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# Manure Spills:

## What You Need to Know and Environmental Consequences

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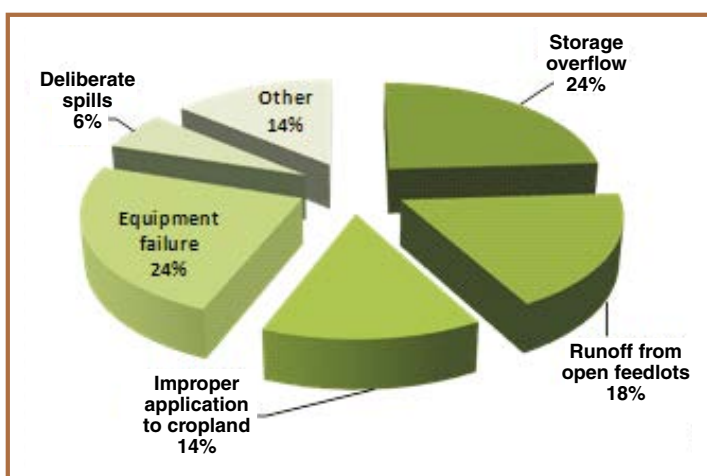
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## Manure Spills

Manure spills are defined as manure that is released into the environment in a manner that exceeds the rate of nutrient uptake by plants or applied in a manner that is not identified in the “**Nutrient Management Plan.**” Manure spills may occur during manure storage, transportation and land application.



**Figure 1.**  
Causes of manure  
spills in Iowa.

(Source: Armstrong  
et al. 2010)

One Iowa State University study indicated that equipment failure and storage overflow are the main causes of on-farm manure spills (**Figure 1**). Stencil and Erb (2015) found that 42% of manure spills occurred at the farmstead site (most involving storage leaks, overflows or pipe/pump problems), 28% were transportation related (vehicle accidents/leaks) and 29% were land application problems or errors, with the remaining 1% unknown.

Similarly, Erb (2019) indicated that 40% of manure spills in Wisconsin were attributed to manure storage equipment failure, lagoon breaches and management, followed by land application (29%) and transportation (30%). The focus of this publication is preventing manure spills during manure storage, transportation and land application.

## Spills From Manure Storage

Typically, liquid manure is stored in a manure storage pond or lagoon for six to 12 months. During this period, manure is added to the storage pond on a regular basis. In addition, feedlot runoff and direct precipitation are added to the storage pond.

Permitted animal feeding operations in North Dakota Administrative Code sections 33.1-16-03.1-04 and 33.1-16-03.1-05 are required to have a liquid level marker or indicator (**Figure 2**) in earthen manure storage ponds or runoff ponds (North Dakota Livestock Program Design Manual) to help the farmer track and manage manure levels. However, this regulation is ignored or the marker is missing in many situations. As a result,

the manure storage or runoff pond may not have enough capacity to take more manure and can overflow.

Inspecting manure storage ponds frequently is a good practice to detect any leakage or rodent/erosion damage to the embankment and alongside pipes, as well as wet areas/seepage on the back slope of a liquid manure storage pond. Any minor repairs (external erosion, small rodent burrows) should be corrected immediately. Otherwise, liquid manure will stress these weak spots and a manure spill will occur.

Prevention is always the best means to minimize the risk of manure spills and the resulting environmental damage.

**Take the following steps to prevent manure spills from storage ponds:**

- Install a permanent marker/staff gauge and regularly monitor manure levels.
- Make proper liquid level management a year-round priority.
- Reserve maximum storage capacity for times when open fields are not available/extended wet weather prevents application.
- Pump down the liquid level or take action to remove liquid from storage and properly apply or transfer it to another storage

structure when the pond has reached its maximum operating level.

Conducting periodic inspections of embankments can minimize the risk of a storage pond spill. Producers should look for:

- Cracking or holes on the embankment and around pipes
- Wet areas on the back slope
- Erosion
- Rodent or tree damage

**If leakage from the base or sidewall of a lagoon or earthen storage structure has occurred, take the following steps immediately to stop additional manure releases:**

- Fix weak spots with clay-type soil.
- Create a dam away from the berm or dig a small hole to catch the spill and make cleanup easier.
- Trap or remove burrowing animals if they are causing holes, fill holes and compact them with a clay-type soil.
- Seek engineering assistance.

Modifications or repairs to any pond or storage facility should be done with technical assistance from a conservation agency, such as the Natural Resources Conservation Service or your local Soil and Water Conservation District.

**If lagoon/storage pond overflow has occurred, take the following steps to minimize additional manure loss:**

- Stop all additional flow into the lagoon and direct the manure to appropriate storage facilities or land apply if weather and conditions allow.
- Lower the volume in the storage pond by applying the liquid to fields at rates provided in the Nutrient Management Plan.
- Make sure no excess surface water is entering the lagoon by checking clean-water diversions (for example, gutters, ditches) and water sources in the barn, such as pipes and watering systems.
- Add soil to the berm to increase the elevation of the dam only with approval of regulatory authorities.

