FEEDLOT DESIGN AND CONSTRUCTION

1. Feedlot site selection

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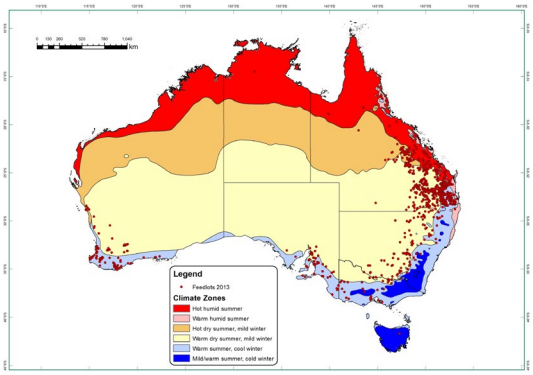

Figure 1. Distribution of feedlots in Australia in relation to climatic zones (2013)

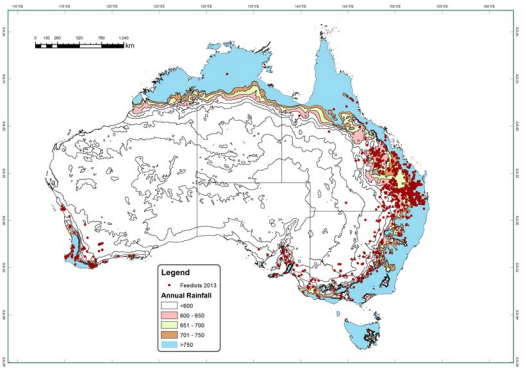

Figure 2. Distribution of feedlots in Australia in relation to mean annual rainfall (2013)

Introduction

A feedlot must be appropriately sited to ensure its economic viability, environmental sustainability and management performance.

Poor site selection can complicate the approval process and lead to costly licence conditions. It may also significantly increase capital costs (e.g. through excess earthworks or high infrastructure costs) and operating costs through long distances for transporting commodities, livestock or finished cattle.

After a site has been selected, the feedlot layout must be planned. This is the main opportunity to maximise operational efficiency and livestock performance whilst minimising initial capital and ongoing maintenance costs. Plans should also allow for potential expansion.

Design objectives

Feedlot site selection should maximise

- economic efficiency of construction
- cattle health, welfare and performance
- social benefit

while minimising

- ongoing maintenance costs
- any adverse environmental impact

Important issues to be considered include

Regional issues

- prevailing climatic and seasonal conditions
- proximity to major arterial road networks, other feedlots or intensive livestock facilities, abattoirs, saleyards and other services
- available labour
- feedstuffs

Site-specific issues

- suitable topography for construction costs and site drainage
- distance to nearest receptors for odour, dust, noise or visual, aesthetic impact
- distance to nearest potable water supplies (i.e. artesian, reservoirs, water catchment areas)
- legal security of an adequate supply of potable water
- risk of impacts on groundwater
- risk of impacts on surface water quality
- access to construction materials (e.g. clay and gravel)
- absence of archaeological and heritage sites or artefacts
- likely impact on threatened or endangered species or ecological communities
- risk of flood or bushfire
- site access in respect to traffic and road safety
- availability of land and suitability of soil for by-product waste utilisation

Mandatory requirements

Any feedlot development must comply with relevant Australian Commonwealth, state and local authority codes and regulations (see *National Guidelines for Beef Cattle Feedlots in Australia*, *MLA 2012*).

Some form of local or regional scale development plan is likely in most states. These plans normally include

- a degree of control on the types of developments allowed
- details of the level of planning and regulatory scrutiny applied
- provision for public comment on significant developments.

While some types of development are excluded in particular areas, most states identify areas where certain types of development such as feedlots are allowed.

However, various Commonwealth and state acts and regulations may influence feedlot site selection where they override local authority planning schemes. Examples include policies associated with

- native vegetation and clearing
- agricultural land conservation
- flora and fauna

All feedlot planning should comply with the *National Guidelines for Beef Cattle Feedlots in Australia (MLA, 2012a)* and with the *National Beef Cattle Feedlot Environmental Code of Practice (MLA, 2012b)*.

