Environmental management for animal-based industries: dairy farm effluent

Western Australia Agriculture Western Australia Bunbury Regional Office.

Dairy Industry Nutrient Strategy Working Group (W.A.)
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Environmental management for animal-based industries - dairy farm effluent

By the Dairy Industry Nutrient Strategy Working Group

Environmental guidelines for animal based industries in Western Australia
Foreword

GUIDELINES FOR MANAGING FARM DAIRY EFFLUENT IN WESTERN AUSTRALIA

The effluent which collects around dairies and their associated feeding facilities should be regarded as a resource to be retained and used on the farm, rather than a waste product for disposal.

These guidelines aim to assist dairy farmers plan effluent management systems which are practical, as well as easy to install and manage, while also being acceptable to the agencies and authorities given the responsibility of protecting the environment.

Farmers have a responsibility to ensure that their activities do not adversely affect the environment beyond their farm. Intensive animal industries can pose particular problems because large numbers of animals held on a small area of land produce a concentration of effluent which needs careful management if it is not to pollute surface or ground water. This is particularly so near sources of drinking water. Poor management of effluent can also pollute farm water supplies.

Increasingly, good effluent management is an integral part of quality assurance. Managing effluent takes time and money to plan, install and manage. But the costs can be offset by the short-term return from better use of effluent on the farm and the long-term return from a more sustainable dairy business.

These Guidelines are part of a series being produced to help managers of intensive agricultural industries reduce the risk of their operations causing unacceptable environmental impacts. Officers from Agriculture Western Australia, Water and Rivers Commission and Department of Environmental Protection co-operated in the production of these Guidelines.

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GUIDELINES FOR THE MANAGEMENT OF FARM DAIRY EFFLUENT IN WESTERN AUSTRALIA

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To help you work out the best way to manage your effluent, work through the following chart.

| Do you have an area of free draining soil which is not waterlogged in winter and which grows pasture all year? |
|---|---|
| **YES** | **NO** |
| Continuous direct application may be possible. Some considerations: | Continuous direct application not possible – storage needed. Some considerations: |
| • don’t apply to catchment of farm water supplies. • don’t apply to pastures being grazed by stock. • use pump and sprinkler designed for effluent. | • makes pumping easier. • solids need to be stored and handled properly. • solids required initially to help seal storage pond. |
| high risk of bacterial contamination of pasture and farm water supplies. | will effluent flow by gravity to the storage pond or will it need to be pumped? |
| • can access more of farm. • can be expensive. • has to be done every few days. • heavy when loaded — can bog in soft paddocks. | for gravity flow, need fall of at least 1 in 80 and pipe diameter of 200mm. • use pump designed for effluent. |
| effluent tanker | storage pond. |
| sump with storage for few days. effluent pump. reliable sprinkler system. | check site for clay content before constructing – pond must seal. |
| emptying the pond. | • pond must be big enough to cope with potential expansion – have size calculated. • think about how to get the effluent out of the pond. |
| land application. | • use pump and sprinkler designed for effluent. • empty pond in early autumn and again in spring on annual pastures or summer on irrigated pastures. |
| • apply to rapidly growing pasture or fodder crop. | • apply to waterlogged soils. • soil test regularly and adjust fertiliser program. |

Dairy effluent management
1 Introduction

1.1 Who prepared the Guidelines

These Guidelines have been prepared by the Dairy Industry Nutrient Strategy Working Group which was established by the previous Dairy Program Advisory Committee (DPAC) of Agriculture Western Australia.

Dairy effluent management has been recognised as an important issue which the dairy industry in Western Australia must face up to. It is better for the industry to establish satisfactory and workable procedures for the management of dairy effluent than to wait and be forced to comply with standards imposed on it.

Ineffective disposal of solid and liquid effluent can cause pollution of surface and ground water resources. Best management practices are needed to prevent degradation of these resources.

Effluent management is also an important component of quality assurance. As quality assurance programs spread through industry, purchasers of dairy products will increasingly be looking back along the production chain to satisfy themselves that environmental concerns are being addressed at all stages.

Most discussion on dairy effluent management focuses on the 10% of the effluent which collects around the dairy - the other 90% tends to be ignored. This is dropped in grazing paddocks and on laneways leading to and from the dairy. An effective management program should consider all of the effluent which is deposited on the farm. The effluent which collects around the dairy is probably the easiest to manage. Laneways within about 100 m of the dairy and associated feeding facilities collect a lot of effluent which it may not be possible to direct into the sump servicing the yard.

Nutrients moving in water draining from laneways and from grazing paddocks need to be managed as part of a whole farm water management program which very few farmers have at this stage. Vegetated filter strips, sediment ponds, settlement basins etc may all have a place in reducing sediment and nutrient loads reaching watercourses and waterbodies. Some of these structures could be on individual farms while some will help manage the drainage from a catchment of several farms. More work needs to be done to develop practical means of reducing the sediment and nutrient loads carried in our drains.

Recognising the importance of dairy effluent management, DPAC established the Nutrient Strategy Working Group to enable industry representatives to be actively involved in planning. Representatives of Land Conservation District Committees (LCDCs) and Western Australian Farmers Federation were invited to an initial meeting which led to the establishment of the Nutrient Strategy Working Group.

Members of the Nutrient Strategy Working Group are:

- Andrew Bett Mundijong; Dairy Council, Western Australian Farmers Federation
- Steve Scott Boyanup; Dairy Council, Western Australian Farmers Federation
- Tom Busher Dardanup; Dardanup Land Conservation District Committee
- Neville Haddon Busselton; Dairy Program Advisory Committee
- David Kemp Busselton; Dairy Program Advisory Committee
- Neil MacDonald Busselton; Sussex Land Conservation District Committee
- Bill Russell Agriculture Western Australia, Bunbury
- Ian Bell Agriculture Western Australia, Bunbury

1.2 What are these Guidelines about

These Guidelines describe the principles behind good effluent management. They provide details of actions you can take on your farm to manage dairy effluent and suggest how you can adapt your operations to save and use the nutrients in the effluent.

Applying the effluent to rapidly growing pasture or fodder crop will be the preferred management method on the majority of farms. Your objective should be to develop a system which allows you to achieve this while minimising the risk of your effluent polluting surface or ground water.

To do this, you will need:

- a means of collecting the raw effluent from the dairy, yards, laneways and any feeding areas in some form of sump
- a means of moving the effluent away from the dairy, either direct to pasture or to a storage system for later application
- a means of moving the effluent from the storage system onto the pasture at a time when the nutrients can be taken up by pasture.

