Tile Drainage in Vermont: The Basics

Factsheet No. 1

Introduction

The Required Agricultural Practices (RAPs) define tile drainage as a conduit installed in cropland beneath the ground surface to collect and/or convey water to an outlet. Installing tile drainage on fields has the potential to pay for itself with more reliable and maybe improve crop yield. However, there are several factors to keep in mind that impact drainage efficiency or return on investment. Refer to the back of this sheet for a list of economic calculators.

Tile Drainage Components

Modern subsurface tile drainage consists of a specially designed system of perforated plastic pipes. Lateral lines connect to mainlines, which connect to the tile outlet (Figure 1).

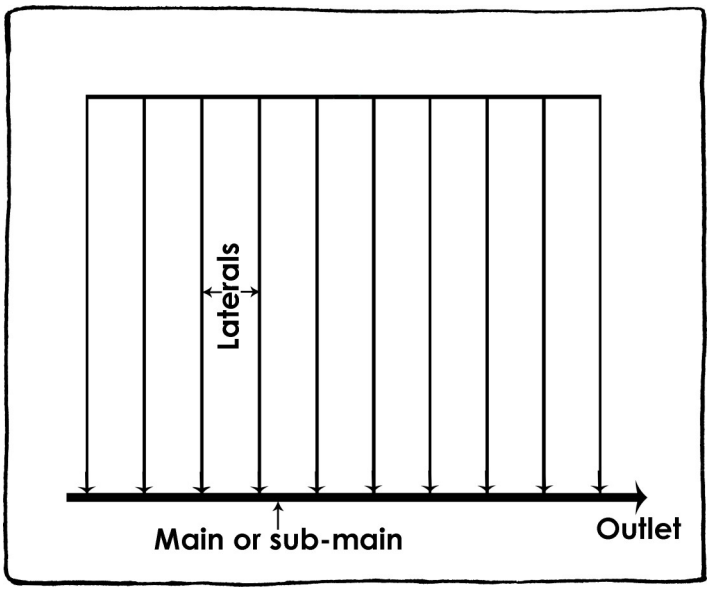

Figure 1. Overhead view of tile drainage system. (Illustration courtesy of Amanda Gervais)

Tile Drainage Layout

There are three basic tile drainage layouts: parallel, herringbone, double main, and targeted (Figure 2). The design should allow for enough excess water to be removed within 24 hours to lower the water table to a level that will not cause crop injury, usually 6 inches the first day, down to a foot 48 hours later. Tile lines should be aligned with field contours not perpendicular to them.

The tile drainage design should be created in such a manner to be efficient and maximize resources. There are several factors that affect tile drainage design including size of area to be tiled, slope, soil type, and crop type.

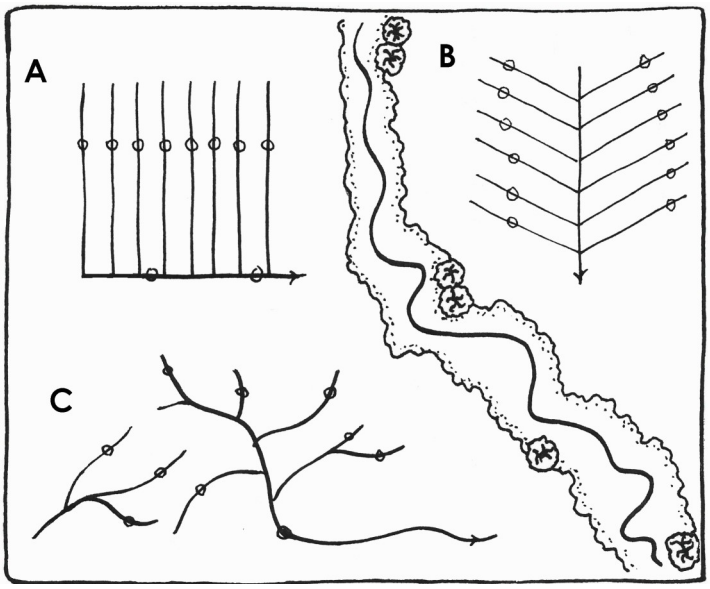

Figure 2. Various drainage layout alternatives. A) Parallel; B) Herringbone; C) Targeted. (Illustration courtesy of Amanda Gervais)

