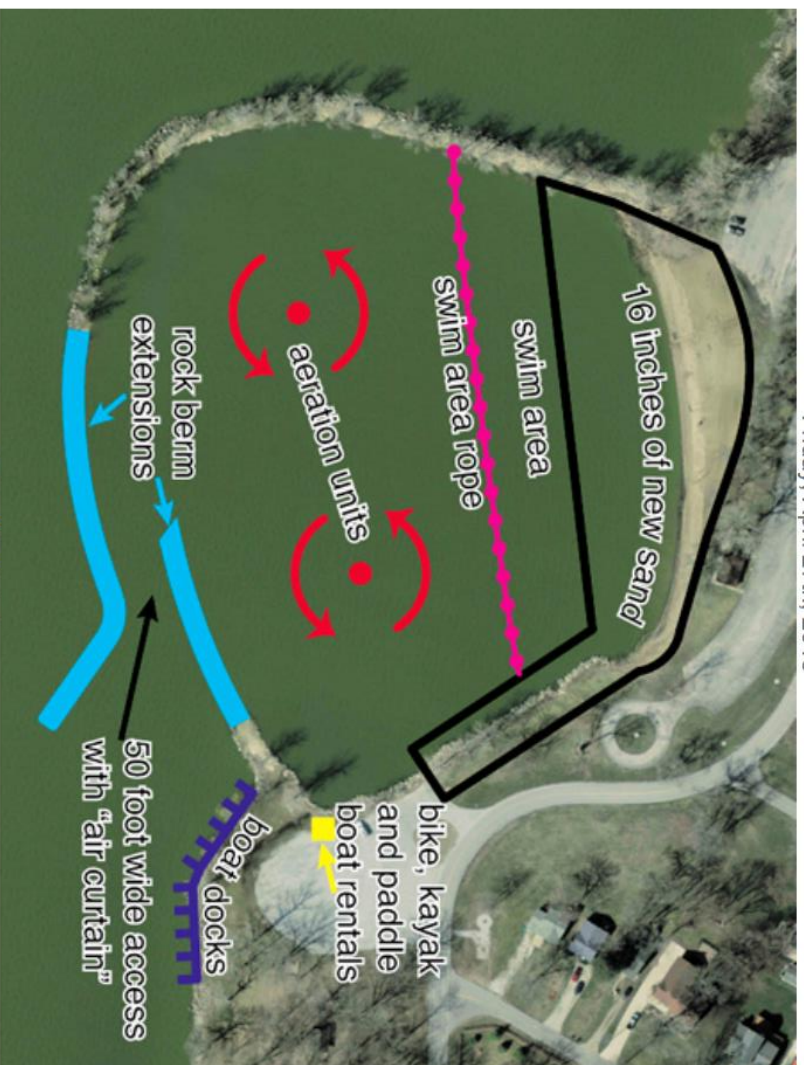


[https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Encroachment/AerationReport\\_FINAL.pdf](https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Encroachment/AerationReport_FINAL.pdf)

# Case Study Examples

## Grand Lake St. Marys Beach

- Isolate beach embayment
- Aeration units and “air curtain”



# In-Lake Management Strategies

## Chemical control

- Algaecides
- Phosphorus inactivation (Alum, Phoslock)
- Flocculation agents
- Oxidizing agents (permanganate, ozone; potentially with nanobubbles)



# In-Lake Management Strategies

## Biological control

- Predators (not successful)
- Barley straw (allelopathic effect)
- Viral controls (lab-scale only)
- Bacterial additives (potential off-label use, in combination)



# Roll Call for Algal Control

- Watershed management (where external load is high)
- Phosphorus inactivation (for internal load or inflow)
- Circulation/mixing (deep versus shallow systems)
- Oxygenation (deep lakes, internal load dominant)
- Dredging (where feasible, benthic mats)
- Algaecides (with proper timing, limited usage, no nutrient control)
- Sonication (for susceptible algae, no control for nutrients)
- Biological controls (moderate P, variable)
- Multi-faceted approach (toolbox)

