BEFORE THE HEARINGS PANEL

In the matter of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council

STATEMENT OF EVIDENCE OF SONIA ANNE WHITEMAN

ON BEHALF OF HORTICULTURE NEW ZEALAND

DATE: 21st DECEMBER 2009

QUALIFICATIONS AND EXPERIENCE

1 My name is Sonia Anne Whiteman. My academic qualifications include a Bachelor of Horticultural Science with first class honours from Lincoln University and a Doctor of Philosophy in Plant Pathology also from Lincoln University. I recently attended and passed a Massey University Fertiliser and Lime Research Centre Short Course on Sustainable Nutrient Management.

2 I am currently employed by Horticulture New Zealand as the Vegetable Research & Innovation Manager. In this role I support a number of the vegetable groups associated with Horticulture New Zealand by:

a. Providing technical advice in my areas of research expertise
b. Assisting annual calls for research and development proposals
c. Developing funding applications
d. Providing project management of research programmes
e. Analysing and providing comment on government policy relating to research.

3 Of relevance to the matters before the Hearing Panel is my involvement as the Project Leader for a recent MAF Sustainable Farming Fund project (MAF 05/004) Nitrogen Management for Environmental Accountability (NMEA). This project was developed as a result of the horticulture and arable industries taking a proactive approach to addressing concerns raised by various Regional Councils about the adverse environmental impacts of synthetic nitrogen fertiliser use. Industry also wanted to ensure farmers and growers had tools that allowed them to use this expensive input as efficiently as possible to ensure maximum profits.

4 The result of the project was the development of an arable, vegetable and fruit module for OVERSEER®.

5 This project forms the basis of the approach that Horticulture New Zealand seeks to be incorporated into the Proposed One Plan in relation to management of nitrogen in horticultural crops and this evidence seeks to set the background and context for use of the arable/vegetable and fruit module of OVERSEER®.

6 In my opinion, my work and experience is relevant in assisting the Hearings Panel to make a decision.

SCOPE OF EVIDENCE

7 I will outline the process undertaken for the project, the development of the NMEA tool and the outcomes.

IN SUMMARY

8 The NMEA Project developed OVERSEER® module for arable, vegetables and fruit that can model nutrient budgets for a range of horticultural and arable crops. The model, now know as Version 5.4.3 and released in early 2009, was developed through a consultative and scientifically robust process. Stakeholders included a wide range of industry participants and regional councils with science providers from Crop and Food Research and HortResearch (now Plant and Food Research) and AgResearch.

9 The science team brought together skills and experience of development of complex mechanistic models to simulate the interactions between plant growth, climate, soil type and management practices such as fertiliser and irrigation. Crop & Food Research have developed expertise in the arable and vegetable sectors resulting in the LUCI framework model, while HortResearch have predominately provided services to the fruit sector through their SPASMO model.

10 The mechanistic models LUCI and SPASMO were used to run a series of simulations at different locations with different soil types and different irrigation and fertiliser applications. These results were analysed to create simplified generic mechanisms for calculating water and nitrogen balances on a monthly time step. Other mechanisms for calculating drainage (evaporation, and transpiration) and mineral nitrogen status (crop nitrogen uptake, residue mineralisation, organic matter mineralisation) were also derived to enable the calculation of nitrate leaching from a user specified crop rotation and management regime.

11 The information was then incorporated into existing OVERSEER® nutrient budgets, as the preferred method for delivery. Outputs from the upgraded OVERSEER® model have been back validated against outputs from the parent models LUCI and SPASMO as well as experimental leaching data showing very good agreement in both tests.

12 The next release of OVERSEER® due early in 2010 will include integration of reporting across an entire farming operation as opposed to individual paddocks – essentially bringing together the pastoral and horticulture/arable components.

13 Training for industry professionals (e.g. fertiliser company employees, consultants/advisers) in the use of OVERSEER® to produce nutrient budgets is currently available from Massey University. Details of both the Advanced and Intermediate Courses are at paragraphs 28-34. An industry led training programme for growers is being developed to ensure wider ensure uptake of the tool.

14 A number of limitations of the use of the model are identified at paragraphs 37-41 including that the data has been extrapolated from a limited number of field trials around New Zealand; that there are limits to current scientific understanding of key processes involved in calculating a nutrient budget, such as the issue of the rate of mineralisation especially over long rotation period; and that not all plant species are currently included in the model.

15 There is potential for OVERSEER® for arable, vegetable and fruit to be used in a regulatory context, however is ongoing investment in this area is required to achieve continuous improvement in the accuracy of the tools to enable them to be relied on to achieve Regional Plan objectives and requirements.

