BEFORE THE HEARING COMMISSIONERS

IN THE MATTER of the Resource Management Act 1991 ("**the Act**")

AND

IN THE MATTER of the Resource Management Act 1991 and the Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010

AND

IN THE MATTER of the hearing of submissions on Variation 2 of the Proposed Land and Water Regional Plan

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STATEMENT OF EVIDENCE OF NICHOLAS CONLAND FOR HORTICULTURE NEW ZEALAND

15 MAY 2015

ATKINS | HOLM | MAJUREY

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Contents

QUALIFICATIONS AND EXPERIENCE

1. My name is Nic Conland, I am an Environmental Scientist. I have a Bachelor of Science (Chemistry, Information Systems), Waikato University, Hamilton, a Diploma of Design (3D), Waikato Polytechnic, Hamilton and a Post Grad Certificate of Proficiency (Environmental Planning and law), Victoria University, Wellington.

2. I have worked for Sinclair Knight Merz (now Jacobs) as an Environmental Consultant since 2010. Previously I worked for Wellington Regional Council for 7 years as an Environmental Regulation Team leader which involved leading and directing a team to monitor and assess for impacts on the environment for a wider range of activities in the rural and urban environments. I have at least 15 years' experience involved in the assessment of environmental effects.

3. I have attended numerous Environment Court mediation sessions as an expert witness. I have prepared evidence for Boards of Inquiry and prepared and presented expert evidence for the District Court.

4. Of particular relevance to this process is my past experience at Greater Wellington Regional Council where I had responsibility for regional compliance with the RMA for freshwater effects as a result of rural landuse.

5. Also as co-author of the Transmission Gully assessment of water quality effects report; which included development for the BoI adaptive management based conditions allow for development while managing and controlling the effects on the environment.

6. I project managed the development and preparation of the Tukituki SOURCE Model, this model was used to test the hypothesis in the proposed Plan Change 6a and the application for the Ruataniwha Water Storage Scheme.

7. I co-authored the SKM Tukituki technical evidence and contributed technical input to the drafting and editing of the final plan provisions with Horticulture New Zealand and the Hawkes Bay Regional Council planning team.

8. I co-authored the Jacobs technical evidence and provided evidence to the Variation 1 Hearing Panel on the 13th October 2014 for the Sustainable Land and Water

Partnership (Including Horticulture New Zealand, Federation Arable Research, DairyNZ and others).

9. My role in the development of the analysis described in this evidence, has been in reviewing the technical reports provided by Environment Canterbury and to consider the catchment responses to the Variation 2 policy and planning provisions.

10. My involvement in Variation 2 has been has been solely to provide advice to Horticulture New Zealand on the technical reports and plans prepared by Environment Canterbury and the primary sector group[1] on our analysis of the effects of Variation 2 on water quantity and water quality through allocation of water and nitrogen in the Hekeo-Hinds Catchment.

EXPERT WITNESS CODE OF CONDUCT

11. I have been provided with a copy of the Code of Conduct for Expert Witnesses and I have read and agree to comply with that Code. This evidence is within our areas 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.

SCOPE OF EVIDENCE

12. My evidence covers the following:

(a) Loads based on connectivity between current landuse and hydrology

(b) Model to determine effects

(c) Advanced Mitigation and catchment effects

(d) Landuse flexibility under plan provisions

(e) This evidence is provided in response to the submissions raised by members of the Horticulture New Zealand technical and planning team.

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[1] The Group includes: DairyNZ, Fonterra, Irrigation NZ, and Federated Farmers.

LOADS BASED ON CONNECTIVITY BETWEEN CURRENT LANDUSE AND HYDROLOGY

13. To analyse the effects of Variation 2, Jacobs reviewed the methods used to develop the water quality and quantity limits and allocation provisions.

14. My experience testing the hypothesis and provisions in regional planning instruments which seek to control landuse through water quantity and quality limits has shown that Councils must be able to demonstrate a clear relationship between landuse and load.

15. This relationship requires an understanding of the hydrological regime both within surface and groundwater.

16. The ability to apply this relationship between load and water quality enables a prediction of risk and the duration of that risk as a temporal interpretation for variability in water quality.

17. We recommend that an integrated science based approach to both management and prediction of effects is best practice for the successful management of the Hekeo–Hinds catchments.

