

Air quality guidance note

Beef cattle feedlots

This guideline deals with air pollution issues. It does not deal with water pollution or noise.

1 Industry description

Feedlots that are intended to accommodate more than 1,000 head of cattle, 4,000 sheep or 400 horses in a confinement area, and rear or fatten them (wholly or substantially) on prepared or manufactured feed (excluding facilities for drought or similar emergencies) are scheduled under the POEO Act. Scheduled feedlots need to hold an Environment Protection Licence and DECC is the Appropriate Regulatory Authority.

Local government has administrative responsibility for environment protection for feedlots of smaller capacity.

Councils can influence the initial siting of all intensive agricultural industries through the development approval process.

This is usually the most important decision on air quality management for these premises.

The environmental management and resolution of any air pollution-based nuisance or off-site impacts caused by odour and dust from such premises are the primary responsibility of the site operator.

This guidance note provides general information on good design and management practices to reduce air emissions from feedlots. It does not apply to nutrient management, cattle health, occupational health and safety, cattle productivity or greenhouse gas emissions.

Guidance on good feedlot design and management can be obtained from a number of sources:

- *A Producers Guide to Starting a Small Beef Feedlot in NSW*, NSW Agriculture, 2001
- *The New South Wales Feedlot Manual*, NSW Agriculture, 1997
- *Feedlot National Guidelines*, ARMCANZ, 1997
- *Designing Better Feedlots*, Queensland Department of Primary Industries, 1994.

1.1 Industry structure

In the last 20 years Australia has seen extraordinary growth in the production of beef in feedlots, mainly for export consumption. Beef markets in the Western Pacific Rim are extremely competitive and demand high-quality products. Feedlots provide the means for producing high quality beef tailored for the needs of this market.

Feedlots are defined as 'a confined yard area with watering and feeding facilities where cattle are completely hand fed or mechanically fed for the purpose of production'.

While output from this industry has continued to rise, the total number of feedlots has declined after reaching a peak in 1995. Smaller feedlot operators have tended to leave the industry after the introduction of a national accreditation scheme by agricultural authorities.



Of 575 feedlots in Australia in 2005, 55% of total capacity was met by 23 feedlots each with a capacity of 10,000 head or more, while 17% was met by 481 feedlots with a capacity of less than 1,000 head (Australian Bureau of Statistics 1301.0—*Year Book Australia, 2005*).

The intensive raising of cattle has resulted in environmental and other challenges, especially when feedlots have been located near rural residential areas.

While large feedlots have tended to provide much of the export demand, smaller facilities coming under the administrative responsibility of local government can also present significant environmental issues.

1.2 Feedlot structure and design

The basic components of a feedlot include:

- pens (usually outdoor but occasionally covered) where the cattle are accommodated
- a feed storage and processing area
- effluent holding ponds (including a sedimentation basin), and
- a solid by-product storage and treatment area.

Most feedlots are sited on large properties, and as such include cropping areas for reuse of treated by-products.

Other features of a feedlot include:

- roads and infrastructure (including a weighbridge)
- veterinary services areas
- administration and accommodation buildings.

The raw materials of feed (grain, hay, silage, etc.) are delivered to the feedlot and stored, ready for processing.

Feed rations are mixed and prepared on demand using methods such as steam flaking or milling, and loaded onto trucks to be distributed into feed bunks (concrete troughs alongside each pen) throughout the feedlot.

Odour emissions can be significant and are considered in sections 2 and 3 below.

In smaller scale feedlots, no feed processing is carried out on-site and self-feeders are used. These require filling only once or twice a week and are easily transportable. However, without regular cleaning, they accumulate manure and spilt feed underneath, increasing odour generation.

Excreted manure and urine accumulates on the feedlot pad (the pen surface) and is cleaned regularly using box scrapers, bobcats or front-end loaders. The manure is then removed to the solid by-product treatment area, or is stored in the middle of the pen—a process called mounding. The manure in the mound is removed when quantities become excessive.



Feed bunk at a large feedlot



Under-fence cleaning



Truck delivering feed to a bunk in a large feedlot



Feedlot pen cleaning using a box scraper

Modern management practices include regular pen cleaning to maintain manure depths on the pen surface at 50 to 100 mm or less.

Previous practices, similar to those used in the US, allowed long periods between cleaning, leading to manure depths of up to 300 mm. Under this system the pen surface took a long time to dry out after rain, increasing odour emissions.

