



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



Progress on Updating Phosphorus Loss Assessment Tools

D. Keith Reid, AAFC

Andrew Jamieson, Jake Munroe, OMAFRA

Canada 

Current OMAFRA P Index

Phosphorus Index [Fall 2014 - Fall 2015]

P-Index Factor	Value	Weight	Rating
1. Soil Erosion 7.92 ton/ac	2	2	4
2. Water Runoff Class B, 5% slope	2	1	2
3. Phosphorus Soil Test 28 mg/L	2	2	4
4. Fertilizer Application Rate 10 lb/ac	1	0.5	0.5
5. Fertilizer Application Method Placed with planter	1	1.5	1.5
6. Manure Application Rate 158 lb/ac	8	0.5	4
7. Manure Application Method Incorporated 1 day	2	1.5	3
			19

OK

Key Source

Factors:

- Soil Erosion
- Fertilizer and Manure Method and Rate
- Soil Test

Key Transport


Factor:

- Water Runoff Class



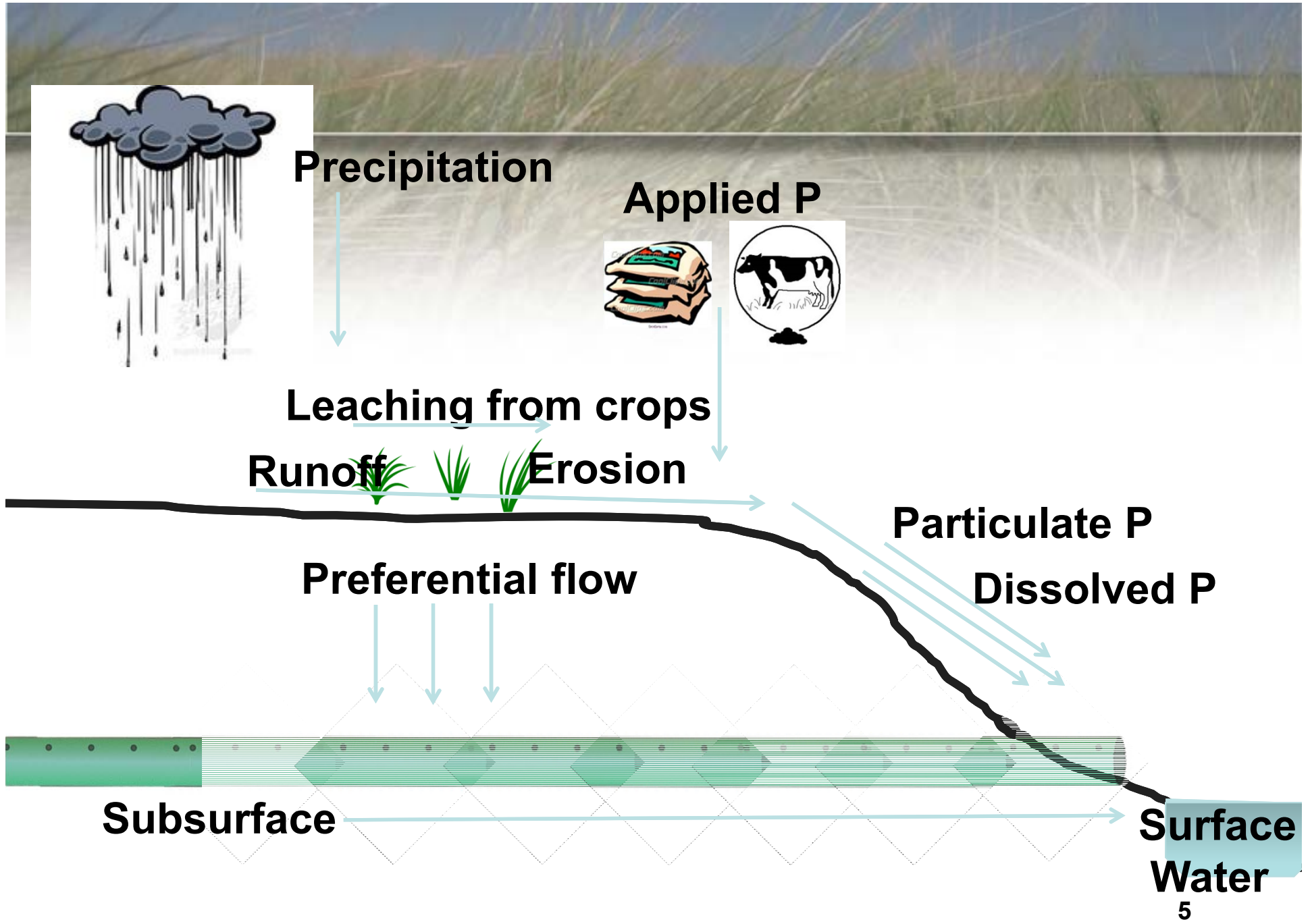
Why are updates needed?

