4.2 Feedpads, calving pads and loafing pads

A **feedpad** permits the supplementary feeding of cows, providing water, space, feed, and effluent and manure removal. Cattle are held or mechanically fed for the purpose of milk production or animal husbandry.

Although there is significant research on feedlots, research on dairy feedpads in Australia is lacking. A **feedlot** is a structure where cattle receive an entire ration for maintenance, weight gain and milk production; in contrast, a feedpad is dedicated to supplementary feeding only.

Feedpads are used to feed hay, silage, mixed rations or concentrates with minimal loss to stock in times of pasture shortage. They also reduce the adverse impact of stock on pastures and soil during wet conditions or pasture renovation. A **loafing pad** can be a component of a feedpad, offering a retirement area for stock to ruminate. Both facilities are supplied with water and sometimes shade. **Calving pads** can be standalone structures or form part of a feedpad complex. In a calving pad, a well drained and sometimes bedded area is provided to enhance the health of calves and their mothers during and after birth.

Both shade and shelter are required if dairy cows are to be exposed to the elements for a long period. Good drainage and harvesting of manure, spilt feed and contaminated bedding are also critical components of pad management. Farmers who use a feedpad aim to maintain a herd and milk flow, increase quality or quantity of milk, and avoid deterioration of tracks or pastures. Other factors are the need to mitigate heat stress and to sustain a herd which cannot be supported through an existing feed base.

Pads need to be planned, designed and built to be economically viable and environmentally sustainable. They also need to comply with animal welfare regulations and accepted community standards for environmental performance. Provision needs to be made for all-weather feed supply, drainage, waste removal from the pad and the remote storage of effluent and manure. Structures should be formed for ease of access and maintenance and to facilitate harvest of manure and contaminated runoff. They must also provide a suitable surface and, if necessary, shelter to prevent pugging in wet weather. Provision of an adequate slope for effluent drainage, ease of animal traffic and movement of mechanical equipment is essential. Diversion of uncontaminated stormwater to drains should be made possible when the pad is clean and not in use.

The planning, design and operation of feedpads, loafing pads and calving pads incorporate a range of objectives:

- safe and easy access for animals, vehicles and farm workers
- adequate room and headspace to provide acceptable conditions for animal production
- the storage of and access to a range of feeds and the use of specialist feeding-out equipment
- availability of bedding material and equipment to renew bedding
- drainage to allow all-weather access and to divert catchment runoff
- collection of contaminated runoff
- harvesting of manure, soiled bedding and spilt feed
- waste storage on impervious surfaces and in well-bunded structures
- use of harvested manure and effluent on crops and pastures
- protection of surface and groundwater resources through prevention of leachate movement and control of runoff

- maintenance of community amenity through odour, noise and insect control.

Principles of waste management

Feedpads can be used on a permanent, regular or occasional basis. They are frequently used during wetter, colder months and just before or after milking, but are more commonly used in response to drought and pasture shortage. Shaded feedpads and loafing areas are also used to relieve heat stress in summer.

Accumulated manure is either cleaned off the pad surface by scraper or front-end loader or is washed off. The design criteria for cleaning a feedpad by floodwashing are similar to those used for cleaning a yard. Runoff contaminated with manure is usually directed to storage before land application. Harvested manure and solids are usually dried for land application.

Calving pads and loafing pads generally incorporate a well bedded and padded surface with well defined surface or subsurface drains. These pads need to be cleaned regularly by front-end loader to remove soiled bedding and manure. Sometimes disinfectant is applied before the supply of new bedding.

The amount of manure generated on the pad depends on the time the animals spend there out of every 24 h (see chapter 1.2 ‘Characteristics of effluent and manure’). In the absence of research it is assumed that the proportion of manure to be managed is related to the time the animals spend on the pad.

Enclosed or covered pads are usually cleaned by floodwashing and scraping. On an enclosed pad or freestall barn the effluent generated depends on the volume of floodwash, the presence of bedding (to absorb effluent) and the amount of washdown water used. An exposed pad has the added burden of rainfall runoff to contain: The volume generated depends on rainfall; usually the volume of effluent storage is dictated by the need to contain runoff from a 24 hour rain event with a recurrence interval of 1-in-20-years.

Regulations

Rules on the development and expansion of pads are ambiguous and so can lead to disputes. The main question is when a broadacre farm becomes an intensive animal enterprise or a feedlot. Under drought conditions or where inclement weather is common, farmers are encouraged to develop structures and systems for supplementary feeding, but local planning ordinances must be followed.

Regulatory requirements for feedpads vary between states, and it is not possible to cover all state requirements here. Planning conditions usually govern buffer distances to neighbouring houses, waterways, groundwater bores, roads and towns; and structures usually need to conform with building standards. Waste management conditions are commonly dictated by the scale of works and usually set requirements for the storage and land application of effluent and manure.

