

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

**SURFACE DRAINAGE-MAIN OR LATERAL**

(No.)

**CODE 608**

**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 subsurface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals have 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 levels; provide for leaching of saline or alkali soils, or a combination of these objectives.

**CONDITIONS WHERE PRACTICE APPLIES**

All lands to be drained shall be suitable for agricultural use within their land capabilities after installation of required drainage and other conservation practices.

An outlet for the open drainage system shall be available, either by gravity flow or by pumping. The outlet shall provide for the quantity and quality of water to be disposed of, with consideration of possible damages above or below the point of discharge. All Ohio drainage and water laws shall be adhered to in the planning and construction of this practice.

**DESIGN CRITERIA**

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.

### Required Capacity of Mains and Laterals

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

Drainage runoff determinations will be made using procedures found in Chapter 14 of the Engineering Field Manual for Conservation Practices.

### Hydraulic Grade Line

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

1. One foot below ground level of fields that will receive normal drainage from open ditches draining more than 1 square mile.
2. 0.5 foot below ground level for ditches draining 40 acres to 640 acres.
3. 0.3 foot below ground level for ditches draining less than 40 acres.

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

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

### Depth Requirements

Drainage ditches shall be designed with enough depth to allow for normal ditch siltation. Increases in design depth and design capacities to provide adequate subsurface drainage or for normal flow shall be made where needed, 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 subsurface drain. The vertical distance between the elevation of a tile drain invert and the design elevation of the ditch bottom shall be at least 1 foot for ditches which 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 defined as 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 grade line and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and if needed, allowances for initial sedimentation.

Side Slopes

Side slopes shall be stable, meet maintenance requirements and be designed based on site conditions. Minimum side slopes for channels based on sub-soil texture are listed below:

<u>Subsoil Texture</u>	<u>Side Slopes</u>
Sand, loamy sand, peat, muck	1:1
Clay, clay loam, sandy clay loam	1.5:1
Silt, silt loam	2:1

Bottom Width

The minimum bottom width for ditches in sandy and muck soils shall be 4 feet. For all other soils, the minimum bottom width shall be 3 feet.

Velocity

When possible, the minimum velocity will be 1.5 feet per second. On flat grades where the design velocity is lower than 1.5 feet per second, the cross-section shall be adjusted to obtain the highest velocity that depth and maintenance permits.

Drainage Areas Less than One Square Mile

The maximum permissible design velocity shall be based on site conditions and shall be such as to result in stability of the ditch bottoms and side slopes. Maximum permissible velocities will be computed using bank-full stage or 10 year frequency stage, whichever is lower. The following table will be used as maximum velocity.

<u>Subsoil Texture</u>	<u>Maximum Velocity ft./sec.</u>
Sand and sandy loam (non-colloidal)	2.5
Silt loam (also high lime clay)	3.0
Sandy clay loam	3.5
Clay loam	4.0
Stiff clay, fine gravel and graded loam to gravels	5.0
Graded silt to cobbles (colloidal)	5.5
Shale, hardpan, coarse gravel	6.0

Drainage Areas Greater than One Square Mile

Channel velocities for newly constructed channels with drainage areas in excess of one square mile shall meet the stability requirements specified for open channels (582).

Value of “n” in Manning’s Formula

Manning’s formula shall be used for 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, shall be used in the solution of the Manning formula for Mains and Laterals with good alignment:

<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

Where site conditions indicate probable serious erosion due to a higher velocity resulting from a lower value of “n” immediately after construction and prior to establishment of vegetation, such lower value of “n” shall be estimated. The resultant velocities shall be considered in designing the ditch and planning and protective measures.

Berms and Spoil Banks

Adequate berms shall be provided as required to provide roadways for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas 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 to near the edge of the ditchbanks. The following minimum berm widths shall be provided except in those cases where spoil is spread in accord with the requirements listed herein.

<u>Ditch Depths</u>	<u>Minimum Berm Width</u>
<u>Feet</u>	<u>Feet</u>
2 – 6	8
6 – 8	10
Over 8	15

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

In areas where spoil spreading is specified on the design, the slope of the spoil after spreading shall not be steeper than 4:1 on the land side and 3:1 on the channel side when a berm is established.

If the spoil is spread to the edge of the channel, the channel side slopes of the spoil shall be shaped to join the side slope of the ditch bank so loose spoil will not roll or wash into the ditch. In the spreading operation, the spoil shall be placed so as not to endanger the stability of the ditch bank and shall not exceed 3 feet in height above the natural ground surface, except by special design. The finished surface shall slope away from the edge of the channel or berm insofar as feasible.

Travelways for Maintenance

All drainage mains and laterals with drainage areas in excess of one square mile shall be provided with travelways for maintenance as specified in Open Channel-582.

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 especially graded channel entrances where surface water or shallow ditches enter deeper ditches.

Grade control structures, bank protection, or other suitable measures shall be used where 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 ordinarily 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 in accordance with Natural Resources Conservation Service Standards for the kind of structure and type of construction involved.

Erosion Control During Construction

Provisions will be made to include temporary measures for control of erosion during construction. Mechanical measures in addition to vegetative measures will be specified as needed. Provisions of Conservation Planning Memorandum OH-1 will be followed in planning temporary erosion control measures.

Vegetative Treatment

Seeding will be in accordance with Critical Area Planting-342.

**PLANS AND SPECIFICATIONS**

Plans and specifications for the construction of Drainage Mains or Laterals, shall be in keeping with this standard and shall describe the requirements for construction of the practice to achieve its intended purpose.

NATURAL RESOURCES CONSERVATION SERVICE  
CONSTRUCTION SPECIFICATION

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**Clearing**

Designated trees, snags, logs, brush, and rubbish to be removed shall be cleared from the channel, berm, area for spoil placement and other areas necessary for construction. Cleared materials will be burned, buried or piled at designated locations, or otherwise removed from the construction site. All burning shall be performed outside the channel and shall conform to regulations in effect in the area. Care must be taken to protect the trees to be saved for environmental purposes.

**Excavation**

Channels shall be excavated to the lines and grades shown in the design. The excavated surfaces shall be reasonably smooth. All excavation operations shall be conducted in a manner that will not restrict flow from existing channels.

**Spoil**

Material excavated from the channel shall be disposed of in the locations and in the manner shown on the drawings. Spoil will be piled or spread in a manner to maintain the stability of the channel banks and with consideration of the existing and future land use of the adjacent area.

All work shall be done in a manner that will reduce sedimentation, erosion and water pollution to the maximum extent possible. This shall be done by:

1. Placing spoil in a location to prevent its sloughing or washing into the channel or water course.
2. Keeping chemicals, fuel, lubricants, sewage, and waste materials out of channel and drainage ways.
3. Limiting the use of excavating equipment to areas outside the channel and drainage ways, except to those few times when no other alternative is possible.