Great Lake Update

Lake Erie Nutrients: Towards a Lake Erie Domestic Action Plan

Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)
Environmental Management Branch

Great Lakes Algal Blooms

- Following extensive phosphorus reduction efforts initiated in the 1970s, harmful algal blooms (HABs) in Lake Erie were largely absent
- However, blooms began to reappear in the western basin of Lake Erie in the mid-1990s
- 2011 – Records setting algal bloom in Lake Erie
  - Significant impacts to fishery, recreational uses, beach access, property values
- 2014 – Harmful algal bloom impacted drinking water supply
  - Interrupted water supply for 500,000 people in Toledo, Ohio
  - Drinking water advisory for Pelee Island
- 2015 – Largest bloom in Lake Erie's History (National Oceanic & Atmospheric Administration)

The Algae Issue – Complex Causes

Phosphorus (P) is the main contributor to lake algal blooms. Many factors will contribute to blooms despite any reductions in agriculture sourced phosphorus.

Residual P

Re-suspension of P from stream and lake sediments

Changing Land Use

- Increased phosphorus discharges from urban and agricultural landscapes due to changes in land use and land management

Aquatic Invasive Species

- Changes to water clarity and nutrient flows caused by Zebra and Quagga Mussels

Higher Percentage of Dissolved P

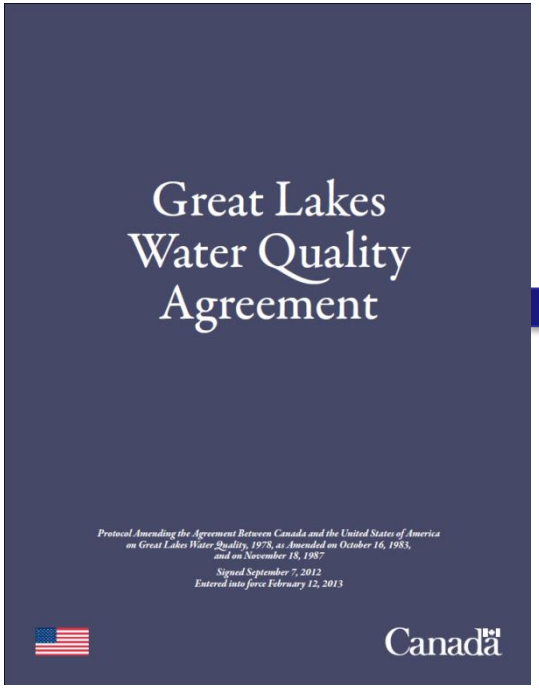
- Reasons are not conclusively understood

Changing Climate

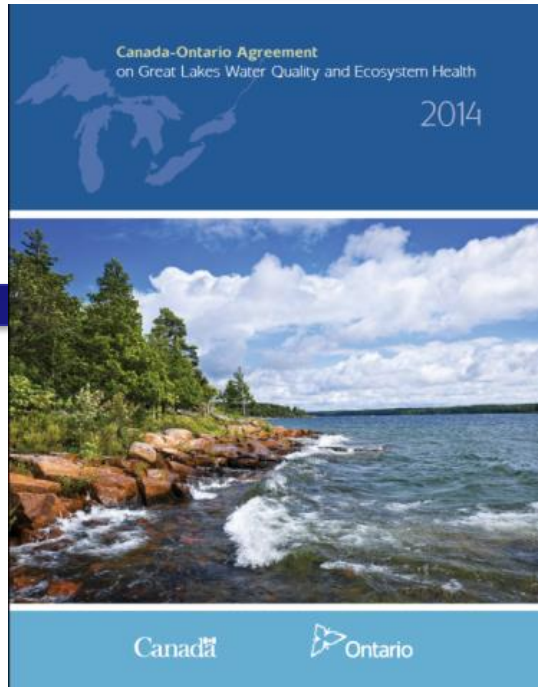
- Increased frequency of severe storms
- Increased temperatures
- Longer growing seasons

Ontario's Great Lakes Commitments

Binational (Canada/US)



Domestic (Canada/Ontario)



New Phosphorus Reduction Targets for Lake Erie by 2016 and Phosphorus Domestic Action Plan by 2018

Recent Great Lakes Activity

- Great Lakes Water Quality Agreement process has determined that a 40% reduction of Phosphorus entering the western and central basins of Lake Erie is needed to improve the health of Lake
  - A proposed reduction of **3,316** Metric Tonnes Annually (MTA) from the United States and **212**MTA from Canada
  - Thames River and Leamington tributaries are Canadian priorities to reduce localized algal bloom issues
- The Premier of Ontario and Governors of Michigan and Ohio signed a Collaborative Agreement on June 13, 2015
  - 40% reduction of Phosphorus to western basin of Lake Erie by 2025, with an interim reduction target of 20% by 2020
- The Great Lakes Commission recently released a Joint Action Plan for Lake Erie that outlines 9 key actions that can contribute to achieving the 40% reduction target (see Appendix A for actions geared to agriculture)

