



4RS NUTRIENT MANAGEMENT
IN AND OUT OF SEASON
WEBINAR SERIES
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Environmental Risk Management in 4R Nutrient Stewardship with a focus on phosphorus for MI-IN-IL

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Agrium Inc.



Arab Potash Company



Belarusian Potash Company



BHP Billiton



CF Industries Holdings, Inc.



Compass Minerals Plant Nutrition



International Raw Materials LTD.



Intrepid Potash, Inc.



K+S KALI GmbH



LUXI Fertilizer Industry Group



The Mosaic Company



OCP S.A.



PhosAgro



PotashCorp



Qatar Fertiliser Company (QAFCO)



Shell Sulphur Solutions



Simplot



Sinofer Holdings Limited



SQM



Toros Tarim



Uralchem



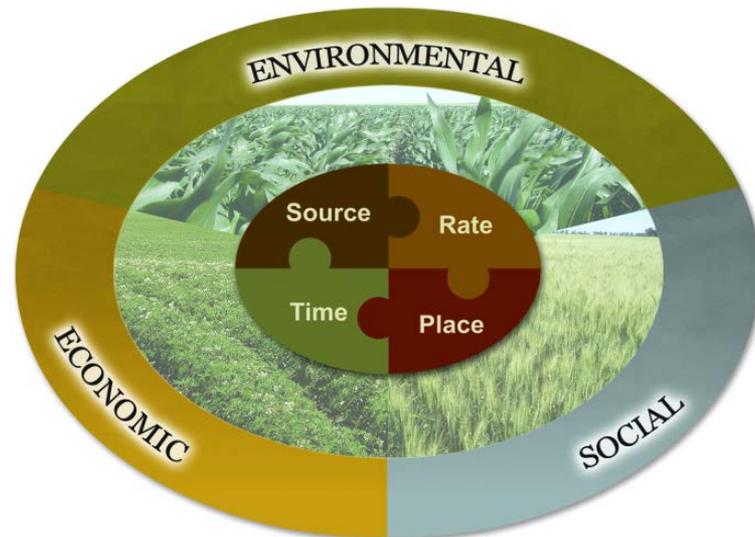
Uralkali

Formed in 2007 from the Potash & Phosphate Institute, the **International Plant Nutrition Institute** is supported by leading fertilizer manufacturers.

Its mission is to develop and promote science for responsible management of crop nutrition

Outline

1. Risk assessment tools for water quality
2. Lake Erie watershed case study
 1. Causes of increasing trend in dissolved P loading
 2. 4R Certification and regulation
3. Using soil tests and nutrient balances to guide risk analysis
4. Sustainability metrics



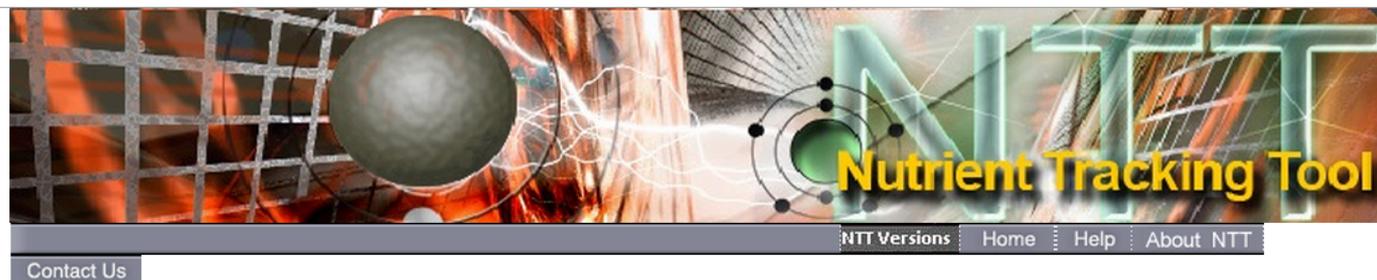


1. Risk Assessment Tools for Water Quality

- Competency Area 5:
 1. Discuss how to use water quality vulnerability assessment tools on a site specific basis for phosphorus nutrient planning.
 2. Evaluate phosphorus management decisions using a water quality vulnerability assessment.
 3. Be able to evaluate how changing a specific phosphorus management strategy will affect the outcome of a risk assessment.
- Michigan: Leaching Index, Phosphorus Risk Assessment tool
- Indiana: Nutrient and Sediment Transport Risk Assessment Tool (NASTRAT)
- Illinois NRCS N Management Guidelines, P Index
- SWAT, APEX, APLE, STEP, NTT
- Source & Transport

Nutrient Tracking Tool

- User interface to APEX
- Soil, management inputs
- Simulates scenarios based on 40+ year local soil and weather data
- N, P, runoff, sediment, crop yields
- Web link - <http://nn.tarleton.edu/NTT/>



Back to Management

Baseline (current) Management Information (BMI)

Add New Operation
 Delete Operations Selected
 Sort
 Copy Selected Operations to Alternative
 Reload

