Water Column

Fall 2015
Vol. 27, No. 3

Another Green Summer

~ *Melissa Clark*

As we reach the peak growing season for lake productivity, many of us have experienced very green lakes with some covered with algal scums that have closed off lake recreation. We have all heard about the remarkably large blooms on Lake Erie in 2014 that were so impressively seen from space. We've anxiously watched them grow again this summer (Figure 1). Unfortunately, it takes such extraordinary events to become a part of the dinner table conversation. Either way, algae is now a topic that has entered the national discussion. Folks have been working to address the watershed activities that contribute to these algal blooms for decades with mixed success because of the inherent challenges of watershed work and the many various stakeholders. I should clarify that while I suggested "soil health = water health" in the last *Water Column*, addressing phosphorus sources and transport pathways is an essential component. This *Water Column* shares information on the consequences of too much phosphorus loading, from the watershed and from years of previous watershed loading that is now residing in the lake sediments fueling growth internally. Many lakes have reached their threshold responding with new uncharacteristic blooms. EPA has recommended phosphorus loading reductions that is summarized within this issue and they are seeking public input.

Figure 1. The remarkably large blooms on Lake Erie in 2014 were impressively seen from space and they've grown again this summer.

Lake Spotlight:

Koontz Lake Deals with Algae Problems

Mark Peterson

UPDATED: AUG 31, 2015: Alga appears poised to become the "Grinch" that stole the Labor Day Holiday.

Potentially dangerous amounts of the bacteria blanketed the north shore of Koontz Lake over the weekend (Figure 2).

"I've owned this house here for ten years, I've never seen it like this, never seen it this bad," said Jim Berger with the Koontz Lake Aquatic Central Committee

"When you see this pond scum floating on top of the water and it's washed in to where it's really thick and you've got these white, green and blue tones to it, that's a particular concern. You don't want to be anywhere near that," said John Ullrich the hopeful founder of a Koontz Lake Conservancy District. It's the goopy, gooey, smelly, kind of slime that is capable of producing toxins.

"It could be harmful or fatal for animals. I was on the phone this morning with them and they said everybody around here has underground sprinkler systems, they said if you have a dog or a small child, can't even use it to water your lawn because if they lick their hands they get deathly sick," said Jim Berger. "This is a planktonic alga which is toxic and it's caused from the heat, lack of movement of water, re-suspension of nutrients from the boats."

The algae problem is not confined to Koontz Lake. Wurster Lake and the public beach at Potato Creek State Park in North Liberty has had an algae advisory posted for much of this year. It permits swimming and boating, but swimmers are warned not to have contact with algae and not to swallow water while swimming. The algae invasion at Koontz Lake came as a surprise, and at a bad time.

"The worst timing you could possibly get, this couldn't come at a worse time with the three-day weekend coming up, the last hurrah for a lot of people everybody will be starting to shut down their homes," said Berger.

"Once you see it, you won't go near it, it's that disgusting," added John Ullrich.

Officials considered spraying the algae, but determined that would be too costly and would have little impact by the Labor Day holiday. Berger feels the long-term solution involves something like dredging to get rid of the nutrients at the bottom of the lake that are fueling the algae growth.

"We have to do something, we can't just let it go, otherwise the lake's just going to get worse and worse. It's not going to get any better on its own," said Berger.

Berger and Ullrich have been pushing for the creation of a conservancy district that could levy taxes on lakefront properties to fund a variety of environmental improvements. They're in the process of gathering signatures and need support from at least 51 percent of the land owners to proceed.

Figure 2. Koontz Lake algal bloom, August 2015.

Recommended Binational Phosphorus Targets

~U.S. EPA

Algae occur naturally in freshwater systems. They are essential to the aquatic food web and healthy ecosystems. However, too much algae can lead to the development of algal blooms, which can be harmful to human health and the environment. Since the 1990s, Lake Erie has been experiencing increasing algal growth, resulting in increased impairment of water quality, as well as increased impairment of the use and enjoyment of the tremendous natural resource that is Lake Erie.

To combat this growing threat, the governments of Canada and the United States are committed to working with others to manage phosphorus concentrations and loadings in Lake Erie as a means of reducing algal growth. This commitment is formalized in the 2012 Great Lakes Water Quality Agreement (GLWQA), which stipulates completion of revised binational phosphorus reduction targets for Lake Erie by February 2016. To learn more about the Agreement, visit **http://binational.net**.

Working in collaboration, federal agencies, state and provincial governments, municipal and local governments, and many other partners convened a GLWQA Nutrients Annex Subcommittee in 2013 to review the interim phosphorus targets for Lake Erie, last revised in 1983, and recommend revisions to those targets. Subject matter experts supported this effort through the development of a technical report.

This newsletter summarizes the GLWQA Nutrients Annex Subcommittee recommendations (Table 1).

What Is the Problem?

Toxic and nuisance algal bloom occurrences in Lake Erie have increased over the past decade. The blooms threaten drinking water quality, increase costs associated with treatment needs, and occasionally force closures of treatment plants. They clog industrial water intake systems, adversely impact commercial and recreational fishing activities and other recreational pursuits, and degrade fish and wildlife habitat and populations.

Excessive algal blooms in the 1960s and 1970s were a major driver for the signing of the first Agreement in 1972. In that first Agreement, the Governments of Canada and the U.S. agreed to reduce phosphorus loads to Lake Erie by more than 50 percent (from 29,000 to 14,600 metric tons per year). In the 1978 Agreement, the two countries agreed to a further reduction of phosphorus loads to Lake Erie to 11,000 metric tons per year (Figure 3). Regulation of phosphorus concentrations in detergents, investing in sewage treatment, and developing and implementing best management practices on agriculture lands successfully achieved those targets. With the achievement of phosphorus load targets, algal bloom development in Lake Erie decreased significantly throughout the 1980s. However, in the 1990s, despite ongoing efforts to limit phosphorus discharges to Lake Erie, toxic and nuisance algal blooms began increasing.

