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EC98-752 Farm*A*Syst Nebraska's System for Assessing Water Contamination Risk Worksheet 9: Livestock Manure Storage

Robert Grisso
University of Nebraska at Lincoln

DeLynn Hay
University of Nebraska at Lincoln, dhay@unlnotes.unl.edu

Paul J. Jasa
University of Nebraska at Lincoln, pjasa1@unl.edu

Richard K. Koelsch
University of Nebraska - Lincoln, rkoelsch1@unl.edu

Sharon Skipton
University of Nebraska&#8211Lincoln, sskipton1@unl.edu

See next page for additional authors

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Authors
Robert Grisso, DeLynn Hay, Paul J. Jasa, Richard K. Koelsch, Sharon Skipton, and Wayne Woldt

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University of Nebraska Cooperative Extension EC 98-752-S

Farm•A•Syst

WORKSHEET 9

Nebraska's Farm Assessment System for Assessing the Risk of Water Contamination

Livestock Manure Storage

Why should I be concerned?

Accumulating manure in storage incurs certain risks to the environment and to human and animal health unless appropriate precautions are taken. Manure can contribute nutrients and disease-causing organisms to both surface water and groundwater.

Manure can be a source of high nitrate levels. The federal and state drinking water standard is 10 milligrams per liter (mg/l; equivalent to parts per million) NO_3-N (nitrate-nitrogen). Levels greater than 10 mg/l can pose a health problem known as methemoglobinemia (blue baby syndrome) for infants under 6 months of age. Nitrate-nitrogen can also affect adults, but the evidence is much less certain. Levels of 35 mg/l should be avoided for livestock, especially young animals and animals in gestation. For most livestock, health effects are normally observed only for concentrations of greater than 100 mg/l nitrate-nitrogen.

Fecal bacteria in livestock manure can contaminate surface and groundwater, causing such infectious diseases as dysentery, typhoid, and hepatitis. Surface water used for drinking water or swimming is at greatest risk. Typical water purification practices such as chlorination are not effective in controlling some of the pathogens found in livestock manure.

Organic matter in manure also poses a risk to surface waters. Rapid degradation of organic matter in manure consumes considerable oxygen. Fish kills resulting from open lot runoff or storage failures are caused in part by the depletion of the oxygen supply in water due to manure degradation.

Storage of manure is an essential tool for managing the application of manure nutrients to crop land. Properly designed and constructed storage facilities can prevent these structures from becoming an environmental risk. Engineering assistance is suggested in designing manure storage structures to insure adequate size and minimize risk of leaks or structural failures.

The goal of Farm*A*Syst is to help you protect the groundwater that supplies your drinking water.

How will this worksheet help me protect my drinking water?

- It will take you step-by-step through your livestock manure storage practices.
- It will evaluate your activities according to how they might affect the groundwater that provides your drinking water supplies and surface waters.
- It will provide you with easy-to-understand "risk level scores" that will help you analyze the relative safety of your livestock manure storage practices.
- It will help you determine which of your practices are reasonably safe and effective, and which practices might require modification to better protect your drinking water.

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Elbert C. Dickey, Interim Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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How do I complete the worksheet?

Follow the directions at the top of the chart on page 3. It should take you about 15 minutes to complete this worksheet and determine your risk level.

Information derived from Farm*A*Syst worksheets is intended only to provide general information and recommendations to farmers regarding their own farm practices. It is not the intent of this educational program to keep records of individual results.

Glossary

These terms may help you make more accurate assessments when completing *Worksheet 9*. They may also help clarify some of the terms used in *Fact Sheet 9*.

Cast-in-place concrete storage: A type of manure storage structure. Located on a concrete pad, it consists of a cast-in-place, concrete structure reinforced with steel. May be on or below grade level.

Concrete stave storage: A type of animal manure storage structure. Located on a concrete pad, it consists of concrete panels bound together with cable, rods, or bolts and sealed between panels. May be on or below grade.

Earthen basin or pit: Manure storage facility constructed according to specific engineering standards. Not simply an excavation. Must be built in compacted clay soils or have a compacted clay liner, plastic liner, or other impermeable liner.

Engineering standards: Design and construction standards as contained in Natural Resources Conservation Service (NRCS) technical guides, state regulations, or land grant university engineering handbooks.

Filter strip: A gently sloping grass plot used to filter runoff from the livestock yard and some types of solid manure storage systems. Influent is distributed uniformly across the high end of the strip and allowed to infiltrate into the soil. Nutrients and suspended material in the runoff water are filtered through the grass, absorbed by the soil, and ultimately taken up by plants. Filter strips must be designed and sized to match the characteristics of the livestock yard or storage system.

