Ministry of the Environment, Conservation and Parks

Phosphorus and Algal Blooms

Source Protection Chair's Meeting

Sept 14, 2021

Ontario

Objectives of presentation

1. Phosphorus in surface waters
2. Algal blooms and influencing factors
3. Phosphorus and algae status and trends
   - Great Lakes
   - Inland waterbodies
4. Policy initiatives and actions to mitigate phosphorus impacts
   - Great Lakes
   - Inland waterbodies
5. Future actions

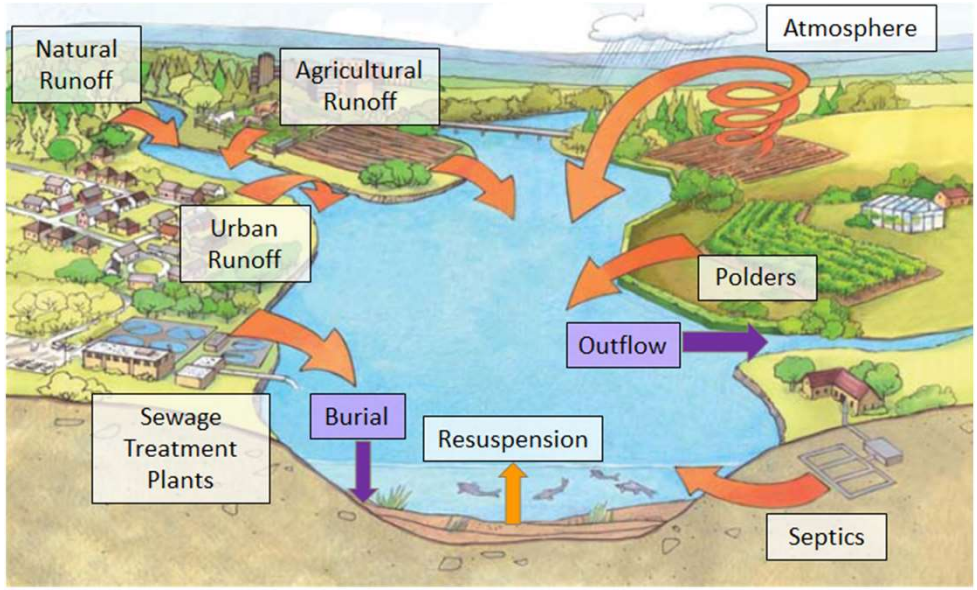
Phosphorus in Ontario's surface water

Phosphorus

- Occurs naturally and is **essential** for plant and animal life.
- Phosphorus is the primary nutrient that promotes growth of algae in freshwater

Phosphorus balance = input (loads) - output

- Inputs to lakes and rivers are increased by human activities.
- Comes from point (e.g., sewage treatment plants) and non-point sources (e.g., agricultural and urban run-off)
- The link between the loads of phosphorus entering a lake and concentrations in a lake is increasingly complex.



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What are algal blooms and are they a problem?

- Algae are an essential component of a healthy aquatic food web.
- Conditions supporting excessive growth of algae can result in a "bloom".
- Algal blooms do occur naturally, but environmental stressors such as excess phosphorus, climate change and invasive species are contributing to increased algal blooms.

When are algal blooms a cause for concern?

Nuisance blooms (e.g., *Cladophora*) – clogging of water intakes and taste/odour issues in drinking water, fouling of beaches, and impact on fish habitat.

Harmful blooms – blue-green algae blooms (also called cyanobacteria) can sometimes produce poisons called “cyanotoxins” that cause skin and eye irritation and if ingested in large quantities can cause flu-like symptoms and are potentially toxic to humans, wildlife, livestock and pets.

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Factors influencing algal blooms

Reducing excess phosphorus is a necessary step to improving the health of an over-enriched ecosystem, but it is not the only factor that influences algal growth.

Weather, light availability and water depth are important. Nuisance and harmful bloom formation is more likely in calm, hot, sunny weather and shallow water when adequate nutrients are available.

- **Possible scenarios with climate change:**
  - More algal blooms anticipated due to **higher temperatures** and **accompanying effects**, such as less lake mixing, less ice-cover, and longer growing period.
  - More severe storms expected to increase phosphorus inputs from non-point sources.
- **Invasive species** have drastically changed phosphorus cycling in lakes.
  - Invasive zebra and quagga mussels established in the Great Lakes in the mid-1990s and have spread to many inland waterbodies.
  - The effects of invasive species on harmful blooms are still unclear.

