Section C:

Design and Production Aspects

11.0 What is Involved with a Feedpad?

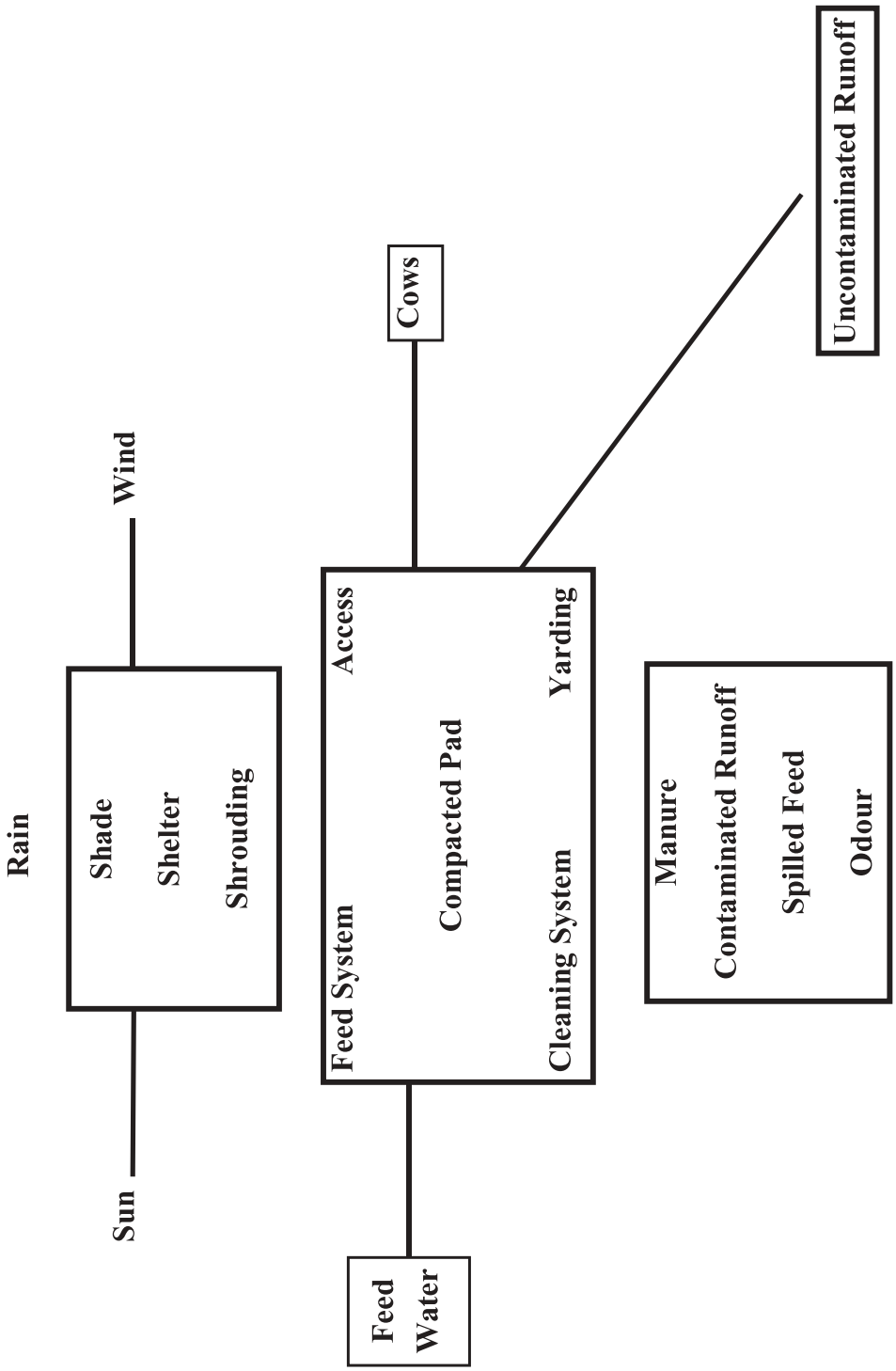


Figure 2: Feedpad components

11.1 Feedpad Uses

Feedpads are utilized on either a regular or on a needs basis. They are frequently employed during wetter, colder months or to provide shade to reduce heat stress in summer or just prior to milking. Rarely are they used for housing cows over a continuous extended period.

Primarily, the aim of dairy farmers seeking to supplementary feed on a pad is to increase quality or quantity of milk through more efficient feed utilisation however, a feedpad can be used for a range of additional reasons including:

- Supplementary feeding of livestock
  - Pre or post milking
  - Longer term feeding am and pm
  - Feeding during daylight hours
- Protecting stock from the elements
  - Providing cooling in extreme heat
  - Protection from cold, wet or windy conditions
- Preventing pasture damage when conditions are wet
- Preventing pasture damage over winter
- Preventing laneway damage
- Facilitating stock mustering and movement
- Allowing for pasture renovation
- Providing shade in the absence of trees on farm
- Better animal husbandry and maintenance of stock health
- Housing/feeding of stock all year round
- Feeding stock in times of pasture shortage

11.2 Deciding to Install a Feedpad

When proposing to install a feedpad, alternative solutions to the problems/reasons for the feedpad should also be considered, as more simplistic solutions could be available.

Irrespective of the sophistication of the feedpad, the decision to install a feedpad needs to be made on a number of levels including those depicted in Figure 3.

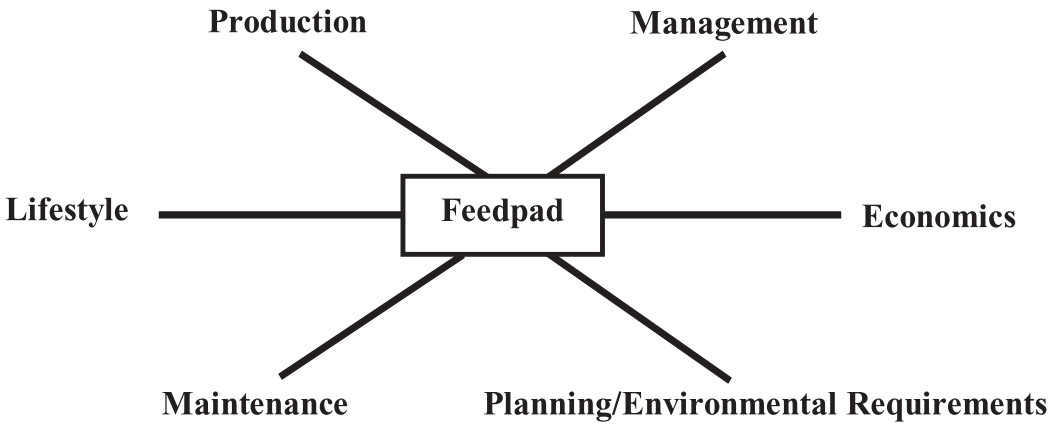


Figure 3: *Feedpad Considerations*

11.2.1 Production

Dairy farm production increases come from improved utilisation of existing land and water resources and from gains in production efficiency all of which can be achieved by utilising a feedpad. Once the objective of optimal pasture utilization has been attained, a feedpad can employ supplementary feeding to produce high protein, low fat milk all year round or just in colder and wetter months.

11.2.2 Farm Management

It should be noted that a cheap feedpad managed properly could be effective and sustainable, while an expensive and elaborate feedpad managed poorly could cause problems.