From Scavia et al. 2014. "Assessing and addressing the re-eutrophication of Lake Erie: Central basin hypoxia," *Journal of Great Lakes Research* 40: 226-246.

Three key issues need to be addressed:

- algal toxins,
- the size of the low-oxygen (hypoxic) area that is created when algae die and decompose,
- and the presence of *Cladophora*.

In 2011, concentrations of the algal toxin microcystin in the open waters of the Western Basin of Lake Erie were 50 times higher than the World Health Organization limit for safe body contact, and 1,200 times higher than the limit for safe drinking water. In August 2014, algal toxins forced closure of the Toledo, Ohio, drinking water treatment plant, and private water users on Pelee Island, Ontario, were warned not to bathe in or drink Lake Erie water. The

Table 1. Proposed Binational Phosphorus Load Reduction Targets

Lake Ecosystem Objectives ***Great Lakes Water Quality Agreement Annex 4, Section B***	**Western Basin of Lake Erie**	**Central Basin of Lake Erie**
Minimize the extent of hypoxic zones in the Waters of the Great Lakes associated with excessive phosphorus loading, with particular emphasis on Lake Erie	40 percent reduction in total phosphorus entering the Western and Central Basin of Lake Erie – from the United States and from Canada – to achieve 6,000 MT Central Basin load	
Maintain algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes	40 percent reduction in spring total and soluble reactive phosphorus loads from the following watersheds where localized algae is a problem:	
	• Thames River – Canada • Maumee River – US • River Raisin – US • Portage River – US • Toussaint Creek – US • Leamington Tributaries – Canada	• Sandusky River – US • Huron River, OH – US
Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the Waters of the Great Lakes	40 percent reduction in spring total and soluble reactive phosphorus loads from the Maumee River (US).	N/A

incident affected more than 500,000 people.

Since the early 2000s, the hypoxic (low-oxygen) area in the Central Basin of Lake Erie has increased to about 4,500 km^2, on average, with the largest hypoxic event of 8,800 km^2 occurring in 2012. Hypoxic conditions can affect the growth and survival of fish species. In 2012, hypoxic conditions were responsible for tens of thousands of dead fish washing up on a 40 km stretch of shoreline between Erieau and Port Stanley, Ontario.

Cladophora is a filamentous green algae that grows on hard substrates in all of the Great Lakes. Beginning in the early 2000s, mats of *Cladophora* in the Eastern Basin of Lake Erie, have caused beach fouling, undesirable odors from decomposing *Cladophora,* clogged industrial intakes and degraded fish habitat.

The GLWQA Nutrients Annex Subcommittee has suggested that the Lake Erie algal problem can best be described in relation to the three main basins of the Lake (Figure 4):

The Western Basin is very shallow with an average depth of 7.4 meters (24 feet) and a maximum depth of 19 meters (62 feet). It is warm, and it receives most of the total phosphorus load because of the size of the Detroit and Maumee Rivers. Since 1994, the Western Basin has received 61 percent of the whole lake annual total phosphorus load, while the Central Basin and Eastern Basin received 28 percent and 11 percent, respectively. As a result, algal blooms dominated by the blue-green alga (cyanobacteria) *Microcystis aeruginosa* occur regularly, fouling shorelines during spring and summer. This species can form blooms that contain toxins (e.g., microcystin) dangerous to humans and wildlife.

The Central Basin is deeper with an average depth of 18.3 meters (60 feet) and a maximum depth of 25 meters (82 feet). Here the excess phosphorus contributes to hypoxic conditions (low-oxygen) in the cold bottom layer of the Lake (the hypolimnion) when algae die and decompose. The biological activity uses up the oxygen during the summer, leaving little to none for the aquatic community which suffocates or moves elsewhere, creating Lake Erie's "Dead Zone."

The Eastern Basin is the deepest of the three basins with an average depth of 24 meters (80 feet) and a maximum depth of 64 meters (210 feet). Here, the excess phosphorus contributes to the excessive growth of *Cladophora*. *Cladophora* isn't toxic, but it is a nuisance and may contribute to human health problems. Beyond clogging industrial water intakes and degrading fish habitat, rotting mats of *Cladophora* on beaches encourage the growth of bacteria and are a factor in beach closures. The presence of *Cladophora* may create an environment conducive to the development of botulism, which results in bird and fish deaths.

