Dairy effluent systems for high rainfall areas Technical Note E03

Introduction

A significant portion of the Queensland dairy industry is established in tropical and sub-tropical, coastal, and tableland areas that have average annual rainfalls greater than 1200 mm. In addition to the climatic factors, the topography in most of the high rainfall dairy farming areas is hilly and often associated with highly permeable red volcanic soils. These conditions require different approaches to effluent management.

The Technical Note E02: Dairy effluent management systems, lists some advantages and disadvantages of effluent ponds and continuous application systems, (e.g. sump-pump-sprinkler systems). This Technical Note supplements the information in the above note by outlining additional issues of particular importance in planning and managing a dairy effluent system in higher rainfall areas.

Effluent pond or continuous application system?

From an environmental perspective, effluent ponds are generally preferable to continuous application systems in drier areas of Queensland (average annual rainfall less than approximately 1200 mm). Ponds allow effluent to be stored until the pasture/crop and soil conditions allow for optimal use of the valuable water and nutrients contained in the effluent. Continuous application systems generally require daily application of effluent, regardless of the weather, crop/pasture or soil conditions. When effluent is applied onto wet ground from a sump-pump-sprinkler system during periods of wet weather, the effluent could run off into a watercourse. In high rainfall areas where the ground is wet for longer periods and steep terrain is common, the risk of effluent entering a watercourse is greater. Such an event may have adverse impacts on the environment and is a waste of potentially valuable water and nutrient resources.

Effluent pond systems are generally designed to have sufficient storage capacity to ensure that they do not overtop more frequently than an average of once every 10 years, except in sensitive environmental areas where less frequent overtopping may be desirable. The calculations used to determine the required pond capacity assume that effluent irrigation only commences after the soil has dried out sufficiently. In high rainfall areas, the soil may not dry out sufficiently for extended periods during the wet season, so there may be limited opportunity for effluent irrigation. In addition, effluent ponds in high rainfall areas may collect large volumes of rainfall runoff from yard and shed roof areas. Under such circumstances, increasing the size of an existing effluent pond, or building a larger effluent pond to increase wet weather storage capacity, is likely to be self-defeating in terms of reducing the frequency of pond spills. The increase in pond surface area associated with a larger pond will, in turn, increase the volume of rainfall collected by the pond, as it becomes a significant additional catchment. It is impractical, therefore, to design a pond system based on the same operating assumptions applied in drier areas.

In an attempt to address the issues outlined above, the following section describes some additional measures that could be applied in planning effluent systems in high rainfall areas.

Effluent pond strategies for high rainfall areas

A combination of the following measures could be applied to reduce the potential for effluent pond spills in high rainfall areas.

Minimise the yard area draining into the effluent system.

Install guttering on all existing rooves covering the dairy and associated yards, and drain the roof runoff into a storage tank or away from the effluent system. This water could be used for various purposes, including hosing the dairy and yards, recycling into the cooling system, and/or supplying cattle drinking water.

Construct a roof over some or all of the yard area, and fit guttering to reduce yard rainfall runoff entering the effluent system. The resulting shade will also assist in relieving heat stress at milking times during the hot summer months.

Install a rainfall diversion device to divert yard runoff away from the effluent system after the yard has been thoroughly cleaned by hosing. With this type of device, wash-down water and dirty runoff from the yards can be collected during milking. The device can then be reset to divert the clean yard runoff from rainfall outside milking hours away from the effluent system (assuming the yards are cleaned after each milking).

Install a single pond system rather than a double pond system. A single pond system has the following benefits over a double pond system:

- the surface area for collecting rainfall is smaller;
- the land area required is smaller (suitable pond sites may be difficult to find where steep terrain is common); and
- the costs associated with sealing a single pond are generally lower.

Construct a deep pond (up to 5 m deep) instead of a shallow pond to minimise the surface area collecting rainfall while satisfying storage capacity requirements.

Site the pond as close as possible to the dairy and construct contour banks to divert any uncontaminated, upslope runoff away from the effluent system.

Cover the pond. While this is likely to be impractical and uneconomic in most cases (particularly for existing ponds), it may be an option worth considering for new ponds in areas of extremely high rainfall (average annual rainfall greater than 2000 mm). Under these circumstances, a cover could be suspended from a post installed in the centre of the pond.

It may be necessary to install an effective solids trap to remove solids from the effluent stream before it enters the pond. This will reduce the required pond desludging frequency and the risk of blockages in effluent irrigation equipment.

