NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WATER TABLE CONTROL

(Acre)

CODE 641

DEFINITION

Water table control through proper use of subsurface drains, water control structures, and water conveyance facilities for the efficient removal of drainage water and distribution of irrigation water.

PURPOSES

This practice may be applied as part of a resource management system to support one or more of the following:

- Improve the soil environment for vegetative growth by regulating the water table.
- Remove excess runoff and subsurface water, facilitate leaching of saline and alkali soil.
- Regulate or manage ground water for subirrigation of crops.
- Improve on-site and off-site water quality by increasing the potential plant root zone depth and increasing the soil depth to a free water table.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to underground conduits installed to a planned spacing, depth, and grade and to the related facilities and structures needed to regulate water table depths for efficient crop production.

This practice applies to areas where:

1. A high water table exists, either natural or induced.
2. The topography is relatively smooth, uniform, and flat to gently sloping.
3. Subsurface conditions are such that a water table can be maintained without excessive water loss.
4. An adequate water supply is available.
5. Benefits of subirrigation, in addition to controlling ground water and surface runoff, justify installation of the system.
6. Soil depth and permeability will permit effective operation of the control system.
7. Saline or sodic soil conditions can be maintained at an acceptable level for efficient production of crops.
8. A suitable outlet exits.
9. Improvement of off-site water quality is needed and may be provided by controlling the water table.

CRITERIA

General criteria applicable to all purposes

A plan based on soils, topography, and crops to be grown shall be prepared. The plan shall show the location elevation, spacing, size, and grade of all conduits, control structures, and outlet channels.

Design for all associated practices are to be made in accordance with other pertinent Engineering Standards such as Subsurface Drain (606); Mole Drain (482); Surface Drainage, Field Ditch (607); Surface Drainage, Main or Lateral (608); Structure for Water Control (587); Irrigation System, Surface and Subsurface (443); Irrigation Field Ditch (388); Irrigation Canal or Lateral (320); Irrigation Water Conveyance (428); and the additional special design criteria contained in this standard.

Capacity

Overall facility design and all component parts shall have the capacity to deliver or remove the flow of water required for irrigation or drainage, whichever is greater.

1. Drainage capacity

Combined capacity of surface and subsurface facilities shall be adequate to satisfy the appropriate drainage coefficient for the crops to be grown.

Where it is necessary to admit surface water through surface inlets to the drain, an adjustment in the required capacity of the drain shall be made as needed to compensate for increased inflow during and after rainfall.

2. Irrigation capacity

Facilities shall be sized to supply the peak period consumptive use rate for the crops to be grown. Local crop consumptive use tables or the Washington Irrigation Guide should be consulted.

Land preparation

Excessive irregularities in the land surface should be removed whenever practical by leveling or smoothing so that grades in the directly of rows are level or continuous, except for minor depressions. Otherwise, surface inlets shall be provided in the depressions for surface water removal. Silt traps should be provided, as needed, depending on the type of surface inlet. From a maintenance standpoint, use as few surface inlets as practical.

Grade of main and laterals

Grade of mains shall be level or constantly sloping toward the outlet and may be either open ditches or closed conduits. Laterals shall be planned on grades as nearly parallel to the ground surface as possible and sloping towards the normal outlet. Lateral grades shall be in accordance with the conservation practice standard for Subsurface Drain (606). Lateral grades may be reduced to 0.05 percent if essential for effective water table control and precautions are taken to minimize sedimentation problems.

Length of laterals - Providing adequate capacity for drainage and irrigation should be considered in planning lateral length. Lateral length may be restricted by requirements for lateral depth relative to desired water-table elevations at the upper end of individual laterals. Laterals should normally not exceed approximately 1,200 feet in length.

Depth of laterals

The subsurface drain should be deeper that the maximum and minimum levels of the desired water table throughout the length of the lateral. It is desirable to place laterals within the soil layer having the highest hydraulic conductivity.

Spacing of mains and laterals

Spacing of main lines and open supply or drainage ditches shall be as needed to enable lateral lines to adequately serve the field area. One or more of the following will determine maximum spacing of laterals to achieve uniform distraction of irrigation water:

1. Analysis using the DRAINMOD program.
2. Using the average spacing recommendation from the local drainage guide, specifically for water-table control systems.
3. Comparing the subject site to existing system with similar soils and crops, where the adequacy of the existing system is known.
4. Small trial areas, where insufficient local data are available for certain soils.

Size of conduits

Conduits shall be sized to provide the desired flow, allowing for friction losses and the hydraulic gradients anticipated, for both drainage and subirrigation. Minimum size of conduits shall be 4 inches.