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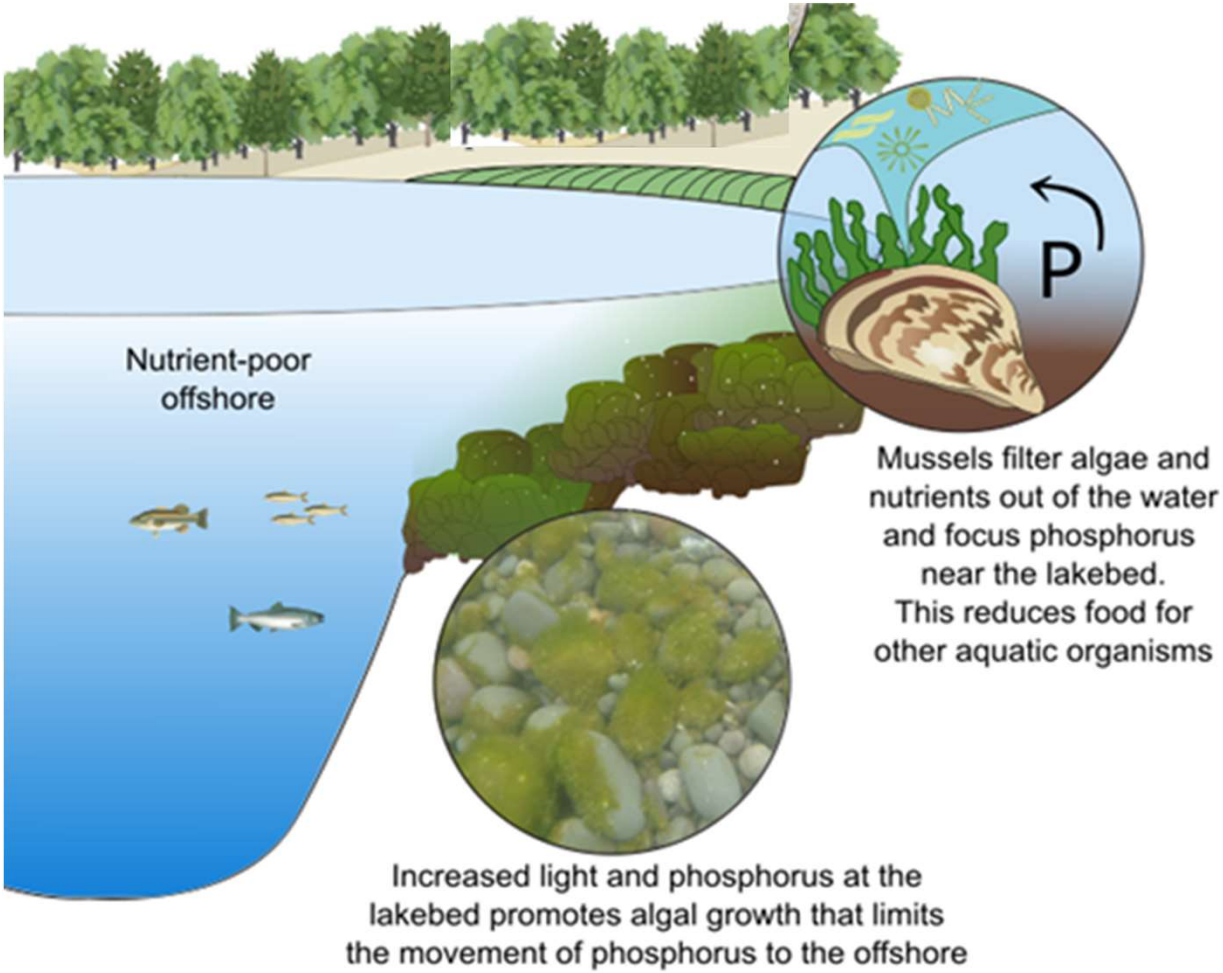
Dreissenids alter phosphorus cycling and algae

Invasive Dreissenid mussels have altered nutrient cycling by removing phosphorus from the water column and moving it to lakebed



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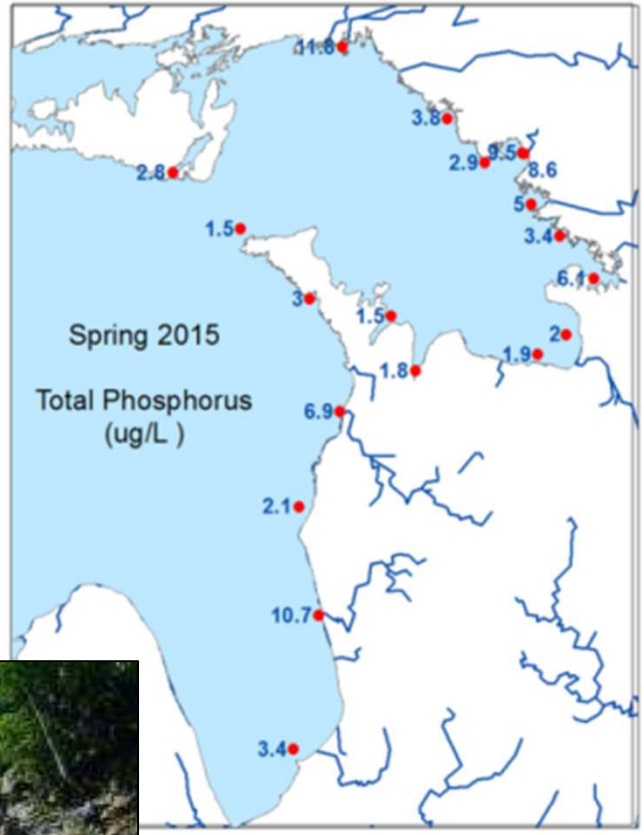
Issue: Phosphorus and nuisance algae