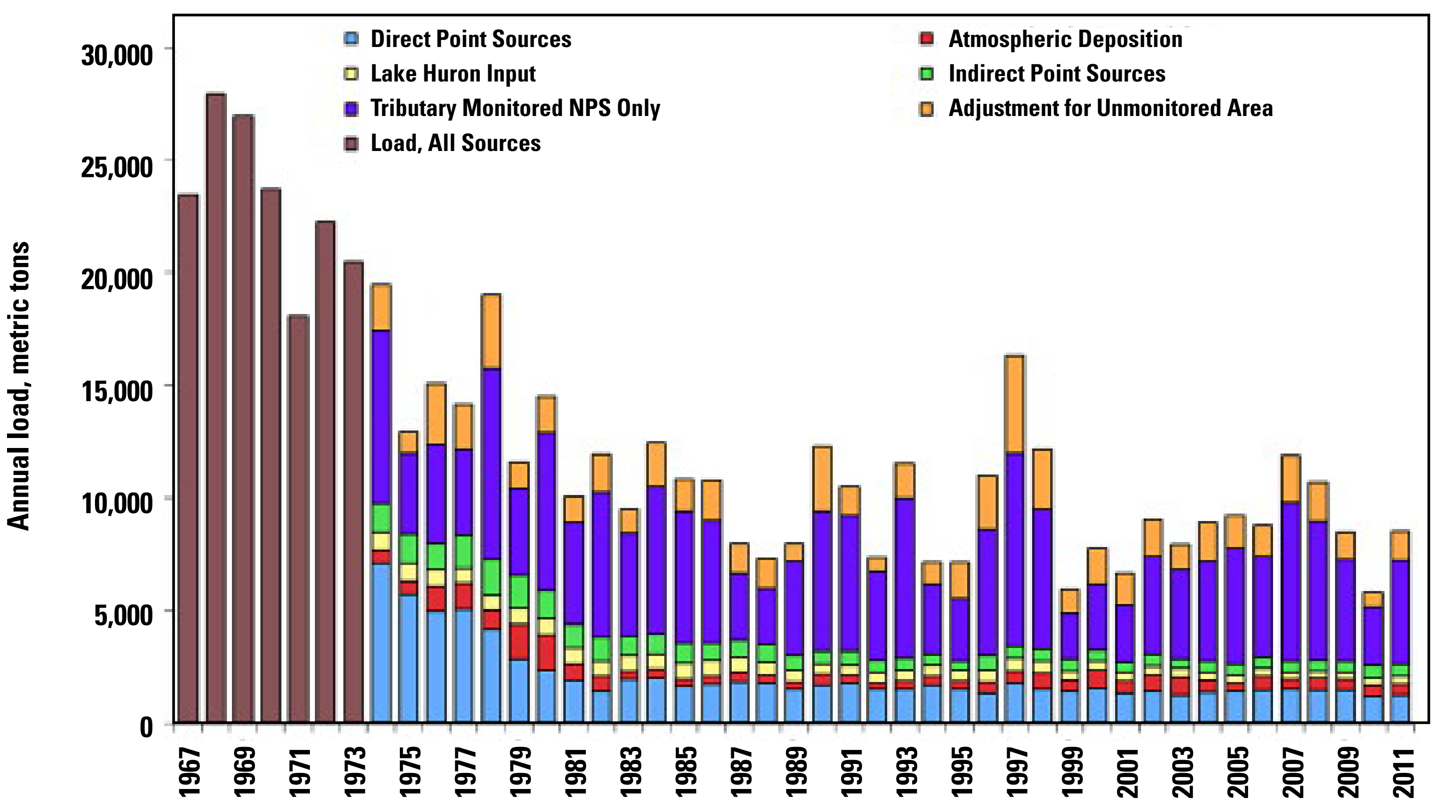

Figure 3. Annual total phosphorus load to Lake Erie.