To be effective, a feedpad needs to be considered as integral to a farm and should be planned as a multi purpose facility that can benefit the farm all year round while complementing the existing farm management (milking, stock movement, calving, supplementary feeding etc.).
Each feedpad should be uniquely designed to be compatible with each dairy farm and dairy management system and should consider:

- Why does the farm require a feedpad? (e.g. reduce heat stress, to provide supplementary feed, reduce paddock pugging etc.)
- What will the feedpad be used for? (e.g. house livestock in wet weather, supplementary feed prior to milking, provision of shade in mid-summer)
- What are the perceived benefits of the feedpad? (reduced need for pasture renovation, less mustering time, increased milk yields)
- What is the most suitable type of feedpad? (open concrete pad, enclosed concrete pad, earthen pad with canopy etc.)
- What scale of feedpad is required based on existing and projected numbers of livestock and the duration that they will occupy the feedpad?

11.2.3 Economics

Landholders should consider the associated costs and benefits of any proposed feedpad. The costs can be minimal if a small well drained holding paddock is utilised but can range up to hundreds of thousands of dollars for constructed pads with roofing etc. In each individual case the following points need to be identified;

- The overall likely cost of the feedpad and cost per head for establishment
- The time frame and stages of construction (e.g. pad in yr 1, paving in yr 2, canopy in yr 3 etc.)
- The expected useful lifespan of the feedpad
- How long until economic benefits from the feedpad will attained.
- The cost of machinery required and the cost and space required for associated infrastructure to complement the feedpad.

11.2.4 Planning/Environmental Considerations

Municipal planning regulations need to be considered when proposing a feedpad as outlined in Section B 'Regulatory Requirements'.

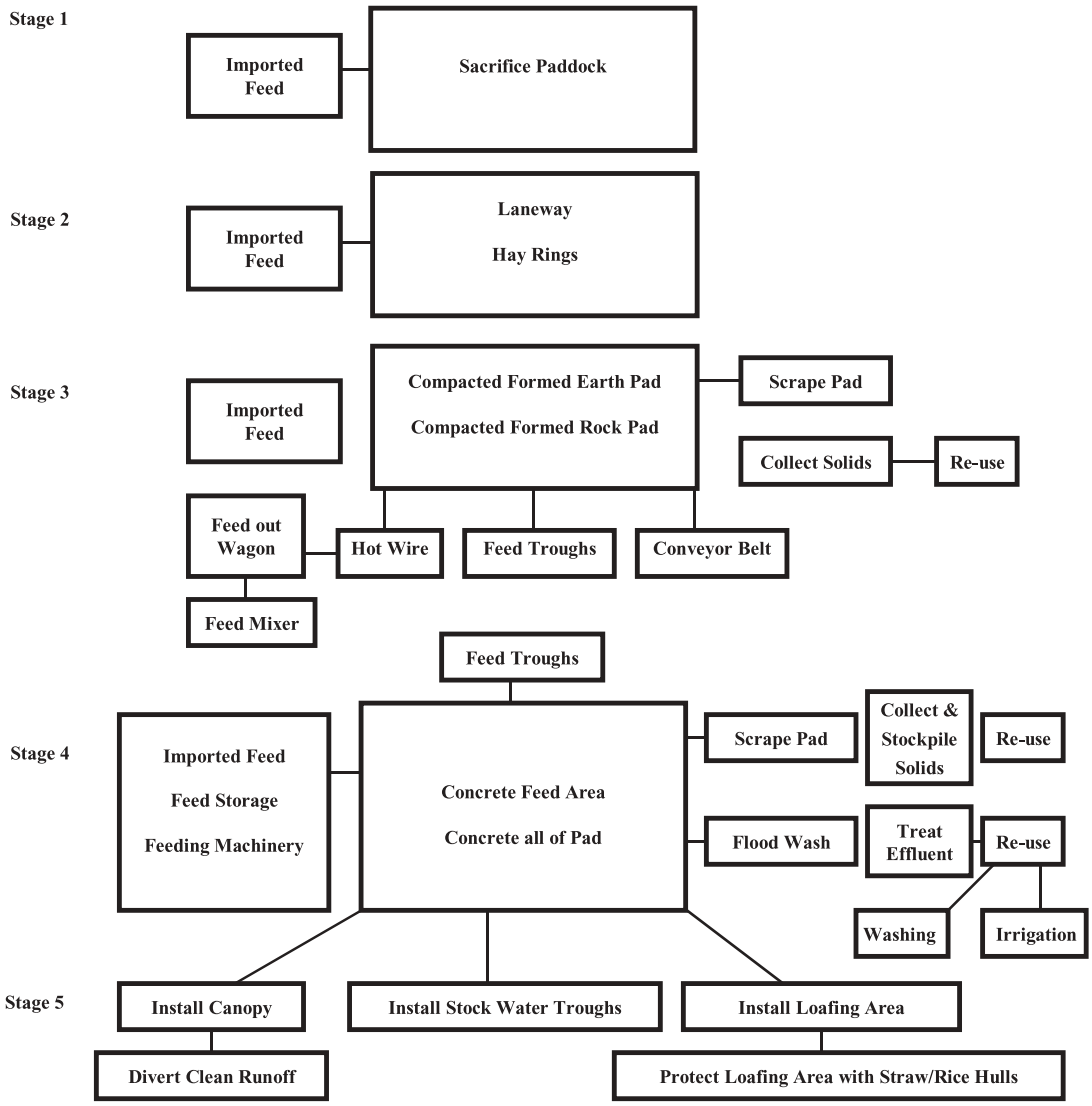
A well designed, constructed, operated and maintained feedpad has less potential to pollute the environment than cows fed intensively in a paddock however, the principles outlined in Section 4 must be adhered to.

11.3 Feedpad Stage Development

It must be recognised that the decision to install a feedpad is not always impulsively made, but often comes about in the natural progression and development of a dairy farm.
A farmer might begin by feeding hay in winter, progress to feeding hay in the laneway and then develop a more substantial raised pad/ laneway for supplementary feeding prior to deciding to install troughs and a roof.

An example of the stage development of a feedpad is provided in Figure 4.

Figure 4; *Feedpad Stage Development*



12.0 Feedpad Siting

In addition to ensuring adequate buffer distances (see Section 9 'Buffers'), the feedpad needs to be sited to ensure it complements and enhances the existing farm and existing management practices.

A number of issues should be considered when selecting a site and once a site is chosen, there should be a response to the question; "why should the facility be located at the selected site rather than somewhere else?", in relation to each of the following points,

- Access to the milking shed, imported feed and farm laneways for stock movement
- Access for employees and vehicles
- Expansion opportunities and stage development
- Slopes and other topographic features
- Visibility from the milking shed or farmhouse
- Any existing site services (e.g. water, channels, drains, electricity etc.)
- Existing vegetation, particularly native vegetation
- Streams, dams and waterways (refer to Appendix F: Definition of a Waterway)
- Existing buildings, particularly neighbouring residences
- Prominence in the landscape, views into the site and general aesthetics and amenity
- The provision of shade in the absence of trees on a farm.
- Boundaries and easements
- Flooding impacts
- Groundwater impacts or consequences
- Uncontaminated stormwater control/ diversion
- Ease of harvest of manure and re-use of wastewater and nutrients
- Prevailing winds in relation to odour propagation and the farmhouse and neighbouring residences.

Where a feedpad is proposed or already exists, care should be taken as there is the potential for conflict to arise in cases of:

- Urban areas
- Residential subdivision taking place
- Changes made to land zoning
- Construction of a new residence in the vicinity

12.1 Topography

In addition to the slope of the pad, the natural drainage regime of the area will need to be considered to facilitate the diversion of uncontaminated storm water runoff, the removal and transfer of wastewater to an effluent storage, the reuse of wastewater especially if this is to be applied via an existing farm reuse system and the drainage and contaminated runoff from the feed storage area.

