Thorndale Demonstration Farm

In 2021, the UTRCA established a 58 acre demonstration farm near Thorndale, Ontario. The farm is used to research and demonstrate a number of agricultural best management practices (BMPs), and showcase how they can improve and protect soil health and water quality while maintaining productivity in the southern Ontario landscape.

The farm exhibits a suite of BMPs, offering multiple opportunities to reduce nutrient and sediment loss at the field scale (**Figure 1**). The highlight feature of the farm is the contoured controlled drainage system which utilizes a series of Agri-Drain control structures to manage sub-surface drainage across 14 acres of the field, which can be compared to the conventional tile system covering the remainder of the farm.

Additional BMPs undertaken on the property include:

- Blind inlet with narrow based berm and stand pipe inlet with broad based berm work to reduce surface erosion and slow water leaving the field;
- Rock chute tile outlet design limits erosion at the edge of field;
- Windbreaks planted along the field boundary to help prevent wind erosion;
- Block planting on a highly erodible section of the farm;
- Pollinator planting to increase biodiversity;
- Cover crops;
- Residue management/strip tillage;
- A storm water retention system using underground chambers to slow the release of storm water from the field (coming 2024).

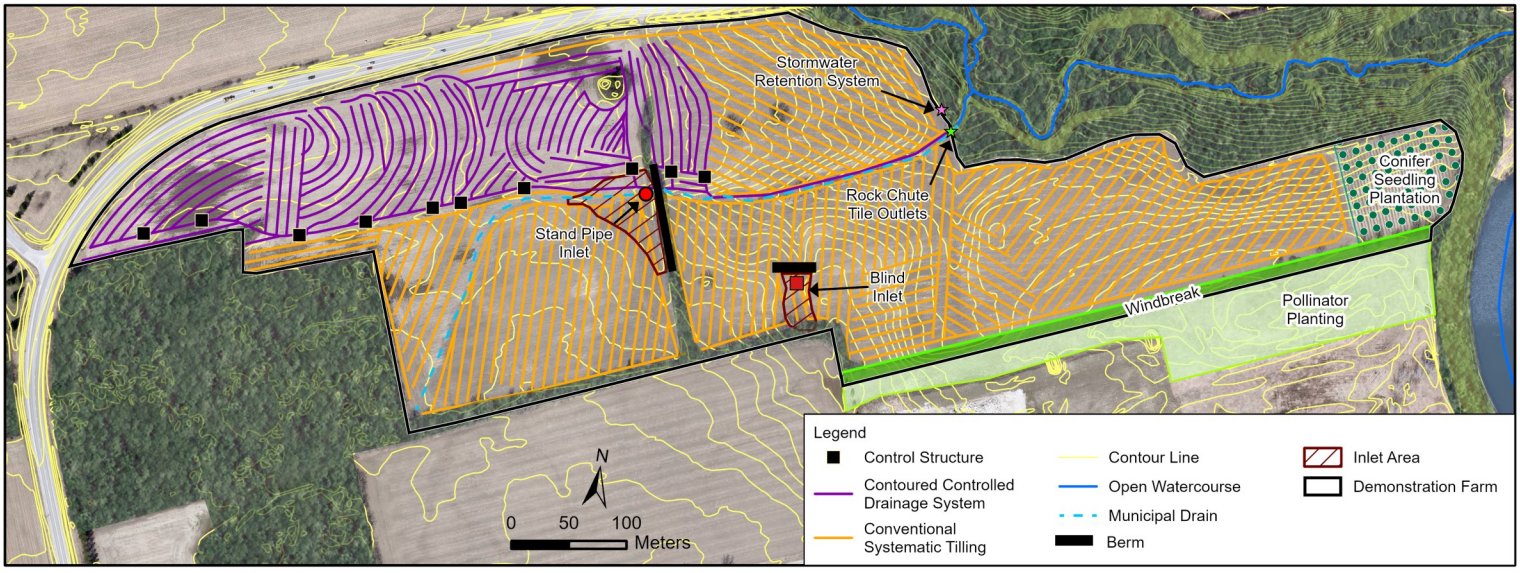

Figure 1 Map of Thorndale Demonstration Farm best management practices.

