A Joint Action Plan for Lake Erie

A Report of the Great Lakes Commission
Lake Erie Nutrient Targets Working Group

September, 2015

A 2014 Great Lakes Commission Lake Erie Water Pollution resolution committed the Lake Erie states and the Province of Ontario to form a working group to develop new and refine existing practices, programs and policies to achieve pollutant reduction targets and/or identify additional remedies to improve water quality in Lake Erie. This report is a product of the Lake Erie Nutrient Targets (LENT) Working Group that formed following that resolution.

It is envisioned that this Joint Action Plan will drive further actions, consultations and discussions that the states and the province can advance in the near term as longer-term efforts are underway through the Great Lakes Water Quality Agreement (GLWQA) Nutrients Annex (Annex 4) process, including release of final Lake Erie nutrient targets in 2016 and Domestic Action Plans in 2018. The actions described here complement and expand on the commitments made by the Governors of Ohio and Michigan and the Premier of Ontario in their Western Basin of Lake Erie Collaborative Agreement signed in June 2015.

PREAMBLE

Lake Erie is the eleventh largest lake on Earth by surface area.[1] Of the five Laurentian Great Lakes, Lake Erie is the southernmost, the smallest by volume, the shallowest, and also the warmest. It is the most biologically productive, supporting the largest Great Lakes sport fishery. Lake Erie has three distinct sub-basins: a very shallow western basin and related islands; a deeper central basin; an even deeper eastern basin that drains into the Niagara River and Lake Ontario. The lake provides drinking water to more than 11 million residents and supports a $1.5 billion sport fishing industry. Lake Erie is a vital resource for the binational Great Lakes region.

Eutrophication is a serious global problem that has re-emerged, resulting in harmful algal blooms[2] in the western basin of Lake Erie, offshore anoxic zones - also known as dead zones - in the central basin, and nuisance levels of *Cladophora* in the eastern basin. All of these problems are linked to excessive loading of nutrients, particularly phosphorus. The primary sources of phosphorus to Lake Erie are urban point and nonpoint sources, and agricultural nonpoint sources. Urban area loadings are associated with municipal and industrial facility point source discharges, Combined Sewer Overflows (CSOs) as well as stormwater runoff containing nutrients from the land, including residential fertilizers. Agricultural nonpoint source pollution occurs primarily in the form of farm and field runoff, which results mainly from fertilizer and manure applications.

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[1] Great Lakes Atlas, 1995, Environment Canada and U.S. Environmental Protection Agency
[2] Harmful algal blooms are overgrowths of algae or cyanobacteria that can occur in both freshwater and marine systems. Some species can produce dangerous toxins.

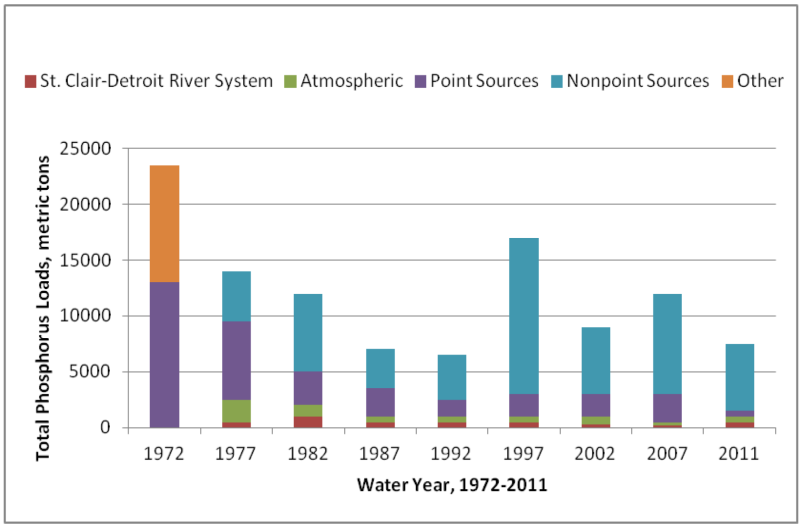

Figure 1: Annual loading of Total Phosphorus to Lake Erie by major sources. Excerpted and modified from Ohio Lake Erie Task Force II Final Report; original data provided by Dr. David Dolan, University of Wisconsin, Green Bay. May 2013.

As shown in Figure 1, point-source contributions have dramatically declined over the past several decades while the relative contribution of nonpoint sources to overall loading has increased. The impacts of excessive nutrients are affected by multiple factors such as climate change, temperature, weather, hydrology and aquatic invasive species. Following extensive phosphorus reduction efforts initiated in the 1970s, harmful algal blooms in Lake Erie were largely absent.

However, blue-green algae (cyanobacteria) blooms began to reappear in the western basin of Lake Erie in the mid-1990s. Monitoring data indicate that since the mid-1990s, total phosphorus has been declining while dissolved reactive phosphorus, or DRP, has been increasing. DRP is the fraction of dissolved phosphorus that is easily absorbed and available to plants and is now widely accepted as the primary nutrient of concern in Lake Erie.[3] The actions called for in this document aim to address current nutrient loading challenges associated with total phosphorus as well as DRP. This Joint Action Plan offers a common roadmap for the Lake Erie states and the Province of Ontario to guide shared activities to help solve nutrient-related problems in Lake Erie.