Use effluent recycled from the pond for flood washing the yards. This reduces the amount of additional fresh water introduced to the effluent system on a daily basis.

Soil permeability and groundwater issues

In high rainfall areas permeable red volcanic soil types (e.g. ferrosols, krasnozems and red earths) are common. Some high rainfall areas are also underlain with shallow, fractured basalts that may allow effluent leakage into groundwater aquifer systems. In these situations, effluent ponds should be treated to reduce the potential for effluent leaching into underlying groundwater (e.g. clay liner, synthetic liner, bentonite).

DPI&F trials on the Atherton Tablelands indicated that the target level of impermeability (0.1 mm/day) was not achieved in three effluent ponds constructed in volcanic soils without clay lining, (Silver, Walker and Armour 2001). The DPI&F Note Clay lining and compaction of effluent ponds (Skerman, Redding and McLean 2002) provides information on clay lining materials and methods that can be used to seal the pond to an acceptable degree of impermeability.

Topography

At sites where the terrain is steep, it may be difficult or impossible to construct a suitably sized pond below the dairy. At other sites, the dairy may be situated too close to a watercourse to allow the construction of a suitable pond.

Continuous application systems

Under certain circumstances, a continuous application system (e.g. sump-pump-sprinkler) may be preferable to an effluent pond system, despite the disadvantages outlined previously. The choice of an appropriate effluent system will generally require careful consideration of a wide range of site-specific factors.

Effluent irrigation management

Managing effluent irrigation also presents a number of challenges in Queensland's high rainfall areas where the terrain is relatively steep. The following issues should be considered in planning and managing effluent irrigation in these areas.

On some farms, shandied effluent (effluent diluted with fresh water) may be applied to crops or pasture through a fresh water irrigation system. This will enable effective distribution of effluent nutrients over a large, productive area of the farm while minimising the risk of overloading the soil with nutrients. The irrigation system must, however, be able to cope with the solids content and more corrosive nature of shandied effluent. In some cases, it may be possible to inject effluent (under pressure) into an existing fresh water irrigation line.

The application of effluent onto steeply sloping land should be avoided. In hilly terrain, effluent irrigation should be confined to the crests of hills and ridges, as far away as possible from creeks and gullies.

Travelling irrigators are not designed to operate on steep slopes where they may become unstable or lose traction. If a travelling irrigator is to be used, sites that maximise the run length should be favoured when selecting an effluent irrigation area.

To avoid excessive runoff and erosion, effluent irrigators should have appropriate nozzles and be operated at optimum pressures to deliver an irrigation application rate that matches the soil infiltration rate.

Pumping equipment must be capable of providing the head required at the irrigator over the entire length of the irrigation run. In steep terrain, the electric motor power required for the pumping head may exceed the capabilities of single-phase electric power, necessitating the installation of a 3-phase power supply, or a diesel or petrol engine. At some sites, this may involve significant expense.

To avoid pond spills, careful scheduling of effluent irrigation is required. During the wet season, effluent should be irrigated onto crop or pasture at the earliest possible opportunity after the soil has dried out sufficiently. Irrigation will reduce the effluent volume in the pond, thereby maximising the capacity available to store further inflows while reducing the risk of pond spills. At the start of the wet season, it is particularly important to ensure that effluent ponds are pumped out in readiness for anticipated inflows, although, some effluent should be retained in the pond to maintain its biological function.

If an effluent pond fills during wet weather and an overflow is imminent, it is generally preferable to irrigate effluent onto a wet irrigation area rather than allow the pond to spill. Irrigation will assist in dispersing the effluent over a large area and provide a greater opportunity for filtering by vegetation.

Conclusions

The planning and management of dairy effluent systems in high rainfall areas presents a number of challenges. While effluent ponds are generally desirable in many situations, they may not always be the most practical and effective option. In some circumstances, carefully designed and managed sump-pump-sprinkler systems may be more appropriate.

This Technical Note identifies issues associated with effluent systems in high rainfall areas and suggests effluent management strategies to improve farm productivity while protecting the environment. It is strongly recommended that farmers in high rainfall areas obtain specialist advice when considering the installation of new dairy effluent systems or modifications to existing systems. Sound advice may avoid the need for costly and difficult modifications of unsatisfactory systems at some future time.

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E01 Clay lining and compaction of effluent ponds

E02 Dairy effluent management systems

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