SITING MANURE STORAGE FACILITIES

THIS CHAPTER EXPLORES:

- **layout and location**
- **soil characteristics**
- **proximity to water**
- **separation distances**
- **legal requirements.**

LAYOUT AND LOCATION

It pays to plan properly. Most conflicts between livestock operations and neighbours can be prevented if livestock facilities are located far enough away from other developments. Conversely, conflicts are reduced when new developments are located far enough away from livestock facilities.

Land use planning commonly groups together compatible land uses while separating incompatible ones. The same principle is applied in municipalities where an area within a municipal boundary is designated solely for industrial, commercial, agricultural or residential development.

MINIMUM DISTANCE SEPARATION FORMULAS

Early settlers established farmsteads near water sources. Today, the impact on surface waters and other environmentally sensitive areas must be considered when planning the construction of new livestock facilities.

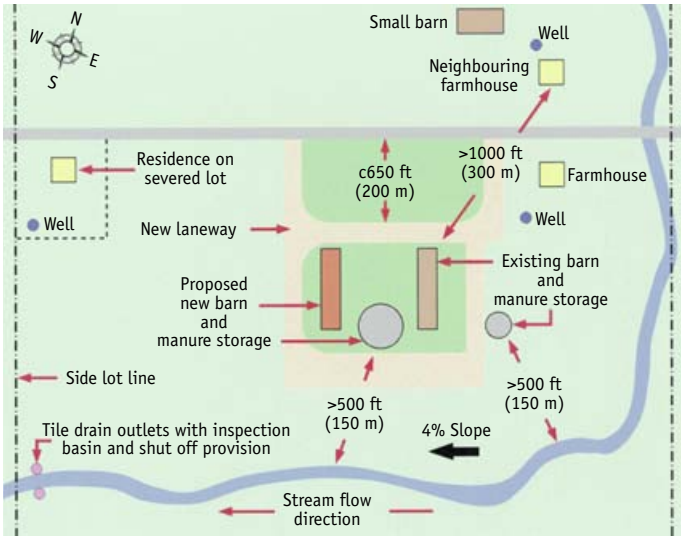
Ontario has established Minimum Distance Separation (MDS) formulas as a tool to determine the recommended separation distance between a livestock facility or manure storage and other land uses. The goal is to prevent land use conflicts and minimize nuisance complaints due to odour. Please note that MDS doesn't account for other types of nuisance complaints such as flies, dust, etc.

MDS varies with type of livestock, size of the farm operation, type of manure produced and the form of development present or proposed.

MDS I provides minimum distance separation for new non-farm development from existing or potential livestock facilities.

MDS II provides minimum distance separation for new or expanding livestock facilities and manure storages from existing or approved non-agricultural development.

Complying with minimum separation distances when choosing a site for livestock facilities can prevent nuisance complaints and lessen environmental risk. (Separation distances shown here are for illustration purposes, and pertain only to the particulars at this operation and site.)

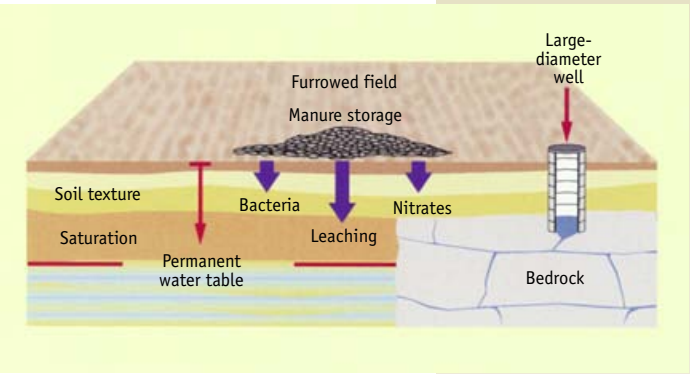


SOIL AND SITE FEATURES

The geology of a proposed site should be analyzed before constructing a livestock or manure storage facility. Synthetic liners may have to be installed in liquid manure storages to reduce the risk to groundwater. Livestock and manure storage facilities located on deep, well-drained, loamy soils on moderate slopes, far away from sensitive natural areas, pose few restrictions for siting livestock facilities. Conversely, a similar facility on a site where bedrock and/or water table are close to the surface may be at higher risk for contaminating groundwater.