The pad should be formed well above natural surface level to promote drainage, increase air movement, to decrease odours and to discourage insects. If the pad is too high it could be excessively prominent in the landscape and may be difficult to shroud. The economics involved in the sourcing and movement of the required volume of suitable soil for feedpad construction will need to be considered.

12.2 Soils

Soils should be investigated to assess their suitability for both pad construction and for the construction of effluent storages. Existing soil survey data is available in most irrigation areas and can be utilised to identify the clay dominant soils that will be required for both pad and effluent dam construction and so that sandy 'prior stream' soils can be avoided. Piezometers may need to be installed adjacent to ponds to detect seepage.

12.3 Groundwater Impacts

Depth to groundwater is important when considering the construction of effluent storage ponds as groundwater can limit the depth of these ponds, thereby increasing surface area. The depth to groundwater should be checked at any proposed sites and information on local groundwater level variation is available for a

range of areas across the Goulburn-Broken Catchment. The permeability of soils on the proposed feedpad site is also important in relation to groundwater contamination.

For more detail, the SEPP on Groundwaters of Victoria should be referred to.

12.4 Flooding

The feedpad surface should be located above the 1 in 100 year flood level and all earthworks should be designed to avoid off-site impact of floodwater discharge either through funneling or backwater effects. The top of any turkey's nest effluent pond embankment should be above the 1 in 100 year flood level. This does not apply to irrigation recycling sumps used to shandy effluent.

12.5 Waste Management

Adequate provision needs to be made for the storage of both solid and liquid wastes removed from the pad. Proximity to sites proposed for the reuse of these wastes must also be considered. It is a recommendation of the dairy effluent strategy that an effluent pond should not be situated within 300 metres of a neighbouring residence. Waste manage-ment is discussed in detail in Section 13.4.

13.0. Feedpad Design

For a summary of a common farm planning and feedpad design process, refer to Figure 5 in Section 14.5. A checklist of relevant planning considerations is provided in Section 15.

13.1 Type of Feedpad

A feedpad can be installed for a wide range of different uses (refer to Section 11.1 'Feedpad Uses') and a range of different types of feedpads are available (refer to Appendix C 'Feedpad Types'). The final option chosen will depend on each individual site, the proposed feeding system and the dairy farm management and therefore the range of potential feedpads is considerable.

The type of feedpad and the associated design features selected will depend on the;

- Proposed use for the feedpad
- Financial resources available
- Suitability of the proposed site
- Amount and type of shelter provided - (for hot or cold conditions) - e.g. vegetated barriers, mesh cloth, metal sheathed canopy or fully enclosed with or without sliding screens
- The type of feed storage (vertical or bunker bins or silos)
- The feed handling system - the conveyance of feed to animals or animals to feed
- The type of feed (grain, silage, pellets by products etc.)
- Mode of cleaning the feedpad and methods of waste harvesting, handling, storage and re-use

The earthworks, buildings, associated structures and equipment need to be designed considering optimum production, safe working conditions for humans, stock movement and health and access for machinery.

13.1.1 Pad Slope

The surface of the actual pad should be designed to provide sufficient slope to contribute to effective drainage and to prevent surface wastewater reaching the subsoil. The pad should be elevated to facilitate fall with a recommended minimum gradient of 1 in 500 and maximum gradient of 1 in 20 depending on the surface of the pad and the proposed method of cleaning. Steeper slopes may be acceptable but require a higher standard of construction and operational management as excess runoff and sediment transport may occur causing possible erosion and pollution problems. The pad should be sloped away from feed and drink facilities and this section could have a different gradient in comparison to the overall slope of the pad. Pad slope and surface must facilitate safe purchase of cow hooves.

13.1.2 Pad Surface Construction Materials

The materials forming the pad are 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 surfaces are:

- Earth and stabilised earth
- Gravel and coarse sand
- Bitumen
- Concrete
- Bricks and concrete blocks

The choice and nature of the surface material will govern the cost, and longevity of the feedpad. The pad surface is also important from a stock health perspective and should minimise stress, disease and injury on animals, especially in relation to stock hooves and the incidence of mastitis.

The pad surface should have a thick enough foundation to spread loads into the ground without causing settlement and should provide a durable, clean and non-slip finish. Low infiltration is desirable to restrict the leaching of nutrients, pathogens and salts into the subsoil and to protect groundwater resources from contamination. A design that allows for stages in construction from earth to stabilised earth through to concrete could also be considered

Earth

A pad can consist of the natural soil surface or soil material can be formed and compacted to produce the pad. Over time, the surface of an earthen pad usually develops a compacted interfacial layer of manure and soil. This forms a biological seal that decreases water infiltration. Studies have shown that leaving a compacted layer of manure on the earthen feedpad surface will decrease the likelihood of nutrients leaching into the underlying soil profile.

The potential of clay soils to crack through shrink/swell processes will need to be considered and a constant moisture state may be required to maintain the integrity of a clay pad. To help maintain pad integrity, soil chemical stabilisers such as hydrated lime or gypsum can be used.

Soils material forming the pad or the bed and banks of effluent storages will need to be compacted to achieve a maximum permeability not exceeding 10^{-9} m/sec. Any earthen pad for storing waste solids will also need to be formed to ensure 10^{-9} m/sec maximum permeability.

Gravel & Sand

Well graded gravel, sand or crushed rock is often placed on a formed and/or compacted earthen pad and on these types of pad surfaces, the development of a manure pack is generally undesirable. Uniformly and poorly graded gravel or sand should not be used for pad construction as material without finer particles can be difficult to compact to an appropriate density as it is often cohesionless.

In the case of some finer sands, all aeration pores can become blocked resulting in an increase in odour from the manure pack or stored manure solids. Material that contains sharp stones should be avoided.

Concrete

Materials such as bitumen, bricks and concrete can provide more durable options for pad surfaces. These materials, and especially concrete, are generally a more costly option. With these materials, care needs to be taken to ensure the surface does not become slippery and when concreting, scoring or grooving of the surface can be employed.

Geotextiles

Geotextiles are thin, flexible, permeable sheets of synthetic material used to stabilise and improve the performance of soil associated with civil engineering works. Geotextiles have a relatively low capital cost, long life span and are resistant to soil chemicals, moisture and bacteria. Geotextiles and rubber mats can be used for filtration, drainage, separation,

reinforcement and sealing or can be employed on the surface of the pad. Filtration restricts the migration of fine soil particles from a soil mass while remaining permeable to water movement. Reinforcement provides stabilisation of the soil and decreases the impact of soil compaction by stock. The drainage capacity of geotextiles allows water to be carried along the plane of the material to an outlet. Water may be conveyed vertically or horizontally. Similarly a one-piece polyester envelope can be fitted over perforated drainage pipes like a sleeve.

13.2 Sizing & Layout

The aim of the feedpad design is to have a rational layout that provides for efficient operation and includes adequate facilities and conditions for maintenance of stock health and protection of the environment. It is not unusual to increase the size of a facility over time to house more cows and provision should be made for this.

13.2.1 Laneways and Access

Good access can be achieved by locating the feedpad in a central location on the site and by designing to minimise vehicle movement, provide for orderly management of stock and allow the collection of wastes.

Stock

The physical dimensions of laneways, races, gates, entrances and exits should be designed to provide ease of access and movement for livestock. Factors to consider include:

- Structures should be designed to take advantage of the social behaviour and natural movement of cows
- Only rounded railing without protrusions should be employed
- The minimum desirable width for laneways is 3.7 m, as herd numbers increase recommended laneway dimensions rise and a 5.5 m laneway is considered adequate for a 120-250 cow herd.
- A compromise is necessary between very wide laneways which occupy land and reduce control of stock movement and narrow laneways which contribute to high pavement loading.
- Avoid the 'funneling' of stock and allow cows to enter a feedpad without changing direction by more than 90º
- All laneways, access and stocked areas should be well drained and as runoff from these areas is typically contaminated, runoff should be graded to catch drains and directed to the feedpad effluent system.