The Guidelines do not specify exactly what you should do; they provide a guide and examples to help you determine the approach that suits your dairying operations.
1.3 Basic components of an effluent management program

Some basic objectives for managing dairy effluent which are covered in more detail in other sections are:

- Dairy shed effluent and run-off from intensive use areas are not allowed to enter surface water courses or underground aquifers.
- Under Dairy Industry Authority regulations, ponds used to store effluent must be at least 45 meters from the milk room of the dairy while sumps should be at least 20 meters away.
- Continuous effluent application systems that depend on pumping should have several days holding capacity in the system. This is necessary to avoid pollution in the event of mechanical breakdown by allowing time for repairs.
- Effluent should not be applied to land during periods of high rainfall when there is a risk of run-off into water courses.
- Ponds should be located a sufficient distance from houses to avoid potential odour problems.
- Where surface runoff may enter the pond or damage the banks, this runoff should be diverted away from the pond, unless this runoff comes from a high use area.
- Ponds should never overflow but emergency spillways should be incorporated into the design to protect them from damage caused by severe storms.
- Avoid run-off into tail drains when effluent is included with water used for irrigation.
- Static sprinklers spreading effluent should be moved regularly to avoid creating polluted areas which may leach to streams or aquifers.

No two dairy farms will have exactly the same effluent management system - farms are different and farmers will want to do different things with their effluent. Farmers are encouraged to look for ideas which reduce the amount of effluent which has to be handled or which make it easier to manage.

It is strongly recommended that you recycle the nutrients in your effluent by applying it to rapidly growing pasture.

A combination of sumps, pumps and ponds will be used by most farmers, with both specifications and layout changing to suit individual farm and farmer circumstances.

1.4 Taxation incentives

Expenditure on facilities to retain and treat dairy effluent are fully deductible for taxation purposes under Section 75D of the Income Assessment Act.

Expenditure incurred on holding dams and drainage pits, if installed primarily and principally for the purposes of assisting in drainage control and, as a result, in preventing land degradation, would be an outright deduction in the year in which the expenditure was incurred.

The installation of any pumping equipment at the drainage pit, storage lagoons and associated piping is considered to be part of an 'operation' for the purposes of preventing land degradation. Its cost would be an allowable deduction under Section 75D in the year in which the cost was incurred.

1.5 Other requirements and conditions

A number of State and local government authorities have requirements for the management of farm dairy effluent, especially in the coastal plain catchment of the Peel-Harvey estuaries. Appendix 9.1 outlines some of the requirements of the Water and Rivers Commission Act 1995, the Waterways Conservation Act 1976, the Dairy Industry Authority Regulations (1997), the Environmental Protection (Swan Coastal Plain Lakes) Policy Approval Order 1992 and the Town Planning and Development Act 1928; Statement of Planning Policy No. 2 - Peel-Harvey Coastal Plain Catchment.

2 Planning to keep effluent on your farm

2.1 Planning in whole farm context

It is essential to plan the management of dairy effluent within the whole farm context and preferably as part of a comprehensive water management program. Property boundaries, wetlands, watercourses, existing laneways and land suitable for re-use of dairy effluent, particularly land suitable for application in winter, should be identified on the farm plan. A planning check list to work through is given in Section 2.2.

Soil testing should be used to determine nutrient requirements and monitor effluent application rates.
2.2 Check list for planning

1. Consult information providers to gain assistance.

2. Consider current farm operations and land use practices and the influence of new works and new activities on these. Determine likely prospects for expansion over ten to twenty years.

3. Identify areas for future development, expansion or modification of existing land use practices.

4. Identify all watercourses and wetlands on the farm plan and whether or not you are in an area where the risk of groundwater pollution is high.

5. Study farm land use and establish the location of the milking shed, farm buildings, farmhouse, neighbouring houses and other fixed physical features which will influence the siting of works.

6. Examine soil profiles at potential sites for storage and at the location of potential areas for land application of effluent.

7. Identify the most appropriate site for land application of effluent to maximise its re-use value. Concentrate on sites with scope for expansion with minimal risk of off-site discharge of effluent.

8. Identify the most appropriate sites for storage of liquid and solid effluent to avoid contamination of underground water, overland flow to watercourses and adverse influence on neighbours through noise or odour generation.

9. Assess pollution risks associated with the failure of the effluent management system.
   (a) pump breakdown
   (b) overloaded sump
   (c) breached embankment
   (d) surface run-off into watercourses.

10. Think about how you can prevent runoff from laneways and other intensive use areas getting into watercourses.

3 Collection, storage and application of farm dairy effluent

3.1 Collection

The less water that enters your effluent management system, the less you have to pump out again. Diverters can be installed at the yard outfall to separate storm water from the dairy effluent, reducing the volume which has to be managed, but there are risks involved. You need to be sure that the diverter always directs your washings into your sump. If you forget to alter the setting, you could find your dairy effluent flowing into your drainage system.

Until someone comes up with a foolproof system, you should probably not try to divert stormwater which falls on the yard away from your sump. The extra storage required is not great and there may be some advantages in collecting this stormwater.

Monitoring has shown that the concentration of salt in storage ponds rises over summer, reaching levels which could affect pasture plants and the operation of the pond. Adding storm water to the ponds will help to dilute the salt and, while the extra storage volume required is not usually great, it is important that you make provision for the stormwater when you are designing your pond.

You should have fewer problems diverting run-off from roofs away from your sump.

Divert surface runoff from ponds constructed on hillsides and re-use clean water from plate coolers around the dairy before disposing of it.

You can reduce the volume of effluent you need to manage by reducing the time your cows spend around the dairy. The less time they spend at the dairy, the less manure they deposit and the less water you need.
to clean the yard. Handling the cows quietly should also reduce the amount of effluent dropped in the yard.

Cleaning can be made easier by
- pre-wetting the yard
- using a high volume, low pressure washing system
- building a yard with a good slope; it is safe to use a slope of up to 1:30 as long as a grit mix is used for the surface.

Aim for a flow of around 250 litres/minute and pressure of 100 to 140 kPa. Recommended pipe diameters are from 38 mm to 51 mm and you should keep the number of right angle bends in the delivery system to a minimum. Shovelling off the solids plus pre-wetting before hosing down uses least water but is probably only an option for smaller herds. Sprinkler systems installed to cool cows in summer also keep the yard wet, making cleaning quicker and easier without using much extra water.

