NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

DIVERSION

(Ft.)

CODE 362

DEFINITION

A channel generally constructed across the slope with a supporting ridge on the lower side.

PURPOSE

This practice may be applied to support one or more of the following purposes.

- Break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing.
- Divert water away from farmsteads, agricultural waste systems, and other improvements.
- Collect or direct water for storage, water-spreading or water-harvesting systems.
- Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.
- Intercept surface and shallow subsurface flow.
- Reduce runoff damages from upland runoff.
- Reduce erosion and runoff on urban or developing areas and at construction or mining sites.
- Divert water away from active gullies or critically eroding areas.
- Supplement water management on conservation cropping or stripcropping systems.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where surface runoff water control and/or management are needed, where soils and topography are such that the diversion can be constructed, and a suitable outlet is available or can be provided.

Diversions shall not outlet on the right-of-way of a public road or utility without written approval from the proper authority.

CRITERIA

Capacity. Diversions as temporary measures, with an expected life span of less than 2 years, shall have a minimum capacity for the peak discharge from the 2-year frequency, 24-hour duration storm. Freeboard shall be not less than 0.5 foot.

Diversions that protect agricultural land shall have a minimum capacity for the peak discharge from a 10-year frequency, 24-hour duration storm. Freeboard shall be not less than 0.5 foot.

Diversions designed to protect areas such as urban areas, buildings, roads, and animal waste management systems shall have a minimum capacity for the peak discharge from a storm frequency consistent with the hazard involved but not less than a 25-year frequency, 24-hour duration storm. Freeboard shall be not less than 0.5 ft.

Design depth is the channel storm flow depth plus freeboard.

Cross section. The channel may be parabolic, V-shaped, or trapezoidal. The diversion shall be designed to have stable side slopes. Vegetated side slopes shall not be steeper than 2:1. Side slopes to be farmed shall not be steeper than 5:1.

The ridge shall have a minimum top width of 4 feet at the design depth with the following exception: The ridge top width may be 3 feet at design depth for diversions with less than

10 acres of drainage area above cropland, pastureland, or woodland.

The ridge height shall include an adequate settlement factor. The top of the constructed ridge at any point shall not be lower than the design settled height times 1.10, and not less than 1.5 feet. Design settled height is the hydraulic flow depth (or storage depth) plus 0.5 foot for freeboard.

The design depth at culvert crossings shall be the culvert headwater depth for the design storm plus freeboard.

Stability and Capacity. Channel grades may be uniform or variable. Minimum depth and width requirements for channel stability shall be determined using the procedures in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 9, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-Lined Open Channels (Sept. 1987); or other equivalent methods. Base stability computations on the peak runoff expected from the same frequency and duration storm used for capacity computations.

The allowable effective stress on the soil may be estimated from the soil erodibility categories below, or may be calculated using site-specific soil properties.

- Easily Eroded: Very Fine Sandy Loam, Fine Sandy Loam, Coarse Sandy Loam, Coarse Sandy Loam, Sandy Loam, Very Fine Sand, Fine Sand, Coarse Sand, Sand, Loamy Very Fine Sand, Loamy Fine Sand, Loamy Coarse Sand, Loamy Sand, Silt loam (Plasticity Index < 12)
- Erodible: Silt loam (Plasticity Index >= 12), Silt, Loam, Sandy Clay Loam, Sandy Clay
- Erosion resistant: Clay loam, Silty clay loam, Silty clay, Clay

Design stress and design velocity shall not exceed the allowable effective stress and allowable velocity in Table 1 below, unless site-specific soil properties (soil type, plasticity index, and void ratio) are used to compute allowable effective stress. When allowable effective stress is computed using site-specific soil properties, design velocity shall not exceed the allowable velocity in Table 1 by more than 20%.

Table 1 - Allowable stress and velocity

Soil Erodibility Category	Allowable Effective Stress (lbs/ft^2)	Allowable Velocity [1/] (feet/second)	
		Annually Vegetated, Retardance E	Permanently Vegetated, Retardance D
Easily Eroded	0.02	1.5	4.0
Erodible	0.03	2.0	4.5
Erosion resistant	0.05	2.5	5.0

[1/] Reduce allowable velocity 10 percent if a long duration flow is expected (such as from a pond or spring). Reduce allowable velocity 20 percent if it is difficult to establish or maintain good grass cover (80% minimum cover over the area) throughout the diversion.

Perennial grass sod must be established in permanently vegetated diversions. Runoff from the contributing drainage area must be diverted from the diversion during the establishment period if field conditions allow.

When a retardance class method is used to determine capacity by the equation

Q =AV,

and the velocity (V) is calculated by using Manning's equation, the highest expected value of "n" shall be used.

