Tile Drainage:
some basics

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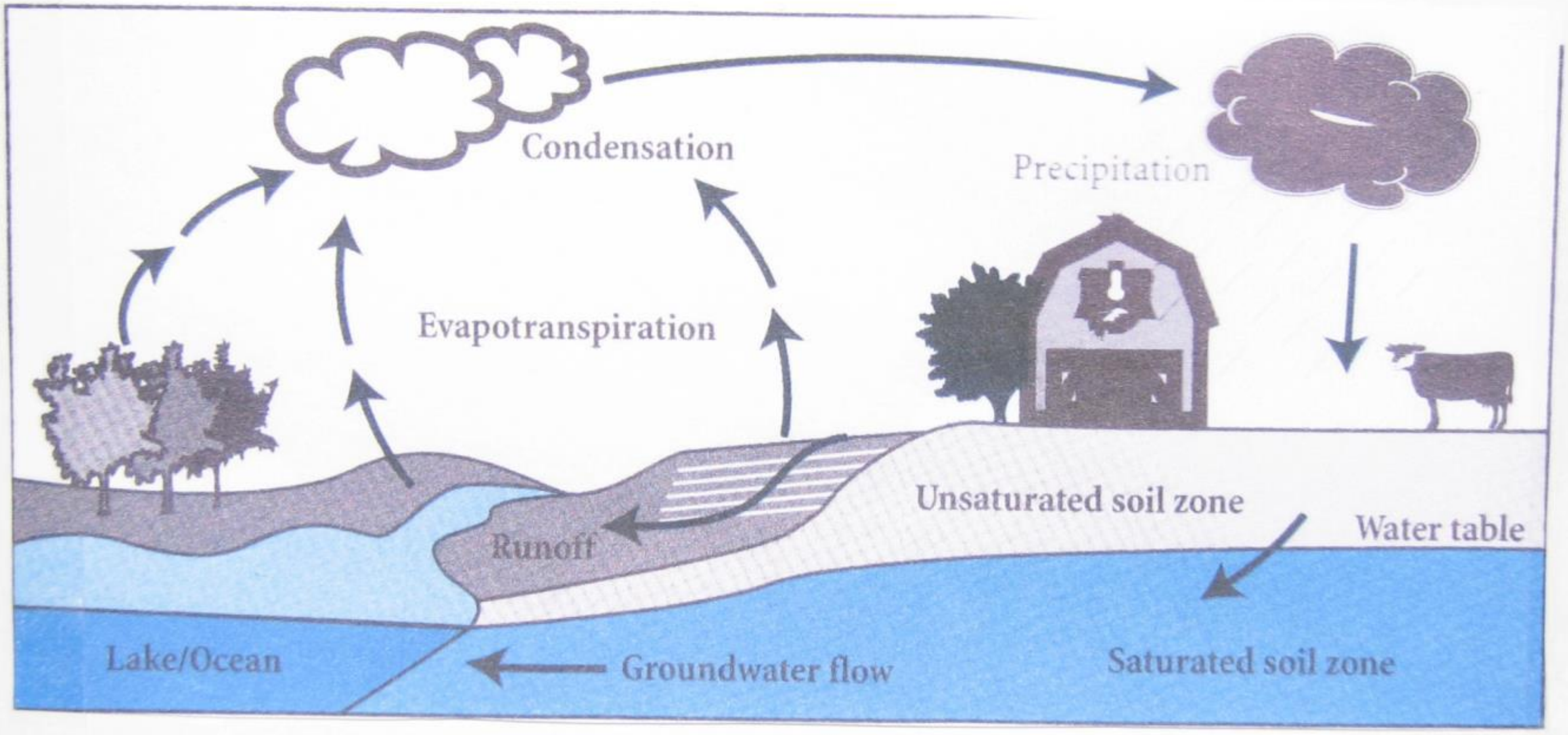
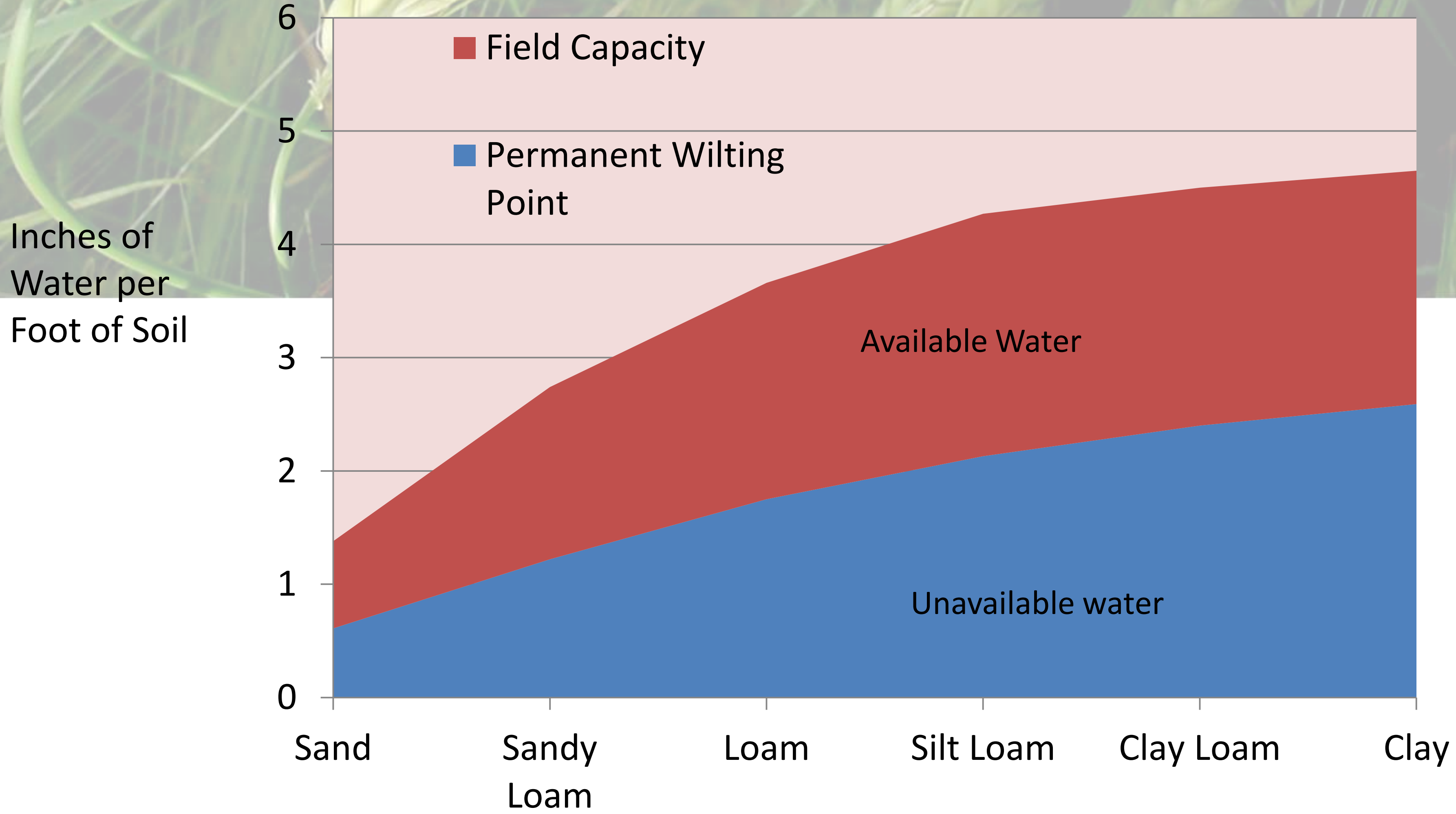
Outline

