REGULATION OF LARGE DAIRY FARMS IN KARST REGIONS OF THE UNITED STATES

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Abstract

During the past several years, an increasing number of large dairy farms have located, or proposed to locate, in karst terrain in the Midwestern United States. The large amounts of manure produced by such dairy farms proves especially problematic to groundwater in karst terrain. Controversies have erupted in Minnesota, Illinois, and Wisconsin, among other states.

In response to the proposed dairies, citizen groups have filed a number of lawsuits against the dairy operators, the dairy industry has filed lawsuits against state agencies, and states have enacted heightened regulations for dairy operations in karst. The majority of the debates have centered on state rules and enforcement. However, local zoning has also been implicated.

The outcomes of these actions have been mixed and have led to increased uncertainty for the dairy operation and its neighbors. On the other hand, regulators and courts have struggled to come up with consistent guidelines to deal with dairies in karst.

This article reviews the regulation of concentrated animal operations, and particularly manure management within such operations, in selected Midwestern states. The commonalities and differences in the regulations are analyzed. The research finds that regulations focused on karst terrain vary greatly, ranging from no special rules for karst in a number of states, to very detailed and complex regulations in Iowa. Common provisions include vertical separation requirements for distances between manure facilities and bedrock in karst, horizontal separation requirements for surface distances between karst features and manure facilities, and more stringent design and construction requirements for facilities located within karst areas. At least two states, Iowa and Ohio, require geological studies prior to locating concentrated animal facilities within karst areas.

The article concludes by suggesting future directions for state regulation of concentrated animal facilities in karst areas. Proactive regulation may reduce conflicts between citizens and animal facility operators in the future.

Introduction

Controversy surrounding the location of concentrated animal operations, particularly large dairies, in karst areas in the Midwestern United States has increased significantly in recent years. These operations produce large amounts of manure. While manure management for these facilities presents challenges everywhere, the challenges prove even more important in karst areas. Karst terrain is more vulnerable to groundwater contamination and citizens have objected to these facilities for that reason, among others (See, e.g., Panno et al., 1996).

This controversy has resulted in lawsuits among state agencies, citizens opposed to the operations and the owners and operators of concentrated animal facilities. Some of the disputes revolve around whether more stringent rules should apply in karst areas, or, more basically, whether the area in question is a karst area. The disputes raise multiple issues, including the question of how states are regulating location of concentrated animal facilities in karst areas differently than location in other areas. If states treat location of concentrated animal facilities in karst areas differently, what approaches are taken?

This article first reviews the distinctions in regulation of concentrated animal facilities and their consequent manure management structures in Illinois, Iowa, Minnesota, and Ohio. The regulations in each state that apply particularly to karst areas are summarized. The author then compares the provisions in the four states, looking for commonalities and differences.

Finally, the article concludes with recommendations for regulation of location of concentrated animal facilities in karst areas.

State Regulations

Many states regulate concentrated animal operations, including large dairies. Regulations include permitting requirements, locational restrictions, and design and construction standards. Although disputes focused on location of such facilities in karst areas abound, no literature examines state regulations specifically aimed at con-

concentrated animal facilities in karst areas. Attempting to partially fill this gap in the literature, this research began by searching comprehensive legal databases Westlaw and LexisNexis for state laws and regulations imposing different rules on concentrated animal facilities located in karst areas as opposed to general regulation of these facilities. The search terms sought to identify regulations including “animal” and “karst or sinkhole”, as well as a combination of these terms, including “manure”.

The results of the search identified no rules or regulations in many states. In other states, only very limited regulations, generally imposing setbacks between the concentrated animal facilities and/or manure storage facilities associated with those facilities and karst features. Four states stood out in the search as including more robust regulation of concentrated animal facilities and their manure in karst areas: Illinois, Iowa, Minnesota, and Ohio. The regulations in those states were identified, examined and summarized.