Materials

The size of the area to be drained impacts the amount of pipe and water structures (e.g. outlets, water control structures, rodent guards, etc.). In fields that have a seasonal high water table or lowland topography that lends to ponding, pump installation may be necessary by tile outlets to mitigate the effects of backflow. A 'filter sock' or 'sleeve' is a water-permeable barrier that slips over the pipe. This additional barrier may be necessary to keep soil particles from entering tile on soils with poorly graded sands, coarse silts, or on soils with 30% or less clay to keep unstable soil particles from entering tile. If old tile needs to be modified, additional materials may be needed.

Spacing

Tile spacing can range from 40' to 15' and depends on soil type, crop type, and value of crop. Tile may be spaced at 40' in gravel, 30' in clay, or closer depending on crop. Drainage coefficient or seasonal high water tables impact tile depth needed to drain the field to a level that will not cause crop injury. Tile depth may depend on frost layer or restrictive soil layer, which is usually 30-48 inches below, rooting depth of the crop, and outlet elevation necessary for adequate outflow.

Surface inlets, air vents, and outlets

Surface inlets, standpipes, or open drains are above ground structures that collect water before it filters through the soil and acts as a direct conduit to tile lines. Surface inlets typically drain low spots. To be in compliance with the Required Agricultural Practices, surface inlets must have a 25' vegetated perennial buffer where no manure can be applied (Image 1). Air vents are above ground structures designed to relieve pressure, increase pipe flow, and reduce potential for blowouts. As of November 2018, surface inlets may no longer be installed within or adjacent to cropland. Outlets are where the tile daylights, allowing water to drain, and when properly installed, prevent erosion of the streambank. Outlets are typically installed 1 foot above normal ditch water and 3-5 feet below soil level.

Field Conditions to Consider

- Tree roots can damage tile lines. Install 15' or more away from tree lines to reduce likelihood of root damage.
- Ledge and rock can impact labor costs and tile effectiveness.
- Slope can impact design. Too little slope and grading is necessary for proper flow and to reduce potential for sedimentation and clogging. Too much slope increases velocity and increases chance of blow out. Variable slope, common to Vermont fields, requires pipe that suites all soil types, which can add to costs.

Image 1. Surface inlet with 25-foot buffer. (Photo courtesy of Vermont Agency of Agriculture Food & Markets)

Tile Drainage Design Plan

Generally, it is highly recommended that a tile drainage plan be designed by a licensed contractor and include the following:

- Lateral spacing, size, depth, grade, length, and material
- Main location, material, size, depth, grade, and capacity
- Details of any construction problems encountered during the installation
- Location of all outfalls, surface water inlets, and other structures
- Location of utilities, sand pockets, springs, etc., that may affect future maintenance.
- Date of construction
- Name of installer (i.e. contractor or landowner)
- Identification of any changes made during installation from the original plan.

Resources

VAAFM RAPs: https://agriculture.vermont.gov/rap

Drainage design calculators:

https://www.extension.umn.edu/agriculture/water/planning/

http://igrow.org/drainage-calculators/

https://www.extension.umn.edu/agriculture/water/planning/online-calculator/

https://www.extension.umn.edu/agriculture/water/planning/drainage-slide-rule/

https://www.prinsco.com/resources/drainage-calculator-by-acreage/

https://www.prinsco.com/resources/profitability-analysis-calculator/

March 2019

A publication of the University of Vermont Extension Northwest Crops and Soil Program.

This material is based upon work supported by USDA/NIFA under Award Number 2015-49200-24225.

THE UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. University of Vermont Extension, Burlington, Vermont. University of Vermont Extension, and U.S. Department of Agriculture, cooperating, offer education and employment to everyone without regard to race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or familial status. Any reference to commercial products, trade names, or brand names is for information only, and no endorsement or approval is intended.

COLLEGE OF AGRICULTURE AND LIFE SCIENCES