Rainfall and run-off

As the pen surface is exposed to rainfall, and is relatively impermeable, considerable run-off occurs with a rainfall event. Modern management, maintaining shallow depths of manure on the surface of the pen, limits the moisture storage capacity of the surface. Hence run-off may occur after 10 to 15 mm of rain.

Well-designed feedlots drain completely into drains that discharge to a sedimentation basin, leaving no ponding on the pen surface. In the sedimentation basin the effluent velocity is reduced, causing solids to fall out of suspension, reducing the treatment requirements for the holding ponds. From the sedimentation basin the effluent typically overflows through a weir into the holding ponds, where anaerobic bacteria break down the organic matter remaining in the effluent. The treated effluent is usually irrigated to land.

All run-off from the feedlot should be diverted to the sedimentation basin and holding ponds. Clean run-off from outside should be prevented from entering the feedlot complex to reduce the required capacity of the effluent holding ponds.

Solid by-products

Solid by-products are typically stockpiled or composted before application to land. Most large feedlots also sell manure off site for application to cropping land as a fertiliser.

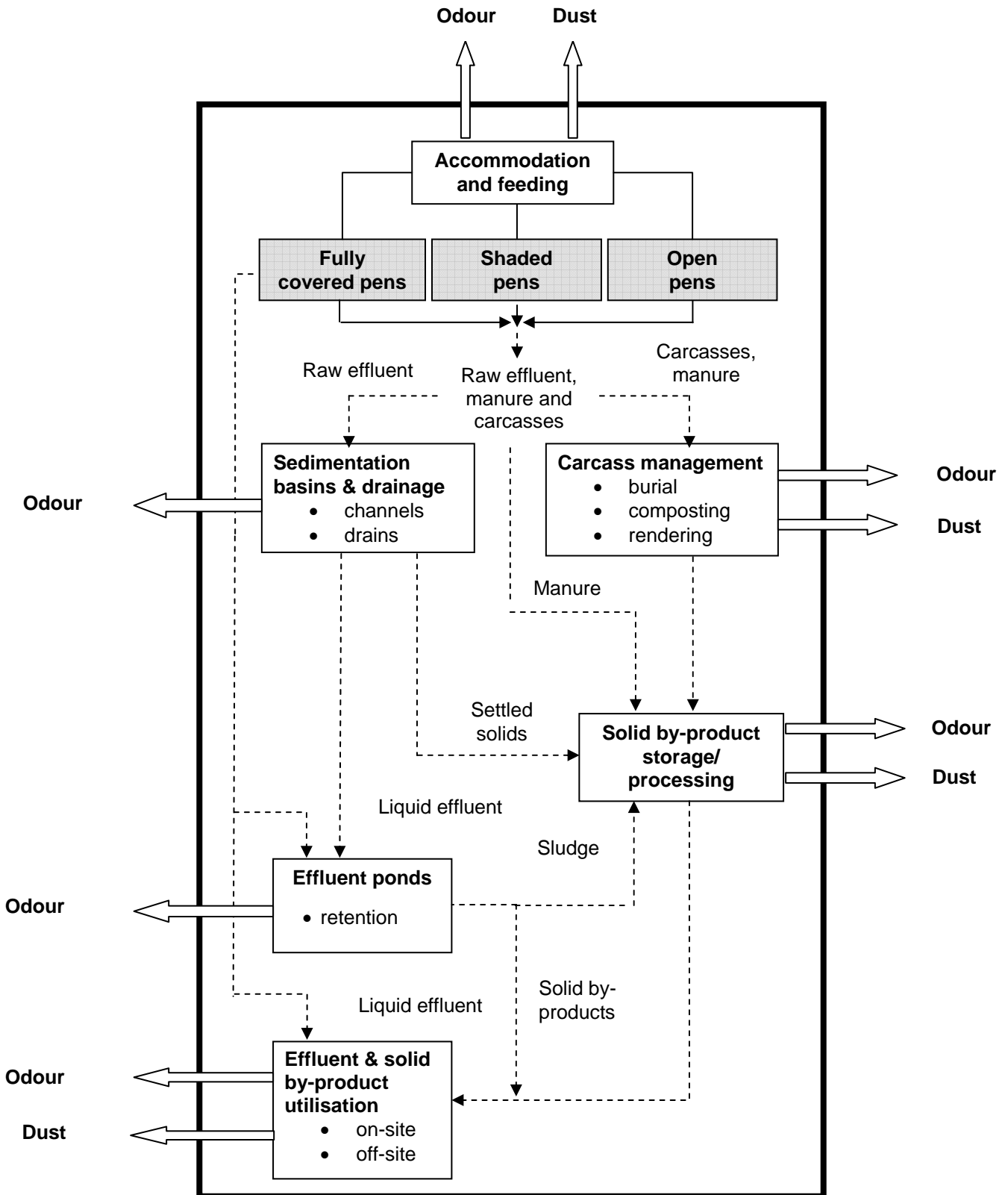
1.3 Production cycle

While they are in the feedlot, cattle are fed a grain-based ration, designed to promote the highest live-weight gain per day. Depending on the feedlot system, live-weight gains range from 1.3 to 1.5 kg per head per day.

Cattle arrive at the feedlot and receive veterinary treatments (vaccination, tagging, etc.) and are slowly introduced to a grain diet. This prevents acidosis occurring (grain poisoning).

The cattle arrive with live-weight ranging from 300 to 450 kg, and are slaughtered when 600 to 750 kg. Starting and turn-off live-weights depend on the market for which the cattle are being produced.

The following diagram shows the flow of by-products through a typical feedlot system and the relevant air quality issues relating to each stage of the production process.



2 Potential emissions to air

The main air pollution problems that can arise from cattle feedlots are odours and dust.

2.1 Odour

Odours at cattle feedlots arise from:

- the surface of holding pens
- feed storage
- run-off collection and treatment (ponds)
- storage and processing of solids
- land application of effluent and solids, and
- disposal of carcasses.

The biggest source of odours at cattle feedlots is **the surface of the pens** in which the cattle are raised, fattened and held.

2.2 Dust

Dust from cattle feedlots arises from:

- movement of cattle within the pens
- storage and processing of solids
- land application of effluent and solids, and
- disposal of carcasses.

Before going on site for an inspection or assessment the following should be checked:

- the consent conditions for the premises or the activity.
- any previous reports on file including diagrams, photographs, maps, etc.

3 Managing air pollution

