IMPROVED EFFLUENT MANAGEMENT ON DAIRY FARMS

WESTERN AUSTRALIAN CASE STUDIES

Funded by Dairy Australia and your dairy service levy

Western DAIRY

Dairy Australia
Your Levy at Work

The Government of Western Australia

SWCC
south west catchments council

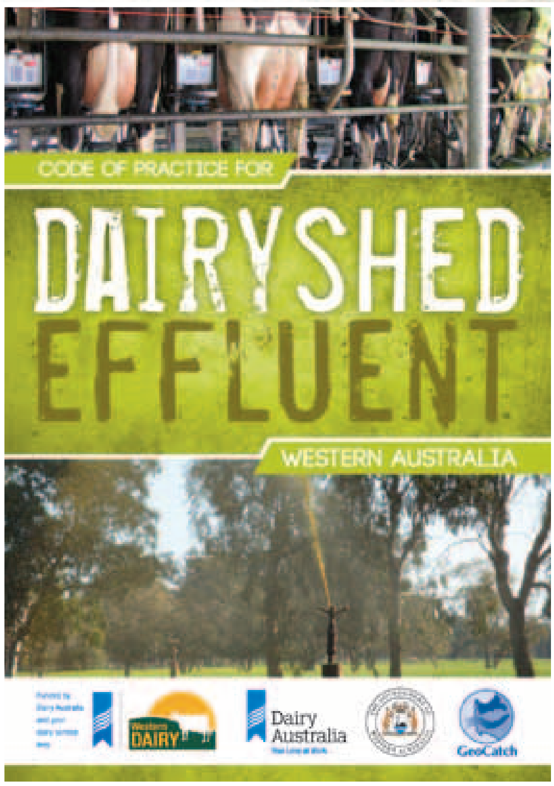
CARING FOR OUR COUNTRY

GeoCatch

FORWARD

The Western Australian dairy industry recognises the importance of having an environmentally sustainable industry that is committed to minimising the impact of dairy shed effluent on the environment. This collection of case studies demonstrates how four dairy businesses have improved their effluent management systems. In doing so they have not only reduced their environmental impact, but importantly, reused the nutrient value of the effluent to grow more fodder and reduce their fertiliser costs.

While every dairy operation is unique, it is hoped that these case studies, in conjunction with the "Code of Practice for Dairy Shed Effluent", can assist dairy farmers in upgrading effluent management systems to meet the ever increasing demand for environmental accountability.



Dale Hanks
Chairman of Western Dairy

CASE STUDY

TRAFFICABLE SOLIDS TRAP AND LARGE SINGLE STORAGE POND

FARMERS
Victor, Denise and Kath Rodwell, Rodwell Farms
LOCATION
Boyanup, Western Australia
DAIRY SHED
Rotary dairy
HERD SIZE
700 cows
LAND AREA
330 ha plus run-off blocks

Victor is a leader in innovation of best practice dairy management. He has long realised the nutrient value of dairy effluent first utilising it in 2008/9, to help produce a maize crop which yielded 18 t/DM ha. The nutrient content of the effluent accounted for 40 per cent of the total fertiliser budget of that crop, and kept the dry matter cost of the maize silage down to $160/t (16c/kg DM). The use of effluent to fertilise summer crops is now part of the standard operating procedure for summer crop production at Rodwell Farms.

THE SYSTEM

When a new rotary dairy was built in 2007 a dedicated effluent management system was also built. It consisted of a large volume trafficable sump, big enough to hold two days worth of effluent without pumping, and a 7 ML storage pond. The large capacity effluent system provides storage over the wet winter months. The effluent can then be irrigated onto paddocks prior to seeding summer crops, while the summer crop is growing, or in the autumn prior to renovating pastures.

An Ocmis VR5 hard hose irrigator, driven by a 130 hp pump, works successfully to deliver a high volume, and the large nozzle orifice minimises blockages. During summer, water is pumped into the effluent pond from an irrigation bore, before it is applied to the crop area. This dilutes the concentration of the effluent, preventing an over application of nutrients, as well as reducing the nutrient load in the storage pond. The dilution also reduces the odour from the applied effluent.

The Ocmis hard hose irrigator used to apply effluent.

The large orifice of the hard hose irrigator minimises blockages.

Utilising the nutrients in the effluent compensates for the operation and labour costs of the system. Victor believes that his system takes no extra work than if he had to dispose of it in an alternative environmentally acceptable manner. Using the hard hose irrigator on the summer crops means there is no additional labour required to utilise this nutrient source.

