PRINCIPLES

THIS CHAPTER INTRODUCES BASIC SCIENTIFIC PRINCIPLES CONCERNING THE DECOMPOSITION PROCESS, AND ITS IMPLICATIONS FOR THE ENVIRONMENT. WE WILL LOOK AT EACH OF THE MAJOR DISPOSAL METHODS IN THIS LIGHT, INCLUDING:

- **burial**
- **disposal vessels**
- **composting**
- **incineration**
- **rendering.**

It's important to understand some of the processes that pose risks related to on-farm deadstock. Knowing what can happen and why will help you manage risk and make better choices among options. It will help you appreciate why some practices are poor, and understand the rationale for BMP options described in detail further on.

Animals die due to predation, injury, illness and, in some cases, old age. Irrespective of the cause, it is important to be prepared and act quickly to reduce the risk of spreading disease, predation by scavengers, and environmental contamination.

DECOMPOSITION

EARLY DEGRADATION

- Muscle decay (aerobic)
- Putrefaction of organs (anaerobic)
- Leakage of body fluids
- Bloating
- Carcass <10% volume loss

MIDDLE STAGES OF DEGRADATION

- Decay of skin, hair
- Putrefaction of fat, cartilage
- Reduction in fluid loss
- Carcass <50% volume loss

LATTER DEGRADATION

- Decay of bones, horns, hooves
- No fluid loss

Soft tissues degrade first, releasing bodily fluids. Nutrients and pathogens in the fluids can attract predators and also pose the greatest risk of water contamination.

ANIMAL CARCASS DECOMPOSITION – THE FIRST STAGES

Decomposition of the carcass starts at the time of death. The rate of degradation is strongly influenced by biological and environmental factors.

Soft tissue is degraded by the processes of putrefaction (anaerobic degradation) and decay (aerobic degradation). Putrefaction results in the gradual dissolution of tissues into gases, liquids, and salts as a result of the actions of bacteria and enzymes. The putrefaction process emits odours and attracts scavengers.

A carcass is degraded by micro-organisms both from within (e.g., inside the gastrointestinal tract) and from outside, meaning the surrounding atmosphere or soil.

Generally body fluids and soft tissues other than fat (i.e., brain, liver, kidney, muscle and muscular organs) degrade first, followed by fats, then skin, cartilage and hair or feathers, with bones, horns, and hooves degrading slowest.

A deadstock is an ecosystem of its own in which various fauna arrive and depart from the corpse at different times. In warm weather, maggots can consume 60% of a carcass in less than a week.

Many kinds of organisms live by feeding on deadstock. Their activities result in the decomposition of the carcass and the recycling of nutrients. The groups of organisms involved in decomposition are bacteria, flies, beetles, mites and moths. Other insects, mainly parasitoid wasps, predatory beetles and predatory flies, feed on the organisms that feed on the corpse.

Nutrients and possible pathogens living within the leached body fluids may pose risks to surface water and groundwater, and promote the spread of disease and predation. This is why special precautions are necessary when handling deadstock before proper disposal.

DECOMPOSITION OF EXPOSED CARCASSES – KEY LIFE FORMS AT EACH STAGE

Bloat begins within 48 hours of death. Cell breakdown will accompany this bloating stage. Decay involving anaerobic bacteria can be subdivided into early, mid and advanced decay. Each stage of decomposition will have specific insects involved, starting with flies, then beetles and finally moths.

The blowflies are the first to arrive and lay eggs. Then come the houseflies and fleshflies. Flies will lay eggs in the body openings and at wound sites if they are exposed and environmental conditions are suitable for fly activity. Maggots will consume the flesh and spread bacteria throughout the carcass.

Now beetles come into the picture, where they feed both on the maggots and the flesh. The remaining dried flesh, skin and tendons will be consumed by certain families of beetles and Tineid moths.

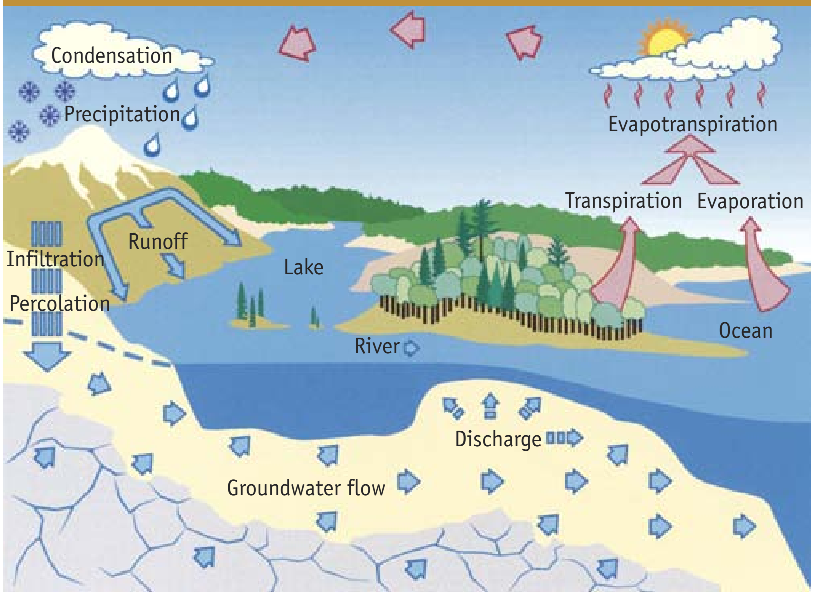
The decay process will depend on the environment, and may not occur at all if flies are excluded from the site.