Process Towards Achieving Reductions

Updated Draft Lake Erie Targets (finalized in 2016)

Early Actions & Draft Plan Released

Domestic Action Plan (2018)

Ongoing engagement with stakeholders to develop most effective reduction tools

Ongoing implementation of existing and new reduction practices

Improved Health of Lake Erie

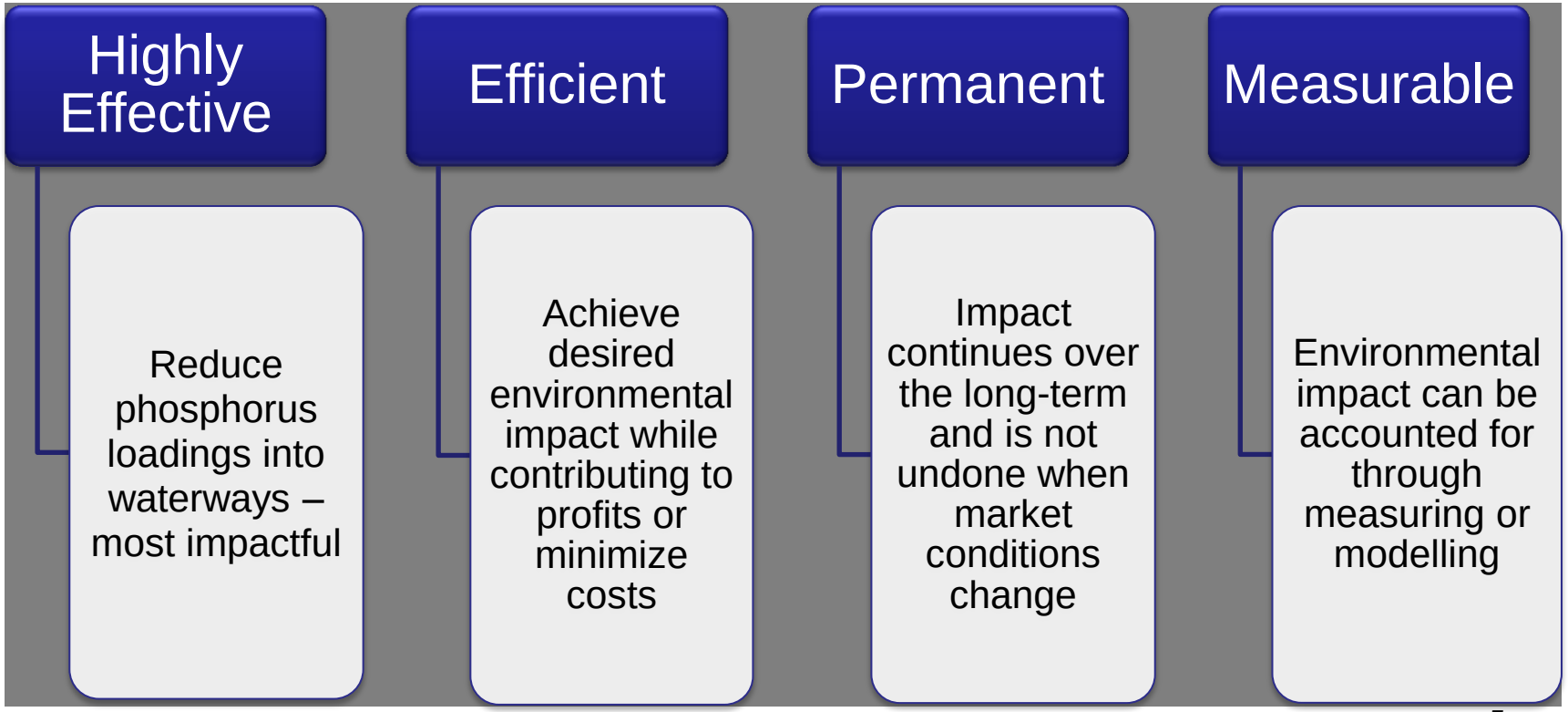
40% Reduction of Phosphorus entering the western and central basins of Lake Erie

Adaptive approach that incorporates new science and information

Development of the Domestic Action Plan

Engagement and collaboration:

- The actions to achieve these goals will be developed in collaboration with stakeholders
  - Critical to have engagement at all levels; farm organizations to individual producers



Key Messages

- Solutions will come from all sectors, however agriculture has a significant role to play
  - Despite the ongoing commitment and actions taken by farmers, conditions in Lake Erie are becoming more severe; achieving the reduction target will require significant change from the status quo
  - Solutions will require engagement and action across the entire agriculture sector
- To have a meaningful impact, engagement and action will need to occur at all levels from leadership to producers
- We know the issue is complex and there are no instant solutions but we challenge each agricultural producer in Ontario – and particularly those farming in the Lake Erie watershed – to think about what actions they can take to reduce phosphorus escaping from their farms
- Everything is on the table at this stage to impact change; including regulatory options, cross compliance, incentives, education and research

Moving Forward

- Collective efforts to engage industry leaders, experts and producers in developing options and taking early action
- Ontario and Canada are planning to engage the agriculture and other sectors on potential actions to achieve reductions to support the development of the Domestic Action Plan
  - Looking for advice to government and actions that industry organizations will take
- Longer term efforts are underway through the GLWQA Nutrients Annex (Annex 4) process including:
  - 2016: Release of final Lake Erie nutrient targets
  - 2016/17: Early actions/drafting Domestic Action Plan
  - 2018: Release of Domestic Action Plans

What Does it Mean for Agriculture?