There are some limitations to the control mechanisms that feedlot operators can use to minimise air pollution.

- Anaerobic processes are necessarily involved, and
- large odorous surface areas are exposed.

3.1 Location of feedlots

Initial location of feedlots and their relationships to sensitive neighbours is critical, because **dispersion** is the main method of amelioration of both odours and dust. This is discussed in Module 3 Part 1, 'Air pollution control techniques' sections 3 and 5.3.

Newer, large feedlots have mainly been established in areas relatively remote from rural towns and urban settlement. Some smaller-size feedlots, many of which are likely to be administered by local government, will be found located where they have the potential to give rise to complaints and unsatisfactory air quality for neighbours.

3.2 Odour

The pen surface is one of the largest sources of odour in a feedlot. Some of the measures which can be adopted to minimise odour emissions from pens are:

Controlling moisture content

Moisture content is influenced by:

- pen design
 - pen slope should be in the range 2%–5%, typically 3%
 - pen surface
 - direction of pen run-off
 - design of feed bunks and water troughs
 - design and construction of any shade structures—these influence pad moisture content in shaded areas
- pen stocking density
- pad cleaning frequency
- pen and water trough maintenance
- ration type, to some extent.

Controlling temperature

Controlling the temperature of the pen surface by using shading structures helps to minimise odours—but to a lesser extent.

The following photographs show pens with good and poor drainage.



Good drainage in a new-style feedlot pad



Poor drainage in an old-style feedlot pad

Managing feed storage

Measures which can be adopted to minimise odour emissions from feed storage facilities include:

- controlling moisture content
- aeration, and
- controlling temperature.

Silage pits can generate nuisance odours and need to be sufficiently separated from receptors.

The key issue for odour emissions from feed distribution is feed wastage. To help avoid this, feed supply needs to be matched to cattle requirements.

Handling and treating run-off

After a storm event, feedlot effluent is predominantly composed of run-off, which picks up and transports some manure into the effluent holding ponds. Some effluent may also come from feed processing operations.

Feedlot drains collect run-off from areas within a feedlot (predominantly pen surfaces and roads) and transport it to the effluent treatment system. The length of drains and the catchment area serviced by each drain vary with feedlot layout.

The effluent treatment system at most feedlots comprises a sedimentation basin and holding ponds. Measures to manage odours from treatment and handling run-off include:

Drain design

- Adequate slope is required (generally 0.5%).
- Self-cleaning drains need an appropriate surface (to prevent scouring).
- Drains should be kept free of manure. The photographs above show good and bad drain management: one is clean and the other has built-up manure.



