# Target Loads, Strategies to Meet Them, Lessons from the Past

Image from 8-23-15

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with a little help from my friends:
Debbie Lee, Jeff Reuter, Dr. Seuss

# 1978 GLWQA

btw #experiment
we don't know exactly what will happen…

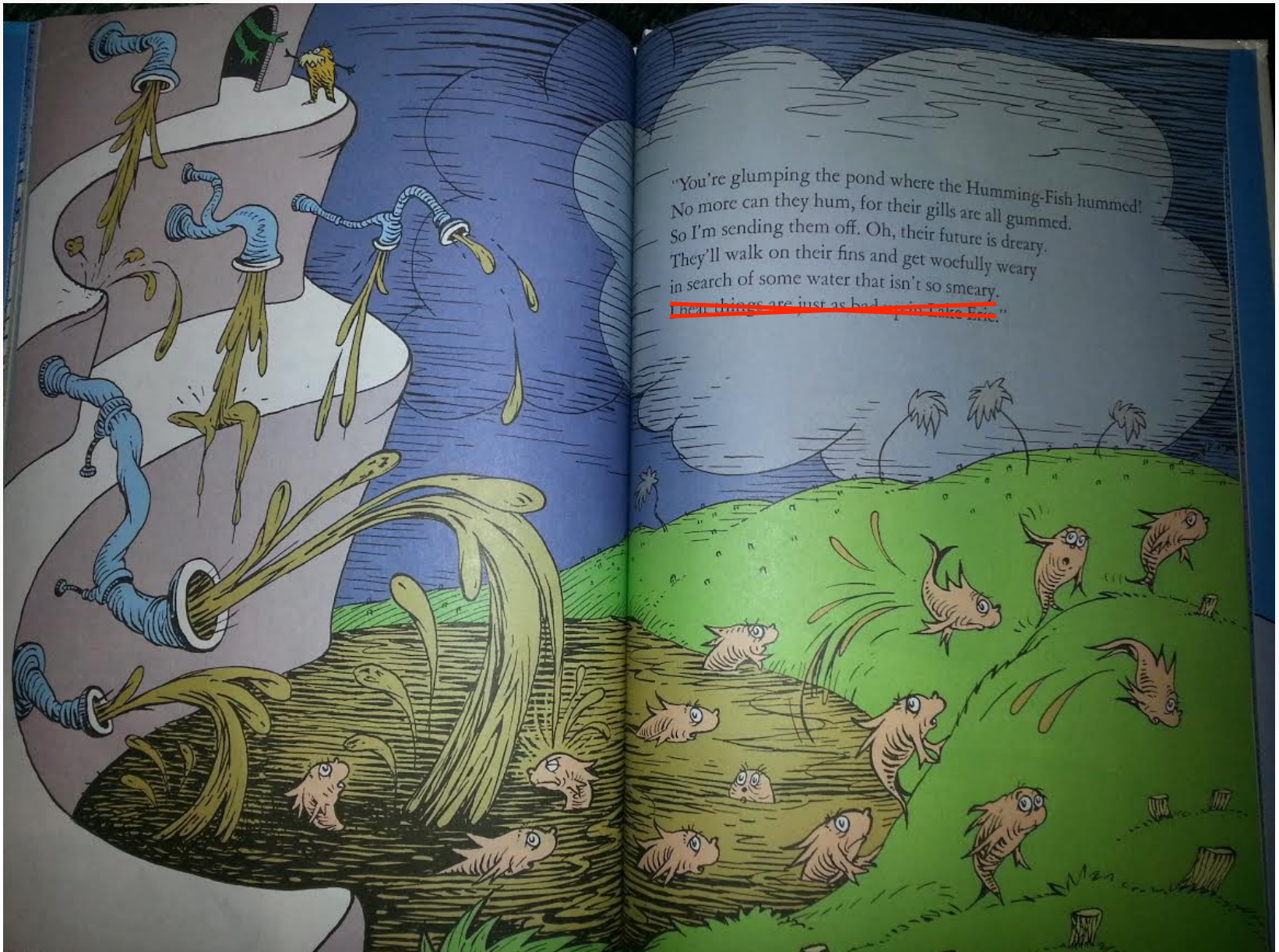
By Joint Proclamation
Henceforth and forever after

The Lake Erie phosphorus load shall not exceed:

**11,000 tonnes/year**

which probably translates to about 15 ug/L

# 1986


"You're glumping the pond where the Humming-Fish hummed!
No more can they hum, for their gills are all gummed.
So I'm sending them off. Oh, their future is dreary.
They'll walk on their fins and get woefully weary
in search of some water that isn't so smeary.