Victor values the nutrients captured by the effluent system at the dairy, coupled with what is applied in the liquid component, at $12,000 per annum. The nutrient contained in the effluent equates to 14 t of nitrogen (30 t urea), 1.5 t of phosphorus (17 t superphosphate) and 4 t of potassium (8 t muriate of potash). This provide enough nutrients to fertilise 77 ha. In addition, the sludge which is removed from the storage pond every three to four years to maintain pond volume, yields a large amount of phosphorus.

Sorghum and Lab Lab grown under irrigation with effluent in 2011

Victor sees the advantages of utilising effluent to supplement his fertiliser program. While the dollar value of the nutrients is pivotal, the sustainability associated with good effluent management is also important. Victor has observed improvements in soil health as a result of applying a more organic form of nutrients. Victor also feels that the crops respond better to smaller applications of nutrients over a greater period of time, as opposed to the more rapid response and decline from conventional fertiliser applications.

SYSTEM ANALYSIS

	BENEFITS	COSTS
GENERAL	Storage over winter minimises environmental risks. Supplementary nutrient available for high demand crops (ie maize). Reduced fertiliser purchases Improved soil health	Hard Hose irrigator purchase Requires adequate pump and power on pond to drive hard hose irrigator. Establishment of main line & hydrants to hard hose sites
	NUTRIENT SAVINGS	**PAYBACK PERIOD**
FINANCIAL DETAILS*	Nutrient applied in liquid effluent Nitrogen 2806 kg = 6 t Urea @ $636/t = $3800 Phosphorus 631 kg = 7 t Superphosphate @ $350/t = $2500 Potassium 3865 kg = 8 t Muriate of Potash @ $708/t = $5700 Total Savings = $12,000	Depending on the investment in the type of application system, the payback period will be determined by the annual yearly savings in fertiliser purchased. 3-5 year payback periods are achievable.

* Fertiliser prices as at Jan 2012

CASE STUDY

TRAFFICABLE SUMP AND DIRECT APPLICATION

FARMERS
Colin, Phyllis, Dwayne & Hayley Neill, Laureldene Farms
LOCATION
Boyanup, Western Australia
DAIRY SHED
Double up herringbone
HERD SIZE
200 cows
LAND AREA
150 ha dryland

Herd expansion, environmental accountability and the potential to grow more grass saw Colin and Dwayne increase the capacity of their effluent management system. The Neills now have a large capacity trafficable sump for solids removal, and direct application of liquid effluent through fixed sprinklers. Liquid effluent is distributed evenly over a two hectare paddock close to the dairy, with solids applied to paddocks identified by soil tests as being lower in potassium or organic matter. The liquid effluent paddock can be used for a summer crop, providing another source of home grown fodder.

THE SYSTEM

Prior to the upgrade, effluent management involved washing down the yard and letting the overflow settle in an adjacent paddock. The old dairy sump had a small capacity and if it overflowed, could potentially flow back into the pit. A trafficable solids trap was installed in 2010 and this allowed effluent to be captured. Solids are removed from the trap periodically, stockpiled and dried. They are then spread onto those paddocks, identified from soil tests, as requiring a boost in fertility. Dwayne calculates that two cubic metres of dried solids per hectare is equivalent to 100 kg of Super, with the added benefit of potassium and nitrogen. Solids are applied to selected paddocks annually, reducing the requirement for capital fertiliser applications. No autumn phosphorus is applied to these paddocks reducing the fertiliser bill.

The recent upgrade included the installation of fixed sprinklers in a paddock close to the dairy. Its close proximity reduced the expense of installing distribution lines, and the strong uniform soil type can hold nutrients, especially phosphorus, reducing the risk of leaching. The fixed sprinklers have a 10 m radius and are mounted on large diameter pine posts to minimise stock damage. The dedicated wastewater sprinklers have interchangeable nozzles, for fine tuning to match pump specifications or distribution area. Good separation of solids at the trafficable sump reduces the incidence of blockages in the distribution lines and sprinklers. However, if it does become blocked the sprinklers are easily removed or nozzles changed if required.

