Factsheet

#23-077 | NOVEMBER 2023

replaces OMAFRA Factsheet #09-027 of the same name

Nutrient Management Act, 2002

Disposal Vessels for On-Farm Deadstock

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Under Ontario Regulation 106/09 of the *Nutrient Management Act, 2002*, disposal vessels are one of the permitted options for the disposal of dead farm animals (deadstock). This factsheet describes what disposal vessels are and how to install, operate and decommission them. This factsheet does not cover all requirements contained in the regulation. Consult the regulation to determine all requirements.

WHAT IS A DISPOSAL VESSEL?

A disposal vessel is a scavenger-proof, leak-proof container installed under, partially, or above ground, into which deadstock are placed to decompose. Figure 1 shows a steel disposal vessel used in a 5-year research trial at an Ontario sheep farm.

Disposal vessels allow year-round burial. Decomposition occurs in a variety of ways:

- aerobic and anaerobic breakdown by micro-organisms
- consumption by insects such as blow flies
- evaporation of water
- release of gases such as carbon dioxide

Disposal vessels — also known as disposal units, burial pits, dead pits and mortality pits — were used in the past in North America for dead poultry.

Figure 1. Steel disposal vessel showing open hatch for placing farm deadstock like sheep.

The former Canada Plan Service described them as "aerobic disposal with limited air pollution." However, these disposal vessels had no bottoms, allowing leachate released during decomposition to drain downward with little regard for groundwater quality. In soils with aquifers close to ground level, groundwater was also able to rise into the vessel, then back out again — clearly an undesirable situation. Localized groundwater problems were reported in literature (Ritter et al., 1988, and Ritter et al., 1995). However, Ontario on-farm research (Fraser, 2009) demonstrated that water-tight disposal vessels will work under the right installation methods and give an assurance that water quality is maintained.

Figure 2. Contents of a disposal vessel for dead sheep. **Figure 2A.** Freshly placed deadstock, F**igure 2B.** Prolific maggot activity in summer, **Figure 2C.** Flat crust after considerable decomposition has occurred and no more deadstock have been placed for a long time.

HOW AND WHY DISPOSAL VESSELS WORK

There are many things that happen when deadstock is placed in a disposal vessel. Deadstock flesh is opened by insects, exposing it to micro-organisms. Decomposition occurs aerobically on top of the pile but also anaerobically to the material buried under other deadstock. Air temperatures in the vessel will fluctuate over the day, the season and when deadstock is added. The rate of water evaporation and release of gases fluctuates. Although the mass of deadstock placed in a vessel can be measured, it is difficult to measure how much mass exits the system through evaporation of water, movement of insects and micro-organisms, and exchange of gases.

Carcass decomposition is faster during warm weather than cold. However, if vessels are installed mostly underground, decomposition continues during the cool fall or early spring because air temperatures inside the vessel remain high enough (usually above freezing) throughout the year.

Figure 2 shows what happens inside a disposal vessel over time. Figure 2a shows virtually no decomposition of recently placed deadstock. Figure 2b shows prolific maggot activity occurring some time later, particularly during hot summer weather. Figure 2c shows a tough, flat, mat-like crust, which results after considerable decomposition has occurred and no more deadstock have been added for some time. Snow was sprinkled on the pile for this picture for visual effect.

ADVANTAGES OF DISPOSAL VESSELS

The advantages of disposal vessels include:

- acceptable when few other viable options exist
- simple and practical to use
- environmentally friendly if done in accordance with the regulation
- relatively inexpensive to install and operate
- good for biosecurity, by keeping deadstock on farm

DISADVANTAGES OF DISPOSAL VESSELS

The disadvantages of disposal vessels include:

- impractical to empty when full, so vessels must be decommissioned as required in regulation
- sometimes challenging to site properly with respect to water table/bedrock as required in the regulation
- difficult to fill and to decommission when installed mostly above ground
- inclined to “float like a boat” if not installed properly
- sometimes complex to install — installing disposal vessels deeper than 1.2 m (4 ft) requires taking certain precautions

SUITABLE DEADSTOCK

Disposal vessels will work with any type or size of deadstock, but they make more sense for operations with dead farm animals that individually weigh up to about 75 kg in size, such as sheep, goats, poultry, smaller swine, calves and fur-bearing animals. The smaller carcass size allows these animals to decompose quickly.