# Lake Erie at the Millennium Conference 1999

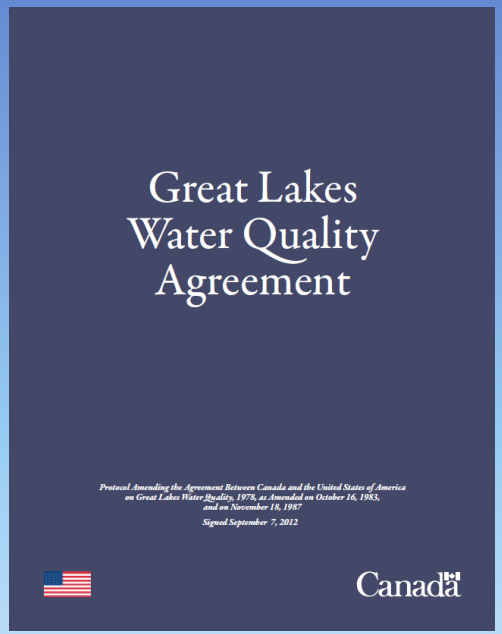
"In the late 1990s there has been pressure by some fishing interests to increase nutrients loads in order to increase fish yields…"

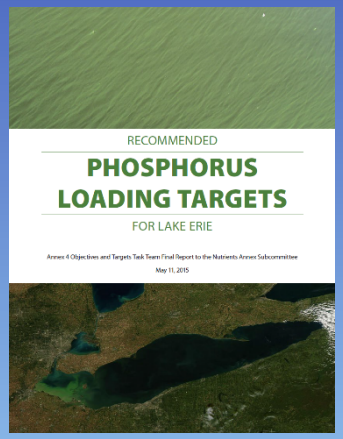
"… n
Mur


"As phos ussels
invaded i tration
increased a
blooms t
Rex Lowe

"Current 70s have
abated, v western
basin (67% and 21%, respectively). … Nevertheless, major blooms of toxic strains of Microcystis occurred in the western basin in 1995 and 1998, suggesting that phosphorus availability may be increasing."
Culver et al.

# 2012 – New GLWQA




Annex 4 - Nutrients

Six Lake Ecosystem Objectives

Update Substance Objectives (target 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

