BEFORE COMMISSIONERS ON
BEHALF OF SOUTHLAND REGIONAL COUNCIL

IN THE MATTER	**Applications for resource consents**
BY	**FAWNA FARMS LIMITED**
	Applicant

EVIDENCE OF
MONIQUE (MO) MARIE TOPHAM
8TH MARCH 2023

BACKGROUND AND QUALIFICATIONS:

1. My name is Monique (Mo) Marie Topham. I hold a Bachelor of Agricultural Science Degree with First Class Honours (Dairy Systems) from Lincoln University. I am a member of the New Zealand Institute of Primary Industry Management (NZIPIM) and have been involved in the dairy industry in consultancy, event facilitation and practical farming since 2013.

2. I am qualified to complete farm systems appraisals. I have developed my skills through my university studies followed by ten years working within the dairy industry in Southland, including operating our own dairy farm business with my husband. I am a Certified Dairy Farm Systems Consultant (certified in 2017) under the NZIPIM certification scheme.

3. I have completed the Sustainable Nutrient Management Courses (Intermediate and Advanced) and am a Certified Nutrient Management Adviser (certified in 2018). I have also completed a course in Greenhouse Gases and am a certified Greenhouse Gas Advisor (certified in 2018).

4. I am a Director and Shareholder of three dairy farming businesses - Fast Track Dairies Limited, Clover Milk Limited and Hedgehope Grazing Limited. These businesses operate two dairy farms in Southland totalling approximately 570ha (dairy platforms and support area). My involvement with these properties, with my other business partners, has been to develop profitable and sustainable farming businesses in all facets, including environmental.

5. I was previously employed by DairyNZ as a Consulting Officer in the Southland, South Otago regional team. In this role I facilitated discussion and information transfer from dairy farmer to dairy farmer and from technical experts to dairy farmers. This resulted in the adoption of new practices and technologies on farm (including environmental).

6. Since resigning from DairyNZ in December 2016, I have been working as a farm systems and nutrient budgeting consultant with LIC FarmWise and more latterly with my own company AgriAce Consulting Limited. I work with dairy farmers throughout Southland supporting them to design, analyse and implement dairy farm systems that meet their environmental, financial, and personal goals. I am also involved in projects supporting the development and extension of new and revised environmental resources for farmers.

7. I am also a member of the Hedgehope Makarewa Catchment Group. This is a locally driven initiative which runs events and undertakes projects within the catchment that are community led and environmentally focussed. A recent project, Understanding Our Landscape, used state of the art technology to determine the susceptibility of the land to losses of a range of contaminants. This information can be used to create a mitigation strategy that targets the areas of the highest risk for contaminant loss. One of the case study farmers had land of varying topography, soil type, and aspect. A key take home for this farmer was that due to the landscape factors some areas, which are unproductive and have a more than proportionate impact on contaminant loss. Retiring, or repurposing this land, and investing more in the remaining land can be better financially and have a positive environmental impact.

8. I have read the Code of Conduct for Expert Witnesses within the Environment Court Consolidated Practice Note 2014 and I agree to comply with that Code. This evidence is within my area of expertise, except where I state I am relying on what I have been told by another person. To the best of my knowledge, I have not omitted to consider any material facts known to me that might alter or detract from the opinions I express.

SCOPE OF EVIDENCE

9. This evidence addresses the effect of a change in Overseer version following the lodgement of the consent application.

10. This evidence addresses the following matters that were raised in the s42a report:

    (a) The auditor's report on the robustness of the Overseer modelling and an error in the auditor's report

    (b) Commentary around the use, uncertainty, and accuracy of the Overseer model considering the Government's Science Advisory Panel's review

    (c) Clarification on of the effect of increasing the effluent disposal area on nitrogen loading.

    (d) Commentary around the ability of Overseer to estimate changes in concentrations of contaminants in receiving environments

    (e) A recommendation to consider soil test variation when creating consent conditions related to soil fertility.

