3 LIVESTOCK

INTRODUCTION

This chapter discusses livestock management practices for protection of the environment. It contains introductory information on the relationship between livestock and the environment. It also contains information on environmental concerns, legislation and beneficial management practices related to:

- indoor poultry and livestock housing
- outdoor livestock areas
- manure handling and storage
- mortality disposal

LIVESTOCK AND THE ENVIRONMENT

Livestock are primarily raised and managed in farm operations for their value as food or food products, or in the case of horses, for recreational or other uses. Environmental concepts related to livestock activities are listed in alphabetical order below.

Grazing

Livestock that graze on pasture or grass rangelands indirectly provide humans with food from forages, a food source otherwise not useable by humans.

Nutrient Cycle

When livestock graze or are fed grains and forage they become part of the nutrient cycle of a site. Depending on the management practices for a given site, livestock may:

- remove nutrients by consumption as in grazing (with some retained in body mass)
- add nutrients by consumption of feed transported to the site (with some deposited as wastes)

Depending on the nutrient requirements of a site, either may be positive or negative to the environment. Evaluate the nutrient status of grazing and feeding areas when deciding on fertilizer or manure application rates.

Vegetation Control

Livestock that graze are used to manage specific undesirable types of vegetation such as weeds and competing vegetation in forests.

INDOOR POULTRY AND LIVESTOCK HOUSING

INDOOR POULTRY AND LIVESTOCK HOUSING ENVIRONMENTAL CONCERNS

Primary environmental concerns related to indoor livestock areas are:

- impacts of indoor poultry and livestock housing on water quality:
  - release of wastes (e.g., manure, milkhouse waste, bedding, spoiled feed) that results in water pollution
  - housing located close to a watercourse or well that results in water pollution
  - cross connection of "dirty water" lines with clean water lines that results in water pollution
- impacts of indoor poultry and livestock housing on air quality:
  - release of methane (CH_4) and ammonia (NH_3) from housed livestock manures that add to the greenhouse effect and smog formation
  - release of particulate matter and ammonia from animal housing as a result of manures and dust that can chemically produce secondary particulate that results in human health risks and in visibility reduction
  - release of odours associated with ammonia or other noxious gases that is carried by dust to surrounding neighbours

For information on these concerns:

➔ see Water Quality and Quantity Factors, page 9-1, refer to Contaminants, and to Oxygen Demand

➔ see Air Quality Factors, page 10-1, refer to Contaminants, to Dust and Particulates, to Greenhouse Gases, and to Odours

➔see Climate Change Factors, page 12-1

INDOOR POULTRY AND LIVESTOCK HOUSING LEGISLATION

The following is a brief outline of the main legislation that applies to indoor housing.

➔ see page A-1 for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to

be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

The *Code* under the *Agricultural Waste Control Regulation* has specific requirements regarding agricultural wastes

- Section 3: agricultural wastes must be collected, stored, handled, used and disposed of in a manner that prevents pollution
- Section 7(1): a storage facility must be located at least 15 m from any watercourse; at least 30 m from any source of water for domestic purposes

The *Code* also has a single reference to air emissions from animal housing:

- Section 17: states that emissions from forced air ventilation systems must not cause pollution

Public Health Act

This Act prohibits activities that may cause a health hazard:

- Section 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard

The Act also has conditions under the Public Health Act Transitional Regulation:

- Section 18: separation distance of wells are to be at least 30.5 m from any probable source of contamination (a probable source could include manure)

Fisheries Act

This Act has two sections of importance to indoor poultry and livestock areas:

- Section 36(3): prohibits the deposit of deleterious substances into watercourses (deleterious substance could include manure)
- Section 38(4): requires reporting infractions of Section 36

INDOOR POULTRY AND LIVESTOCK HOUSING BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable indoor housing related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Protection of Water Quality

An indoor structure allows for convenient collection and containment of livestock manure and waste feed. However, inappropriate barn location, improper construction practices or improper management can contribute to pollution from wastes or leachate. Implement the following practices for indoor facilities:

- locate facilities away from yard drain inlets, ditches, wells and watercourses
  - at least 30.5 m from wells (*Public Health Act*)
  - at least 15 m from watercourses (*Agricultural Waste Control Regulation*)
  - 30 m or more from a water intake used for domestic purposes (suggested)
- locate facilities so that an adequate buffer can be established and maintained between indoor housing and watercourses
- keep wastes or leachate from entering a watercourse
- construct floors to contain all wastes

- deposit waste feed into manure storages or store separately to prevent leachate generation
- place berms around buildings or grade landscapes near structures to keep snow melt or other water flow from entering the indoor facility

➔ see Buildings and Roads, page 2-9

Milkhouse Waste. Collect and deposit milkhouse waste into a manure storage facility for eventual land spreading as a fertilizer. Alternative disposal systems require a permit from MOE.

Building Drains. Buildings are often surrounded by perimeter drains to carry clean roof water and soil moisture away from the foundation. If the barn or barnyard also has drains collecting contaminated water, implement the following practice:

- test that these drains are not cross connected to the clean water drains
- add a MOE-approved dye into the contaminated water drain, and check that the dye does not show up in the clean drain line discharge

Protection of Air Quality

Indoor poultry and livestock housing can impact air quality by emitting dust, particulate and gaseous compounds. These emissions can be a nuisance as well as impact human and environmental health.

Particulate Emissions Reduction. Implement the following practices to reduce particulates and dust from livestock housing:

- practice dust suppression techniques and implement dust suppression technology
- clean up dust accumulations inside the barn
- use clean, low dust litter for bedding
- when loading bedding into barns, use methods that result in minimal dust production
- incorporate a program of washing down both the interior and exterior of barns to remove dust accumulations
- clean fans, hoods and screens regularly to avoid dust build up
- properly locate ventilation exhaust fans
- direct discharge away from other buildings and neighbours
- equip fans with hoods that deflect exhausted air towards the ground (the ground cover acts as a filter), or install chimney fans with discharge openings at least 4 m (suggested) above ground level (to maximize dilution)
- take advantage of prevailing winds to carry particulates away from sensitive areas
- maintain foliage or implement vegetative filters near exhaust fan discharges to trap a proportion of dust exiting the barn

➔ see Buffers, page 11-4

📖 **Fine Particulates – What They are and How They Affect Us**

📖 **Siting and Management of Poultry Barns**

Ammonia Emissions Reduction. To reduce ammonia emissions that contribute to the formation of secondary particulate and cause odour concerns, implement the following practices:

- balance the diet to maximize feed efficiency to minimize excreted nitrogen
- use enzymes when possible to enhance feed efficiency and reduce phosphate excretion

➔ see Manure Gas Emissions Reduction, page 3-35, and refer to Nutrition and Ration Management

Odour Reduction. Odours often result from livestock housing due to manure, enteric fermentation, and the release of ammonia, and dust.

➔ see Odours, page 10-13

Exhaust Filters. Mechanical air filtration systems trap approximately 45% of fine particulate and 80% of coarse particulate from animal housing areas.

- install mechanical filters on ventilation exhaust fans
- ensure filters are cleaned and maintained at regular intervals

Biofilters. Biofilters result in approximately an 80% reduction in ammonia and 95% reduction in hydrogen sulphide emissions and can be used as an alternative to mechanical filters. Mechanical filters trap particles and emissions, whereas biofilters trap particles and emissions and also provide an environment for aerobic biological degradation of trapped compounds that results in a reduction of odour emissions.

- install biofilters to reduce odorous emissions
- biofilters are proven effective for use on deep pit manure exhaust; swine, dairy and mushroom facilities; and are minimally effective in poultry facilities
- **Caution:** dust and dander in certain types of poultry housing can cause exhaust filters and biofilters to backup

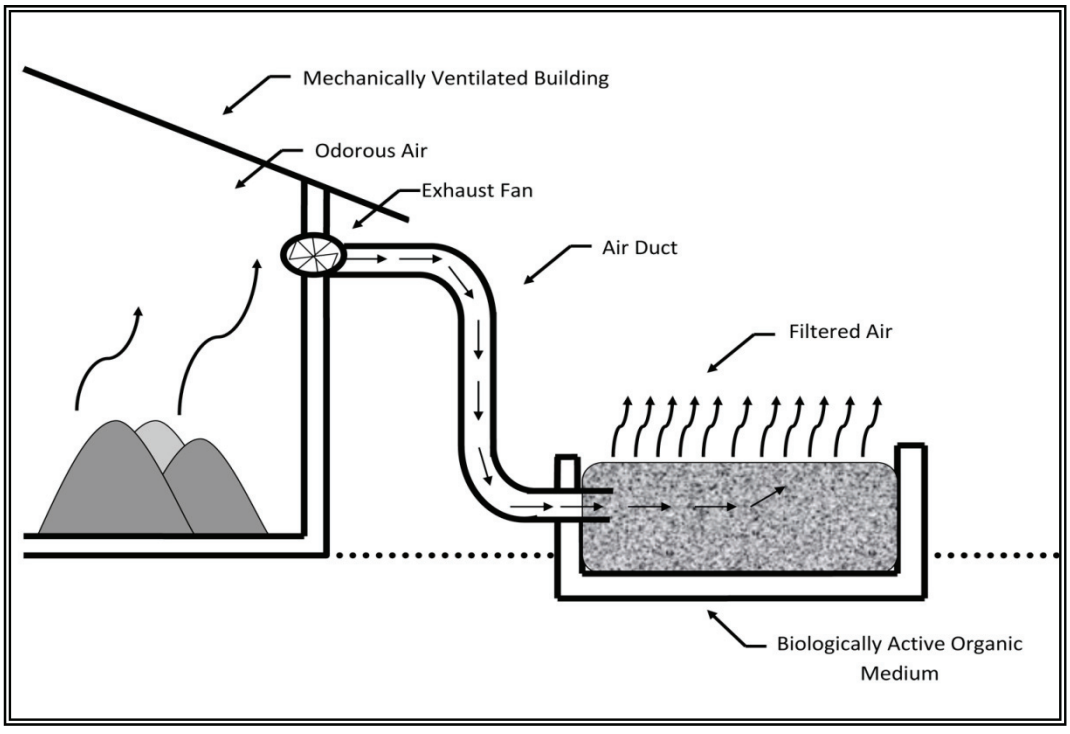


Figure 3.1 Biofilter System on an Indoor Livestock Facility

Table 3.1 Considerations When Installing a Biofilter*

1. Determining the media:

Natural Media: Peat Soil (heavy loam), Compost (yard waste)
Woody Media: Wood chips, Straw

A ratio is suggested of 30:70 or 50:50 of compost and wood residues (i.e. chips, shreds).

2. Determining the airflow rate from livestock housing:

Biofilters used to treat ventilating air exhausted from a livestock building should be sized to treat the maximum ventilation rate

Facility Type	Ventilation Requirements Liter per second Per Animal
Hogs – Gestation	71
Hogs – Farrowing	236
Hogs – Nursery	17
Hogs – Finishing	57
Broiler/Layer (2.3 kg)	2
Turkey (18 kg)	15
Dairy (635 kg)	222

3. Size and footprint of biofilters:

The depth of the biofilter depends on the design and the amount of contact time the odorous air spends in the biofilter:

- typically 25 to 45 cm deep

The footprint of the biofilter depends primarily on the amount of air needing treatment:

- typically biofilters are 0.8 to 1.4 ft^2 per 1000 cubic feet per second (cfs) of airflow

*adapted from University of Minnesota, Biofilters for odour control, 2000

Table 3.1, above, outlines considerations to take into account when installing a biofilter to reduce odours and emissions from livestock housing facilities.

Vegetative Filters. Vegetative filters trap a portion of dust from barns exhaust fans, reduce the visual impacts of agriculture, and decrease odour. In a vegetative filter, wind is channelized from the barn exhaust through a planting of trees, allowing particulates to be caught in the vegetation.

