Watershed Adaptation Options

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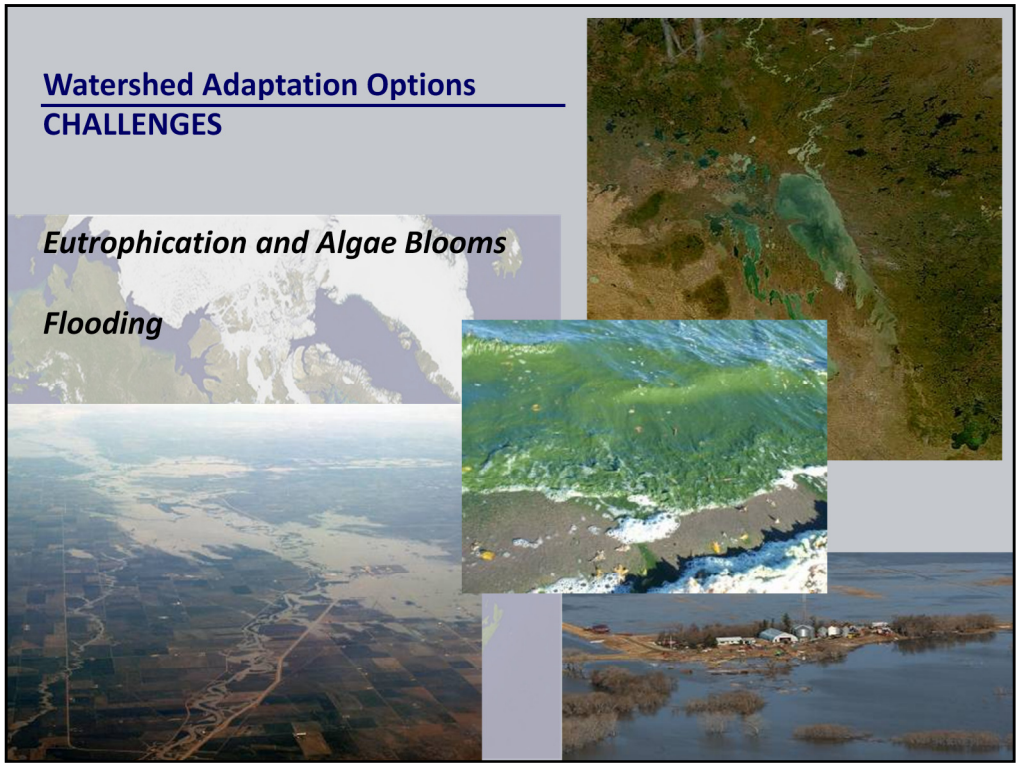
Living Lakes Canada
May 23, 2012
Winnipeg, Manitoba

UNIVERSITY OF MANITOBA

Today I am going to present some developing ideas that the Watershed Systems Research Program is beginning research on with its partners in the Lake Winnipeg watershed.



Here, in the Canadian Prairies, we face considerable challenges in managing our surface waters.

Most notable is the eutrophication of and algae blooms in Lake Winnipeg.

But, these and other water quality problems exist in many of our surface waters.

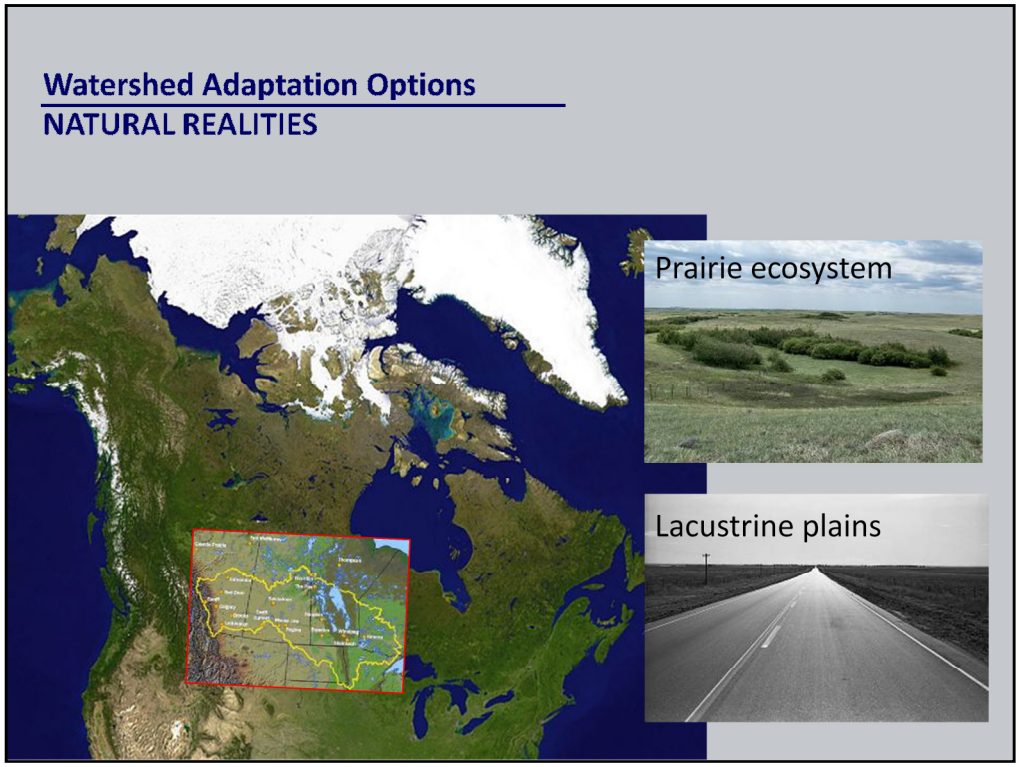
We also have flooding along the Red and Assiniboine Rivers.

Often resulting from snowmelt. Apparently, occurring more frequently, the biggest floods of the last century having occurred in the last 20 years.

Without significant human intervention, it is likely these challenges will intensify in the future.
We should expect more widespread, more severe, and more frequent flooding and algae blooms.
... we are on a trajectory, driven by increasing human pressures, climate change...

Even with intervention, it is likely that some of these challenges will persist well into the future.
... there is a legacy of nutrient loading in soils and sediments ... there will be a long, slow flush.

The status quo is becoming less acceptable, if not unacceptable.
A new ideas and new approaches **(Unconventional)** are necessary.