**Flood washing** using a large quantity of water tipped onto the yard at its highest point will reduce the time taken to clean the yard but it uses a lot of water. Recommended flood washing criteria are:

- a volume of 500 L per metre width of yard
- a minimum velocity of 1.0 m/sec
- a minimum grade for rapid flush of 1:50
- a cross-yard slope of only 25 mm at the top of the yard, increasing to a greater slope at the bottom to direct the large volume of water to the outlet
- the sump receiving flood washing effluent to be at least big enough to hold the volume of water discharged in one operation of the tank

A successful flood washing system needs a large volume of water and an adequate flow rate to dislodge solids. However, flood washing generally needs a water reuse system to reduce water consumption to acceptable levels. Salt buildup under our conditions may reduce its usefulness.

Remove sand, gravel and other foreign material from the effluent before it enters your management system. Removing these solids reduces the volume of effluent you have to move and reduces the wear and tear on pumps. To function successfully, solids traps need to be cleaned regularly.

Remember that dairy cow manure is corrosive. All moving parts in pumps, couplings and sprinklers need to be kept clean and well lubricated. Preventative maintenance is essential for the reliable operation of any effluent management system.

### 3.2 Solids separation

Removing solids from your dairy effluent can make management easier. As well as the reduced wear and tear on pumps from removing sand and gravel, storage ponds won’t silt up as quickly and there will be fewer problems pumping the liquid fraction through sprinklers. However, the solids need to be stored and spread which means extra work.

Using a trap to remove sand and gravel is nearly always beneficial but a case can be made for putting the rest of the solids into the pond. On sandy soils, the solids help form a biological seal and, in a well designed and managed pond, there will be some breakdown of solids. With the right pump and sprinkler, most of the contents of a pond can be pumped out onto pasture.

The general layout of a solids separation system is shown in Figure 2.

While there are many variations (no two dairy layouts are exactly the same), consider the following points when designing a solids separation system.

- The design should allow for solids removal by tractors or other equipment available on the farm.
- A large solids trap may take too long to dry out over winter, making it difficult to empty. Two smaller traps will be better than one large one.
- If the solids are to be stored before being used on the farm or sold off the farm, direct the drainage from the storage site back into the effluent management system.
- Liquid from the solids trap can either be applied direct to pasture or moved to a storage pond for later application.
- All solids should be pumped into the pond until the biological seal has formed; leave the slats or mesh out until this has happened which could be up to six months in sandy soils.

### 3.3 Ponds

To maximise uptake of nutrients and minimise runoff, apply dairy effluent to actively growing pasture. Under our conditions, this means that some form of storage will usually be necessary.

Regard pond systems as a means of **storing** effluent, not **treating** it. Most ponds systems will produce some breakdown of solids and will also reduce bacterial loads but they will have practically no effect on nutrient loadings, particularly phosphorus.
The liquid that comes out of ponds is unacceptable for discharge into any surface or groundwater body on your property.

Conduct a site investigation with a backhoe before starting construction of ponds, to assess the suitability of the soil type and the level of the water table.

The size of the required pond system is determined by the milking shed wash down volume, size of the herd, milking time, rainfall and evaporation.

The design, siting and construction of storage ponds will be different for each farm but there are some general considerations.

- Ponds must be at least 45 m from the dairy milk room and should not be close to houses - yours or your neighbours.
- Pond size should take account of future increases in cow numbers - better a bit bigger than needed than a bit smaller.
- Thoroughly test the site before construction begins, to ensure that the pond will seal.
- Think about how you will empty the pond before you start building it - can you use a bottom pipe to gravity feed the liquid into an irrigation system?
- Using a bulldozer to construct the pond usually produces walls that are less liable to slump.
- Allow for machinery access to remove solids.
- Securely fence all ponds to exclude children and stock.
- Provide a freeboard of at least 0.4 metre above the maximum water depth, after the walls have settled, to allow for storage of direct rainfall on the ponds.
- Empty ponds every year to prevent a buildup of salinity; the remaining sludge should not exceed a depth of 0.5 metre. This is best done during spring so the effluent can be applied to actively growing pasture.

Computer programs which take account of cow numbers, local rainfall and runoff from yards are available for designing storage ponds. These programs can provide for single or multiple storage ponds, depending on your circumstances.
Dairy effluent management

Table 1. Nutrient content of dairy effluent - samples collected from storage ponds in autumn and spring in south-west Australia

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These programs have generally been developed using data from outside Western Australia and some modifications may be needed to suit local conditions. It appears that the rate of build up of sludge in local ponds is not as rapid as experienced in south east Australia, probably because of our generally higher temperatures. This means that ponds should need cleaning less frequently than expected.

However, the rate of sludge buildup is also affected by the salinity of the effluent. As the effluent becomes more saline, the bacteria which break down the solids become less effective so it is important to manage the effluent to prevent the accumulation of high salt loads.

Empty ponds regularly, twice a year if possible, after the autumn break and again in spring. Emptying in autumn means that you will have maximum storage capacity over winter - reducing the risk of your pond overflowing. Emptying in spring allows you to apply nutrients to rapidly growing pasture before evaporation over summer concentrates the salt to potentially dangerous levels. If you do not empty your pond regularly, you should check its salinity level before you apply the effluent to sensitive pasture.

Two pond systems

Two pond systems are designed to achieve biological treatment of raw waste and operate best where there is a continuous through flow of waste water. They reduce the solids content of the effluent and make the resulting water suitable for a wider range of uses, including reuse for wash down of yards.

Two pond systems represent best management practice from an environmental protection viewpoint. In catchments where environmental problems are being experienced (eutrophication of waterways, for example), progression to best management practice should be the objective. This will minimise the risk from large storage ponds rupturing in a 24 hour ten year storm event and discharging raw effluent into nearby streams and waterways.

The level of treatment achieved is not sufficient to make the water suitable for discharge into any surface or ground water body and it must be contained on the farm.

If continuous controlled application to growing pasture is not possible, some storage will be required. Either the aerobic second pond can be made big enough to provide sufficient storage and improve the level of treatment or a third pond can be constructed.

Application of treated effluent from a two pond system to pasture can be very flexible. Application to pasture may be possible in dry periods over winter in the knowledge that unexpected rainfall which might wash some of the treated effluent off the property will have minimal environmental effect.

In two pond systems, the trafficable sump often used with single storage ponds is not necessary and is effectively replaced by an anaerobic pond adjacent to the storage pond.

In two pond systems, effluent enters the first or anaerobic pond where solids settle and are broken down by bacteria which thrive in the absence of oxygen. This reduces the level of nutrients flowing into the second pond.

