FARM & FOOD Care ONTARIO

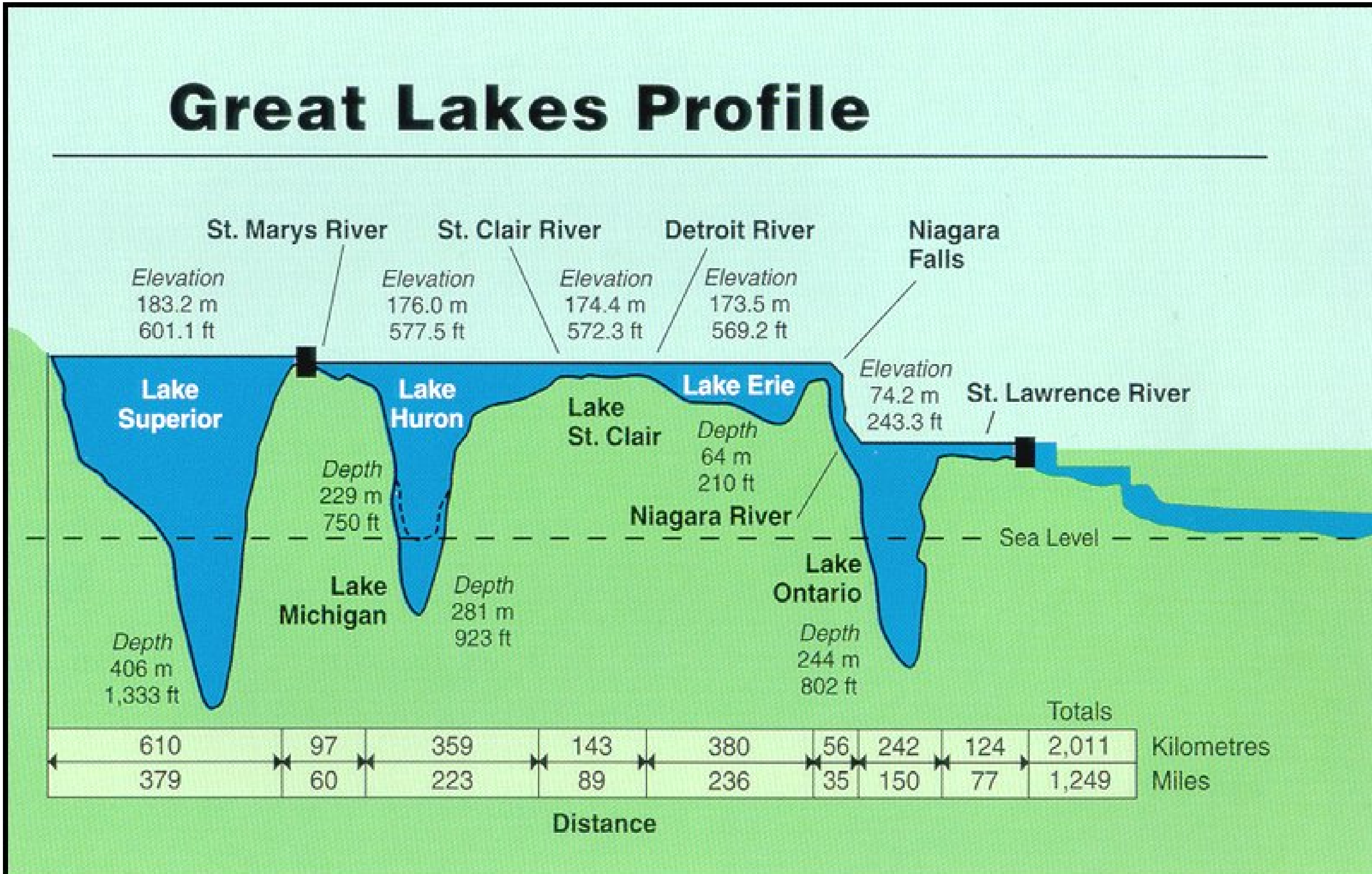
Aug 10 Great Lakes agriculture strategy session

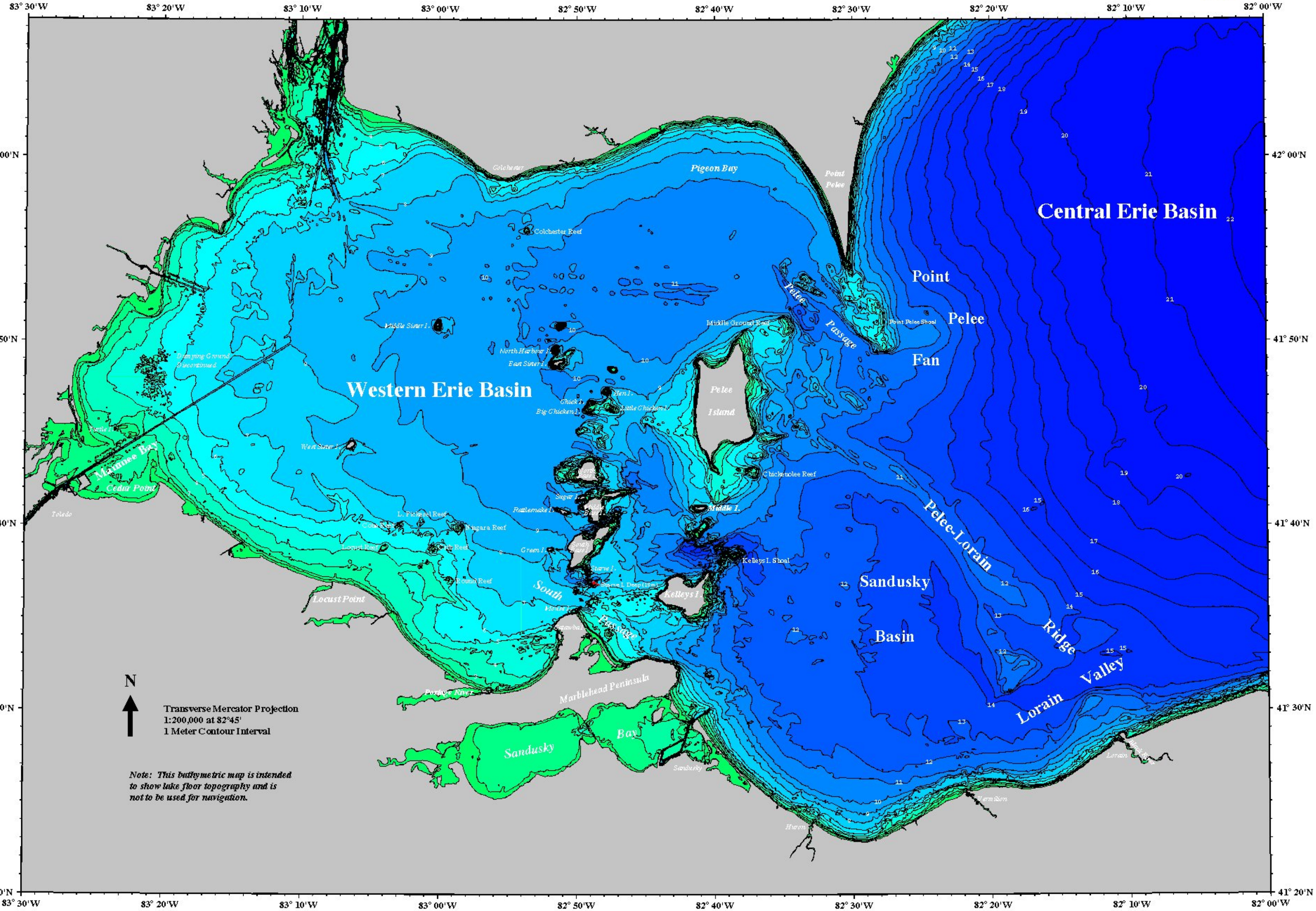
Farm & Food Care Hosts:
Bruce Kelly

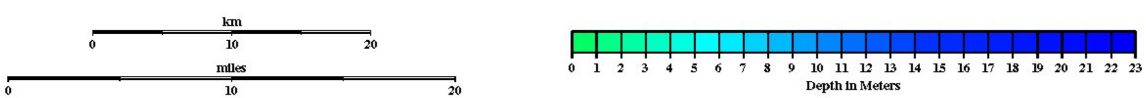
Who is Farm & Food Care Ontario?

- First coalition of its kind, whole sector approach – all types of farmers and associated businesses working together.
- Funded by members, sponsors, projects.
- Common goal – building public trust in food and farming.

Building Public Trust in Food & Farming in Canada


Great Lakes Profile
St. Marys River
St. Clair River
Detroit River
Niagara Falls
Elevation 183.2 m 601.1 ft
Elevation 176.0 m 577.5 ft
Elevation 174.4 m 572.3 ft
Elevation 173.5 m 569.2 ft
Elevation 74.2 m 243.3 ft
Lake Superior
Lake Huron
Lake St. Clair
Lake Erie
St. Lawrence River
Depth 229 m 750 ft
Depth 64 m 210 ft
Niagara River
Sea Level
Lake Michigan
Depth 281 m 923 ft
Lake Ontario
Depth 406 m 1,333 ft
Depth 244 m 802 ft
Totals
610 97 359 143 380 56 242 124 2,011 Kilometres
379 60 223 89 236 35 150 77 1,249 Miles
Distance





Bathymetry Compiled by:

Lisa A. Taylor	National Oceanic and Atmospheric Administration, National Geophysical Data Center
John S. Warren	Department of Fisheries and Oceans, Canadian Hydrographic Service

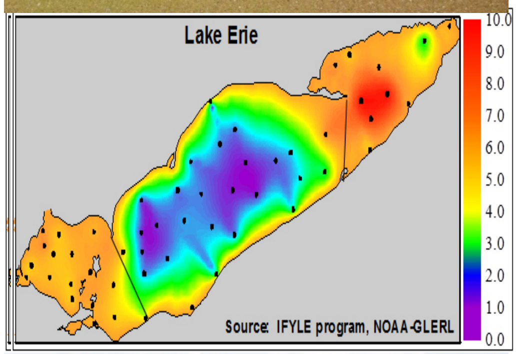
Environment Canada Environnement Canada

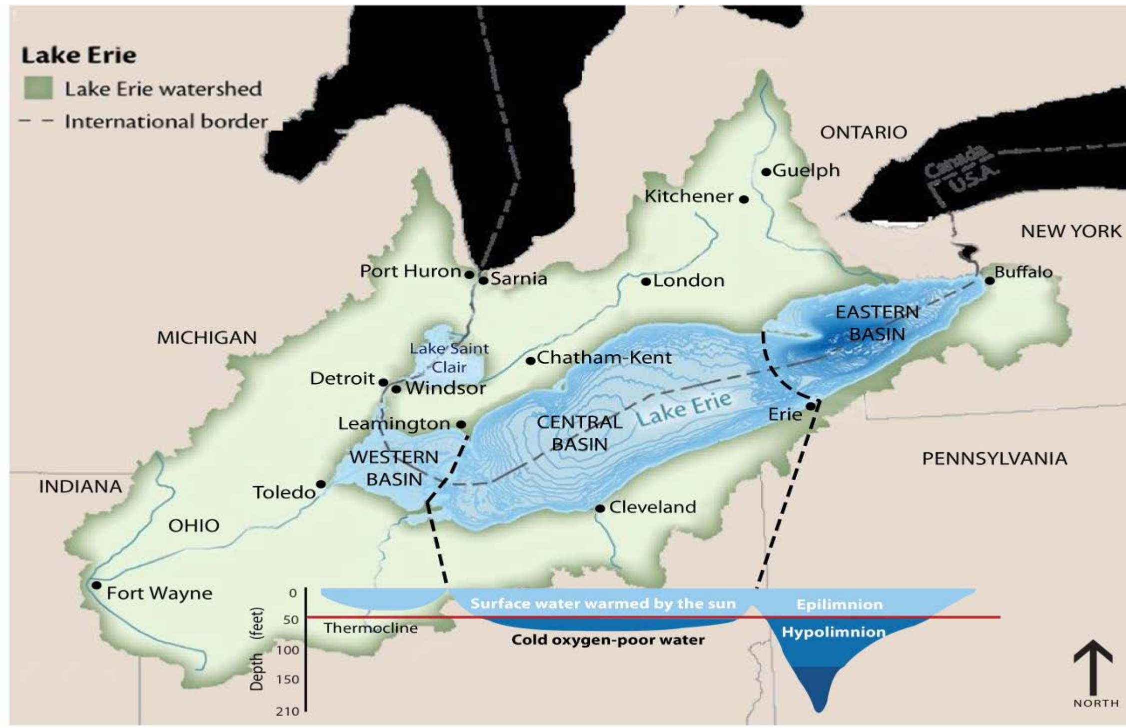
RECOMMENDED BINATIONAL PHOSPHOROUS REDUCTION TARGETS FOR LAKE ERIE

July 14th , 2015

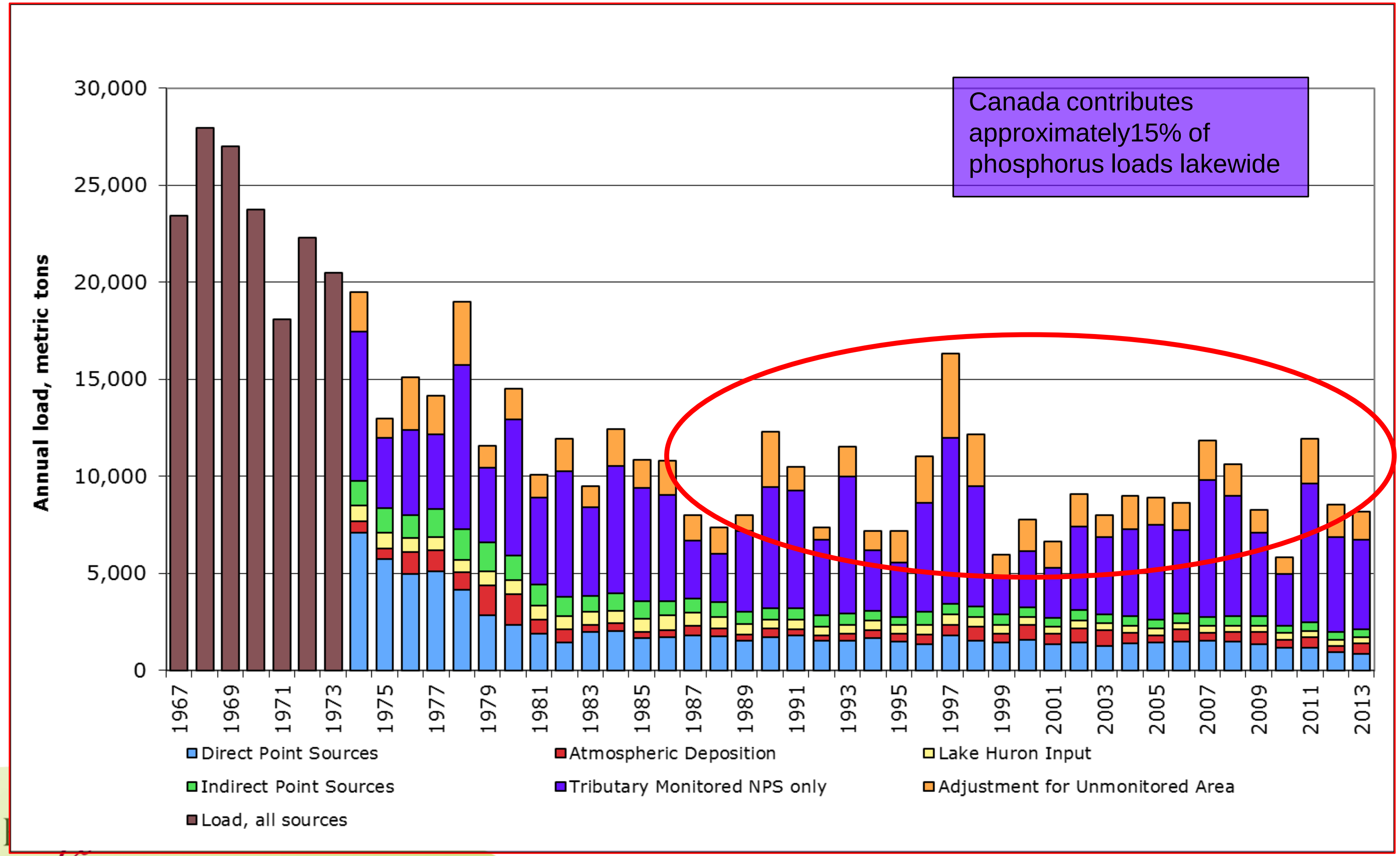
Susan Humphrey – Environment Canada
Sandra George – Environment Canada

Current ecosystem conditions





Phosphorus Loadings over time



Proposed Bi-National Phosphorus Load Reduction Targets

Proposed Bi-National 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% reduction in total phosphorus entering the Western Basin and Central Basin of Lake Erie – from the United States and from Canada - to achieve 6000 MT Central Basin load	
Maintain algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes	40% 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 % reduction in spring total and soluble reactive phosphorus loads from the Maumee River (U.S.)	N/A

Where are we at today?

Experimental Lake Erie Harmful Algal Bloom Bulletin

National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory

06 August, 2015, Bulletin 08

06 Aug - The Microcystis cyanobacteria bloom has intensified in the western part of the western basin. Yesterday extensive severe scum was present west and south of West Sister Island to both the Ohio and Michigan shorelines. All areas in dark red in the satellite image had scum. The bloom also continues to extend eastward, although with only patchy scum areas, through the islands to the northeast offshore of Point Pelee. Microcystin is present in this bloom, with toxin levels especially high in scums.

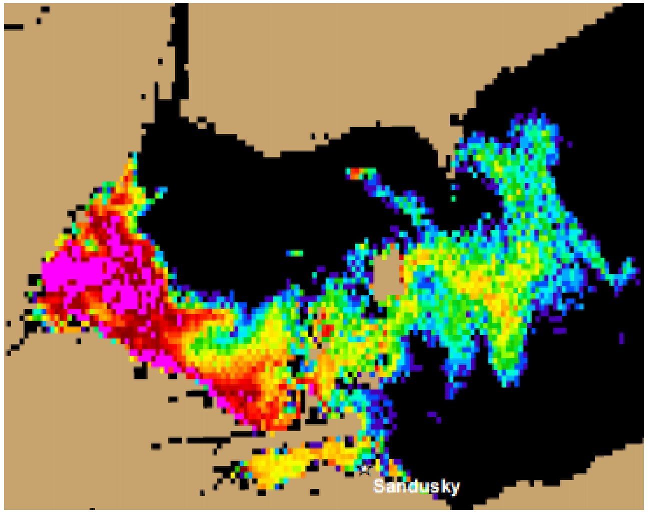


Figure 2. Nowcast position of bloom for 06 August, 2015 using GLCFS modeled currents to move the bloom from the 05 August, 2015 image.

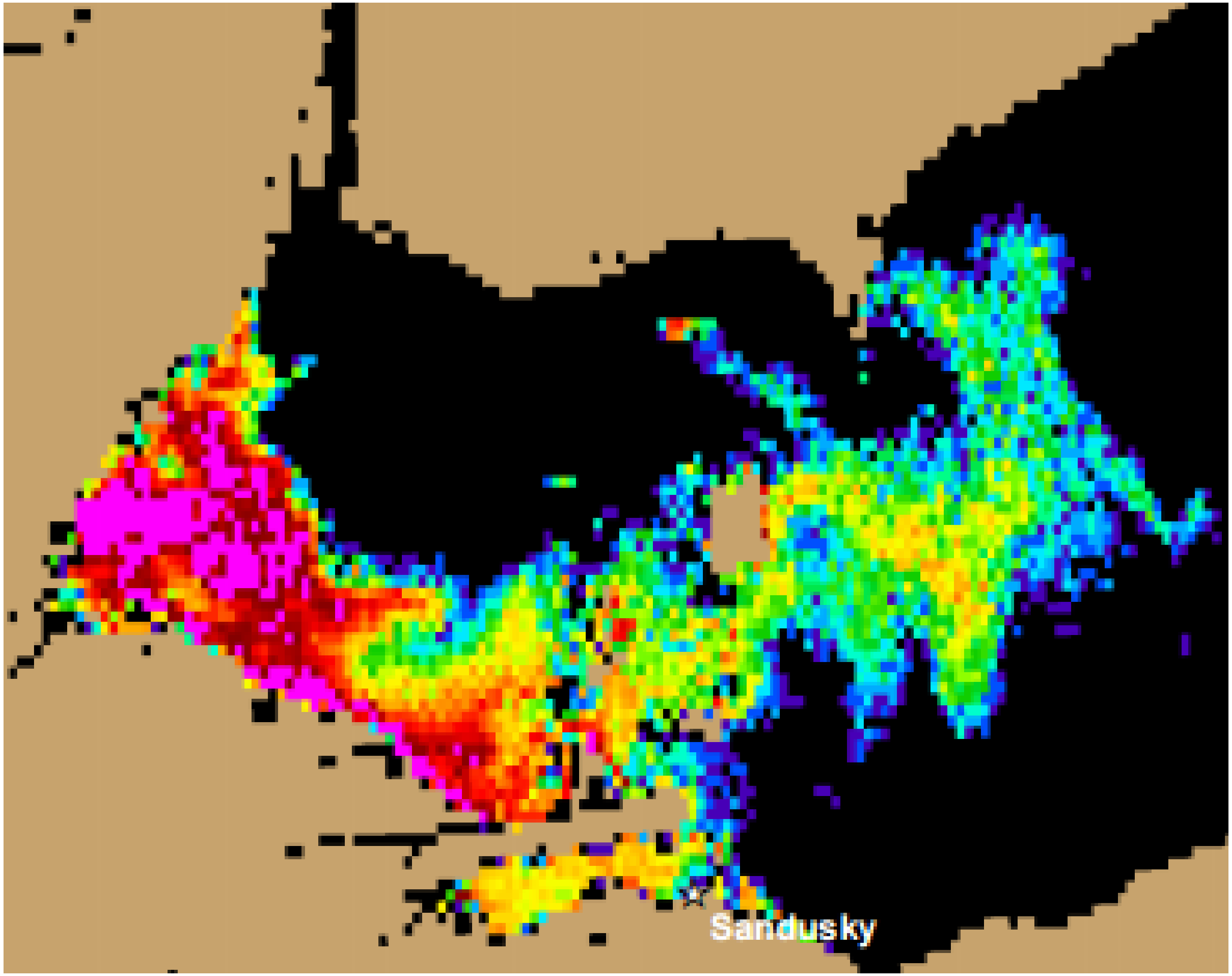
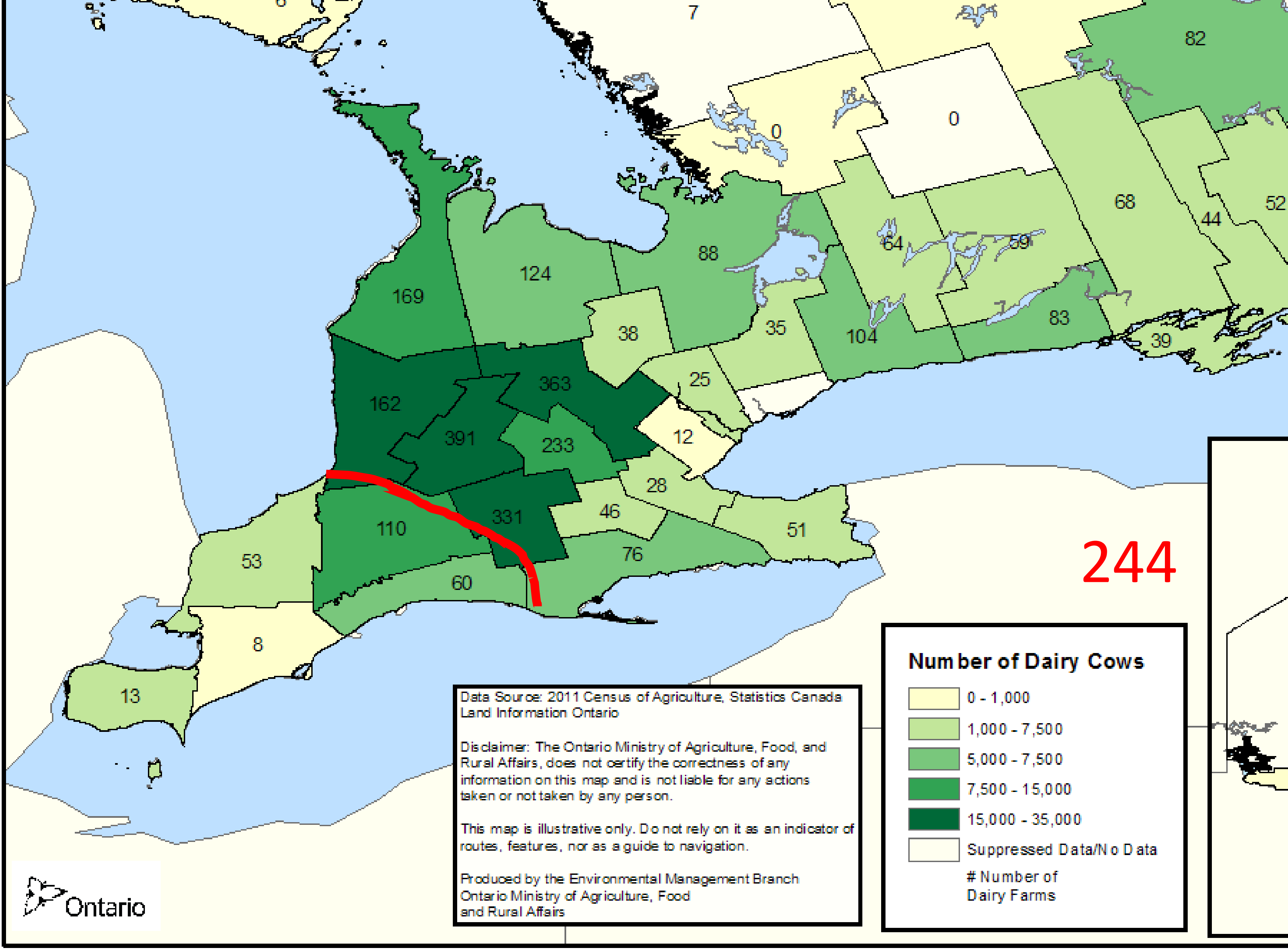
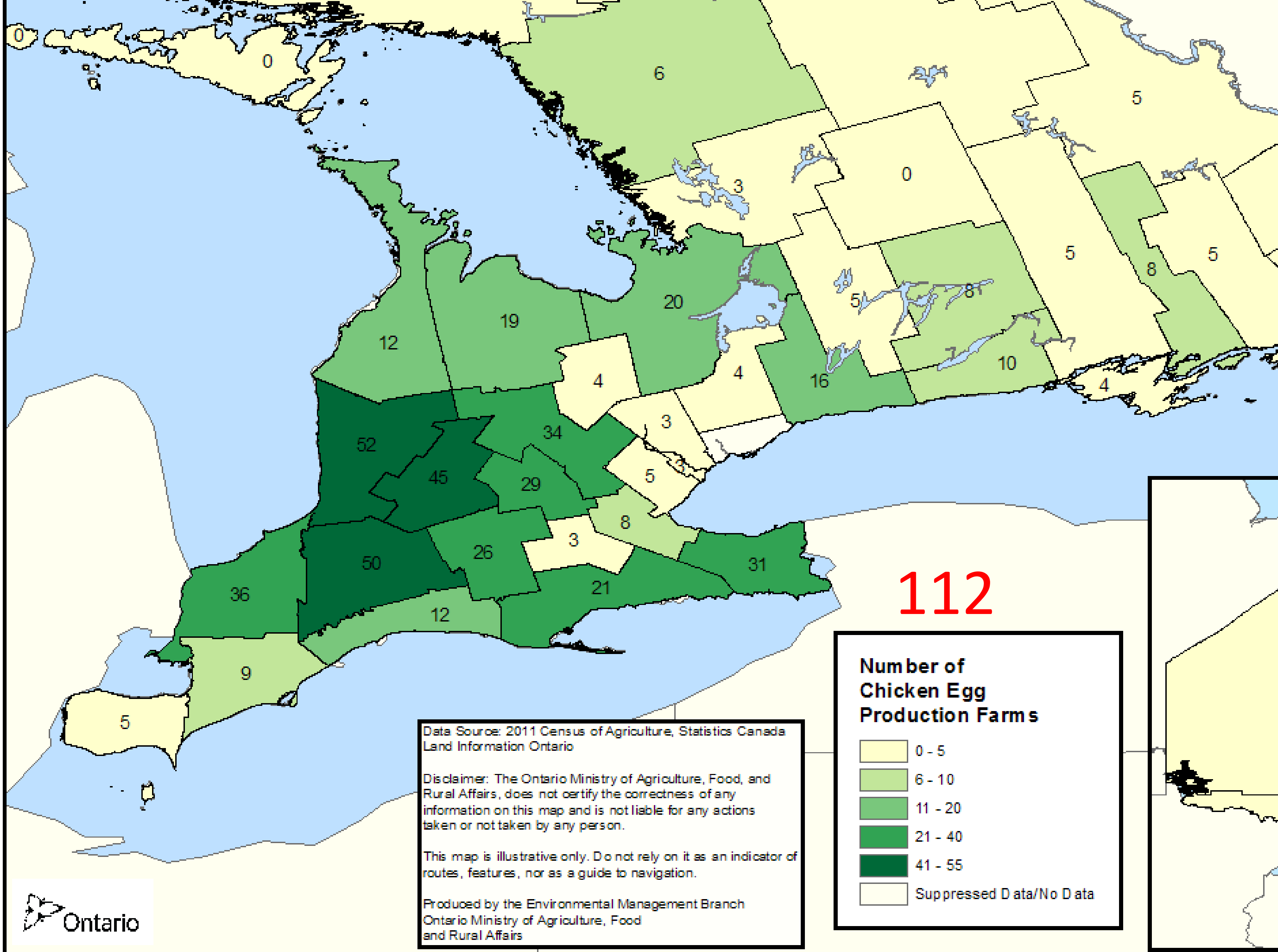


Figure 2. Nowcast position of bloom for 06 August, 2015 using GLCFS modeled currents to move the bloom from the 05 August, 2015 image.

So Who Does this impact?


