Irricon resource solutions

## OVERSEER Nutrient Budget Review

For: Environment Southland – Opio Dairy Limited

Prepared by: Nicky Watt, CNMA

Date: 24th January 2025; updated 4th February 2025

www.irricon.co.nz

## Quality Control

| | |
|---|---|
| **Title** | Overseer Nutrient Budget Review for Environment Southland – Opio Dairy Ltd |
| **Issue Date** | 24th January 2025; updated 4th February 2025 |
| **Version** | FINAL |
| **Job Reference** | W8964.6 |

Prepared by: Nicky Watt – Environmental Consultant

Signature:______________

# Contents



# Tables

## 1.0 Introduction

1. Regarding the consent application for Opio Dairy Limited, I have reviewed the following OVERSEER FM® Nutrient Budget (OVERSEER) files:
   a) v3 Baseline Opio Dairy Platform
   b) v3 Baseline Sheep and Beef
   c) v3 Proposed

2. Along with the files I have reviewed the following accompany report: for "OverseerFM farm system modelling to support a consent application for a dairy boundary realignment and expanded dairy" prepared by Lee Baldwin, Baldwin Agri Solution and checked by Miranda Hunter, Roslin Consultancy Ltd. I have completed a robustness check on the file for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.5.8.

3. It must be assumed that the information provided in the OVERSEER files shows 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.

4. A 'sensibility test' has been undertaken on the Opio Dairy 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 soil 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.

5. 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.

## 2.0 Overseer Audit

### 2.1 Appropriateness of the Overseer inputs

1. The Overseer FM files submitted and 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 are no deviations from the BPDIS.

## 2.2 Production and Stocking Rate

3. The combination of the comparable land area for the Sheep & Beef and Dairy models had a total of area 226.7 ha and an effective area of 217 ha. The Proposed model had a total area of 220.3 ha (should be 226.7 ha?) and an effective area of 217 ha. The combination of the base models had a dairy revised stocking rate of 24.8 RSU/ha on the effective dairy grazed pasture area. The Proposed model had a dairy revised stocking rate of 29.4 RSU/ha for the effective grazed pasture area or a 15.6 % increase in RSU/ha for effective dairy grazed pasture area. The combination of the sheep & Beef and Dairy models had a total revised stocking rate of 25.6 RSU/ha for all animals on the effective area. The Proposed model had a total revised stocking rate of 30 RSU/ha for the effective area or a 14.7% increase in RSU/ha for effective area (see Table 2 below).

4. Reviewing the NZ Dairy statistics for the 2019/2020 season, shows the average milk solids production on this property for the Dairy model at 597.3 kgMS/cow and 1768 kgMS/ha is respectively higher than the Southland Regional average of 418 kg MS/cow and higher than the Southland Regional average of 1133 kgMS/ha. The Proposed model at 585.1 kgMS/cow and 1521 kgMS/ha is respectively higher than the Southland Regional average of 418 kg MS/cow and higher than the Southland Regional average of 1133 kgMS/ha.

5. The stocking rate for Dairy Model at 3.0 cows/ha higher than the Southland average for the 2019/2020 season of 2.71 cows/ha (Invercargill). The stocking rate for Proposed Model at 2.6 cows/ha is lower than the Southland average for the 2019/2020 season of 2.71 cows/ha (Invercargill).

**Table 1: Summary of production and stocking rate**

| | Sheep & Beef[1] | Dairy[2] | Proposed[3] |
|---|---|---|---|
| Total Ha | 35 | 229.7 | 220.3 |
| Effective Area (ha) | 35 | 220 | 217 |
| Effective Pasture Area (ha) | 35 | 161 | 217 |
| KgMS | - | 268800 | 330000 |
| MS kg/ha grazed | - | 1768 | 1521 |
| MS kg MS/cow | - | 597.3 | 585.1 |
| Dairy RSU | - | 4990 | 6386 |
| Dairy RSU/ha (pasture area) | - | 22.6 | 29.4 |
| Replacement RSU | - | 107 | 123 |
| Sheep RSU | 396 | - | - |
| Beef RSU | 77 | 73 | - |
| Total RSU | 473 | 5170 | 6509 |
| Total RSU/effective ha | 13.5 | 23.5 | 30.0 |
| Lactation Length | - | 266 | 266 |
| Cows/ha (per ha grazed) | - | 3.0 | 2.6 |
| Cows October | - | 450 | 550 |
| Cows June | - | 200 | 400 |
| Cows July | - | 100 | 400 |
| Replacements June | - | - | - |
| Replacements July | - | - | - |
| N lost kgN/ha/yr | 17 | 51 | 35 |
| N Lost kgN/ha/yr (comparable area) | 17 | 9405/191.7= 49.1 | 35 |