Contoured Controlled Drainage Design

Controlled drainage structures are used to manage sub-surface drainage on a field. Gates in the structure allow the user to control water table height across the field, by holding back water in the laterals for subsurface irrigation during drier summer months, and draining excess moisture as required during planting and harvest (**Figure 2**). Positioning lateral tile along contours allows for more consistent tile depth which keeps the tile in the topsoil and water more readily available to plant roots. From a water quality perspective, by holding back and slowly releasing water during rain events, peak flows and sediment and nutrient runoff entering watercourses are reduced.

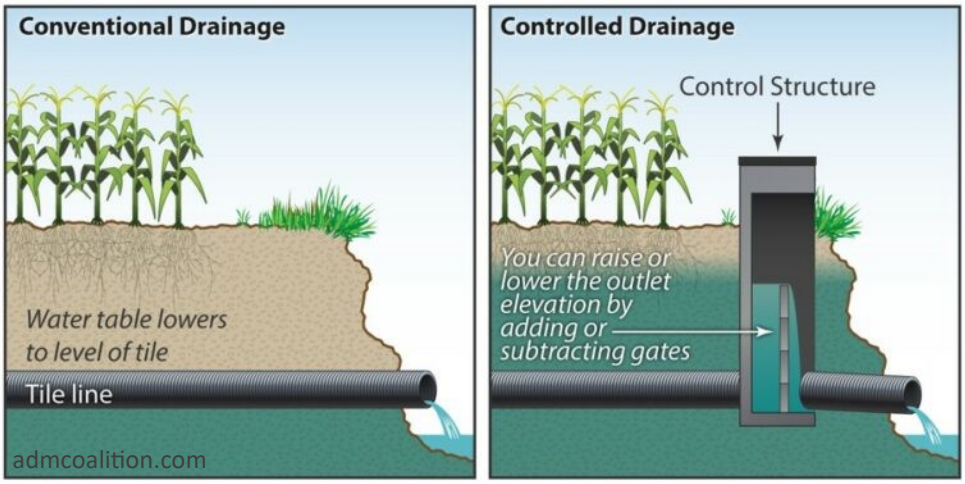

Figure 2 Conventional and controlled drainage schematic and their respective influence on the surrounding water table.

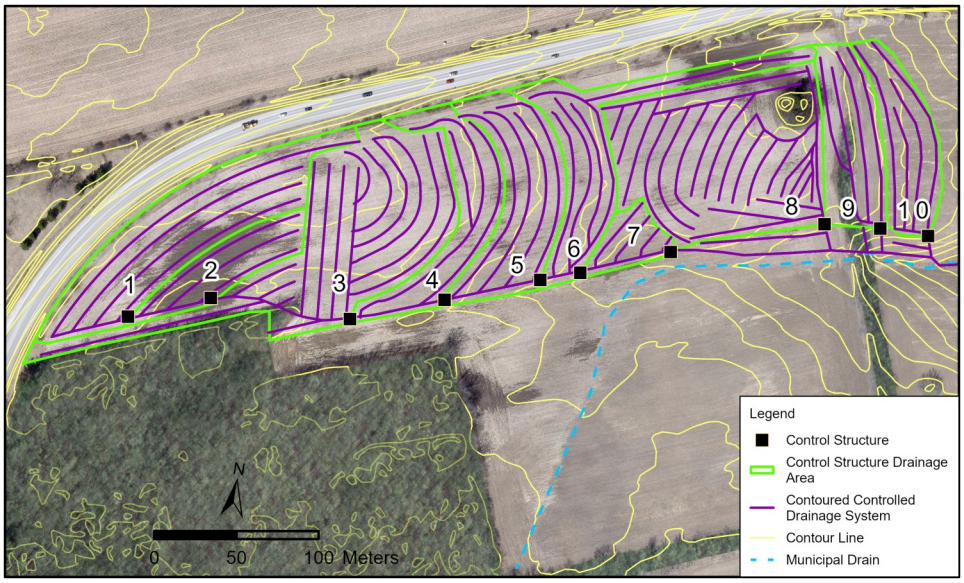

Figure 3 Map of Thorndale Demonstration Farm contoured controlled drainage system control structures and their respective drainage areas.

