

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**

**SURFACE DRAINAGE, MAIN OR LATERAL**  
**(Ft.)**  
**CODE 608**

**DEFINITION**

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

**PURPOSE**

This practice may be applied as part of a water management system to collect and convey excess surface or subsurface water.

**CONDITIONS WHERE PRACTICE APPLIES**

This standard applies to ditches for conveyance 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.

This standard does not apply to collection of water from within a field. Surface Drainage, Field Ditch (607) should be used for that situation.

**CRITERIA**

Mains or laterals having a drainage area of more than 640 acres must meet the stability requirements of Open Channel (582).

The design and installation shall be based on surveys and investigations sufficiently detailed to ensure successful implementation of this practice.

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

Whether the outlet is by gravity flow or by pumping, the outlet shall be sufficient for the quantity and quality of water conveyed.

All drainage practices shall be installed in accordance with Iowa drainage laws.

**Drainage Requirements.** Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meet 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 runoff curves in accordance with the Iowa Drainage Guide.

The minimum drainage requirements and minimum capacities for multi-purpose channels protecting agricultural lands shall be determined in accordance with Open Channel (582).

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by:

- Evaluating site conditions, including irrigation water deliveries

- Irrigation canal or ditch losses
- Soil stratification and permeability
- Deep percolation losses
- Field irrigation losses
- Subsurface drain discharge
- Quantity of surface water to be carried by the drainage ditch

**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 foot below fields that will receive normal drainage from ditches draining more than 640 acres
- 0.5 foot for ditches draining 40 to 640 acres
- 0.3 foot for ditches draining less than 40 acres

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

Hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be accounted for in the design.

**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 normal water surface is the elevation of the usual low flow during the growing season.

The clearance between a subsurface drain invert or a field ditch outlet and the design elevation of the ditch bottom shall be at least 1 foot to account for sediment accumulation in the main or lateral, except where lower values are

specified for a job due to unusual site conditions.

**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 on-site conditions.

The Iowa Drainage Guide or other local information shall be used to determine side slope limits for specific soils and/or geologic materials. Slopes shall be stable during rapid drawdown conditions.

**Velocity.** The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. Design velocities shall not be less than 1.5 ft/s to avoid excessive sedimentation except on flat grades where the design velocity is less than 1.5 ft/s, a channel cross section shall be selected to obtain the highest velocity permitted by depth and maintenance requirements.

The velocity for newly constructed channels with drainage areas in excess of 640 acres shall meet the stability requirements specified for Open Channel (582).

**Capacity Design.** Manning's equation 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 values of "n" shown in Table 1, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving Manning's equation for mains and laterals when determining the required capacity.

**Table 1. Recommended Manning's "n"**

Hydraulic Radius (feet)	"n"-value
Less than 2.5	0.040 - 0.045
2.5 to 4.0	0.035 - 0.040
4.1 to 5.0	0.030 - 0.035
More than 5.0	0.025 - 0.030

**Berms and Spoil Banks.** Adequate berms at a safe distance from the drain shall be provided and shaped, as required, to:

- Provide access for maintenance equipment
- Eliminate the need for moving spoil banks in future operations
- Provide for work areas and facilitate spoil bank spreading
- Prevent excavated material from washing or rolling back into ditches
- Lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks

The minimum berm widths are shown in Table 2.

**Table 2. Minimum Berm Width**

Ditch Depth (feet)	Berm Width (feet)
2 - 6	8
6 - 8	10
More than 8	15

The spoil shall be spread as soon as practical.

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. Provision must be made to channel water through the spoil bank and into the ditch without causing erosion.

**Related Structures and Ditch Protection.**

Mains and laterals shall be protected against erosion where surface water or shallow ditches enter deeper ditches. This may be achieved through the use of chutes, drop structures, pipe drops, other suitable structures, grassed waterways, critical area seeding, filter strips, or specially graded channel entrances.

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

Each structure for an open ditch system shall be designed according NRCS standards for the kind of structure and type of construction used. The "island-type" method of construction shall be used to protect the structure from washout by flows exceeding design capacity.

Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

**Channel Vegetation.** Vegetation shall be established on all channel slopes, berms, spoil, and other disturbed areas according to Critical Area Planting (342).

Channel side slopes are to be seeded as soon as possible after excavation. Seeding shall be done in accordance with Critical Area Planting (342).

## CONSIDERATIONS

When planning this practice consider:

- Possible damages above or below the point of discharge that might involve legal actions or other offsite impacts
- Potential impacts on wetlands or other water related wildlife habitat
- Impact on cultural resources
- Use of riparian buffers, filter strips, and fencing
- Potential water quality impacts for soluble pollutants, sediments, and sediment-attached pollutants
- Potential changes in soil moisture that will effect the growth of desirable vegetation
- Effect on ground water recharge and quality of ground water

## 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.

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. The list includes most, but may not contain all, of the specifications needed for a specific project:

- IA-1 Site Preparation
- IA-5 Pollution Control
- IA-6 Seeding and Mulching for Protective Cover
- IA-21 Excavation

- IA-27 Diversions
- IA-45 Plastic (PVC, PE) Pipe
- IA-51 Corrugated Metal Pipe
- IA-52 Steel Pipe Conduits
- IA-61 Loose Rock Riprap
- IA-92 Fences
- IA-95 Geotextile

## **OPERATION AND MAINTENANCE**

A site-specific operation and maintenance (O&M) plan shall be provided to and reviewed with the landowner(s) before the practice is installed. The plan shall adequately guide the landowner(s) in the routine maintenance and operational needs of the surface main or lateral. The plan shall also include guidance on periodic inspections and post-storm inspections to detect and minimize damage to the drain and appurtenant structures.

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 640 acres shall be according to the standard for Open Channel (582).

## **REFERENCES**

USDA-NRCS, National Engineering Handbook (NEH), Part 650, Engineering Field Handbook (EFH), Chapter 14, Drainage

Iowa Drainage Guide, Iowa State University, Special Report 13