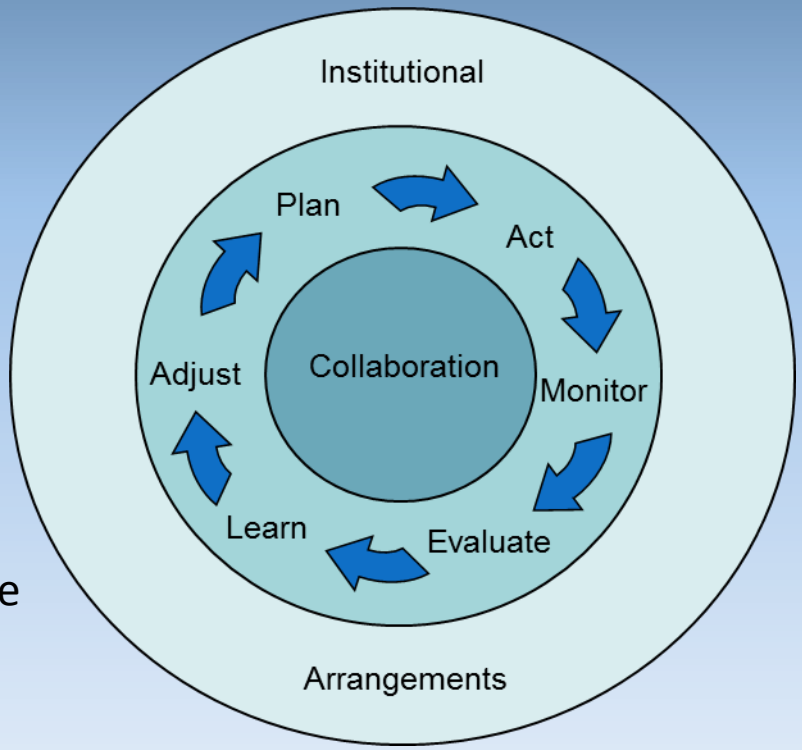
# Recommended Phosphorus Load Targets

| Summary of Phosphorus Load Targets | | |
|---|---|---|
| **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** | | |
| **Maumee River** | | |
| | Spring (Mar-July) | Annual |
| **Total Phosphorus load** | 860MT# | |
| **D** | | |
| **Other Western Basin Tributaries and Thames River** | | |
| **Total Phosphorus load** | 40% reduction * | |
| **Dissolved Reactive Phosphorus load** | 40% reduction* | |
| **Central Basin Hypoxia – Aug –September Average Hypo- limnetic 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** | | |

btw #experiment
we don't know exactly what will happen…

# Adaptive Management - An Imperative

- 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**

**Holling, C.S., and Chambers, A.D. 1973. Resource science: the nurture of an infant. Bioscience **23: 13-20.***

# Active vs Passive Adaptive Management


**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

POLICYFORUM

CLIMATE CHANGE

## Stationarity Is Dead: Whither Water Management?

Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.

P. C. D. Milly,[1]* Julio Betancourt,[2] Malin Falkenmark,[3] Robert M. Hirsch,[4] Zbigniew W. Kundzewicz,[5] Dennis P. Lettenmaier,[6] Ronald J. Stouffer[7]

Science 2008

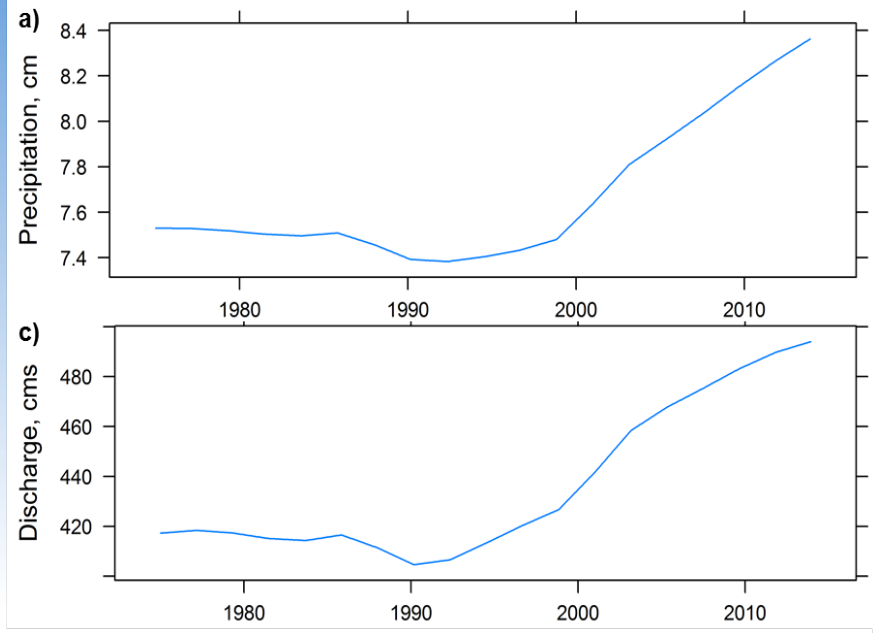
Environmental Science & Technology

Article

pubs.acs.org/est

## Long-Term and Seasonal Trend Decomposition of Maumee River Nutrient Inputs to Western Lake Erie

Craig A. Stow,*[,†] YoonKyung Cha,[‡] Laura T. Johnson,[§] Remegio Confesor,[§] and R. Peter Richards[§]