<input type="checkbox"/>	Crop	Operation	Year	Month	Day	Till/Fert/Irrigation/Animals	Amt/Plant Pop	Depth	NO3-N Fraction	PO4-P Fraction	Org-N Fraction	Org-P Fraction
<input type="checkbox"/>	CORN	Tillage	1	May	1	4W ASST 100 HP DIESEL						
<input type="checkbox"/>	CORN	Fertilizer	1	May	2	Commercial Fert.	30	0	1.000	1	0.000	0.000
<input type="checkbox"/>	CORN	Planting	1	May	2	Planter 30 inch	28328					
<input type="checkbox"/>	CORN	Harvest	1	Oct	15							



Phosphorus Transport

- Competency area **5.4**: “Evaluate management strategies, including modifying phosphorus transport processes, which will reduce phosphorus loss to surface water and groundwater.”
- Addressed in P indexes and models
- Buffers, waterways, conservation tillage, cover crops to manage losses of particulate P and sediment
- Controlled drainage to manage dissolved P loss

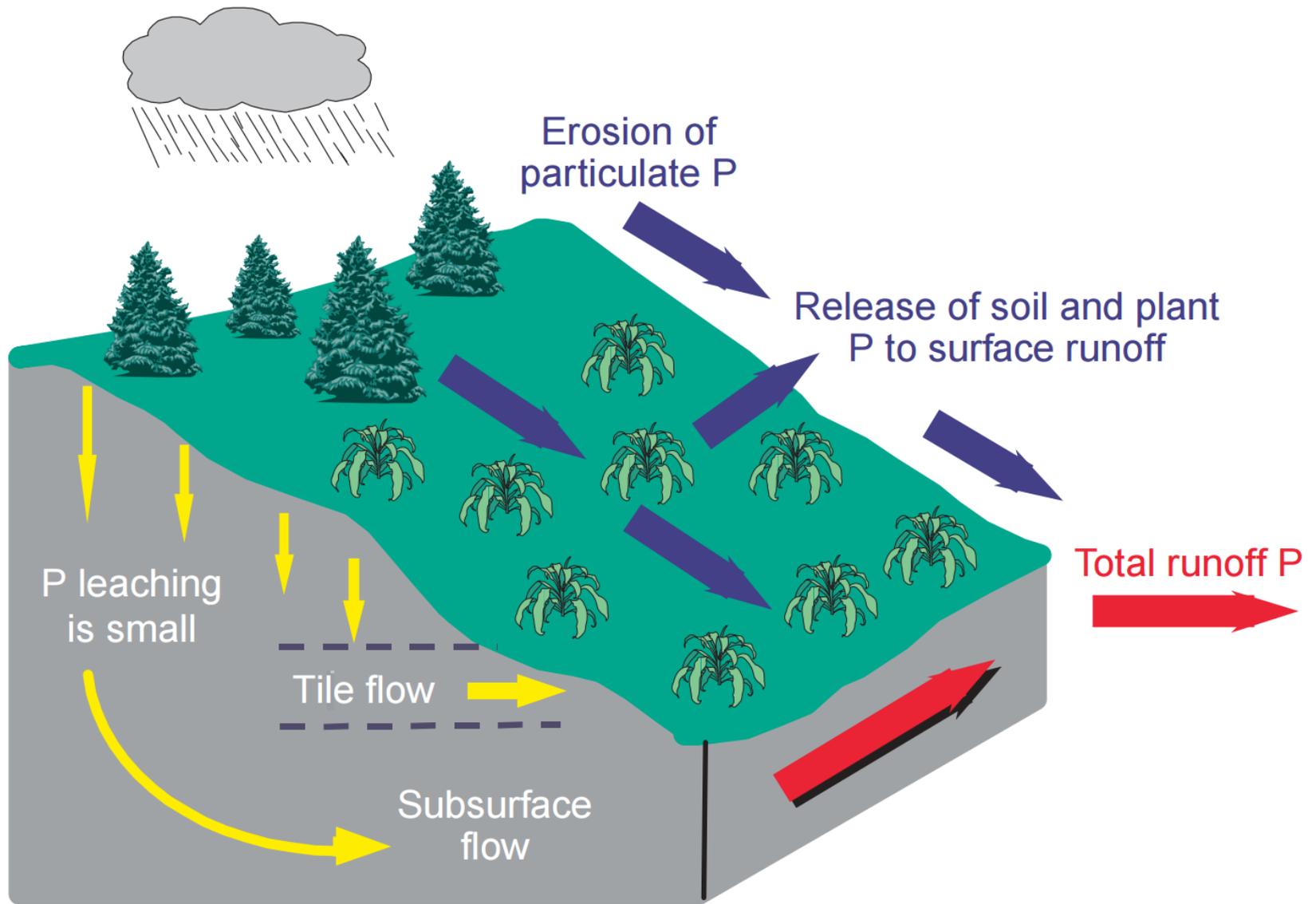


Figure 8. Phosphorus can be released from soil and plant material to surface and subsurface runoff water or lost by erosion.



