DISPOSAL VESSELS

DISPOSAL VESSELS CAN BE A GOOD DISPOSAL OPTION FOR SMALLER DEADSTOCK. THIS CHAPTER COVERS:

- **how and why they work**
- **desired depth, materials, orientation, accessibility, size**
- **considerations for excavation and decommissioning**
- **how to estimate costs.**

HOW AND WHY DISPOSAL VESSELS WORK

Disposal vessels have been used in the past for dead poultry in the United States and Canada. They are also known as disposal units, burial pits, dead pits, or mortality pits. They are scavenger-proof, leak-proof containers into which deadstock are placed to decompose naturally.

The use of disposal vessels is simple.

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

Decomposition occurs by a variety of mechanisms:

- ▶ aerobic and anaerobic breakdown by micro-organisms
- ▶ consumption by insects such as blowflies
- ▶ evaporation of water
- ▶ release of gases such as carbon dioxide.

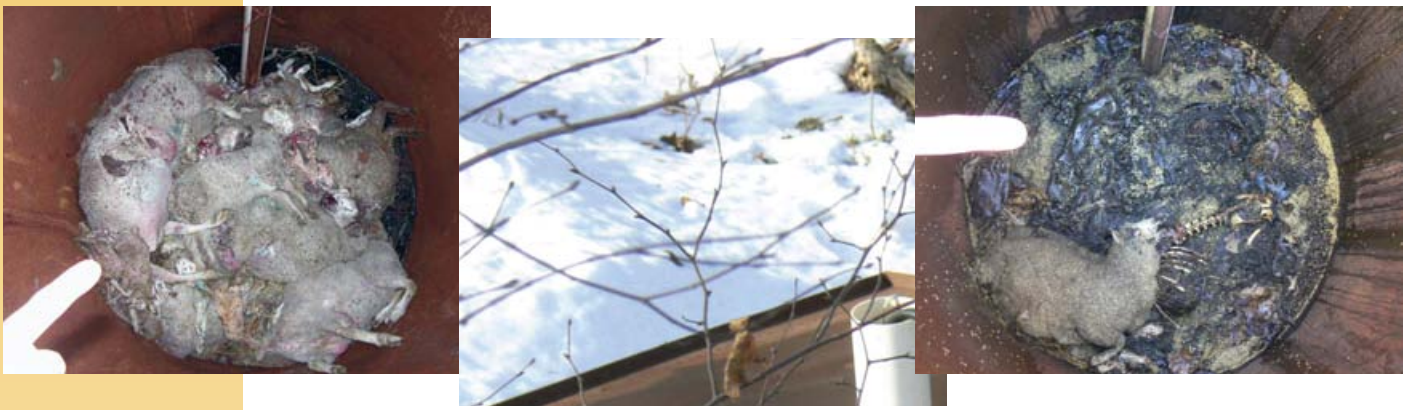
Many things happen when livestock die and are placed in a disposal vessel. Deadstock flesh is opened by insects, exposing it to micro-organisms. Decomposition occurs aerobically on top of the pile, but may also decompose anaerobically when buried by other deadstock. Air temperatures in the vessel will fluctuate over the day, the season, and when deadstock are 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 buried 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.

Options for installing disposal vessels:

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

This disposal vessel was used for a recent on-farm trial for disposal of dead sheep.



The photo series shows sequential pictures in the same vessel over a few months. In April, carcasses show little decomposition because several deadstock were added over a short period and air temperatures were cool over the winter and spring. In July, prolific maggot and insect activity occur because of higher air temperatures. In November, considerable decomposition can be seen after a summer and fall of high temperatures, with a tough mat-like crust remaining between carcasses.

Previous disposal vessels had no bottoms, allowing liquids released during decomposition to drain downward with little regard for groundwater quality. In soils with high permanent or temporary water tables, water could also rise into these former vessels – clearly an undesirable situation.

Recent Ontario on-farm research has demonstrated the effectiveness of watertight disposal vessels, offering assurance that water quality is maintained.