Feathers do not decompose quickly, so avoid disposing of poultry in a disposal vessel. One of the other allowable disposal options for poultry, such as composting or storing them in a large chest freezer for periodic pick-up by a licensed deadstock collector, might be more practical and cost effective.

Disposal vessels also make more sense for operations with a maximum of approximately 65 kg of deadstock per week to manage. Biological activity fluctuates

in a vessel, but adding too many deadstock at once can overwhelm the system, slow decomposition and cause odours. For example, this could occur if large volumes of fur-bearing deadstock were disposed of all at once in a vessel, after fall pelt harvest.

Research (Fraser, 2009) demonstrated that a 10-m^3 (353 ft^3) disposal vessel (maximum size allowable under the regulation) will ultimately hold at least 14,400 kg (31,680 lb) when deadstock are added at a reasonable rate, allowing ample time for decomposition to occur. In the research project, this rate was about 65 kg/week (143 lb/week). At this rate, it would take over 4 yr to fill a 10-m^3 disposal vessel. If the weight of deadstock is expected to exceed 65 kg/week, consider either using more than one disposal vessel, filling them concurrently, or other disposal options, such as pick-up by a licensed deadstock collector.

Livestock operations such as sheep or goat farms have few viable deadstock options (Figure 3):

- Licensed deadstock collectors rarely want to collect sheep or goats for economic reasons.
- Burying in winter is impossible because of frost in most areas or because the operation is located on soil that is shallow to bedrock.
- Composting does not generate high enough temperatures to destroy proteins responsible for scrapie, a fatal brain disease. Producers do not want to spread the resulting compost on fields because of the possible spread of this disease.
- Incineration is more difficult because of the wool in sheep, and it is a very costly option.

Figure 3. Disposal vessels are particularly suited for sheep (or goat) farms, which have fewer viable deadstock disposal options than other livestock operations.

INSTALLING DISPOSAL VESSELS

The options for installing disposal vessels (Figure 4) are:

- above the ground on a supporting structure
- on the ground, or slightly below ground
- partially, or fully below ground

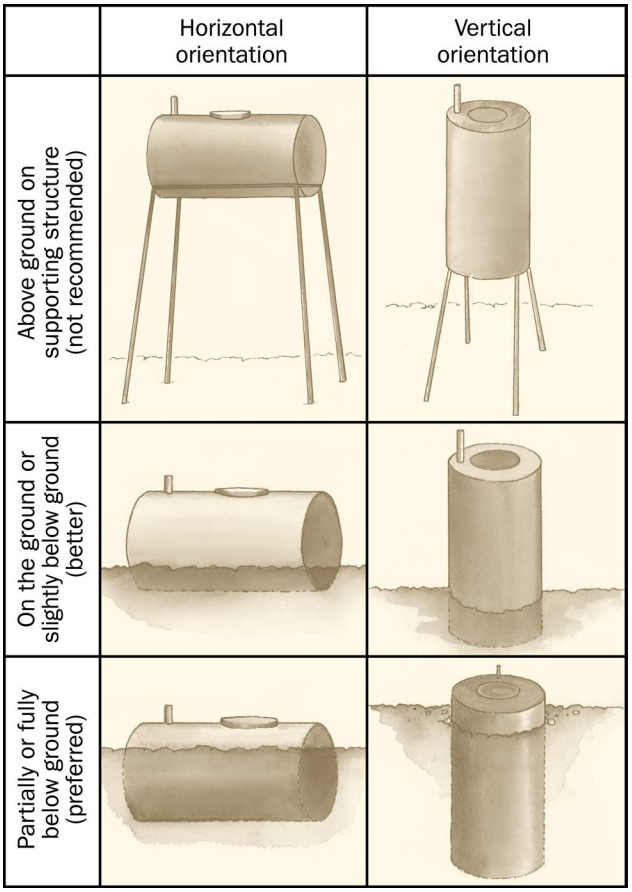

Figure 4. Of the three options for installing disposal vessels, installing them partially or fully below ground is preferred. Installing a disposal vessel above ground on a supporting structure is not recommended.

