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Canada

Nutrient Sources and Agricultural Management Practices

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Lake Winnipeg Basin
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Agricultural Management in Cold Regions

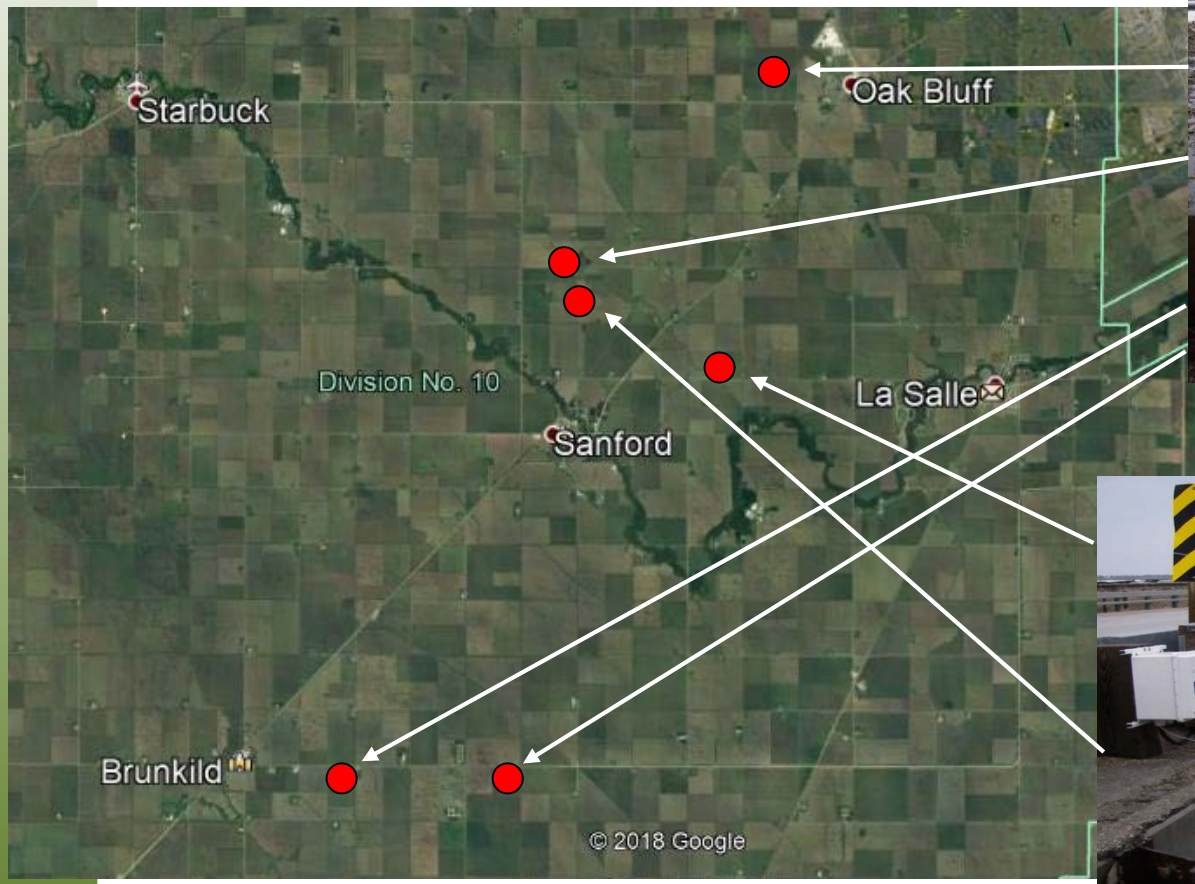
Knowledge from other regions is not always applicable

