Dairy Green Ltd

Practical Engineering Solutions

Consents, Effluent, Stock water, Irrigation

Design through to Installation

6 June 2023

CFL - Jardine

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Dear Steven

Drop Test Results: CFL - Jardine, Effluent Pond, 2 - 3 June 2023

1. Background

As required by the Otago Regional Council, to confirm your effluent pond is not leaking, a drop-down test was carried out between the 2nd and 3rd of June 2023.

Site and Set Up

The farm is located at 367 Jardine Road, Awamoko.

Effluent flows by gravity from the cow shed to a pump sump, it is then pumped to a solids separator. From there the liquid effluent flows to a synthetically lined storage pond.

There was no crust on the pond and the surface was not frozen during testing.

The dimensions of the pond at the water level during the test period were:
North 40.9 m

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East	24.3 m
South	41.6 m
West	26.6 m

The dimensions of the pond catchment area at the top bank level during the test period were:

North	43.3 m
East	26.7 m
South	44.0 m
West	29.0 m

The total pond catchment area was 16 % greater than the wetted area during the test.

The plans for the pond show a maximum design depth of 4.0 m including 0.5 m of freeboard. At the time of the test the liquid level was 0.6 m below the maximum design depth, i.e. 97 % full.

Below is an aerial photo that shows the effluent pond. The laser drop test unit was installed at the north side of the pond, as marked.

3. Test Methodology

You were notified when the test was to be run and confirmation was received that there would be no liquid inflow or outflow during the test period.

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The monitoring equipment was set up at the pond by Evan Sanderson, as described below. NIWA provide a service of independently hosting all the data collected by the monitoring equipment. The NIWA Neon website was checked to confirm that data was being recorded and sent to the website.

3.1. Water Level Monitoring Unit

A laser distance measuring unit was set up vertically over the pond surface. A reflective disc was placed on the pond surface to ensure constant, repeatable readings.
The laser was set up within a PVC pipe which acts as a stilling well.
Distance readings to the pond surface were taken at 10 second time intervals and sent to NIWA's Neon logging system.

3.2. Meteorological Station

A weather station orientated to the North was also set up and the data it collected sent to NIWA's Neon system at 10 second intervals. It measured:

- Air temperature
- Wind speed
- Wind direction
- Rainfall

3.3 Evaporation Loss Monitoring

To record evaporation and rainfall in real time a bucket was installed suspended from a strain gauge with 9.0 L of effluent in it, on the pond bank.

4. Results Recording

Recording of results was carried out to comply with Otago Regional Council, Final Plan Change 8 Part B: Animal waste storage and application, schedule 18, Schedule of pond drop test requirements and criteria.

Recording details are summarized below:

- The minimum test period has to be 24 hours.
- The wind speed must not exceed 14m/s for the duration of the test.
- Readings are to be taken every 10 seconds.

- For maximum accuracy the wind velocity has to be very low, in the order of 1m/s. This is because wind at the test site has been observed to have two effects, the first

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being to cause waves and the second to push water to one side of the pond from the other, (a seiche effect). The accuracy of the laser distance recorder is such it will detect changes as small as 0.2 mm. To accurately determine the true pond level requires calm conditions at the start and end of the test period.

- When a period of 24 hours or more has lapsed the information is downloaded and the results interpreted.

- The GPS location of the pond and equipment set up is recorded. For this test the equipment was located at **E**1435655 **N**5022962, at the north side of the pond.

Laser at the north side of the pond.

5. Results Summary

The results for the test are summarised in Table 1 and discussed below. The plot of wind speed and pond height shows that at times wind caused waves on the pond surface, but the wind speed did not exceed 14m/s. A period was identified at the start and end of the test period when the pond surface was stable and accurate height readings were established.

The start time was assumed to be at 10:30:30 hours on the 2 June 2023.
The distance from the laser to the reflective disc on the pond surface was 414.8 mm and the wind speed 1.4 m/sec.

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The finish time was assumed to be at 10:34:00 hours on the 3 June 2023.
The distance from the laser to the reflective disc on the pond surface was 400.0 mm and the wind speed 1.3 m/sec.