- We know more about P sources and transport than we did twenty years ago
- The original P Index had not been validated against water quality data
 - With its structure, it would be very difficult to validate
- The original structure resulted in large jumps in predicted risk, with small changes in management
- We needed a way to objectively assess the impact of tile drains on P loss



Evolution of phosphorus risk indicators

- Additive: $P \text{ source} + P \text{ transport}$
- Multiplicative: $P \text{ source} * P \text{ transport}$
- Component: $\Sigma (P \text{ source} \times \text{transport})$
 - Transport coefficients are specific to each source
 - Management as a modifying factor



Updates to P Index

- Change the name to P Loss Assessment Tool for Ontario (PLATO)
- Change from additive to component structure
 - Add tile drainage components
- Account for particulate and dissolved P separately, and report as total bioavailable P
- Assess risk from both inherent conditions (soil type and landscape, crop, STP, tillage), and applied P
- Assess risk from P applications for both growing and non-growing season



Four main components

Inherent P Losses:

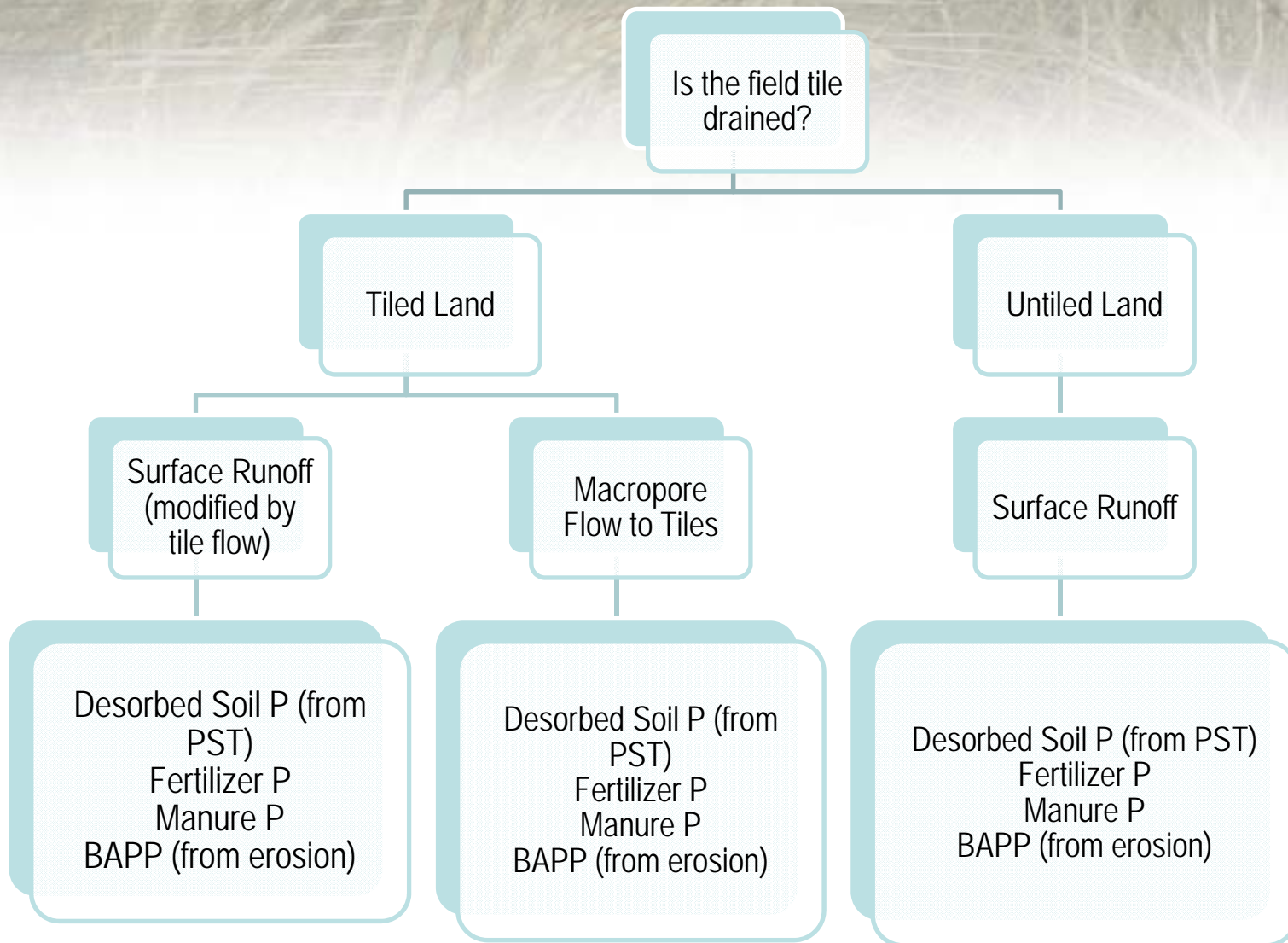
1. Bioavailable Particulate P (BAPP) loss from soil erosion
2. Dissolved P loss by soil desorption of water-extractable P

