NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

DRAINAGE WATER MANAGEMENT

(Ac.)

CODE 554

DEFINITION

Control of water surface elevations and discharge from surface and subsurface drainage systems.

PURPOSES

The purposes of this practice are to:

- Improve water quality.
- Improve the soil environment for vegetative growth.
- Reduce the rate of oxidation of organic soils.
- Prevent wind erosion.
- Enable seasonal shallow flooding.
- Prevent discharge of manure or nutrient laden water carried through subsurface drainage into waters of the State.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- The topography is relatively smooth, uniform, and flat to gently sloping.
- The field has a subsurface drainage system.
- A water table may be maintained without excessive seepage and without having an adverse impact on adjoining properties.
- Liquid manure applied onto a crop field can rapidly flow into the subsurface drainage system and be discharged unless the flow is controlled. This standard applies to permanent structures installed as part of the subsurface drainage system to control discharge. This standard does not include the purchase or rental of temporary tile plugs installed on tile outlets to prevent manure discharge. However, this standard may be used as a guide for managing the use of tile plugs.
- A nutrient management plan requires that manure must be applied to fields containing subsurface drainage at times of the year when crops cannot utilize the nutrients, and it is likely that nutrients will be discharged through the subsurface drainage system.
- One of the intents of drainage water management is to install permanent control structures in a subsurface drainage system that allows the tile outlet to be closed during periods when manure or nutrient laden water could cause a pollution incident if discharged. This can be accomplished by installing control structures on each outlet or installing header mains to reduce the number of outlets. Reducing the number of outlets is generally preferred unless cost prohibitive

CRITERIA

General Criteria Applicable To All Purposes

The system shall be designed to remove the water required for adequate drainage. The rate of outflow and the level of the water table shall be controlled by structures or pumps. Water velocities in the soil near the drain shall be kept slow enough to prevent soil particles from entering the drainage system.

Structures and pumps shall be located where they are accessible and subject to convenient control. Designs of critical components shall be in accordance with pertinent NRCS Practice Standards, including Subsurface Drainage, 606, Structure for Water Control, 587, and Underground Outlet, 620.

Drainage water management shall be planned, designed, and installed to meet all Federal, State, and local laws and regulations.

A minimum length of 10' of solid pipe shall extend upslope of the flow control structure, and the pipe shall be installed to prevent seepage of stored water around the flow control structure.

The structures shall be designed and spaced so that they can raise the water surface no higher than 6 inches below the ground surface anywhere along the profile of the tile main or connected laterals.

The structures shall be designed so that water is not backed up into a main or lateral beyond a property line (invert elevation at P/L) unless the upstream landowner has given written permission. In NRCS assisted projects, this permission shall be documented in the case file assistance notes.

All valves, controlled drainage structures, storage structures, and fittings shall be watertight for a static head equal to 1.5 times the maximum design head.

Existing subsurface drainage systems considered for conversion to a controlled drainage system must be investigated to determine that the system can be modified without causing failure. In NRCS assisted projects, evidence of this investigation is to be documented in the case file assistance notes.

Critical dates and target elevations will be determined on a site-specific basis in accordance with the purpose, crop and crop rotation, climate and growing season, topography and soils, crop management schedule and machinery/equipment, and related factors.

Additional Criteria To Improve Water Quality (Nitrate Reduction)

The system shall prevent automatic discharge of storm water during minor rainfall events. The controlled discharge of excess water shall account for water not otherwise removed by evapotranspiration and seepage. The uniformity of storm water draw down shall be controllable throughout the areas influenced by the designed system. The distance the water must travel in surface ditches before it reaches the main discharge point shall be maximized when practical.

The subsurface drainage system shall be designed to allow closure of the outlet between harvest (when no crop is growing) and until two weeks prior to field preparation or planting of the next crop.

Additional Criteria To Improve Soil Environment For Vegetative Growth

The combined capacity of the surface and subsurface facilities shall satisfy the appropriate drainage coefficient for the crops to be grown. The water table shall be held between predetermined elevations at all points in the design area when the system is being used for sub-irrigation.

Structures for water control shall be installed wherever necessary and field surfaces graded and smoothed to ensure that moisture from the controlled water table is available to the crop. Structures shall be sized such that design flows over the flashboard or through the control structure can be maintained with a maximum head of 0.5 feet during normal operation. Structures shall be designed so that the control can be removed to return to the drainage mode when desired. Water tables should be dropped slowly to prevent high exit gradients, which may draw sediment or other pollutants into the drains. Ease of management and operation of the control structures shall be considered. Automatic devices should be considered to lower the flashboard or control the position of the outlet structure during sudden or high peak flows following infrequent storms. Pumping may be needed to achieve the objective in some sites.