V3 Baseline Sheep and Beef – Sheep & Beef[1]
V3 Baseline Opio Dairy Platform - Dairy[2]
V3 Proposed - Proposed[3]

| Table 2: Summary of combined production and stocking rate | | |
|---|---|---|
| | Combined | Proposed |
| Total Ha | 264.7 | 220.3 |
| Effective Area (ha) | 255 | 217 |
| Effective Pasture Area (ha) | 196 (201 ha comparable land area) | 217 |
| KgMS | 268800 | 330000 |
| MS kg/ha grazed | 1768 | 1521 |
| MS kg MS/cow | 597.3 | 585.1 |
| Dairy RSU | 4990 | 6386 |
| Dairy RSU/ha (pasture area) | 24.8 (comparable area 201 ha) | 29.4 |
| Replacement RSU | 107 | 123 |
| Sheep RSU | 396 | - |
| Beef RSU | 150 | - |
| Total RSU | 5643 | 6509 |
| Total RSU/ha | 25.6 (using 220 ha) | 30.0 |
| Lactation Length | 266 | 266 |
| Cows/ha (per ha grazed) | 3.0 | 2.6 |
| Cows October | 450 | 550 |
| Cows June | 200 | 400 |
| Cows July | 100 | 400 |
| Replacements June | - | - |
| Replacements July | - | - |
| Total N Lost (kg/yr) | 12259 | 7752 |
| N lost (kg/ha/yr) | 46.3 | 35 |
| Tota N lost (kgN/yr) -comparable area | 10015 | 7752 |
| N Lost (kgN/ha/yr) – comparable area | 44.2 (226.7 ha) | 35 |

## 2.3 Cropping

6. The combination of the Sheep & Beef and Dairy models showed an area of 8 ha of kale (labelled as swede) grazed June to Aug by sheep and 4 and 59 ha of forage barley harvested in February and exported. The Proposed model had no area in crop. This is a 100% decrease in crops grown and grazed in the Proposed model (see Table 4 below).

| Table 3: Crop Details | | | |
|---|---|---|---|
| | Sheep & Beef | Dairy | Proposed |
| Swede Crop Rotation (ha) | 8 (entered as kale) | - | - |
| Swede Yield (tDM/ha) | 12 | - | - |
| When grazed | June to Aug | - | - |
| Grazed By | Sheep | - | - |
| Forage Barley Crop (ha) | - | 59 | - |
| Forage Barley Yield (tDM/ha) | - | 11.4 | - |
| When grazed | - | Harvested Feb | - |
| Grazed By | - | Cut and exported | - |

| Table 4: Combined Crop Details | | |
|---|---|---|
| | Combined | Proposed |
| Swede Crop Rotation (ha) | 8 (labelled as kale) | - |
| Swede Yield (tDM/ha) | 12 | - |
| When grazed | June to Aug | - |
| Grazed By | Sheep | - |
| Barley Crop (ha) | 59 | - |
| Rape Yield (tDM/ha) | 11.4 | - |
| When grazed | Harvested Feb | - |
| Grazed By | Cut and exported | - |