ADVANTAGES AND DISADVANTAGES OF DISPOSAL VESSELS

ADVANTAGES	DISADVANTAGES
• provide disposal option where few options exist (sheep)	• impractical to empty when full, so vessels must be decommissioned
• simple and practical to use	• require proper siting with respect to water table/bedrock
• environmentally friendly, if done according to the new regulation	• can be difficult to lift deadstock into
• use readily available materials and equipment	• can be more difficult to decommission when installed mostly above ground
• relatively inexpensive to install and operate	• can "float like a boat" if not installed properly
• keep deadstock on farm – promoting biosecurity	• require precautions during installation – especially when installing disposal vessels deeper than 1.2 m (4 ft)

SUITABLE DEADSTOCK FOR DISPOSAL VESSELS

Disposal vessels will work with any type or size of deadstock, but they make more sense for operations with deadstock that **individually weigh up to about 75 kg (165 lb)** such as: sheep, goats, poultry, smaller swine, calves and furbearing animals. The smaller carcass size allows them to decompose quickly. Feathers do not decompose quickly so it is not recommended to dispose of poultry in a disposal vessel. It might be more practical and cost-effective to use one of the other allowable disposal options for poultry, such as storing them in a large chest freezer for periodic pickup by a licensed deadstock collector, or composting.

Disposal vessels also make more sense for **operations with no more than about 70 kg (154 lb) 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 furbearing deadstock after fall pelt harvest were disposed of all at once in a vessel. Research shows a 10 cubic metre (353 ft^3) disposal vessel (maximum size allowable under the new regulation) will ultimately hold up to about 15,000 kg (33,000 lbs). Assuming this disposal vessel was filled over a four-year period, this requires an average of about 70 kg (154 lb) per week. Operations with more than this amount of weekly deadstock might consider more cost-effective options such as pickup by a licensed deadstock collector where that service is available.

Some operations have few viable deadstock options, such as sheep or goat farms:

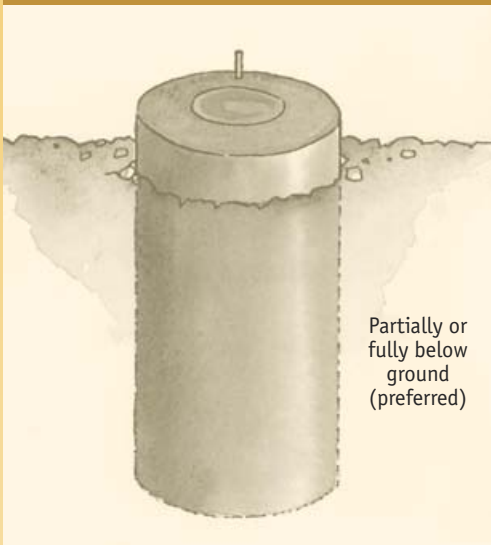
- **licensed deadstock collection** may be cost-prohibitive, and unavailable in some areas
- **burying** in winter is impossible because of frost in most areas and many operations are located on soils that are shallow to bedrock
- **composting** does not generate high enough temperatures to destroy proteins responsible for scrapie, a fatal brain disease in sheep – producers do not want to spread the resulting compost on their fields due to fear of possible spread of this disease
- **incineration** is more difficult because of the wool in sheep, and it is a very costly option.

INSTALLING DISPOSAL VESSELS

You have three options for installing disposal vessels: above the ground on a supporting structure; on the ground or slightly below ground; or partially or fully below ground.

Installing a disposal vessel **above the ground** on a supporting structure is **not recommended** for several reasons. The supporting structure would need designing to withstand the weight of materials inside when it becomes full and ready for decommissioning. The vessel itself may not be designed for the possible unbalanced weight of the decomposing and decomposed materials inside. Also, it would be costly, difficult and hazardous to place deadstock inside, and decommissioning would be time-consuming, costly and possibly hazardous.

VERTICAL ORIENTATION



Installing a disposal vessel **on the ground or slightly below ground** is better and may be the only viable option if there is a shallow bedrock or aquifer issue. The new 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 farther 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, placing at least part of the vessel below ground will assist in anchoring it.

Installing a disposal vessel **partially or fully below ground** is preferred for several reasons. It's easier to lift deadstock into the vessel, especially if you place it so 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. It keeps the vessel warmer in winter because of heat from the surrounding soil, aiding in the decomposition. It's easier and less costly to decommission the vessel because it's already mostly underground.

For safety reasons, it's a good idea to place a flag near a below-grade disposal vessel to warn people it is there. Be sure to take into account the possible depth of snow around the vessel in winter.