Vehicles

The feedpad design should also provide adequate areas for all-weather vehicle access and factors to consider include:

- The minimum desirable width for laneways is 3.7 m to facilitate vehicle movement.
- Room for the distribution of feed to the pad
- Room for cleaning operations
- The delivery and storage of feed to the site, especially the movement of trucks
- Access from a main or secondary road
- Wherever possible, avoid a layout which requires a vehicle to 'back' in a space where low structures are obscured.
- Adequate area must also be provided for the collection of wastes such as stockpiled solids and the cleaning of effluent storages and solids traps.

13.2.2 Yard Requirements

When comparing the daily spacing requirements of a 600 kg dairy cow grazing compared to an animal on a feedpad, the allowance is approximately 200 m^2/cow grazing to 9 m^2/cow on a feedpad. For this minimum space of 9m^2/head, an allowance of 10% greater should be included to provide flexibility. Obviously smaller cows will require less space but it is best to augur on the large size to ensure adequate space is provided.

The spacing requirements of feedpads will vary considerably due to the type of feedpad, the construction materials, individual sites, environmental conditions and management practices. In addition, the amount of feeding area or trough space per cow and the amount

of time the cows are on the pad also influences spacing requirements.

The area provided for cattle has a significant influence on the density of manure and the moisture content of this manure and therefore pad cleaning should also be considered in the space requirement. The stocking rate also influences feedpad conditions such as dust, odour, runoff, muddy lot conditions as well as fly breeding.

13.2.3 Feed Troughs

A recommended trough length for a 600 kg cow is estimated to be 0.3 m for animals fed once a day, although an allowance of 1m per 600kg of live weight is preferred, particularly where young animals dominate the herd. For a fully grown cow, the height of the trough should range from 600 mm to 1,200 mm. Feed can also be placed at ground level as long as cow hooves cannot intrude. The spacing requirement for feed troughs will vary with cattle size, feed rations and feeding frequency and the duration that the cattle have access to the feeds. It is always better to augur on the large size with the allocation of space. The design of feed troughs and feed areas should also consider the type of feed, distribution of feed, cleaning of spilt feed, general maintenance and the minimisation of odours.

13.2.4 Height & Orientation

Additional sizing and layout design considerations should include:

- The height of the shed has to be accessible to machinery for use in cleaning and feeding (recommended minimum ridge height of 7 m). Standard building should be used.
- Adequate height of the shed to promote sufficient ventilation, but at the correct height to provide protection and comfort to stock.
- Positioning of the eaves and canopy of the feedpad will affect the amount of shading and sunlight obtained and therefore orientation is important. Winter sunlight can provide warmth for stock, help dry the feedpad surface and reduce the incidence of disease. Shading may be required in hot weather.

13.3 Drainage

It is recommended that feedpads be built on a raised platform to promote natural drainage and gravity conveyance of waste and runoff. Drainage is required for all weather access, the collection of contaminated runoff and the diversion of uncontaminated stormwater. The protection of surface and ground water resources through prevention of leachate movement and by controlling stormwater discharge must be assured.

The drainage systems should be designed to accommodate the runoff from the feedpad and associated works area for a 1 in 20 year 24 hour storm event using Australian Rainfall and Runoff Data and an example of this type of calculation is provided as Appendix J. Additional water from sources such as laneways, feed storage areas, canopies, washing systems and trough spillages should also be included in any storage volume calculations.

13.3.1 Rainfall Diversion

Runoff contaminated with faeces, urine, spilled feed or silage liquor should be directed into the effluent system and some areas may require drains or diversion banks. Uncontaminated (clean) rainfall runoff, including uncontaminated surface runoff from around the feedpad and rainfall runoff from pad canopies should be diverted to the natural drainage system of the area. It is not usually desirable to have uncontaminated runoff enter the feedpad effluent system.

13.3.2 Contaminated Runoff

Rainfall that is not diverted is a significant factor which must be considered in the design of exposed feedpads and is affected by the slope, rainfall intensity and management practices. Runoff from livestock areas contains relatively high concentrations of nutrients, salts,

chemicals, debris, pathogens and oxygen demanding organic matter. Whenever changes are made to cow flow such as at entry points to facilities, road underpasses and laneways, provision should be made for the diversion of contaminated runoff from these areas to the effluent reuse system. Further details on the management of contaminated runoff are provided in the following sections.

13.4 Waste Management

A very important consideration in feedpad design is the removal of manure as there is enhanced potential for both water and air pollution from accumulations of manure. In areas where animals are concentrated on small amounts of land, wastes are generated at rates and quantities that cannot be assimilated by the land. In the absence of vegetative growth there are no prospects for the utilisation of nutrients from the surface. Therefore accumulated waste must be exported off the feedpad and onto an adequate land area for reuse. Storage may be required prior to land application, especially in the case of liquid waste generated during cold or wet weather.

Regulations for the management of effluent that apply to dairy sheds also apply to feedpads and to this end reference should be made to the Dairy Shed Act. It should be noted that an existing dairy shed effluent storage is unlikely to be able to accommodate the waste generated from a feedpad.

In relation to feedpad waste management, the following points should be considered:

- Waste must not leave the farm boundary with the exception of land application purposes.
- The waste management system should not create odours.
- Waste must not pollute any watercourse or groundwater.
- The waste management system must comply with the acts, policies and regulations listed in Appendix G.
- The waste management system should operate with minimal maintenance input.
- Land slopes, pad and laneway layout and vehicle and stock movements should be considered when designing the waste management system.
- Suitability of soils for the construction of effluent storage ponds.
- Availability and location of areas with suitable soils and enterprises for waste reuse.
- Other feedpad wastes such as dead animals or silage wrap need to be considered and should be managed as for the existing best practice for dairy farms.

A waste system should be well planned, designed, constructed and managed, as it has the potential, if poorly managed, to affect human and stock health and pollute the environment.

13.4.1 Pad Cleaning

The type of pad surface dictates the method of cleaning employed and therefore the ease and cost of cleaning. Both flushing and mechanical scraping techniques are used. A stone dust pad will not be suitable for flushing whereas an open concrete pad may be suitable for both scraping and flushing. Where the waste is relatively dry, typically where rainfall has not influenced moisture content, cleaning can consist of the scraping of solids. Even an open pad can generate very little liquid waste.

13.4.2 Solid Wastes

In the case of pads where the only cleaning is the removal of solids by scraping, the following default values apply and should be adjusted for the apportionment of time and the proportionate weight of cows (refer to Appendix L).

500 kg dairy cow fed on harvested feed

Raw manure	40 kg/cow/day
Solids	4.2 kg/cow/day

This manure could be in a relatively dry solid form or in the form of a liquid or slurry. The amount and consistency of manure will depend on factors such as production levels, feed type, pad material, feedpad construction, environmental factors and the duration the cows and the manure is on the pad.

The pad is typically scraped with a front-end loader or a blade and the solids are reused directly or stockpiled within a controlled drainage area prior to being applied to land or composted.

13.4.3 Pad Flushing

Where flushing is to be used to clean pads, attention needs to be paid to the design of the flushing system. Factors that need to be considered include:

- Will the pad be scraped first
- The method of water discharge
- The volume of water required
- The velocity of water during flushing
- The control of runoff - size of pipes and structures etc.
- The use of sediment/solids traps
- The reuse of water.
- The concentration of salts and nutrients which accummulates over time with reuse.