## 2.4 Soils and Drainage

7. The soil areas are with margin of error for all soils and drainage comparable (see Table 5 below).

| Table 5: Soil and Drainage | | | | | |
|---|---|---|---|---|---|
| | Sheep and Beef (ha) | Dairy (ha) | Combined (ha) | Proposed (ha) | % difference |
| Apar_6a.1 | 21 | 106.1 | 127.1 | 127.1 | 0 |
| Pukem_6a.1 | 14 | 70.8 | 84.8 | 84.8 | 0 |
| Makar_3c.1 | - | 5.1 | 5.1 | 5.1 | 0 |
| Total* | 35 | 182 | 217 | 217 | |
| Drainage | 26.3 | 136.5 | 162.8 | 162.8 | |

*Note did not table the 38 ha not in proposed model

## 2.5 Supplements Fertiliser and Pasture Growth

8. Supplements are imported to meet cow demand (see Table 4 below). Pasture silage has been made where there was a surplus of pasture. The combination of the Sheep & Beef and Dairy models had an average pasture growth calculated at 16.7 tDM/ha and the Proposed model had a pasture growth of 17.4 tDM/ha for all pasture. This is a 4.0% increase in pasture growth. The N used on all pasture blocks for the combination of the Sheep & Beef and Dairy models was an average of 175 kgN/ha compared to 189 kgN/ha on average to pasture in the Proposed model. This is a 7.4% increase in N fertiliser used on average on pasture. There is expected to be 2.9% less supplement imported, and 41.9% more silage harvested in the Proposed model compared to the combination of the Sheep & Beef and Dairy models (see Table 7 below).

| Table 6: Supplements Fertiliser and Pasture Growth | | | |
|---|---|---|---|
| | Sheep & Beef | Dairy | Proposed |
| Supplements Imported (tDM) | - | 566.3 | 550 |
| Supplements Imported Effective Area (tDM/ha) | - | 2.27 | 2.53 |
| Silage Harvested (tDM) | 35 | 287.5 | 554.7 |
| Silage Harvested (tDM/ha) | 1.0 | 1.3 | 2.6 |
| Total Area (ha) | 35 | 229.7 | 220.3 |
| Effective Area (ha) | 35 | 220 | 217 |
| Effective Pasture Area (ha) | 35 | 161 | 217 |
| Dairy RSU | - | 4990 | 6386 |
| Dairy RSU/ha (pasture area) | - | 22.6 | 29.4 |
| Replacement/Beef RSU | - | 107 | 123 |
| Sheep RSU | 396 | - | - |
| Beef RSU | 77 | 73 | - |
| Total RSU | 473 | 5170 | 6509 |
| Total RSU/ha | 13.5 | 23.5 | 30.0 |
| Cows/ha (per ha grazed) | - | 3.0 | 2.6 |
| Effluent area (ha) | - | 40 | 217 |
| N Fertiliser applied non-effluent pasture(kgN/ha) | 9 | 201 | 189 |
| N Fertiliser applied effluent Area (kgN/ha) | - | 201 | 189 |
| Pasture Growth dairy area (tDM/ha) | - | 17.4 | 17.4 |
| Pasture Growth support/other area (tDM/ha) | 12.1 | - | 17.4 |

| Table 7: Combined Supplements Fertiliser and Pasture Growth | | |
|---|---|---|
| | Combined | Proposed |
| Supplements Imported (tDM) | 566.3 | 550 |
| Supplements Imported Effective Area (tDM/ha) | 2.27 | 2.53 |
| Silage Harvested (tDM) | 322.5 | 554.7 |
| Silage Harvested Eff Pasture (tDM/ha) | 1.5 | 2.6 |
| Total Area (ha) | 264.7 (226.7 ha comparable land area) | 220.3 |

| | | |
|---|---|---|
| Effective Area (ha) | 255 (220 ha comparable land area) | 217 |
| Effective Pasture Area (ha) | 255 (220 ha comparable land area) | 217 |
| Dairy RSU | 4990 | 6386 |
| Dairy RSU/ha (pasture area) | 22.6 | 29.4 |
| Replacement/Beef RSU | 107 | 123 |
| Sheep RSU | 396 | - |
| Beef RSU | 150 | - |
| Total RSU | 5643 | 6509 |
| Total RSU/ha | 25.6 (using 220 ha) | 30.0 |
| Cows/ha (per ha grazed) | 3.0 | 2.6 |
| Effluent area (ha) | 40 | 217 |
| N Fertiliser applied non-effluent pasture(kgN/ha) | 201 | 189 |
| N Fertiliser applied effluent Area (kgN/ha) | 201 | 189 |
| N Fertiliser applied Average (kgN/ha) | 175 | 189 |
| Pasture Growth dairy area (tDM/ha) | 17.4 | 17.4 |
| Pasture Growth support/other area (tDM/ha) | 12.1 | 17.4 |
| Average pasture growth (tDM/ha) | 16.7 | 17.4 |