18. I conclude that the methods used to predict the effect of future landuse change on water quality are currently unreliable, and therefore we consider the assessment of benefits associated with the variation 2 to also be unreliable.

MODEL TO DETERMINE EFFECTS

19. The intent of any modelling is: to approximate a natural system and represent, through relationships of the observed and predicted data, outcomes and results for supporting decision making on natural systems where an uncertain result needs to be tested. The degree of certainty in a model can be evaluated by calibration to observed data and the use of strong empirical relationships. The degree of simplification and errors in base assumptions can materially affect the confidence in the results from any model. The review undertaken points to some risks to the policy framework sought in Variation 2. The paragraphs below summarise these risks.

20. The ECan modelling takes a simplified approach to water drainage, where a 'single bucket' daily soil-water balance

model generates the amount of water used for irrigation and water draining through the soil profile into groundwater for dryland and irrigated land.

21. The overall load calculations are based on the OVERSEER nitrogen loads and drainage forming a concentration which is averaged across the shallow groundwater bucket.

22. There is significant uncertainty (this is acknowledged by the author L. Scott;) in this approach from:

(a) Groundwater recharge being received from the braided rivers which border the Hekeo-Hinds Plains

(b) Averaging of spatial (vertical and lateral) variation in nitrate concentrations

(c) Groundwater recharge from water races being discounted

(d) Denitrification is ignored. From our study in the Selwyn Waihora catchment and Variation 1 submissions, this is (only) likely to be occurring in areas with deep groundwater upwelling intersecting with shallow groundwater in heavy soils.

(e) Temporal conditions and differences for nitrogen migration through groundwater are ignored.

(f) The Managed Aquifer Recharge (MAR) mitigation is applied as virtual drainage, evenly distributed across the Hekeo-Hinds Plains. In principle any benefits will occur only in the groundwater location where the water is injected.

(g) Loads from the upper catchment(s) are largely ignored with a recommended annual average load based on two years data.

(h) The 'scale factor' or ratio for average groundwater to surface water concentrations is applied to all scenarios irrespective of the interventions theoretically proposed.

23. These are issues related to the conceptual understanding of groundwater and how nitrogen moves from the land usage in the catchment into streams. The approach in Variation 2 says that the groundwater aquifers are unconfined, but then

states that all nitrogen stays in shallow groundwater while deep groundwater is sourced from major rivers.

24. This 'separation' means that there is no allowance for broad-scale dilution or nitrogen attenuation effects. Also the MIKE SHE and the Regional Distribution model's water balance shows a significant component of outflow directly to the ocean. The water balance indicates that at least 50% of the summer flow discharges to the ocean and most of the winter flow.

25. This means that a proportion of the N load is passing into the ocean.

26. Unrealistic modelling has the potential to overestimate irrigation demand and drainage to groundwater. The MIKE SHE model assumes that 41% of all recharge is from irrigation activities.

27. The approach for determining stream concentrations doesn't allow for seasonal and annual changes in flow conditions due to differences in shallow and deeper groundwater contributions to flow (where concentration is load/flow).

28. The generalised relationships of surface (or quick) flows as inputs to the groundwater model provide less flexibility in accounting for changes occurring in the upper hill country, particularly for representation of the surface water transfers from the Rangitata Diversion Race to the irrigation schemes and corresponding land use changes (proposed as development scenarios) directly related to increased water allocation in the command areas. Such water usage would most likely modify the surface water flow component in terms of both flow and water quality.

29. Identifying and developing a workable sustainable water management solution for the Hekeo-Hinds catchment was undertaken through a collaborative planning process. The collaborative process to determine a water management solution for the catchment first evaluated the current situation or baseline (at 2011); a development scenario (expansion of 28,500 Ha); an environmental scenario, and the potential options (expansion and mitigations) scenario, which explored community (social, cultural, economic and environmental) outcomes sought. These plausible futures

(described as scenarios) were then explored with the Zone Committee and Community Focus Groups.

30. These scenarios explore the tolerance required to balance the conflicting influences on the catchment.

31. The accuracy of predictions made for the scenarios depend upon the ability of the combination of models used by ECan to represent the connections between implementation of policy on physical outcomes for the catchment and the dynamics of the movement of flow and nutrients through the catchment via surface and groundwater flow pathways.