- The Basics of Soil Water
- Why tile drainage
- How it works
- NARF tile drainage project



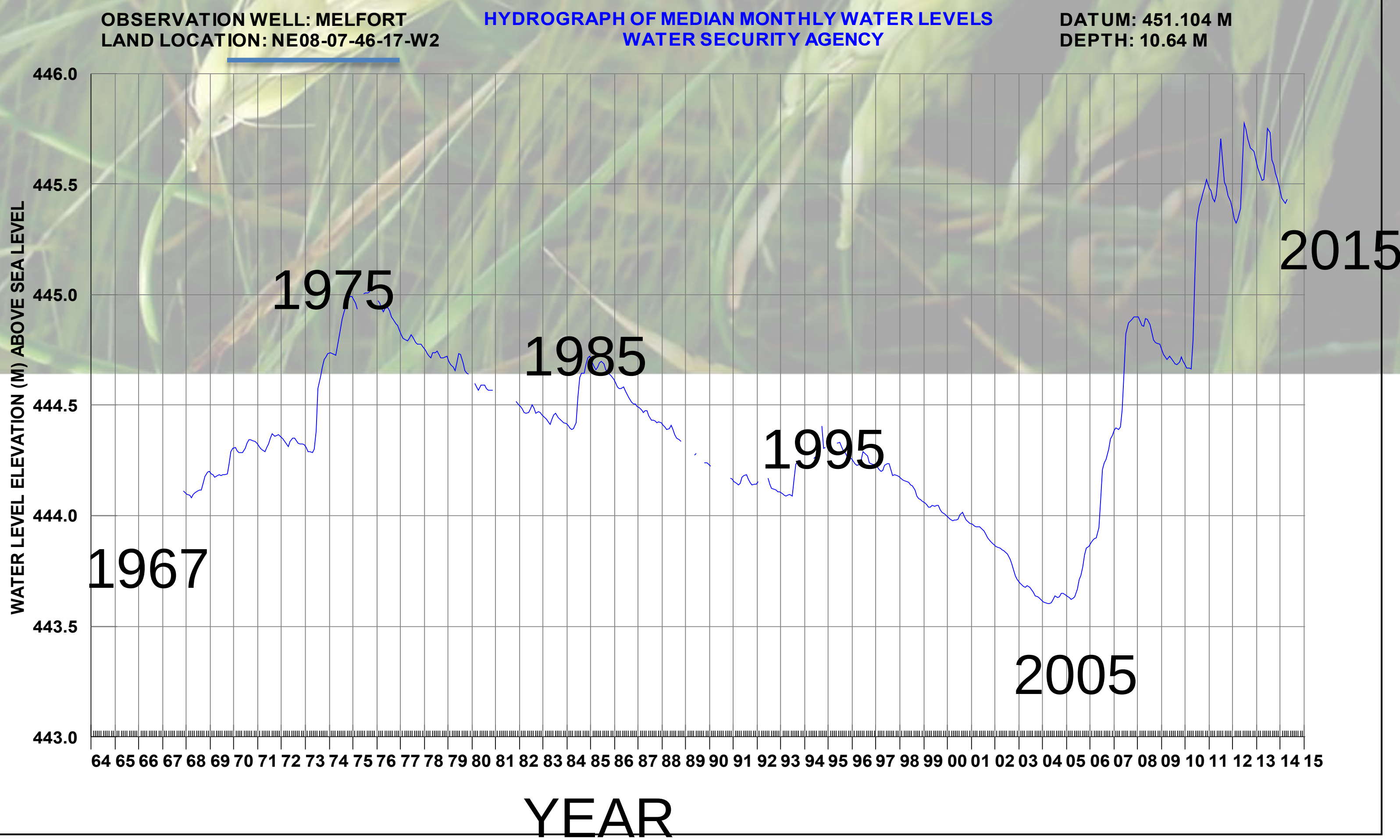
The Hydrologic Cycle

Relationship Between Soil Texture and Soil Water



MELFORT OBSERVATION WELL : 1967: Meneley

Well Depth : 35 feet : Water level now 15 feet below ground



Water tables are higher in NE SK than they have been in the past 50 yr

Observation Well Data Available at:

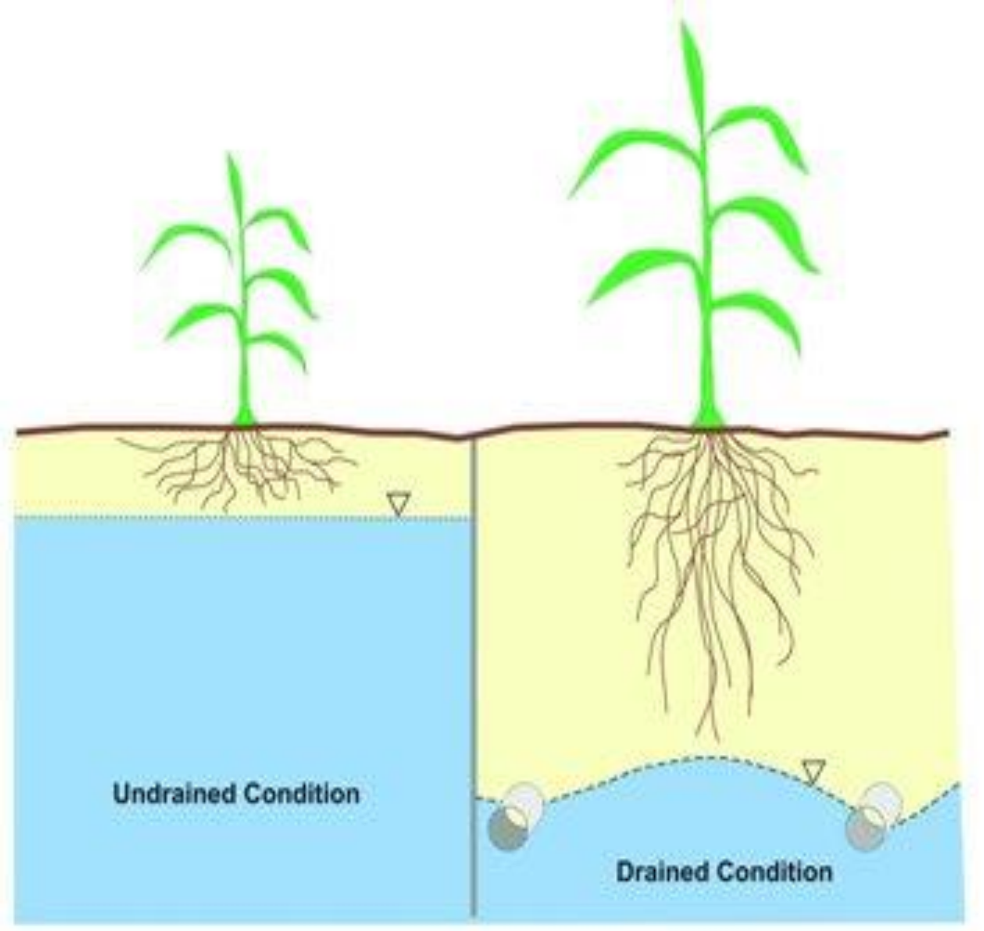
www.wsask.ca

(Water Security Agency Moose Jaw)

Why Tile Drainage?

- Excess water regularly limits crop production
  - Roots need oxygen to function, and saturated soil has no oxygen
- Potential to correct saline soil by leaching out salts

