REPORT

File: RL015

Report No.: 2003/378
Prepared for: Policy Committee
Prepared by: Selva Selvarajah, Director Resource Management
Date: 25 May 2003

Subject: Farm dairy effluent discharges

---

1. Précis

Adverse effects of farm dairy effluent discharges to water could be significant when there is limited assimilative capacity of surface water. A majority of dairy farms irrigate effluent to pasture in the Otago Region, however, a small but significant number of farms still hold resource consents to discharge effluent to water. There are best practicable options such as effluent irrigation during dry conditions, sufficient effluent storage, storm water diversion, waste minimisation and waste water recycling to avoid or minimise adverse effects on water quality. The report recommends that advice on effluent best practicable options be provided to dairy farmers, and that any consent applications to discharge farm dairy effluent to water to be assessed with consideration given to the above best practicable options.

2. Background

There are 354 dairy farms in the Otago Region. Generally, farm dairy (milking shed) effluent is discharged into treatment or storage ponds or sumps. Treatment ponds are two pond systems and require resource consent to discharge treated effluent to water. 16 farms have discharge consents. The balance of the farms apply effluent to pasture. Provided certain conditions are met, land application of effluent does not require a resource consent except in certain ground water protection zone areas.

If managed poorly, land application of effluent can cause adverse effects on the environment. The Council performs regular annual inspections of all farm dairy effluent discharges. Last milking season 12 infringement notices ($750 each) were served on farms that failed to comply with the permitted activity rules and caused adverse effects on water quality. The major causes for non-compliance were insufficient storage of effluent, application of effluent during saturated conditions and excess effluent application.

The report will assess the issues related to consented pond discharges to water and provide directions on future management options. The report will also discuss the issue of non-complying land based systems and provide measures to avoid future noncompliance.

3. Council policy

The 16 confirmed dairy effluent discharges to water are in the Clutha District (11) and Dunedin City Council (5) areas. In line with this Council's recent emphasis on the protection of waterways from stock damage and regional surface water quality improvement, a clear direction is needed to manage the above discharges through the consent and education process. In most cases farmers consider that because of poor soil and climatic conditions they are unable to adopt land based discharges and hence continue to rely on discharges to surface water.

The Regional Policy Statement Policy 6.5.5 states, "...***To promote a reduction in adverse effects of contaminant discharges into Otago's water bodies through*** *:...* (d) *promoting discharges to land where practicable and where there are no significant adverse effects on ground water or surface water resources or soil,...".* The Proposed Regional Plan: Water, Policy 7.7.1 states, "**...** ***To promote discharges of contaminants to land in preference to water where appropriate.****..".* In short the Council's policy requires preference to be given to land based discharges over discharges to surface water, provided land based systems achieve the desired environmental outcomes.

4. Effluent quality and quantity

As shown in Table 1 raw effluent contains very high levels of contaminants and after treatment by a two pond system a significant reduction in contaminant levels could be achieved. The treatment efficiency of the two pond system is good for contaminants such as faecal coliforms where the levels are better than those of a typical primary treated municipal effluent. However, the reduction in BOD, SS and nutrients is poorer compared to municipal discharges.

Table 1. Characteristics of raw and treated farm dairy effluent

Characteristics	**Raw effluent**	**2nd Pond discharge**
pH	8.6	7.9
BOD (Biochemical Oxygen Demand) mg/L	2000	83
SS (Suspended solids) mg/L	4780	220
TP (Total phosphorus) mg/L	49	20
TN (Total nitrogen) mg/L	355	91
Ammoniacal-N mg/L	130	69
Faecal coliforms cfu/100 mL	2×10^7	3.5×10^4

Source: [1]Selvarajah, 1996 and various.