ADVANCED MITIGATION AND CATCHMENT EFFECTS

32. The simplified conceptualisation of the groundwater systems into shallow and deep aquifers is appropriate for the Canterbury Plains hydrogeological approach. Critical, however, is the appreciation that the systems are interconnected and a simple segregation of the two systems is not generally warranted.

33. The simplified "bucket" structure adopted for the groundwater systems ignores the lateral variability in transmissivity and the distinct differences between the shallow and deep "aquifers".

34. There is some risk for some unintended consequences from the mitigation measures proposed where irrigation efficiency promotes lower on-farm irrigation, but if the same stocking rates are retained it not only reduces the drainage volume for the aquifer recharge but increases the localised concentrations or nitrogen leached.

35. The broad scale effect of irrigation efficiency is potentially reducing aquifer recharge and lowering groundwater levels. The extra water is irrigated elsewhere and creates a higher load due to increased field drainage on previously dryland soils.

36. Overall a higher nitrogen load within localised areas having lower (more nitrogen) concentrated groundwater.

37. The MAR intervention needs the same kind of rigour applied to the proposed use where the report (Golder Associates, 2014) states on (p30, last para.) that "The effects of MAR on

water quality are site specific, dependent on influent and receiving water quality and the host geology. "

38. Although the MIKE SHE modelling for MAR outcomes look promising for improving reliability to nearly 100% and improving lowland stream flows, they were inconclusive regarding improving groundwater levels and were obviously silent on water quality outcomes.

LANDUSE FLEXIBILITY UNDER PLAN PROVISIONS

39. We have given consideration to Appendix B of the Section 42A Report and agree with the need to undertake an assessment process. In addition, for our Variation 1 assessment we assessed a range of allocation mechanisms.

40. Environment Canterbury have established a catchment load based on OVERSEER® data with some interpolation for gaps in farm system data based on relative changes in biophysical properties. This is a good approach and similar to our evidence for Selwyn Waihora. The method provides an attribute based table to assign nitrogen leaching values to a particular landuse depending on the soil types and relative climate associated with the particular farm property.

41. The Scott 2014 R13/93 (Scott, 2014) report assigns a nitrogen load to the agricultural practices in the Hekeo-Hinds catchment.

42. This load of 3400 is to be reached by 2035 and is described as a 'target' under the National Policy Statement for Freshwater Management 2011 (**NPS**).

43. I looked at the soils in the NZLRIS layer within the Hekeo-Hinds catchment suitable for Horticultural and Arable landuse. The fertile soil types below were identified.

Table 1 **Soil suitable for horticultural landuse**

Hinds Fertile Soils	
SERIES	**SOIL TYPE**
Mayfield	silt loam
Paparua	sandy loam
Ruapuna	shallow soils
Taitapu	silt loam
Templeton	silt loam
Templeton	shallow silt loam

Temuka	silt loam
Waimairi	deep soils
Waimakariri	silt loam
Wakanui	silt loam on sandy loam
Wakanui	silt loam
Wakanui	shallow silt loam
Waterton	silt loam
Willowby	silt loam

44. We looked at these in terms of their potential to support horticultural and arable crops. It is noted that in practice these soils support many landuses in combination including lifestyle blocks, dairy and dairy support.

45. When I aggregated the areas for each soil class this shows there are 17392 Ha's of fertile soils in the Hekeo-Hinds catchment. At present 7777 Ha are used for horticulture and arable product purposes.

46. The percentage of fertile soils currently used for horticulture or arable is actually 45%. It suggests that 9615 Ha of land could convert under the Variation 2 policies to either horticulture or an arable landuse (or diversify the existing use types to include these landuses).