SITE CHARACTERISTICS AFFECTING GROUNDWATER CONTAMINATION

Groundwater quality is degraded when inadequately filtered water carries contaminants downward through the soil to the groundwater. Once a groundwater aquifer is contaminated, all water wells drawing water from that aquifer are at risk of being polluted. Soil texture, depth to bedrock, and depth to groundwater significantly affect the degree of risk.



Raw manure and manure nutrients can leach to groundwater on sites with coarse-textured soils, shallow depths to bedrock, and/or high water tables.

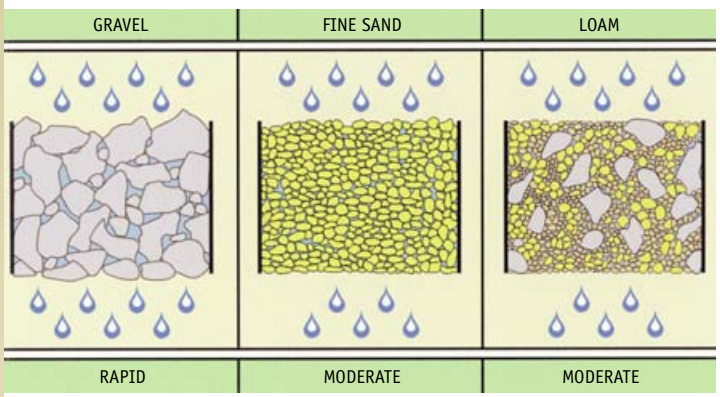
Coarse-textured soils may require concrete floors and/or synthetic liners or imported and compacted clay to seal the soil from the risk of groundwater contamination.

Soil Texture

Soil texture is the relative coarseness or fineness of soil particles. It's the most important determining factor in the ease and speed with which water and contaminants can move through soil to groundwater.

Coarse-textured soils such as gravels and sands have large pore spaces between the soil particles. This allows water to quickly percolate downward to groundwater.

Fine-textured soils provide better natural protection for groundwater. In these soils, such as clays and clay loams, the movement of water and contaminants through the soil is very slow. They act as a natural filter and allow for biological and chemical breakdown of contaminants before they reach groundwater.

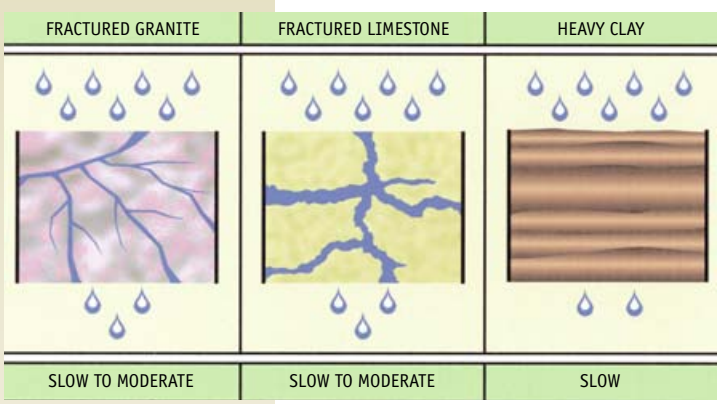


Soil texture can be assessed using hand-texturing methods or with laboratory particle-size analyses to describe the relative fineness or coarseness of the soil particles. Soil maps can provide an indication of the soil texture at the site.

Water moves slowly through uncracked clay soils and very quickly through gravelly and sandy soils.