13.4.4 Liquid Effluent

Removal from Pad

While some feedpad systems generate little liquid waste, others can generate substantial amounts. Ideally, open drains should be employed for conveyance of feedpad effluent and catch drains with a minimum slope of 0.5% are ideal. Large diameter pipes can also be suitable and the larger the diameter of the pipe, the less slope that is required. Grated pits, pipes less than 100 mm diameter and proud concrete edges for pits should be avoided. An effluent system, which is reliant on a pump, is prone to problems.

Removal of Solids from Effluent

Ideally, a waste system should facilitate the separation of solids from liquid wastes to reduce the amount of solids entering the liquid effluent storage. Typically a solids trap, sedimentation basin or a form of terracing is used.

Flood washing

In the case of flood washing, the quantities of wastes generated are determined by the volume of liquid which is the volume used to flood wash. No additional volume is added for the manure collected as it is expected that this will be off set by evaporation from the storages and during the flood washing. The flood washing system volume needs to be totaled for the period when wastes need to be stored such as over winter for irrigation reuse systems (Refer to Appendix J)

Pond Sizing

It is not essential that a discrete wastewater storage be provided for a feedpad. As long as adequate storage exists on the farm to preclude off site discharge, environmental objectives can be met. However, the volume of any wastewater storage(s) required must be determined and provision for both the collection of runoff from rainfall (refer to Appendix J) and any volume generated by a flood washing system provided. The approximate volume generated by a flood washing system can be relatively easily calculated. The storage of liquid wastes prior to reuse must be considered and this volume can be substantial where wastes are reused as irrigation and need to be stored over winter while irrigation is not feasible. Where this is the case, reference should be made to the Rainfall and Evapotranspiration graphs in Appendix K to determine over what period rainfall exceeds evapotranspiration and therefore crops will not be using water and wastewater will need to be stored.

Effluent Treatment

Effluent storage ponds can be designed to provide anaerobic and/or aerobic treatment processes in single or dual pond systems. This is generally adequate if effluent is left for an appropriate length of time prior to reuse, allowing these treatment processes to take place. No matter what the detention period or the effectiveness of conventional pond treatment, no off farm discharge should be contemplated by regulated tanker transport.

13.4.5 Waste Reuse

Feedpad wastes can most beneficially be used in a manner that obtains the maximum benefit from the nutrients they contain. A crop

production system should be utilised that provides a balance between nutrients and water applied and losses due to evapo-transpiration and harvesting of the crop. A list of different crop options, along with production requirements and nutrient uptakes is provided as Appendix M. The site selected for land application of liquid wastes must have sufficient area to utilise all water applied (see water budget in Appendix K), however it is more likely that the nutrient content of the water will dictate the area of land that the liquid effluent should be reused over. An example of a nutrient budget is provided as Appendix L.

The land application site could be on farm or alternatively arrangements must be entered into with owners of land outside the farm to reuse wastes. In the case of the latter, attention must be paid to the transport of the wastes and the transfer of diseases between farms.

Machinery is available for the spreading of solid wastes onto land, whereas liquid wastes, when not being employed for flood washing, can be applied to land by tanker or through an irrigation system. Liquid effluent applied to land in the form of irrigation must be applied by an approved irrigation method and not discharged from one point continuously. It is appropriate to mix wastewater in with flood irrigation water providing relatively accurate mixing and application is available.

Regulations apply to the application of wastes to land and for runoff from agricultural land irrigated with effluent and these are listed in Appendix G. The Biological Oxygen Demand (BOD) of the waste stream and the presence of pathogens should be considered when reusing wastewater.

13.4.6 Combining Effluent & Reuse Systems

It is highly unlikely that existing dairy effluent ponds will have sufficient capacity for the feedpad however, a feedpad effluent system could be designed to cater for both waste streams. Generally a feedpad effluent system should not be directly linked to the farm irrigation tailwater reuse system.

However, provision can be made to periodically transfer effluent to the reuse or irrigation system to allow effluent to be applied to the farm providing relatively accurate mixing and application is available.

13.5 Nutrient and Salt Management

Nutrients collected from a feedpad system in the form of solid or liquid waste should be used to enhance production and these wastes should be applied to land where some form of cropping or pasture can utilise the nutrients.

A crop production system should be utilised that provides a balance between nutrients and water applied and losses due to evapotranspiration and harvesting of the crop. The crop production system could be pasture utilisation for milk production, a fodder crop to produce inputs for the feedpad or a commonly used crop in the area. A list of different crop options, along with production requirements and nutrient uptakes is provided as Appendix M.

The establishment of a feedpad and the associated distribution of nutrients in effluent reuse will change the overall nutrient management on a farm and this needs to be taken into account when applying fertilisers.

13.5.1 Nutrient Budgeting

The amount of nutrients generated can be determined by using default figures for the amount of nutrient that the average dairy cow produces per day (see Table 1). This can then be adjusted for the time on the pad and for the weight of the cows in question.

Nutrient	Production
N	0.225 kg/day
P	0.047 kg/day
K	0.145 kg/day

Table 1: *Default figures for production of nutrients of dairy cattle for a 500 kg animal.*

A nutrient budget is then used to demonstrate that the amount of nutrients generated and then reused (i.e. applied to a crop or pasture) is balanced with the amount of nutrients removed in product from the system, thereby confirming the application of wastes is a sustainable process. The crop should remove all of the nutrients applied to prevent the build up of nutrients in the soil and the possible contamination of groundwater. The site selected for land disposal of wastes must have sufficient area based on nutrient concentrations. An example nutrient budget for the land application of both solid and liquid feedpad waste is provided as Appendix L.

Alternatively, a minimum default value of 1 hectare per 5 cows could be utilised if the animals are always located on the pad, with amendments made based upon the apportionment of time. Higher rates of application can only be used if a detailed appraisal of the soils, crops and nutrient cycling of the enterprise shows such rates to be sustainable. More detail on this complex process of nutrient cycling is provided in Appendix N.

13.5.2 Monitoring

Areas where effluent or solids are spread will require careful monitoring to ensure no buildup of nutrients or salts occurs in the soils and that no groundwater contamination occurs. Annual soil testing is recommended and regular groundwater monitoring should also be carried out.

13.5.3 Salts

Feed and water contain salts such as sodium and potassium salts and it is common for salt to accumulate in a feedpad environment. Salt accumulated in the wastewater stream should be spread back on land in conjunction with water and nutrients, as it obviously cannot be separated from the effluent.

13.6 Water Supply

It is essential that cattle have access to a sufficient supply of drinking water of adequate quality. Farm water supplies should supply at least 20 L/cow/hour to meet the likely requirements of the herd. Table 2 provides general guidelines for stock water consumption.

Foodstuff, topography, age, bodyweight and climate provide a major influence on these consumption rates. Always augur on the conservative side when allowing for the water requirements of stock on a feedpad. The longer the stock are on the pad the greater the demand for water.

Water troughs should be well separated from feed troughs. Provisions should be made for water spillage 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 assembled. Ideally troughs should be located on the high point of a water line to reduce sediment and to facilitate purging air

Table 2; *Stock water consumption.*

Body Weight (kg)	Average Water Consumption (L/day)
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

from the pipeline. In pen situations, troughs may be positioned and shared between adjacent pens.

A watering system may be required for dust suppression and while excess runoff from this practice should be minimal, any runoff should be direct to the feedpad effluent system.

It should be noted that in accessing water, a licence may be required from G-MW to extract water from a waterway or groundwater.

