NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SINKHOLE AND SINKHOLE AREA TREATMENT

(Acres)

CODE 527

DEFINITION

The treatment of sinkholes and/or sinkhole areas to reduce contamination of groundwater resources and/or improve farm safety.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes.

- To improve Water Quality
- To improve farm safety

CONDITIONS WHERE PRACTICE APPLIES

On any land surface or existing practice where soils and geologic conditions have led to the development of sinkholes.

Sinkholes, as applied under the definition above, are located primarily within three geographic regions of Oklahoma: the Gypsum Hills of western portions of the state, the Ozark Mountains of northeast Oklahoma, and the Arbuckle Mountains of south-central Oklahoma. However, several counties in eastern Oklahoma have sinkholes resulting from coal mining activity and these sinkholes also apply under the above definition.

Sinkholes developed in the Gypsum Hills are formed in highly soluble gypsum substratum while sinkholes developed in the Arbuckle and Ozark Mountains are formed in karst limestone and dolomite bedrock.

Limestones and dolomites in south-central Oklahoma overlie the Arbuckle Aquifer, Oklahoma's only sole source aquifer, and therefore, any potential contamination must be avoided.

CRITERIA

General Criteria Applicable to All Purposes

Sinkhole treatment or component practices shall comply with all federal, state, and local laws, rules and regulations. The owner or operator is responsible for securing any required permits. This standard does not contain the text of any federal, state, or local laws governing sinkhole treatment.

A geologic investigation of the potential impact of the treatment on groundwater, surface water, and the karst features will be conducted by a *qualified geologist.

***An individual who meets the minimum requirements for the title of Certified Professional Geologist as defined by the American Institute of Professional Geologists.

Excess surface water caused by construction activities will be diverted from the sinkhole area in accordance with the Oklahoma NRCS Diversion (362) or other applicable conservation practice standards for guidance.

The type of treatment selected will be based upon the resource protection need and the outlet conditions, and may include surface water control measures, and direct sinkhole treatment.

Nutrient and pest management plans will be developed for the contributing drainage area of the sinkhole.

Vegetative Treatment

Subsurface conditions vary greatly due to solution activity in response to groundwater, particularly in sinkholes within the Gypsum Hills of western portions of Oklahoma. For this

reason, minimum dimensions described below may vary with local conditions. Since farm safety is essential, caution should be exercised to ensure that any equipment used near the sinkhole is safely beyond the sinkhole rim.

All sinkholes treated will have a vegetated filter strip a minimum of 25 feet wide and may be extended to up to 100 feet wide to control concentrated flow channels entering the sinkhole.

Appropriate erosion and sediment control measures will be used to reduce the amount of sediment entering sinkhole openings during the establishment of the vegetative buffer.

Existing vegetation may be used for the buffer area provided all other criteria in this standard are met.

In areas where vegetation is to be established, the buffer strip will be planted to a native grass mixture. Guidance for establishing native grass vegetation is addressed in the Oklahoma NRCS Critical Area (342) standard.

The sinkhole and the surrounding buffered area will be fenced in accordance with the Oklahoma NRCS Fence (382) standard.

Livestock will be excluded from the vegetative buffer except where applicable for maintenance purposes.

Nutrients and herbicides may be used for establishment of vegetation as required. Refer to Oklahoma NRCS Nutrient Management (590) standard and Pest Management (595) standard for guidance. Once vegetation is established, nutrients, herbicides, pesticides, and animal waste will not be applied within an established buffer. Only mechanical treatments shall be used for needed weed control.

In situations where contaminant is carried by overland flow, every effort should be made to first treat the contamination source prior to sinkhole treatment.

In some cases, it may be necessary to completely plug a sinkhole with a sealant rather than treat it with a filter. Acceptable sealing materials are provided in ASTM D 5299, part 6.4. An example of this would be a sinkhole in a feedlot or a site that is difficult to protect by any other method.

Surface Water Control

Changes to the volume of surface water that enters a sinkhole may disturb the underground hydrology. To the extent possible, the surface water flow should be maintained at historic (or predevelopment) volumes.

Pre-existing concentrated flow channels may be stabilized but should not otherwise be altered. If a plug or inverted filter is used, the area to be protected shall be delineated by a qualified geologist. Concentrated flow caused by the construction activities shall be dispersed with a suitable spreading structure.

Adequate protection of most sinkholes can be achieved by the use of vegetative buffers and livestock exclusion. However, if an open sinkhole is a safety hazard, it may be closed with a rock filter, as shown in NRCS Engineering Technical note #8 – Sinkhole Closing, or by other methods approved by the State Conservation Engineer.

Sinkholes opening within animal waste facilities or feedlots shall be filled with appropriate soil material to prevent contamination of surface streams or groundwater supplies.

Sinkholes opening into caves may not be filled under any circumstances. Fences or gated openings may be used for safety reasons.

CONSIDERATIONS

The practice should work in conjunction with conservation cropping systems, pest and nutrient management, and practices that control sheet, rill and gully erosion.

Existing as well as planned land use should be considered when evaluating proper treatment of sinkholes. In particular, structures, septic fields, wells, feedlots, ponds, and animal waste storage systems should not be located over a sinkhole site or within the area of impact.

Sinkhole treatment should not result in excessive surface water ponding or high soil moisture conditions over an extended period of time.

Treatment of one sinkhole may have an effect on other sinkholes or solution features in the vicinity.

The use of a Conservation Easement for the buffer and sinkhole should be considered.

PLANS AND SPECIFICATIONS

Plans and specifications for Sinkhole and Sinkhole Area Treatment will be in keeping with this standard and will describe the requirements for applying the practice to achieve its intended purpose.

1. Plan view showing sinkhole and sinkhole area. Include topographic information and photographs.
2. The geologic investigation will include a study of potential impacts on the karst resource.
3. Planned treatment measures.
4. Delineate the drainage area of sinkhole on a topographic map.
5. Availability of safe outlet for surface water, if applicable.
6. Operation and Maintenance requirements.
7. Special safety requirements.
8. Environmental Assessment.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan will provide specific instructions for maintaining the sinkhole and sinkhole area treatment, including repair and/or replacement of damaged components.

REFERENCES

1. American Institute of Professional Geologists, 1400 W. 122nd Avenue, Suite 250, Westminster, Colorado 80234, 303-412-6205 • Fax: 303-253-9220 • aipg@aipg.org
2. *Arbuckle-Simpson Hydrology Study, 2007 Annual Report,* U.S. Bureau of Reclamation, February 2008.
3. *Estimating Runoff and Peak Discharges,* USDA-NRCS, Engineering Field Handbook, Chapter 2, August 1987.
4. *Urban Hydrology for Small Watersheds,* USDA-NRCS, Technical Release 55, June 1986.
5. *Graded Riprap Stone, Quarried Stone for Erosion and Sediment Control, National Crushed Stone Association, June 1978.*
6. Koerner, R. M., *Designing with Geosynthetics,* Prentice-Hall, Englewood Cliffs, NJ, 1985.
7. *Geology*, USDA-NRCS, National Engineering Handbook, Part 531, Section 8, Chapter 1, 1978.
8. NRCS, Field Office Technical Guide, Section IV.
9. Geology, USDA-NRCS, National Engineering Manual, Part 531.21, September 1999.
10. White, W.B., *Geomorphology and Hydrology of Karst Terrains*, Oxford University Press, Inc., New York, New York, 1988.
11. *Recommended Best Management Practices for Proposed Activities in Karst Areas – Oklahoma,* U. S. Fish & Wildlife Service, June 24, 2003.