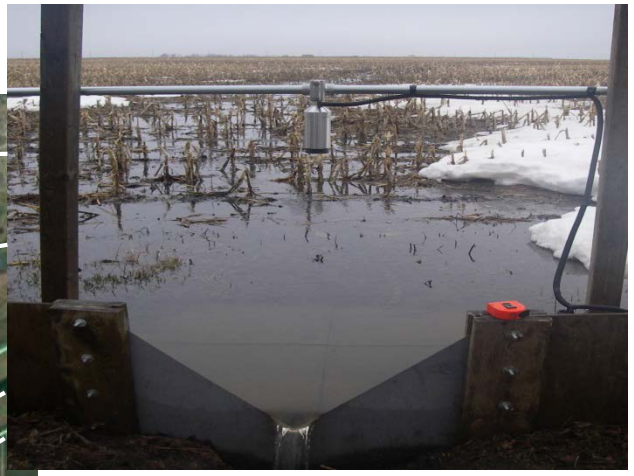
- Most nutrient transport in snowmelt
- Most nutrients transported in dissolved forms
- Limited infiltration into frozen soils
- Dormant vegetation
- Effect of freezing

Lake Winnipeg Study

- Measurement of edge-of-field and in stream losses of nutrients in the La Salle basin
  - Difficult hydrology
  - Determine water quality drivers
  - Relate to other LWB sites
- Identification of nutrient sources in vegetation
  - Nutrient release from vegetation during snowmelt
  - Often overlooked as a source