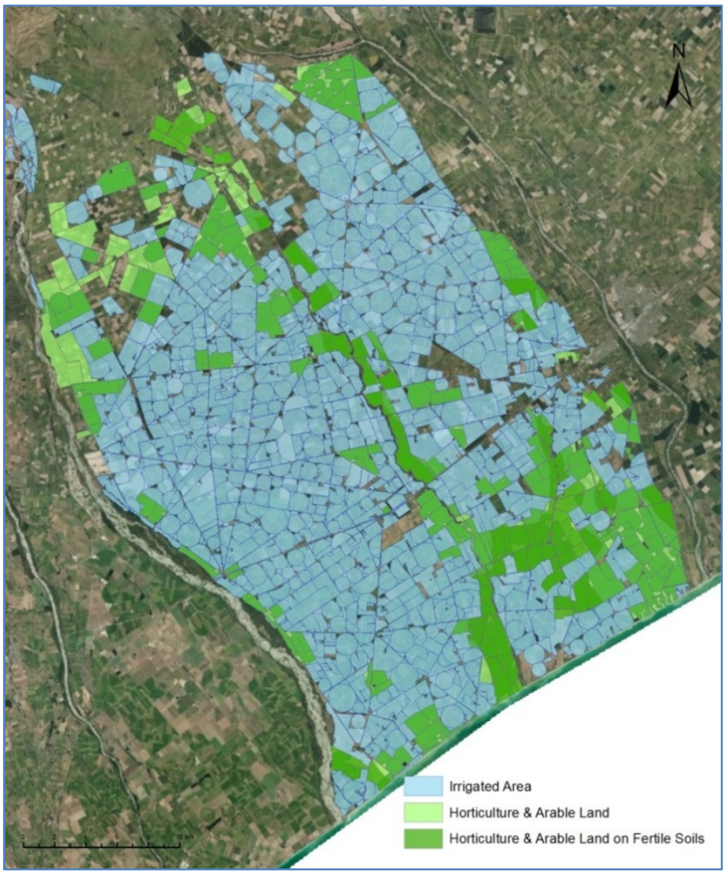
47. The following figures illustrate the locations and areas for the fertile soils coincident with horticultural and arable land.

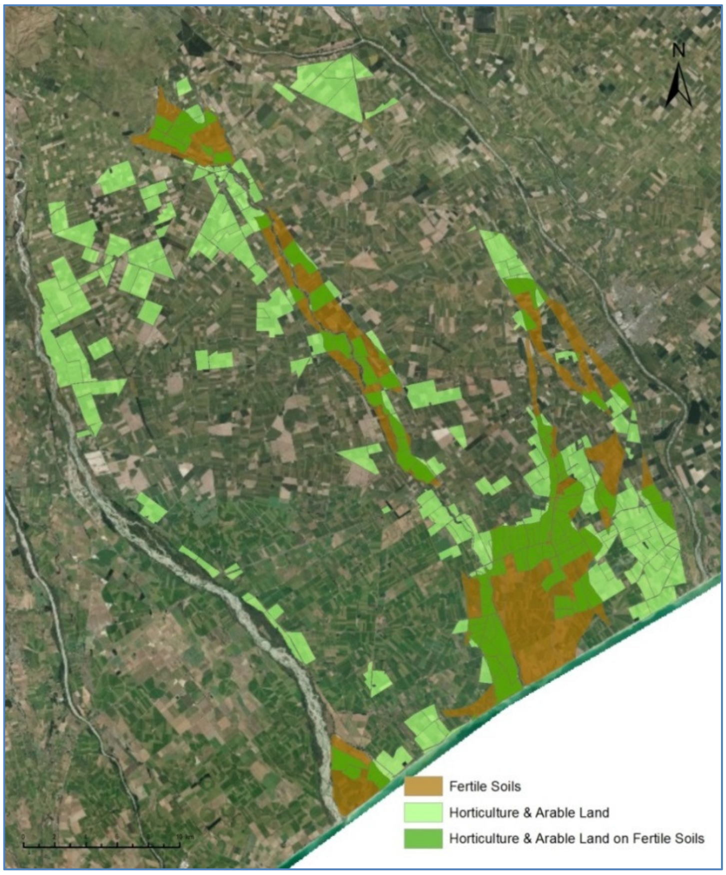
48. I also looked at the land areas currently in seasonal irrigation (Source: Shirley Haywood, Dairy New Zealand) and examined the fertile soils without irrigation or existing horticulture and arable.

49. This analysis revealed there are around 2941 Ha of fertile soils in the catchment not currently irrigated or used for horticulture or arable uses which is 17% of the total fertile soil in the catchment.

50. The Water Quality and limit setting report R13/93 (Scott, 2013) provides some of its assumptions on page 8 which give the assumed losses for horticulture as 14 kg/ha/year.

51. The complete conversion of these fertile soils to horticulture would account for 41 tons of the nitrogen target, which would be within the error margin of the load calculation.