Tile Drainage Effect on Crops

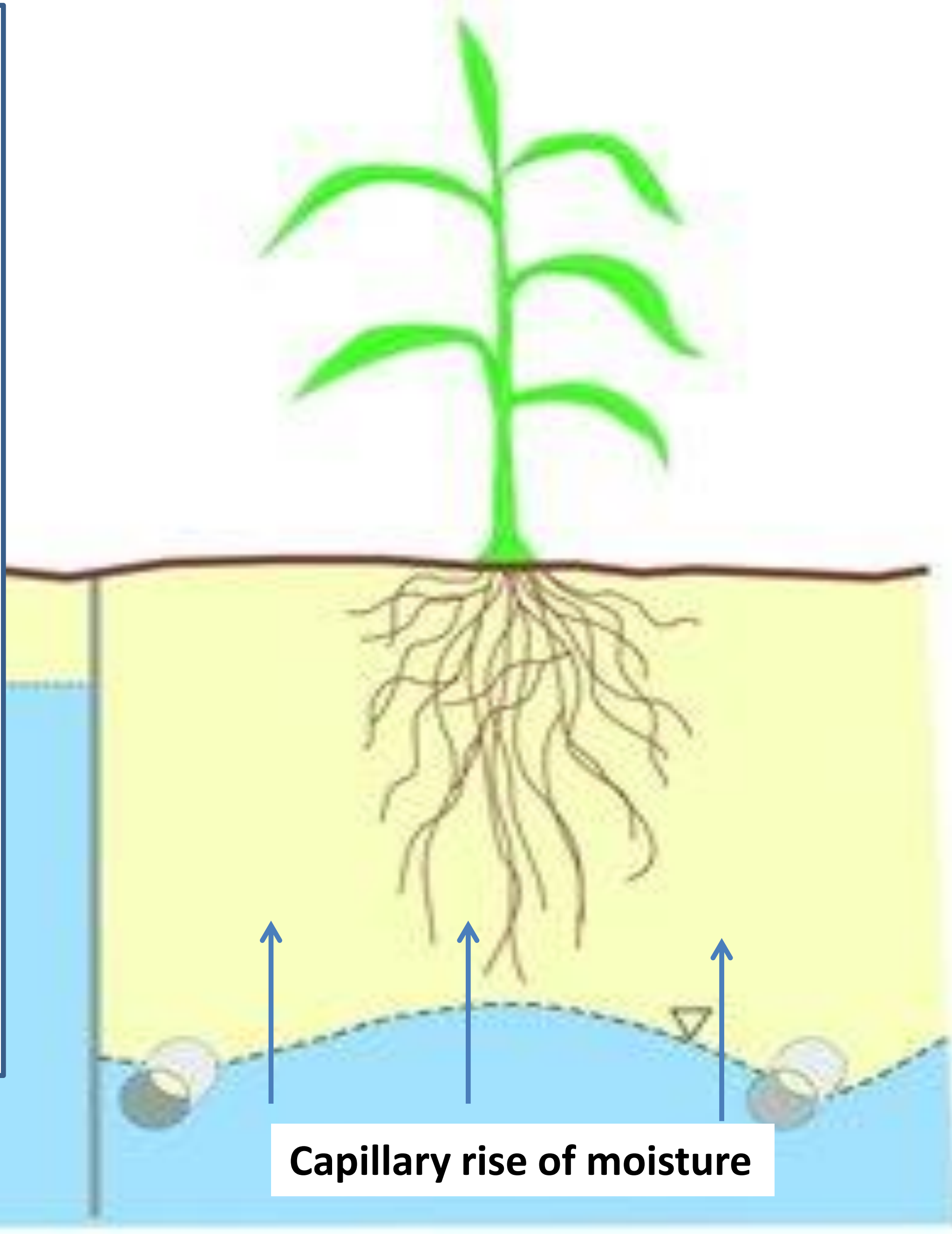


Canola and barley in saturated soil

Removal of excess water

- Increases water use by crops
- Increases crop growth and grain yield
- Increases temporary storage space in soil for water from rains or spring runoff.
- Reduces surface runoff and delays peak streamflow after rains.
- Can leach salts from saline soil.
- Allows more timely field operations with lower equipment costs

Drained soil can benefit from subsoil moisture



Yield Improvement (%) with Tile Drainage

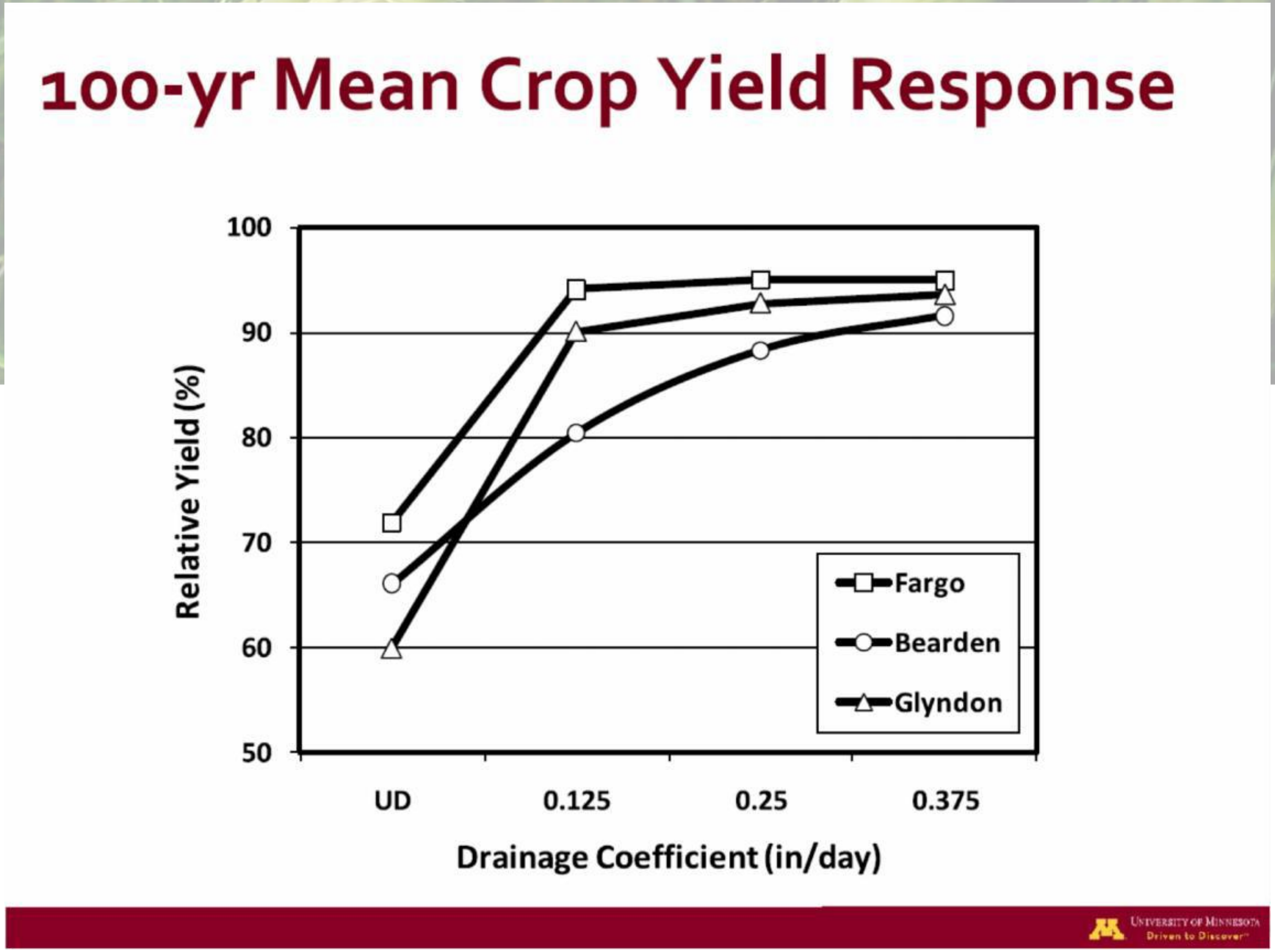
Crop	Manitoba[1] 1990's	Ontario [2] 1979-1986	Iowa [3] 1984-1986	Ohio [4] 1962-1980
Spring grains	20	22		
Winter wheat		17		
Corn	20	26	10-45	20-30
Soybean		7	4-15	7-14
Potato	10-50			