Both raw and treated effluents are excellent liquid fertilisers with high levels of plant nutrients. More than 99% of the effluent is water which results from washing the farm dairy. It has been estimated that on average 50 L/cow/day of water is used for farm dairy washing. This means a 500 cow herd farm may discharge 25,000 L/day of effluent. This effluent has a fertiliser value of $6250 per year based on nitrogen (N), phosphorus (P) and potassium (K) contents. Applying effluent to the maximum loading of 150 kg N/ha will also apply 25 kg P/ha and 105 kg K/ha. In short, farm dairy effluent has good fertiliser value and hence should be used as a ***resource*** rather than ***waste***.

5. Effects of treated effluent discharge on surface water quality

Although the two pond systems are capable of reducing contaminant levels substantially, the potential adverse effects of treated farm dairy effluent discharges on surface water quality are significant. Such adverse effects have been well documented by Hickey *et al.*,[2] 1989 and Selvarajah[1], 1996. These papers emphasise that treated farm dairy effluent discharges to surface water require many fold dilutions to mitigate adverse effects. For example to meet contact recreation criteria and to avoid nuisance algal proliferations, more than 2700 fold dilution is required for faecal coliforms and nutrient discharges of farm dairy effluent origin. In order to remove the toxicity caused by free ammonia in the effluent a dilution of 250 fold is required to minimise adverse effects on fish. This means that a discharge from 220 cow herd would require a surface water flow of 58 L/s. Such an estimate assumes

---

[1]Selvarajah, N. 1996. Dairy farm effluent treatment pond performance in the Waikato Region: A preliminary review if the regional survey. ***In*** *"Tertiary options for dairyshed and piggery wastewaters", Proceedings of a seminar held at Massey University (Ed IG Mason), Department of Agricultural Engineering, Massey University, Palmerston North, June 1996.*

[2]Hickey, CW., Quinn, JM and Davies-Colley, R.J. 1989. Effluent characteristics of dairy shed oxidation ponds and their potential impacts on rivers. New Zealand Journal of Marine and Freshwater Research 23, 569-584.

there are no other non-point or point discharges in the catchment.

6. Best practicable options

6.1 "Deferred irrigation system"

The most important factor contributing to a successful land based effluent system is adequate effluent storage. Sufficient storage ensures avoiding effluent application to land during saturated conditions. Current consent holders have two pond systems that provide such storage. It has been estimated that for a 500 cow herd a two pond system could hold up to 4600 m^3 of effluent (first pond up to 2500 m^3 and second pond up to 2100 m^3). If the entire pond effluent is irrigated at 25 mm hydraulic loading rate, approximately 18 ha of land is required for irrigation. With an estimated daily influent of 25 m^3 for a 500 cow herd, it will require 184 days to fill both ponds. Since cows are not milked during May, June and July in most cases (exceptions are town milk suppliers) there is no effluent discharge to ponds during most part of winter.

With the above system the farmer has the flexibility of choosing appropriate weather and soil conditions to empty the ponds. The mean annual rainfall in the consented areas ranges from 700 to 950 mm. The rainfall is evenly distributed with a mean monthly rainfall of 80-90 mm for most of the year (lowest range being 65-75 mm experienced during July, August and September). There are dry days during summer with low soil moisture levels requiring additional soil moisture input for pasture growth. Therefore, effluent can be irrigated during summer provided dry days are selected. An irrigated paddock may be visited only *once a year* for effluent irrigation, resulting effectively in zero discharge to surface water.

6.2 Storm water diversion

Whilst storage of effluent is one of the key positive factors contributing to the success of effluent irrigation, a high volume of effluent could be a significant negative factor. As stated before, 99% of the effluent is water that is used for washing the farm dairy. Most farms also discharge their storm water from roof and yard into treatment ponds. This is a substantial amount of water input to the pond system. For example in areas with 900 mm annual rainfall a 30 m x 10 m farm dairy roof could generate about 270 m^3 of storm water per year. Roof water could be diverted into a farm drain. With a simple mechanical provision, yard storm water could also be diverted away from ponds once washing has been completed.