Controlled drainage systems are most commonly used in relatively flat fields, as one control structure is required for every 18” of grade change to ensure proper distribution of water across the field. The Thorndale Demonstration Farm is testing the controlled drainage application on a sloping field, using multiple control structures to manage sub-surface drainage across the field. Ten control structures are positioned along the main drain at lateral junctions, where each structure controls sub-surface drainage for a specific portion of the field (**Figure 3**). Seven of these structures are located on the main drain in sequence, and three others are independently connected by sub-headers. In this application tile laterals are installed on contour at approximately 0.1-0.15% grade.

Monitoring

The farm is instrumented to monitor the effectiveness of the contoured controlled drainage system in improving water quality and reducing peak flows during storm events throughout the growing and non-growing seasons, compared to the conventional tile drainage system on the remainder of the field. To do this, each control structure is continuously monitored to assess how much water is being held back in the tile and the duration of time. Event-based water samples are collected to determine water quality differences between the drainage halves over time. Yield data is also collected at harvest to note any differences in productivity between the two treatments. Monitoring began in June, 2023.

Preliminary Observations and Lessons Learned

→ Controlled Drainage Storage Capacity

- Control gates were set to 12" below the soil surface and closed on May 23rd, until removing pre-harvest on September 18th. Gates remained open for the remainder of the monitoring period through January, 2024.
- During the period where control structure gates were closed, water overflowed the gate at the last control structure in the sequence approximately 25% of the time. When control structure gates were removed in the non -growing season, water flowed almost continuously at all control structures.
- When gates were closed, four instances were observed where control structure gate overflow exceed the capacity of the tile drainage below it during large rain events, so that water temporarily infilled both sides of the control gate. In two of these instances the water level elevation in one structure backed up water into the structure behind it in sequence. Moving forward, this could be resolved by slightly lowering the gate height of the downstream structure to remove excess water from this area of the system earlier.

→ Tile Outlet Flow and Nutrient Loading

- During the growing season in the first year of monitoring, when control structure gates were closed (monitored from early June through September), similar discharge responses were observed at the tile outlets when rain events followed wet conditions (**Figure 4a**).
- During the growing season when rain events followed dry conditions, the conventional drainage outlet reported higher peak flows and event nutrient loads (Total Phosphorus, Nitrate, and Total Suspended Solids) than the controlled drainage treatment (**Figure 4b)**. Two rain events were observed where the conventional drainage showed a flow response at the outlet and the controlled drainage treatment had no flow response, as dry conditions leading up to the events meant no water overflowed the control structure gates.
- During the non-growing season when control structure gates were removed (monitored October through January), the controlled drainage treatment experienced a larger peak flow response than the conventional drainage treatment corresponding with higher event nutrient loads (**Figure 4c)**. This highlights the need to close control structure gates during the non-growing season, as contoured drainage more quickly intercepts the water into lateral tiles leading to larger peak flows and more nutrients leaving the field if allowed to flow freely.
- A larger data set is required to better understand the relationships between flow events and nutrient loading for both drainage treatments under varying environmental and agronomic conditions.