➔ see Buffers, page 11-4,
➔ see Vegetative Buffers, page 10-14

Electrostatic Precipitators for Dust Reduction. Reduce dust emissions from indoor livestock facilities by applying a safe electric charge to the air space. Electrostatic precipitators reduce dust in the air by charging the airspace to force particles to come together and fall out of the air. This reduces the impacts to both indoor and outdoor air quality.

- implement electrostatic precipitators in livestock housing at beginning of the livestock cycle
- clean up dust accumulations to ensure the technology remains effective

OUTDOOR LIVESTOCK AREAS

OUTDOOR AREA ENVIRONMENTAL CONCERNS

Primary environmental concerns related to outdoor livestock areas are:

- livestock manure and feed that results in soil, water, air pollution and/or greenhouse gas emissions
- livestock grazing that results in loss of wildlife habitat and weed transmission, or results in soil compaction or erosion, or water pollution

For information on these concerns:

- ➔ see Impacts on Biodiversity and Habitat, page 7-8, and refer to Farm Activities and Impacts
- ➔ see Soil Quality Factors, page 8-2, and refer to Compaction, and to Contaminants
- ➔ see Water Quality and Quantity Factors, page 9-2, and refer to Contaminants, and to Oxygen Demand
- ➔ see Air Quality Factors, page 10-1, and refer to Contaminants, and Odours
- ➔ see Climate Change Factors, page 12-1

OUTDOOR AREA LEGISLATION

The following is a brief outline of the main legislation that applies to outdoor livestock areas.

- ➔ see page A-1 for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Game Farm Act

This Act requires farms with bison, fallow deer and reindeer have a license to operate. Licenses specify containment fencing requirements among other items.

Environmental Management Act

The *Code* under the *Agricultural Waste Control Regulation* defines and regulates confined, seasonal feeding and grazing areas. Table 3.2, page 3-10 lists typical names used for various livestock areas.

Confined Livestock Area. This is an outdoor, non-grazing area in which livestock are confined by fences, structures or topography. Most or all feed is brought to the livestock and deposited manure nutrients exceed crop needs if a crop is grown at all.

- Section 10: outdoor under pen storage of manure is permitted for up to 9 months (unique to fur farms)
- Section 12: manure must be applied to land as a fertilizer or soil conditioner
- Section 28: livestock in a confined livestock area can not have access to a watercourse for watering (a conditional exception is allowed for a rangeland holding area)
- Section 29(1): areas must be operated in a way that does not cause pollution
- Section 29(2): areas are to be at least 30 m from any watercourse, high tide watermark or any source of water used for domestic purposes

Seasonal Feeding Area. This is an area used for both crop production and for seasonal feeding of livestock. Most of the feed is brought to the site and manure nutrients do not exceed crop needs.

- Section 26(1): the area must be operated in a way that does not cause pollution, and have berms where necessary to prevent agricultural waste runoff from causing pollution
- Section 26(2)(a): locations for feeding must be at least 30 m from watercourses or high tide watermark, unless written permission has been obtained for a closer location from MOE
- Section 26(2)(b): locations for feeding must ensure that manure is spread as a fertilizer or soil conditioner and that no accumulation of manure pollutes
- Section 26(3): permanent feed bunks require written permission from MOE for their location
- Section 27: livestock are allowed access to natural watercourses, provided feeding meets item 26 and the access is located and maintained as necessary to prevent pollution

Grazing Areas. This is an area where livestock are sustained primarily by direct consumption of the feed growing on that area.

- Section 25: livestock are allowed access to natural watercourses, provided they do not cause pollution

Public Health Act

This Act prohibits activities that may cause a health hazard:

- Section 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard

The Act also has conditions under the *Public Health Act Transitional Regulation*:

- Section 18: separation distance of wells are to be at least 30.5 m from any probable source of contamination (a probable source could include manure)

Water Act

Water licences are required from Front Counter BC for use of surface water. A licence is not required for livestock drinking directly from a watercourse in a

grazing area or in a rangeland situation. Approval is required for any work in or about a stream.

Wildlife Act The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

Fisheries Act This Act has three sections of importance to outdoor livestock areas:

- Section 35: prohibits harmful alteration, disruption or destruction of fish habitat (e.g., hoof action in or around streams) unless authorized
- Section 36(3): prohibits the deposit of deleterious substances into watercourses (deleterious substances would include manure)
- Section 38(4): requires reporting infractions of Sections 35 or 36

Species at Risk Act This Act has sections that protect listed species, their residence and critical habitat. It applies to federal lands, internal waters (i.e., all watercourses), territorial seas of Canada, and the air space above them.

The provisions of the *Species at Risk Act* (known as the 'safety net') could be invoked on BC crown and private lands using a federal order under the Act if provincial action is not sufficient to protect listed species.

OUTDOOR AREA BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable outdoor area related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Broad environmental concerns of outdoor livestock areas are expressed in this rule-of-thumb:

> **Keep clean water away from manure,**
> **Keep manure away from clean water.**

Fur Farms Section 10 of the *Code* under the *Agricultural Waste Control Regulation* permits outdoor under-pen storage of manure for up to 9 months (unique to fur farms). For information on manure

➔ see Manure Beneficial Management Practices, page 3-23

Game Farms Farming of bison, fallow deer and reindeer have unique management requirements under the *Game Farm Act*.

📖 **British Columbia Game Farm Manual**

The *Code* under the *Agricultural Waste Control Regulation* defines three outdoor livestock areas. Common terms used for these areas are outlined in Table 3.2, next page.

Table 3.2 Typical Outdoor Area Terms for Livestock Groupings			
Livestock Type	**Outdoor Area (as defined by the *Code* under the *Agricultural Waste Control Regulation*)**		
	Confined	**Seasonal**	**Grazing**
Beef Cattle	feedlot handling corral calving pen	overwintering calving areas	pasture range
Bison	feedlot handling corral calving pen	overwintering calving areas	pasture
Chickens & Turkeys	free range	free range	—
Dairy Cattle	yard	—	pasture
Fallow Deer & Reindeer	—	overwintering fawning areas	pasture
Fur farms	—	—	—
Game Birds (e.g. pheasant)	free range	free range	—
Goats	yard	—	pasture
Horses	arena paddock	overwintering foaling areas	pasture range
Laying Hens	free range	free range	—
Llamas & Alpacas	pen	—	pasture
Ostriches & Emus	pen	—	—
Hogs	yard	—	pasture
Rabbits	—	—	—
Sheep	handling corral lambing pen	overwintering lambing areas	pasture range - cut blocks
Water Fowl	free range	free range	—

Horse Riding Arenas

Horse riding arenas are considered to be confined livestock areas and must be managed as such. Ideal arena footing materials should have a low potential for producing leachate, for instance sand is better than woodwaste. If woodwaste is used its leachate must be managed ➔ see Woodwaste, page 2-27. Dry areas with good drainage will provide a more serviceable, easily maintained facility regardless of the type of footing chosen. Do not locate arenas in wet areas, that by nature pose the highest pollution potential when woodwaste, manure, or urine are in contact with water. Divert water around the arena to ditches or streams to minimize pollution.

📖 **Building an Environmentally Sound Outdoor Riding Ring**

Outdoor Calving Areas

Cattle calving areas can be either confined livestock areas or seasonal feeding areas. Where contaminated runoff is at risk of reaching watercourses, give

special attention to runoff control. Calf manure often contains *Cryptosporidium parvum*, a protozoan pathogen that can cause illness in humans if ingested in drinking water.

Confined Livestock Areas

Commonly called pens, yards, loafing areas, or exercise areas, confined livestock areas may be used either for many months to house livestock or for short periods of time to give indoor-housed livestock fresh air and sunshine. They may be used for feeding, watering or confinement purposes.

There are a number of ways to manage confined livestock areas to reduce the likelihood of depositing deleterious substances into water frequented by fish or of causing water pollution. Implement the following practices:

- locate facilities away from yard drain inlets, ditches, wells and watercourses
  - at least 30.5 m from wells (*Public Health Act*)
  - at least 30 m from a watercourse or high tide watermark (*Agricultural Waste Control Regulation*)
- install a hard surface (e.g. concrete, asphalt) instead of a soil-based yard, as indicated by Worksheet #1, next page
- install a water supply system as watercourse access is not permitted from confined livestock areas (a conditional exception is allowed for a rangeland holding area)
  ➔ see Livestock Water, page 9-13
- establish and maintain an adequate buffer between the outdoor area and any watercourse to keep wastes, or leachate from the wastes, from entering a watercourse
  ➔ see Buffers, page 11-4
- handle, process, and store feed properly
  ➔ see Crop Processing, and Forage Crop Storage, page 4-10
- divert upland area “clean water” away from confined livestock areas
- collect confined livestock area contaminated runoff (“dirty water”) or use sites where contaminated runoff is prevented from reaching watercourses
  ➔ see Runoff, page 9-42
- if contaminated runoff is collected
  - estimate the volume to be collected using Worksheet #11, page 9-47
  - use the water appropriately

  ➔ see Contaminated Water Collection, Storage and Use , page 9-44
- prevent the escape of manure from the area and collect and spread it as a fertilizer (*Agricultural Waste Control Regulation* requirement)

Worksheet #1 — Soil-Based Confined Livestock Areas — Determining Suitability and Size — Workbook Question 89

Question: A producer in Merritt has 100 head of feeder cattle weighing as much as 350 kg and wants to house them on a continuous basis on a soil-based yard. The soil is a low risk soil.

Reset

Is a soil-based yard suitable and what is the minimum yard space required for continuous use?

Information:

Precipitation on the site from Oct 1 to April 30 (select site)	Merritt	280 (1)	mm
Risk of leachate movement in soil (refer to table 8.1)	☑ Low ☐ High	LOW (2)	risk
Number of livestock		100 (3)	head
Average weight of livestock		350 (4)	kg

Minimum space for soil-based yards

continuous use	6 m^2 per 100 kg	5
day use only	2 m^2 per 100 kg	6

Calculation:

Step 1 — Determine if a soil-based yard is suitable.

Is Box 1 less than 600 mm, and is Box 2 low risk?

YES — **Continue to step 2 or 3**

Step 2 — Determine the size of the soil-based yard if it is continuous use.
(A soil-based yard area of 6 m^2 /100 kg or greater is suitable for continuous use)

Equation:					
Soil-Based Yard Size =	**Number of Livestock**	**x**	**Average Weight**	**x**	**Minimum Space 6 m^2/100 kg**

= 100 (3) head x 350 (4) kg x 0.06 (5) = 2100 (7) m^2

Step 3 — Determine the size of the soil-based yard if it is day use only.

Equation:					
Soil-Based Yard Size =	**Number of Livestock**	**x**	**Average Weight**	**x**	**Minimum Space 2 m^2/100 kg**

= 100 (3) head x 350 (4) kg x 0.02 (6) = 700 (8) m^2

Answer: For this Merritt farm example, a soil-based confined livestock area is suitable, with a continuous use yard for 100 cattle averaging 350 kg requiring a minimum area of 2,100 m^2

Soil-Based vs. Hard-Surfaced Yards. In general, extensive use for more than 72 hours continuously of soil-based, confined livestock area is best suited to sites that have **all** of the following:

- are located in low precipitation climates, less than 600 mm October 1st to April 30th inclusive ➔ see Appendix Figure B.1, page B-2
- and have soil with a low risk of contaminant movement ➔ see Table 8.1, page 8-16
- and have low-density livestock use, requiring the following minimum areas
  - for continuous use, an area of 6 m^2 or greater per 100 kg of livestock
  - for day-only use, an area of 2 m^2 or greater per 100 kg of livestock

Use hard surface confined livestock areas if **any one of the above conditions are not met.** Refer to Worksheet #1, previous page, for an example of determining suitability and sizing a soil-based confined livestock area.

Confined Soil-Based Yards. Heavy traffic and sustained use of soil-based confined livestock areas, especially in wet conditions, either destroys plant cover totally or leaves a cover that is sparse and weedy. In addition, soil compaction prevents precipitation from infiltrating the soil, causing ponding and increased runoff flow that could cause erosion.