Nitrogen Management for Environmental Accountability (NMEA)

16 The objective of the NMEA project was to develop a tool that would provide accountability with regard to nitrogen inputs and resulting nitrate leaching losses across a wide range of production scenarios within the arable, vegetable and horticulture industries. To achieve this the tool needed to be technically robust and meet the requirements of both growers and Regional Councils. The end result has been development of a system that will allow growers to demonstrate responsible use of nitrogen inputs and thereby assist in satisfying Regional Councils that activities are consistent with the requirements of Regional Plans.

17 The Stakeholders for the project included:

Industry: Fresh Vegetable and Process Vegetable Product Group,
Potatoes New Zealand,
Foundation for Arable Research,
Pipfruit New Zealand,
Summerfruit New Zealand,
New Zealand Citrus Growers,
Sustainable Winegrowers New Zealand,

Zespri (on behalf of the kiwifruit industry),
Avocado Industry Council,
New Zealand Buttercup Squash Council and
FertResearch.

Regional Councils: Environment Canterbury,
Hawke's Bay Regional Council,
Environment Waikato,
Marlborough District Council,
Tasman District Council,
Environment Bay of Plenty,
Horizons Regional Council,
Greater Wellington Regional Council,
Northland Regional Council,
Auckland Regional Council and
Otago Regional Council.

18 A number of these stakeholders formed a project team (led by myself) who met on a regular basis (generally three times a year).

19 The Science providers included key staff from Crop & Food Research and HortResearch (now Plant & Food Research) and AgResearch.

20 Prior to the tool being developed a scoping exercise was done to:

- identify requirements of both Regional Councils and industry;
- evaluate existing nutrient management tools;
- ascertain national and international requirements and restrictions on nitrogen use;
- review current management practices with regards to nitrogen use.

21 The end result of this scoping exercise was a comprehensive document referred to as Milestone Zero (http://www.maf.govt.nz/sff/about-projects/search/05-004/milestone-zero-final-report.pdf) that has proved a valuable resource for industry and Regional Council alike. A copy of the report has also been provided to Commissioners. Key findings were presented at a joint industry/Regional Council workshop from which a brief for the project team was developed.

22 The science team members were selected to provide the width of experience required to produce the required tool. The team brought together scientists who have over many years developed complex mechanistic models to simulate the interactions between plant growth, climate, soil type and management practices (such as fertiliser and irrigation). These models are essentially computer based research tools that can access databases of soil and climate information, overlay plant growth models and using a series of mathematical equations predict outputs such as yield, nitrate leaching (amount and concentration) under a user selected management regime. These models have been validated by comparing predicted with actual outputs from field trials. Crop & Food Research have developed expertise in the arable and vegetable sectors resulting in the LUCI framework model, while HortResearch have predominately provided services to the fruit sector through their SPASMO model.

23 It is widely recognised that LUCI and SPASMO should only be used by experts. However, user-friendly and often crop specific forms have been developed for use by industry, with a view to achieving optimum efficiency of inputs while achieving maximum or desired yields. Regional Councils have also contracted Crop & Food Research and HortResearch to use the models to predict potential adverse environmental impacts of nitrogen use by the horticulture and arable sectors.

24 The mechanistic models LUCI and SPASMO were used to run a series of simulations at different locations with different soil types and different irrigation and fertiliser applications. These results were analysed to create simplified generic mechanisms for calculating water and nitrogen balances on a monthly time step. Other mechanisms for calculating drainage (evaporation, and transpiration) and mineral nitrogen status (crop nitrogen uptake, residue mineralisation, organic matter mineralisation) were also derived to enable the calculation of nitrate leaching from a user specified crop rotation and management regime. This research has been submitted to the New Zealand Journal of Crop and Horticultural Science for publication [Nitrogen balance model for environmental accountability in cropping systems, by R Cichota, HE Brown, RF Zyskowski, VO Snow, DI Hedderley, S Thomas, DM Wheeler] and has been presented at an international workshop [Cichota R, Brown HE, Snow VO, Wheeler DM, Zyskowski RF, Hedderley DI (2009) Assessing nitrate leaching from cropping systems using a nutrient budget model. In '16th Nitrogen Workshop - Connecting different scales of nitrogen use in agriculture'. Turin, Italy. (Eds C Grignani, M Acutis, L Zavattaro, L Bechini, C Bertora, PM Gallina, D Sacco) pp. 579-560.]