7
82
0
0
68
44
52
64
59
88
124
169
38
35
104
83
39
25
363
162
391
233
12
28
331
46
51
110
53
76
60
8
13
244
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
Disclaimer: The Ontario Ministry of Agriculture, Food, and Rural Affairs, does not certify the correctness of any information on this map and is not liable for any actions taken or not taken by any person.
This map is illustrative only. Do not rely on it as an indicator of routes, features, nor as a guide to navigation.
Produced by the Environmental Management Branch
Ontario Ministry of Agriculture, Food
and Rural Affairs
Number of Dairy Cows
0 - 1,000
1,000 - 7,500
5,000 - 7,500
7,500 - 15,000
15,000 - 35,000
Suppressed Data/No Data
Number of Dairy Farms
Ontario


112
Number of Chicken Egg Production Farms
0 - 5
6 - 10
11 - 20
21 - 40
41 - 55
Suppressed Data/No Data
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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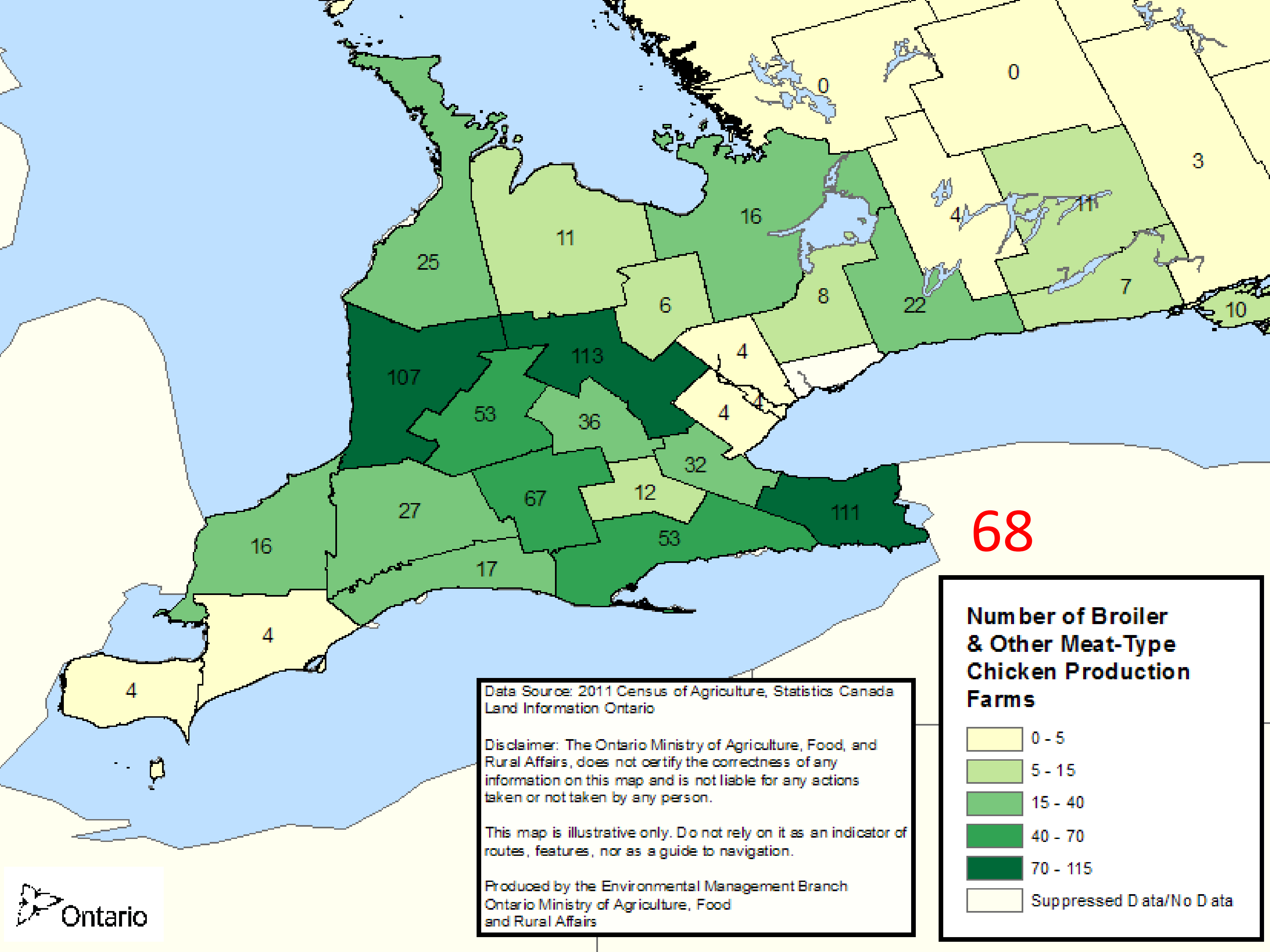

0
0
3
16
4
11
25
11
6
8
22
7
10
113
107
4
53
36
4
32
12
67
27
111
16
53
17
4
4
68
Number of Broiler & Other Meat-Type Chicken Production Farms
0 - 5
5 - 15
15 - 40
40 - 70
70 - 115
Suppressed Data/No Data
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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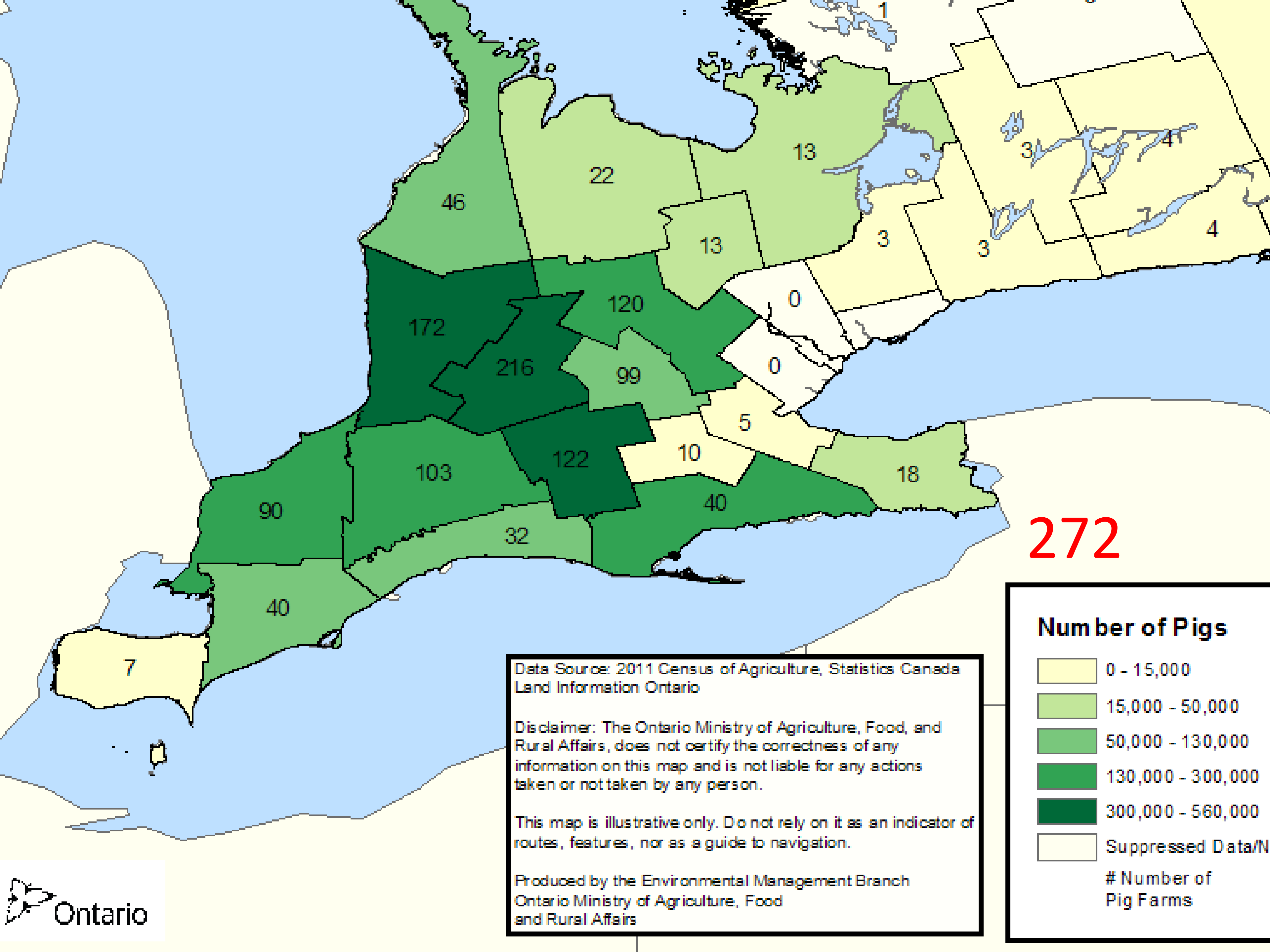
1
13
22
46
3
4
3
4
13
3
3
120
0
172
216
99
0
5
10
122
103
18
90
40
32
40
7
272
Number of Pigs
0 - 15,000
15,000 - 50,000
50,000 - 130,000
130,000 - 300,000
300,000 - 560,000
Suppressed Data/N
Number of
Pig Farms
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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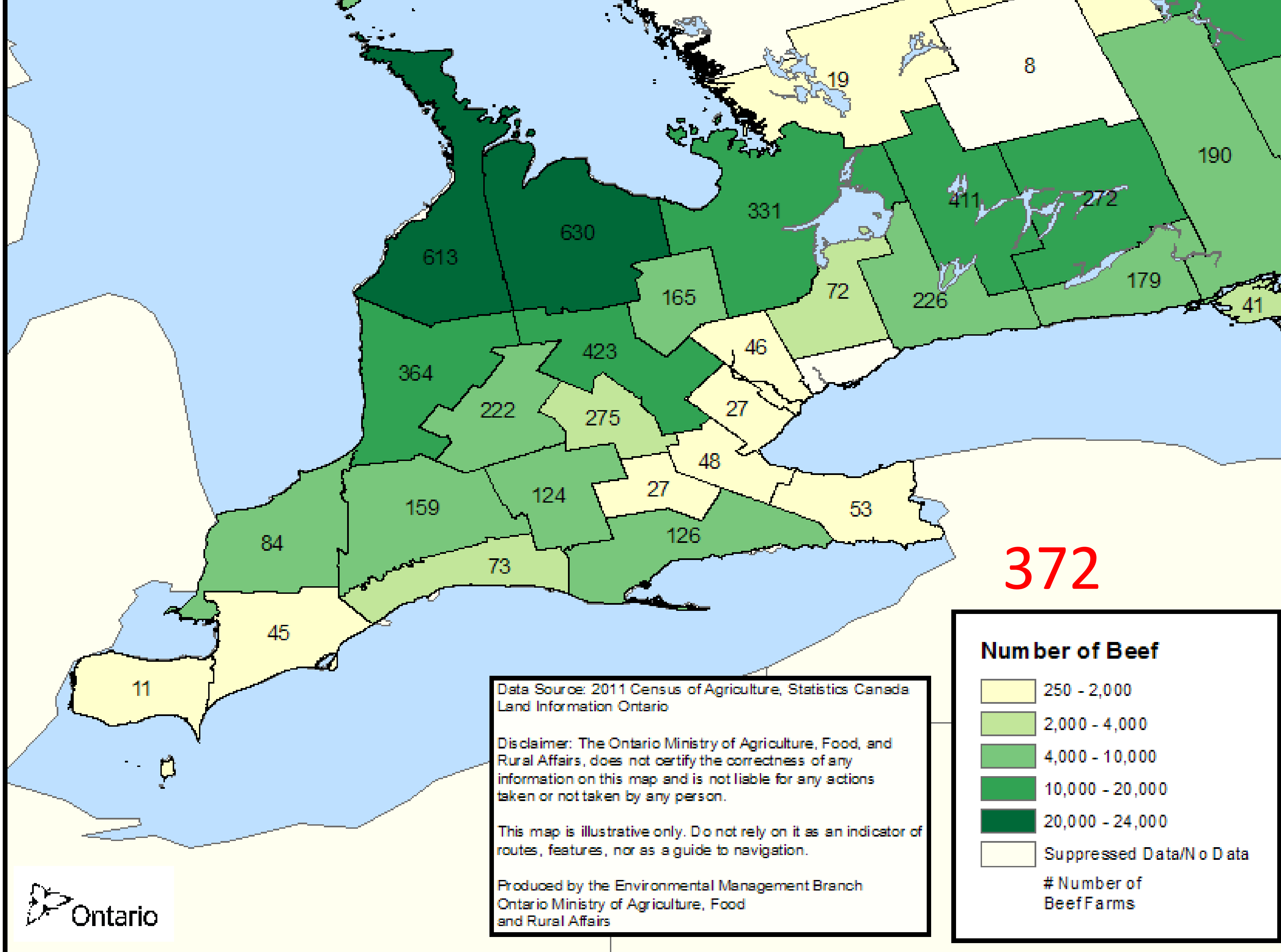

19
8
190
331
411
272
630
613
165
72
226
179
41
46
423
364
222
275
27
48
27
124
159
53
84
126
73
45
11
Number of Beef
250 - 2,000
2,000 - 4,000
4,000 - 10,000
10,000 - 20,000
20,000 - 24,000
Suppressed Data/No Data
Number of Beef Farms
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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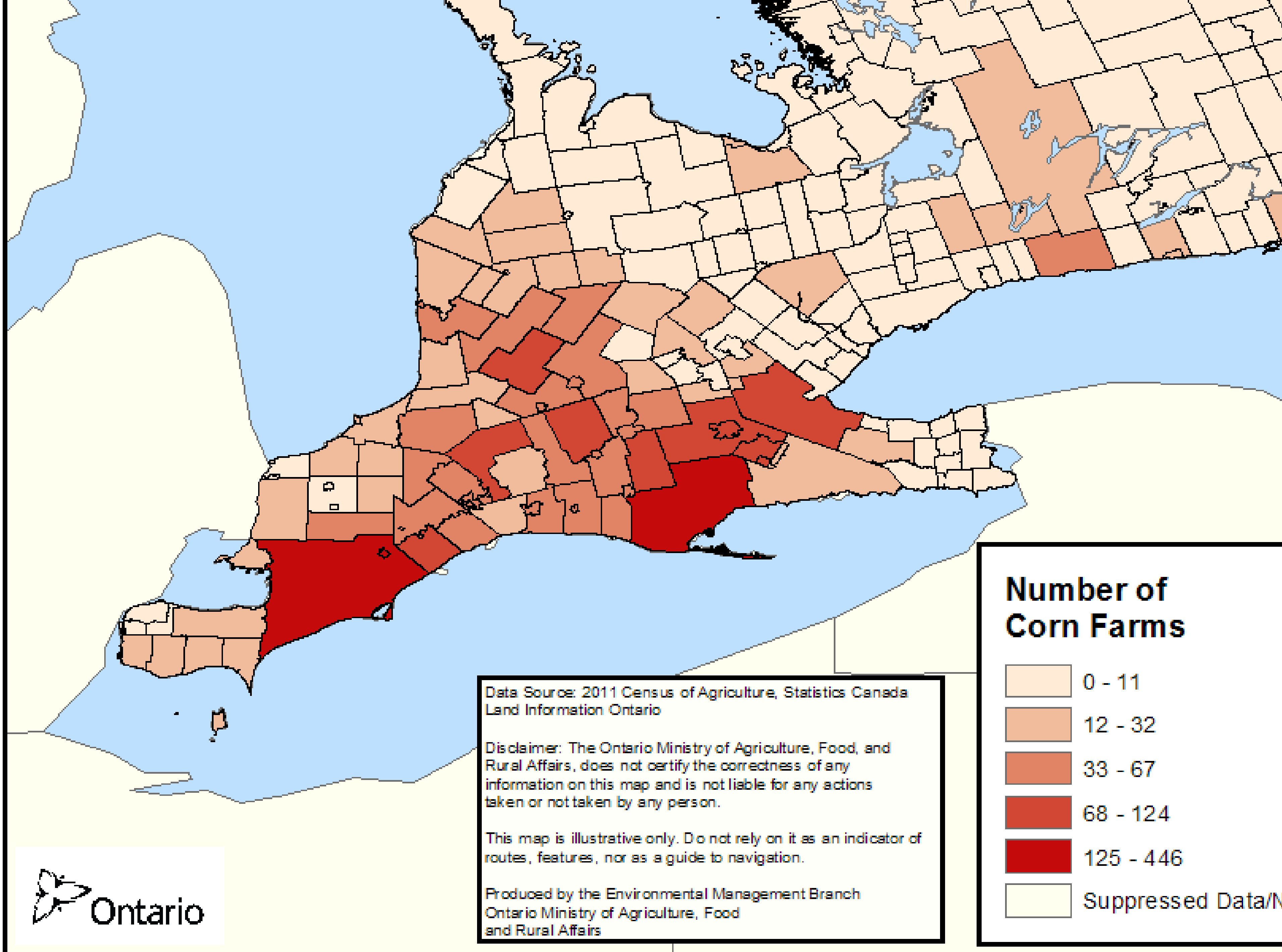
Number of Corn Farms
0 - 11
12 - 32
33 - 67
68 - 124
125 - 446
Suppressed Data/N
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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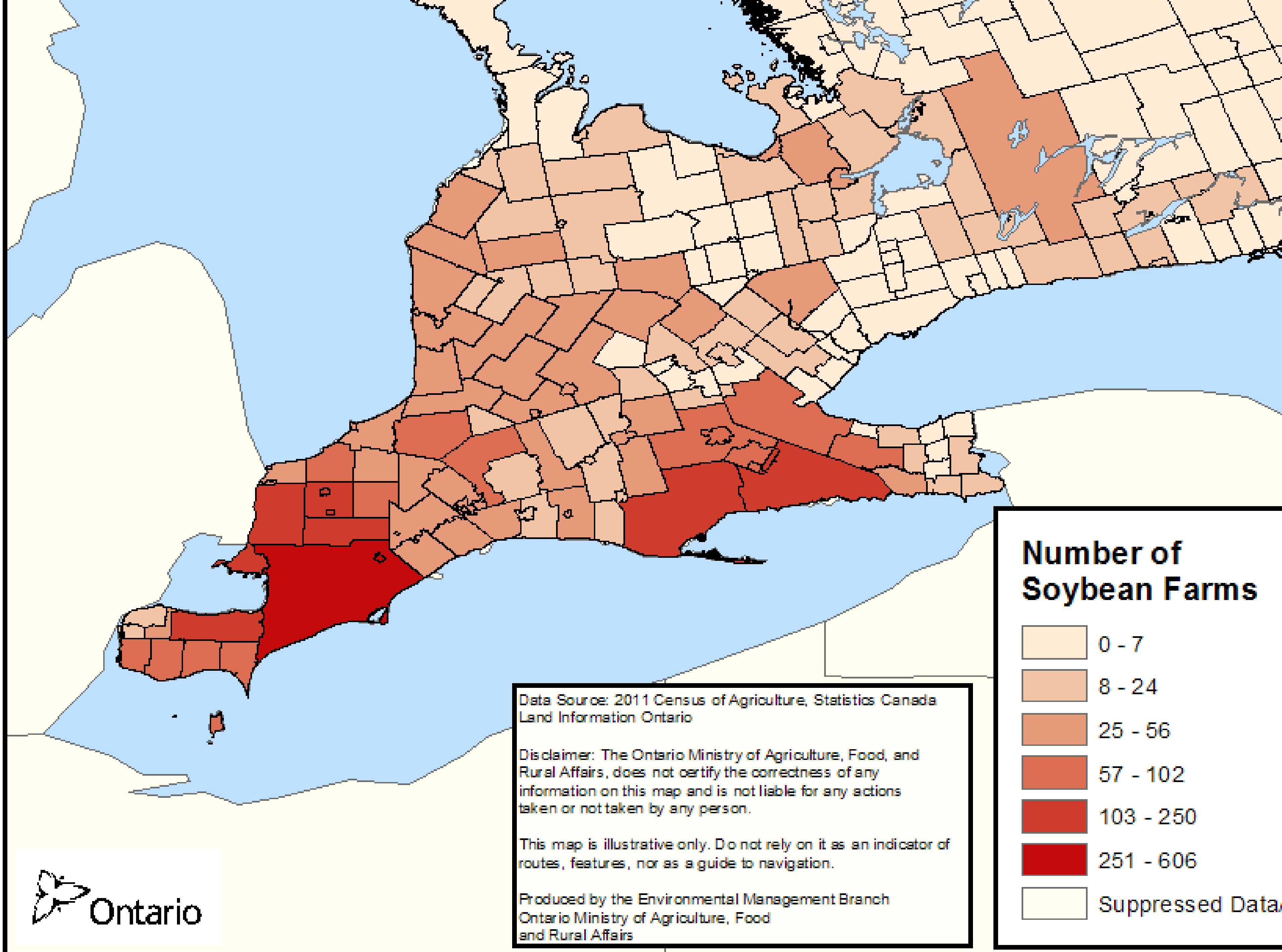

Number of Soybean Farms
0 - 7
8 - 24
25 - 56
57 - 102
103 - 250
251 - 606
Suppressed Data
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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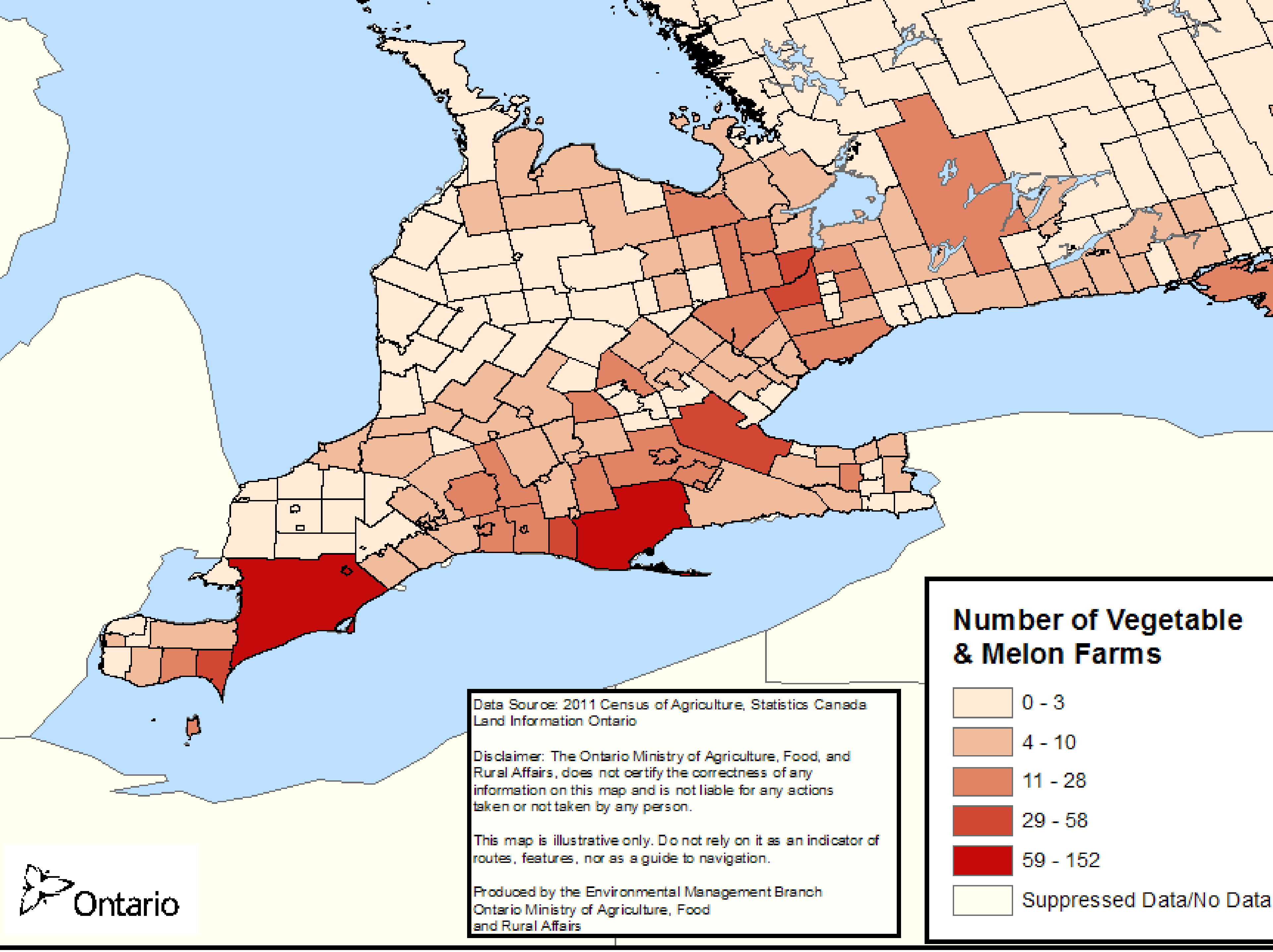
Number of Vegetable & Melon Farms
0 - 3
4 - 10
11 - 28
29 - 58
59 - 152
Suppressed Data/No Data
Data Source: 2011 Census of Agriculture, Statistics Canada
Land Information Ontario
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Ontario

Phosphorus in Lake Erie

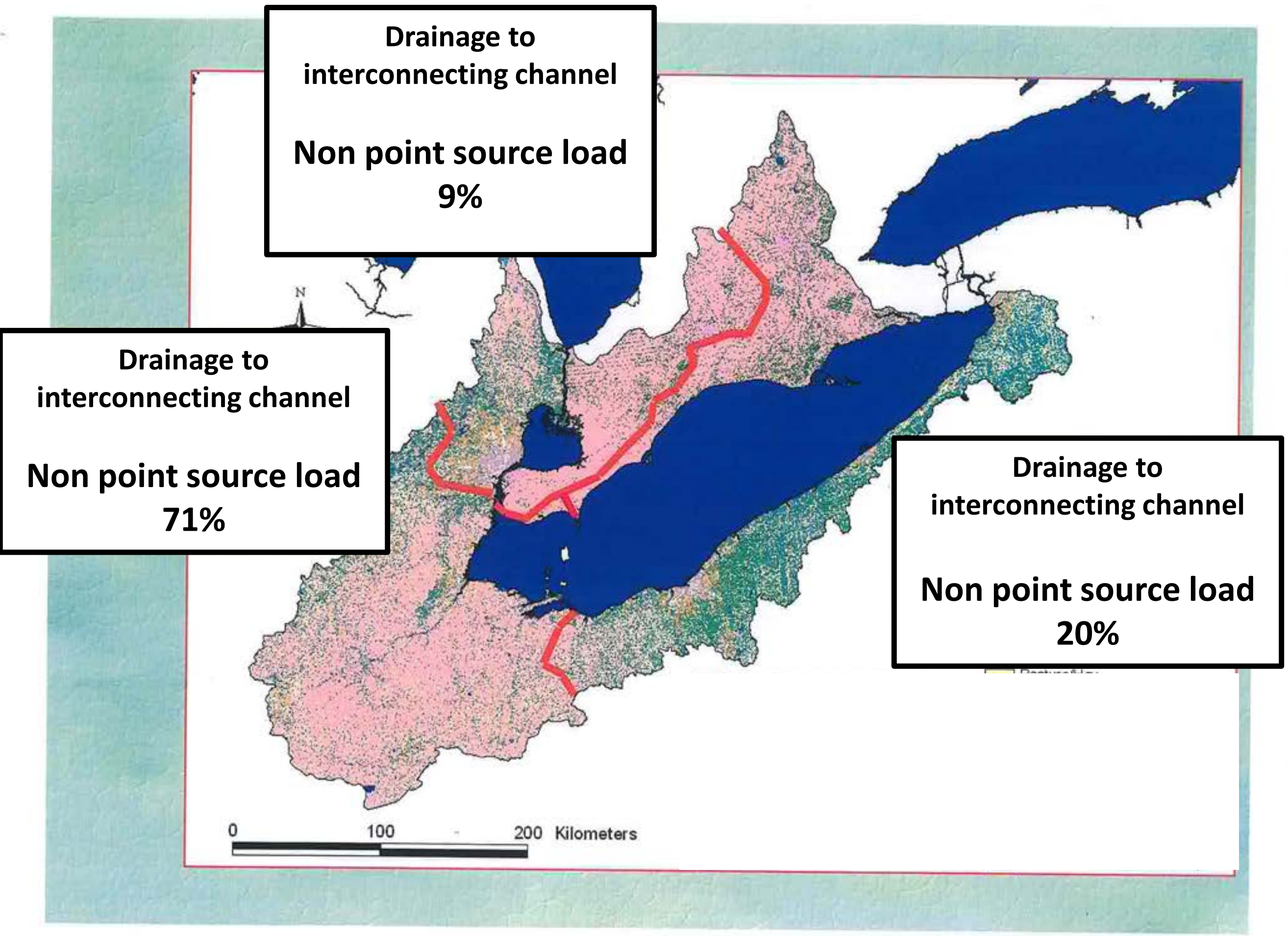
HOW MUCH ARE WE LOSING?

WHAT CAN WE QUANTIFY?