Cladophora mats



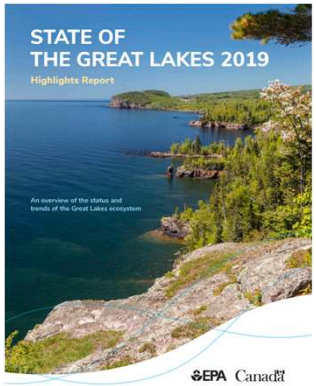
Lake Huron – very low phosphorus, undergoing "desertification"

Issue: Phosphorus and harmful algal blooms

Cyanobacteria
(blue-green algae) blooms

Great Lake 'hotspots'

Trends in phosphorus and algae - Great Lakes



State of the Great Lakes 2019 reported an overview of the status and trends in the Great Lakes ecosystem

Sub-Indicators Supporting the Indicator Assessment					
Sub-Indicator	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
Nutrients in Lakes	Unchanging	Deteriorating	Deteriorating	Unchanging	Deteriorating
Harmful Algal Blooms	Undetermined	Undetermined	Undetermined	Deteriorating	Deteriorating
Cladophora	Unchanging	Unchanging	Undetermined	Unchanging	Undetermined

STATUS

Good Fair Poor Undetermined

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Status of phosphorus and algae – Great Lakes

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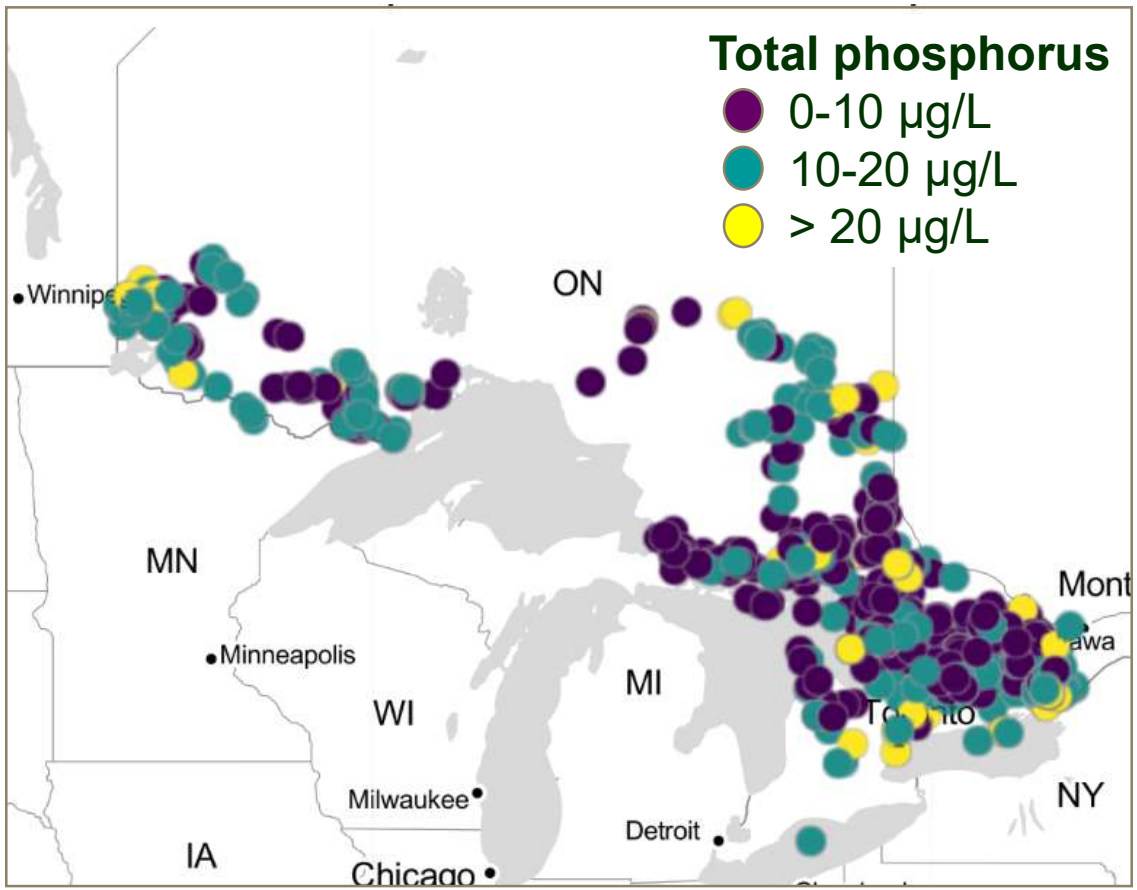
Phosphorus status – Inland Lakes

