Targets for Lake Erie HAB Reduction

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Image from 8-23-15
By Joint Proclamation
Henceforth and forever after

The Lake Erie phosphorus load shall not exceed:

11,000 tonnes/year

which probably translates to about 15 ug/L
1986

Image from 8-23-15
Lake Erie Total Phosphorus Loading, 1967-2011

Target generally met since 1990s
Increase in western basin HABs
Annex 4: Nutrients – 6 Lake Ecosystem Objectives
1. minimize hypoxic zone extent - particular emphasis on Lake Erie
2. algal biomass below nuisance condition
3. algal species consistent with healthy aquatic ecosystems in nearshore
4. cyanobacteria toxins below levels that threaten human or ecosystem health
5. oligotrophic state in open waters of Superior, Michigan, Huron, and Ontario
6. mesotrophic conditions in western, central basins of Erie, oligotrophic conditions in eastern basin

Update Substance Objectives (target phosphorus concentrations)
Update Phosphorus Load Targets
Do this for Lake Erie within 3 years (February 2016)

Annex 4 Subcommittee has been meeting regularly since late 2013
Recommended Phosphorus Loading Targets Report - May 2015
Developed using 9 parallel models
### Recommended Phosphorus Load Targets

#### Summary of Phosphorus Load Targets

<table>
<thead>
<tr>
<th>Region</th>
<th>Objective</th>
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<tbody>
<tr>
<td>Western Basin Cyanobacteria – Bloom biomass less than or equal to 2004 or 2012 9 years out of ten, and/or reduce risk of nearshore localized blooms</td>
<td>Spring (Mar-July): 860MT*, Dissolved Reactive Phosphorus load: 186MT*</td>
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<tr>
<td>Maumee River</td>
<td>Spring (Mar-July): 860MT*, Dissolved Reactive Phosphorus load: 186MT*</td>
</tr>
<tr>
<td>Other Western Basin Tributaries and Thames River</td>
<td>Total Phosphorus load: 40% reduction <em>, Dissolved Reactive Phosphorus load: 40% reduction</em></td>
</tr>
<tr>
<td>Central Basin Hypoxia – Aug –September Average Hypolimnetic oxygen of 2mg/L or more</td>
<td>Total Phosphorus load: 6000MT **</td>
</tr>
<tr>
<td>Cladophora – insufficient information to establish target</td>
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</tbody>
</table>

#### Eastern Basin Cladophora Substance Objectives

- **Spring (Mar-July):** 860MT*, Dissolved Reactive Phosphorus load: 186MT*
- **Annual:**
  - **Total Phosphorus load:** 860MT*
  - **Dissolved Reactive Phosphorus load:** 186MT*
- **Other Western Basin Tributaries and Thames River**
  - **Total Phosphorus load:** 40% reduction *
  - **Dissolved Reactive Phosphorus load:** 40% reduction*
- **Central Basin Hypoxia – Aug –September**
  - **Average Hypolimnetic oxygen of 2mg/L or more**
  - **Total Phosphorus load to WB & CB, including Detroit River and atmospheric load:** 6000MT **
- **Cladophora – insufficient information to establish target**
Western Basin Cyanobacteria Phosphorus Load Estimates

Figure 6. Source distribution of annual TP load (MTA) to the western basin of Lake Erie for 2011-13 water years, and the average TP concentration in those sources during that time (based on Maccoux personal communication)
Central Basin Hypoxia

Lake Ecosystem Objective
1. minimize the extent of hypoxic zones in the Waters of the Great Lakes associated with excessive phosphorus loading, with particular emphasis on Lake Erie;

![Central Basin Hypolimnetic Dissolved Oxygen](image)

**Figure 18**
Ongoing Changes in Lake Erie System

Long-term precipitation increasing

Long-term Maumee River discharge increasing
Long-Term Maumee River Phosphorus Inputs (smoothed)

Concentration

Load
Long-Term Maumee River Nitrogen, Solids Inputs (smoothed)

Concentration

Load

e) 6.0
   5.5
   5.0
   1980 1990 2000 2010
   TN (mg/L)

g) 4.5
   4.0
   3.5
   1980 1990 2000 2010
   NO3 (mg/L)

h) 2600
   2400
   2200
   1980 1990 2000 2010
   NO3 (kg/month)

i) 90
   80
   70
   60
   1980 1990 2000 2010
   SS (mg/L)

j) 95000
   90000
   85000
   70000
   1980 1990 2000 2010
   SS (kg/month)
Load is convenient for accounting
Load = flow \times concentration
Flow and concentration have independent effects
Flow affects nutrient distribution and delivery
Algal growth is driven by local nutrient concentration
Need to reconcile ongoing flow increases
The need for sustained, long-term phosphorus modeling in the Great Lakes

Thus, it would be prudent for the Great Lakes community to invest in a sustained, coordinated modeling effort to carry us into the future.

Ideally this endeavor would include:

- A suite of models of differing complexity and resolution, based on alternative assumptions.
- An ongoing skill assessment of model capabilities.
- Models with the capacity for rigorous uncertainty analysis.
- A home on the internet with documented code and supporting data available to make the process as transparent as possible and allow the community to use and vet the models.
- Regular updating.
- A standing committee to guide development and implementation.
- Support by well-designed monitoring program.
10. How complex should models be?

It is clear that aquatic biogeochemical models are becoming more complex, but there is no clear agreement regarding whether this is appropriate.

- Greater model complexity = Greater predictive accuracy?
- Results equivocal
- As a community we are not very good about assessing, reporting accuracy/reliability
Where do things stand?

- Proposed targets officially adopted (February 2016)
- Moving forward with Domestic Action Plans
- *Cladophora* workshop January 26-28
- Annex 4 Task Team developing monitoring/research priorities
- Adaptive Management Plan
What is Adaptive Management?

• Well established concept – extensive literature*
• Decision-making under uncertainty
• Reduce uncertainty via ecosystem-scale experiment - not usually feasible
• Recognize management actions as experiment
• Learn – Testable hypotheses supported by appropriate research and monitoring
• Update management actions with new knowledge

➢ Active learning process – not trial and error

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Active vs Passive Adaptive Management

Less learning  |  More learning

Passive
Choose “best” management
Monitor
Evaluate

Active
Deliberate, structured experimentation
Choose management to push system
Develop testable hypotheses, alternative models
Structure monitoring, research to test hypotheses, differentiate models

➤ Best to be closer to the active side
Implementing Adaptive Management

To effectively implement, requires:

- Defined problem
- Authorization to address problem
- Institutional framework to support collaboration
- Defined objectives
- Work plan and reporting cycle
- Performance measures
- Stakeholder involvement

- Resources
- Political will
In Conclusion

- Recommended targets moving forward – still work to be done – Adaptive Management
- Adaptive management has become buzzword - has to be an imperative
- Otherwise we’ll make same mistake as 80s
- System is changing on time scales that matter
- Requires resources and political will

- Current focus on Erie - HABs, hypoxia, Cladophora
- Ontario work to begin soon - Cladophora
- Offshore Michigan and Huron - oligotrophication

Thank You!