13.7 Storage and Supply of Feed

An adult cow (500 – 650 kg) will require 15 – 25 kg/head/day of feed. The feed supplied should meet the nutritional requirement of the herd and be (of a quality) to promote consumption and avoid putrefaction. Care needs to be taken to maintain balance between the supplementary feed ration and any pasture consumed. Care should also be taken to avoid feedstuff containing chemical residues or contaminants. The feed should be stored in a secure, well ventilated environment that is vermin proof and easily cleaned on a regular basis. Some types of feed are recognized to contribute more to odour generation from a site than others.

Brewer's grain and some by-products are more offensive than grain, pellets and silage. Ideally, any feed sources that generate offensive odours should rely on short-term storage and regular delivery. As silage liquor is recognised to be a strong effluent, any leachate or runoff from feed storage sites should be collected and diverted into the effluent system. Bunding the silage storage area could help achieve this.

13.8 Feed Distribution

The process of feed conveyance and distribution provides a potential source of spillage, which contributes to odour, the contamination of run-off and increased problems with vermin. Ideally, stormwater run-off from all surfaces in receipt of stored, spilled or distributed feed should be diverted to the effluent management system. The type of feed troughs or feed area and the location of these must be compatible with the feedstuffs being distributed. Feed troughs should be capable of being regularly cleaned by scraping or hosing.

One of the most important aspects of feedpad management and maintenance is the regular cleaning of spilt feed as failure to do so can lead to excessive odour and vermin problems.

The successful operation of a feedpad relies heavily on good feed management, including careful consideration of:

- Feed source
- Feed storage
- Feed distribution
- Spillage control
- Vermin control
- Leachate control
- Odour control
- Efficient distribution
- Regular cleaning
- Animal Nutrition

13.9 Odour Minimisation

In relation to odour, reference should be made to the Guideline feedpad principles outlined in Section 4. Odour is produced from anaerobic biological activity that occurs in the decomposition of manure, spilt feed and other organic matter. Cow numbers, climatic conditions, type of feed and duration of feed storage and feedpad operation and management can affect odour from a feedpad.

Overall, a combination of design, management and regular cleaning and maintenance will reduce or virtually eliminate the risk of offensive odours. Design will assist the reduction in odour potential by eliminating opportunities for odour generation.

For example, having fully enclosed feed and water trough bases prevents a build up of spilt feed and manure in a difficult to clean location. While management and design reduce odour generation, buffer distances are a necessary means of reducing the impact of emissions.

Criteria has been determined, based on potential odour production, which relate the type of feedpad, cow density, cow duration on the feedpad and the class of feedpad to the distance from all sensitive uses. Details on buffers are provided in Section 9 'Buffer Distances' and a formula for the determination of buffer distances is provided in Appendix H.

The salient issues regarding offensive odours from feedpads include:

- Odour is generated from wet manure, urine, spilt wet feed, anaerobic holding ponds and stock.
- Odour is generally the most significant single problem that would be experienced in the operation of a feedpad.
- Storage of feeds and particularly by-products often enhance the magnitude of odour.
- Buffer distances are required (between feedpads and receptors) in order to prevent significant impact on the receptor.
- Unfortunately odour nuisance is often a very subjective issue
- Odour is very hard to measure, there is no single method for testing or unit for measurement

13.10 Noise

In relation to noise, reference should be made to the Guideline feedpad principals outlined in Section 4. Noise is rarely a problem in the operation of a feedpad, but should still be considered.

In relation to noise:

- The feedpad siting should optimise the distance between the feedpad and any neighbours.
- Hours of operation need to be assessed in order to reduce the impact on nearby neighbours e.g. during daylight hours only.
- The timing of delivery of feed or the transport of stock has the potential to cause problems as heavy vehicles entering or leaving feedpad premises before 6 am and after 10 pm may provide grounds for noise complaints.
- Truck access, general access points and roads on the premises should be located a minimum of 250m from neighbouring residences and all vehicles operating on-site and off-site should have efficient exhaust mufflers. Advisory truck routes may be useful for minimizing the impact of truck noise on townships.
- Feeding machinery needs to be properly maintained, with all noise abatement equipment installed.
- The location and design of all mechanical equipment including pumps, feed augers, and other equipment should minimise the likelihood of mechanical noise or vibration being identified off-site.
- Noise generated by the transfer and preparation of stock feed from sources such as hammer mills, roller mills, grain elevators and screw conveyors should not exceed existing ambient background noise before 6.00 am and after 10.00 pm. Enclosure and efficient insulation may be required for feed preparation plant.

Noise levels generated on the feedpad should not exceed (the levels stipulated) in the EPA Noise Guidelines.

13.11 Landscaping

Landscaping plays an important part in softening the visual impact of a feedpad and the development needs to be integrated into the landscape to the extent possible utilising natural site features.

Belts of landscaping should be established around the feedpad area to provide a heavy visual screen from roads, public areas and nearby residences. Where possible, existing trees should be retained and incorporated into the design of landscaping. A planning permit is required to remove native vegetation.

The establishment of vegetation can act as a windbreak or vegetative shrouds can be located to avoid wind tunneling and to promote dispersion of gases. Major plantations assist in lowering the watertable and help to reduce

any seepage and waterborne nutrients that have escaped from the site. Trees and other vegetation should be established down-slope from the feedpad in a location suitable to assist in filtering of any seepage. However, it must be noted that any trees planted as part of landscaping should be located a suitable distance from the feedpad as shade cast by vegetation can lead to wet spots on th epad and related areas which can lead to significant problems. Careful design is required in the selection of the type of landscaping and type of species selected for both the areas immediately surrounding the facility and the landscaping established a significant distance away.

The landscape design and species selected should be low maintenance and not require further watering following the initial planting period and the first summer season.

However, any landscaping should be maintained and any dead or diseased plants replaced.

While utilising native vegetation will provide native biodiversity benefits, deciduous trees could be more appropriate. It is also difficult to keep trees alive in the presence of manure or heavy stock traffic, especially native trees which are not tolerant of high nutrient and water levels and compaction.

13.12 Community Perceptions and Amenity

To help ensure acceptability, the expectations of a rural community and the development of an enterprise that is compatible with the landscape should be considered.

A feedpad can be perceived as a feedlot or even worse as an intensive animal or 'battery' industry by the public and even with the agriculturally orientated there is growing antipathy to their development.

This is because feedpads are viewed as a point source of odor, nutrients, noise and pests or insects. In addition, factors such as the build up of manure is perceived as being an animal welfare issue.

The establishment of aesthetically acceptable feedpads that are managed in an appropriate manner, have healthy stock and are kept clean with limited odour problems can help overcome these perceptions. It is generally regarded that if a facility looks good, it is less likely to attract negative attention.

14.0 Construction, Maintenance & Management

14.1 Construction Responsibilities

It should be noted that the site landholder and feedpad owner has the responsibility for compliance with all regulations. It is essential that the landholder has contacted all relevant agencies, submitted all relevant documentation and received written approval where required well prior to the commencement of construction.

Construction should take place only after a permit is granted and works are approved. Supervision is essential to ensure that an adequate quality of works is achieved. This construction work should take place when weather conditions are optimal and the risk of dust or excessive rain is minimal. Initially the feedpad area should be prepared to allow for the control of sediment during construction, providing for the diversion of uncontaminated stormwater.

A member of the Irrigators Survey and Design Group (ISDG) should survey the feedpad site. In addition, all works should be laid out by qualified personnel and be in accordance with the plan.

14.2 General Management

The operation, management and maintenance of a feedpad have a critical bearing on the efficiency and effectiveness of feedpad operation. With the reduction in area, requirements for skilled managers, higher technologies and energy all increase significantly.