Does what we do **HERE**

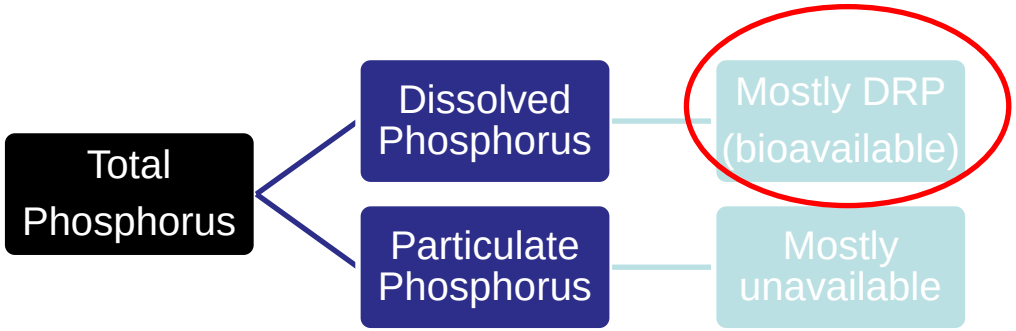
- ❑ **Tile Drain**
- ❑ **Work Fields**
- ❑ **Apply Fertilizer, Manure & Biosolids**
- ❑ **Grow Crops**

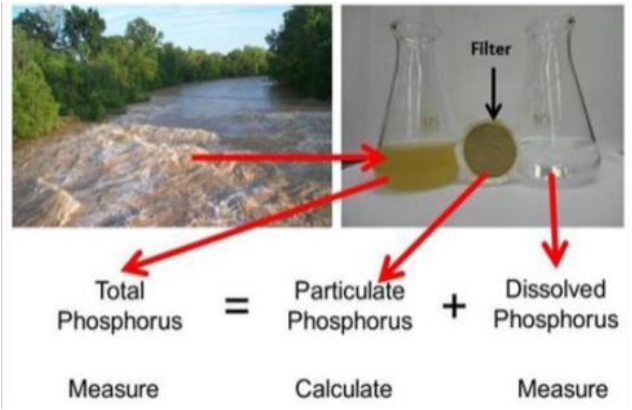
Really matter out **THERE?**

- ❑ **Nuisance Algal Blooms**
- ❑ **Impacts to Drinking Water**
- ❑ **Reduced Oxygen**
- ❑ **Beach Closures**

Dissolved Reactive Phosphorus

- Phosphorus enters the Lakes in two basic forms, with different bioavailability (to support algae):
  - Most **dissolved P** is dissolved reactive P (DRP), which is 100% bioavailable
  - **Particulate P** is mostly unavailable to algae, and the portion that is bioavailable may settle to the lake bottom before being released to support algal growth

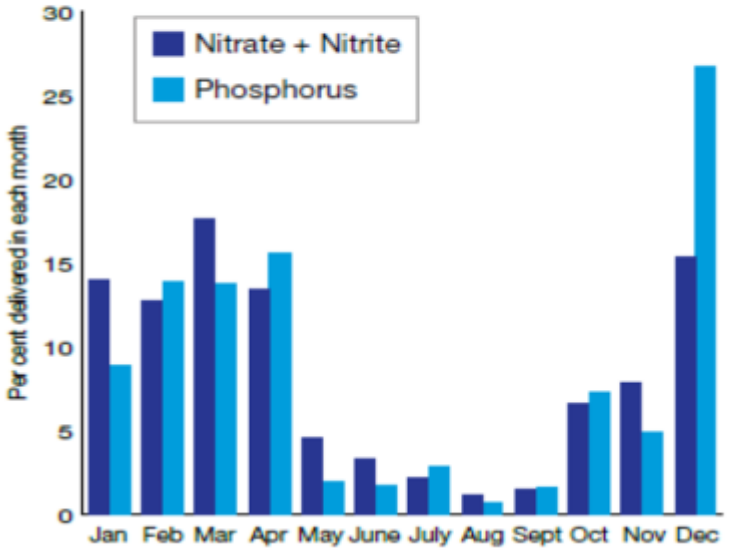




- Changes in agriculture have been identified as contributing to upward trends in DRP export. These include (Heidelberg University):
  - Increased broadcasting of fertilizer without incorporation
  - Build-up of P concentration at soil surface due to broadcast fertilizer applications, crop residue breakdown on the soil surface, and decline of mold board plowing
  - Unnecessary fertilizer or manure application when P is already available in soil
  - Soil compaction that increases surface runoff
  - Increased tile drainage coupled with the development of macropores