Gabrielle Ferguson, OMAFRA

Farm and Food Care
GUELPH, ON
August 10, 2015

DISTRIBUTION OF NPS LOAD BY WATERSHED (AVG 1967 – 2008)



An Estimate of Average Ontario Lake Erie Farmland contribution

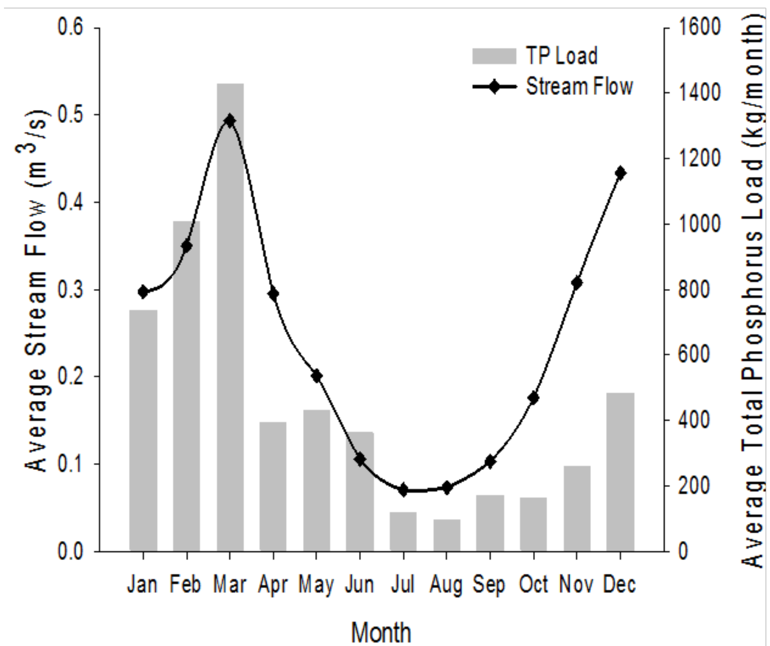
Total load 10,000 kg/yr

From Ontario ~ 20 % to 25%

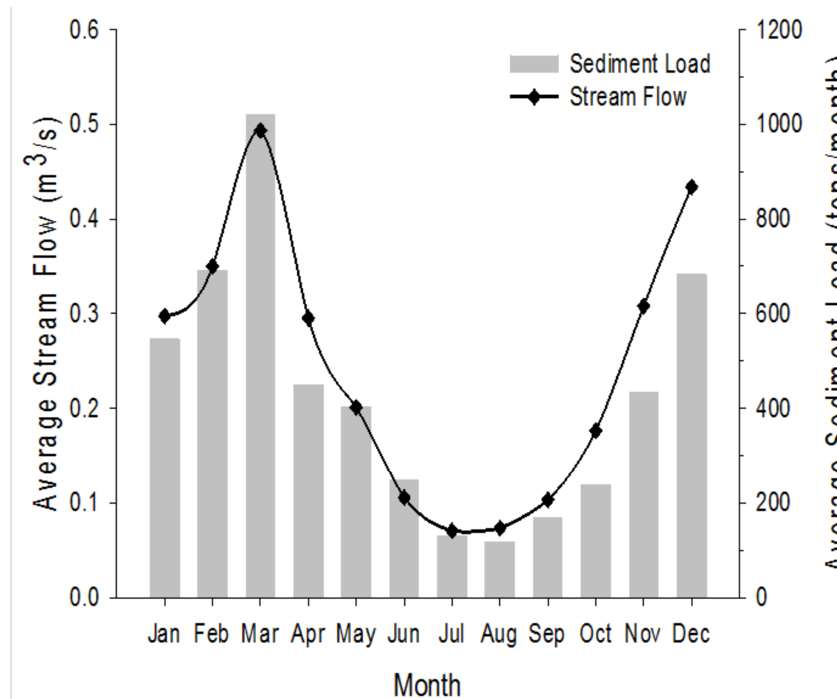
Average TP Load from Cropland (kg/ha/year) ~0.63 – 0.78

(Source: Lake Erie Lakewide Management Plan, Nov 2008)

60 -80% of sediment and phosphorus loading occurs during the non-growing period (Nov 1 to April 1)

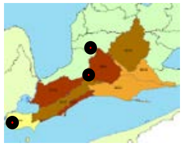


Average Total Phosphorous loading by month (2002 to 2011)

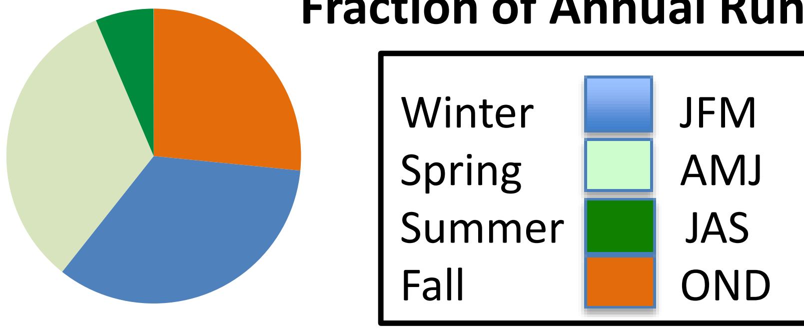


Average Total Sediment loading by month (2002 to 2011)

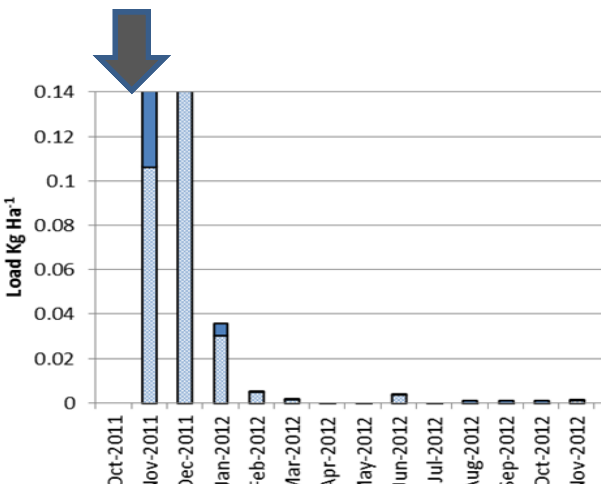
Timing and Frequency of P Application



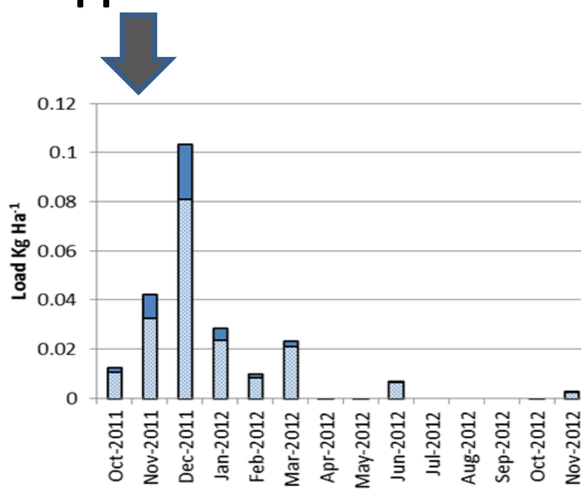
Fraction of Annual Runoff



Manure P applied mid-Oct



Fertilizer P applied mid-Oct



M Macrae, U of Waterloo

Phosphorus Rate and Timing

NMAN 6 years	Agronomic P205	Crop Removal P205
No-till soys P bcst	0-0-0-0-0-0 0	38-38-38-38-38-38 228
cC-cS-cW P band	18-0-0-18-0-0 36	83-0-83-83-0-83 332
No-till C-S P bcst	18-0-18-0-18-0 54	70-38-70-38-70-38 324
C-nS-nW Pbcst/incorp	18-0-0-18-0-0 36	166-0-0-166-0-0 332

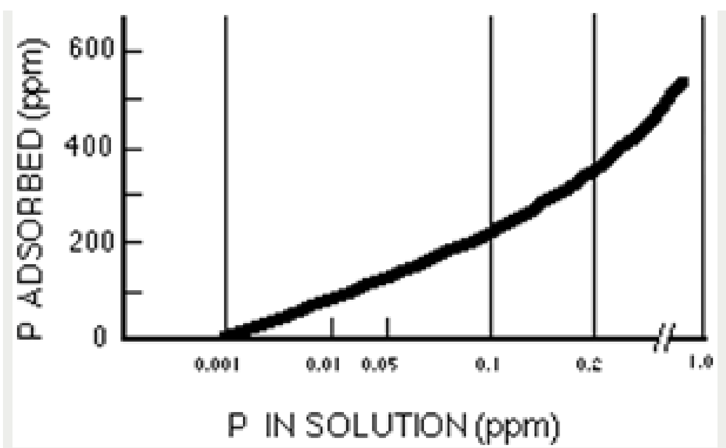
Soil Test level 25 ppm

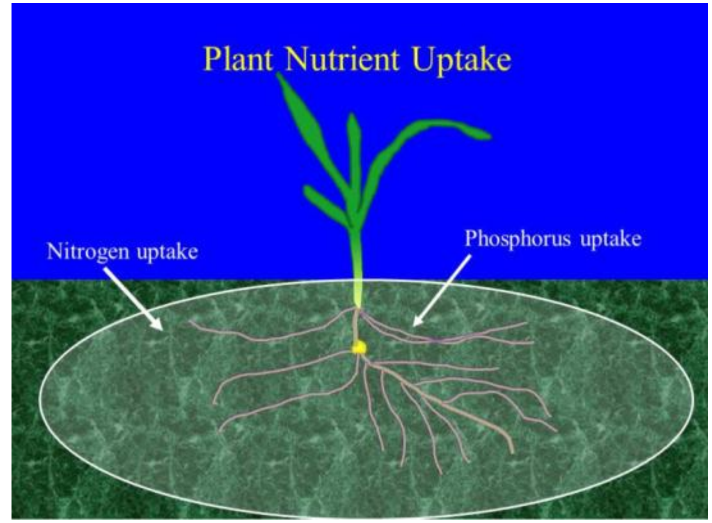
K. McKague, OMAFRA

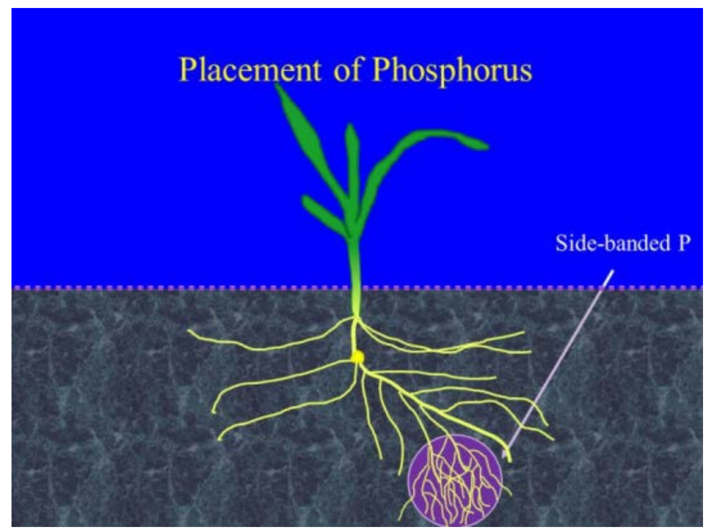
Phosphorus Uptake

P deficiency

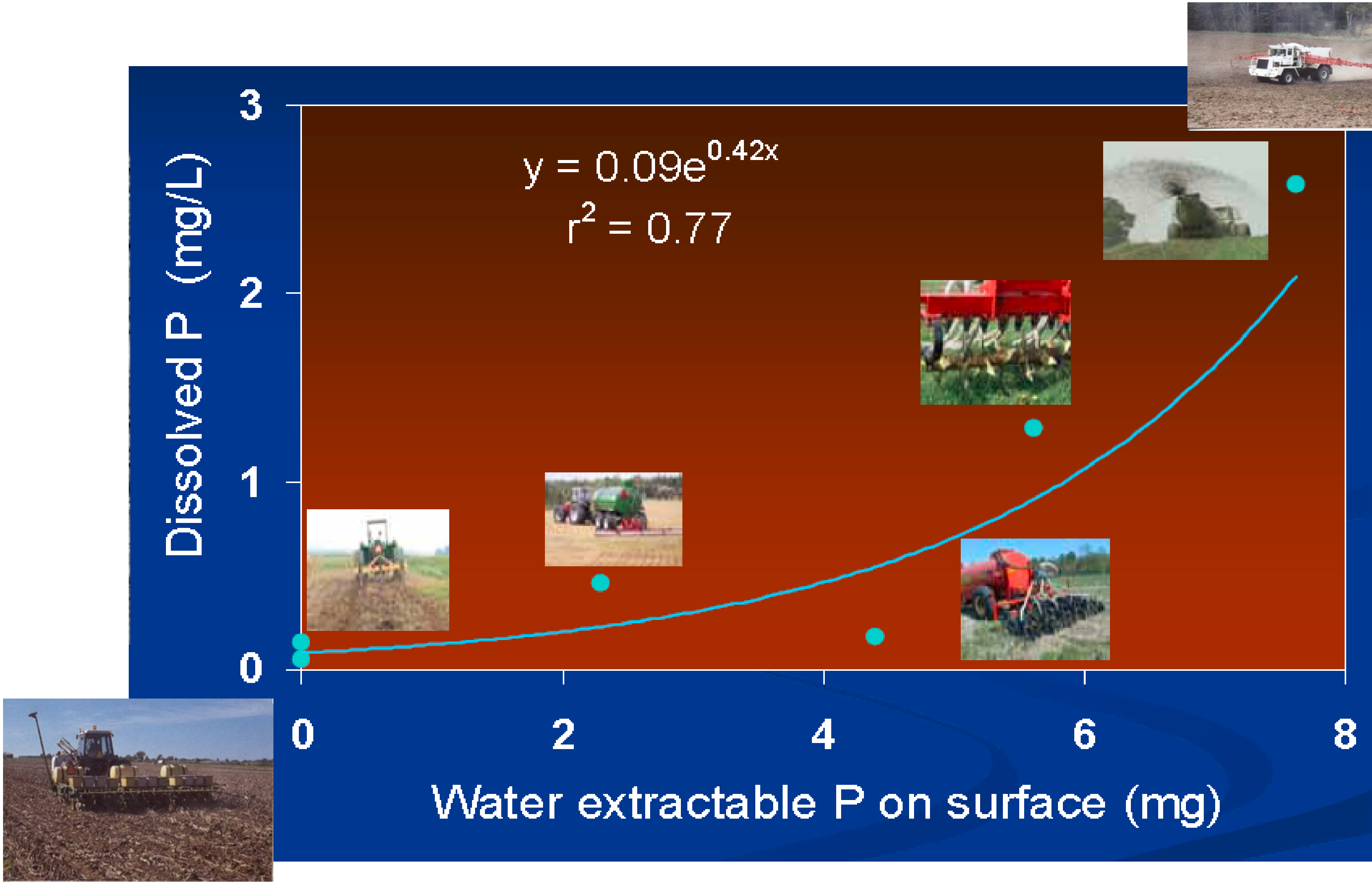
P in soluble form and in close proximity to roots is taken up by plants







Placement of P Application



Source: Kleinman (Penn State, USDA- ARS)

Phosphorus Rate and Timing

NMAN 6 years	Ontario P-Index	USLE (ton/ac/yr)
No-till soys P bcst	20	1.3
cC-cS-cW P band	16	6
No-till C-S P bcst	24.5	1.6
C-nS-nW Pbcst/incorp	9.3	2.2

K. McKague, OMAFRA

Lower numbers are better

Healthy Soils = Healthy Waters
And more profit for farmers

2 feet of deposition – 25 yrs

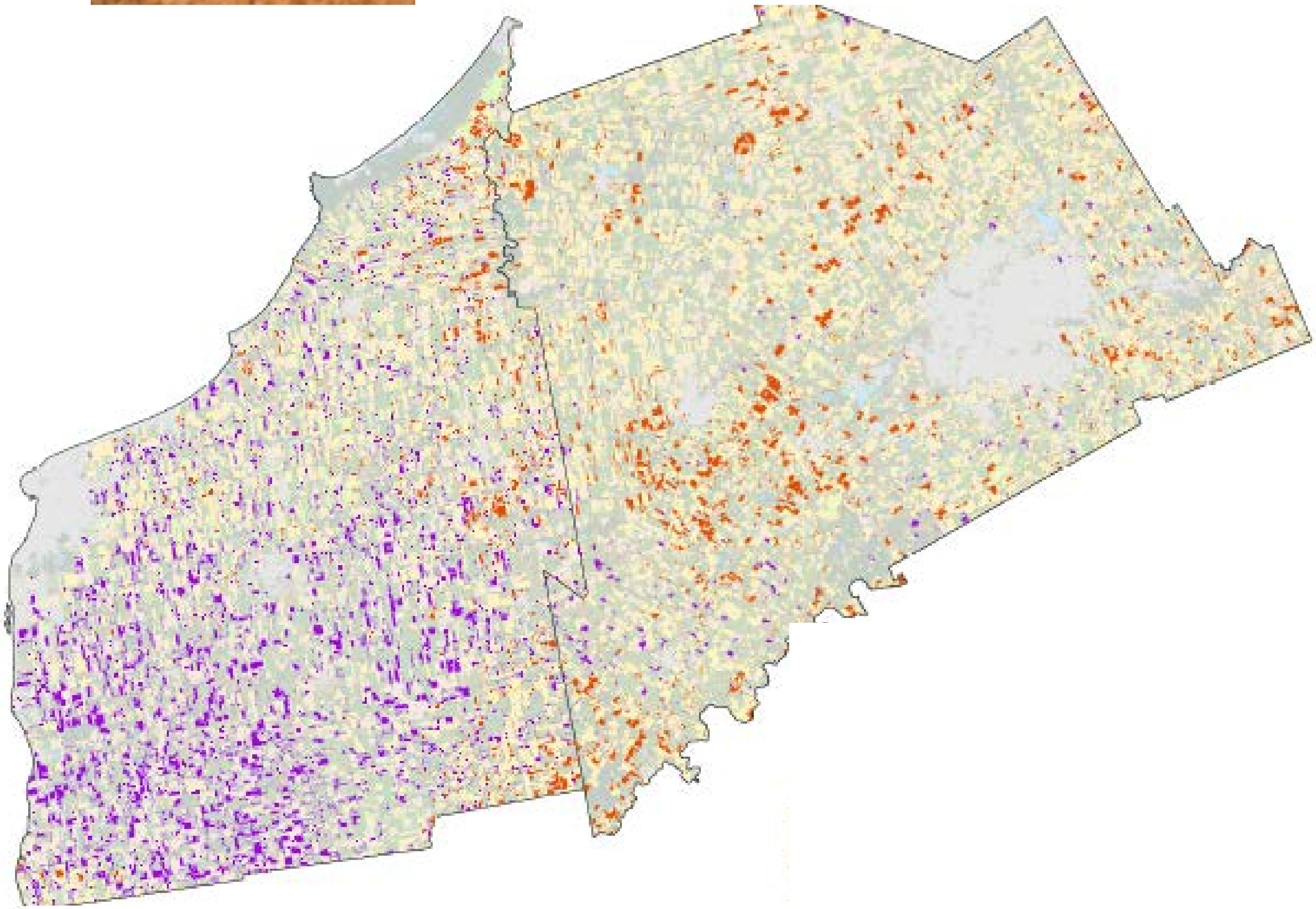
Can't see the losses in any one year

Unpredictable weather erratic storms + yearly fluctuations

Side-by-Side trial

same soil, slope, rainfall, current management

Lack of Crop Diversity across Ontario



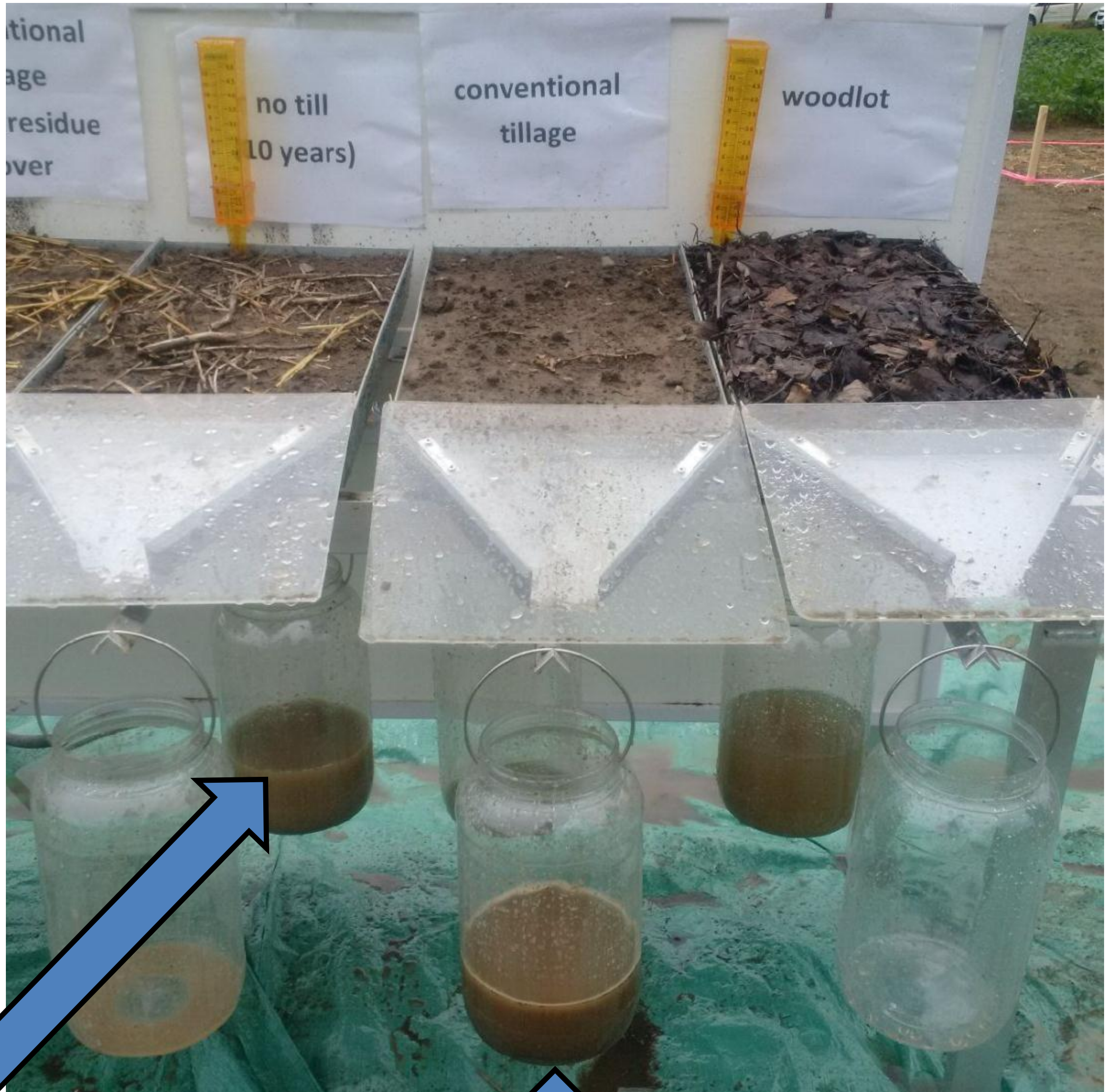
Lambton and Middlesex
Fields with only Corn or Soybeans
2011 – 2013

Add Wheat =
+10% Ridgetown
+14% Elora

Rotation effect over 34 years = +22% yield

+ 31 bu/ac adding wheat to Corn-Soy rotation (zero N)

Convention Tillage – is 30% residue enough?



"Tile" Flow

"Overland" Flow

No
"typical"
P losses

Research

Loam
0.3-0.5 kg/ha

Clay
0.7-1.0 kg/ha

Cover crops

reduce soil loss = less P loss

Chatham-Kent
Soybeans
~40% less soil loss

	With Cover Crop	No Cover Crop
Annual Erosion T/ha/yr	0.19	.33
Soil conditioning index	0.3 A higher SCI value =	0.1 improving soil health

RUSLE2 = **R**evised **U**niversal **S**oil **L**oss **E**quation **2**
Download RUSLE2 computer tool from:
*www.omafra.gov.on.ca/english/engineer/**rusle2**/index.htm*

Filtering Particulate P

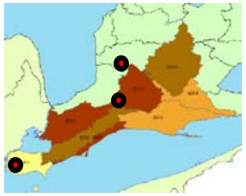
Grassed Waterways effectiveness

Sep 2011

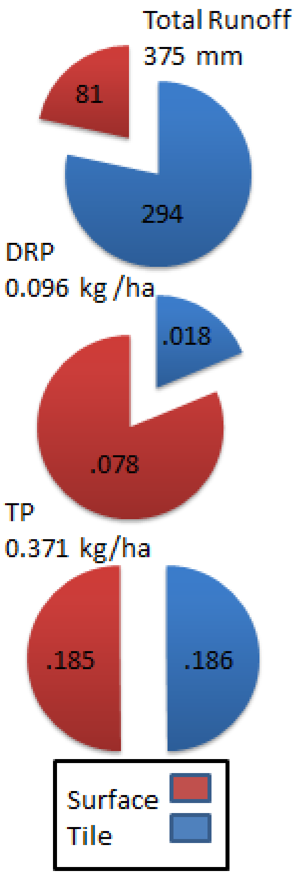
	[TSS] (mg/L)	[TP] (mg/L)
Top	96	8.7
Bottom	26	0.5

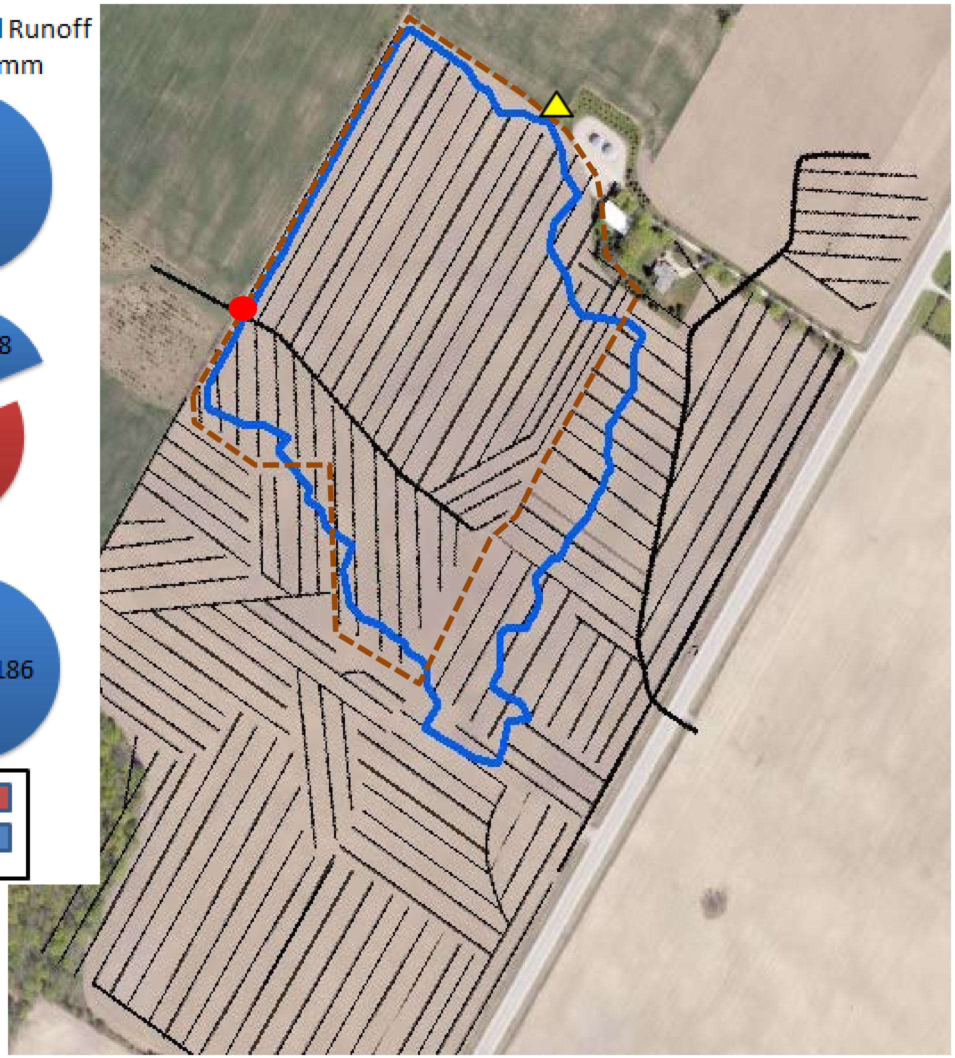
Jan 2013

	[TSS] (mg/L)	[TP] (mg/L)
Top	80-170	0.4
Bottom	80-170	0.4



TRAPPING FIELD RUNOFF



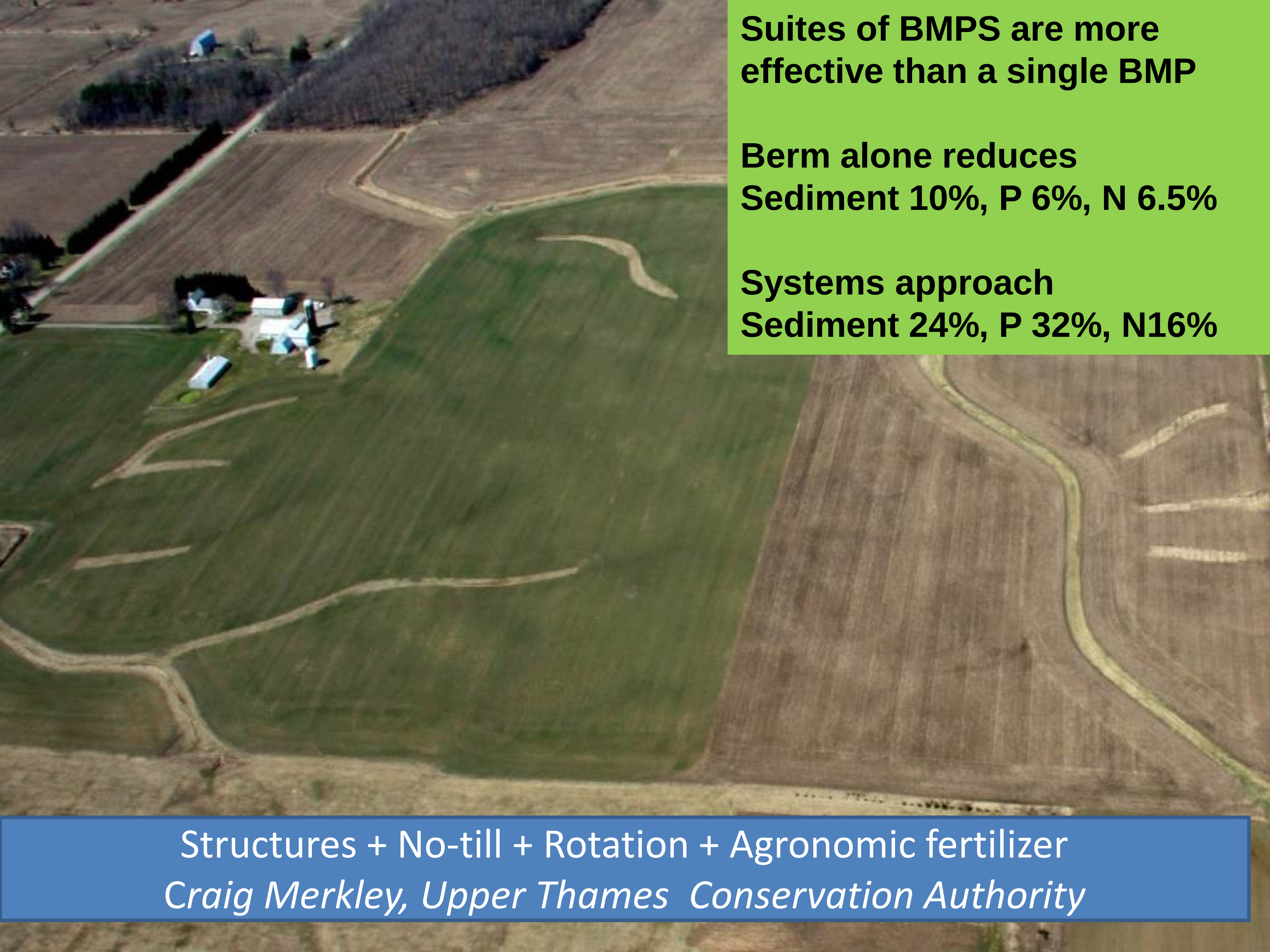


3 years
3 sites, CBW rotation

Avg Precip: 954 mm
Avg Runoff: 331 mm
Overland - 20%
Tile - 80%
Avg Annual P loss:
TP 0.3-0.5 kg/ha
DRP 0.03-0.1 kg/ha

8 ha/20 acre
STORAGE SIZE NEEDED
4 m deep rectangular pond
(2:1 side slopes)
107 m X 107 m (1.1 ha surface area)

Source: U of Waterloo, 2015



Suites of BMPS are more effective than a single BMP

Berm alone reduces
Sediment 10%, P 6%, N 6.5%

Systems approach
Sediment 24%, P 32%, N16%

Structures + No-till + Rotation + Agronomic fertilizer

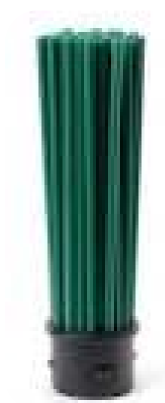
Craig Merkley, Upper Thames Conservation Authority

Filtering Particulate P

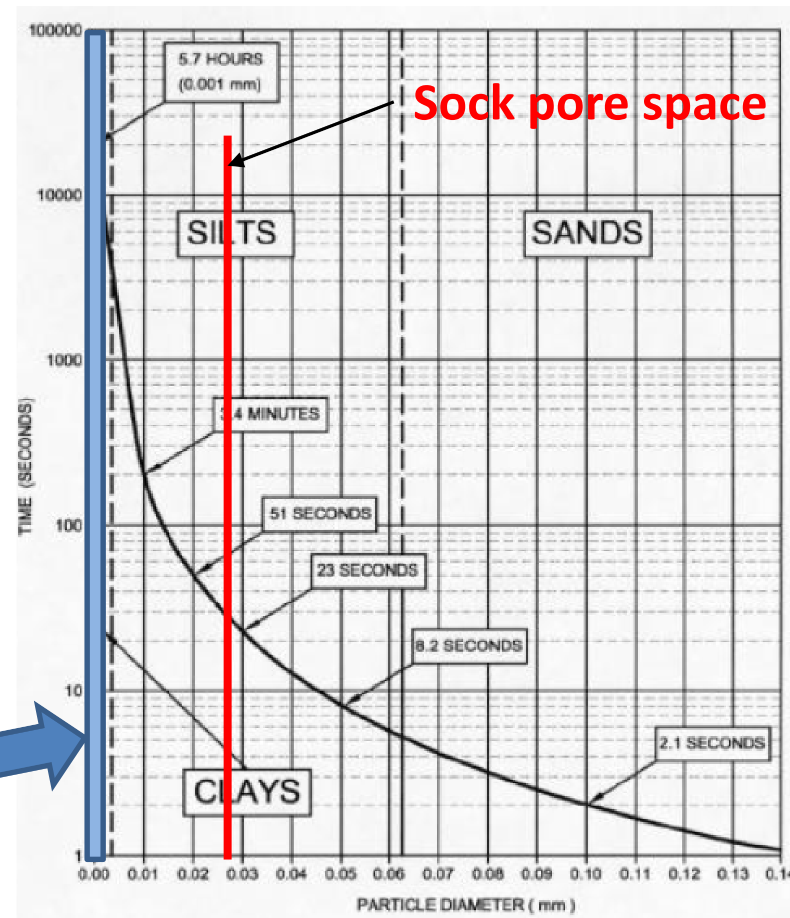
Runoff ponding time is key

- Smaller discharge tile/orifice
- Alternative inlet designs/socks?