Non-vegetated, wet and muddy confined livestock areas do not provide many of the benefits for which they are intended. High moisture conditions contribute detrimentally to the health of animals. As well, excessive amounts of manure and other waste accumulate, increasing the risk of contaminated runoff.

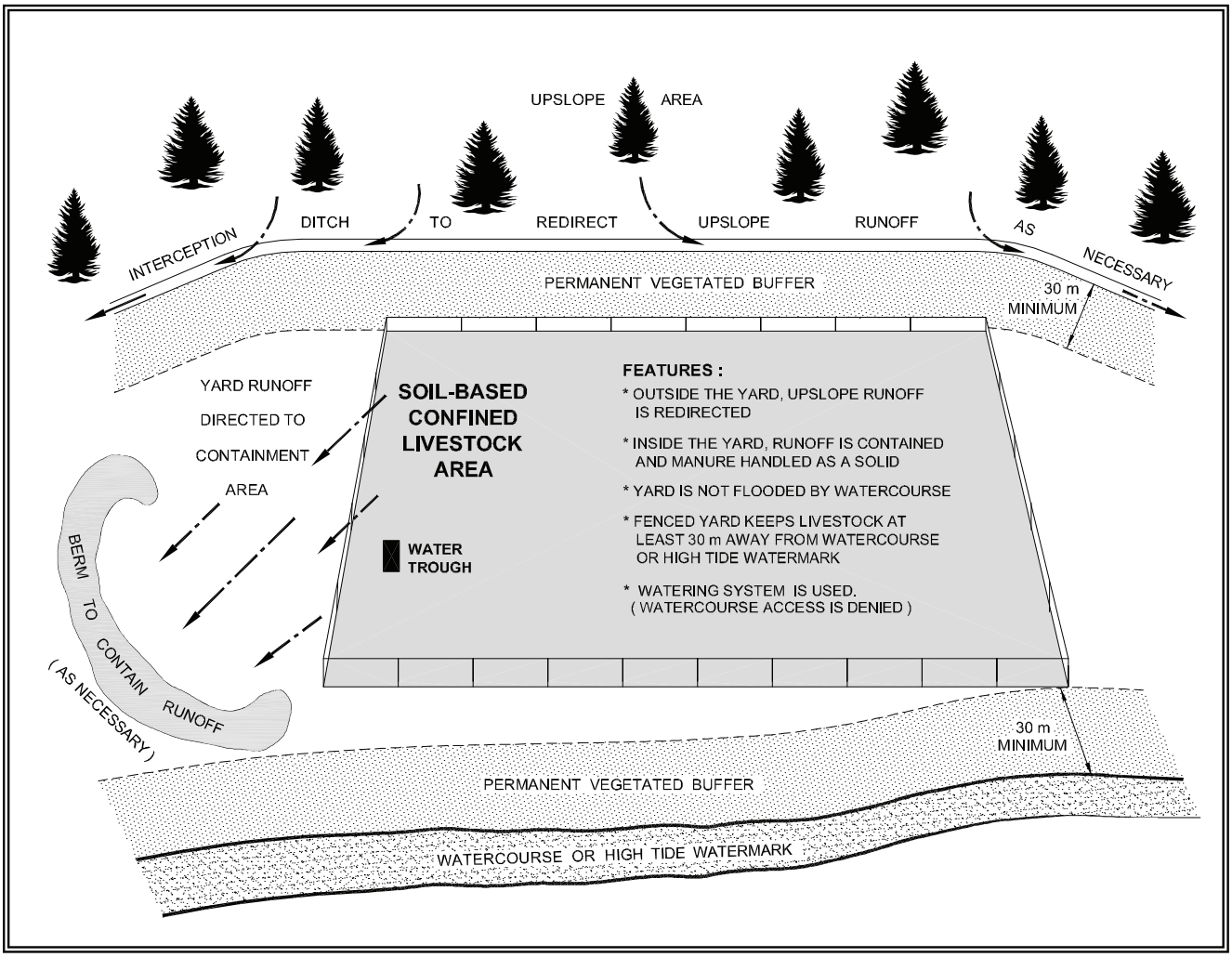


Figure 3.2 An Environmentally-Sound Confined Livestock Area – Soil-Based Yard

For soil-based yards, shown in Figure 3.2, previous page, include the general confined area beneficial management practices, and implement the following practices:

- align bedded mounds to drain runoff to collection areas, then use the water appropriately
  ➔ see Contaminated Water Collection, Storage and Use , page 9-44
- install hard surfacing to heavy livestock traffic areas and to areas along feed bunks and adjacent to waterers

Confined Concrete or Hard-Surfaced Yards. For concrete or hard-surfaced yards, shown in Figure 3.3, below, include the general confined area points on page 3-11, and implement the following practices:

- minimize the yard area to reduce the amount of precipitation that mixes with manure, and to reduce the labour needed to keep the area clean
- divert roof water and clean water from surrounding areas to prevent mixing with contaminated water within the yard
- regularly clean the open yard area by scraping wastes to storage structures suitable for either semi-solid or liquid manure

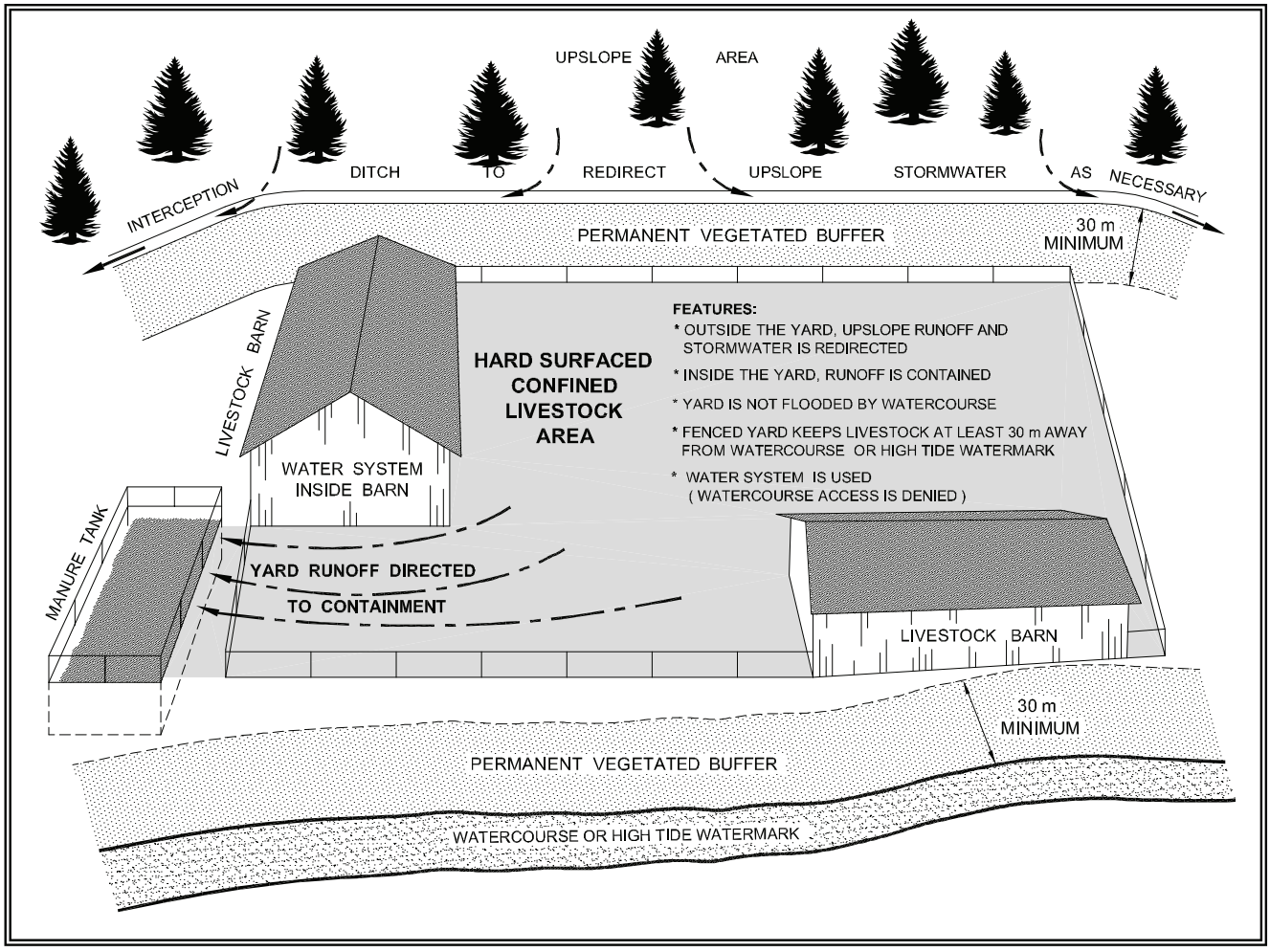


Figure 3.3 An Environmentally-Sound Confined Livestock Area – Hard-Surfaced Yard

Estimating Confined Livestock Area Runoff Volume. Use Worksheet #11, page 9-47, to estimate runoff volume:

- the formula uses a design storage capacity based on the most winter precipitation expected in 25 years (recommended by MOE)
- the winter storage period (either 6 or 7 months) depends on when the storage can be emptied in the spring
  - during the cropping season (May to October) any contaminated runoff can be directly applied to cropland for utilization

Seasonal Feeding Areas

Seasonal feeding areas are unique for two reasons:

- they are used for crop production, seasonally they are used for feeding livestock, and
- under the *Code* under the *Agricultural Waste Control Regulation*, these are the only areas where manure can be deposited (by the livestock) on crop land during winter (i.e., where livestock are fed, manure is deposited)

Section 26 of the *Code* under the *Agricultural Waste Control Regulation* requires seasonal feeding areas are managed so that:

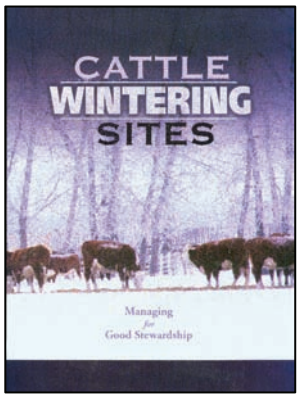
- livestock or livestock manure is spread over the crop land such that no area receives more nutrients than the crop needs
- runoff that leaves the area does not cause pollution

As seasonal feeding areas are used during the non-growing season, (not a preferred time to be spreading manure), the risk of runoff causing pollution is high. Runoff protection measures will be required for:

- high precipitation climates (precipitation is greater than 600 mm from Oct 1st to April 30th inclusive)
- areas where snow melting on frozen ground causes runoff

General Considerations. Implement the following practices:

- have stocking densities that do not cause soil compaction
- handle, store, and process feed properly
  ➔ Crop Processing, and Forage Crop Storage, page 4-10
- harrow manured areas in the spring to break manure clods
- collect and spread manure that is generated near fixed feed bunks as a fertilizer
- monitor watercourses for impacts from livestock watering and bedding by
  - checking visually for channel instability caused by hoof action from livestock having access to watercourses
  - lab testing for chemical and bacteriological contamination of watercourses caused by runoff or direct livestock access
- maintain runoff controls (e.g., ditches, berms, etc.)
- before using a feeding area, and where practical and appropriate, remove snow to reduce contaminated runoff
- limit livestock use of wet pastures to prevent soil compaction by keeping livestock in confined areas
- limit access to riparian areas by using fencing and off-stream watering
- when used as cow calving areas, give special attention to runoff flows
  ➔ see Outdoor Calving Areas, page 3-10
  📖 **Cattle Wintering Sites: Managing for Good Stewardship**



Site Considerations. For seasonal feeding areas, shown in Figure 3.4, next page, implement the following practices:

- locate facilities away from yard drain inlets, ditches, wells and watercourses
  - at least 30.5 m from wells (*Public Health Act*)
  - at least 30 m from a watercourse or high tide watermark (*Agricultural Waste Control Regulation*)
- locate such that contaminated runoff cannot reach adjacent watercourses
- locate where feeding site leachate cannot reach ground water
  - do not choose sites where ground water is near the surface or that have soils that will allow leachate to easily move to ground water
- locate in areas that are not subject to flooding nor receive significant runoff
- locate in such a way that upslope water can be diverted away from the feeding area
  - this will minimize the volume of contaminated water to contain
  - livestock may also benefit by having a drier site

