BEFORE COMMISSIONERS APPOINTED
BY THE WAIKATO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the First Schedule to the Act
AND	
IN THE MATTER	of Waikato Regional Plan Change 1- Waikato and Waipā River Catchments and Variation 1 to Plan Change 1
AND	
IN THE MATTER	of submissions under clause 6 First Schedule
BY	**BEEF + LAMB NEW ZEALAND LIMITED** **Submitter**

EXECUTIVE SUMMARY OF TIMOTHY JASON COX
27 June 2019

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BACKGROUND

1. My full name is Timothy Jason Cox.

2. I am a water resources engineer and scientist, specializing in water quality and hydrologic modelling.

3. I am currently employed by Streamlined Environmental and the USA consulting firm CDM Smith.

4. I have read the Code of Conduct for Expert Witnesses in the Environment Court's 2014 Practice Note and agree to continue to comply with it.

SCOPE OF EVIDENCE

5. I have been requested by Beef + Lamb New Zealand to provide expert evidence on catchment modelling of landuse and water quality as it relates to the modelling underpinning the proposed Waikato Regional Plan Change 1 (WRPC1) and as it relates to potential methods of implementation of the Plan Change. My focus is only on nutrients.

6. I previously submitted evidence for Hearing Stream 1. That evidence presents my own modelling work which builds on the catchment modelling performed by the NIWA team for the CSG. For details on the constructed model, parameterisation, and modelling software, I refer you to this earlier evidence.

7. In my evidence developed for Hearing Stream 2, I:

    - Firstly, reviewed recent water quality data in the mainstem of the Waikato River;

    - Secondly, used this new data, in combination with updated landuse and emissions (export) profiles, to re-calibrate my numerical model with respect to nitrogen parameterisation; and

    - Lastly, used the updated model to investigate alternative nitrogen allocation policies. These simulations are intended to supplement the predictive simulations already performed by the Healthy Rivers

technical team and to investigate, quantitatively, potential nutrient allocation strategies to achieve the desired water quality outcomes.

8. I'll now briefly summarise a few key points from that work.

Land Use Change and Instream Nitrogen Trends

9. To support my modelling work, I undertook an analysis of recent measured total nitrogen concentrations in the mainstem of the Waikato and identified statistically significant increasing trends in total nitrogen throughout the mainstem for the past 5 – 6 years. It is worth noting that increasing long term trends in nitrogen are already generally known to Council, but they may not be aware of the high rate of increase apparent in the most recent data.

10. This water quality trend appears to align with changes in landuse for roughly the same period. My modelling shows that dairy nitrogen emissions in the catchment have increased significantly over the past 10 – 12 years. Modelled dairy nitrogen emissions are approximately 30% higher for a 2018 landuse snapshot, compared to a 2006 simulation. The model indicates that total nitrogen loads from dry stock and forest have decreased over that same time period.

11. These results highlight the fact that an increase in dairy farming is the likely primary driver of the observed rising nitrogen concentrations.

Model Re-Calibration

12. Results of the updated model calibration show an overall increase in nitrogen attenuation in the catchment in the new model, compared to the original NIWA model. The overall areal-weighted average nitrogen attenuation coefficient for the catchment increased from 28% (original NIWA model) to 42% (updated calibration model). This is not unexpected, as I believe that both dairy farm land areas, and pastoral farm nitrogen export coefficients, were underestimated in the original NIWA model. This underestimation of loading would have led to an underestimation of catchment attenuation in their calibration process.

13. An important implication of this is that the original model underestimated the available pool of nitrogen which could be allocated across land uses. This

would also have had a significant impact on the economic and scenario modelling performed by the technical leaders group and the conclusions drawn from that work.

14. I used the updated model to perform basic mass balance simulations of current nitrogen loading in the catchment. Results of that work show that the relative contribution of dairy to the total nitrogen load is generally higher in the updated model compared to the original model and compared to the NIWA model used to underpin PC1. *Sample results are provided on the screen*. For example, at the bottom of the catchment (Port Waikato), the total dairy contribution has increased from 55% to 68%, between the two model versions. Conversely, the modelled relative contribution of dry stock to nitrogen loads has generally decreased at all sites in the updated model.

15. To address the same questions about phosphorus modelling, I also applied the updated model to simulate current phosphorus loading in the catchment. While those results were not presented in my formal evidence, I present them now. *Sample results shown on screen*. These results again show a higher relative contribution of dairy to the total P load, and a lower contribution by the dry stock sector, compared to the original NIWA model. This is particularly true of the upper catchment. This updated model shows the dairy sector to be the largest contributor of phosphorus load in the catchment.

16. As I noted previously, I believe that the updated model is a more accurate reflection of current conditions than the original model.

Nutrient Allocation

17. It is my opinion that Plan Change 1 should be more prescriptive with respect to laying out a feasible pathway for achieving final water quality targets. Currently, there appears to be no practical vision for achieving stated goals and this has created significant uncertainty and concern among stakeholders. It is my opinion that a transparent contaminant allocation strategy, supported by technical analyses, would go a long way toward addressing this concern.

18. As an example, my modelling has shown that long-term nitrogen targets could be achieved in the basin with an equal allocation of nitrogen export “allowances” across all land use types, even without reductions in point sources, but would require significant land use change. Under such a scheme, the extent of load reduction required by upstream diffuse sources varies widely by location in the basin due to disparities in the proposed long-term nitrogen targets.

19. Further to that last point, based on these modelling results and other modelling analyses, I believe that the proposed long-term nitrogen targets, presented in Table 3.11-1 of the draft Plan Change 1 report, are overly ambitious at certain locations (e.g. at Waipapa). I believe that these targets warrant further review.

20. Another viable allocation scheme could be based on land use capability classification (LUC), as presented in my evidence and described in detail in the evidence of my colleague Dr. Alec Mackay. Supported by modelling, or a similar quantitative accounting system, an allocation of nutrient export allowances could be made based on the natural capital of the land that both achieves water quality objectives and optimises the use of catchment lands within the imposed water quality constraints. The modelling results presented in my evidence quantify such allocations for nitrogen as a function of prescribed water quality targets.

21. Samples of both sets of modelling results are summarised in the tables shown on the screen. The first shows the modelled nitrogen export allowances (kg-N/ha/yr), allocated equally across the catchments, required to achieve the existing PC1 long-term nitrogen targets. This model run indicates the extent of land use change required to achieve these outcomes. The second shows the modelled nitrogen export allowances (kg-N/ha/yr), allocated equally across the target catchments, required to achieve an alternative set of nitrogen concentration targets, based on ecosystem health, that have been proposed by an external party and are described in my evidence. This second allocation is clearly a more achievable set of numbers. The third table shows the modelled nitrogen export allowances (kg-N/ha/yr), allocated by LUC class and Freshwater Management Unit, required to achieve those same alternative nitrogen concentration targets.

22. Either type of allocation approach could be combined with a nutrient trading system as a viable option for regulating nutrients in the basin going forward.

23. I recommend that PC1 be expanded to include a sensible allocation plan. Such an allocation would provide certainty, desired by stakeholders, and, in my opinion, greatly strengthen the plan with respect to achieving water quality objectives.

DATED this 27th day of June 2019

Tim Cox