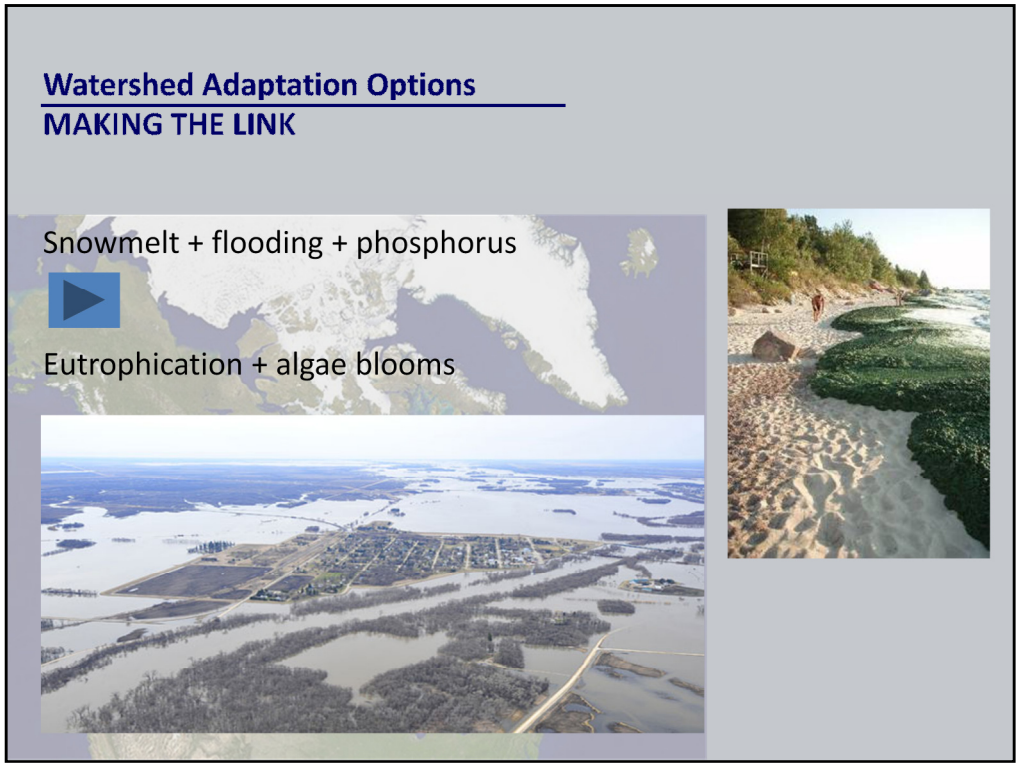
This is a large watershed in a prairie ecosystem. We are working with a water deficit – potential evapotranspiration exceeds precipitation

The problem is that we have too much water some times, and too little other times...season to season, year to year. ... a situation amplified within the landscape through runoff.

The floodplains receiving runoff are extensive, nearly level impermeable clays, and the receiving lakes are very large and very shallow – they are highly sensitive to excess water and its contaminants.

Since the land was settled, the land has been drained to create productive farmland that has helped to build Canada.
However, it is undeniable that with agricultural land occupying large parts of the flood plain it is a major contributor to runoff leading to flooding, and to nutrients losses leading eutrophication and algae blooms.

Farm, municipal and provincial drainage structures have greatly exacerbated this contribution.



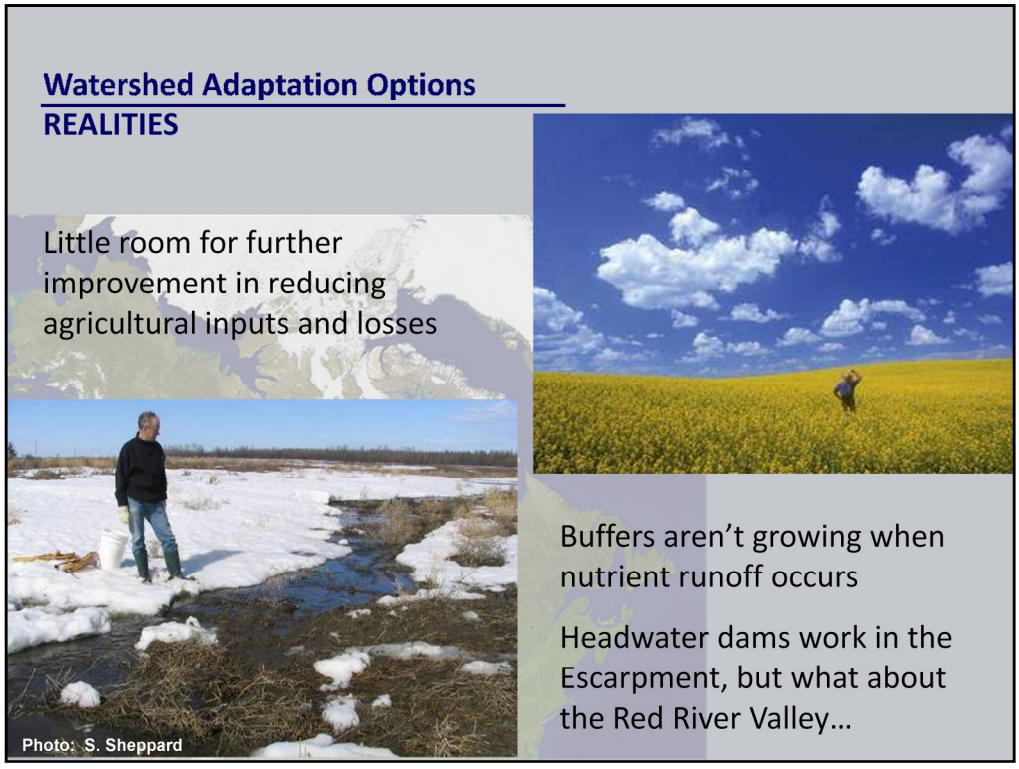
And, these two issues are related.

We recognize the strong linkage between snowmelt runoff, flooding, phosphorus contamination of surface waters, and eutrophication of and algae blooms in lakes.