- locate in such a way that all contaminated runoff can be contained
- implement downslope diversion to direct contaminated water onto adjacent established perennial forage for containment to allow nutrients to be used by the crop in the next growing season
- for small volumes, berm to direct or contain contaminated water onsite
- for large volumes, construct an impervious pond to contain the contaminated water

Watering. When watering livestock outdoors, implement the following practices:

- use an off-stream watering system to ensure low risk (**A** in Figure 3.4)
  ➔ see Livestock Water, page 9-13
- where an off-stream watering system is not feasible, use an access to a watercourse that is low impact (**B** in Figure 3.4)
  ➔ see Watering Livestock Directly from Watercourses, page 9-13

Bedding. When bedding livestock outdoors, implement the following practice:

- situate bedding sites to keep manure accumulations away from surface water and riparian areas
  - provide windbreaks that lure livestock away from treed riparian areas
  - locate water and feed sites to minimize the use of problem bedding areas
- if used, collect woodwaste bedding at least once a year (preferably in the spring) and handle appropriately ➔ see Woodwaste, page 2-27

Feeding. When feeding outdoors, implement the following practices:

- clean up wasted or spilled feed before it becomes a pollution risk
- locate feeders to ensure that manure build up around feeders does not pollute watercourses
- meet crop needs by moving feeding locations or portable feeders around the site as required to provide good manure distribution
- get approval for location of permanent feeders from MOE (*Agricultural Waste Control Regulation*)

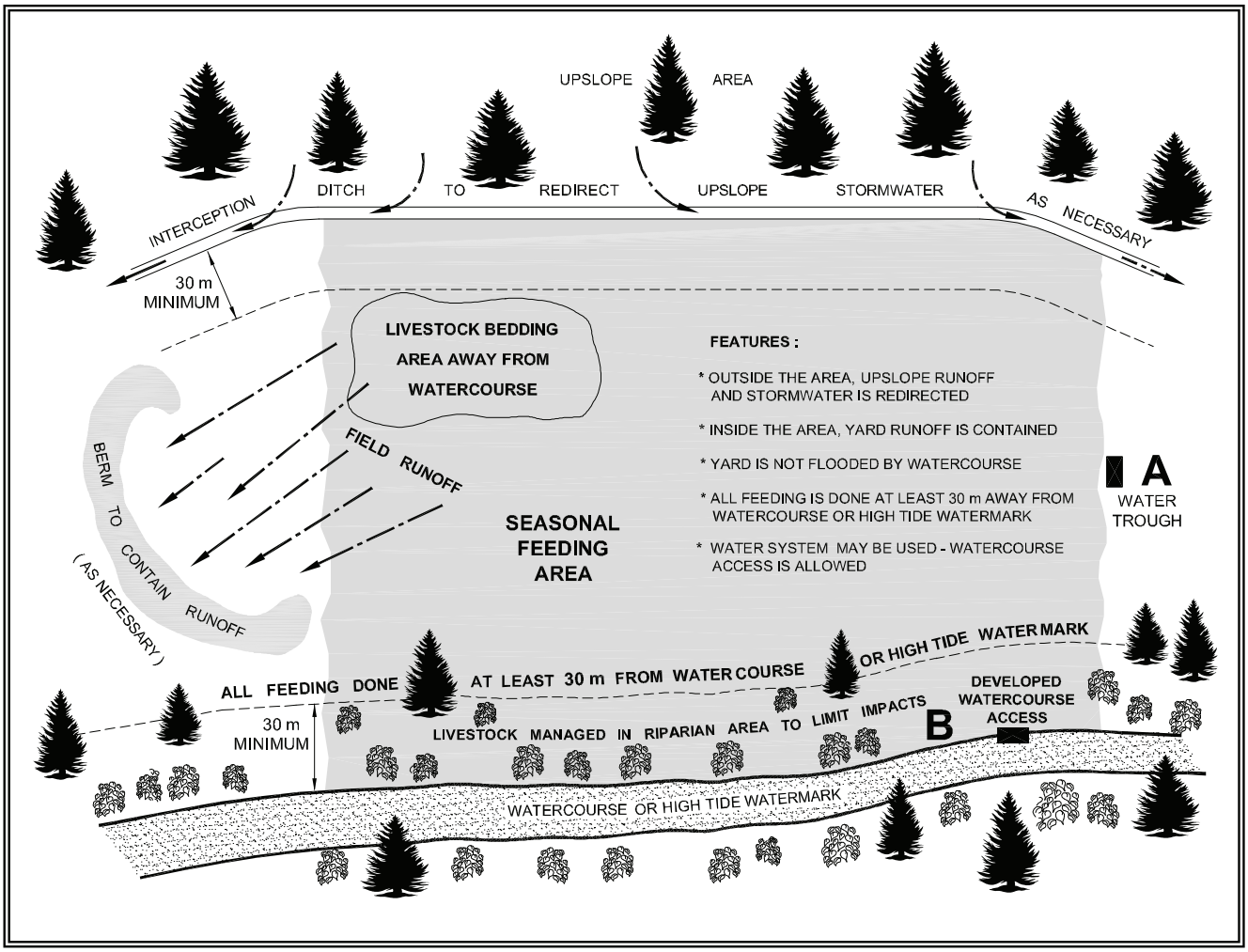


Figure 3.4 An Environmentally-Sound Seasonal Feeding Area

Perennial vs. Annual Crops on Seasonal Feeding Areas. For seasonal feeding areas with **perennial** forage crops, feeding intensity is normally low to prevent damage to the crop. Generally, the practices suggested above provide appropriate environmental protection. However, where a perennial crop is going to be plowed under the following year and feeding intensity is to be high, treat the feeding site as an annual crop site (see below).

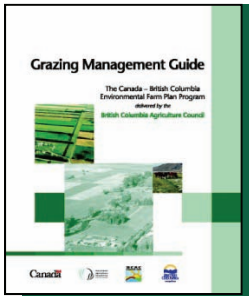
For seasonal feeding areas with **annual** forage crops, feeding intensity may not be governed by crop damage concerns. It is possible for these sites to take on some characteristics of confined feeding areas (e.g., dense manure pack, bare soil). In these cases, manage the areas similar to confined areas.

➔ see Confined Livestock Areas, page 3-8

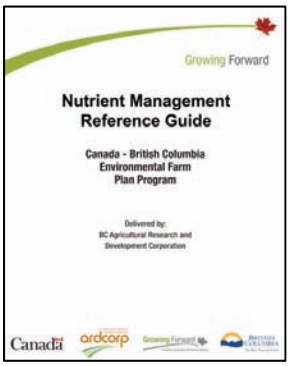
Grazing

Grazing areas vary from intensively-managed pastures to rangelands. Maintain the health of grazing areas by following the practices outlined in the Grazing Management Guide publication.

http://www.for.gov.bc.ca/hra/Practices/index.htm



Grazing Management Guide **is a publication that forms a part of the Environmental Farm Plan series on Beneficial Management Practices. Its purpose is to provide a checklist and guidelines for protecting pasture and range health. Is recommended to be used by producers having either pastures or private rangelands or who graze Crown land under a grazing lease. Table 3.3, next page, gives four basic pasture and range assessment questions that direct producers to the use of this publication.**



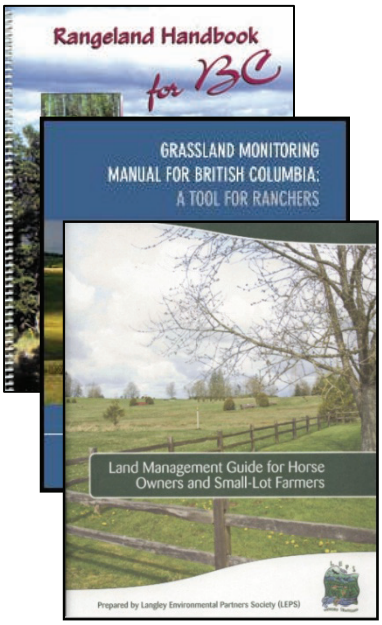
Manure Nutrients. If rainfall is adequate or if irrigation is used, pastures may have high productivity, and could support high stocking rates for long periods. Because grazing animals do not excrete more nutrients than they consume, manure nutrients produced during grazing will not exceed amount needed by the crop being grazed. As a result, collection and storage of manure will not be required and effective management will move livestock to distribute manure evenly over the grazed area. Manage sites experiencing contaminated runoff to ensure that nutrients stay on the pasture.

If manure distribution is uneven, as is possible around supplemental feeding areas, manure may have to be redistributed. If fertilizer is applied in addition to manure excreted during grazing, care must be used to not exceed crop needs.

📖 **Nutrient Management Reference Guide**

With intensively-managed pastures, such as grazing livestock on irrigated pastures, implement the following practices:

- use livestock waterers where feasible
- although access to watercourses is allowed, it is recommended that livestock waterers be installed on intensively managed pastures and that accessible portions of the watercourse be fenced off where appropriate
  📖 **Watering Livestock Directly From Watercourses**
- prevent stream banks from being trampled upon to protect fish habitat and stream banks from erosion
  ➔ see Watering Livestock Directly from Watercourses, page 9-13
- ensure that contaminated pasture runoff does not enter any watercourse
  ➔ see Runoff, page 9-42
- ensure no leachate is allowed to reach ground water
- do not graze livestock on saturated soils because they are easily compacted
- manage grazing to maintain a crop stubble that will filter runoff and hold soils in place
- place salt and mineral blocks or sources to lure livestock away from watercourses and sensitive areas
- harrow pastures regularly to break up manure clods, particularly in drier regions



For information on rangelands, refer to:

📖 **Rangeland Handbook for BC**
📖 **Grassland Monitoring Manual for British Columbia: A Tool for Ranchers**
📖 **Land Management Guide for Horse Owners and Small Lot Farmers**

Weeds. Weeds may be spread by grazing livestock. Control weeds before they become a problem. ➔ see Weeds, page 5-9

Table 3.3 Basic Pasture and Range Assessment Questions ★

1.Do Desirable Plants Make Up More Than One-half of the Vegetation Cover or Weight?

Desirable plants are those that contribute positively to the management objectives of your site, plants that:

- are readily consumed and persistent
- provide consistent amounts of forage (high tonnage)
- are perennial, except in tame pastures that are specifically being managed for annual species
- prohibit the introduction or spread of invasive plants; and
- provide enough litter and residue to conserve soil moisture and maintain soil stability

Undesirable plants can include those that are invasive, poisonous and those that crowd out desirable species.In tame pasture, undesirables may include woody invaders (rose, aspen, snowberry etc.) and those that are typically not eaten by most livestock or cause undesirable side effects when eaten.

A Southern Interior grassland composed primarily of low growing, relatively non-

A Southern Interior grassland composed of more than one-half highly productive and desirable large bunchgrasses.

An example of a Peace River aspen stand showing the removal of desirable tall forbs, grasses and shrubs. All that remains are low growing forbs that

Peace River aspen stand with an abundance of desirable plants including highly productive grasses, forbs and shrubs.

Examples of Desired Plant Communities

2. Does Leaf Length, Seed Production, Colour, and Overall Productivity of Desirable Plants Indicate Strong Vigour?

Plant vigour is reflected primarily by the size of a plant and its parts in relation to its age and the environment in which it is growing. However, periodic drought in dry land environments will lower the apparent vigour and annual productivity of desired plants. Plants with low vigour have a greater potential to be replaced by weedy invasive and low quality or poisonous plants.

Peace River aspen stand showing poor vigour, productivity and a loss of desirable tall forbs and

Peace River aspen stand showing excellent vigour, productivity and a mixture of desirable tall forbs, grasses and shrubs.

Southern Interior bunchgrass grassland showing poor vigour, productivity and a lack of desirable large

Southern Interior bunchgrass grassland showing excellent vigour, productivity and a dominance of large, more robust bunchgrasses.