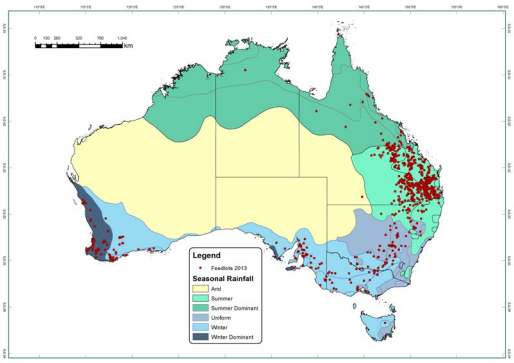

Figure 3. Distribution of feedlots in Australia in relation to seasonal rainfall (2013)

Site selection criteria

Climate

Climatic conditions affect both the environmental performance of a feedlot and the welfare and performance of the cattle in the facility. Environmental problems associated with wet conditions include odour, run-off and manure buildup while high summer temperatures with high humidity may result in animal welfare issues.

Sites with a high annual moisture deficit (low rainfall and/or high evaporation rates) are preferable, with an average annual rainfall of less than 750 mm recommended. Figure 2 shows the distribution of feedlots in Australia as related to mean annual rainfall, with most being in areas with less than 750 mm of rainfall. Summer-dominant rainfall is also preferable as pens under with winter-dominant rainfall tend to remain wet throughout the winter months. This can lead to excessive odour, reduced cattle performance and the formation of muddy dags on slaughter cattle. Figure 3 shows the distribution of feedlots in Australia in relation to seasonal rainfall.

Excessive heat load in cattle can be an issue in areas of high temperature and high humidity. Figure 1 shows the distribution of feedlots in relation to climatic zone, with few feedlots in critical areas. Excessive heat load in cattle can be managed through appropriate diet and the provision of shade (see *Section 16 – Shade*).

Winter-dominant rainfall with a low evaporation rate can result in wet pens and potential odour nuisance.

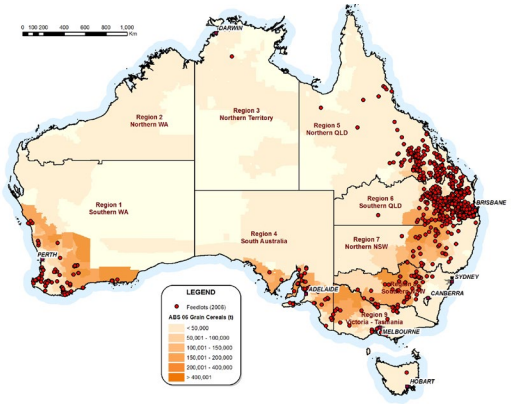

Figure 4. Distribution of feedlots in Australia in relation to grain growing zones (2013)

A natural slope of 2–4% allows for drainage and minimal earthworks for site development. Steeper slopes may encourage erosion.

Local topography may cause fog and odour to drift down a valley undispersed.

Access to feedstuffs

Reliability of supply of feed commodities such as grain and roughages (hay, silage) is critical. The existence of other major intensive livestock and industrial users of grain combined with high inter-annual variability in seasonal conditions can affect this reliability, so proximity to major bulk storage and rail facilities can be a worthy consideration. Most feedlots are sited within major grain growing regions as shown in Figure 4. Roughage is also an important component of feed and can be expensive to transport long distances. If the feedlot site is not suitable for producing silage, close access to grain or cotton by-products is important.

Site topography

Sites with a uniform natural slope of two to four percent will help minimise the cost of earthworks by providing the fall required within the drainage system. It will be more difficult (and expensive) to design and implement adequate drainage on a low gradient, but practical feedlot construction can be accomplished with sufficient earthworks.

There should be sufficient depth of soil to accommodate the excavation (cut and fill and borrowing) necessary for earthworks during construction. This applies particularly to areas where sedimentation basins and holding ponds might be located.

Local topography

As feedlot odours drift downhill under still weather conditions it is undesirable to site a feedlot at the top of a confined valley with sensitive receptors below. Sites should be avoided where katabatic drifts can carry offensive odour to receptors. Katabatic drifts can travel many kilometres in the relatively still conditions of early morning or late evening where little or no odour is dispersed.