- Adjust inlets to increase ponding times in non-growing season?



CLAY

Filtering Dissolved and Particulate P

Wisconsin Findings

Blind Inlet Nutrient Reductions vs Riser Inlet

Nutrient	2009 % Reduction	2010 % Reduction
Sediment	11*	79
Ammonium-N	30	59
Nitrate-N	34% increase	24
Total Kjehldahl N	66	48
Soluble P	64	72
Total P	52	78

Expected life: 10 years

Indiana Findings: (7 years)

Total P – 66% lower

Dissolved P – 50% lower

TSS – 64% lower

Wind Erosion - Windbreaks

"For every ten feet in height of a tree windbreak, you will see an increase in yield for approximately four to five times that (40' to 50') into the field."

Earl Elgie, Kent County

Special thanks to:

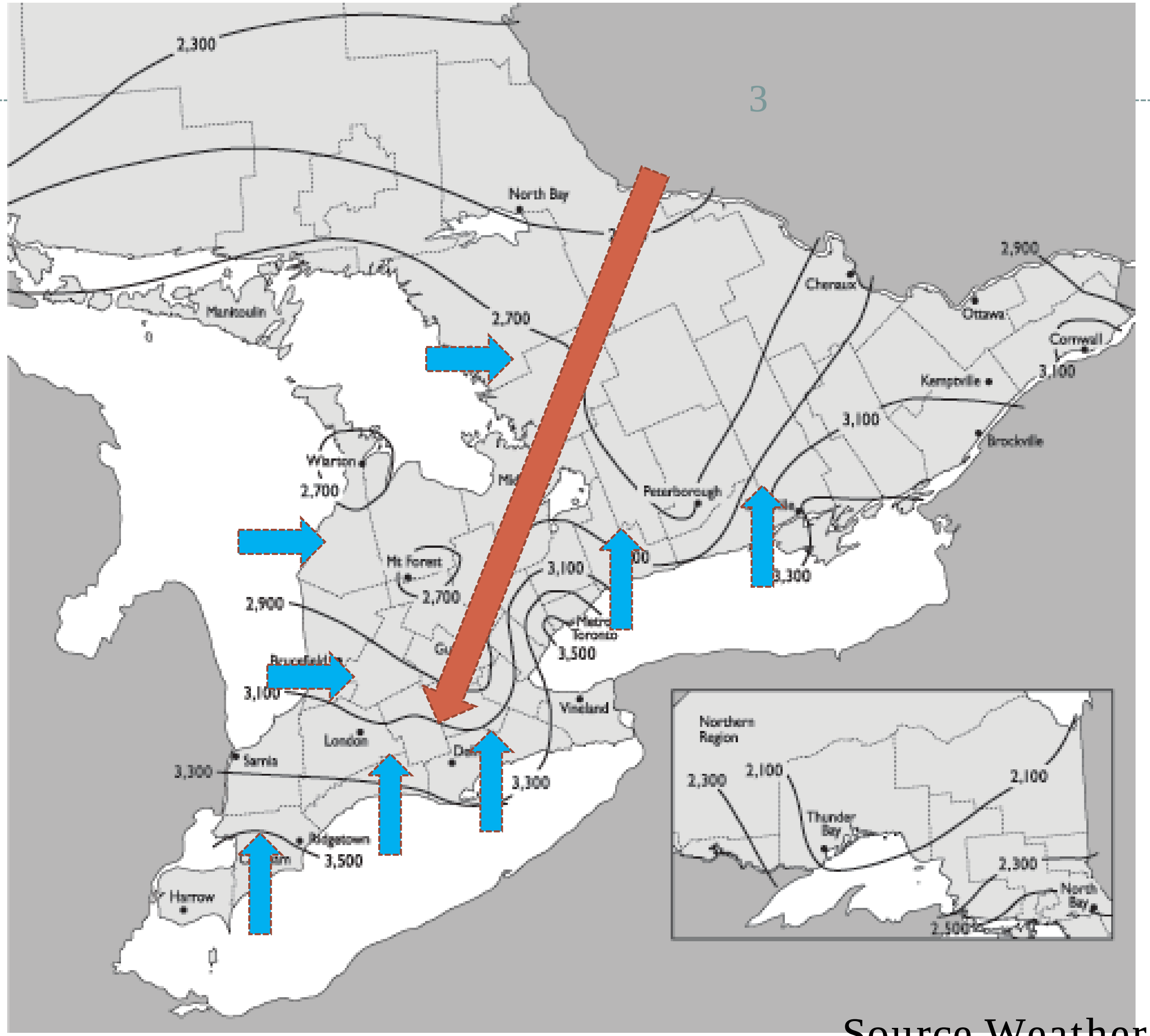
Cindy Bradley MacMillan, Jacqui Empson Laporte, OMAFRA
Andrew Graham & Christine Schmalz, OSCIA
Dr. Merrin Macrae, University of Waterloo, Kevin McKague OMAFRA
Dr. Tom Bruulesma, IPNI
Adam Hayes, Anne Verhallen, Ted Taylor, Chris Brown OMAFRA
Craig Merkely, UTRCA and Anne Loeffler, GRCA
Staff of the Kettle Creek/ Upper Thames River and
Ausable Bayfield Conservation Authorities
who shared their expertise and experience

The 4 Rs and the Agro-ecosytem

DR. IVAN O'HALLORAN, UNIVERSITY OF GUELPH, RIDGETOWN CAMPUS


Right Product
Right Placement
COMMON
SENSE
Right Rate
Right Time

Ontario's Biophysical Condition – climate



Fall → Spring:

Runoff & tile flow

Source Weather Innovations Inc.

Ontario's Biophysical condition – physiography and soils

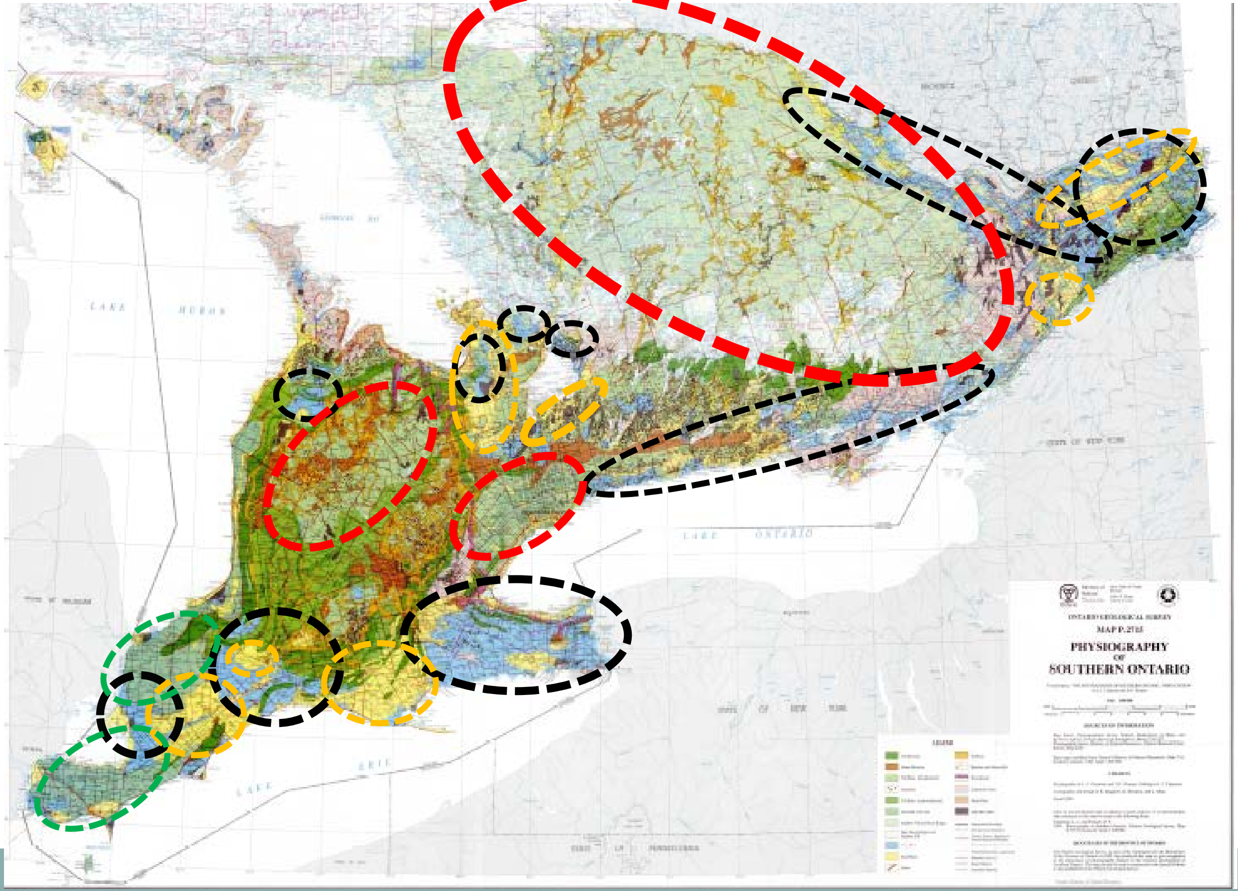
Clay Plains

Sand Plains

Till Plains

Till Moraines

Kame Moraines



30 % poorly drained
30 % imperfectly drained

Balancing Act

- Agriculture → Necessity

- Environmental Impact → Reality

“Simplifying the Message to the Point of Being Wrong”

- In the soil
  - P has low solubility
  - P binds tightly to the soil
- Therefore P **only** moves when soil erodes → depends on perspective

Agronomic Loss vs Environmental Impact

- Assume -~ 2 ppm change in Soil Test P to change fertilizer P recommendation and this represents an agronomic significant amount

- Takes about 15-20 kg fertilizer P to increase soil test P by 1 ppm →similar to decrease??
- → so loss of 30-40 kg P/ha to maybe be a significant agronomic loss

- Assume - ~ 40 cm runoff/drainage water at 0.03 mg/L (Water Quality guidelines)

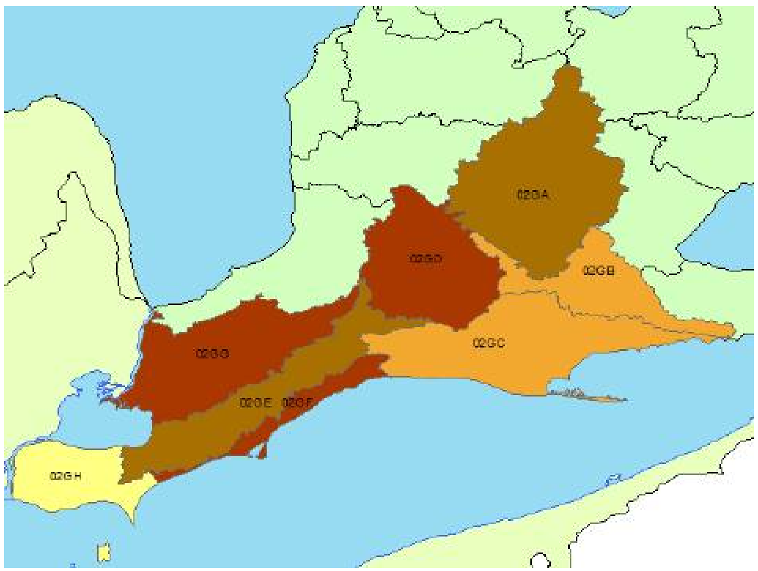
- 0.4 m x 10,000 m^2/ha x 1000 l/m^3 x 0.03 mg/L = 0.12 kg /ha

What is the Estimated P Loading Contribution from Ontario Cropland?

Consider Ontario croplands draining to Lake Erie or Lake St. Clair only (see below).

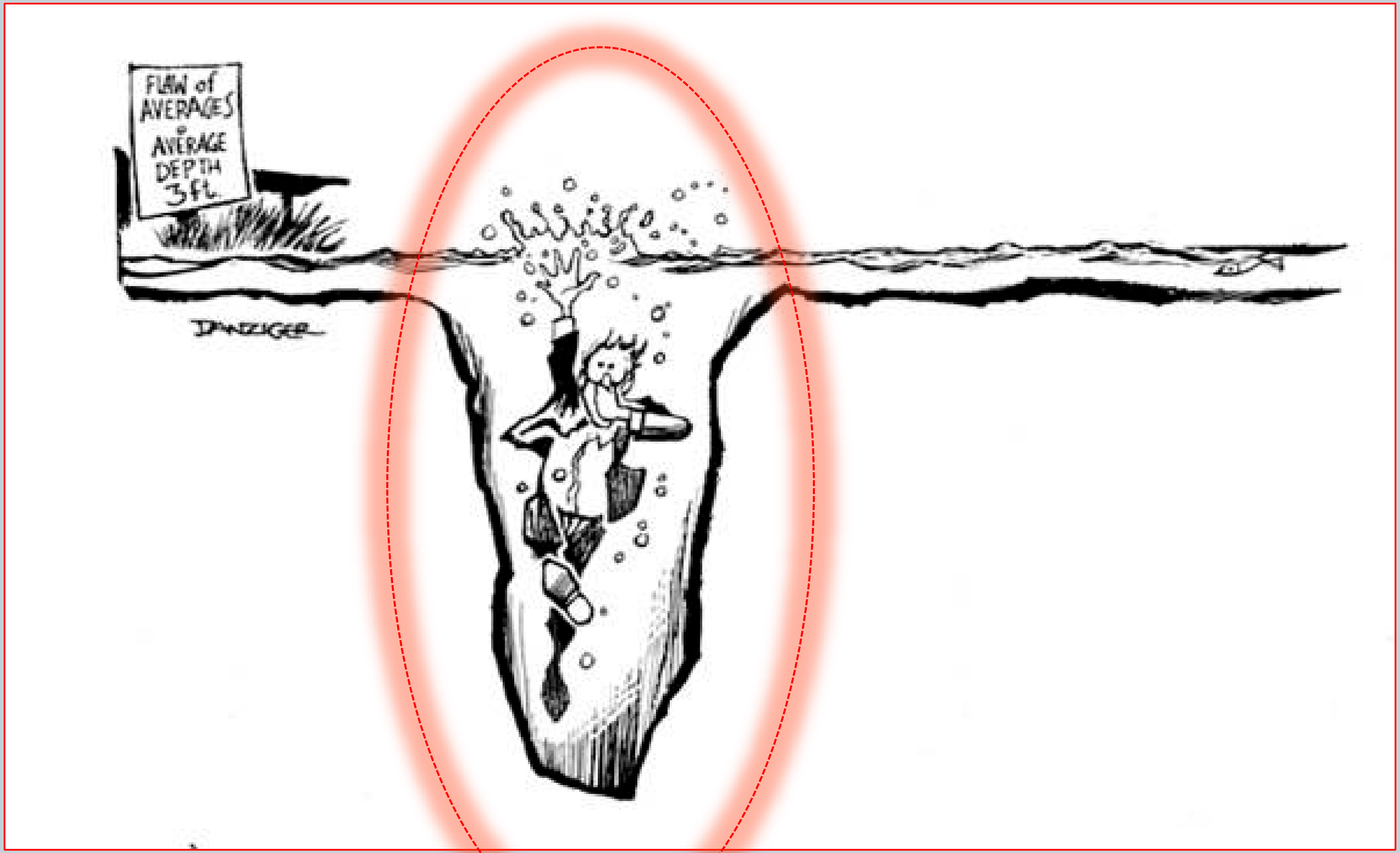
Assume from Lake Erie studies that 10% of the total NPS P loading to lake Erie originates from Ontario Cropland. NPS P is estimated to be 60% of the total P loading. Therefore NPS P loading form Ontario Cropland is 0.1 *0.6* 10000 T/yr = 600 T/yr (600,000 kg/yr)

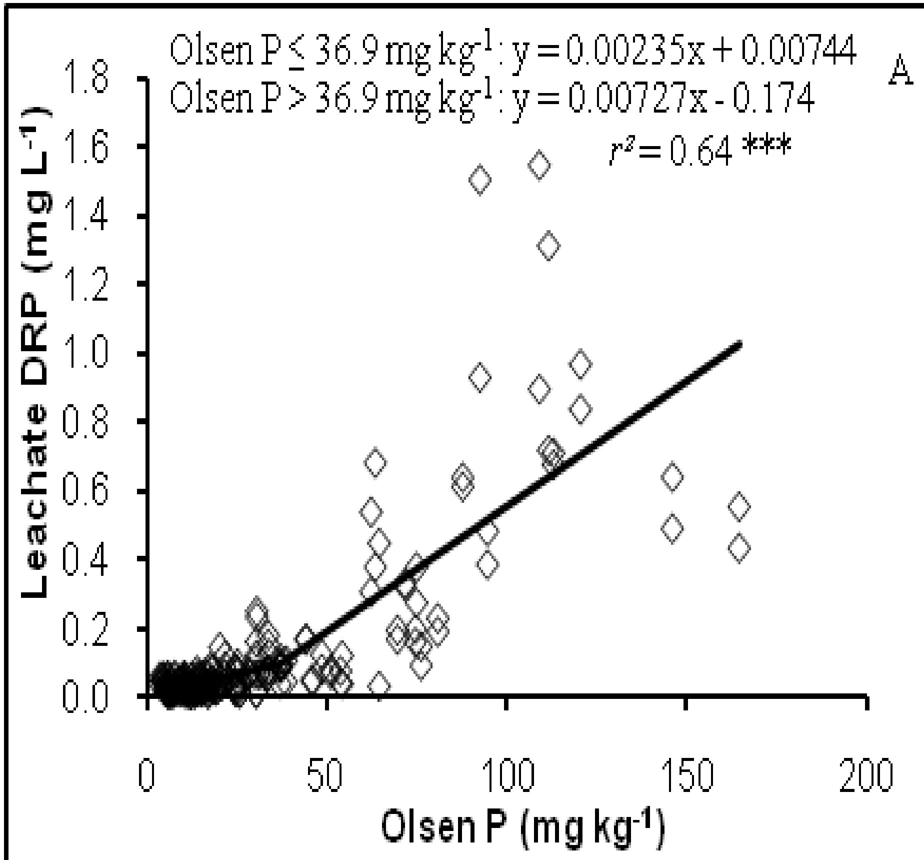
Source: Env Canada, 2014



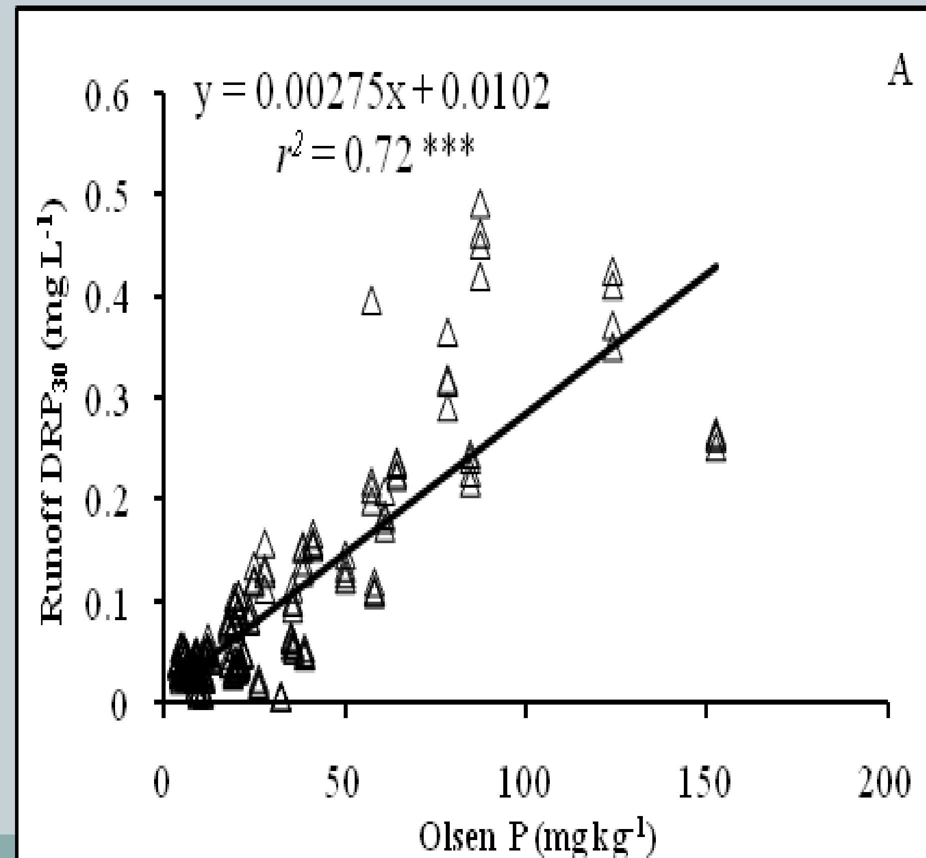
Region/Watershed	Area (km2)	Cropland (%)	Cropland Area (ha)
Grand River CA	6965	71	494515
Longpoint CA	2900	78	226200
Kettle CA	520	79	41080
Catfish CA	490	80	39200
Thames River WS	5820	82	477240
Lake Erie N. Shore	737	82	60434
St Clair CA/Sydenham	4100	86	352600
Essex CA	1631	79	128849
TOTAL:	**23163**		**1820118**
Estimated Net NPS P from Ontario (kg/year)			600,000
Average TP Load from Cropland (kg/ha/year)			**0.33**

“The FLAW of Averages”



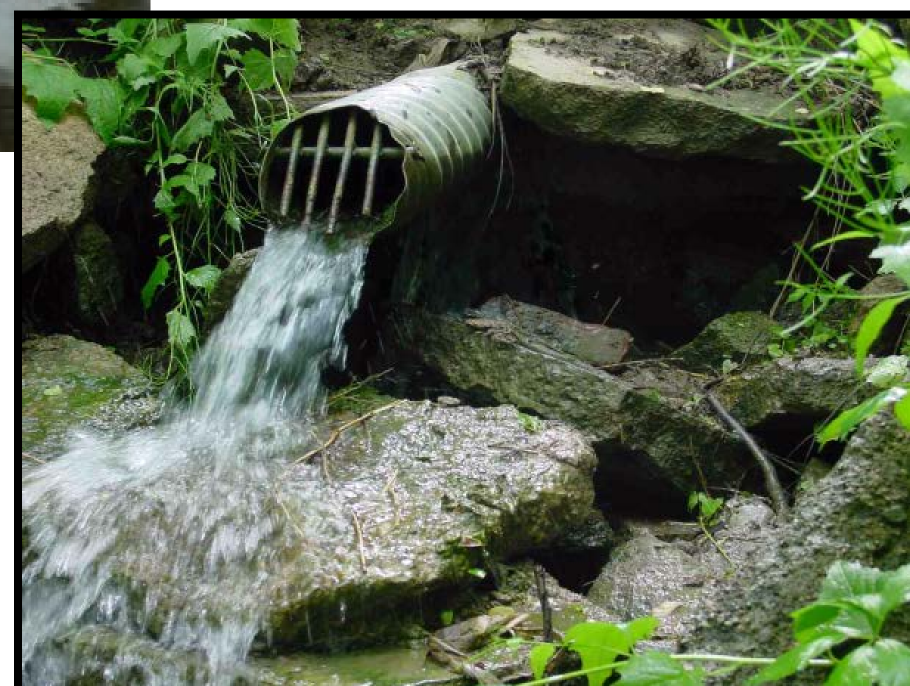


Leaching DRP and STP



Runoff DRP and STP

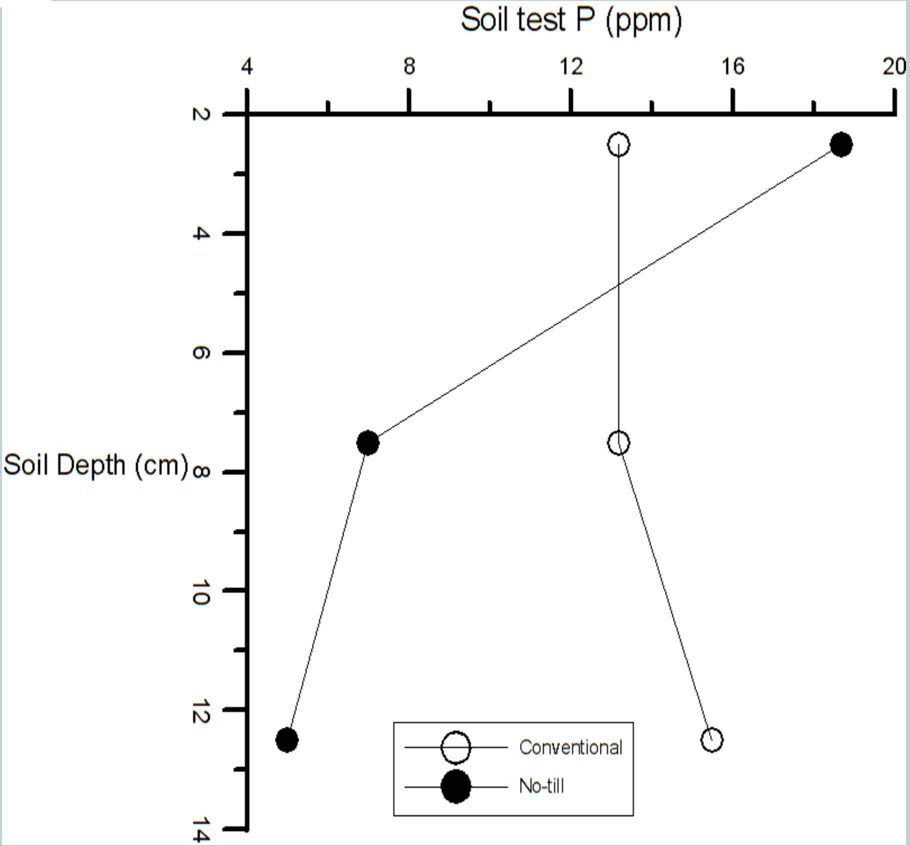
Nutrient losses in tile flow
- soil types
- annual losses and timing
- nutrient sources
- tillage systems