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[3] *Ohio Lake Erie Phosphorus Task Force II Final Report,* November 2013
http://www.epa.ohio.gov/portals/35/lakeerie/ptaskforce2/Task_Force_Report_October_2013.pdf
International Joint Commission. *A Balanced Diet for Lake Erie: Reducing Phosphorus Loadings and Harmful Algal Blooms* – A Report of the Lake Erie Ecosystem Priority, February 2014
http://www.ijc.org/files/publications/2014%20IJC%20LEEP%20REPORT.pdf
Great Lakes Commission. *A Summary of State and Provincial Programs in the Great Lakes – St. Lawrence River Region.* September 2012. http://glc.org/files/main/news/FINAL-NutrientManagement-Sept2012.pdf
"Detroit River – Western Lake Erie Basin Indicator Project." *EPA.* 2009
http://www.epa.gov/med/grosseile_site/indicators/maumee-p.html

GOAL FOR LAKE ERIE

The citizens of the Lake Erie basin and the governments that represent them share a collective goal of a healthy Lake Erie system that supports biological, social, economic and cultural values of the region, is free from nuisance and harmful algal blooms and minimizes hypoxia. To achieve this goal, the LENT Working Group has identified a target of reducing phosphorus loads into western and central Lake Erie by 40 percent (from 2008 levels) by 2025 to achieve this goal. The 40 percent reduction target was identified by the Ohio Task Force in 2012[4] and the International Joint Commission (IJC) in 2013[5]. It has been endorsed by the Governors of Ohio and Michigan and the Premier of Ontario in the Western Basin of Lake Erie Collaborative Agreement signed in June 2015. The 40 percent reduction is also consistent with the proposed phosphorus reductions identified by the Great Lakes Water Quality Agreement (GLWQA) Nutrients Annex Subcommittee.[6] The LENT Working Group further proposes an interim phosphorus reduction target of 20 percent by 2020. The interim target is intended to focus and support early actions by jurisdictions as they work toward the longer term reduction target. These proposed interim and longer term reduction targets are aspirational and set forth a broad framework for actions that will help reduce cyanobacteria (blue-green) blooms and it is hoped the occurrences of harmful toxins produced by cyanobacteria. The targets do not mean that every source will need to reduce phosphorous by the same amount. Rather, they represent overall reduction targets for Lake Erie that can drive action in the near term as longer-term efforts are underway through the GLWQA Nutrients Annex (Annex 4) process, including release of final Lake Erie nutrient targets in 2016 and Domestic Action Plans in 2018. The U.S. and Canadian Domestic Action Plans will apportion load allocations by country and identify priority management actions that will meet the phosphorus loading targets. The GLWQA further requires that the U.S. and Canada report on progress toward meeting those load reduction targets every three years. In this way, the Domestic Action Plans have the potential to serve a function similar to large watershed-scale Total Maximum Daily Loads (TMDLs) in the United States.[7]

Figure 2: Lake Erie showing western central and eastern basins.

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[4] *Id.* Ohio Lake Erie Phosphorus Task Force

[5] International Joint Commission, *supra* note 5

[6] The Annex 4 Subcommittee presented the recommended Phosphorus load reduction target for Lake Erie on May 29, 2015 to the Great Lakes Executive Committee.

[7] A TMDL determines the maximum amount of a pollutant that a waterbody can receive (pollution load) and still meet water quality standards, and an allocation of that pollutant load among the various sources of that pollutant. The U.S. Clean Water Act requires that states develop TMDLs for all the waters listed as impaired on their "303(d) list". http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overviewoftmdl.cfm

The targets and timelines herein will be pursued using an adaptive management approach whereby they may be revised based on regular monitoring, new information, discussions and knowledge of the system (see Joint Action number VIII). Importantly, they may be modified and revised to align with the recommendations coming out of the Annex 4 process. Ontario actions would also be aligned with commitments and actions under the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, 2014 (COA).

JOINT ACTIONS

The following joint actions provide a framework for collective action among the four states bordering Lake Erie and the Province of Ontario toward solving the nutrient-related problems facing Lake Erie. Toward this end, they reflect a shared commitment to use these actions to formulate individual total phosphorus loading reduction plans (or other policy or programmatic efforts) to achieve strategic nutrient reductions. The Joint Actions presented here were identified through a consultative process with the LENT Working Group and through interviews with experts working on nutrient reduction strategies across North America.[8] Though not an exhaustive list, the joint actions presented here are known or have shown promise to reduce nutrient loads into receiving waters and contribute to improved water quality. If implemented, these actions will make important progress to achieve phosphorus load reduction targets and the goal of a healthy Lake Erie free from problems associated with excessive nutrients. These actions may be refined and adapted as new information arises about nutrients or the efficacy of various practices and their effects on nutrient-related problems. These joint actions will be pursued collectively by the Lake Erie jurisdictions based on each jurisdiction's needs, authorities, capacities and constraints.

I. Reduce nutrient applications on frozen or snow-covered ground

Description

The action calls for effectively managing or restricting manure, fertilizer and biosolids applications under the following conditions: on frozen or snow-covered ground, on saturated soil, or when the weather forecast calls for a severe rain event. To support this action, agricultural producers are encouraged to develop and follow plans that include best management practices that will be implemented to prevent excess manure and fertilizer nutrient loss and properly manage nutrients. Best management practices should include using crop-specific agronomic rates for nutrient applications and soil testing to ensure proper implementation.