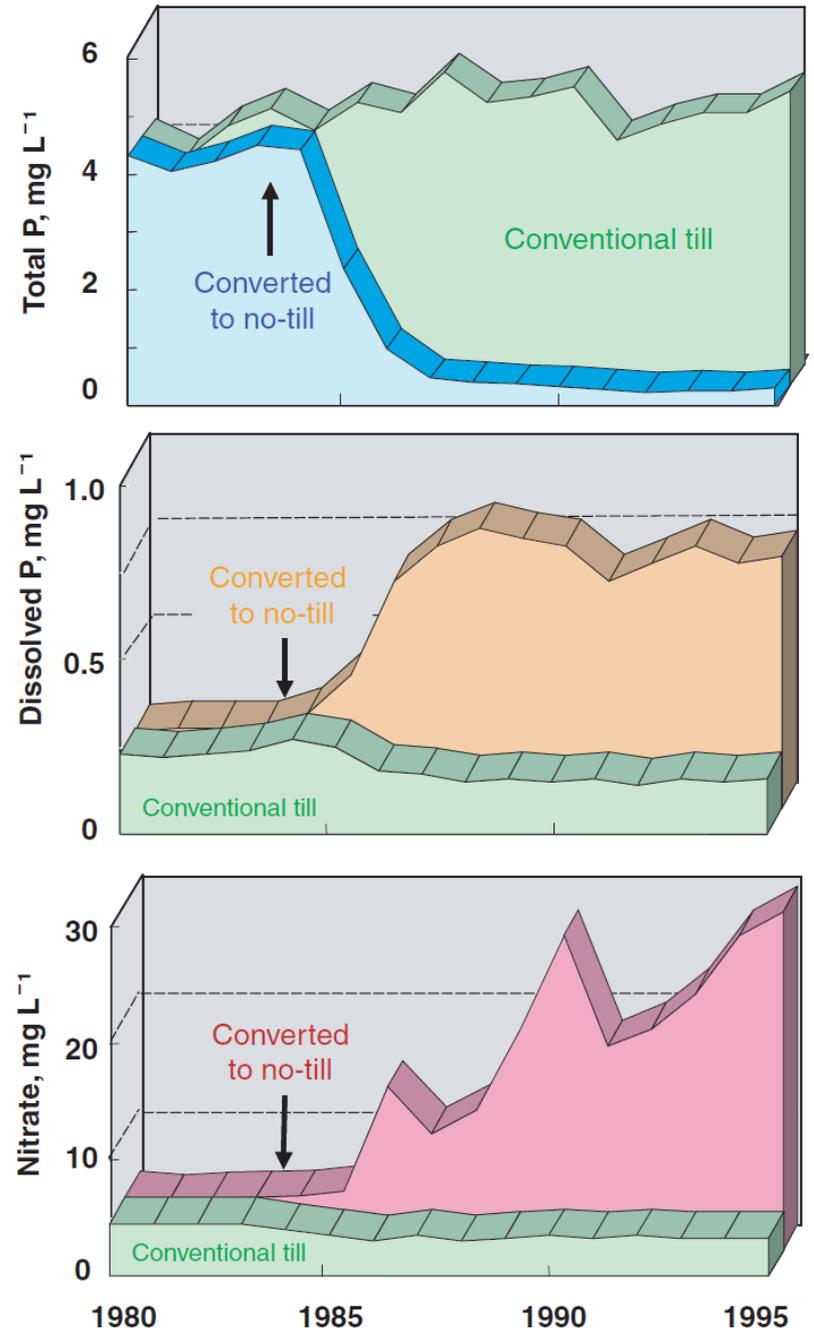
Tillage and phosphorus loss

- Competency area **5.5**: “Discuss how tillage system (including no-till) affects environmental losses of phosphorus.”
- Surface residue cover reduces soil erosion.
- Minimizing tillage increases soil aggregation and resistance to dispersion of clay
- Conservation tillage increases stratification of soil available P
- No-till decreases loss of particulate P but increases loss of dissolved P.

Tillage increases erosion, but can increase dissolved P and nitrate

Figure 9. The conversion of conventional moldboard plow wheat to no-till wheat decreased total P transport in surface runoff but increased dissolved P in runoff and ground water nitrate (3 to 25 m) for several watersheds in Oklahoma. Data from Sharpley and Smith 1994.

