

**Manitoba Association of Watersheds**

# **Prairie Riparian Areas: Opportunities and Challenges for Production and Conservation**



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# Thanks to

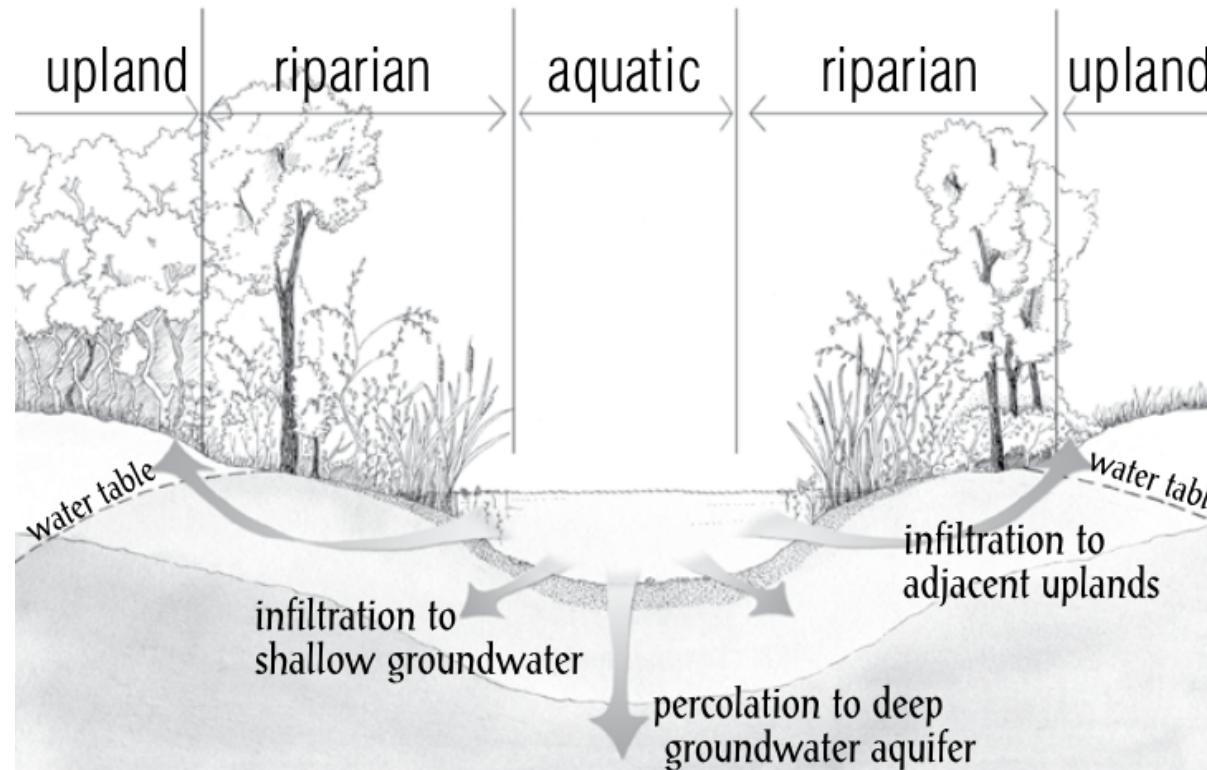
- Collaborators & research groups
  - David Lobb (U of M)
  - Phil Owens (UNBC)
  - Merrin Macrae (U of W)

- Funding
  - Lake Winnipeg Basin Stewardship Fund
  - NSERC
  - ECCC
  - Ducks Unlimited Canada
  - AAFC
  - Deerwood and Soil and Water Management Association
  - Manitoba Beef & Forage Initiatives



# What is a riparian area?

- Transitional zone between the aquatic part (the waterfilled basin of the lake or wetland) and the surrounding terrestrial (or upland) area ([Cows and Fish 2009](#))
- "Wetter than dry" but "drier than wet" ([MB Ag](#))
- The strip of moisture-loving vegetation growing along the edge of a natural water body ([Hilliard & Reedyk 2020](#))



# What is a riparian area?

Goes by many names

- Vegetated buffer strip
- Vegetated filter strip
- Buffers
- Riparian corridor
- Grass buffer
- Riparian forest



# What does a riparian area look like?

- Trees around a small retention dam



# What does a riparian area look like?

- Grasses around a small wetland



# What does a riparian area look like?

- Trees along a stream



# What does a riparian area look like?

- Do wet depressional areas have a riparian zone?



# What does a riparian area look like?

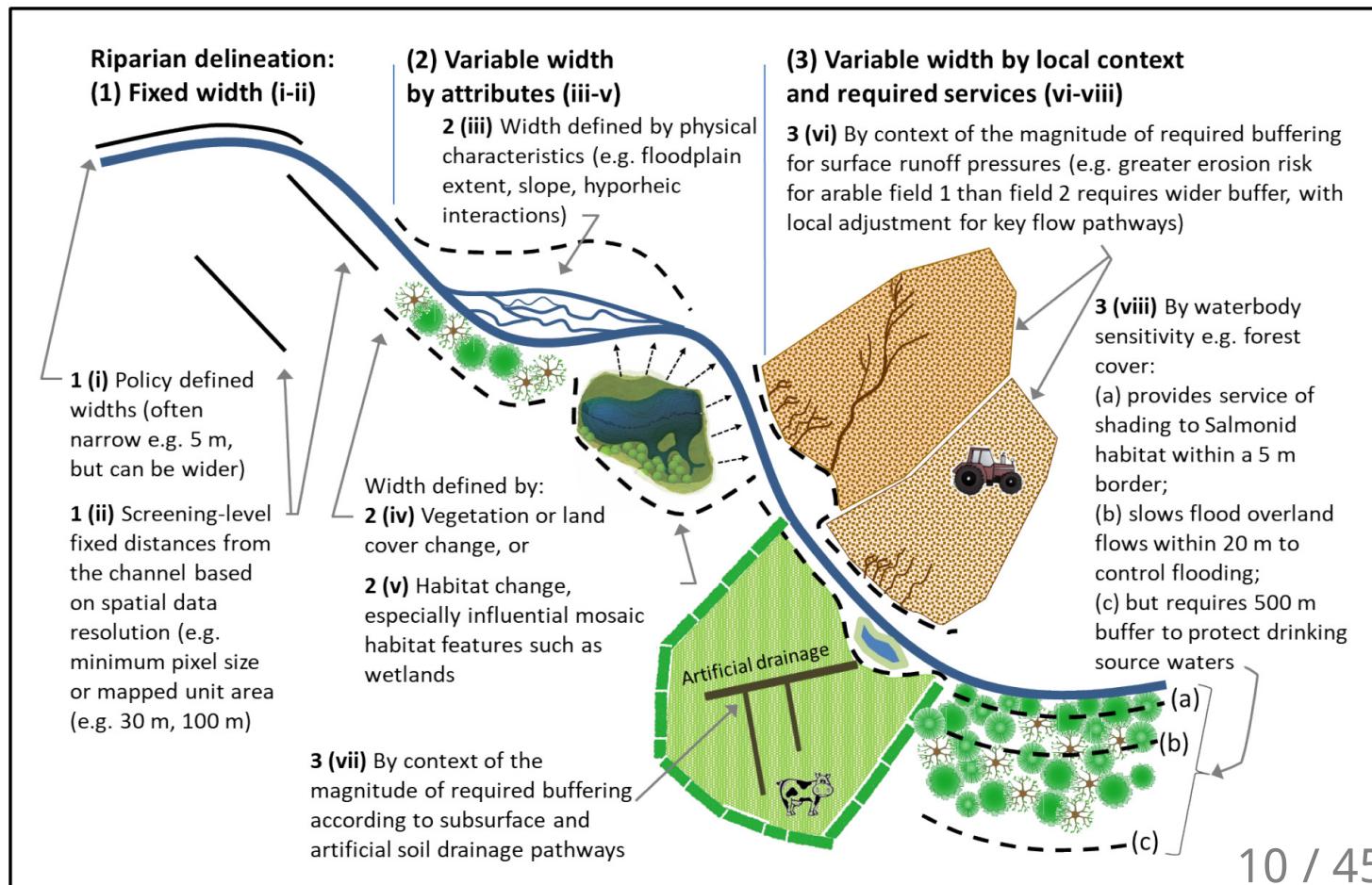
- Do ditches have a riparian zone?



# Defining a riparian area

Where does (should) it start and end?

- Historical observations
- Too steep/wet to farm
- Fence line
- Vegetation types
- Hydrology
- Ecosystem function
- Regulatory



# Riparian functions

## Recreation



Lobb

11 / 45

# Riparian functions

## Habitat

- High plant and animal biodiversity
- Important corridors in a very fragmented landscape



# Riparian functions

## Channel characteristics

- Changes in the vegetation resulted in changes in characteristics
  - Treed vs grassed ([Satchithanantham et al. 2019](#))

**Table 3.** Summary statistics of geomorphological characteristics for both forest and nonforest reaches.

Parameter (units)	Forest		Nonforest		Paired <i>t</i> test <i>p</i> -value
	Mean	SD	Mean	SD	
LWD (pieces/100 m of stream)	7.50	4.67	1.00	1.84	<0.01
Detritus (%)	39.19	16.98	24.69	17.12	0.05
Bankfull width (m)	8.49	2.50	5.69	2.51	<0.01
Mean bankfull depth (m)	0.85	0.23	0.80	0.35	0.84
Width to depth ratio (m/m)	10.53	3.09	7.65	2.60	<0.05
Flood prone width (m)	24.3	7.74	25.25	7.34	0.41
Entrenchment ratio (m/m)	3.16	1.12	5.49	2.08	<0.01
Incision ratio (m/m)	1.60	0.43	1.53	0.27	0.59
Cross sectional area (m <sup>2</sup> )	7.86	4.62	5.37	5.15	<0.01
Sinuosity (m/m)	1.5	0.35	1.25	0.30	<0.05

# Riparian functions

## Part of the farm

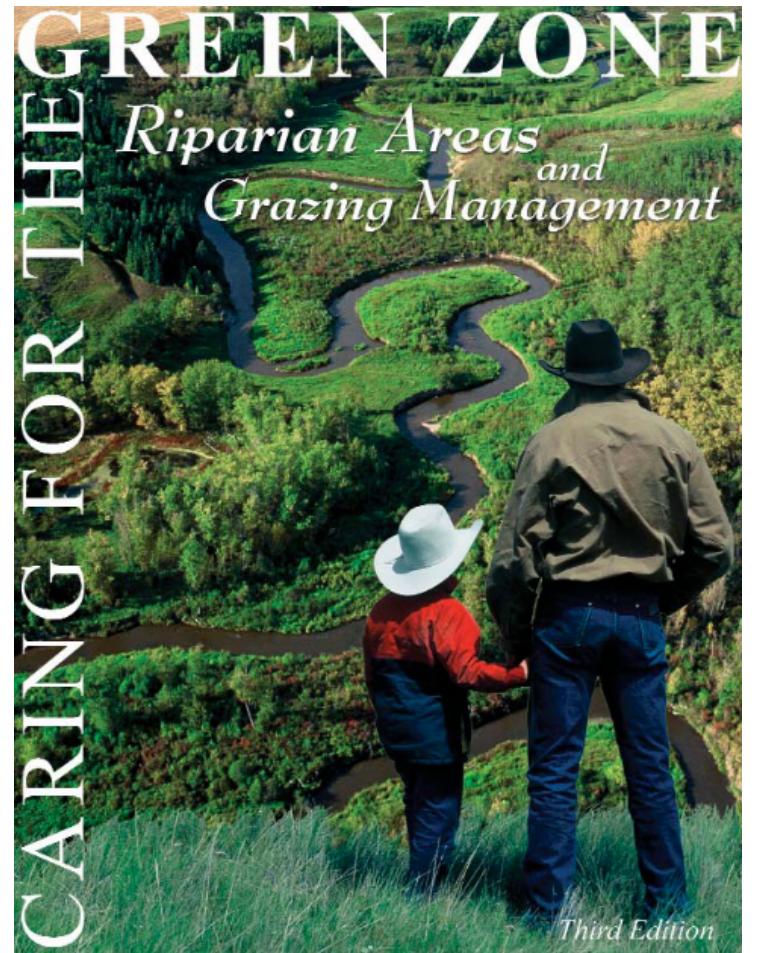
- Riparian areas can account for 5 to 10% of the farm area
  - Up to 25% in the prairie pothole region



