OVERSEER Nutrient Budget review

For: Environment Southland – Piobiare Homestead Ltd

Prepared by: Nicky Watt, CNMA

Introduction

1. Regarding the consent application for Piobiare Homestead Ltd, 939 Lochiel Branxholme Road, Invercargill. I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – adj-copy 1
   b) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – proposed1 -copy 1- copy 1

2. Along with the files I have reviewed the following accompanying report:
   - Farm Scenario Plan -2015/18 Averaged Nutrient Budget & Report - Prepared by Mark Crawford, Senior Farm Environmental Consultant

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 v6.3.0.

4. It must be assumed that the information provided in the OVERSEER files that the current farming system as modelled is a viable farming system, using actual stock and fertiliser inputs. Therefore, the actual and proposed scenario is also assumed to be appropriate for the location and climate.

5. A 'sensibility test' has been undertaken on the Piobiare Homestead Ltd nutrient budgets with the following five 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 two 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.

3. The Current and Proposed models have a total area of 165.1 ha (160.2 ha effective). There is increase in the Current Model Beef RSU from 2570 (2.9 cattle/ha) to 2644 (3.0 cattle/ha) in the Proposed model.

4. The cattle equivalent stocking rate at 2.9 and 3.0 cows/ha is higher for the Current and Proposed models, respectively, when compared to the Southland average for the 2017/2018 season of 2.64 cows/ha. The Proposed model stocking rate is 3.3% higher than the Current model.

Table 1: Summary of Production and stocking rate

	Current[1]	Proposed[2]
Total Ha	165.1	165.1
Effective Area (ha)	160.2	160.2
Sheep RSU	12	12
Beef RSU	2570	2644
*Cattle Equivalent Stocking Rate/ha	2.9	3.0
N lost kg/ha/yr	28	27

[1] PIOBIARE HOMESTEAD LTD c/-N&R PYPER – adj-copy 1
[2] PIOBIARE HOMESTEAD LTD c/-N&R PYPER – proposed1 -copy 1- copy 1
*Assuming 5.5 SU/ha, to compare to dairy stocking rate/ha

5. The total crop area for the Current model was 17.6 ha fodder beet and 8.8 ha new grass and 18 ha fodder beet and 9 ha new grass in the Proposed model (see table 2 below). This is an increase of 2.2% increase in crops in the Proposed Model.

Table 2: Crop Details

	Current	Proposed
Fodder Ha	17.6	18.0
Fodder Yield (tDM/ha)	25	25
New Grass Ha	8.8	9

6. The wintering barn is used to stand off more animals over time in the Proposed Model compared to the Current Model (see Figures 1 & 2 below).

Figure 1: Current Model Wintering Barn

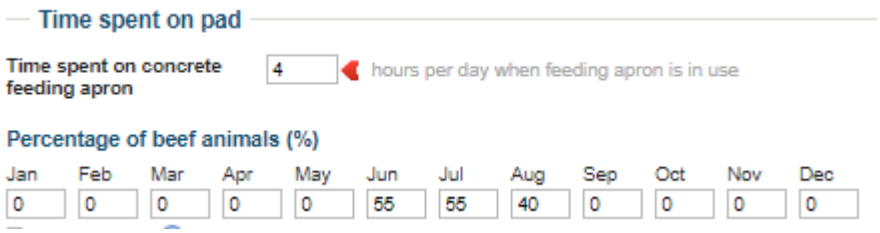
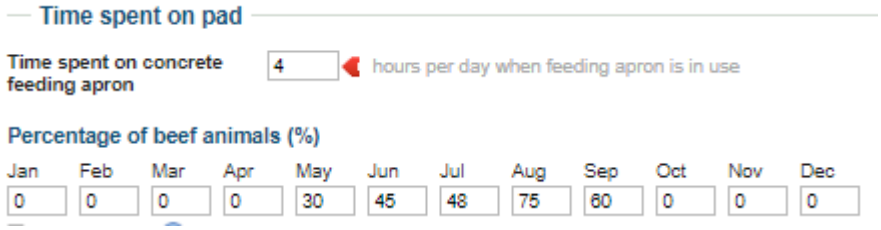


Figure 2: Proposed Model Wintering Barn



7. Supplements imported have changed to meet cow demand (see Table 3). Pasture silage has been made where there was a surplus of pasture.