6.3 Waste minimisation

Water use on most dairy farms is high. If simple practices (such as (a) scraping the dung from the farm dairy and yard before hosing it down after milking, (b) using a washing (hosing) system that uses low volumes of water and cleans effectively, and (c) washing once a day) are adopted the water use could be cut down by more than 50%. This means that an existing 500 cow herd effluent volume of 25 m^3/day could be halved to 12 to 13 m^3/day. Such a reduction means that the effluent ponds or storage systems emptied during summer will not fill up rapidly and will not require further emptying in the same season.

6.4 Waste water recycling

In addition to washing the farm dairy after milking, the dairy yard also requires washing to remove dung and sediments. Unlike the farm dairy, yard washing does not require good water and hence treated waste water from the second pond could be pumped for use for initial cleaning purposes. This water could be used liberally since it will not increase waste water input to the storage or pond system.

7. Other alternatives

There are no good alternatives to effluent irrigation. Installation of rock filters, third pond and constructed wetlands have been considered in the past. Rock filters do not treat faecal coliforms and nutrients effectively. Whilst third ponds can reduce all contaminant levels to varying degrees, the

discharge would still require many fold dilution in the receiving environment. The performance of constructed wetlands is highly unpredictable. In general they fail to treat phosphorus, ammoniacal nitrogen and faecal microbes effectively. Therefore the discharges from constructed wetlands would also require sufficient dilution to mitigate adverse effects on surface water.

8. Consent process

The discharge of treated farm dairy effluent water is a discretionary activity pursuant to Rule 12.8.3.1 of the Regional Plan: Water. The Council may grant or decline the application and may impose conditions in accordance with section 108 of the Resource Management Act. This means that any existing consent holder (as renewal) or new applicant could apply for resource consent to discharge treated farm dairy effluent to water. The Council cannot refuse to receive a consent application unless it is a prohibited activity. All existing consent holders should be advised by the Council about the deferred irrigation system and required to consider this option carefully before lodging new applications.

Most consents to discharge effluent to water expire this year (11) and next year (2). The balance of the consents expire after 2005 (actual expiry between 2006-08). It is important that the consent holders are informed of the best practicable options to avoid discharge of effluent to water. In future every effluent discharge consent should be assessed to examine whether the applicant had effectively considered all or any of the following options: deferred irrigation system, storm water diversion, waste minimisation, waste water recycling. Technically if all the above are adopted, existing consents may not require renewal.

9. Non-compliance of land based systems

As stated before, poorly managed land based systems can result in adverse effects on the environment. Such adverse effects include runoff of effluent to surface water, bypass-flow through tile drain system affecting surface water quality, and excessive effluent loading resulting in nutrient leaching and ultimately poor ground water quality. The main causes for excessive effluent application and application to saturated soils are irrigation system management and insufficient storage. The best irrigation system, when used on saturated soils, will result in effluent runoff or effluent leaking into tile drains. Saturated conditions are experienced more often in artificially drained catchments and therefore sufficient storage is required to apply effluent when soil conditions are suitable. In such cases a minimum of one month effluent storage combined with good practices on waste minimisation and waste water recycling is required.

10. Conclusions

In the Otago Region, farm dairy effluent could be managed sustainably provided dairy fanners have sufficient effluent storage and apply effluent strategically when soil conditions are appropriate. This, combined with other best practicable options such as waste minimisation, waste recycling and storm water diversion, can ensure a substantial reduction in waste water volume requiring treatment or irrigation. Effluent application to pasture can minimise nutrient loss and improves soil fertility, hence it is a 'win-win' situation.

11. Recommendations

(a) That the Council incorporate information on deferred irrigation systems, storm water diversion, waste minimisation and waste water recycling into its dairy advisory information.
(b) That any renewal or new applications for farm dairy effluent discharges to water be considered only once the applicants have either adopted or considered implementing deferred irrigation system, storm water diversion, waste minimisation and waste water recycling practices.

Selva Selvarajah
Director Resource Management