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| **IN THE MATTER** | of the Resource Management Act 1991 |
| **AND** | |
| **IN THE MATTER** | of the Proposed Canterbury Land and Water Regional Plan |

**STATEMENT OF REBUTTAL EVIDENCE OF DAVID GRAEME MCCALL FOR GROUP 2 HEARING**

## 1. INTRODUCTION

1.1 My name is David Graeme McCall. I hold the degrees of Doctor of Philosophy in Agricultural Economics and Farm Management (Massey University, 1984) and Bachelor of Agricultural Science Hons I (University of Canterbury, 1977). In my PhD I developed a computer model to describe and study pastoral grazing systems by simulation. The model was one of only two whole farm models internationally at the time. This original model is the foundation of a number of models used in New Zealand and internationally, including the Farmax model.

1.2 I am a member of the New Zealand Institute of Agricultural Science and the New Zealand Institute of Primary Industry Management.

1.3 I am employed by DairyNZ Limited as a senior manager, leading the Development and Extension team. This team leads farmer change initiatives for the dairy industry, many of which are explained in more detail in Mr James Ryan's evidence for the Group 1 hearing. I have been with DairyNZ and its predecessor Dexcel for 6 years.

1.4 In my early science career from 1978 to 1998 I was employed by MAF and then AgResearch. I studied farm systems both in the field and via modelling. This included sheep/beef, goat and dairy farm systems. Key achievements included development and technology transfer of the Stockpol decision support model which was subsequently branded Farmax. Farmax predicts the production and economic effects of changes to a farm system. My work also included the modelling and research, in collaboration with AgResearch soil scientists, on the original OVERSEER (then named Outlook) soil fertility decision support model.

1.5 I also established and led AgResearch's first modelling and decision support teams in the 1990s. I was internationally recognised for work in decision support modelling in 1991 at a conference in Texas, in the US. I have authored or co-authored 120 scientific papers and articles on both modelling and the study of farm systems.

1.6 From 1999 through 2006 I worked in business development for AgResearch and then Celentis (2002), a biotech company.

1.7 I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

## 2. SCOPE OF EVIDENCE

2.1 This evidence covers exaggerated claims of nitrogen leaching loss reductions presented in Ms Dewes' case study evidence and shows the unattainability of the minimum sustainable leaching loss target (20 kg N / ha) for dairy farming using Ms Dewes' figures.

2.2 My evidence presents economically and environmentally sustainable reductions in nitrogen leaching across catchments from two extensive whole of catchment studies in Canterbury.

2.3 Finally, industry action on other minimum standards presented in Ms Dewes' evidence is briefly noted.

## 3. PRACTICAL N REDUCTIONS

3.1 Ms Dewes asserts confidence that large reductions in nitrogen leaching can be sustained across the industry by Canterbury dairy farmers at minimal or no financial cost to farmers.

3.2 Linked to this is a fixed leaching target of 20 kg N/ha which Ms Dewes asserts is sustainable financially with some capital expenditure and that a target of 20 kg N/ha (as measured by OVERSEER 6) should apply across all zones in Canterbury (paragraph 172).

3.3 Putting aside the fact that nitrogen is not the limiting nutrient for all zones or all rivers within zones (see for example paragraph 4.3 of the Group 2 rebuttal evidence of Ms Hayward) and the inefficiencies of mitigating nitrogen where it will not solve water quality problems, there are major omissions in Ms Dewes' analysis which discredit the basis for her confidence.

3.4 Ms Dewes' assertions are made without reference to; existing data on current leaching losses by all farmers across Canterbury catchments; correct assessment of the size of the irrigation efficiency opportunity; the effect on farmer's business cash-flows and thus ability to withstand market volatility.

3.5 There are "whole of catchment" studies in both Hurunui and Selwyn-Waihora that show that nitrogen leaching reduction can be achieved by dairy farmers, with farm businesses remaining viable and competitive (McCall 2012; Howard et al 2012). This is by virtue that all businesses in the catchment operate at the technical optimum for nitrogen use efficiency and profit (McCall 2012).

