ESE
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Sub-Irrigation

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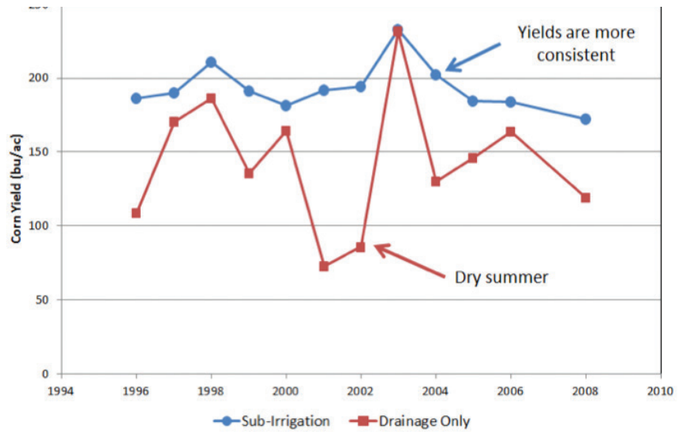
Sub-Irrigation

If you have water storage or a water source, Sub-Irrigation (SI) allows you to achieve complete control over the water in your field by managing the biggest variables in farming, too much or too little rain. With an SI system, both of these factors are under your control. This is done by installing a control structure on your tile line that allows you to vary the depth of the water table. Irrigation water can be put back in the field through these same tile lines when needed. This allows crops access to water when nature does not provide it.

Benefits of Sub-Irrigation

Yield Increases – SI gives sufficient water to the crops no matter the rainfall. This means that the plants will continuously have water available to them in their root zone. SI leads to less plant stress and produces higher yields. By far the biggest benefit of SI is achieving consistent yields, in turn leading to higher averages. This allows for more accurate predictions of yields leading to more accurate income predictions and budgets. A 12 year study in northwest Ohio found that during dry summers, **corn yields have increased over 100%** compared to non-SI fields. In the same growing conditions, **soybean yields increased by around 60%.**

SI Improves Production and Reduces Loss



This shows data from a 12 year study in NW Ohio. Notice how consistent yields from the SI field are, it takes the variability out of farming. Research by J. Allred et. al (2012)

Reduced Nutrient, Soil, and Water Loss

As an added bonus, SI systems serve as a dual-purpose drainage system. They reduce nutrient runoff while providing huge yield boosts. In a study done of claypan (dense, slowly permeable) soils, **nitrate losses to tile lines were reduced by over 75%.** This is because less water is drained from the field, allowing for less water flow. Water and energy usage for irrigation purposes can be reduced by up to 50% compared to traditional overhead systems. This is because the water is put in the root zone and evaporation is greatly reduced when the water is applied directly into the soil. By keeping the soil profile moist, soil erosion is greatly reduced from heavy rainfall events and wind.

Incentives and Cost Share Programs

While the yield alone would pay for the additional costs of an SI system, the NRCS also offers incentive programs. The Environmental Quality Incentives Program (EQIP) offers financial assistance to farmers for things such as management plans, water control structures, and in some states, switching from a previously used irrigation system. Rates vary by state, so contact us for the most up-to-date information. A certified Techincal Service Provider (TSP) is required to design the required drainage plans in order to receive NRCS assistance. ESE employs multiple TSP's that specialize in drainage management plans.

Sub-Irrigation

How It Works -- The 3 S's

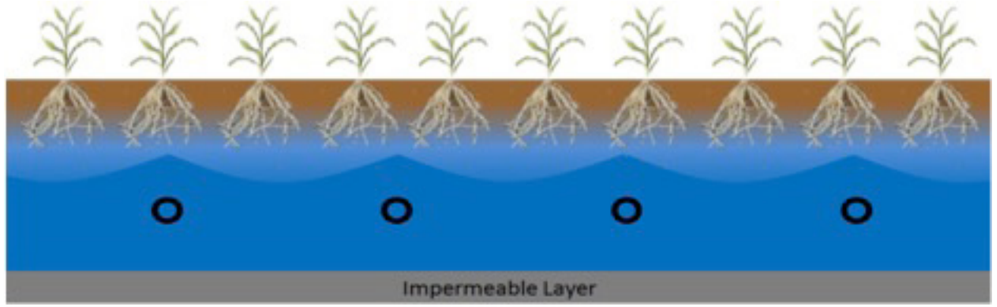
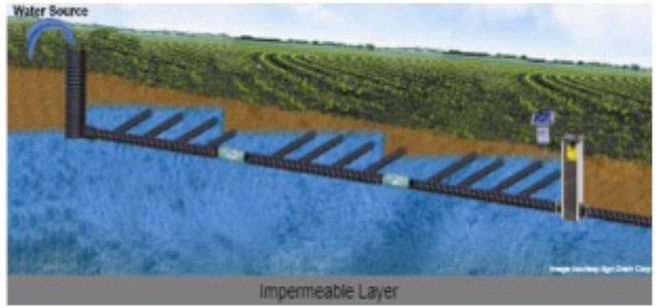