Farm operations are part of the overall water cycle. They have an impact on the quantity and quality of both surface water and groundwater.

RISKS TO WATER QUALITY

Water is a universal carrier and its properties enable it to dissolve many substances and carry them with its flow. Pollutants can be carried with water through all phases of the water cycle.

THE WATER CYCLE



Water is in constant motion, continually recycling through the environment in a series of pathways called the water cycle. Precipitation, mostly in the form of rain or snow, falls on land, buildings and bodies of water. Precipitation can be temporarily stored in ponds, lakes and rivers, held by snow and vegetation, or stored as ice and snow.

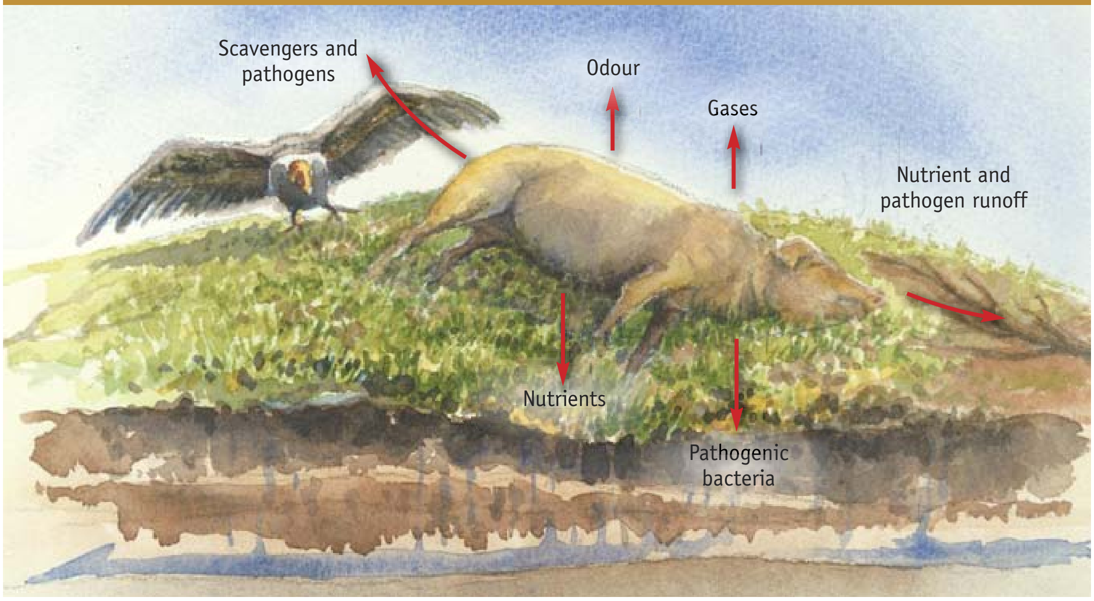
Some of the water falling on land and buildings flows overland as runoff to bodies of surface water (e.g., lakes and rivers). Some of the water that is held by soil or vegetation will infiltrate soil materials, to be stored as groundwater. Groundwater can then move to lakes, rivers, ponds, wetlands, wells, or to the soil surface. Groundwater flowing to the surface, or small surface-water bodies, form part of a larger surface-water system called a watershed. At the soil surface, water can be evaporated directly to the atmosphere, or transpired (evapotranspiration) when plants release moisture during rapid growth.

The amount of water in the soil under or near any disposal site depends on soil characteristics (properties and quality), length and degree of slope, temperature and weather conditions, and the condition of the soil or yard area near the deadstock disposal site.

The decomposition of deadstock releases pathogens, nutrients (in both mineral and organic form) and gases. If not controlled, these can be potential pollutants. They can move into surface water by being attached to sediment eroded from agricultural land, or dissolved in runoff. They can also infiltrate soil to contaminate groundwater.

Pathways to surface water and groundwater have to be identified and controlled. This is done by establishing physical barriers. Soil can be considered a physical barrier if conditions are right.

WATER CONTAMINATION



Improperly disposed deadstock can be a source of water contamination and greenhouse gases. Nutrients, organic debris, and pathogens can leach to groundwater or run off to surface waters. Exposed deadstock are a source of odours and greenhouse gases as they decompose.

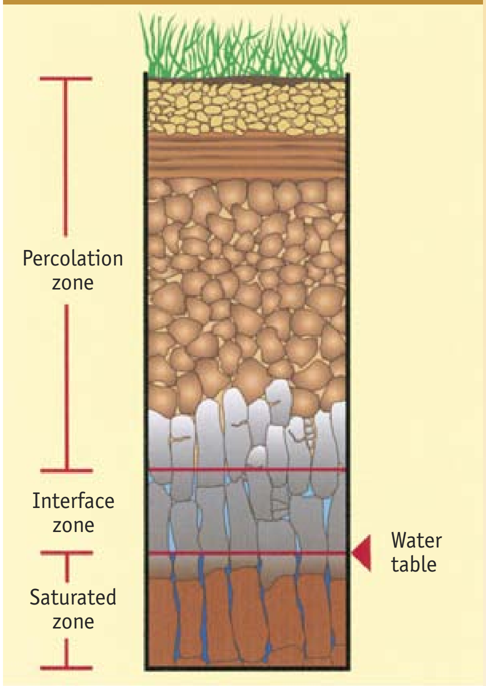
RISKS TO SURFACE WATER

When water falls on a bare soil in late spring, the majority evaporates. One-quarter runs off to ponds, watercourses, lakes and other depressional areas, and the remainder infiltrates the soil.

