

BEFORE THE INDEPENDENT COMMISSIONERS

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments, and Variation 1 to proposed Plan Change 1

AND

IN THE MATTER of submissions under clause 6 First Schedule

ON BEHALF OF **BEEF + LAMB NEW ZEALAND**
Submitter

EXECUTIVE SUMMARY OF DR JANE MARIE CHRYSTAL
26 MARCH 2019

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INTRODUCTION

1. My full name is Dr Jane Marie Chrystal.
2. I am a soil scientist specialising in farm systems and environmental impact modelling. I am employed by Beef and Lamb New Zealand as their Senior Environment Data Analyst.
3. I have been engaged by Beef + Lamb New Zealand to provide evidence based on case studies of the nutrient losses of sheep and beef farms in Waikato with a particular focus on reviewing the farm level modelling that underpins the scenario testing in PC1, for the hearing on Proposed Plan Change 1 for the Waikato and Waipa Rivers, and Variation 1 to this plan change (PC1).
4. Prior to working for Beef and Lamb New Zealand I was employed by AgResearch for 11 years. There my work focused mainly on the dairy industry, specifically modelling nutrient losses from dairy farms using Overseer and also generating base farm files using Farmax DairyPro. The topic of my PhD was Dairy wintering systems in Southern New Zealand – quantification and modelling of nutrient transfers and losses from contrasting wintering systems.
5. I provided a Statement of Evidence in Chief on behalf of Beef + Lamb New Zealand dated 15 February 2019
6. I confirm the qualifications and experience set out in my Statement of Evidence in Chief.
7. As set out in my Evidence in Chief, I have read the Code of Conduct for Expert Witnesses in the Environment Court's 2014 Practice Note and I have complied and continue to comply with it. I confirm that the opinions I have expressed represent my true and complete professional opinions. The matters addressed by my evidence are within my field of professional expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

EXECUTIVE SUMMARY

8. The sheep and beef sector in New Zealand is extensive, low input and diverse. Since 1990 national stocking rates have declined from 14 to 12

stock units per hectare. In comparison, national average dairy stocking rates have increased since 1985 from 2.3 cows per ha to 2.85 cows per hectare in 2015. This is an increase in stock units per hectare from 17 to 21.

9. Specific to Waikato the Overseer files of B+LNZ sheep and beef farm survey data for 2015/16 year has an average stocking rate of 11.2 stock units per hectare. This compares to a stocking rate of 22 stock units per hectare for Waikato dairy farms as published by DairyNZ and LIC. I calculated this from the published value of 2.95 cows per hectare and I assumed one cow was equivalent to 7.5 stock units. This shows that the stocking rate of dairy farms in Waikato is double that of sheep and beef farms.
10. This executive summary provides alternative nitrogen (N) leaching values from the sheep and beef sector in Waikato to those used as the base values for the PC 1 modelling. I believe that the values I present are a more accurate representation of the true nitrogen leaching losses of the sheep and beef and Dairy sectors than the values used in the HRWO modelling due to the methodology undertaken. I have shown that the modelling conducted for PC1 significantly underestimated the losses from the sheep and beef sector. The implications, as also discussed in the evidence in chief of Dr Cox, is that the modelling is unreliable at best and could significantly misrepresent the relationship between current land uses and water quality.
11. This executive summary also provides further information in relation to the N leaching values of the dairy industry, increasing the level of doubt in relation to the original values used in the initial PC1 modelling for the industry. In my evidence in chief, I gave the following reasons for considering the dairy leaching values to be underestimated:
 - a. Data was taken from farm data entered in a voluntary database (DairyBase) and then 'average' farms were modelled in Farmax and Overseer.
 - b. Sheep and beef data was under estimated and the same methodology of creating 'average' farms was used for both sectors.
 - c. Taking published historic Waikato dairy and sheep and beef Overseer figures and scaling the sheep and beef data up to the 17 kg N/ha/yr in 2015/16 using Overseer version 6.3 and using the same method to scale up the dairy values, suggests that the dairy

value was closer to 52 kg N/ha/yr rather than the average of 32 kg N/ha/yr used in the PC1 modelling.