## 2.6 Overseer Outputs

9. The N lost to water for the combination of the comparable area for Sheep & Beef and Dairy models was 44.2 kgN/ha/yr (10015 kgN/annum) compared to 35.2 kgN/ha/yr (7752 kgN/annum) for the Proposed model which is a 22.6 reduction in the total N loss. The P lost for the combination of the comparable area for Sheep & Beef and Dairy models was 1.0 kgP/ha/yr (236 kgP/annum) compared to 0.94 kgP/ha/yr (208 kgP/annum) for the Proposed model which is a 11.9% decrease in total P loss (see Table 9 below). It is assumed that the information provided in this farming system is modelled as a viable farming system, using actual stock and fertiliser inputs.

**Table 8: Overseer Outputs**

| **Overseer v6.5.8** | Sheep & Beef | Dairy | Proposed |
|---|---|---|---|
| **N lost to water kg/ha/yr** | 17 | 51 | 35.2 |
| Total N lost kg/farm | 610 | 11649 | 7752 |
| **P lost kg/ha/yr** | 0.7 | 1.0( | 0.94 |
| Total P lost kg/farm | 23 | 233 | 208 |
| *Other sources – N* | 8 | 463 | 632 |
| *Other sources – P* | 4 | 107 | 104 |

**Table 9: Combined Overseer Outputs using comparable area**

| **Overseer v6.5.8** | Combined (226.7 ha) | Proposed (220.3 ha) |
|---|---|---|
| **N lost to water kg/ha/yr** | 44.2 | 35.2 |
| Total N lost kg/farm | 10015 | 7752 |
| **P lost kg/ha/yr** | 1.0 | 0.94 |
| Total P lost kg/farm | 236 | 208 |
| *Other sources – N* | 471 | 632 |
| *Other sources – P* | 111 | 104 |

## 2.7 Change in Overseer Block Pools

10. The organic pool for N indicates the amount of N that is being either immobilized as seen by a 'positive' Organic pool N value or being mineralized as seen by a 'negative' Organic pool N value. N being immobilized is being used for increased biological activity and temporarily locked up. Once the microorganisms die the organic N in their cells is converted by mineralization and nitrification

to plant available nitrate. It appears N is potentially being immobilized in all models (see Table 10 below).

11. The inorganic soil pool for P indicates the amount P that exceeds soil P maintenance as seen by a ‘positive’ inorganic soil P value or is less than the soil P maintenance requirements as seen by a ‘negative’ inorganic soil P value. Above maintenance P was applied to the all the Baseline models and slightly above maintenance fertiliser for the Proposed model (see Table 11 below).

| Table 10: Change in N Block Pool | | | |
|---|---|---|---|
| | Sheep & Beef | Dairy | Proposed |
| Organic Pool | -4 | 1 | 111 |
| Inorganic Mineral | 0 | 0 | 0 |
| Inorganic Soil Pool | 22 | 59 | 0 |

| Table 11 Change in P Block Pool | | | |
|---|---|---|---|
| | Sheep & Beef | Dairy | Proposed |
| Organic Pool | 4 | 7 | 15 |
| Inorganic Mineral | 1 | 3 | 3 |
| Inorganic Soil Pool | 14 | 16 | 2 |

## 2.8 Rain and Clover N Biological Fixation

All plants, including forage crops, need relatively large amounts of nitrogen for growth and development. Biological nitrogen fixation is the term used for a process in which nitrogen gas (N2) from the atmosphere is incorporated into the tissue of certain plants. Only a select group of plants can obtain N this way, with the help of soil microorganisms. Among forage plants, the group of plants known as legumes (predominantly Clover in NZ pastures) are well known for being able to obtain N from air N2. The OVERSEER Technical Manual – Characteristics of Pasture, April 2015 indicates that biological N fixation is based on total pasture production and includes the fertiliser induced reduction in N fixation.