(f) Clarification on the periods that each stock class has been modelled as present on farm in light of the draft consent conditions

11. This evidence addresses the concerns raised by Coal Action Murihiku regarding a perceived increase in greenhouse gas emissions in the proposed farm system.

BACKGROUND

12. The applicant purchased an established dairy farm at Feldwick in June 2022. A forestry management company called IFS Growth has recently purchased a neighbouring mixed livestock property – settlement date early 2023. It is proposed that some of the IFS Growth property be subdivided, sold to the applicant, and converted to dairy. The remaining area owned by IFS Growth would be planted in trees.

13. I have worked with Fawna Farms Limited previously, in December 2021, as they completed their due diligence on purchasing the Feldwick property. I gave an update on recent changes in the regulatory framework, such as the release of the NES-F and we discussed the potential impact of limit setting on the Feldwick property. I also advised that Fawna Farms Ltd should collect as much information as possible from the previous owners regarding their management of the property. This information formed the basis for completing the Fawna Farms Limited YE2020 budget (discussed below).

14. I have been involved in producing nutrient budgets for this application since being approached by Fawna Farms Limited in winter 2022. Four nutrient budgets were completed in the application to estimate the losses of nitrogen and phosphorus in the 19-20 season compared with the proposed land use:

(a) Fawna Farms YE2020

(b) IFS Growth YE 2020

(c) Fawna Farms Proposed

(d) IFS Growth Proposed

15. To estimate the losses of nitrogen and phosphorus from the landholding in the YE2020 and in the proposed system, the sum of losses in 14a and 14b was compared to the sum of losses from 14c and 14d.

16. The applicant and IFS Growth purchased the properties after the YE2020 season was completed. For the YE2020 nutrient budgets, farm system information was collected from the previous owners. Where possible, this information was verified using Google Earth and records provided by the previous owners for soil testing, fertiliser use and milk production. Where information was not available a conservative approach was taken using industry benchmarks and professional judgement.

17. The nutrient budgets were prepared using "Overseer Best Practice Data Input Standards" (March 2018). No deviations from these protocols were made during the modelling assumptions.

18. Soils types and areas were obtained from soil mapping provided by OverseerFM and soil settings from SMap. Climate settings were obtained from the Overseer climate station tool. This approach has been consistent throughout all the nutrient budgets completed. All assumptions have been discussed in detail with the applicant. The applicants display a good level of understanding of the inputs and assumptions that have been used.

19. The results of the nutrient budgeting, presented in the Overseer modelling report are shown below. This report is attached in full in the appendices of the Environment Southland s42a report (starting on page 73). A summary of the results is given below:

20. <u>Fawna Farms Limited – OverseerFM farm system modelling to support a consent application for expanded dairy – 30th September 2022</u>

    (a) Overseer modelling was completed using Overseer version 6.4.3. Summarised results from this modelling are given in Table 1 and estimate a 6.8% decrease in N loss and a 39.4% decrease in P loss.

Table 1. Comparison of the estimated nutrient losses for the Year End 2020 and the proposed system as estimated by OverseerFM version 6.4.3.

	YE 2020	Proposed	Estimated change
Area (ha)	825.5	825.5	
Total Farm N Loss (kg)	31,706	29,565	6.8% decrease (2,141 kgN)
N Loss/ha (kgN/ha/yr)	38	36	
Total Farm P Loss (kg)	1,069	648	39.4% decrease (421kgP)
P loss/ha (kgP/ha/yr)	1.3	0.8	
Total Revised Stock Units (RSU)	14,671	12,598	14.1% decrease (2,073 RSU)

For clarity, I have included a brief description of the four farm systems:

(b) Fawna Farms YE2020:

(i) 870 crossbred cows milked at peak producing 418,777kgMS (481kgMS/cow)

(ii) 230 calves reared and grazed on farm until 1st Mayt

(iii) 220 incalf heifers returned to the platform on 1st May and were wintered on farm

(iv) Imported feed consisted of 523t of PKE and DDG, and 132tDM of baleage

(v) 20ha and 21.4ha of swedes were grown for the 2019 and 2020 winter respectively