12. I also summarise the use of Overseer in both modelling and scenario testing and in a regulatory sense.
13. I have completed Overseer nutrient budgets (using version 6.3.0) for 38 of B+LNZ's sheep and beef farm survey farms. These farms are selected by Statistics New Zealand to be a true representation of the sheep and beef farm population in Waikato.
14. My results give an average N leaching loss of 17 kg N/ha/yr. This is higher than the value of 10.9 kg N/ha/yr used as the base farm values that underpin the HRWO modelling.
15. In his rebuttal, Richard Cresswell from Wairakei Pastoral said that he believed I was correct with my assessment that the sheep and beef N leaching values used in the base modelling underpinning PC1 were too low but that I was incorrect with my extrapolation that the dairy nitrogen leaching value was also too low. However, I still believe that the PC1 dairy N leaching values were under estimated. I believe this because:
 - a. In the HRWO modelling the same methodology of using an 'average' farm was applied to both sectors and I was able to provide alternative values for sheep and beef farms due to having access to B+LNZ's sheep and beef farm survey farms. I believe that the same methodology of a statistically significant survey of actual dairy farms is required to get a more accurate estimation of dairy farm N leaching.
 - b. Since submitting my evidence in chief, I have received information related to three Waikato dairy farms for which Overseer generated N leaching values were published by real estate agents in sales information. All three of those farms had N leaching values greater than the highest value in the range used for the base modelling for PC1 which was 10 to 60 kg N/ha/yr. The leaching values for the three actual Waikato dairy farms were 68, 72 and 85 kg N/ha/yr. Again, this gives me reason to believe that values of N leaching from dairy farms in Waikato that form the base of all the scenario modelling in PC1 are underestimated.

16. In addition, the difference in N leaching values from what was used in the PC1 modelling is highlighted again in the evidence of Richard Allen from Fonterra Ltd. The PC1 modelling, as explained by Matthew Newman from DairyNZ in his evidence, used 26 'average' dairy farms generated from 2013 DairyBase data. These farms were then applied across different soil types and climates in Waikato. The resulting modelled N leaching loss for the Upper Waikato was 40 kg N/ha/yr (and the average Waikato loss was 32 kg N/ha/yr). Mr Allen, in his evidence, presented a graph of the 2015/16 season N leaching values from 560 Fonterra farms in the Upper Waikato and I calculated, from that graph, an average leaching loss of 47 kg N/ha/yr which is 17.5% higher than the values used in the base PC1 modelling.

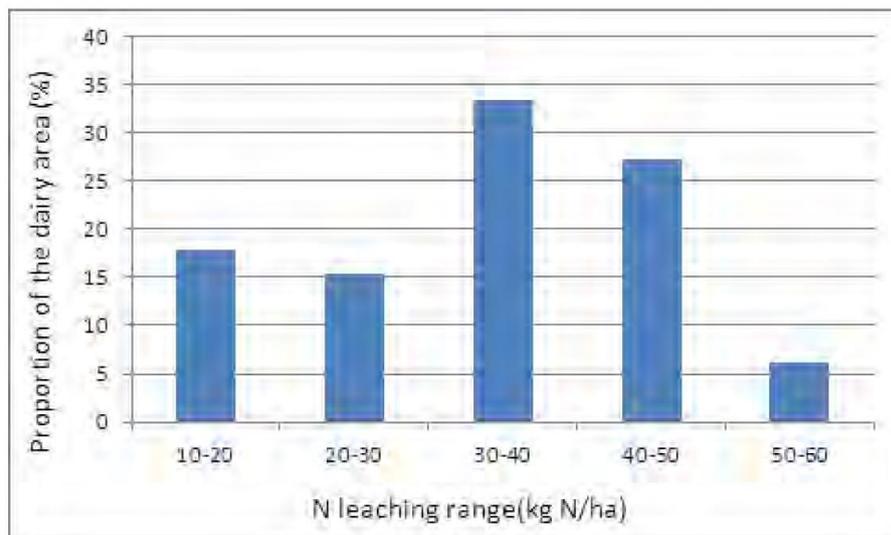


Figure 1: EIC Matthew Newman from DairyNZ, 2013 figures using Overseer v 6.1.2 for the whole Waikato.