Installing a disposal vessel above the ground on a supporting structure is not recommended for the following reasons:

- The vessel requires a supporting structure specifically designed to withstand the full and possibly unbalanced weight of materials inside.
- Above-ground installation would be costly.
- Placing deadstock inside an above-ground vessel is difficult and hazardous.
- Decommissioning above-ground vessels is time consuming and possibly hazardous.

Installing a disposal vessel on the ground or slightly below ground is better and may be the only viable option if there is shallow bedrock or aquifer in the area. The regulation requires the lowest point of a disposal vessel that is partially or fully below ground to be at least 0.9 m (3 ft) above the top of the uppermost identified bedrock layer or aquifer, unless the disposal vessel is placed on an impervious pad.

However, the further out of the ground a disposal vessel is, the more difficult it is to place deadstock inside and the more difficult it is to decommission. If possible, place at least part of the vessel below ground to help anchor it.

Installing a disposal vessel partially or fully in the ground is preferred for the following reasons:

- Lifting deadstock into the vessel is easier, especially if the access hatch is about 0.6 m (2 ft) above ground. Hatches more than 1.2 m (4 ft) above ground are not recommended.
- Heat from the surrounding soil keeps the vessel warmer in winter, which aids in the decomposition.
- Decommissioning the vessel is easier and less costly because it is already mostly underground.

Place a flag near below-grade disposal vessels to warn people they are there. Be sure to take into account the possible depth of snow around the vessel in winter.

Figure 5. This newly installed, horizontally oriented disposal vessel, made of recycled plastic by an Ontario manufacturer, is easy to transport and install. Two holes facilitate uniform filling. Sandy soil has been added around the vessel for larvae to find a convenient place to pupate.

DISPOSAL VESSEL MATERIAL

Disposal vessels can be made from steel, concrete, plastic, fibreglass or other materials (Figure 5). They must be designed for external soil pressures when installed below grade, internal carcass pressures when installed above grade, or both. Other than the duct, vessels must be impervious and leakproof when the hatch is closed to comply with the new regulation.

Purchasing new disposal vessels, regardless of material type, could be cost-prohibitive. Normally, producers will obtain previously used vessels, such as cylindrical steel fuel tanks, for this purpose, provided they are thoroughly emptied and cleaned of residual fuels because of the environmental risk and safety concerns of fire and/or explosion.

It is important that once a disposal vessel is installed, it be filled to capacity and decommissioned properly because a partially filled underground vessel could deteriorate and cave in over time, posing a safety risk. Over time, the vessel contents become a mass of bones and organic materials no different than if many deadstock were simply buried in the soil at one time.

Where possible, plan the vessel size to correspond with your projected disposal needs over a few years, remembering that the regulation requires the interior volume of a vessel to not exceed 10 m^3 (353 ft^3).

SITING

Disposal vessels do generate some odours and flies when in use. They represent a potential threat to surface and groundwater if they leak or overflow. To minimize potential nuisance complaints from neighbours and any potential threat to water quality, select the proper setbacks when locating a vessel. Table 1 shows the setbacks for disposal vessels required by the regulation.

Table 1. Minimum Setbacks to Features Required Under the Regulation

Feature	Setback
Highway	30 m
Lot line of land on which vessel is located	15 m
Flow path to the top of the bank of the nearest surface water or tile inlet	100 m
Field drainage tile	15 m
Lot line of land with an industrial or parkland use	100 m
Lot line of land in a residential area, or from land with a commercial, community or institutional use	200 m
Municipal well	250 m
Drilled well with depth of at least 15 m and watertight casing to depth of at least 6 m	50 m
Any other well (such as a gas well)	100 m
Livestock housing facility, outdoor confinement area and residential structure (neighbour's house) located on land not part of the land on which the disposal vessel is located	100 m
Another disposal vessel on the same parcel of land	15 m
Areas subject to flooding every 100 years	Not allowed
Organic soil or hydrologic soil group AA and/or A	Allowed

ORIENTATION

Ontario on-farm research has compared the advantages of vertical vs. horizontal orientation of equally sized, cylinder-shaped disposal vessels (Table 2).