Most of the water falling on hard-top or compacted sites will run off.

Excessive runoff is of particular concern, since it can take soil, nutrients and bacteria from deadstock disposal sites with it.

SURFACE WATER TABLE ZONES



Water moves – or percolates – through soil pores and cracks to a saturation zone known as the water table.

RISKS TO GROUNDWATER

Site selection is important when planning a deadstock disposal site. The following factors can be significant in selecting sites.

SITE FEATURE	DESCRIPTION	SIGNIFICANCE
DEPTH TO BEDROCK	• soil depth to unfractured bedrock and bedrock-controlled aquifers	• shallow soils have less soil volume to treat potential organic materials below disposal sites • less depth means less distance to groundwater
DEPTH TO WATER TABLE	• depth of soil to zone of permanent saturation in soil • soils with an imperfect or poorly drained drainage classification experience high water tables (<1 m or 3.25 ft)	• 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
SOIL TEXTURE	• soil texture is the relative fineness or coarseness of the soil (e.g., sandy loam, clay, silty clay loam)	• the ease and speed with which water and contaminants can move through the soil to groundwater is partially dependent on soil texture • water moves quickly through coarse (sandy and gravelly) soils and slowly through fine (clayey) soils
POROSITY	• pores are the spaces between soil particles and clumps (peds) of soil	• soils with fine- and medium-sized pores retain more water and drain less • water moves quickly through soils with many large pores, cracks and tunnels – created by roots and soil fauna
SOIL LAYERS	• soils often contain layers of different textures, porosities and densities	• soils with layers of various-textured soils (known as "stratified") will slow the speed with which water moves downward through the soil profiles • in uniform soils, the water table will move up and down with the seasons • if a layer of soil occurring naturally or caused by cultivation restricts water movement, a perched water table may be present

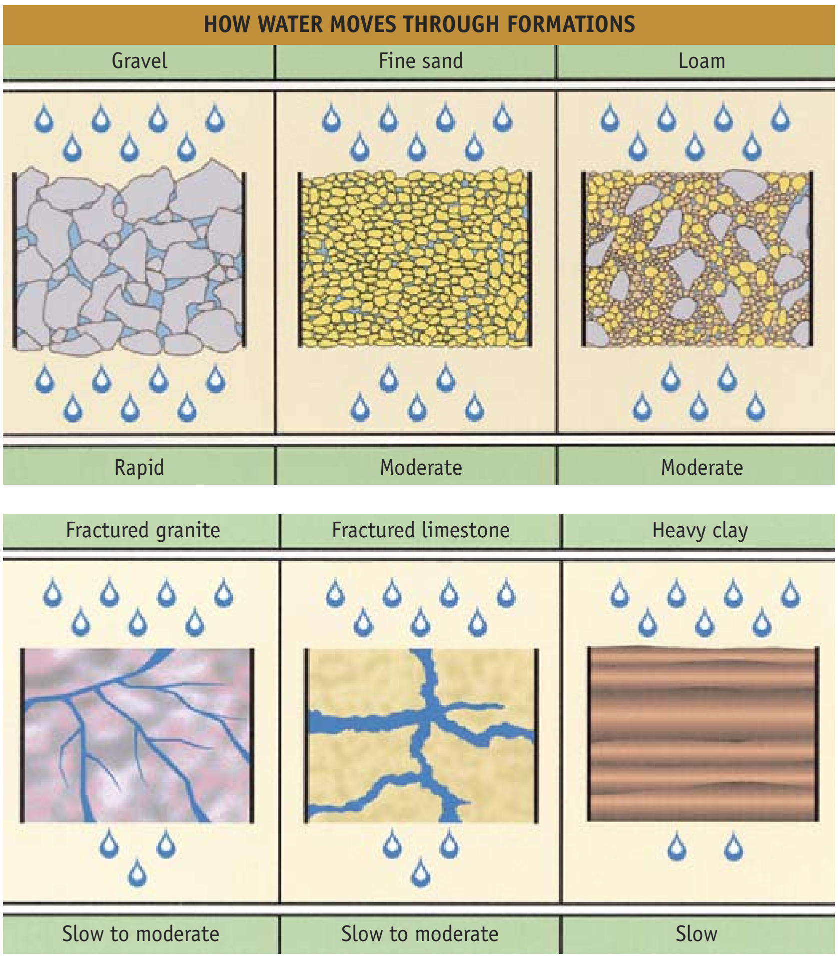
NUTRIENT LEACHING

Pathogens and nutrients in solution will move with soil water. Leaching occurs when these pathogens and nutrients (e.g., nitrates $[NO_3^-]$) move through soil pores and large cracks below the root zone. The amount of leaching is related to:

- **the concentration of pathogens and nutrients in the soil solution**
- **the overall supply of available nutrients in the soil**
- **soil texture – water moves quickly through sandy soils and cracked clay soils**
- **soil layering or stratification – this will slow the movement of water though the soil profile**
- **coarse fragments – soils with large volumes of stones and gravels are more prone to leaching**
- **soil depth to bedrock or water table – less soil depth means quicker travel time.**

Water percolates quickly through sands and gravels and very slowly through clays.

Most bedrock types are not impenetrable. Water moves through cracks and fissures to shallow water tables.



