Farm Dairy Effluent Irrigation Evaluations

Traveller 3

System details

- Medium traveller with rubber orifices on rotating boom
  - Used to apply all effluent generated from the shed and feed-pad
  - Irrigator run at 'full' speed
  - Wetting width approx 42m
  - Overlap varies between runs with average 38m

- Soils are variable; mostly silt loam
  - Significant ponding and runoff on day of visit

- Irrigation
  - Farm is Pivot irrigated

Figure 1. Effluent irrigator ready to cross catch can transect – note hose burst at left.

Consent Details

Effluent consents held:

To discharge farm dairy effluent and contaminants from the operation of a feedpad, onto 123 ha of land in circumstances which may result in the contaminant, (or any other contaminant emanating as a result of natural processes from that contaminant), entering water.

3. The discharge is to be only of that from operation of a farm dairy and feedpad effluent as produced by a maximum herd size of 1400 cows.
4. All effluent from the dairy shed and feedpad, and leachate from the fresh food bins, shall be collected in a sump with a capacity of no less than 102 m^3.
5. Effluent shall be irrigated over no less than 70 hectares annually, located within the shaded areas shown on Attachment 1, attached to and forming part of this document. This area excludes the buffer zones referred to in condition 6 of this consent.
6. Notwithstanding condition 5, no effluent shall be discharged, either directly or indirectly through spray drift, within:
   (a) 50 metres of any legal property boundary; or
   (b) 30 metres of any existing bore or well used for potable supply, or any surface water body (including water races & farm drains).
7. The total nitrogen loading from the discharge of effluent shall not exceed 130 kg of nitrogen per hectare during any 12-month period ending 30 June.
8. The total combined nitrogen loading (from nitrogen-based fertilisers & effluent) onto any area over which effluent is discharged in any year, shall not exceed 200 kg N/ha for that year ending 30 June.
9. The rate of effluent application to land shall not exceed 15 mm per pass, or a maximum annual application of 30 mm. [see advice note]

Effluent Irrigation Evaluation

Medium Traveller

This irrigator was applying effluent at rates in excess of the soil's infiltration and water holding capacities. This was easily identified with ponding covering much of the wetting area and effluent running up to 3m to the side on relatively flat ground. A summary of system performance is given in Table 1.

Table 1: Summary of Effluent Irrigation Performance

Traveller	No Overlap	38m Overlap	
Wetting Diameter	42		m
Lane Spacing	38		m
Instant Application Area	1384		m2
Machine speed	0.85	0.85	m/min
Effluent Mean Depth	11	11.8	mm
Mean Application Rate	13.3	15.8	mm/h
Wetting Ring Area	742	742	m2
Max Application Rate	24.8	24.1	mm/h
Hi Quart Mean Depth	17.8	18.2	mm
Lo Quart Mean Depth	7.0	8.4	mm
DU high	1.62	1.54	
DU low	0.64	0.71	

The maximum application rate is calculated from the area of the ring wetted by the irrigator boom as it rotates. Most of the effluent is applied in a ring between 12m and 19m out from the centre of the irrigator. In this smaller area, the effective instantaneous application rate is doubled and reasonably high, causing noticeable ponding and run off.

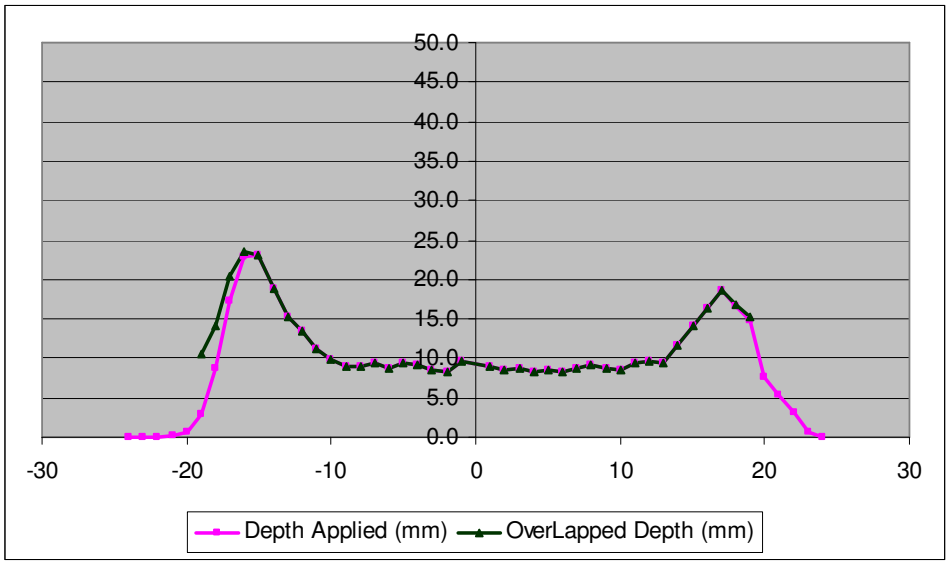

Figure 2. Effluent application pattern measured at normal pressure and full machine speed and calculated overlapped pattern based on 38m hydrant spacing

In the graph (Figure 2), the depths measured in the field are shown as the pink line. The calculated overlapped pattern is shown as the black line.

The peaks at the sides of the application pattern are typical of travelling irrigators. Because of the ring application pattern and the forward movement, the sides receive effluent for a longer period than the centre of the travel path.

The average application rate without accounting for overlap between successive runs (13.3mm) is within the consent requirements (15mm per pass). The peaks at the sides of the wetted strip are in excess. If the effect of overlapping successive runs is taken into account, the average applied depth (15.8mm) is slightly over the consent limit. Given the runs are separated in time, this is of little consequence. However, it also means that two applications in one year would slightly exceed the total annual maximum applied depth permitted in the consent (30mm).

Recommended Improvements

1. The machine was severely affected by nozzle blockages by debris.

Nozzles completely blocked 6 times during testing, with double blockages being followed by the delivery hose bursting in two places. The hose splits required removal and repair. Three blockages were caused by peach stones , presumably from feed pad material. Two blockages appeared to be caused by tar glued stones. One was caused by an ear tag and one by a piece of broken alloy sheet.

- Check stone traps and pump screening to avoid debris entering the system
- An alternative sump system – increasing size and retention time and separating into two parts – would allow more settling and reduce blockages.

2. There is surface ponding

The high application rate on small areas is causing surface ponding. This is causing redistribution through overland flow, though not to sensitive areas in the field where testing took place.

Holes dug in the area immediately following application showed clear evidence of 'preferential flow', with soil wet to several centimetres in many parts, but wetted through the topsoil and into sub-soil in some locations. This is typical of high application rates to dry and potentially hydrophobic soils.

- Increasing machine pressure and speed will help reduce ponding. Increasing the width of the wetting ring will also help.

3. Pressure must be managed

On the day of testing, the machine was applying slightly more depth of effluent than desirable.
Increasing pressure should increase machine speed resulting in a reduction in depth applied.

4. The boom applies effluent in a narrow ring.

- Fitting splash plates, diffusers or diffusing nozzles could increase the area of instantaneous application.
- Figure 3 shows a splash plate fitted to a large travelling irrigator to deflect and widen the stream from the end nozzle. Figure 4 shows a split crimped rubber nozzle option.

Figure 3. Splash plate fitted to end nozzle to widen spread

Figure 4. Rubber nozzle crimped & cut to increase footprint

A policy of alternating machine paths would help improve the overall uniformity over successive applications. This will not help on a single event basis, but will over the course of a season.