Examples of Plant Vigour

3. Is Litter and Plant Residue Fairly Abundant and is Some of it Composed of Desirable Plants?

Litter and standing plant residue (dead material), in various states of decay, provides additional surface cover that:

- promotes nutrient cycling by providing organic matter to the soil
- reduces soil erosion by wind and water including reducing raindrop impact
- increases water infiltration into the soil by slowing runoff and providing a pathway into the soil profile
- promotes moisture retention by reducing evaporation

In order for litter and plant residue to be rated as fairly abundant, approximately 25 percent of the standing forage mass should either be dead or consist of dying leaves and stems:

- on tame pastures, less than 25 percent should either be dead or consist of dying leaves and stems
- anything greater than 25 percent may be excessive – too much litter and standing plant residue dead material will reduce the feed of the forage consumed and animal intake, as well as inhibits new plant shoot growth and seedling emergence

Southern Interior grassland with relatively little litter.

Southern Interior bunchgrass grassland with fairly abundant litter and plant residue (>25%), some of which is composed of desirable plants.

Examples of Plant Litter

4. Is the Area Free of Evidence Indicating Soil Movement or Loss?

When managing your grazing lands it is extremely important to prevent human caused soil movement or loss by maintaining adequate plant cover and minimizing the amount of exposed (bare) soil. Any loss of soil will lower the productivity of a site by removing finer soil particles like clays, silts and organic matter all of which are integral in maintaining soil fertility and a sites moisture holding capacity.

- soil compaction should be minimized as it decreases the amount of water available to plants by reducing water infiltration into the soil profile

Evidence of soil compaction:

- push a metal rod, pencil, or knife into the soil and interpret the ease of penetration
- compare in-field resistance to penetration with resistance found at a grazed fenceline
- compacted soil layers will increase the amount of resistance encountered
- the more noticeable the difference in resistance, the greater the compaction is in that pasture

Evidence of soil movement or loss includes:

- the presence of debris dams of plant residue that build up at obstructions or span between obstructions (sheet erosion)
- the presence of rills, which are small incised channels that run parallel to one another down a slope, indicate that serious soil loss is occurring
- the deposition of heavier soil particles downwind of obstructions such as fencelines, buildings and vegetation

Example of rills on a Southern Interior grassland.

Example of a gully on a Peace River pasture.

Examples of Soil Movement or Loss - Rills, Gullies and Pedestaling

★ **Pastures and ranges that do not have these features should refer to the *Grazing Management Guide* publication for assistance in more detailed assessment and management ideas to improve**

conditions.

MANURE HANDLING AND STORAGE

Manure is a valuable by-product of livestock operations. However, to realize its potential value and to avoid pollution problems, well-planned manure handling and storage systems are essential.

MANURE HANDLING AND STORAGE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to manure handling and storage are:

- manure handling, spillage, storage facility leakage, or overtopping that results in soil or water pollution, or impacts to habitat
- insufficient storage that requires manure spreading during high-risk seasons that results in water pollution
- inappropriate field storage that results in water pollution
- release of methane (CH_4) and nitrous oxide (N_2O), greenhouse gases that contribute to climate change
- release of ammonia (NH_3), volatile organic compounds (VOC) and nitrogen oxides (NO_x) which can chemically produce secondary particulate that results in pollution, human health concerns and visibility reduction
- release of odours associated with ammonia and other contaminants
- release of hydrogen sulphide and other air contaminants that result in air pollution

➔ see Chapter 6, Soil Amendments, regarding manure application to land

For information on these concerns:

➔ see Impacts on Biodiversity and Habitat, page 7-8, refer to Farm Activities and Impacts
➔ see Soil Quality Factors, page 8-2, refer to Contaminants, to Micronutrients and Metals, and to Salts
➔ see Water Quality and Quantity Factors, page 9-2, refer to Contaminants, and to Oxygen Demand
➔ see Air Quality Factors, page 10-1, refer to Contaminants, to Dust and Particulates, and to Odours
➔ see Climate Change Factors, page 12-1

MANURE HANDLING AND STORAGE LEGISLATION

The following is a brief outline of the main legislation that applies to manure handling and storage.

➔ see page A-1 for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Environmental Management Act

The *Code* under the *Agricultural Waste Control Regulation* has specific requirements regarding manure storage and use.

- Section 4: manure may be stored on a farm only if it is produced or used on that farm
- Section 5: when manure is stored, it must be stored in a storage facility, in field storage or, in the case of fur bearing animals, under their outdoor pens
- Section 6: a manure storage facility must be of sufficient capacity to store all manure for a period needed to allow its application as a fertilizer, prevent the escape of any waste that causes pollution, and be maintained in a manner to prevent pollution
- Section 7: a manure storage facility must be located at least 15 m from any watercourse and at least 30 m from any source of water for domestic purposes
- Section 8: solid manure may be stored on a field for 2 weeks or less if it is used within 2 weeks and stored to prevent pollution; it may be stored for no longer than 9 months if it is located at least 30 m from any watercourse or any source of water used for domestic purposes, and stored in a manner that prevents pollution
- Section 9: field-stored manure must be covered (Oct. 1st to April 1st) in areas that receive a total average precipitation more than 600 mm during Oct. 1 to April 30 (refer to Appendix Figure B.1, page B-2)
- Section 10: for fur bearing animals, manure can be stored for up to 9 months if under pen storage is at least 15 m from a watercourse and at least 30 m from any source of water used for domestic purposes and stored in a manner that prevents pollution

The *Spill Reporting Regulation* requires spills of a polluting substance (including manure) be reported immediately to Provincial Emergency Program (PEP) at 1-800-663-3456 (24 hour service). Report spills of manure greater than 200 kg or 200 litres.

Public Health Act

This Act prohibits activities that may cause a health hazard:

- Section 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard

The Act also has conditions under the *Public Health Act Transitional Regulation*:

- Section 18: separation distance of wells to be at least 30.5 m from any probable source of contamination (a probable source could include manure)

Fisheries Act

This Act has two sections of importance to manure management:

- Section 36(3): prohibits the deposit of deleterious substances into watercourses (deleterious substance could include manure)
- Section 38(4): requires reporting infractions of Section 36

Migratory Birds Convention Act

This Act has a section of importance to manure management:

- Section 35(1): prohibits the deposit of any substance harmful to migratory birds to any area frequented by migratory birds

MANURE HANDLING AND STORAGE BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable manure related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

➔ see Chapter 6, Soil Amendments, regarding manure use (i.e. application to land)

Manure Handling

Minimize the risk of causing pollution when manure handling during cleanup of pens or barns and moving to or from storage facilities by implementing the following practices:

- contain manure during transport within equipment to avoid spills
- ensure manure is not carried onto public roads by equipment tires
- limit the amount of manure handling near watercourses
- in case of a pipe break when piping manure near watercourses, have a containment method, such as a double-walled pipe within 10 m of the watercourse (suggested) and a low pressure switch to turn off the pump
- where manure is moved from barns or pens to storage facilities by scraping over outside hard surfaces, ensure runoff from these surfaces is collected
- have a manure spreading plan ➔ see Nutrient Application, page 6-8
- where possible, use air emission and odour-reduction practices
  ➔ see Air Emissions, page 10-5,
  ➔ see Odours, page 10-13

Manure Storage

Storage of manure is necessary during times of the year when manure cannot be applied to cropland, either because the crop will not be able to utilize the nutrients, or the risk of causing pollution is too high.

Storage Facilities. A storage facility is a permanent structure designed and operated to contain manure and other agricultural wastes in an environmentally sound manner and sized to hold wastes until they can be used as a fertilizer.

Implement the following practices for all manure storage structures:

- only store manure produced, or that will be used, on the farm (do not store manure produced off the farm that will be used off the farm, *Agricultural Waste Control Regulation*)
- have facilities designed by a professional engineer whether of earthen, concrete or metal construction
- size facilities to provide storage for the manure, any contaminated water that may enter, and if not roofed, precipitation
- size to enable the wastes to be stored until it can be spread as a fertilizer
  ➔ see Manure Storage Sizing , page 3-27
- cover solid or semi-solid manure storages in high rainfall climates (greater than 600 mm total winter precipitation)
  ➔ see Appendix B.1 for a map showing high and low precipitation areas, page B-1
- incorporate leak detection with semi-solid and liquid storages as shown in Figure 3.5, next page
- incorporate secondary containment with liquid storages
- locate on a well-drained graded site, to divert clean runoff away (collecting clean water is an expense to be avoided)
- protect from 100-year flood events
- establish and maintain an adequate buffer between manure storage and watercourses to prevent wastes or leachate from polluting
  ➔ see Buffers, page 11-4

Leak Detection. Good management of semi-solid and liquid manure storages requires a means of monitoring for leaks. If a storage facility is built on fine-textured or "clayey" soil, install a tile line draining to a dry observation well underneath the structure. Check the observation well for the presence of leachate at least four times a year. Implement the following practices (see Figure 3.5, next page):

- install a tile line under the middle of the facility, and
- under the facility at the toe of the sloping wall for lagoon type, or
- about 1 m (suggested) inside the perimeter for concrete or steel walled type facilities
- install a tile line for every 3,000 m^2 of floor area (suggested)

In coarse-textured soils, lines underneath storages may not detect leakage because percolation paths tend to be more vertical than in less permeable soils. Complete monitoring would include regular testing for ammonia and nitrate levels in ground water around the facility.

Secondary (Failure) Containment. If a structural failure of a liquid manure storage facility would result in manure entering a watercourse, install some form of secondary containment. Secondary containment can be as simple as a berm away from the manure storage located and sized such that any manure

that might escape from the failed structure could be contained behind the berm. Sizing will normally be equal to the volume of manure stored.

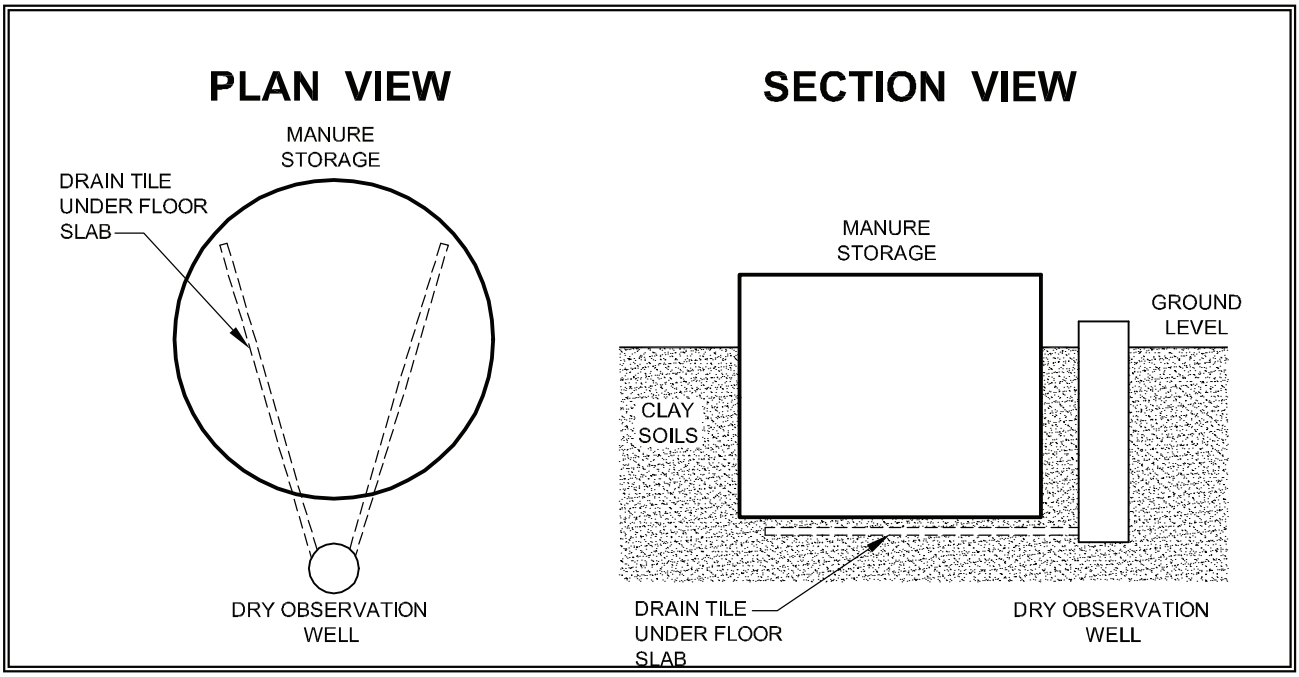


Figure 3.5 Leak Detection Under a Manure Storage Facility

Solid Manure Storage

Solid manure has a solid content of 20% or more and retains its shape when piled. Uncovered solid manure structures are suitable only if runoff from such storages is collected. Typical features of solid manure storage are shown in Figure 3.6, page 3-27. In addition to the practices described in Manure Storage, page 3-23, implement the following practices:

- construct a concrete base and a curbed sidewall along at least one side to allow easy unloading of the facility
- in high rainfall climates, construct a sump to collect and store the contaminated leachate for future land spreading

Field Storage of Solid Manure. Field storage is **temporary** storage, used just prior to spreading on cropland. Under sections 8 and 9 of the *Code* under the *Agricultural Waste Control Regulation*, only solid manure may be piled in a field storage area, and **storage time is to be limited**. Field storage is not meant to replace a storage facility and storage directly on the ground is not recommended in high rainfall climates and in areas with high water tables.