Non Growing Season P Loss

Majority of nutrient export in non-growing season:

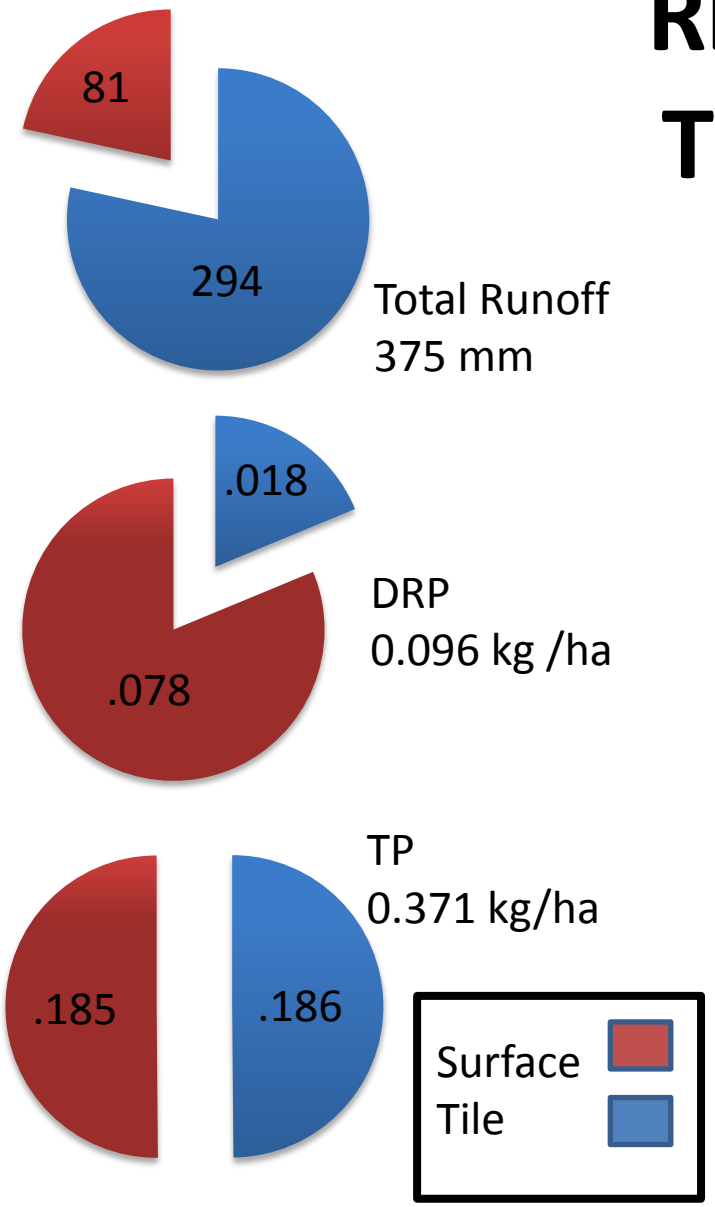


MOECC Water Quality in Ontario 2012 Report

- Highest risk period for Phosphorus loss from agriculture is in the non-growing season (Nov – April)
- Intense rainfall events during this period are increasing with climate change
- Over 80% of Phosphorus loss can occur in this period

Relative Contribution of Tile and Surface Runoff to Annual P Load

(Maitland Site: May 2012 – Apr 2013)



Source: C. Van Esbroeck – Thesis

General Conclusions

Surface – not dominant pathway for water movement (~22%) but accounts for:

81% DRP loss

50% total P loss

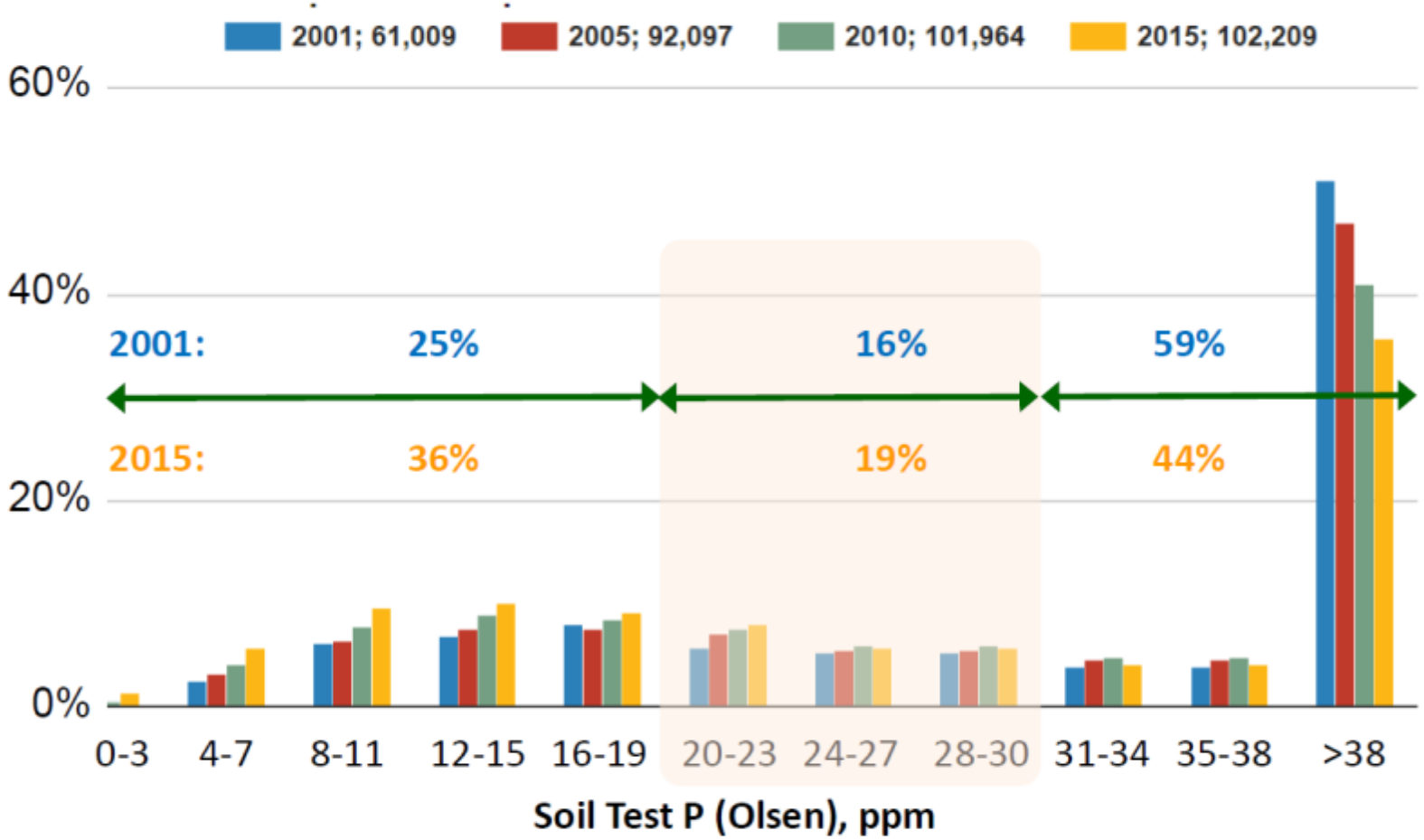
Ag Production – Changes in Lake Erie Watersheds

Changes in production trends have had impacts on Phosphorus, including:

- Expansion of Greenhouse production
- Hay/Forage to corn and soybeans
- Increasing size of farms/fields
- Ownership to renting
- Increased distiller grains in livestock rations

Phosphorus in Ontario's Soils

Ontario has more soils very high in P than Ohio



http://soiltest.ipni.net

Phosphorus Rate and Timing

Reduce tillage and Use Ontario Recommendations

NMAN 6 years	Agronomic P205	Crop Removal P205	Ontario P-Index	USLE (ton/ac/yr)
cC-cS-cW P band	18-0-0-18-0-0 36	83-0-83-83-0-83 332	16	6
C-nS-nW Pbcst/incorp	18-0-0-18-0-0 36	166-0-0-166-0-0 332	**Less P** 9.3	**Less soil loss** 2.2