(vi) Olsen P of 33

(vii) Pastoral fertiliser of 219kgN/ha was applied in split applications from August to April

(viii) Effluent was applied to 67.1ha of the platform

(c) IFS Growth YE2020:

(i) The property was operated as a mixed dairy support, beef trading and sheep breeding/finishing farm. Year-end 2020 stock numbers on farm were:

(1) 210 R1 dairy Heifers

(2) 530 MA dairy cows

(3) 89 Wagyu R3s

(4) 218 Jersey and Belted Galloway mature bulls

(5) 160 R1 dairy cross steers and heifers

(6) 250 hoggets

(7) 40 lambs

(8) 35 ewes

(ii) No feed was imported

(iii) 33.7ha and 29.2ha of swedes and fodder beet were grown in the 2019 and 2020 winters respectively

(iv) Olsen P of 32

(v) Pastoral fertiliser of 17kgN/ha on the flat and rolling areas, and 6kg/ha on the easy hill area

(vi) 31.5ha of QE2 covenanted native bush and a further 22.2ha of native bush (uncovenanted)

(d) Fawna Farms Proposed:

(i) 1200 Crossbred cows milked at peak producing 480,000kgMS (400kgMS/cow)

(ii) 300 dairy calves will be reared on farm until the 1st Dec

(iii) 285 incalf heifers will return to the platform on the 1st May

(iv) All cows will be wintered on farm

(v) 300TDM imported feed made up of PKE and DDG

(vi) 53.7ha of swedes will be planted

(vii) Olsen P will target 32

(viii) Pastoral nitrogen fertiliser will be 189kgN/ha applied in split dressings from August to April

(ix) Effluent will be applied to the entire hydranted area – 176.2ha

(x) 24.1ha of QE2 covenanted native bush will be left undisturbed

(e) IFS Growth proposed

(i) 245.5ha will be planted in pine trees

(ii) 29.6ha of native bush and QE2 covenanted area will be left undisturbed

21. The key drivers of a decrease of 6.8% in nitrogen loss are shown below. Some factors decrease nitrogen loss risk while others increase risk. In comparison to the current system, the proposed system has:

(a) Decrease in nitrogen loss

(i) Less area grazed by livestock due to the conversion to forestry

(ii) Reduced nitrogen fertiliser on the winter crops

(iii) Reduced stock on farm, as estimated by RSU

(iv) Reduced stock on a per ha basis on the original dairy area

(v) Increase in effluent area

(vi) Removal of the sheep, beef and third party dairy grazing operation

(vii) Decrease in imported feed to the landholding (decrease risk)

(b) Increase in nitrogen loss

(i) Increase in pasture productivity of the area converted to dairy

(ii) Increase in total nitrogen fertiliser applied

22. The key drivers of the 39.4% decrease in phosphorus loss are shown below. Some factors decrease phosphorus loss risk while others increase risk. In comparison to the current system the proposed has:

(a) Decrease in phosphorus loss:

(i) A reduction in grazed area due to conversion to forestry.

(ii) Decrease in Phosphorus fertiliser use

(iii) Slight decrease in Olsen P on the original dairy farm

(iv) Decrease in stock on farm, as estimated by RSU

(v) Reduced stock on a per ha basis on the original dairy area

(vi) Increase in effluent area

(vii) Decrease in imported feed to the landholding – particularly DDG and PKE Removal of sheep, beef and third party dairy grazing operation

(viii) Fencing off streams

(b) Increase in phosphorus loss:

(i) Increase in pasture productivity of the area converted to dairy

(ii) Installation of new laneway and increased use of existing laneways on the additional area

OVERSEER VERSION CHANGE

23. In December 2022, following lodgement of the application, there was a version change of Overseer to version 6.5.0. Prior to this release, Overseer has assumed that crops and pasture will only uptake nitrogen from the top 600mm of soil. This release is an update to the Overseer model to account for N uptake below 600mm during periods when plant nutrient requirements are not being met in the top layer.