In Ontario, the Provincial Water Quality Objective (PWQO) for total phosphorus in lakes is < 20 µg/L to "avoid nuisance concentrations of algae in lakes"

- 95% of inland lakes in the Lake Partner Program meet this objective



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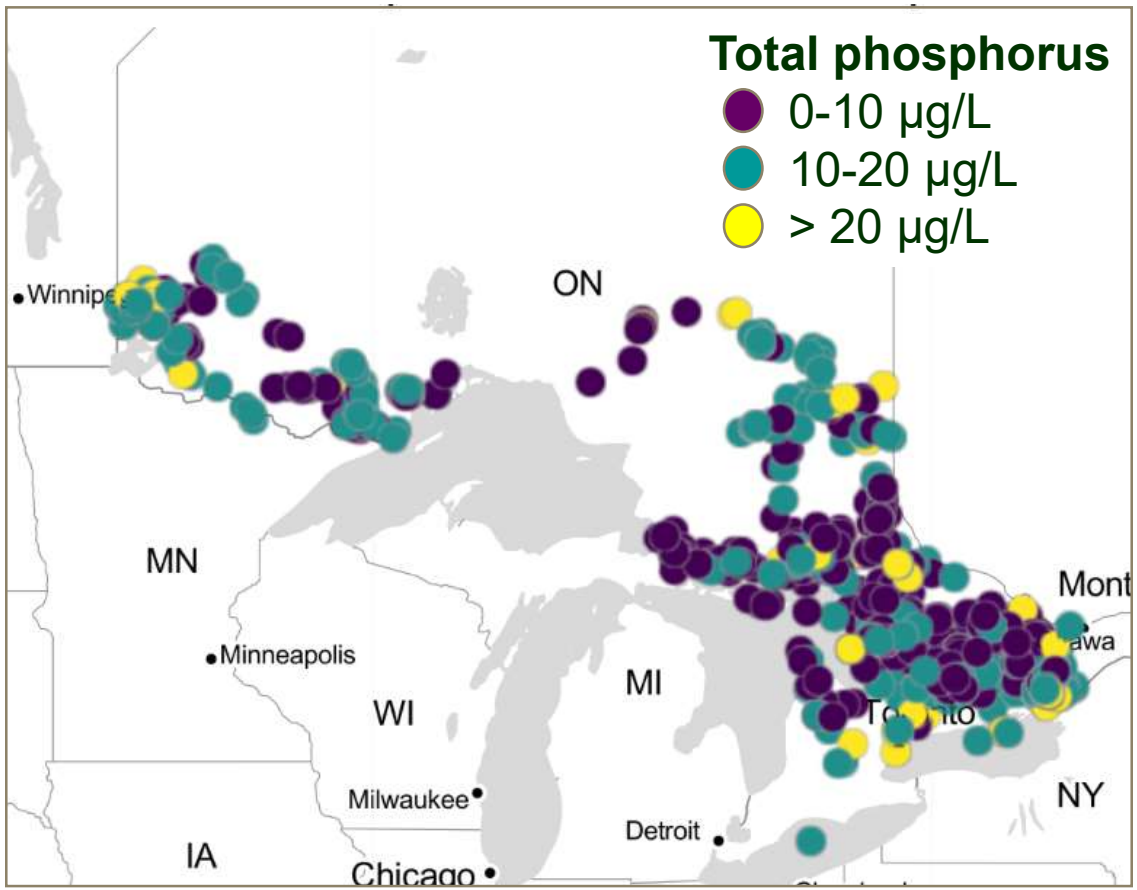
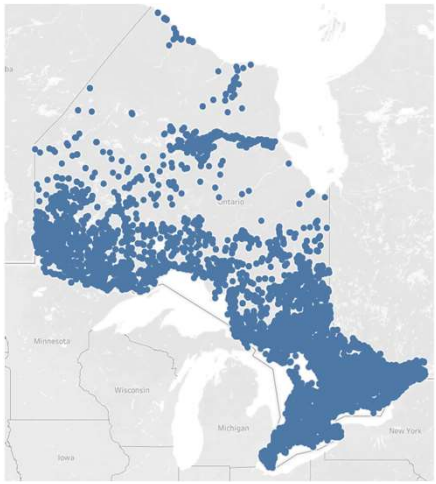