When a retardance class method is used for farmed (annually vegetated) channels, maximum channel velocity shall be computed by using a Manning's equation roughness coefficient "n" value of 0.035, and the channel capacity shall be computed using an "n" value of 0.06. Refer to Table 1 for Allowable Velocity – Annually Vegetated, Retardance E.

When a retardance class method is used for permanently vegetated channels, maximum channel velocity shall be computed using Retardance D, and the channel capacity shall be determined using the maximum expected retardance (generally Retardance B or C). Refer to Table 1 for Allowable Velocity – Permanently Vegetated, Retardance D.

Location. The outlet conditions, topography, land use, cultural operations, cultural resources, and soil type shall determine the location of the diversion.

Protection against sedimentation. Diversions normally should not be used below high sediment producing areas. When they are, a practice or combination of practices needed to prevent damaging accumulations of

sediment in the channel shall be installed. This may include practices such as land treatment erosion control practices, cultural or tillage practices, vegetated filter strip, or structural measures. Install practices in conjunction with or before the diversion construction.

If movement of sediment into the channel is a problem, the design shall include extra capacity for sediment or periodic removal as outlined in the operation and maintenance plan.

Outlets. Each diversion must have a safe and stable outlet with adequate capacity. The outlet may be a grassed waterway, a lined waterway, a vegetated or paved area, a grade stabilization structure, an underground outlet, soil infiltration, a stable watercourse, a sediment basin, or a combination of these practices. The outlet must convey runoff to a point where outflow will not cause damage. Vegetative outlets shall be installed and established before diversion construction to insure establishment of vegetative cover in the outlet channel.

The release rate of an underground outlet, when combined with storage, shall be such that the design storm runoff will be detained below the required freeboard.

All components of an underground outlet shall be designed according to Conservation Practice Standard 620, Underground Outlet.

To prevent the diversion from overtopping, the designed outflow capacity of the outlet(s) must be achieved at, or below, the design depth of the diversion at their junction.

Level diversion. A level diversion with closed ends may be used above a level terrace system on land of good permeability. Soil infiltration must permit draining the design storm from the diversion channel within a reasonable period so crops or vegetation are not significantly damaged by water. Generally, level diversions should only be built on soils with an intake rate of 0.5 or greater. Refer to Section KS652.0204 in National Engineering Handbook Part 652, *Irrigation Guide*. A level diversion may use a combination of outlets.

Generally, the design water depth should not exceed 2 feet. This recommendation can be varied depending on climate, soils, and producer acceptance of crop damage due to flooding and untimely farming operations in wet areas. Channels should be deeply ripped a minimum of 6 inches.

Vegetative Establishment. Diversions shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting (342). Species selected shall be suited to the site conditions and intended uses. Selected species will have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the diversion.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, fabric checks, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the diversion can significantly reduce the flow through the diversion during establishment.

Lining. If the soils or climatic conditions preclude the use of vegetation for erosion protection, non-vegetative linings such as concrete, gravel, rock riprap, cellular block, or other approved manufactured lining systems may be used.

Liners shall be designed in accordance with NRCS Conservation Practice Standard Lined Waterway or Outlet (468).

CONSIDERATIONS

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped.

At non-cropland sites, consider planting native vegetation in areas disturbed due to construction.

Maximize wetland functions and values with the diversion design. Minimize adverse effects to existing wetland functions and values. Diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology. Any construction activities should minimize disturbance to wildlife habitat. Opportunities should be explored to restore and improve wildlife habitat, including habitat for threatened, endangered, and other species of concern.

For vegetated diversions, avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where these areas can not be avoided, seek recommendations from a soil scientist for ameliorating the condition or, if not feasible consider stock piling the topsoil, over-cutting the diversion and replace the topsoil over the cut area to facilitate vegetative establishment.

On landforms where archeological sites are likely to occur, use techniques to maximize identification of such sites prior to planning, design, and construction.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for diversions that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

- A plan view of the layout of the diversion.
- Typical cross sections of the diversion(s).
- Profile(s) of the diversion(s).
- Disposal requirements for excess soil material.
- Site specific construction specifications that describe the installation of the diversion. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be prepared for use by the client. The plan shall include specific instructions for maintaining diversion capacity, storage, ridge height, and outlets.

The minimum requirements to be addressed in the operation and maintenance plan are:

1. Provide periodic inspections, especially immediately following significant storms.
2. Promptly repair or replace damaged components of the diversion as necessary.
3. Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment yielding areas are in the drainage area above the diversion. Establish necessary clean-out requirements.
4. Each inlet for underground outlets must be kept clean and sediment buildup redistributed so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
5. Redistribute sediment as necessary to maintain the capacity of the diversion.
6. Maintain vegetation and trees and control brush by hand, chemical and/or mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.
7. Control pests that will interfere with the timely establishment of vegetation
8. Keep machinery away from steep sloped ridges. Keep equipment operators informed of all potential hazards.

REFERENCES

USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.

USDA, NRCS. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 9, Diversions