BURIAL AND DECOMPOSITION

The time required for buried deadstock to decompose depends on many factors:

- species and size
- air temperature and humidity
- soil type and texture
- drainage
- burial depth
- how many deadstock are packed in the hole.

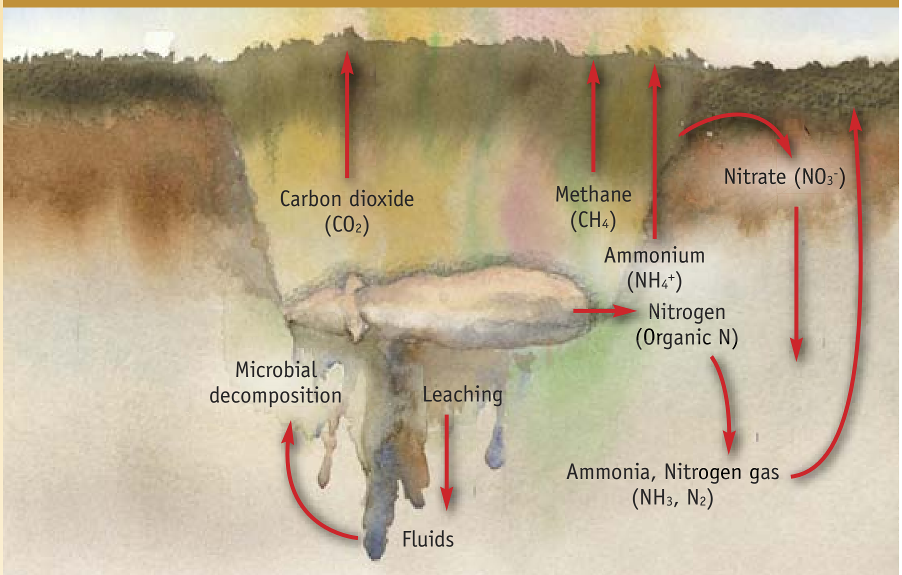
Deadstock left exposed on the soil surface can become skeletonized in two to four weeks during spring, summer or fall. However, deadstock buried 2 metres (6.5 ft) deep can take at least 10 years to reach the same state, depending on conditions.

Most pollutants such as nitrates are released during the earlier stages of decomposition, but very large mass burial sites could continue to release pollutants for many, many years. This is one reason it is important to limit the number of buried deadstock in one hole.

Buried deadstock are subjected to anaerobic and aerobic decomposition.

As previously noted, anaerobic decomposition (putrefaction) is a natural process involving decomposition of organic material by microbes in the absence of oxygen. This begins immediately after burial within soft tissues where fluid content limits the amount of available oxygen. Putrefaction is usually accompanied by objectionable odours of hydrogen sulphide and other reduced organic compounds that contain sulphur.

EARLY DECOMPOSITION – BURIAL SITES



Nutrient-rich body fluids escape during the early stages of decomposition. In the mid stages, buried deadstock are further decomposed by soil microbes, and assimilate into the microbes' living biomass.

Aerobic decomposition of tissue by soil fauna takes place in the presence of oxygen. Carcass tissues exposed to well-aerated soil surfaces will undergo aerobic decomposition, which should not create odours.

It's estimated about 50% of the total available fluid volume "leaks out" the first week following death and nearly all within the first two months. Fluids can leach from the site and pose a risk to surface water and groundwater – particularly on sites that are highly permeable, shallow to bedrock, or shallow to the soil water table.

Remaining fluids and carcass tissues are then subjected to decomposition by soil microflora and fauna. Microbial decomposers assimilate nutrients from tissues to form their body mass. Methane is released in soils with little oxygen available (anaerobic) and carbon dioxide in soils with lots of oxygen available (aerobic).

The fate of nitrogen released during decomposition is also affected by soil oxygen levels. Ammonium and ammonia are produced under both anaerobic and aerobic conditions. The amount that is then converted to nitrate, nitrous oxide, and nitrogen gas is dictated by changes in soil oxygen levels.

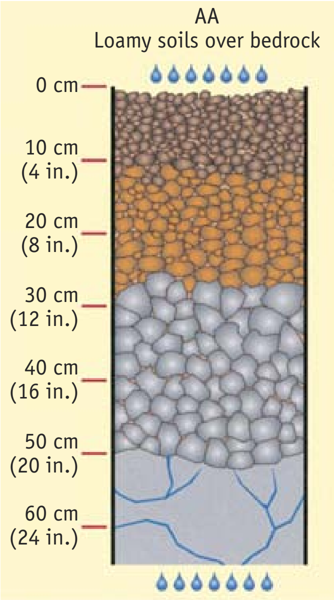
POTENTIAL ENVIRONMENTAL RISKS OF BURIAL

Groundwater Contamination

Nitrates from the later stages of decomposition could leach from burial sites. However, this risk is site-specific and is closely related to the amount of nitrate-nitrogen in the burial area and the speed at which water moves downward to the groundwater.