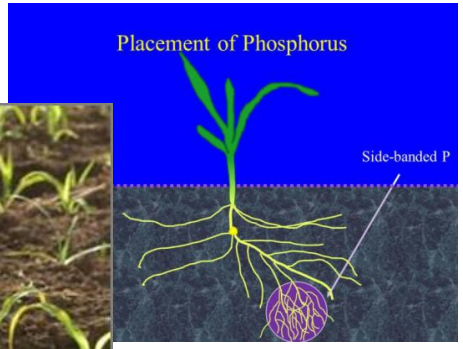
Incorporation ≠ plowing

Soil Test level 25 ppm

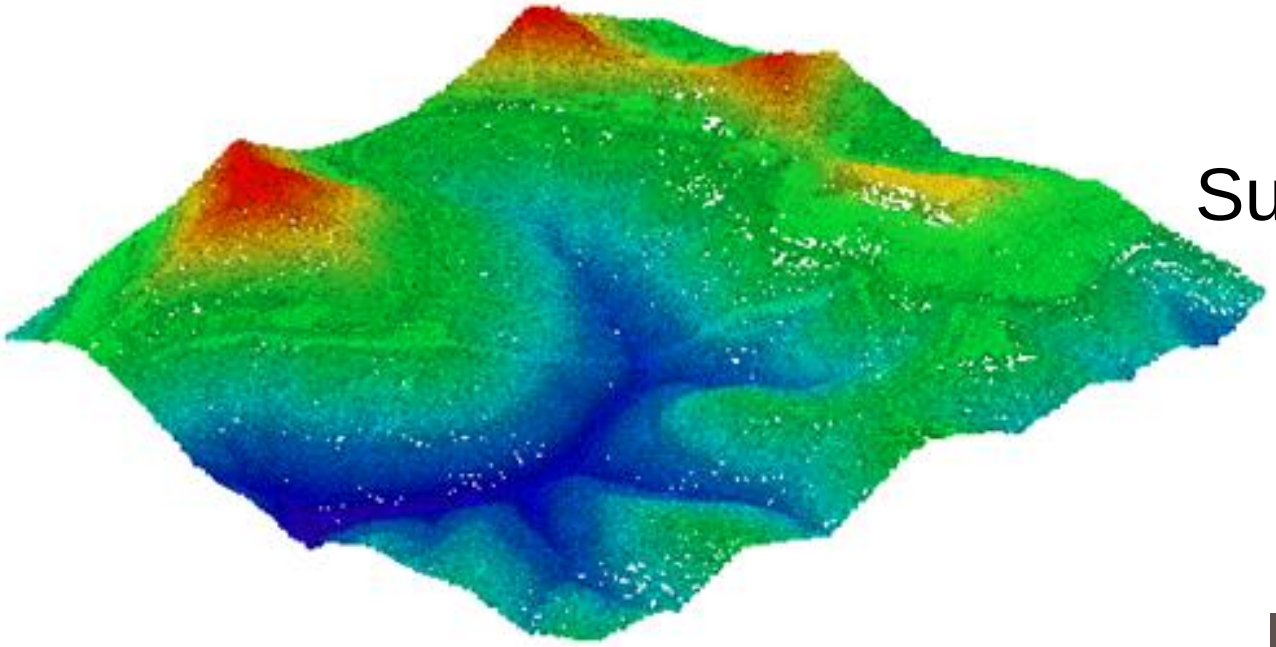
K. McKague, OMAFRA, NMAN

4Rs Strategy

- Place
- Time
- Rate
- Source

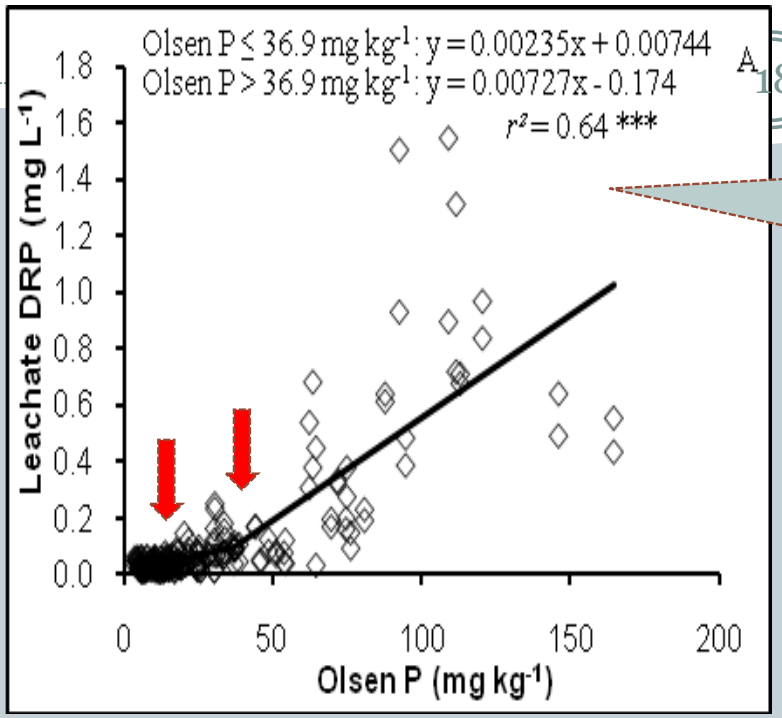


Field