Rationale

Spreading nutrients, especially liquid manure, on frozen or snow-covered ground can significantly increase the risk of runoff. Frozen soils have virtually no infiltration capability so nutrients are not able to permeate the soil, and there are no growing crops to absorb the nutrients. If applied under any of the above conditions, fertilizer, manure and biosolids can be washed away by spring snow

[8] *Additional Options for Lake Erie Nutrient Reduction* is a related document that includes additional actions identified by experts interviewed but are not included in this Joint Action Plan because they require further research and exploration. This document can be downloaded at http://glc.org/projects/water-quality/lent/.

melt and other heavy precipitation events. Not only does this contribute to excessive loadings into nearby receiving waters, it also wastes the nutrients and does not benefit field health.

Benefits and Challenges

Effectively managing or restricting nutrient applications on frozen ground will reduce or eliminate unabsorbed excess nutrients from running off fields and polluting nearby waterways. It also has the potential to save producers money by not paying for fertilizer for which there is no real farming benefit. Adhering to nutrient management plans, manure application risk assessments and certain application standards will help minimize the risk of nutrient runoff before and during the growing season.

One challenge to this action may be for livestock farms that produce more nutrients than may be agronomically required for their fields or for those farms where manure storage capacity is inadequate for the operation. Options for this group would be to install larger storage facilities, which may also involve moving to a liquid manure storage system. The spreading of liquid manure may pose a greater risk for nutrient runoff via field tile during the growing season. Producers need to empty their manure storage facilities in the fall to ensure storage capacity for the coming winter months. However, depending on the timing of harvest and the onset of winter weather, this may not be possible without some spreading on frozen ground or transporting the excess manure offsite, which can be very costly.

Timing and Anticipated Ecosystem Improvements

A phased approach to restricting nutrients on frozen or snow-covered ground will enable the agricultural sector to adapt to improved best management practices and adhere to nutrient management requirements prescribed in each jurisdiction. Any new approaches will be developed in consultation with the agriculture sector. Progress toward reduction of nutrient applications on frozen or snow-covered ground should be reviewed periodically.

II. Adopt 4Rs Nutrient Stewardship Certification program or other comprehensive nutrient management programs

Description

The 4Rs Nutrient Stewardship Certification program is a voluntary agricultural retailer certification program focused on nutrient stewardship. The program offers a special designation to retailers and crop advisors who assist producers with the implementation of best management practices (BMPs) that optimize the efficiency of fertilizer use, including

- *Right fertilizer:* Select fertilizer products based on the nutrients required for optimal plant growth, soil conditions and delivery mechanisms.
- *Right rate:* Determine the correct application rate at which fertilizers should be applied.
- *Right time:* Time the application of fertilizer to optimize fertilizer application rates and plant uptake. Apply fertilizer at times when the plant needs it most and that will minimize the amount of nutrients lost to runoff or leaching.
- *Right place:* Proper placement of nutrients maximizes plant uptake and can reduce erosive losses.

Rationale

The objective of the 4Rs program is to match nutrient supply with crop requirements and to minimize nutrient losses from fields. These practices support efficient and effective crop production that is more environmentally sound and can improve soil health while controlling costs. This approach allows crop consultants and producers to adapt proper nutrient management to a particular operation or type of cropping system, and supports improved soil health and water quality. Although technology gives producers better control of nutrient delivery, use of any of the 4Rs BMPs may not require extensive investments.

Benefits and Challenges

The 4Rs concept offers enhanced environmental protection and sustainability, as well as increased production and profitability. With better soil and crop management come higher yields. Coupled with optimized nutrient management, producers are in a position to maximize profits.

To ensure that voluntary approaches are having the desired effect on reducing phosphorus to the Lake Erie basin, 4Rs or other nutrient management and stewardship programs (public and private) should implement appropriate metrics to measure progress and assess effectiveness. For example, progress can be tracked by measuring phosphorus losses before and after BMP implementation. Edge-of-field monitoring, however, is costly and will likely need to be coupled with other data and/or modeling to assess performance. Soil testing, as recommended by the program, can help in determining the best fertilizer for a farm.

Although engaging agribusiness can sometimes be a challenge to implementing 4Rs, in the western Lake Erie basin agribusiness has been very engaged and supportive in part due to early and frequent outreach. The Tri-State Western Lake Erie Basin Phosphorus Reduction Initiative project, funded by the U.S. Department of Agriculture's Regional Conservation Partnership Program (Western Lake Erie RCPP), will be promoting the 4R Nutrient Stewardship program in Ohio, Michigan and Indiana between 2015 and 2019. Crop consultants and agronomists will play a key role in educating producers about proper nutrient treatment and the application of the 4Rs.

Timing and Anticipated Ecosystem Improvements

The Western Lake Erie RCPP is a five-year program that will begin in 2015 with a focus on cropland and incidental land, which collectively makes up 76 percent of agricultural land in the Western Lake Erie Basin (WLEB).

III. Reduce total phosphorus from seven key[9] municipal dischargers in the western and central Lake Erie basins by phasing in growing season (April-September) average effluent limits of 0.6 milligrams total phosphorus per liter by 2020. Conduct optimization and upgrade studies to evaluate costs and compliance options for reducing point source discharge of nutrients.