Tillage and P Loss

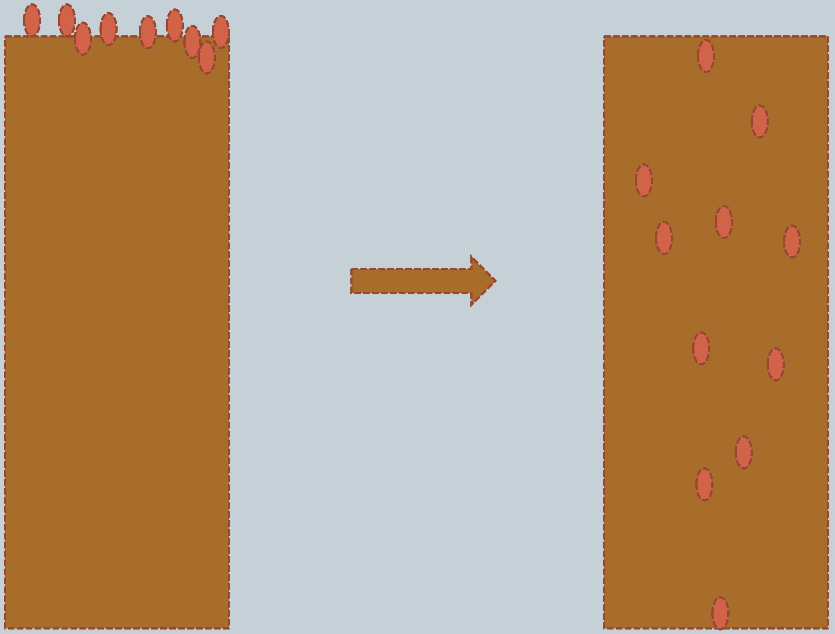
- P stratification in the soil → crop residues & surface applications of P

- **Note:** Soil test P differences would likely be greater if smaller depth increments used



Potential Consequence of Fall Surface Applied P (by the numbers)

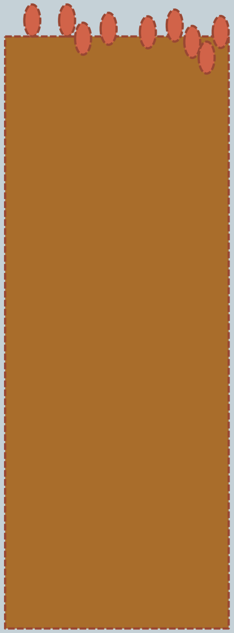
20 kg/ha P fall applied (~45 kg/ha or 41 lb/ac of P_2O_5)



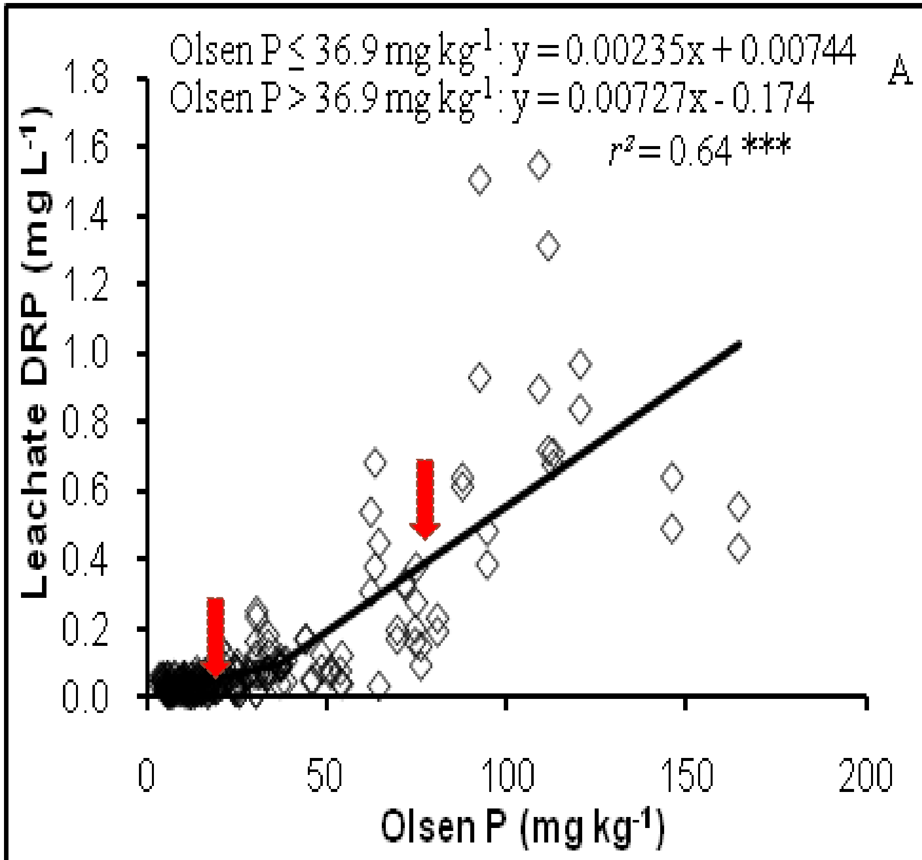
- Incorporated
  - ↓ P at surface less available for surface runoff
  - ↑ erosion potential
  - through soil loss ??? → likely depends upon degree of mixing and flow through soil

Consequence of Fall Surface Applied P (by the numbers)

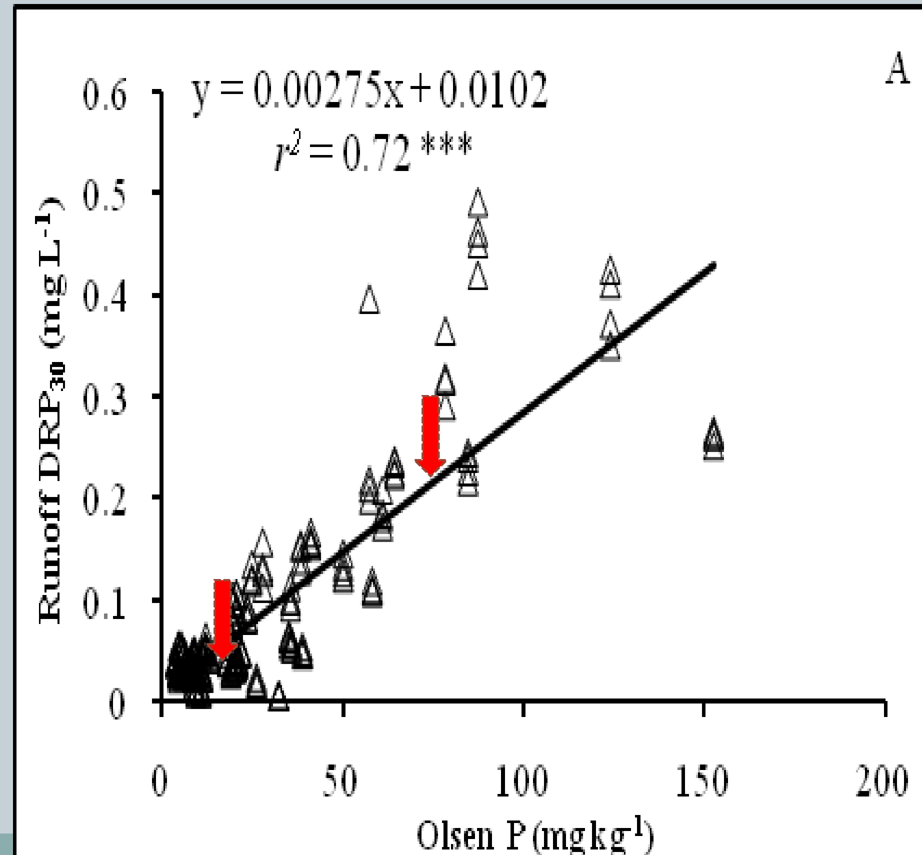
20 kg/ha P fall applied (~45 kg/ha or 41 lb/ac of P_2O_5)



- Not Incorporated
  - Most of P stays at surface
  - Effective application rate is ????
    - If stays in top 2.5 cm → 6 x the rate
- Impact on soil test P
  - ↑ 6 – 60 ppm



Leaching DRP and STP



Runoff DRP and STP

4R's & Nutrient Management

Right Product

Right Placement

Agronomy & Environment

Right Rate

Right Timing

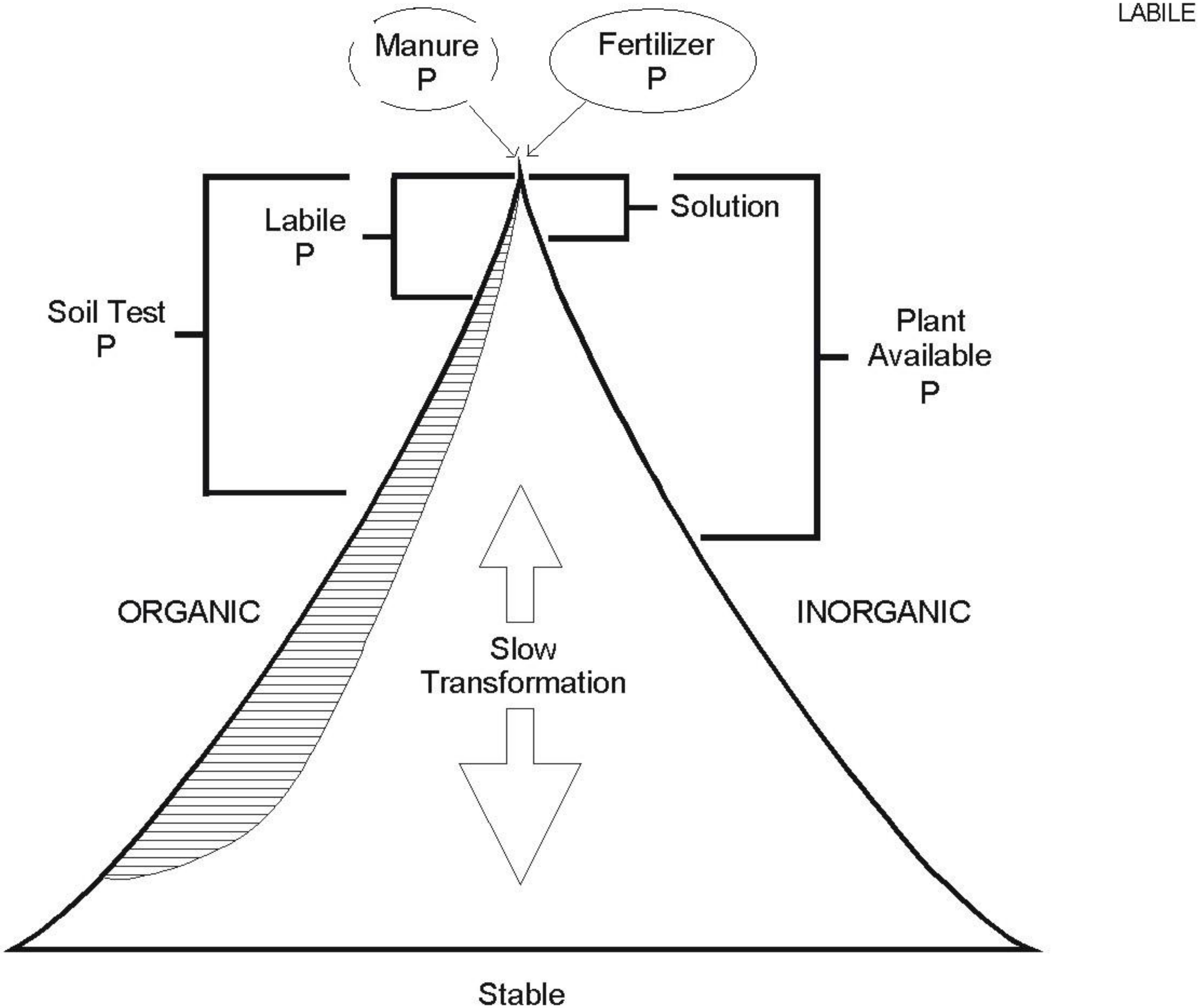
Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

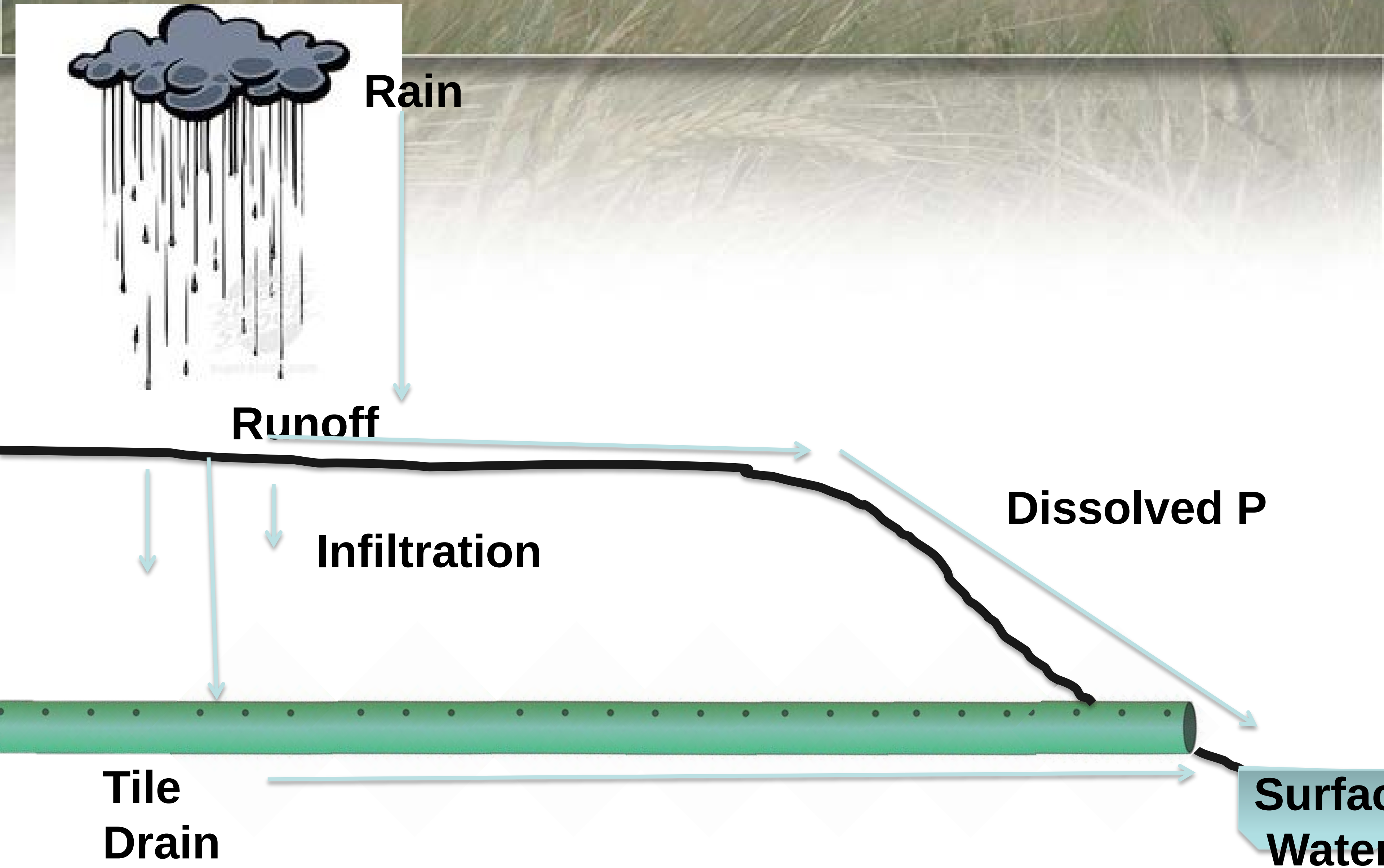
Phosphorus Primer – How P behaves in soil, and why it doesn’t always stay put!

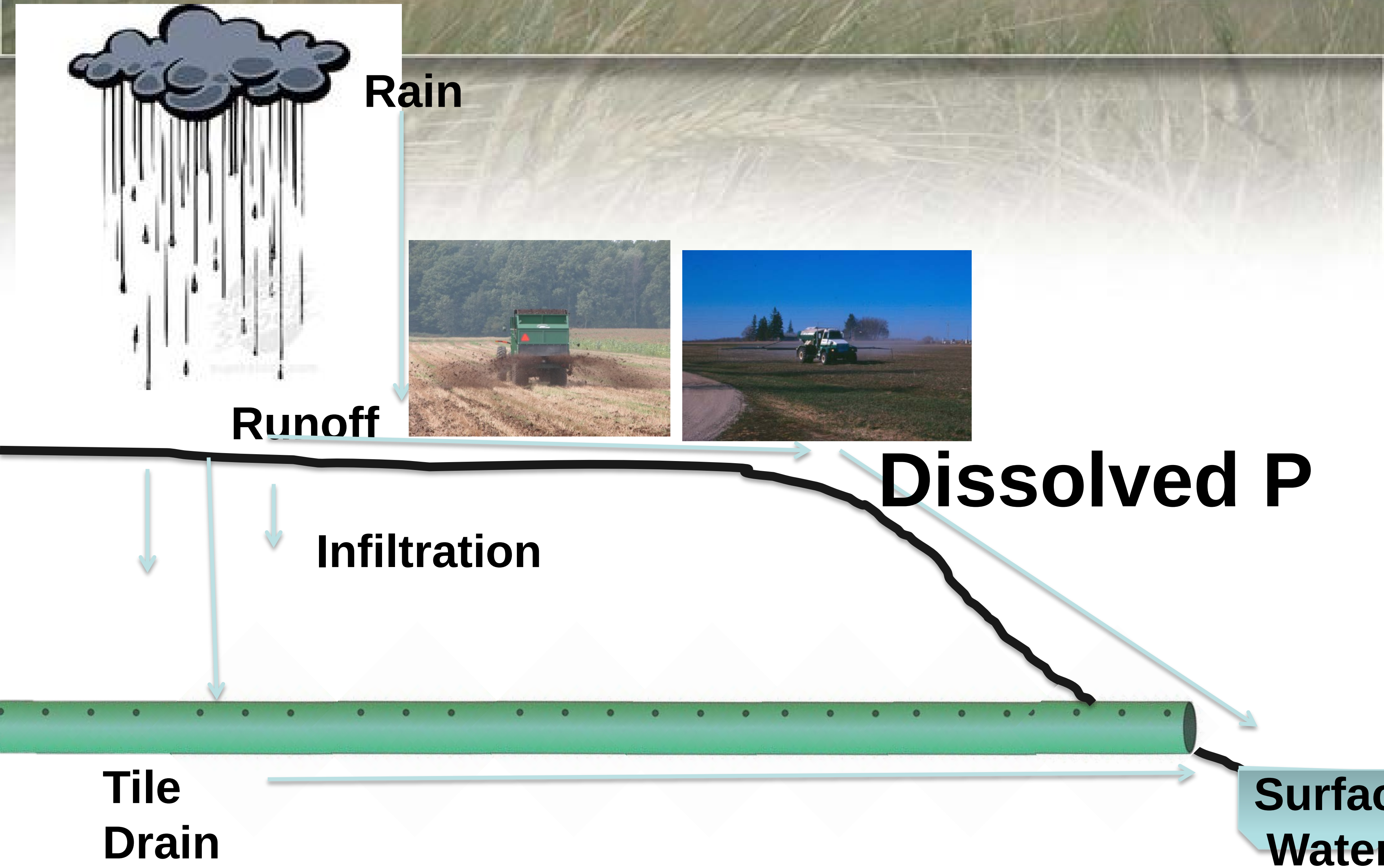
D. Keith Reid

Canada

Forms of P in the soil




Rain
Runoff
Dissolved P
Infiltration
Tile
Drain
Surfac
Water


Rain
Runoff
Dissolved P
Infiltration
Tile
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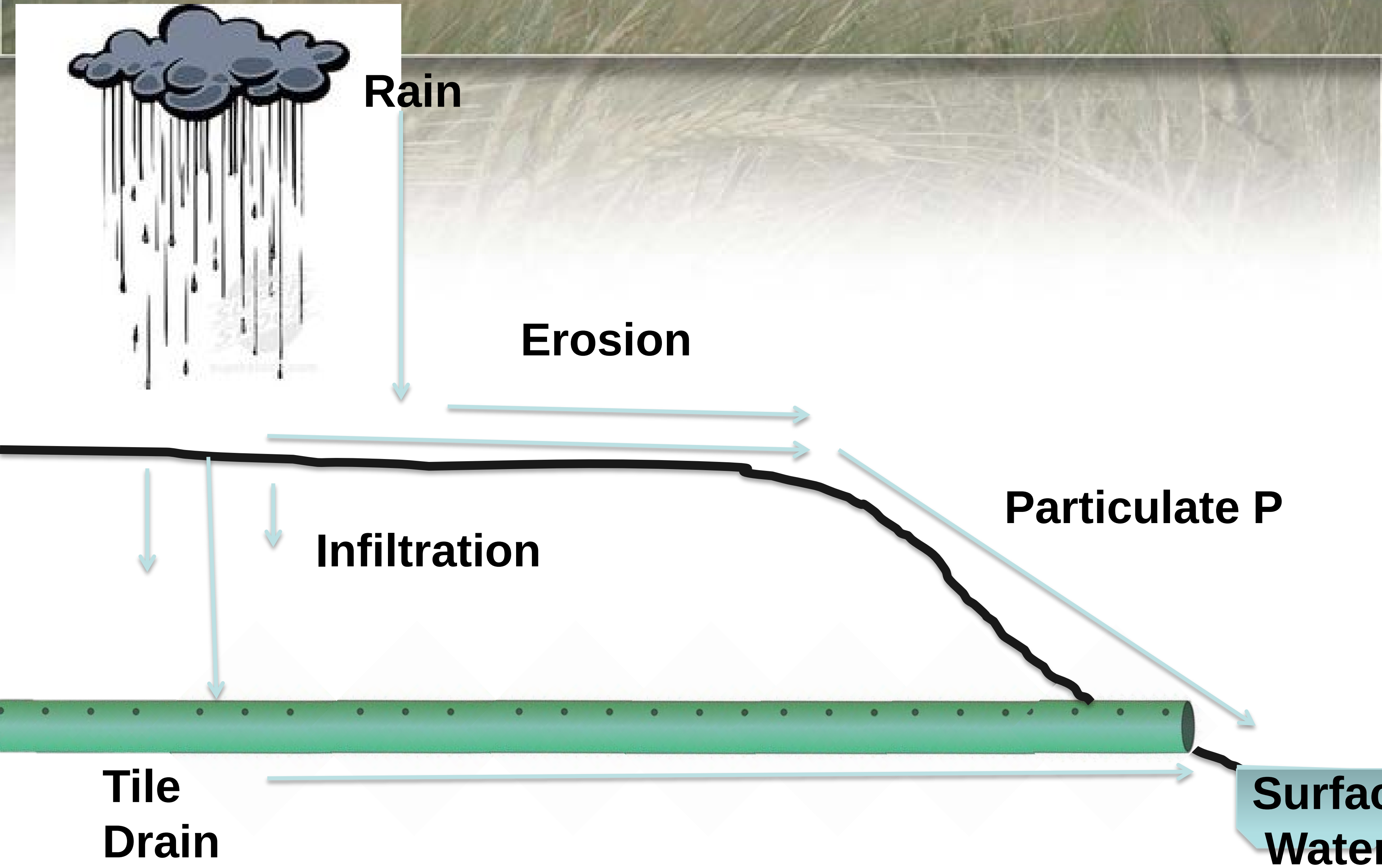
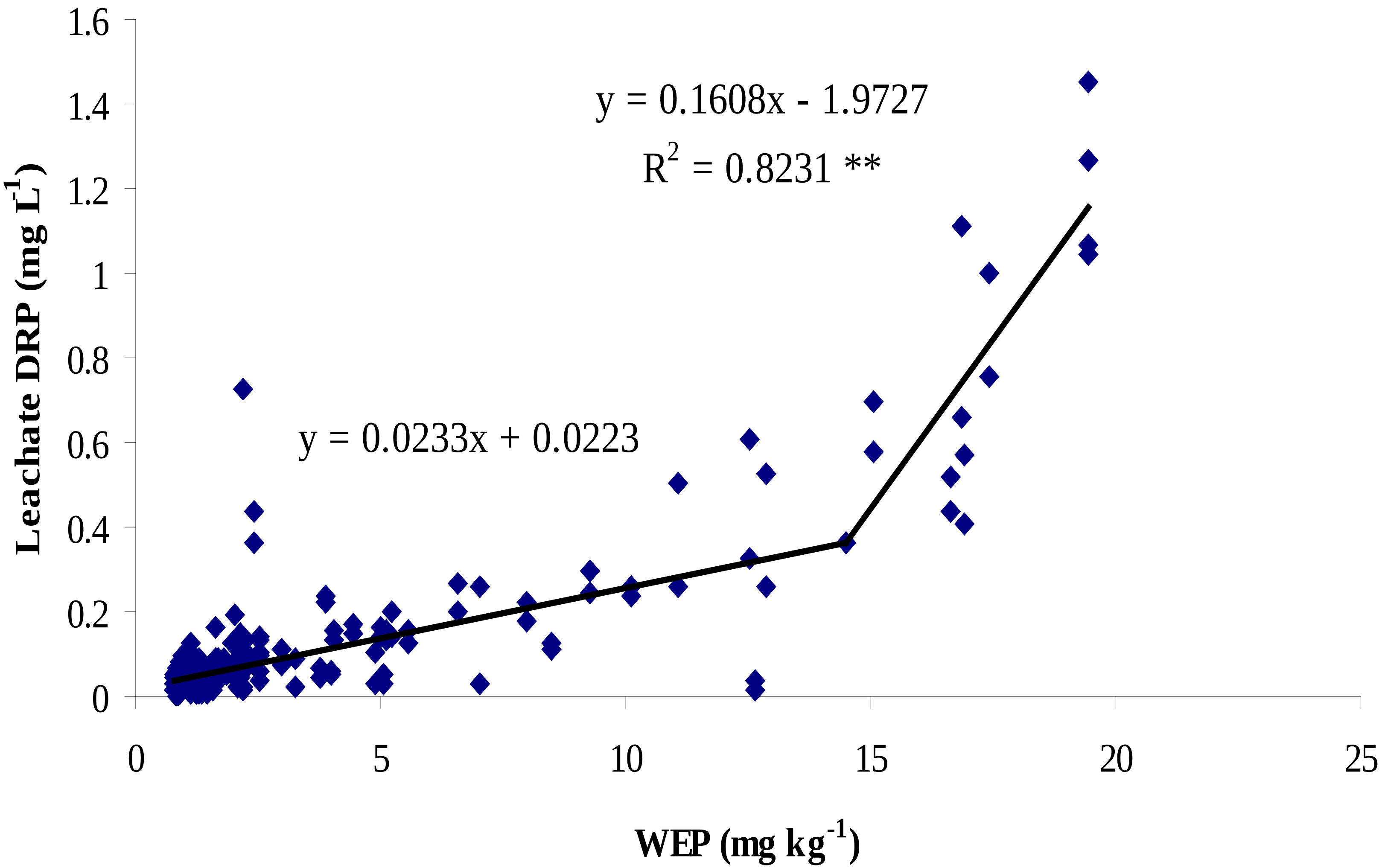
Surfac
Water