3.6 Both of the above studies were comprehensive, well designed whole of catchment studies that surveyed a large number of farms in each catchment (32 in Hurunui and 80 in Selwyn-Waihora) and clustered each surveyed farm into one of 10 (Selwyn-Waihora) or 4 (Hurunui) representative farms which were modelled on a farm systems model (GSL by Mr B Ridler) to give a whole of catchment picture.

3.7 Minimum nitrogen leaching losses for efficient individual farms in these studies varied by farm because of soil type and rainfall.

3.8 In the Hurunui study using OVERSEER version 5.4, which on average predicts lower nitrogen leaching losses than the current OVERSEER 6, the minimum nitrogen leaching varied between 19 and 28 across farms with a mean of 23 kg N leaching /ha. In the Selwyn-Waihora study the mean minimum nitrogen leaching using OVERSEER 6 was 45 to 50 kg N/ha on lighter soils. This also shows the difference due to OVERSEER version.

3.9 Both studies above factored in the upgrade of low efficiency flood irrigation infrastructure to efficient centre pivot irrigation infrastructure. This was for 7% of dairy farms in Hurunui-Waiau and for 4% of dairy farms in Selwyn-Waihora.

3.10 Across the Hurunui-Waiau catchment, reductions in total nitrogen leaching loss of 13% from nitrogen efficiency gains and a further 4% from the upgrade of irrigation infrastructure are realistic targets. This results in 17% overall which could be achieved by dairy farmers with time to adapt.

3.11 In Selwyn-Waihora a 10% reduction in nitrogen leaching loss can be achieved across the catchment by all land-uses with only 4% more dairy farms going into negative returns at a payout of $6 / kg milk solids, Howard et al (2012).

3.12 It can be seen that even a 30% to 50% reduction in nitrogen leaching (Ms Dewes' paragraphs 23, 84) will not physically reach a leaching figure of 20 kg N / ha for Selwyn-Waihora farmers measured using OVERSEER 6.[1]

3.13 Finally, Ms Dewes' quotes leaching reductions from the latest science experiments. These do show hope for reductions in nitrogen leaching in future (paragraph 90 – 92). The issue is that the cows used in these experiments are of a genetic merit that will not be widely available to farmers for another 10 years. These high genetic merit cows can eat more and produce significantly more milk per cow than the average 2013 cow at low stocking rates. Compared to the Lincoln demonstration farm (which operates on current best practice) a farming system with the high genetic merit cows shows a 22% reduction in leaching.

1. The current leaching taken from Table 17, Howard et al 2012.

## 4. PRECISION IRRIGATION

4.1 The major leaching loss reductions asserted by Ms Dewes were achieved by selecting the active irrigation management option in OVERSEER 6.

4.2 The examples presented by Ms Dewes greatly exaggerate the effect of this technology because of the assumptions embedded in OVERSEER 6 and the way it was used by Ms Dewes.

4.3 Notwithstanding the inefficiency of flood irrigation infrastructure, which is used on a small percentage of dairy farms, and which is acknowledged in the widely used “Canterbury look-up” tables (Lilburne et al 2010), it is the comparative inefficiency of pivot spray-irrigation which has been exaggerated compared to precision irrigation.

4.4 OVERSEER 6 settings for pivot spray irrigation give average to worst case leaching predictions for that technology whereas active irrigation management gives un-validated best case predictions.

4.5 Firstly for pivot irrigation settings, in OVERSEER 6 there is no ability to enter monthly rainfall data and no account is taken of farmers adjusting monthly irrigation for actual rainfall. This often leads to overestimation of drainage and thus overestimation of leaching for the pivot-irrigation settings.

4.6 Secondly for pivot irrigation, best practice, as demonstrated by the Lincoln University demonstration farm, is to leave a 25mm deficit after centre pivot spray irrigation to create headroom for rainfall and thus reduce drainage. Also, decision rules promoted widely by the Lincoln University demonstration farm and taken up by farmers are to not irrigate within 5 days of forecast rain.

4.7 Conversely, precision irrigation assumptions in OVERSEER 6 assume only 5% drainage which is why it predicts very low nitrogen leaching losses from urine patches. The 5% figure is an assumption that allows little leeway for unforeseen heavy rainfall events after precision irrigation and has not been validated in practice. For this reason, as Mr Curtis points out in paragraph 24 of his Group 2 rebuttal evidence, the protocol is not to select this option when using OVERSEER.

