BEFORE THE INDEPENDENT HEARING PANEL APPOINTED BY WAIKATO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (the Act)
AND	
IN THE MATTER	Submissions made on Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River Catchments

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PRIMARY STATEMENT OF EVIDENCE OF STUART JOHN FORD – BLOCK 2 FOR HORTICULTURE NEW ZEALAND

3 May 2019

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SUMMARY

1. When councils seek to use OVERSEER® (**Overseer**) as a tool to aid their legislative intentions in the vegetable sector I have some serious doubts about Overseer's ability to accurately predict the performance of the sector in terms of both N and P leaching. So there still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector.

2. It is my opinion that if a range of leaching values could be simulated in APSIM as proxies which the growers could then quite simply plug into their own situation. It would then be quite appropriate for utilisation of modelling capability, or a particular decision support tool, which is highly technically accurate but is not necessarily open to all to use.

3. It is my opinion that PC 1 would be better served by adopting a definition of the factors that should be considered in choosing an appropriate decision support tool, like those proposed in HortNZ's submission than specifying that it should be a particular tool.

INTRODUCTION

Qualifications and experience

4. My full name is Stuart John Ford. I am a Director of The AgriBusiness Group and work as an agricultural and resource economist based in Christchurch. I have a Diploma in Agriculture and Bachelor of Agricultural Commerce from Lincoln University and have undertaken post graduate studies in Agricultural and Resource Economics at Massey University.

5. I am a member of the New Zealand Agriculture and Resource Economics Society and the Australian Agriculture and Resource Economics Society. I am also a member of the New Zealand Institute of Primary Industry Management.

6. I have spent 37 years as a consultant in the agricultural industry, with the last twenty years specialising in agricultural and resource economics and business analysis.

7. I have undertaken a wide range of economic impact and cost benefit assessments of proposed statutory planning proposals.

8. I have prepared evidence and presented it to District and Regional Council Hearings Panels as well as the Environment Court and Special Hearing Panels on Conservation Orders.

Code of Conduct

9. While this is not a hearing before the Environment Court, I can confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses produced by the Environment Court and have prepared my evidence in accordance with those rules. My qualifications as an expert are set out above.

10. I confirm that the issues addressed in this brief of evidence are within my area of expertise.

11. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Role

12. I have been asked to prepare evidence for HortNZ in support of their key submission points on PC1.

13. I have worked as a consultant economist to HortNZ for approximately the last seventeen years in my specialist field which is economics and resource use, which in this case revolves around the modelling of nutrients and their discharges.

14. I have extensive experience in the use of Overseer in the pastoral, arable, horticultural, including the commercial vegetable production (**CVP**), sectors across New Zealand. I have also attended training in the use of APSIM and although I profess to have a working knowledge of its capabilities, I do not profess to have a detailed knowledge of its capabilities.

15. I undertook production of the report “Nutrient performance and Financial Analysis of Lower Waikato Horticulture Growers” for HortNZ and the Waikato Regional Council (**WRC**) which was used by the WRC in the production of the Healthy Rivers Wai Ora (**HRWO**) model.

16. I then assisted Chris Keenan in making a presentation to WRC in relation to HortNZ‘s concerns about the inadequacies of

Overseer in terms of its modelling capabilities to accurately model a commercial vegetable producers operation and about HortNZ's preference for the use of APSIM to enable a more accurate prediction of the discharge of the various nutrients.

17. I have then assisted HortNZ in the modelling undertaken by Jacobs by supplying them with the results of my earlier report which had been updated to the results that were produced by the latest version of Overseer.

18. I have taken part in meetings with WRC staff in relation to the opportunity to create a range of proxy nutrient discharge predictions for commercial vegetable producers using APSIM and the ability for the commercial vegetable producers to have their involvement in the GAP scheme accepted as a Certified Industry Scheme under PC 1.