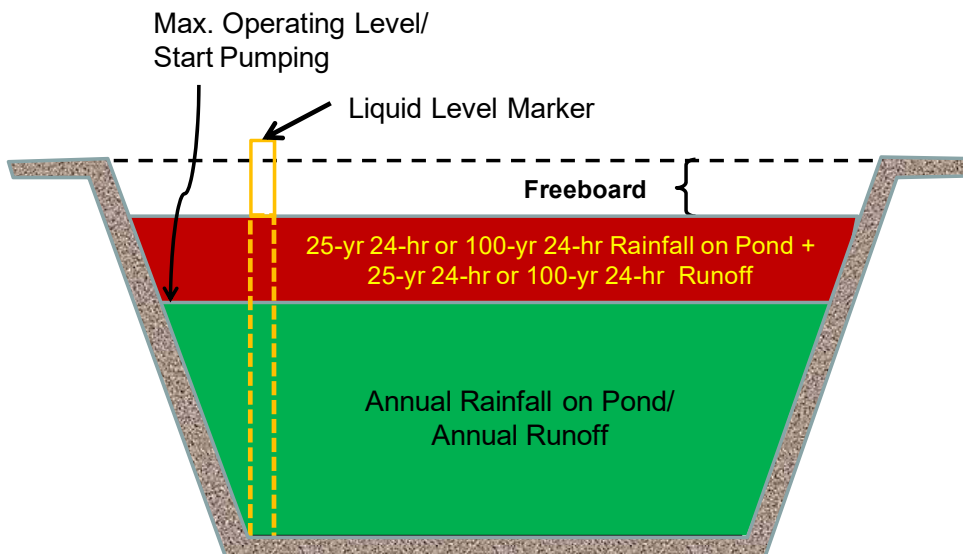
## Spills During Manure Transport

Manure spillage can occur while pumping and transporting manure from the storage system to the crop field. Often manure is applied through pivot irrigation or other automatic means. Mechanical failure during pumping is one of the largest causes of manure spills.

Mechanical failure may occur due to the pump/pipe/hose connections malfunctioning or breakage.

Periodically checking connections for leakage or obstructions during pumping is important. If something, such as manure solids, sand or other material, is obstructing the manure's flow, the pipe connection may burst and manure will end up in an unwanted area.

Monitoring line pressure while pumping manure is important because pressure buildup may indicate an obstruction, while pressure loss may indicate a leak.



**Figure 2. Capacity of a runoff storage pond (not to scale).**

### **If you find leaks from the manure distribution system, take the following steps to stop spills:**

- Stop the irrigation pump.
- Close valves or clamp hoses to eliminate further discharge.
- Separate pipes to create an air gap and stop flow.
- Repair all leaks before restarting pumps.

While less common, spills of wet-solid manure (mainly beef manure in North Dakota) during transportation are no less important. Wet-solid manure contains the same nutrients and pathogens as liquid manure and has the potential to cause the same environmental pollution issues.

The least frequent to occur but highest volume wet-solid spill would come from a manure spreader tipping over, likely because of a combination of excess speed and getting too close to the shoulder of the road or turning a corner. The most frequent type of wet-solid manure spill in North Dakota occurs when spreaders are filled past capacity and manure falls off the top onto the roadway. This is not only unsightly and has the potential to cause pollution when it moves off the roadway; it also creates a safety hazard for trucks/cars and motorcycles.

## **Spills During Land Application**

Manure is land-applied to meet the crop's nutrient requirements. When application equipment is not properly calibrated, manure may not be applied at rates to meet the crop's needs, resulting in over- or underapplication of manure.

Additionally, if manure is not incorporated into the soil, the risk of surface runoff increases. Frozen ground prevents manure incorporation, uptake by plants and in soil, and increases the chance of manure running off the intended field.

Several ways are available to stop manure from entering water streams. For example, a setback distance (minimum 100 feet) or buffer can be established around manure-application areas to prevent manure runoff into surface water.

Avoid winter application of manure; however, choosing fields with some vegetation and minimal slopes will help prevent manure loss.

But if runoff is occurring from the application field, **the following actions can help minimize the impact from spills while applying manure to cropland:**

- Stop manure application immediately.
- Create a temporary diversion or berm to contain the manure on the field.
- Incorporate the manure to reduce further runoff.
- Evaluate and eliminate the cause or causes of the runoff (application rates, equipment failure, soil moisture, time of application) before resuming field application.

Unintentional off-site manure movement also occurs on tile-drained fields. Note that while tile drainage provides a means of removing excess water from fields, it also can move manure directly to surface water.

The risk is highest when the solids content of the manure is less than 2.5%, higher rates of liquid manure are injected, and fields have been in no-till or strip tillage for a number of years. Avoid, if possible, applying manure when tile are flowing, and monitor tile outflow during and after application.

## **How to Handle a Manure Spill**

Even if the manure does not come into immediate contact with a water system, the spill or accumulated leakage eventually can migrate to nearby surface water and/or to the aquifer.