25 The Project Team obtained permission to incorporate these equations into the existing OVERSEER® nutrient budgets. OVERSEER® was selected as the preferred method of delivery because it is:

- Accepted by a number of Regional Councils as a preferred method of completing a nutrient budget;
- Extensively used in the pastoral industry and so already known by some industry consultants and farmer/growers;
- Underpinned by a well established owners group (consisting of MAF, FertResearch and AgResearch) who are committed to continually upgrading OVERSEER® and supporting training.

26 Outputs from the upgraded OVERSEER® model have been back validated against outputs from the parent models LUCI and SPASMO as well as experimental leaching data showing very good agreement in both tests.

27 Considerable consultation occurred during the development of the NMEA tool. The project was profiled at a number of conferences and in industry journals. Prior to release, the upgraded OVERSEER® was demonstrated to a number of potential end-users to obtain feedback:

- Two workshops were held with growers and council officers in Ohakune on the 18th, and in Horowhenua on the 19th of June (attended by approximately a dozen people);
- Two full day workshops were run sequentially for fruit and vegetable growers, arable farmers and fertiliser company representatives and Regional Council employees in Wellington late in December 2008 (approximately 30 people attended over the two days);
- A number of specific individuals (mainly from the fertiliser industry and research institutes) were asked to test the tool prior to its release.

28 The NMEA tool was released early in 2009 as the OVERSEER® arable, vegetable and fruit nutrient budgets version 5.4.3. Please refer to: http://www.agresearch.co.nz/overseerweb/. The next release of OVERSEER® due early in 2010 will include integration of reporting across an entire farming operation as opposed to individual paddocks – essentially bringing together the pastoral and horticulture/arable components.

Training

29 The focus moving forward for the project is providing training to increase awareness in relation to efficient N fertiliser use and to ensure uptake of the tool. The original project had a training milestone, however it became apparent that the training would require resources beyond that budgeted for. While OVERSEER® is relatively easy to use, an understanding of the fundamentals of nutrient cycling is required in interpreting the results and recommending any resultant management changes.

30 Massey University Fertiliser and Lime Research Centre recently offered a Short Course on Sustainable Nutrient Management (also referred to as the Intermediate Course) with a focus to upskill current users on the upgrade to OVERSEER®. The course was attended by approximately 35 people including employees from Horticulture New Zealand, Foundation for Arable Research, large vegetable companies, fertiliser companies, kiwifruit packhouses, diagnostic laboratories, wine companies and consultants. The course was run over three days and concluded with a 2 hour written exam and included sections on:

- key nutrient cycles;
- crop demands (both vegetable, arable and fruit);
- adverse environmental impacts of fertilisers;
- diagnostic techniques;
- nutrient budgeting (specifically using horticulture and arable OVERSEER® models).

This is only the second time this course has been offered and it will not be offered again until specifically requested (at least 15 participants are required to offer the course.)

31 Applicants to the course were required to have completed at least one tertiary level course in Soil Science or Land Resource Management or have significant practical or professional experience in production agriculture/horticulture or environmental science. For this reason the course will not be appropriate for a number of growers/farmers. To address this issue MAF SFF has agreed to provide additional funding with support from industry to develop a grower focused course which it is hoped will be run during 2010.

32 The NMEA project team discussed at length who constitutes an appropriate user of OVERSEER® if it is applied in a regulatory context. The options discussed ranged from growers provided they had attended an industry accredited course (such as proposed in Para 29) to attendees of the Massey University Advanced Sustainable Nutrient Management Course.

33 It is noted that in order to complete the Advanced Course attendees must have already successfully completed the Intermediate course. The Advanced course involves completing a series of case studies, including a dairy scenario, arable (field crops) scenario, and a scenario selected by the student. Students then attend a course at Massey University where latest literature on nutrient management and regional council policy is discussed. Students work in groups and discuss the case studies with a focus on preparing a nutrient management plan for growers/ farmers.

34 Anecdotal evidence from Massey University suggests the self selected case studies are predominantly dairy examples with very few fruit or vegetable examples.

35 Of the 202 students who have completed the Advanced Course 164 were from the fertiliser industry, 11 were regional council staff, 11 were farm consultants, 9 were researchers and the remaining 7 were listed as “other”.

Use of the NMEA tool in a Regulatory context

36 Issues remain around the application of the tool in a regulatory context. It was hoped that national agreement on ‘acceptable’ levels of nitrate leaching could be reached to advise users of the nutrient budgets as to whether or not their activities were acceptable. However, due to the complexity of this issue and the variation both between and within Regional Councils on what are acceptable levels, the focus has changed to using outputs from OVERSEER® as a basis for determining and monitoring limits on a case by case basis.