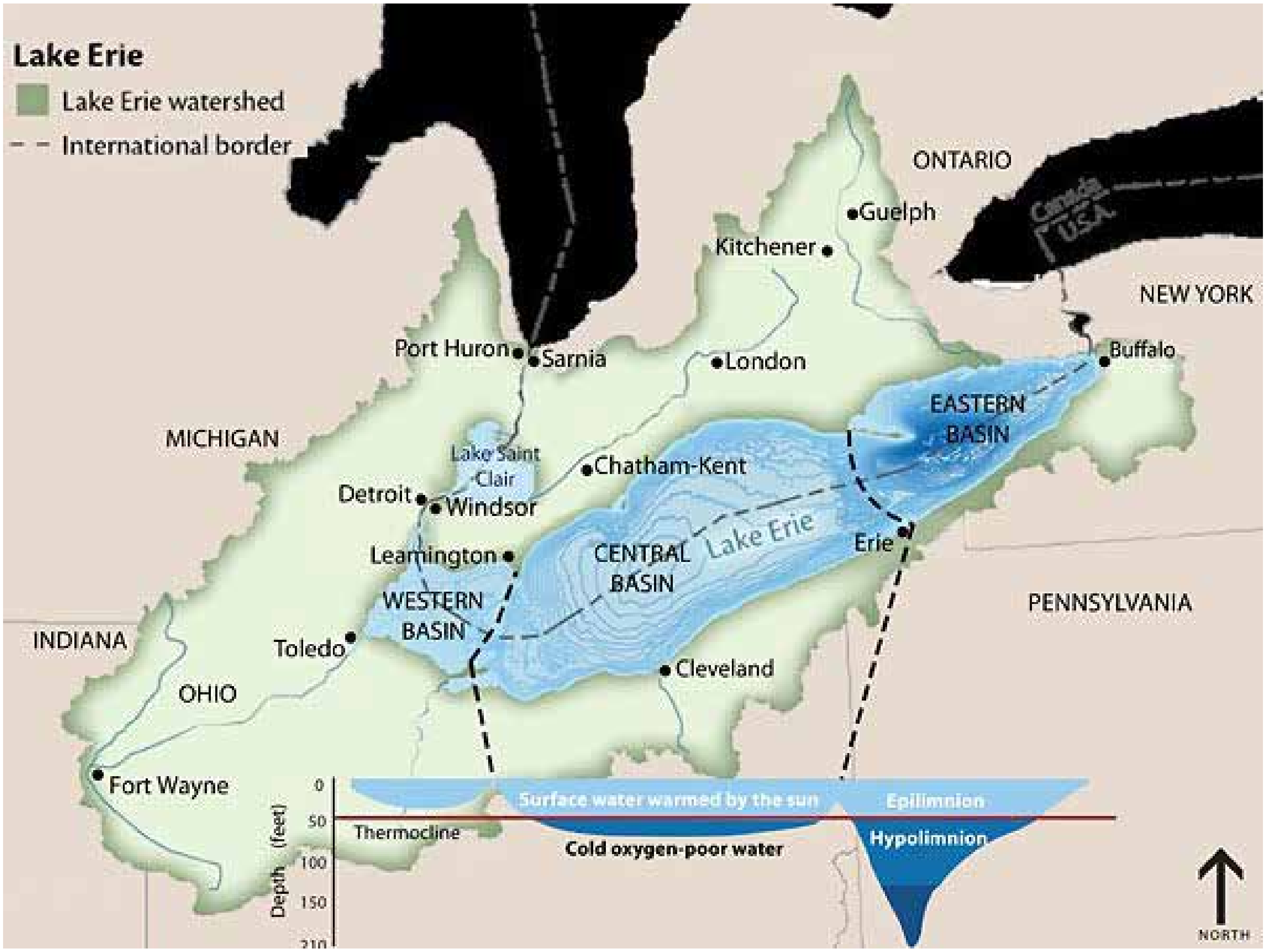

Figure 4. Lake Erie Watershed and cross-section.

Why Is Algal Growth Increasing?

A number of factors affect algal growth, including climatic conditions and nutrient availability. Increasing temperatures in recent years is creating longer growing seasons for algae and contributing to increased algal growth. More frequent high-intensity spring storms are resulting in nutrients being washed off of urban and agricultural lands, as well as causing bypasses and overflows from sewage treatment facilities, which also contain nutrients. Spring nutrient loads are an important factor affecting algal growth.

Overall, monitoring has shown that despite significant year-to-year variation in loads, the total annual amount of phosphorus entering the Lake has been relatively stable over the past 15 years. However, there has been a significant increase in the proportion of the phosphorus load to Lake Erie that is in dissolved, as opposed to particulate, form. Dissolved phosphorus is more easily taken up by algae and contributes to increased algal growth. The reason for the increase in the proportion of phosphorus in dissolved form is not fully understood.

Zebra and Quagga mussels, both aquatic invasive species, have increased water clarity and changed nutrient cycling in Lake Erie, resulting in higher levels of algal growth, particularly close to the shore. So why is Lake Erie experiencing more algal growth than the other Great Lakes? The answer is that, as the smallest of the Great Lakes by volume, and the shallowest, Lake Erie waters are the warmest and most biologically productive. Drainage basin characteristics also play a role.

All of the Great Lakes experience issues associated with algae. The governments of Canada and the U.S. have committed to the review of phosphorus targets for all Great Lakes through the 2012 GLWQA. The experience garnered in reviewing Lake Erie targets will inform these reviews. Importantly, experts agree that, while many factors contribute to algal growth, controlling phosphorus concentrations and loads is the best way to reduce algal growth in the Great Lakes.

What Is the Desired Outcome?

Eliminating algae entirely is not the goal. Too little algal growth would not support a healthy aquatic ecosystem. The goal is to identify and achieve the right level and type of algal growth to support a healthy and productive Lake Erie ecosystem. The Agreement provides guidance in relation to what constitutes a healthy and productive ecosystem from an algal production perspective. It does this in the form of the following six Lake Ecosystem Objectives:

1. Minimize the extent of hypoxic zones associated with excessive phosphorus.
2. Maintain the levels of algae below the level constituting a nuisance condition.
3. Maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters of the Great Lakes.
4. Maintain cyanobacteria at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the waters of the Great Lakes.
5. Maintain an oligotrophic state, relative algal biomass, and algal species consistent with healthy aquatic ecosystems, in the open waters of Lakes Superior, Michigan, Huron and Ontario.
6. Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie.

How Were the Recommended Targets Determined?

The GLWQA Nutrients Annex Subcommittee studied information on algal patterns and species, lake circulation, and sources and loadings of phosphorus.

First, the group decided to align the relevant Lake Ecosystem Objectives to each of the three main basins of Lake Erie.

In the Western Basin, where blue-green algae (cyanobacteria) is the problem, the GLWQA Nutrients Annex Subcommittee determined that the focus should be on Lake Ecosystem Objective #4 ("Maintain cyanobacteria at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the waters of the Great Lakes"). Having reviewed the available data, the GLWQA Nutrients Annex Subcommittee proposed that in order to reasonably achieve this Objective in the Western Basin, efforts should be directed toward achieving conditions similar to those experienced in 2012, in nine out of 10 years.

Why 2012?

In 2012, the amount of cyanobacteria present in the Western Basin was considered to be a mild bloom; no significant impacts were noted, with the exception of some bloom conditions in inner Maumee Bay. Therefore, a reasonable threshold to limit the cyanobacteria metrics would be at a level below those seen in 2012.

Why Nine Years Out of 10?

In a year with extremely wet conditions in the spring (i.e. heavy rainfall) there will likely be substantial algal blooms despite phosphorous reduction efforts. In consideration of this, the work group proposed meeting the 2012 thresholds for algal blooms, on average, nine years out of 10.

In the Central Basin, where hypoxia is the problem, the GLWQA Nutrients Annex Subcommittee determined that the focus should be on Lake Ecosystem Objective #1 ("Minimize the extent of hypoxic zones associated with excessive phosphorus"). The GLWQA Nutrients Annex Subcommittee proposed that in order to reasonably achieve this Objective in the Central Basin, efforts should be directed toward achieving an average late summer (i.e. August to September) hypolimnetic (cold bottom layer) dissolved oxygen concentration in the Central Basin of Lake Erie of 2.0 mg/l or higher.

In the Eastern Basin, where *Cladophora* is the problem, the GLWQA Nutrients Annex Subcommittee determined that the focus should be on Lake Ecosystem Objective #2 ("Maintain the levels of algae below the level constituting a nuisance condition"). Having reviewed the available science and modeling, the GLWQA Nutrients Annex Subcommittee proposed that in order to reasonably achieve this Objective in the Eastern Basin, efforts should be directed toward achieving *Cladophora* biomass of less than 50g/m2.

