

October 2007

Animal Health and Welfare Branch

INFOSheet

Ministry of Agriculture, Food and
Rural Affairs
www.ontario.ca/livestock

Manure Storages for Small- to Medium-Size Horse Farms – Part A

The information contained in this information sheet was extracted from a Factsheet of the same name (Order No. 07-045) written by H.W. Fraser

Introduction

There are an estimated 325,000 horses on about 53,000 Ontario farms — an average of six horses per farm. Many horse owners do not consider the need to handle and store their manure and often view it as a waste and nuisance rather than a resource. They are afraid of introducing, or recycling, intestinal parasites and/or weed seeds by applying the manure on their pastures — a valid concern, since many horse owners pile their manure without encouraging the proper composting that would kill parasites and seeds. Improperly handled horse manure can also affect the quality of surface water and groundwater because it contains phosphorus, nitrogen and pathogens, just like other livestock manures (Figure 1).

The ideal horse manure storage should be simple yet effective, labour efficient and cost-effective. It should prevent contamination of surface water and groundwater, encourage proper composting and make the manure more useful for crop production. This information sheet (Part A) will help you understand the need for correct horse manure storage and Part B will explain how to construct an ideal horse manure storage for up to 10 horses.

Do These Problems Sound Familiar?

If you agree with some, or all, of the following statements about manure at your horse farm, consider constructing a manure storage:

- I think horse manure is more environmentally friendly than other manure types.
- I've heard about new "manure rules" in Ontario but I have no idea if they apply to me.
- I see juices running away from my horse manure. I see flies and smell odours around it.
- I'm concerned about parasites and/or weed seeds, so I don't spread manure, and my pile is growing.
- The manure broker I hire to truck my manure has to "chase" it around the yard in order to pick it up.



Figure 1. Brown water running off horse manure piles should be contained in storage so it won't reach surface water or groundwater.

Bringing the Resources of the World to Rural Ontario

- It is really tricky transporting my manure by wheelbarrow from the horse barn to the pile.
- I want to do my part to protect water quality, but I've heard constructing storages is expensive.

Let's look at how to address some of these issues with the construction of your ideal horse manure storage.

Is Horse Manure Environmentally Friendly?

NMAN is a software tool that helps farmers determine suitable nutrient application rates for current and future crops. The database contained in NMAN, a software program produced by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), inventories the manure nutrient contents of many kinds of Ontario livestock manures collected over the years.

At writing, there are almost 1,100 dairy manure samples in the NMAN database, but only 40 samples of Ontario horse manure, even though there are almost as many horses in Ontario as dairy cows.

NMAN's companion software program MSTOR uses information about livestock manure volume production to determine how much manure needs to be stored, based on the type and size of production system. Table 1 shows made-in-Ontario information about horses⁽¹⁾. A 454-kg (1,000-lb) horse produces about 2.0 tonnes (2.2 tons) of manure/year, including bedding. So, the average farm with six horses would produce a manure pile every year that would completely fill a large room, 6 m x 6 m x 2.4 m high (20 ft x 20 ft x 8 ft). Imagine how large a manure pile 325,000 horses would create !

The nutrient content of horse manure is comparable to beef manure containing bedding. Horse manure contains pathogens like other manures. So, nutrients and pathogens contained in runoff from horse manure piles could cause environmental issues if allowed to flow to surface waters via ditches or tile drains, or to groundwater via shallow bedrock or coarse soils under a manure pile.

New Rules for Manure in Ontario

There are new rules about the storage and handling of livestock manure in the *Nutrient Management Act, 2002 (NMA)*, and Ontario Regulation 267/03. See the OMAFRA website at www.ontario.ca/omafra or call the Nutrient Management Information Line at 1-866-242-4460.

The free publications listed below are available at any OMAFRA office and can be ordered through the OMAFRA website. Click on English, then the Nutrient Management button, then Livestock Sources.

- Publication 827, *A Small Horse Farm Example: Your livestock operation under the NMA, 2002*
- Publication 830, *A Riding Stable Example: Your livestock operation under the NMA, 2002*

You fall under NMA rules if:

- You currently have 300, or more, medium-sized horses housed simultaneously on your "farm unit" (uncommonly large horse farm by Ontario standards), or
- You're applying for a building permit to build a new horse barn or manure storage OR expand an existing horse barn or manure storage AND you will have more than 5 NU (e.g., 6 or more medium-sized horses) when the project is complete.

Table 1. Horse manure characteristics from the NMAN database, MSTOR program and NMA 2002 Nutrient Management Protocol (range of analyses based on asis, or wet basis, for 40 samples, May 2007).

