



What is an algal bloom and why do we care?

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Outline

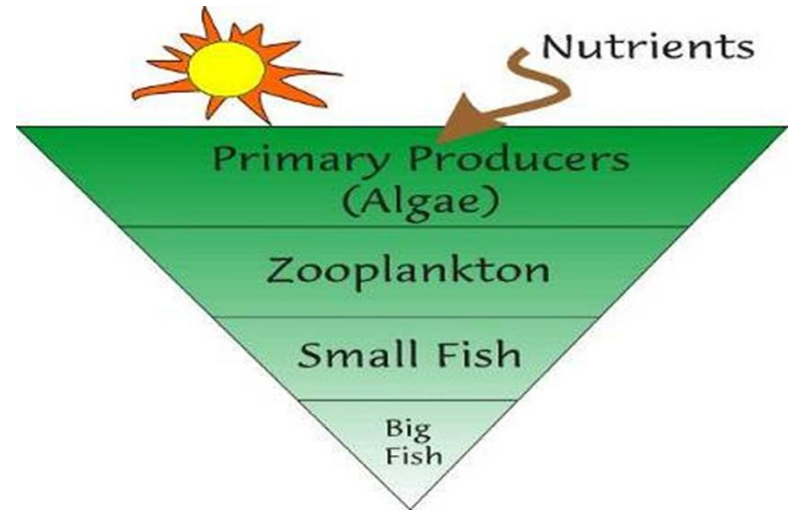


- Introduction to algae and algal blooms
- Ontario's blue green algal response protocol
- Trends in bloom reports in Ontario
- Future work

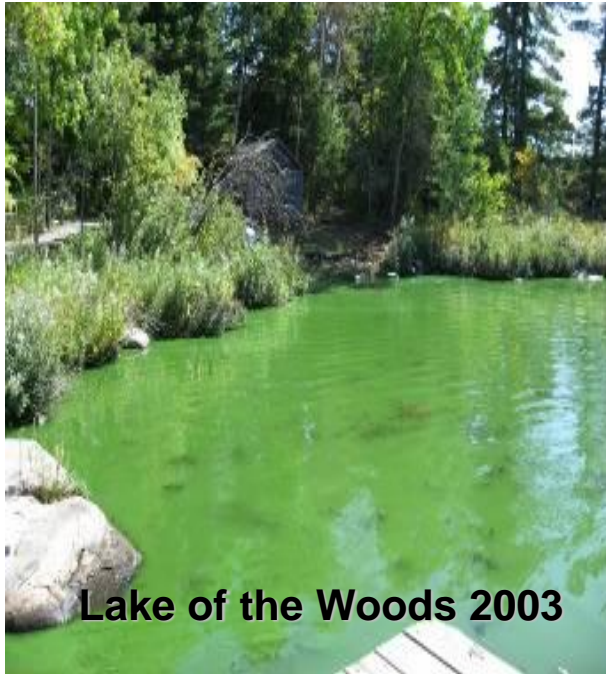
What are algae?

Algae are

- aquatic organisms that resemble plants
- found in all water bodies
- recent estimate of 72,500+ species
- range from microscopic to 10m+
- many different types
 - attached
 - free-floating
- important and necessary part of lake food webs



Algal Blooms



Lake of the Woods 2003

- A “bloom” is the excessive or nuisance amount growth of one or more species of algae
- Blooms can...
 - Impact the appearance of water,
 - Result in unpleasant tastes or odours,
 - Reduce water clarity
 - Colour the lake a vivid green, brown, yellow, or red,
 - Lower oxygen levels,
 - Produce toxins (cyanobacteria)

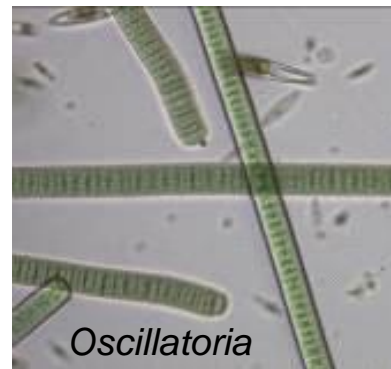
Blue-green algae are of particular concern

Cyanobacteria

- a type of photosynthetic bacteria
- called algae due to their ecology
- have inhabited the earth for > 2 billion yrs
- live in a wide range of environments



Examples



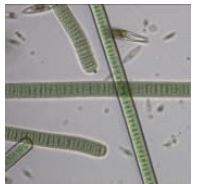
Bloom forming cyanobacteria



- Toxins produced by cyanobacteria can be classified as:
 - **Hepatotoxins** – e.g. microcystins, cylindrospermopsin and nodularins, affect the liver
 - **Neurotoxins** – e.g. anatoxins and saxitoxins, affect the nervous system
 - **Irritant toxins**



- Toxins are released to the water when algal cells die.
- When ingested, cyanotoxins induce symptoms such as fever, diarrhea, abdominal pain, nausea and vomiting.