[1] Verbally reported in surveys; [2] Irwin, 1997; [3] Kanwar *et a*l 1988;
[4] Schwab *et al* 1975, and Schwab *et al* 1985

DRAINMOD Results – Red River Valley ND

Sands, 2011; Sands et al. 2013

http://www.redriverbasincommission.org/Conference/Proceedings/28th_Proceedings/Sands.pdf



Producer Results from MB 1990s –

Anecdotal - Largest Tiled Farm Reported Benefits

- • **BENEFITS SEEN !**
- – Earlier start
- – Reduced drown out
- – Access for spraying and cultivation
- – Compaction reduced
- – HOPE for salinity reduction
- – Better timing and utilization of fertilizer/pesticides
- – Decreased surface runoff

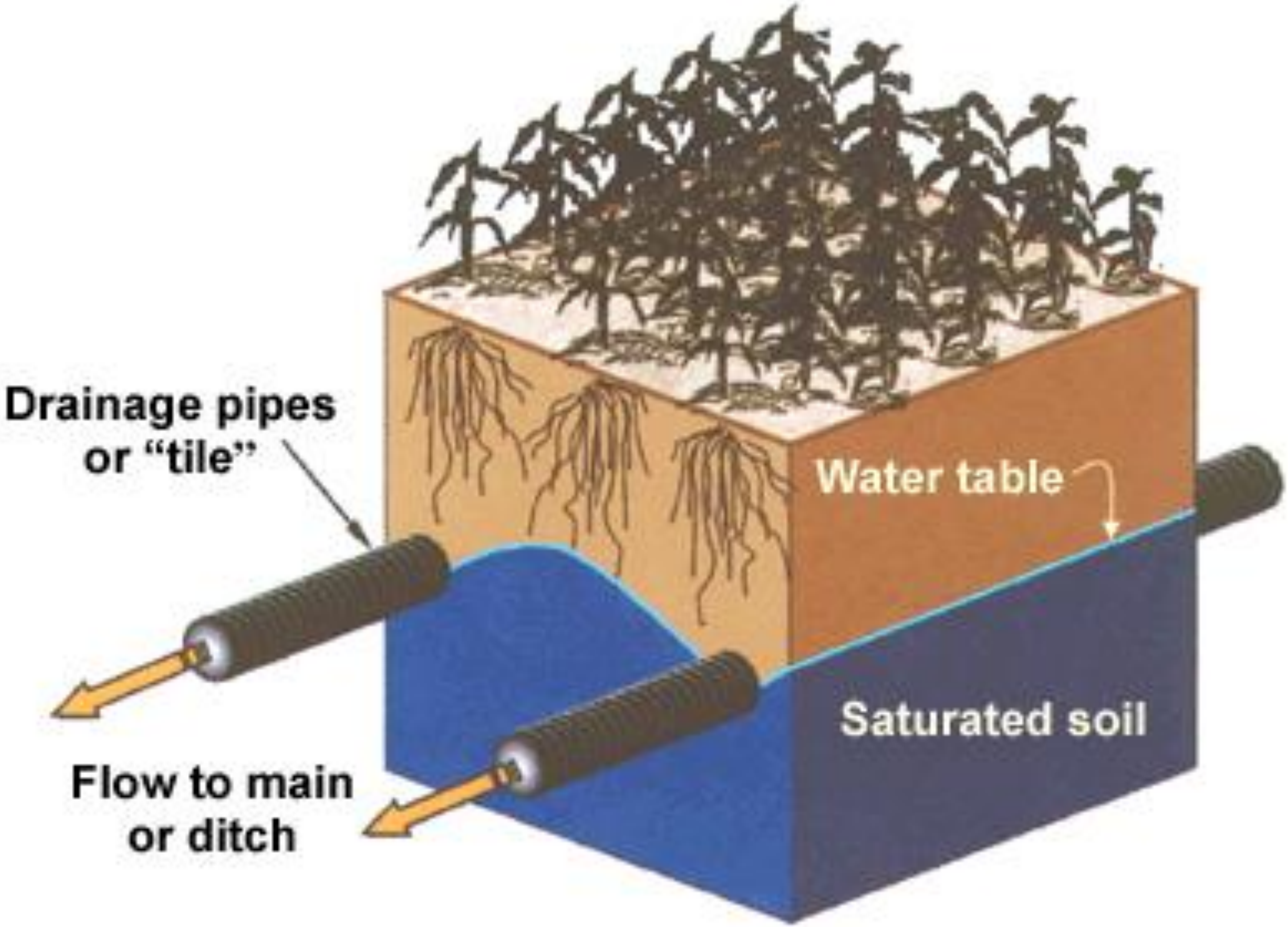
Where Tile Drainage Fits Best

- High value crops
- Coarser textured soils
- Crops with low tolerance to excess water
- Level topography
- Large amounts of surface residues
- Poor surface drainage
- Ample or excessive precipitation
- Seeding and harvest times are critical