The potential risk of N-leaching increases on sites with:

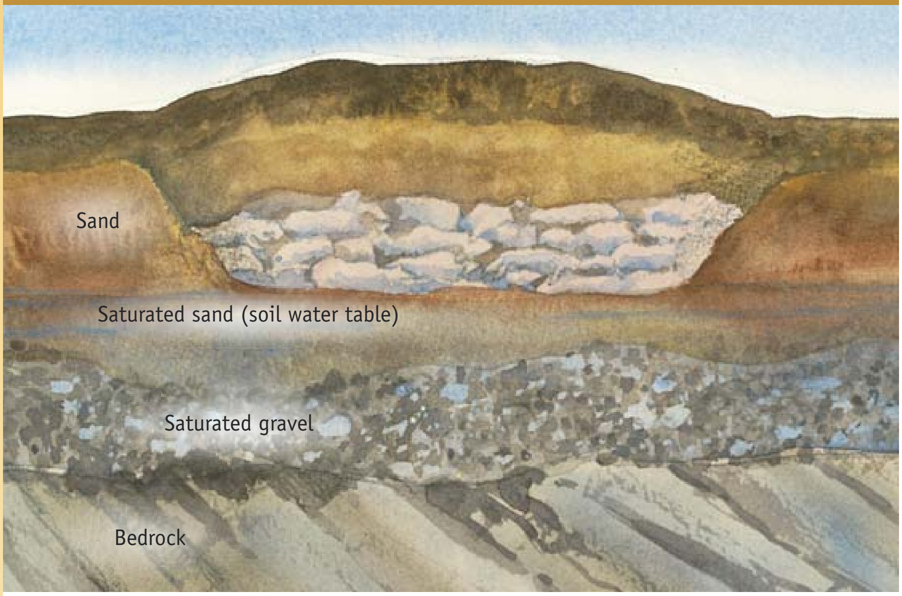
- ► shallow depths to bedrock
- ► shallow water tables or surface aquifers
- ► high sand and gravel content.



Sites such as this with bedrock or a water table close to the soil surface are unsuitable for burial.

The greatest risk for nitrate-nitrogen contamination is from sites with many deadstock buried in a small area, and with a shallow distance to bedrock or with a coarse-textured soil that has a permanent water table within 1 metre (3.25 ft) of the soil surface.

HIGH-RISK BURIAL SITE



Sites with the greatest potential risk are shallow to bedrock, and have large quantities of deadstock located in freely draining soils with shallow water tables.

ENVIRONMENTAL IMPACTS OF MASS BURIAL – THE U.K. EXPERIENCE

Considerable attention was paid to the potential environmental, human and animal health risk during and following the 2001 outbreak of foot-and-mouth disease (FMD) in the United Kingdom. The potential hazards associated with burials included body fluids, chemical and biological leachate components, and hazardous gases.

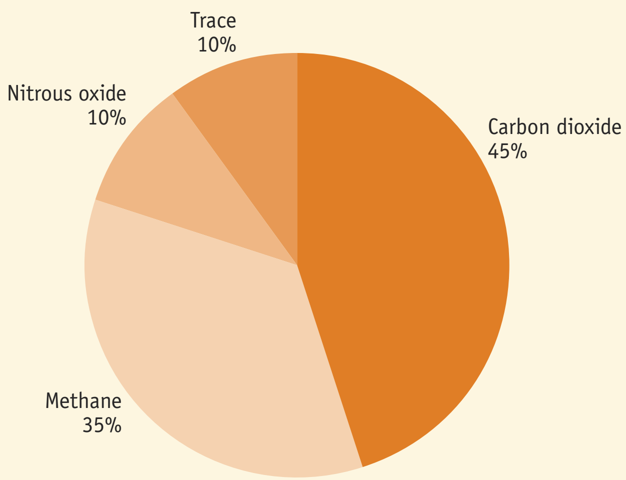
Precipitation amount and soil permeability are key to the rate at which contaminants leach from mass burial sites. Therefore the surrounding soils' natural ability to weaken or attenuate the decomposing materials is also key to reducing the risk to groundwater.

The U.K. experts found that the best soil type for maximizing natural attenuation properties was loam. Soil investigations revealed high levels of ammonia, total dissolved solids (TDS), biochemical oxygen demand (BOD), and chloride in a monitoring well closest to the burial site (within 0.6 m). Average ammonia and BOD concentrations were very high for 15 months following burial. Little evidence of contaminant migration was observed farther away. However, researchers cautioned that groundwater contamination could occur when large numbers of deadstock were buried in high-risk sites.

Greenhouse Gas (GHG) Release

Burial sites release two greenhouse gases of concern: methane and nitrous oxides.

GREENHOUSE GAS RELEASE FROM BURIAL SITES



There is limited research on GHG release from burial sites. One report estimated composition at about 45% carbon dioxide, 35% methane, and 10% nitrous oxide. Trace amounts of other gases (e.g., hydrogen sulphide) comprise the remainder.

TSE = transmissible spongiform encephalopathy
BSE = bovine spongiform encephalopathy
CWD = chronic wasting disease

Pathogen Contamination

Risks from microbiological contaminants are believed to be minimal as these organisms generally have short lifespans and/or are filtered by soil or aquifer material. However, the presence of preferential pathways, such as cracks in the soil, may increase the risks.

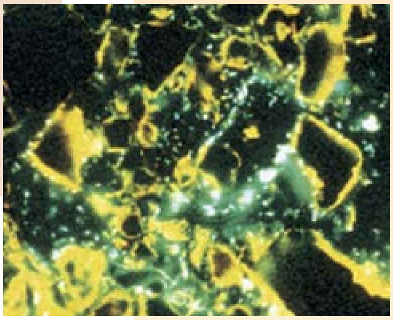
PATHOGEN SURVIVAL

A pathogen is any virus, bacterium, or protozoa capable of causing infection or disease in other animals or humans. Pathogens range from bacteria such as salmonella and E. coli, to protozoa such as Cryptosporidium parvum and Giardia.