The second or aerobic pond is shallow, encouraging the penetration of sunlight and aeration of water by wind to maintain higher oxygen levels.

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3.4 Land application

On the majority of farms, dairy effluent will be disposed on-farm. There is scope for separating the solids and drying and selling this material.

For maximum uptake of nutrients, apply dairy effluent to actively growing pasture. Don’t apply effluent to waterlogged paddocks - the pasture is unlikely to be growing very quickly so it won’t take up the nutrients and you run the risk of the effluent running off into drains and creeks. If you apply effluent to dry paddocks over summer, opening rains will wash many of the nutrients through the soil before plants have developed enough roots to take them up.

Some options for land application are:

- Shandy effluent with irrigation water by feeding it into the head ditches; be careful not to allow runoff into the tail drain unless you can pick this water up somewhere else on your property.
- Pump the effluent onto freshly grazed pastures after the break; by the time the cows come round again, the regrowth should be clean and palatable.
- Apply the effluent to hay or silage paddocks in spring. This is the time of most rapid pasture growth and nutrient uptake and there should be adequate rain to wash the effluent off the leaves before you cut the pasture.

The amount of effluent you can apply to an area of land depends on the capacity of the land to handle the volume of water and the nutrient requirements of the plants growing on the land. If either of these are overloaded, you will not gain maximum benefit from the effluent and you run the risk of polluting surface or groundwater.

Dairy effluent is a potential source of plant nutrients and you should take account of this when planning your fertiliser program. The nutrient content of dairy effluent is very variable but some figures from our local monitoring program are shown in Table 1.

These are figures from samples collected from storage ponds in autumn and spring and it needs to be stressed that there is great variation in nutrient concentration of farm dairy effluent.

Your soil testing program will indicate the nutrient requirement of the land to which you are applying your dairy effluent and you can use the above figures to calculate how much of that requirement could be supplied by the dairy effluent. An example is shown in Appendix 9.5

Figure 5. Collection sump at the Jetta dairy, Wokalup.

Regular soil testing is important for any nutrient management program. It is important that you know the level of the major nutrients in your soils, how these levels are changing over time and how they vary over the different soils on your farm. Record this information for each of your paddocks so that you can keep track of what’s happening to the store of nutrients on your farm.

Your management should aim to minimise the loss of nutrients from the farm and your fertiliser program should aim to replace those nutrients sold off the farm in produce. The nutrients in your dairy effluent should be considered as part of your fertiliser program.

Salinity is also important. If storage ponds are not emptied regularly, levels of salt in the sludge and liquor can rise to levels high enough to damage pasture. Damage is less likely if the effluent is applied to well established pasture but seedling plants are much more susceptible. This is another point in favour of applying the effluent to hay or silage pasture in spring.
Pumps are critical in most effluent management systems and they probably cause more heartache than any other part of the system. As a general rule, the more effective your solids separation system, the fewer problems you will have with your pumps. In any case, using a pump designed to handle dairy effluent is the way to go. If you are pumping effluent containing solids, make sure that your pump has the capacity to pump rapidly enough to keep the solids in suspension.

4.2 Pumps

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If you are pumping effluent, talk to your supplier about what you will need for your particular circumstances. Distance pumped, head and presence or absence of solids all need to be considered when designing your system. You also need to consider what effect sunlight might have on the performance of the pipe. If the pipe is designed to be buried, leaving it on the surface may reduce its performance and will shorten its life. Some guidelines:

- If the fall is from 1 in 60 to around 1 in 80, use 200 mm pipe if relying on gravity; if the fall is less than this, use a pump.
- Use sewer class pipe rather than stormwater class.
- If pumping more than about 100 m or more than about 10 m static head, use 75 mm, class 4.5 pipe; 50 mm can be used for shorter distances or lower heads.
- UPVC pipe can normally handle higher pressures than polythene pipe but has less flexibility to handle surge pressure.
- Leaving PVC in the sun for only a few months can halve the life it would have underground.

4.4 Sprinklers

Regardless of whether you are spraying raw effluent or effluent from which the solids have been removed, use a sprinkler designed to handle effluent.

Whether you use a single, skid mounted sprinkler or a travelling irrigator, you need a spray jet which is flexible enough to pass solids larger than the nozzle diameter.

Move all sprinkler systems regularly to avoid effluent ponding on a small area. You need an easy way of moving skid mounted sprinklers. With travelling irrigators, an effective cut-off mechanism is essential. Spray pot sprinklers can also be effective but they tend to have a small wetted diameter and poor distribution pattern. With some of the more expensive travelling irrigators, there is scope to either hire them for the time needed or share with neighbours.
Reliability is essential as the consequences of having a pump out of action for any length of time can be serious.

Characteristics of some common types of effluent pumps are shown in Appendix 9.2

Whatever pump you use, remember that it will break down occasionally and it will need maintenance so make sure that you can get at it easily.

It is strongly recommended that you use a purpose built manure pump, regardless of whether or not you separate out any solids.

4.3 Pipes

The type of pipe you use will depend on what you expect it to do. If the pipe is expected to move effluent containing solids by gravity, you need to use at least 150 mm pipe. Blockages will be a problem with anything less than this. The steeper the grade, the smaller the pipe you can get away with but this is one place where size does make a difference. Separating out the solids makes it easier to move the remaining liquid.

If you are pumping effluent, talk to your supplier about what you will need for your particular circumstances. Distance pumped, head and presence or absence of solids all need to be considered when designing your system. You also need to consider what effect sunlight might have on the performance of the pipe. If the pipe is designed to be buried, leaving it on the surface may reduce its performance and will shorten its life. Some guidelines:

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Figure 8. Vaughan travelling irrigator.

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UPVC pipe can normally handle higher pressures than polythene pipe but has less flexibility to handle surge pressure.

Leaving PVC in the sun for only a few months can halve the life it would have underground.
4.5 Slurry tankers

Slurry or vacuum tankers are useful for moving semi-liquid effluent and they can cope with most of the material which ends up in storage ponds. They give you a bit more flexibility than other spreading systems in that they allow you to access more of the farm. They can be difficult to use on wet areas but you probably shouldn’t be spreading effluent on wet paddocks anyway. Tankers are generally expensive but there is scope for either a contracting service or for neighbours to share one. Make sure that the tanker is well cleaned before it comes onto your farm.