Erosion reduced (95%) and surface runoff (33%)





Scale and location of watersheds

- Competency area **5.6**: “Compare the differences in the geographic scale, soil, topography, and location of watersheds (e.g. national, regional, local) on the environmental impacts of phosphorus on surface and groundwater resources.”
- Climate – seasonal pattern of runoff-generating rainfall, temperatures in water bodies relative to algal growth potential
 - Lake Winnipeg – snowmelt in Manitoba and Saskatchewan
 - Lake Erie – fall and spring
 - HAB forecast model based on March-July TP loading
 - Kansas – late spring, early summer



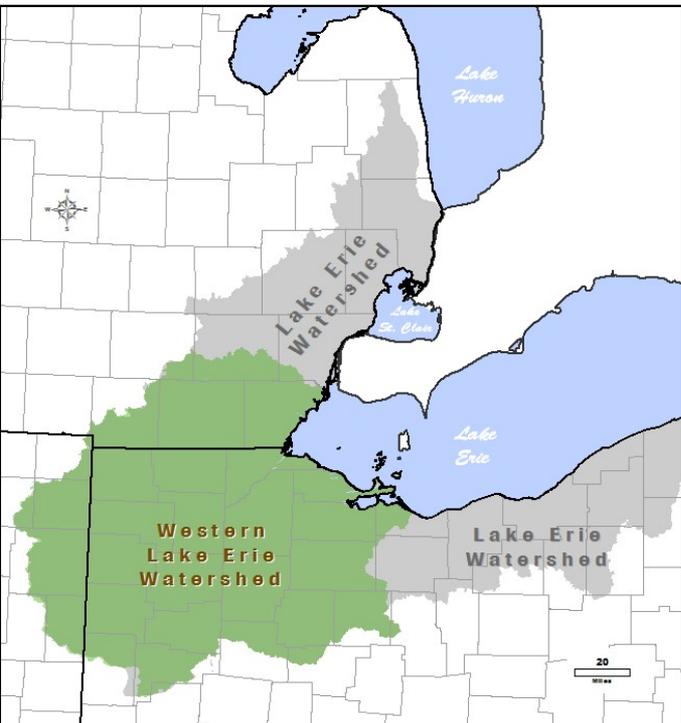
Role of Phosphorus in Eutrophication

- Competency area **5.7**. “Discuss the role of phosphorus, including legacy phosphorus, in the eutrophication process and the potential consequences of eutrophication.”
- In fresh-water systems, P most frequently limits algal growth
- Definition of legacy phosphorus:
 - P accumulated from human activities within a watershed
 - Legacy of past management activities, reflected in “sinks and stores of P along the land-freshwater continuum” (Sharpley et al, 2013, JEQ)
 - In soils
 - in sediments and biomass in ditches, streams, rivers, lakes, wetlands and estuaries
- Legacy may delay ecological response to nutrient management

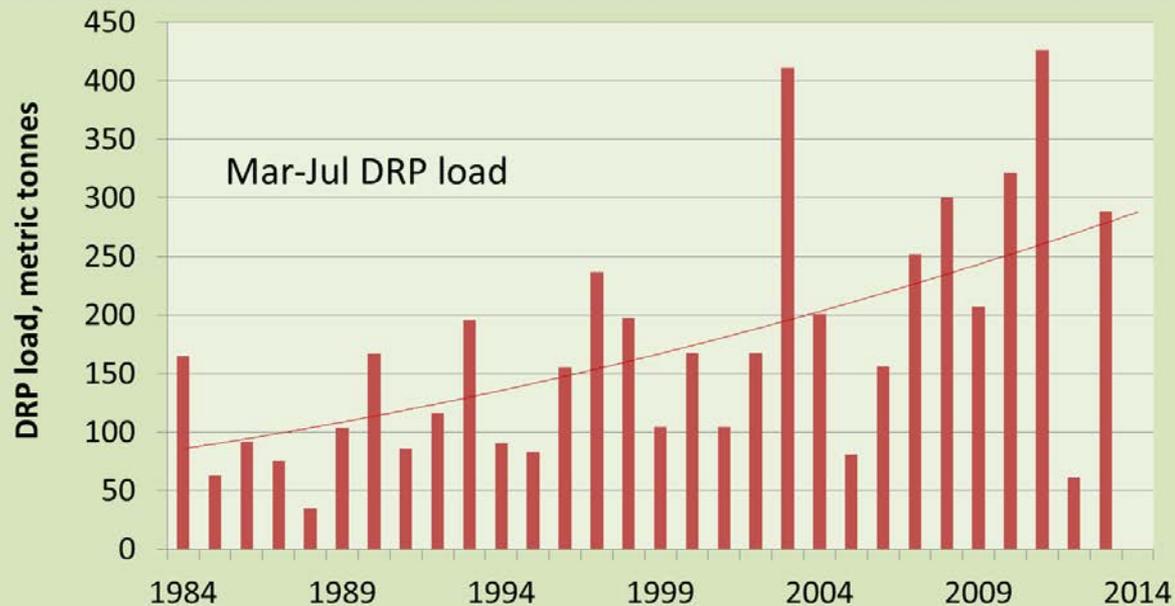
2. Case Study: Lake Erie Watershed, 1995-2015

- Causes of increasing trend in dissolved P loading
 - Weather patterns and climate shifts
 - Drainage
 - Tillage
 - Source, rate, time and place of P application
- 4R Certification and regulation
 - Collaboration
 - Criteria
 - Impact