Most livestock viruses are not passed to humans. With the exception of prions, few pathogens survive more than a few days when outside a livestock host and in the natural, aerobic environment, such as the earth's surface. Prions, the reported causative agent of TSEs (BSE, scrapie, CWD) are very stable and can remain infectious for an extended period of time outside the body.

Soil is good at trapping bacteria and other organisms, filtering out most protozoa and bacteria. Soils with high organic matter and clay content are more effective at filtering viruses.

However, pathogens can bypass soil filters by following macropore flow or preferential flow to shallow aquifers, or through tile drainage systems.



FACTORS AFFECTING PATHOGEN SURVIVAL

FACTOR	IMPACT	SOIL SURFACE	IN BURIAL PIT
TEMPERATURE	• high temperatures denature pathogen tissues	• high temperatures at soil surface during growing season	• few temperature fluctuations in pit; moderate conditions may allow survival
FREEZING + FREEZE-THAW CYCLE	• this causes cell membrane fracture plus desiccation	• freeze-thaw conditions prevail beyond growing season	• pit depth could be below frost line
EXPOSURE TO DRY CONDITIONS	• this causes cell membrane fracture plus desiccation	• dry conditions experienced throughout growing season	• subsoils may be moist and humid most of the time
pH	• pH extremes cause desiccation from salt effect	• surface soils often have neutral pH	• acidic or basic conditions found in certain parent materials could reduce survival
OXYGEN LEVELS	• most pathogens require partially aerobic conditions	• surface conditions are most often aerobic	• subsurface conditions highly variable ○ well-drained, sandy soils are mostly aerobic ○ poorly drained clays are often anaerobic at depth

DISPOSAL VESSELS AND DECOMPOSITION

The time required for deadstock to decompose within a disposal vessel depends on many factors:

- ► species and size of carcass
- ► air temperature and humidity
- ► vessel depth
- ► how many carcasses were added at one time.

Decomposition of deadstock inside a disposal vessel is not much different than if they were left exposed on the soil surface. Skeletonization would occur in two to four weeks during spring, summer or fall. The major improvement, though, is that four-legged scavengers cannot get at the deadstock, and any body fluids released during the early stages are unable to leach into surrounding soil or groundwater.

Like carcasses buried in soil, carcasses in disposal vessels are also subjected to aerobic and anaerobic decomposition.

Anaerobic decomposition (putrefaction) is a natural process involving decomposition of organic material by microbes in the absence of oxygen. In vessels, this can occur if many deadstock are added at one time, or if very large carcasses are added that limit the availability of oxygen for carcasses deeper within the pile.

Aerobic decomposition of tissue takes place in the presence of oxygen. Carcass tissues exposed on top of the pile in the vessel to aerobic conditions should not create odours.

As with soil burial, it's estimated about 50% of the total available fluid volume leaks out the first week following death and nearly all within the first two months. Because these fluids remain in the vessel, most evaporate over time and research has shown the remaining mass of material becomes very dry and dense.

Remaining carcass tissues are then subjected to decomposition by a vast array of beetles and insects such as blowflies. Research has also shown a tremendous amount of heat is released during the decomposition process.

Deadstock become skeletonized in a short period under the right conditions inside a disposal vessel.

POTENTIAL ENVIRONMENTAL RISKS

Groundwater Contamination

There is little risk of groundwater contamination from disposal vessels if they are installed correctly, because leachate is fully contained. Steel vessels will deteriorate over time, but by the time this occurs, the vessel has long since been decommissioned and its contents will become essentially biologically inactive.

During Ontario research, a tile drain was installed near the base of one disposal vessel to demonstrate the vessel was leakproof. It drained water very seldomly over the five-year project. Sampling demonstrated the drained water contained no contaminants.

Greenhouse Gas (GHG) Release

Although there is no known research on GHG released from disposal vessels, it is likely that methane and nitrous oxides are released during decomposition.

Pathogen Contamination

Risks from microbiological contaminants are believed to be minimal as these organisms generally have short lifespans and are contained within the vessel.

Insect Movement

Insects, larvae and beetles can and do both enter and leave disposal vessels. There is a risk that the increase in fleshfly populations may increase the likelihood of fly-strike (myiasis) for surrounding livestock. However, this risk is considered minimal – especially with the new regulation's required setbacks from neighbouring livestock operations.

Composting is a form of managed aerobic decomposition similar to the natural process that occurs near the surface of a forest floor. When managed properly, it's nearly odourless and risk-free.

COMPOSTING AND DECOMPOSITION

Composting is a managed biological procedure that controls the environmental conditions and therefore the rate of aerobic decomposition.

Improperly constructed, uncovered and otherwise poorly managed compost piles may experience unfavourable anaerobic conditions.