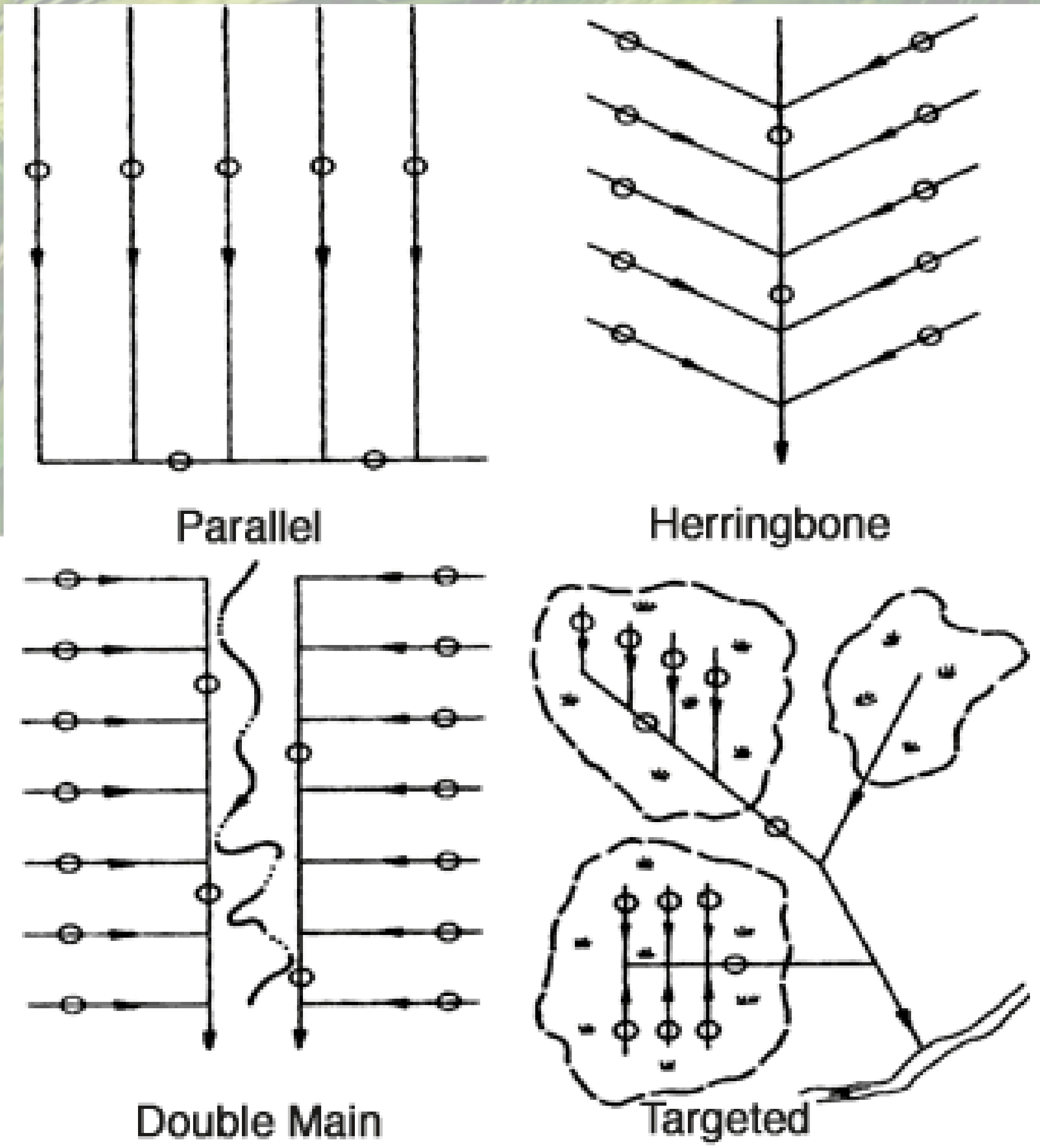
Parallel Drain Spacing and Depths (ft)

(Source: University of Minnesota)

		DRAIN SPACING (FT)		
Soil Type	**Soil permeability**	**Good drainage**	**Excellent drainage**	**Drain depth**
Clay loam	Very low	50	35	3.0-3.5
Silty clay loam	Low	65	45	3.3-3.5
Silt loam	Mod Low	90	60	3.5-4.0
Loam	Moderate	140	95	3.8-4.3
Sandy loam	Mod high	210	150	4.0-4.5


Drainage pipes
or "tile"
Water table
Saturated soil
Flow to main
or ditch

Tile Designs



Parallel

- most commonly used design
- usually the most efficient and cost-effective
- The header pipe is installed along the field edge (or edge of the area to be tiled) and the laterals tee in at regular intervals.

Targeted

- designed to target smaller problem areas where other parts of the field do not require drainage.
- Usually a main pipe will be installed and then submains and laterals branch off it.
- This method is best suited to rolling land or fields with springs or salinity pockets.

Where will the water go?