# Riparian functions

## Part of the farm

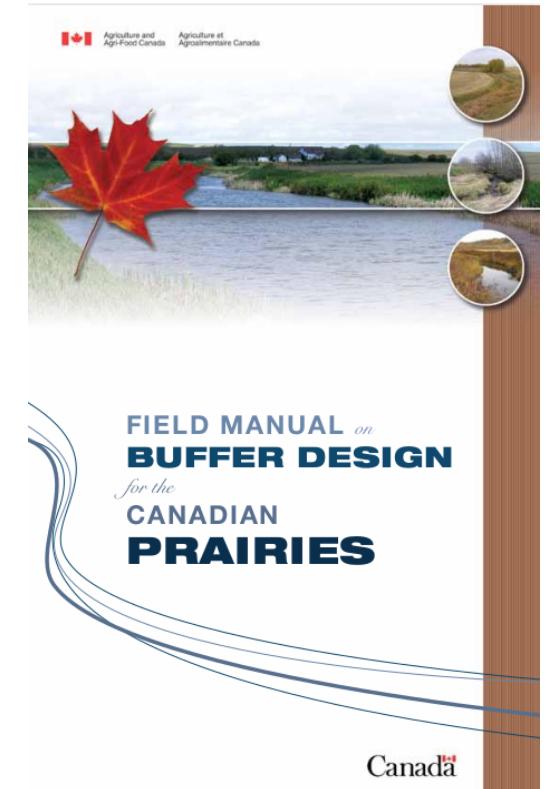
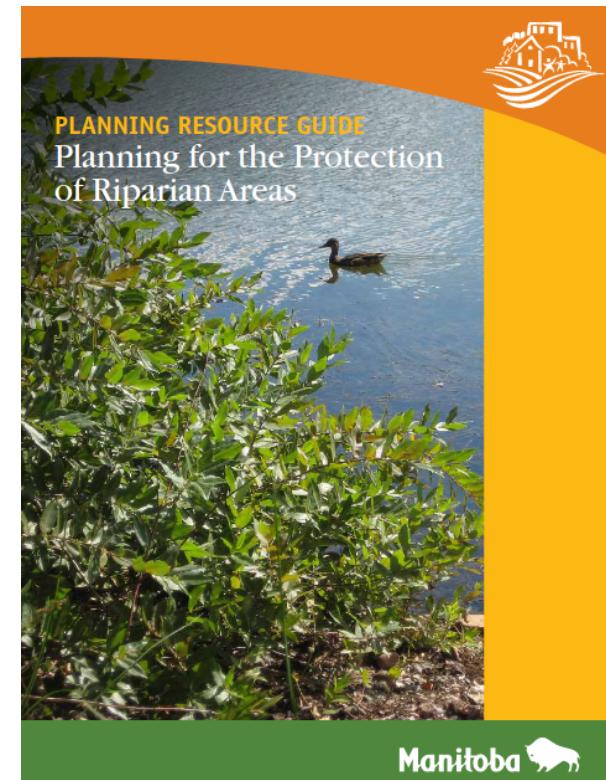
- Important source of forage, especially during drought



# Riparian functions

## Surface water management

- Often cited as an effective means of reducing the loading of nutrients to surface waters
  - Nutrients, sediment, pathogens, and other pollutants are filtered by riparian soil and vegetation
- Slow runoff → reducing peak flows



# Riparian functions

## Surface water management

- Eutrophication and algae blooms on Lake Winnipeg
  - Lots of public interest/pressure/outrage in improving water quality
- Riparian areas are considered part of the solution



# Riparian areas as filters

## Experimental (lab and field)

- Uniform flow of water
- Newly established
- Warm climate/temperature
- Rainfall

Provides lots of good and important information but how well does it transfer to the prairie landscape?

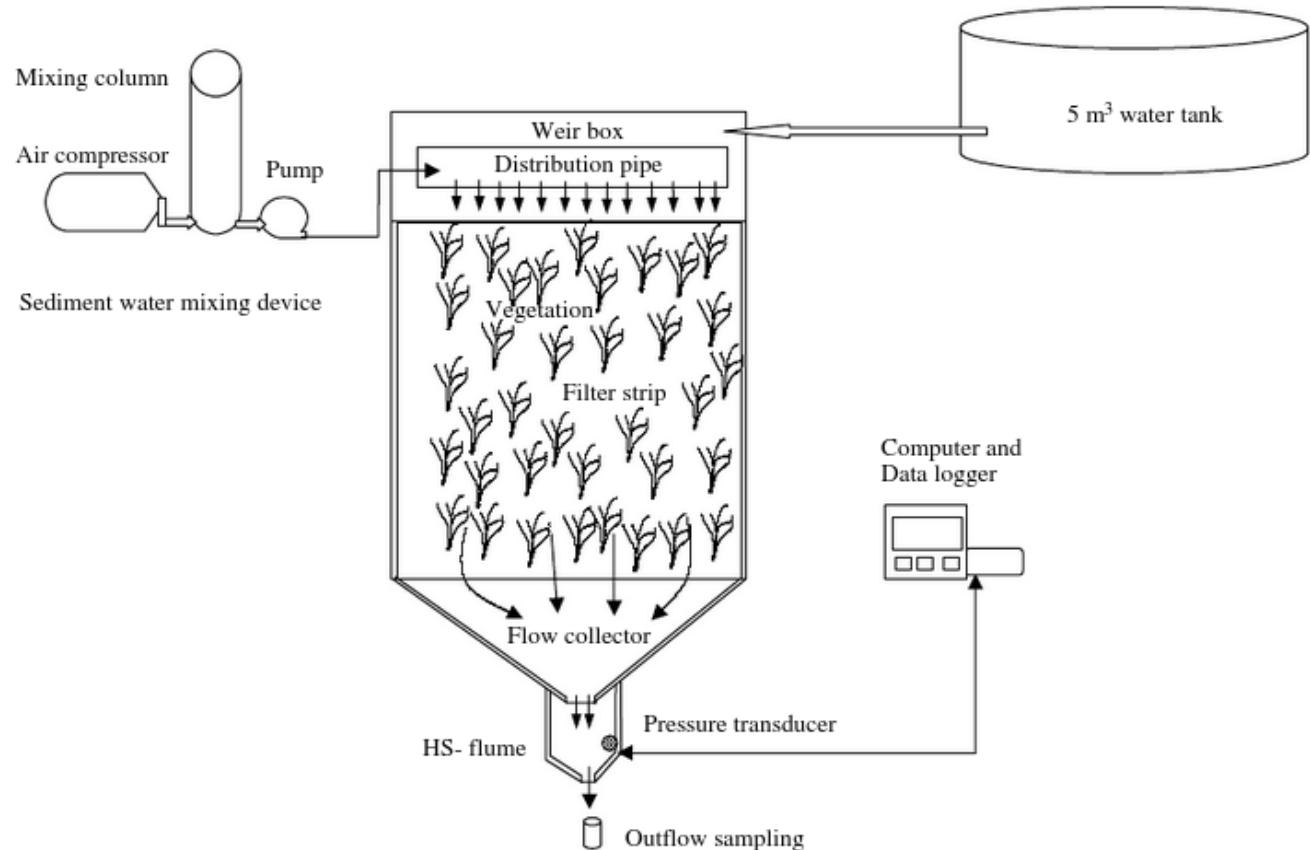
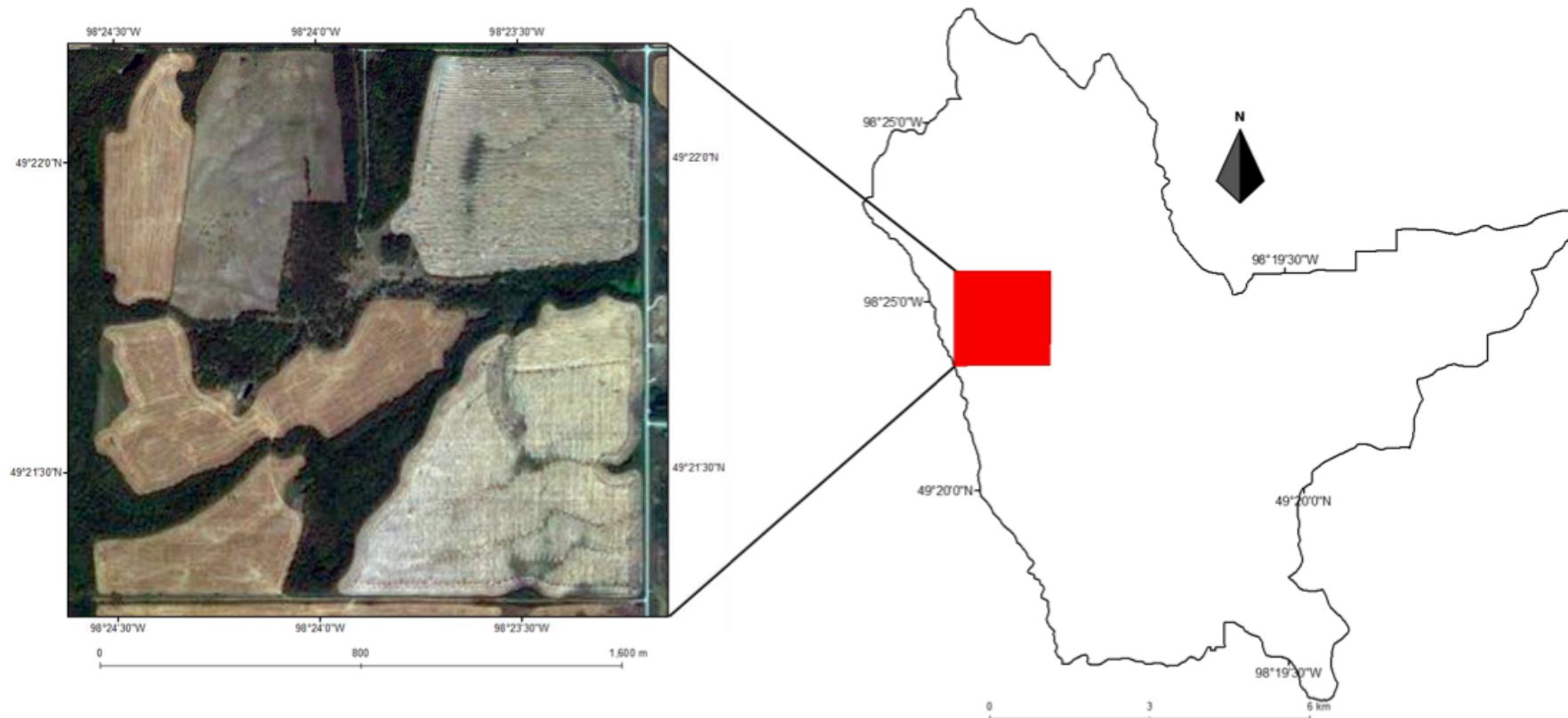