To contain the manure, do a preliminary assessment of the situation and contact the appropriate authorities. Take the following basic steps in case of manure spills:

### **Basic Steps**

1. Devote your full attention to the situation.
2. Care for any human injuries.
3. Stop the source of the spill.
4. Contain the spill.
5. Assess the extent of the spill and note any obvious damages.
6. Contact the appropriate agencies (within 24 hours).
7. Clean up the spill and make repairs.
  - Use a pump to recover liquid manure or a skid steer loader to recover solid manure.
  - Remove manure from the roadway.
  - Flush the manure off vegetation with water.
  - Apply the manure to cropland as per the approved rate.
8. Prepare and submit a summary report. In North Dakota, the report needs to be submitted in five days.

At the same time, prepare a preliminary assessment and notification of the situation for the appropriate authorities. **The assessment and notification should include:**

- Incident description
  - Your name
  - Facility name
  - Telephone number
  - Details of the incident
  - Exact location of the facility
  - Location or direction of spill movement
  - What corrective measures have been undertaken
- Whether the manure reached any surface waters
- Approximate amount of manure released and the duration
- Any damage, such as employee injury, fish kills or property damage

- Whether the spill left the property
- Whether the spill has potential to reach surface waters

According to North Dakota Administrative Code chapters 33-16-01 and 33-16-03.1, spill records must be kept on site for a minimum of three years for animal feeding operations and five years for concentrated animal feeding operations (North Dakota Livestock Program Design Manual, 2018).

When a spill or accident happens, you must contact the appropriate department within 24 hours. In North Dakota, spill notification can be made by calling 701-328-5210 during normal working hours or the Division of Emergency Services at 800-773-3259 during nonworking hours (including weekends and holidays).

## How to Avoid Spills

The majority of manure spills can be prevented through management and careful manure application.

## Management

- Inspect manure storage structure walls and berms for leaks or punctures periodically.
- Install a pond marker/staff gauge, which is essential for recording manure levels.
- Monitor manure storage capacity and apply manure before the pond is full.
- Perform proper lagoon/runoff storage pond maintenance.
- Make proper lagoon liquid level management a year-round priority.

## Apply Manure Wisely

- Apply manure at the recommended rate.
- Do not apply manure immediately before, during or immediately after a heavy rain or snowmelt.
- Watch for pressure changes and inspect pipe connections.
- Make multiple smaller applications because soils can absorb them better than one larger application.
- Do not exceed the wet-solid manure spreader capacity.

## Environmental Consequences of Manure Spills

A manure spill may cause immediate or future pollution. The biggest concern with manure spillage is surface and ground-water pollution. Spills or accumulated leakage eventually can end up in the nearby surface water and/or an aquifer.

Surface water contamination due to manure spills may pose a significant threat to aquatic ecosystems, and excessive nutrients may cause eutrophication in freshwater ecosystems. Nitrate contamination (at or above 10 milligrams per liter) of groundwater may lead to Blue-baby syndrome in infants if contaminated groundwater is used as drinking water.

Cleaning up manure spills is expensive and time-consuming. Therefore, prevention should be the goal, rather than cleaning a manure spill mess.

In case of manure spills, take corrective measures immediately. Proper management practices and a little supervision can minimize manure spills and the related environmental concerns.

## Suggested References

- Armstrong, S.D., D.R. Smith, B.C. Joern, P.R. Ownes, A.B. Leytern, C. Huang and L. Adeola. 2010. Transport and Fate of Phosphorus During and After Manure Spill Simulations. *Journal of Environmental Quality*, 39: 345-352
- Armstrong, S.D., D.R. Smith, P.R. Ownes, B. Joern and C. Williams. 2010. Manure spills and remediation methods to improve water quality. In E. Lichtfouse (ed.) *Genetic Engineering, Biofertilisation, Soil Quality, and Organic Farming*. Springer, New York, pp 201- 215.
- Comprehensive Nutrient Management Plan Development Course. 2006. Feb. 13-15, 2006, Kansas City, Mo., Iowa State University, Ames, Iowa.
- Erb, K. 2019. Manure Spill Causes and Case Studies. University of Wisconsin-Extension (personal communication).
- Livestock and Poultry Environmental Learning Community: <https://lpecl.org/manure-spills-and-emergency-planning>, accessed Jan. 15, 2020.
- North Dakota Livestock Program Design Manual, 2018. North Dakota
- Department of Environmental Quality: [https://deq.nd.gov/publications/WQ/2\\_NDP-DES/AFO\\_CAFO/ND\\_Livestock\\_Design\\_Manual\\_20181213.pdf](https://deq.nd.gov/publications/WQ/2_NDP-DES/AFO_CAFO/ND_Livestock_Design_Manual_20181213.pdf), accessed Jan. 15, 2020.
- Stencil, K., and K. Erb. 2015. A preliminary analysis of manure spills, 2010-2014. Presentation to the Wisconsin DNR NE Region staff, Green Bay, Wis., (Aug. 17, 2015).

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