Glass-lined steel storage: A type of aboveground storage structure. Located on a concrete pad, it consists of steel panels bolted together. A glass layer is fused to the surface to provide corrosion protection.

Leachate: Water soluble materials that move down through the soil with water.

Water table depth: Depth of the top of groundwater. This depth is sometimes indicated in the county soil survey, but varies within a county. This information may be available from your well construction report or from hydrogeological reports and groundwater flow maps of your area. A local well driller, University of Nebraska Cooperative Extension Educator or NRCS specialist may also be able to help you gather this information.

There are two types of water table: the water table typically noted in a well log as an indication of usable water supply; and the seasonal high water table. The seasonal high water table is most important in regard to construction of livestock manure storage facilities because it can help determine if facility construction problems may result.

Livestock Manure Storage and Runoff Holding Pond: Assessing the Risk of Surface Water and Groundwater Contamination

1. Use a pencil. You may want to make changes.
2. For each category listed on the left that is appropriate to your farm, read across to the right and circle the statement that best describes conditions on your farm. (Skip and leave blank any categories that don't apply to your farm.)
3. Then look above the description you circled to find your "risk number" (1, 2, 3, or 4) and enter that number in the blank under "YOUR RISK."
4. Allow about 15-30 minutes to complete the worksheet and figure out your risk for livestock manure storage practices.

	HIGH RISK (risk 4)	HIGH-MODERATE RISK (risk 3)	MODERATE-LOW RISK (risk 2)	LOW RISK (risk 1)	YOUR RISK SCORE
Nebraska DEQ permit or letter of exemption	***Do not have a Nebraska DEQ operating permit for my manure storage or treatment lagoon.***	***Have a Nebraska DEQ permit for manure storage or treatment lagoon, but it may not be current due to expansion of livestock numbers.***	_____	Have a current Nebraska DEQ operating permit for all manure storage and treatment lagoon facilities OR A letter of exemption from DEQ.	
LIQUID OR SLURRY MANURE STORAGE, HOLDING POND OR LAGOON: (evaluate only the methods you are using)					
Location (earthen only)	Constructed in coarse-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown; OR Evidence of seepage observed during construction; OR Construction site was not evaluated for evidence of seepage.	Constructed in medium- or fine-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown; OR Evidence of seepage or coarse material during construction; OR Construction site was not evaluated for evidence of seepage or coarse material.	Constructed in medium- or fine-textured soils[1]; AND Construction site evaluation reveals no evidence of seepage or coarse material; AND Fractured bedrock or high water table is likely to be more than 2 feet below storage bottom.	Constructed in medium- or fine-textured soils[1]; AND Soil core samples are taken at midpoints of each of four storage sides to 2 feet below storage bottom. No indication of coarse material, high water table or fractured bedrock observed; OR Laboratory tested percolation rate of completed liner is less than 1/28" per day (prior to filling with manure).	
Location (concrete or steel storage tank only)	Constructed in coarse-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown.	Constructed in medium- or fine-textured soils[1]; AND Fractured bedrock or high water table less than 2 feet below storage bottom or depth is unknown.	_____	Constructed in medium- or fine-textured soils[1]; AND Fractured bedrock or high water table are more than 2 feet below storage bottom.	

Bold Italic type: Besides representing a higher risk choice, this practice also violates Nebraska law.

1. Coarse textured soils...gravels, sands and sandy loams. Medium or fine-textured soils...silt loams, loam, clay loams, silty clay.