Figure 1. Schematic of supply and monitoring system and experimental setup

# Riparian areas as filters

## Uniform flow of water?

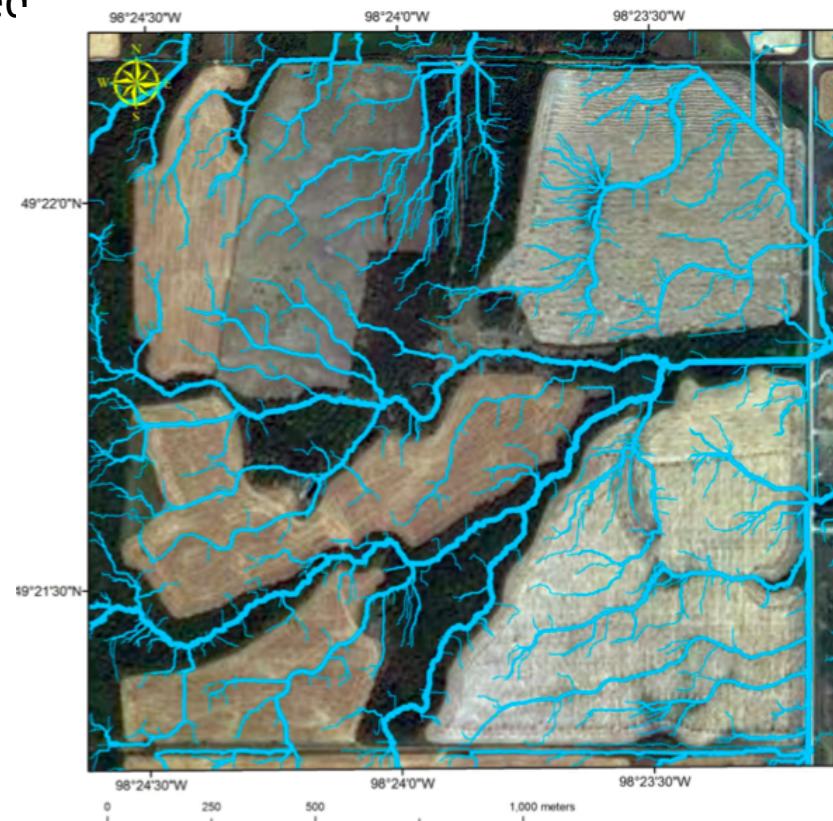
- Lots of nice looking riparian areas in this section



# Riparian areas as filters

## Uniform flow of water?

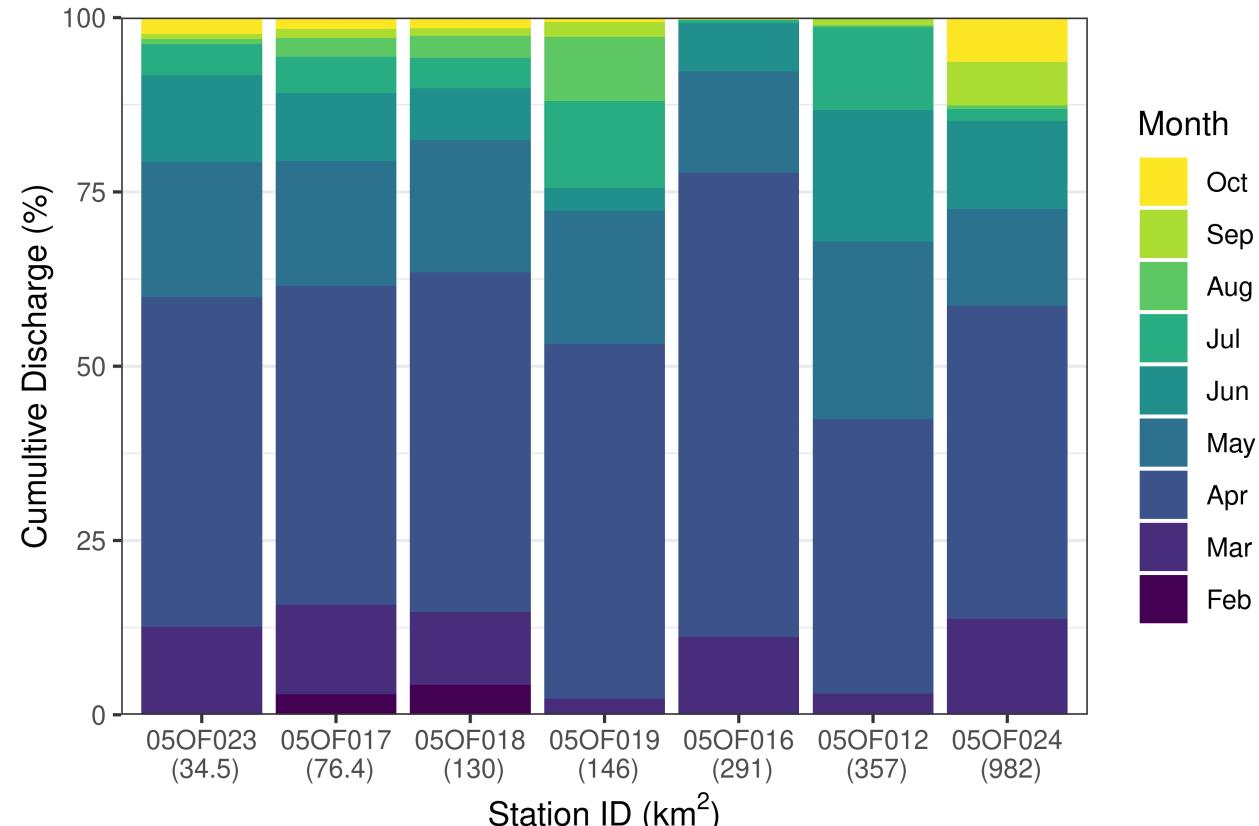
- Only 1-2% of the length of the field-edge vegetation intercepts surface runoff
  - Convergence in the landscape results in concentrated flow paths
  - Most of the riparian areas are **NOT** filtering runoff
  - Variable width may help improve filtering without putting land out of production



# Riparian areas as filters

## Warm climates and rainfall events

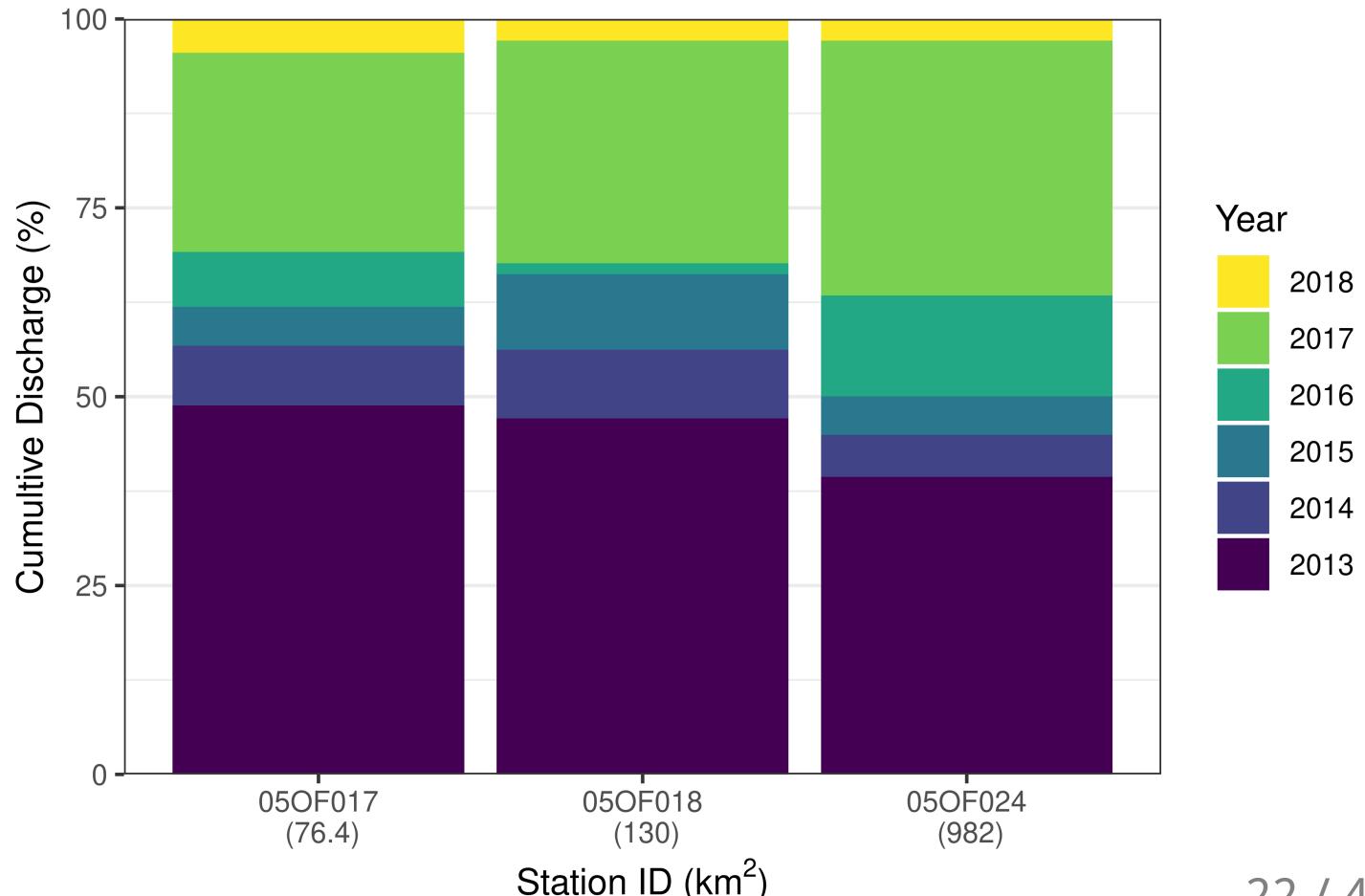
- Information on the efficacy of riparian areas in other locations may not be the same here
  - Snowmelt driven hydrology
  - Most of the time riparian areas are **NOT** filtering runoff



# Riparian areas as filters

## Inter-annual variability

- Lots of variability between years
  - A few years can account for much of the total flow
  - Riparian areas are more important in some years but less so in others