19. I attended the PC 1 workshop and expert conferencing that was looking at the Economic and Scientific modelling. I attended both days of the PC 1 workshop that was looking at providing a solution to the commercial vegetable production sectors specific issues.

Purpose and Scope of Evidence

20. The purpose of my evidence is to comment on the issue of the use of Overseer as an appropriate model for estimating the N leaching of the commercial vegetable production sector or the criteria for the choice of an alternative model that best represents the potential leeching performance of the CVP.

21. I also wish to comment on the necessity for the CVP sector to produce an NRP and a 75th percentile figure.

EVIDENCE

Overseer

22. At p 298 in the Section 42A Report the Officers state that they acknowledge the limitations of Overseer while both the Technical Leaders Group (**TLG**) and the CSG determined that it was appropriate for use in the modelling undertaken and for establishing the Nitrogen Reference Point (**NRP**).

23. I would like to make the following points as to why I would question Overseer's appropriate use for commercial vegetable producers:

    (a) Overseer is a "black box" piece of software which means that its operation is not open sourced and therefore it is not able to be reviewed as to the accuracy of what it is modelling. At the same time it has not been externally reviewed in any form.

    (b) The modelling of Phosphorus (**P**) is crude in the way that Overseer analyses and reports the transfer of P across the surface of the ground.

    (c) The gross nature of the inputs used in entering data into Overseer (monthly data is the finest input timeframe) which are unable to accurately reflect the complexities of relatively fine scale vegetable production systems.

    (d) The fact that Overseer is not currently capable of modelling all possible crop types therefore forcing the modeller to choose proxy crops to represent the crop.

    (e) The fact the Overseer is a long term averaging tool which has a fixed, and somewhat limited, array of long term climatic data which it uses to spread the climatic data entered over, which represents an average of thirty years data.

    (f) In a paper written for ECan by Hulme[1] she identified 21 examples of complexities that were encountered during modelling in Overseer for the arable and commercial vegetable production sector and detailed the work arounds that she had to adopt to make the modelling work.

24. I also note that the Parliamentary Commissioner for the Environment (**PCE**) recently released his report "Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways December 2018" where he concludes that *" a significant amount of information needed to confirm Overseer's use in a regulatory setting is lacking*". He then goes on to make

[1] Hume et al 2015. MGM Technical Report Arable and Horticultural crop modelling. Report written by Plant and Food for ECan.

a number of recommendations as to what needs to be done to make Overseer suitable for use in a regulatory setting.

25. It is HortNZ's policy to work with Overseer to try and improve the accuracy of the N leaching figures produced by the tool. However, when councils seek to use Overseer as a tool to aid their legislative intentions in the vegetable sector I have some serious doubts about Overseer's ability to accurately predict the performance of the sector in terms of both N and P leaching.

26. In the report[2] which I wrote for HortNZ I identified a number of challenges related to modelling vegetable crops in Overseer which had a potential negative effect on our ability to accurately model the N leaching performance of the vegetable growing sector.

27. In that report The AgriBusiness Group commented on a review of the use of Overseer in the Arable and Horticultural sector as follows:

> *"The Foundation for Arable Research carried out an independent review of the use of OVERSEER in the arable sector, which incorporated consideration of the horticultural sector. It came up with the following conclusion:*
>
> *OVERSEER® is the best tool currently available for estimating N leaching losses from the root zone across the diversity and complexity of farming systems in New Zealand. This review sets out a pathway for improving its fitness for this purpose in the arable sector (see recommendations). It also highlights that the new challenges facing OVERSEER® place demands on the development team and model owners that need to be acknowledged and resourced appropriately."*

28. The review came up with the following recommendations which are relevant to the horticultural sector. The first of which is:

> *"OVERSEER® crop model estimates of N leaching should be evaluated against measurements of N leaching to identify whether there are any systematic errors in predictions."*

29. We note that this has been the subject of new projects facilitated and led by HortNZ and the Foundation of Arable Research through the "Rootzone Reality" Programme establishing a national network of lysimeters. Of direct relevance is the extension of this project in partnership with Auckland Council and Waikato Regional Council. The extension has led to a series of additional trial sites where

[2] The AgriBusiness Group (2015): Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers

groups of fluxmeters have been installed under cropping land in Pukekohe, Pukekawa and Matamata to directly measure nitrogen discharges below the rootzone. The work was commenced in 2014 with installation of sites. It will take at least 3-4 years to establish measurements that are useful. It will take additional time for the Overseer owners to incorporate the new information into modelling predictions.