Table 2. Advantages for Below-Ground Vertical or Horizontal Cylinder-Shaped Disposal Vessels

Below-Grade Vertical	Below-Grade Horizontal
Deeper, therefore warmer soil, helping decomposition in colder weather	Shallower, therefore better suited to sites with shallow bedrock or aquifer
Easy to install one large hatch on flat end	Room for more, but likely smaller, access hatches along long top of vessel
Easier to fill vessel as deadstock distribute more uniformly	Less excavation = lower installation costs

ACCESS HATCH AND AIR VENT

At least one access hatch is needed, but more may be necessary on long, horizontally oriented disposal vessels to ensure the entire vessel gets filled. The hatch needn't be airtight, since loosely fitting ones encourage entry of flies and insects. Hatches 0.9 m (3 ft) square will fit 75-kg (165-lb) animals. However, large steel hatches are very heavy. Install all-weather hinges and large handles for easier opening. Lock hatches between uses (Figure 6).

Figure 6. Hatches must be large, strong, easy to open during any kind of weather and locked between uses. Note the air vent beside the hatch, which is about 10 cm x 10 cm (4 in. x 4 in.), large enough to encourage flies and beetles that scavenge on deadstock to find their way into the vessel.

The regulation requires vessels to have at least one duct that is large enough to allow flies and other insects to enter the vessel and to allow air movement in and out of the vessel. Locate this duct above the surface of the ground (and expected snow levels) so it is exposed to air at all times. Except for this duct, the vessel must be impervious and leakproof when the hatch is closed. Further, the vessel must protect the deadstock from scavengers, rodents and pests other than insects.

SIZING THE DISPOSAL VESSEL

Every deadstock has a different shape and weight. The mass of deadstock in a disposal vessel has an effective density defined as "the weight of deadstock placed over time, divided by the volume they take up in the disposal vessel over time." Because of the exodus of flies, other insects, moisture and gases, the actual weight of materials remaining in the vessel will be less than what was added, so the effective density rises over time.

Ontario research (Fraser, 2009) showed that the effective density over 4 yr rose from 640 kg/m^3 (40 lb/ft^3) to 1,600 kg/m^3 (100 lb/ft^3). Shorter filling times result in a lower effective density, while longer periods result in a higher effective density. For planning, assume a maximum effective density of 1,600 kg/m^3. Individual results may vary.

Under the regulation, individual disposal vessels can be no larger than 10 m^3 (353 ft^3 or 2,200 Imperial gallons, or 2,642 U.S. gallons). However, the top 10% of the vessel will remain unfilled due to the filling/settling process. When designing the vessel, assume only 90%, or 9 m^3, is available for receiving deadstock, and try to plan to fill it no sooner than 5 yr before decommissioning. So, 9 m^3 x 1,600 kg/m^3 = 14,400 kg to fill the vessel (31,680 lb). Assuming 5 yr to fill, this is about 55 kg/week (121 lb), which should work for a sheep herd of about 400 ewes with typical death losses.

EXCAVATING

It is beyond the scope of this factsheet to describe all the safe excavation steps for installing a disposal vessel. However, be aware that regardless of the type of material a disposal vessel is made of (even concrete), it can float like a boat under the right (or wrong) water table conditions.

O. Reg. 106/09 specifies that the bottom of the disposal vessel be at least 0.9 m (3 ft) above the top of the uppermost identified bedrock layer or aquifer. Excavate one or two test pits in the vicinity of the proposed disposal vessel site to confirm groundwater/bedrock conditions. If test pits show discoloured "mottled" subsoil, there might be a seasonal high water table, even if there is no water present in the hole during excavation.

