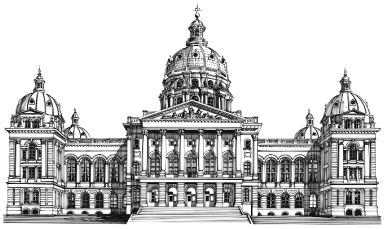
ISSUE REVIEW

Iowa Legislative Fiscal Bureau



Dennis Prouty
(515) 281-5279
FAX 281-8451

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Des Moines, IA 50319
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Earthen Waste Storage Structures in Iowa

ISSUE

This ***Issue Review*** summarizes the findings and recommendations of a study done by Iowa State University on potential sources of contamination from animal confinement earthen waste storage structures.

AFFECTED AGENCIES

Department of Natural Resources

CODE AUTHORITY

Chapter 455B, Code of Iowa

Chapter 65, Environmental Protection Division Section 567, Iowa Administrative Code

BACKGROUND

In HF 708 (FY 1998 Agriculture and Natural Resources Appropriations Act), the General Assembly appropriated $200,000 from the Agriculture Management Account to Iowa State University and directed the university "…*to determine the extent to which the structures (earthen waste storage structures) contribute to point and nonpoint pollution in this state."*

CURRENT SITUATION

The study by Iowa State University, titled *Earthen Waste Storage Structures in Iowa*, was released in August 1999 and is composed of four research papers. These include:

- *Hydrogeologic Settings of Selected Earthen Waste Storage Structures Associated with Confined Animal Feeding Operation in Iowa*. This paper investigates potential contamination from the siting of waste storage structures.
- *Management and Maintenance of Earthen Manure Structures: Implications and Opportunities for Water Quality Protection*. This paper examines potential contamination due to poor management and maintenance of waste storage structures.

- *Measurement of Seepage from Earthen Waste Storage Structures in Iowa*. This paper attempts to determine possible contamination from seepage of manure.
- *Soil Sampling and Analysis Around Earthen Waste Storage Structures in Iowa*. This paper examines studies of soil samples around waste structures for manure contamination.

Study Findings

Hydrogeologic Settings of Selected Waste Storage Structures Associated with Confined Animal Feeding Operations in Iowa

Researchers used site locations, soil, and water table data of 34 earthen waste storage structures to determine the potential risks of ground and surface water contamination.

Chapter 65, Environmental Protection Division Section 567, Iowa Administrative Code, recommends that the top of the liner or basin floor of earthen waste storage structures be at least four feet above the water table. Researchers found 28 of the 34 (82.0%) studied were deeper than 10 feet, indicating a majority of structures may be below the water table. Current allowable seepage rates of earthen storage structures of 1/16 of an inch per day may allow saturated liners of deep structures to connect with water tables. Researchers also stated sites with high and changing water tables, due to frequent small floods, can compromise structure liners, increasing the risk of failure.

Section 455B.204 (2b), Code of Iowa, states an animal feeding operation structure must be located at least 200 feet away from a lake, river, creek, or ditch. While the sites studied met this requirement, it was found that most sites were located 1,000 feet from ephemeral streams, streams that flow in response to precipitation, and 26 of the 34 (76.0%) sites were located within 2,000 feet of perennial streams. The researchers believed even at these distances there is an increased potential for surface water contamination from leakage or failure of an earthen waste storage structure.

Structures located on soils with high permeability, 25 of the 34 (74.0%) sites, also pose a risk of ground water contamination. High permeability allows greater movement of water and air through soil. Soils with low permeability are sites of potential risk of surface water contamination from runoff.

Six of the 34 (18.0%) sites studied were located on flood plains over alluvial aquifers. Alluvial aquifers are considered to be vulnerable to contamination since they lie close to the land surface. Researchers also noted manure applied on floodplains present a greater risk of contamination of streams.

Management and Maintenance of Earthen Manure Structures: Implications and Opportunities for Water Quality Protection

In this study researchers looked at potential risks of contamination due to poor management and maintenance of 33 earthen waste storage structures. The risks of contamination at these sites included: minor spills during manure transfer and handling at 18 (55.0%) sites, erosion of compacted liners at nine (27.0%) sites, animal burrowing in berms at eight (24.0%) sites, plugging of inlet pipes at four (12.0%) sites, tree growth in berms at two (6.0%) sites, and inadequate freeboard at two (6.0%) sites. Freeboard is the distance between the liquid level in the structure and the lowest part of the berm or outlet.

Most spills happened when pumps were used to transfer liquid manure into tank vehicles for transport or for land applications. Erosion occurred at inlet pipes, pump out areas, and at berm

sides if agitation jet streams remained stationary for long periods of time and not kept in constant motion. Animal burrowing in berms, when liquid manure levels are low, may cause leakage during periods when levels are high. Plugging off inlet pipes can result in the back up of manure into confinement buildings and possible overflow out of buildings, manholes, and vents. Tree growth in berms, like animal burrowing, can led to leakage when roots grow into berms during low liquid manure levels. Inadequate freeboard was an uncommon problem but had resulted in a major spill at one of the sites.

Measurement of Seepage from Earthen Waste Storage Structures in Iowa

This study examined the possibility of contamination from liquid manure seepage from 28 earthen waste storage structures constructed between 1987 and 1994.