# Riparian areas as filters

## Typical prairie riparian area during the snowmelt period

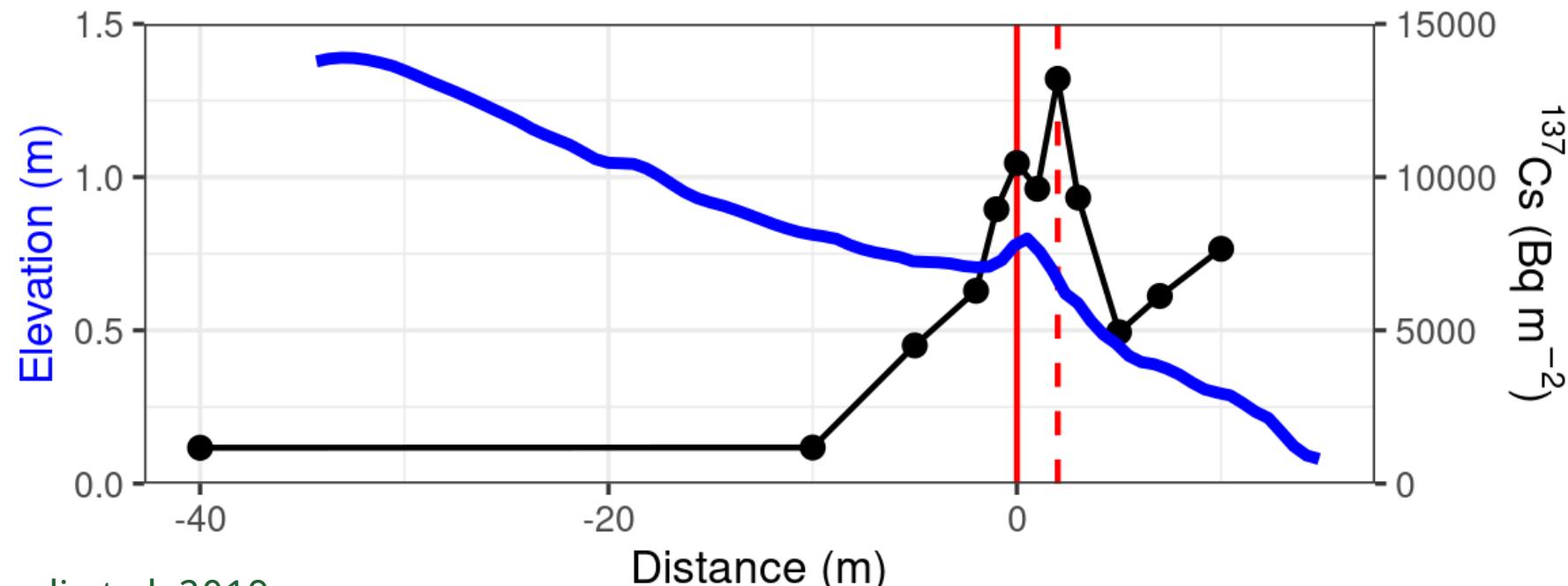
- Frozen soils and dead and dormant vegetation
  - Filtering capacity is not very good during the most critical period



# Riparian areas as filters

## Sediment and nutrient accumulation

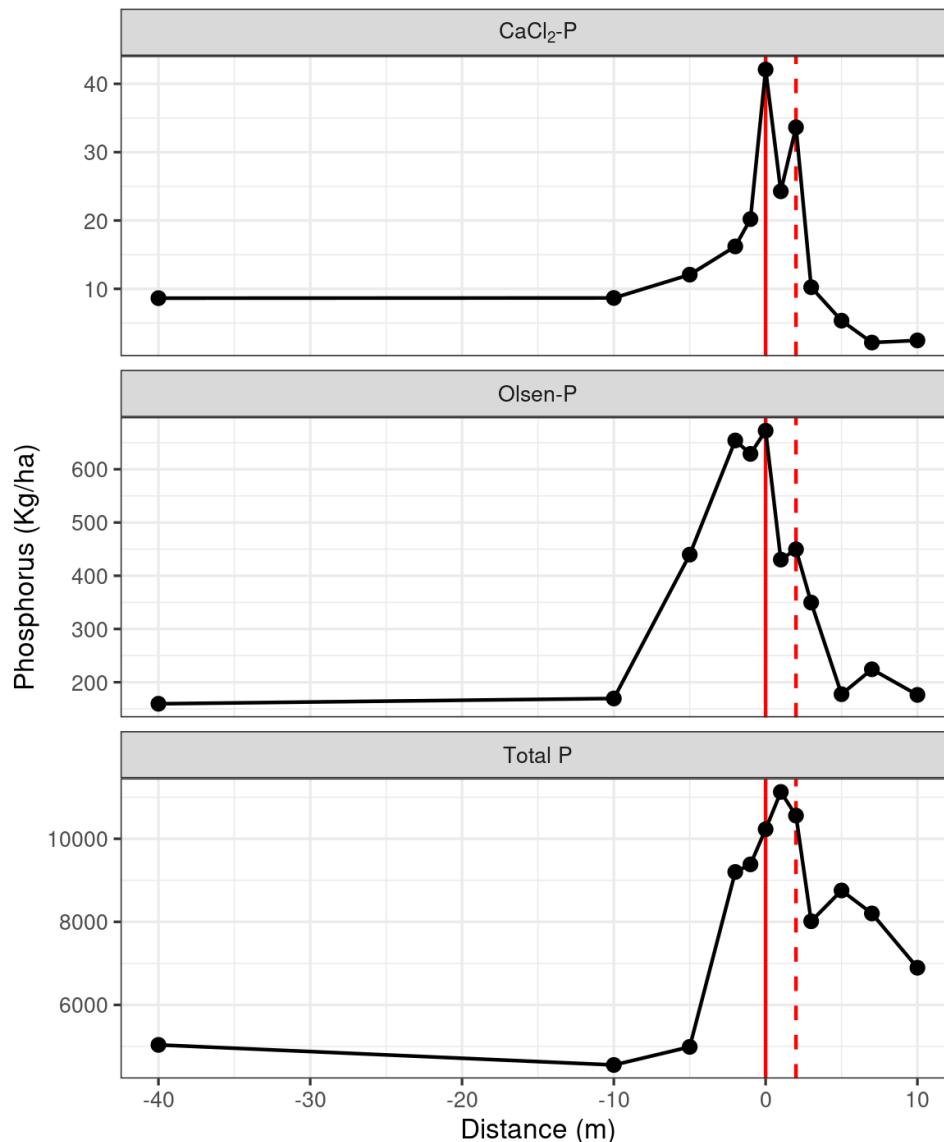
- Accumulation of soil at the edge of the field an within the riparian area
  - Created a step (tillage erosion)



# Riparian areas as filters

## Sediment and nutrient accumulation

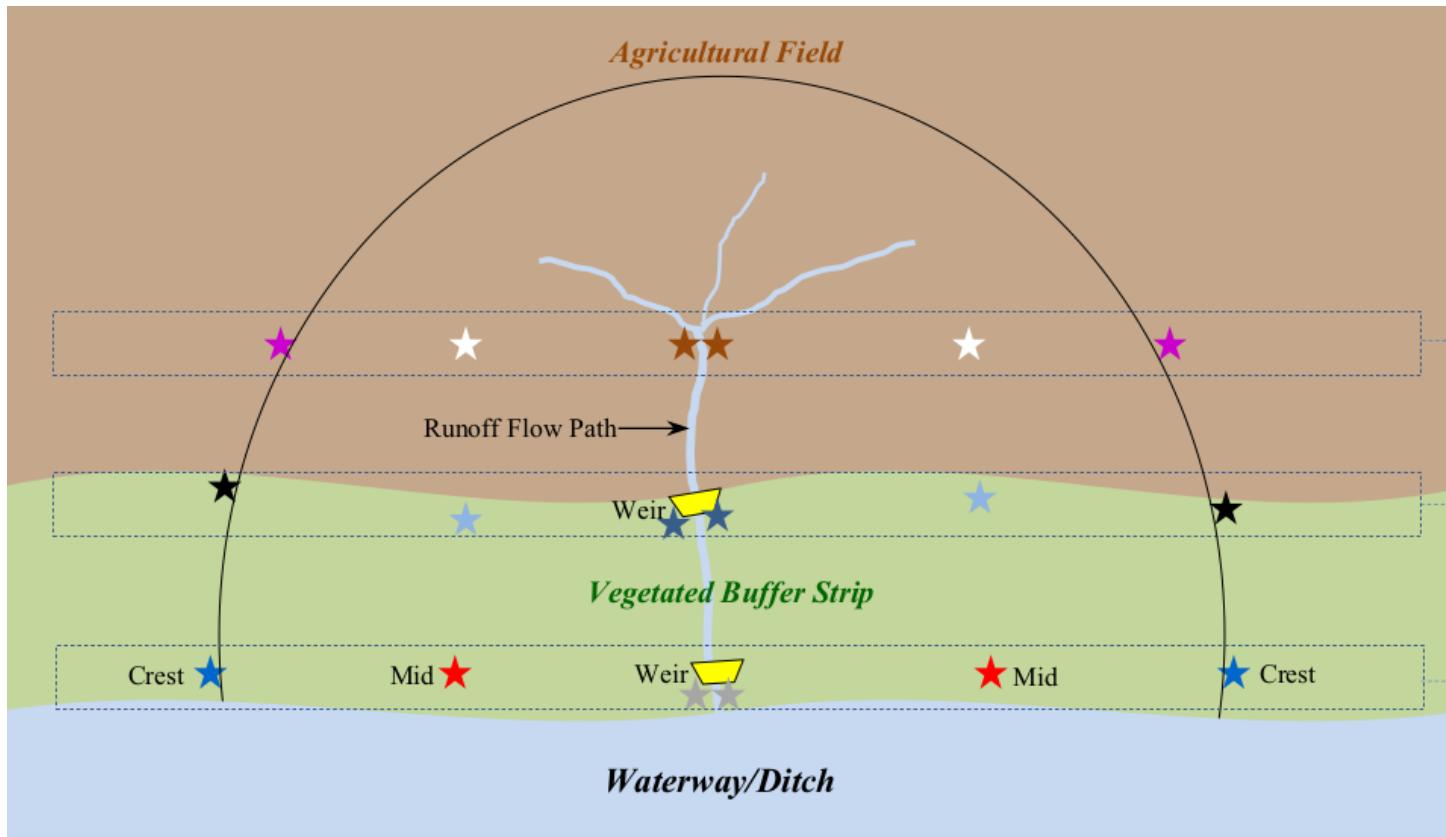
- Accumulation of nutrients at the edge of the field and within the riparian area
  - Ability to retain nutrients declines over time