To manage water quality, we must manage surface water runoff

To reduce nutrient losses – traditional approaches:
-Manage inputs of nutrients through nutrient management plans
-Reduce soil erosion through conservation tillage
-Planting riparian buffer strips

To reduce flooding – traditional approaches:
-Headwater dams to reduce downstream flooding
-Holding water on fields and releasing once risk of downstream flooding has reduced



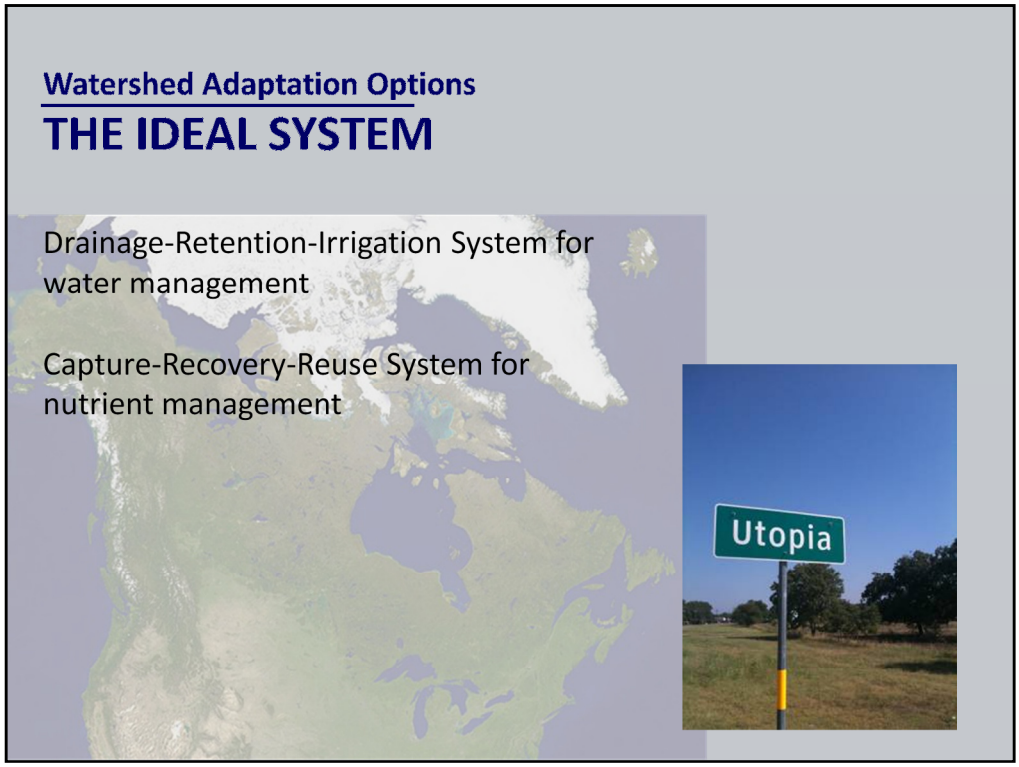
What we know about these management systems in the prairies

There is little scope to reduce field losses much further, and there is a legacy of nutrient applications in the system such that if nutrient inputs stopped tomorrow, nutrients would continue to be lost.

Most of the nutrients, particularly phosphorus, are in a dissolved form in snow melt

Conservation tillage increases the losses of dissolved phosphorus (probably lost from decayed plant material)

Most of the phosphorus is lost at a time when buffer strips are not growing and able to take up nutrients.



With more extreme weather events anticipated through climate change, we need to think in a different way…

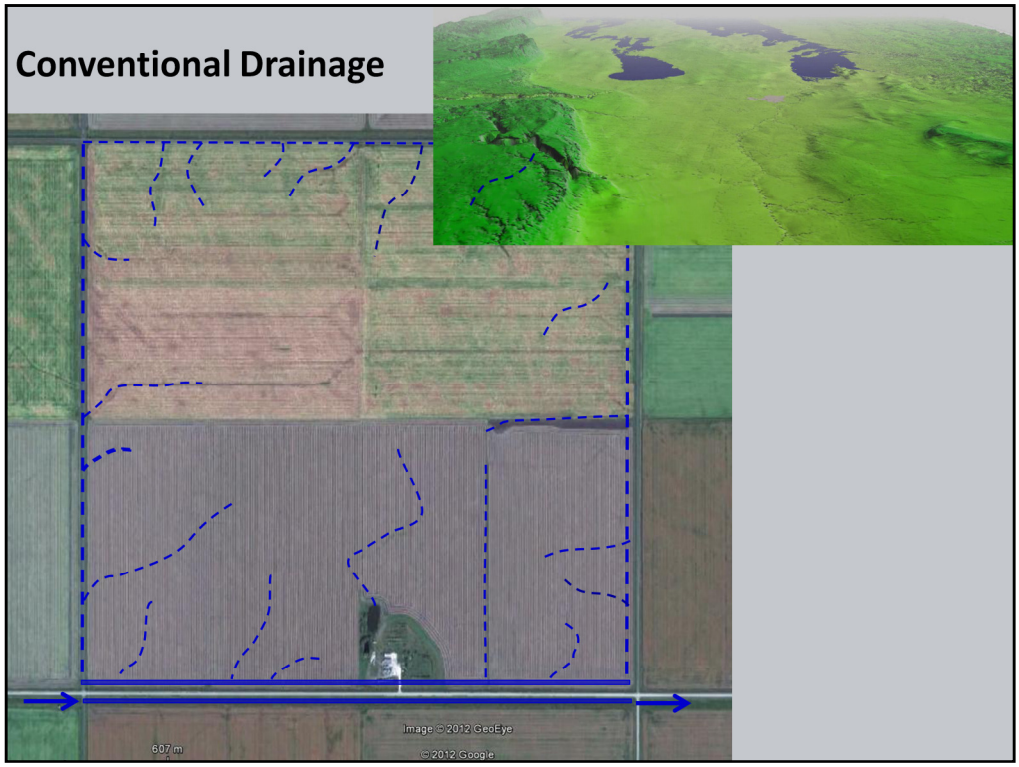
In an ideal world

Water, a precious resource in drier times, would be retained for use when the crops need it

And the nutrients contained within the water would be recovered and available for crops that need them

Drainage-Retention-Irrigation System for water management
Capture-Recovery-Reuse System for nutrient management

...a combination of the two...