	HIGH RISK (risk 4)	HIGH-MODERATE RISK (risk 3)	MODERATE-LOW RISK (risk 2)	LOW RISK (risk 1)	YOUR RISK SCORE
Design (earthen, concrete, or steel)	Not designed to current engineering standards.[1]	Designed according to current engineering standards.[1]	Designed according to current engineering standards.[1] Plans signed / sealed by licensed engineer.	Designed according to current engineering standards.[1] Plans signed / sealed by licensed engineer. Construction monitored by designer.	
Construction (earthen only)	Earthen structure installed without any compaction of earthen liner (i.e. construction by power shovel).	Earthen structure installed using track-mounted or rubber-tired construction equipment. No specific efforts made to compact all bottom and bank surfaces.	Earthen structure installed using heavily-weighted, rubber-tired construction equipment. Specific efforts made to compact all inner surfaces of bottom and banks.	Earthen structure installed using vibrating or sheepsfoot roller or equivalent compaction equipment for compacting all inner surfaces of bottom and banks.	
Management (earthen only)	Weeds are not controlled; AND Signs of earthen liner erosion are observed.	Weeds are not controlled; OR Signs of earthen liner erosion are observed.	Embankments have established grass growth and weeds are regularly mowed; AND No erosion of liner is observed.	Embankments have established grass growth and weeds are regularly mowed; AND No erosion of liner observed; AND Emergency plan is available.	
SEMI-SOLID OR SOLID STORAGE: (evaluate only the methods you are using)					
Stacked in field (on soil base)	Stacked for more than 30 days OR Stacked on coarse-textured soils.[2] Fractured bedrock or water table shallower than 20 feet OR Upslope surface water not diverted.	Stacked for less than 30 days; Medium- or fine-textured soils.[2] Water table is deeper than 20 feet AND Upslope surface water diverted around pile.	Stacked for less than 30 days; Medium- or fine-textured soils;[2] Water table is deeper than 20 feet AND Upslope surface water diverted around pile; AND New location for pile each year.	Never stacked on field or bare soil.	
Stacked in feedyard[3] • Groundwater contamination	Earthen yard with coarse-textured soils.[2] Fractured bedrock or water table shallower than 20 feet.	Earthen yard with medium- or fine-textured soils.[2] Water table deeper than 20 feet without animals for several months at a time.	Earthen yard with medium- or fine-textured soils[2] and filled almost continuously with livestock. Water table deeper than 20 feet.	Well-maintained concrete yard.	

Bold Italic type: Besides representing a higher risk choice, this practice also violates Nebraska law.

1. ASAE Standard Engineering Practices including EP393.2 (Manure Storages), EP403.2 (Design of Anaerobic Lagoons for Animal Waste Management), EP 470 (Manure Storage Safety) and EP340.2 (Installation of Flexible Membrane Linings) or comparable standards set by the Natural Resource Conservation Service or the University of Nebraska.
2. Coarse textured soils...gravels, sands and sandy loams. Medium or fine-textured soils...silt loam, loam, clay loams, silty clay.
3. Access of dairy cows to stored manure is in violation of Nebraska Department of Agriculture dairy permit requirements and the Federal Pasteurized Milk Ordinance.

	HIGH RISK (risk 4)	HIGH-MODERATE RISK (risk 3)	MODERATE-LOW RISK (risk 2)	LOW RISK (risk 1)	YOUR RISK SCORE
SEMI-SOLID OR SOLID STORAGE: (evaluate only the methods you are using) (continued)					
Stacked in feedyard[1]. Surface water contamination	***Feedlot with no surface runoff containment and upslope clean water not diverted.***	***Feedlot with surface runoff only partially contained and upslope clean water only partially diverted.***	All feedlot surface runoff is directed to settling basin and grass filterstrip. All clean water is diverted.[2]	All feedlot surface runoff is contained in appropriate size storage. All clean water is diverted.	
Stacked on concrete	***No roof AND Liquid runoff is allowed to enter farm drainage, road ditch, intermittent or continuous stream or natural wetlands.***	***No roof AND Liquid runoff from storage is diverted to pasture or crop land.***	No roof AND Liquid runoff from storage is diverted to properly designed grass filter strip for handling storage runoff.[2]	Roofed storage: No liquid exits storage. Upslope clean water is diverted; OR No roof: Liquid runoff is collected in separate storage. Upslope clean water is diverted.	
Stored in animal housing[2] on:	Earthen floor of coarse-textured soils[3] and subjected to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	Concrete floor or compacted earthen floor of medium- or fine-textured soils[3] and subject to surface water runoff. Water table or fractured bedrock shallower than 20 feet.	Concrete floor or compacted earthen floor of medium- or fine-textured soils[3] and protected from surface water runoff. Water table or fractured bedrock deeper than 20 feet.	Building has concrete floor, protected from surface water runoff.	
LOCATION AND OTHER FACTORS					
Distance from livestock manure storage to nearest surface water source.	Less than 100 feet	100 to 199 feet	200 to 500 feet	Greater than 500 feet	
Location of livestock manure storage in relation to drinking water well	***Well is within 100 feet.[4]***	Well is 100 to 250 feet AND Downslope or at grade.	Well is more than 250 feet AND Downslope or at grade.	Well is more than 100 feet AND Upslope.	
Storage capacity (see *Worksheet #10 Livestock Yard Management* for capacity of runoff holding ponds)	***Less than four months (before 1996) Less than six months (after 1996)***	_____	At least six months for storages emptied by irrigation system.	At least nine months for storages emptied by irrigation system. At least six months for storages emptied by all other systems.	
Storage status when emptied,	Often less than 1 foot of freeboard remains when emptied.	Occasionally less than 1 foot of freeboard remains when emptied.	_____	When emptied , capacity to handle 25 year, 24 hour storm event is still available; OR More than 1 foot of freeboard remains (whichever is greater)	

Bold Italic type: Besides representing a higher risk choice, this practice also violates Nebraska law.