Illinois

Illinois regulates manure management under the Illinois Department of Agriculture. Waste handling facilities for large livestock operations are covered. 510 Ill. Compiled Statutes 77/13 provides construction standards for livestock waste handling facilities (other than earthen livestock waste lagoons). All livestock waste handling facilities constructed of concrete must meet the strength and load factors set forth in the Midwest Plan Service’s Concrete Manure Storage Handbook (MWPS-36) and any future updates. Other general requirements refer to waterstops, waste storage volume and protection from precipitation (510 Ill. Compiled Statutes 77/13(a)(1)). In addition, standards are set for prefabricated handling facilities, facilities keeping semi-solid livestock waste and solid livestock waste, and holding ponds used for the temporary storage of livestock feedlot run-off (510 Ill. Compiled Statutes 77/13(a)(2)-(5)). The Midwest Plan Service’s Livestock Waste Facilities Handbook (MWPS-18) provides standards in these areas.

Additional construction requirements and siting prohibitions apply to construction in floodplains, in areas where aquifer material is present within 5 feet of the bottom of the facility, and karst. The regulations prohibit construction of livestock management facilities and livestock waste handling facilities in the 100-year floodway of a 100-year floodplain (510 Ill. Compiled Statutes 77/13(b)

(1)). A non-lagoon livestock waste handling facility constructed in area where “aquifer material” is present within 5 feet of the bottom of the facility must be “designed to ensure structural integrity of the containment structure and to prevent seepage of the stored material to groundwater” (510 Ill. Compiled Statutes 77/13(b)(3)). Footings and underlying structure support must be incorporated into the design standards in accordance American Society of Agricultural Engineers (ASAE) EP393.3 Dec1998 (R2018) Manure Storages (Ibid). “Aquifer material” includes “fractured carbonate that is ten feet or more in thickness” (8 Ill. Admin. Code 900.103).

Construction of non-lagoon livestock waste handling facilities in karst areas must meet the design standards in ASAE EP393.3 Dec1998 (R2018) to prevent seepage of the stored material into groundwater (510 Ill. Compiled Statutes 77/13(b)(2)). Owners and operators should consult with the soil and water conservation district, the University of Illinois Cooperative Extension Service, or other resources to determine whether the proposed location consists of a karst area. (Ibid). In addition, no such facilities may be constructed within 400 feet “of any natural depression in a karst area formed as a result of subsurface removal of soil or rock materials that has caused the formation of a collapse feature that exhibits internal drainage” (Ibid). The USGS 7.5 minute quadrangle topographic map or Department of Agriculture field determination shall indicate whether such a natural depression exists (Ibid).

Iowa

Iowa regulates the management of manure from large livestock facilities under the Animal Agriculture Compliance Act, Iowa Code Ann. §§ 459.101, et seq.; the Animal Agriculture Compliance Act for Open Feedlot Operations and Animal Truck Waste Facilities Act, Iowa Code Ann. §§ 459A.101, et seq.; and the Animal Agriculture Compliance Act for Dry Bedded Confinement Feeding Operations, Iowa Code Ann. §§ 459.102, et seq. Prior to constructing, expanding, or modifying a confinement feeding operation structure, information must be submitted and a permit acquired (Iowa Admin. Code 567-65.9(459, 459A)). The information must include whether the proposed location is in karst terrain (Iowa Admin. Code 567- 65.9(459, 459A)(1)q.). If the location lies within karst terrain, a soils exploration study must be included unless a qualified Illinois Department of Agriculture staff member states that a soils exploration study

is not needed (Ibid). A printed map that clearly shows the location of each structure must be included in any case, and the soils exploration study must be included if the site lies on karst terrain (Iowa Admin. Code 567-65.9(459, 459A)(5)).

“Formed manure storage structures” refer to “a covered or uncovered impoundment used to store manure from an animal feeding operation, which has walls and a floor constructed of concrete, concrete block, wood, steel, or similar materials” materials (Iowa Code Ann. § 459.102(30)). Although formed manure storage structures are allowed in karst terrain, increased standards for concrete apply (Iowa Admin. Code 567-65.15(459, 459A)(15)c.). In addition, these structures must also meet the following requirements if storing dry or nondry manure and located on karst terrain:

- A professional engineer, National Resource Conservation Service (NRCS) qualified staff or qualified organization must submit a soil exploration study based on results from soil borings or test pits to determine the vertical separation. A minimum of two soil borings or test pits is required. After the soil exploration, the borings and pits must be properly plugged.
- A minimum 5-foot layer of low permeability soil or rock between the bottom of the structure and the bedrock is required if the structure is not designed by a professional engineer or qualified NRCS staff member.
- If the separation distance is less than 5 feet, the structure must be designed and sealed by a professional engineer or qualified NRCS staff member who certifies the structural integrity of the structure. A 2-foot-thick layer of compacted clay liner material must be constructed beneath the floor of the structure. However, the regulations recommend that the structure be above ground if the vertical separation distance is less than 5 feet. (Iowa Admin. Code 567-65.15(459, 459A)(15)c.).