Native vegetation

Clearing native vegetation can be subject to various regulatory controls. State and local council requirements must be checked before commencing any feedlot development that may involve vegetation clearing. Although clearing may be possible under certain conditions (e.g. with offset plantings), it may be necessary or easier to consider an alternative site. Retention of native vegetation can provide a benefit in minimising the environmental impacts of a new development as well as providing a sensitive and secure visual amenity buffer to the local community.

Sufficient land

Sufficient land is needed for the feedlot complex (pens, cattle handling, feed mill and commodity storage, effluent ponds and manure storage) and should include provision for potential expansion.

A reasonable rule of thumb for the feedlot complex area should be at least three times the pen area. The pen area is the maximum number of cattle multiplied by the stocking density. Hence, a 5000 head feedlot at 15 m^2/head requires 7.5 ha of pens and the total feedlot complex would require about 22.5 ha of land. Additional land will almost certainly be needed for effluent irrigation and some solid manure disposal, along with a buffer zone between the development and nearby sensitive receptors.

Threatened and endangered species

To protect threatened and endangered species, the following potential direct or indirect issues may need to be assessed

- endangered or threatened ecological communities or ecosystems
- critical habitat for endangered or vulnerable species
- wildlife corridors
- wetlands of international, national or state importance (e.g. RAMSAR, High Ecological Significance in Great Barrier Reef catchments)
- migratory species

Some of the above matters are covered by the relevant Commonwealth and state legislation (e.g. the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, the EPBC Act) under bilateral agreements. This means compliance with federal and state legislation can generally be assessed simultaneously by the relevant state agency. In general however, it is not desirable to locate feedlots near National Parks as these are sensitive areas and have frequent visitors.

Nearby vegetation can provide a visual buffer for a feedlot, but could constrain areas for liquid and solid waste utilisation and limit expansion.

Water supply

Security of an adequate water supply is vital. A feedlot requires a secure, highly reliable water supply that is correctly licensed, of sufficient capacity and of suitable drinking quality for livestock. That security must be in both a legal (i.e. a legal right to the required volume) and a physical sense (i.e. the physical ability to pump, store and deliver the required volume of water). In areas where water usage is regulated this usually necessitates having an industrial or similar high security water licence, allocation or entitlement. A secondary or emergency water supply is also desirable to enable ongoing supply in the event of a failure of the primary supply.

Water uses at a feedlot include

- drinking water for cattle (and horses)
- dust suppression
- feed processing
- cattle and vehicle wash down
- general cleaning
- landscaping
- staff and office amenities
- dilution of feedlot effluent before application on land.

More information about water requirements for feedlots is provided in *Section 4*.

A feedlot site with sufficient land for infrastructure development and for potential expansion.

Protection of water resources

Feedlot developments are required to demonstrate that surface water quality and riverine ecosystems can be protected. In determining water access, developments that alter environmental flow regimes, particularly in regard to the transfer of licences or allocations, should be considered in consultation with the relevant authorities that have regulations and policies to deal with these issues.

Security of water, both in quantity and quality, is critical for feedlot development.

Feedlots should be sited outside of the 1 in 100 year flood coverage area and have road access during major flooding.

Flooding

Feedlot sites should generally be above a 1 in 100 year average recurrence interval (Q_{100}) flood height. In some cases it might be possible to protect the site using levees or similar structures. However, as levees will affect the hydraulic characteristics of streamflow (in particular flood heights) their installation may not be allowable. Some state and local governments also have guidelines which stipulate that waste utilisation areas need to be above specific flood heights (e.g. Q20 or Q50 floods). These local guidelines should be consulted. Consideration should also be given to all-weather road access during periods of severe flooding.

Geotechnical qualities

It may be possible to use soil and gravel materials available on the site or materials borrowed from sites close by for construction purposes. This particularly applies to clay that might be used as a lining material in feedlot pens, the feedlot drainage and effluent storage systems, composting pads and silage storage bunks. The suitability of soil for earthworks is assessed on the basis of its geotechnical qualities. This is discussed in more detail in *Section 7*.

Geotechnical information of the site is gained by excavating test pits, sampling and analysing the engineering properties of the soil material.