  - Important factor in the effectiveness of WQ BMPs
- Evaluation of agricultural management practices wrt WQ
  - Collaboration with AAFC
  - Apply field and laboratory data

Lake Winnipeg Sites





Long-term Data

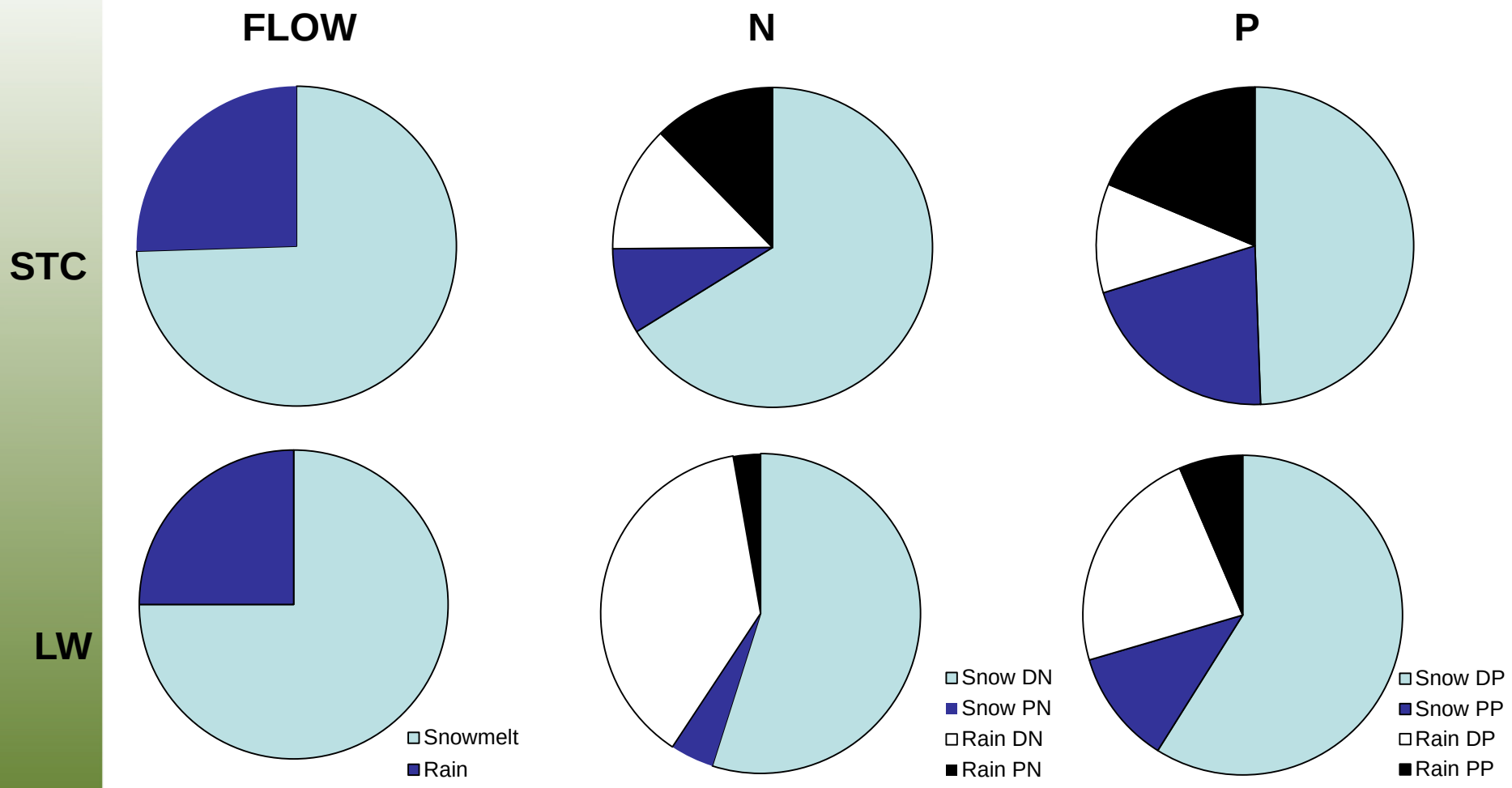
- Needed to identify water quality drivers
- Volume of runoff is most important factor controlling nutrient loss
  Depends on:
  - Amount of snow
  - Fall conditions
  - Speed of melt
  - Mid-winter melting
- Nutrient sources affect concentration in runoff
  Also affected by
  - Volume of runoff
  - Interaction with runoff