Applied P Losses:

3. Dissolved P loss from applied fertilizer P (growing and non-growing season)
4. Dissolved P loss from applied manure P (growing and non-growing season)

All assessed in both surface runoff and tile drainage

PLATO Structure

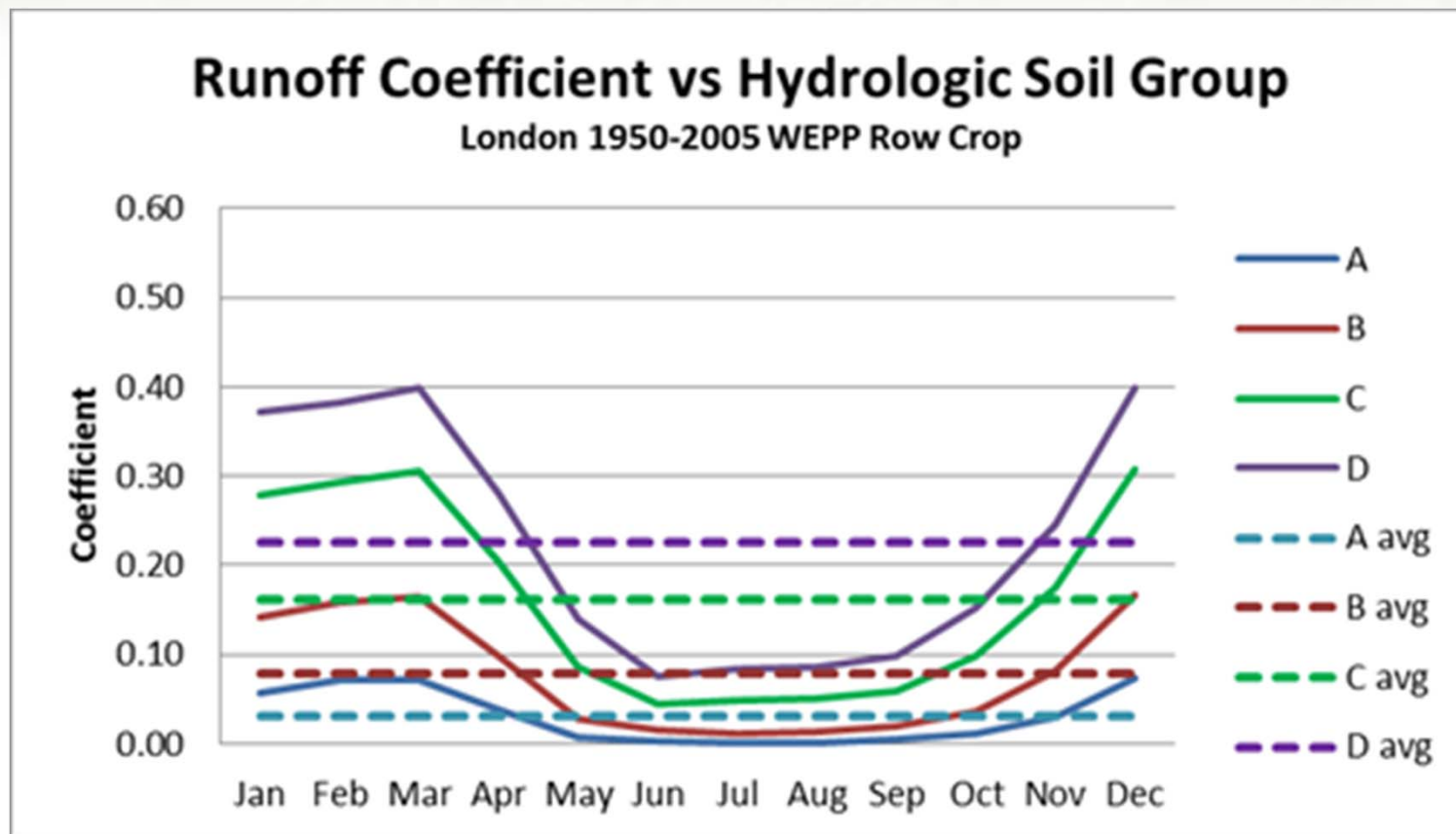


Bioavailable particulate P (BAPP)