5 Management of intensive use areas

5.1 General principles

Intensive use areas are where stock concentrate for any length of time - laneways, feed sheds, feed paddocks, sacrifice paddocks and night paddocks. On many farms, stock spend more time in these areas - and deposit more effluent - than they do at the dairy. Without proper management, this effluent can cause just as many problems as that dropped at the dairy and it can be more difficult to manage. Your aim should be to manage your cows so that their effluent is naturally distributed over as much of the grazing area as possible. You need a system of laneways which promotes rapid movement to and from the dairy and a paddock layout which allows, as far as possible, all paddocks to be grazed in rotation.

The more effectively effluent is distributed around the farm, the fewer problems there will be from odour and safety. Greenhouse gas generation will also be reduced.

Intensive use areas are generally close to the dairy and it is important that effluent from these areas does not find its way into farm water supplies. Nutrient and bacterial contamination of farm and dairy water supplies can lead to health problems for the family and quality problems in milk.

5.2 Laneways

Laneways can generate large quantities of effluent because they are heavily used by stock and they are generally designed to shed water quickly. Drainage water from laneways should not be directed into watercourses which leave the property without passing it over a vegetated area where some of the sediment and associated nutrients can be removed. Water draining from laneways should be directed onto pasture paddocks at intervals along the laneway to prevent buildup of large volumes of water and its associated load of sediment and nutrients.

The more time that cows spend in laneways, the more effluent will be dropped there so look for ways to get cows back into paddocks as quickly as possible. Some ideas:

- can you hold the cows on concrete at the dairy until milking is finished then move them back to the paddock in a group? The concrete area should drain into a sump.
- provide water and shade in paddocks rather than in laneways.
- cows tend to bunch up at right angle bends in laneways, slowing down movement and increasing the amount of effluent dropped. Good cow flow from the paddock, through the dairy and back to the paddock maximises the time cows spend in the paddock and minimises the amount of effluent dropped in laneways.

If at all possible, runoff from the intensively used laneways around the dairy and associated structures should be directed to the effluent management system. Over time, it may be possible to stabilise or otherwise treat these laneways so that the effluent can be scraped off. It may also be possible to design the drains in this area so that solid effluent which collects in them can be removed, rather than being flushed away.

5.3 Feed sheds

Many farms have invested in sheds where hay, silage or other bulk feeds are fed at some time of the year, usually over summer on dryland farms or winter on irrigation farms. Stock in these areas are usually standing on concrete or other hard surface so it is relatively easy to collect and handle effluent. They are generally close to the dairy so drainage should be directed into the storage ponds. Solid effluent can be scraped to a holding area and stockpiled for later spreading on the farm or sale off the farm. Drainage from the holding area should be directed to the storage pond.

5.4 Feed paddocks

Many dryland farmers confine the milkers to a paddock close to the dairy over summer and feed hay or silage. The paddock usually has (or had) good
tree cover so there’s plenty of shade. Apart from the fact that most native trees can’t handle the nutrient buildup which goes with large numbers of stock in a small area for a long time, these nutrients have the potential to pollute surface and sub-surface waters.

By the end of summer, there is usually no pasture cover on these paddocks and rain will wash soil and effluent into the nearest watercourse. On sandy soils, opening rains will move nutrients through the soil before pasture has developed enough of a root system to take them up. If the groundwater is not being used - it may be too salty, for example - this may not be a problem.

However, high levels of nitrates in drinking water can cause serious health problems and high bacterial levels can affect milk quality. Try not to use the same paddock year after year or try and rotate stock round a number of paddocks over summer.

Sacrifice paddocks are similar to feed paddocks except that they may only be used for a few weeks over the break of the season while pastures on the rest of the property are getting established. Nutrient buildup is likely to be less of a problem but surface runoff can still be an issue.

Water draining from these paddocks can only be managed as part of a whole farm water management plan. For these paddocks in particular, look for ways of diverting runoff from the first rains into a sediment basin or sump to settle out some of the suspended solids. This first runoff generally contains a high concentration of nutrients and you should be looking for ways to keep it on the farm. Once a pasture cover has been established, drainage water is likely to be less of a problem.

5.5 Night paddocks

Night paddocks are less of a problem than feed paddocks because growing pasture is utilising some of the nutrients deposited by the milkers. The continuous grazing which night paddocks receive is not conducive to high pasture production, even though these paddocks are usually the most fertile on the farm. Soil testing usually shows that these paddocks do not need added fertiliser. The convenience of night paddocks is outweighed by reduced pasture production from continuous grazing and by having too many nutrients concentrated in a small area where they cannot be used effectively.

5.6 Silage stacks

Effluent draining from silage stacks smells unpleasantly and means the loss of valuable nutrients - minerals, sugars and nitrogen compounds. It is a very strong pollutant and should not be allowed to enter watercourses. The volume of effluent can be minimised by wilting the grass before carting it to the storage area; aim for at least 25% dry matter in the grass being ensiled. Silage stacks should not be sited close to watercourses.

6 Effluent and animal and human health

6.1 Potential pathogens in effluent

There is an element of risk associated with any effluent management system but a properly managed system should pose no particular problems. Most disease causing organisms are short lived outside the animal. Worms may be a problem, especially on heavily stocked areas and where there are a large number of young stock. Calf and calving paddocks should not be used as effluent disposal areas. Some organisms may survive if protected in thick patches of dung so it is important to spread the effluent thinly over pasture.

Cattle are usually reluctant to eat pasture within four to five days of having effluent applied to it, minimising the risk of them ingesting harmful organisms. Nevertheless, it is safer to wait for about two weeks before letting stock back in on treated pasture. If the effluent is applied to short, freshly grazed pasture, by the time the stock get back to the treated area, the effluent will have been washed off the leaves and into the soil, minimising the risk to stock.

6.2 Other considerations

Leptospirosis is a health issue for those in close contact with dairy animals and precautions should be taken to reduce the risk of infection. (see Farmnote No. 54/95 ‘Leptospirosis in dairy cattle’, Agdex 411/653)

The urine of infected animals is the most important means of spread of leptospirosis. An infected animal can shed leptospires in the urine for many months.
effluent and it is important that there are minimal restrictions in airflow over this part of the system. Trees need to be very carefully sited if these ponds are to work effectively.

Plant trees far enough away from ponds so that the pond surface is not shaded. Shading can reduce the effectiveness of the pond, giving rise to odour problems. There have also been problems with pine needles clogging ponds so keep trees well back.

8.0 Assistance available

Advice on designing effluent management systems, including the use of the Pond program for designing storage ponds, is available from Agriculture Western Australia offices at Bunbury and Busselton.

