OVERSEER Nutrient Budget Review of proposed

For: Environment Southland – South Dairies Ltd

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Introduction

1. Regarding the consent application for South Dairies Ltd, I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) SD1 Consent Conditions AUTH-20171302-01/04
   b) SD2 APP-20147281-01-v1
   c) SD 7ha Support
   d) Ovr-South Dairies Proposed (1)

2. Along with the files I have reviewed the following report:
   - Overseer Modelling Report prepared as part of a consent application for expanding dairying, prepared by Miranda Hunter, Roslin Consultancy Limited.

3. I have completed a robustness check on the files for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.3.1.

4. It must be assumed that the information provided in the OVERSEER files that the have been modelled are a viable farming system, using actual stock and fertiliser inputs. Therefore, they are also assumed to be appropriate for the location and climate.

5. A 'sensibility test' has been undertaken on the South Dairies Ltd nutrient budgets with the following four output screens from OVERSEER forming the basis of the determination of the robustness of the nutrient budget:
   a) Is the nutrient loss consistent with what you would expect for an operation of this type and soils in this location?
   b) Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?
   c) Check the 'Other values' block reports for rainfall, drainage, and PAW
   d) Select the Scenario reports other values and check the production and stocking rate
   e) Select the pasture production in the scenario report and check pasture growth.

6. Answers to each of these five points will be provided further in this report and then a final determination of the robustness of the nutrient loss to water will be provided at the end of this report.

OVERSEER AUDIT

Appropriateness of the Overseer inputs

1. The four XML files stated in paragraph 1 of this report have been reviewed for consistency between the files and appropriateness of the inputs regarding the farming systems and the Overseer Best Practice Data Input Standard (BPDIS).

2. I concur that there is no deviation from the BPDIS for all predictive files.

3. All models appear to have the correct area and is summarized in Section 7.0 of Roslin Consultancy Ltd report, dated 14th March 2019.

4. Reviewing the NZ Dairy statistics for the 2017/2018 season, shows the milk solids production on these properties are in fact higher than the Southland regional average of 408kg MS/cow. The stocking rate is also higher than the Southland average for the 2017/2018 season of 2.64 cows/ha. Milk solid production per cow for the SD Proposed model (457.4 MS/ha) is slightly higher when compared to the average (455.9 MS/ha) of SD1, SD2 and 7ha support models (baseline models). The stocking rate for SD Proposed (3.1 cows/ha) is slightly lower when compared to the average (3.17 cows/ha) of the baseline models (see table 1 below).

Table 1: Summary of Production and stocking rate

	SDI*	SD2***	7ha Support****	Baseline Models	SD Proposed**
Total Ha	248.5	179.8	7.5		435.8
Effective Ha	238.1	173.8	6.6		418.5
MS kg/ha grazed	1480	1369	-	1433	1410
MS kg MS/cow	451.3	462.1	-	455.9	457.4
RSU	7361	5290	151		12834
Lactation Length	268	268	-		268
Cows/ha	3.3	3.0	-		3.1
Cows June	0	320	200		520
Cows July	32	320	200		552
Peak Cows (Sept)	780	510	-		1290
Bulls (Dec/Jan)	22	15	0		37
Young Stock (Aug-Dec)	197	130	0		327
N lost kg/ha/yr	58	58	29	57	57

*SD1= SD1 Consent Conditions AUT-20171302-01/04
**SD Proposed= Ovr-South Dairies Proposed (1)
***SD2=SD2 APP-20147281-01-v1
****7ha Support= SD 7ha Support
Baseline Models = Average of SD1, SD2 and 7ha Support

5. The fodder beet has been rotated around each block for SDI and for the SD Proposed. SD2 and 7ha support did not have fodder beet rotated through.

Table 2: Crop Details and Drainage

	SDI	SD2	7ha Support	SD Proposed
Crop Effective Ha	12	-	-	12
Yield (tDM/ha)	25	-	-	25
Cultivation	Conventional	-	-	Conventional
Sown	November	-	-	November
Crop	Fodder Beet	-	-	Fodder Beet
Blocks	All	-	-	All
Drainage Area (ha)	230	173.8	6.6	410.4

6. Supplements imported in SD Proposed at 2.87 tDM/ha is slightly less than the total of the baseline models (SD1, SD2 and 7ha support) at 2.96 tDM/ha. The SD Proposed Overseer model shows the pasture production is 14.4 tDM/ha compared to the baseline models average is 14.54 tDM/ha. This is around 0.1 tDM/ha decrease in pasture production (see Table 3a above) The nitrogen fertiliser used is 184 kgN/ha for SD Proposed which is slightly less than the average of 187 kgN/ha for baseline models.