Description

The 0.6 milligram phosphorus per liter (mg/l) limit by the seven facilities should be in place by 2020, or during the next permit renewal, whichever comes sooner. Optimization and upgrade studies provide facilities with information on the anticipated costs to achieve total phosphorus effluent limits that enable them to evaluate the cost-effectiveness of compliance options (e.g., optimizing existing operations, investing in facility upgrades or pursuing alternative compliance options). Optimization and upgrade studies are a priority for the seven key municipal dischargers identified here, but this should not preclude individual jurisdictions or facilities from conducting additional studies to help determine costs and compliance options. In addition, this action should be pursued with ongoing implementation of long-term correction programs for CSOs and possible acceleration of long-term CSO control plan implementation schedules for combined collection systems that discharge to Lake Erie or its tributaries.

Rationale

The Nutrients Annex (Annex 4) Subcommittee, convened pursuant to the GLWQA, has determined that these seven key U.S. Wastewater Treatment Facilities (WWTFs) plus the City of Fort Wayne, IN, deliver a significant portion of the point-source total phosphorus load to the western and central basins. Although all point and nonpoint dischargers play a role to improve water quality in Lake Erie, short-term point-source reduction efforts at these key facilities is a strategic approach that should result in load reductions and water quality benefits. Optimization at the facilities, for example, involves fine-tuning plant operations to minimize total phosphorus in the treated effluent and generally requires only minimal capital expenditures. Upgrades generally require facility expansions or other larger capital investments. Operational changes through optimization can be implemented in a shorter timeframe. However, in some cases, facilities may not be able to meet effluent limits through optimization alone. Studies that assess costs of achieving a reduction target or discharge limit optimization, upgrades and alternative options provide facilities with information to make cost-effective decisions (e.g., compare costs among optimization techniques, capital improvements and upgrades, or offsite conservation investments) and thereby support an adaptive management approach. Short-term investments may focus on optimization, while longer-term investments enable cost-effective solutions in light of evolving policies and markets. U.S. and Canadian efforts to reduce untreated CSOs will also further reduce total phosphorus loads into the Lake Erie basin.

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[9] Key municipal dischargers to the western and central basins include the City of Detroit Water and Sewerage Department (MI); the Wayne County-Downriver WWTF (MI); Ypsilanti Community Utility Authority (MI); City of Toledo WWTF (OH); and three WWTFs in the Northeast Ohio Regional Sanitary District (Easterly WWTF, Southerly WWTF, and Westerly WWTF).

Benefits and Challenges
Benefits include potentially significant load reductions at lower costs, because existing facilities that contribute the greatest point-source loads to the western and central basins will be optimized. In addition, achieving these reduced loading targets could happen in a relatively short timeframe. Currently, federal and state funding is not available to finance optimization and upgrade studies, so facilities will need to find new sources of revenue to cover these costs, which may prove difficult. However, armed with information about cost effectiveness, these studies may build political support for longer-term solutions and help avoid investments in less cost-effective options.

Timing and Anticipated Ecosystem Improvements
As an example, the Detroit WWTF was issued a revised discharge permit[10] in 2013 that called for optimization of total phosphorus removal and compliance with a growing season average of 0.6 mg/l. As a result, the facility is now typically discharging 0.2 – 0.45 mg/l total phosphorus, which has already reduced the nutrient load by a few hundred metric tons. Determining the timing for ecosystem improvements is difficult due to the variety of factors that affect water quality in Lake Erie (e.g., invasive species and meteorological trends)[11].

IV. Encourage and accelerate investments in green infrastructure for urban stormwater and agricultural runoff, including ecological buffers for rivers, streams and wetlands.

Description
Green infrastructure can provide multiple ecosystem service benefits, including improved water quality, habitat, recreational amenities, carbon sequestration, and flood protection. Rainwater harvesting systems collect and store rainfall for later use or release. Green infrastructure includes structural best management practices (BMPs) such as detention basins and filter strips, as well as non structural BMPs such as erosion control ordinances and buffers/setback zones to protect natural features like community water supply wells. In this way, ecological buffers are a type of green infrastructure that can be designed to interrupt or slow runoff water and help keep it and associated pollutants from entering nearby waterways. In the U.S., acquiring land or access to land for ecological buffers and BMPs generally occurs through outright purchase, purchase of special easements, or leases, though other arrangements are possible.

In contrast to traditional "gray" infrastructure (e.g., storm sewers and stormwater management ponds), where natural ecological processes are replaced with hard structures and engineered systems, green infrastructure is designed, constructed and maintained to enable or enhance certain ecological processes. A common example of green infrastructure in urban environments is permeable surfaces that allow natural infiltration to occur. In agricultural and other rural settings, ecological

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[10] The permit was issued by the Michigan Department of Environmental Quality, which has authority to administer the National Pollution Discharge Elimination System (NPDES) permit program in the State of Michigan pursuant to the Clean Water Act. The monthly average permit limit for total phosphorus is 0.7 mg/l, year round (each and every month).
[11] Michalak et al. (2013). Record-setting algal bloom in Lake Erie caused by agricultural and meteorological trends consistent with expected future conditions. Proceedings of the National Academy of Sciences of the United States of America. Retrieved from www.pnas.org/cgi/doi/10.1073/pnas.1216006110

buffers, restored wetlands, and naturally designed stream channels, such as two-stage or multi-staged ditches, are other examples of viable green infrastructure options.

There are several ways to encourage and accelerate investments in green infrastructure. Implementation can occur through regulatory programs where green infrastructure requirements are incorporated into permits for effluent discharge (e.g., wastewater facilities and stormwater systems) or into permits for development projects that receive federal or state funding. Alternatively, projects that incorporate green infrastructure could receive a stormwater fee reduction credit on their stormwater fees or local taxes. Other ways to fund green infrastructure include federal, state and local grant programs; water utility incentives for developers and homeowners; and rewards and recognition for innovation and increased awareness of green infrastructure by the public and decisionmakers.