> **IT MAKES SENSE TO RE-USE THE SOLIDS WE COLLECT AND NOT LET THAT NUTRIENT VALUE FERTILISE THE NEIGHBOURS PLACE"**
> **DWAYNE NEILL.**

Colin and Dwayne saw the installation of sprinklers as a simple system that would require minimal labour. The system has few moving parts, and changing the distribution area from one pair of sprinklers to another, can be done by one person in less than five minutes. Each sprinkler is isolated by a ball valve on the feed line, on the upright post, where the sprinkler is mounted. It uses mains pressure poly pipe, so no special skills or tools were required to install it. The main cost was hiring a trench digger for three days and a local contractor with experience in effluent design. The installation of the sprinklers was done over three days between milkings. The Neills plan to install more sprinklers to capitalise on the benefits of distributing effluent across a greater area of the property and to reduce nutrient build up in any one area.

Sprinkler distributing effluent

Sprinkler used for effluent distribution

A novel innovation in this effluent system is the retrofitted weeping wall in the trafficable solids trap. When it was built the trap had a small capacity weeping wall, so a secondary sump was sunk behind the trap and plumbed in to capture liquid from the trap. Because of the risk of weakening the concrete wall at the back of the trap, a retrofitted weeping wall was placed inside the trap, in front of the sump entry point to further remove solids. Built on a steel frame with vertically positioned boards, cleaning is easy from the top of the wall with a six millimetre galvanised rod, and it can be moved with the loader when cleaning the trap if required.

A retrofitted trafficable sump. Note vertically positioned boards. The new sump can be seen behind the trap in the background.

SYSTEM ANALYSIS

BENEFITS	COSTS
Simple operation and low labour requirement Even effluent distribution over fixed area Reduced fertiliser applications Improved soil health	Mains pressure poly pipe Poly pipe fittings Sprinklers Trench digger hire Contractor

CASE STUDY

TRAFFICABLE SUMP AND TRAVELLING IRRIGATOR

FARMERS
Rodney and Nicole May
LOCATION
Cowaramup, Western Australia
DAIRY SHED
Swing-over rapid exit
HERD SIZE
210 cows
LAND AREA
190 ha arable
plus run-off blocks

Farming in the Cowaramup region, at the headwaters of the Carbanup River, Rodney and Nicole May are acutely aware of the impact that nutrient run-off can have on local waterways. Importantly, they don't want to see the "fertiliser dollar value" of effluent flowing down the creek. They believe that this nutrient resource is much better utilised on farm, to grow more pasture.

THE SYSTEM

Soil test results from existing effluent application paddocks showed nutrient levels were at a point which would not provide any additional pasture growth. The decision was made to increase the area where the effluent was spread to minimise the risk of nutrient run-off occurring. The extension has been effective with phosphorus levels on the new area less than half the amount of the original area.

The current system comprises of a trafficable solids trap that collects dairy and yard run-off, and pumps it to a Vaughan travelling irrigator. Funding from GeoCatch allowed the Mays to increase the area where effluent is applied through the installation of a three inch distribution main line. They now apply effluent to 14.5 ha which is regularly cut for silage and hay. Increasing the area for effluent distribution also required the purchase of a higher capacity pump. The paddocks are located away from the Carbanup River, reducing the risk of run-off into the waterway.

Solids are regularly removed from the trafficable solids trap to enable the pump to operate efficiently. The solids are stockpiled for drying adjacent to the trap, and then spread on the paddocks which are selected using soil test results. Run-off from the solids pile is directed back into the trap to ensure maximum nutrient content is captured.

> **"THE NUTRIENT BENEFIT FROM THE DRIED SOLIDS IS CERTAINLY HELPFUL, HOWEVER WE ARE REALLY KEEN ON THE BENEFITS THAT THE DRIED SOLIDS PROVIDE IN IMPROVING SOIL ORGANIC CARBON LEVELS"**
> **RODNEY MAY.**

The labour requirement of the system is low, with the main task being the removal of the solids from the trap, and the shifting of the travelling irrigator between paddocks. Rodney estimates that shifting the travelling irrigator takes a half to one hour per week. Regularly cleaning the trap prevents it from becoming a labour intensive job, and minimises the chance of a blockage in the pump and distribution lines.

A recent audit of the nutrient being captured by the system found that on an annual basis it was collecting approximately 2 t of nitrogen (4 t of urea), 300 kg of phosphorus (3 t of superphosphate) and 800 kg of potassium (2 t of muriate of potash). Based on fertiliser prices in January 2012 this equates to $4,500 worth of fertiliser. This saving more than compensates for the labour involved in moving the travelling irrigator.

