

SOIL CONSERVATION SERVICE

ENGINEERING STANDARD

SURFACE DRAINAGE -MAIN OR LATERAL

Definition

An open drainage ditch constructed to a designed size and grade.

Scope

This standard applies to ditches for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and sub-surface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than one square mile must meet the stability and maintenance requirements of the standard for open channels (582). Field ditches for the disposal of surface water (607) are not applicable.

Purpose

To dispose of excess surface or subsurface water, intercept ground water, control ground water levels, or a combination of these objectives.

Conditions Where Practice Applies

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping, the outlet shall provide for the quantity and quality of water to be disposed of. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

Design CriteriaCompliance with Laws and Regulations

Design, installation, and/or construction shall comply with State and local laws and regulations. Such compliance is the responsibility of the owner; however, the responsible SCS technician, before giving any technical assistance, will inform the owner of his responsibility for complying with all State and local laws and regulations.

The design and installation shall be based on adequate surveys and investigations.

Drainage Requirements

Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

Capacity

The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficient curves.

Hydraulic Gradeline

The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 foot below fields that will receive normal drainage from ditches draining more than one square mile.
2. 0.5 feet for ditches draining 40 to 640 acres.
3. 0.3 feet for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops, such as trees and grasses, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where flow is contained by dikes.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

Depth

Drainage ditches shall be designed deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to

provide adequate subsurface drainage or for normal flow. The increase shall be based on an evaluation of site conditions. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The clearance between a drain invert and the ditch bottom shall be at least one foot for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

Cross Section

The design ditch cross section shall be set below the design hydraulic gradeline and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and if needed, allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of onsite conditions.

Velocity

The maximum permissible design velocity shall be based on site conditions and shall be such as to result in stability of ditch bottoms and side slopes. A desirable minimum velocity is 1.5 feet per second. On flat grades where the design velocity is below this value, the cross section shall be adjusted to obtain the highest velocity that depth and maintenance limits permit. The velocity for newly constructed channels with drainage areas in excess of one square mile shall meet the stability requirements for open channels (582).

Capacity Design

Manning's Formula shall be used in determining the design velocity, and the value of n shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of n, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining the design for required capacity.

<u>Hydraulic radius</u>	<u>n</u>
Less than 2.5.	0.040--0.045
2.5 to 4.0	.035-- .040
4.1 to 5.0	.030-- .035
More than 5.0.	.025-- .030

Berms and Spoil Banks

Adequate berms shall be provided and shaped, as required, 1:0 provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work area and facilitate spoil bank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The following minimum berm widths shall be provided, except where spoil is spread according to the engineering standard for spoilbank spreading:

<u>Ditch width</u>	<u>Minimum berm width</u>
Ft.	Ft.
2 --6	8
6-8	10
More than 8	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes. Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

Related Structures and Ditch Protection

Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterway, or specially graded channel entrances where surface water or shallow ditches enter deeper ditches.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures generally shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

Each structure for an open ditch system shall be designed according to SCS standards for the kind of structure and type of construction used.

Seeding

Sodding, seeding, fertilizing and mulching shall conform to the recommendations for permanent seeding in the Pennsylvania Technical Guide which is

available in SCS offices or in the current Pennsylvania Agronomy Guide published by The Pennsylvania State University.

Operation and Maintenance

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of one square mile shall be according to the standard for open channels (582).

Plans and Specifications

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

Clearing

The channel area shall be cleared of trees, logs, stumps, and other materials necessary for construction. Care must be taken to protect all trees to be saved for environmental purposes. All material shall be disposed of by an acceptable method as shown on the plans.

Excavation

Channels shall be excavated to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth. Construction activities shall be carried on in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent sediment pollution of water.

Spoil

Spoil shall be disposed of as shown on the plans or as marked in the field.

Structures

All structures and other related protection devices shall be installed as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during the installation period.

Vegetation

Vegetation shall be planted at times and rates shown in the plans or in the specifications for each job.