7. The 0.14 tDM/ha decrease in pasture growth is accounted for in the 0.1 tDM/ha decrease in pasture grown and slight decrease in N fertiliser applied. The stocking rate and cows per month are the same when comparing the average of the baseline models and the SD Proposed model (see Table 3a below).

Table 3a: Supplements imported and Harvested

	SDI	SD2	7ha Support	Baseline Models	SD Proposed
Supplements Imported (tDM)	530	680	30		1200
Supplements Imported (tDM/ha)	2.21	3.91	4.55	2.96	2.87
Effective Area (ha)	238.1	173.8	6.6		418.5
RSU/ha	7361	5290	151		12834
N Fertiliser applied (kgN/ha)	184	194	97	187	184
Pasture Intake (kgDM/ha)	14846	14177	3848		14456
Silage Harvested to storage (kgDM/ha)	0	0	9148		0
Pasture Intake including supplement (kgDM/ha)	14846	14177	12996	14540	14456

8. The N lost to water and P loss is same for the SD Proposed (57 kgN/ha) and average (57 kgN/ha) of the baseline models, and SD2 models, (see Table 4 below). It must be assumed that the information provided in all the models are farming systems is modelled as a viable farming system, using actual stock and fertiliser inputs and are also assumed to be appropriate for the location and climate.

Table 4: OVERSEER outputs

Overseer v6.3.0	SDI	SD2	7ha Support	Baseline Models	SD Proposed
N lost to water kg/ha/yr	58	58	29	57	57
Total N lost kg/farm	14333	10414	218		24913
P lost kg/ha/yr	1.4	1.3	0.6	1.3	1.3
Total P lost kg/farm	338	230	5		576
Other sources – N	788	480	4		1330
Other sources – P	133	91	1		228

Change in block pools

9. It appears N is potentially being immobilized for SD Proposed average of the baseline models. This is observed with a positive value in the inorganic pool for N.

Table 5: Change in block pool (N)

	SDI	SD2	7ha Support	SD Proposed
Plant Material	-6	0	0	-3
Organic Pool	92	119	142	102
Inorganic Material	0	0	0	0
Inorganic Soil Pool	2	0	0	2

10. The phosphate added to all the models met P maintenance requirements resulting in little to no change the inorganic soil pool.

Table 6: Change in block pool (P)

	SDI	SD2	7ha Support	SD Proposed
Plant Material	-1	0	0	0
Organic Pool	15	16	15	16
Inorganic Material	2	2	2	2
Inorganic Soil Pool	-1	1	0	-1

Rain/clover N Fixation

11. N added to the SD Proposed model is slightly below the average of the baseline models (187 kgN/ha). In all cases (for the dairy farm models as shown below in table 8) consideration has been given to effluent being applied (less N on effluent blocks).

12. The small increase in biological fixation in the SD Proposed model when compared to the average of baseline models which will likely be due to the decrease in average N applied. This is deemed to be an acceptable variance and within the limitations of the model.

Table 7: Biological fixation

	SDI	SD2	7ha Support	Baseline Models	SD Proposed
Biological Fixation	95	87	42	97	93
Average N applied to whole farm kg/ha/yr	184	194	97	187	184

13. It is likely the decrease in N applied and slight increase in biological fixation for SD Proposed when compared to the average of the baseline will maintain the pasture production modelled for SD Proposed.

Pasture Production

14. The effluent N inputs for SD Proposed are in line with the average of the baseline dairy models (see table 8 below).

15. Fertiliser inputs of N in the SD Proposed model is 1.3% less on the effluent areas and 4.1% less N fertiliser being applied to the non-effluent areas compared to the average of the 2 dairy farm baseline models.

16. Pond solids, separate solids and solids from the wintering pad area, are all applied to all blocks in all models. Liquid effluent, using <12 mm), is applied for all dairy farm models.

17. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. The pasture production on this property is higher than the long-term growth. This has been explained by Roslin Consultancy Ltd in Section 10.8.

18. The animal distribution is modelled the same in all scenarios.

Table 8: Pasture production and N inputs (fertiliser and effluent)

	SDI	SD2	Baseline Models	SD Proposed
Effluent Area (ha)	183	105.4	288.4	288.4
Pasture Growth (tDM/ha/yr)				
Effluent	17.5	16.7	17.2	17.0
Non-Effluent	17.5	16.7	17.2	17.0
N Fertiliser inputs (kg/ha/yr)				
Effluent	187	183	185	183
Non-Effluent	231	227	229	220
N Effluent Inputs (kg/ha/yr)				
Effluent	56	68	61	64
Non-effluent (includes solids)	33	42	37	35
Total N Inputs (kgN/ha/yr)				
Effluent	243	251	246	247
Non-Effluent	264	269	266	256

Changes Modelled

19. As described in the report provided by Roslin Consultancy Ltd, Section 10.7, on farm system modelling of SD Proposed, the table below details the data that has been included in the SD Proposed model to reflect the 3 baseline models and shows if it has been accurately modelled.

Table 9: Modelling of SD Proposed

Total Area changed	Yes (sum of baseline models, 435.8 ha)
Effective area changed	Yes (sum of baseline models 418.5 ha)
Increased Effluent area	Yes (sum of dairy baseline models 1288.4 ha)
Changed from wintering pad to feed pad and times on	Yes, changes proposed made
Animal changes	Yes (cows each month add to total of cows in baseline models)
Supplement changes	Yes (total supplement imported is slightly less than the total of the baseline models and is reflected in the slightly lower pasture harvest)
Fertiliser and Nitrogen	Yes (P fertiliser applied to maintain Olsen P levels, slightly less N applied in the SD Proposed model)

20. Most of the changes look reasonable and are robust.

21. It is important that these changes are measured and monitored as if they are not adhered to the N losses proposed may not occur.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

22. The questions below were described at Paragraph five of this report. Whilst these have been answered throughput this report, this section summarizes the answer to each question to make an overall conclusion about the robustness of the nutrient budgets.

Is the N loss consistent with what you would expect for an operation of this type and soils in this location?

23. Based on my experience, the N loss estimates are reasonably consistent with an operation of this scale and soil types present.

Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?

24. There was a small increase in biological fixation for SD Proposed compared to baseline models which is likely be due to the decrease in average N applied. This is deemed to be an acceptable variance and within the limitations of the model.

Check the 'Other values' block reports for rainfall, drainage, and PAW

25. The rainfall and soil information have been entered based on protocols for the location and soil type selected.

Production and stocking rate

26. Based on my experience as well as reviewing NZ Dairy statistics for the 2017/2018 season the stocking rate and milk solid production are higher than the Southland Region average in the 2017/2018 season.

27. The milk solids production per cow modelled for SD proposed at 457.4 kgMS/cow/annum is higher than the Southland regional average of 408kg MS/cow but in line with the average of the 2 dairy farm baseline models milk production.

28. The stocking rate, for all dairy farm models, is higher than the Southland average for the 2017/2018 season of 2.64 cows/ha.

29. It is assumed that all the models are based on actual information and all scenarios represent viable production and stocking rates.

Select the pasture production in the scenario report and check pasture growth.

30. A detailed explanation of the pasture production has been outlined in the above sections.

31. There is a small decrease in pasture production between the SD Proposed and the baseline models and a corresponding small decrease in N applied and decrease in supplement being imported. The pasture production of SD proposed seems in line with expectations.

32. There is a shortfall of pasture production in the SD proposed model, but this is due to the decrease in supplement imported.

33. I have assumed an adequate level of robustness for all scenario Overseer Modelling as it is based on an actual farming system, and with that, I have assumed actual stock and fertiliser inputs used.

34. The data input protocols have been followed for all scenarios with no deviations. This leads to a high level of robustness for the relevant input data for example, climate, soils, and pasture type.

35. Based on the above information, I consider that the robustness of the nutrient loss estimates for models to be as follows:

    a) SD1 **high**
    b) SD2 **high**
    c) Support **high**
    d) SD Proposed **high**

36. It is vital that the proposed plans for the farm system are effectively measured and monitored as if these are not adhered to then the proposed N losses may not occur.

References:

New Zealand Dairy Statistics 2017/2018. Produced by LIC and DairyNZ 2018. https://www.dairynz.co.nz/media/5790451/nz-dairy-statistics-2017-18-web.pdf

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Overseer Technical Manual – Characteristics of Pasture, April 2015

Smith. L. C. 2012. Proceedings of the New Zealand Grassland Association 74: 147-152 (2012) *Long Term pasture growth patterns for Southland New Zealand: 1978-2012.* www.grassland.org.nz/publications/nzgrassland_publication_2284.pdf