Depth to Bedrock

Oftentimes where bedrock is close to the surface, so are shallow aquifers. This is particularly true with fractured-bedrock types such as limestone, dolomite, sandstone and weathered shales.



Groundwater can move quickly through fractured limestone and granite bedrock formations.

Open fractures in the bedrock allow rapid movement of water and contaminants to groundwater. If the depth of soil over the bedrock is shallow, there is little opportunity for filtration or restricting the flow of contaminants to the bedrock layer. Once the water and contaminants reach fractured bedrock, the movement to groundwater is very rapid.

Depth to bedrock can be determined using hand or mechanical excavation equipment. Soil and geology maps can give a general indication of bedrock depth. Experience with local excavations, digging footings or post-holes, or seeing bedrock at the surface can also indicate bedrock depth.

Depth to Groundwater

Filtering and treatment of contaminated water by natural processes primarily take place in soil above the water table in the unsaturated zone of soil. In a naturally occurring, high water table, water and contaminants have little time to move through unsaturated soil before reaching shallow aquifers.

Water table depths can fluctuate significantly, depending on the season. In Ontario, the water table is usually highest in the spring or fall. Depth to water table can be assessed by:

- digging a hole in June or September and observing the depth to free water in the hole
- using soil colour features and the soil drainage method to assess drainage class – usually done by soil specialists and engineers
- referring to a local soil map to assess drainage class (e.g., imperfect or poor drainage).

Soils with grey-blue colours and rust blotches in the upper 50 cm (20 in.) from the soil surface indicate a high water table and poor drainage.

CONTAMINANTS AND RISK ASSESSMENT

Contaminants found in manure and other waste materials are mobile in surface water and groundwater. Key potential contaminants found in manure and other organic wastes include:

- phosphorus – in solution or attached to soil from runoff or tile effluent, can cause excessive algal blooms
- bacteria – in stored and applied manure, can reduce quality and safety of surface waters and can contaminate drinking water supplies
- pathogens – disease-causing organisms and single-cell pathogens from manure can travel with runoff to contaminate surface water and groundwater
- biological debris – organic matter from manure creates in-water habitat for bacteria and pathogens.

Keeping the potential source of contamination as far as possible from surface water is the most effective preventive strategy.

At any given site, there are two kinds of contamination sources. **Point sources** occur where potential contaminants are concentrated or stored in one spot, e.g., manure piles or fuel storages. A spill or a long-term leak is a point source, having the potential to contaminate groundwater. **Non-point sources** exist where potential contaminants are spread out over a greater area, e.g., pesticide or fertilizer applied to fields. Regardless of source, the primary consideration is the relative speed with which contaminants move through the soil.

A qualified person using on-site assessment, visual features and soil maps can assess site suitability. A study by a qualified specialist may be required to determine site characteristics.

For more information, see the Ontario Ministry of Agriculture, Food and Rural Affairs factsheet on assessing ground water contamination potential on your farm.

POTENTIAL FOR GROUND WATER CONTAMINATION				
HYDROLOGIC SOIL GROUP	DEPTH TO WATER TABLE*			
	LESS THAN 1 M (3 FT)	1-4.5 M (3-15 FT)	5-14 M (16-45 FT)	GREATER THAN 14 M (45 FT)
BEDROCK (within 3 ft)	1–High	1–High	1–High	1–High
MUCK/ORGANIC	1–High	–	–	–
RAPID	1–High	1–High	1–High	2–Moderate
MODERATE	1–High	1–High	2–Moderate	3–Low
SLOW	1–High	2–Moderate	3–Low	4–Very low
VERY SLOW	1–High	3–Low	4–Very low	4–Very low

* If you do not know the depth to water table, use the highlighted depth column (1-4.5 m).

SUMMARY OF SITING RECOMMENDATIONS FOR MANURE STORAGE FACILITIES

Livestock and manure storage facilities are systems with many components. Whether you're planning to build a new facility, or fine-tune your current operation, you should account for all inputs, including solid and liquid materials, such as:

- manure
- bedding
- waste feed
- wastewater, including:
  - water spilled from drinkers and troughs
  - water from washing operations
  - water added for dilution
  - precipitation
  - yard runoff.