Illustration shows the ideal water table in a SI system. Water is delivered through tile lines to the root zone, allowing crops to only use the water they need. An impermeable layer is needed to help hold water in the soil profile.

Structures and Pumps



Using a water source, control structure, and watergates to manage 1 foot zones. Image courtesy of Agri Drain.

SI requires what is referred to as the 3 S's; surface, soil, and source. A flat surface will be more economical to install. Control structures are needed in order to hold your water at the desired depth. Structures can be controlled manually, remotely, or be programmed for automation. Structures are required every 1-foot change in elevation for SI. Water Gates, manufactured by Agri Drain Corp., can also be used for SI in 1 foot increments. Water Gates are completely buried to allow for convenient field operation. Proper soils are also needed for an effective SI system. Primary soils should have a restrictive layer present to help prevent water seepage and allow the water table to be elevated. Intake pumps are also required for an SI system to draw water from an external source.

Design

The best fields for SI generally have large, flat or gently sloping areas. Design starts by separating the field into management zones. These zones differ in elevation by 1 foot and have an influence zone of 1.5 feet. Flat fields will be more economical to install, maximizing profit. Once zones are determined, laterals are carried along the contours of the field. This allows for maximum interception of the water as it naturally flows downhill.

Water Source

Availability of a dependable water source is something that needs to be considered. Wells and ponds are common examples. The availability of this source will greatly impact the cost of installation and return on investment.

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Drainage Water Management

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Drainage Water Management

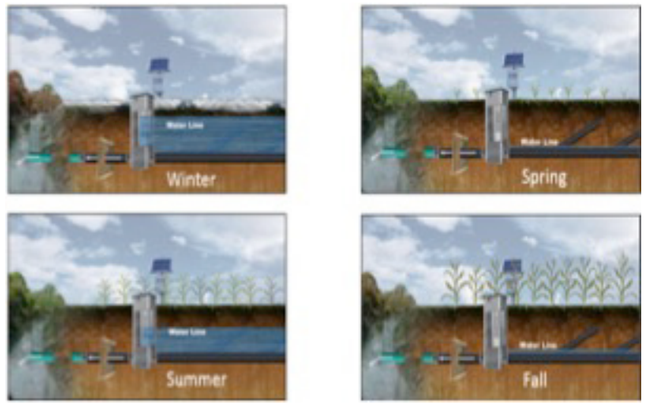
Drainage Water Management (DWM) is an effective water conservation tool that allows for improved water quality, field trafficability, and yields. DWM allows users to manage their own water table, given sufficient rainfall. This is done by installing a control structure on a main or sub-main to vary the depth of the water table.

Benefits of Drainage Water Management

Yield Increases – DWM helps minimize the amount of water that is removed from the soil profile when drainage is not required by crop production. Holding back water during the dry parts of the growing season allows for an optimal water zone for proper rooting depth. Studies have shown, on average, around a 10% increase in yields compared to traditional drainage can be observed. Nutrients held with the water are also available to the crop during the peak growing period. Use of DWM has the potential to substantially improve production and profitability.

Reduced Nutrient Runoff

Improved water quality downstream starts with proper nutrient management on your field. By retaining more water in the soil profile, DWM reduces nutrient runoff by increasing crop uptake and in-field denitrification. By allowing the water to be in the soil profile for a longer period of time, nutrients become available to the crop. Nitrogen not taken up by the crop is exposed to the natural denitrifying bacteria already in the field, thereby reducing nutrient loss to waterways. In addition, if less water is leaving your field, fewer nutrients will be discharged into receiving water bodies.



Water is held back during the growing season and drained for planting and harvesting. Image courtesy of Agri Drain.