24. The pasture and crop species grown in the YE2020 and proposed scenarios do not meet the requirements for taking up nitrogen from below 600mm soil depth. As a result, **the Overseer version change has not had any effect on the estimated losses of nitrogen and phosphorus** in any of the nutrient budgets presented in the application and summarised above.

OVERSEER MODELLING AUDITORS REPORT

25. In October 2022, following the lodgement of the consent application, Environment Southland contracted Nicky Watt of Irricon, a Certified Nutrient Management Advisor (CNMA) to undertake a 'sensibility test' of the Overseer files provided as part of the consent application. This report is attached in full in the appendices of the Environment Southland s42a report (starting on page 256).

26. The auditor's report concluded that "I have assumed an adequate level of robustness around the YE20 models of actual Overseer Modelling as they are based on actual farming systems, and with that, I have assumed actual stock and fertiliser inputs used. The data input protocols have been followed with some deviations. This leads to a **high** 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."**

    It should be noted that elsewhere in the auditing report it noted that "there are no deviations from the BPDIS (best practice data input standards)" and that no comment has been made to explain the deviation/s described in the conclusion.

27. In her report (paragraph 28), Ms Watt has assessed whether the mitigation measures described in my report have been included in the proposed modelling. She agreed that the mitigations identified had been modelled correctly apart from one. The mitigation was "decrease in total RSU from the combined YE20 models to the combined proposed models". Unfortunately, when Ms Watt was calculating the total Revised Stock Units (RSU) she did not include beef in the YE2020 scenario. In table 2 I have shown the Revised Stock Units for each stock type in each scenario. This clearly shows a decrease in total RSU on the landholding in the proposed system.

Table 2. Revised Stock Units as estimated by Overseer for the YE2020 and Proposed scenarios

Stock type	YE2020		Proposed	
	Fawna Farms	IFS Growth	Fawna Farms	IFS Growth
Dairy	9126		12131	
Dairy Replacements	621		416	
Dairy Grazing		1447		
Beef	125	2316	51	
Sheep		1036		
Total	**14671**		**12598 (14.1% decrease)**	

27. I note that in the s42a report, section 3.3.2.6 Mr Gericke has not raised any concerns regarding the appropriateness and robustness of the Overseer modelling completed.

OVERSEER UNCERTAINTY, LIMITATIONS AND ASSUMPTIONS

28. Overseer is designed as a decision support tool and allows comparisons between farm management scenarios. As with any model there are assumptions and limitations (as outlined report[1]).

29. <u>Overseer Assumptions:</u>

(a) Long term annual average model. The model uses annual average input and produces annual average outputs.

(b) Near equilibrium conditions. Model assumes that that the farm is at a state where there is minimal change each year.

(c) Actual and reasonable inputs. It is assumed that input data is reasonable and a reflection of the actual farm system. If any parameter changes, it is assumed that all other parameters affected will also be changed.

(d) Good management practices are followed. OverseerFM assumes the property is managed at industry agreed good management practice for a specific list of factors including effluent and fertiliser applications. OverseerFM does not assume that all industry agreed good management practices are undertaken on farm.

[1] Fawna Farms Limited – OverseerFM farm system modelling to support a consent application for expanded dairy, September 2022, page 18

30. Overseer Limitations:

(a) Overseer does not predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving water body. A catchment model is needed to estimate the effects of the nutrient losses from farms on groundwater, river or lake water quality.

(b) Overseer does not calculate outcomes from extreme events (floods and droughts), but provides a typical years result based on a long-term average.

(c) Overseer does not calculate the impacts of a conversion process, rather it predicts the long-term annual average nutrient budgets for changed land use.

(d) Overseer is not spatially explicit beyond the level of defined blocks.

(e) Not all management practices or activities that have an impact on nutrient losses are captured in the Overseer model.

(f) Overseer does not provide for modelling of all farm systems in New Zealand.

(g) Components of Overseer have not been calibrated against measured data from every combination of farm systems and environment.