Circumstances leading to odour production and other detriment due to the operation of the feedpad must be avoided and appropriate operations and maintenance must be undertaken in relation to the type of feedpad, especially in relation to the method and frequency of cleaning.

Feeding out equipment should be operated to minimise spillage and feed residues should be removed from troughs at least weekly. Water troughs and float valves should be maintained to minimise overflows and spillage and should be located adjacent to a drain.

General routine cleaning and maintenance should include the cleaning of spilt feed and the elimination of any wet patches, repairing potholes in the feedpad and cleaning under fences around the feedpad. Drainage channel, diversion banks and dam wall maintenance should be undertaken, along with the maintenance of any settling area, retention pond or dispersion areas.

Maintenance and operation of the waste reuse system must not lead to soil degradation or pollution off-site and must not lead to any material detriment due to odour or other cause. Records should be kept of stock numbers, stock duration on the pad, feed types and production levels to provide information for nutrient and water budgets for waste reuse. The key for good management is to maintain a clean surface and ensure that all manure and wastewater is collected, stored and exported for re-use.

In the future dairy companies in receipt of milk may require appropriate QA support for the facility.

14.3 Animal Welfare

Of fundamental importance in the planning and design of a feedpad is to provide a production environment that is conducive to the maintenance of animal health and the avoidance of animal stress. This may entail provisions for shade and shelter if dairy cows are to be exposed to the elements for a long period, as well as the maintenance of as clean a standing area as possible. Cattle standing in a build up of manure are seen by many as an animal welfare problem.

If cattle are housed for an extended period it is important to seek professional counsel if behaviour or disease problems become endemic.

Wherever possible make use of wind and sunlight for drying surfaces and shade for cooling stock and avoid sharp rocky surfaces, proud concrete, steel protrusions, or rough approach ramps.

Aspects of herd movement and pecking order can be utilised to the advantage of the operation and should therefore be studied. The nutritional requirements of the herd should be met along with the water supply requirements.

14.4 Occupational Health and Safety

Feedpad operators must be aware of occupational health and safety issues including:

- Machinery guards
- Safe machinery operation
- Feed storages and confined spaces issues
- Fencing of dams and effluent ponds
- Slippery surfaces

14.5 Planning & Design Summary

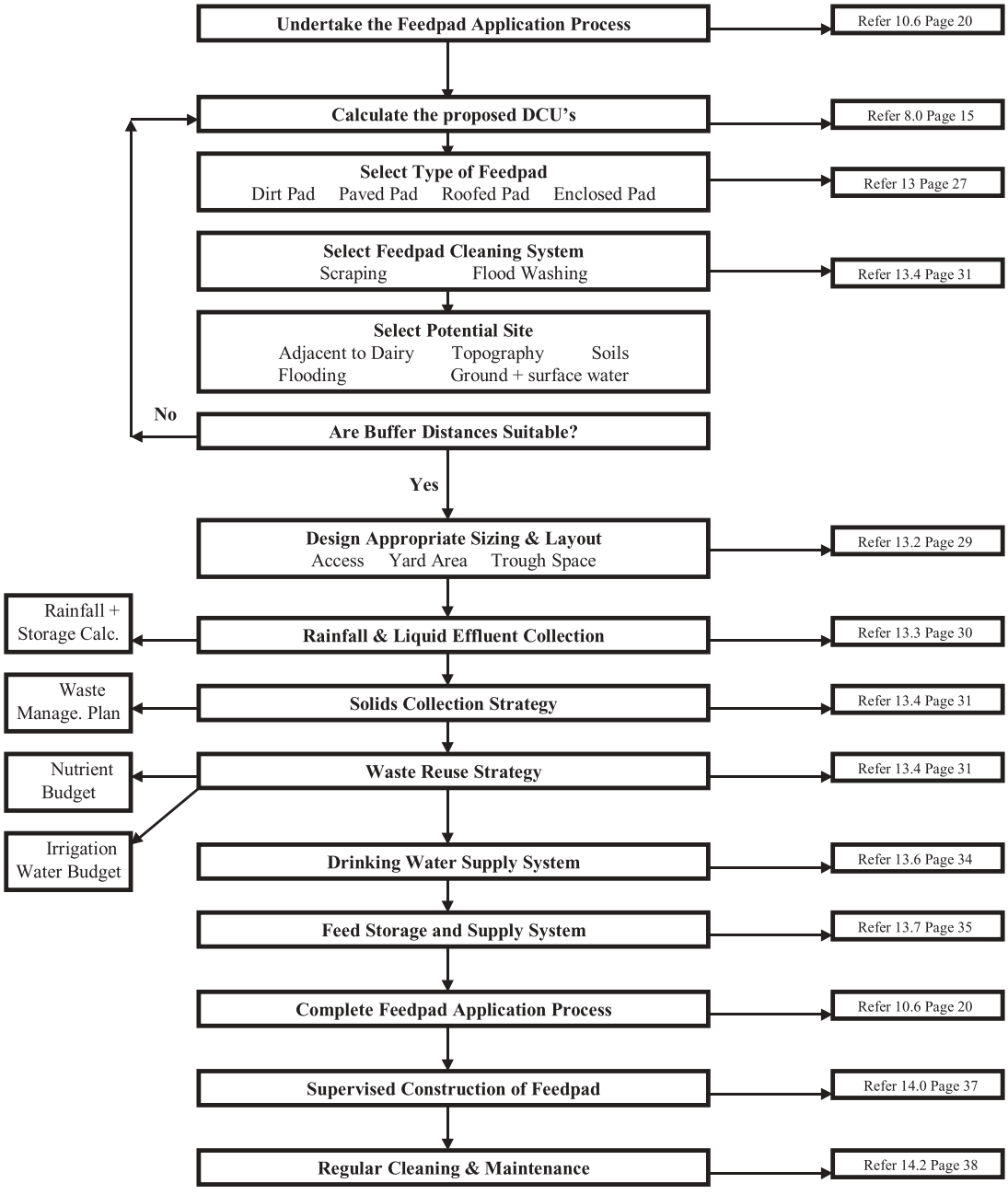


Figure 5; *A summary of a common feedpad planning and design process.*

15.0 Feedpad Planning, Design & Establishment Checklist

The checklist set out below indicates the decision sequence and the order of consideration which proponents should give to the establishment of a feedpad. It is a summary only and does not replace the detailed requirements and calculations required under these Guidelines.

1	Will the feedpad be located in Goulburn Broken Catchment?	Refer 5.1	Yes / No
2	Does the feedpad fit the Guideline definition?	Refer 6.1	Yes / No
3	Will the feedpad be located in a Declared Special Water Supply Catchment?	Refer 5.2	Yes / No
4	Will the feedpad house less than 50 or more than 5,000 head.	Refer 5.3	Yes / No
5	Will the feedpad fit with the Guideline principles?	Refer 4.0	Yes / No
6	Will the feedpad be in a Rural Zone?	Refer 7.1	Yes / No
7	Is a planning permit required? - Discuss with Municipal Council	Refer 10.1	Yes / No
8	Is the feedpad site covered by any Overlays?	Refer 7.1	Yes / No
9	Have the functions of the feedpad been considered?	Refer 1.2	Yes / No
10	Have aspects such as economics, production, management & the environment been considered?	Refer 11.2	Yes / No
11	Has feedpad stage development been considered?	Refer 11.3	Yes / No
12	How many cows will use the pad	Refer 17.3 + Other Case Studies	.....
13	What will be the average weight of the cows using the feedpad?	Refer 17.3 + Other Case Studies	.....kg
14	What will the peak monthly average duration on the pad be?	Refer 17.3	.....hrs
15	How many DCU will be using the feedpad?	Refer 17.3	.....DCU
16	What area will the actual pad cover?	Refer 17.4	.....m^2
17	How many DCU/m^2 will occupy the feedpad?	Refer 17.7	.....