# Riparian areas as filters

## Assessing the filtering capabilities

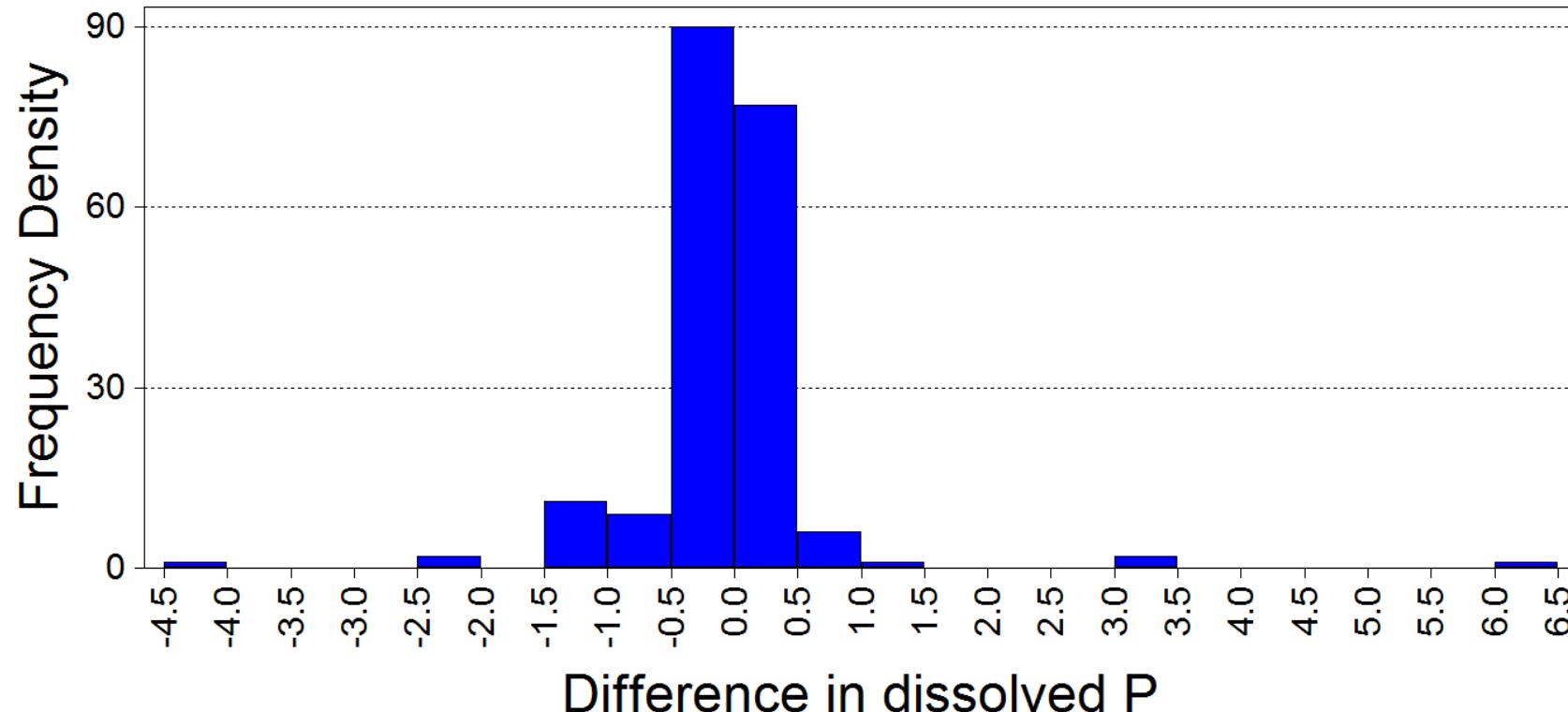
- Three sites across MB



# Riparian areas as filters and sources

Riparian areas can be a source of dissolved nutrients

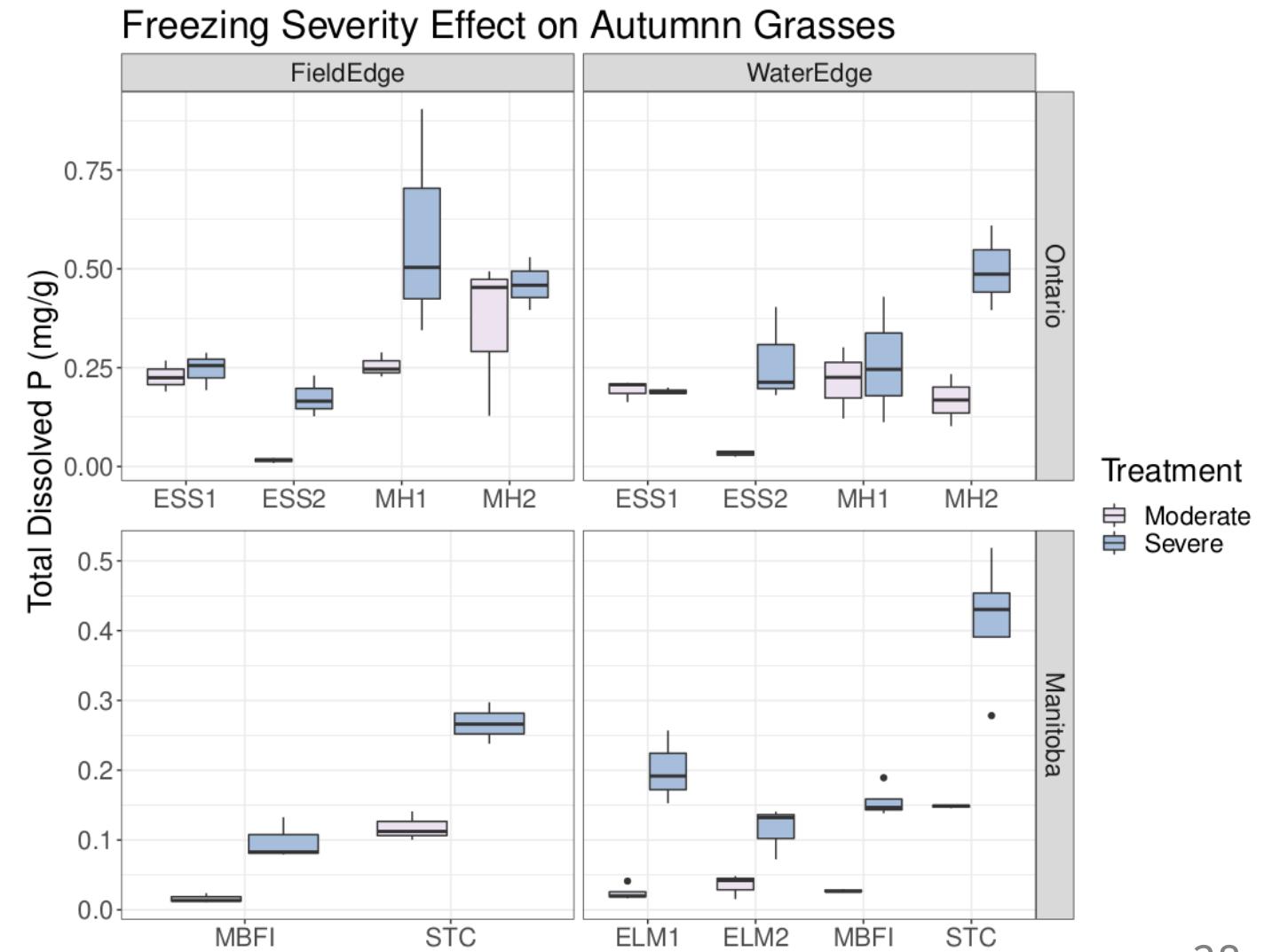
- Both the soil and vegetation can contribute



# Riparian areas as sources

## Freeze-thaw

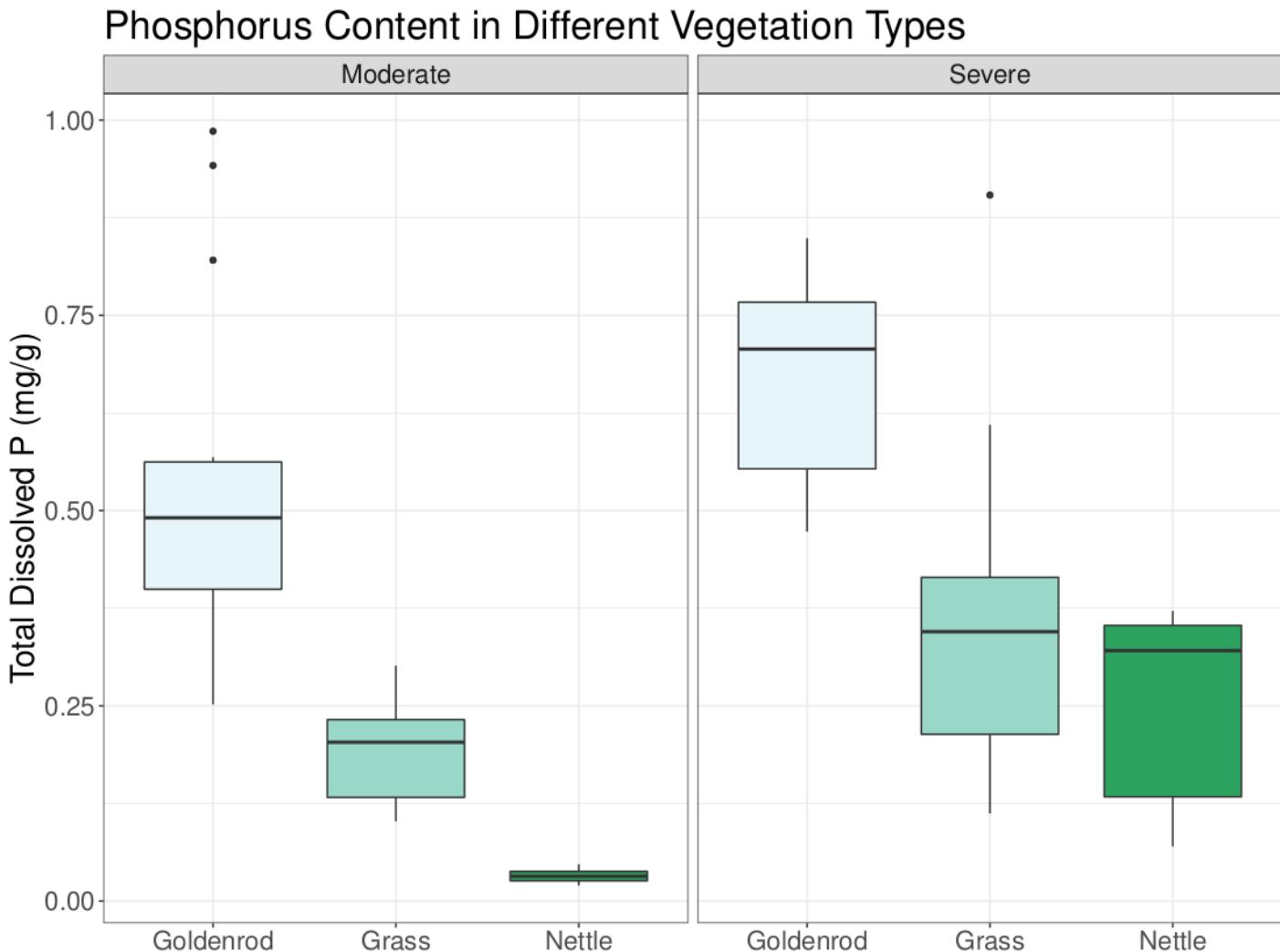
- Freezing vegetation releases water soluble P