SYSTEM ANALYSIS

BENEFITS	COSTS
Less risk of nutrient run-off into adjacent waterways Not irrigating waterlogged soils in winter due to better drainage at new site Reduced fertiliser applications Improved soil fertility & health	Pipe, hydrants & fittings for distribution line Contractor & labour for installation of main distribution line New distribution pump
FINANCIAL SUMMARY	**OTHER SYSTEM CHANGES AS A RESULT**
Nutrient savings versus capital costs = approximately a 13% return p.a. The upgrade will pay for itself in 7-8 years and provide real returns in years 9 and beyond. If fertiliser prices or cow numbers increase, the payback period will be decreased.	Effluent applications have increased Possible increase in power consumption as now pumping a greater distance Application area further from dairy making it harder to monitor travelling irrigator.

Rodney May with his new Gormann Rupp Effluent sump.

Newly installed hydrant for effluent distribution

"WE DO NOT HAVE TO ENGAGE A SPECIALIST CONTRACTOR TO DEAL WITH OUR EFFLUENT, WE CAN MANAGE IT OURSELVES AND CAPTURE THE FERTILISER DOLLAR VALUE"

NICOLE MAY.

CASE STUDY

TWO POND SYSTEM WITH IRRIGATION HOLDING DAM

FARMERS
Graham, Ken, Bevan & Rhys Ravenhill,
Ravenhill Pastoral Co
LOCATION
Narrikup, Western Australia
DAIRY SHED
Rotary Dairy
HERD SIZE
1100 cows
LAND AREA
890 ha including cropping

Simplicity best describes the effluent management system used at Ravenhill Pastoral Company. The effluent produced by 1100 cows is minimised through split herd management which reduces the amount of time that cows spend in the yards each day. The dairy is situated on a hill top and the undulating topography means gravity assists the removal of effluent from the yards and milk processing factory. The effluent enters a two pond system which removes all solid material. The clean liquid effluent is then transferred to an irrigation holding dam where it is mixed with irrigation water. It is then applied to a summer crop (maize) or irrigated pasture under a centre pivot.

THE SYSTEM

In 2003 Ravenhills added a second pond to enhance the separation of solids and increase the storage capacity of effluent over winter. The first pond in the system removes the majority of solid matter from the effluent, a large amount being sand transported into the yard by the cows. The build-up of solids is removed with an excavator every few years. The value of the nutrient recovered in the sludge accounts for the cost of the excavator hire. Fibrous material and straw accumulates on the surface of the first pond and is gradually broken down by bacteria.

The second pond contains minimal quantities of larger solids. Bubbling on the surface indicates that aerobic activity is aiding the breakdown of any remaining solids. Effluent is removed from the second pond via a T-Piece, which minimises solids contamination, and is transferred into a 5000 L holding tank.

The "T" Piece on the effluent pond

The effluent holding tank. T Piece pipe seen entering tank (90mm PVC stormwater pipe)

> **"IT HAD TO BE A SIMPLE SYSTEM AS THERE IS NO TIME LEFT IN THE DAY TO BE SCRAPING OUT A PIT. NOW ALL OF OUR DRY SOLIDS AND ALL LIQUIDS ARE DELIVERED AND SPREAD EVENLY OVER THE CENTRE PIVOT TO GROW LARGE AMOUNTS OF FORAGE. THE INCREASE IN YIELDS AND QUALITY OF FORAGE HAS CERTAINLY PAID FOR THE UPGRADE" BEVAN RAVENHILL .**

The only mechanical component of the system is the electric transfer pump which shifts effluent from the holding tank to a 9 ML irrigation holding dam. The dam provides ample storage for effluent captured during the wetter months, and it can then be applied to summer crops, reducing their fertiliser requirement. The two pond system has a minimal labour requirement, and where topography is appropriate would be a simple system for dairy farmers to implement.

A disadvantage of effluent systems that incorporate long term storage is the loss of nitrogen due to volatilisation. Effluent stored in ponds for longer than six weeks loses approximately 50 per cent of its nitrogen content to the atmosphere. While this reduces the potential to save on fertiliser costs, a significant amount of nitrogen can still be applied through irrigation water or by directly applying effluent to paddocks.

With Ravenhill's 1100 cow herd spending an average of two hours per cow in the yard each day, the annual amount of nutrient captured in the liquid component of the effluent is 4 t nitrogen (8 t urea), 800 kg phosphorus (9 t superphosphate) and 5 t potassium (10 t muriate of potash). Based on fertiliser pricing in January 2012, this can be valued at approximately $15 000.

Clear effluent entering irrigation dam.

Bevan, Graham (obscured) and Ken Ravenhill in Maize grown with supplementary nutrient from effluent. A significant decrease in the potassium required was noticed since the adoption of using effluent on summer crops.