STC and LWBI data

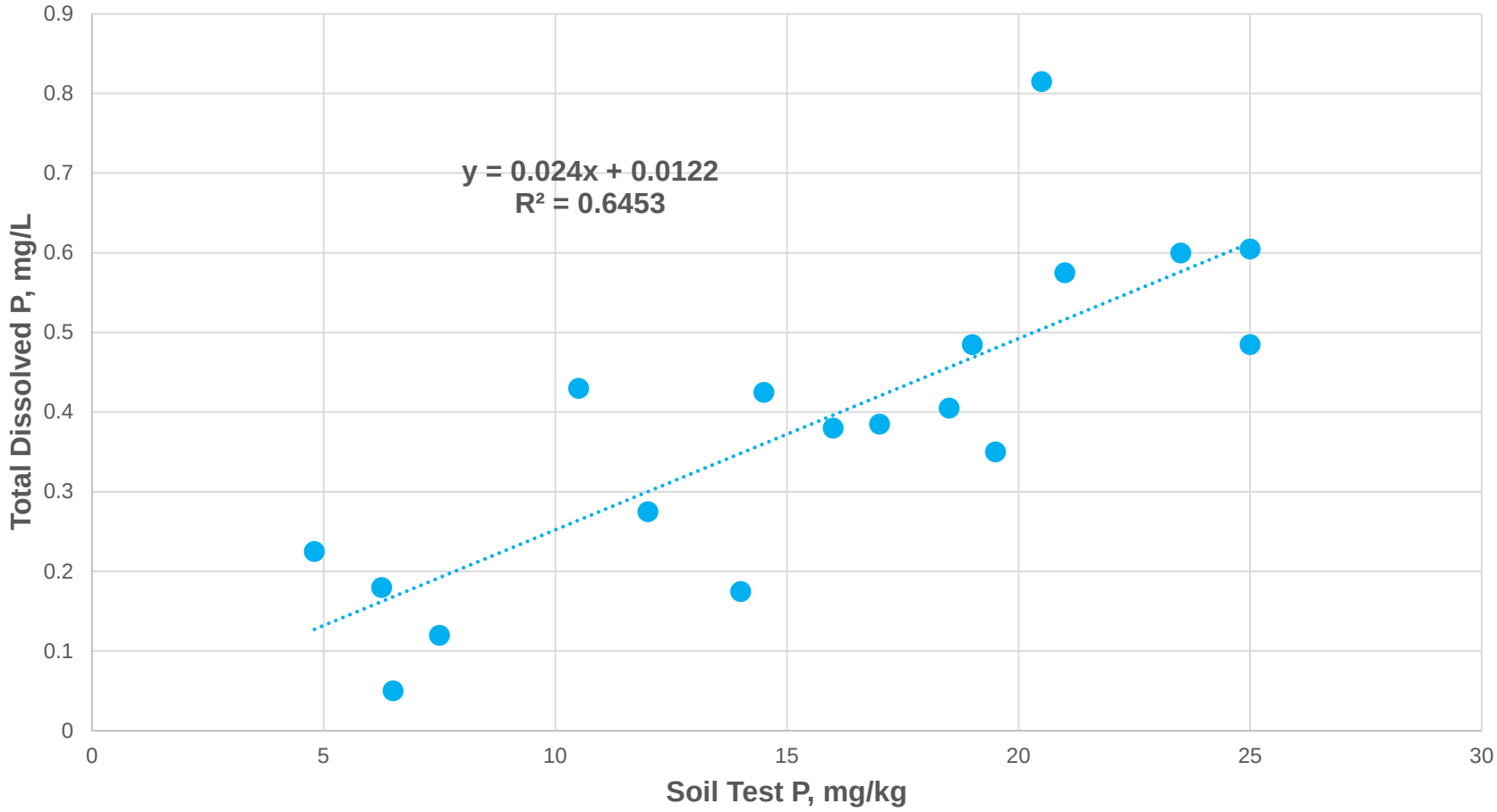
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
F3 SE																	x	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
F4 NE																	x	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 1													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 2													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 3													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 4													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 5													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 6													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 7													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 8													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 9								XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 9C													x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 10	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 11	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 12								XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 13								XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX									
MS 14								XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX									
MS 18																	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 19																	x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
MS 20																		XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
H240	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Miami	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
BC 1																		x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
OB 2																		x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
BH 5																							XXX	XXX	XXX	XXX
BL 6																							XXX	XXX	XXX	XXX
Culvert 4																		x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Bridge 3																		x	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