In certain nearshore areas, where localized cyanobacteria blooms are the problem, the GLWQA Nutrients Annex Subcommittee focused on Lake Ecosystem Objective #3 ("Maintain algal species consistent with healthy aquatic ecosystems in the nearshore waters of the Great Lakes"). Having reviewed satellite imagery and other available data, the GLWQA Nutrients Annex Subcommittee proposed that in order to reasonably achieve this Objective in certain nearshore areas, efforts should be directed toward reducing nearshore cyanobacteria blooms. With the relevant Lake Ecosystem Objectives identified and quantified, the GLWQA Nutrients Annex Subcommittee next identified the level of phosphorus reduction required to achieve the desired outcomes.

Modeling experts from the United States and Canada used nine different computer simulation models to correlate changes in phosphorus levels with levels of algal growth. By comparing and contrasting the results of these models, the GLWQA Nutrients Annex Subcommittee was able to arrive at phosphorus load reduction targets, calculated using 2008 data. 2008 was selected due to the quality of the data available for that year and because conditions in Lake Erie in 2008 are considered representative of an "average" year.

What are the Recommended Phosphorus Reduction Targets?

Western Basin: Modeling showed that spring loading of phosphorus from the Maumee River is the determining factor in the production of cyanobacteria in the open waters of the Western Basin of Lake Erie (Figure 5). The GLWQA Nutrients Annex Subcommittee found that to achieve 2012 conditions in the Western Basin in nine out of 10 years, there should be a reduction of 40 percent in spring loads of both total and dissolved phosphorus from the Maumee River. A 40 percent reduction to the Maumee equates to a target spring load of 860 metric tons per year of total phosphorus and 186 metric tons per year of soluble reactive phosphorus under high spring discharge conditions. The GLWQA Nutrients Annex Subcommittee has defined spring as the period between March 1 and July 31 each year.

Central Basin: Modeling showed that phosphorus concentrations in the Central Basin of Lake Erie are the result of loadings from sources discharging to both the Western Basin, including those along the Huron-Erie corridor, and the Central Basin. To achieve a minimum concentration of dissolved oxygen of 2 mg/l in the bottom waters of the Central Basin, there should be a reduction in the load of total annual phosphorus to the Western and Central Basins to 6,000 metric tons per year. This is a 40 percent reduction from the 2008 load.

Eastern Basin: For the Eastern Basin, the work group has not recommended a target to address nuisance algae (Cladophora) at this time. Additional science is required to link phosphorus loadings to

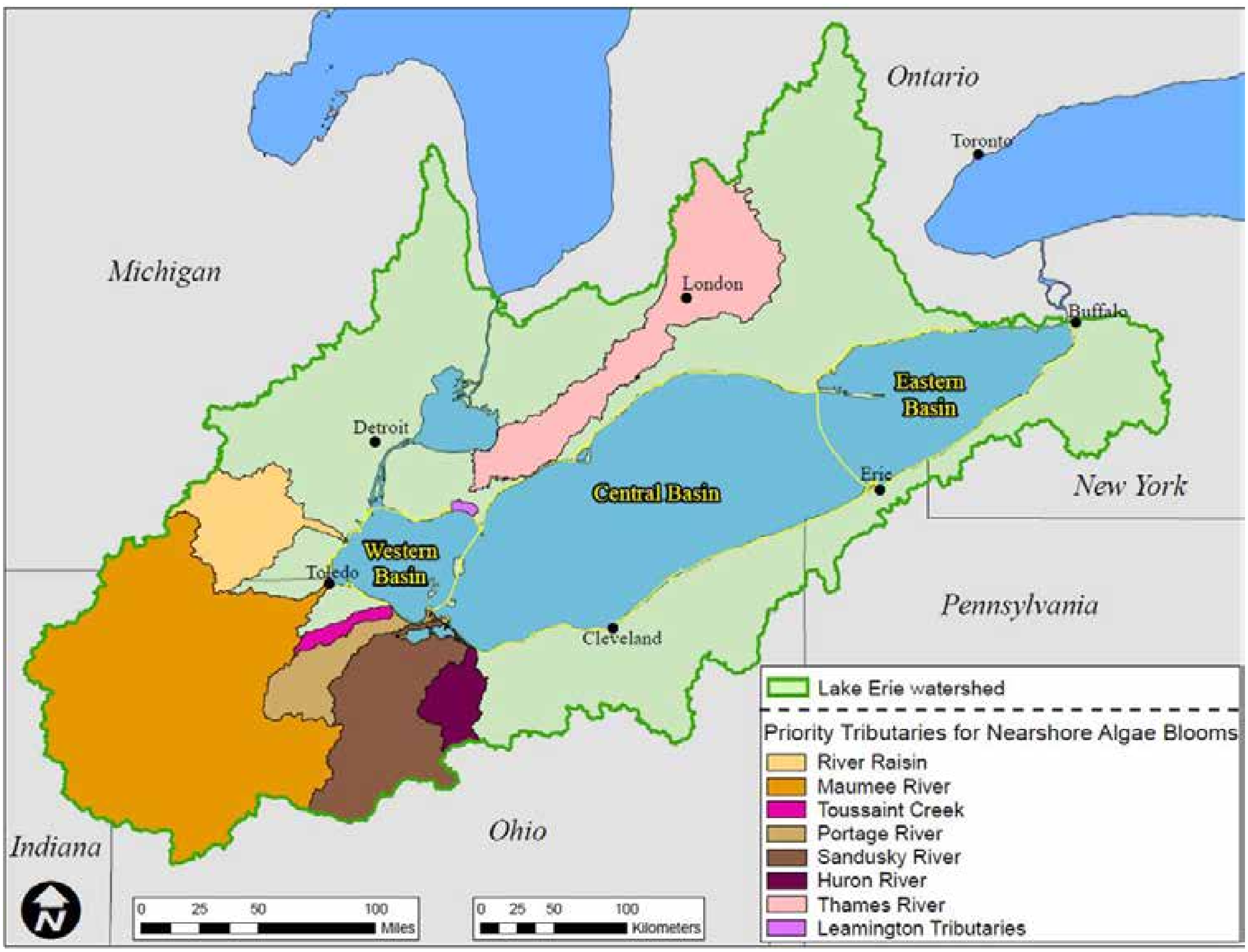

Figure 5. Lake Erie priority watersheds.