Locations with phosphorus data



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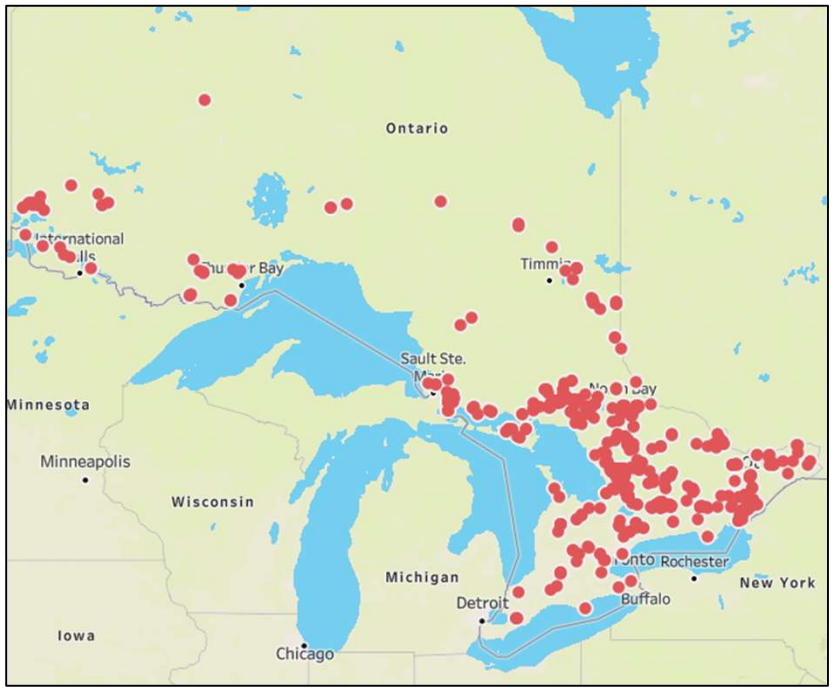
Algae Status - Inland Lakes

- Areas of known repetitive harmful blooms include Ramsey Lake, Lake of the Woods, Muskrat Lake, Three-Mile Lake, Lake Scugog, and several bays on Lake Nipissing.
- Harmful blooms can also occur in low-phosphorus lakes (e.g., in Algonquin Park).

Lake of the Woods

- Harmful and nuisance blooms are an ongoing public concern on both sides of the international border. Algal blooms can cover up to 80% of the lake's surface.

Inland lakes and rivers
Confirmed reports of blue-green algae blooms



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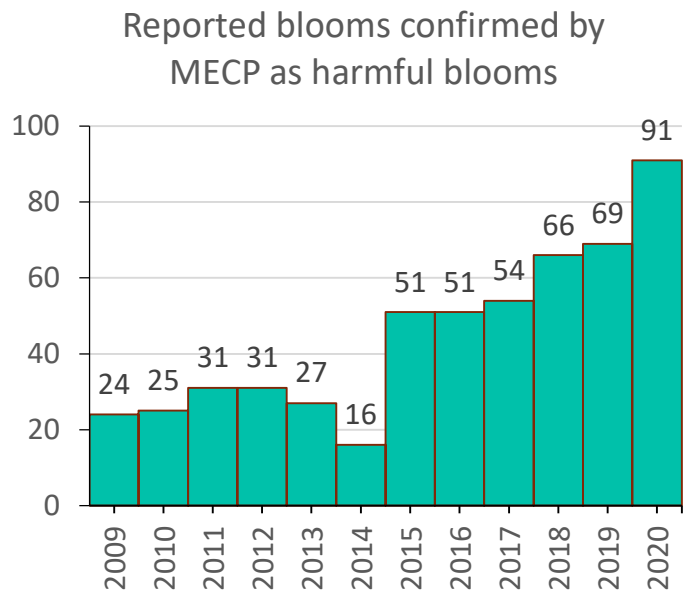
Harmful Algal Blooms – Surface Water Trends

- In the 1960s and 1970s, harmful blooms were a concern, especially in Lake Erie.
- In the 1980s-1990s, efforts to reduce phosphorus inputs, such as banning phosphate-containing detergents, decreased algal bloom occurrences.
- Today, a pattern of increasing blooms is occurring in parts of the Great Lakes and some of Ontario's inland waters.