- External contact during recreational activities, such as swimming, boating or water skiing may result in itchy, irritated eyes and skin.
- Toxins may accumulate in fish tissue; research to date indicates that eating fish should be avoided during a bloom, and for at least two weeks after.

Bloom forming cyanobacteria

Bloom forming conditions include:

- sufficiently high levels of nutrients (water or sediments)
- calm weather
- strong sunlight
- high air and water temperatures
- relatively shallow water

These conditions usually occur from mid summer into fall



Global increase in algal blooms – nutrient enrichment & climate change

“Nutrient over enrichment... has promoted the growth of cyanobacteria... Climate Change is a potent catalyst for further expansion of these blooms”

Paerl & Huisman (2008) Blooms like it hot. *Science*. 320 (5872): 57-58.



Algal bloom response

Previous approach:

- Algae viewed as a temporary nuisance due to odour and fouling aspects
- Algae were often assessed as a low risk priority

Algal bloom response

Current approach:

- Adoption of an Ontario Drinking Water Standard for microcystin-LR 0.0015 mg/L (O. Reg 169/03, schedule 2)
- As a result of concern of health risks to humans and animals, algal blooms became higher priority
- **Any cyanobacterial bloom is regarded as being potentially toxic**
- 12-point action plan that includes comprehensive protocol for responding to occurrences of blooms of cyanobacteria

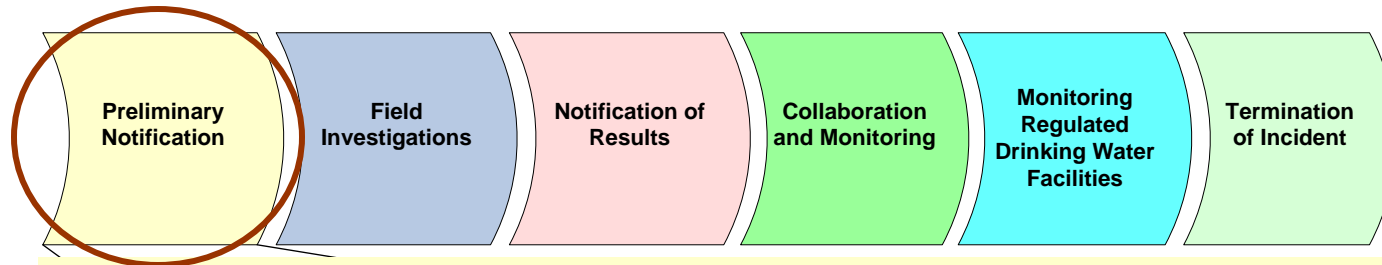
Algal bloom response

MOECC Response Protocol

- Ensures communication and collaboration among the various stakeholders
- **MOECC role is to gather, assess and provide basic scientific & technical information with which the Health Unit can assess risks to humans**
- Health Unit makes decisions as to whether notification of the public is required, and what actions should be taken



Algal bloom response – Process Map



Report of Algal Bloom

MOECC District Office

- Intake of algal bloom report
- Assesses information, decide if cyanobacteria are present
- If cyanobacteria are present, notify local Health Unit and MOECC Safe Drinking Water Branch; Issues Management

Health unit

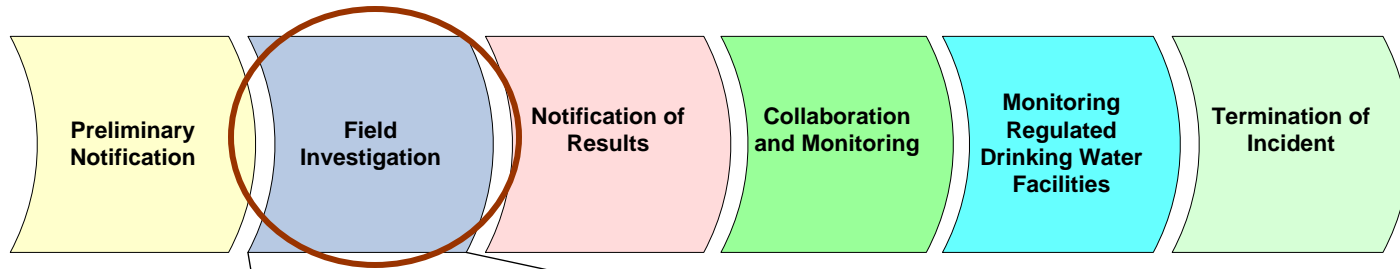
- responsible for decision on public notification