Field storage is the **least desirable** method of storing manure due to the inherent difficulty in containing leachate. Because constant attention is required to operate and monitor a covered field storage site in a manner that does not cause pollution, only use such systems until a permanent facility can be built.

Note: The *Code* under the *Agricultural Waste Control Regulation* has different requirements for field stored solid manure depending on what time of year the manure is stored in the field (such as in the winter or in the summer) and if the manure is stored for more than or less than 2 weeks. Refer to the *Code* under the *Agricultural Waste Control Regulation* in Appendix A for details.

For field storage of solid manure implement the following practices:

- locate field storage away from ditches, wells and watercourses
- at least 30.5 m from wells (*Public Health Act*)
- at least 30 m from a watercourse if stored more than two weeks (*Agricultural Waste Control Regulation*)
- 30 m or more from a water intake used for domestic purposes (suggested)
- locate on a graded site to divert runoff away
- locate on fine-textured or "clayey" soils to protect ground water from leachate (avoid locating on coarse textured or gravely soils)
- protect from possible flooding events
- build up piles quickly, then cover and leave until used; field storages are not meant to be loaded on a daily or weekly basis
- cover with a tarpaulin or plastic to keep rainwater from entering the pile and to prevent the escape of effluent
- the *Code* under the *Agricultural Waste Control Regulation* requires piles to be covered (Oct 1st to April 1st) where total average precipitation is greater than 600 mm from Oct. 1st to April 30th

Semi-Solid Manure Storage

Semi-solid manure has less than 20% solids, but does not flow freely as liquid manure. In addition the practices described in Manure Storage, page 3-23, implement all of the following practices:

- construct reinforced concrete walls or adequately strong wooden walls along at least three sides, to contain manure
- construct concrete floor sealed at the walls to provide manure tight storage and prevent the entrance of ground water or runoff
- in areas with high water table, construct entirely above ground to minimize inward seepage of ground water
- construct an adequate roof to keep out rain and snow particularly in areas with high annual or seasonal precipitation (unless extra size is less expensive than the roof or extra dilution is of value)
- in drier interior regions, an uncovered storage structure may be suitable
- in high rainfall climates, construct a sump to collect and store the contaminated leachate for future land spreading
- if roofed or enclosed, have ventilation to prevent any accumulation of hazardous gases and to aid in the drying of the wastes
- construct access doors or bulkheads of tight fitted tongue-and-groove pressure treated timbers and collect any seepage
- have a system to detect leaks
- construct a suitable concrete slab area for tractor and manure spreader activity, sloped away from the building so that water on the slab does not enter the storage area
- if runoff becomes contaminated, ➔ see Runoff, page 9-42

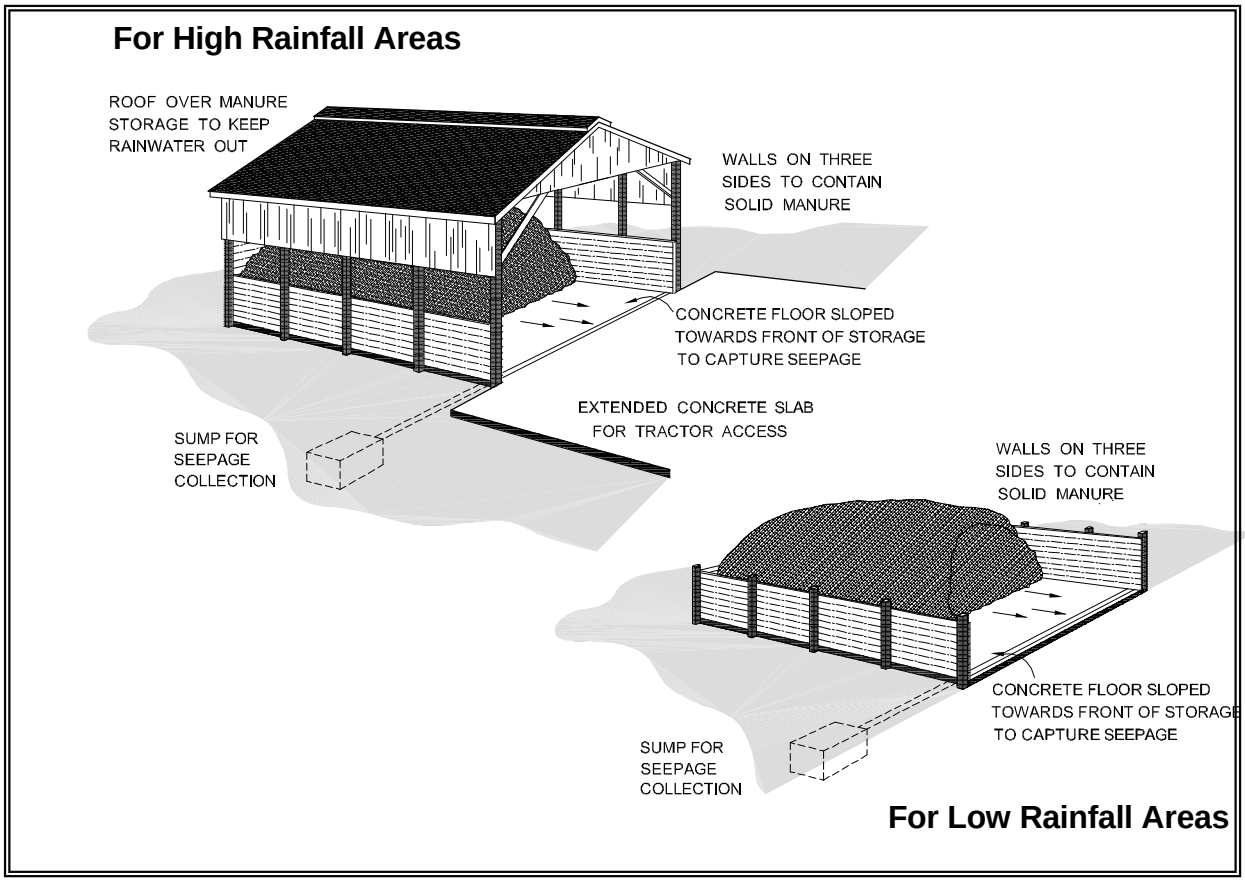


Figure 3.6 Typical Solid Manure Storage Facilities

Liquid Manure Storage

Liquid manure storage structures are used for containing liquid wastes such as manure or contaminated water. In addition the practices described in Manure Storage, page 3-23, implement the following practices:

- construct of sulphate-resistant concrete with a compressive strength of 20 MPa or greater (suggested), plastic, glass-lined metal, etc.
- if very large, construct cross walls and/or baffles to facilitate agitation
- if constructed entirely or partially above grade
- ensure valves close tightly and install backup valves
- install a manure level indicator that is readable from the ground
- if constructed entirely below grade and covered
- install childproof access ports weighting 20 kg or more (suggested)
- divert clean runoff away from the tank
- have a system to detect leaks
- install an auto shut off for manure transfer tanks
- have secondary containment
- limit uncovered surface area to reduce odour and fly problems

Manure Storage Sizing

Size a storage facility to allow all manure generated on the farm to be used as a fertilizer with little chance of causing pollution. Note that manure storage sizing

assumes the facility will be empty, or near empty, at the start of the no-spread season.

Estimating Daily Manure Volume. The average daily livestock waste volumes produced by livestock type or class may be obtained using the standard values listed in Table 3.4, page 3-29. More accurate estimates can be obtained by measuring actual manure volume produced.

Determining Storage Duration. Manure storage requirements vary depending on the farm location in the province. Typically, 6 months (180 days) of storage are required for the Fraser Valley and Vancouver Island. Other parts of BC may need 7 months (210 days) or more of storage. Variations within regions depend on crops grown and field accessibility factors such as soil type, soil temperature, and local rainfall. Storage requirements are reduced on farms where manure is spread on grasslands on well drained soils.

➔ see Appendix B.1, page B-2, for BC map showing recommended storage periods

Determining Manure Storage Size. Size storages using Worksheet #2, page 3-30, for liquid manure or Worksheet #3, page 3-32 for solid manure. Using the appropriate worksheet, follow the steps below:

- Step 1: estimate daily manure volume
- Step 2: determine manure storage required
- Step 3: determine total storage required
- to determine contaminated runoff to be collected for the duration of time that manure spreading is not possible, use Worksheet #11, page 9-47
- estimate the amount of other contaminants, such as silage leachate
- Steps 4 and 5: determine the effective depth and size the storage facility

Note that if a chosen width and depth does not give the preferred length, choose different width(s) and/or depth(s) until the calculated length is acceptable. For the same depth, a wider width will reduce the length; a narrower width will increase the length.

📖 **Sizing Dairy Manure Storage Facilities**

Table 3.4 Average Daily Livestock Waste Production and Suggested Storage

Worksheets #2, #3

Class of Animal		Waste Production	Liquid[1] Manure Storage	Solid Manure Storage [2]	
				Solid [3]	Liquid Leachate
		Litres/day	Litres/day	Litres/day	Litres/day
Beef Cattle	Cow or Bred Heifer	28	40	34	
	Calves (to 230 kg)	7	10		
	Yearlings (to 340 kg)	14	20	17	
	Heavy Feeders (to 500 kg)	21	31	23	
Dairy Cattle	Dairy Calves (0 to 3 months old)	6	6		
	Dairy Calves (3 to 6 months old)	8	11		
	Heifers (6 to 15 months old)	16	22	19	4
	Heifers (15 to 26 months old)	24	35	25	7
	Dairy Cow – free stall (avg. 640 kg)	60	75	63	12
	Dairy Cow – tie stall (avg. 640 kg)	60	67	65	10
	Dairy Cow – loose housing (avg. 640 kg)	60		75	
	Milk centre wastes per milking cow	22 to 45 [4]			
Ducks	(avg. 1.4 kg)	0.15			
Goats	(avg. 64 kg)	2.6			
Horse	(avg. 450 kg)	26.1		56.6	
Poultry Eggs	Pullets – cage housing	0.039		0.039	
	Pullets – floor housing	0.039		0.059	
	Layer	0.13		0.13	
	Broiler Breeder Layer – cage housing	0.14		0.14	
	Broiler Breeder Layer – floor housing	0.14		0.18	
Poultry Meat	Broiler Breeder Pullets	0.049		0.077	
	Broiler Chicken	0.054		0.096	
	Roaster Chicken	0.057		0.090	
	Turkey Broiler	0.20		0.29	
	Turkey Heavy Hen	0.29		0.41	
	Turkey Heavy Tom	0.33		0.47	
Rabbits	Doe and Litter	0.71			
Sheep	Ewe or Ram	2.8	6.8	4.2	
Hogs	Dry Sow, Boar or Gilts	11.3	15.8	13.6	
	Nursing Sow and Litter	16.8	23.5		
	Nursery Pigs (5 to 20 kg)	1.8	2.5		
	Grower Pigs (20 to 60 kg)	4.5	6.3		
	Finisher Pigs (60 to 100 kg)	8.6	12.0		
	Grower Finisher Pigs (20 to 100 kg)	7.2	10.1	10.1	
Veal	(avg. 91 kg)	5.6			

[1] Liquid manure production includes typical spilled drinking water and wash water.