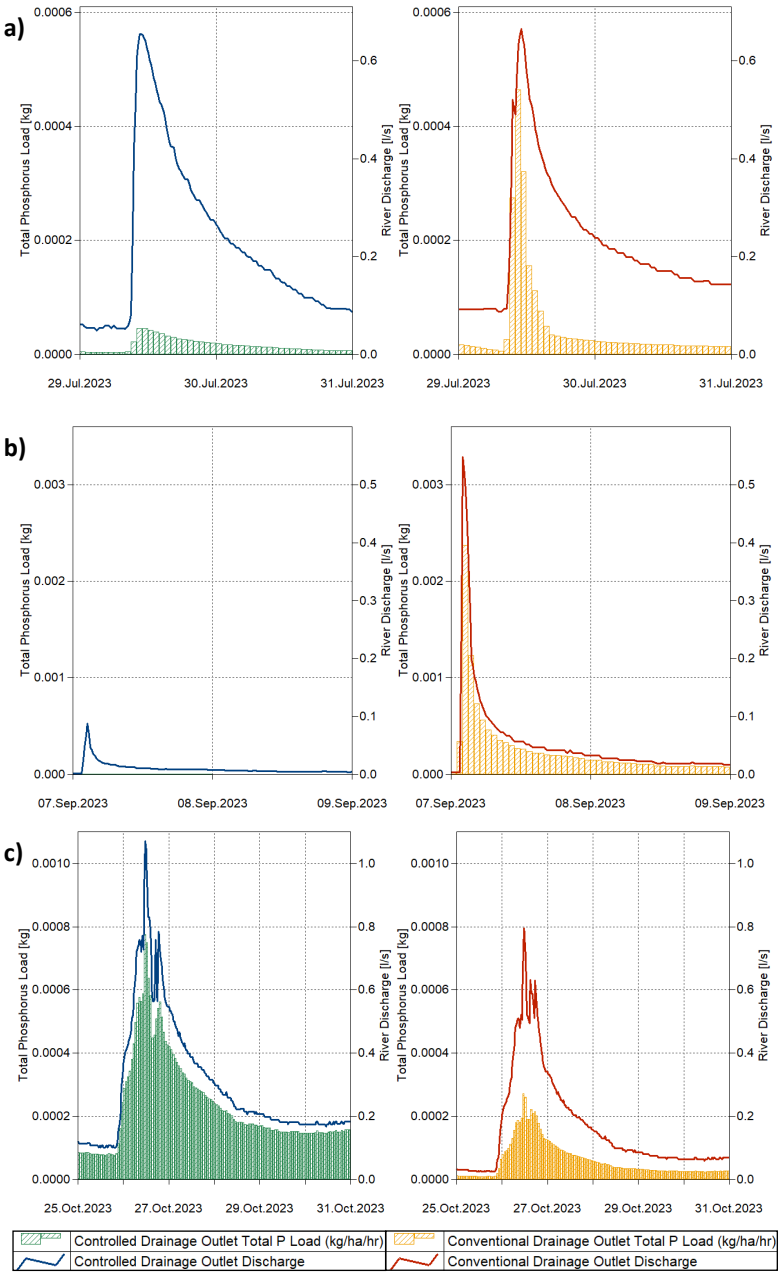

Figure 4 Example of controlled and conventional tile outlet event discharge (l/s) and Total Phosphorus loading (kg/ha/hr) for a) wet, growing season, b) dry, growing season, and c) non-growing season.

→ Soybean Yield

- In the first year of monitoring, which experienced a wetter than typical growing season, the controlled drainage section of the farm reported a soybean yield benefit of 4 bu/ac over the conventionally tiled section of the farm.

Next Steps

Water quantity and quality monitoring will continue in order to expand the data set to be able to assess larger trends over varying seasonal conditions and crops.

Future monitoring will include the stand pipe inlet for water ponding duration during rain events, as well as surrounding groundwater levels in both drainage treatments to assess the impact of controlled drainage in the lateral tiles.

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Middlesex Soil and Crop Improvement Association

For More Information

UTRCA hosts visitors for field day events to learn about the various BMPs demonstrated on the farm. To inquire about upcoming field days or for questions about the Thorndale Demonstration Farm, contact:

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