# Monitoring Program

Data needs to determine triggers for response and evaluate effectiveness of treatment

- Algae, cyanobacteria types and abundance (phycocyanin, genetics, cyanotoxins)
- Water quality (nutrients, pH, temperature, oxygen; spatial and temporal)
- Lake bathymetry
- Inflow and outflow sources
- Other biological communities

# HAB Guidance Documents

**Treatment Optimization Protocol (short term options)**

<https://epa.ohio.gov/Portals/28/documents/habs/TreatmentOptimizationProtocol.pdf>

**Cyanotoxin General Plan (long term planning)**

<https://epa.ohio.gov/Portals/28/documents/habs/HABGeneralPlanGuidance.pdf>

*Sections specific to source water management*

*Updated documents in 2019*



# Treatment in Source Waters

- OAC 3745-83-01(d) Operational requirements
  - ANSI/NSF Standard 60 Drinking Water Treatment **Chemicals**
    - Includes algaecides
  - ANSI/NSF Standard 61 Drinking Water System **Components**
- ***Encourage new reservoir management technologies to comply!***

# Permitting Process for Algaecide

- Ohio General NPDES permit (OHG870002):
  - Effective January 1, 2017
  - Expiration December 31, 2021
  - Fee required for renewal
  - Submit to Division of Surface Water
- Applications “in, over or near” surface water
- Notice of Intent (NOI) are required for direct application to drinking water reservoirs

[http://www.epa.ohio.gov/dsw/permits/GP\\_Pesticide.aspx](http://www.epa.ohio.gov/dsw/permits/GP_Pesticide.aspx)

# Restrictions for Algaecide in Drinking Water Source

- Due to the potential release of cyanotoxins, algaecide use is restricted in drinking water sources during a severe bloom (scum or >100,000 cells/mL cyanobacteria)
- Exemptions:
  - Bloom is not producing cyanotoxins
  - Source water is isolated
  - Treatment capacity for extracellular cyanotoxins

<https://www.epa.ohio.gov/Portals/28/documents/HABS/>

<Publications/AlgaecideApplicationFactSheet.pdf>

# Algaecide Application Notes

- Follow label instructions and be aware of environmental impact and practical considerations
- Apply algaecide during early stages of bloom, before cyanotoxins are detected in raw water, and only to areas where cyanobacteria are present

# Treatment in Source Waters

- OAC 3745-91 Plans Approval
  - Required for any new source or alteration in source
  - Specifies substantial change to water quality
  - Five Year Review date 10/26/2020
    - Early Stakeholder Outreach may begin prior to 3/26/2020
    - Potential exemption criteria for certain types of reservoir management treatment technologies

**Subscribe to rules emailing list at <https://epa.ohio.gov/ddagw/rules>**

# Treatment in Source Waters

- Reservoir treatment form in development
  - Ease reporting, allow tracking
- Survey planned for end of HAB season 2019



# Interstate Technology & Regulatory Council (ITRC) Project

- Strategies for Preventing and Managing Harmful Cyanobacterial Blooms
- Goal: Develop technical and regulatory guidance for preventing and managing blooms
  - Technical review of common reservoir and watershed management practices
  - Fact sheets and website expected end of 2020
- ***Consider joining the team!***

[\*http://itrcweb.org/\*](http://itrcweb.org/) *Membership/TeamRegistration*

# Upcoming Events

- Stone Laboratory
  - Algae Identification, August 5-6, 2019
  - Dealing with Cyanobacteria, Algal Toxins, and Taste & Odor, August 7-8, 2019
- Algae Blooms, HABs and Toxic Algae Remediation Workshop
  - Toledo, OH, September 10-11, 2019

[www.nationalalgaassociation.com](http://www.nationalalgaassociation.com)



# Ohio EPA Central Office HAB Section

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