12. The Biological fixation for the combination of the comparable area of the Sheep & Beef and Dairy models was 83 kg/ha /year compared to the Proposed model at 122 kg/ha/year. This is a 32% increase (see Table 13 below).

13. The N added to pasture for the combination of the comparable area of the Sheep & Beef and Dairy models was 171 kgN/ha compared to 189 kgN/ha for the Proposed model (a 9.5% increase in N Fertiliser used).

14. The increase in biological fixation in the the Proposed model can largely be explained by the decrease in stock rate and large increase in supplements harvested on farm which offsets the increase in N fertiliser applied.

| Table 12: Biological Fixation | | | |
|---|---|---|---|
| | Sheep & Beef | Dairy | Proposed |
| Total Area (ha) | 35 | 191.7 | 220.3 |
| Biological Fixation (kg/ha/yr) | 77 | 84 | 122 |
| Average N applied to whole farm kg/ha/yr | 27 (9 to pasture) | 184 (201 to pasture) | 189 (209 to pasture) |

| Table 13: Combined Biological Fixation | | |
|---|---|---|
| | Combined | Proposed |
| Total Area (ha) | 226.7 | 220.3 |

| | | |
|---|---|---|
| Biological Fixation (kg/ha/yr) | 83 | 122 |
| Average N applied to whole farm kg/ha/yr | 160 (171 to pasture) | 186 (189 to pasture) |

## 2.9 Pasture Production and N inputs

15. The average effluent N inputs for the Dairy model was 82 kgN/ha from liquid (40ha) and 34 kgN/ha for solid (51 ha) effluent (see table 8 below). The average effluent N inputs for Proposed model was 47 kgN/ha from liquid to 217 ha and 47 kgN/ha from solids to 217 ha for solid applications.

16. Fertiliser inputs of N from effluent and fertiliser for the Dairy model, to pasture, was 267 kgN/ha (see Table 14 below). The fertiliser inputs of N from effluent and fertiliser to pasture, was 236 kgN/ha pasture in the Proposed model (see Table 14 below).

17. Liquid effluent is applied onto the dairy pasture blocks for the Dairy model every month using a <12mm application method to 100% of the blocks. The Proposed model has liquid effluent applied to the dairy pasture blocks all year, using a <12mm application method to 100% of the blocks. The Dairy and Proposed models had solid effluent, from the pond, was applied in December. The Dairy model had separated solid effluent applied in September. The Proposed model had separate solid effluent applied in December. The Proposed model had separate solid effluent from the uncovered wintering pad applied in December (solids form the wintering pad in the Dairy model was not applied).

**Table 14: Pasture production and N inputs (fertiliser and effluent)**

| | Dairy | Proposed |
|---|---|---|
| Effluent Liquid Area (ha) | 40 | 217 |
| Effluent Solids Area (ha) | 51 | 217 |
| | | |
| Pasture Growth (tDM/ha/yr) | | |
| Effluent | 17.4 | 17.4 |
| Non-Effluent | 17.4 | 17.4 |
| | | |
| N Fertiliser inputs (kg/ha/yr) | | |
| Effluent | 201 | 189 |
| Non-Effluent | 201 | 189 |
| | | |
| N Effluent Inputs (kg/ha/yr) | | |
| Effluent | 82 | 47 |
| Solids | 34 | 47 |
| | | |
| Total N Inputs (kgN/ha/yr) | | |
| Effluent | 267 | 236 |
| Non-Effluent | 236 | 236 |

18. The pasture production for all models have been modelled as varying based on topography, climate, and development status.

19. Fertiliser inputs of N are moderate for the combination of the Sheep & Beef and Dairy models and high for the Proposed model (see Table 7 and Table 14 above).