Number of MECP-confirmed reports of harmful blooms in inland lakes, rivers and Great Lakes bays is increasing, likely due to:

- increased public awareness and reporting of suspected blooms
- changes in climate-related factors that promote harmful algal growth
- additional nutrients, particularly phosphorus from human activities



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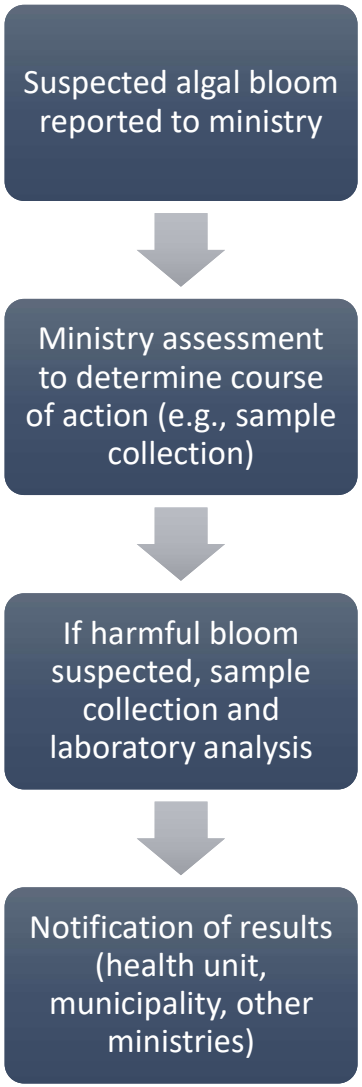
Ontario's Response to Harmful Algal Blooms

- Action Plan (See Appendix A) to harmful algal blooms
- Protocols in place for responding to complaints of algal blooms and work with local authorities and medical officers of health.
- The Ministry works with owners and operators of regulated **drinking water systems** to ensure compliance with Ontario's Drinking Water Quality Standards, and to ensure contingency plans are in place to keep drinking water safe from potential impacts of harmful algal blooms.
    - Since 2019, ministry has been incorporating requirements for a harmful algal bloom monitoring, sampling and reporting plan into the license of the 203 municipal residential drinking water systems that use surface water as their source; to be finalized in March 2022.



Ministry gathers, assesses and provides scientific and technical information, as appropriate.

Ministry laboratory can provide confirmation and toxin analysis within 24 h if needed.

Public health agencies provide public health messaging (beach postings and notices to residents on drinking water concerns for non-regulated systems).

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Policy initiatives and actions - Great Lakes

Great Lakes Agreements

- Ontario participates in the cooperative management of the Great Lakes guided by the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health (COA) and Canada-U.S. Great Lakes Water Quality Agreement (GLWQA).
    - Under both agreements, Ontario (MECP as lead) participates in numerous science and implementation projects geared to reducing phosphorus loadings at both the lakewide (Lake Erie) and local scale (see Appendix C for Bay of Quinte).
- Recognizing that Lake Erie is the most stressed of the Great Lakes, Canada and the U.S. developed science-based targets under the GLWQA for **Lake Erie** to reduce phosphorus loads by 40% compared to 2008 levels for western and central basins of the lake.
    - Ontario target: 212 metric tonnes; U.S. is responsible for a much larger reduction.
    - Eastern basin target is pending further science.

Lake Erie Action Plan

- To help meet the bi-national phosphorus load reduction targets under GLWQA, Canada and Ontario developed the **Lake Erie Action Plan.** This also helps Canada and Ontario meet their commitments under COA.
- U.S. developed an overarching plan with individual plans from bordering Lake Erie states.
- Canada-Ontario Lake Erie Action Plan includes over 120 federal, provincial and partner actions to achieve the 40% reduction in phosphorus, e.g., encouraging effective techniques to keep phosphorus on farmland and out of the watershed, improving wetland conservation, and upgrading municipal wastewater treatment and collection systems.
- The ministry's **Multi-watershed Nutrient Study,** started in 2014, aims to quantify changes in nutrient/land use relationships since the 1970s and to assess the scope for change in agricultural nutrient inputs (e.g., phosphorus loadings) to the Great Lakes. The study has become a key action in the Canada-Ontario Lake Erie Action Plan (see Appendix D).

Policy initiatives and actions - Inland Lakes

Lake of the Woods

- In winter/spring 2021, Ontario participated in an ECCC-led consultation to examine the potential for establishing a phosphorus reduction target for the Canadian portion of the watershed. Next steps are pending discussions with ECCC.

Muskoka Watershed Conservation and Management Initiative
https://www.ontario.ca/page/protecting-muskoka-river-watershed

- The Muskoka watershed is facing pressures including due to stresses such as increased development and flooding caused by severe weather events, as well as algal blooms.
- The Muskoka Watershed Advisory Group was established in August 2019 to provide advice and recommendations to the Minister on priority areas and issues in the Muskoka watershed.
- As part of the initial $5 million commitment to protect the Muskoka River watershed, in April 2021, MECP announced $4.25 million for 16 projects. The funding will support projects that will help safeguard the region from environmental pressures, such as severe weather and flooding, while also improving the health of the watershed.