Rationale

Green infrastructure can harness natural processes to infiltrate, recharge, evaporate, harvest and re-use stormwater. Designed properly, green infrastructure delivers superior water quality benefits along with the specific functions for which it is built, such as flood control, water delivery, and water treatment. Green infrastructure also provides ancillary ecological and/or societal benefits, such as aesthetic improvements, recreation opportunities and/or other environmental benefits like enhanced wildlife habitat. Some green infrastructure, such as green roofs and walls, can also improve air and water quality while reducing energy costs. Over the long term, green infrastructure is more likely to be a cost-effective solution to address multiple ecological and societal challenges related to water quality.

Benefits and Challenges

While funding and regulatory options are available, they are generally insufficient and often are confounded by poor coordination and integration into water management programs. The lack of funding is the most cited barrier for implementing green infrastructure.

Creative solutions are needed to finance green infrastructure, which may be costlier in the short term, when compared with traditional gray infrastructure. In the U.S., innovative financing mechanisms have emerged from the building retrofit experience, such as Property Assessed Clean Energy (PACE) and third-party Power Purchase Agreement (PPA)-type models. In these third-party financing models, a third-party investor makes funds available to owners to make changes to their property to reduce stormwater runoff. In exchange, the property owner enters into a contractual relationship with the third party (a public or private entity or a public-private partnership) to share the stormwater fee for a term of years until the third-party capital provider has attained repayment or the desired financial returns. [12] Innovative uses of the U.S. Clean Water Act's Clean Water State Revolving Fund (CWSRF) may also support watershed protection and green infrastructure projects. To access these funds for this purpose, specific watershed protection and/or green infrastructure activities must be spelled out in each state's 319 (nonpoint source) program as well as in the state's CWSRF "intended use plan." Using the CWSRF as a loan guarantee instead of a direct loan offers the potential to greatly increase the amount of funds available for green infrastructure/watershed

[12] Natural Resources Defense Council, 2013. *Creating Clean Water Cash Flows. Developing Private Markets for Green Stormwater Infrastructure in Philadelphia.* January, 2013. http://www.nrdc.org/water/stormwater/files/green-infrastructure-pa-report.pdf.

protection programs. However, there must be a reliable and dedicated funding stream to use CWSRF as a loan guarantee.[13]

Initial capital investment costs can be expected to go down as demand for green infrastructure increases and marginal costs decrease. Green infrastructure can require additional land or space that may be costly or is not readily available for purchase; or funding may not be available to acquire the land or waterway access needed to create/install the green infrastructure. Consideration of the full life-cycle costs of green infrastructure, including the multiple ecosystem services it can provide compared to gray infrastructure costs, can help leverage investments toward this greener approach.

Timing and Anticipated Ecosystem Improvements

Once it is built or installed, most green infrastructure begins delivering ecosystem benefits within a relatively short time period. Public and private programs to finance, incentivize or otherwise encourage green infrastructure should be available so that these stormwater management systems can contribute to water quality improvements quickly.[14]

V. Work with federal partners to develop plans to reduce the open-water disposal of dredged material and to advance beneficial re-use of dredge material as an alternative.

Description

States are concerned that U.S. Army Corps of Engineers (USACE) policies regarding open-water disposal of dredged material may result in altering the movement, cycling, timing, re-suspension and recirculation of nutrients to the lake. Ohio has recently adopted legislation (Senate Bill 1 of 2015) that provides for the elimination of open-water disposal by 2020, except in limited circumstances, which can include use of sediment as beach nourishment and the creation of in-lake habitat. Pennsylvania law prohibits open-lake disposal of dredged material unless it is classified as clean. Michigan effectively prohibits open-water disposal in Lake Erie as state law does not allow disposal in waters less than 30 meters deep (the western basin is shallow, so open water disposal is not allowed).

Rationale

Operation and maintenance of ports and navigation channels in Lake Erie is vital to the economies of the states and Ontario. However, concern has existed for many years over the practice of open-water disposal, especially in the western basin. Legislation adopted in Ohio sends a clear signal to federal agencies on the importance of finding alternatives to the practice in the near future.

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[13] Curley, Michael, 2014. *Financing watershed protection under the Clean Water Act: Loan guaranties could unlock millions for project funding.* Viewpoint. January 2015, WE&T Magazine; Vol. 27, No.1. Water Environment Federation, Washington, D.C.

[14] "A Business Model Framework for Market-Based Private Financing of Green Infrastructure", S.K. Sinha, J. W. Ridgway, J.E. Edstrom, J. Andersen, P. Mulvaney, M. Quigley, and E. Rothstein, Environmental Consulting & Technology, Inc., Report, 46 pp, December 2014.

Benefits and Challenges
The USACE, which maintains ports and harbors through dredging the federal navigation channel, will need to exercise flexibility in its interpretation of the federal standard defining dredge disposal options. States will need to work with the Corps to help identify and promote beneficial re-use of dredged materials, which can include the creation of habitat and use as building or fill material.