	One Adult Horse
Weight (medium-sized horse)	454 kg (1,000 lb)
Nutrient units under the <i>Nutrient Management Act</i>	1 nutrient unit (1 NU)
Volume of solid manure & bedding produced per day	0.04 m ³ (1.42 ft ³)
Volume of solid manure & bedding produced per year	14.7 m ³ (519 ft ³)
% dry matter	23%–63% (36% average)
% N (nitrogen)	0.22%–0.9% (0.5% average)
% P (phosphorus)	0.05%–0.4% (0.15% average)
% K (potassium)	0.1%–1.0% (0.4% average)
NH ₄ -N (ppm) (fresher manure has a higher level)	10–2,800 (637 average)
Carbon/nitrogen (C:N) ratio	12:1 to 63:1 (30:1 average)
Organic matter	19%–62% (26% average)
Typical beddings used	Shavings, peat, sawdust, straw

Check with your municipality to determine if a building permit is required for your manure storage. Typically, permits are required for structures with high walls, roofs or specialized construction needs due to structural concerns (Figure 2).

The need for engineered design of the small horse manure storages described in this information sheet is waived if these storages meet all the following criteria:

- volumes less than 600 m³ (21,189 ft³)
- floor areas less than 600 m² (6458 ft²)
- wall heights 1 m (3.25 ft) or less. (Note: walls must be 1 m or less, but the manure can be stored as deep as is practical).

There are siting restrictions for storages phased-in under the NMA, but it also is a best management practice to meet, or exceed, these minimum setbacks:

- 15 m (50 ft) away from any field tile drains
- 15 m (50 ft) away from a drilled well
- 100 m (328 ft) away from a municipal well
- 30 m (100 ft) away from any other wells
- 50 m (164 ft) flowpath away from surface waters or tile inlets such as catch-basins

How Can Storage Stop Odours, Flies or Runoff?

There is no guarantee a storage will stop all odours, flies or runoff from manure, but one can help. Odours are produced from manure when conditions in the pile, such as very wet, tightly packed manure, are allowed to become *anaerobic* — decomposing in the absence of oxygen.

Aerobic conditions (when oxygen is present) produce fewer bad odours. Conditions in a pile of manure behind your barn might be aerobic near the top of the pile where water drains away from it, but anaerobic at the lower edges of the pile where the runoff water remains.

Ontario research demonstrated that runoff occurs from the sloped sides of a pile of manure⁽²⁾. The larger the pile footprint, the more perimeter with sloped sides it has and the more runoff it produces (Figure 3). Creating a deeper pile using walls to create more vertical sides promotes the soaking-in of rainfall, reducing runoff while making the pile's moisture content more uniform.

Flies need food, moisture, optimum temperatures and a place to hide in order to breed and proliferate. The conditions are perfect for this inside a damp manure pile. If the pile is dry, flies are kept to a minimum.

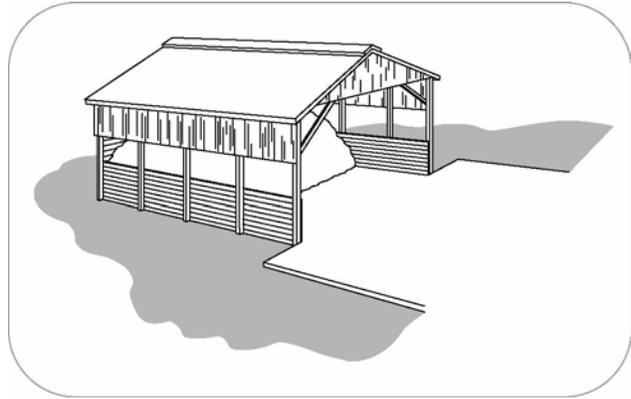


Figure 2. This *Canada Plan Service (CPS-10383)* manure storage (available at www.cps.gov.on.ca) requires a building permit since it has important structural requirements.



Figure 3. Horse manure placed directly on the soil creates large, shallow piles, which collect rainfall. The contaminated water sits at the pile base, generating odours and establishing a breeding spot for flies.

Won't Spreading Manure on my Pasture Result in Parasites and Weeds?

If your horse manure is encouraged to properly compost, temperatures in the pile will reach levels high enough to kill parasites, weed seeds and even fly larvae. Ideally, maintain a core temperature in the manure pile of 55°C (131°F) for 15 days. During composting, micro-organisms, such as bacteria and fungi, break down organic material into a stable, dark brown, soil-like material. This process requires a proper balance of carbon, nitrogen, oxygen, moisture and temperature.