# Riparian areas as sources

## Freeze-thaw

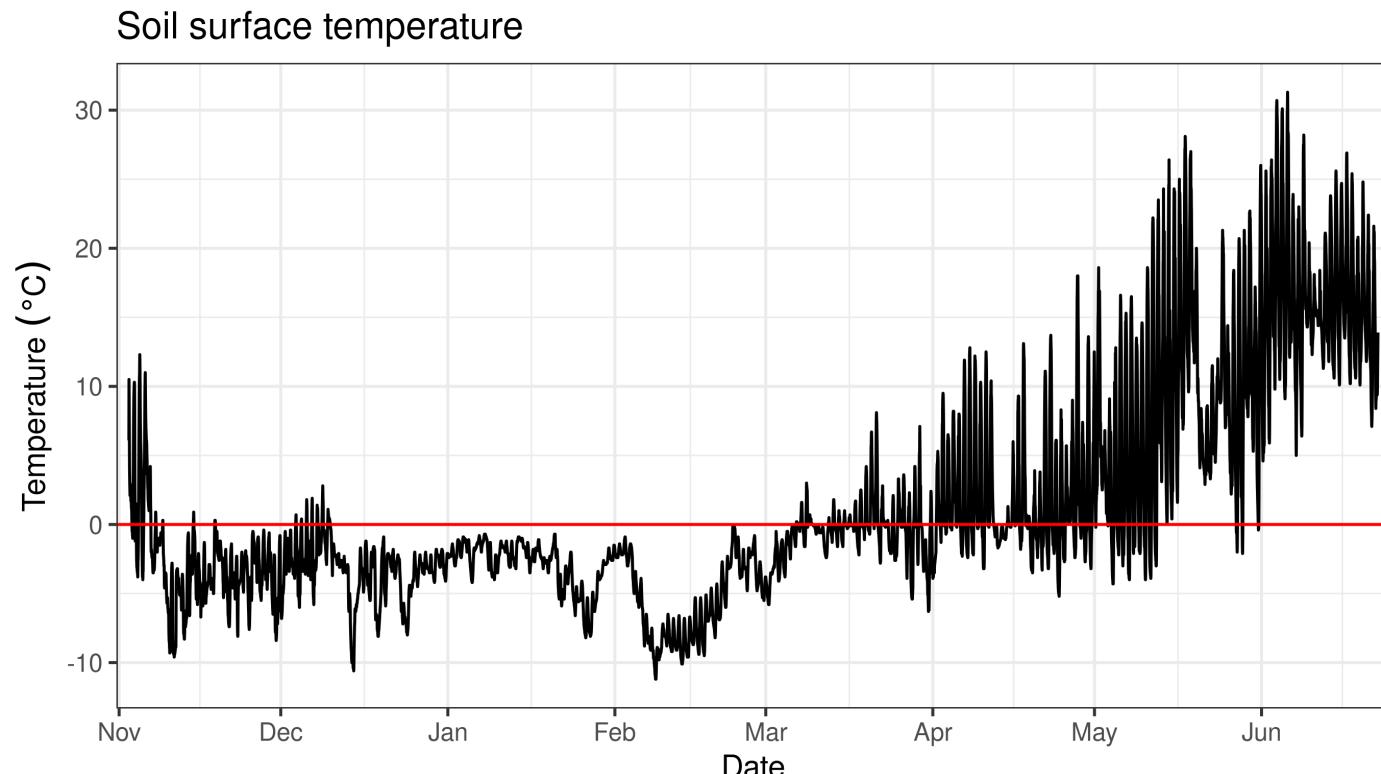
- Different vegetation types have different potential to release P



# Riparian areas as sources

## Freeze-thaw

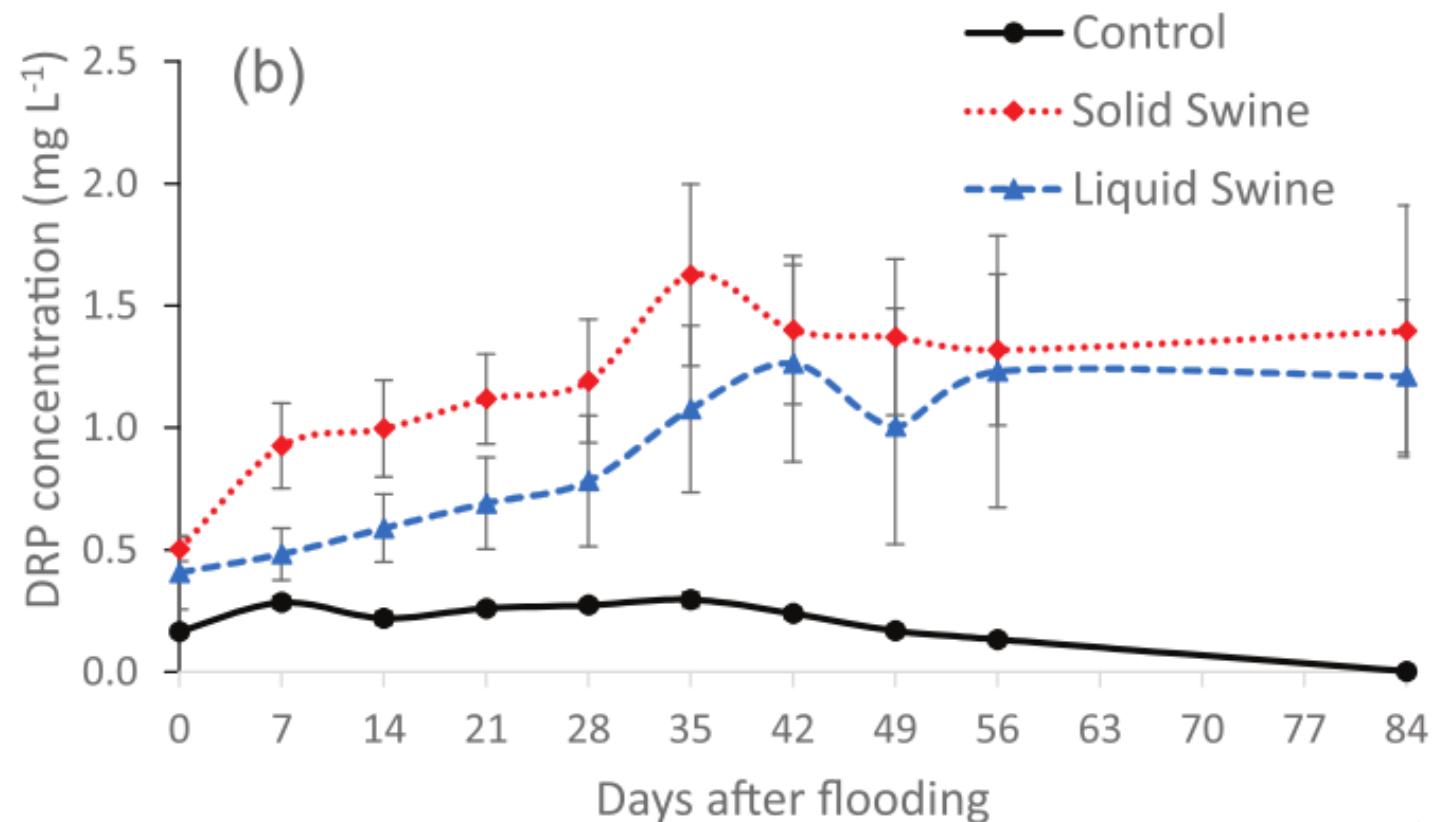
- Many lab experiments use unrealistic temperatures
  - Snow is a good insulator



# Riparian areas as sources

## Flooding

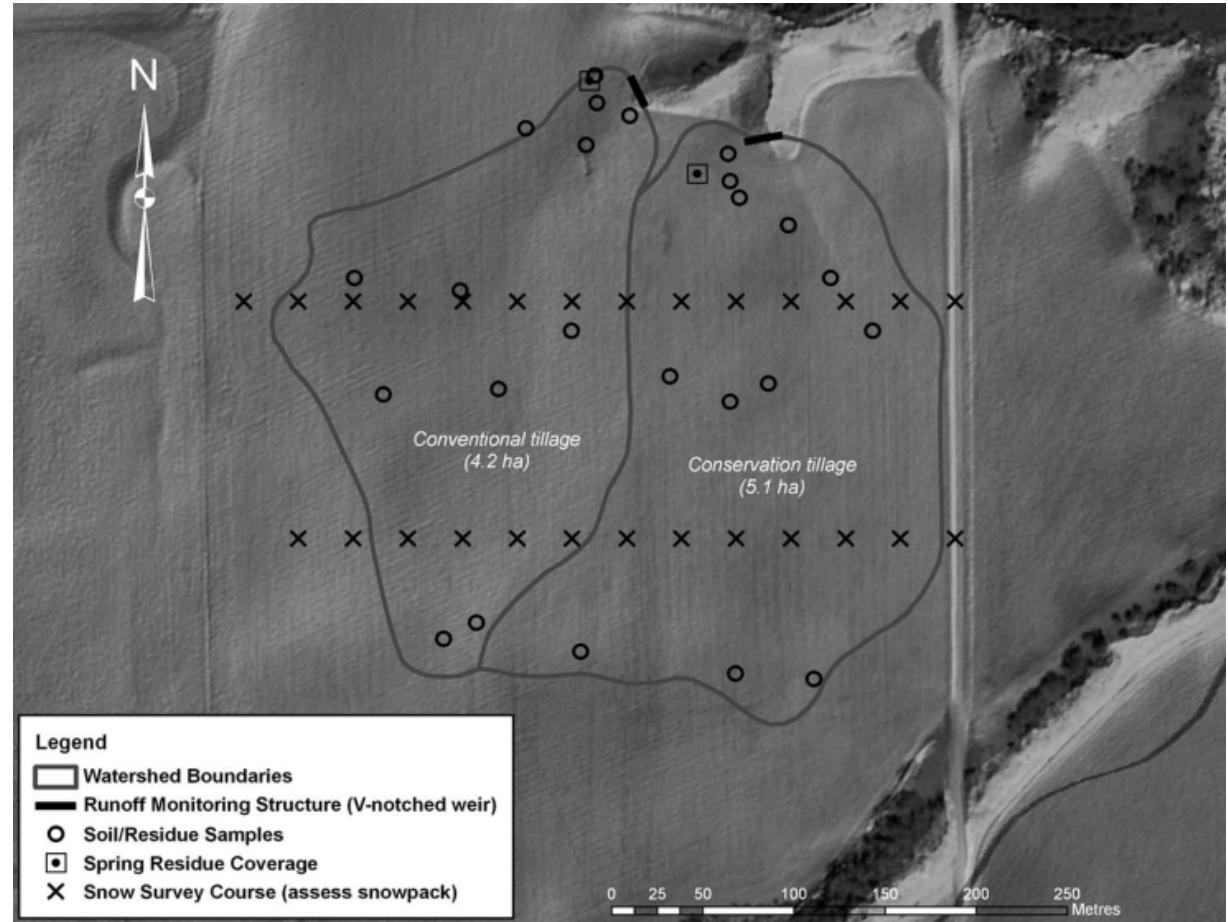
- Prolonged flooding makes the soils anaerobic
  - Can enhance P release from soils



# Riparian areas as filters

Riparian areas are the LAST line of defense

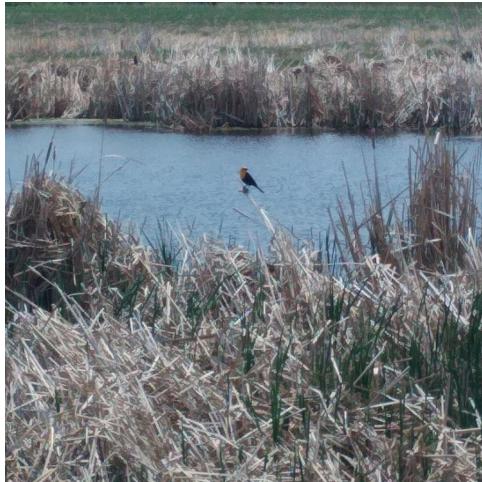
- Manage soils and crops to reduce the runoff and nutrients leaving agricultural land
  - Conservation tillage can increase dissolved P losses



# Riparian areas as filters and sources

Riparian areas are the LAST line of defence

- Manage soils and vegetation in the riparian area
  - Harvest as a removal mechanism
  - Terrain can be difficult for equipment
- Riparian areas are more than just filters
  - Habitat, stream stabilization etc.