345 Site Years

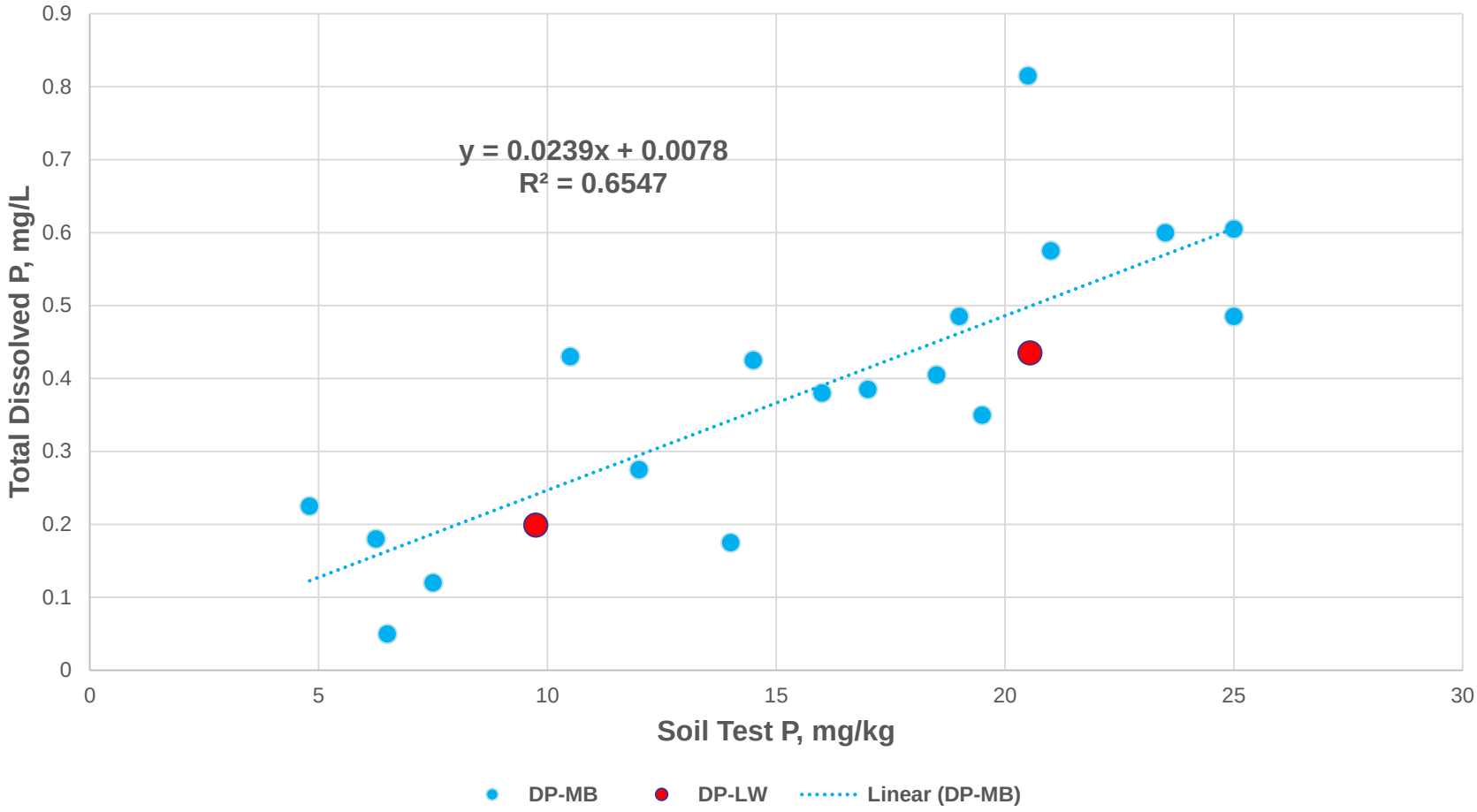
Snow-Rain Summary – Edge of Field



TDP in Runoff v Soil Test P



La Salle Data Added



Plant Residue Work

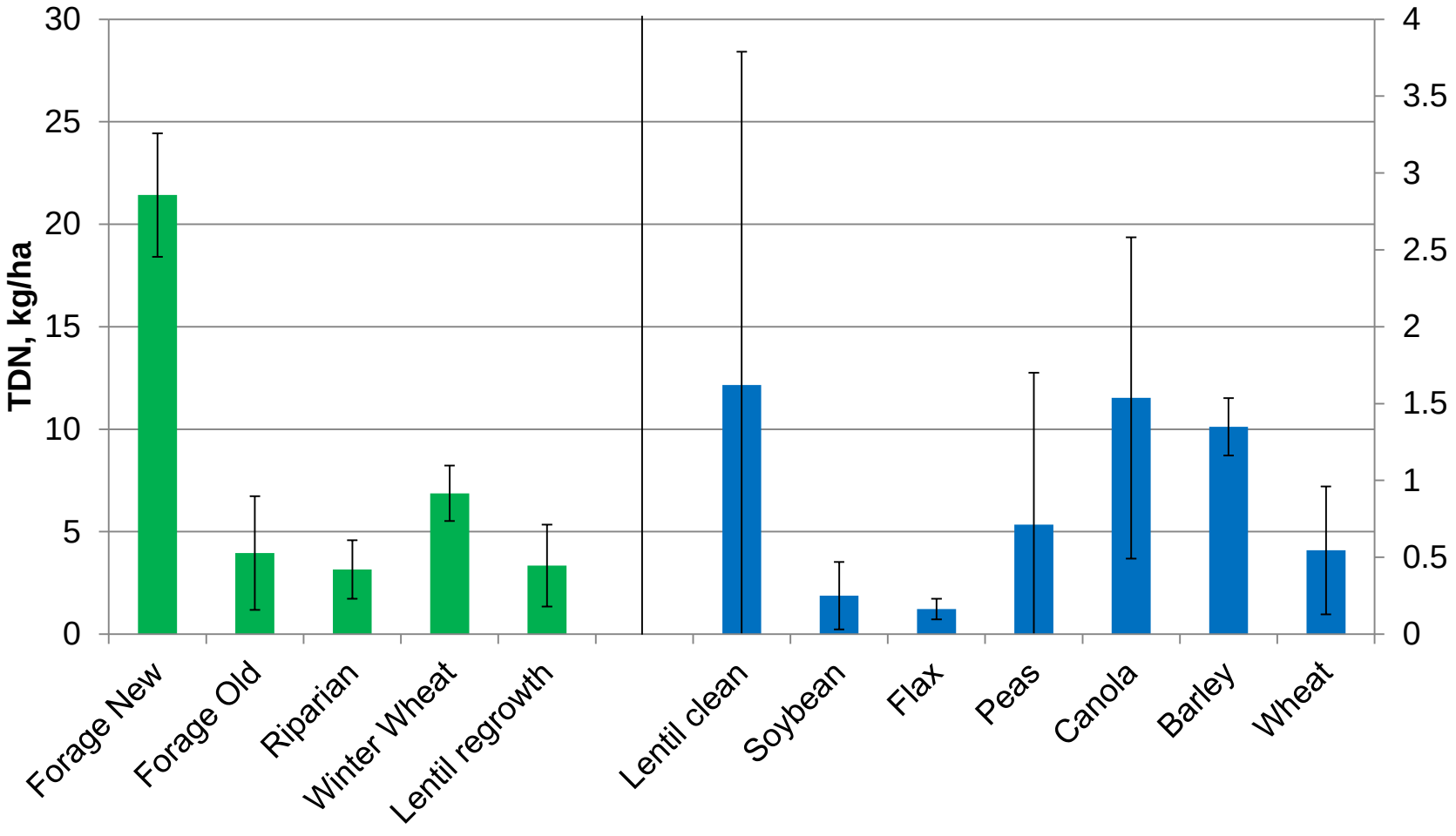
- To investigate the potential for different crop and plant residues to contribute nutrients to snowmelt
- To identify interactions between soil, plant and snow nutrients during snowmelt

- To evaluate the effect of environmental conditions on nutrient release
- To advance the understanding of drivers of nutrient mobilization and transport during snowmelt