VI. Pilot innovative performance-based and/or market-based nutrient reduction projects.

Description
Performance-based incentives, or "pay for performance," are payments based on the achievement of specified environmental outcomes. The performance outcomes may be based on goals or targets set by a policy, regulation, or voluntary stakeholder group.[15] With performance-based incentives, producers can earn the largest incentive payments from choosing the most effective actions for their specific farm or fields. This approach provides flexibility for producers to find the most appropriate and cost-effective solutions for their specific farming operation or resource concern.

Performance-based incentive projects have been and are currently being successfully implemented in portions of the WLEB (e.g., The Stewardship Network's Cooling Hotspots: Motivating Farmers to Reduce Nutrient Losses, 2014 Great Lakes Restoration Initiative grant). Water Quality Trading (WQT) is an example of a performance-based approach that is also a market-based approach. With WQT, water quality credits are calculated and traded based on the amount of pollution reduced and the payment comes from a permitted facility that is required to reduce pollution. WQT projects are underway in Wisconsin, Ohio and Pennsylvania (as part of Chesapeake Bay states' TMDL implementation). Another innovative performance-based approach is Wisconsin's Adaptive Management Option, which allows permitted facilities to develop and implement pollution actions across an entire watershed to comply with their permit. The Wisconsin Adaptive Management Option has some similarities to WQT in that conservation occurs on the land throughout the watershed (instead of only at the regulated facility) and that there are generally co-benefits (the conservation practices usually do more than reduce a single pollutant).

Rationale
Current programs for controlling nonpoint source pollution from agriculture lands largely rely on financial assistance programs (e.g., Farm Bill and the Canada-Ontario Farm Stewardship Program) that compensate agricultural producers for their conservation practices based on the costs they incur related to specific practices and not necessarily based on whether ecological conditions improve (i.e., environmental performance). Although these programs are important tools, outcome-based approaches have greater potential to inspire new and innovative solutions because they provide incentive payments based on the achievement of farm or site-scale environmental performance outcomes. Site or farm-level performance assessments should be linked to broader watershed-scale

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[15] Vermont and Winrock International. (n.d.). "Developing Stakeholder-driven, Performance-based Incentives for Agricultural Pollution Control." A National Facilitation project implemented by The University of Vermont, supported by the U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service, National Integrated Water Quality Program, under Agreement No. 2006-51130-03668.

goals and objectives, (e.g., watershed plan, TMDL). Water quality trading and other market-based approaches have the potential to offer a cost-effective, flexible option for meeting wastewater treatment facilities permitted nutrient load limits while encouraging the installation of conservation practices in rural and urban areas.

Benefits and Challenges

Focusing on environmental performance at the watershed scale brings diverse or multiple stakeholders together to collaborate toward common goals and objectives, either through market forces or regulations, or a combination of both. The "multiple stakeholders" can be all point-source permit holders, or all point-source permit holders with a certain effluent volume, such as is being done with the San Francisco Bay area watershed based permit.[16] Alternatively, it can focus on all Municipal Separated Storm Sewer System (MS4) nonpoint-source permit holders in a watershed as is done with Michigan's watershed-based permitting.[17]

Implementing pilot programs using innovative approaches, like "pay for performance" incentives, can complement and help promote alternatives to traditional cost-share approaches. These alternative programs have proven to reduce phosphorus loss from agricultural land by providing flexible, performance-based outcomes that benefit both the producer and water quality. In the case of WQT, the payment comes from effluent discharge permit holders who opt to pursue WQT as a less costly compliance option. Strict or stricter discharge limits on existing facilities, TMDLs and other policies can help drive this "demand" for market-based approaches. Without adequate demand, however, market-based approaches may be less viable and the actual payment for performance would likely still rely on federal and state agency programs or private foundations. Pay for performance also offers ancillary environmental benefits from the installation of conservation practices. For example, the desired "performance" may be reductions in phosphorus, but many conservation practices do more than just reduce phosphorus. With any performance-based approach, robust, well-vetted and agreed-upon quantification methods are needed for quantifying reductions in nutrient loadings. Time and resources are also needed to develop and test associated methods and protocols.

Timing and Anticipated Ecosystem Improvements

A pilot nutrient reduction performance-based incentive effort may take approximately one to three years to implement. In the case of a WQT program, if the results indicate adequate demand exists and protocols have been agreed to by stakeholders, then a multijurisdictional trading program could be considered to achieve long-term reductions.

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[16] San Francisco Bay Nutrients Watershed Permit (California Order R2-2014-0014) sets forth a regional framework to facilitate collaboration on studies that will inform future management decisions and regulatory strategies for nutrient reduction. This 2014-2019 permit cycle is the first phase of what is expected to be a multiple permit effort. This first phase aims to: track and evaluate treatment plant performance, fund nutrient monitoring programs, support load response modeling, and conduct treatment plant optimization and upgrade studies for nutrient removal. (excerpted from http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2014/R2-2014-0014.pdf)

[17] Michigan's watershed-based permitting case study. Downloaded 7-20-15 at http://water.epa.gov/polwaste/npdes/basics/upload/wq_casestudy_factsht3.pdf

VII. Phase out residential phosphorus fertilizer application within five years.

Description
Residential fertilizer can be over applied or wrongly applied to lawns and can run off into nearby waterbodies; contributing to excessive nutrient loadings. Unless turf is being newly established in an area, a fertilizer with high levels of phosphorus is usually not necessary because soils are often nitrogen limited. Thus, established lawns do not typically need extra phosphorus, and any extra that is applied may enter a surrounding waterbody.