“Unformed manure storage structures” are generally prohibited in karst terrain or an area that drains into a known sinkhole (Iowa Code Ann. § 459.308(3); Iowa Admin. Code 567-65.15(459, 459A)(8)a.). “Unformed manure storage structures” lack walls and a floor made of concrete, concrete block, wood, steel, or similar materials (Iowa Code Ann. § 459.102(30), (58)). The statute provides that unformed manure storage structures may locate in these areas if a 25-foot vertical separation dis-

tance exists between the bottom of the structure and the underlying limestone, dolomite, or other soluble rock (Iowa Code Ann. § 459.308(3)). However, the regulations flatly prohibit these structures in karst terrain (Iowa Admin. Code 567-65.15(459, 459A)(8)a.).

Additional requirements apply to stockpiling dry manure on karst terrain. A vertical separation of at least 5 feet of low permeability soil or rock must exist between the bottom of the stockpile and the underlying bedrock (Iowa Code Ann. § 459.311D(1)); (Iowa Admin. Code 567-65.2(459, 459A)(10)b.(1)). A professional engineer licensed in Iowa, a Natural Resources Conservation Service staff or a qualified organization must submit a soil report to support the application (Iowa Admin. Code 567-65.2(459, 459A)(10)b.(1)). The report must be based on soil borings, test pits or well data that describes the subsurface material and the vertical separation (Ibid). A minimum of 2 soil borings or test pits, one at each of the stockpile, is required if acceptable well data are not available (Ibid). Each soil boring or test pit must be properly plugged and the plugging documented in the report (Ibid).

If dry manure is stockpiled on karst terrain for more than fifteen consecutive days, a structure with walls and a floor made of concrete, concrete block, wood, steel or similar materials; or a qualified stockpile cover must be used (Iowa Code Ann. § 459.311D(2); (Iowa Admin. Code 567-65.2(459, 459A)(10)b.(2)). If using a qualified stockpile cover, however, the stockpile must be located on reinforced concrete at least 5 inches thick (Ibid). A qualified stockpile cover is a “barrier impermeable to precipitation that is used to protect a stockpile from precipitation” (Iowa Code Ann. § 459A.102(4), (6), (19), (41)). Dry bedded manure stockpiled on karst terrain or an alluvial aquifer area must comply with the same requirements as dry manure (Iowa Admin. Code 567-65.2(459, 459A)(11)b.).

An unformed animal truck wash effluent structure may not be constructed on karst terrain or an area that drains into a known sinkhole unless a 25-foot vertical separation exists between the bottom of the structure and the bedrock (Iowa Code Ann. § 459A.404(5)). An unformed animal truck wash effluent structure “means a covered or uncovered impoundment used to store” “a combination of manure, washwater-induced runoff, or other runoff” coming from “an operation engaged in washing [vehicles] used to transport animals” (Iowa Code Ann. § 459B.201(1)).

Construction of a dry bedded confinement feeding operation structure on karst terrain or in an alluvial aquifer area must contain a vertical separation distance of low permeability soil or rock of at least 5 feet from the bottom of the floor of the structure and the bedrock material or the underlying sand and gravel aquifer (Iowa Code Ann. § 459B.201(1); Iowa Admin. Code 567-65.15(459, 459A)(8)b.(1)). A professional engineer licensed in Iowa, a Natural Resources Conservation Service staff or a qualified organized must submit a soil report to support the application (Iowa Admin. Code 567-65.15(459, 459A)(8)b.(1)).