Liquid level changes of earthen waste storage structures were measured during periods of no precipitation and no discharge of manure into or out of the structures. Since evaporation from liquid manure structures differs from evaporation of other water bodies, measures of the liquid levels were taken during periods when evaporation would be low. Liquid level measurements were usually taken at night or in the early morning hours when humidity levels were 90% or greater, wind speed did not exceed three miles per hour, and temperatures were cooler.

At the time of this study, Chapter 65, Environmental Protection Division, Section 567, Iowa Administrative Code, regulations specified a maximum seepage rate of 1/16 of an inch per day at a liquid depth of six feet. In early 1999, these regulations were changed to a maximum seepage rate of 1/16 of an inch per day when the structures were filled to the maximum allowable depth. These new regulations require proof of seepage compliance prior to the start up of such structures.

Measurements of seepage rates were compared to the current regulations during the period of the study, and to the new regulations. Under the regulations in effect during the study, it was found that 12 of the 28 (43.0%) sites had seepage rates significantly less than 1/16 of an inch per day at a liquid depth of six feet, 15 of the 28 (54.0%) sites were close to the regulation seepage rates, and one site had seepage rates significantly higher than regulations. When compared to the new regulations four of the 28 (14.0%) had seepage rates significantly less than allowed, 10 of the 28 (36.0%) had seepage rates significantly greater than the new regulations, and the remaining 14 (50.0%) sites had seepage rates close to the new regulations.

Soil Sampling and Analysis Around Earthen Waste Storage Structures in Iowa

To determine possible contamination of seepage from earthen waste storage structures eight soil samples of eight feet depths, within 50 feet of the berms, were taken around 31 sites. At all structures studied a ninth soil sample was taken at an upslope area 100 to 1,000 feet away for comparison background samples.

Each eight-foot sample was divided into one-foot increments and analyzed for ammonium nitrogen in the soil and water, and for nitrate-nitrogen, chloride, and sulfate in water. Chloride is not a pollutant, but chloride in liquid manure is usually higher than in precipitation. High chloride concentration in water from the site samples indicates the source as animal manure.

Higher ammonium nitrogen, nitrate-nitrogen, and/or chloride levels compared to background samples occurred at almost all sites studied. However, these higher levels usually only occurred at one or two of the eight samples taken indicating only local contamination. It was also found that at all but five of the study sites a previous feedlot or manure spill may have been a possible cause of the higher levels found.

Study Recommendations

Researchers made the following recommendations for the reduction of the potential risks of ground and surface water contamination from earthen waste storage structures:

- Use additional geologic, hydrogeologic, and soil data for structure siting.
- Use *Geotechnical, Design, and Construction Guidelines*, Natural Resources Conservation Service, 1997, as a starting point for improved detailed siting, design, and construction regulations.
- Use groundwater monitoring to locate water tables during construction and over the lifetime of earthen waste storage structures.
- Use construction methods, hydrogeological, and topographic conditions to determine setback distances from water bodies.
- Avoid construction of structures on alluvial aquifers unless additional steps are taken to avoid the contamination of these aquifers.
- Avoid manure application on frequently flooded soils, like floodplains.
- Avoid the construction of structures on sites with shallow water tables.
- Use greater care in the transfer of manure between structures and application equipment.
- Mow berms frequently to reduce animal burrowing and tree growth.
- Visually check structures to insure adequate freeboard.

ALTERNATIVES

The General Assembly may choose to implement all or some of the researcher's recommendations through legislation.

BUDGET IMPACT

The Department of Natural Resources estimates the annual costs of implementing the first two recommendations; using additional geologic, hydrogeologic, and soil data for structure siting and using *Geotechnical, Design, and Construction Guidelines*, Natural Resources Conservation Service, 1997, as a starting point for improved detailed siting, design, and construction regulations, would be approximately $20,000 to $40,000, depending on the number of construction applications received each year. The first two recommendations address the same issue of siting, design and construction and the needed information is already used by the Department for construction applications. The increased costs would come from cross-referencing this information with the actual site information, which would amount to approximately $200 per application, and the Department receives an estimated 100 to 200 construction applications per year. The increased cost to each applicant for acquiring more detailed site information is estimated at $200.

Groundwater monitoring is already used to locate water tables prior to the construction or the design of structures. Using groundwater monitoring to locate water tables during and over the lifetime of earthen waste storage structures, the third recommendation, would require the use of at least three permanent monitoring wells at each structure site. The estimated annual cost to the Department of Natural Resources to monitor the water table, if the wells were visited once a year, is $40,000 for permitted structures and an additional $60,000 to $100,000 for structures which are not

permitted. The cost per visit to monitoring these wells would be approximately $100 and there are currently 400 permitted structures and 600 to 1,000 structures that are not permitted. The monitoring wells could also be used to detect structure leakage through water quality sampling. The cost per water quality sample is approximately $100 per visit. The cost of monitoring structures for leakage would depend upon the number of water quality samples collected each year. The Department estimates the cost per well to the structure owners would be $1,200 to $1,500.

The estimated cost to the Department for the fourth recommendation, using construction methods, hydrogeological, and topographic conditions to determine setback distance from water bodies, is a one-time cost of $10,000 . The costs would cover the time to formulate and develop rules to take the new recommended conditions into account.

The remaining recommendations would be of little or no cost to the Department of Natural Resources.

STAFF CONTACT: Sherry Weikum (Ext. 17846)