Western Lake Erie: DRP trends increasing since early 1990s



Maumee River, Mar-Jul DRP, 1984-2013
flow-weighted mean concentration



Effect of tillage on preferential flow and phosphorus transport

Soil type: Silt loam

Tile depth: 90 cm

Soil test P: 30 ppm Mehlich-3P

Tillage: No-till

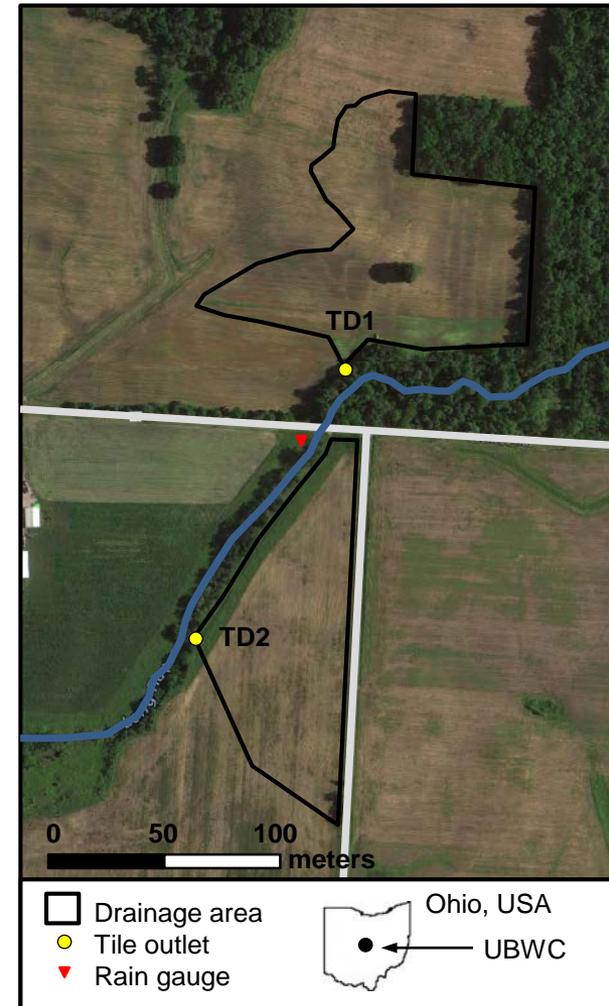
2014 management

May 6th – Applied MAP @ 45 kg P/ha

May 8th – Tilled field TD1 (disc)
(TD2 remained no-till)