The report must be based on soil borings, test pits or well data that describes the subsurface material and the vertical separation (Ibid). A minimum of 2 soil borings or test pits, one at each of the stockpile, is required if acceptable well data are not available (Ibid). Each soil boring or test pit must be properly plugged and the plugging documented in the report (Ibid). In addition, the structure must have a floor consisting of reinforced concrete at least five inches thick (Iowa Code Ann. § 459B.201(2); Iowa Admin. Code 567- 65.15(459, 459A)(8)b.(2)). Iowa Admin. Code 567-65.15(459, 459A)(14) provides further standards for the concrete.

Iowa regulations also require an increased separation distance between manure stockpiles and qualified stockpile structures and sinkholes of 400 feet for dry bedded manure and 800 feet for all other stockpiles and stockpile structures (Iowa Admin. Code 567-65.11((459,459B)(8)b.).

Finally, the Iowa Department of Agriculture may “evaluate” any animal feed operation to determine whether (1) manure from the operation is being discharged to waters of the state and the operation fails to provide the minimum level of manure control; (2) manure from the operation is causing or can reasonably be expected to cause pollution of a water of the state; or, (3) manure from the operation is causing or can reasonably be expected to cause a violation of state water quality standards. (Iowa Admin. Code 567-65.5(459, 459A)(1)). The Department may consider, among other factors, the proximity of the operation to sensitive areas, including karst terrain (Iowa Admin. Code 567- 65.5(459, 459A)(2)a.).

Minnesota

Minnesota’s Pollution Control Agency shares authority with counties with respect to regulating animal feedlots.

An animal feedlot or manure storage area may not be constructed within 300 feet of a sinkhole (Minn. Rules 7020.2005, Subpart 1). Counties, however, must forward to the state for permit issuance and other proceedings any facility capable of holding 500 or more animal units or the manure produced by 500 or more animal units proposing liquid manure storage areas within 1,000 feet of an open or filled sinkhole, a known cave, a resurgent spring, a disappearing stream, a karst window or a blind valley (Minn. Rules 7020.1600, Subpart 4a).

Construction or expansion of a liquid manure storage area is generally prohibited in areas where geologic conditions are suitable for sinkhole development and where four or more sinkholes exist within 1,000 feet of the proposed site, if the manure storage area possesses a capacity of more than 250,000 gallons (Minn. Rules 7020.2100, Subpart 2). Likewise, animal feedlots capable of holding fewer than 300 animal units or manure storage areas capable of holding liquid manure produced by fewer than 300 animal units may not construct a liquid manure storage area where the distance to bedrock is less than 5 feet (Ibid). Where the distance to bedrock is more than 5 feet but less than 20 feet, the manure storage area must be concrete-lined, above ground, or composite-lined (Ibid).

Animal feedlots in these sinkhole areas that are capable of holding 300 or more, but less than 1,000 animal units, and manure storage areas capable of holding manure from that number of animal units, generally may not construct a liquid manure storage area where the distance to bedrock is less than ten feet (Ibid). The manure area may be constructed where the distance to bedrock is five feet or more, but less than ten feet, where the manure storage is (1) aboveground; (2) concrete-lined with a secondary liner consisting of a synthetic liner, HDPE liner two foot or greater cohesive soil liner; or, (3) composite-lined with at least a three-foot compacted cohesive soil liner under the synthetic liner (Ibid). Where the separation distance is ten feet or more, but less than 30 feet, the manure storage area must be concrete-lined, aboveground, or composite-lined (Ibid).

For animal feedlots capable of holding 1,000 or more animal units or manure storage areas capable of holding the manure produced by that number of animal units, a liquid manure storage area is prohibited where the distance to bedrock is less than ten feet (Ibid). Where the distance

to bedrock is ten feet or more but less than 15 feet, the manure storage must be (1) aboveground; (2) concrete-lined with a secondary liner consisting of a synthetic liner, HDPE liner, or a two foot or greater cohesive soil liner; or, composite-lined with at least a three-foot compacted cohesive soil liner under the synthetic liner (Ibid).