Incentive and Cost Share Programs

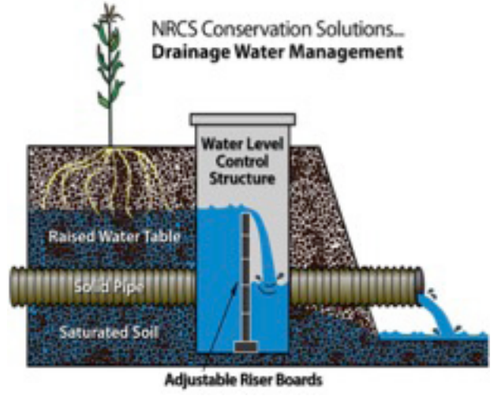
While a 10% increase in yield alone would pay for the additional costs of a DWM system, the NRCS also offers incentive programs. The Environmental Quality Incentives Program (EQIP) offers financial assistance to farmers for things such as drainage plans and water control structures. Rates vary by state, so contact us for the most up-to-date information. A certfied Techincal Service Provider (TSP) is required to design the required drainage plans in order to receive NRCS assistance. ESE employs multiple TSP's that specialize in drainage management plans and provide this service. This service often comes an little to no cost for the producer after EQIP funding is applied.

Drainage Water Management

How It Works

Control Structures

Water is kept back in the fields by raising the water table by use of a water control structure. These structures use a series of stop-logs to set the water level. These structures come in all different sizes and heights, to fit your exact needs. They can be controlled manually, remotely by computer/smartphone, or programmed for complete automation. For DWM purposes, these control structures are needed for every 2-foot change in elevation. Water Gates, manufactured by Agri Drain Corp., can also be used for DWM in 1 foot increments. Water Gates require no surface exposure and are completely buried to allow for convenient field operation.



How DWM Works. Graphic courtesy of NRCS.

Design

The best fields for DWM generally have large, flat or gently sloping areas. The design process starts by separting the field into different management zones. These zones differ in elevation change by 2 foot if a control structure is used or 1 foot if a water gate is used. This creates a zone that is covered by its own control structure. Flat fields are most economical because they require fewer management zones. After zones have been established, laterals are set along the contours. This allows for maximum intercept of the water as it flows downhill leading to better management of your water.

Design of laterals along the contours. Photo courtesy of Keith Rohwer.

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Subsurface Drainage

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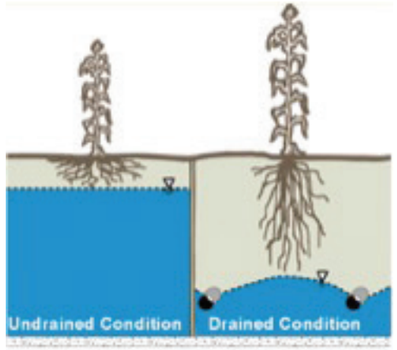
Subsurface Drainage

How It Works

Subsurface drainage removes excess water that can dampen plant growth or prevent trafficability across an agricultural field. Throughout much of the US (Midwest, Lower Mississippi Valley, Eastern Seaboard, and elsewhere) there is often a restrictive layer in the soil profile that does not allow water to pass through. Too often, this leads to a high water table that can severely stunt root development and crop health. Soil type and depth of restrictive layer will often govern the design of a drainage system.



In a subsurface drainage system (right), the roots are no longer saturated. This allows for stronger root development and more accessible water. Photo courtesy University of Minnesota Extension.

Benefits of Subsurface Drainage

If drainage did not exist across North America, millions acres would not be farmable. Benefits of drainage include helping soil health, crop growth, and crop resilience. It is important to realize that excess moisture in the soil profile during the early spring appears across the entire field, and not only where surface water is observed. Having a patterned tile system allows for more consistent moisture levels throughout the soil profile. This leads to increased yields across the entire field and substantially higher yields in previously wet areas.

A tile outlet drains water to the receiving stream.

Environmental Factors

Although subsurface drainage can help to improve productivity, it is important to consider some of its unintended consequences. Subsurface drainage can take away needed moisture during peak growing season and contribute to increased nitrate levels in receiving streams. This can cause unfavorable conditions for aquatic life and create costly treatment requirements for municipalities using that stream for drinking water. Drainage, both surface and subsurface, has been associated with flooding at times, especially if the soil is already saturated. Instead of water being held in fields, it releases to waterways. This can cause a rush of water adding to flooding downstream. Because of these factors, ESE highly encourages drainage water management be considered first.