Rationale
Michigan and New York have laws that prohibit phosphorus fertilizer application unless the lawn is new or has a proven phosphorus deficiency. A Michigan-based study[18] has shown an average 25 percent reduction in phosphorus runoff into a river in southeast Michigan as a result of the phosphorus ban. Some states outside of the Lake Erie basin have more detailed regulations, but the underlying principle is the same. Several fertilizer companies in Ohio and Ontario have also voluntarily eliminated phosphorus in commercial brands. No restrictions are currently in place in Pennsylvania.

Benefits and Challenges
Fertilizer companies may need to change their chemical ratio for fertilizer mix that is sold for residential use and/or may also need to change their product for specific markets in the Lake Erie basin states and the Province of Ontario.

Timing and Anticipated Ecosystem Improvements
A phasing out of virtually all phosphorus in residential fertilizer is recommended by 2020, except under circumstances where compelling information is presented that confirms a need for phosphorus. Water quality benefits will accrue as phosphorus runoff from turf grass and associated pollution loads into receiving waters is drastically reduced.

VIII. Target Conservation at the Watershed Scale.

Description
Targeted agricultural conservation is the idea of directing conservation activities to those areas known to be contributing relatively more pollution in a given watershed or where the relative contribution (e.g., due to location, nearby land uses, and/ or hydrogeomorphic conditions) is known to have particularly negative impacts on water quality. Understanding where the most important loads of phosphorus are can help focus scarce resources to those areas where conservation investments will yield maximum ecological improvement.

Targeting can be done at multiple scales. For example, watersheds within western Lake Erie can be targeted, and then sub-watersheds and even lands within those subwatersheds can be further targeted. Targeted conservation in urban settings might focus on investments in green infrastructure

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[18] Lehman, John T., Douglas, W. Bell, and Kahli E. McDonald. "Reduced River Phosphorus following Implementation of a Lawn Fertilizer Ordinance." *Lake and Reservoir Management* 25.3 (2009): 207-12.

that reduce urban runoff, combined and sanitary sewer overflows. In rural communities, conservation may have the greatest impact by focusing on managing home sewage treatment systems with an eye on watershed-scale impacts. Home sewage treatment systems are generally managed by municipalities to protect human health, but given the increasing number and footprint of homes and communities on private septic systems, watershed-scale impacts are also an important consideration. On rural agricultural lands, targeted conservation focuses on those watersheds and subwatersheds that are most prone to high rates of soil loss and pollution runoff in light of the current agricultural uses of that land.

Rationale
Conservation dollars are consistently oversubscribed and there rarely is adequate funding to meet all conservation needs. Targeting conservation within a watershed enables limited funds to be used for conservation activities that will have the greatest impact on improving water quality and other ecosystem services.

Benefits and Challenges
Federal and state/provincial conservation priorities are not always consistent. Some federal programs are designed to address a particular problem in a way that does not align with a state or provincial conservation priority. This can make it difficult to target limited financial resources to a geographic area. A clear expression of state/provincial conservation priorities and their communication to federal agencies can help. Likewise, federal agencies can build flexibility into their program priorities to support conservation in priority areas identified by the state or province.

It is critical to include affected stakeholders from the outset and build partnerships with them to support the targeted approach. The affected stakeholders may be different in urban, suburban/exurban, and rural agricultural settings. How this conversation is crafted is important. Using words like "targeting" or "focusing" that are positive and collaborative can encourage people to work together. Adequate data to support the location and sources of loadings and their relative contributions is fundamental to the targeted conservation approach.

There is extensive opportunities implement this approach across the Lake Erie basin. The tri-state RCPP project and certain projects being implemented by The Nature Conservancy exemplify this targeted approach.

Timing and Anticipated Ecosystem Improvements
The timing of ecosystem improvements will vary depending on the location and type of conservation. Ecosystem improvements are likely to be greater and occur more quickly with a targeted approach.

IX. Within five years, validate or refine the reduction targets and timelines using an adaptive management approach.

Description
An adaptive management approach will be used to track the progress made under the Joint Action Plan and will be used to adjust the targets and actions based on new science and knowledge. Information to track progress and a forum to adjust targets and actions will be essential. The GLWQA Annex 4 Subcommittee process will be one forum and source of information for refining domestic actions using adaptive management. Additional information sources and a forum for

continued state and provincial collaboration will be needed. Possible topics warranting further research that could affect the targets, timelines, or action items herein include

- examining the relative contribution of various sources of nutrients into Lake Erie (including internal cycling of phosphorus once it enters the lake) and targeting actions that are likely to have the greatest impact on reducing of nutrient-related ecological problems in Lake Erie, such as harmful algal blooms, nuisance algal blooms and abundance of toxic bacteria;
- investigating the role of zebra and quagga mussels and their relationship to algal blooms and their toxicity;
- developing and testing of mussel management techniques;
- measuring the performance of BMPs at increasing nutrient uptake and reducing nutrient runoff, as well as the cost effectiveness of pollution reduction steps;
- understanding harmful algal blooms and toxin production; and
- studying the impacts of climate change on algal bloom production in Lake Erie.

Rationale

New data, tools and technologies will inevitably illuminate our knowledge of excessive nutrients, their sources, relative contributions and impacts on Lake Erie. This information should be periodically assessed and adjustments to this Joint Action Plan should be made accordingly.

Benefits and Challenges

The collaborative process that created this Joint Action Plan will need to be maintained or re-instated to accommodate new information and make any changes to implement actions in this document. This requires leadership—an entity to manage that collaborative process—and a commitment of time and resources by the leading entity and all those that need to be engaged in the process.

