Surface Drain, Main or Lateral (Ft.) 608

DEFINITION

An open drainage ditch constructed to a designed cross section, alignment and grade.

PURPOSE

This practice is 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 collected primarily by drainage field ditches and subsurface drains. It provides minimum requirements for channels that provide drainage outlets for agricultural lands.

This standard does not apply to collection of water with a surface field ditch. NRCS Conservation Practice Standard, Surface Drain, Field Ditch (607), should be used for that situation.

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

CRITERIA

Drainage Requirements. Locate and design mains and laterals to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs.

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 design capacity of the ditch shall be based on the watershed area; the topographic, soil, and land use information; and use of the appropriate drainage curves or coefficients.

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, and quantity of surface water to be carried by the drainage ditch.

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

Structures constructed under this practice shall not compromise the structural integrity or flow capacity of existing structures within the system (e.g., bridges or culverts).

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 (1 square mile).
- 0.5 feet for ditches draining 40 to 640 acres.
- 0.3 feet 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.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be accounted for in the design. Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. 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. Where site conditions allow, the invert

elevation of the main or lateral shall be at least 1 foot lower than the invert elevation of subsurface drains or field ditches that outlet into the main or lateral.

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 based on site conditions.

The drainage guide or other local information shall be used to determine side slope limits for specific soils and/or geologic materials. If such information is not available, the design side slopes in the main or lateral shall not be steeper than those recommended for ordinary conditions in NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d). Stability during rapid drawdown conditions must be considered.

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 1.4 feet per second to avoid excessive sedimentation.

The velocity for newly constructed channels with drainage areas in excess of 1 square mile shall meet the stability requirements specified for the NRCS Conservation Practice Standard, Open Channel (582).

Manning's equation shall be used in determining the design velocity. Manning's n value shall be based on channel hydraulic radius, channel alignment, an aged channel condition, and probable vegetative growth expected under normal maintenance. Unless special site studies are available to justify other values, the appropriate Manning's n factor in NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d), or in the local Drainage Guide, shall be used to determine the required design capacity.

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 the future; provide for work areas and facilitate spoil bank spreading; prevent excavated material from washing or rolling back into ditches; and lessen sloughing of ditchbanks caused by heavy loads near the edge of the ditchbanks. Spoil material shall be spread as soon as practical. Minimum berm widths shall be those recommended in NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d) or the local Drainage Guide, except where the spoil is spread according to NRCS Conservation Practice Standard, Spoil Spreading (572).

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 convey water flows through the spoil bank and into the ditch without causing serious erosion.

Related Structures and Ditch Protection. Drainage 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 suitable measures such as chutes, drop structures, pipe drops, 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. Grade control structures shall meet the NRCS Conservation Practice Standard, Grade Stabilization Structure (410).

Structures shall be protected from washout by flows exceeding design capacity.

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

Channel vegetation. Vegetation shall be established according to NRCS conservation practice standard Critical Area Planting (342).

Use vegetation adapted to the site that will accomplish the desired purpose. Preference shall be given to native species in order to reduce the introduction of invasive plant species; provide management of existing invasive species; and minimize the economic, ecological, and human health impacts that invasive species may cause. If native plant materials are not adaptable or proven effective for the planned use, then non-native species may be used. Refer to the Field Office Technical Guide, Section II, Invasive Plant Species, for plant materials identified as invasive species.

CONSIDERATIONS

Consider the potential effects of installation and operation of surface drainage mains or laterals on the

cultural, archeological, historic and economic resources.

When planning this practice, the following shall be considered, as applicable:

- The use of a low-flow or two stage channel design.
- Impacts of sedimentation downstream.
- Possible damages above or below the point of discharge that might involve legal actions or other offsite impacts
- Potential impacts on wetlands.
- Impacts on cultural resources.
- Use of riparian buffers, filter strips and fencing
- Potential water quality impacts of soluble pollutants and sediment-attached pollutants.
- Impacts to wildlife.
- Impacts of invasive species movement and establishment through the drainage network.

PLANS AND SPECIFICATIONS

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

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations
- Construction drawings/specifications with:
  - Location map
  - "Designed by" and "Checked by" names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable.
- Record of approvals of in-field changes affecting function and/or job class, where applicable.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.

REFERENCES

NRCS Engineering Field Handbook, Part 650, Engineering Field Handbook, Chapter 14, Water Management (Drainage).