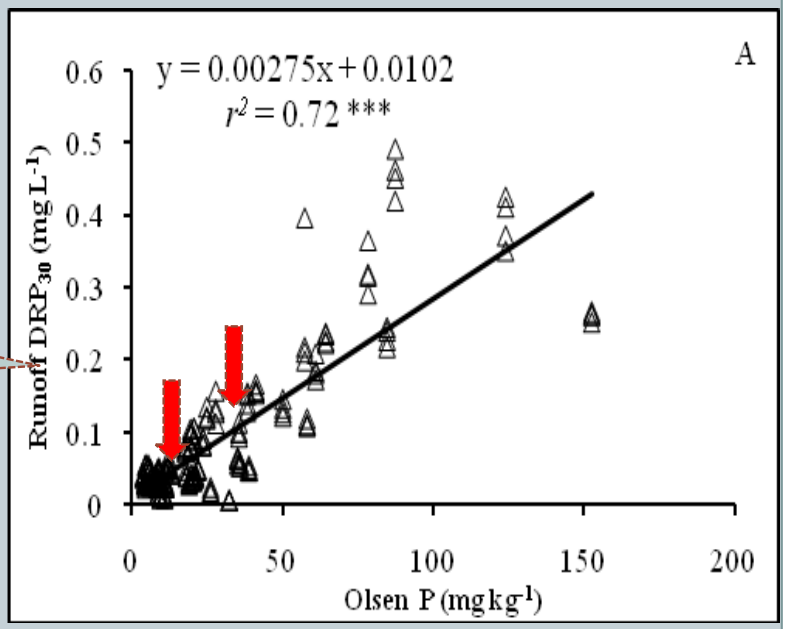
Sub-watershed

Runoff and Leaching Studies for Phosphorus



Leaching
DRP and STP

Runoff
DRP and STP



High soil test levels increase P loss

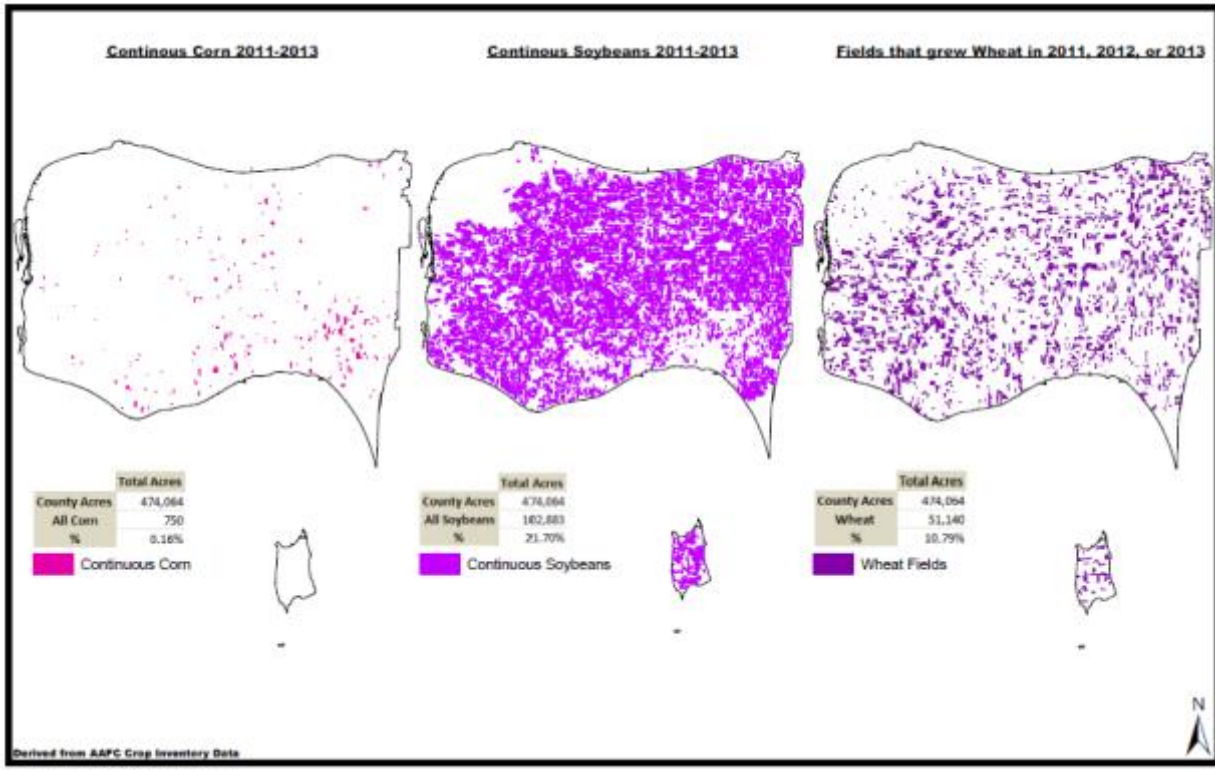
Crop Rotation

More Yield
Adding Wheat to
Corn/Soy:

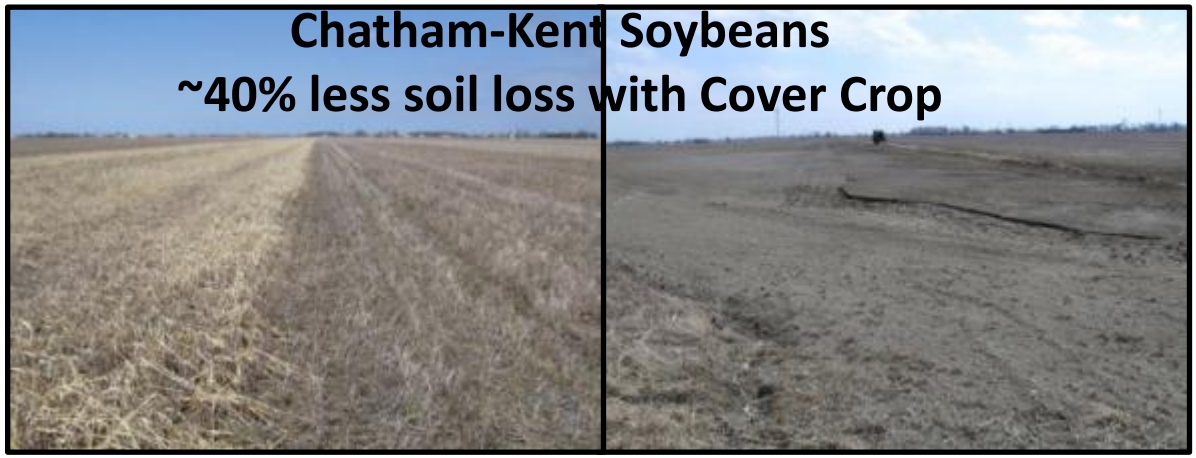
+10% Ridgetown
+14% Elora

Over 34 years +22%
yield

B Deen, U of Guelph, 2014



Chatham-Kent Soybeans
~40% less soil loss with Cover Crop



Erosion
0.19 t/ha/yr

SCI = 0.3

Erosion
0.33 t/ha/yr

SCI = 0.1

P-Containing Materials and Winter Application

- First choice: Don't do it!
- When soil is frozen there is no opportunity for infiltration
- Winter rain events result in high surface runoff
- Nutrients on the soil surface will move with surface water
- Soil with low aggregate stability will move with surface water
- Snow melt often occurs with rainfall

Manure applied and incorporated Jan 15

To prevent a storage spill: materials containing phosphorus should not be applied unless they can be incorporated same day

Infiltration

some to “Tile” Flow

“Overland” Flow

BMP Implementation

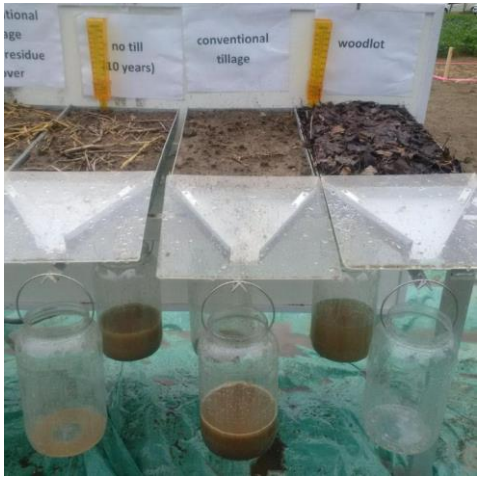
ACT (Avoid – Control – Trap)

1. Apply nutrients using 4Rs principles
2. Keep nutrients in place once applied (soil health)
3. Trap nutrients before edge of field

Top 2 Focus Areas for BMPs

To reduce P loading to Lake Erie from Ontario agriculture non point sources:

1. Place P in the right place and the right time
2. Reduce surface runoff (reduce soil erosion and cover the soil)



Summary of BMP Effectiveness

	BMP	Growing Season	Non-Growing Season	High Flow Events
Managing Nutrients	Right Place	H	H	H
	No Winter Spreading	N/A	H	H
	Right Time	H	H	H
	Right Rate	H	M	H
	Soil Testing and P recommendations	H	M	M
	Test organic amendments	H	M	M
	Right Source	M	M	M
	P in Feed Rations	H	H	H
	Nutrient Mgmt Planning	H	M	M
Water Infiltration	Crop Rotation	M	M	M
	Cover Crops	L	M to H	M to H
	Conservation Tillage	M	M	M

Key Science-based Conclusions

- ACT (Avoid first, Control, Trap)
- Need to be able to address soil and P loss in major rain events
- Need to focus on P losses in non-growing season
- Improved soil health is an important part of the solution
  - Reduced erosion and increased water retention in soil
- Drainage needs to be considered as part of the solution
- Multiple BMPs are more effective, but solutions need to be tailored on a farm by farm basis
- Phosphorus loss potential varies significantly across the landscape and within fields
- Actions need to be targeted for the greatest impact with limited resources

Appendix A: Great Lakes Commission – Joint Action Plan

Great Lakes Commission - Joint Action Plan

- The Great Lakes Commission's Joint Action Plan for Lake Erie outlines 9 key actions to address urban and rural sources of phosphorus.
  - **Reduce nutrient applications on frozen or snow covered ground**
  - **Adopt "4Rs Nutrient Stewardship Certification program" or other comprehensive nutrient management programs**
  - Reduce total phosphorus from seven key municipal dischargers
  - **Encourage and accelerate investments for green infrastructure for urban storm water and agricultural runoff, including ecological buffers for rivers, streams and wetlands**
  - Reduce the open-water disposal of dredged material
  - **Pilot innovative performance-based and/or market-based nutrient reduction projects**
  - Phase out residential phosphorus fertilizer
  - **Targeted Conservation at the Watershed Scale**
  - Within five years, validate or refine the reduction targets and timelines using an adaptive management approach