20. It is assumed the combination of the Baseline models represent the actual farm system with actual stock, crop area and fertiliser inputs, it is assumed that the pasture production is accurate and reasonable.

21. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr.

22. The pasture production for the combination of the Sheep & Beef and Dairy models for pasture was 16.7 tDM/ha compared to 17.4 tDM/ha for the Proposed model which is respectively 24% and 27% higher than the Southland average. The dairy pasture production for the Dairy model which was 17.4 tDM/ha compared to 17.4 tDM/ha for the Proposed model which are both 27% higher than the Southland average (see Table 7 above).

23. The Dairy model: Allowing for the Overseer model assuming an average metabolisable energy (ME) value of 10.5 MJME/kgDM for pasture and South Island pastures have a ME value closer to 11 MJME/kgDM the models output of pasture growth would drop by 4.5% (16.7 kgDM/ha). Also, the model had used actual data and is assumed that pasture renewal has occurred, and new pasture can account for a 15-20% improvement in pasture growth. Plus, there is 239 kgN/ha fertiliser which can account for 2.0 tDM/ha (10 to 1 response). All these factors account for the higher pasture growth.

24. Proposed model: The small increase in pasture growth against the combined base models can be accounted for in the increase in N applied to pasture despite the decrease in stocking rate.

25. The animal distribution is modelled as 'No difference between blocks' for all the models. The Dairy and Proposed models also had Based on animal present on block'.

## 3.0 Mitigations Modelled

26. Reporting out lined the following: As described in the Nutrient Budget Report for "OverseerFM farm system modelling to support a consent application for a dairy boundary realignment and expanded dairy" prepared by Lee Baldwin, Baldwin Agri Solution and checked by Miranda Hunter, Roslin Consultancy Ltd. Page 7 and 17 of this report shows that there are several mitigation measures indicated to mitigate N/P loss that have been included in the Proposed modelling. Table 15 below details if the mitigation measures have been included in the proposed scenario and if they are accurately modelled.

| Table 15: Mitigations for Proposed scenario | |
|---|---|
| Remove winter cropping | Yes, there is a 100% decrease in winter crops grown and grazed in the Proposed model (only use grass and Baleage for wintering stock) |

| | |
|---|---|
| Increase in effluent application area | Yes, the effluent application area has increased from the Dairy model area of 40 ha to the Proposed model area of 217 ha (an 81.6% increase). |
| Reduced stock intensification of dairy cows grazed (spread over a larger area) | Yes, the cows per ha have decreased from 3.0 cows/ha to 2.6 cows/ha. |
| Addition of a second feed pad and increase months feed pads used | It is not clear in the modelling if there is a second feed pad, but the uncovered wintering pad is being used June to September (only June in the Dairy model) |
| *Less purchased feed and increase in pasture harvested on farm | Yes, there was 2.9% less supplement imported, and 41.9% more silage harvested in the Proposed model compared to the combination of the Sheep & Beef and Dairy models |
| *Olsen P decreased in Dairy area and increased in Sheep & Beef area | Yes, the Dairy model had Olsen P levels 40, 42 and 36 for the Platform Effluent and non-effluent areas which have decreased to 35 in the Proposed Model. The Sheep & Beef Olsen P has increased from 16 to 30 in the Proposed model. |
| *Use of low solubility phosphate fertiliser | Yes, High RPR P fertiliser was applied in January in the Proposed model |

*I have included these mitigations that have been modelled but not reported

27. All mitigations identified in the OverseerFM report have been modelled correctly.

28. 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.

29. Some good management practices assumed in Overseer are maintain accurate and auditable records of annual farm inputs, outputs and management practices (Overseer output is only as good as the data entered); Fertiliser is being applied according to the Fertmark and Spreadmark Codes of Practice; Feed is stored to minimise leachate and soil damage; Compliant effluent systems as defined by DairyNZ; Stock exclusion from water ways; Irrigation efficiency greater than 80%; farm race and bridge/culvert nutrient runoff is directed to paddocks; grazing managed to minimise losses from critical source areas.