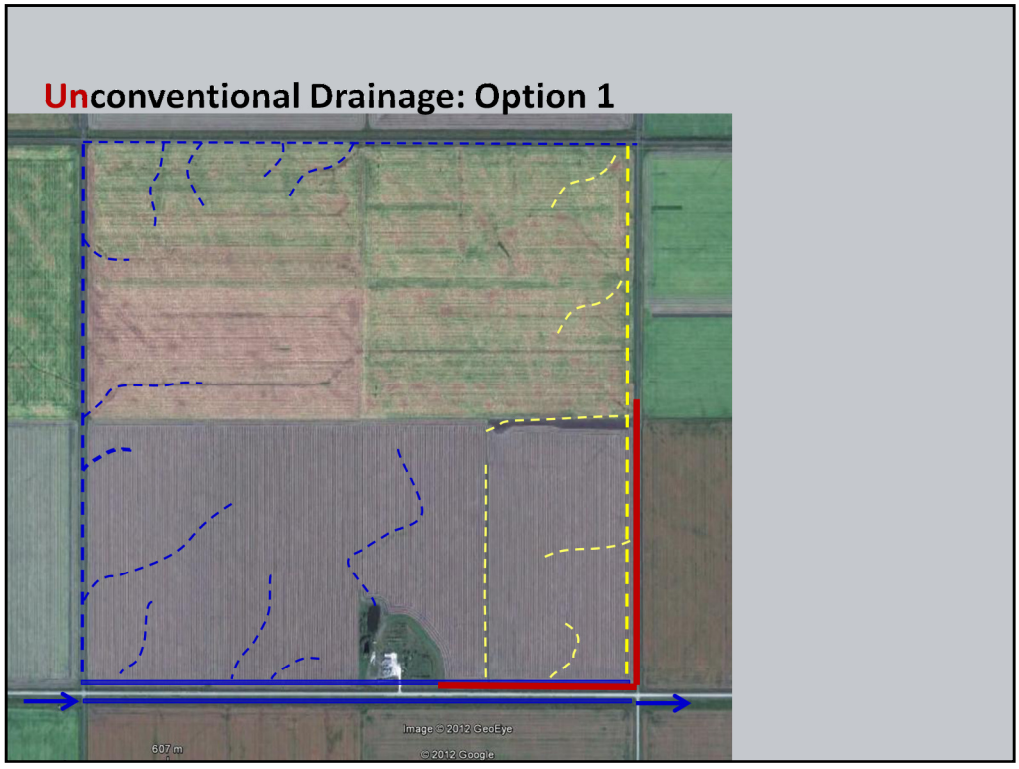


What are we working with.... A typical unit of farm land in the Red River Valley, where field drains link up with larger roadside drains.

The existing drainage system ... not highly effective.
Conveys runoff from farm fields downstream as fast as possible ... treats water as waste.
Not realizing all of the potential benefits of the limited water which is available.

Drainage ditches are often choked with cattails and weeds,
filled with sediment,
littered with garbage
and lined with utility cables and poles

Often banked to prevent ditch water from upstream flooding fields.

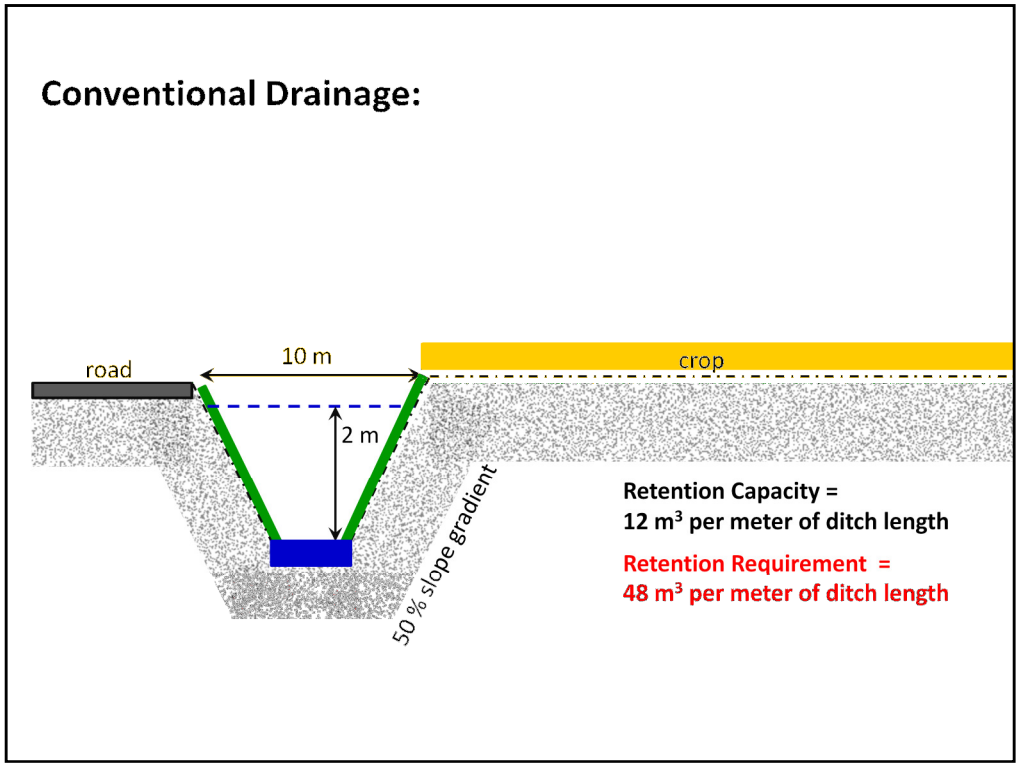


One Option:

Back-Flood Dams –> similar to Waffle Design, using the existing drainage system

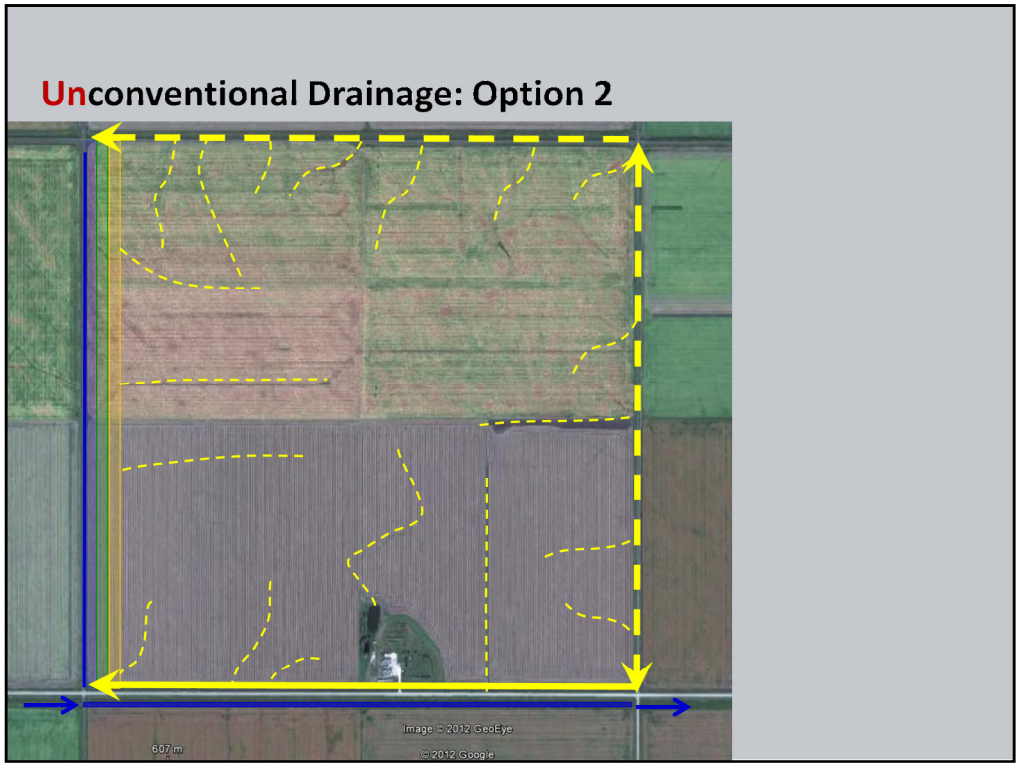
May have value for forage/grazing, enhances biomass production over the growing season