Filter and filter materials

Because of water movement into and out of the conduits in water-table control laterals with fluctuating hydraulic heads, the potential for

movement of fine soil particles may be greater than in regular drainage laterals. Suitable filters shall be used where needed to prevent for movement of fine soil particles (for guidance see Chapter 14 of the Engineering Field Handbook). Determining the need for a filter or selecting a filter is critical.

Generally, only properly graded sand and gravel filters, as defined in the subsurface drain standard (606), should be used as filters around conduits in water-table control systems.

For coarser textures and well-graded sands, filters may not be necessary. For fine-textures and poorly graded sands, a geotextile filters may be used. If geotextile filters are to be used in any other soils, they should be tested to prove they will function satisfactorily. These tests should be made against the soils in which the filters will be installed

These tests are necessary unless sufficient field installations are available in similar soils to indicate that these geotextile filters have not clogged under similar water-table control conditions. In soils where iron oxide problems are known to exist and a filter is needed, a knitted geotextile material or sand gravel filter shall be used.

Envelopes and envelope material

Envelopes shall be used around subsurface drains if needed for proper bedding of the conduit or to improve the characteristics of flow of ground water into the conduit. The design of envelope and/or filter materials shall conform to the procedures outlined in National Engineering Soil Mechanics Note 1, "Guide for Determining the Gradation of Sand and Gravel Filters".

Water control structures

Water control structures shall be installed as necessary to insure the water table is held within 1.0 ft of the desired elevation.

Water control structures shall be sized to provide the required drainage flow over the flashboard or otherwise throughout the control structure with a minimum head of 0.5 feet for normal operations. In all cases, drainage flow elevations shall be controlled so that crop damages do not occur as a result of an extended period of saturation in the root zone. Structures shall be designed so that control can be quickly removed when return to the drainage mode is desired.

CONSIDERATIONS

Water Quantity

1. Effects the water budget, especially effects on volumes and rated of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Effects on the movement of dissolved substances below the root zone and to ground water.
3. Potential effects on wetlands or water related wildlife habitats.
4. Effects of pesticides and nutrient use on surface and ground water quality.

Water Quality

1. Effects on erosion and the movement of sediment, pathogens, organic material and soluble and sediment-attached substances carried by runoff.
2. Effects on the movement of dissolved substances below the root zone and to ground water.
3. Potential effects on wetlands or water-related wildlife habitats.
4. Effects of pesticide and nutrient use on surface and ground water quality.

PLANS AND SPECIFICATIONS

Plans and specifications for installing water table control facilities shall be in keeping with this standard and shall describe the requirements for applying all components of the facility to achieve its intended purpose. Incorporate by reference, appropriate conservation practice standards and specifications required to install the facility.

OPERATION AND MAINTENANCE

Operation and Maintenance plans must be prepared for use by the landowner or operator responsible for the water-table control system and components operation and maintenance. The plan should provide specific instructions for operating and maintaining water table control facilities to insure they function properly. Minimum requirements to be addressed in the Operation and Maintenance Plan are

Operation Plan

Water table control should ensure prolonged saturation of the root zone does not occur. For very shallow rooted crops, such as vegetables, the best method of operation may be to ease the ground water to near 12 inches of the ground surface for a short period until the surface layer of the soil becomes wet. Once this condition is reached the water table is then allowed to recede by evapotranspiration to some predetermined level until the crop needs to be irrigated again. Additional water is than applied and the cycle is repeated. This procedure allows air to move into the soil and plant root zone for optimum root development.

For deeper-rooted crops, it is customary to maintain the water control structures at a predetermined level for the various crop stages; thus, variations in the water table will result only from rainfall and differing consumptive use rates during any particular crop stage.

Water control structures should be designed so that adjustments may be easily made to facilitate removal of large storm discharges. Trafficability in the spring and during harvest can also be facilitated by timely lowering of the water table. Flashboard type structures normally allow for adequate management of the water table.

Maintenance Plan

1. Prompt repair or replacement of damaged components is necessary
2. Remove debris and foreign material from structures, drains, inlets, outlets, and other components that hinders system operation
3. Maintain good vegetative cover on all slopes and watercourses.

List items specific to the project on the “Operation and Maintenance Worksheet”.

REFERENCES

USDA NRCS, National Engineering Field Handbook, Chapter 14.

USDA NRCS, Standard Drawings Handbook - Washington.

USDA NRCS, National Engineering Handbook, Part 624, Drainage of Agricultural Lands.

ASCE No 70, Assessment and Management of Saline Soils.

USDA NRCS, National Engineering Soil Mechanics Note 1, "Guide for Determining the Gradation of Sand and Gravel Filters".

NRCS, WA
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