BEFORE THE HEARING COMMISSIONERS APPOINTED BY ENVIRONMENT CANTERBURY

IN THE MATTER	of the Resource Management Act 1991 (**RMA** or **the Act**)
AND	
IN THE MATTER	of Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan

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STATEMENT OF EVIDENCE OF THOMAS NATION (SPATIAL ANALYSIS) ON BEHALF OF HORTICULTURE NEW ZEALAND 17 JULY 2020

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INTRODUCTION

Qualifications and experience

1. My full name is Thomas Edward Nation.

2. I hold a Bachelor of Science (**BSc**) with first class honours in Geography from Canterbury University. I am a certified environmental practitioner (2019).

3. I am currently a Director and Spatial Consultant for Collaborations Ltd, an applied science consulting company.

4. I have ten years' experience in the field of Geographic Information System (**GIS**) analysis and six specialising in environmental GIS analysis, previously working as the GIS Team Lead for Jacobs Ltd. I have worked alongside Horticulture New Zealand (**HortNZ**) on several regional plan change processes in a technical GIS capacity including the recent Waikato Plan Change 1 Healthy Rivers process.

Expert Witness Code of Conduct

5. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 December 2014. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Involvement in project

6. I have been commissioned by HortNZ to undertake a GIS investigation looking at the future expansion of the commercial vegetable production sector (**CVP**) and the effect it may have on nitrogen loading, with regard to the proposed Plan Change 7 to the Canterbury Land and Water Regional Plan (**PC7**).

Purpose and scope of evidence

7. This evidence addresses the HortNZ submission items that pertain to PC7 rules 5.42CA and the proposed new rule 5.42XX.

8. I have undertaken a technical GIS based assessment to evaluate the nitrogen load impact on the Canterbury sub

regional chapter catchments (**sub catchments**) for three scenarios:

(a) Expansion under the proposed permitted activity rule (5.42CA). Increasing the growing footprint of CVP operations that have a total footprint under 0.5 hectares (**ha**) to the permitted cap and assessing the change in sub catchment nitrogen load. This evidence also considers if the cap was increased to 5ha;

(b) The potential expansion area in each sub catchment if their respective nitrogen loads were to increase by 0.5% and 1%. This evidence also considers the percentage load increase required to allow for 1000 ha required expansion for population growth.

(c) The area available for root vegetable rotations to expand within the existing grand-parented nitrogen limit.

GIS ANALYSIS OF THE EFFECTS OF PC7 RULES

9. PC7 sets a limit of 0.5 ha as a permitted activity (rule 5.42CA).

10. HortNZ has suggested a rule modification and the addition of a new rule to allow for the further expansion of the existing CVP footprint.

11. I have undertaken GIS analysis to assess what impact the proposed expansion will have on the baseline sub catchment nitrogen loads.

12. The baseline sub catchment nitrogen load information was sourced from an Environment Canterbury (**ECan**) technical report "Assessment of nitrogen losses from commercial vegetable operations in Canterbury – 2018". The load information in this memo references Hill & Ford 2016 and states that the data is the "latest consistent estimate of regional nitrogen root zone loads" which were obtained during the baseline period of 01 July 2009 to 30 June 2013.

13. In addition to the sub catchment nitrogen loads, I have used specific land use nitrogen leaching rates provided by Mr Stuart Ford in a memo from June 2020.

14. I have analysed the available datasets to determine the existing footprint of CVP. I compared baseline numbers from

the ECan technical report with the NZGAP certified grower database accessed in June 2020 and some recent Agribase statistics.

15. The baseline CVP area of 12,275ha in the ECan technical report is very similar to the Agribase and NZGAP figures. As outlined in the evidence submitted by Ms Rachel McClung at HortNZ, although expansion of some crops occurred between the baseline period and today, it has occurred within pastoral and arable systems within the grand-parented nitrogen cap. In addition, the evidence presented by Mr Stuart Ford indicates that the area of CVP has remained static since 2013.

16. I therefore consider it appropriate to use the baseline nitrogen loads for this analysis.

17. With regards to GIS data, I have used publicly available data in the form of the Land and Water Regional Plan (**LWRP**) sub regional chapter catchments and Agribase farm boundary layers from ECan and the Land Use Capability (**LUC**) layer from Landcare research. **Figure 1** in **Appendix 1** illustrates the land analysed in this assessment.

18. I have carried out the GIS analysis in three parts, the first addressing the permitted activity rule 5.4CA, the second addressing the proposed new rule allowing for further expansion for future domestic demand and the third looking at root vegetable expansion within the existing baseline nitrogen limit for export.