# Managing riparian areas

## Cattle grazing

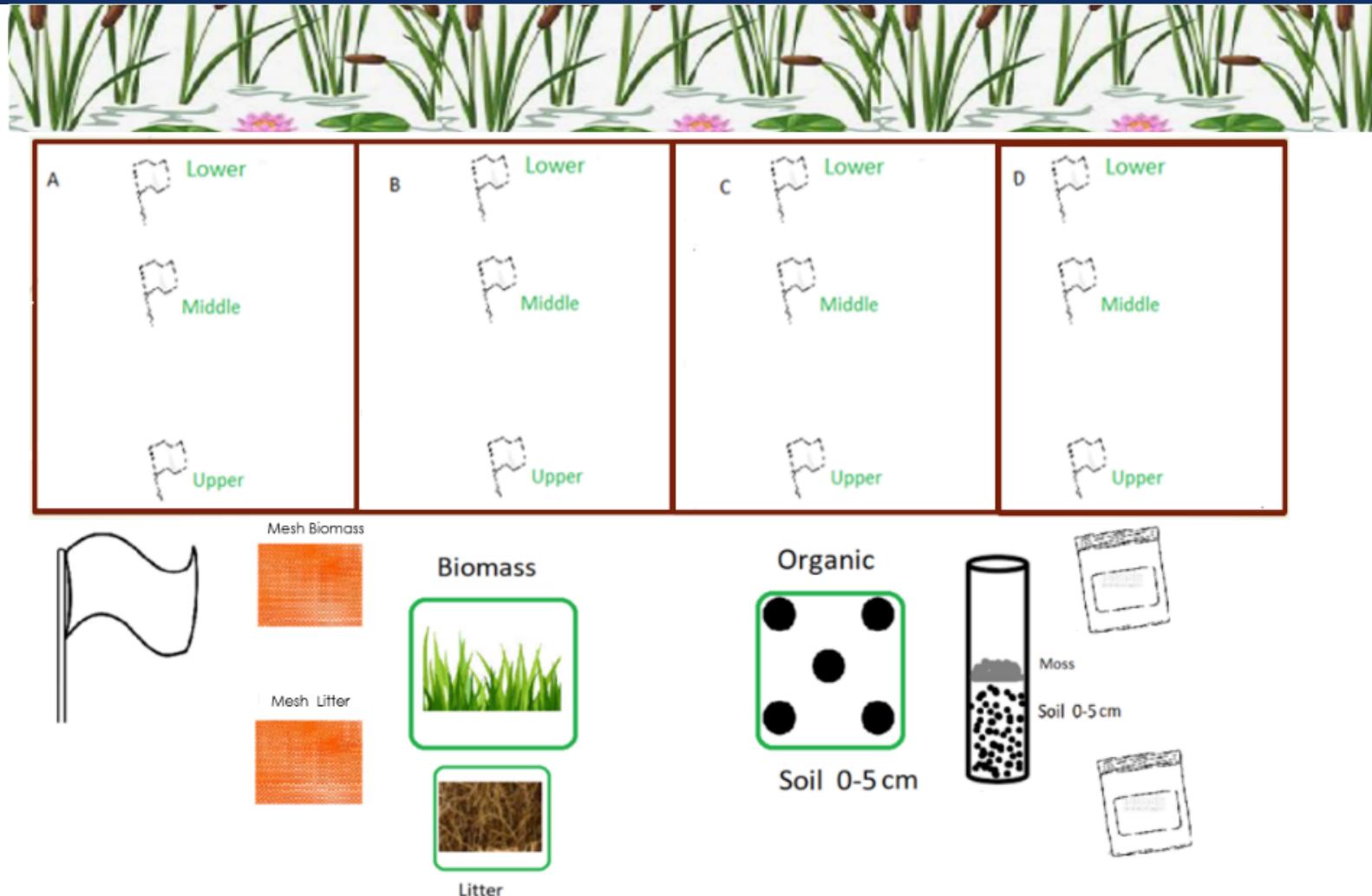
- Fall grazing
  - Drier soils (less compaction)
  - Limit disturbance to active nests
  - Extending the gazing season
  - Remove vegetation prior to winter



# Managing riparian areas

## Cattle grazing

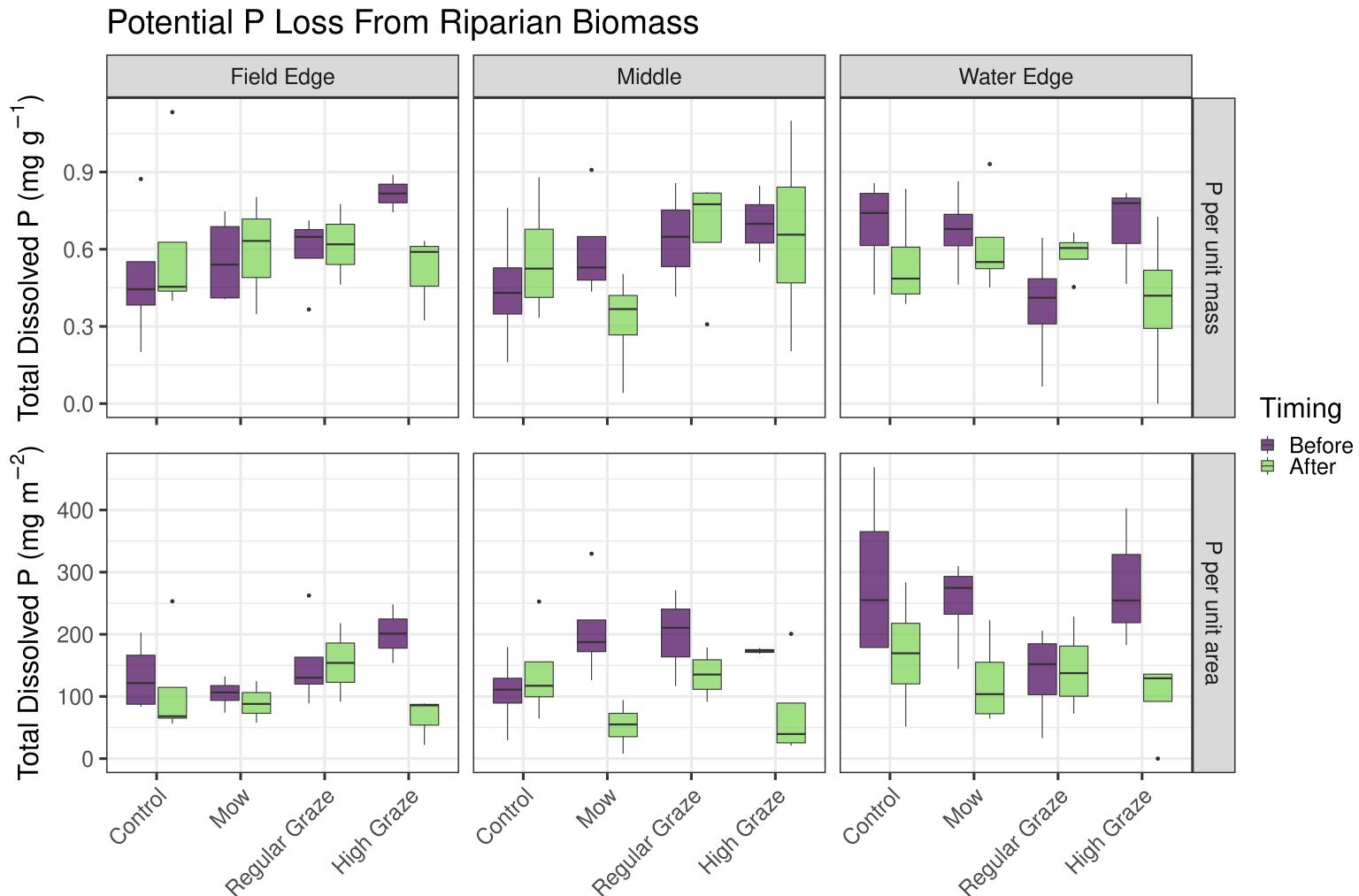
- 4 treatments
  - Control (do nothing)
  - Regular graze
  - High graze
  - Mow
- Distribution of P
  - Biomass
  - Litter
  - O horizon
  - Mineral soil



# Managing riparian areas

## Cattle grazing

- Preliminary results



# Whats next?

## Challenges and opportunities

- Addressing water quality and quantity before it gets to the riparian area
  - Remember riparian areas are the last line of defense
  - Practices that promote efficient use of water and nutrients should remain a priority

## Easier said than done!

- Management practices to address one issue may have unintended consequences

# Whats next?

## Challenges and opportunities

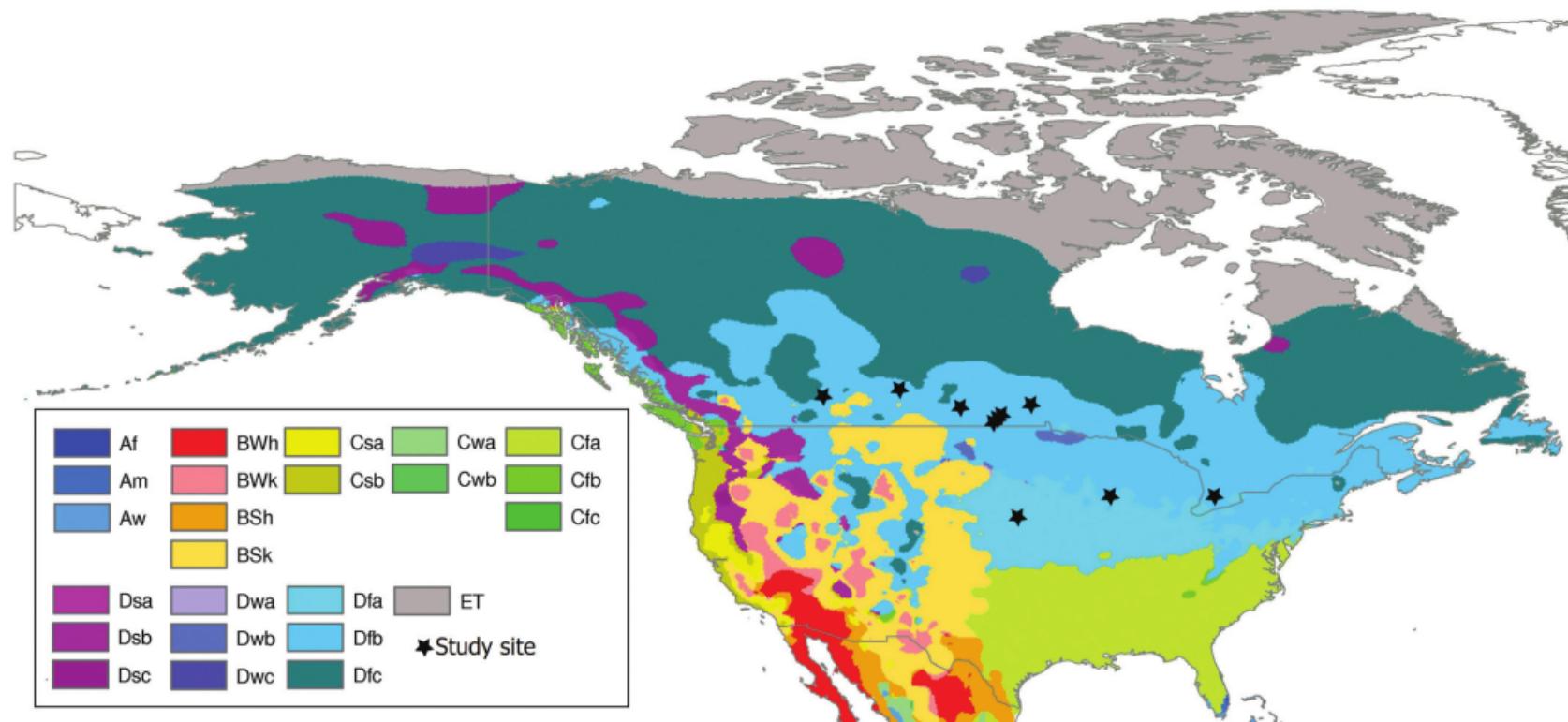
- The concepts of healthy soils and crops should be extended beyond the fence line
  - Farm doesn't end at the field edge
  - Need to balance other riparian functions