Horse manure composts naturally with the mixture of carbon in the bedding, nitrogen in the manure and oxygen, as it is bulky. The ideal carbon to nitrogen (C:N) ratio is from 25:1 to 35:1, and ideal dry matter content is 40% to 60% (much like a damp sponge after the water is wrung out). The C:N ratio and dry matter content can only be known by lab analysis, however, Table 1 shows that most horse manures are close to the ideal ranges. Heat is produced during composting, but the process slows if the air is too cold.

Manure storage assists composting since the piles are more compact, especially with walls to help retain heat in winter. Walls promote uniform soaking-in of rainfall, which encourages composting. Periodic turning of the pile, where possible, introduces oxygen. This stimulates biological activity, speeds composting and raises pile temperatures. Turning is easier in a pile with a concrete floor and walls.

Why Build a Storage if I Get a Manure Broker to Take All my Manure Away?

Many horse farmers pay manure brokers to take their manure because they do not have any use for it in crop production (Figure 4). The fee is based on how difficult it is to remove the manure, how many trips are needed, and who is willing to take and use the manure. Some horse farmers get local cash croppers to remove and use their manure. In either case, storage helps reduce removal costs and make horse manure more attractive for others to use since it:

- densifies the manure — since horse manure is so light and bulky, it isn't cost-effective to transport.
- helps retain nutrients, making the manure more useful for crop production.
- makes manure removal easier, in any weather, particularly if there is a concrete floor and walls.
- makes it easier to estimate volumes for transport.



Figure 4. Horse manure on this farm is removed by a broker using large equipment and a large truck, so it is important to leave lots of room for manoeuvring.

How Can I Make it Easier to Get Manure from the Horse Barn into the Storage?

Most horse farmers use wheelbarrows to move manure from the stalls to storage. If the path is wet, bumpy or narrow, the resulting pile of manure ends up very large and too shallow (1 m deep, or less) as in Figure 3. The key is to reduce the distance you have to manoeuvre over the surface of the manure and find ways to elevate the manure more easily. You could install a fixed-in-place stable cleaner to elevate the manure, but this is expensive.

Here are some ideas to consider:

- Construct the storage so there is access from all sides at an elevated level using soil backfilled against the outside of the walls (Figure 5).
- Construct the storage into the side of a hill that is below the level of the barn (Figure 6).
- Purchase a simple portable belt conveyor that moves manure some distance and to higher levels in the storage (Figure 7).

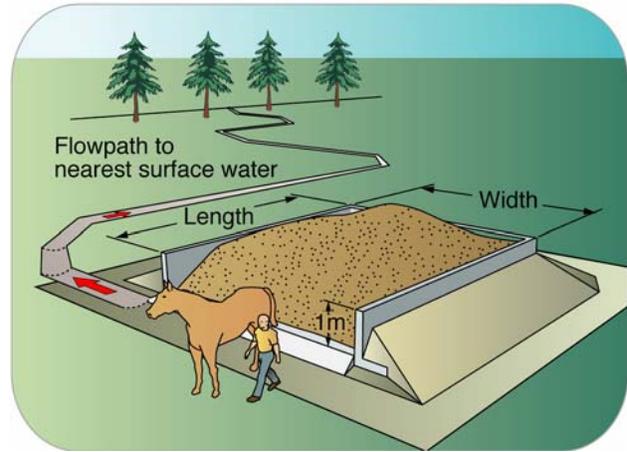


Figure 5. Backfill against the outside walls extending near the top can double as a wheelbarrow ramp, if the slope is not too great.



Figure 6. Storage in the side of a hill makes it easy to dump wheelbarrows. Install safety stops at the top edge.

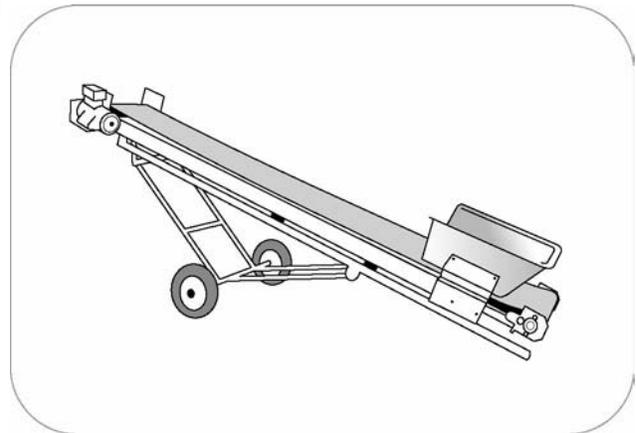


Figure 7. Belt conveyors are expensive but will save lots of labour and storage costs by making it easier to stack manure higher and in all areas of the storage.

Part B of *Manure Storages for Small-to Medium-Size Horse Farms* will explain how to construct an ideal horse manure storage for up to 10 horses.

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