N
Irrigated Area
Horticulture & Arable Land
Horticulture & Arable Land on Fertile Soils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Fertile Soils
Horticulture & Arable Land
Horticulture & Arable Land on Fertile Soils

POLICY PROVISIONS AT RISK FROM CURRENT APPROACH

52. After considering the baseline data collected by ECan and in particular the increasing trends for nitrate concentrations in groundwater, I agree in general with the findings of the reports for a need for load reductions and interventions to change to the conditions which are causing the concentrations in the groundwater and lowland streams to be elevated.

53. The modelling approach and the assumptions made as inputs to the modelling pose a risk for the ability of these tools to adequately act as a management tool. In this context a flawed calculator will provided a false answer.

54. The current water quality model is a spreadsheet which faithfully accounts for the summed OVERSEER load in the predicted drainage. This model makes no account for any connection to the catchment hydrology, including temporal changes in drainage (from climate or irrigation). This modelling approach cannot calibrate the load with either surface or groundwater quality (spatially or temporally). The R13/93 report even goes so far as to say "…it is impossible for the model to accurately predict" (page 11, Scott, 2013).

55. The tools for catchment management under the NPS have a dependency between the farm or enterprise scale generation of load; the catchment scale aggregation/ distribution of load; and the transport and attenuation to rivers and aquifers. When one of these elements is wrong it creates a fundamental problem for predictions from these tools in the catchment.

56. Where these tools are inaccurate the stakeholders are then required to react against a load to water quality relationship which may inflate or depreciate the risk. An inflated risk will mean that costs to farmers will be in excess of the risk. A deflated risk means the environment will suffer as interventions are taken too late or at a low level.

57. If a probabilistic approach were taken to the inherent error in the modelling and the precautionary principle applied equally to the inflated or deflated risks then the modelling would be reviewed and improved at the time steps provided in the plan provisions (Policy 13.4.13(b) and table 13(g)).

58. In this way the likelihood of a false prediction would be reduced and the data collected in the interim would allow for better representation of the catchment hydrology.

59. When the degree of difference between the current load and the 'target' is so wide and the time frames for the unqualified reductions are relatively short the risk in the decisions is high. The change for the reductions in on farm estimates of nitrogen represents a 'cliff' in terms of the mitigations required and the ability to achieve the level of mitigations proposed.

60. A solution would be to increase the time intervals in the plan provisions to allow a steeper or shallower gradient of change to occur when the relationship between water quality and load was better represented (or at the very least calibrated).

CONCLUSIONS

61. I have considered the risks inherent in modelling outcomes for two catchment processes under the NPS in the last two years. There are common areas of risk for Variation 2 and I raise five key questions in regard to the relative consequences for the existing and proposed allocations for current farming and for the introduction of the MAR scheme:

    (a) What is the N load?

    (b) What are the effects on groundwater quality?

    (c) What are the effects on water quality?

    (d) What is the effect of the proposed MAR on water quality?

    (e) What is the effect on MALF and seasonal durations for min flow (reliability)?

62. I believe to implement the Variation 2 Plan would require these questions to be answered to determine the validity of setting an allocation limit to manage catchment inputs and achieve the groundwater and surface water objectives.

63. I do not consider the modelling approach used by Environment Canterbury to be sufficiently reliable to predict the effect of proposed plan change on achieving the proposed objectives of the plan, nor to assess the effects of the plan.

64. I recommend that policy provision 13.4.13 is changed to reflect a review of modelling assumptions prior to setting the first step change. The logical time to undertake the modelling would be in 2017 when the GMP targets for load generation can be used for calculating the farm scale generation of loads.

65. The likely increases in catchment load would then be able to be assessed in a calibrated model which can predict not only the water quality outcomes but target the locations for mitigations.

66. This would meet the attributes of an adaptive management approach (Environment Court; Crest Energy Kaipara Ltd v Northland Regional Council 2009) with subsequent time steps applying a targeted load reduction and mitigations.

REFERENCES

Scott, L,. 2013. Hinds Plains water quality modelling for the limit setting process. Environment Canterbury Technical Report R13/93

Durney, P., Ritson, J., 2014. Water resources of the Hinds/Hekeao catchment: modelling scenarios for load setting planning process. Environment Canterbury Technical Report R14/51.

Golder Associates, 2014. Managed Aquifer Recharge (MAR) as a tool for managing water quality and quantity issues. Environment Canterbury Technical Report R14/80.

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Nicholas Conland

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