30. The second recommendation was:

> *"OVERSEER® crop model estimates of N leaching should be evaluated against predictions of long term leaching produced by established, detailed research models e.g. APSIM."*

31. HortNZ, Foundation for Arable Research and the Fertiliser Association of New Zealand contracted Plant and Food Research to test Overseer results in comparison with APSIM. The project was started in early 2015 and delivered its final report[3] in early 2017.

32. The analysis identified that there were key places in the calculations where differences are occurring in the output of N leaching data in both the arable and horticultural rotations which they ran through both models. It was the opinion of the authors that these differences were caused by inaccuracies in the way that Overseer was modelling both the arable and horticultural rotations.

33. The Plant and Food Research team recommended that it would be worthwhile to carry out further investigation into:

    (a) Create outputs of all the components of the water and nitrogen balances in Overseer and SCRUM-APSIM and key predictor variables to enable full comparison of the models.

    (b) Further investigation into the Overseer hydrology model in order to identify what is causing it to over-estimate leaching rates and the possible methods of improvement.

    (c) A detailed comparison of the components of the N balance is needed in order to determine where improvement is required.

[3] Khaembah E, Brown H (2016): OVERSEER crop module testing – end of project report

34. The third recommendation from the FAR review into Overseer was to:

> *"The testing outlined in recommendations (1) and (2) is likely to identify and justify areas for further development of OVERSEER® to improve N leaching predictions."*

35. As far as I am aware none of the three recommendations made in that report have been completed. This is at least partially due to the development of Overseer being limited by the expenditure of capital and partially due to the low priority put on the development of vegetable production capability by Overseer.

36. So there still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector.

37. I note that in the Section 42A Report for the Block 2 hearings the Officers' note that:

> *"…Overseer use for CVP is subject to an expert conferencing session and will be discussed in a future section of this report."*

38. I was involved in the expert conferencing on CVP and would report that in my opinion that it reached a conclusion where the parties could not conclude to agree on a satisfactory way forward. However, there was a considerable expression of a general desire to continue to work through the issues.

39. One of the key issues of disagreement, from my perspective, was the HortNZ offer to allow the calculation of some proxy N leaching figures which ranged across the various soil types represented and across a range of representative rotations which are able to be modelled more accurately in APSIM than in Overseer.

40. These leaching values would be listed in a table and then would be used by the CVP growers to estimate their N and P and sediment leaching values. It could well be that some of the growers may prefer to have their own leaching values developed fully through the use of APSIM. Whichever means that they were developed under, both the growers and the WRC would have a more realistic value to use in estimating the impact of the CVP sector as a whole and the impact of any Good Farming Practices (GFP) and any possible further mitigations which they were able to adopt in order to achieve the water quality targets as part of the development and actions in their FEP.

41. Section C1.1.13 in the S42A Report analyses submissions relating to Overseer versions. Officers determine to amend Schedule B of PC1 to require NRP to be calculated using the "most recent" version of Overseer. Should the Panel or Council determine to apply the NRP as an activity threshold and retain the "most recent" version approach, I would recommend that any NRP threshold developed in the course of this plan would therefore have to be adjusted accordingly each time also.