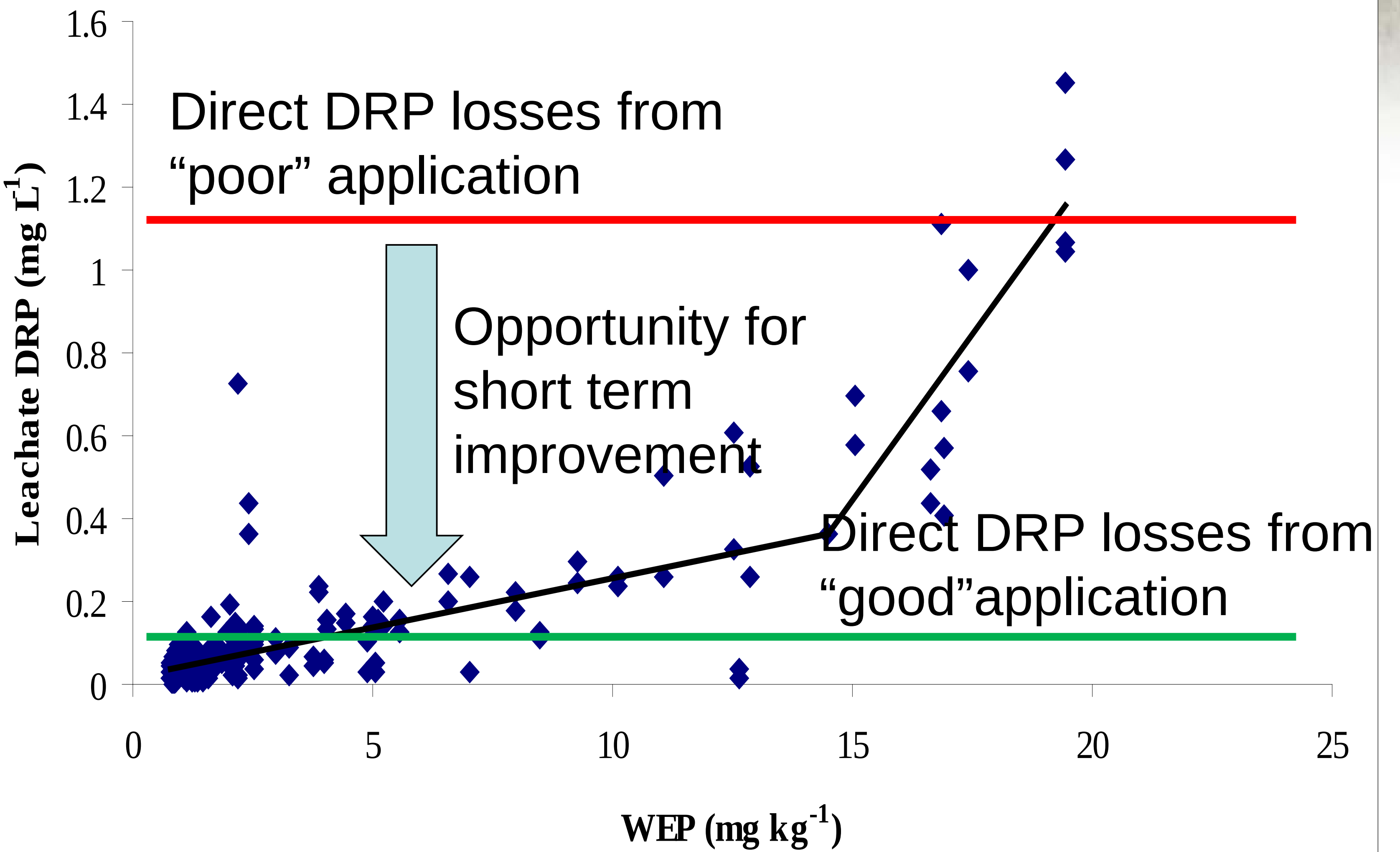

Rain
Erosion
Particulate P
Infiltration
Tile
Drain
Surfac
Water

Dissolved P Losses vs. Soil P



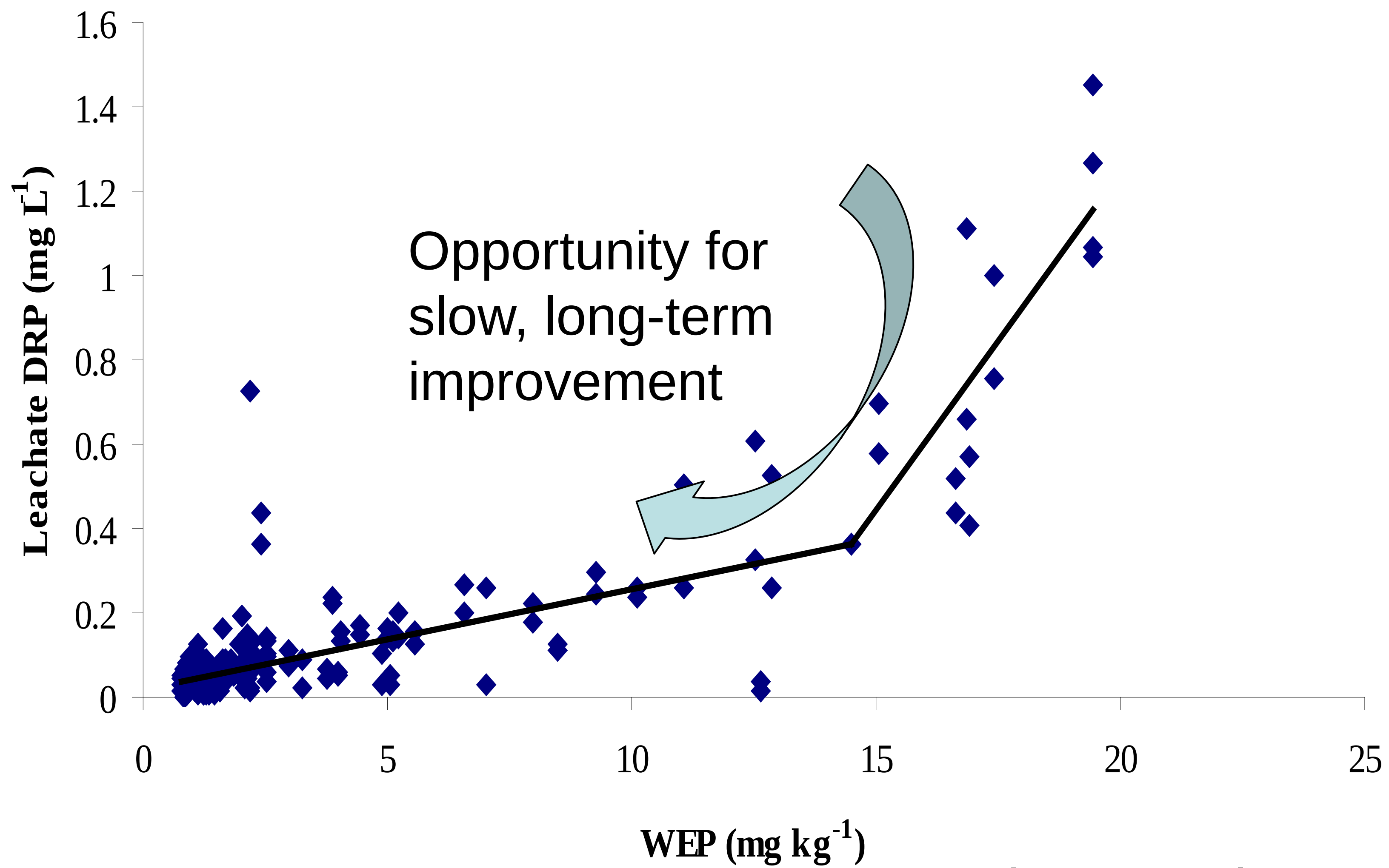
Zhang et al, 2010

Dissolved P Losses vs. Soil P and Management



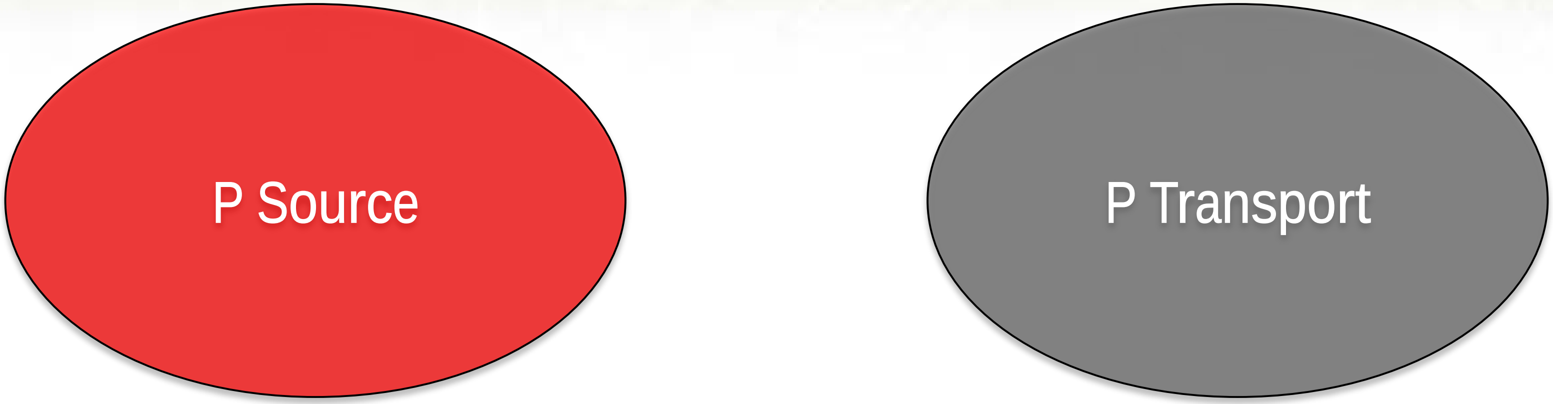
Zhang et al, 2010

Dissolved P Losses vs. Soil P and Management



Zhang et al, 2010

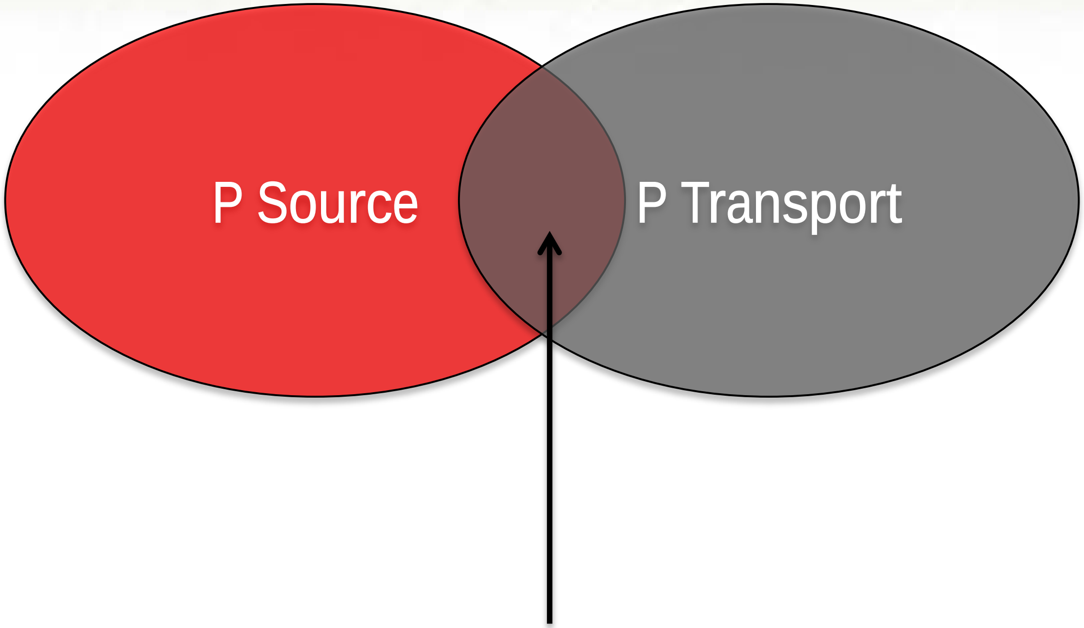
P Risk Assessment



High P source, but no transport = limited risk

High transport, but no P source = limited risk

P Risk Assessment



Critical Source Areas

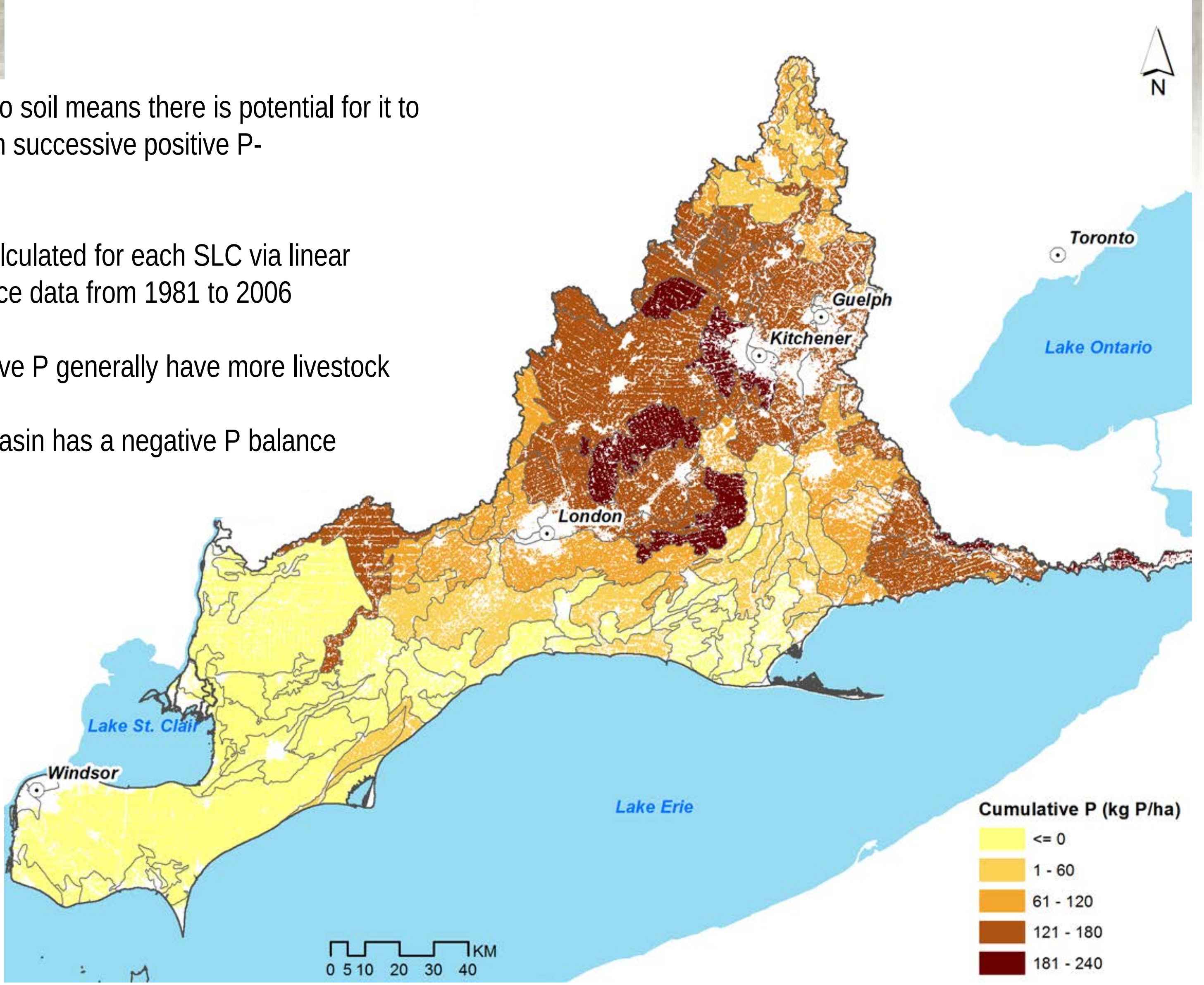
(Adapted from Kleinman, 2015)

Potential approaches to managing P loss

- Control Erosion
  - Highly effective where particulate P losses dominate, little effect on DRP losses
- Subsurface placement of P (banding or incorporation)
  - Immediate reduction in DRP losses in runoff and tile
- Application timing
  - Spring/summer generally lower risk than fall/winter
- Reduce P rates, P drawdown
  - Effective where history of excessive P applications
- Enhance infiltration
  - Reduces transport component

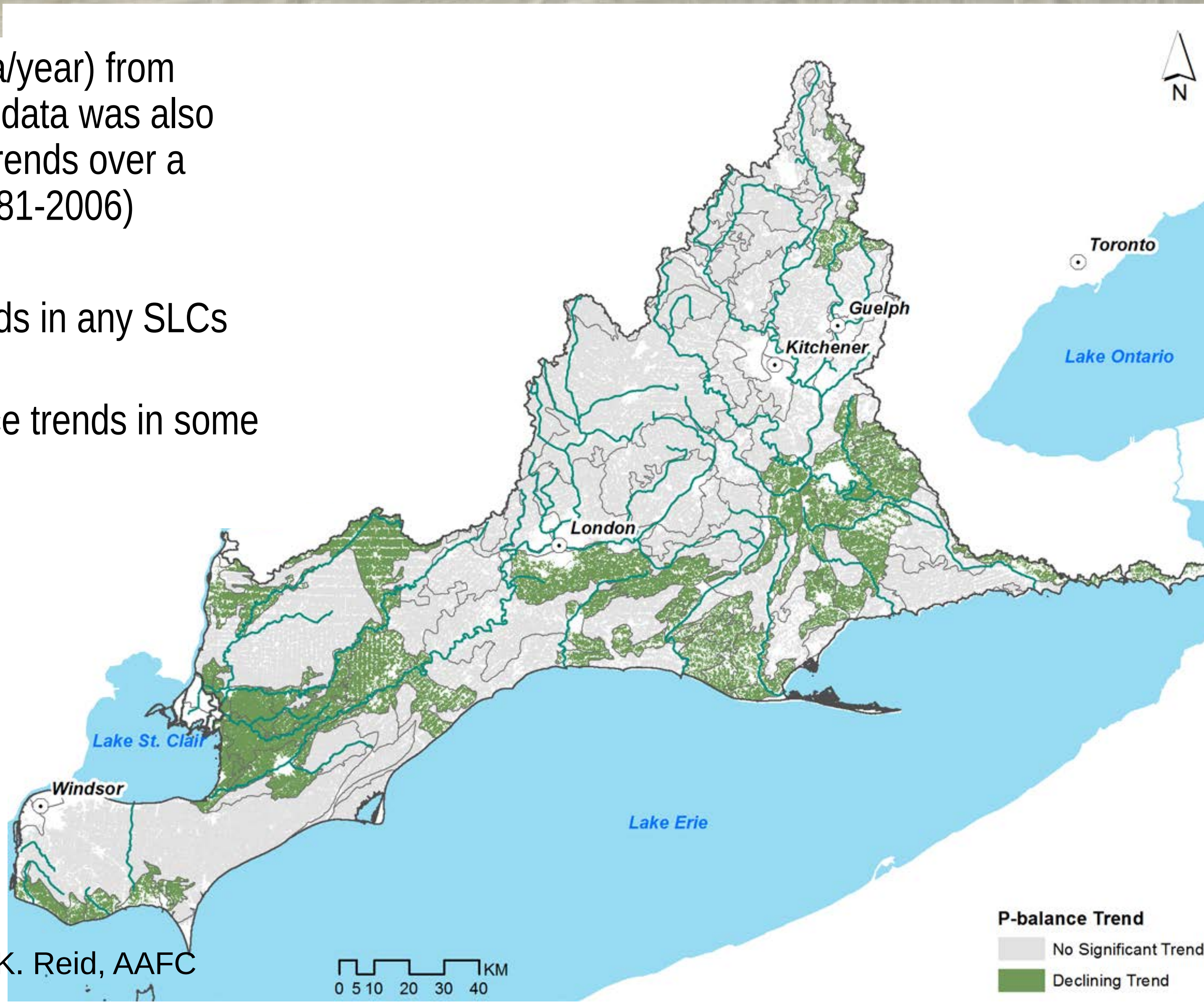
Cumulative Phosphorus Balance

- The capacity of P to bind to soil means there is potential for it to accumulate over time with successive positive P-balances
- Cumulative P (kg P/ha) calculated for each SLC via linear interpolation from P-balance data from 1981 to 2006
- SLCs with higher cumulative P generally have more livestock
- Significant portion of the basin has a negative P balance



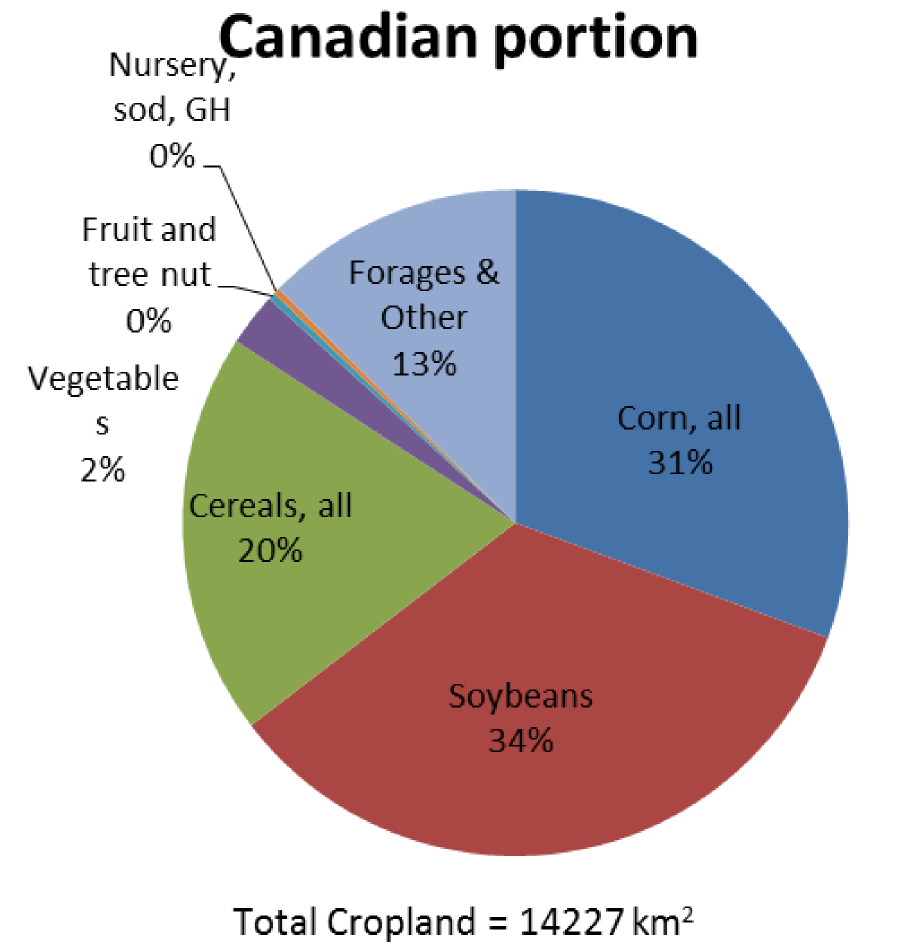
Phosphorus Balance Trend

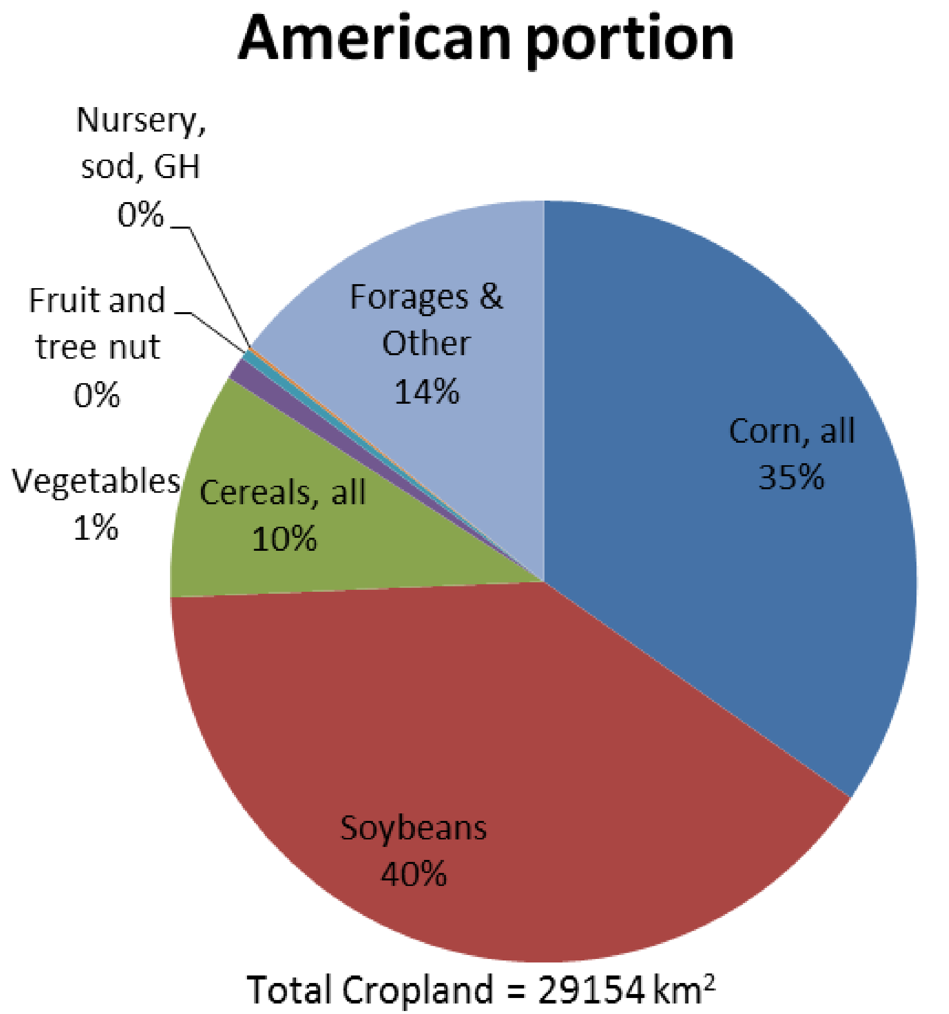
- P-balance (kg P/ha/year) from each Census year data was also used to calculate trends over a 25-year period (1981-2006)
- No increasing trends in any SLCs
- Declining P-balance trends in some SLCs in the basin



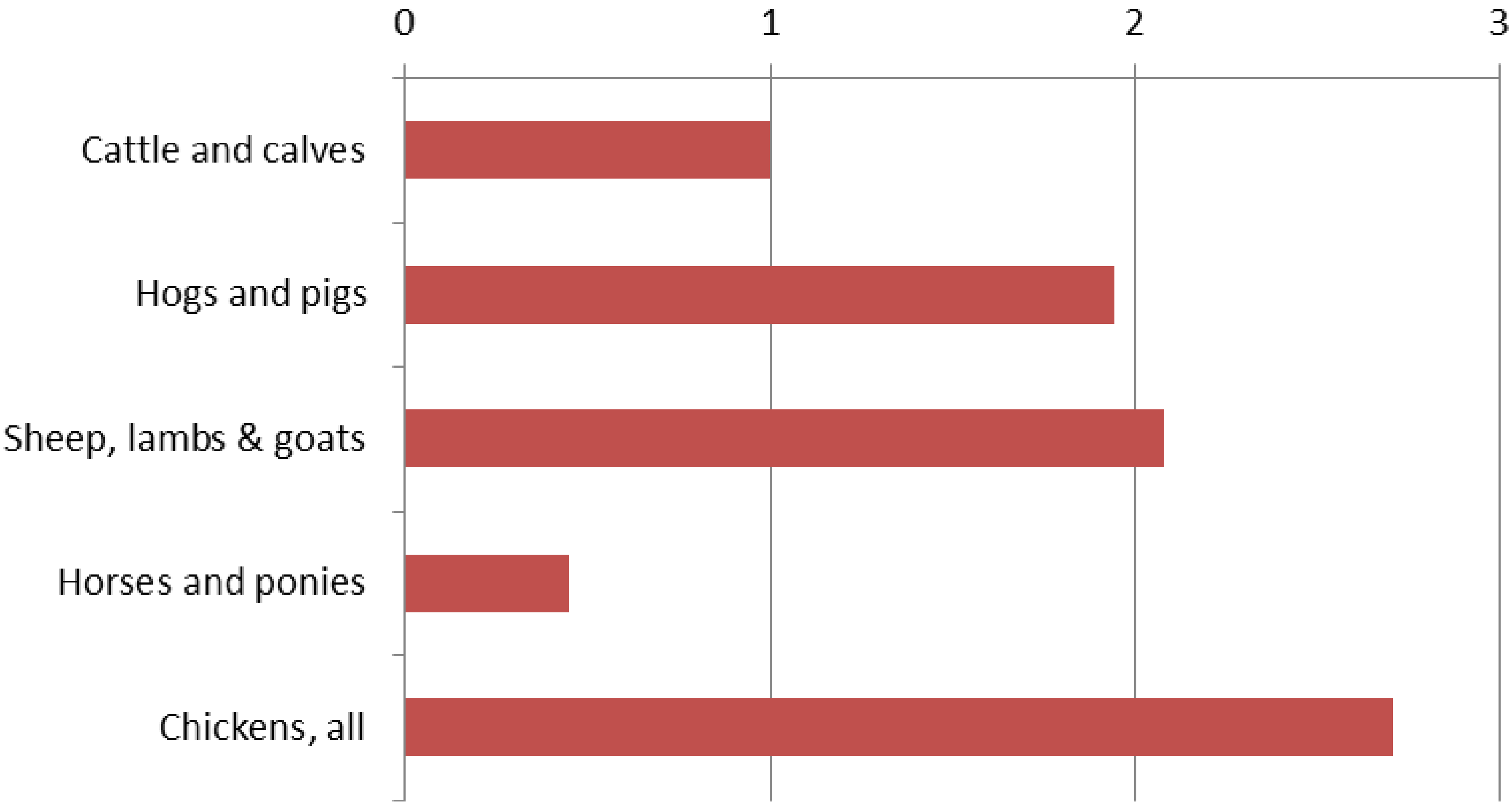
Source: E. Van Bochove, K. Reid, AAFC

Distribution of Cropland in Lake Erie Basin





Number of livestock in Canadian relative to the U.S. Lake Erie basin

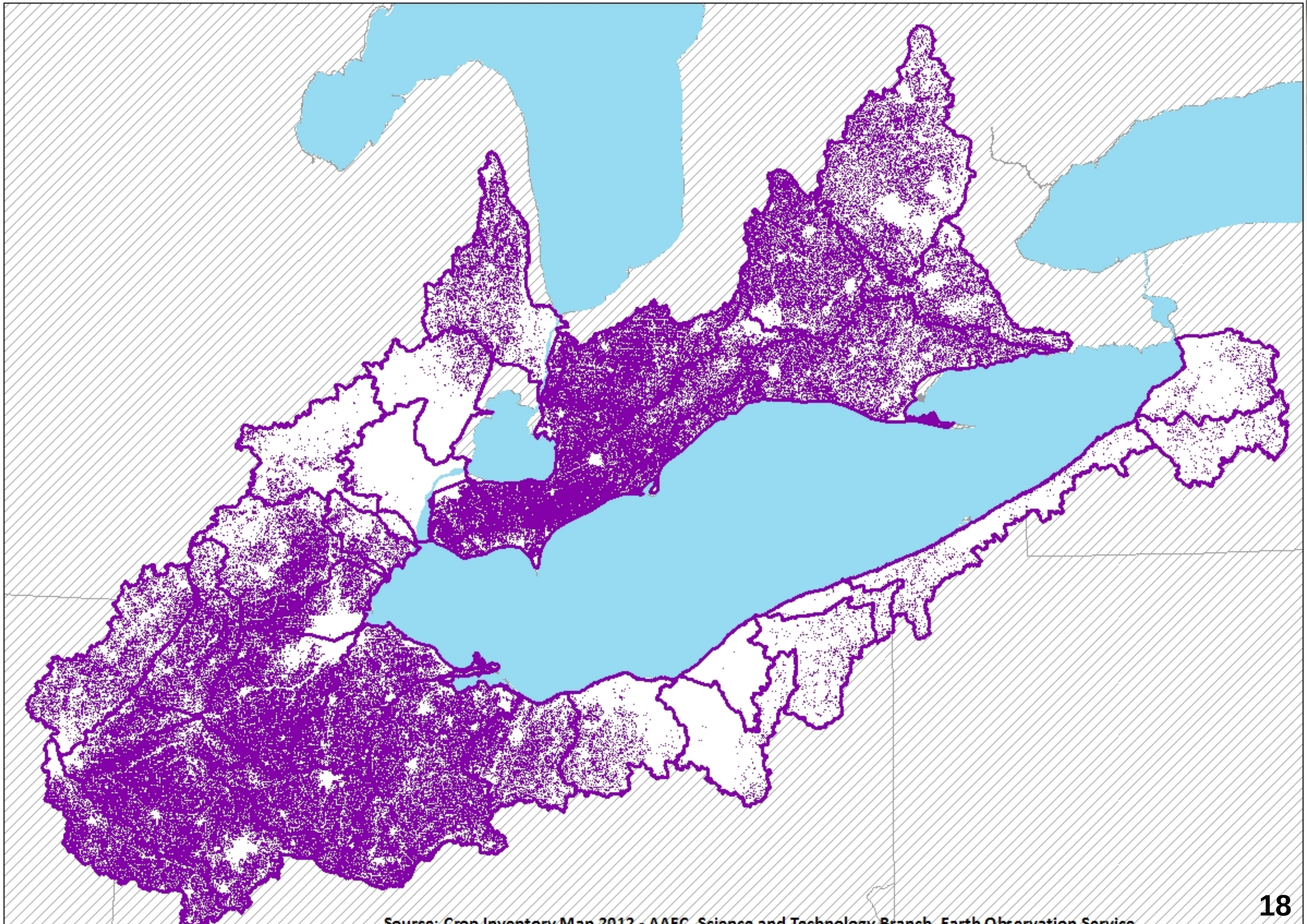


Consequences of differences in crops and livestock between Canada and U.S.:

- Greater proportion of nutrients from manure in Ontario
- Higher variability in distribution of nutrients
- More tillage for manure incorporation
- More complexity in crop rotations

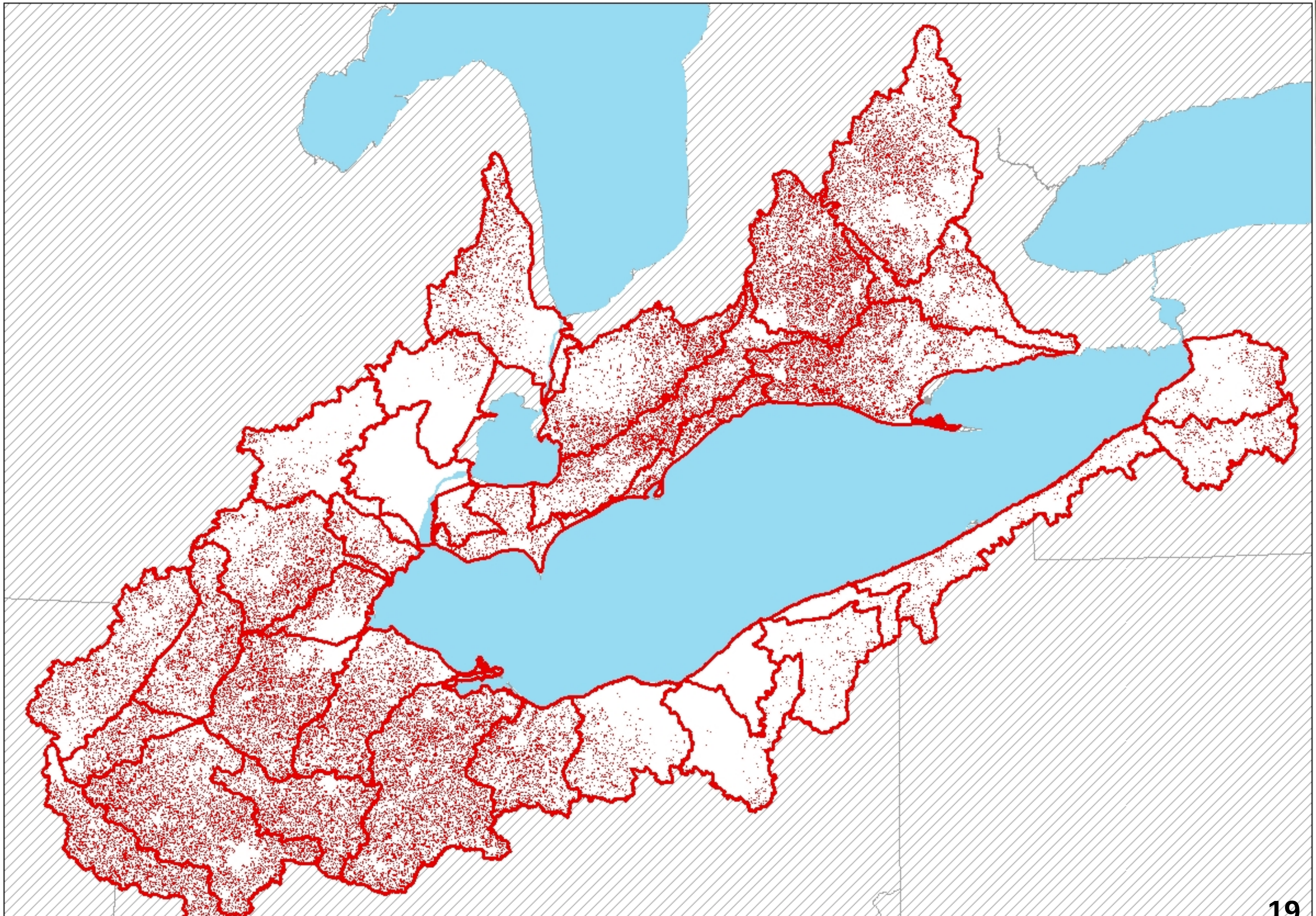

Questions?