Analysis of soil and water samples to assist in developing a land application program can be carried out by a number of laboratories. Some laboratories are:

- **Australian Agricultural Laboratories** (Soil)
  3 Halley Road
  Balcatta, 6021
  08 9345 3814

- **Chemistry Centre** (Soil and water)
  125 Hay Street
  East Perth, 6004
  08 9325 5544

- **CSBP and Farmers** (Soil)
  2 Railway Parade
  Bayswater, 6053
  08 9377 9177

- **C H Bailey and Son** (Soil)
  12 Hurrell Way
  Rockingham, 6168
  08 9592 1044

- **AMDEL** (Soil)
  154 Hampden Road
  Nedlands, 6009
  08 9325 7311

- **Analabs** (Soil and water)
  52 Murray Road
  Welshpool, 6106
  08 9458 7999

- **Agro-Nutritional Research Laboratory** (Soil)
  2C Main Street
  Osborne Park, 6017
  08 9444 6247

- **Sheen Analytical Pty Ltd** (Soil)
  41 Furnace Road
  Welshpool, 6106
  08 9451 9388

- **SGS Australia Pty Ltd** (Soil)
  80 Railway Parade
  Welshpool, 6106
  08 9458 9666

- **Summit Fertilisers** (Soil)
  Lot 1000 Ocean Street
  KWINANA, 6167
  08 9439 1844

- **Kingsley Agricultural Lab** (Soil and water)
  RMB 382
  Bridgetown, 6288
  08 9761 7512

- **Valley Laboratory Services** (Soil and water)
  25 Clarke Street
  Dunsborough, 6281
  09 9755 3626

Contact the laboratory before sending in samples for analysis.

Acknowledgments

Guidelines for managing farm dairy effluent have been produced by a number of groups. Those consulted in the production of these Guidelines are

- **Guidelines for the management of dairy shed effluent in the south east of South Australia**, published by the South East Dairy Effluent Guidelines Group, July 1995
- **Dairy Farm Effluent Management in the Mount Lofty Ranges** (anon)
- **Guidelines for Management of Milking Shed Wastewater and Intensive Stock Use Areas on Dairy Farms – Lower Murray Irrigation Area**, prepared by Lower Murray Irrigation Action Group, April 1994


See also:
- Farmnote No. 57/91 ‘Fly control of dairy farms’ (Agdex 410/614)
- Farmnote No. 54/95 Leptospirosis in dairy cattle (Agdex 411/653)
Leptospira excreted in urine can survive for some time in wet soil and for many days in surface water. New infections take place through cuts and abrasions on the skin when animals stand in contaminated water or on contaminated ground.

Effluent from infected animals can spread the disease to neighbouring farms downstream if the effluent is allowed to leave the property. To prevent spread of disease, it is important that effluent is retained and managed on the property of origin.

Effluent should not be applied to any crop being grown for human consumption without clearance from the Health Department.

6.3 Safety

Dairy effluent storage ponds and sumps are as hazardous as any other water storage on the farm.

In some two-pond systems, the first or anaerobic pond often crusts over and may have grass growing on it. It is essential that these ponds are securely fenced to exclude children and stock. In general, properly designed storage ponds should not crust over so they should never look as if they have a solid surface. A secure fence is still a good safety precaution.

Trafficable sumps may be more of a safety problem given that they are generally close to the dairy and they may look solid enough to walk on. These are unlikely to be a hazard to stock but they could be dangerous to children.

Minimum storage sumps are often constructed from well liners and the safety aspects of these need to be considered. Fencing is not often practical so a secure cover should be fitted.

The same applies to pump pits which should have a secure cover fitted.

Other occupational health and safety issues you need to consider are waterproofing electrical installations, guarding exposed V-belts and providing a safe means of lifting pumps out of pump pits.

7. Other environmental issues

7.1 Soil erosion and dust

Soil erosion and associated nutrient loss is a problem from sacrifice paddocks and summer feeding paddocks and it is important that this issue is considered when you are establishing these areas. There should be no soil erosion problems from any other part of a well designed effluent management system.

Dust is a potential problem from sacrifice and summer feeding paddocks as it is almost impossible to maintain plant cover on these areas unless stock can be moved through a succession of paddocks over summer. Strategic shelterbelts will prevent most problems. Dust may also be a problem from solid effluent stockpiles and these need careful management as they will often be in the vicinity of the dairy.

7.2 Odour

All animal industries have characteristic smells but most farmers don’t notice them because they are used to them. The smell from well designed and operated effluent management systems is not usually a problem. Although you may not notice a smell, your visitors or neighbours might and you need to do everything you can to avoid problems developing.

Storage ponds should be sited at least 200 m from the nearest house, yours or a neighbours, and effluent disposal areas should be at least 100 m from a house. If you spread your effluent continuously on a small number of paddocks, these areas should be about 300 m from a house.

Your effluent sprinklers should produce large droplets rather than a fine mist and effluent should be applied at a rate that does not allow it to pond on the surface for more than one hour after application. Belts of trees can be used to screen disposal areas from view.

7.3 Insect pests

Insects are not generally a problem but solid effluent stockpiles may be a breeding area for flies of various types until they dry out (see Farmnote No. 57/91 ‘Fly control on dairy farms’, Agdex 410/614).

7.4 Aesthetic considerations

Once established, storage ponds need not be conspicuous - on many farms, the fence around them is all you can see. Where the ponds are used solely to store effluent, trees can be planted around them to provide additional screening but should not be planted on the embankments. In some two-pond systems, the second pond is used to aerate the
9 Appendices

9.1 Regulations relating to effluent management

Several State and Local Government agencies have an interest in how farm dairy effluent is managed and you need to be aware of these. It is important that you check with your local authority for any particular requirements or conditions which apply in your area.


Under the Water and Rivers Commission Act, the Commission has responsibility for the ‘conservation, protection and management of the State’s (land-based) water resource’.

The Water and Rivers Commission Act has vested in it the following Acts and by-laws:

- Country Areas Water Supply Act 1947
- Metropolitan Water Authority Act 1982
- Metropolitan Water Supply, Sewerage and Drainage Act 1909
- Rights in Water and Irrigation Act 1914
- Waterways Conservation Act 1976

The protection of Public Drinking Water Supply Areas (PDWSAs) against the effects of pollution is managed under the Country Areas Water Supply Act 1947 and the Metropolitan Water Supply, Sewerage and Drainage Act 1909 which allow for the writing of by-laws to protect water quality in catchment areas, water reserves and Underground Water Pollution Control Areas (UWPCAs). Both these Acts are administered under the Water and Rivers Commission Act 1995.