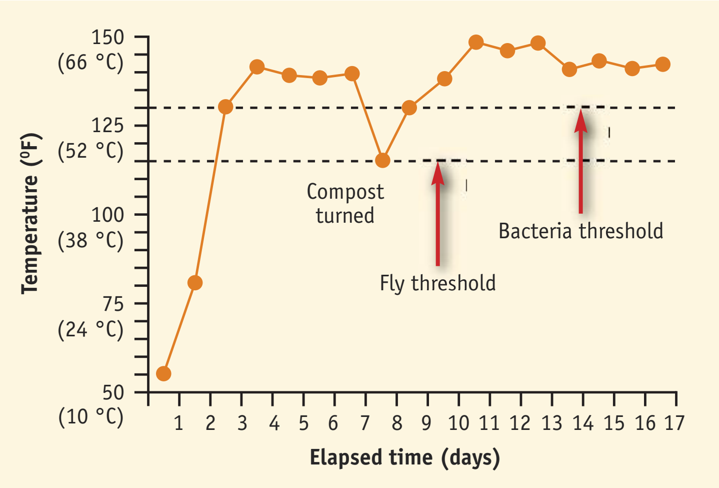
In aerobic decomposition, living organisms (which use oxygen) feed upon the organic matter. They use the nitrogen, phosphorus, some of the carbon, and other required nutrients. Much of the carbon serves as a source of energy for the organisms and is burned up and respired as carbon dioxide (CO_2). Since carbon serves both as a source of energy and as an element in the cell protoplasm, much more carbon than nitrogen is needed. Generally about two-thirds of carbon is respired as CO_2, while the other third is combined with nitrogen in the living cells.

If the excess of carbon over nitrogen (C:N ratio) in organic materials being decomposed is too great, biological activity diminishes. Several cycles of organisms are then required to burn most of the carbon.

When organisms die, their stored nitrogen and carbon become available to other organisms. Other organisms use the nitrogen from the dead cells to form new cell material, once more excess carbon is converted to CO_2. Thus, the amount of carbon is reduced and the limited amount of nitrogen is recycled.

Finally, when the ratio of available carbon to available nitrogen is in sufficient balance, nitrogen is released as ammonia. Under favourable conditions, some ammonia may be converted to nitrate. Phosphorus, potash, and various micronutrients are also essential for biological growth. These are normally present in more than adequate amounts in compostable materials and present no problem.

Initially, mesophilic organisms, which live in temperatures 20–46 °C (68–115 °F), colonize in the materials. When the temperatures exceed approximately 49 °C (120 °F), thermophilic organisms, which grow and thrive in the temperature range of 46–71 °C (115–160 °F), may flourish and replace the mesophilic bacteria in the decomposition material. Only a few groups of thermophiles carry on any activity above 71 °C (160 °F).



Oxidation at thermophilic temperatures takes place more rapidly than at mesophilic temperatures and, hence, a shorter time is required for decomposition (stabilization). The high temperatures will destroy pathogenic bacteria, protozoa (microscopic one-celled animals), and weed seeds.

Aerobic oxidation of organic matter produces no objectionable odour. If odours are noticeable, either the process is not entirely aerobic or some special conditions or materials are present that are creating an odour. Aerobic decomposition or composting can be accomplished in pits, bins, stacks or piles, if adequate oxygen is provided. Turning the material at intervals or other techniques for adding oxygen are useful in maintaining aerobic conditions.

Compost piles under aerobic conditions attain a temperature of 60–71 °C (140–160 °F) in one to five days depending on the material and the condition of the composting operation. This temperature can also be maintained for several days before further aeration. In time, the material will become anaerobic unless it is aerated by turning.

In contrast to aerobic decomposition, heat is not produced under anaerobic conditions. The lack of heat generated in the anaerobic destruction of organic matter is a disadvantage if contaminated materials are used.

High temperature is an important factor in the destruction of pathogens and parasites.

In anaerobic decomposition, the pathogenic organisms do eventually disappear in the organic mass, as a result of the unfavourable environment and biological antagonisms. The disappearance is slow, and the material must be held for periods of six months to a year to ensure relatively complete destruction of pathogens.

Contaminated water (leachate/ wastewater) is any water that has come into contact with composting areas.

POTENTIAL ENVIRONMENTAL RISKS

Groundwater and Surface Water

Compost leachate contains:

- organic carbon
- organic nitrogen
- nitrates and ammonia
- phosphates
- miscellaneous other nutrients and salts – potassium, magnesium, chlorides, etc.

Clean rainfall from outside the composting area needs to be excluded so that it does not flow through the area and become contaminated. All runoff from within the operational areas needs to be collected and managed as it is likely to be contaminated with debris, nutrients and possibly pathogens.

The composting process may generate leachate that can pollute surface water, stormwater and groundwater if not managed effectively. All activities involving receiving, processing, composting and storing the final product should be conducted on a paved or compacted area (e.g., compacted quarry rubble, concrete or asphalt) capable of withstanding heavy equipment.

The pad needs to be designed and constructed to ensure that leachate flows to a low point for collection and subsequent storage, treatment, disposal or reapplication onto compost piles or windrows. Suitable collection devices include concrete sumps, while suitable storage, treatment and disposal facilities include appropriately sized tanks or lagoons.

Greenhouse Gas

Composting stabilizes carbon and nitrogen, but how much ammonia and carbon dioxide are lost during this process?

In theory, more aeration will lead to aerobic decomposition and CO_2 production, rather than methane. However, poorly managed composting processes result in increased methane and ammonia generation. It has been documented that during the composting process, ammonia and methane are emitted at the initial phases and nitrous oxides during the mid-phases.

Adherence to composting guidelines will ensure proper moisture levels, aeration and temperatures – which will make for more effective composting and a net-positive scenario for greenhouse gas emissions, as methane is more harmful than CO_2.

Follow composting guidelines to ensure proper moisture levels, aeration and temperatures. This will lead to more effective composting and a net-positive scenario for GHG-emissions, as methane is more harmful than CO_2.

Pathogen Risks

During active composting (first phase), pathogenic bacteria are inactivated by high thermophilic temperatures, with inactivation a function of both temperature and length of exposure.