Modification of rule 5.42CA

19. PC7 sets a limit of 0.5 ha as a permitted activity (rule 5.42CA). It is the view of HortNZ that this limit is inequitable, inefficient and wholly ineffective.

20. In order to test what a rule change would look like in practice, I have calculated what the load increase at a sub catchment level might be if the rule were to stay the same and if it was increased to 5 ha.

21. This involved analysing crop information for growers under the existing and proposed cap, increasing their footprint to a 0.5 ha and 5 ha cap and summarising the nitrogen load increase per sub catchment. **Appendix 2** outlines the methodology in more detail.

22. The analysis shows that increasing the CVP footprint to the 0.5 ha cap results in a nitrogen load between 0.0001% and

0.0014% of the current sub catchment nitrogen loads. Increasing the growing footprint up to a 5 ha cap increased the nitrogen load by a maximum of 0.25% in the Christchurch West Melton sub catchment (**Table 1, Appendix 2**).

Expansion to meet future domestic demand

23. It is predicted that the population of the Canterbury Region will increase from 628,600 (June 2019) to 730,000 by 2043 (Stats NZ).[1]

24. HortNZ are seeking a new restricted discretionary rule to allow for the expansion of the CVP area to meet the anticipated increased demand on supply.

25. I have carried out GIS analysis to look at the area of expansion that could be achieved if the sub catchment nitrogen loads were to increase by 0.5% and 1%.

26. I have also calculated what the percentage increase in nitrogen load could be if CVP was to expand by 1000 ha (the CVP expansion area required to meet future population demands based on HortNZ's submission).

27. This involved:

    (a) applying nitrogen leaching rates to all land uses on Land Use Class (**LUC**) 1 and 2 land;

    (b) calculating the average loss rate;

    (c) working out the difference between the average nitrogen loss and the nitrogen loss from four different horticultural rotations (**Table 2, Appendix 3**).

28. The nitrogen loss difference was then analysed against the total nitrogen load for each sub catchment and possible expansion areas were calculated based on 1% and 0.5% increases in sub catchment nitrogen load.

29. This analysis resulted in possible expansion areas between 6523 ha and 35031 ha depending on the horticultural rotation and percentage load increase (**Table 3, Appendix 3**).

1.http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/SubnationalPopulationProjections_HOTP2013base/Commentary.aspx
[https://www.stats.govt.nz/information-releases/subnational-population-estimates-at-30-june-2019-provisional

30. The nitrogen load increase required for 1000 ha of expansion is approximately 0.05% based on the most intensive rotation (**Table 3, Appendix 3**).

Expansion to provide for export

31. An additional scenario (provided by Mr Ford) was considered where root vegetable CVP rotations can expand throughout the region within the grand parented nitrogen load. The nitrogen load on arable and dairy land was split between the average load (70%), lower 15%, and upper 15% (**Table 2, Appendix 3**). The results of this scenario are described below:

    (a) The total area of arable land in the LUC 1 and 2 land is 66212 ha. With consideration to the split above, there could be 9932 ha of arable land with a leaching rate of 32kg/ha/yr. This would allow root vegetable cropping in the lower 15% of leaching to expand to this land with a slight improvement in total nitrogen load;

    (b) The total area of dairy in the LUC 1 and 2 land is 60763 ha. With consideration to the split above, there could be 9115 ha of dairy land with a leaching rate of 33kg/ha/yr. This would allow root vegetable cropping in the lower 15% of leaching to expand to this land with a slight improvement in total nitrogen load;

32. Potatoes New Zealand **(PNZ)** predict 5000 ha additional potatoes growing in Canterbury by 2030. Onions New Zealand predict an additional 1000 ha by 2030. This expansion is to serve export markets and is in addition to the expansion of existing rotations that would be required to support local population growth. The evidence of this scenario shows that the predicted expansion can be accommodated within the grand parented nitrogen load.

33. My analysis demonstrates that where an increase in CVG is proposed this does not result in all circumstances in an exceedance of the lawful nitrogen loss rate (or Baseline GMP Loss Rate as proposed in the section 42A report).

CONCLUSIONS AND RECOMMENDATIONS

34. In my opinion the GIS analysis carried out for this evidence is based on the best available data and is fit for purpose.

35. Based on the NZGAP certified cropping database, my evidence shows that the current permitted activity rule that

allows CVP to expand to 0.5 ha does not result in the 1000 ha of expansion HortNZ have stated is required to meet future population growth.