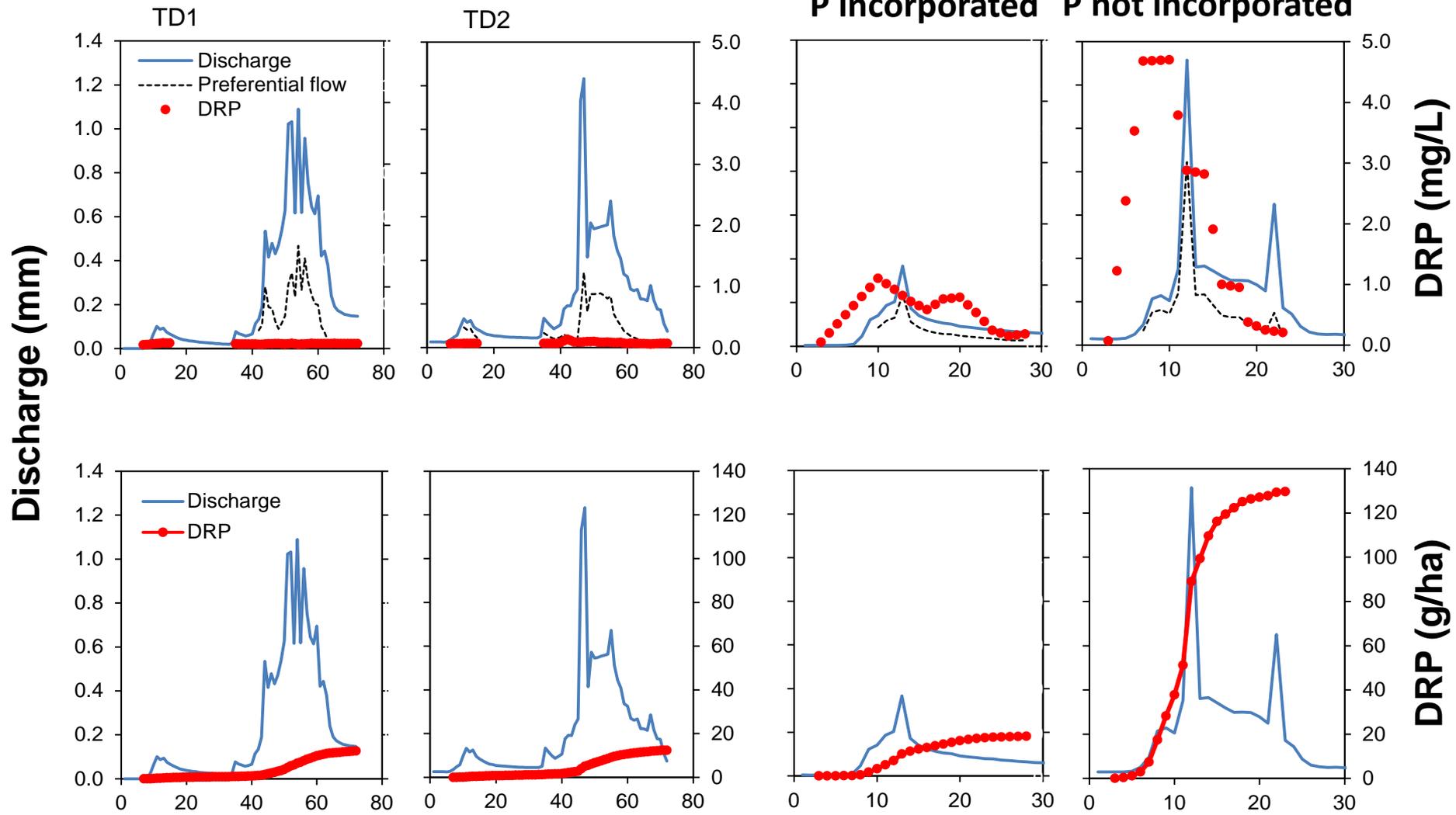
Study Objective

Compare P transport before and after tillage and between tilled and no-till fields



Before P application & tillage (April 28th)

After P application & tillage (May 12th)

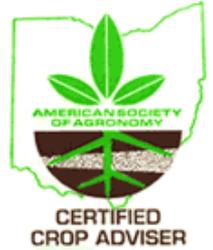
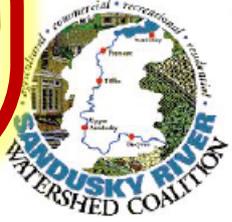


Incorporating P reduced DRP loss from 130 g/ha to 18 g/ha

Developing 4R Nutrient Stewardship Certification



Farm Marketing Programs of Michigan
Michigan Corn Growers Association

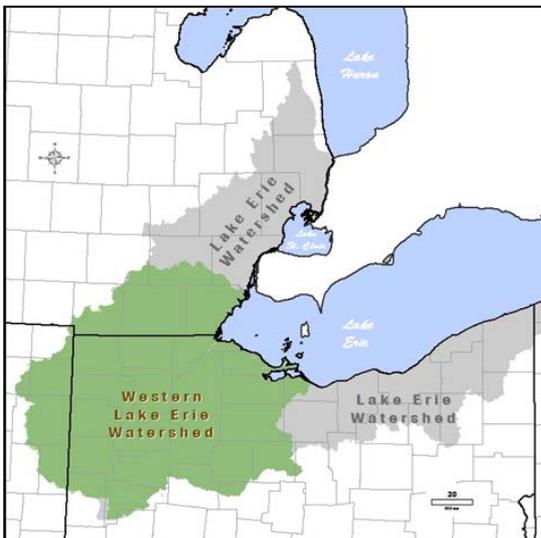




4R Certification for Agri-retailers in the Lake Erie Watershed

Key criteria:

- Recommendations are consistent with the land-grant university, allowing for adaptive management.
- A certified professional reviews the nutrient recommendations made for the grower customers.
- **Source:** All sources of fertilizer are accounted for in the nutrient recommendation.
- **Rate:** Soil tests are less than four years old; application equipment is calibrated annually.
- **Time:** Avoids spreading P on frozen or snow-covered fields; no broadcast prior to a predicted heavy rainfall.
- **Place:** P is applied below the soil surface whenever possible.