Possible Future Actions

Some possible actions to help tackle algal blooms could include:

- Investing in wastewater and stormwater infrastructure projects aimed at reducing nutrient loadings from urban sources (e.g., improved stormwater management, sewage treatment plant upgrades and optimization).
- Update Ministry's wastewater and stormwater policies to encourage the use of innovative technologies including considering stricter pollution limits that would help reduce nutrient loadings.
- Continue to encourage low impact development and other green infrastructure initiatives to reduce urban run-off.
- Continue to work with OMAFRA, agriculture sector/other partners on best management practices and phosphorus management initiatives.

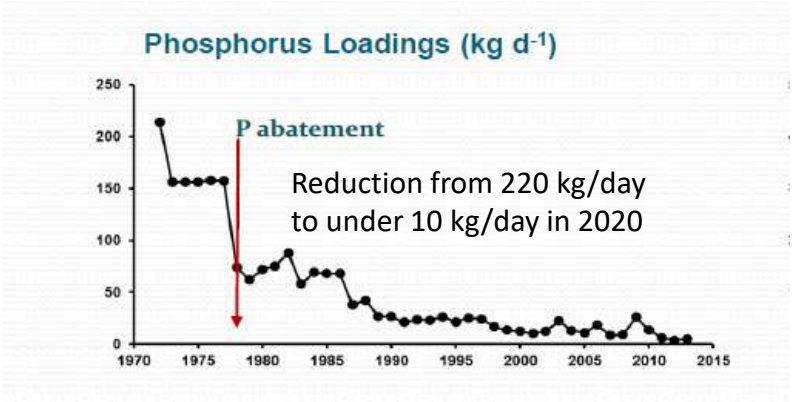
Appendix slides

Appendix A: Ontario's Action Plan for Blue Green Algal Blooms

- Ontario has an action plan outlining how we are working with our partners, to fight algal blooms in the Great Lakes and other lakes and rivers:
  1. Communicating, engaging and working with partners
  2. Reducing nutrients
  3. Protecting our drinking water sources
  4. Science and innovation
  5. Support and financial investment to improve water quality
  6. Legislation and regulatory tools
  7. Water quality standards and guidelines
  8. Monitor for blue-green algal blooms at municipal drinking water systems
  9. Public Health protection via Ontario's comprehensive protocol for responding to suspected blooms
  10. Contingency plans at municipal drinking water systems to keep water safe
  11. Analytical laboratory services to test for algal toxins
  12. Drinking water system courses

Appendix B: A Success Story: Phosphorus Load Reduction in the Bay of Quinte

- Bay of Quinte is on track to be removed from the List of Areas of Concern under the 9th COA (by 2026).
- The Bay of Quinte, a large multi-basin, Z-shaped bay in Lake Ontario, has had a long history of eutrophication and algal blooms which contributed to its designation as an Area of Concern under COA and the GLWQA.
- Municipal sewage treatment facilities were identified as a major contributing source of phosphorus.
- Work to reduce phosphorus loadings included introducing a "phosphorus wastewater load cap" in the 1990's restricting phosphorus levels in effluent from all sewage treatment plants within the watershed.
- This reduction, in conjunction with other factors, has improved water clarity and reduced algal blooms.
- Currently, an even more stringent "phosphorus wastewater loading cap" is being considered which would further reduce phosphorus loadings by up to 60%



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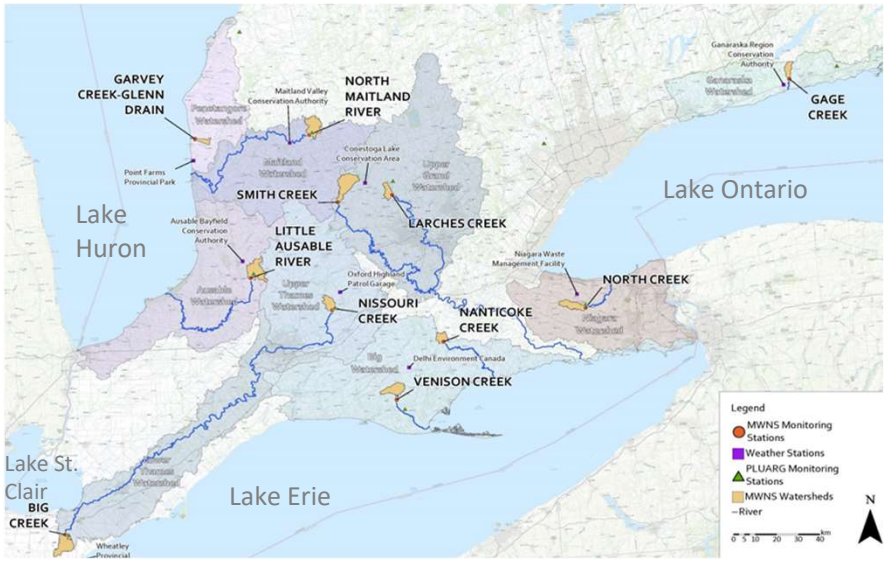
Appendix C: Multi-watershed Nutrient Study