Manure and effluent utilisation areas

Unless pen runoff can be disposed of totally by evaporation (see *Section 12*), suitable land will be needed for the irrigation of effluent.

Depending on the local demand for manure, suitable land may also be required on the property for spreading the solid manure. The utilisation area(s) should be arable agricultural land with

- soil without any serious limitations on plant growth (such as plant nutrients, available water capacity and structural issues)
- an area large enough to sustainably utilise the nutrients likely to be applied, without risk to surface or sub-surface water supplies
- a climate capable of reliably producing dryland crops, or with reliable access to water for irrigation (expansive waste utilisation areas may be required where it is only possible to undertake dryland cropping).

It may be possible to use land of lesser quality (i.e. land with some significant limitations) but a higher level of management (and monitoring) will generally be required to overcome the constraints. Grazing of effluent disposal areas removes only small quantities of some nutrients such as phosphorus and is therefore generally not a preferred strategy in an effluent disposal program. Additionally, there are withholding periods of up to three weeks before stock graze pastures that have received effluent application, to protect both people and animals from potential pathogen transfer.

Manure and compost may be used off-site, in which case land availability for manure utilisation is of less importance than the availability of land for effluent reuse. Further details on managing the sustainable utilisation of the nutrients in manure and effluent are described in the manual for *Beef cattle feedlots: waste management and utilisation.*

Conservation of agricultural land

State legislation and/or the local authority planning policy may consider the conservation of agricultural land. For example, in Queensland Good Quality Agricultural Land (GQAL) and Strategic Cropping Land (SCL) are agricultural lands that are protected from most non-agricultural developments. While effluent and manure disposal areas should be on arable agricultural land, the converse is true for the actual site of the feedlot complex. When siting a feedlot, consideration should be given to its likely effects on agricultural land conservation.

Manure and effluent utilisation area adjacent to a feedlot site.

Salinity and groundwater

The lining of feedlot structures with clay or similar liners will generally result in the feedlot complex posing a minimal risk to landscape salinity or groundwater contamination. The application of feedlot effluent and manure to land may increase soil salinity, especially in low rainfall zones, and this may directly or indirectly increase deep drainage and groundwater recharge. Accordingly, areas that may not be suitable as manure and effluent utilisation areas, or that may require expensive or intensive management and mitigation measures, include the sites with one of more of the following

- shallow water tables or springs
- existing salinity problems
- highly permeable soils.

The guidelines for feedlot developments also recommend a minimum separation distance from bores. The significance of the above is generally higher in areas where seasonal rainfall is frequently higher than soil evaporation (e.g. winter rainfall areas in southern Australia). Where possible, sites with any of these problems should be avoided.

Community amenity

Community amenity is afforded by maintaining the environmental attributes that contribute to physical or material comfort of community members. Nuisance is caused by the unreasonable loss of amenity and can be related to odour, noise, dust and increased traffic associated with the operation of the feedlot on local roads. Central to whether loss of amenity is reasonable or not is the frequency, duration and magnitude of the events that might threaten amenity. A secondary, but important, consideration is the context in which the threat occurs and the prior experience of those being exposed.

Air quality

Feedlots can be a source of fugitive odour and dust emissions. These emissions are termed fugitive since they are not emitted from a readily controlled point (e.g. a duct, vent, chimney or stack) and it is therefore impossible to readily capture or contain them.

Once emitted into the atmosphere, the significance of these fugitive emissions (or the likelihood of their causing a nuisance) is largely dependent on the atmospheric dispersion and dilution that takes place between the source of the emission and the potential receptor. For coarser particulate emissions, such as feedlot dust, some degree

of settling will take place between the source and the receptor. Vegetation buffers can be useful in diminishing the impact of odour and dust emissions.

The amount of dispersion, dilution and settling after emission is a function of distance – the required distance varying with the prevailing atmospheric stability. Ways of determining the required distance (or distances) include

- fixed separation distances
- odour and particulate dispersion modelling
- variable separation distance formula (where the applicable distance is a function of the scale of the operation, the level of feedlot management applied, the atmospheric conditions commonly experienced at the site and the nature of the surrounding terrain).