DISPOSAL VESSEL MATERIAL

Disposal vessels can be made from steel, concrete, plastic, or fibreglass, as long as they are designed for external soil pressures when installed below grade, or for internal pressures from the deadstock when installed above grade.

Purchasing new disposal vessels, regardless of material type, could be cost-prohibitive. However, used vessels, such as cylindrical steel fuel tanks could be used, provided they are **thoroughly emptied and cleaned of residual fuels** because of the environmental risk and safety concerns of fire and/or explosion. Steel vessels might even be preferred since they will deteriorate long after the disposal vessel has been filled and its contents have long since decomposed and become a mass of essentially biologically inactive organic materials.

It's important that once a disposal vessel is installed, it be filled to capacity and decommissioned properly, because a partially filled underground steel tank will cave in over time through rusting and could pose a safety risk. However, properly filled with deadstock and properly decommissioned, this should pose little safety risk. Over time, the vessel contents are little different than if several deadstock were simply buried in the soil at one time.

Where possible, plan the vessel size to correspond with needs over a few years, remembering the regulation states the interior volume of a vessel must not exceed 10 cubic metres (353 ft^3). Inspect above-ground vessels yearly for signs of corrosion or damage, and take corrective action.

DISPOSAL VESSEL ORIENTATION

Recent and continuing Ontario on-farm research has compared vertical (like standing a pop can on end) versus horizontal orientation (like lying a pop can on its side) of equally sized, cylindrical disposal vessels.

COMPARATIVE ADVANTAGES

BELOW-GRADE, VERTICALLY ORIENTED VESSELS	BELOW-GRADE, HORIZONTALLY ORIENTED VESSELS
• deeper, so soil is warmer, assisting decomposition in colder weather	• shallower, so fewer bedrock or groundwater concerns
• easy to install hatches on flat end	• can install more hatches
• easier to fill vessel as deadstock distribute more uniformly	• lower installation costs, as less excavation required

ACCESS HATCHES AND AIR VENTS

Access hatches don't need to be airtight, since loosely fitting ones encourage entry of flies and insects. However, hatches need to be large enough to manoeuvre awkwardly shaped, large, bloated, or rigored deadstock.

More than one hatch may be necessary on long, horizontally oriented disposal vessels to ensure the entire vessel gets filled. Hatches 0.9 metres (3 ft) square are large enough for 75 kg (165 lb) deadstock. However, large steel hatches are very heavy.

Simple all-weather hinges should be installed and hatches should have large handles – allowing them to open easily and widely. For safety reasons, hatches should be locked between uses.

Disposal vessels should have at least one air vent or duct large enough to allow flies and other insects to enter and to allow air movement in and out of the vessel. In field tests, a 10 × 10 cm (4 × 4 in.) duct was found to be sufficient. Make sure the duct is above the surface of the ground and above expected snow levels. Except for this duct, the vessel must be impervious and leakproof when the hatch is closed.

Hatches do not need to be elaborate, but must be large, strong, easy to open during any kind of weather, and locked between uses. Air vents on top only need to have openings large enough to encourage flies that scavenge on deadstock to find their way into the vessel.

SIZING OF DISPOSAL VESSELS

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 mass of decomposed deadstock becomes denser over time. Ontario research showed the effective density over four years rose from 640 kg/m^3 to 1,600 kg/m^3 (40–100 lbs/ft^3).

Shorter filling times will result in a lower effective density; longer periods will result in a higher effective density. For planning purposes, use 1,600 kg/m^3. Individual results may vary.

In Ontario, Regulation 106/09 under the Nutrient Management Act, 2002: Disposal of Dead Farm Animals states that individual disposal vessels can be no larger than 10 m^3 (10,000 litres, 353 ft^3).

Ontario research has demonstrated that the top remaining 10% of the vessel will be unusable – so that only 90%, or 9 m^3, is available. If we assume the disposal vessel is planned to be filled over a five-year period with an eventual effective density reaching 1,600 kg/m^3, this means that this size of vessel will hold up to: **9 m^3 × 1,600 kg/m^3 = 14,400 kg of deadstock**. This is about 55 kg (120 lb) per week over the five-year period.

BEFORE EXCAVATING

Regardless of the type of material a disposal vessel is made of (even concrete), it can float like a boat under certain water table conditions – or when surface water is allowed to run into disturbed soil outside a vessel perimeter.