37 As with all models the tool is an approximation of what occurs in reality. There is some uncertainty around the accuracy of the tool because:

- It is based on extrapolation of data from a limited number of field trials to properties all around New Zealand;
- It is limited by current scientific understanding of how plants use water and nutrients, soil processes and the fate of nutrients in the environment. A particular

weakness has been identified in the way that the existing model predicts the amount of nitrogen being supplied naturally by the soil organic matter. A proposal was submitted to MAF SFF for the 2009/10 funding round to analyse existing data sets to quantify improved methods for estimating nitrogen from soil organic matter and integrate these methods into existing tools including OVERSEER® arable/vegetable and fruit. Unfortunately the application was not successful but it has been resubmitted this year.

38 The rate of mineralisation simulated by OVERSEER® has raised specific concerns in the Ohakune region. Virtually all nitrogen in soils is present in an immobilised organic form; inorganic forms are either quickly taken up by plants or lost from the system (e.g. through leaching). Organic nitrogen is mobilised into inorganic forms by the actions of a range of microorganisms in a process called mineralisation. In undisturbed soil mineralisation rates are low so organic nitrogen builds up to a relatively high level, particularly where leguminous (nitrogen fixing) crops are present. The process of mineralisation is accelerated following cultivation as the microorganisms involved in mineralisation are provided with additional oxygen which facilitates growth rate and soil aggregates are shattered exposing the organic nitrogen within to the actions of the microorganisms. The rate at which OVERSEER® models this process to occur, and when OVERSEER® calculates that it occurs, is based on analysis of only a few actual measurements of mineralisation (mainly from Canterbury field trials). This creates uncertainty about how accurately the rate of mineralisation calculated by OVERSEER® reflects the rate in other regions (e.g. Ohakune).

39 During the consultation process growers in Ohakune observed that OVERSEER® was predicting a relatively high level of nitrate leaching in the absence of fertiliser applications. A unique rotation approach is used in Ohakune to maintain soil structure and suppress disease occurrence whereby land is typically maintained in pasture and only cropped one – three years in ten. Based on the information presented in point 33 is would be expected that this management practice would result in the build-up of relatively high levels of organic nitrogen during the years of pasture which is then mineralised following cultivation and is then available for plant uptake or leaching. However, it is acknowledged that there is uncertainty about the rate and the timing of mineralisation which results in uncertainty about the level of nitrate available to be leached.

40 There are also issues with the application of the model. Given the available budget there were limits to how many plant species could be included. As such OVERSEER® can only provide budgets for kiwifruit, apples, grapes, avocadoes, peaches, barley, oats, maize, wheat, lupins, mustard, clover seed, ryegrass seed, broccoli, brussel sprouts, cabbage, cauliflower, lettuce, spinach, beans, lentils, peas, kumura, potatoes, beets, carrots, parsnips, onions, sweetcorn, squash and outdoor tomatoes. This list was selected on the basis of investment in the NMEA project and readily available scientific information on plant growth models.

41 It is noted that while this is an extensive list of crops, it does not include all crops grown in the Horizons Region. One such crop is berries. There is the ability to add other crops to the model, however such additions would be contingent on a range of factors, such as availability of crop data, funding and participation by stakeholders.

42 For these reasons it is desirable that there is ongoing investment in this area to achieve continuous improvement in the accuracy of the tools to enable them to be relied on to achieve Regional Plan objectives and requirements.

ENDS

References:

Oral presentations

The Foundation for Arable Research Annual Conference 2007

The Horticulture New Zealand Annual Conference 2007

The New Zealand Association of Resource Management Conference 2007

Landwise Conference on the 14th May 2008 in Gisborne

Summerfruit Conference on the 22nd July 2008 in Havelock North

Horticulture New Zealand Conference July 2008

FertResearch Technical Conference (16th October, 2008 Blenheim)

Oral presentations were given to the Land Managers Group (20 Regional Council staff members) on the 3rd of September in Christchurch 2008 and the Resource Managers Group (17 Regional Council staff members) on the 12th of September 2008 in Christchurch

Publications

The 2007 Cropping Year Book

COUNTRYWIDE article 18 May 2008

The New Zealand Cropping Yearbook 2009.

A poster presentation was given at the Fertiliser and Lime Research Centre Conference Palmerston North 11th February 2009.