Fixed separation distances are typically absolute minimums and may not be considered adequate for larger feedlots. Dispersion modelling and variable separation distance formulas have a more robust scientific basis, but require a substantial body of information to estimate and characterise the emissions. It is often not well suited at an investigatory or preliminary stage. In such cases, the use of variable separation distance formulas can provide a reasonably conservative guide as to what are the likely required separation distances. Separation distance guidelines can be found in Appendix B of the *National Guidelines for Beef Cattle Feedlots in Australia (MLA, 2012a)*.

Noise

Ambient noise levels in rural areas are usually low (<30 dB), particularly at night. As a consequence any new, unusual or particularly loud noise is likely to be noticed, measurable and therefore have some potential to cause a nuisance – more so than if the same noise was to occur in a busy urban environment.

Factors affecting the amount of noise reaching a receptor include the

- nature of the surrounding terrain
- vegetative state of the buffer zone or surrounding terrain
- atmospheric conditions
- frequency and tonal qualities of the noise.

In beef cattle feedlots, common sources of noise emissions include

- stock handling activities (such as loading, unloading, moving, drafting)
- vehicle movements (including feed trucks, trucks delivering commodities and livestock transport trucks)
- feed milling and handling
- other plant and equipment.

For the 'normal' noise emissions from the feedlot complex, the separation distances typically required to mitigate air quality impacts will usually afford protection from noise impacts at these same receptors. Exceptions to this may include

- less common or intermittent noises (e.g. noise from construction activities)
- frequent or unusual nighttime activities (e.g. night-time milling and mixing of feed, livestock deliveries)
- traffic noise along roadways servicing the feedlot.

Confining noisier activities to daytime and, where unavoidable, evenings, will normally minimise the risk of adverse noise impacts. However, in instances such as the loading or unloading of cattle in summer (particularly where daylight saving applies) animal welfare considerations may preclude confining operations to such times. The design capacity of the feed mill and mixing facilities could be such as to avoid routine operation at night. Selective use of access routes to the feedlot can reduce specific off-site noise issues.

Visual amenity

In designing and siting a feedlot, due consideration should be given to its visual impact. Advantage should be taken of any natural screening provided by topography or vegetation. Highly visible sites should be avoided. Where a site is visible, buffers of trees or earth mounds can be developed between the site and nearby vantage points.

As with noise complaints, the separation distances required to address air quality impacts often provide for significant mitigation of visual impacts at nearby residences or townships, particularly in low-relief terrain. The ongoing maintenance and management of the feedlot and its associated infrastructure in a clean and tidy condition will generally assist the positive visual impact of the facility.

Roads and traffic

When selecting a feedlot site, the following impacts of traffic should be considered

- local road network
- internal road infrastructure
- traffic noise
- road safety.

Local and state governments generally have criteria by which they judge the significance of an impact on the road network. Typically these will involve a threshold increase in road traffic volumes or pavement loads that correspond to what would otherwise be expected with the 'normal' growth in the Australian economy (e.g. the average percent increase in national GDP).

National and state standards apply to road design in Australia. These standards cover a diverse range of matters, not the least of which is road safety. Owing to the volume of heavy transport they can generate, feedlot developments may require the upgrading of roads and bridges to comply with the standards. Common requirements include the need for all-weather access and the upgrading of turnoffs and road junctions servicing a development. Such upgrading work may particularly apply on major roads where the higher traffic volumes trigger the need to install slip and turning lanes. The feedlot may be required to contribute some or all of the cost of any upgrading work necessary.

Owing to low ambient noise levels in rural areas (particularly at night), traffic noise may require specific consideration. In such cases, noise-related conditions such as curfews on traffic movements or having designated access routes may be applied.

Consideration should also be given to enabling access to the facility by B-double, B-triple and road train transport where applicable. This will reduce the ongoing operating costs of the feedlot.

Proponents are encouraged to consult with the responsible authority early in the planning stages to identify any standards and road requirements, identify whether the proposal needs to be referred to a roads authority and the arrangements for upgrading public roads.

Mining leases

Searches should be undertaken to ensure that the proposed feedlot will not be located on an existing or possible future mining or gas lease.