- A tile installation is only feasible if there is a viable outlet
- Point of adequate discharge

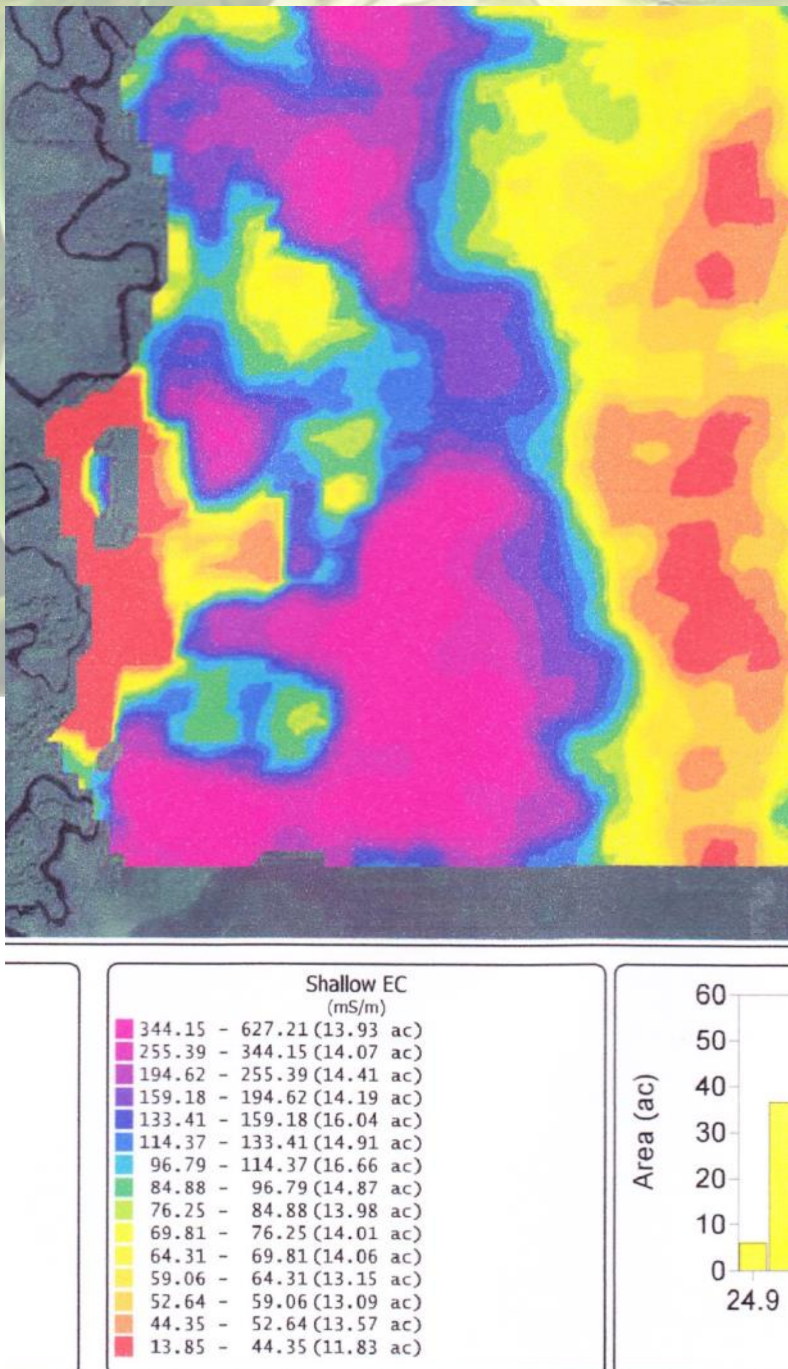
Tile Drainage Project

- Initiated in fall 2014
- Funded by co-operating farmer, NARF, ADOPT and Shark Ag consulting
- 40 acre site 1 mile E of Melfort Research Farm