Distribution of Field Crops in Lake Erie basin



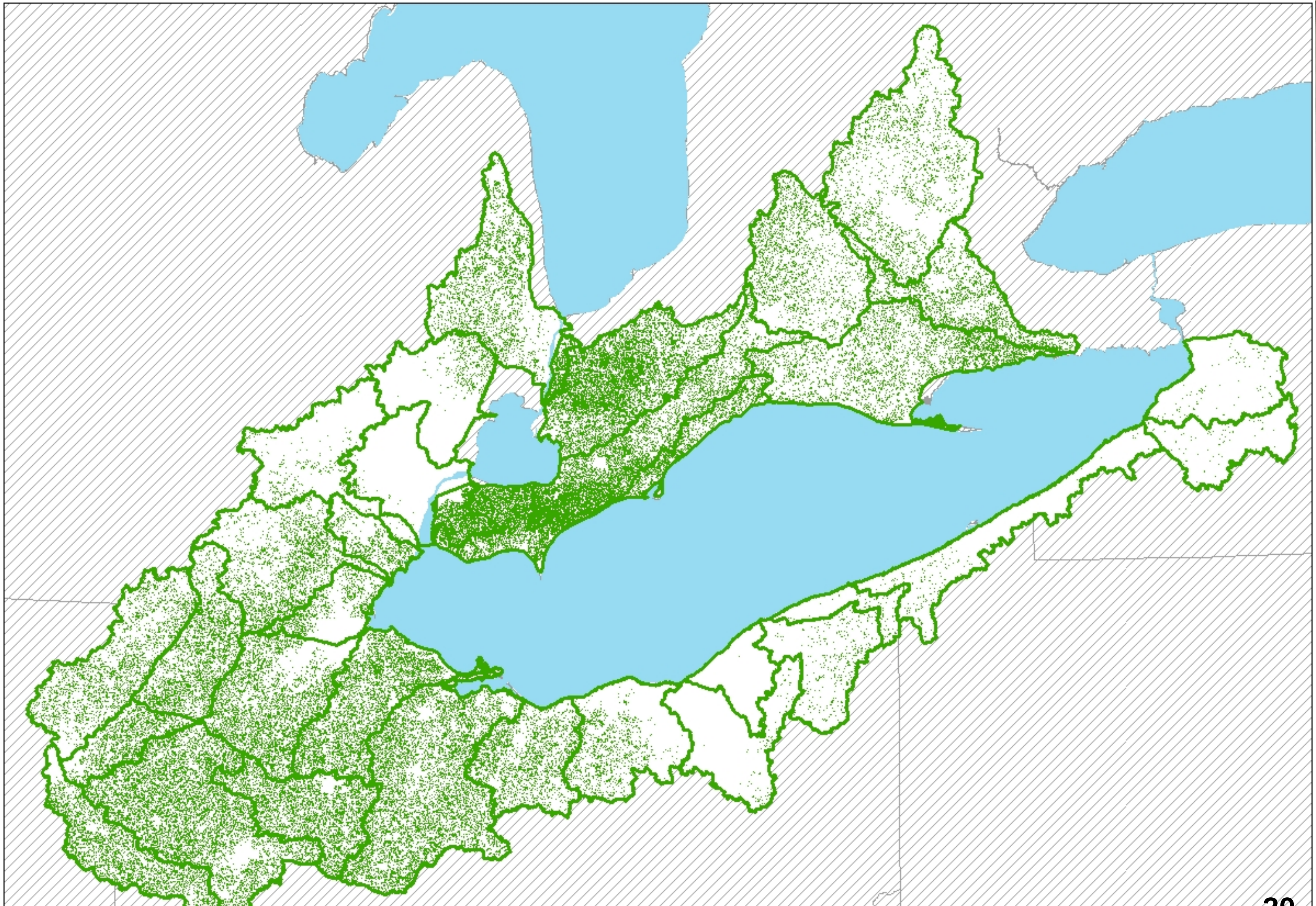
Source: Crop Inventory Map 2012 - AAFC, Science and Technology Branch, Earth Observation Service
CropScape: Cropland Data Layer 2012 -USDA, National Agricultural Statistics Service, Research and Development Division

Distribution of Corn in Lake Erie basin



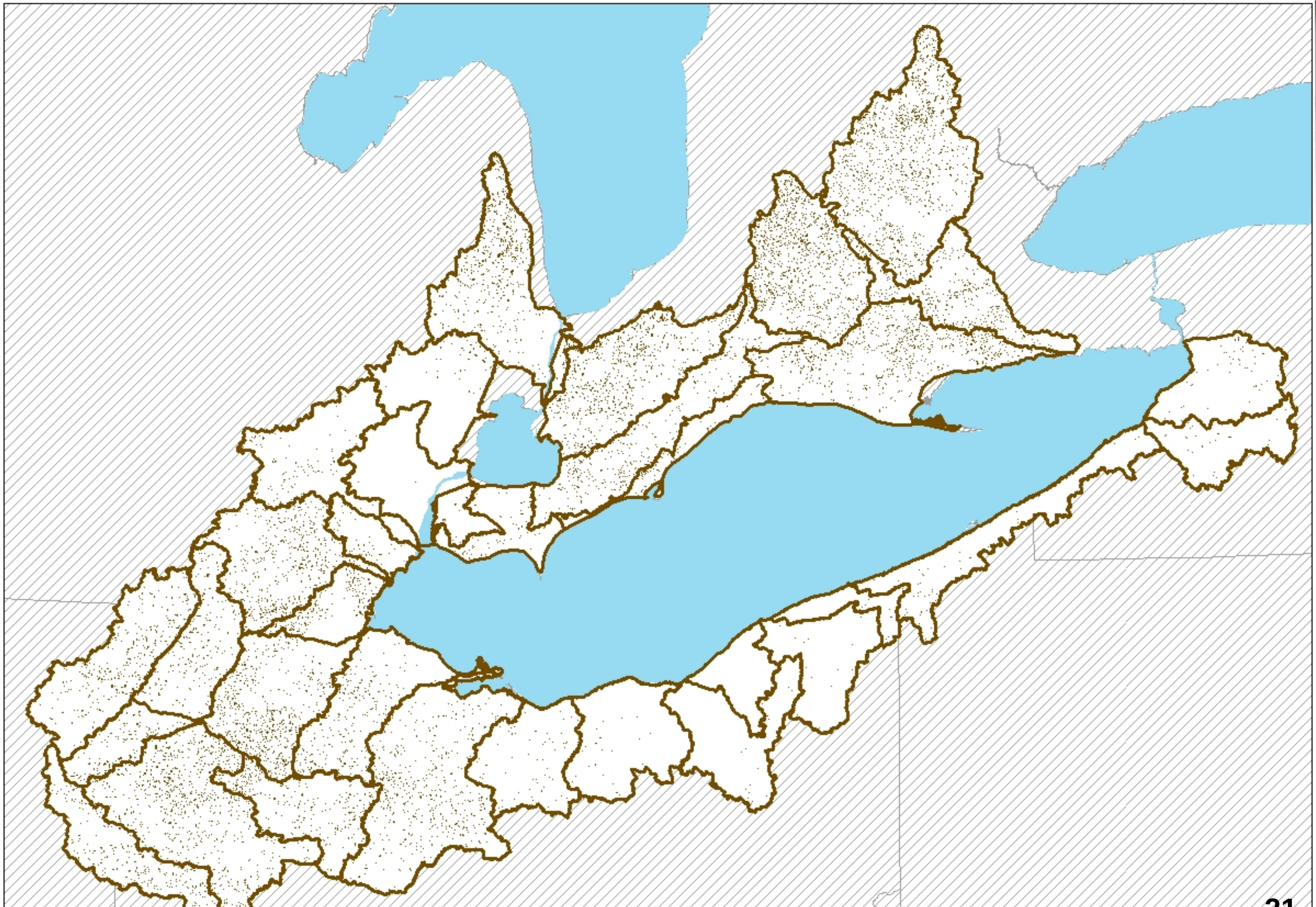
Source: Crop Inventory Map 2012 - AAFC, Science and Technology Branch, Earth Observation Service
CropScape: Cropland Data Layer 2012 -USDA, National Agricultural Statistics Service, Research and Development Division

Distribution of Soybeans in Lake Erie basin



Source: Crop Inventory Map 2012 - AAFC, Science and Technology Branch, Earth Observation Service
CropScape: Cropland Data Layer 2012 -USDA, National Agricultural Statistics Service, Research and Development Division

Distribution of Cereals in Lake Erie basin



Source: Crop Inventory Map 2012 - AAFC, Science and Technology Branch, Earth Observation Service
CropScape: Cropland Data Layer 2012 -USDA, National Agricultural Statistics Service, Research and Development Division

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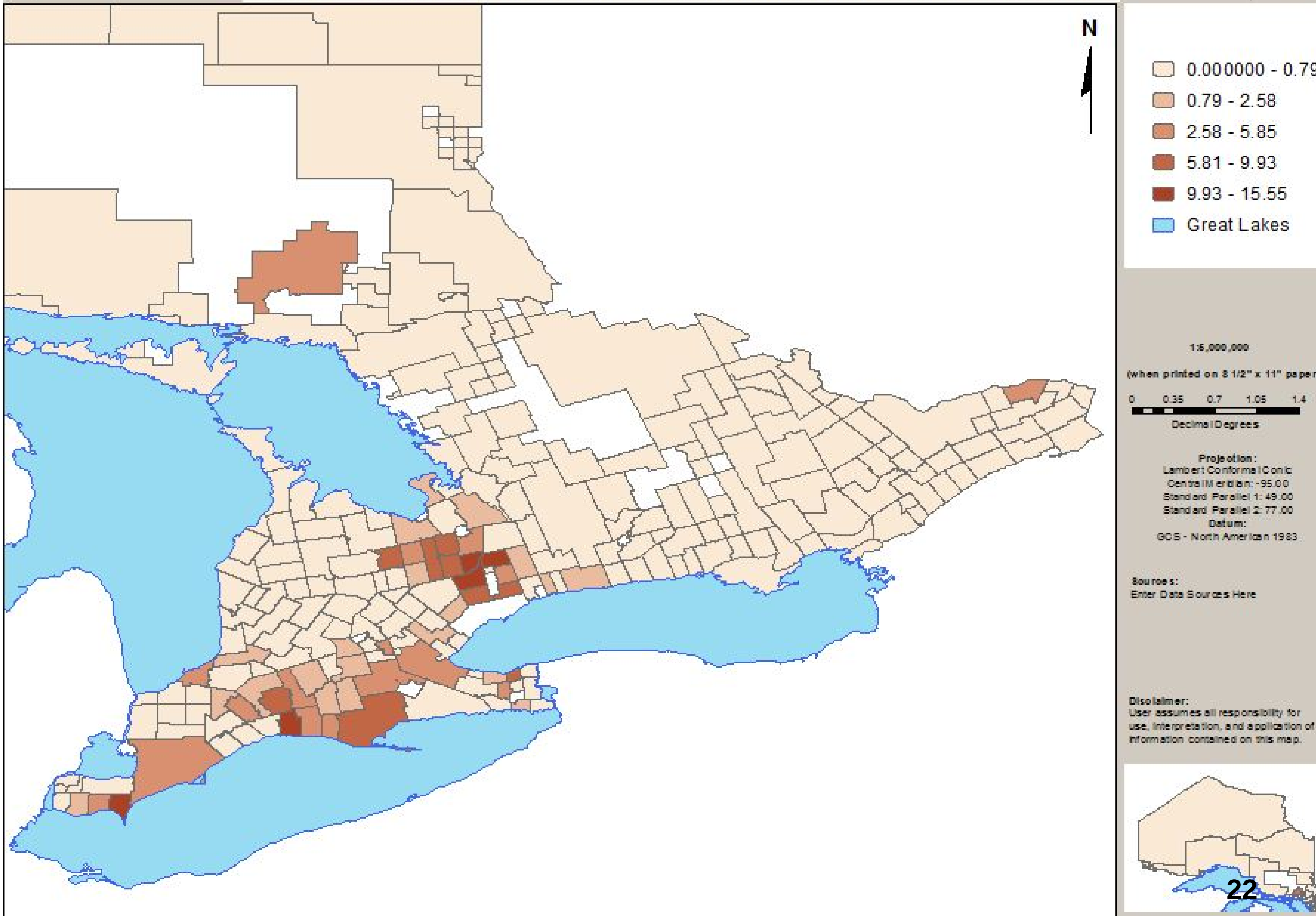
Hectares of Vegetables in CCS as a Percentage of Hectares of Farmland in CCS



Produced by Agriculture and Agri-Food Canada
Science and Technology Branch, Agri-Geomatics

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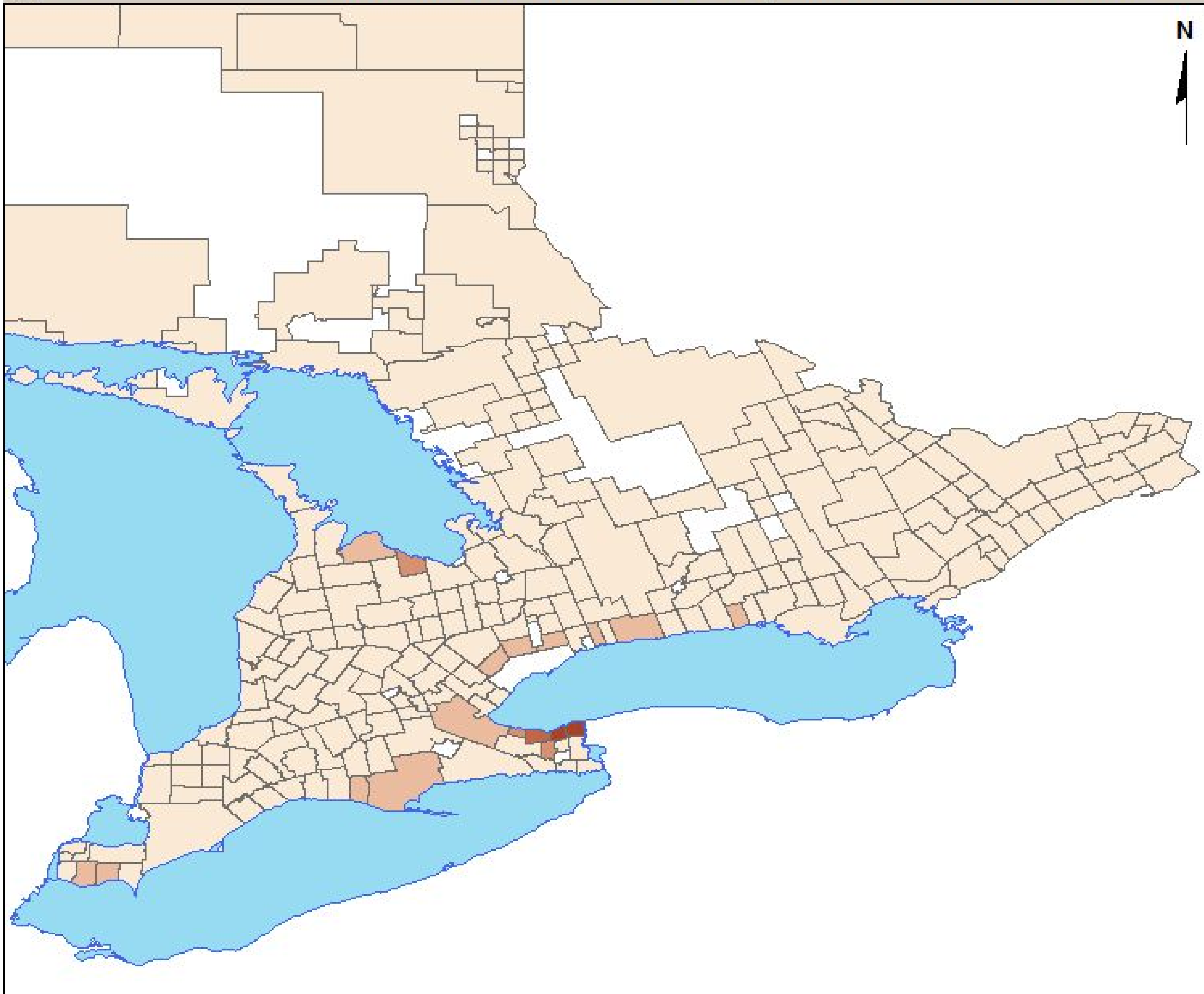
Hectares of Fruit in CCS as a Percentage of Hectares of Farmland in CCS



- 0 - 0.77
- 0.77 - 3.76
- 3.76 - 15.10
- 15.10 - 35.29
- 35.29 - 69.20
- Great Lakes

1:6,000,000

(when printed on 8 1/2" x 11" paper)

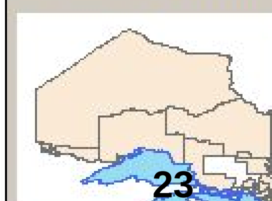
0 0.35 0.7 1.05 1.4

Decimal Degrees

Projection:
Lambert Conformal Conic
Central Meridian: -95.00
Standard Parallel 1: 49.00
Standard Parallel 2: 77.00
Datum:
GCS - North American 1983

Sources:
Enter Data Sources Here

Disclaimer:
User assumes all responsibility for use, interpretation, and application of information contained on this map.



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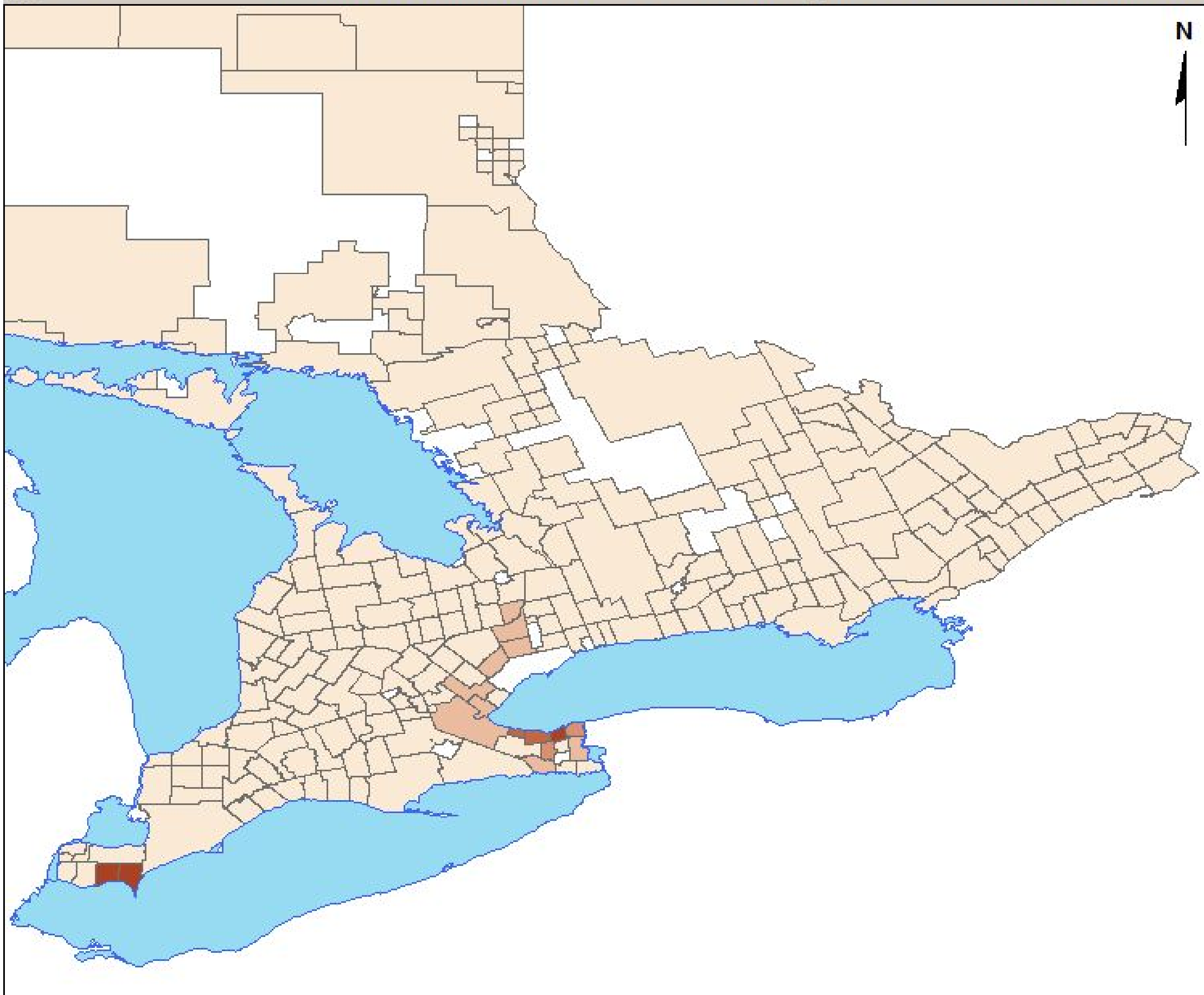
Hectares of Greenhouse in CCS as a Percentage of Hectares of Farmland in CCS



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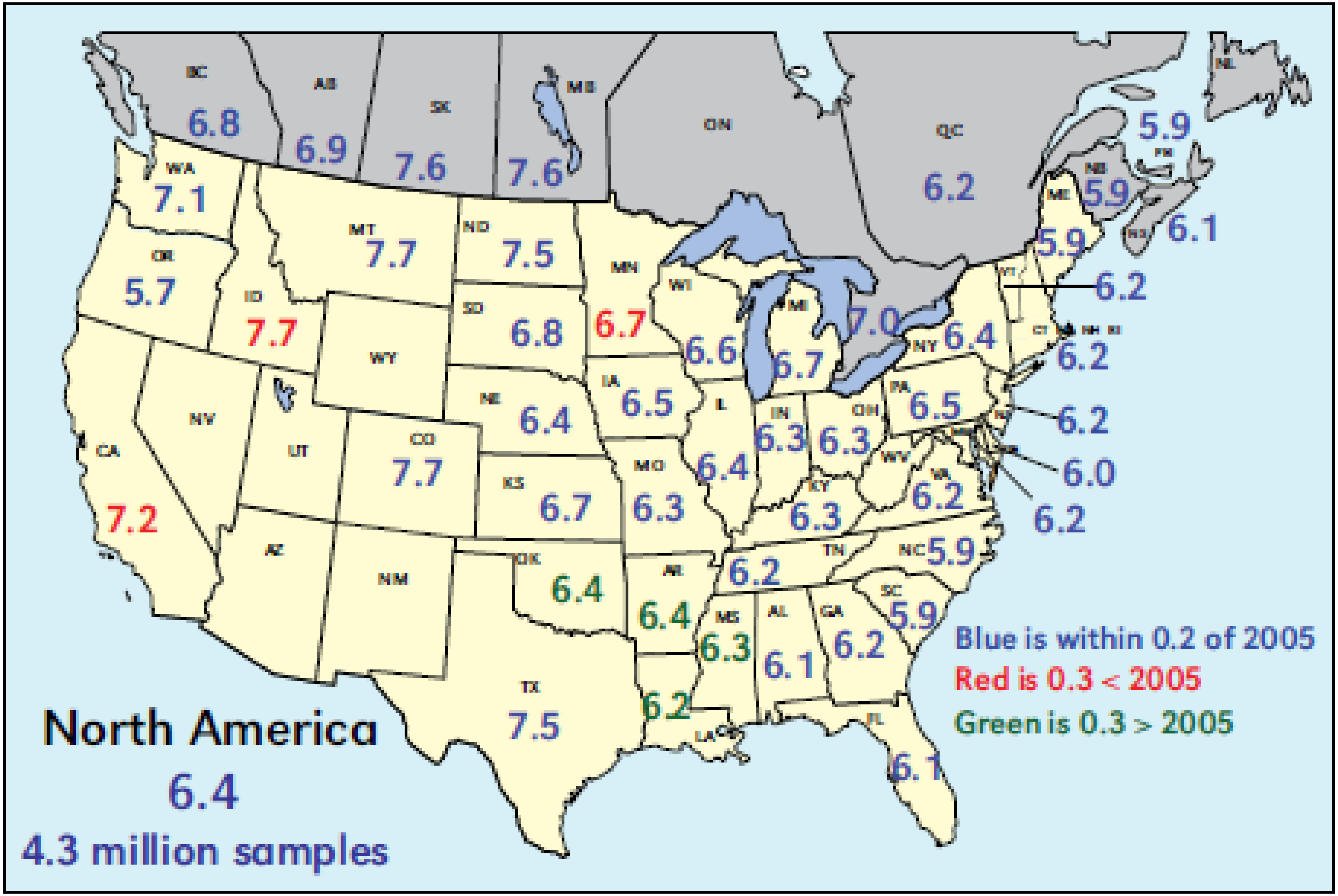
Science and Technology Branch, Agri-Geomatics

Canada

Other factors affecting P export

- Drainage patterns
  - Thames River drains into Lake St. Clair rather than directly into Lake Erie; P retention plus dilution from Lake Huron
- Soil pH
  - Much higher incidence of calcareous soils in Ontario than Ohio or Michigan; more P tied up with calcium or magnesium

Median Soil pH Levels in 2010



Source: International Plant Nutrition Institute

Other factors affecting P export

- Drainage patterns
  - Thames River drains into Lake St. Clair rather than directly into Lake Erie; P retention plus dilution from Lake Huron
- Soil pH
  - Much higher incidence of calcareous soils in Ontario than Ohio or Michigan; more P tied up with calcium or magnesium
- Tile Drainage
  - Extensive tile drainage throughout the basin; trend to intensifying drainage systems in Ontario (narrower spacing)
- Fertilizer recommendation systems

Contrasting Fertilizer Recommendation Systems

Ontario

- Sufficiency Approach – Expectation is that response to fertilizer will maximize return to fertilizer in the year applied.
- Application method affects response to fertilizer, greatest with banding at planting
- Most farmers perceive value in additional time and labour for banding fertilizer