... More efficient use of water and nutrients... temporarily retains surface water



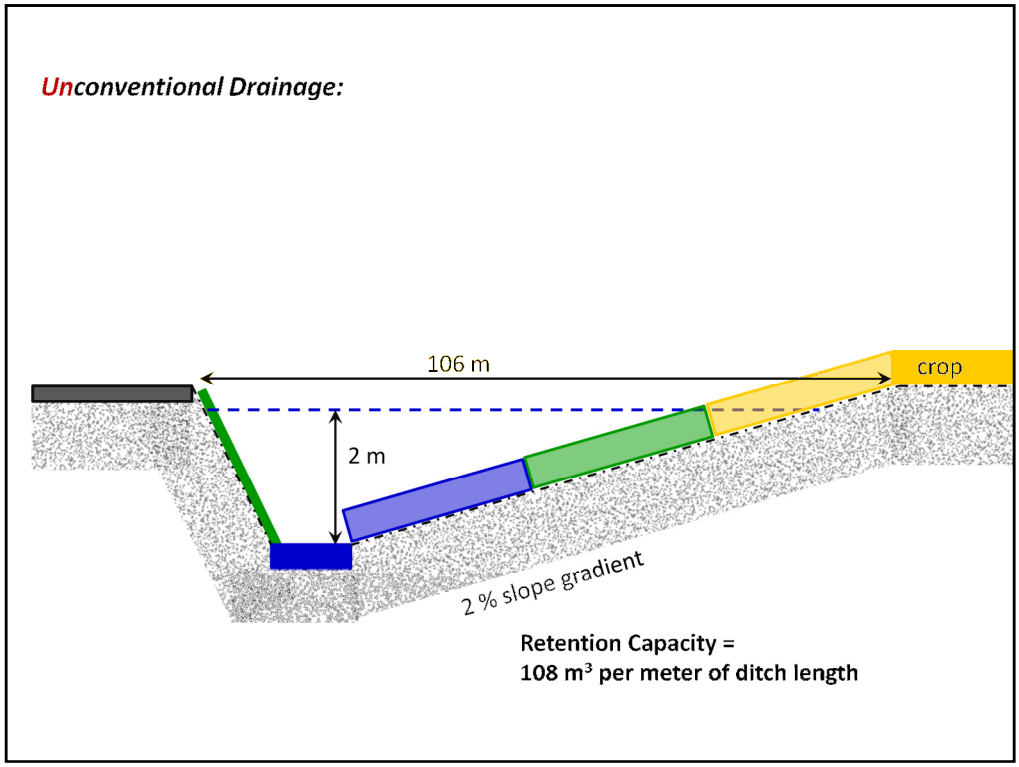
Existing ditches are designed to convey runoff and have limited capacity to store runoff, even temporarily. The existing ditches have the capacity to store about ¼ of the average annual snowmelt run-off

The design of existing ditches do not provide for filtering and capture of nutrients by vegetation, but you could harvest the vegetation that grows in them for nutrient recovery.



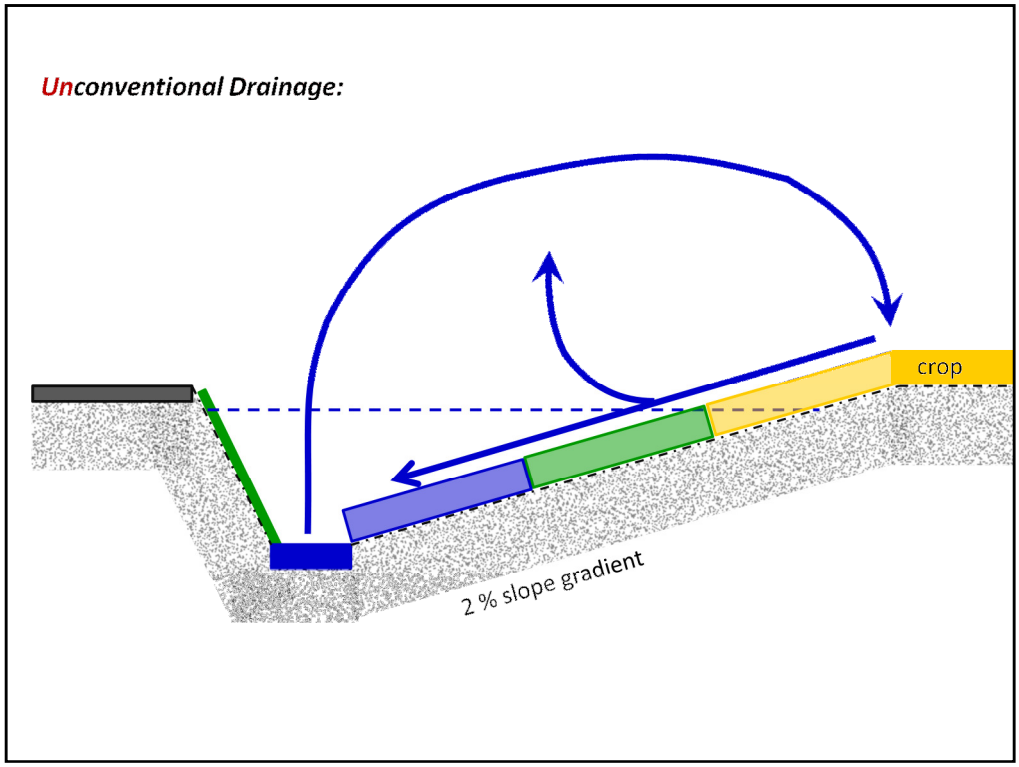
Use the existing ditches and expand them.