Long-term precipitation increasing

Long-term Maumee River discharge increasing

# Implementing Adaptive Management

To effectively implement, requires

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

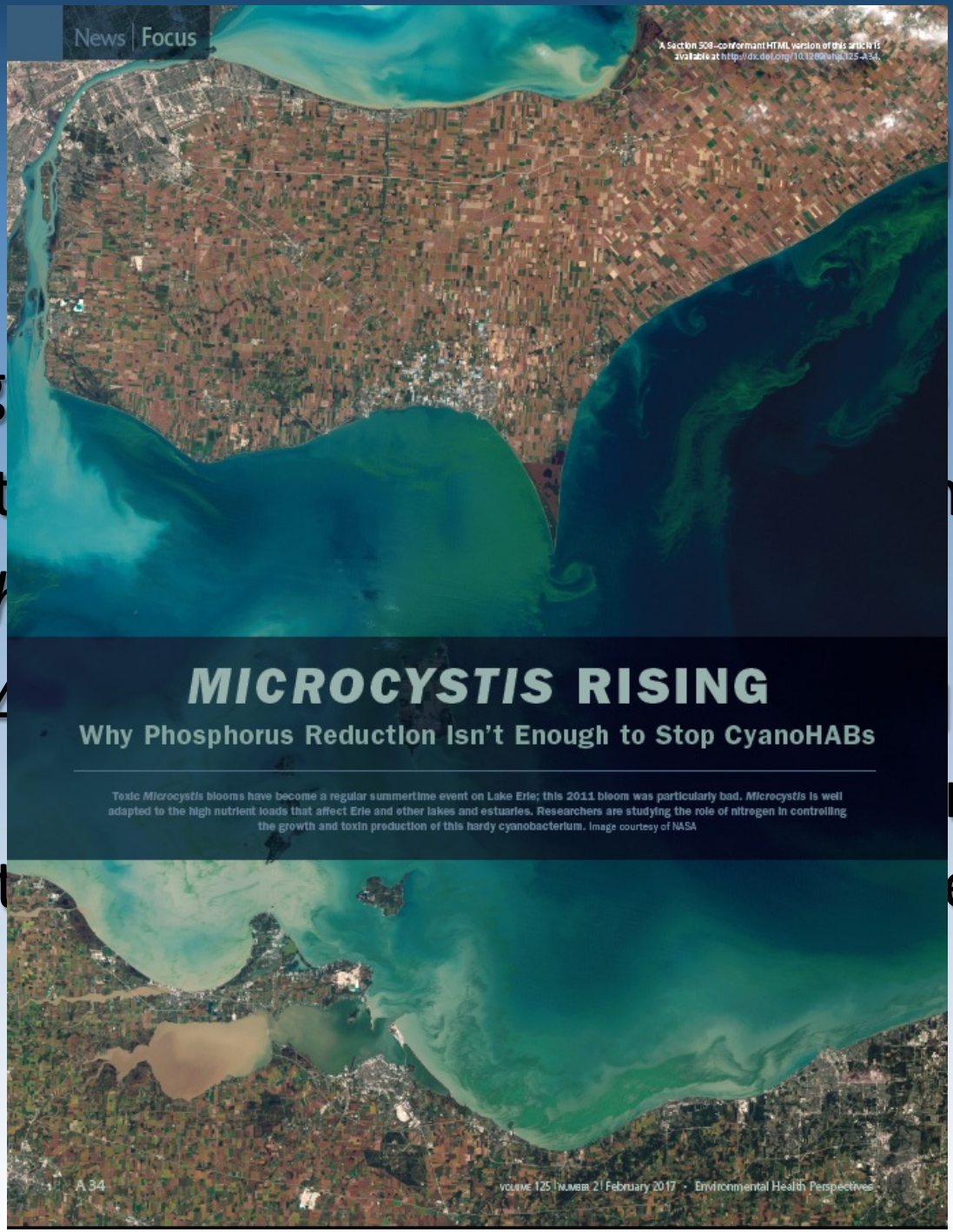
Under Development

Draft Report - (24 November 2015) RECOMMENDATIONS FOR MONITORING, MODELING, RESEARCH AND REPORTING TO SUPPORT ADAPTIVE MANAGEMENT

- Resources
- Political will

?

- Moving
- Domest ment
- *Cladoph*
- Annex 4 anagement Plan to riorities, load est es



# In Conclusion

- Going forward, our willingness and ability to monitor, evaluate, and update the targets will be more important than the original targets

Thank You!