INTRODUCTION

Soils that get too much water and become saturated are vulnerable to erosion and can seriously impair crop growth. A drainage system removes this excess water from cropland – returning the soil to an unsaturated condition, and safely returning the water to the water cycle. This chapter outlines the basic principles of cropland water movement, and how drainage systems capture and move excess water.

Agricultural drainage systems are an essential infrastructure for Ontario food production. Proper drainage reduces the impact of excess water, conserves topsoil, and improves crop input efficiency. Because drainage contributes to higher productivity on our best land, more land can be maintained for natural areas and other uses.

Surface drainage removes excess surface water from cropland through drainage channels, land grading, and surface inlets. *Subsurface drainage* – also known as *tile drainage* – removes excess soil water from the soil profile using plastic tubing, or clay and/or concrete tile.

The term *cropland drainage* refers to surface and subsurface components. *Agricultural drainage* refers to cropland drainage as well as outlets and drainage channels.

Today's drainage projects are well-designed, due to improvements in drainage technology and a greater understanding of:

- precisely what soils and crops need
- rural and agricultural water management concerns
- overall watershed management
- the value and functions of natural areas.

Water is a shared, essential resource, and agriculture is one of its many users. Farmers are responsible for managing drainage water properly – protecting its quality and quantity for downstream users.

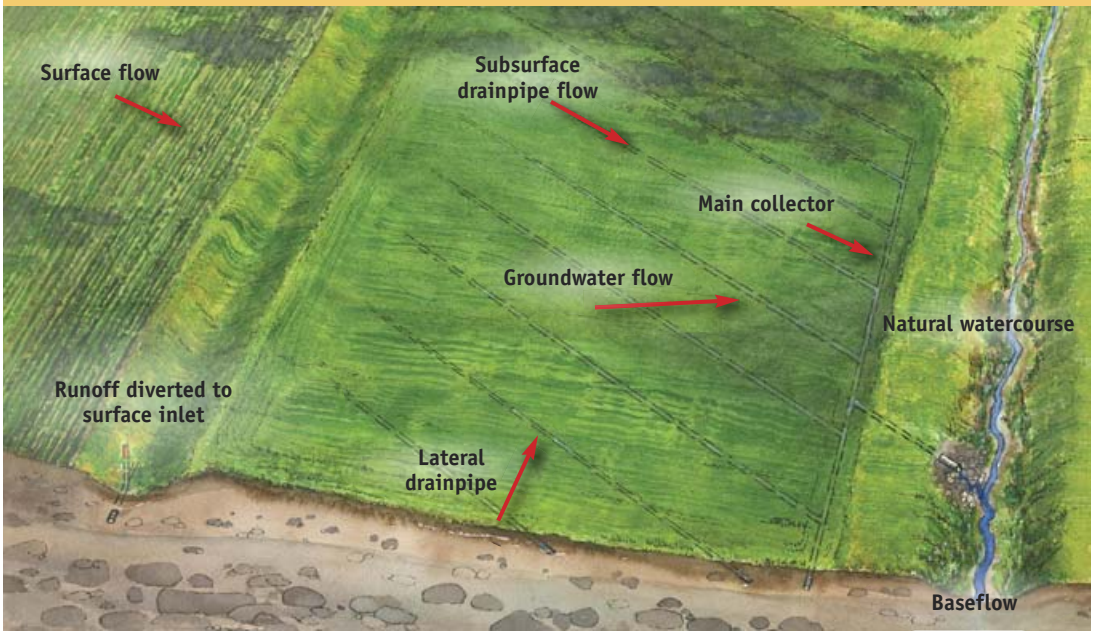
"The objective of cropland drainage is to remove enough water to facilitate good crop growth and not a drop more – because water conservation is critical to crop growth."
Dr. Richard Cooke, University of Illinois

When it comes to basic drainage terminology, there is some variation across Ontario and among farmers, contractors, engineers, and industry people. To keep it simple, we will use the terms *subsurface drainage* and *drainpipes* in lieu of *tile drainage* and *tiles*. A complete glossary appears on page 62.