The regulation specifies that the bottom of the vessel must be at least 0.9 m (3 ft) above the uppermost identified aquifer or bedrock layer. Excavating one or two test pits in the vicinity of the proposed disposal vessel site is a good idea to confirm aquifer or bedrock layer. Test pits can show if there are rust spots (mottles) and grey (gley) colours in the subsoil, indicating there might be a seasonal high water table, even if there is no water present in the hole during excavation. Even so, be absolutely certain that high water table problems will not occur before excavating the hole or after the vessel is installed.

Soil must be uniformly backfilled and compacted around the vessel in layers, then sloped against the vessel to shed surface water. Otherwise, surface water could run down the outside of the vessel and still create a floating problem. Keep excavated soil nearby for future decommissioning.

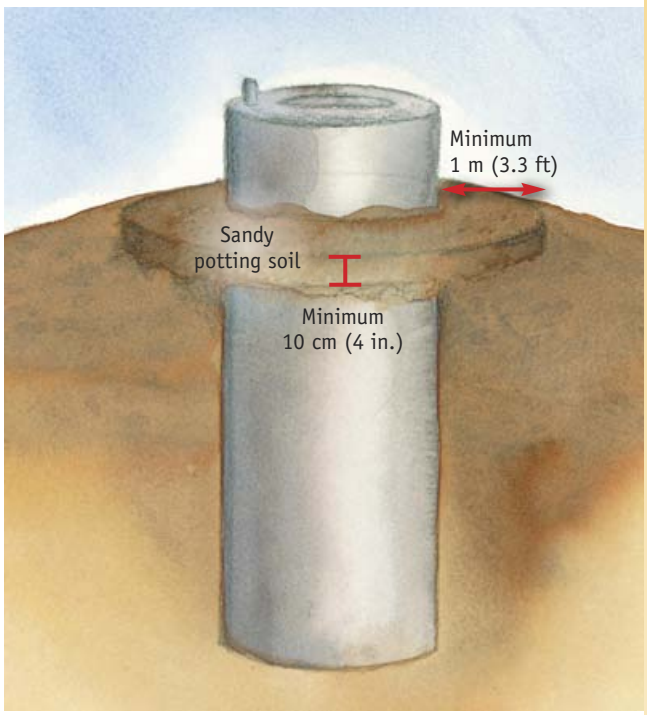
It is beyond the scope of this book to describe all the steps for safe excavation to install a disposal vessel. Several site suitability criteria are listed in Ontario Regulation 106/09 made under the Nutrient Management Act, 2002: Disposal of Dead Farm Animals. Information is included on dealing with soil type, water table and bedrock depths, setbacks to neighbours, wells, and more.

FILLING THE DISPOSAL VESSEL

Although it may seem easy to put deadstock into a disposal vessel, it should be placed with care – because once it is placed, it should not be moved.

For safety reasons, you should never go inside the vessel to move deadstock. You wouldn't want to anyway because of the odours, flies, maggots, and noxious gases. Where possible, do not install the vessel higher than 1.2 m (4 ft) above grade since this makes it difficult to lift deadstock into it. Avoid ladders and steps, and use good lifting techniques. At times it will not be a pretty sight inside a disposal vessel, especially during hot weather when deadstock are added. It is unavoidable to have some larvae find their way out of the vessel, wriggling away as they prepare to find a place to pupate.

- Keep the hatch closed and locked between uses and keep the surrounding area clean, picking up materials if they fall off deadstock.
- Backfill the vessel with a small amount of sandy potting soil, or similar loose soil (not clay) in a ring outside and around the vessel giving a place for larvae to pupate. Make this pupating area at least 1 m (3.3 ft) wide and at least 10 cm (4 in.) deep. For a 10 m^3 (353 ft^3) vessel with a diameter of 2 m (6.5 ft), this would be at least 1 m^3 (35 ft^3) of sand.
- Locate vessels at least 100 m (328 ft) from residences, according to the regulation. Stay farther away if possible. There will be strong odours within 25 m (82 ft) of vessels. Anecdotal evidence suggests most wildlife avoid going near disposal vessels.



Backfilling with sandy potting soil at depth of about 10 cm (4 in.) and in a ring 1 m wide (3 ft) outside and around a disposal vessel gives a place for larvae to pupate.

DECOMMISSIONING

Under the new Ontario regulation, "A disposal vessel must be promptly closed once it is no longer used for the disposal of dead farm animals."