30. Overseer will account for bad practices such as nitrogen (N) applied that exceeds the plants' ability to absorb the excess N, application of N in the winter, high stocking rates, land left fallow between crops and irrigating high water application rates causing N drainage to name a few.

31. The Overseer modelling completed for this farm does not have any of the 'Bad Practices' as suggested in paragraph 31, and it would be assumed the FEMP would cover any good management practices (not limited to) outlined in paragraph 30.

# 4.0 Concluding Comments

## 4.1 Determination of the robustness of the nutrient loss to water

32. 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?*

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

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

34. The Biological fixation for the combination of the comparable area of the Sheep & Beef and Dairy models was 83 kg/ha /year compared to the Proposed model at 122 kg/ha/year. This is a 32% increase (see Table 13 above).

35. The N added to pasture for the combination of the comparable area of the Sheep & Beef and Dairy models was 171 kgN/ha compared to 189 kgN/ha for the Proposed model (a 9.5% increase in N Fertiliser used).

36. The increase in biological fixation in the the Proposed model can largely be explained by the decrease in stock rate and large increase in supplements harvested on farm which offsets the increase in N fertiliser applied.

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

37. The rainfall and soil information have been entered based on protocols for the location and soil type selected. The combination of the Sheep & Beef and Dairy Models soil areas and drainage is within acceptable marginal differences when compared to the Proposed model soils and drainage.

*Production and stocking rate*

38. Reviewing the NZ Dairy statistics for the 2019/2020 season, shows the average milk solids production on this property for the Dairy model at 597.3 kgMS/cow and 1768 kgMS/ha is respectively higher than the Southland Regional average of 418 kg MS/cow and higher than the Southland Regional average of 1133 kgMS/ha. The Proposed model at 585.1 kgMS/cow and 1521 kgMS/ha is respectively higher than the Southland Regional average of 418 kg MS/cow and higher than the Southland Regional average of 1133 kgMS/ha.

39. The stocking rate for Dairy Model at 3.0 cows/ha higher than the Southland average for the 2019/2020 season of 2.71 cows/ha (Invercargill). The stocking rate for Proposed Model at 2.6 cows/ha is lower than the Southland average for the 2019/2020 season of 2.71 cows/ha (Invercargill).

40. It is assumed that the Dairy model was based on actual year end information.

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

41. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr.

42. The pasture production for the combination of the Sheep & Beef and Dairy models for pasture was 16.7 tDM/ha compared to 17.4 tDM/ha for the Proposed model which is respectively 24%

and 27% higher than the Southland average. The dairy pasture production for the Dairy model which was 17.4 tDM/ha compared to 17.4 tDM/ha for the Proposed model which are both 27% higher than the Southland average (see Table 7 above).

43. The Dairy model: Allowing for the Overseer model assuming an average metabolisable energy (ME) value of 10.5 MJME/kgDM for pasture and South Island pastures have a ME value closer to 11 MJME/kgDM the models output of pasture growth would drop by 4.5% (16.7 kgDM/ha). Also, the model had used actual data and is assumed that pasture renewal has occurred, and new pasture can account for a 15-20% improvement in pasture growth. Plus, there is 239 kgN/ha fertiliser which can account for 2.0 tDM/ha (10 to 1 response). All these factors account for the higher pasture growth.

44. Proposed model: The small increase in pasture growth against the combined base models can be accounted for in the increase in N applied to pasture despite the decrease in stocking rate.

45. The animal distribution is modelled as 'No difference between blocks' for all the models. The Dairy and Proposed models also had Based on animal present on block'.

## 5.0 Conclusion

The data input protocols have been followed with some deviations. This leads to a h**igh** level of robustness for the relevant input data for example, climate, soils, and pasture type. Based on this, I consider that the robustness of the nutrient loss estimates for the Proposed model to be **high.**

## 6.0 References:

New Zealand Dairy Statistics 2019/2020. Produced by LIC and DairyNZ 2020.
https://www.dairynz.co.nz/media/pfznwly2/nz-dairy-statistics-2019-20-dnz.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

https://connect.dairynz.co.nz/2022-23_Dairy_Statistics/