31. Overseer Uncertainty

(a) Overseer modelling uncertainties are acknowledged. This uncertainty centres around the model's ability to accurately determine nutrient losses, however these are practically impossible to measure accurately. Measured results from parts of paddocks or more rarely whole paddocks have been carried out using lysimeters, suctions cups and other collection technologies but it is not practicable to capture nutrient losses from a whole farm and across the multiple soil and landscape variations that may occur. This means there are few benchmarks to compare against.

(b) Overseer is used for modelling a wide range of farm systems in many different geographical settings; validation or calibration data for all circumstances is not possible, therefore the issue of uncertainty associated with whole farm nutrient loss estimates will increase for situations that are well outside the calibration /validation range.

(c) Pastoral blocks within Overseer have been through the most calibration and testing (most of which has been on dairy farms) but more data from calibration/validation of the Overseer model is required to reduce the uncertainty, most notably for:

- Cropping and Sheep and Beef
- Clay and shallow and light textured soils
- High (and low) rainfall locations >1200mm

(d) Traditionally Overseer has been calibrated against a set of farmlet trials however Version 6 (2012) has also undergone a range of logic tests. The farmlet trials utilised in the calibration and validation of Overseer are outlined in Table 6 below. Calibration trials completed in Southland have occurred at Tussock Creek and Edendale (approximately 50 and 70km away respectively):

Table 3 – Overseer Calibration and Validation (Parliamentary Commissioner for the Environment, 2018[1])

Management block	Nitrogen calibration	Phosphorus calibration
Pastoral	Calibration (undertaken in 2012) used nutrient loss measurements from farmlet studies at eight locations. These were: Edendale, Southland (intensive beef); Tussock Creek, Southland (dairy); Kelso, Otago (dairy); Lincoln University Dairy Farm, Canterbury (dairy); Massey University Dairy Farm, Manawatū-Whanganui (dairy); Ruakura, Waikato (dairy); Scott Farm, Waikato (dairy); and Wharenui, Bay of Plenty (dairy). A recalibration exercise is currently underway.	Calibration (undertaken in 2005) used data from 23 sites: Canterbury (2), Otago (3), Southland (2), Manawatū (5), Northland (2), Waikato (4), West Coast (2), Wellington (1), Hawkes Bay (2).
Crop	Arable crops – very limited calibration (one Lincoln site).	Arable crops – none due to a lack of experimental sites. Forage crops – limited to 2 sites in Otago and 1 in Southland.
Fruit crop	None due to a lack of experimental sites.	None due to a lack of experimental sites.
Trees and scrub	None due to a lack of experimental sites.	None due to a lack of experimental sites.
Wetlands and riparian	Very limited calibration based on published studies.	Very limited calibration based on published studies.
House	Very limited calibration (based on one international study).	None.

(e) Uncertainty around Overseer outputs tends to be much lower within the range of the calibration data set outlined in Table 1. Most of the calibration and validation data used to date is focused on flat, pastoral, dairy enterprises, with primarily free draining soils and moderate rainfall located in the Waikato, Southland, Canterbury and Manawatu.

32. The following steps were taken during the modelling process to minimise the impact of uncertainties:

(a) Adherence to Best Practice Data Input Standards (BPDIS)

(No deviations to BPDIS were made, no work arounds required)

(b) Use of Overseer is within the model's parameters (for soils, climate and farm system)

(Standard approach)

(c) Method and consistent methodology between scenarios

(Standard approach)

(d) Site visit to cross check information

(Standard approach - Understanding the property and the management blocks is critical to blocking in Overseer)

(e) Blocking completed taking into account land use, management systems, soils, topography and enterprise

(Standard approach – consistent with BPDIS)

(f) Consistency in modelling between the current and proposed files

(Standard approach - "apples with apples")

(g) Expertise, experience and qualifications of the user

(Standard approach - Certified Nutrient Management Adviser and Dairy Farm Systems Expertise)

(h) Outputs are reviewed against expected results relative to soils, climate, land use and inputs

(Standard approach – reviewed against previous modelling results and research trials)

(i) Overseer files are internally peer reviewed (for adherence to BPDIS, feasible farm systems and data entry)

(Standard approach - Certified Nutrient Management Adviser and Dairy Farm Systems Expertise)

33. The use of Overseer as a modelling tool is recognised in the Proposed Southland Water and Land Plan[2] (PSWLP). Appendix N (of PSWLP) indicates that the latest version of the Overseer model (or an approved alternative model) should be used on properties over 20ha or when a material change in land use occurs. As far as I am aware no alternative to Overseer has been approved by Environment Southland.