# Whats next?

## Challenges and opportunities

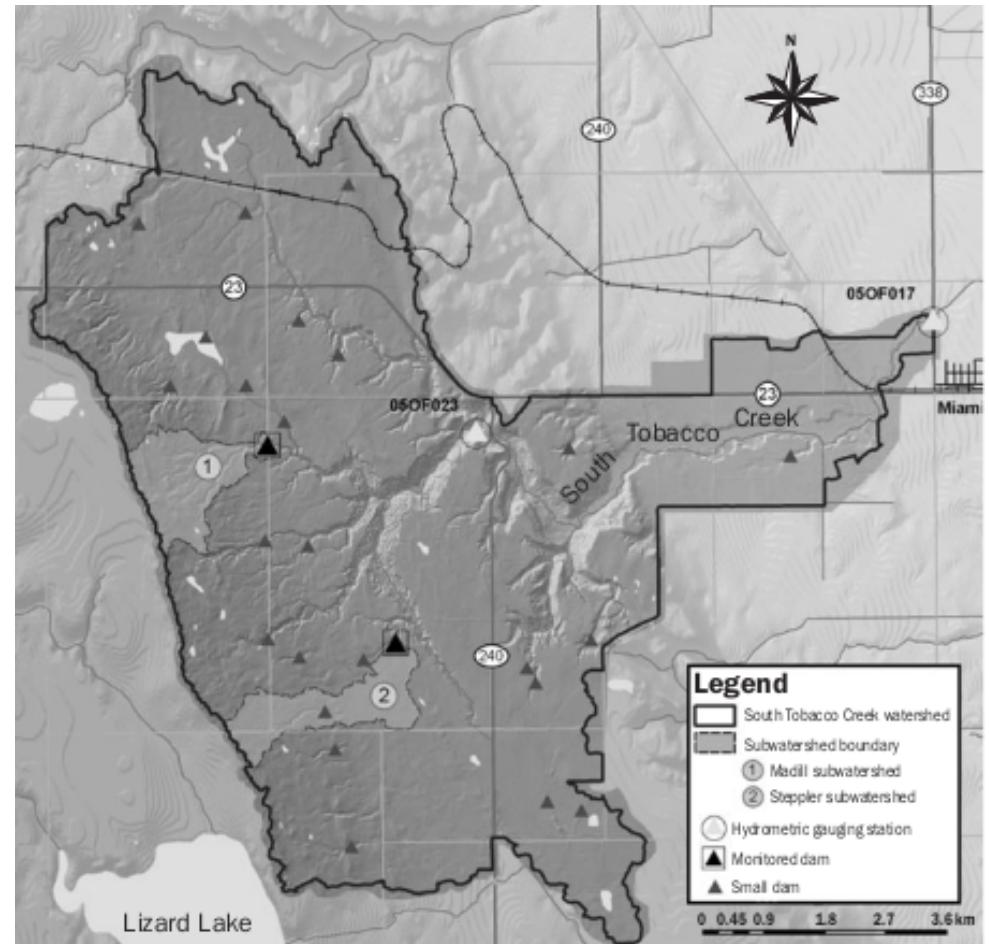
- Need home-grown cold-climate research to support decision making



# Whats next?

## Challenges and opportunities

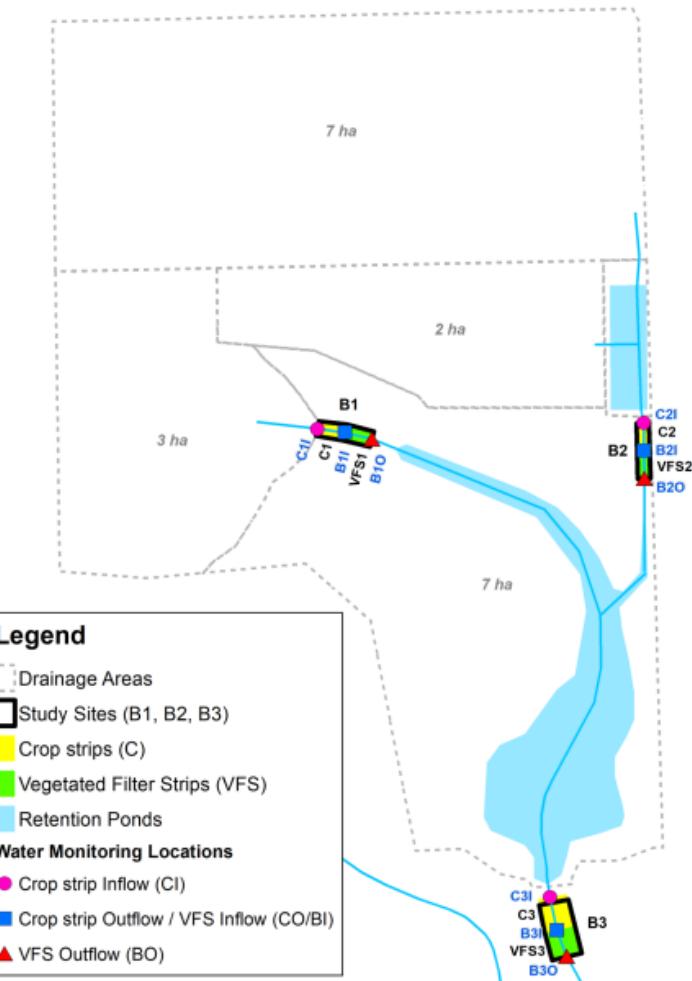
- Cold climate and snowmelt driven hydrology in the prairies means we can't completely depend on riparian areas to improve water quality
  - Other management options should be explored



# Whats next?

## Challenges and opportunities

- Cold climate and snowmelt driven hydrology in the prairies means we can't completely depend on riparian areas to improve water quality
  - Other management options should be explored



# Whats next?

## Challenges and opportunities

- Increases in the frequency of severe weather and flooding
  - Are riparian areas designed and maintained to accommodate this?
  - This is when we need riparian areas the most!



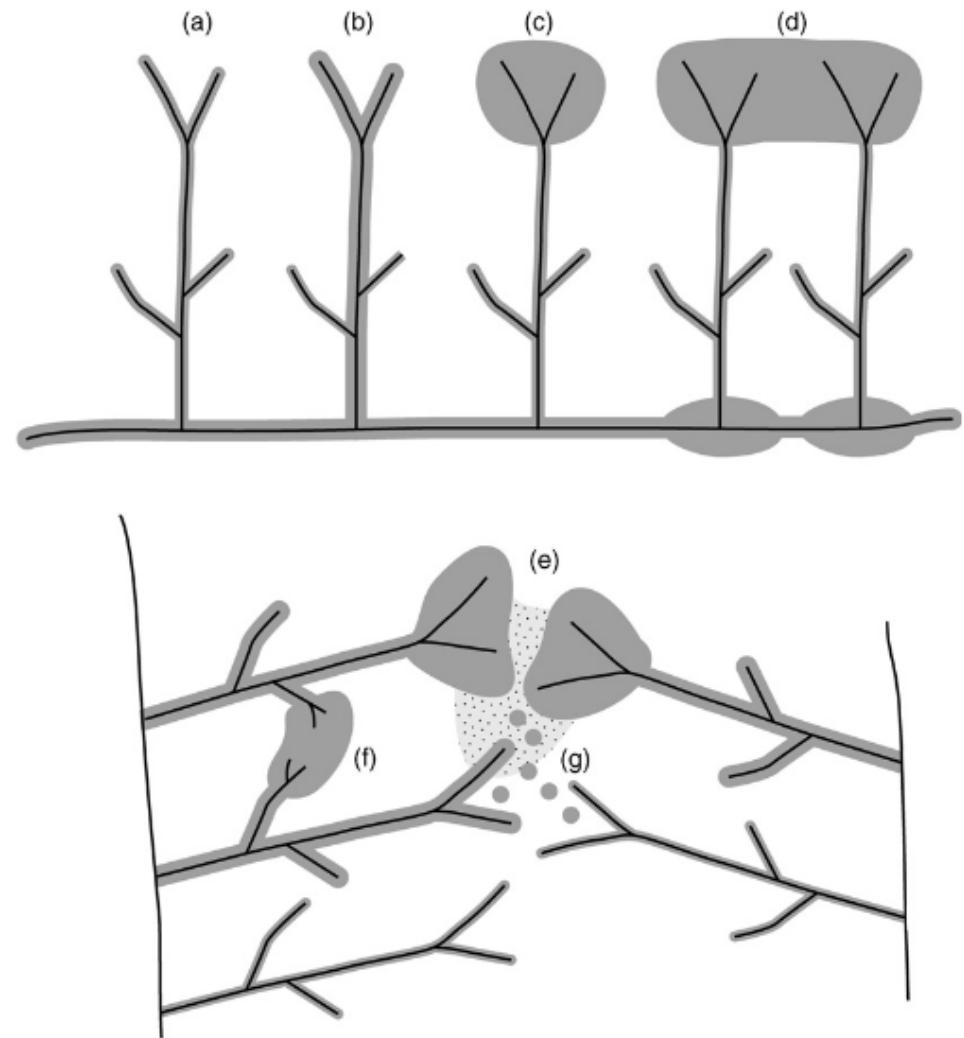
# Whats next?

## Challenges and opportunities

- Creative designs will likely take a team of people
  - Producers
  - Engineers
  - Hydrologists
  - Biogeochemists
  - Pedologists
  - Biologists
  - Ecologists
  - Economists

Implementation requires financial and technical support

"spaghetti and meatballs"; Olson et al. 2007



# Whats next?

## Challenges and opportunities

- If you have had good success, or challenges, with building, maintaining, and using riparian areas please come and chat with me
- It's a great way for me to:
  - Learn what others are doing (no need to reinvent the wheel, or make the same mistakes)
  - Explore the questions and directions research should be addressing
  - Make new collaborations

# Take home messages

- Multiple functions
- Cold climate & snowmelt driven hydrology
- Concentrated flows
- Part of the farm

Thank you!



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Slides: <https://github.com/alex-koiter/presentations> (PDF)

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