BENEFITS AND CHALLENGES OF SURFACE AND SUBSURFACE DRAINAGE

Among its benefits, drainage boosts productivity and helps manage erosive surface-water flow after rainfall events. However, it can also act as a conduit for inputs if cropland BMPs are not in place above ground. This chapter summarizes the benefits and challenges of cropland drainage.

KEY BENEFITS

SURFACE DRAINAGE AND EROSION CONTROL STRUCTURES

Properly managed, surface drainage and erosion control structures can do more than improve yields.

The potential on-farm benefits of surface drainage and erosion control include:

- reduced risk of drowned crops
- less soil compaction and erosion
- maintained soil infiltration rates
- improved functioning of subsurface drainage systems
- increased land values.

The potential off-farm benefits of surface drainage include:

- reduced flooding and sediment loading (due to reduced overland flow and erosion)
- reduced risk of phosphorus loading (as well as other crop inputs).

High-value crops are often more susceptible to damage or drowning (total crop failure) caused by ponding or prolonged wetness from storm events. Surface drainage reduces the risk of damage to crops.

Surface inlets move excess surface water on croplands to subsurface drainage systems. Intake rates are controlled when flow restrictors (orifices) are used in surface inlet structures.

SUBSURFACE DRAINAGE

The decision to install new or improve existing subsurface drainage is usually supported by evidence of some on-farm economic advantage.

By removing excess gravitational soil water in the plant root zone, subsurface drainage provides these potential on-farm benefits:

- ► improved field access and longer growing season
  - ▷ wet soil takes longer and much more heat than dry soil to warm up in the spring
- ► improved growing conditions – aeration, temperature, fertility and rooting depth
- ► increased production and crop quality
- ► greater protection from crop failure caused by excess water
- ► improved soil quality, e.g., reduced soil compaction
- ► reduced fuel consumption and wear and tear on equipment
- ► improved drought tolerance as root systems develop better
- ► improved soil conditions for harvest.

Subsurface drainage improves growing conditions for roots. Better root growth results in greater biomass above and below the ground. More organic matter is returned to the soil. Above-ground biomass improvements are measured as increased yields and reduced per-unit production costs. Increased root biomass improves soil life, improves subsurface soil structure, reduces soil density, and increases porosity.

Removing excess subsurface water allows soil to warm up sooner for earlier seed germination, and improves equipment access for field operations in the spring. Drier fields also extend the harvest period, and require less fuel for equipment operation. Spring tillage and fall harvest equipment cause less soil degradation.

The potential off-farm benefits of subsurface drainage include:

- ► reduced water quality impacts by reducing runoff and erosion
- ► reduced greenhouse gas (nitrous oxide and methane) emissions
- ► improved opportunity for soil and water conservation systems – conservation tillage needs cropland drainage to work effectively
- ► higher quality, greater yield of food products
- ► less need for irrigation water due to better root development
- ► may result in longer stream-flow duration after a rainfall event compared to undrained cropland in some watersheds
  - ▷ this assists with maintaining stream baseflow (groundwater discharge to watercourses), thus benefiting aquatic habitat
- ► may reduce peak watershed flow rates in some watersheds.

Cropland drainage systems enhance the soil's hydrologic ability to absorb water and transmit water downward during a rainfall event. It takes time for the soil to hydrate to a saturated condition, and it takes more time for the water to reach the cropland drainage system before being conveyed to a stream. Also, the volume of surface water runoff is reduced, and surface runoff is delayed.

These two functions have the overall impact of reducing peak flows in ditches and streams. In some cases, surface runoff is eliminated if the rainfall rate is slow enough to infiltrate completely into the soil. During fast or heavy rainfall rates, subsurface drainage systems have little or no impact as the rainfall comes too fast to infiltrate the soil regardless of the soil condition.

KEY CHALLENGES

CROP INPUTS

Surface water collected by surface drainage and erosion control structures can have the following materials in solution or attached to sediment in suspension:

- ► surface-applied nutrients
- ► manure and manure-based pathogens
- ► pesticides.

Further, some crop inputs are not completely assimilated by soils or used by the intended crop, and can leach with gravitational water to the drainpipe. These include:

- ► crop nutrients in solution
- ► manure and manure-based pathogens.

Nitrate-nitrogen, a soluble form of nitrogen, has great potential to move wherever water moves. Nitrates are readily taken up by plants. However, under certain conditions, nitrates will move beyond the root zone. Subsurface drains can provide a pathway for nitrates that have moved below (leached from) the root zone. Nutrient management BMPs – such as following recommendations for timing, placement and rates – will reduce nitrate loss.

Remember that drainage systems are a conduit, not a source. Use BMPs when applying nutrients, manure or pesticides to all fields, with or without subsurface drainage, and especially to fields with surface inlets. See other BMP books, and read on for more information.

RATE OF WATER REMOVAL

In the past, the sole goal for drainage was to provide a good growing environment by removing excess water. Now, drainage activities are finer-tuned to remove only water that is detrimental to crop growth and to minimize impacts to the overall water system.

Drainage system designs should consider cumulative impacts in a particular setting. For example, surface inlets are a very easy method of managing surface water problems. However, too many and/or too large inlets can increase peak flow rates in the receiving channel.

WET OR TEMPORARILY PONDED AREAS: TO DRAIN OR NOT TO DRAIN?

Removal of temporarily ponded surface water from croplands has potential benefits – not the least of which are increasing usable land area and improving access for field operations. On the other hand, some temporarily inundated sites, although not permanent, may function to provide water storage and temporary habitat for a variety of plant and wildlife species.

Small wet areas in croplands can be important habitat for migratory waterfowl and other wildlife. If these periodically wet areas have been cropped previously, it is likely that these areas do not meet the criteria to be classified as wetlands. If you are unsure, contact your local Conservation Authority or resource agency. You should carefully assess each site before deciding whether or not to drain it.

To guide your decision on whether to drain a temporarily ponded site, weigh the pros and cons first. Consider the history of water impact, crop flooding, the duration of ponded water, whether soil will be productive if drained (not all will be as good as hoped), use by wildlife, and other related factors.