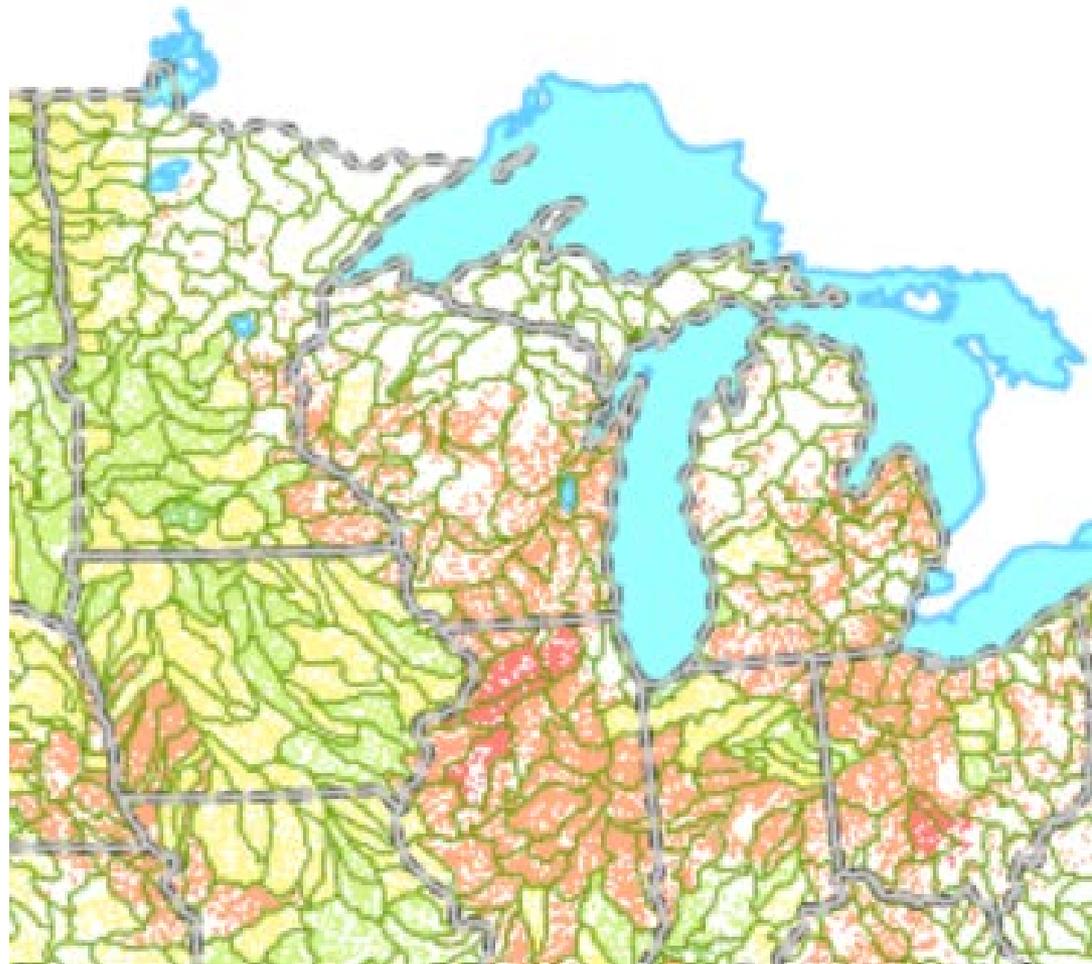
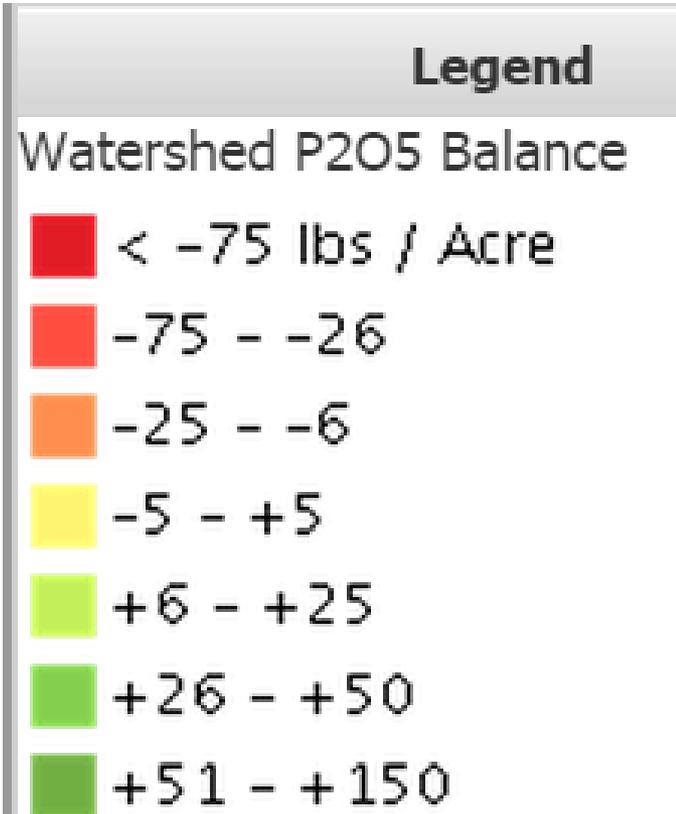
<http://4Rcertified.org/>