Manure = fecal material + undigested feed + urine + bedding + uncontaminated water + wastewater + other wastes.

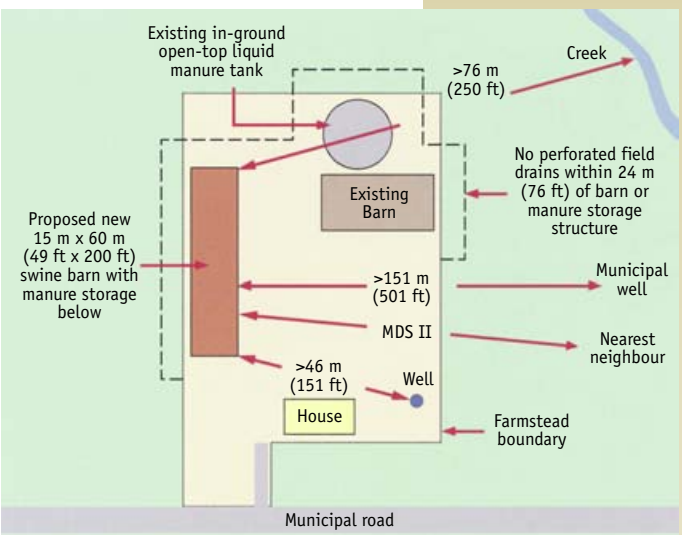
It bears repeating: when managing manure, account for all materials – especially liquids.

For Ontario farmers, a number of legal requirements (e.g., NMA and Building Code) may apply. These could include specific setbacks from wells, site investigations, observation stations for tile drains within 15 metres (49 ft) of a manure storage, and structural design.

New or Expanding Permanent Manure Storage Facilities

Should be located:

- at least 24 metres (76 ft) from a drainage tile, whether existing or to be constructed OR any tile within this distance or below the storage should be non-perforated and all joints properly sealed
  - this water could also be collected and stored or treated – see section on vegetative filter strip systems
  - some conditions, such as on clay soils where foundation drains are recommended, allow a third option: in this case, a perforated tile connected to an observation station should be adequate to verify that only uncontaminated (clear) drainage water is being removed from the site
- at least 151 metres (501 ft) from a municipal well
- at least 46 metres (151 ft) from any other well
- at least 24 metres (76 ft) from a drainage tile – whether existing or to be constructed, and
- with a flow-path that is at least 50 metres (164 ft) from the nearest surface water.