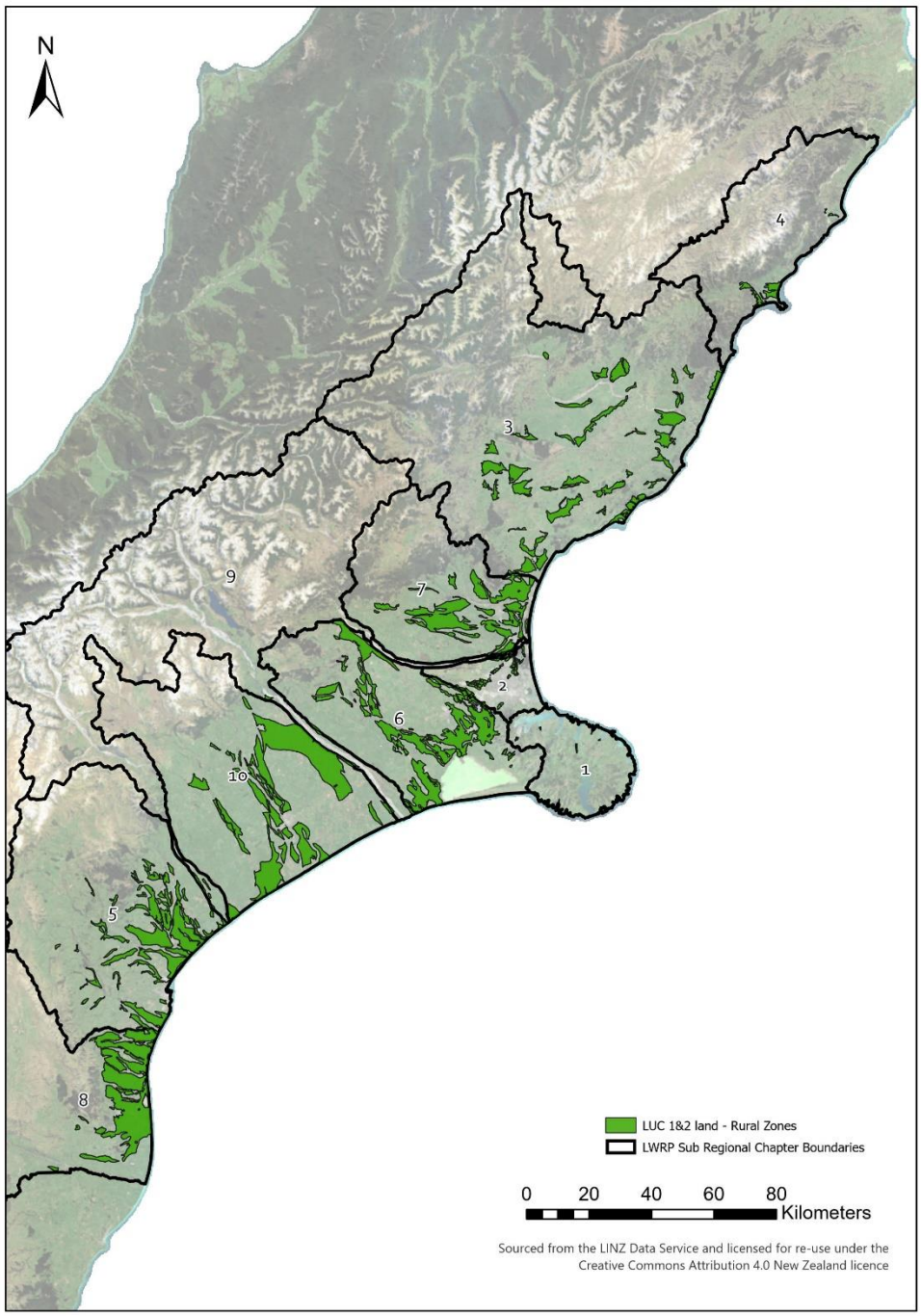
36. **Table 2, Appendix 3** illustrates that certain CVP rotations can expand onto other existing land uses without increasing nitrogen load and may even reduce the sub catchment load.