Well-constructed self cleaning concrete drain at a feedlot



Poorly maintained drain—
weeds and manure build-up

Sedimentation basin design

Important issues are:

- weir design and weir maintenance
- basin surface area
- vehicle access into the basin for solids removal



Dry sedimentation basin showing weir to effluent holding pond

Sedimentation basin management

- regular removal of solids
- keeping entry and exit structures well maintained.

Holding pond design

Capacity is critical. Ponds need adequate volume to:

- treat incoming manure, and
- accommodate volume changes after an inflow event.

Holding pond management

Holding ponds should retain some effluent at all times, providing there is sufficient capacity to prevent overtopping during inflow events.

Waste solids

Feedlot waste solids are usually reused through application to land as a fertiliser. In most instances application rates are low, and the material is applied to each area in small quantities.

Land application of effluent

When effluent is applied to land, the key **management factors** influencing odour emissions are:

- application rate
- quantity of material remaining on the soil surface after application
- odour potential of the material being applied
- checking weather forecasts to make sure receptors are upwind
- avoiding weekend application if local odour impacts are likely.

The key **design factors** influencing odour emissions are:

- level of treatment achieved—effluents should be aerobic if applied by spray
- quantity of aerosols formed during application.

The potential for aerosols to impact on receptors depends largely on the proximity of receptors to the application area and the dispersion conditions at the time of application.

Surface, drip or trickle (surface or subsurface) irrigation will produce less aerosols than spray irrigation, but are often not a viable alternative for effluent application.

Effluent application methods

Potential effluent application methods include:

- spray irrigation
- surface irrigation
- irrigation with droppers
- drip irrigation
- tanker spreading
- deep injection.

Odour emissions are influenced by the method of application used and how the application is managed.



Travelling effluent irrigator with droppers

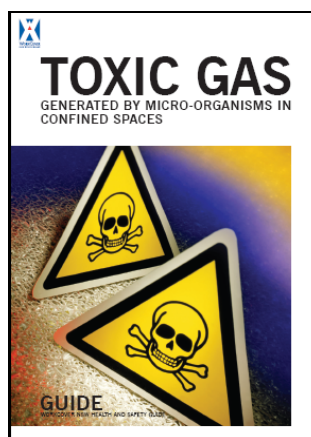


Tanker spreading of effluent

Sludge tankers

The use of sludge tankers can pose a health and safety risk for workers. To avoid this:

- follow appropriate health and safety precautions, and
- refer to guidelines such as the WorkCover NSW publication *Toxic gas generated by micro-organisms in confined spaces*, www.workcover.nsw.gov.au/Publications/OHS/SafetyGuides/toxic_gas.htm.



Solid waste handling and land application

- Odour emissions can be minimised by maintaining a dry surface and preventing water-logging of materials.
- Solid by-products should be formed into piles where possible.
- Piles should be established on a low-permeability, slightly sloping surface.
- Operations disturbing stockpiled material should be undertaken away from neighbouring receptors and during the middle of the day as much as possible, when weather conditions are most likely to disperse any odours.
- Solid wastes (manure, settled solids from sedimentation and treatment ponds, carcasses, spilt feed and grain dust) should be treated as soon as possible after collection.

Moisture content of solid waste

Moisture content of solid waste is influenced by:

- rainfall
- shape of the pile

- drainage from the pile base
- typical particle size of the material, and
- frequency of pile disturbance.

Downwind odour

The timing of operations that disturb stockpiled materials (e.g. shifting piles or spreading material) influences downwind odour concentrations.

Anaerobic activity in solid waste

Anaerobic activity in solid wastes can be avoided by composting the material, but this requires extra management and access to appropriate equipment.

- The moisture levels, degree of aeration and other factors influence the odour emissions. (See Module 3, section 5.6.)
- For effective results composting requires expert design and close management.
- A delay between collection and treatment of solid by-products influences odour emissions.

Treatment of carcasses

Carcasses can be treated by composting, burial or rendering.

Composting carcasses

Carcasses are readily composted, but the volume of material used to cover the carcass is important for controlling odour emissions. The amount of cover required depends on the soil type.



Carcass composting

Composting and the POEO Act Schedule

Composting which:

- receives over 200 tonnes per year of animal waste, food waste, sludge or bio-solids, or
- receives over 5,000 tonnes per year of wood waste, garden waste, or natural fibrous material, or
- receives any organic waste and is located within 500 m of any land zoned residential, or within 250 m of a school, hospital or a dwelling not associated with the facility

renders the operation scheduled under the POEO Act and the premises become the administrative responsibility of DECC.