Agricultural drainage has several components:

- ► surface drainage
- ► subsurface drainage
- ► drainage outlets
- ► natural watercourses and/or constructed drainage channels (ditches or pipe systems).

WATER MOVEMENT ON CROPLAND



Rain or snowmelt collects on the soil surface. At this point the water has several pathways it can take.

SURFACE FLOW – A large portion evaporates directly from the soil surface. Another portion will pond or flow across the surface as runoff, until it reaches a surface water body such as a natural watercourse or ditch. Some of the surface runoff may be directed to subsurface drainpipes via surface drainage components such as surface inlets.

SUBSURFACE FLOW – Some precipitation will infiltrate the soil surface where it's absorbed into the soil profile. Some of the infiltrated water will be taken up by plants and then transpired into the atmosphere. Once the soil is saturated, the excess (gravitational) water will continue to move downward to the soil water table. If subsurface drainpipes are in place, some of this water will move towards them.

Subsurface drainpipes provide a pathway for excess water to move from the upper soil profile near the drainpipe, and be conveyed to a larger-diameter collector drainpipe or "main" that controls the flow rate of drained water as it moves to an outlet. The water table is in constant flux, usually moving very slowly in the downgrade direction. Eventually this water returns to the surface, e.g., streams, lakes, rivers. When it reaches a stream, it is referred to as *baseflow*.

Drainage water will then exit to either a natural watercourse or more often to a constructed drainage channel – usually an open ditch or a buried larger-diameter drainpipe. Ultimately, drainage water is conveyed to larger bodies of surface water, including streams, creeks, rivers or lakes.

Too much water is as much a problem as not enough water. To imagine subsurface soil water, drop a sponge in a bucket of water, then remove the sponge. The water that freely flows from the full sponge is excess (gravitational) water. What remains in the sponge is similar to what remains in the soil.

Visual evidence of inadequate drainage includes: surface wetness, lack of vegetation or poor crop-stand density, crop stands of irregular colour and growth, and variations in soil colour on the ground surface.

Why drain cropland?

Without drainage, Ontario would have a much different and significantly less viable agricultural industry, and we would not enjoy the high quality, quantity and diversity of locally grown foods on our tables.

Overly wet soils are a major obstacle to crop production. Seasonally saturated soils become suitable for tillage and crop production after subsurface drainage has removed excess water from a portion of the upper soil profile above the drainpipe.

Drainage removes ponded water from the soil surface and facilitates the removal of excess water within the root zone in the soil profile.

Why do some soils benefit from drainage for cropland production?

Some soils benefit from subsurface drainage; others don't. Subsurface drainage will benefit soils with a naturally high water table, as well as soils with low permeability or soils with groundwater discharge. Soils such as those with high clay content most often benefit from surface and subsurface drainage.

Some soils do not benefit from subsurface drainage – including some sandy and loamy soils that are free of any water table activity in the rooting zone throughout the year. These soils contribute to more groundwater recharge than soils such as clay where the water movement is much slower.

THE BMP APPROACH: INTEGRATING BMPs ACROSS YOUR OPERATION

Throughout these pages, cropland drainage is considered part of an overall on-farm soil management system.

If you're a farmer, use this book to help you:

- ▶ better understand how drainage systems work
- ▶ see opportunities for improvements in existing systems
- ▶ integrate drainage-specific BMPs with other cropland BMPs to reduce runoff and flooding.

✔ This checkmark indicates a BMP. Every BMP improves a drainage system's effectiveness and reduces environmental impacts.

You'll find plenty of references to other BMP books for more in-depth information on related topics. The BMP series has a wealth of information to help you manage soil, nutrients, pesticides, and irrigation on agricultural land. A complete list appears on page i.

The BMPs in this book are intended to help landowners manage drainage systems more effectively, and reduce negative environmental impacts related to cropland drainage systems.