Most of the concerns that planning authorities and neighbours have with intense dairy production relate to odour, noise, light access, heavy vehicle movement, loss of property value and amenity, the fate of wastes and the use of medications. Some animal welfare groups campaign against intensive animal housing, and occasionally the RSPCA gets involved in the regulation of facilities.

Planning and construction

To be effective, a pad needs to be considered as integral to a farm. Integrated farm planning is essential to deciding the site and size of a pad: the whole farm needs to be considered, not just the pad. Landholders proposing to install pads should look beyond the immediate problem that prompted the pad and consider the likely long-term effects

of their actions, and evaluate associated costs and benefits in detail. They must also consider existing and future neighbours, and development prospects for their own and neighbouring properties.

To minimise the energy and labour requirements of a pad, place it near a milking shed or in clear sight of the shed or farmhouse. Avoid placing it in clear view of neighbours or next to a major road, and site it for minimum obtrusion.

Pads should be formed well above the natural surface level to promote drainage, increase air movement and discourage insects. The design should allow for all-weather access by machinery and cows and for waste removal. The positioning of the pad should be dictated by the location of the milking shed's access track and the holding yard. Pads should be planned as multipurpose facilities which can be used to benefit the farm all year round.

Avoid siting a pad where topography favours katabatic drift to neighbours located downhill or where rural residential development is encroaching. Chapter 5.1 'Odour emissions and buffers' provides detail on odour propagation and control.

Aspect and dimensions

Intensive animal production prompts community concern for the potential for adverse environmental impacts and animal welfare. These factors must be taken into account in the sizing of feedpads to provide adequate facilities and conditions for maintenance of the health of stock and protection of the environment. Case studies are presented in Davison and Andrews (1997).

Dimensions for components of a feedpad are usually set by experience or personal preference, and should allow for herd expansion. The recommended alignment or aspect of feedpads tends to vary from one part of Australia to another; for example, in Queensland a north–south alignment is favoured, whereas in Victoria an east–west alignment is popular.

Siting and sizing

Space requirements for animals on a feedpad are usually a function of how it the pad to be used and how long the animals are to stay on it. When designing any farm facility, consider the physical dimensions of structures and laneways. Adequate areas must be set aside for stock movement and vehicle access. The approaches to and from a feedpad are subject to intensive stock movement. The minimum desirable width for laneways is 3.7 m to facilitate vehicle movement. As herd numbers increase, recommended laneway dimensions rise; for example, in a 120- to 250-cow dairy, 5.5-m laneways are adequate (Wrigley and Phillips 1993). A compromise is necessary between very wide laneways, which occupy land and reduce control of stock movement, and narrow laneways, which funnel stock and contribute to high pavement loading. In the case of feedpads, large trucks will need to bring in feed without excessive backing, so they need adequate vertical clearance too.

Minimum space requirements

As a general guide, a 600-kg dairy cow requires a minimum area of 9 m^2, preferably 15 m^2 (these provisions must be seen as indicative only, given the immense variety of pads in use). (In contrast, a grazing animal requires around 200 m^2.) An allowance of 10% greater than the estimated need will provide flexibility in feed type and ration (ARMCANZ 1997). Obviously, smaller cows require less space, but it is best to adopt the larger size to allow for future needs. Space requirements depend on the availability of land, environmental conditions, management practices, type of housing and the pad construction materials.

Allowance for cattle spacing also has a significant influence on the amount of manure and its moisture content. The incidence of mastitis and other stock diseases is increased by manure accumulation, so it is wise to be generous with space. Cramped conditions can lead to dust, odour, runoff, mud and fly breeding. Generous space allows udder wash and wipe equipment to be used if required.

In such a restricted area, requirements for skilled managers, up-to-date technologies and energy all increase.

Feed troughs

The spacing requirement for feed and water troughs depends on cattle size, type of enclosure, type of feed and feeding frequency. The minimum trough length for a continuously confined 600-kg cow fed once a day is 0.3 m (ARMCANZ 1997). Guidelines from the USA (Mid West Plan Service 2000) allow a feed bunk space of 0.46 m per cow for mixed rations fed several times per day, or 0.66 to 0.76 m per cow for once-a-day feeding. The allowance depends on the type of feeding system: this could range from a wall with a hot wire to a conventional feed trough or a feeder. If too much room is allowed, wastage can increase; the objective should be to allow the animals to feed and then move back.

Water requirements

Cows must have free access to good drinking water. Table 1 provides general guidelines for water consumption. Feed, geography, age, bodyweight and climate have a major influence on the consumption rate. Under drought conditions where no pasture is available and cows must be kept cool to avoid heat stress, these allowances must be seen as minimal: at least 150 L per cow per day is recommended.