Timing and Anticipated Ecosystem Improvements

The Lake Erie jurisdictions will continue to collaborate on water quality challenges including implementation of the Western Basin of Lake Erie Collaborative Agreement, LENT, the GLWQA Annex 4 Subcommittee process, and the binational Lake Erie Lakewide Action and Management Plan. Among other items, Annex 4 proposes to develop a science plan for Lake Erie that can identify science priorities and, when implemented, can be used to validate or refine the reduction targets. Updates to this Joint Action Plan will be considered to align with the GLWQA and reporting on related domestic arrangements (e.g., COA).

X. Collaborate toward an integrated monitoring, modeling, tracking and reporting network for the Lake Erie basin by 2020.

Description

A multi-sector collaboration to build an integrated, outcome-based monitoring and modeling network for Lake Erie by 2020 can help solve the identified problems in Lake Erie, including nuisance and harmful algal bloom production and associated catalysts (e.g., invasive mussels and climate change). Such a network would be implemented using an adaptive management approach and would likely include efforts to measure nutrient losses at the edge-of-field, as well as load reductions of TP and SRP in streams and rivermouths. This includes development and application of consistent methods for quantifying load reductions at edge-of-field as well as refinements to watershed models that are calibrated to incorporate edge-of-field data with other data to assess in-stream loads and water quality trends. This information should be reported to, or linked from, one central portal. An integrated tracking, accounting and reporting system would include processes and mechanisms for identifying, tracking and reporting on progress toward achieving the reduction targets proposed here (40 percent by 2025 and 20 percent by 2020), including specific sources and reduction potential of phosphorus and nitrogen from different locations. It would also identify underlying drivers/causes that contribute to those sources and their relative contribution, to the extent known, using the best available science. Both regulated and unregulated point sources and diverse nonpoint sources would be tracked, including agricultural feeding operations, manure/fertilizer management systems, and home septic systems.

Rationale

Different tools are needed to analyze the effectiveness and impacts of conservation practices and investments at different scales. Information technology tools can complement on-the-ground monitoring to analyze trends and progress toward achieving environmental goals at multiple scales. Coupling in-stream monitoring with monitoring at rivermouths of Lake Erie tributaries as part of a network allows for tracking and measuring changes in pollution loads and progress toward achieving water quality improvement goals across major sub-watersheds within the Lake Erie basin. Additionally, an integrated tracking, accounting and reporting system will provide a framework for using monitoring and modeling results to assess progress toward interim and long-term targets. It will provide a benchmark from which changes and improvements can be measured. Designed properly, the tracking and reporting should allow implementers to assess which efforts are working and where adjustments need to be made. In short, it will enable an adaptive management approach to refine, adjust or modify actions so that they are designed and pursued in ways to maximize their ability to solve nutrient-related problems in Lake Erie. Chesapeake Bay's integrated accounting program—chesapeakestat.com—is noted as being integral to the success of that multi-jurisdictional effort to clean up the Chesapeake Bay. Annex 10 (Science Annex) of the GLWQA calls for similar measures to enhance coordination of science and supporting activities for the entire Great Lakes basin.[19] This action supports the Annex 10 process with a specific focus on Lake Erie.

Benefits and Challenges

Public policy and the public at large increasingly demand to know whether public investments in restoration are resulting in ecological improvements. Answers to questions such as "how many pounds of phosphorus will this restoration project keep from going into nearby waterways?" are expected at multiple scales—ranging from individual farms to the Lake Erie basin as a whole. There are a multitude of tools and methods for estimating environmental improvements, but most were designed to assess specific types of actions or ecosystem components, or at a specific scale, and cannot be integrated with others. Monitoring can show whether a stream, river or lake is improving, but only in limited circumstances can monitoring results be linked to specific restoration actions. Monitoring is costly and implementing monitoring of every farm, stream and river is not feasible. Models can help fill in the gaps. Development of common and accepted protocols for appropriate models that integrate monitoring data and can be adapted over time is foundational to a robust system that can predict and account for ecosystem outcomes and trends. An integrated network

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[19] Annex 10 to the 2012 Protocol of the Great Lakes Water Quality Agreement calls for "enhancing the coordination, integration, synthesis, and assessment of science activities…. including monitoring, surveillance, observation, research, and modeling…."

leverages existing monitoring and modeling efforts to be mutually supportive in assessing progress toward improved water quality and in making strategic conservation and restoration investments. Dedicated staff is needed to coordinate the development and, ultimately, operation of integrated monitoring and tracking systems. Agreement must be reached on the science used to track progress and systems need to be put in place that enable data and information sharing via a common platform. This takes time as well as staffing and financial resources. The framework for Chesapeakestat.com, for example, has taken more than a decade to implement and it will take years before the parent site and suite of supporting web products that track progress and accountability are fully functional.

Timing and Ecosystem Improvements
A fully integrated monitoring and modeling network for the Lake Erie basin is likely to take many years. Interim steps can be taken to enhance collaboration among those agencies and organizations engaged in monitoring and modeling that can improve collective the assessment of water quality trends and inform more effective protection and restoration activities. Any monitoring and modeling under this Joint Action Plan would not duplicate efforts being undertaken under the GLWQA. A tracking and accounting system is critical to assessing progress, understanding effectiveness of certain actions, and adapting to allow for improvements.