Archaeological and heritage issues

Impacts on Aboriginal, European and natural heritage need to be considered during the assessment process for a feedlot development. Most state governments maintain registers of known sites and these should be consulted before selecting a development site. Notwithstanding the status of a property in these registers, it is still possible that a detailed site assessment will be required before gaining development approval or consent. Proponents are encouraged to consult with the responsible authority early in the planning stages to identify any requirements. The selection of sites with no heritage issues is an advantage.

Local plans or planning schemes

These plans are normally made and administered by a local government authority (e.g. a shire or local council). Typically these local plans establish zones or similarly designated areas where certain types of development are allowable after some relatively basic considerations. Other developments may require more intensive scrutiny and consideration (i.e. impact assessment).

Where local government areas encompass rural areas, there will normally be rural or agricultural zoning which allows most traditional agricultural activities (e.g. cropping or grazing) to take place with few, if any, approval requirements. Often, feedlot developments are allowable in these rural areas or zones after some form of impact assessment. However, in some cases (e.g. in a rural zone where the dominant land use is horticultural, such as orchards or vineyards frequented by tourists), a feedlot development may be a prohibited development (i.e. not allowable even with impact assessment).

Copies of local plans are usually available for perusal or purchase at the offices of local government authorities. Increasingly, these documents are freely available on the Internet. It should also be noted that these plans are subject to frequent revision, and the fact that a previous development was allowed does not mean a new one will be permitted.

Regional plans

Regional plans are normally a 'big picture' version of local plans. They are an increasing common strategic planning instrument, particularly where sensitive areas such as riverine wetlands overlap a number of local government areas.

It is common for local plans to be drafted to accommodate the requirements of any regional plan, and consequently compliance with a local plan will provide compliance with the regional plan. Nevertheless, some local plans predate regional ones and there may be some specific requirements, additional to those of the local plan, which need to be addressed. Local government planning departments can provide advice on these matters.

Catchment management plans

In some states, catchment management plans have a formal status in legislation and regulation. Like regional plans, catchment management plans usually cover a number of local government areas and their requirements may already be reflected in the respective local government plans. However, catchment management plans are generally a newer form of planning and their requirements may not always be addressed by local plans. Checking whether a catchment management plan exists and what is its official status is recommended to anyone considering developing a feedlot. For example in Queensland and Victoria, feedlots are excluded from Declared Catchment Areas which are the areas immediately surrounding municipal water supply dams.

Access to building materials

Consideration should be given to the on-site availability or nearby off-site access to the following

- suitable clay for lining of feedlot pens, drains, effluent holding ponds, manure storage and composting pads
- suitable gravel for construction and maintenance of feedlot pens, drains, composting pads, roads, cattle lanes and hard stand areas
- suitable materials for road base and sub-grade
- concrete aggregate (if mixing on-site) or ready-mixed concrete.

Clay pits and quarries for even moderately sized feedlots may themselves require a development approval and licence and as a result, an environmental impact assessment or similar report.

Labour availability

Feedlots can have a significant requirement for labour – about one person for every 750 to 1000 head of capacity. In larger operations where these requirements cannot be met by family or staff residing on-site, proximity to towns, villages or a nearby source of potential employees may be a significant consideration in determining the scale and location of the proposed development. Consideration may also need to be given to the provision of on-site accommodation if the feedlot is located some distance from major residential areas.

Electricity

Most feedlots require reliable, 3-phase power. Due to the cost of installing overhead supply it is desirable to locate a new feedlot where 3-phase power already exists.

Development staging

The staging of feedlot developments is quite common. Staging a development can help establish that

- predicted impacts of the final development are reliable
- impacts are capable of being properly managed
- success in managing the impacts can be reliably monitored.

This can be advantageous to both the developer and the regulatory agencies.

Further reading

Guidelines for the establishment and operation of cattle feedlots in South Australia, Department of Primary Industries and Resources (SA) and Environment Protection Authority, 2006, Adelaide.

Guidelines for the Environmental Management of Beef Cattle Feedlots in Western Australia, Bulletin 4550, 2002, WADo Agriculture (ed.), Western Australia Department of Agriculture, Perth, WA.

National Guidelines for Beef Cattle Feedlots in Australia – 3rd Edition, Feedlot Industry Accreditation Committee (ed.), June 2012, Meat & Livestock Australia, Sydney, NSW.

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