34. Uncertainty around Overseer model estimates tends to be lower within the range of the calibration data set i.e. where we have the most information. Most of the calibration data used to date is focused on flat, pastoral, dairy enterprises, with primarily free-draining soils and moderate rainfall. Pastoral farms in the Waikato, Southland, Canterbury and Manawatu, form the OVERSEER calibration data set. Consistency in modelling when developing scenarios is a key to creating equivalence in uncertainty. When scenarios are compared focus should be on the difference in estimated outputs, rather than absolute numbers.

35. In July 2021, a report "Overseer whole model review – assessment of the model approach" was released by[3] the Science Advisory Panel for the Ministry for the environment. The report raised concerns that Overseer:

(a) Assumes a steady state system when farm systems are in reality dynamic

(b) Assumes average climate data and therefore cannot model episodic events

---

[1]Parliamentary Commissioner for the Environment (2018). *Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways.* Pg 31.
[2] Proposed Southland Water and Land Plan, Decisions Version, 4th April 2018
[3] Science Advisory Panel to the Ministry for the Environment (2021). *Overseer whole-model review Assessment of the model approach* (2021). Pg 95.

(c) Uses monthly time steps

(d) Does not balance mass

(e) Does not account for variation in water and nutrient distribution through the soil profile

(f) Does not adequately accommodate deep rooting plants

(g) Focuses on nitrates (and omits ammoniacal N and organic matter)

(h) Is not spatially explicit with regards to surface water, nutrient transport and critical landscape factors

36. The government responded to the Science Advisory Panel report described in the previous paragraph in August 2021. The government identified four options to address the concerns raised in the report including the creation of a *new risk index tool,* development of a next generation Overseer, to have greater use of *controls on practices and inputs* to manage nitrogen loss or a completely new approach to managing and understanding diffuse nutrient loss risk. I note that, of the options given by the government, only the option of *greater use of controls on practices and inputs* is available to regulators currently.

37. The recommended consent conditions proffered by Environment Southland in the s42a report include both Overseer output figures and farm system input parameters. The farm system input parameters that have been recommended to be consented include many of those identified as key reasons for a nutrient loss reduction in the proposed system (paragraphs 21 and 22), as well as other mitigations offered outside of Overseer (such as 5.5ha of native plantings and a 10m buffer strip to winter forage crops) that were included in the farm environmental management plan.

EFFLUENT DISPOSAL AREA

38. The s42a report contains an error regarding nitrogen loading from effluent disposal in Southland (section 3.3.2.1). The report states that “The guideline derived from the 1999 SoilWork Limited report on farm effluent disposal in Southland, is that a discharge area of 4 hectares per 100 cows will limit nitrogen loading to 150 kg/ha/year. For 1,200 cows, that means an area of at least 48 hectares. Therefore, spreading the effluent over the 271 ha discharge area will

achieve an average nitrogen loading of 27 kg/ha/year. That should be well below nitrogen requirements to maintain soil fertility, so the effluent discharge will have the effect of offsetting fertiliser use, rather than adding to it. That, in turn, should mean that the loading from the nutrients in the effluent will not increase nutrient losses to water either directly by overflow or bypass flow, nor indirectly as a result nutrient loading effects."