... temporarily block Finger Ditches (terminal main drains)



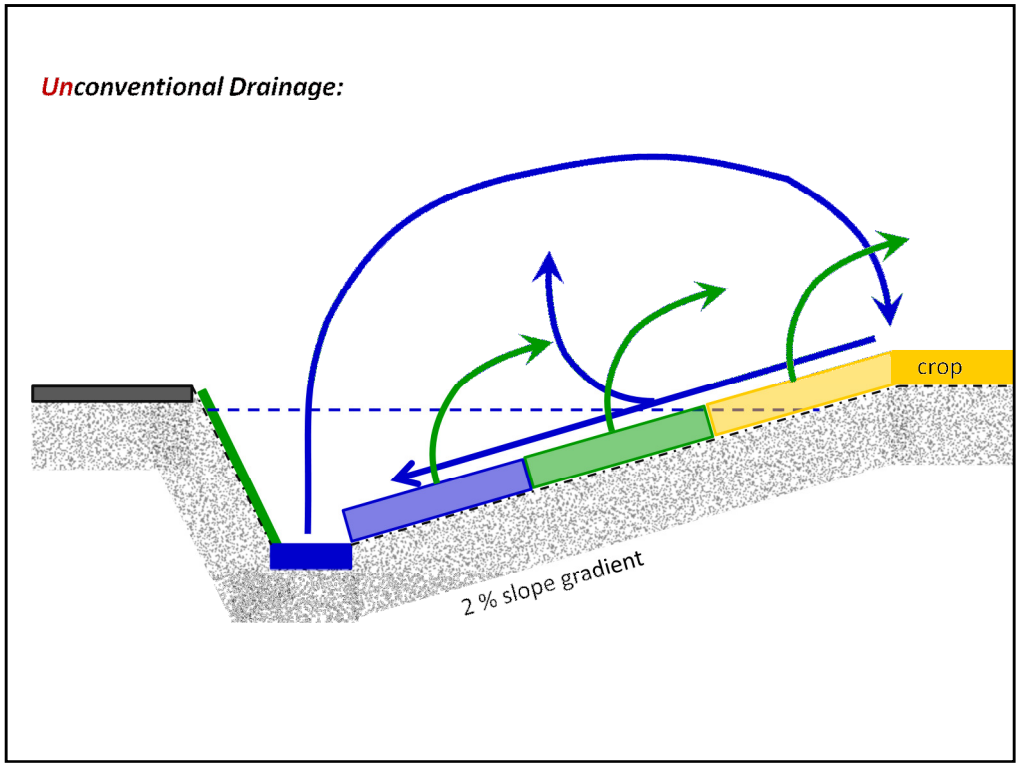
Retention of Runoff

Delayed release to reduce downstream impacts

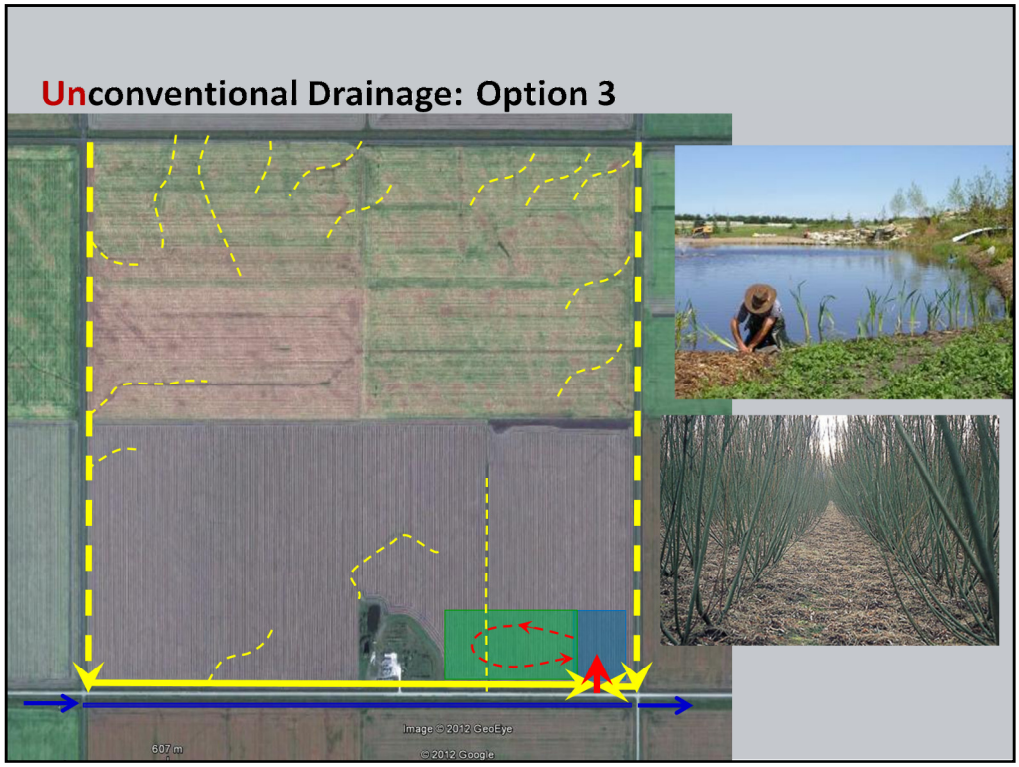


The benefits of this option are that you could

Irrigate onto a filter field using the retained water – the plants will use the water and nutrients, and evapotranspiration is enhanced



The nutrients can be removed from the system if the biomass growing there could be harvested.