Backfill the soil uniformly, compact it around the vessel in layers, then slope it against the vessel so surface water does not run down the outside shell of the vessel and cause the vessel to float. Keep excavated soil stockpiled nearby for eventual decommissioning.

Add sandy potting soil, or similar loose soil (not clay), in a ring at least 1 m (3.3 ft) wide and 10 cm (4 in.) deep outside and around the disposal vessel to give a place for escaping larvae to pupate. For a 2-m (6.5-ft) diameter, vertically oriented vessel, this would be at least 1 m^3 (1.3 yd^3) of soil (Figure 7).

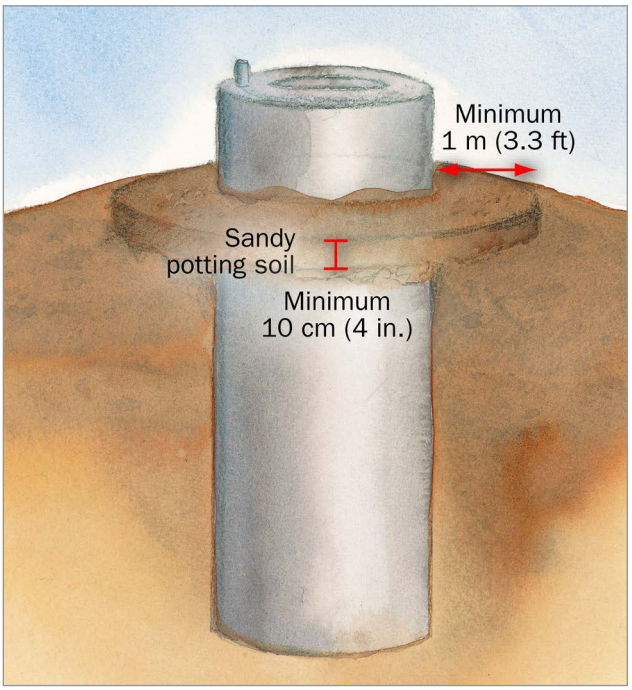

Figure 7. Drawing of a disposal vessel backfilled with soil to create a ring for pupating larvae.

FILLING

The recipe for filling the disposal vessel is simple:

1. Open the secured hatch.
2. Place deadstock inside.
3. Close and secure hatch.
4. Let natural processes proceed.

Place deadstock in a vessel carefully. Once placed, it should not be moved. NEVER ENTER A DISPOSAL VESSEL to move deadstock. Vessels are filled with noxious gases, odours, flies, maggots and beetles.

To reduce odours and keep the disposal vessel area clean:

- Keep the hatch closed and locked between uses and clean up the area after placing deadstock.
- Locate vessels at least 100 m from neighbours. Stay further away if possible. There will be strong odours within 25 m (82 ft) of vessels. Anecdotal evidence suggests that wildlife avoid going near disposal vessels, probably because the odour warns them there is something inside they should not eat.

DECOMMISSIONING

O. Reg. 106/09 states that a "disposal vessel must be promptly closed once it is no longer used for the disposal of dead farm animals."

Use as much of the originally excavated soil as possible, then open the hatch to allow filling the remainder of the vessel with soil (Figure 8). Burying the entire vessel allows its contents to continue to decompose and settle over time, while the soil settles with it. Burying also puts the vessel out of sight and makes the area safer to work nearby. Compact that soil if possible. Add another layer of at least 0.6 m (2 ft) of soil on top. Taper the soil away from the vessel steeply to:

- create a steep "hill" to help prevent tractors and other equipment from getting too close in future (barriers such as large stones would also help)
- allow for settling both into and around vessel
- help prevent any scavenging
- encourage rapid surface drainage of clean rainfall away from the disposal vessel