- Source:
 - Eroded soil (from USLE)
 - Bioavailable portion of TP in eroded soil
- Transport (proportion of source, 0-1):
 - In surface runoff
 - Proportion of annual precipitation as surface runoff (RRC_{year})
 - Modified by presence of tile drains, buffer strips
 - In tile drains
 - Proportion of annual precipitation as tile drainage ($SSRRC_{year}$)
 - Proportion of flow that reaches tile through macropores
 - Design factor (spacing between tile drains)

Phosphorus Assessment Tool

RRC_{year} = Regional Runoff coefficient (mm/mm)
Estimated Annual Runoff (based on Curve number) /
local annual precipitation data



Dissolved P desorbed from soil

- Source:
 - Soil test P (Olsen)
 - Proportion of STP into runoff
 - Annual precipitation
- Transport
 - In surface runoff
 - Proportion of annual precipitation as surface runoff (RRC_{year})
 - Modified by presence of tile drains, buffer strips (smaller than for PP)
 - In tile drains
 - Proportion of annual precipitation as tile drainage ($SSRRC_{year}$)
 - Proportion of flow that reaches tile through macropores
 - Design factor (spacing between tile drains)

Dissolved P from fertilizer application

- Source:
 - Application rate, modified by application method
 - Distribution between infiltration and runoff (K_r)
- Transport
 - In surface runoff
 - Proportion of seasonal precipitation as surface runoff (RRC_{seasonal})
 - Modified by presence of tile drains, buffer strips (smaller than for PP)
 - In tile drains
 - Proportion of seasonal precipitation as tile drainage ($SSRRC_{\text{seasonal}}$)
 - Proportion of flow that reaches tile through macropores
 - Design factor (spacing between tile drains)

Dissolved P from manure application

- Source:
 - Application rate, modified by application method
 - Proportion of manure P that is water soluble
 - Distribution between infiltration and runoff (K_r)
- Transport
 - In surface runoff
 - Proportion of seasonal precipitation as surface runoff (RRC_{seasonal})
 - Modified by presence of tile drains, buffer strips (smaller than for PP)
 - In tile drains
 - Proportion of seasonal precipitation as tile drainage ($SSRRC_{\text{seasonal}}$)
 - Proportion of flow that reaches tile through macropores
 - Design factor (spacing between tile drains)

Phosphorus Availability Factor

P_{av} = P availability factor (unitless)

Table 8 – P availability based on material type

Material Type	P_{av}
Cattle Manure	0.58
Swine Manure	0.4
Chicken Manure	0.2
Turkey Manure	0.3
Biosolids	0.3
Other	0.3
Fertilizer	1

Values summarized from literature;
Chris Brown (OMAFRA) is collecting samples
to confirm for Ontario manures

PLATO Outputs

Sum of (Source X Transport) for each component:

Inherent Risk:

Surface BAPP

Tile BAPP

Surface Desorbed P

Tile Desorbed P

Applied P Risk:

Surface Fertilizer P

Tile Fertilizer P

Surface Manure P

Tile Manure P

The sum of the Inherent and Applied Risk
is the PLATO score

Provisional PLATO Ratings

Scenario Testing – Scoring

- 4 Categories based on the percentile of 16128 individual scenarios

Category	Range	Score
Very Low	< 50th Percentile	<30
Low	50th to 75th Percentile	30-60
Medium	75th to 90th Percentile	61-140
High	>90th Percentile	>140

Interpretation of Results

- High Inherent P
 - Dominant losses are a result of long-term management and soil/landscape features of field
 - High erosion can be addressed by changing tillage system, crop rotation or adding structural erosion controls
 - High dissolved P losses means working to reduce STP, managing water flow
- High Applied P
 - Dominant losses are a result of fertilizer or manure application, and can be changed quickly
 - Focus on application timing and placement, then rate.

Potential delivery pathways for PLATO

- Adding to agri-suite set of programs on OMAFRA website
- Provided to agribusiness as API code to be integrated into their field management software



Canada