MOECC Safe Drinking Water Branch

- Notifies regulated drinking water facilities, if any

Spills Action Centre if after hours

Algal bloom response – Process Map



Confirm/Suspect blue-green algae

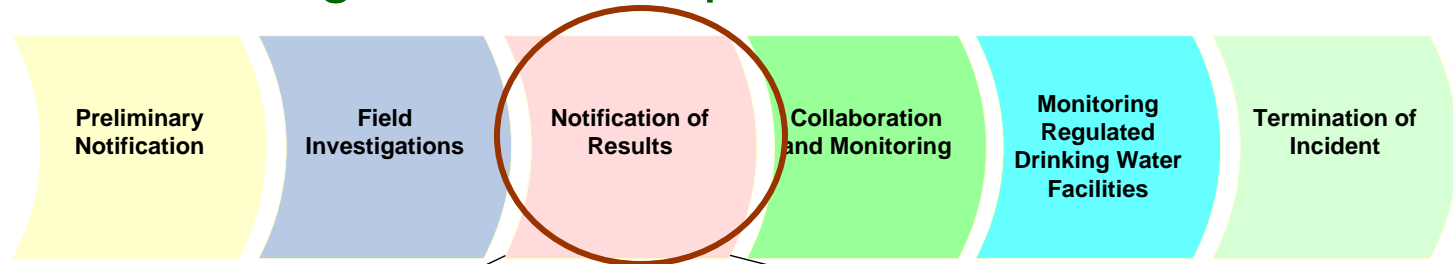
MOECC District Office

- Health Unit may request MOECC conduct a field investigation
- This may be performed by the Technical Support Section of MOECC Operations Division

Environmental Sciences and Standards Division of MOECC

- Provides information on sampling protocols
- Determines presence/absence of cyanobacteria
- Screens samples with cyanobacteria present for algal toxins
- Communicates results to requestor

Algal bloom response – Process Map



Results from Field Investigation

MOECC District Office

- Notifies all potentially impacted parties (Health Unit, Municipality, CAs, OMAFRA, MNRF, etc.)

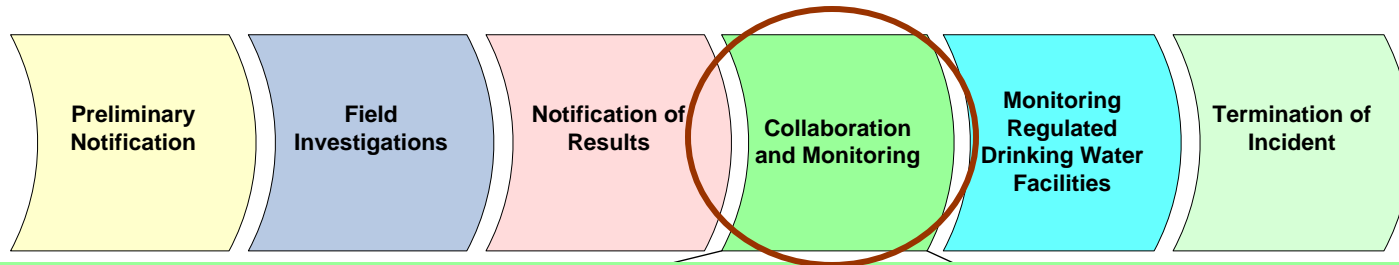
Health Unit

- Decides whether public health is at risk
- Provides appropriate notification (e.g., news release, beach posting)
- Communicates results to requestor

MOECC Safe Drinking Water Branch

- Notifies regulated drinking water facilities in the area, and ensures appropriate action is taken

Algal bloom response – Process Map



If algal bloom continues

MOECC District Office

- Monitors field conditions as requested by the health unit
- Reports back to other agencies, continue to document the incident and manage issues