39. While the 4 ha per 100 cows has been used as a "rule of thumb" it is more useful to use Overseer to estimate nitrogen loading from effluents and manures (as it considers lactation period, milk production, imported supplements, pasture grown). In the situation of Fawna Farms, in the YE2020 scenario, Overseer has estimated that an effluent area of 55ha was required to ensure a loading of less than 150kgN/ha. This equates to 6.3ha per 100cows. The previous owners had consent to apply effluent to 248.4ha. I have however modelled the area that they actually applied liquid effluent to (67.1ha). In the YE2020, solids were separated using a weeping wall and applied to the non-effluent area. Actual N loading on the liquid effluent area was 95kgN/ha/year.

40. In the proposed scenario, Overseer has estimated that an effluent area of 71ha is required to ensure a loading of less than 150kgN/ha. This equates to 5.9ha per 100 cows. The applicant has proposed to increase the consented effluent area to 271.4ha. However, for consistency and to be conservative, I have modelled the minimum area that the applicant has agreed to apply liquid effluent (with available effluent infrastructure) to in the proposed system – 176.2ha. Nitrogen loading on the liquid effluent area is estimated to be 56kgN/ha. An area of 271.4ha in the consent will allow for the applicant to maintain flexibility regarding being able to further increase the effluent area if conditions allow.

NITROGEN CONCENTRATIONS

41. The s42a report has identified that "the application does not demonstrate that the requirement in regulation 24(1)(b) of the NES-F will be achieved." This rule states that a consent "may be granted only if the consent authority is satisfied that the consent will not result in an increase concentrations of contaminants in freshwater or other receiving environments (including the coastal marine area and geothermal water), compared with the concentrations as at the close of 2 September 2020."

42. The Overseer model does not give information regarding the nitrogen concentration of water leaving the property. Overseer estimates concentration of nitrate in water below the root zone. The Overseer model is also unable to estimate the effect of any attenuation that may occur between the root zone and the receiving water body. The model estimates the nitrogen concentration in drainage water below the root zone in a limited number of situations including pastoral blocks of flat or rolling topography and for all fodder crop and crop blocks. It does not estimate the concentration of losses below the root zone for other block types including trees and scrub. It also does not estimate the concentration of losses under a pastoral block with an easy hill or steep topography due to the complexity of the hydrology on hill topography. Due to the presence of easy hill and steep hill topography pastoral blocks, and trees and shrubs blocks, it is not possible to compare YE2020 estimated nitrogen concentrations with the proposed system estimated nitrogen concentrations.

43. However, logic would dictate that a decrease in contaminant load will have a corresponding decrease in concentration assuming other key factors such as climate, soil type and location are held consistent. In the case of Fawna Farms Limited, Overseer has estimated that losses of Nitrogen will be 2141 kg N / annum (6.8%) lower in the proposed system compared to the YE2020. Phosphorus losses are estimated to be 421 kg P / annum (39.4%) lower in the proposed system compared to the YE2020.

PROPOSED OLSEN P CONSENT CONDITION

44. Mr Gericke has included draft consent conditions. In the draft land use consent, condition 14 relates to Olsen P on the property. Olsen P is a measure of plant available phosphorus. A study by Edmeades *et al.* concluded that variability in soil test results for Olsen P is 15-20%[3] due to laboratory and field-sampling variability. This means that test results from a paddock with an Olsen P of 32 could range from 26 to 38.

45. The application proposes an Olsen P of 32 on the Fawna Farms Limited property. As the consent is currently written, the applicant would be required to reduce their fertiliser Phosphorus applications if the Olsen P was greater than 32. This condition does not allow for any upside variation in Olsen P test results

[3] Edmeades, D.C.; Cornforth, I.S.; Wheeler, D.M. Getting maximum benefit from soil testing.NZ Fertiliser Journal 1985

and is likely to result in actual Olsen P being below that proposed in the application. A consent condition that considered the upside variation would be preferable.

PROPOSED STOCK NUMBER CONSENT CONDITION

46. In the draft land use consent, condition 6 relates to the maximum stock numbers permitted on the property. The condition reads:

> 6. The farming activities shall be limited to:
>
> (a) a maximum milking herd of no more than 1,200 cows; and
> (b) a maximum of 300 R1 cattle, 285 R2 cattle and 25 mating bulls.