Table 3: Supplements imported and Harvested

	Current	Proposed
Supplements Imported (tDM)	535	592
Supplements Imported (tDM/ha)	3.34	3.70
Total Area (ha)	165.1	165.1
Effective Area (ha)	160.2	160.2
Cattle Equivalent Stocking Rate/ha	2.9	3.0
N Fertiliser applied (kgN/ha)	139	138
Pasture Growth with Effluent (TDM/ha)	12.78	11.81
Pasture Growth (TDM/ha)	12.78	11.81
Pasture Growth Lease (tDM/ha)	11.51	10.63
Pasture Growth Average for Non-Effluent Areas (tDM/ha)	11.91	10.97
Silage Harvested to storage (tDM)	592	592

8. The Proposed Overseer model shows the pasture production as 11.81 tDM/ha for effluent land and an average of 10.63 tDM/ha for non-effluent land. The Current Model pasture production is 12.78 tDM/ha effluent land and 11.91 tDM/ha for non-effluent land. The N used in the Proposed model was 138 kgN/ha and the N applied to Current model was 139 kgN/ha. The supplement used in the Current model was 3.34 tDM/ha and the Proposed is predicting using 3.70 tDM/ha. Based on this information, despite the slight rise in the stocking rate the Proposed model has a decrease in pasture harvested which is justified by the 9.7 % increase in supplement imported and greater number of animals spent on the wintering block (see Tables 1 & 4 above and figures 1 & 2 above).

9. The Current Model N loss was 28 kgN/ha. The Proposed Model shows a N Loss of 27 kgN/ha (See table 4 below). The Current Model P loss was 0.7 kgP/ha and the Proposed Model shows a P Loss of 0.7 kgN/ha. It must be assumed that the information provided in the Current Model farming system is modelled as a viable farming system, using actual stock and fertiliser inputs. Therefore, the Proposed scenario is also assumed to be appropriate for the location and climate.

Overseer Outputs

Table 4: OVERSEER outputs

Overseer v6.3.0	Current	Proposed
N lost to water kg/ha/yr	28	27
Total N lost kg/farm	4698	4383
P lost kg/ha/yr	0.7	0.7
Total P lost kg/farm	121	118
Other sources – N	113	118
Other sources – P	19	19

Change in block pools

10. Overall there is no significant difference in the change in block pool values between the Current and the Proposed scenario for N & P.

11. It appears N is potentially being immobilized; this is observed with a positive value in the Organic pool for N. This value remains reasonably constant in Current and Proposed models.

12. Above maintenance P was applied for both the Proposed and Current Models which is seen by the positive Inorganic Soil Pool levels.

Table 5: Change in block pool (N)

	Current	Proposed
Plant Material	22	13
Organic Pool	48	52
Inorganic Material	0	0
Inorganic Soil Pool	5	5

Table 6: Change in block pool (P)

	Current	Proposed
Plant Material	1	0
Organic Pool	9	9
Inorganic Material	4	4
Inorganic Soil Pool	31	27

Rain/clover N Fixation

13. The Biological fixation for the Proposed Model at 25 is a 16.7% decrease in fixation (see table 7 below).

14. Average N added to the proposed scenario is only slightly lower than the Current Model.

15. The decrease in biological fixation in the Proposed Model is is not from N fertilizer but in part due to extra effluent area and extra effluent produced from the Winter Pad (see Table 8 below) and decrease in pasture production and increase in supplement being imported. This is deemed to be an acceptable variance and within the limitations of the model.

Table 7: Biological fixation

	Current	Proposed
Biological Fixation	30	25
Average N applied to whole farm kg/ha/yr	139	138

16. It is not known if the increase in N applied through effluent and imported supplement and decrease in biological fixation will be able to maintain the pasture production modelled.

Pasture Production

17. The effluent spread area is proposed to increase by 11.8% in the Proposed Model. The total effluent N inputs will increase from the Current Model to the Proposed Model by 10.5% due to the increase in effluent area and similar effluent N/ha applied (see table 8 below).

18. Fertiliser inputs of N differ for effluent and non-effluent area in both Current and Proposed Models. The N applied to the effluent blocks are 15 kgN/ha less than the non-effluent areas.

19. Pond solids and liquid effluent from Wintering Barn are applied to effluent areas only in both Current and Proposed Models. Liquid effluent is applied to the land using <12mm application depth.

20. 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 currently like the long-term growth on the effluent areas and 6.2% lower on the non-effluent areas. The annual pasture growth for the Proposed Model at 11.81 tDM/ha is 7% lower for effluent areas and 13.6% lower than the Southland average long-term pasture growth.

21. The Proposed model pasture production is 7.9% lower on the non-effluent blocks and 7.6% lower on the effluent blocks compared to the Current Model pasture production.