changes in algal production prior to recommending phosphorus reduction targets for this area of the Lake. Nonetheless, it is important to note the targets that have been recommended for the Western and Central Basins work in concert, not in isolation. Because all tributaries to Lake Erie, including the Detroit River and the Huron-Erie Corridor, contribute phosphorus loads to the Eastern Basin, the reductions needed to address algal blooms and hypoxia will lower phosphorus concentrations in the Eastern Basin as well. This will help address nuisance algal issues in the Eastern Basin, while maintaining enough nutrients to support the fisheries.

Nearshore Waters: In some nearshore areas, including river mouths and embayments, phosphorus loads from the watershed contribute to localized blooms of cyanobacteria. Reducing spring total and soluble reactive phosphorus loadings in these watersheds by 40 percent is expected to reduce localized blooms of cyanobacteria in those areas. The working group has identified the following watersheds where localized cyanobacteria blooms are a concern: in Canada, the Thames River and Leamington area watersheds; in the U.S., the Maumee River, River Raisin, Portage River, Toussaint Creek, Sandusky River and Huron River watersheds. These watersheds are different from each other; as such the 40 percent reduction should be considered as a starting point. As programs are implemented, and research and monitoring efforts increase knowledge and understanding of phosphorus movement in these tributaries and the nearshore, reductions less than or greater than 40 percent may be required in each of these watersheds to resolve the associated nearshore cyanobacteria blooms.

Why aren't Phosphorus Concentration Objectives being Recommended?

The GLWQA Nutrients Annex Subcommittee has focused its recommendations on phosphorus loading reductions, not on phosphorus concentrations. Phosphorus concentration objectives were established in the past for the Great Lakes. However, the GLWQA Nutrients Annex Subcommittee found that phosphorus concentrations in the nearshore and open waters vary considerably over space and time, making them very difficult to track in a meaningful way through monitoring programs.

As a consequence, the GLWQA Nutrients Annex Subcommittee is recommending that phosphorus concentration objectives not be established for Lake Erie at this time. However, the GLWQA Nutrients Annex Subcommittee has estimated the phosphorus concentrations expected to result from the recommended phosphorus load reductions (see Table 2 below).

What are the Next Steps?

U.S. Environmental Protection Agency (EPA) will be soliciting input on the recommendations of the GLWQA Nutrients Annex Subcommittee. Following consideration of input received, Environment Canada and the EPA will finalize targets in February 2016.

U.S. EPA Seeks Public Input on Binational Phosphorus Reduction Targets to Combat Lake Erie Algal Blooms

CHICAGO (July 7, 2015) – The U.S. Environmental Protection Agency is seeking public input on proposed phosphorus reduction targets to combat harmful algal blooms in Lake Erie. The Great Lakes Water Quality Agreement requires the United States and Canada to adopt targets to reduce excess phosphorus levels for Lake Erie by early 2016.

"The United States and Canada are committed to cutting phosphorus levels to protect Lake Erie from harmful algal blooms," said U.S. EPA Region 5 Administrator/Great Lakes National Program Manager Susan Hedman. "Public input is an important part of the process as both countries work to meet the 2016 deadline to adopt final phosphorus reduction targets."

In 2013, a binational workgroup was convened to develop recommended phosphorus reduction targets for Lake Erie. The workgroup included representatives from federal,

Table 2. Substance Objective for Total Phosphorus Concentration in the Open Waters of Lake Erie (mg/L)

Basin	Interim Objectives *Great Lakes Water Quality Agreement Annex 4, Section C*	Expected Outcome from Implementation of Proposed Load Reduction Targets
Lake Erie (Western Basin)	15	12
Lake Erie (Central Basin)	10	6
Lake Erie (Eastern Basin)	10	6

state and provincial environmental and agricultural agencies, as well and academic experts and members of nongovernmental organizations. The phosphorus reduction recommendations developed by the workgroup were presented during the semiannual Great Lakes Executive Committee meeting in Chicago at the end of June. **http://binational.net/glec-cegl/**. The recommendations call for a 40 percent reduction in:

– Total phosphorus entering the Western Basin and Central Basin of Lake Erie from the U.S. and Canada.

– Spring total and soluble reactive phosphorus loads from the Maumee River; and

– Spring total and soluble reactive phosphorus loads from the following watersheds where localized algae is a problem.

Canada: Thames River, Leamington Tributaries.

US: River Raisin, Portage River, Sandusky River, Huron River, Maumee River, Toussaint Creek.

For more information about the proposed phosphorus reduction targets and for instructions about providing input for the U.S. targets, please visit **http://www2.epa.gov/glwqa/recommended-binational-phosphorus-targets** or **http://binational.net**.

Release Date: 07/07/2015
Contact Information: Peter Cassell, 312-886-6234, cassell.peter@epa.gov (media only)

Have you checked out the Indiana Clean Lakes Program Web page lately?
Take a look at www.indiana.edu/~clp/ and see what's new and happening with the program and with Indiana lakes!