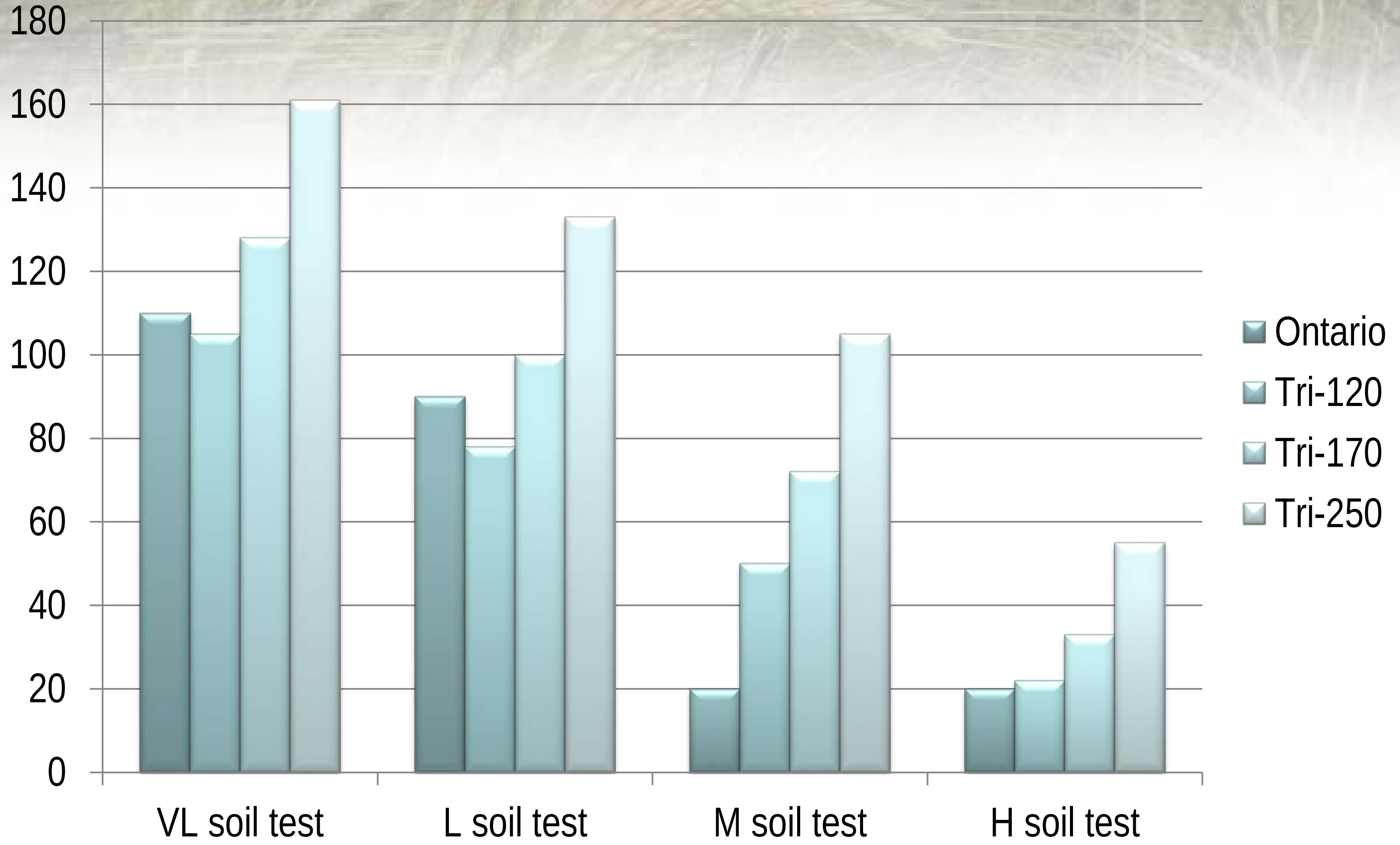
Tri-State (Michigan, Ohio, Indiana)

- Build up and maintenance approach – build up soils so fertility does not limit yield, then replace nutrients removed.
- Application method has no effect on efficiency of maintenance applications
- Most farmers perceive greater benefit to timely planting than response to fertilizer at planting

Comparison of Ontario and Tri-State P Recs

Ontario Soil Test values	Tri-State Soil Tests	Ontario Rec's	Tri-State Recommendations at Realistic Yield Goals (bu/ac)		
Olsen (ppm)	Bray (ppm)		*120*	*170*	*250*
0-3	5	110	105	128	161
6-7	10	90	78	100	133
13-20	15-30	20	50	72	105
21-30	35	20	22	33	55
31+	40	0	0	0	0

Ontario and Tri-State P Recommendations



Consequences for Risk of P losses

- Tendency is for more banded P fertilizer in Ontario compared to Tri-State area
- This is changing over time, as larger farms in Ontario move to broadcast fertilizer because of time limitations and labour costs
- Some large farms have adopted air delivery systems to allow use of banded fertilizer on large planters (not cost effective for small to medium size planters)
- Highest risk scenario is broadcast application without incorporation in the fall or winter

Conclusions

- The Canadian and U.S. sides of the Lake Erie basin are more similar than different, BUT the differences will affect the amount and form of P entering the lake
- Canadian side has greater concentration of livestock (particularly swine and poultry), more cereals and more specialty crops (vegetables, greenhouses)
- Fertilizer recommendation systems adopted in each jurisdiction in the 1960s have consequences to the way phosphorus is managed, and therefore to the risk of P losses.

Canada

Phosphorus and Agricultural Best Management Practices: What Works?

Great Lakes Strategic Planning Session
August 10, 2015
Guelph.

Chitra Gowda, B. Eng., M.A.Sc.
Source Water Protection Lead
Conservation Ontario

Presentation Overview

- Roadmap of P Load Reduction
- Review of Agricultural BMPs
- Source Water Protection Links
- Achieving the Targets: Strategies for Discussion

Roadmap of P Load Reduction

2008:

Lake Erie P Load: 10,722 Metric Tons per Annum.

2015: Proposed P Load Target: a 40% reduction from 2008 level, by 2025.

2015-2025:

Manage P Loadings: through effective education, outreach and BMPs.

2020: Meet Interim P Load Target of 20% reduction from 2008 level.

2025: Meet P Load Target.

Review of Agricultural Best Management Practices

- In 2013, Mari Veliz, Brynn Upsdell of the Ausable Bayfield Conservation Authority (CA) and Chitra Gowda (at the time, Essex Region CA) collaborated to conduct a comprehensive review of studies assessing agricultural BMPs.
- A total of 37 scientific/ technical studies, 3 BMP review papers and 1 watershed management plan development paper were reviewed.


A Review of Studies Assessing Rural Best Management Practices at Field and Watershed Scales

Prepared by: Chitra Gowda, Essex Region Conservation Authority
Mari Veliz, Ausable Bayfield Conservation Authority
Brynn Upsdell, Ausable Bayfield Conservation Authority

Date: March 19, 2013

Agricultural BMPs which reduced Total Phosphorus (TP) and Dissolved Reactive Phosphorus (DRP) by at least 20% each

Agricultural Best Management Practice	TP	DRP
Zero/no tillage	√	Increased.
Crop rotation	√	√
Fertilizer reduction	√	√
Cover crops	√	√
Controlled tile drainage	√	√
Constructed wetland intercepting tile drainage	√	√
Gully plugs: water and sediment control basins (WasCobs)	√	√
Livestock fencing	√	√
Manure application rates based on soil needs	√	√
Reduced farmyard runoff by redirecting clean water	√	√
No winter manure application	√	√
Reduced fall and winter manure application	√	√
Poultry litter incorporation	√	√
Spreader adjustment (for hog slurry): spreader was equipped with trailing pipes, followed by shallow cultivation	√	No data.

Source of Information: C. Gowda, M. Veliz, B. Upsdell, March 2013. A Review of Studies Assessing Rural Best Management Practices at Field and Watershed Scales.

Review of Agricultural Best Management Practices

Challenges and Considerations:

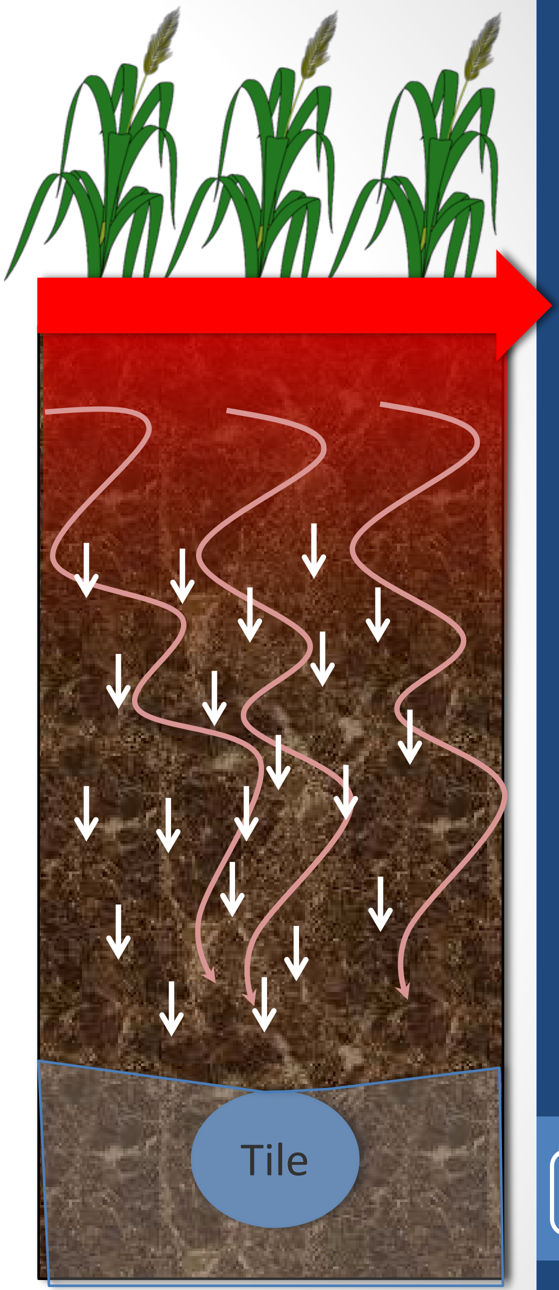
- It is difficult to assess the benefit of measures at a watershed scale; conversely the **assessment at a smaller scale** (generally, 1500 ha or less) is found to be practical and accurate.
- During wet weather events, the runoff can span over topographic watershed boundaries, thus bringing additional nutrient and soil loading into the study area. **BMPs must work during high flows also**!
- '**One size does not fit all**'. Watershed characteristics (soil type, topography, etc.), changing landscapes (land uses, altered hydrology, etc.), and climate conditions will influence the impact the BMP has, and its assessment. BMPs are also needed for **sub-surface drainage** as much of Ontario is tile drained.

Source of Information: C. Gowda, M. Veliz, B. Upsdell, March 2013. A Review of Studies Assessing Rural Best Management Practices at Field and Watershed Scales.

Some Current BMPs…

No-till Vs Tillage:

- Breaks up pores
- Mixes in P to lessen surface concentrations
- This may lessen load to tile drains
- *But* more erosion in surface runoff



Slide courtesy of: Dr. Merrin Macrae, Associate Professor, Geography and Environmental Management, University of Waterloo

Some Current BMPs…

Cover Crops, Riparian Buffer Strips, Grassed Waterways, Water and Sediment Control Basins (WASCoBs)

- Build soil organic matter
- Slow surface erosion
- *But* may not work in winter, and may supply dissolved P

Slide courtesy of: Dr. Merrin Macrae, Associate Professor, Geography and Environmental Management, University of Waterloo

Strip tillage potential?

- **May reduce P loss!**

Why?

- Breaks up preferential pathways in subsurface
- P only applied in tilled areas (where crops planted)
- No-till strips provide benefit of improved soil organic matter, less erosion
- Possibly less P applied overall AND less P loss?

Slide courtesy of: Dr. Merrin Macrae, Associate Professor, Geography and Environmental Management, University of Waterloo

Source Water Protection Links

Great Lakes Targets and the Clean Water Act

- The Clean Water Act was passed in 2006 to protect sources of drinking water in source protection areas in Ontario.
- The Clean Water Act indicates that the Ministry of Environment and Climate Change (MOECC) can establish targets for Great Lakes water quality and quantity improvement.
- Once targets are established for specific lakes, policies must be written to address them. These will be mandatory policies in local Source Protection Plans.

Source Water Protection Links

Map courtesy of: Essex Region Conservation Authority

Source Water Protection Links

BMP Resources :

- Risk Management Measures (RMM) Catalogue: hundreds of BMPs for water quality and quantity protection. http://www.trcagauging.ca/RmmCatalogue/
- BMPs sorted by effectiveness and cost into a hierarchy table by City of Orillia; contact Chitra at Conservation Ontario:

Measure Name	Measure Short Description	MOECC Rated Effectiveness	Implement-ation Cost
Nutrient Management Training	Nutrient management training provides information on practices that could contribute to maximize the use of the prescribed materials, reduce nutrient loss and environmental damage and maximize crop uptake of nutrients.	3 - Low	Low
Locate Contamination Sources Downslope of Well(s)	Considering source water protection in the farm management process minimizes contamination threat to groundwater. For example, allocate the storage area in the down slope of the well, and prevent ponding of surface water in the vicinity of the well.	1 - High	Low
Grassed Waterways	Grassed waterways are a good solution to slow the water flow and protect channels from the eroding forces of runoff water when the watershed area generating the runoff water is relatively large.	2 - Medium	Low
Usage of Farm Water and Sediment Control Basins	Erosion control structures installed to prevent bank and gully erosion on farmlands. The runoff water is temporarily stored behind the berm, eliminating its erosive capabilities further down slope.	1 - High	Low - Medium

Achieving the P Reduction Target: A Few Strategies for Discussion

Summary:

- Proposed target: 40% reduction from 2008 P Loading to Lake Erie.
- To be achieved by 2025 by various sectors: municipal, agricultural, residential, on both sides of the border.
- Comment period for proposed target ends August 31.

A Few Strategies for Discussion:

- Components of a Phased Approach for the Agricultural Sector:
  - ✓ Time: 2015 + 10 years
  - ✓ Type of practice: crop/livestock, scale of operation: **prioritize?**
  - ✓ Type of BMP: cultural, structural: **rank (effectiveness, cost)?**
  - ✓ Stewardship: funding agency programs to prioritize **high impact BMPs** for P load reduction to Lake Erie.

Thank you.

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Nutrient Management Strategies

Chris Attema (NMP)

Summary

- 10-years: A significant % of livestock agriculture with an approved Nutrient Management Strategy
- NMA compared to the Lake Erie Nutrient Target (LENT) recommendations (June 2015)
- NMA compared to 4R-Principles
  - Source – Rate – Place –Time
- Difference between a Nutrient Management Strategy & a Nutrient Management Plan
- NMP Phase-In Policy in *Wisconsin*

Number of Nutrient Management Strategies

Livestock Type	Totals
Dairy	1869
Beef	1107
Horses	1091
Swine	921
Chickens	838
Sheep	270
Goats	210
Turkey	116
Veal	75
Other	79
TOTAL	6576

4708 active, approved Nutrient Management Strategies

Note: A significant number of the strategies that indicate horses are operations that commercially raise another type of livestock, but may have one or two horses for recreational purposes. Also, a number of these are Old Order Mennonite farms that have a few draft horses, but raise another type of livestock commercially

Lake Erie Nutrient Targets Working Group

- June 2015: *An Interim Report of the Great Lakes Commission Lake Erie Nutrient Targets Working Group*

Manage nutrient applications on frozen or snow covered ground

Description
The action calls for the management of manure, fertilizer and biosolid 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.

- **Managing** or eliminating nutrient applications on frozen ground

Lake Erie Nutrient Targets Working Group

- Ontario: Winter spreading NOT RECOMMENDED
  - Alternatives to winter spreading e.g. temporary manure storage
  - CONTINGENCY - appropriate site selection
- Current Winter spreading rules in the Nutrient Management Act, 2002, under Ontario Regulation 267/03 are consistent with the LENT recommendation to manage nutrient application on frozen / snow covered ground
  - Liquid manure : injection or incorporation of within six hours of land application.
  - Solid manure: incorporated into the soil within six hours of land application, or surface applied on fields with a living crop or crop residue.

Lake Erie Nutrient Targets Working Group

- While the winter spreading rules in the Nutrient Management Act, 2002, under Ontario Regulation 267/03 apply to phased-in farms, other environmental legislation regarding the release of contaminants applies to everyone.
  - Environmental Protection Act
  - Ontario Water Resources Act
  - Fisheries Act

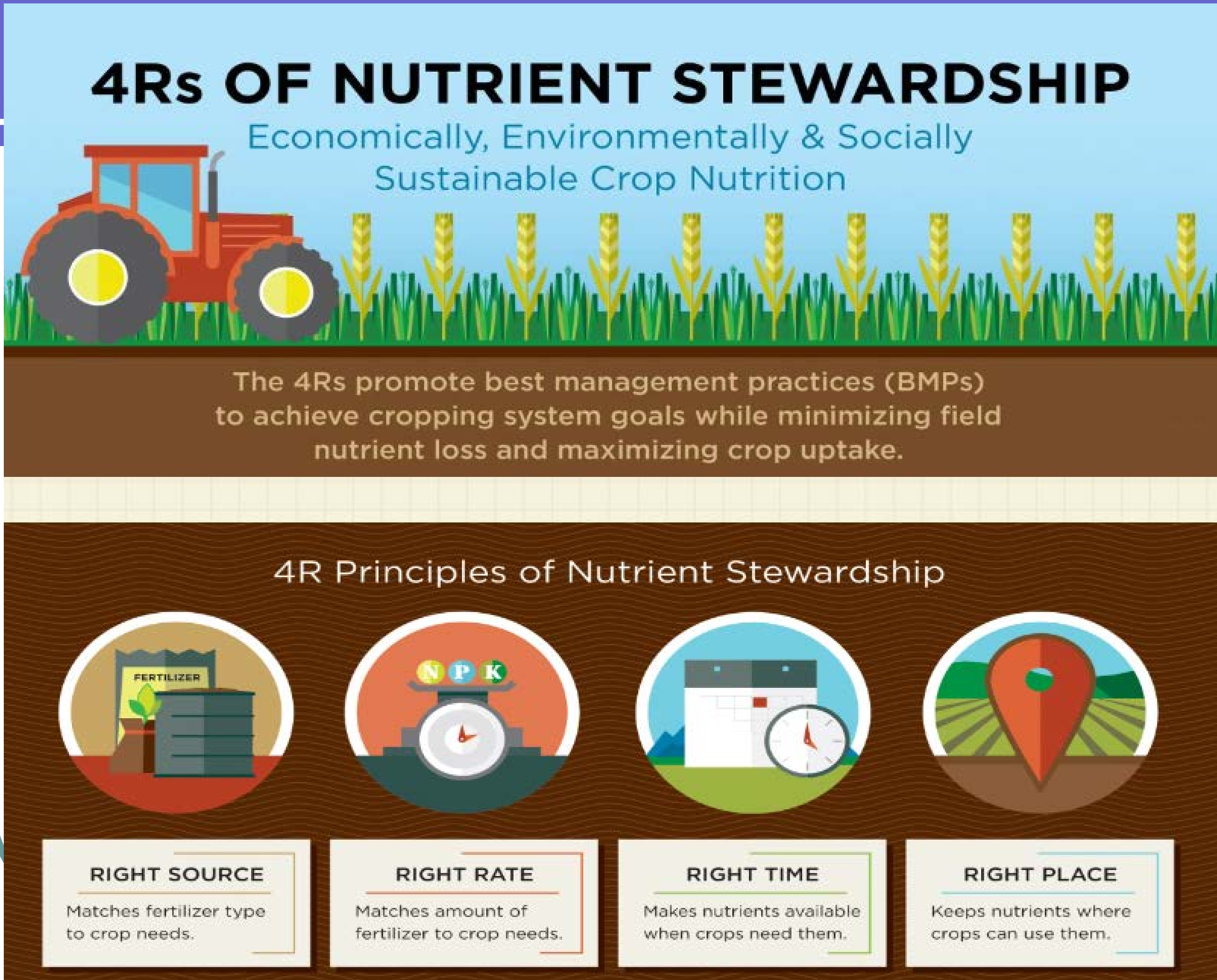
Lake Erie Nutrient Targets Working Group

- June 2015: *An Interim Report of the Great Lakes Commission Lake Erie Nutrient Targets Working Group*

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:

- **Voluntary**
- Is the Ontario Nutrient Management Act and NMAN-software consistent with the 4-R principles?


4Rs OF NUTRIENT STEWARDSHIP
Economically, Environmentally & Socially Sustainable Crop Nutrition
The 4Rs promote best management practices (BMPs) to achieve cropping system goals while minimizing field nutrient loss and maximizing crop uptake.
4R Principles of Nutrient Stewardship
FERTILIZER
N P K
RIGHT SOURCE
Matches fertilizer type to crop needs.
RIGHT RATE
Matches amount of fertilizer to crop needs.
RIGHT TIME
Makes nutrients available when crops need them.
RIGHT PLACE
Keeps nutrients where crops can use them.

Nutrient Management Strategy	**Nutrient Management Plan**
# and type of livestock Manure storage Runoff management Temporary in-field storage sites Limited destination information 0.75 – 1.0 NU/acre 1 NU = 43 kg N or 55 kg P_20_5	Detailed indiviual field maps Crop rotation - yields –tillage Soil test - slope Nutrient information Source - Rate – Time – Place Incorporation -Nutrient balance N-Index P-Index

Nutrient Management Plan: Regulation Challenges

- Detailed individual field Nutrient Management Plan
- Practical implementation challenges for both the regulator & the regulated
- Plan – Approval – Record Keeping – Audit

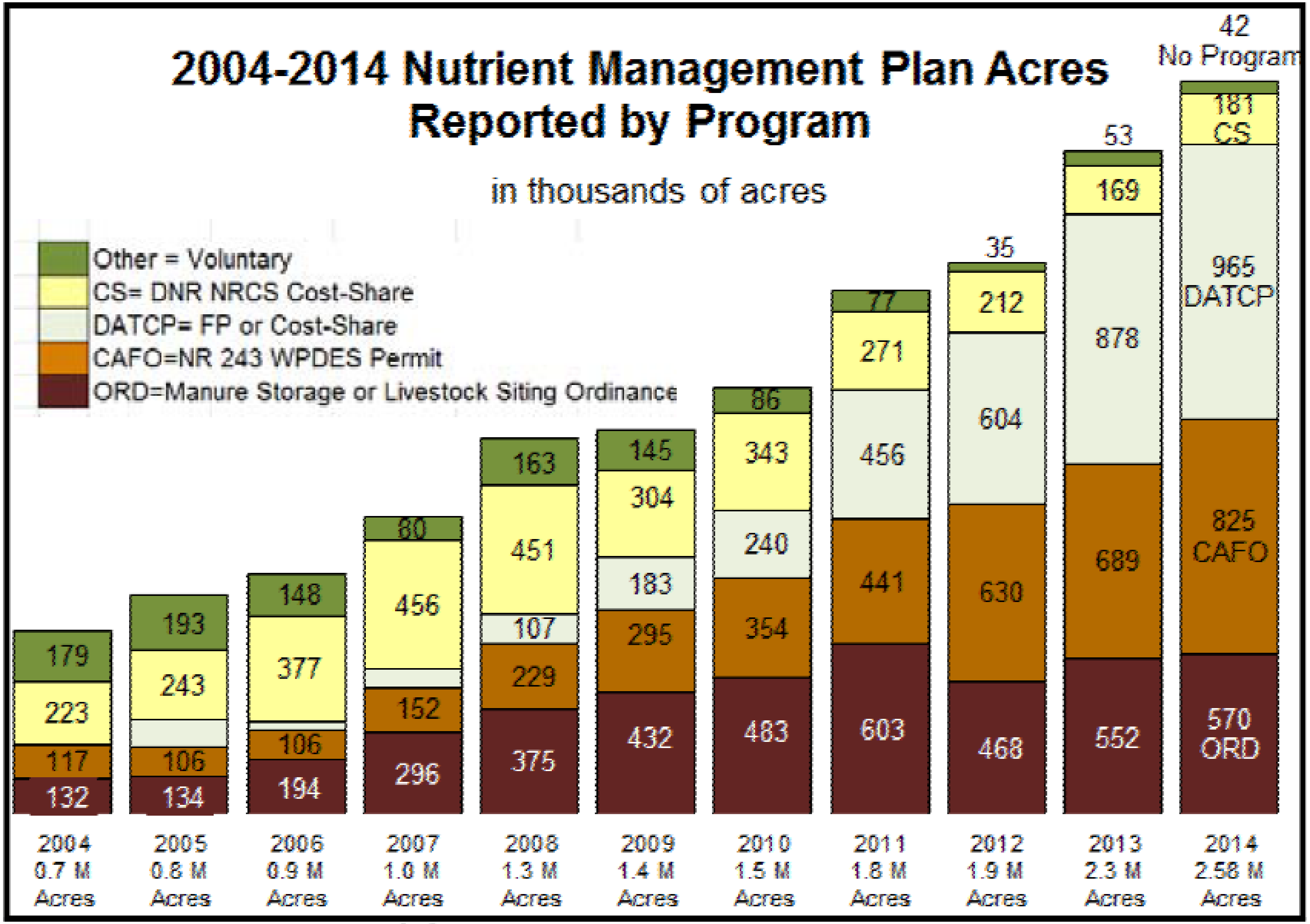
  - Is Regulation the right approach?
  - A credible and thorough Regulatory Impact Analysis should consider if other approaches (education – awareness – voluntary) can meet the desired objective
  - What would be the ‘phase-in’ trigger for non-livestock farms?

Wisconsin Nutrient Management

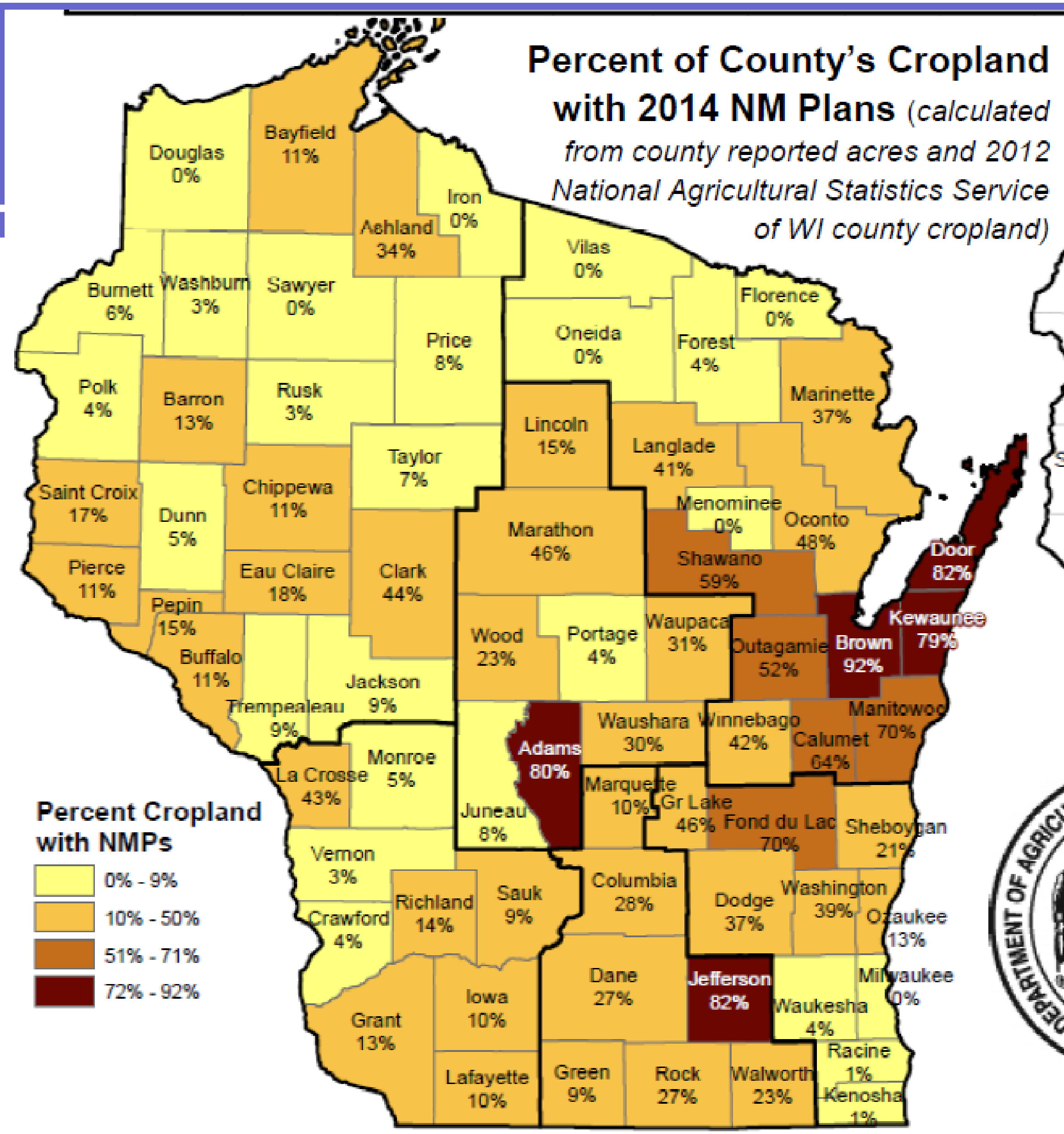
When can a NM Plan be Required?

Farms can be required to implement nutrient management with a $28/ac cost share offer or if:

1. Causing a significant discharge.
2. Regulated by local manure storage or livestock siting ordinances, or by a DNR WPDES permit,
3. Accepting NM planning or manure storage cost share funds, or
4. Participating in the Farmland Preservation Program.



2004-2014 Nutrient Management Plan Acres
Reported by Program
in thousands of acres
Other = Voluntary
CS= DNR NRCS Cost-Share
DATCP= FP or Cost-Share
CAFO=NR 243 WPDES Permit
ORD=Manure Storage or Livestock Siting Ordinance
179
223
117
132
193
243
106
134
148
377
106
194
80
456
152
296
163
451
107
229
375
145
304
183
295
432
86
343
240
354
483
77
271
456
441
603
35
212
604
630
468
53
169
878
689
552
42
No Program
181
CS
965
DATCP
825
CAFO
570
ORD
2004
0.7 M
Acres
2005
0.8 M
Acres
2006
0.9 M
Acres
2007
1.0 M
Acres
2008
1.3 M
Acres
2009
1.4 M
Acres
2010
1.5 M
Acres
2011
1.8 M
Acres
2012
1.9 M
Acres
2013
2.3 M
Acres
2014
2.58 M
Acres



2,580,000-acres X $28.00 /acre =

$72,240,000 US