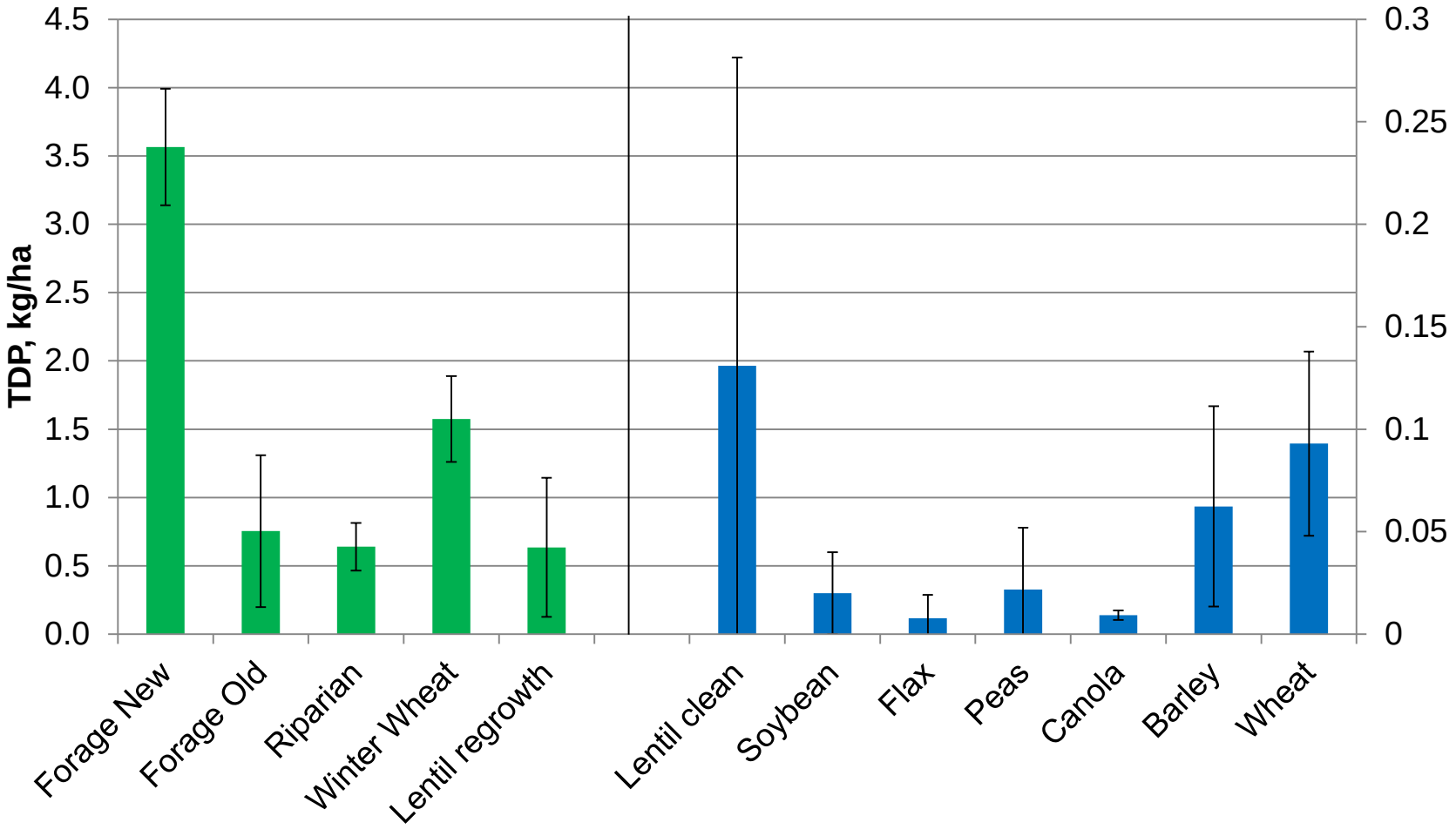
Snowmelt Simulation

- Collect plant residues and shallow surface soil (active layer) from a standard-sized quadrat in field
- Freeze samples to -25°C
- Simulate snowmelt on residue, soil and combined samples through daily -5 to +5 °C cycles
- Assess:
  - Types of residues
  - Interaction between residue and soil
  - Number of cycles
  - Effect of ponding
  - Relationship to edge of field runoff