18	How will the feedpad be cleaned	Refer 13.4	.....
19	How often will the feedpad be cleaned?	Refer 13.4	.....
20	What is the S1 buffer factor for the feedpad?	Refer 17.7	.....
21	What is the distance to the nearest receptor?	Refer 17.7	.....m
22	What type of receptor is the nearest receptor?	Refer 17.7	.....
23	What is the S2 buffer factor for the feedpad?	Refer 17.7	.....
24	Will there be more than 1 feedpad located in the vicinity of the receptor?	Refer 17.7	Yes / No
25	What is the topography in the vicinity of the feedpad?	Refer 17.7	.....
26	What is the S3 buffer factor for the feedpad?	Refer 17.7	.....
27	What is the vegetation density in the vicinity of the feedpad?	Refer 17.7	.....
28	What is the S4 buffer factor for the feedpad?	Refer 17.7	.....m.
29	Does the feedpad comply with the Fixed Buffer Distances?	Refer 17.7	.....m.
30	What is the buffer distance requirement for the feedpad?	Refer 17.7	.....m.
31	What is the maximum loading of the feedpad?	Refer 17.7	.....DCU.
32	What is the maximum no. of cows permitted on the feedpad?	Refer 17.7	.....cows
33	Is the feedpad site topography suitable?	Refer 12.1	Yes / No
34	What soil types will the feedpad be sited on?	Refer 12.2	.....
35	Are the feedpad site soils suitable?	Refer 12.2	Yes / No
36	What is the depth to groundwater under the site?	Refer 12.3	.....m.
37	Is there an elevated risk of groundwater contamination?	Refer 12.3	Yes / No
38	Could the site be affected by 1 in 100 year flooding events?	Refer 12.4	Yes / No
39	What slope will be employed on the pad surface?	Refer 13.1	.....%
40	What material(s) will be used to construct the pad surface?	Refer 13.1	.....
41	Has access for both stock and vehicles been considered?	Refer 13.2	Yes/No
42	What area will be available per cow on the feedpad?	Refer 13.2	.....$m.^2$

43	What length of feed trough will be available per cow?	Refer 13.2	……..mm
44	Which direction will the feedpad be orientated (east/west etc.)?	Refer 13.2	……..…..
45	Will clean rainfall be diverted or collected?	Refer 13.3	Yes / No
46	Will all contaminated runoff be collected?	Refer 13.3	Yes / No
47	What is the area of the feedpad from which runoff will be collected?	Refer 17.9	……m2
48	What is the average annual rainfall?	Refer 17.9	……..mm
49	What area will the proposed storage cover?	Refer 17.9	……m2
50	What is the 1 in 20 years 24 hour rainfall event?	Refer 17.9	..…….mm
51	What volume is required to accommodate rainfall runoff from the feedpad and the associated feedpad works area?	Refer 17.9	……...ML
52	What volume of water will be used in flood washing?	Refer 20.8	……...ML
53	Will flood washing water be recycled?	Refer 20.8	Yes / No
54	Will liquid effluent need to be stored over winter?	Refer 20.8	Yes / No
55	For how many months does rainfall exceed evapotranspiration?	Refer 20.8	……..…..
56	What volume is required for the feedpad drainage system and associated storage?	Refer 20.8	……...ML
57	How much solids will be produced per annum	Refer 20.10	……..…..t
58	How much nitrogen will be produced per annum?	Refer 20.10	...……...kg
59	How much phosphorus will be produced per annum?	Refer 20.10	……...kg
60	How much potassium will be produced per annum?	Refer 20.10	...……...kg
61	Over what area will the nitrogen need to be reused?	Refer 20.10	..... ha
62	Over what area will the phosphorus need to be reused?	Refer 20.10	.....ha
63	Over what area will the potassium need to be reused?	Refer 20.10	..... ha
64	What area will the total wastes need to be reused over?	Refer 20.10	..... ha
65	Has salt cycling been considered?	Refer 13.5	Yes / No

66	Has a plan for the reuse of both liquid and solid wastes been formulated?	Refer 20.10	Yes / No
67	How much stock drinking water will be supplied per cow?	Refer 13.6	L
68	Has the type of feed been considered?	Refer 13.7	Yes / No
69	Has the type of feed storage been considered?	Refer 13.7	Yes / No
70	Has feed storage area runoff been considered?	Refer 13.7	Yes / No
71	Has feed distribution been considered?	Refer 13.8	Yes / No
72	Has special feed distribution/mixing machinery been considered?	Refer 13.8	Yes / No
73	Has odour production & minimisation been considered?	Refer 13.9	Yes / No
74	Has noise production & minimisation been considered?	Refer 13.10	Yes / No
75	Has landscaping and general amenity been considered?	Refer 13.11	Yes / No
76	Have general construction requirements been considered?	Refer 14.0	Yes / No
77	Has feedpad maintenance been considered?	Refer 14.2	Yes / No
78	Has feedpad management been considered?	Refer 14.2	Yes / No
79	Has animal welfare been considered?	Refer 14.3	Yes / No
80	Has occupational health and safety been considered?	Refer 14.4	Yes / No
81	Has the proposal been discussed with the Municipal Council?	Refer 10.1	Yes / No
82	Do other agencies need to been notified?	Refer 10.2	Yes / No
83	Have nieghbours been informed?	Refer 10.2	Yes/ No
84	Will earthworks affect flooding or discharge from the property?	Refer 10.2	Yes/ No
85	Will native vegetatoin be removed?	Refer 10.2	Yes/ No
86	Will a building be constructed?	Refer 10.2	Yes/ No
87	Has a detailed scaled drawing of the feedpad been prepared?	Refer 10.4	Yes/ No
88	Has all required documentation been prepared?	Refer 10.3	Yes/ No
89	If necessary, has an application been submitted to the Municipal Council?	Refer 10.2	Yes/ No
90	If necessary, has written approval been received from the Municipal Council?	Refer 10.2	Yes/ No

16.0 Contacts & References

16.1 Further Information

Dairy farmers contemplating a feedpad often find accessing technical information and advice difficult. Some of the main agencies where further information can be accessed include:

• DNRE	-	Kyabram Dairy Centre	PH: 5852 0500
• GMW	-	Tatura	PH: 5833 5000
• GBCMA	-	Shepparton	PH: 5822 2288
• DRDC	-	Murray Dairy	PH: 5852 0524
• University of Melbourne	-	Dookie	PH: 5833 9200
• EPA	-	Wangaratta	PH: 5721 7277
• Local Councils	-	Moira, COGS etc	
• Milk Companies	-	Bonlac, Murray Goulburn, Tatura Milk etc.	

16.2 References & Further Reading

DAEM (1995) *Victorian Code for Cattle Feedlots*. Victoria Feedlot Committee and Department of Agriculture, Energy and Minerals (DAEM) Victoria, Melbourne.

DNRE (1992) *Draft Code of Practice Piggeries.* Department of Natural Resources and Environment Victoria.

DNRE (2001) *Dairy Shed Effluent Pond Sizing Manual*. Department of Natural Resources and Environment, Victoria.

DNRE (2001) *Target 10 "NutriMatch" Worksheet.* Department of Natural Resources and Environment, Victoria.

R. Wrigley & Monks (1993) *Managing Dairy Shed Wastes Volume One*. Workshop proceedings. Dairy Research and Development Corporation, Glen Iris, Victoria.

R. Wrigley (1994) *Managing Dairy Shed Wastes Volume Two*. Workshop proceedings. Dairy Research and Development Corporation, Glen Iris, Victoria.