Within UWPCAs, the Commission administers by-laws to control land use. Controlling land use helps to prevent activities that could cause groundwater pollution.

The Commission uses the following three levels of water quality protection within all PDWSAs. The PDWSAs are divided into three priority classifications for their present and future public water supply catchments, namely Priority 1 (P1), Priority 2 (P2) and Priority 3 (P3) source protection areas.

Priority 1 (P1) Source Protection Areas are defined to ensure there is no degradation of the water resource. They cover land generally owned by the State where protection of water quality for public drinking water is the most important beneficial use and most development is not permitted.

Priority 2 (P2) Source Protection Areas are defined to ensure there is no increased risk of pollution to the water resource. Provision of public water supply is a high priority in these areas. Restricted development may occur under specific conditions.

Priority 3 (P3) Source Protection Areas are defined to minimise risk of pollution to water resource. They are areas where substantial water resources of economic or strategic importance exist, but where there has been significant development. The objective is to manage land use rather than restrict development.

Dairy farming is an unacceptable land use in Priority 1 Water Source Protection Areas.

Dairy farming is a restricted land use in Priority 2 and 3 Water Source Protection Areas.

Restrictions may apply to the amount of nutrients, particularly nitrogen, used in a protected public drinking water supply area. The Water and Rivers Commission are currently reviewing acceptable criteria for nutrient loading rates for particular areas to protect beneficial uses (drinking water supplies, ecosystem protection).

Proposals for the establishment of new dairy farms in Priority 2 and 3 areas should be referred to the Water and Rivers Commission.

Under the provisions of the Waterways Conservation Act 1976, the Commission has a conservation function and associated powers in respect of waterways and adjoining land in areas declared as management areas under the Act.

Information supplied by the Water and Rivers Commission

9.1.2 Dairy Industry Authority Regulations (1977) under the Dairy Industry Act

47 Effluent from a dairy shall not be discharged or allowed to flow in a manner which creates or leads to local ponding, putrefaction, run-off or contamination of any land or water supply.
6.6.2 In considering applications for the use of land or a rezoning for intensive agriculture, a local authority shall take account of the environmental advice of the EPA and land suitability advice from the Department of Agriculture. The responsible authority will take account of soil types, slope and groundwater flows and surface water drainage and proximity to the Estuary in considering the suitability of land for intensive agricultural use. Generally, only land in the foothills of the Darling Scarp or deep yellow Spearwood soils on the western edge of the catchment have suitable qualities to sustain intensive agriculture apart from such uses which rely on hydroponics and thereby do not result in contamination of groundwater or surface drainage, or include red mud, or other suitable soil amendment at rates recommended by the Department of Agriculture.

6.6.3 Proposals which would provide additional direct drainage to the Estuary, its tributaries or Water Authority drainage systems will not be permitted without appropriate nutrient reduction measures.

6.6.4 Works approval and licenses will be required from the EPA where the proposal has a wastewater discharge or falls within the list of scheduled premises under Part V of the Environmental Protection Act. Some intensive agricultural proposals may require environmental impact assessment under Part IV of the Environmental Protection Act. (Section 6.6)
Soils containing less than 20% clay may not seal well, even though the organic matter in the effluent will help your pond seal over time. Sites with cracking clays should be avoided.

Using a bulldozer to construct the pond nearly always ensures that the walls are more stable and better compacted than if an excavator is used. Pond walls need to be as compact and impermeable as possible. Use of excavators is therefore not generally recommended unless additional compaction can occur. Walls which are constructed with too steep a slope or which are not compacted properly are liable to slump, reducing the capacity of the pond and increasing the likelihood of it leaking.

Before beginning construction, use a backhoe to dig a hole in each corner of the proposed site and another in the centre, down to 1 metre below the proposed depth of the pond. If suitable clay is not found, either try another site or be prepared to line the pond with clay brought in from elsewhere or with a synthetic liner.

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Remove topsoil and stockpile it for later use.

Excavated spoil is used to construct the banks of the pond and should be levelled and compacted as construction proceeds to ensure that a well compacted bank is formed. Walls should have a 1 in 3 slope and bank tops should be 3 to 4 meters wide to allow for machinery access during construction and for periodic cleaning. Provision needs to be made to divert surface runoff away from the pond.

Soils containing less than 20% clay may not seal well, even though the organic matter in the effluent will help your pond seal over time. Sites with cracking clays should be avoided.

9.3 Pond siting and construction

Ponds must be sited at least 45 m from the milk room and should be at least 200 m from any houses.

Use the Pond computer program or similar to calculate volume and dimensions of the pond.

### Table: Characteristics of some common types of pumps

<table>
<thead>
<tr>
<th>Type of pump</th>
<th>Maximum solids content</th>
<th>Pump head (m)</th>
<th>Power needs (kW)</th>
<th>Applications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional centrifugal (horizontal shaft)</td>
<td>5%</td>
<td>&gt;60</td>
<td>35</td>
<td>recirculation</td>
<td>must have high quality effluent</td>
</tr>
<tr>
<td>Open and semi-open vertical shaft</td>
<td>15%</td>
<td>&lt;25</td>
<td>40</td>
<td>transfer to storage, gravity irrigation, tanker filling</td>
<td>low lift capability avoids priming and foot valves</td>
</tr>
<tr>
<td>Submersible centrifugal</td>
<td>15%</td>
<td>&lt;10</td>
<td>7.5</td>
<td>transfer to storage</td>
<td>low lift capacity, uncommon</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>20%</td>
<td>&lt;10</td>
<td>7.6</td>
<td>transfer to storage</td>
<td>very simple in operation</td>
</tr>
<tr>
<td>Helical screw (rotor)</td>
<td>6%</td>
<td>&gt;60</td>
<td>30</td>
<td>sprinkler irrigation, pumping over long distance, pumping to elevated storage</td>
<td>good for high solids; abrasive material can destroy stator</td>
</tr>
<tr>
<td>Piston pump</td>
<td>20%</td>
<td>&lt;10</td>
<td>7.5</td>
<td>transfer to storage of fibrous material, sludge pumping</td>
<td>limited use for effluent, good for solids and slurries</td>
</tr>
<tr>
<td>Vacuum pump</td>
<td>10%</td>
<td>max lift 3.5 m</td>
<td>40</td>
<td>tanker loading, priming siphons</td>
<td>good for livestock effluent</td>
</tr>
</tbody>
</table>
A freeboard of at least 0.4 m after settlement should be provided above the maximum liquid depth to allow for direct rainfall on the pond and a spillway incorporated to protect the walls in the event of severe storms.