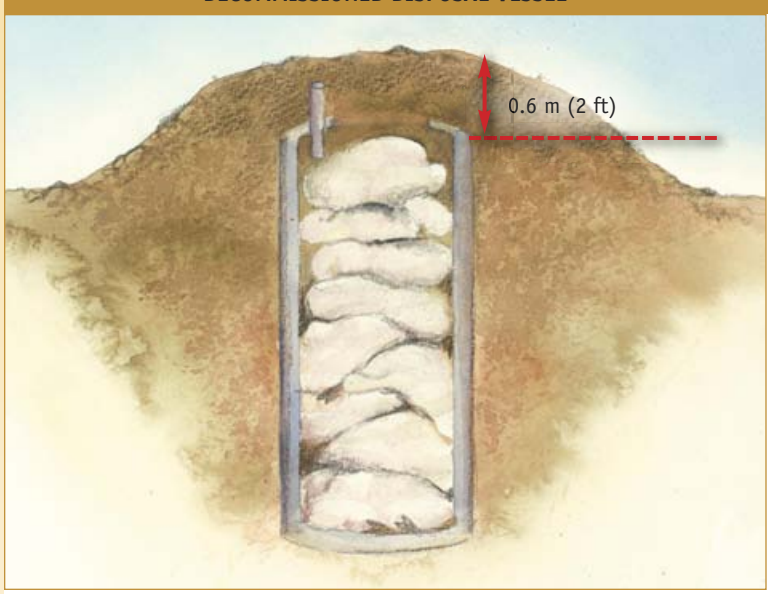
The purpose of closing a disposal vessel is to render it no longer usable or accessible. It's also important to make the site safer. One way to do this is to:

1. Open the hatch to allow access for filling the remainder of the vessel with soil, then compact that soil where possible.
2. Add another layer of at least 0.6 m (2 ft) soil on top.
3. Taper the soil away from the vessel no steeper than 2:1 (2 m horizontally for every 1 m vertically).

This may seem quite steep, but the purpose of the soil is 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
- keep the vessel out of sight
- encourage rapid surface drainage of clean rainfall away from the disposal vessel.

DECOMMISSIONED DISPOSAL VESSEL



The purpose of closing a disposal vessel is to make it 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. **Regardless, there is unlikely to be enough extra soil from the original excavation, so additional soil will be needed.** Soil from vessel 2 could be used to decommission vessel 1; soil from vessel 3 could be used to decommission vessel 2, and so on.

Depending on time of year, place topsoil as a top-dressing on the decommissioned pile, then plant quick-growing grasses to help stabilize the soil.

Bright flagging should be installed to warn people about the decommissioned vessel location. Obviously it's simpler to decommission a disposal vessel that was originally more below than above ground.

What remains in the ground is a mass of essentially biological inactive materials not unlike well-cured compost with scattered bones – all inside a vessel that may deteriorate over a long period of time, depending on material.

ESTIMATING THE COST OF A DISPOSAL VESSEL

Joanne has a 100-ewe operation and anticipates about 600 kg of dead sheep annually. She'd like the vessel to last 10 years, so it must eventually contain 6,000 kg of dead sheep.

Assuming the eventual effective density is 1,600 kg/m^3, this means the vessel must be at least 6,000 kg ÷ 1,600 kg/m^3 = 3.75 m^3 (3,750 L) in volume.

She can purchase a strong used 5,000-L steel fuel tank which should be large enough, considering it can only be filled to 90% of its volume (4,500 L). The vessel dimensions are 1.5 m diameter by 2.7 m long. She will ensure it has been cleaned of residual fuels.

Joanne has done a site investigation and verified there is no identifiable bedrock layer or aquifer within 0.9 m of the proposed bottom of her disposal vessel. She plans to install the vessel vertically, with 2.1 m of the tank below grade and 0.6 m of the tank above grade. The 1.5 m diameter should give room to install a 0.9 × 0.9 m hatch.

The used vessel will cost $200 from a scrap yard, $250 to truck it to her farm, $250 to modify it with an access hatch and air vent, $250 to install it, and $250 to decommission it, for a total life cost of $1,200.

So if the ultimate weight of sheep that can be placed in the disposal vessel is 6,000 kg (possibly more), then the cost of disposal is about $0.20/kg ($0.09/lb), not including labour to transport and fill the disposal vessel.