

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

VEGETATED SINKHOLE BUFFERS

(Acre)
Code 768

DEFINITION

A vegetated buffer zone upgradient from a sinkhole and adjacent drainage area.

PURPOSES

- To stabilize the soil area immediately at the edge of the sinkhole by reducing erosion by water.
- To entrap contaminants such as: sediment, bacteria, salts, nutrients, pesticides and other pollutants contained in runoff water prior to entry into a sinkhole.
- Provide diversity to the area in form of plants and wildlife.
- Identify and protect the area to prevent accidental entry.
- To produce forage and other products of the vegetation.

CONDITIONS WHERE PRACTICE APPLIES

Sinkholes in cropland fields, sinkholes requiring buffering or substances from animal wastes, sinkholes requiring trapping of sediment from road and/or other construction sites, and sinkholes requiring buffering of substances from municipal wastes.

CONDITIONS WHERE VEGETATED BUFFERS SHOULD BE CONSIDERED

- Where water quality is impaired and adjacent land use contributes to the degradation.
- To protect good quality of underground water.
- Where natural vegetation has been deleted.

CRITERIA

Vegetated sinkhole buffers should be designed to encourage sediment deposition, sheet flow, infiltration and absorption of contaminants. Vegetated sinkhole buffers will consist of up to three zones and be designed to filter surface runoff as sheet flow.

The Puerto Rico Department of Natural and Environmental Resources Law 111 legally protects sinkholes.

Criteria for the Placement of the Vegetative Row Barrier

Zone I

This zone will begin 1 to 3 meters from the outer edge of the sinkhole. Zone I will provide land stabilization, create a physical barrier to sediment and provide shade to moderate interior temperature in the sinkhole enhancing habitat for wildlife.

Vegetation will consist of a stiff, erect, perennial grass barrier around the sinkhole.

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

Criteria for the Placement of the Vegetative Filter Strip

Zone II

This zone will consist of an additional zone or strip of land parallel to the vegetative row barrier and will create a buffering zone to absorb, adsorb, and infiltrate solutions from the water flows.

Predominant vegetation will consist of shrubs, forbs and grasses. Nitrogen fixing species should be discouraged where nitrogen removal or buffering is desired. Agroforestry practices could be allowed. Buffer widths will vary depending on slope, drainage size, land use and cultural practices but a minimum width of 50 feet from the mouth of the sinkhole for cropland and livestock.

Zone III

Zone III will begin at the outer edge of zone II. This zone will provide sediment filter, nutrient uptake and mainly reduce the velocity of surface water runoff. Therefore, convert concentrated flow to sheet flow before entering zone II. It is expected that this measure reduce the invasion of grasses inside field crops if grasses are planted into zone II.

Criteria for Design

All purposes:

Species selected for each zone. Species must be adapted to the site. For species selection, see table Conservation Plants and Their Uses (USDA-NRCS, PR & USVI), filed in Section II of the FOTG. Other species may be considered if they possess the desired characteristics.

- a. To stabilize the soil:

Zone I: Stiff, erect, dense, fibrous rooted, perennial vegetative materials with sterile or low germination seeds are recommended.

Zone II. Preferably perennials, rhizomatous, stoloniferous, deep and fibrous rooted and non-fertile seed producing plants are recommended. Some forbs and shrubs could be used to create biodiversity. Agroforestry practices such as: establishing plants

which their leaves or fruits could be harvested with minimum soil disturbance can be implemented. This practice is not recommended near cropland due to the harmful effects of pesticides for human consumption.

Zone III: Vegetation will consist of stiff, erect, dense, fibrous rooted, perennial vegetative materials with low germination or invasion capabilities.

- b. For contaminant entrapment:
 - Select fast growing vegetative materials with high number of stems/feet², erect or caespitose growth and perennial.
2. Soil preparation and water management for planting:
 - a. Seedbed preparation: Reduce tillage practices are encouraged. Conservation tillage conserve soil and reduces time, fuel and labor costs.
 - b. Soil fertility: Avoid fertilization whenever possible. Test for soil pH. Often times the only practice needed is liming, to help in the establishment of the vegetation, the purpose of this practice are not high yields or high production from crops, nutrients could be available from the runoff water.
 - c. Weed and insect control: If needed identify the pest and use Integrated Pest Management (IPM). If pesticide will be used, follow local and federal regulations and instructions from the manufacturer. Consider that in many occasions what is viewed as a weed may be doing a buffering activity and could be well adapted to the site.
 - d. Water management: Water flows must be converted to sheet flows. Water from surface drains should not be allowed to pass through the vegetated sinkhole buffer in pipes or tile thus circumventing the treatment process. Other practices could be considered.

3. Establishment procedure :
 - a. Plant selection, plant spacing, etc. (For species selection, see table Conservation Plants and Their Uses (USDA-NRCS, PR & USVI), filed in Section II of the FOTG.
 - b. Buffer shape: Should compliment natural features (see Figure 1).
 - c. Plan to establish the vegetation at the beginning of the rainy season.
4. Operation and maintenance:
 - a. Stand density: Zone I: more than 50 stems/feet² at maturity. Replanting may be necessary to maintain adequate density.
 - b. Clipping: Clippings are permitted for maintenance purposes if water value can be protected. For maintenance purposes clippings should be performed preferably before seedbed formation. Clipping is necessary to maintain young growth and enhance nutrient absorption and tillering rates.
 - c. Safety: Although fencing does not ensure total safety it is a practical way to keep livestock and people out of the sinkhole premises. Monitoring for fences is advisable.
 - d. Storm damage: After severe climatological disturbances vegetated sinkhole buffers must be monitored for possible damages. Replace fences and/or establish vegetation if necessary, to maintain the intended purpose.

PLANNING CONSIDERATIONS

Evaluate source, type and quantity of sediment and pollutant, slope, soil type, location, state and local regulations, wildlife, weed potential, and other special needs as threatened and/or endangered species and ground water quality. Fundamental aspects such as: selection of plant species, land use, aesthetics, social, cultural and economical must be considered when designing and establishing this practice.

PLANS AND SPECIFICATIONS

Plans and specifications will be in keeping with this standard and shall describe the specific requirements for properly establishing, managing and maintaining the Vegetated Sinkhole Buffer practice. Use narrative statements in the conservation plan, or other acceptable documentation. To provide specifications to the land user on the establishment of this practice refer to Conservation Practice Standards 330, 344, 462, 382, 393, 412, 512, 519, 550, and 612.

1. Consider type and quantity of pollutants that could be derived from the drainage area.
2. Where applicable, consider other conservation practices that will support the intended purpose of the vegetated sinkhole buffer, such as: grassed waterways and contour farming among others.
3. The layout and density of the vegetated sinkhole buffer should compliment natural features.
4. Fencing around sinkholes to regulate access and prevent accidents is advisable near residential and grazing areas.
5. The vegetated sinkhole buffers would not perform efficiently until the vegetative row barriers and vegetative filter strips have grown and rooted. Mulching, diversion, barriers of hay bales and/or rocks for sediment retention are some of the supporting practices that could be used during establishment period of the vegetation.
6. The land user should be responsible of establishing and maintaining this practice.

Figure 1