4.8 Ms Dewes' farm 1 case study relates to the dairy farms that still use flood irrigation technology. The scenario converted it to an "actively managed irrigation farm" in the OVERSEER 6 setting. Farm intensification was not greatly altered between scenarios. Imported feed was reduced only to 980 tonnes from the baseline 1033 tonnes. However, farm performance was significantly improved in the "managed irrigation" scenario by the growth and consumption of an additional 2 tonne DM/ha of pasture and increased stocking rate. The 2 tonne/ha figure is an anecdotal figure quoted by irrigators that has not been validated. In the absence of choosing the managed irrigation setting in OVERSEER 6 these assumptions would be expected to produce increased nitrogen leaching. The 80% reduction reported is due to the high sensitivity of OVERSEER 6 to choice of the "managed irrigation" setting, which as stated is un-validated.

4.9 Results of the farm-3 case study also reported reductions in nitrogen leaching by choice of the "active irrigation management" setting, showing the high sensitivity of OVERSEER 6 to this setting even when compared with "pivot spray irrigation" which was the baseline. Secondly, the base farm wintered cows on the milking platform. Ms Dewes' scenario included cows wintered off of the milking platform. This accentuates levels of reduction achievable compared to most Canterbury dairy platforms where this is already practiced.

4.10 A third issue with Ms Dewes' OVERSEER analysis relates to farm 2, where she asserts that a combination of cut and carry and precision irrigation result in a 91% reduction in nitrogen leaching. This represents use of the OVERSEER 6 model outside of its valid range. The dominant mechanism causing nitrogen leaching in OVERSEER 6 is the drainage of nitrogen out of urine patches by a combination of irrigation water and rainfall. With a "24/7" cut and carry system described there are no urine patches on pasture susceptible to drainage.

4.11 The exaggeration of both start and end nitrogen leaching on the three case study farms presented gives false confidence of both the scope to reduce nitrogen leaching and the achievability of a sustainable minimum of 20 kg N / ha.

## 5. FINANCIAL ANALYSIS OMISSIONS

5.1 Another omission in Ms Dewes' evidence on the three farms picked as case study farms is lack of a full financial analysis to back her assertions of worst case scenarios for financial implications (paragraph 127).

5.2 I note that the three farms chosen for analysis were among the Region's very best in terms of profitability. They were highly profitable farms, well above average profitability and close to the top 10%.

5.3 Ms Dewes has presented no full cash-flow analysis to show the true financial implication of the additional capital expenditure and reduced operating profit on the case study farmers' business risk and viability.

5.4 The risk statistic presented is not a relevant predictor of a farmer's true business risk. It is merely an indicator of the profit margin that a farmer makes on each kilogram of milk solids produced. Ms Dewes has not taken account of interest commitments from existing or new capital expenditure required as part of the scenarios tested.

## 6. INDUSTRY ACTION

6.1 Ms Dewes makes a number of references to the industry's inaction in addressing minimum standards (paragraphs 32, 154)

6.2 Minimum practice standards listed by Ms Dewes' (paragraph 114) are acknowledged by the dairy industry and form part of the Sustainable Dairying Water Accord. Fonterra suppliers are well on the way to achieving many of these targets through initiatives under the Clean Streams accord Mk I. Other dairy companies have now committed to the new Accord and are joining Fonterra to put processes, recording and consequences in place for suppliers to achieve the new Accord targets.

6.3 Minimum practice standards have the advantage that they address more than just nitrogen issues and they can be used to make existing farm businesses both nitrogen and economically efficient.

6.4 Ms Dewes seems unaware of the efforts to develop audited self-management against standards in Hurunui-Waiau. The system is already in development between farmers, industry and Environment Canterbury and has the features asked for in paragraphs 144 and 149 – 151.

## References

Howard S, Romera A, Doole G.J. (2012). Selwyn-Waihora nitrogen loss reductions and allocation systems. Report prepared by DairyNZ for consultation with the Selwyn-Waihora zone committee on possible controls on diffuse source nitrogen losses. 81pp.

Lilburne L, Webb T, Ford R, Bidwell V (2010). Estimating nitrate-nitrogen leaching rates under rural land uses in Canterbury. Environment Canterbury report R10/127.

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