Design plans and specifications for liquid manure storage areas require soils records that identify the soil texture, depth to regional water table, and depth to the seasonal high water table (Minn. Rules 7020.2100, Subpart 4). In areas susceptible to soil collapse or sinkhole formation, this information must be recorded to at least a depth ten feet below the bottom of the proposed liquid manure storage area, or until bedrock is encountered (Ibid). In addition, in these areas, a map must be produced of the proposed site, showing the location of all open and filled sinkholes, depression areas in the landscape, known caves, resurgent springs, disappearing streams, karst windows, and blind valleys within one-half mile of the proposed site location (Ibid).

The owner or operator of an animal feedlot must prepare a manure management plan. The plan must include, among other items, "...a description of protective measures to minimize the risk of surface water and groundwater contamination when applying manure or process wastewater in...soils with less than three feet above limestone bedrock...and land within 300 feet of ...sinkholes without constructed diversions..." (Minn. Rules 7020.2225, Subpart 4, D(9)). In addition, manure cannot be applied to land within 50 feet of a sinkhole. (Minn. Rules 7020.2225, Subpart 8). Where manure is applied to land that slopes towards a sinkhole and is less than 300 feet from the sinkhole, the manure must be incorporated within 24 hours (Ibid). However, no setback is required where diversions prevent manure-contaminated runoff from entering the sinkhole (Ibid).

Short-term manure stockpiles may not be located within 300 feet of flow distance and 50 feet horizontal distance of sinkholes or rock outcroppings (Minn. Rules 7020.2125, Subpart 2). Finally, no animal manure, manure-contaminated runoff, or process water from an animal feedlot may be discharged to a sinkhole, fractured bedrock, or "other natural or constructed channels that convey fluids to groundwater" (Minn. Rules 7020.2003, Subpart 1).

Ohio

Regulation of concentrated animal facilities in Ohio falls under the purview of the Ohio Department of Agriculture. Specifically, Chapter 903 of the Ohio Code, Ohio Revised Code §§ 903.01, et seq., addresses the permitting and regulation of concentrated animal feeding facilities, including manure management on such facilities. Operators of concentrated animal feeding facilities must obtain a permit from the state (Ohio Revised Code §903.03). The application for a permit must include a manure management plan that conforms to best management practices (Ohio Revised Code §903.03(C)(3)).

Regulations provide details as to permitting and manure management. Manure storage or treatment facilities shall be designed and constructed in accordance with the regulations (Ohio Admin. Code 901:10-2-02). No fabricated structures, manure storage ponds or manure treatment lagoons may be located in a karst area without groundwater monitoring and engineered controls (Ohio Admin. Code 901:10-2-02(H)). The groundwater monitoring and engineered controls must be installed and implemented as approved by the director of agriculture (Ibid).

Before installation of fabricated structures, a subsurface geological exploration must be completed (Ohio Admin. Code 901:10-2-03(A)). For fabricated structures storing liquid manure, the subsurface geological exploration must evaluate whether the proposed structure will be located within a karst area (Ohio Admin. Code 901:10-2-03(A)(2)(g)). Similar subsurface geological explorations must be completed for manure storage ponds or manure treatment lagoons (Ohio Admin. Code 901:10-2-03(B)). These explorations must also determine whether the storage pond or lagoon will be located within a karst area (Ohio Admin. Code 901:10-2-03(B)(6)).

The only substantive guidance for design and construction in karst areas applies to manure storage ponds or manure treatment lagoons located in karst areas (Ohio Admin. Code 901:10-2-06(A)(10)). Ponds or lagoons within karst areas must be designed to prevent seepage of manure to groundwater (Ohio Admin. Code 901:10-2-02(A)(10)(a)). Any portion of a manure storage pond or manure treatment lagoon that is located below pre-construction soil levels and located within a karst area must be utilize a rigid material like concrete or steel or a properly designed clay or synthetic liner, when appropriate (Ohio Admin. Code 901:10-2-02(A)(10)(b)). The

findings of the geologic exploration dictate the requirements (Ibid).

Summary of the Four States' Regulations

The state regulations examined ranged from the extremely detailed and complex requirements in Iowa to the relatively minimal requirements in Ohio. No conclusions are advanced as to which state regulations are, or could be, more effective.

However, although Ohio requires a subsurface geological exploration and special design and construction standards, little detail or guidance is provided. Iowa, on the other hand, includes extremely detailed requirements. Further research needs to determine whether the requirements are based on sound science and will yield favorable results.