Rendering carcasses

Rendering carcasses is an excellent disposal method for producers located nearby a rendering plant.

Rendering and the POEO Act Schedule

Rendering plants with an intended production capacity of more than 200 tonnes per year of tallow, fat or their derivatives or proteinaceous matter, are scheduled under the POEO Act and the premises are the administrative responsibility of DECC.

Burying carcasses

For carcasses that are buried, odour emissions are influenced by the amount of soil cover over the carcasses. The amount of cover required depends on the soil type.

Treating odour emissions

Odour emissions from composting can be minimised by maintaining adequate moisture and oxygen supply. Guidance should be obtained regarding proper design and management of composting systems.

Solid by-products should be treated as soon as possible after collection to minimise odours.

Where by-products are stored, temperature and exposure to wind and water should be minimised as much as possible.

A good depth of soil or compost substrate should cover carcasses (1 m minimum) and surface water run-off should not be able to enter the area.

3.3 Dust

Dust emissions from feedlots are unlikely to cause impacts unless receptors are located nearby.

- **Dispersion conditions** (separation from sensitive sources) adequate for managing off-site odour impacts are usually also adequate for managing off-site dust impacts.
- **Moisture content** can be important. Manure, grain dust and composted material contain fine particles that contribute to dust emissions when these materials are dry.
- Dust within feedlot accommodation areas is influenced by **pen stocking density**.
- Dust can arise from the **feedstuffs** used. Attention should be paid to:
 - design and management of storage and feed processing areas, including their siting
 - use of wind breaks
 - design and management of roads within the feedlot.
- Farms that have **on-farm milling facilities** may generate some dust during feed mixing.
- Dust emissions from **solids storage and processing** are unlikely to cause impacts unless receptors are located nearby. Areas where solids are processed or stored should be sited away from receptors where possible. Dust emissions will be influenced by the moisture content and particle size of the materials.

- The quantity of dust carried off site can be reduced by **installing windbreaks**, such as vegetative screens or hessian walls, or by **wetting dusty material**.
- **Water sprays** can settle dust and consolidate dusty surfaces, but will not always be feasible in many feedlot situations.
- **Timing and management** of any operations involving the movement of dusty materials is critical.

4 Considerations for consent conditions

Other conditions may be necessary to control environmental impacts other than air pollution.

4.1 Standards to be met

- In cases where odour modelling and testing is to be undertaken, odours from the premises to comply with the requirements of DEC draft policy *Assessment and management of odour from stationary sources in NSW* (2001).
- Solid particle emissions to comply with POEO (Clean Air) Regulation 2002 for any stack discharges on the site:
 - 400 mg/m³ for plant installed before 1 Aug 1997 (not for a new development consent)
 - 250 mg/m³ for plant installed between 1 Aug 1997 and 1 Sept 2005 (not for a new development consent)
 - 100 mg/m³ for plant installed after 1 Sept 2005.
- Smoke emissions to comply with Ringelmann 1 or 20% opacity.
- Compliance testing to be considered in each situation but unlikely to be necessary on construction sites. (Construction sites? Should this be text about need for compliance testing as appears in other guide notes?)
- Plant to be operated and maintained in a proper and efficient manner which does not cause air pollution, in accordance with s. 124 and 125 of the POEO Act.
- Materials to be handled in a proper and efficient manner which does not cause air pollution, in accordance with s. 126 of the POEO Act.

4.2 Operational and control requirements

- Odours from the premises not to be detectable at the nearest sensitive land use.
- All feedlot pens to have adequate slope, a hard surface and shed water directly to a drain.
- Feed bunk and water trough design to enable regular cleaning of the pen surface.
- All feedlot drains to have adequate slope so that solids do not settle in the drain, and hard surfaces to prevent scouring.
- The sedimentation basin to have adequate surface area so that inflowing run-off ponds as a shallow layer.
- The sedimentation basin to be maintained so there is always adequate capacity for settling solids from inflow events.