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

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

	Current	Proposed
Effluent Area (ha)*	67	76
Total Effluent N (kg/yr)	5226	5776
Pasture Growth (tDM/ha/yr)		
Effluent	12.78	11.81
Non-Effluent	11.91	10.97
N Fertiliser inputs (kg/ha/yr)		
Effluent	141	141
Non-Effluent	155	155
N Effluent Inputs (kg/ha/yr)		
Effluent	78	76
Non-effluent (includes solids)	0	0
Total N Inputs (kgN/ha/yr)		
Effluent	219	217
Non-Effluent	155	155

**Effluent area is area that receives liquid effluent and solids (Paro_4a.1 Effluent/Waiki_30a.1 Effluent/Waiki_30a.1 YG/Paro_4a.1 YG)*

Mitigations Modelled

23. As described in the Farm Scenario Plan of the Piobiare Homestead Ltd summarized on page 22, there are several mitigation measures to mitigate N loss that have been included in the proposed scenario. The below table details if the mitigation measures have been included in the proposed scenario and if they are accurately modelled.

Table 9: Mitigation option for proposed

Aerodrome analysis- Contain all increased stock within landholding (added dry cows and replacements to Piobiare (support block)	As from the Aerodrome Modelling – can confirm extra dry cows and replacements have been added to Piobiare.
The farm has a wintering barn which captures the effluent which is applied to pasture October and November	Yes, both the Current and Proposed models have a winter barn (entered as a covered wintering pad or animal shelter) and effluent is collected and spread in October and November
There will be additional use of the Wintering Barn over May and September	Yes, the barn is being used over May and September, currently only used June/July/August
Little change in N fertilizer applied	Yes, there is a slight decrease in total N applied, no change in N fertilizer applied to each block
Effluent stored and applied at appropriate times and Current area receives 90.7 ha including crops	Yes, effluent is stored and applied at appropriate times, but Current effluent area is 67 ha and Proposed effluent area is 76 ha
Effluent applied to highest risk Paroa soils during highest risk periods could be minimized	Most of the farm receives effluent to the Paroa soils, not sure what the mitigation is?

24. Most of the mitigation measures are robust.

25. It is important that these mitigation measures are measured and monitored as if they are not adhered to the N loss reductions proposed may not occur.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

26. 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?

27. 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?

28. Overall there is no significant difference in the change in block pool values between the Current and the proposed scenario for N & P.

29. There is a 16.7% decrease in biological fixation in the Proposed model and a small decrease in N Fertiliser applied. The increase in biological fixation is mostly due to the increase in N applied from Effluent in the Proposed model (increased effluent area with similar effluent N applied/ha) and increase in supplements imported. This is deemed to be an acceptable variance and within the limitations of the model. Clover and pasture inputs are similar for Current and Proposed Models.

30. It is not apparent from reviewing the Overseer technical manuals or the nutrient budgets if the difference in pasture production and effluent N accounts for all the increase in biological fixation.

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

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

Production and stocking rate

32. Based on my experience as well as reviewing NZ Dairy statistics for the Current and Proposed stocking rate is higher than the Southland Region average in the 2017/2018 season.

33. The stocking rate at 2.9 cows/ha for the Current model and 3.0 cows/ha for the Proposed model are higher than the Southland average for the 2017/2018 season of 2.64 cows/ha.

34. It is assumed that since the Current Model is based on year end information that it represents viable production and stocking rate.

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

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

36. The Proposed Overseer model pasture production is 7.6% lower for effluent land and an average of 10.7% lower for non-effluent land compared to the Current Model pasture production. The N fertilizer used in the Proposed model is slightly lower than the N applied to Current model. The supplement used in the Proposed model is predicted to be 9.7% more than the Current model. Based on this information, despite the slight rise in the stocking rate, the Proposed model has a decrease in pasture harvested which is justified by the increase in supplement imported and greater number of animals spent on the wintering block.

37. 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 currently similar to the long-term growth on the effluent areas and 6.2% lower on the non-effluent areas. The annual pasture growth for the Proposed Model at 11.81 tDM/ha is 7% lower for effluent areas and 13.6% lower than the Southland average long-term pasture growth.

38. I have assumed an adequate level of robustness around the Current Model of actual Overseer Modelling as it is based on an actual farming system, and with that, I have assumed actual stock and fertilizer inputs used.

39. 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.

40. Based on the concerns raised regarding some of the inputs and outputs in the Overseer models, I consider that the robustness of the nutrient loss estimates for the Proposed scenario are **medium-high,** this is due to the robustness of the nutrient loss estimates for the actual scenarios is **medium-high**.

41. The area of concern in the current and proposed models is: The current and proposed blocks do not have the effluent area in the report matching what was modelled (see page 22 of report on mitigations which indicates Current is 90.7 ha modelled but only 67ha is modelled).

42. It is vital that the proposed changes to the future farm system are effectively measured and monitored as if these are not adhered to then the reductions in N loss proposed 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.pdf
Overseer Definition of Terms, previously Technical Note 6. May 2016
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