A Day with Indiana's Agricultural Water Quality Monitoring Experts

~ Lori Lovell

I recently had the pleasure of representing Indiana Clean Lakes Program at the "Ag Water Quality Monitoring Forum: Advancing Indiana's Nutrient Management and Soil Health Strategy," hosted by Indiana Water Monitoring Council on August 28. With the purpose of bringing together Indiana's leading researchers to discuss nutrient management, conservation practices, and water quality monitoring research design, the event offered presentations by researchers and nutrient management practitioners, a networking lunch, and a facilitated breakout session. The events of the meeting made for a full day at the Indiana Farm Bureau Building in Indianapolis.

The morning began with a welcome from Jill Reinhart of the USDA Natural Resources Conservation Service. Justin Schneider of Indiana Farm Burea then provided updates on the Indiana Nutrient Management and Soil Health Strategy. The importance of partnerships with farm retailers, and consultants was stated as key to achieving nutrient management goals. Schneider concluded by offering some of the questions remaining among those focused on nutrient management strategy in Indiana.

Indiana University's Adam Ward presented Iowa's nutrient management plan as a case study. As a major contributor to nutrient pollution to the Mississippi and Gulf of Mexico, Iowa become a leader in science-based nutrient management out of necessity. Ward presented a brief history of water resource management in Iowa and some of the details that make Iowa's Nutrient Reduction Strategy a successful framework.

Duke University's Alison Eagle followed with her presentation on 4R nutrient management's impact on nitrogen loss reductions in corn-based systems across the nation. For those curious, the 4 R's stand for right source, right rate, right time, and

Figure 6. Researchers, practitioners, and concerned citizens listen to a presentation on nutrient management at August 28's Ag Water Quality Monitoring Forum. Photo source: (Indiana Water Monitoring Council).

right place as they relate to fertilizer applications to crop systems. Eagle stressed the importance of filling in geographic gaps within the crop yield and nutrient loss data with future research experiments.

After a short coffee break, Jeff Frey of the US Geological Survey continued on the theme of experimental design. Presenting edge-of-field monitoring techniques and planning considerations, he provided a basis for formulating a successful nutrient monitoring program. While Frey provided an overview of study design, Carol Newhouse offered insight into IDEM's management of data generated by such experiments. The organization's External Data Framework provides a systematic, transparent, and voluntary method for water quality data acquisition. The program sorts submitted data based on sampling design robustness and documentation level into three categories that designate the usability by IDEM Office of Water Quality.

After a networking lunch provided by Indiana Farm Bureau, Kevin King from the USDA Agricultural Research Service in Ohio presented additional information on edge-of-field research design and implementation. Stressing collaborations, partnerships and outreach, King prepared us well for Linda Prokopy's presentation on adoption of improved nutrient management practices. Prokopy, of Purdue University, provided empirical evidence that further suggested farm retailers and consultants are essential to the adoption process. The two groups were among the most trusted sources of information to farmers, well ahead of the governmental and non-profit organizations better represented at the conference.

After hearing about approaches to increasing adoption of improved nutrient management practices, we entered a facilitated breakout session primed for strategic thinking. Ron Turco of Purdue University began the session by dividing into four groups, and tasking the groups with responding to the following questions:

- Are we asking the right questions?
- What would the 'ideal' ag water quality monitoring project look like?
- What can we do differently to accelerate implementation of the strategy?

After an hour of deliberation, the four groups reassembled and exchanged notes. As each group shared their thoughts, Jill Reinhart recorded our ideas for future use by the Nutrient Management and Soil Health Strategy steering committee.

To learn more about Indiana's Nutrient Management and Soil Health Strategy, visit inagnutrients.org.

An Update from the 22nd Annual Secchi Dip-In

~ Lauren Salvato

The North American Lake Management Society (NALMS) took over the Secchi Dip-In in March 2015 after twenty-one years of operation under Dr. Bob Carlson of Kent State University. The Secchi Dip-In was created to enable volunteers to submit water clarity measurements to an online database and see how their data compare on a variety of scales- regional to international. The program has also been utilized for volunteers to begin monitoring efforts and to increase monitoring efforts within their communities.

The 22nd annual Secchi Dip-In concluded July 2015, Lakes Appreciation Month, with 520 submissions. Thank you to all volunteers who have submitted their water clarity data. We are still collecting data! We will accept data throughout the year and would like to exceed last year's numbers. Help us reach our goal of 850 submissions. You can submit data online: **http://www.secchidipin.org/data/**. Twenty-eight states participated in this year's Dip-In including Canadian provinces Ontario and British Columbia (Figure 7).