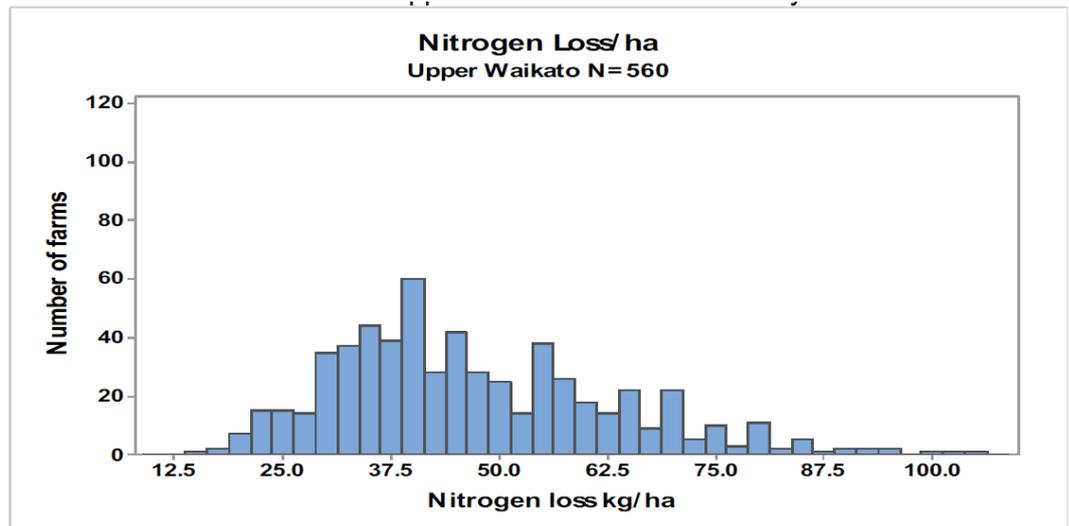


Figure 2: EiC Richard Allen, Fonterra. 2015/16 season Upper Waikato

17. I suggest that it is crucial that the base farms, on which all scenario modelling relies are as accurate as possible and are a true reflection of the industry. Without improved certainty or resolution of the base files, the relationship between land uses and water quality cannot be determined, nor the relative contribution by sector to water quality outcomes, nor the outcomes of scenario modelling in relation to allocation or mitigation.

18. I believe that it is important to undertake a reassessment of the modelled base farms that underpin the PC1 scenario modelling. I believe that methodology similar to that undertaken by B+LNZ using actual farms that are independently selected to represent the population is conducted for the dairy industry. Or methodology as close to that as is possible given confidentiality constraints. Alternatively, if it isn't possible, sensitivity analysis, as conducted by Dr Cox, using a range of base files and thus a range in possible N leaching values, could be used to determine different spreads of base data including in scenario testing.

19. I have reviewed the evidence of Dr Graeme Doole from DairyNZ. Economic modelling is not my area of expertise so I cannot comment on the suitability of the HRWO economic model. However, my comments above regarding the accuracy of the base data with which scenario testing and modelling is conducted is relevant for the HRWO model as well and I consider that the

base data underestimated N leaching for the reasons I have already outlined.

20. I have reviewed the evidence of Matthew Newman from DairyNZ. I agree that the use of Overseer is the most appropriate nutrient model for estimating farm nitrogen losses (paragraph 8.3) when conducting scenario testing.
21. I also understand the time pressures, the cost and the confidentiality issues associated with obtaining individual farm data. However, it is important that the base files from which all scenario testing is conducted are as accurate as possible and are a true representation of the nutrient profile of the sector.
22. However, I do not agree with the methodology used to generate the base dairy files (paragraph 7.2). DairyNZ used DairyBase to obtain their data from which they created 'average' files that they believe represented the region. DairyBase is a voluntary benchmarking tool for physical and financial farm performance. Due to its voluntary nature there is little confidence that the farms represent the demographic of the region.
23. While I support the use of Overseer when conducting modelling scenario testing. There are a number of factors to take into consideration when applying the Overseer model for use in Regulation. The model uses annual average climate data, which means that the results may not be accurate when combined with specific annual data for stock numbers, fertiliser and irrigation applications. Overseer is constantly evolving as more scientific data and soils data become available and as model bugs and errors are corrected. This means that farms can have significant changes in their leaching values through version change alone with no change to their farming system.
24. Requiring all farms to have an Overseer nutrient budget will be time consuming and costly. It will also require large numbers of qualified staff to carry out the farm visits and Overseer data input, as well as an auditing system to ensure that the Overseer files comply with data input standards.
25. There is also significant 'noise' around the output figures. So a reported figure of 20 kg N/ha/yr is actually plus or minus an undefined percentage

that could be as high as 30% thus the actual loss figure could be anywhere between 14 and 26 kg N/ha/yr.

26. For these reasons if the WRC decides to use Overseer output values they need to consider how to account for version changes, variation between users (data input methodology), and provide flexibility in nitrogen discharges beyond 2014/15 or 2015/16 years for those farm systems which farm to the grass curve. I suggest that focusing on the trends in direction of contaminant loss values, in particular for higher discharging land uses, is the important metric rather than holding farmers to an absolute value as grandparenting does.

DATED this 26th day of March 2019

Jane Chrystal