Additional Criteria To Reduce The Rate Of Oxidation Of Organic Soils

Drainage beyond that necessary to provide adequate root zone for a crop shall be kept to a minimum. When practicable, the water table shall be raised to the surface, or to a designated maximum elevation, for a sufficient time to return the saturated zone to anaerobic conditions. The implementation of this practice must result in a reduced average annual thickness of the aerated layer of the soil.

Additional Criteria To Prevent Wind Erosion

The system shall provide sufficient moisture to the soil surface, either by ponding or capillary action, to prevent wind erosion when there is insufficient organic residue or plant material on the surface.

Additional Criteria To Enable Seasonal Soil Saturation Or Shallow Flooding

The system shall provide saturation to the surface or shallow flooding for sufficient time to accomplish the desired pest control, provide wildlife habitat, or reduce the rate of oxidation of organic soils.

Additional Criteria Where the Primary Function of the Controlled Drainage System is to Prevent the Discharge of Land Applied Liquid Manure.

- This practice is limited to field(s) receiving manure as part of a Comprehensive Nutrient Management Plan and the manure is applied to the field following Conservation Practice Standards (633) Manure Utilization and Nutrient management (590).
- In-line controlled drainage structures must be designed to contain the volume of manure that can enter the subsurface drainage system without discharge from the system. This will require close management of the water surface elevation within the controlled drainage structures prior to manure application.
- Flow-through type storage facilities shall have a valve on the downslope side of the facility. The valve will be open during normal drainage mode and closed prior to manure application. The storage sump shall be sized to facilitate the removal of captured manure within 24 hours of manure flow into the storage structure. Although this standard does not include the portable pump required to empty the facility, the producer must have the pump on site before NRCS will certify completion of this practice.

CONSIDERATIONS

The concept of drainage water management is based on the premise that the same drainage intensity is not required at all times during the year.

The management of field water table elevations and drainage discharges from surface drainage systems should be performed to maximize crop yield and minimize water quality impacts.

The effect of managing the drainage system on adjacent fields should be evaluated. The installation and operation of a water level control structure should not impact adjacent fields or drainage systems.

In order for the practice to be economical and practical, each control structure needs to influence a significant amount of the field; therefore, drainage water management is generally limited to very flat fields with slopes typically less than 0.5 percent. It is possible to apply the practice on very moderate slopes if the tile system is designed with the laterals on the contour and a series of control structures are installed to step down the control elevations. This increases both drainage system cost and management.

Raising the water table during the growing season will generally increase evapotranspiration and may increase crop yield. Care must be practiced to maintain sufficient aerated crop root zone so as not to do damage to the crop.

Drainage water management may effect the water budget, especially volumes and rates of runoff, infiltration, evaporation, transpiration, possible deep percolation and ground water recharge because of the increase in the amount of water stored in the field.

Drainage water management may increase base flow because of increased gradient from fields to surface water conduits. Higher field water tables may also increase deep seepage and lateral losses, since this water will pass through reduced (low oxygen) zones.

Drainage water management may increase runoff, which would reduce tile flow and lower nitrate loading to surface water. Runoff generally has a lower concentration of nitrate than tile flow water.

Drainage water management may increase runoff, which could increase movement of suspended sediment and attached substances.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard as necessary and shall describe the requirements for applying the practice to achieve its intended use.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that will identify the intended purposes of this practice and that will identify critical dates and target elevations of the water level necessary to accomplish the intended purposes.

The plan shall also include the operation and maintenance of critical components of the infrastructure used to manage the drainage water.

The Operation and Maintenance Plan for this practice when a storage structure is used must address the following as a minimum:

- Manure should not be applied to fields that have tile flow exceeding base flow; application is to be delayed until tile flow exceeding base flow stops.
- All valves necessary to prevent tile discharge are to be closed prior to manure application.
- Valves are to remain closed until manure flow into the storage structure has stopped for a minimum of 24 hours.
- All pumping equipment must be available and operational once tile flow is blocked.
- Manure accumulated in the storage facility is to be pumped back onto the field at a pumping rate low enough to prevent erosion, and should be directed in a way to reduce the likelihood of flow back into the tile system.

The operation and maintenance plan for a controlled drainage system installed primarily to prevent discharge of nitrates needs to address the following as a minimum:

- Flow from the system is to be controlled following fall harvest until the field needs to be drained to allow tillage or planting of the next crop.
- Prior to tillage, harvest, and other field operations, the water table should be at a depth to provide trafficability throughout the field.
- After planting and other necessary field operations, the water table control device can be set to allow infiltration from rainfall to bring the water table to the desired level to provide capillary water to the plant root zone. This will vary, depending on the crop.
- Field water table observation wells should be installed, and water table levels be observed as part of the operation plan

REFERENCES

- National Handbook of Conservation Practices (NHCP), Practice Standard 554, Drainage Water Management

- National Engineering Handbook (NEH), Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage)
- NEH Part 623, Irrigation
- NEH Part 624, Chapter 10, Water Table Control