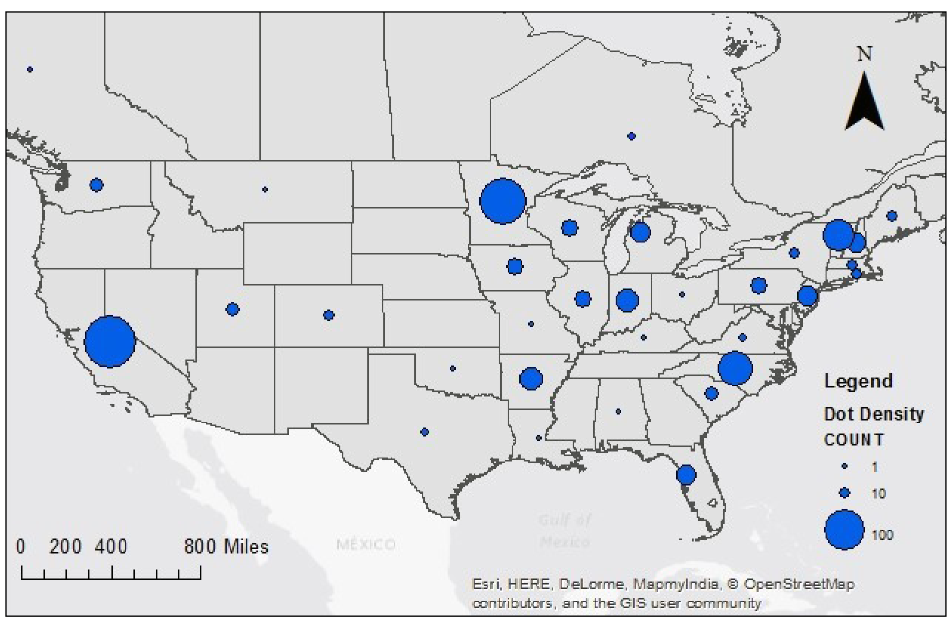

Figure 7. Number of submissions for the 2015 Secchi Dip-In. Values displayed proportionally by state and province.

Volunteer Corner

~Sarah Powers

As part of our Aquatic Invasive Species Monitoring Program we have been holding workshops since 2012 on aquatic plant identification. These workshops have grown and evolved since the first workshop at Pokagon State Park with a total of eight workshops so far.

This summer we hosted two workshops, both at new locations, including the IU Research and Teaching Preserve (IURTP) in Bloomington and a second at the Crooked Lake Biological Field Station north of Columbia City (Figure 8). Each of these locations offered something new for us and drew different groups of individuals.

The IURTP provided the opportunity for several IU students and IDEM interns to attend the workshop, 18 attendees total. This was the first Friday workshop we have done and we look forward to doing more in the future during the week. We had a fantastic turn out and look forward to hosting more workshops centrally located in future. This past weekend we had an event at the Crooked Lake Biological Field Station that included a morning workshop and an afternoon lake social and networking session. This was the first time we have held an event of this type, and we hope to make it an annual gathering. The morning workshop drew 14 individuals from the surrounding area. The workshop is collection of lecture on why we are concerned about aquatic invasive species, how to survey, plant identification information and hands on time to identifying plants. The hands-on identification is always the favorite portion of the day (Figure 9).

The afternoon lake social at Crooked Lake was a real treat. We have discussed having a volunteer lake social for many years and our first test run was well received. Thanks to our generous sponsorship from the Indiana Lakes Management Society (ILMS) we were able to provide refreshments at both workshops, lunch at the lake social, and two individuals received complimentary membership and conference registration for ILMS 2016 annual conference. The Tippecanoe Watershed Foundation also provided informational materials for guest sharing the work the organization is doing in the area, including the Clear Choices Clean Water information.

While this year most of the attendees of the social were from the workshop we also had eight new individuals stop by including some young lake enthusiasss. During the social and networking we lunched, chatted and got out on the water for lake tours as well as fish and plant collection. It was a fantastic event for all ages.

If you would like to attend, participate, or sponsor next year's Lake Social please contact us as we are already planning for next year!

Figure 8. Sunrise at the Crooked Lake Biological Station.

Figure 9. Aquatic Plant Workshops conducted by the Indiana Clean Lakes Program. Locations vary all of the state. These two workshops were at the Crooked Lake Biological Station and the Indiana University Research and Teaching Preserve.

Aquatic Invasive Monitoring Plant Highlight

These will be the 14th plant in the plant highlight series. We will be featuring one aquatic plant in each *Water Column* issue. We will feature both native and invasive plants to improve our plant identification skills.

Sago pondweed (*Stuckenia pectinata*), *NATIVE*

Sago pondweed is commonly called fennel pondweed and sometimes called ribbon weed. Sago pondweed is a perennial plant that arises from thickly matted rhizomes. It has no floating leaves. The stems are thin, long and highly branching with leaves very thin and filament-like, about 1/16 of an inch wide (<2 mm) and 2 to over 12 inches long tapering to a point. The leaves grow in thick layers and originate from a sheath. The fruit is nut-like 1/8 to 1/4 inches long and 1/10 to 1/8 inches wide.

Submerged portions of all aquatic plants provide habitats for many micro and macro invertebrates. These invertebrates in turn are used as food by fish and other wildlife species (e.g., amphibians, reptiles, ducks, etc.). Sago pondweed is an excellent food for waterfowl which eat both the fruits and the tubers.

You can find more information about our Invasive Plant Monitoring Program and the Sago Pondweed on the Clean Lakes Program website **www.indiana.edu/~clp**. We will be updating the Invasive Plant Monitoring page to include links to several resources and tips on identification guides.

Identification tips:

- Fully submerged plant, no floating or emergent leaves
- Leaves with the typical zigzag-formed stem.
- Long narrow linear leaves
- The main difference from other narrow-leaved pondweeds is that the stipule joins the leaf base, when it is pulled the sheath and stipule comes away, similar to a grass sheath and ligule.

Coming July 2016, the Lake Observer App!

A Mobile App for Recording Lake and Water Observations

In a collaboration with NALMS, the US Environmental Protection Agency (EPA) and the Global Lake Ecological Observation Network (GLEON), the Lake Observer Mobile App was created to enable volunteers to submit water quality data using their smartphones.Stay tuned for more announcements. **https://www.lakeobserver.org/**.

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The Secchi Dip-In

The North American Lake Management Society will be making changes to the 2016 Secchi Dip-In! Please take the time to take a short, 14-question survey. We would appreciate your thoughts and feedback. Access the survey on the home page of the Secchi Dip-In's website: **www.secchidipin.org/**.

Perspectives

"Iron rusts from disuse; water loses its purity from stagnation... even so does inaction sap the vigour of the mind."

~ Leonardo Da Vinci