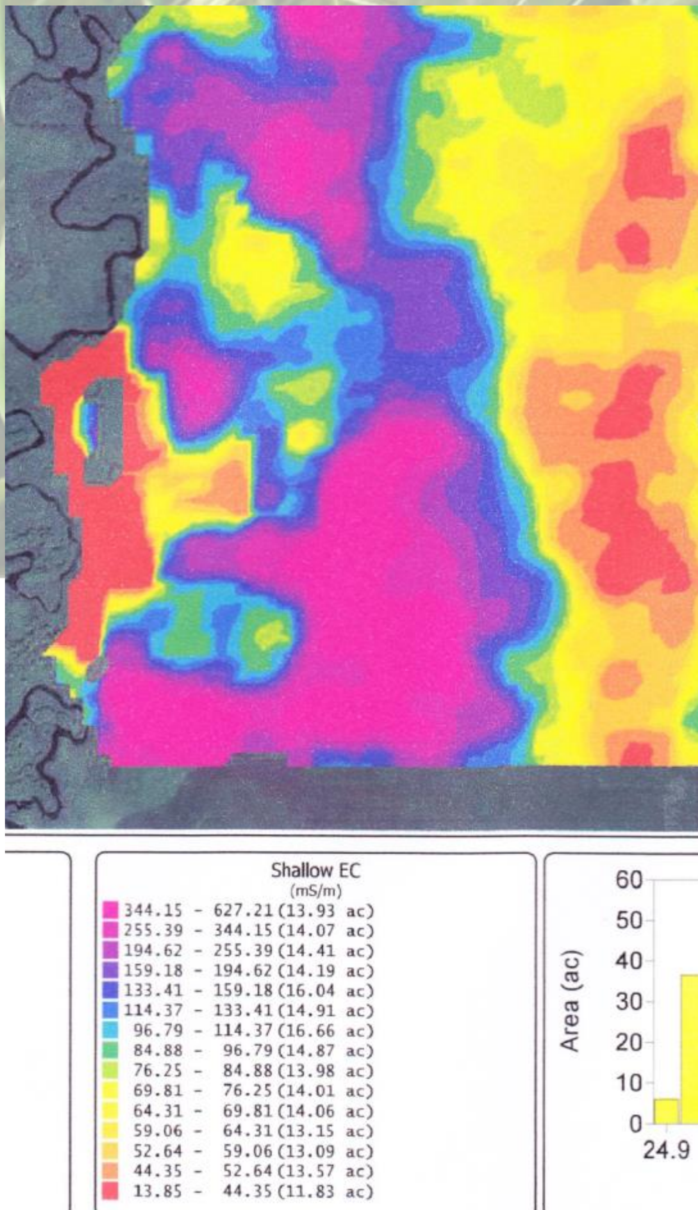
Tile Drainage Project

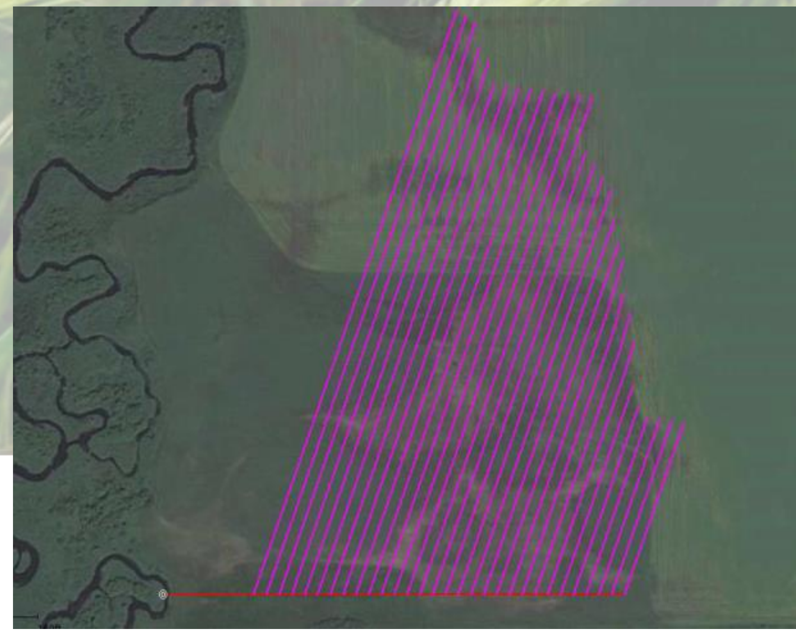
- Salinity mapping done in summer of 2014 prior to tile installation
- Tile drainage system engineered and installed Oct. 2014.
- 3 piezometer wells installed to approximately 10 ft depth.
  - Well 1: on tile drained perennial forage – installed fall 2014
  - Well 2 on undrained cultivated cropland. Installed fall 2014
  - Well 3: on un-drained perennial forage – installed spring 2015
- Water sampled from wells and outlet for EC measurement starting in fall 2014.

Site Map - Salinity




Cultivated
Perennial
forage
Tile drains
Melfort creek


Shallow EC
(mS/m)
344.15 - 627.21 (13.93 ac)
255.39 - 344.15 (14.07 ac)
194.62 - 255.39 (14.41 ac)
159.18 - 194.62 (14.19 ac)
133.41 - 159.18 (16.04 ac)
114.37 - 133.41 (14.91 ac)
96.79 - 114.37 (16.66 ac)
84.88 - 96.79 (14.87 ac)
76.25 - 84.88 (13.98 ac)
69.81 - 76.25 (14.01 ac)
64.31 - 69.81 (14.06 ac)
59.06 - 64.31 (13.15 ac)
52.64 - 59.06 (13.09 ac)
44.35 - 52.64 (13.57 ac)
13.85 - 44.35 (11.83 ac)
Area (ac)
60
50
40
30
20
10
0
24.9



Tiles Installation

Tile Drainage Project

- Water levels in wells measured weekly from early spring to freeze up.
- Water flow measured at outlet commencing in early spring and continuing until freeze-up.
- Weekly water sampling for EC measurements at the outlet

Tile Drainage Project Evaluation

- Measure forage yield from the drained and un-drained forage areas.
- Obtain yield maps for the cropped area of the field annually.
- Repeat salinity mapping at 5 year intervals.

Results to Date

- Water began flowing as soon as tiles installed. And continued past freeze – up.
- Initial EC was 8000 at outlet and 9000 in the creek.
  - Interesting that creek > than outlet: ie most creek flow is due to subsoil seep into creeks.
- Water continued flowing until early Dec of 2014.

Spring 2015

- Water table was above the top of the well on undrained cultivated land after wet snow in May
- On un-drained forage water table was within 1 ft of surface in mid-May.
- Drained areas, water table was slightly above tiles

Results continued

- Impossible to measure when flow began in spring as creek was above outlet
- First flow measurements made in late April 2015.
- Flow increased after each rainfall event,
  - soil was at or near field capacity above drains.
- Flow decreased to zero by July 20, 2015, but resumed July 27 (5.5 inch rain over 6 hr).

Results

- EC tends to decline after precipitation events, and increase during periods of low precipitation.
  - Range 4000 to 9000.
- In total we have drained in excess of 2 million gallons of salty water from the site
  - Total exceeds 2.5 acre inches.

Results

- No apparent effect on forage yield BUT drained area was highly saline, and undrained much less affected by salts.
- No sign of flooding damage in 2015 Canola crop on drained area.

SUMMARY

- Tile drainage is permitted but requires approvals
  - Water Security Agency
  - Know point of adequate outlet
- Tile drainage is a long term investment
  - Not unlike buying or clearing more land
- Tile drainage likely has much less detrimental impact than surface drainage
  - Slower water discharge and increased temporary storage
  - Less soil disruption
- Tile drainage requires careful planning and consideration
  - Best to have designed professionally

Acknowledgements

Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada

Growing Forward

Saskatchewan Ministry of Agriculture

The project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement.

Technical support from Jessica Pratchler, Stephanie Ginter, Gayelene Daqenais, Jillian Anderson, Rikki Schick

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