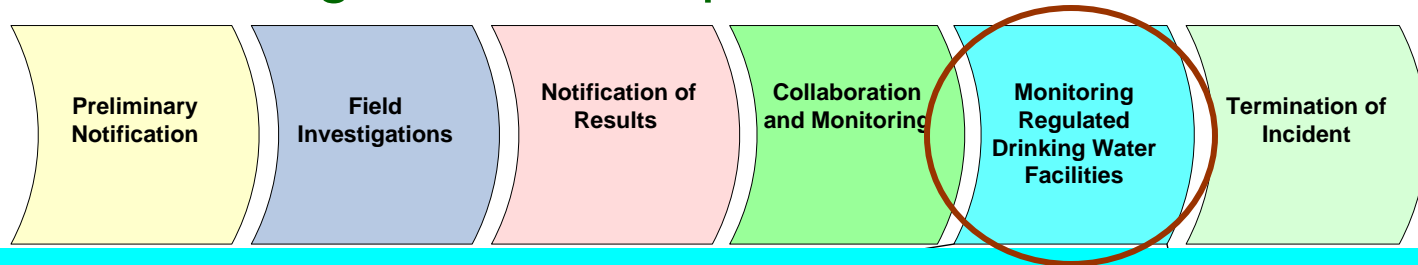
Health Unit

- Provides input on health issues, safety of drinking water, need for testing
- Responsible for decisions on public notification

MOECC Safe Drinking Water Branch

- Collaborates with health unit, district office, etc.
- Continues to work with regulated drinking water facilities

Algal bloom response – Process Map



If a regulated drinking water facility is or may be impacted

MOECC Safe Drinking Water Branch

- Works with regulated facilities, determine needs, coordinate monitoring program, notify involved parties of the results, work with health unit, district office, etc.
- Reports back to other agencies and continue to document the incident

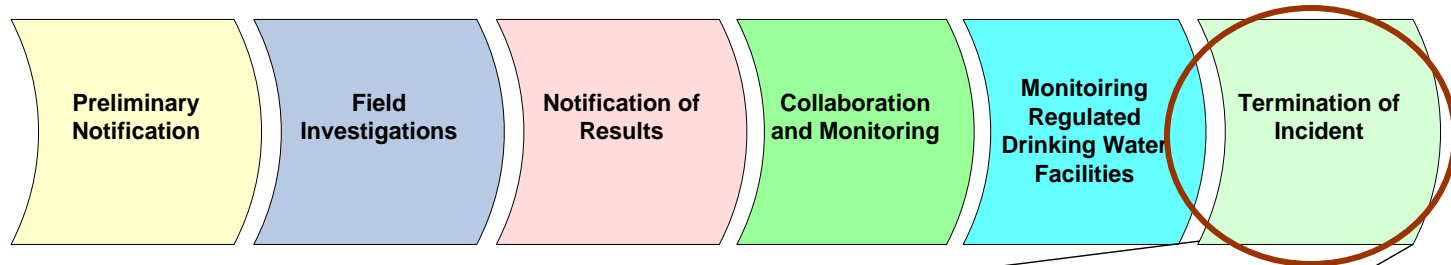
MOECC District Office

- Reports back to each party involved

Environmental Sciences and Standards Division

- Continues to report results of identification and reports microcystin levels to all parties

Algal bloom response – Process Map



Absence of cyanobacteria or algal bloom ends

Health Unit

- Makes the ultimate decision to close the incident file and notifies MOECC district office
- Notifies the public

