Preparing for Harmful Algal Blooms (HABS) in Arizona

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Mr. Scherer currently manages ADEQ's Source Water Protection Program. He is a registered geologist with 30 years combined experience in both environmental consulting and regulatory oversight. Since joining ADEQ in 2007, he has completed Source Water Protection Plans for public water systems throughout Arizona. Additionally, Mr. Scherer is the senior hydrologist for the drinking water monitoring and protection unit which provides regulatory oversight for over 1500 public water systems throughout Arizona.
**Purpose:** Preparing for Harmful Algal Blooms (HABS)

**Process:**
- Background on Harmful Algal Blooms (HABs)
- Impacts in Arizona
- Best Management Practices
- Case studies of HABs in Drinking Water
- Open Discussion

**Payoff:** Tools to develop HABs Management /Action Plan
BACKGROUND
Terminology

**Harmful Algal Blooms** | Overgrowth of algae. Blooms do not have to produce toxins in order to be considered harmful to the environment. (Eutrophication and dead zones)

**Cyanobacteria** | Plantlike organisms that receive their energy from light. (They photosynthesize!) Commonly referred to as blue-green algae.

**Cyanotoxins** | Toxins that can be produced by cyanobacteria. They can include neurotoxins and hepatotoxins.
Types of HABS

Blue/green Algae (Cyanobacteria)
Associated environmental and human health impacts

Red Algae (Red Tide)
Associated with fish kills and indirect human health impacts

Golden Algae
Associated with fish kills

Image Credit: USGS Open-File Report 2015-1164
Image Credit: Texas Dept of Parks and Wildlife-Winston Denton
Image Credit: Texas Dept of Parks and Wildlife
Causes

- Light Availability (summer)
- Alteration of Water Flow (slow flow)
- Nutrient Loading (both Nitrogen and Phosphorus)
- Water Temperature
Health Impacts

Exposure Pathways

- Direct contact
- Inhalation
- Ingestion-Water
- Ingestion-Food

Common Cyanotoxins and Health Impacts

- Microcystin and Cylindrospermopsin | Toxic to liver and kidney, can cause intestinal unrest and fever
- Anatoxin-A | Damage to nervous systems, can cause seizures and paralysis
Drinking Water Health Advisory

EPA has Health Advisory criteria for cyanotoxins since 2015

<table>
<thead>
<tr>
<th>Cyanotoxin</th>
<th>Bottle-fed infants and pre-school children</th>
<th>School-age children and adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcystin</td>
<td>0.3 ug/L</td>
<td>1.6 ug/L</td>
</tr>
<tr>
<td>Cylindrospermospsin</td>
<td>0.7 ug/L</td>
<td>3 ug/L</td>
</tr>
</tbody>
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There is no federal standard in Safe Drinking Water Act.

However, cyanotoxins were included in multiple Containment Candidate Lists and the Unregulated Contaminant Monitoring Rule.
IMPROVEMENTS IN ARIZONA
Arizona Surface Water Intakes

Active Intakes
Arizona’s Source Water Breakdown

- Groundwater Only: 96%
- Surface Water Only: 2%
- Both: 2%
2% of PWS in Arizona Serve 52% of the People
Lakes on the Colorado River

Image Credit: USGS
Lake Mead (USGS)

- Good range for total phosphorus and nitrogen
- Low risk of exposure to algal toxins
- Equal to or better than many other lakes in the Western US
Lakes on the Agua Fria & Verde Rivers
Lakes on the Salt River
BEST MANAGEMENT PRACTICES (BMPS)
Properly Identify HAB’s

- Accurate identification is necessary to protect effects of algal toxin exposure
- Visual observation/Microscopic identification
- Not all algal blooms are toxic
- Non-toxic blooms can turn toxic if conditions exist and can last from days to months
Harmful blooms may manifest in parallel streaks or clumped dots.
May appear similar to spilled blue, green or white paint
Algal blooms can turn the water a bright “pea green” soup color
Soupy Oil Scum Appearance
Residential/Commercial Grounds Maintenance

- Bag all leaves, grass and debris; remove from property
- Organic materials can decompose in freshwater resources releasing undesirable nutrients which can fuel nuisance plant and/or algae growth
- Scoop up pet waste and dispose of properly
Establish a beneficial buffer that will:

- Intercept runoff, which prevents sediment, trash and organic materials from entering waterbodies during rainstorms
- Filtrate excess nutrients
- Provide a natural barrier by allowing deep-rooted plants and vegetation to grow 3 to 5 feet from the edge of the waterbody
- Prevent erosion and sedimentation
Reduce Nutrients

- Reduce fertilizer and pesticide use
- Prevent fertilizers from washing into sewers and going into waterways
- Apply fertilizers made of organic products
- Install rain gutters and downspouts to slow down rain
- Encourage commercial reduction of fertilizer use
Reduce Nutrients

- Inefficient use of fertilizer is a major problem. More than half of the synthetic fertilizer ever applied to the world’s fields has been applied in the past 30 years.