Stockpiled topsoil can be spread over the banks to promote growth of grass to reduce erosion over winter. Do not allow trees to become established on the banks.

Ponds should be fenced to exclude children and livestock but machinery access should be provided.

Ponds should not be constructed
- in areas likely to be prone to landslide
- across drainage lines
- in areas prone to groundwater contamination
- within 100 m of water supplies (specific hydrologic conditions should be determined)

9.4 Some suppliers of dairy effluent handling equipment

Note: This table is a first attempt to list local suppliers of dairy effluent handling equipment and there will undoubtedly be omissions. These omissions are unintentional and represent our incomplete knowledge of who sells what. If you know of suppliers who should be listed, please let Bill Russell or Ian Bell at AgWA in Bunbury know and they will be added to the list.
9.5 Calculating nutrients supplied from dairy effluent

Using nutrient concentrations from Table 1:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total nitrogen</td>
<td>230</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>40</td>
</tr>
<tr>
<td>Total potassium</td>
<td>320</td>
</tr>
</tbody>
</table>

Applying 1ML/ha (or 1,000 cubic meters, 1 TCM/ha or 100 ml of water), then nutrients applied are:

- **Nitrogen**: 1 ML x 230 mg/L = 230 kg/ha N
- **Phosphorus**: 1 ML x 40 mg/L = 40 kg/ha P
- **Potassium**: 1 ML x 320 mg/L = 320 kg/ha K

Nutrients in effluent are not all available in the year of application; assuming 50% availability for N and P and 90% for K, available nutrients applied are:

- **Nitrogen**: 230 kg/ha x 0.5 = 115 kg/ha available N equivalent to 250 kg urea
- **Phosphorus**: 40 kg/ha x 0.5 = 20 kg/ha available P equivalent to 180 kg superphosphate
- **Potassium**: 320 kg/ha x 0.9 = 288 kg/ha available K equivalent to 576 kg muriate of potash

In practice, it is unlikely that 1 ML/ha of effluent would be applied in one application so the rate of nutrients applied would be reduced accordingly.

9.6 Case studies

**Effluent management on an irrigation farm**

**Tony Italiano, Harvey**

The Italiano family milk about 180 cows on their 115 ha flood irrigation farm at Harvey. They upgraded their effluent management system in 1995 to allow better management.

Effluent is collected in a sump at the outlet from the dairy and is pumped 500m to a storage pond from where it is pumped onto pasture or to the irrigation head ditch.

The sump, which was retained from the previous system, is constructed from a single concrete well liner and would have a current construction cost of about $200.

The **Reeve pump** is driven by a 3 HP motor and moves the effluent through 500 meters of 50mm poly pipe to the pond. The pump cost about $3,100.

Because of the distance from the pump to the pond and the fibrous nature of some of the effluent, the joints in the poly pipe had to be removed and the pipe butt-welded to avoid plugs of material forming in the joints and blocking the pipe.

The pond has a capacity of about 3,500 cubic meters, providing sufficient storage capacity for the effluent from 200 cows for four to five months.

It was built by Carbone Brothers using a D7 dozer and cost about $3,500 to build. The pipe from the pump is taken over the wall and is suspended from a strained wire so that the effluent drops into the centre of the pond.

To get the effluent onto pasture, a 150mm diameter bottom drain pipe passes through the wall of the pond and discharges into a pumping sump constructed from concrete well liners. Flow of effluent into the sump is regulated by a disc valve fitted to the end of the pipe in the sump. From the sump, effluent can be pumped away and distributed onto pasture, either by shandying with irrigation water or by pumping through a travelling irrigator. The pond also has a 90mm poly
floating suction line which comes through the wall at ground level. This line enables the watery liquid from the top of the pond to be drawn off and pumped back into the bottom of the pond to mix the effluent prior to land application.

**Effluent management on a dryland farm**

Gary and Kerry Cain, Margaret River

The Cain system, installed in 1996, consists of a sump at the dairy to collect washings from the yard and some run-off from the laneway, a pump to get the waste away from the dairy, a pond to store the waste until it can be spread onto pasture and a travelling irrigator to spread the waste.

**The sump** is small and is not designed for long term storage. It has been built so that a tractor and bucket can be used to clean out any solids (sand, gravel etc) which settle out or don’t go through the pump. The sump cost about $600 to build.

**The pump** is a Rankin manure pump, bought from Rankins Welding Service, P.O. Box 59, Lockington, Victoria 3563 at a cost of about $1,630 landed on the property. These pumps are designed to handle farm dairy waste. They are extremely simple in operation and very robust and easy to repair if something goes wrong. They are a low pressure pump and will pump waste about 150 m. It cost about $150 to install the pump at the dairy.

The waste is pumped through a 100 mm pipe to the pond. This pipe size was used because it was initially thought that the waste would flow by gravity from the sump to the pond - there is a fall of about 2 m over the 150 m from the dairy to the pond - but this was not successful. As a rule, 50 mm pipe is adequate for pumping systems. The pipe is buried. When the system was set up initially, the pipe cut through the wall of the pond about 1.5 m from the top; this was necessary to provide fall from the dairy but it reduced the effective capacity of the pond. With the installation of the pump, the pipe was reinstalled over the top of the pond wall and extended so that the waste dropped into the centre of the pond. The pipe cost about $1,000 plus $250 for hire of the backhoe.

**The pond** was sized using the Pond computer program which takes account of the number of cows likely to be milked in the future, the volume of water generated at the dairy from all sources, whether or not storm water is collected in the pond, how long the waste will be stored for and rainfall and evaporation at the site. This information determines the volume of storage required.

The pond is about 50 m long by about 30 m wide and has a capacity of about 3,000 cubic meters, sufficient to cope with the waste generated by 150 cows and store it for 4-5 months. The walls have a batter of 2:1 and they are 3 m wide at the top to allow machinery access. The pond is fenced.

The pond was built by Vasse Transport and Earthmoving and cost about $6,000 to build.

**The irrigator** is a Vaughan travelling irrigator from South Australia, supplied through Bunbury Machinery and costs about $3,200. It is driven by a diesel pump, costing about $800 secondhand. The intention is to use existing aluminium pipe in conjunction with the hose which comes with the irrigator to spread the waste over a number of paddocks.

The pond was sized using the Pond computer program which takes account of the number of cows likely to be milked in the future, the volume of water generated at the dairy from all sources, whether or not storm water is collected in the pond, how long the waste will be stored for and rainfall and evaporation at the site. This information determines the volume of storage required.