[2] Some solid manure storages will have a liquid leachate which must be stored separately.

[3] Including bedding.

[4] This is a typical range – less milking centre waste is produced per cow for large milking herds compared to small herds.

Worksheet #2 — Sizing Liquid Manure Storage — Workbook Question 103

Question: A dairy farmer in Enderby wants to build a manure storage facility to hold manure from a 100 milking cow herd, milking centre wastes, 512 m^3 of contaminated runoff and 35 m^3 of silage juices for 180 days. What length should the uncovered facility be, if 3 m deep and 20 m wide?

What size of liquid manure storage is required for this livestock operation?

Information:

Reset

Desired storage duration (select site) — Enderby	180	1	days
Precipitation on the site from Oct 1 to April 30	0.456	2	m
Storage depth	3	3	m
Storage width	20	4	m
Check if storage is roofed: ☐	NO		
Runoff to be stored from roofs and confinement yards - from Worksheet 11	512	5	m^3
Other liquid wastes to be stored	35	6	m^3

Calculation:

Step 1 Establish daily manure volume

Equation:

Daily Manure Production for type and Class of Class of Livestock = Number of Animals x Animals Daily Manure Production Rate

Class of Animal	7 Average Number on Farm		8 Liquid Manure Storage Litres per day per animal		9 Total Storage Required Litres/day
Dairy - Calves (0 to 3 months old)	10	x	6	=	60
Dairy - Calves (3 to 6 months old)	10	x	11	=	110
Dairy - Heifers (6 to 15 months old)	28	x	22	=	616
Dairy - Heifers (15 to 26 months old)	33	x	35	=	1155
Dairy - Cows – free stall (avg. 640 kg)	20	x	75	=	1500
Dairy - Cows – free stall (avg. 640 kg)	100	x	75	=	7500
Dairy - Milk centre wastes per milking cow	100	x	30	=	3000
		x		=	0

Farm daily manure volume

Equation:

Farm Daily Manure Production = Sum of the Daily Manure Production For Each Livestock Type or Class

	13941	10	Litres/day
Converted to m^3:	13.9	11	m^3/day

Step 2 Determine manure storage required

Equation:

Manure Storage required = Farm daily manure production x Days of storage required

= 13.94 (11) m^3/day x 180 (1) days = 2509.38 (12) m^3

Step 3 Determine total storage required

Equation:

Total storage required = Manure Storage required + Contaminated runoff (liquid storage only) + Other Liquid Wastes

= 2509 (12) m^3 + 512 (5) m^3 + 35 (6) m^3 = 3056.38 (13) m^3

Step 4 Determine effective storage facility for rectangular tanks

NOTE: If calculated length is unsuitable, choose different width or depth until size is suitable.

Equation:

Effective storage depth	=	Storage depth	-	Precipitation at the site (0 if roofed)	-	Safety freeboard (normally 0.2 m)
	=	3 (3) m	-	0.456 (2) m	-	0.2 m = 2.3 (14) m

Equation:

Storage length	=	Total storage required	÷	Effective depth of storage	÷	Storage width
	=	3056 (13) m^3	÷	2.3 (14) m	÷	20 (4) m = 65.2 (15) m

Answer: An uncovered manure storage facility for this farm should be 3.0 m deep by 20.0 m wide and 65.0 m long to hold precipitation that falls directly into the storage and 3,056 m^3 of waste.

Worksheet #3 Sizing Solid Manure Storage Workbook Question 103

Question: A layer farmer in Abbotsford wants to build a manure storage facility to hold litter from a 50,000 layer flock and 25,000 pullets (floor housed) for 180 days. What length should the uncovered facility be, if 3 m deep and 20 m wide?

What size of solid manure storage is required for livestock operation?

Information:

Reset — Desired storage duration (select site): Abbotsford

	180	1	days
Storage depth	3	2	m
Storage width	20	3	m
Other solid wastes to be stored	0	4	m^3

Calculation:

Step 1 Establish daily manure volume

Equation:

Daily Manure Production for type and Class of Class of Livestock = Number of Animals x Animals Daily Manure Production Rate

Class of Animal	5 Average Number on Farm		6 Solid Manure Storage Litres per day per animal		7 Total Storage Required Litres/day
Eggs - Layer	50000	x	0.13	=	6500
Eggs - Pullets – floor housing	25000	x	0.059	=	1475
		x		=	0
		x		=	0
		x		=	0
		x		=	0
		x		=	0
		x		=	0

Farm daily manure volume

Equation:

Farm Daily Manure Production = Sum of the Daily Manure Production For Each Livestock Type or Class

Farm daily manure volume	7975	8	Litre/day
Converted to m^3	8.0	9	m^3/day

Step 2 Determine manure storage required

Equation:

Manure Storage required = Farm daily manure volume x Days of storage required

8.0 (9) m^3/day x 180 (1) days = 1435.5 (10) m^3

Step 3 Determine total storage required

Equation:

Total storage required = Manure storage required + Other solid wastes

= 1435.5 (10) m^3 + 0.0 (4) m^3 = 1435.5 (11) m^3

Step 4 Determine effective storage facility for rectangular tanks

NOTE: If calculated length is unsuitable, choose different width or depth until size is suitable.

Equation:

Effective storage depth = **Storage depth** - **Safety freeboard (normally 0.2 m)**

3.0 2 m - 0.2 m = 2.8 12 m

Equation:

Storage length = **Total storage required** ÷ **Effective depth of storage** ÷ **Storage width**

= 1435.5 11 m^3 ÷ 2.8 12 m ÷ 20.0 3 m = 25.6 13 m

Answer: An uncovered manure storage facility for this farm should be 3.0 m deep by 20.0 m wide and 25.6 m long to hold 1,436 m3 of waste. **Note:** an uncovered solid manure storage is not recommended due to the risk of spontaneous combustion. Also precipitation falling in this manure storage facility would generate contaminated runoff that would need to be collected and handled as a liquid waste. A roof on the storage facility to exclude precipitation is recommended.

Manure Gas Emissions Reduction

Carefully plan and manage the handling, composting, spreading or storage of all wastes to avoid the creation of gas emissions and nuisance conditions.

Implement the following practices to minimize the release of emissions from manure:

- choose manure storage options that will reduce the release of emissions, such as:
  - using dry rather than wet storage methods when there is the option
  - use enclosed storages that reduce air movement across the surface of manure storage
- minimize the handling and agitation of manure during storage
- minimize amount of bedding in manure, such as straw or woodchips
- keep storage tanks cool by either insulating or placing below ground
- for liquid manures, separate urine and feces immediately upon excretion to reduce ammonia emissions
- do not wet or re-wet solid manure to avoid N_2O emissions
- incorporate vegetative buffers around manure storage facilities
  ➔ see Buffers, page 11-4
- use methane collection and utilization techniques such as anaerobic digestion
  ➔ see Climate Change Mitigation Beneficial Management Practices, page 12-10, and refer to On-Farm Energy Production

  📖 **Farm Practices - Manure Storage and Use**

Covered Storage. Cover storages, particularly for liquid manure, to reduce gaseous emissions that are air contaminants and can lead to odours. Liquid systems can also be covered with permeable covers, such as mineral oil, straw or peat on tanks or lagoons. A secondary but major benefit in covering storages for all types of waste is that snow and rain are excluded, thereby reducing the amount of material needed to be both handled and stored. In addition, covers

keep solid manure dry, which is necessary to prevent anaerobic conditions from occurring and to reduce the risk of leachate generation.
To reduce emissions from covered storage, use the following as guidelines:

- for solid manure storages install an impermeable cover, impermeable base, and run-off control
- for tanks and lagoons for liquid manure storage, install either an impermeable or permeable cover
- install an air-inflated fabric roof system or floating cover on an open tank
- use bottom loading tanks for liquid manure storage to minimize aeration

Table 3.5 shows effectiveness of manure cover options in reducing emissions for various air contaminants.

Table 3.5 Efficacy of Covered Manure Storage Options for Emission Reduction

Cover	Type	Effectiveness (%)				
		Odour	H2S	NH3	Life Expectancy	Relative Capital Cost (1 = most expensive)
	Inflatable plastic	95	95	95	10 years	1
	Floating plastic	95	95	95	10 years	2
	Natural crust	10 – 90**	10 – 90**	10 – 90**	2 to 4 months	5
	Straw	40 - 90	80 - 95	25 - 85	Up to 6 months	4
	Geotextile (non-woven, 6.35 mm thick)	15 - 75	0 - 100	25 - 50	3 - 5 years	3

Adapted from University of Kentucky, College of Agriculture, Using Covers to Minimize Odor and Gas Emissions from Manure Storages, José R. Bicudo, David R. Schmidt, and Larry D. Jacobson
**depends on thickness and other physical characteristics of the natural crust.

Nutrition and Ration Management. Nitrogen in manure can be controlled through nutrition and ration management by formulating diets as close as possible to the requirements of the animal. For optimal growth, animals are often overfed crude proteins to meet the intake levels needed of valuable amino acids. In this case other amino acids are supplied in excess and excreted in urine as ammonia or in manure as undigested protein. Controlling the amount of Nitrogen uptake particularly in non-ruminants, including poultry and swine, can significantly reduce nitrogen losses as ammonia or during land application. This can be done by:

- reducing protein in diets and formulating diets closer to the animals needs
- supplementing diets with synthetic amino acids to allow the dietary protein (nitrogen component) to be minimized
- have a nutrition analysis done on your feeding practices

📖 **Reducing Nitrogen and Phosphorus in Manure Through Ration Changes**

Anaerobic Manure Handling. The decomposition of manure in the absence of oxygen, known as anaerobic decomposition, results in the release of many odorous and often dangerous gases, including ammonia, hydrogen sulphide, and methane. Gas release is increased when manure is disturbed or spread. Anaerobic conditions occur within one hour when wet manure is stored in piles or as little as 15 minutes when liquid manure is stored in tanks. Manure odours from solid manure can be minimized by:

- keeping manure sufficiently dry to allow air movement and aerobic conditions through the pile to occur
- using appropriate manure timing and application techniques

Manure Treatment

Treatment is usually considered an unnecessary expense if manure can be applied directly to land. Solid liquid separation, a relatively common practice for liquid waste systems, offers advantages that improve handling. Such systems typically only remove a small fraction of the total solids and nutrients and do not significantly alter liquid storage volumes required.

Treatment systems are currently being developed that use physical, chemical and biological technologies to redistribute as many nutrients as possible from the liquid portion to solids.

Manure Treatment for Odours. In situations where well-managed manure storages or field spreading practices are not enough to control odours, manure treatment options can be considered. These could include:

- aerobic treatment and carbon reduction for liquid manure systems
- composting for solid manure
- using additives to manure or bedding for odour reduction
- using emission and odour control technology on housing or storage facilities, such as scrubbers or electrostatic precipitators

Manure Additives. Ammonia emissions can be controlled by using additives to manure, feedlots, manure piles and land applying along with manure

spreading. Additives to control ammonia emissions function by binding ammonia, by inhibiting the enzyme that breaks urea down to ammonia, or a pH balancing. Additives can be incorporated in manure slurries, manure piles or in livestock holding areas.