Thomas Nation

17 July 2020

APPENDIX 1

Figure 1 - LUC 1 and 2 Land in Canterbury



APPENDIX 2

Modification of rule 5.42CA - GIS methodology and results

The methodology employed is outlined below:

1. New Zealand Good Agricultural Practice (**NZGAP**) Certified crop areas for Canterbury extracted in May 2020 was provided by HortNZ;

2. The NZGAP data was filtered to include only those operations with a total growing area under 0.5 ha and 5 ha, respectively. The filtered operations were then assigned to a LWRP sub regional catchment based on their recorded district council. This was preferred to their registered address which often differs from their growing address;

3. The difference in area between the permitted activity cap and current footprint was calculated. The difference was also calculated between an increased cap of 5 ha and the existing horticulture operations under 5 ha;

4. The average nitrogen leaching rate per sub catchment was calculated using LUC 1&2 land based on **Table 2** and explained in **Appendix 3**. It is assumed that expansion would occur on LUC 1&2 land;

5. The increase in nitrogen load was calculated by subtracting the average nitrogen leaching rate (d) from the average intensive vegetable leaching rate (**Table 2**). It is assumed that most smaller horticulture operations will be intensive;

6. The increase in growing area calculated in (c) was multiplied by the increased nitrogen leaching rate (e) to identify the increase in total nitrogen load. The nitrogen load increase was then summarised per sub catchment to identify the percentage of the existing total load (**Table 1**);

7. It is noted that the total expanded area of CVP calculated in (c) is 3.6 ha for a 0.5ha cap and 155ha for a 5ha cap. Both numbers are much lower than the required expansion for population growth presented by HortNZ in their submission.

Table 1 – Nitrogen load increase associated with permitted rule expansion

LWRP Sub Regional Catchment	Catchment Nitrogen Load (kg/yr)	Nitrogen load increase up to 0.5ha cap (kg/yr)	Percentage of total catchment nitrogen load up to 0.5ha cap	Nitrogen load increase up to 5ha cap (kg/yr)	Percentage of total catchment nitrogen load up to 5ha cap
Ashburton	7450000	7.8	0.0001	439.7	0.006
Christchurch - West Melton	490000	6.9	0.0014	1235.7	0.252
Selwyn - Waihora	4440000	4.1	0.0001	671.3	0.015
Waimakariri	3630000	29.5	0.0008	627.2	0.017
Waitaki	7940000	26.5	0.0003	526.0	0.007

APPENDIX 3

Expansion to meet future domestic demand – Methodology and Results

The methodology employed is outlined below:

1. Identified the LUC 1&2 land in the Canterbury region and refined it to remove any land not zoned rural (Figure 1, Appendix 1);

2. Intersected this land with the Agribase land use layer provided by ECan and removed any existing horticulture areas;

3. Applied a leaching rate to the Agribase land use classes based on some recent technical work carried out by Stuart Ford and the Agribusiness group (Table 2);

4. Leaching rates were provided for dairy, sheep and beef, arable, dairy support and lifestyle operations which make up 87.5% of the area in the analysis. For the remaining land uses, the lifestyle leaching rate was applied except for native forest and forestry where a leaching rate of 3kg/ha/yr was assumed (based on previous plan change work in Canterbury);

5. The layer was intersected with the LWRP sub regional chapter catchments and the total nitrogen load summarised;

6. The average nitrogen leaching rate for the LUC 1&2 land in each sub catchment was calculated and then subtracted from the commercial vegetable growing numbers in Table 2 to work out the increase in load under various growing rotations;

7. Calculated what a load increase of 1% and 0.5% is for each sub catchment from table 1;

8. Divided the increased nitrogen leaching rate calculated in (f) by the 1% and 0.5% load increase from (g) to work out the possible area of CVP expansion (table 3).

Table 2 – Land uses and associated leaching rates kg/ha/yr – The Agribusiness Group 2020

Rotation	15% variation - lower end	Average nitrogen leaching rate kg/ha/yr	15% variation - higher end
Arable (dairy grazing)	24	28	32
Dairy Support	31	37	42
Dairy	25	29	33
Sheep and Beef	16	18	21
Lifestyle	8	9	11
Green Vegetable	39	46	53
Root Vegetable	29	34	39
Intensive Vegetable	36	42	48
Intensive Vegetable with Fallow	45	53	61

9. Table 2 illustrates that the variation across nitrogen leaching rates can allow for CVP expansion to occur within the existing baseline nitrogen load.

Table 3 – CVP expansion area based on 1% and 0.5% sub catchment nitrogen load increase

Horticulture Rotation	Nitrogen load increase per sub catchment	Total area of expansion (ha) for all sub catchments within PC7
Green Vegetable	**1%**	**16926.2**
	0.5%	**8463.1**
Root Vegetable	**1%**	**35031.2**
	0.5%	**17515.6**
Intensive Vegetable	**1%**	**20412.6**
	0.5%	**10206.3**
Intensive Vegetable with Fallow	**1%**	**13045.3**
	0.5%	**6522.7**
	0.05%	**652.3**