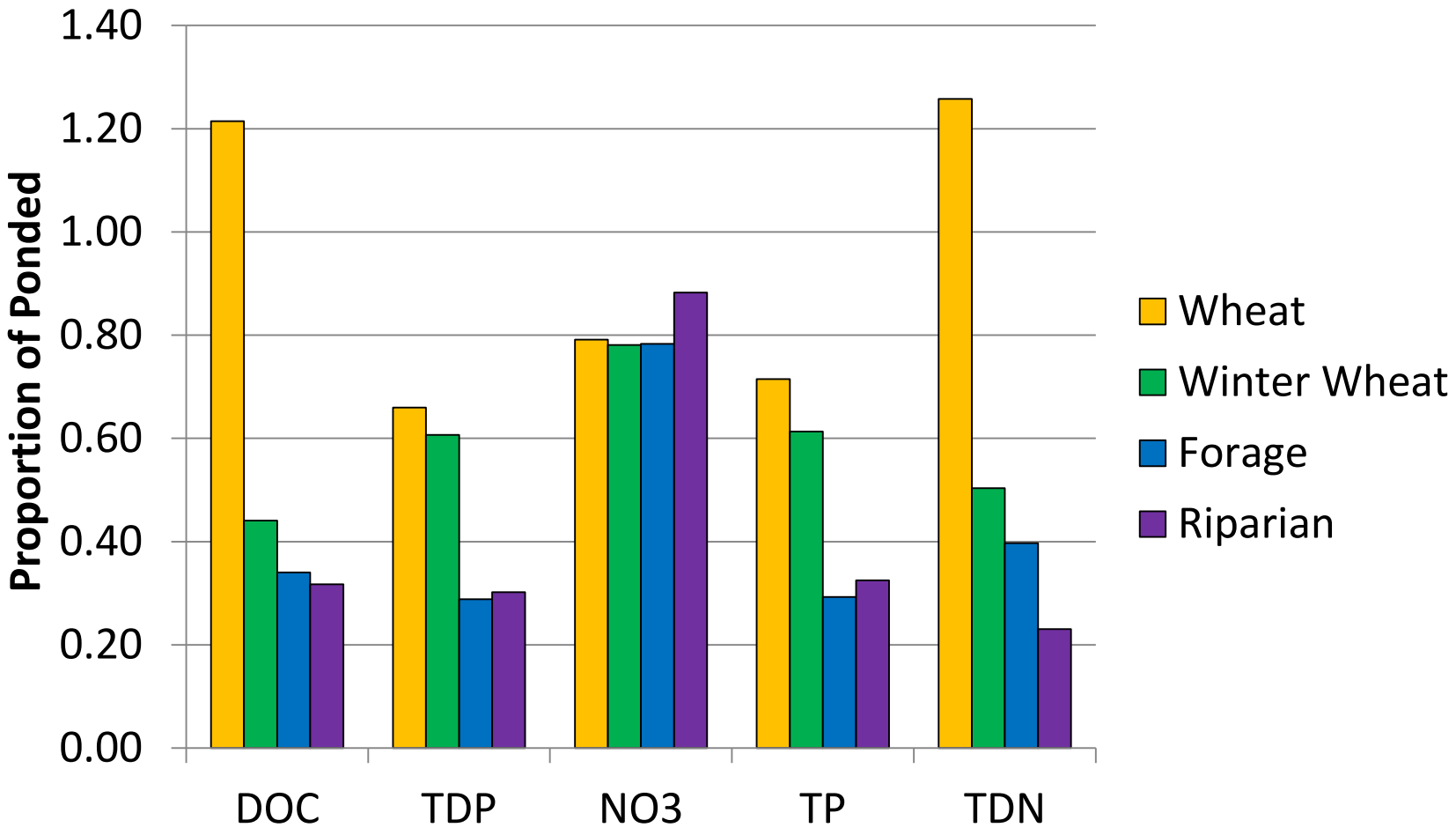
TDN Released from Residues



TDP Released from Residues



Drainage


1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Proportion of Ponded
DOC
TDP
NO3
TP
TDN
Wheat
Winter Wheat
Forage
Riparian

Nutrient Sources & BMPs

- Soils are an important source of P in annual cropland
  - Shallow soil runoff interaction zone
  - Interaction dependent on conditions at soil surface
- Vegetation
  - Can be an important nutrient source
  - Freezing can release nutrients from plant material
- Fertilizers and manures
  - Nutrients cycle through soil and vegetation
  - Balance to crop requirements
  - Sub-surface placement should reduce potential for loss
  - Timing of application is important

Progress with Agricultural Management

- Review Paper
  - Helen Baulch, Jane Elliott, Marcos Cordeiro, Don Flaten, David Lobb and Henry Wilson.
    Soil and Water Management: Opportunities to mitigate nutrient losses to surface water on the Northern Great Plains.
    Environmental Reviews – In Press
- BMP Workshop
  - Red River Basin/Cold Climate Agricultural Nutrients BMP Workshop
    April 2009
    Crookston, MN
- Agricultural Water Futures Program
- AAFC Living Labs

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