- Feedlot pens to be cleaned regularly, including under fences.
- Feedlot pens to be checked after cleaning to make sure the surface is hard and even.
- Holding ponds to be maintained so that sedimentation does not reduce their capacity by more than the designed sludge capacity.
- All operations and activities occurring at the feedlot to be carried out in a manner that will minimise dust at the boundary of the premises.
- Solids storage areas to have impervious, free-draining surfaces.
- All solid by-products (e.g. manure, settled solids, spent bedding, sludge) to be stored in an impervious, free-draining, bunded area.
- Solids to be stored as far away from sensitive receptors as practicable.
- Wherever possible, movement of solids to be carried out in weather conditions which minimise emission of odours.
- Application of solids to land to be carried out in weather conditions which minimise odour and dust emissions and any impacts on sensitive receptors. Solids to be incorporated into soil immediately after application.
- Spray from effluent application not to drift beyond the boundary of the premises.
- Carcasses to be disposed of in a manner which minimises odour and dust emissions.
- Carcasses which are buried to be covered with sufficient soil to prevent odour emissions.

Beef cattle feedlots: air quality management checklist

This checklist has been designed for:

- local government officers—to help identify potential air emission problems and provide advice to operators.
- operators—to help identify and manage potential air emission problems.

Company

Address

Site location

Contact	Permit assessment
	Complaint response
Phone	Compliance inspection
Fax	Time & date of inspection
Email	Inspector's name

A Site location and context

What are nearby sensitive land uses?

	Land use	Distance	Comments
North			
South			
East			
West			

What are the prevailing winds at the site? morning/afternoon/night

Summer		Autumn	
Winter		Spring	

How will the surrounding topography and any nearby buildings affect dispersion of any air pollution that is emitted from the site?

B Sketch plan of the site

Draw a sketch plan of the site showing the surrounding land uses, nearby buildings and local topography.



Note particularly:

- nearby sensitive land uses (schools, homes, other affected premises, etc.)
- locations of any complainants
- locations and heights of nearby buildings or trees
- locations and heights of stacks on premises
- wind directions during times of complaint (night and day)
- any other relevant features.

Comments:

C Results of odour survey

Date	Time	Location ¹	Wind speed ² (estimate)	Wind direction	Temperature ³	Weather: cloudy sunny	Odour type	Odour strength: weak medium strong	Comment

- 1 Make observations upwind and downwind of source premises.
- 2 Estimate in metres per second, or knots, or by the Beaufort scale or failing that, descriptively, e.g. still; light breeze, moderate wind, strong wind and so on.
- 3 If the temperature is not known or cannot be measured at the time of the survey, then find and record it later.

D Core business and activities

Tick for 'yes' and add comments as appropriate.

Types of operation

Operation	Number	Size (head cattle)	Comments
Open pens			
Shaded pens			
Covered pens			

Treatment of wastes

Wastes treated	Method	Comments
Liquid effluent	Sedimentation	
	Holding ponds	
Manure	Sedimentation	
	Piles	
Solids or sludge	Application to land	
Carcasses	Composting	
	Rendering	
	Burial	

Operational conditions

Tick for 'yes' or cross for 'no'.

Aspect	Condition or activity	✓ or ✗ or NA
Accommodation—pens	Are the pens dry?	
	No wet patches in pen surface?	
	No holes in pen surface?	
	No mounds of manure under fences?	
	Pens sloping directly towards drains?	
	No piles of spilt feed around feed bunks?	
Effluent collection, storage and treatment	Effluent drains mostly clear of manure?	
	Effluent drain surfaces hard and even?	
	Sedimentation basin relatively dry?	
	Sedimentation basin weir clear?	
	Pond not odorous?	
	No solids visible on or through pond surface?	
	Are ponds pink/purple in colour?	
No bubbles visible breaking the pond surface?		
Solids treatment and storage	Is the area tidy?	
	Solids stored in well-defined piles?	
	Area dry and well drained?	
	Carcasses well covered?	
	Stormwater excluded?	
	Operations during day only?	
Land application	No by-products visible on soil surface?	
	Vegetation on soil surface?	
	Spreading operations done during day?	

Comments and recommendations on operations:

E Management of odorous materials

How are odorous materials stored?

	Open storage	Covered storage	Bin or hopper storage	Comments
Feed				
Manure				
Carcasses				
Compost				

How are odorous materials moved?

Operation	Weather considered?	Comment
Manure		
Pond de-sludging		
Land application		

Comments on the general standard of housekeeping:

F Complaints from nearby premises

Odours

Date	Complainant	Distance and direction from feedlot	Time of day	Comments

Dust

Date	Complainant	Distance and direction from feedlot	Time of day	Comments

General comments on complaints:

List any attachments here:
