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CAFOs

Concentrated Animal Feeding Operations

Karst Terrain and Seasonal High Water Tables: *Their Importance for Siting Concentrated Animal Feeding Operations*

ENVIRONMENTAL ISSUES

EXPERT REVIEWED

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To view the entire series, visit <http://www.ansc.purdue.edu/CAFO/>.

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Concentrated Animal Feeding Operations (CAFOs) generate large amounts of animal manure that is collected and stored in earthen, concrete, or other man-made containment systems. This manure must be stored and managed efficiently to ensure optimum nutrient use efficiency for crops and to minimize potential nutrient losses to soil, water, and air.

The purpose of this publication is to discuss two important soil limitations of Indiana soils: karst terrain and seasonally high water tables. These two soil properties are important for siting manure storage systems for both new CAFO operations and existing operations considering expansion.

Regulations

Indiana's regulations are designed to minimize point source pollution associated with manure storage facilities. Regulations that discuss site restrictions for construction of new waste management storage systems for liquid or solid manure are found in Rule 327 IAC 16-8-1. These regulations state that waste management systems will not be constructed in areas that include karst terrain, a floodway, 100 year flood plains or soils with seasonal high water tables.

Karst Terrain

Karst is a special type of landscape that is formed by the dissolution of soluble rocks, including limestone and dolomite. When underground water interacts with limestone, the water dissolves the

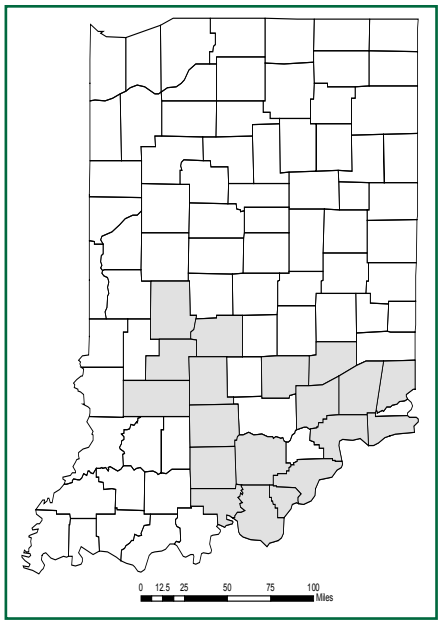

Figure 1. *Map showing the distribution of Indiana counties containing karst terrain.*

limestone to form what is known as karst topography, an amalgamation of caves, underground channels, and a rough and rolling ground surface. About 15 percent of the United States land surface consists of soluble limestone, which can be easily dissolved by the weak solution of carbonic acid found in underground water.

Common land use issues associated with karst regions include ground subsidence, sinkhole collapse, groundwater contamination and unpredictable water supply. Because large openings in the subsurface, including caves and other openings are often part of a karst aquifer,

can act as conduits to transport groundwater great distances very rapidly without the benefit of it being filtered through soil or rock.

Where Are Karst Areas?

Several southern Indiana counties contain karst terrain (Fig 1). To determine if your proposed site contains karst topography, consult the county soil survey of the area that's available from the local NRCS or county Extension office, or utilize the online USDA-NRCS Web Soil Survey. For more information about Web Soil Survey and CAFOs, see Purdue Extension publication, ID-367-W.

Considerations for CAFOs in Karst Areas

If you have options, it is better to avoid installing earthen storage systems in karst topography unless the site is thoroughly characterized and there is minimal chance of contaminating groundwater through a fissure in the limestone substrate. To construct a storage facility in karst areas, you are required to submit the following information to the commissioner:

- soil characterization data from the shallower of either bedrock or 10 feet below the lowest point of the proposed waste management system;
- depth of the seasonal high water table;
- design specifications of your proposed structure that indicates your design will protect the environment;
- other information that the commissioner deems necessary to ensure protection of human and environmental health.

Seasonally High Water Tables

Many Indiana soils are underlain by a dense, impermeable, or very slowly permeable layer that restricts vertical water movement, resulting in seasonally high water tables. In the northern two-thirds of the state, this impermeable layer is dense glacial till (a compacted zone formed during the glaciation periods). In the southern one-third of the state, soils commonly are underlain by sandstone or shale bedrock (impermeable layers) or a fragipan (weakly cemented dense layers that are very slowly permeable). In winter and early spring when snow melt or high rainfall occurs prior to the spring growth of plants, water accumulates on top of these impermeable layers to cause seasonally high water tables.

A seasonally high water table can be problematic when siting waste management systems. During high precipitation events with low evapotranspiration, the

Figure 2. *Soil A is well drained (oxygen rich) and does not have a seasonal water table (note the brown color). Soil C is poorly drained (oxygen deprived), and is saturated by water for most of the time (note the gray color). Soil B alternates between being saturated and oxygen rich (note the brown and gray colors).*

soil is saturated and very little oxygen remains. When the soil is deprived of oxygen, it is unable to effectively treat pathogens (e.g., *E. coli*) commonly found in animal and human waste.

Identifying Seasonally High Water Tables

Seasonally high water tables in soils are identified by concentrations and depletions of iron oxides. Iron oxides are a major coloring agent in soils, and if they are present, the soils are brown to red (see soil A in Figure 1). When soils are saturated with water for a significant period of time, the iron oxide minerals dissolve, leaving gray areas in the subsoil. Soil horizons that are saturated much of the time, are almost gray (see soil C in Figure 2 at a depth of 2 - 4 feet), while horizons that alternate between saturation and aeration leave a mixture of brownish and grayish colors, called mottling (see Soil B in Figure 2). The extent and depth of this mottling pattern is used to determine the maximum height of the seasonally water table.

To determine if the proposed construction site contains a seasonally high water table, you should contact an Indiana Registered Soil Scientist to evaluate your site. These professionals can characterize the soils below your storage facility and assess the seasonal water table status of your site regardless of the time of year. The Registry of Indiana Professional Soil Scientists can be found online at the http://www.isco.purdue.edu/irss/ Web site.

Considerations for CAFOs in Soils with Seasonally High Water Tables

If seasonally high water tables are present in the area you want to construct your storage facility, the rules allow you to lower the seasonally high water table with a drainage system as long as you provide an access point for sampling the drain. Additional design standards (i.e., monitoring systems, liners, additional compaction, etc.) may be required by the commissioner deems the proposed site to be problematic for storage facilities (i.e., has a high water table, on steep slopes, shallow distance to bedrock, etc.).

Summary

In order to protect human and environmental health, additional restrictions have been placed on construction of CAFO waste storage facilities in karst terrain and soils with high water tables. It is best to avoid these conditions; however, if these cannot be avoided, have the soil conditions characterized by a professional, and then design your facility accordingly in order to protect human and environmental health.

Additional Resources and Referenced Information

- Web soil survey publication ID-367-W
- Indiana Confined Feeding Operations – 327 IAC 16
  - http://www.in.gov/legislative/iac/T03270/A00160.PDF
- Indiana Web Soil Survey
  - http://soils.usda.gov/survey/online_surveys/indiana/index.html