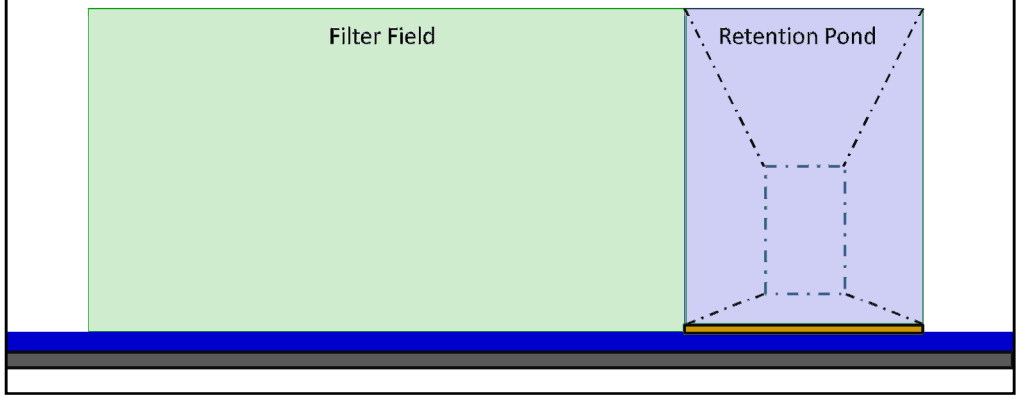


This option uses the existing ditches to collect runoff and direct it to a dug retention pond or filter field system, so the water and nutrients can be effectively and efficiently applied to a growing crop.

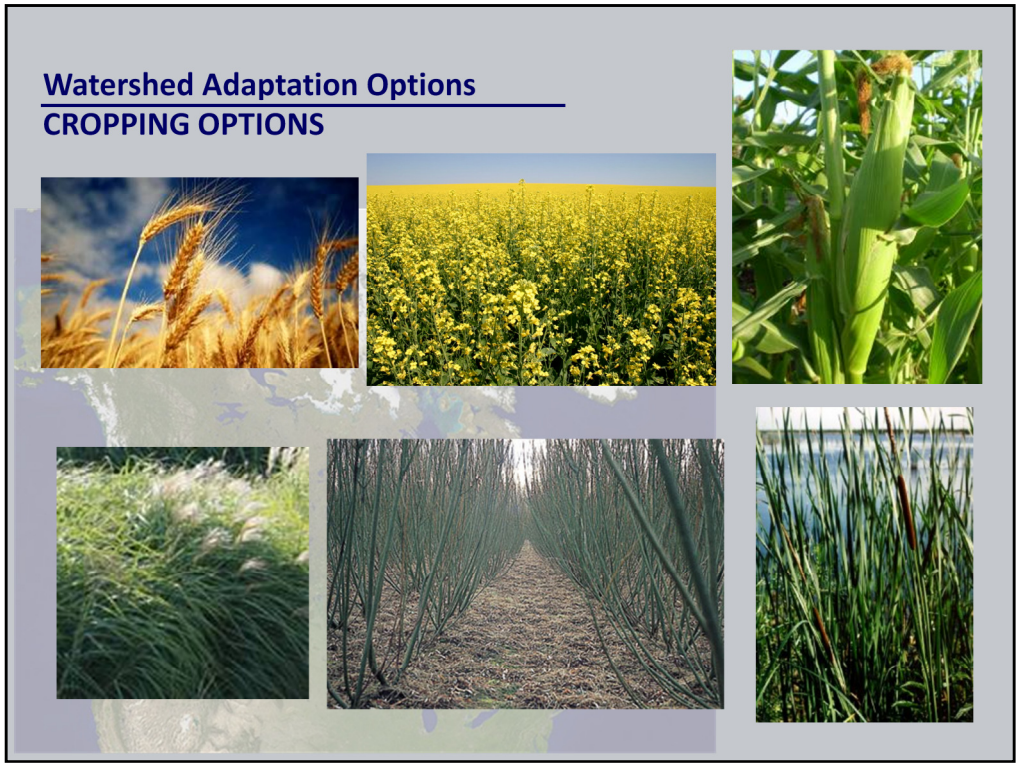
With all three options, the goal must be to:
Retain and reuse most of the water and nutrients in most years, 9 of 10 years, 19 of 20 years,
even 4 or 5 would be a significant improvement.

Not all of the water and nutrients. We must accept the inevitability of extreme events and manage appropriately.
What are we working with.... A typical unit of farm land in the Red River Valley

Unconventional Drainage:



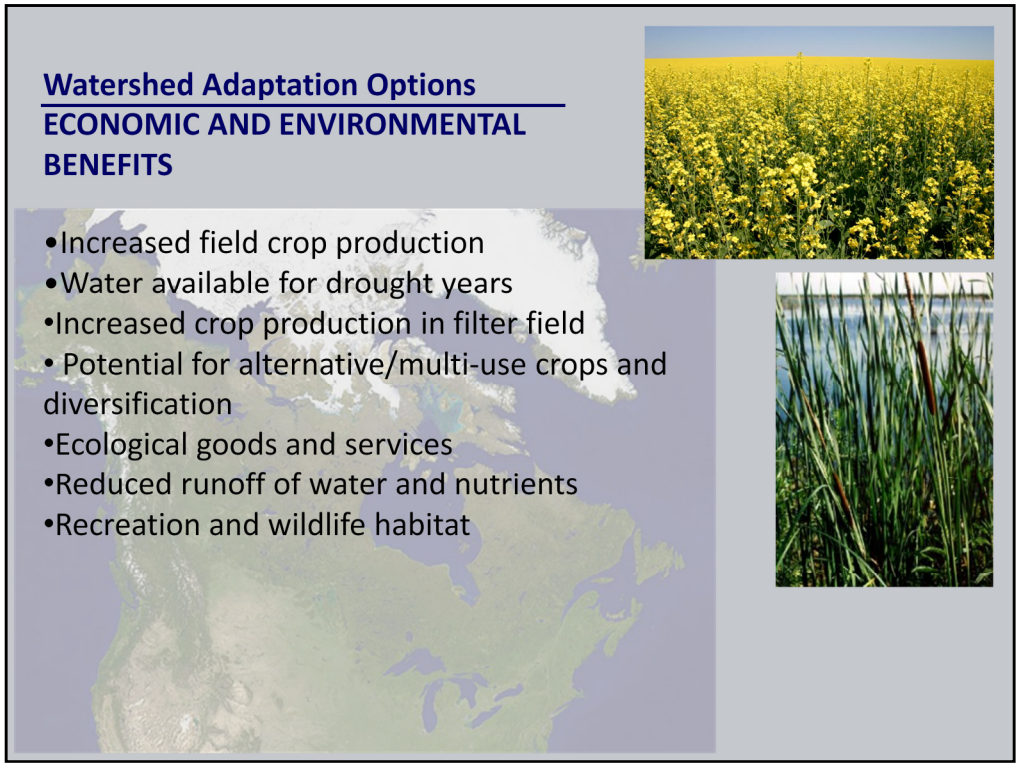
Water retention



Cropping options under these systems include conventional crops such as wheat, canola corn or forage crops that would benefit from irrigation

Or growth of biomass crops for alternative niche uses.