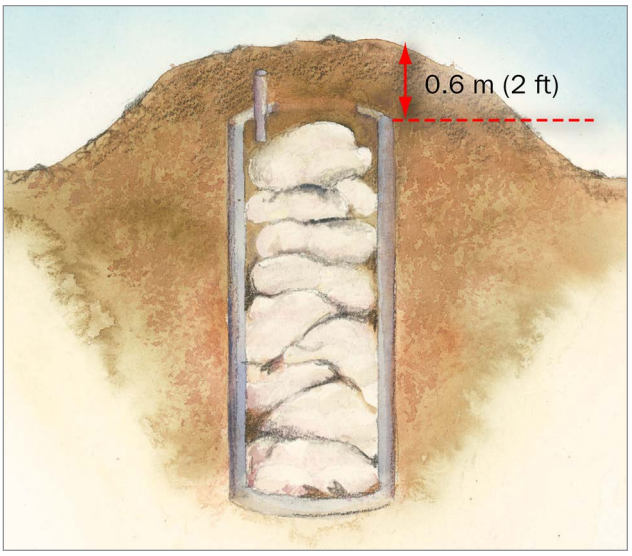

Figure 8. The purpose of decommissioning is to make the vessel no longer usable or accessible. It's also important to make the site safer.

The higher the vessel was originally installed above grade, the higher the resulting final pile, so this is one reason to install as much of the vessel below grade as possible in the first place (Figure 9). Where much of the vessel has been installed high above ground, there is unlikely to be enough soil from the original excavation, so additional soil will be needed.

Figure 9. Use the soil from excavating the hole for a new vessel to decommission a vessel that is full. An experienced excavator can do the job in a few hours, with proper planning.

Soil from excavating a hole for your next vessel could be used to decommission the current vessel, and so on. Place topsoil as a top-dressing on the decommissioned pile then plant quick-growing grasses to help stabilize the soil.

What remains after decommissioning is a mass of essentially biologically inactive organic materials not unlike cured compost, but with many bones, all inside a vessel that may deteriorate over a long period of time, depending on material.

Some people may question why the vessel contents wouldn't simply be removed, spread on the land like compost, then the disposal vessel reused.

This would be difficult, especially for vessels below ground:

- The vessel contents will be tightly packed inside and cannot be pumped or dug out.
- The vessel contents will contain a lot of bones, which will not spread particularly well.
- The vessel will be extremely heavy and virtually impossible to lift and tip over to dump the contents.
- Unless the access hatch is large, dumping contents will be like "shaking pennies out of a piggy bank."

On sheep farms, doing this runs the risk of transmitting scrapie disease.

Example: Disposal Vessel Costs

Joanne has a 100-ewe operation and anticipates about 600 kg of dead sheep annually. If she wants the vessel to last 10 years, what size would it be and what would its cost per kg be over that 10-yr period?

The vessel will eventually contain: 600 kg/yr x 10 yr = 6,000 kg

Assuming eventual effective density of 1,600 kg/m^3: 6,000 kg ÷ 1,600 kg/m^3 = 3.75 m^3 (3,750 L) volume

A used 5,000 L steel fuel tank is large enough, even if only filled 90%: 5,000 L x 90% = 4,500 L

Dimensions of a 5,000 L vessel are 1.5 m diameter by 2.7 m long (5 ft x 9 ft). Joanne has done a site investigation and verified there is no identifiable bedrock layer or aquifer within 0.9 m (3 ft) of the proposed bottom of her disposal vessel. She plans to place the vessel on its end vertically, 2.1 m below grade and 0.6 m above grade (7 ft below and 2 ft above).

The vessel costs are:

$200 to buy it from a scrap yard
$250 to truck it to the farm
$250 to modify it with access hatch and air vent
$250 to install it
$250 to decommission it

= $1,200 total life cost

The cost to own the disposal vessel* is: $1,200/6,000 kg = $0.20/kg ($0.09/lb)

* excluding labour to transport deadstock to the vessel

Additional information on the requirements of specific disposal methods is available from deadstock management of farm animals in Ontario.

RESOURCES

Ritter, W.F., A.E.M. Chirnside. 1995. *Impact of dead bird disposal pits on groundwater quality on the Delmarva Peninsula*. Bioresource Technology, 53: 105-111.

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Published by the Ontario Ministry of Agriculture, Food and Rural Affairs

ISSN 1198-712X
Également disponible en français (Fiche technique 23-078)

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