Common regulations in the four examined states include vertical separation considerations. Illinois, Iowa, and Minnesota all used these criteria in some respects. All four state regulations also include more stringent design and construction requirements for facilities in karst areas. Illinois relies on uniform design and construction standards, while the other states promulgate specific standards or give discretion to the permitting body.

As summarized in Table 1, three of the four states (Ohio being the exception) address horizontal separation (set-backs) between animal and/or manure facilities and karst features. Two states (Iowa and Ohio) require studies, while Minnesota and Ohio also require a plan. Minnesota requires soil records, but not a study.

Conclusions and Recommendations

States vary greatly with respect to whether and how special regulations apply to location of concentrated animal facilities and associated manure facilities in karst areas. Recent and ongoing debates and controversies suggest that special requirements may be warranted. In addition, the public should be involved in the promulgation of these regulations to provide transparency and increased likelihood of acceptance.

Many states do not distinguish location of concentrated animal facilities in karst areas from location in other areas. If karst areas are distinguished, often very little additional regulation is provided in karst areas. Illinois, Iowa, Minnesota, and Ohio appear to more ro-

bustly regulate location of concentrated animal facilities in karst areas. Even amongst these states, however, the regulation differs greatly, ranging from relatively minimal regulation in Ohio to detailed and complex regulation in Iowa. However, these four states generally regulate both vertical and horizontal separation between animal and manure facilities, and karst features. In addition, more stringent design and construction requirements in karst areas are typical in these four states. Specific geological investigations and plans also prove fairly typical.

The four states included in this study represent the most stringent regulators of concentrated animal facilities and resulting manure in karst terrain. Many states fail to provide any special requirements in karst areas.

State legislatures and regulators in states with karst areas should study the regulations in these four states and incorporate some of the regulatory techniques. Iowa and Minnesota employ a broad range of tools. The particularized requirements in Iowa also provide a model.

Given the heterogeneity of karst areas, studies and plans that focus on specifics may prove more effective than uniform regulations. Iowa and Ohio require studies, while Minnesota requires soil records. The information from the studies can be used to tailor requirements to particular sites, which should prove more effective than general requirements.

Further research is needed to address the effectiveness of particular regulatory techniques. In addition, Illinois, Iowa, Minnesota, and Ohio stakeholders should be consulted to determine the effectiveness of their programs. In the meantime, states with karst regions that presently fail to provide special protections from groundwater contamination in karst areas from concentrated animal facilities should use the four states examined here as models for regulatory regimes.

Acknowledgments

The author acknowledges the support of the West Virginia University College of Law and the Hodges/Bloom Research Fund.

	Illinois	Iowa	Minnesota	Ohio
Vertical separation requirements	5 feet minimum;; or the bottom of the facility must be “designed to ensure structural integrity of the containment structure and to prevent seepage of the stored material to groundwater”	5-foot layer of impermeable soil or rock if not designed by professional engineer for some structures; differing standards depending on structure	5 feet, concrete or composite lining requirements if less than 20 feet	
More stringent and construction requirements	ASAE EP393.3 Dec 1998 (R2018)	Designed by professional engineer unless vertical separation requirement met	Concrete or composite liner requirements, depending upon vertical separation	Ponds or lagoons within karst areas must be designed to prevent seepage of manure to groundwater; Any portion of a manure storage pond or manure treatment lagoon that is located below pre-construction soil levels and located within a karst area must be utilize a rigid material like concrete or steel or a properly designed clay or synthetic liner, when appropriate
Horizontal separation requirements	400 feet from certain karst features	400 feet or 800 feet from certain karst features for certain structures	Short-term manure stockpiles may not be located within 300 feet of flow distance and 50 feet horizontal distance	
Geological investigations		Soil Exploration Study	Soil records required	Subsurface geologic investigations
Plans			Design Plan; Manure Management Plan	Manure Management Plan
Prohibitions on certain facilities		Unformed manure storage structures	Manure storage area possesses a capacity of more than 250,000 gallons	
Increased concrete requirements		X		

Table 1. State requirements in karst.

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