Lots of possibilities for diversification!



Direct On-Farm Economic Benefits are necessary to justify implementation!!

Increased field crop production through better drainage.

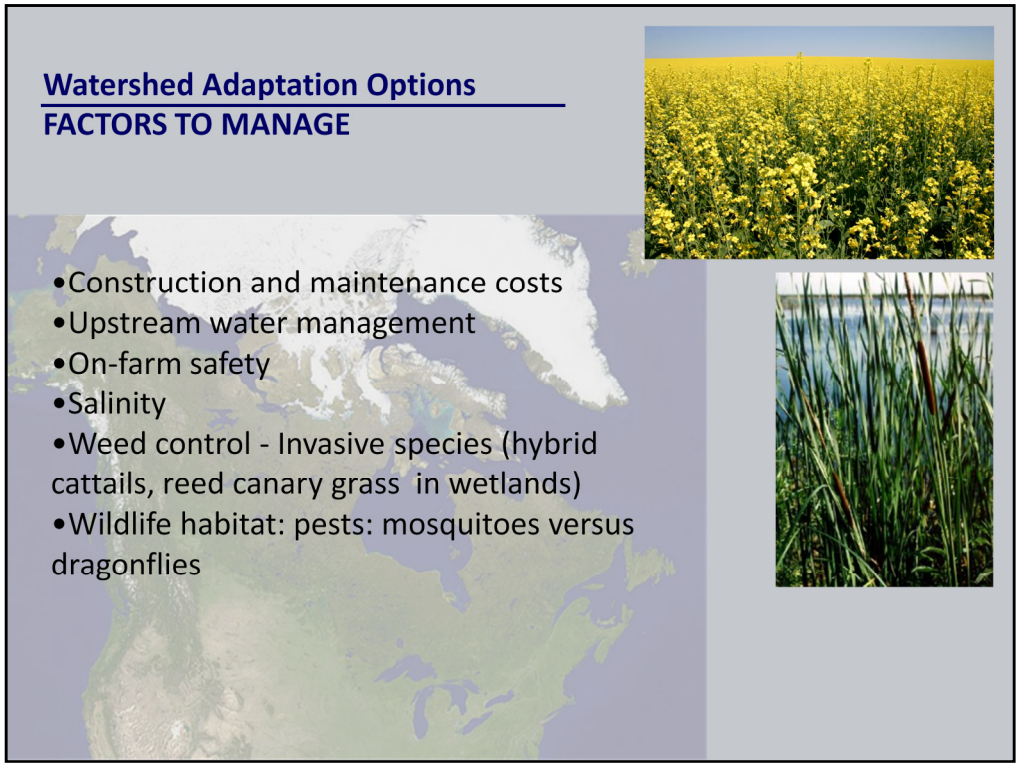
Potential for irrigation of field crops in drought years.

Increased crop production in filter field from added water and nutrients.

Potential for alternative crops and diversification using the filter field.

Threats to be managed:

Construction and maintenance costs
Upstream water management
On-farm safety
Salinity
Weed control - Invasive species (hybrid cattails, reed canary grass in wetlands)
Wildlife habitat: pests: mosquitoes versus dragonflies



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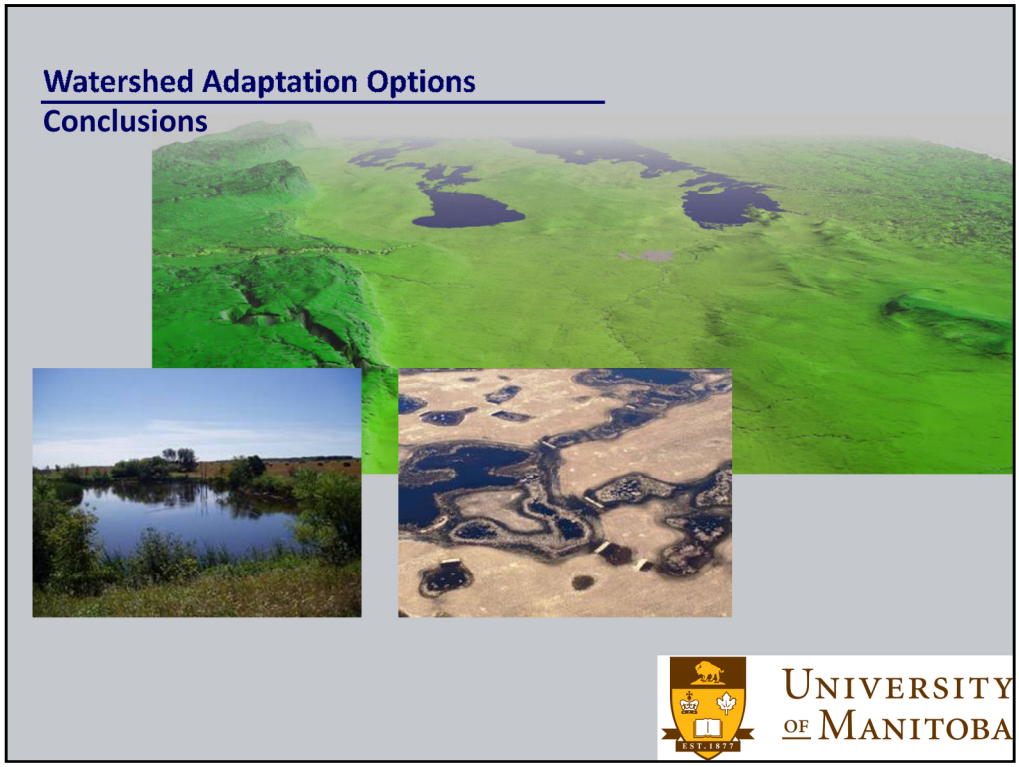

There is a need for Unconventional drainage systems for agricultural lands
Systems that integrate a Drainage-Retention-Irrigation System for water management
and a Capture-Recovery-Reuse System for nutrient management.

We already see elements of such systems in Manitoba
- Retention dams in the Escarpment Region
- Restored wetlands in the Prairie Pothole Region

And we are finding a great deal of interest amongst Manitoba landowners in managing water differently.

The big challenge is the Red River Valley, the dominant contributing area for phosphorus loading into Lake Winnipeg, ... and the land at greatest risk of flooding.