The heat generated during carcass composting results in some microbial destruction. However, it may not be sufficient (in terms of temperature and exposure) to completely sterilize the end product. This means some potential exists for survival and growth of pathogens. The levels of pathogenic bacteria remaining in the end product depend on the heating processes of the first and second phases, and also on cross-contamination or decontamination of the end product.

In order to maximize pathogen destruction, it's important to have uniform airflow and temperature throughout the compost pile. Because deadstock compost is an inconsistent, non-uniform mixture, pathogen survival may vary within different areas of the compost.

Temperature uniformity is facilitated by proper aeration, and reduces the probability of microbes escaping the high temperature zone. In spite of non-uniform temperatures, pathogenic bacterial activity is reduced when the temperature in the middle of the pile reaches 65 °C (149 °F) within one to two days. That is, a high core temperature provides more confidence for the deadstock composting pasteurization process.

Achieving an average temperature of 55–60 °C (131–140 °F) for a day or two is generally sufficient to reduce pathogenic viruses, bacteria, protozoa (including cysts), and helminth ova to an acceptably low level. It is important to note that under no composting conditions are temperatures reached that inactivate prions. Nor will these conditions inactivate the endospores produced by spore-forming bacteria.

In this context, pasteurization refers to managed heating of the decomposing carcass by microbes.

Endospores are highly resistant bacterial cells formed when an organism is under stress.

INCINERATION

Incineration refers to fuel-assisted cremation of deadstock. Specially designed on-farm incineration units use fuel, temperature controls and enclosed environments to reach high temperatures and secondary combustion (afterburner on flue) – to reduce gaseous emissions.

Open-air burning includes burning deadstock in open fields or on combustible heaps called pyres.

POTENTIAL ENVIRONMENTAL RISKS

It's generally accepted that large-scale open-air burning pollutes. Large deadstock-burning pyres can release toxic gases, carcinogens and particulate matter. For this reason, open-air burning is not permitted.

Properly operated fixed-facility incineration units pose fewer pollution concerns. Properly operated afterburner-equipped incinerators should not pose serious problems for the environment.

The regulation for deadstock disposal under the Nutrient Management Act, 2002 requires that an operator must not use an incinerator to incinerate deadstock unless the incinerator is a type that has been issued a Verification Certificate by Environmental Technology Verification (ETV) Canada Incorporated. The incinerator must have a secondary chamber capable of maintaining the gases that enter it from the primary chamber for at least 1 second at a temperature of 1,000 °C (1,832 °F) or higher, or at least 2 seconds at a temperature of 850 °C (1,562 °F) or higher.

DISEASE AGENT CONSIDERATIONS

Regardless of incineration method used, bacteria (including spore-formers), and viruses should not survive incineration. There has, however, been much speculation that open-air burning can help spread the foot-and-mouth (FMD) virus. Several studies have examined this question, and while the theoretical possibility cannot be eliminated, there is no such evidence.

Prions, the disease agents responsible for TSEs (e.g., scrapie, BSE, and CWD) are highly durable.

RENDERING

The process of rendering deadstock reduces the carcasses to meat and bonemeal (proteinaceous solids), tallow, and water. The recycling and processing services of renderers reduce the massive problems of disposal from farms/feedlots, slaughterhouses, food processors, restaurants, and institutions.

The rendering process is accomplished by eight steps.

Step 1

Remove undesirable parts

↓

Step 2

Cook and separate fat and protein materials

↓

Step 3

Dry and grind the concentrated protein

↓

Step 4

Treat to refine gases, odours, and wastewater

↓

Step 5

Separate the three end-product portions (proteinaceous solids, melted fat, and water)

↓

Step 6

Dry the proteinaceous solids to be used as an animal feed if permitted

↓

Step 7

Discharge the water as sludge

↓

Step 8

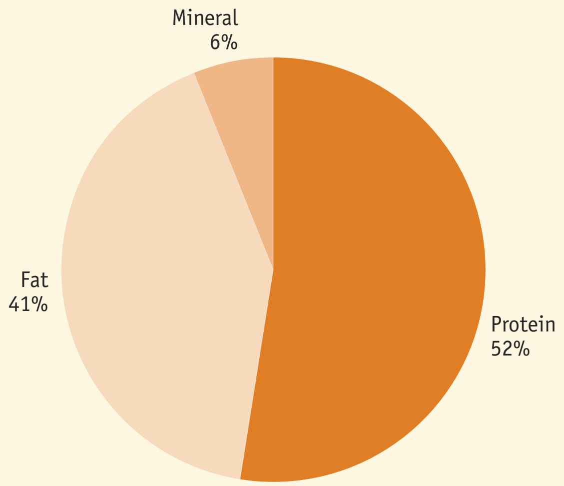
Store fats for refining

Fresher carcasses make better by-products because of less deterioration.

The use of carcasses in advanced stages of decomposition is undesirable because hide removal and carcass cleaning are very difficult. As well, the fat and protein resulting from such carcasses is generally of low quality.

If prohibited for animal feed use, the product will be classified as inedible and may only be used as a fertilizer. Tallow can be used in livestock feed and production of fatty acids, and can be manufactured into soaps.

FRESH CARCASS COMPOSITION – 32% DRY MATTER



A typical fresh carcass contains approximately 32% dry matter, of which approximately 52% is protein, 41% is fat, and 6% is mineral. Rendering provides a hygienic means of disposing of deadstock if proper processing conditions are adhered to. The end products have economic value and can be stored for long periods of time.