1. Access of dairy cows to stored manure is in violation of Nebraska Department of Agriculture dairy permit requirements and the Federal Pasteurized Milk Ordinance.
2. Permitted under Nebraska law in limited situations as determined by Nebraska Department of Environmental Quality.
3. Coarse textured soils...gravels, sands and sandy loams. Medium or fine-textured soils...silt loam, loam, clay loams, silty clay.
4. Illegal for new well construction. Existing wells must meet separation requirements in effect at time of construction.

Your groundwater vulnerability score from *Worksheet 2* was _____
Note: If the surface texture, subsurface texture, or depth to groundwater used to calculate this score are not characteristic of the site conditions present for the activities / practices discussed in this worksheet, calculate a new vulnerability score for this site.

If your groundwater vulnerability score is:
- 1 to 1.4: your site has a LOW VULNERABILITY to pollution reaching groundwater.
- 1.5 to 2.4: your site has a MODERATE-LOW VULNERABILITY to pollution reaching groundwater.
- 2.5 to 3.4: your site has a HIGH-MODERATE VULNERABILITY to pollution reaching groundwater.
- 3.5 to 4.0: your site has a HIGH VULNERABILITY to pollution reaching groundwater.

Your surface water vulnerability score from *Worksheet 2* was _____
Note: If the surface texture, slope toward surface water, or distance from surface water used to calculate this score are not characteristic of the site conditions present for the activities / practices discussed in this worksheet, calculate a new vulnerability score for this site.

If your surface water vulnerability score is:
- 1 to 1.4: your site has a LOW VULNERABILITY to pollution reaching surface water.
- 1.5 to 2.4: your site has a MODERATE-LOW VULNERABILITY to pollution reaching surface water.
- 2.5 to 3.4: your site has a HIGH-MODERATE VULNERABILITY to pollution reaching surface water.
- 3.5 to 4.0: your site has a HIGH VULNERABILITY to pollution reaching surface water.

Look over your worksheet scores for individual activities:

- **Low risk** practices (1's): are ideal and should be your goal regardless of your site's vulnerability to pollution reaching ground or surface water. Cost and other factors may make it difficult to achieve a low risk rating for all activities.

- **Moderate-low risk** practices (2's): provide reasonable water quality protection unless your site's vulnerability to pollution reaching ground or surface water is moderate-high or high.

- **High-moderate risk** practices (3's): do not provide adequate protection in many circumstances, especially if your site's vulnerability to pollution reaching ground or surface water is high or high-moderate. They may provide reasonable water quality protection if your site's vulnerability to pollution reaching ground or surface water is low to moderate-low.

- **High risk** practices (4's): pose a serious danger of polluting water, especially if your site's vulnerability to pollution reaching ground or surface water is high, high-moderate, or moderate-low. Some high risk activities may not immediately threaten water quality if your site's vulnerability to pollution reaching ground or surface water is low, but still pose a threat over time if not corrected.

Read ***Fact Sheet 9 Improving Livestock Manure Storage*** and consider how you might modify your farm practices to better protect your drinking water supply and other ground and surface water supplies. Some concerns you can take care of right away; others could be major or costly projects requiring planning and prioritizing before you take action.

Summary Evaluation for Livestock Manure Storage Worksheet

Summarize your potential high risk activities in the following table and consider the response options you can take to reduce the potential for water quality contamination.

High Risk Activities and Activities Impacted by Site Vulnerability	**Response Options (Check One)**		**Taking Action** For "immediate action possible" items, note practices and when each will occur. For issues "requiring further planning," note estimates, consultations, or other activities necessary and when each will occur. Establish a target date for making necessary changes.
	Immediate Action Possible	**Further Planning Required**	

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Nebraska Farm*A*Syst team members included: Robert Grisso, Extension Engineer, Ag Machinery; DeLynn Hay, Extension Specialist, Water Resources and Irrigation; Paul Jasa, Extension Engineer; Richard Koelsch, Livestock Bioenvironmental Engineer; Sharon Skipton, Extension Educator; and Wayne Woldt, Extension Bioenvironmental Engineer.

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