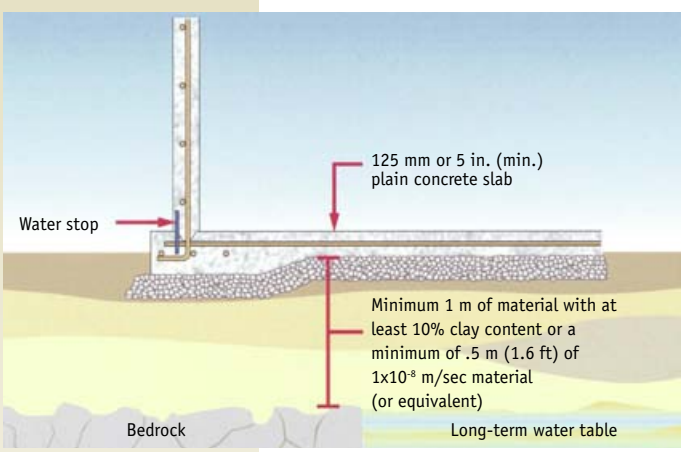


New or Expanding Permanent Liquid Manure Storage Facilities

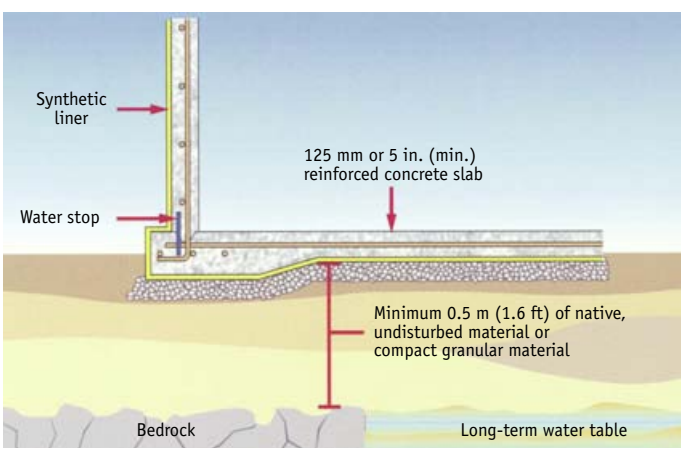
If you plan to construct a new or expanding liquid manure storage, you're required by law to have a site investigation by a professional engineer or geo-scientist. The table on page 36 specifies the site requirements for several types of liquid storages.

To view current, legally correct compliance information for the Nutrient Management Act, look up: http://www.omafra.gov.on.ca/english/agops/index.html

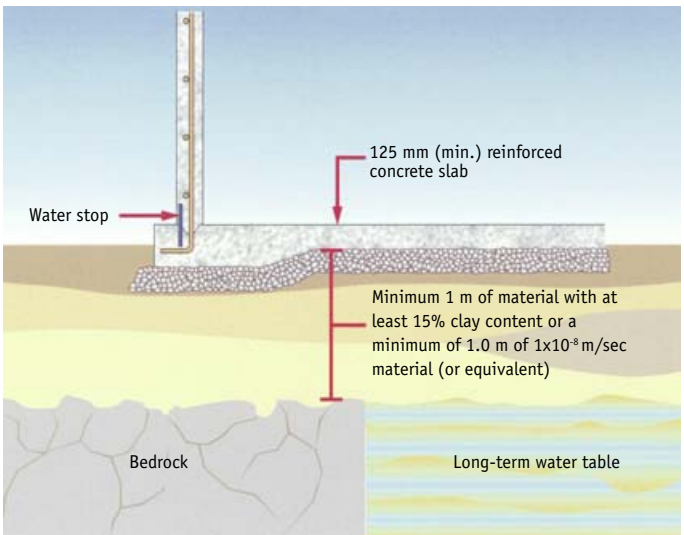
SITE REQUIREMENTS FOR PERMANENT LIQUID MANURE STORAGE FACILITIES	
LIQUID MANURE STORAGE TYPE	**REQUIREMENTS**
FOR STORAGES WITH REINFORCED CONCRETE FLOORS	
concrete or steel permanent storage facilities with UNLINED FLOORS	• a minimum thickness of 0.5 metre (1.6 ft) of a hydraulically secure soil over bedrock or a permanent water table, or • a minimum thickness of 1.0 metre (3.3 ft) of a soil material with a minimum clay content of 10%
concrete or steel permanent facilities with LINED FLOORS	• a minimum thickness of 0.5 metre (1.6 ft) of a native undisturbed soil over bedrock or a permanent water table
FOR STORAGES WITH UNREINFORCED CONCRETE FLOOR	
concrete or steel permanent facilities with UNLINED FLOORS	• a minimum thickness of 1.0 metre (3.3 ft) of a hydraulically secure soil over bedrock or a permanent water table, or • a minimum thickness of 1.0 metre (3.3 ft) of a soil material with a minimum clay content of 15%
concrete or steel permanent facilities with LINED FLOORS	• a minimum thickness of 1.0 metre (3.3 ft) of a native undisturbed soil over bedrock or a permanent water table
FOR EARTHEN MANURE STORAGES earthen, lined	• a minimum of 2.0 metres (6.5 ft) of hydraulically secure soil over bedrock or a permanent water table • the interior surface must be either of the following: ○ synthetic or geosynthetic liner or equivalent ○ engineered soil liner
FOR RUNOFF STORAGES (NOT MANURE) earthen, unlined	• a maximum storage depth of 3.0 metres (10 ft) and maximum storage volume capacity of 2,500 cubic metres (88,290 ft^3) • at least 2.0 metres (6.5 ft) of hydraulically secure soil over bedrock or an aquifer between the bottom and sides of the proposed facility • at least 150 mm (6 in.) of the interior surface material that is disked and recompacted to a specification that is equal to hydraulically secure soil



