NATURAL RESOURCE 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 all ditches where the primary purpose is for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains. It also covers minimum drainage requirements for multi-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than 1 square mile must meet the stability and maintenance requirements for the standard for OPEN CHANNEL (582). FIELD DITCH (607) for the disposal of surface water does not apply.

PURPOSE

To dispose of excess surface or subsurface water, intercept groundwater or to control groundwater levels; to provide for leaching of saline or alkali soils, or a combination of these objectives.

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all land as permitted by SCS policy for wet lands. All areas 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. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

DESIGN CRITERIA

General

The design of the entire drainage system shall comply with all state laws pertaining thereto.

The design and installation shall be based on adequate surveys and investigations made as outlined in the Engineering Field Manual and the SCS National Engineering Handbook, Section 16, Chapter 2.

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

The capacity of mains and laterals shall provide for the removal of excess water based on climatic and soil conditions and the needs of crops.

The required capacity shall be determined by proper consideration of size and slope of drainage area, climatic and soil conditions and needs of crops expressed in terms of a drainage coefficient.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

Exhibit 14-2, Chapter 14 Engineering Field Manual, Figure 5.4, Chapter 5, Section 16, National Engineering Handbook, may be used in estimating for open ditch design, the total discharge from flat watershed areas - those having average slopes less than 25 feet per mile. Under normal conditions Curve C will be used. For lands with steeper slopes, use the next higher curve to give equal protection.

The minimum drainage requirements and minimum capacities for multi-purpose channels protecting agricultural lands shall be determined in accordance with the principles in Chapter 3 and 5, Section 16, National Engineering Handbook.

The required capacity of open drains in irrigated areas shall be determined by evaluating site conditions, including the following:

Irrigation water deliveries; ditch losses; soil stratification and permeability; deep percolation losses; field irrigation losses; and quantity of surface water to be carried by the drain.

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 1 mi^2.
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.

Velocity

Optimum velocity is normally 2 to 4 feet per second, when operating at design flow.

The following table shows the common range in maximum permissible velocities in bare channels after aging, for 8 classes of soils occurring in Nebraska:

MAXIMUM PERMISSIBLE VELOCITIES

Common Classification			Maximum Safe Velocities Ft/Sec
USDA	UNIFIED Description	UNIFIED Symbol	
Sand, loamy fine sand, fine sand, loamy sand (very low in clay content)	Fine sands Silty sands	SW, SP SM	1.50 - 2.50
Sandy loam, fine sandy loam (low in clay content)	Silty sands Sandy silts	SM, ML	1.75 - 2.50
Silt loam (low in clay content) soils or soil materials from Brule	Sandy silts	ML	2.00 - 3.00
Loam, very fine sandy loam, silt loam (less than 18 percent clay	Sandy silts	ML	2.00 - 3.50
Silt loam, silty clay loam, loam, clay loam (18 to 35 percent clay)	Sandy silts Clayey silts	ML, CL	2. 50 - 3.50
Silty clay loam, clay loam (35 to 40 percent clay)	Clay silts	ML, CL, CH	3.75 - 5.00
Siltyclay, clay (more than 40 percent clay	Silty clay	CH	4.00 - 5.00
Bedrock (shale clays)	Clay, shale	CH	6.00

- When a range is shown, the lower value applies to water that is clear, and the higher to water that is transporting colloidal materials.

Normally, a minimum velocity of 1.5 feet per second is desirable. On extremely flat grades, an adjustment in channel cross-section may be necessary to maintain this velocity. The velocity of constructed channels with drainage areas in excess of 1 square mile shall meet stability requirements of OPEN CHANNELS (582).

CAPACITY DESIGN

Manning's formula shall be used for determining the design velocity. The value of "n" shall be based on alignment, estimated vegetative condition to be expected with normal maintenance, other roughness factors and the hydraulic radius.

The following values of "n" can be used for an assumed aged channel with good maintenance and alignment.

Hydraulic Radius	"n"
Less than 2.5	0.040 - 0.045
2.5 to 4.0	0.035 - 0.040
4.0 to 5.0	0.030 - 0.035
More than 5.0	0.025 - 0.030

Cross Section

The designed cross-section - that section carrying the flow - shall lie below the hydraulic gradient as designed. This section shall meet capacity, velocity and depth requirements.

Side slopes shall be stable for existing soil and site conditions and meet maintenance requirements. Where drainage ditch is built on cropland and is to be crossed with farm machinery, a side slope of 4:1 or flatter should be used.

Depth

A drainage ditch may be over-dug six (6) inches in depth to allow for normal ditch siltation. An increase in design depth over normal flow requirements may be made to provide subsurface drainage where needed.

Main or laterals that serve as outlets for existing closed drains shall be designed for a normal water surface at or below the invert of the outlet end of the closed drains. The flowline of the main or lateral shall be a minimum of 1 foot below the invert of a closed drain where it enters the open ditch. The "normal water surface" is defined as the elevation of the normal low flow during the growing season.

Berms and Spoil

Depending upon site conditions and construction equipment used and other considerations, the spoil may either be piled in a dike paralleling ditch or spread to areas adjacent to the drain.

If a paralleling spoil bank is to be used either permanently or only during construction, a berm will be provided between the inside toe of the spoil dike and the top of the back slope of the ditch. The minimum berm widths shall be as follows:

Ditch Depth-Ft.	Minimum Berm Width-Ft.
2-6	8
6-8	10
Over 8	15

A means shall be provided for adjacent surface water to enter the ditch through spoil materials without causing erosion.

Related Structures and Ditch Protection

When surface water enters mains and laterals, they shall be protected against erosion by chutes, drop structures, pipe drops, grassed flumes or specifically graded channel entrances.

Grade control structures, water control structures, bank protection or other suitable measures shall be used where necessary to control erosion in the main or lateral.

Culverts and bridges shall have adequate capacity and depth to provide drainage needs and to minimize obstruction to flow. The minimum diameter of culvert pipes shall be 18 inches.

Capacities of pipe or drop structure will normally be determined on the basis of the estimated flows using applicable drainage coefficient and curve. The "island" type of construction is recommended to prevent washout.

All structures in an open ditch system shall be designed in accordance with Soil Conservation Service standards.

OPERATION AND MAINTENANCE

Requirements for operation and maintenance of all drainage mains and laterals have a drainage area in excess of 1 square mile shall be in accordance with the standard OPEN CHANNEL (582).

CHANNEL VEGETATION

Vegetation shall be in accordance to the CRITICAL AREA PLANTING (342).

PLANS AND SPECIFICATIONS

Plans and specifications for the construction of Drainage Mains of the requirements for construction of the practice to achieve its intended purpose. Refer to S-608-1 for guide specifications.