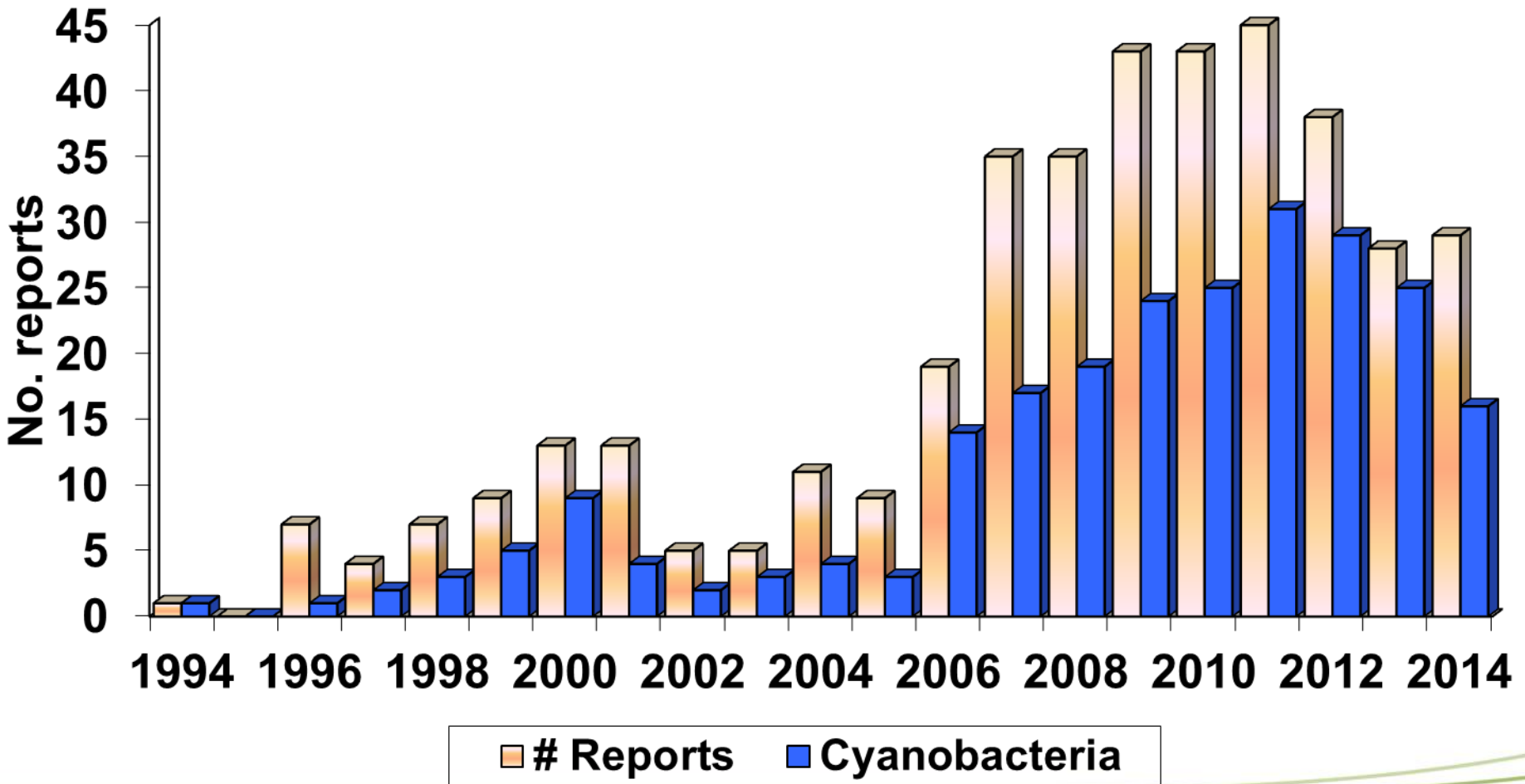
MOECC District Office

- Notifies parties involved that the bloom has ended
- Closes the incident file

Safe Drinking Water Branch

- Notifies regulated drinking water facilities

Number of reports in which cyanobacteria confirmed



What is the MOECC doing about blooms?

Twelve Point Plan released in Fall 2014

- includes education and outreach – info on ontario.ca and new fact sheets

Blue-Green Algae Incidence Response

- provincial response to reports of algal blooms
- tracks the occurrence & prevalence of algal bloom reports throughout the province

Drinking Water Surveillance Program

- Blue-Green Algae Toxins Survey
- algal toxins are monitored at a selection of municipal drinking water facilities

Nutrient Reduction

- legislation (e.g., Nutrient Management Act, Ontario Water Resources Act) & numerous programs have been implemented to reduce nutrient loading to Ontario waterbodies

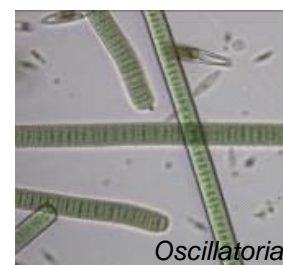
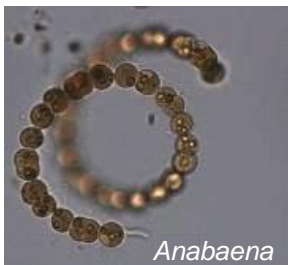
Research & Monitoring

- MOECC partners with government, universities, NGOs, & other stakeholders on numerous efforts to understand algae & the factors that promote algal blooms

New research: Enhanced cyanobacterial monitoring project

Objectives

- to determine when blue-green algae become abundant
- to measure the size & duration of blooms
- to identify factors that trigger blooms in different lakes
- ultimately, to better understand when & why blue-green algal blooms occur; this information will support future efforts to predict algal blooms



Take away messages

- Algal blooms are increasing in Ontario
- MOECC has released a 12 point plan to address blue-green algal blooms
- MOECC is working to better understand the factors that promote algal blooms & the actions needed to reduce the occurrence of harmful algal blooms
- Collaborative research & monitoring projects play an essential role in protecting Ontario's water resources



Conestoga Lake 2004 - *Aphanizomenon*



Lake Erie, western basin 2008

SEP 19 2008



Kingston inner harbour 2010 – *Anabaena*



Little Lake Panache 2006 -
Planktothrix rubescens



Filamentous green algae:



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