Subsurface Drainage

Think Drainage Water Management First

Example of a patterned tile system in a field. Photo courtesy of Ontario MAFRA.

It is important to always consider drainage water management as the first option when installing drainage systems. A small additional investment will enable the user to manage water levels and flow rates given sufficient rainfall. This investment is greatly reduced with flat topography. ESE highly encourages landowners to install DWM in circumstances where it is affordable. In other cases, installing DWM may not be a financially secure decision for the landowner. In these circumstances, the field will show immense changes in elevation (slope >2%) and not have flat areas that are suitable for DWM. If drainage is still desired on the field, one of our edge-of-field water quality practices can still be installed for environmental benefits. Although the yield increase associated with DWM will not apply, water quality will be significantly enhanced. These practices are outlined in the "Water Quality" folder.

Subsurface Drainage Retrofits

If a landowner wishes to have drainage, but does not want to invest in DWM at that time, the tile system should be designed such that DWM could be applied in the future. If the drainage system is not designed with DWM in mind, it may be very difficult to retrofit the system. ESE recommends the option for DWM always be left open for the landowner. This allows for a functional drainage system with ease of retrofitting in the future.

Installing a 12" main with an Inter-Drain 2050 SP. Photo courtesy of Clark Farm Drainage.

Contractors

ESE is glad to work with your contractor or recommend one from your area. Our goal is to give you and the contractor the easiest possible transition from design to installation. To do this, ESE is able to use design software that will easily pair with your contractor's installation equipment and software.

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Water Quality Practices

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Water Quality Practices

Water quality is a growing concern in agriculture. Drainage Water Management and Sub-Irrigation are used as a direct solution to improve crop production and reduce nutrient loss. Described below are alternative “edge-of-field” practices that can be used to treat tile water as it leaves the field to improve water quality.

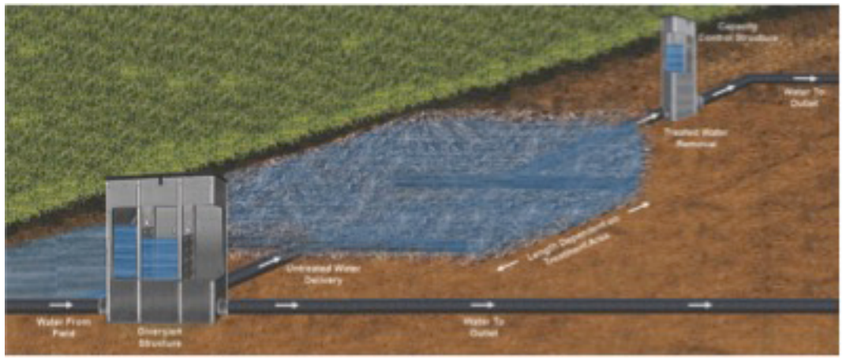

Diagram depicting flow through a woodchip bioreactor.

Woodchip Bioreactors

Woodchip bioreactors are placed near a tile outlet on the edge of a field. A large pit is filled with woodchips and control structures are set in place to route water through the bioreactor. As the water passes through the woodchips, denitrifying bacteria will use the woodchips and consume nitrates in the water. Woodchip bioreactors will also be available for financial assistance through the EQIP program with the NRCS starting in FY2016.

Benefits

Reduction of nitrates in bioreactors are typically between 30-50% but have been recorded at over 90% depending on the drainage system and amount of rainfall. Like buffers, everything happens underneath the ground surface making bioreactors ***easy to manage and farm around.*** A lifetime of over 20 years can be expected for the woodchips.

Water Quality Practices

Saturated Buffers

Saturated buffers are a proven edge-of-field practice used to improve water quality. In saturated buffers, tile water from the field is routed through the root zone of a buffer via a distribution line. Without this practice, drained waters would bypass standard buffers making them much less effective. Saturated buffers direct excess water through the buffer so denitrification can occur.

Benefits

Plants in the buffer will uptake nitrates in the water. This also provides an energy source for denitrifying bacteria to thrive. The plants and bacteria convert nitrates into harmless nitrogen gas in a process known as ***denitrification. Reductions in nitrate are still being studied, however extremely impressive results of more than a 90% reduction in nitrates have been observed. Another advantage is that no farm ground needs to be taken out of production*** for this practice. If topography allows, this practice can be installed on pre-existing buffers.

A control structure and monitoring equipment set up to monitor hydraulic conditions at a saturated buffer sight.