For clarification, in the Overseer nutrient budget modelling, the stock identified in (b) are on farm for just a portion of the year, rather than the entire year. For completeness, I have included the monthly stock numbers modelled in the Fawna Farms Proposed budget. These can also be found on page 23 and 24 of the modelling report:

Table 4. Monthly stock numbers as proposed and modelled for the Fawna Farms Proposed scenario.

	Dairy Herd (FJx)	**Breeding bulls (2yr old jersey)**	**Calves (reared on farm)**	**Incalf heifers**
July	1240			
August	1240		150	
September	1220		300	
October	1200	25 (arrive 20th)	300	
November	1200	25	300	
December	1200	25		
January	1200	25		
February	1200			
March	1172			
April	1117			
May	1060			285
June	955			285

GREENHOUSE GAS EMISSIONS

47. In their submission, Coal Action Murihiku raised concerns that the proposed system would result in greater greenhouse gas emissions than the current scenario due to the increase in cow numbers on farm.

48. Agricultural emissions refer to the losses of methane and nitrous oxide. Overseer gives an estimation of these Greenhouse Gas emissions from each of the scenarios modelled. Figures are presented in CO_2 to account for the different warming potentials of Methane and Nitrous Oxide. The estimated losses of methane and nitrous oxide are shown below:

Table 5. Agricultural greenhouse gas emissions as estimated by Overseer version 6.5.0. Emissions are presented as Carbon Dioxide equivalents.

Emissions by source (eCO_2/tonnes/year)	**Fawna Farms YE2020**	**IFS Growth YE2020**	**Fawna Farms Proposed**	**IFS Growth Proposed**
Methane	3137.2	1416.4	3972.7	None
Nitrous Oxide	1064	398.1	1358.6	None
Total Agricultural Emissions	4201.2	1814.5	5331.3	
	6015.7		5331.3 (11.4% reduction)	

49. For completeness, it should also be noted that Overseer estimates emissions of carbon dioxide related to the activities of the farm business. These carbon dioxide emissions occur both on and off farm. Emissions of carbon dioxide are regulated under the Emission Trading Scheme and are therefore not considered agricultural emissions. In the case of this application, if emissions of carbon dioxide were included in the calculations above, the reduction in emissions would be 12.2%.

50. It should be noted that the calculations above do not consider any carbon sequestration achieved through the planting of the pine forestry or the 5.5ha of natives proffered by the applicant. This sequestration could be taken into account via the emissions trading scheme.

CONCLUSION

51. A version change of Overseer has occurred since the lodgement of the application. Estimated losses of nitrogen and phosphorus under the current version (6.5.0) are the same as in the previous version (6.4.3).

52. Ms Watt of Irricon completed an audit of the applicant's overseer modelling. This "sensibility test" considered the modelling to be of high robustness. An error in the auditor's report was identified and, for completeness, was corrected.

53. Overseer modelling uncertainties, assumptions and limitations are acknowledged, and steps have been taken to minimise the impact of these factors.

54. The applicant has proposed to increase the effluent application area on farm. The proposed application area is much greater than that applied to in the YE2020. It is also less than the proposed consented area which will allow the applicant flexibility to increase effluent application area in future.

55. Overseer is not a suitable tool for estimated the effect of a proposal on the concentration of contaminants in the receiving waterbody. However, assuming no change in climate, soil type, location and topography between scenarios, logic dictates that contaminant load could be used as a proxy.

56. It is recommended that soil test variation is considered when creating consent conditions related to Olsen P.

57. A clarification was made regarding the period that each stock class is present on farm.

58. Overseer has given an estimation of agricultural greenhouse gas emissions for each of the scenarios modelled. Overseer estimates that emissions of agricultural greenhouse gases would decrease by 11.4% in the proposed scenario.

59. Modelling using Overseer version 6.5.0 estimate that losses of Nitrogen and Phosphorus would decrease by 6.8% and 39.4% respectively.

Monique (Mo) Topham

AgriAce Consulting Limited

8th March 2023