APSIM

42. APSIM is a modular modelling framework developed by Queensland DPI, CSIRO and University of Queensland involving interacting sets of biophysical, management and data entry modules. The modular framework affords potential for new modules to be added to the model from various research initiatives or for parameters of varying soil or management activities to be shared. APSIM potentially offers several advantages over Overseer, including:

    (a) Ability to integrate daily climate inputs;

    (b) Ability to integrate dynamic management inputs;

    (c) Finer temporal resolution in modelling processes and calculating outputs.

43. APSIM is increasingly being used in New Zealand to help understand and quantify farming practices and the efficacy of the program has been evaluated against the industry and government standard Overseer modelling platform. APSIM has been shown to provide comparable long-term results whilst also providing additional temporal information and agricultural process capability (Snow, et al., 2009; Cichota and Snow, 2010; Cichota, et al., 2012; Cichota, et al., 2013; Vibart, et al., 2015).

44. In New Zealand our ability to use APSIM in arable and CVP sectors with a high degree of confidence is enhanced by the development of SCRUM-APSIM by Plant and Food Research.

45. SCRUM-APSIM is the Simple Crop Resource Uptake Model operating within the APSIM framework (www.apsim.info/). The crop model SCRUM, was developed using the mechanisms and coefficients of the Overseer crop model (Cichota et al. 2010), and so the two models have similar functionality with

regard to crop processes. However, unlike Overseer, SCRUM includes dynamic water and N functions to allow production to decrease when water or N shortage occurs. Documentation of the SCRUM model can be viewed at http://www.apsim.info/ApsimxFiles/SCRUM454.pdf. Within APSIM, the nutrient and soil water modules function on a daily time-scale, allowing continuous simulation of changes in the N and water status in response to weather, management and crop uptake (Probert et al. 1998; Holzworth et al. 2014).

46. In particular, the greater flexibility in development of management practices and the ability to incorporate time-sensitive and transient farming scenarios (such as variable fertiliser applications; changing practice with time and climatic variability) allow realistic farming scenarios to be developed and provides a solid platform for future impact predictions on a daily time-step.

47. APSIM has the following advantages:

(a) Data can be entered in daily time steps.

(b) The results of known research trials can be entered into its source code.

(c) Actual annual weather conditions can be entered into it.

(d) The algorithms used can be adjusted to reflect what is known about the growth habit of the crop.

48. The major disadvantage is that it requires a degree of specialist knowledge in terms of its set up and operation.

49. It is my opinion that this disadvantage could easily be overcome if a range of leaching values could be simulated as proxies which the growers could then quite simply plug into their own situation. It is my opinion that this means of use is quite appropriate for utilisation of modelling capability, or a particular decision support tool, which is highly technically accurate but is not necessarily open to all to use.

50. I concur with Mr Keenan's view that because of the relatively small numbers of operators that would have the potential to use APSIM that capacity exists to enable accurate representation of the CVP sector.

Choice of the most appropriate decision support tool

51. At present under PC 1 there is a very strong push to nominate Overseer as the model of choice, or an alternative model approved by the CEO to be used by farmers to establish their NRP and to be used in their FEP as the decision support tool that could be used.

52. As previously discussed in this evidence Overseer would not be the decision support tool of choice for at least the CVP sector. This is for a number of reasons including the lack of accurate information produced and because it causes the emphasis to be placed on N when there are four contaminants that must be considered.

53. It is my opinion that PC 1 would be better served by adopting a definition of the factors that should be considered in choosing an appropriate decision support tool like those proposed in HortNZ's submission than specifying that it should be a particular tool.

54. In that way the adequacy of the tool being used can be evaluated by either the auditor of the FEP or the council staff, in the case where they were applying for a consent, to determine whether the model used was appropriate.

CONCLUSION

55. When councils seek to use Overseer as a tool to aid their legislative intentions in the vegetable sector I have some serious doubts about Overseer's ability to accurately predict the performance of the sector in terms of both N and P leaching. So there still remains a high degree of uncertainty as to the results produced by Overseer in the CVP sector.

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Stuart Ford for Horticulture New Zealand
3 May 2019