The resurgence of algal blooms led to the Multi-Watershed Nutrient Study (MWNS) being established in 2014. The study includes 11 small agricultural watersheds in southern Ontario.

The study was designed to address the following questions:

- Have agricultural nutrient loadings changed compared to 40 years ago (during the algal bloom surge of the 60s & 70s)?
- Has the relationship between agricultural land use and loadings changed?
- Have the most important forms of phosphorus (total vs. dissolved) changed?
- What scope/potential is there to change the diffused nutrient exports from agriculture?



Preliminary results indicate:

- Seasonal timing of phosphorus loading shifted from spring to winter.
- Amount of many nutrients moving into streams increasing at most sites
- Scientific analyses of the data are currently underway

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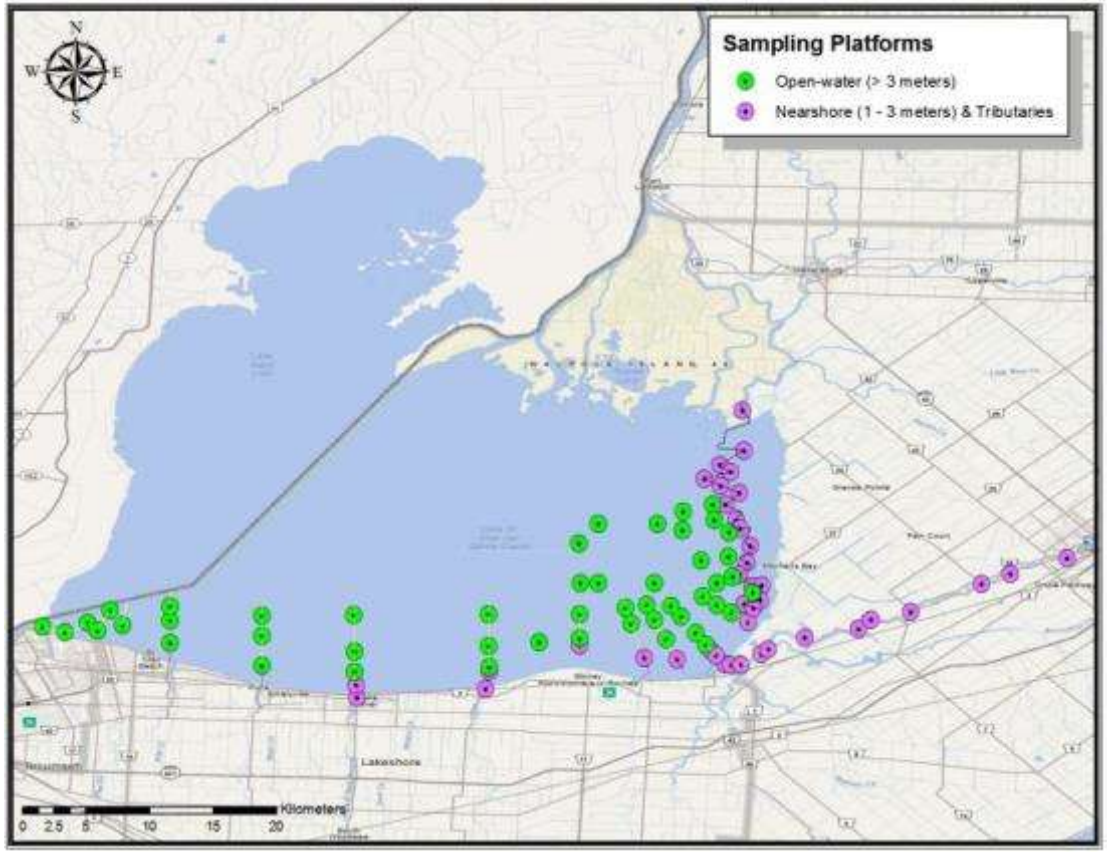
Advancing Science:
Algal Blooms in Thames R and Lake St. Clair



Lake St. Clair Nearshore and Thames River Project will assess water quality conditions and harmful algal blooms in Lake St Clair and the Thames River

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Advancing Science:
Real time water monitoring buoys