- use manure additives to reduce ammonia from liquid or dry manure
- manure additives are effective for the following systems:
  - storage slurry, storage dry pile or onsite in livestock holding areas

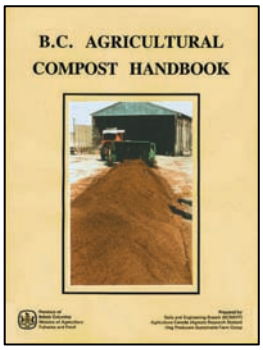
📖 **Manure Treatment Options vs. Available Land Base**

Manure Use

Manure produced on the farm can be used on-farm, by other farmers, or by the public.

Land Application. The best current option for manure disposal is in its application to crops as a fertilizer to provide nutrients or to improve soil conditions.

➔ see Chapter 6, Soil Amendments



Compost. On-farm manure can be composted and then used on the farm or sold off the farm. Section 15 of the *Code* under the *Agricultural Waste Control Regulation* specifies composting conditions. If a producer wants to take in manure from other farms to compost and then market the compost off the farm, approvals from MOE and the Provincial Agricultural Land Commission are required.

➔ see Compost, page 2-32.

📖 **B.C. Agricultural Compost Handbook (series of Factsheets)**

Soilless Media Production. Untreated manure can be used along with other materials such as sand or sawdust to create a suitable media for landscaping or nurseries. However, in most cases composted manure is the preferred choice. Separated solids, or solids with finely chopped bedding, can also be used.

Refeeding. Recycling of some types of manure to livestock as a feed ingredient is permitted under the federal *Feeds Act*. Agriculture and Agri-Food Canada requires the registration of all feed ingredients and their sources. Because consumer opinion towards refeeding is generally adverse, it is recommended that this practice not be implemented for livestock feeds in BC.

Manure Spills

If a manure spill occurs, implement the following practices:

- construct berms or other containment measures to prevent its spread
- clean up the site by removing the manure and soil with excess nutrients for eventual use as a fertilizer or soil amendment

Reporting Requirement

Under the *Spill Reporting Regulation*, manure spills greater than 200 kg or 200 litres must be reported immediately to the Provincial Emergency Program (PEP) at 1-800-663-3456 (24hr service).

Manure Contingency Plan

Develop a contingency plan when storing any amount of manure. The plan should outline a timely and effective response to any emergencies involving the release of manure products into the environment from:

- accidental spills, such as when transporting, storing, applying or dispensing
- equipment failures
- release due to building fires or vandalism
- release due to natural events, such as forest fires, floods, or earthquakes

📖 **Contingency Plan – Template for On-Farm Planning**

MORTALITY DISPOSAL

MORTALITY DISPOSAL ENVIRONMENTAL CONCERNS

Primary environmental concerns related to dead animal disposal are:

- death of livestock due to disease that results in disease spread
- holding or burial sites that result in surface or ground water or air pollution
- flies or rodents that results in a nuisance and disease transfer to people, livestock or wildlife
- attraction of predators to the site that may be undesirable for wildlife

For information on these concerns:

- ➔ see Water Quality and Quantity Factors, page 9-2, and refer to Contaminants, and to Oxygen Demand
- ➔ see Air Quality Factors, page 10-1, and refer to Odours
- ➔ see Impacts on Biodiversity and Habitat, page 7-8, and refer to Farm Activities and Impacts

MORTALITY DISPOSAL LEGISLATION

The following is a brief outline of the main legislation that applies to mortality disposal.

- ➔ see page A-1 for a summary of these and other Acts and Regulations

Drinking Water Protection Act

This Act and Regulations have requirements regarding the protection of drinking water quality and regulate domestic water systems (those serving ***more*** than one single-family residence).

- Section 23(1): subject to subsection (3), a person must not (a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or (b) do or cause any other thing to be done or to occur if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system

Forest and Range Practices Act

This Act has conditions under the Range Planning and Practices Regulations:

- Section 35: requires dead livestock within 100 m of a watercourse in a community watershed be removed as soon as the holder becomes aware of the dead livestock

Environmental Management Act

The *Code* under the *Agricultural Waste Control Regulation* makes provisions for on-farm mortality disposal through composting, burial and incineration provided that the disposal activities are carried out on the farm where the animal died.

- Section 23: outlines the requirements for burial or incineration, including
  - burial pits located at least 30 m from any source of water used for domestic purposes
  - incineration emissions not exceed 180 mg per m^3 of particulate matter and 20% opacity
- Section 24: outlines the requirements for composting, including
  - composting site located at least 15 m from a watercourse and at least 30 m from any source of water used for domestic purposes

The *Spill Reporting Regulation* requires spills of a polluting substance (including mortalities) be reported immediately to Provincial Emergency Program (PEP) at 1-800-663-3456 (24 hour service). Report spills of mortalities greater than 200 kg or 200 litres. Or report any amount, if the mortality spill contains organisms that are or that are reasonably believed to be infectious.

Public Health Act

This Act prohibits activities that may cause a health hazard:

- Section 15: a person must not willingly cause a health hazard, or act in a manner that the person knows, or ought to know, will cause a health hazard

The Act also has conditions under the *Public Health Act Transitional Regulation*:

- Section 18: requires separation from wells to be at least 122 m from any cemetery or dumping ground (cemetery could include buried mortalities)

Wildlife Act

The provincial *Wildlife Act* protects wildlife designated under the Act from direct harm, except as allowed by regulation (e.g., hunting or trapping), or under permit. Legal designation as Endangered or Threatened under the Act increases the penalties for harming a species. The Act also enables the protection of habitat in a Critical Wildlife Management Area.

The Act makes it an offence to feed dangerous wildlife (e.g. bear, cougar, coyote, wolf).

Health of Animals Act

The Health of Animals Act enables regulatory control over Specified Risk Material (SRM), so that it does not enter the animal feed system. Regulations under this Act (enhanced feed ban) require that producers do not feed any animal products containing SRM to livestock and that abattoirs properly identify SRM to ensure that it is removed from the feed system. A permit from the Canadian Food Inspection Agency (CFIA) is required to handle, transport or dispose of cattle carcasses and certain cattle tissues if they are moved off of the farm of origin. Composting processes do not destroy SRM, therefore composted mortalities must be handled in accordance with CFIA regulations as the compost is still considered to contain SRM.

MORTALITY DISPOSAL BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable mortality disposal related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Livestock Mortality Disposal

Dispose of mortalities in a manner that protects surface and ground water. For livestock of all classes and types implement the following practices:

- remove dead animals from buildings and fields as soon as possible
  - dead animals may be carriers of disease and, if not promptly removed, will attract wildlife, rodents and flies, and produce offensive odours
- dispose of dead animals in an approved manner within one day
  - where this is not possible, freeze or store in a covered container for disposal at a more convenient time
- know the cause of death of an animal in order to select an appropriate disposal option as shown in Table 3.6, next page

Do not dispose of dead animals into manure pits or onto land during manure spreading operations. If experiencing excessive death losses contact MOE immediately for acceptable site-specific mortality disposal options.

Off-Farm Disposal. The default for disposal of farm animals is to manage the disposal on the farm where the animal died. If off-farm disposal is needed it should be done at an authorized facility or through an authorized service provider. Options for off farm ruminant mortality disposal must meet the regulatory requirements of the Canadian Food Inspection Agency and MOE for the handling of specified risk materials (SRM).

On-Farm Mortality Disposal. By following the beneficial management practices referred to on the next page for on farm disposal of any livestock species, producers should not contravene the Canadian Food Inspection Agency and MOE regulatory requirements.

Secondary Users. In BC a few rendering plants or secondary user operations accept dead animals. For information regarding the closest operation contact your respective livestock association. Dead animals should be stored in either airtight containers or freezers until they can be picked up by a rendering company or deadstock collection service provider. Deadstock collectors may only accept dead animals within 24 hours of their death.

Composting. Composting of smaller dead animals is commonly practised. Research has demonstrated the ability to safely compost larger livestock, if properly monitored. When composting mortalities, implement the following practices:

- follow general composting guidelines ➔ see Compost, page 2-26
- install moisture control options for compost piles, in high precipitation areas a roof is necessary
- use absorbent materials for the compost base and cover mortalities with a minimum of 300 mm (suggested) of woodchips, litter or straw – top and sides

- space layers of small dead animals with organic matter
- larger animals may need to be cut into small pieces for efficient composting
- specified risk material regulatory requirements must be followed when composting bovine mortalities
  - CFIA Specified Risk Material Transport Permit is required to move compost offsite

Table 3.6 Mortality Disposal Options Based on Cause of Death

Cause of Death	Most Preferred Method ←				→ Least Preferred Method
	Rendering	Composting	Municipal or Private Refuse Site	Incineration	On-farm Burial
Disease [1] (withdrawal time of medication not met)	✓[2]	✓[2]	✓	✓	✓[3]
Disease [1] (no medication, or withdrawal time met)	✓	✓	✓	✓	✓[3]
Poisoning	X	X	✓	✓	✓[3]
Weather (hot or cold)	✓	✓	✓	✓	✓[3]
Flood, Earthquake, and Forest or Building Fire	✓	✓	✓	✓	✓[3]
Starvation	✓	✓	✓	✓	✓[3]

✓ means this disposal option is recommended, subject to any footnote
X means this disposal option is not recommended
[1] Depends on disease: check with veterinarian
[2] Depends on medication used: check with veterinarian
[3] On-farm burial only at suitable sites. ➔ see Livestock Mortality Disposal, page 3-30

Landfills. In some cases, approved landfills operated by municipalities, regional districts, or private owners are made available for the disposal of dead animals. Contact site managers prior to delivering carcasses. Take large animal mortalities to landfills within one day of death. Small animal mortalities, such as poultry, may be stored in a frozen state in airtight containers for as long as required prior to disposal.

Incineration. Incineration of dead animals by open burning is an unacceptable practice. Generally, a single-chamber two-burner incinerator, or equivalent, is required. Single-burner incinerators are unlikely to meet the requirements in the *Code* under the *Agricultural Waste Control Regulation.* Where dedicated incinerators are employed for small animal disposal, implement the following practices:

- locate so that prevailing winds carry exhaust fumes away from neighbours
- be fire safe
- operate until all material is consumed

- meet emission requirements

Burying. Consider burial pits for dead animals as the least preferred method for disposal. Contact MOE if considering on-farm burial.

If burial pits are the only option, locate them at least 30 m from any source of water used for domestic purpose (*Agricultural Waste Control Regulation*), and 30.5 m from a well (*Public Health Act*). Stagger burial sites throughout a property, not crowded together, and cover with earth; approximately 1 m (suggested) the day they are buried. Alternatives to on-farm burial will likely be necessary during the winter season in cold climates. Advice on appropriate burial practices is available in the publication 🕮 **Large Animal Disposal – On-Farm Burial Option**. It is highly unlikely that on-farm sites suitable for burial are available within the Lower Mainland and other flood plains throughout BC.

Place no more than 700 kg of mortalities per hectare per year in a single burial pit. This will ensure the nitrogen loading of the soil is limited to less than 50 kg of nitrogen per hectare per year. Locate only where seasonal ground water levels are at least 1 m below pit bottom and where soil type is dense. Do not dig pits on floodplains or in low-lying areas prone to seepage.

Natural Disposal. The deliberate disposal of livestock mortalities by natural disposal is not permitted under Section 6(3) of the *Environmental Management Act*. For any mortalities that are known to have occurred on crown or private land the farmer or rancher must make every reasonable effort to recover and properly dispose of the mortality through accepted methods (see table 3.4). It is an offence under the *Wildlife Act* to feed dangerous wildlife (bear, cougar, coyote and wolf).

Mass Mortality Contingency Plan

Develop a contingency plan for mass mortalities. The plan should provide a timely and effective response to any emergencies involving the unexpected impact to the environment, from:

- unusually high numbers of mortalities resulting from disease, vandalism, loss of electrical power, etc.
- accidental spills of livestock or livestock mortalities
- impacts due to building fires or natural events, such as forest fires, floods, or earthquakes
- impacts due to vandalism, such as poisonings

🕮 **Contingency Plan – Template for On-Farm Planning**