- Less than half of this fertilizer reaches the crops it’s intended for. The rest runs off into the wider environment and eventually to waterways and potentially the ocean.
Residential BMP’s

- Wash your car over grass or gravel, not on the street, to keep the soap from running into the storm sewer
- Maintain septic systems; monitor for cracks and fissures

Image Credit: Joyline.com
Residential BMP’s

Courtesy of WKTV Journal
Preventative Measures | Xeriscape

Plant native flowers, plants and vegetables that more likely to thrive without added fertilization
Preventive Measures | Phosphorous Locking

- Image from Solitude Management, Inc.

Image Credit: Solitude Management, Inc.
Preventative Measures | Aeration

- Improves circulation
- Increases dissolved oxygen
- Fountains and aerators help circulate stagnant water and facilitate the conversion of phosphorous and nitrogen to nutrient forms that do not sustain algae as food
Preventative Measures | Biological Augmentation

- Application of beneficial bacteria/enzyme compounds
- Beneficial bacteria can help consume additional waterbody nutrients that fuel nuisance algae blooms
- Facilitates the degradation of the organic materials (nutrient sources)
- Competes for nutrient “food source” a probiotic for your waterbody
Preventive Measures | Sample Water

- Regularly test water quality – to identify impairments

- Dissolved oxygen, pH or nutrient levels identified to establish baseline water chemistry
Preventative Measures | Sample Water

- Water quality data can be used to predict and prevent
- Proactive steps to protect your lake or pond
CASES STUDIES
HABs and Microcystin in Toledo, Ohio

Harmful algal bloom in Lake Erie left 500,000 residents without safe drinking water for 3 days in Toledo, Ohio in 2014.

Finished water results were above 1 $\mu g/L$

Emergency Do Not Drink Warnings issued.
HABs and Microcystin in Salem, OR

- Bloom occurred in the Detroit Reservoir
- Increased levels of microcystin in the Distribution System
  - Samples collected on 5/23/18 showed cylindrospermopsin levels of 6.9 ppb
  - Samples collected on 5/24/18 showed microcystin levels of 0.75 ppb
  - 1st advisory issued on May 29, 2018
  - 2nd advisory issued on June 5, 2018
  - Samples collected on 6/6/18 showed microcystin levels of 0.63 ppb
- Anatoxin-A detected, but not above health advisory levels.

**DO NOT DRINK THE TAP WATER – MAY 29, 2018**

INFANTS, YOUNG CHILDREN, AND OTHER VULNERABLE INDIVIDUALS

Applies to City of Salem, City of Turner, Suburban East Salem Water District, and Orchard Heights Water Association

Image Credit: Cityofsaalem.net

Image Credit: 13 ABC News
HABs in Lake Havasu

Toxin of Concern: Microcystin

ADEQ images captured at Rotary Beach 11/22/17
Downstream Effects of Lake Havasu Bloom

- 7 Drinking Water intakes located on Lake Havasu or immediately downstream.
- 1 State Park and 6 private systems notified of the levels of microcystin
- Over 5,000 people served
Preparing for Harmful Algal Blooms

EPA Guidance: Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water - June 2015

Figure 1. Potential management steps public surface water systems may use to determine whether cyanotoxins are present in raw water or finished drinking water.
Commercially available test strips can be used to quantify Microcystin levels in finished drinking water.

ADEQ has used similar test strips to monitor for Microcystin in Lake Havasu based on recreational standards; accurate analytical results.

Analysis include 1-2 mL sample and takes roughly 25 minutes to complete; simple analytical method.
Cyanotoxin Treatment Technologies

Treatment options depend on type and concentration of cyanotoxin

- Conventional Filtration Processes
- Oxidation Processes (Chlorine, Potassium Permanganate, Ozone)
- Adsorption (Granular Activated Carbon)
ADEQ Drinking Water Value Stream is working to provide resources to AZ Public Water Systems.

**ADEQ Goals**

- Online access to a management plan of helpful guidance on harmful algal blooms
- List of laboratories that analyze for cyanotoxins
- Estimated date of project completion is September 2019
Discussion

- What aspects of Harmful Algal Blooms most impact your water system?

- Does your water system currently have a plan to
  - Monitor
  - Manage
  - Communicate

- What resources could ADEQ provide to assist your water system in being more prepared for harmful algal blooms?
Thank you!

E-mail feedback & input on Harmful Algal Bloom resource website

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