It is essential to allow adequate water for stock on a feedpad; the longer the animals are confined, the greater will be the demand for water. The climate and the moisture content of the ration will dictate consumption, so Table 1 is indicative only, and rates must be tempered by local knowledge and experience. If the water is saline, the stock will drink more and the wastewater will be more salty and more difficult to reuse.

Table 1. Stock water consumption.

Body weight (kg)	Average water consumption ($L \cdot day^{-1}$)
50	6–7
70	7–9
90	10–11
120	14–16
150	18–25
190	25–35
350	35–40
540–730 (dry cows)	20–40
540–750 (lactating cows)	45–110

Source: ARMCANZ (1997).

The reticulation system should supply at least 20 $L \cdot h^{-1}$ per cow to meet the short-term needs of the herd (Holmes *et al.* 1987). The pipe diameter to meet these requirements needs to be at least 75 mm, and the operating head must be at least 10 m. A tank could be used for short-term supply in the event of a power failure. Water troughs should be well separated from feed troughs. Provision should be made for water flow directly into the drainage system and for drainage control in the event of burst mains or a jammed float valve.

To provide an adequate and constant water supply to stock, a circular loop water line can be installed. Troughs should be located on the high point of a water line to reduce

sediment and to facilitate purging air from the pipeline. In pens, troughs may be positioned and shared between adjacent pens.

Dimensions of pads and sheds

- In a freestall barn or covered feedpad, the height of the canopy has to be accessible to machinery to allow cleaning, feeding and maintenance in the enclosure (with a minimum ridge height of 7 m for access by a front-end loader or backhoe). Standard building frames will aid expansion and planning approval.
- The height of the ridge should allow for the stack effect to remove gases via a ridge vent. The right height of the canopy will promote ventilation while protecting stock.
- The minimum height of eaves should be 3.7 m, although this could be adjusted by the need to provide shade.
- A roof pitch of 1:3 (18°) will allow convective heat dissipation.
- Positioning of the eaves of a shed or canopy to catch winter sunlight will provide warmth for stock, help dry the feedpad surface and reduce the incidence of disease.
- Careful locating and positioning of the shed will create summer shade.
- An east–west aspect is encouraged for Victorian covered feedpads.
- Sheds should be sited near feed stores and effluent storages.
- A pen area of 9 m^2 is desirable to allow the movement of stock to and from troughs (although 1.5 m by 3 m is adequate).
- Laneways, races, entrances and exits should be designed to take advantage of the social behaviour and movement of cows. Use only rounded railing without protrusions in areas of stock congestion. Rounded edges on concrete are essential.
- The shed should be readily seen from the house or milking shed.
- Trees planted to shroud the shed should not completely obscure the view.

Surface of the pad

- Dairy feedpad surfaces should provide sufficient slope for effective drainage. A compacted earthen surface needs a gradient of at least 1:500 (0.2%), but a concrete surface can be drain at a slope of 1:2000 (0.5%) or even shallower if smooth. However, operating experience shows that it is better to aim for slopes in the 2% to 4% range. The earthen pens of beef cattle feedlots drain best at a slope of 3%. The achievement of a suitable slope is based on site-specific conditions, and material choice must be determined by the soil type, cost of construction and amount of shade.
- Surfaces should prevent effluent from reaching subsoil.
- Surfaces should have a thick enough foundation to spread loads without settling.
- Surfaces should minimise stress, disease and injury of animals.
- Surfaces should provide a durable, clean working area.
- Surfaces should be designed to be renovated easily and avoid breaking down when in contact with bedding material.

Concrete feeding aprons have been found to reduce odour propagation and feed wastage and to improve animal health and maintenance. The minimum recommended width is 3 m, with a thickness of 125 mm (which includes a reinforcement cover of 50

mm). For both floodwashing and dry scraping, a 3% slope is favoured. Ideally, a one-way diversion will divert effluent away from the earthen surface of the pen; to achieve this, the concrete edge of the apron should be slightly bunded. Alternatively, the concrete can be sloped back to the trough to form a wide gutter for flooding or removal of rainfall runoff.

Feedlot and feedpad profiles (on bare earthen surfaces) usually contain a compacted interfacial layer of manure and soil. This forms a seal that decreases water infiltration into the soil. Low infiltration restricts the leaching of nitrates, salts and ammonium into the subsoil and protects the groundwater from contamination.

Pad construction materials

The materials forming the pad exert one of the most significant controls on pad performance. Ideally the pad surface should be evenly graded and compacted to form a smooth, impervious surface. Materials used for pad surfaces are many and varied. The most common pad surfaces are:

- earth and stabilised earth
- gravel and coarse sand
- bitumen
- concrete
- rubberised mats.

Loafing pads and calving pads are covered with a softer layer such as:

- rice hulls
- straw
- sawdust
- sand
- almond husks and fruit pips.