3. Soil tests and nutrient balances to guide risk analysis

- Nutrient Management Plans
- NuGIS
- IPNI soil test summaries



P balance, 2011



SOIL TEST LEVELS IN NORTH AMERICA

2010

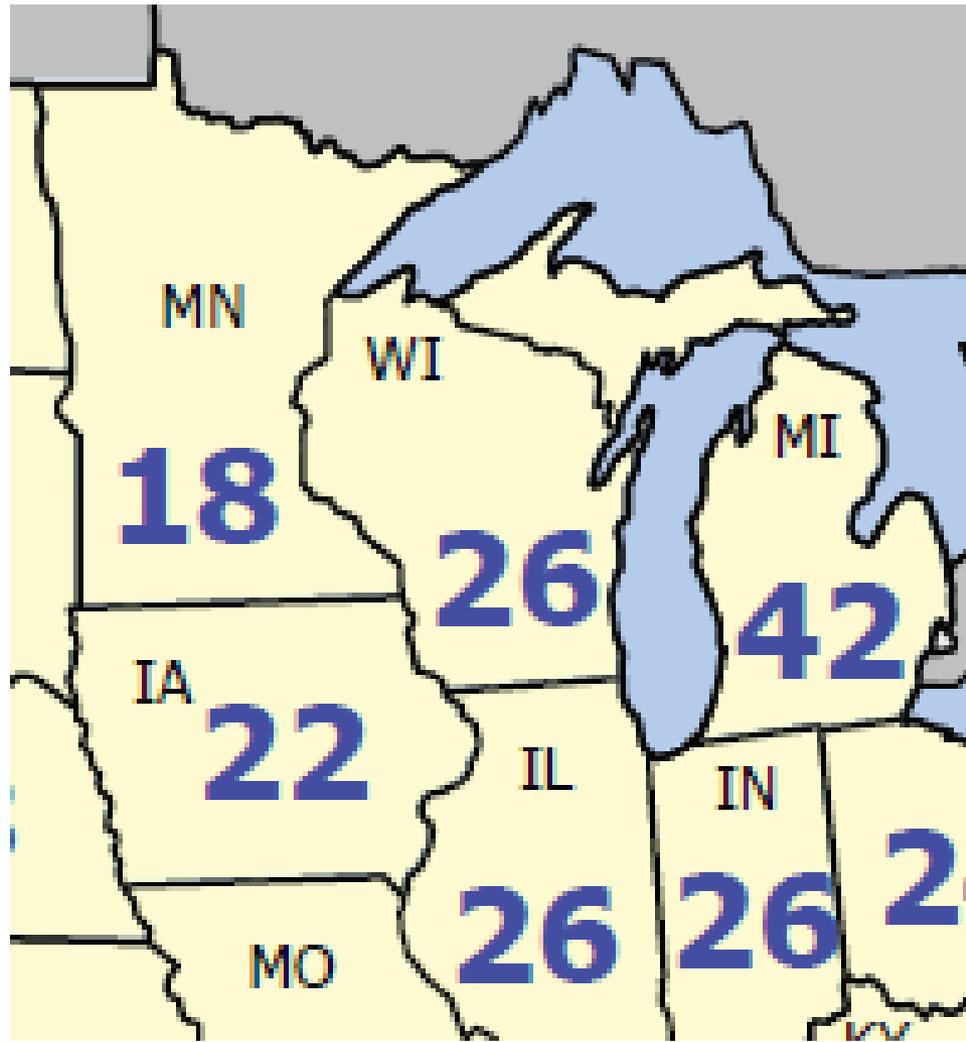


Publication No. 30-3110



Summary Update

Soil test P



Median Bray P1 equivalent soil test levels in 2010.





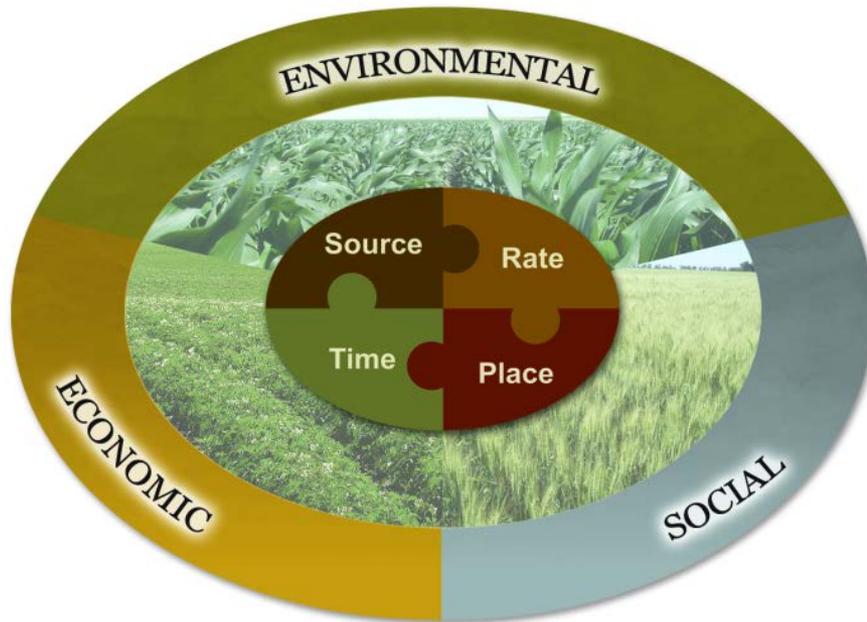
4. Sustainability Metrics

- Field to Market FieldPrint Calculator
- Water Quality metric
- Balancing environmental, economic, and social goals

4R: "right" means sustainable



Field to Market™
The Keystone Alliance for Sustainable Agriculture



Home Our Goals How To Make A Difference Share What You've

Home How To Make A Difference Fertilizer Optimization



**How to Make a Difference -
Fertilizer optimization**



FARM & FOOD
Care ONTARIO

“Building public trust”



4R
PLANT
NUTRITION



5. 4R Specialty References

- <http://www.nutrientstewardship.com/>
- <http://www.ipni.net/4R>
- <http://nane.ipni.net/topic/lake-erie-algal-blooms>