The total time elapsed was 24 hours and 03 minutes, 30 seconds.

The laser measured a change in distance to the pond surface of 14.8 mm decrease. Therefore, the pond surface rose 14.8 mm over the test period.

During the test the dairy shed sump pump was triggered to turn on and effluent from the sump was pumped to the pond via the solids separator. The sump is 7m x 8m with straight sides, there was a clear mark left 29cm up from the liquid level on the side of the sump wall. This indicates the height the effluent was at before the pump started. From these measurements it can be calculated that 7m x 8m x 0.29m = 16.2 m^3 of effluent was pumped from the sump to the solids separator. The sump was checked just after the pump has stopped and no inflow into it was observed at this time. It can be concluded effectively only the volume of the sump as calculated above was transferred to the pond, via the solids separator.

On the afternoon of the 2nd between 15:55:20 hours and 16:17:30 hours the pond level rose 15.0 mm, this equates to a volume of 15.8 m^3. During this time there was no change in the wind speed or the wind direction and there was no rain. Typically the solids content in dairy effluent is in the order of 2%-3%. A solids separator will remove 80% of the solids in the whole effluent, in this case 16.2 m^3 was reduced to 15.8 m^3, a reduction 2.5%. These calculations confirm that the change in pond height of 15.0mm can be directly attributed to the sump pump turning on.

For this reason the 15 mm increase in the pond level will be removed from the calculations for the calculation of the change in pond height.

There was no rainfall during the test. The evaporation bucket was calculated to lose 2.6 mm depth during the test period. The pond should have mimicked the evaporation bucket result. It can be concluded the pond level should have fallen 2.6 mm due to evaporation. The change in pond height was a net decrease of 0.2 mm (14.8 - 15.0 = -0.2).

The graphs were studied to determine the cause of the difference between the observed result and the expected result based on the evaporation bucket performance. Observations made when there was minimal evaporation and when the wind speeds where low shows very good pond performance. For example, from 23:02:00 hours on the 2nd to 08:23:10 hours on the 3rd a period of 9 hours, 21 minutes and 10 seconds, the evaporation bucket recorded no change in height and the pond also recorded no change in height.

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The difference of 2.4 mm to the expected result can be explained by a combination of the margin of error in the measuring equipment and mostly that the evaporation bucket can evaporate at a higher rate than the pond. This has been observed before, the bucket has a relatively small thermal mass and can evaporate at a higher rate than the pond during periods of high evaporation.

In summary the change in pond height due to evaporation follows the same trend line as the evaporation bucket change in height, except the magnitude is different. This has resulted in a lesser net reduction in pond height compared to the evaporation bucket.

The following table summarises the results.

TABLE 1: DROP TEST RESULTS SUMMARY, CFL - Jardine, Effluent Pond

Start Time	2 June, 10:30:30	
Finish Time	3 June, 10:34:00	
Total Time	24 hrs, 03 minutes, 30 seconds	
Start Depth (mm)	414.8	
Finish depth (mm)	400.0	
Change in depth (mm)	- 0.2 (14.8 - 15.0)	
Rainfall (mm)	+ 0.0	
Evaporation (mm)	- 2.6	
Net Change in Depth After		
Rain and Evaporation (mm)	+ 2.4	
Net Change per 24 Hours (mm)	+ 2.4	
Pond Level, % of Design Depth	97	
Net Change if Pond at 75% of	NA	
Design Height. (mm/24hrs)		

6. Conclusion

The pond complies with the requirements of the Otago Regional Council, Final Plan Change 8, Part B: Animal waste storage and application, Schedule 18, Schedule of pond drop test requirements and criteria, with a leakage rate of less than 2.0 mm/24 hours.

The pond is suitable for storing effluent as the infiltration rate from the pond is less than 2.0 mm per 24 hours.

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Yours faithfully

JOHN SCANDRETT

Agricultural & Engineering Consultant

Appended

Depth and wind speed graph for the test period.

Depth and rainfall/evaporation graph for the test period.

Depth and wind speed for the start of the test period.

Depth and wind speed for the end of the test period.

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