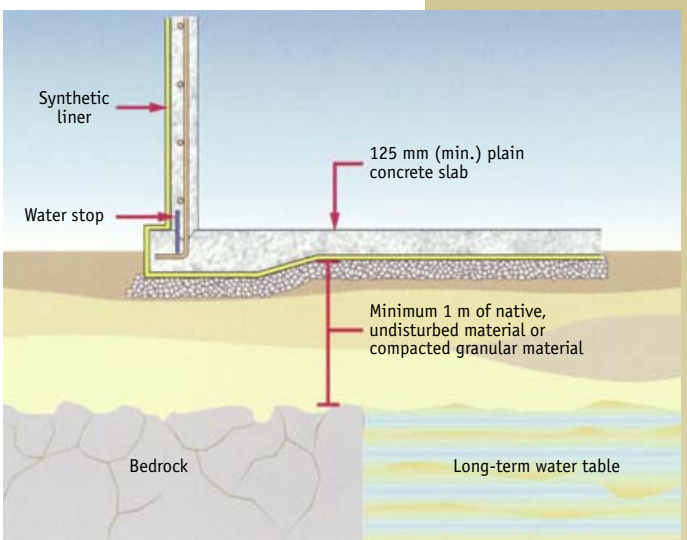
Unlined, reinforced floor



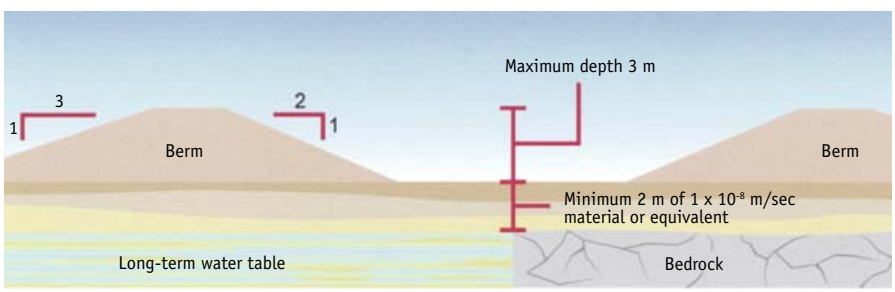
Lined, reinforced floor



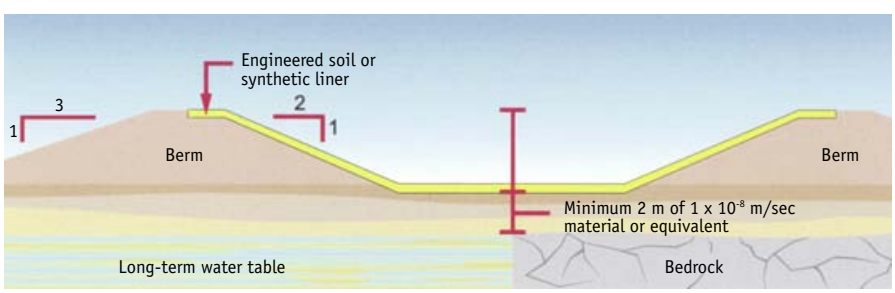
Unlined, unreinforced floor



Lined, unreinforced floor



Earthen runoff storage



Lined, earthen liquid manure storage