SYSTEM ANALYSIS

	BENEFITS	COSTS
GENERAL	Two ponds eliminates the requirement for a trafficable sump reducing clean out requirements Effluent entering the irrigation holding dam is clean and does not block sprinklers Fertiliser, particularly potassium, is captured and re-used on high demand crops	Holding tank, pump & 1 km of 2" poly pipe 1st Pond clean out every 3 years Storage systems loss of N to atmosphere by volatilisation
	NUTRIENT SAVINGS	**PAYBACK PERIOD**
FINANCIAL SUMMARY	The value of the nutrient captured within the effluent (~$15 000 p.a.) is greater than the initial investment in the system ($13 000). After the first year, the benefit has been seen in the soil and also in reduced fertiliser purchases to grow crops with a high nutrient demand.	The value of the nutrient captured within the effluent (~$15 000 p.a.) is greater than the initial investment in the system ($13 000). After the first year, the benefit has been seen in the soil and also in reduced fertiliser purchases to grow crops with a high nutrient demand.
Assumptions: Area required to irrigate captured effluent without risk of nutrient runoff is 50 ha Suitable topography required for low labour, 2 pond separation system		

REFERENCES AND FURTHER READING

Effluent and Manure Management Database for the Australian Dairy Industry, 2008. Available online at < www.dairyingfortomorrow.com > *select tools & guidelines* > *effluent and manure management database.*

DairySAT – Dairy Self Assessment Tool
Available online at < www.dairyingfortomorrow.com.au > *select tools & guidelines* > *DairySAT*

Dairy Australia
Available online at < www.dairyaustralia.com.au > animal, feeds & environment > environment > soils, nutrient and effluent

Department of Water – Water Quality Protection Notes
Available online at < www.water.wa.gov.au > *select publications* > *find a publication* > *series browse* > *water quality protection notes*

- WQPN 6 Vegetation buffers to sensitive water resources (2006)
- WQPN 22 Irrigation with nutrient-rich wastewater (2008)
- WQPN 26 Liners for containing pollutants, using synthetic membranes (2009)
- WQPN 27 Liners for containing pollutants, using engineered soils (2010)
- WQPN 33 Nutrient and irrigation management plans (2010)
- WQPN 39 Ponds for stabilising organic matter (2009)
- WQPN 80 Stockyards (2006)

Department of Water - Field Sampling Guidelines: a guideline for field sampling for surface water quality monitoring programmes, 2009. Available online at < www.water.wa.gov.au > *select publications* > *find a publication*

Water & Rivers Commission (2001) Position Statement: Wetlands.

DAFWA Farmnote No. 418 – Soil Testing High Rainfall Pastures
Available online at < www.agric.wa.gov.au > *select publications* > *farmnotes*

DAFWA Bulletin 4689: DairyCatch Environmental Best Practice Guidelines, 2006.
Available online at < www.agric.wa.gov.au > *select publications* > *bulletins*

George, R.J, Bennett D.L., Bell, J.R.M and Wrigley,R.J, 1999. Observations of Shallow Groundwater Contamination Due to Leakage of Dairy Ponds on the Swan Coastal Plain, WA. Resource Management Technical Report 192, Agriculture WA.

ARMCANZ & ANZECC, 1999. National Water Management Strategy: Effluent management guidelines for dairy sheds in Australia.
(A joint publication of the Agriculture and Resource Management Council of Australia and New Zealand, and the Australian and New Zealand Environment and Conservation Council.)

CONTACT POINTS FOR FURTHER INFORMATION

Western Dairy
PO Box 341
Mundijong, Western Australia 6123
Tel: + 61 8 9525 9222
Mob: + 61 (0)418 931 938
E: esther@westerndairy.com.au
www.westerndairy.com.au

Dairy Australia
Level 5, IBM Centre, 60 City Road
Southbank, Victoria 3006
POSTAL ADDRESS:
Locked Bag 104, Flinders Lane, Victoria 8009
Tel: + 61 3 9694 3777
Fax: + 61 3 9694 3733
Memberline: 1800 004 377
Consumerline: 1800 655 441
www.dairyaustralia.com.au

THIS PROJECT HAS RECEIVED FUNDING FROM THE GOVERNMENT OF WESTERN AUSTRALIA THROUGH THE STATE NRM PROGRAM.

Dairy Australia
Your Levy at Work

Funded by Dairy Australia and your dairy service levy

Western DAIRY

THE GOVERNMENT OF WESTERN AUSTRALIA

SWCC south west catchments council

CARING FOR OUR COUNTRY

GeoCatch