Frequently, gravel and sand are laid without grading to finer particles. This cohesionless material is then hard to compact to an appropriate density with minimal permeability. Generally, uniform and poorly graded gravel or sand should not be used for pad construction, as manure harvesting is made difficult and the manure contains gravel and sand.

There are advantages and disadvantages to all types of feedpad surfaces. Availability and cost usually govern the choice. Compacted earth is the cheapest but least resilient material, and concrete is the most expensive but the longest lasting. A design which allows for stages in construction from earth to stabilised earth to concrete is often desirable. But whatever material is used, the foundation must be well prepared.

Geotextiles

In recent years the use of geosynthetics for compacted pads has grown. Geosynthetics are a relatively new concept in engineering materials. One of the largest groups of geosynthetics is the geotextiles. These are thin, flexible, permeable sheets of synthetic material used to stabilise and improve the performance of soil in civil engineering works (Ingold and Miller 1988). Functions can include filtration, drainage, separation, reinforcement and moisture blocking. Filtration restricts the migration of fine soil particles while permitting water movement. Reinforcement stabilises the soil and decreases compaction by stock.

The drainage capacity of geotextiles allows water to be carried along the plane of the material to an outlet, either vertically or horizontally. A one-piece polyester envelope

material can be fitted over perforated drainage pipes like a sleeve. Geotextiles have a relatively low capital cost and are resistant to soil chemicals, moisture and bacteria. They offer a viable approach to pad surface construction at a relatively low cost with a long life span, allowing lateral subsurface drainage. A suitable arrangement for separating soil layers and for stabilising, reinforcing and draining a pad uses a compacted earth foundation 200 mm thick covered with 100 mm of sand, then the geotextile mat, and finally a compacted clay-based surface 300 mm thick.

Cleaning and maintenance of pads

Drainage of pads

Runoff from paved feedpads is affected by slope, rainfall intensity and management practices. Feedpad runoff contains relatively high concentrations of nutrients, salts, chemicals, debris, pathogens and organic matter, and must be collected, treated and stored for reuse. Rainfall must be considered in the design of feedpads, especially exposed pads, as it can generate contaminated runoff. Adequate provision is required for collecting runoff from heavy rain. The tank or pond should be able to accommodate at least a 1-in-10-year, 1-h rainfall.

For good drainage, the feedpad slope should be between 2% and 4%. Slopes outside this range may be acceptable but require a higher standard of construction and operational management. If they are too steep, high-intensity runoff and sediment transport may cause erosion and pollution.

The drainage system of a feedpad should incorporate:

- drains or diversion banks
- a sedimentation basin to remove solids from liquid effluent
- catch drains (minimum slope of 0.5%) to carry storm runoff and effluent.

Ideally, open drains should carry feedpad effluent. Large-diameter pipes are also suitable; the larger the diameter, the less slope is required. Avoid grated pits and pipes <100 mm in diameter as they can easily block and are difficult to clean. Information on sumps, pumps and pipes is provided in chapters 1.5 ‘Sump design’ and 1.6 ‘Pipes’. Pads built on a raised platform will promote natural drainage and gravity conveyance of waste, thus avoiding problems of pump blockage.

Removal of wastes from pads

Effluent, manure and soiled bedding must be removed from a pad to maintain a clean surface and reduce pathogen concentrations. Storage will be required if waste is generated during cold or wet weather or at a time of year when land application cannot take place. Wastes include:

- solid or semi-solid dried and packed manure
- effluent
- waste feed
- waste bedding
- entrained earth, manure, spilled feed and bedding in effluent, which need to be separated by gravity or a grille.

Unless solids are frequently removed from the surface of a feedpad, all wastes will end up in the holding pond.

Floodwashing of pads

Floodwashing is popular for cleaning the paved surface of the feed alley and feeding apron of a feedpad. This practice can aid in the recycling of water and reduce the volume of effluent to be stored in holding ponds, thus reducing the required size of storage. The washdown volume must be applied as a surge flow by a high-flow pump or by gravity release from a tank. If recycled effluent is used for floodwashing, at least two ponds should be used, and only the treated effluent from the second pond should be used for yard washdown. See chapter 1.4 ‘Floodwash systems’.

Checklist

Before building a feedpad, consider the following factors:

- the cost of substitute-feeding of cows on a pad versus the cost of pasture productivity decline due to compaction and disturbance of soils
- likely fluctuations in the price of feed and selling price of milk
- the increased handling and movement of stock on feedpads
- space requirements for access of stock to feed and water
- removal of effluent from the pad; rainfall; and effluent storage
- the environment and contamination of ground and surface waters
- efficient planning, siting, construction and management of the feedpad
- potential risks of odour and adverse community reaction.

A typical system and stages in development are presented in Appendix B.

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