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.

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 having a drainage area of more than 1 mi^2 must meet the stability and maintenance requirements of the standard for open channels (582). Field ditches for disposal of surface water (607) are not applicable.

PURPOSE

To dispose of excess surface or subsurface water, intercept ground water, control ground water 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 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.

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.

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 coefficients.

The required capacity of open ditches for subsurface drainage in western 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.

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 ft. below fields that will receive normal drainage from ditches draining more than 1 mi^2.
- 0.5 ft. for ditches draining 40 to 640 acres.
- 0.3 ft. 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 1 ft 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 on-site conditions.

Velocity

The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. A desirable minimum velocity is 1.5 ft/s. On flat grades, a channel cross section shall be selected on the basis of the depth and maintenance requirements, which will result in the desirable minimum velocity if possible.

The velocity for newly constructed channels with drainage areas in excess of 1 mi^2 shall meet the stability requirements specified 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 Manning's Formula for mains and laterals when determining the design for required capacity.

Hydraulic radius	*n*
Less than 2.5 …….	0.040 – 0.0.45
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, to provide access 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 too near the edge of the ditchbanks. The following minimum berm widths shall be provided, except where the spoil is spread according to the engineering standard for spoil bank spreading:

Ditch depth width	Minimum berm
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 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.

Additional criteria for split ditches used in sugarcane.

Planning. Modern farm operations are demanding that improved drainage systems be established on individual fields so that mechanized equipment can be operated more efficiently.

A well planned drainage system utilizing shallow parallel field laterals, long rows and shallow drainage field ditches or other drains, result in good drainage and permits efficient use of mechanized farm equipment. This type of drainage system can best be accomplished in connection with a well planned and coordinated program of land grading.

The field technician, within the limits specified herein, should vary ditch depths and side slopes to obtain the most practical drainage systems for individual farmers.

Ditches should have straight courses when topography, field conditions and property boundaries permit. Necessary curves should have reasonably smooth alignment. Excessive cuts against grade and creation of unnecessarily small and irregular areas should be avoided when feasible.

If, in an area where irrigation is practiced, or probably will be used, the drainage system should be planned to fit into the irrigation system.

The farm road system should be considered when planning the drainage system. Good planning of farm roads results in the use of a minimum number of culverts and bridges and reduces farm operating costs.

Drainage Requirements. Drainage systems may be developed using either (a) field lateral ditches which are deep and narrow with steep side slopes, or (b) field lateral ditches which are shallow and wide with flat side slopes. A good drainage system can be developed by varying the ditch depths, bottom widths and side slopes to meet the needs of each individual farm. Needed grade stabilization structures should be provided.

A system of parallel laterals spaced at intervals which will limit runoff to quantities which can be handled by shallow ditches is desirable. This will permit drainage field ditches or runoff from other drains to enter the laterals with a minimum of overfall and erosion, holding the need for grade stabilization structure to a minimum.

Capacity. The required capacity will be determined by using the following drainage formulas:

1. Gravity Drainage

Land Use	Formula
a. Hill areas	$Q = 131\ M^{5/6}$
b. Cultivated	$Q = 45\ M^{5/6}$
c. Improved pasture	$Q = 30\ M^{5/6}$
d. Rice	$Q = 22\ ½\ M^{5/6}$
e. Woodland	$Q = 10\ M^{5/6}$
f. Marsh range	$Q = 10\ M^{5/6}$
g. Industrial and Municipal	
1. Hill areas	$Q = 164\ M^{5/6}$ [1/]
2. Flat areas	$Q = 56\ M^{5/6}$ [1/]

[1/] Minimum – increase if desirable to do so. Q = runoff in CFS; M = drainage area in square miles.

2. Drainage of Leveed and Pumped Areas

   Refer to Chapter 14 of the Engineering Field Manual, Figure S-14-23 on Page S-14-72. The discharge amount may be reduced by the available sump storage.

3. Multi-purpose channels for PL-566 Watershed Projects and Channels with

Drainage Area greater than one (1) Square Mile.

The requirements for such channels shall be in accordance with the standard for Open Channel (582).

Depth Requirements. Ditch depths shall be selected which will best suit the needs of the individual farm and the desires of the farmer for ditch maintenance. Deep ditches normally require less frequent maintenance and more grade stabilization structures.

In order to permit the use of shallow field laterals, capacities may be increased by flattening side slopes and widening ditch bottoms rather than increasing ditch depths. Shallow ditches normally required more frequent maintenance and reduce the number of required grade stabilization structures.

In no case shall designed ditch depths be less than one foot, except split ditches in uncrowned row cropland in the sugarcane area shall have minimum design depths below normal ground as shown below.

Type	Design Depth
"V" or Semi-"V" type	1.3 feet
Trapezoidal type	1.6 feet
"V" or Semi-"V" type in combination with the rotary ditches	1.8 feet
Trapezoidal type in combination with the rotary ditches	2.0 feet

Split ditches in crowned row cropland in the sugarcane areas shall have a minimum design depth of one foot below normal ground. Design depth plus an allowance for initial sedimentation should be 1.3 feet.

The split ditch must have sufficient capacity to drain the area served.

Ditches bordering crowns in pasture land shall meet the requirements of Code 310, Bedding.

Cross Section. The minimum design cross section for all split ditches shall be 3.3 square feet below normal ground exclusive of allowance for siltation.

Velocity. Permissible Design Velocities

Soil Texture & Unified Soil Classification Symbol	Maximum Velocity ft./Sec.
Silts and very fine sandy loams (ML, CL-ML, SP)	1.0
Silty clay loams, fine sandy loams, sandy loams, and loams (CL, SM)	2.0
Silty clays, sandy clay loams, clay loams, and sandy clays (CL, CH, SC)	3.0
Stiff clays and high plastic soils (CH, MH)	4.0

The standard for Open Channel (582) contains the methods to be used in Louisiana when a channel requires special design to meet the limiting velocities given in the table above.

Berms and Spoil Banks. For ditches located in or adjacent to rice land other contour levee irrigation systems, the berm width may be reduced to 2.0 feet where the cross-sectional area of the spoil bank does not exceed 20 square feet.

OPERATION AND MAINTENANCE.

Requirements for operation and maintaining all drainage mains and laterals having drainage areas in excess of 1 mi^2 shall be according to the standard for Open Channels (582).

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, and other suitable structures or grassed waterway, 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.

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

Capacities of pipe or drop structures shall be determined by use of the applicable drainage coefficients. The “island-type” method of construction shall be used to protect the structure 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 the standard for Channel Bank Vegetation (322).

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.
- Impact on cultural resources.
- Use of riparian buffers, filter strips and fencing.
- Potential water quality impacts for soluble pollutants and attached sediment pollutants.
- Effects on the water budget components, especially with regard to effects on runoff, soil water, and water tables.
- Potential changes in soil moisture that will affect the growth of desirable vegetation.
- Effect on ground water recharge.
- Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses.
- Effects on the salinity of drained soils and downstream water courses.
- Effects on wetlands.
- Effect on the quality of ground water.
- Potential for changes in downstream water temperature.
- Effects on downstream visual quality.

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.