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

STATEMENT OF EVIDENCE BY STUART JOHN FORD
FOR HORTICULTURE NEW ZEALAND

29 AUGUST 2014

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1. QUALIFICATIONS AND EXPERIENCE

1.1 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.

1.2 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.

1.3 I have spent over thirty years as a consultant in the primary industries, with the last fifteen years specialising in agricultural and resource economics and business analysis

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

1.5 As part of my work I have been extensively involved in the calculation of nutrient discharges through the use of OVERSEER and the economic assessment of mitigation strategies that farmers can use to reduce their discharges and runoff. Some relevant pieces of work include "The Impact of Water Related Management Changes" which was written for the (then) Ministry of Agriculture and Forestry and "Selwyn Te Waihora Nutrient Performance and Financial Analysis" which was prepared for ECan and Irrigation NZ.

1.6 Two particular pieces of work which I have carried out for the Horticultural sector are "Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers" which was prepared for the Ministry of Primary Industries and Horticulture New Zealand and "Nutrient Performance and Financial Analysis of Horticultural Systems in the Horizons Region" which was prepared for Horticulture New Zealand.

1.7 In both cases I developed example grower rotations across a range of growers which were then modelled in OVERSEER and then a range of mitigation techniques were modelled across the representative models. At the same time budgets were created for each model and the impact of the

mitigations was tested to determine the financial impact of each mitigation.

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

1.9 I have been asked by Horticulture New Zealand to provide this evidence.

1.10 In preparing my evidence I have reviewed:

1.10.1. ECan: Proposed Variation 1 to the Proposed Canterbury Land and Water Regional Plan.

1.10.2. ECan: Proposed Variation 1 to the Proposed Canterbury Land and Water Regional Plan Section 32 Evaluation Report.

1.10.3. Robson M for ECan: Technical report to support water quality and quantity limit setting in Selwyn Waihora Catchment.

1.10.4. Lilburne et al (2013): Estimating nitrate nitrogen leaching rates under rural and uses in Canterbury. Report No R14/19 for ECan. (Lookup Table Report)

1.10.5. Snow V et al (2008): Steady state nitrate leaching: Predictions for selected Canterbury Plains soil types, climates and farm systems. Report No R08/65 for ECan. (The Lookup Report)

1.10.6. Green S, Clothier B (2008): Nitrate leaching under various land uses in Canterbury.

1.10.7. Green S, Clothier B (2009): Nitrate leaching under various land uses in Canterbury.

1.11 I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Consolidated Practice Note dated 1 November 2011. 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.

2. CONTEXT AND SCOPE OF MY EVIDENCE

2.1 My evidence is given in support of the submission by the Horticulture New Zealand in relation Variation 1 (Selwyn Waihora) to the Proposed Land and Water Regional Plan ("**Variation 1**"). In particular I will be providing evidence regarding the work I have done that provides an overall analysis of the cost of Variation 1 to the horticultural sector in the region.

2.2 In the evidence that follows I consider the following matters:

2.2.1. The nature of horticultural land in the region;

2.2.2. My analysis of the economic impact on the horticultural sector of Variation 1;

2.2.3. A review of the economic evidence for the Council; and

2.2.4. My conclusions and recommendations.

2.3 By way of a high level overall summary it is my evidence that there is a much higher adverse economic effect on the horticulture sector than is currently demonstrated by the evidence from the Council

3. THE NATURE OF HORTICULTURAL LAND IN THE REGION

3.1 My evidence relates to vegetable growers. This is a definition of growers that range from intensive market garden operations which have a combination of a wide number of crops which include leafy greens, brassicas, root crops and cucurbits through to the more traditional arable farmer who includes a relatively small area of process crop or root vegetables in their rotation.

3.2 All of these growers are on relatively deep soils which has a major impact on limiting the amount of N leaching which occurs in their operations.

4. MY ANALYSIS OF THE ECONOMIC IMPACT ON THE HORTICULTURE SECTOR OF VARIATION 1

Limits in the Lookup Table Report

4.1 The purpose of the Lookup table report was to provide a range of Nitrogen loss factors that could be used across a

range of land uses and soil types in a known location. At the time that it was initiated it was felt that it was impossible to model the results accurately so it was decided to base the analysis on what could be modelled and then create relationships to fill in the other land uses and soil types. The relationships were created at a series of workshops which incorporated the scientific knowledge at the time. In the majority of instances the relationships were created as a consensus of opinions of those attending the meetings.

4.2 The report was updated when the latest version of OVERSEER (Version 6) was made available in the middle of 2013. Despite Version 6 of OVERSEER having an extensive range of vegetable crops available to be modelled and an increased ability to model arable operations with a higher degree of accuracy neither the vegetable models nor arable model were updated to include the results of OVERSEER modelling.

4.3 Therefore the modelling which was carried out on the Arable model was carried out by the use of LUCI09 model and the vegetable modelling was carried out using the SPASMO model. Some of the information that makes up the results that you can get from modelling in OVERSEER is informed by the same science that is used in the LUCI 09 and SPASMO results, but how comparable the two modelling results are, is unproven.

4.4 A review of the reports by Plant and Food into their SPASMO modelling which created the N leaching values for vegetable growing indicate that in the case of the 2008 report they modelled a continuous rotation of a single crop lettuce. For their subsequent report (2009) they again modelled a continuous sequence this time using a brassica crop.

4.5 In both of their modelling exercises they applied a single dressing of 150 kg N / ha of Urea to the surface of the crop at sowing and then allowed it to be washed through by irrigation and rainfall.

4.6 While the adoption of this model technique may have been adequate to demonstrate the sort of results and interrelationships that occur between the soil types for this class of land use it does not necessarily reflect the results that we could expect from the growers operations. This is

because the range of crops grown is far more diverse than that modelled and that the both the rate of application, frequency of application and means of incorporation of fertiliser is different than that practiced by growers.

4.7 This creates a difficulty in that the creation of the N leaching factors have been undertaken by a separate means to those derived by OVERSEER. However the performance of growers operations have to be reported in an OVERSEER format. How comparable the results are has not been tested so it is impossible to make a definitive statement on their applicability to the actual situation.

4.8 I also have concerns about the way that the relationships were then developed as there is no explanation of the various relationships developed by the experts. In the update report it states that "these results were then extrapolated following a similar set of rules and trends as were used in the previous version of the lookup table". I am not sure what this means by a "similar" set of rules and trends. Does this means that a whole new set of relationships were created that were similar to the ones that were developed by the experts or what? On what basis were they developed? To me this does not indicate a very scientific methodology in developing the relationships.

4.9 I conclude that the method used to calculate the N leaching performance of growers is very theoretical in nature and do not indicate a very robust method of allocation. This is particularly so in light of the fact that there is the capability within OVERSEER to actually model the majority of the potential land uses and soil types.

Limits in the way that ECan then allocated the land uses

4.10 In order to create a catchment wide model ECan then used AgriBase data to allocate the soil leaching factors across the range of land uses and soil types found in the catchment.

4.11 As I have already stated there is a huge range of operations in this sector from market gardeners to arable farmers. I understand how the AgriBase data is collected and the frequency of updating it. This would lead me to contend that it could not accurately identify the range of operations present on a farm enough to be available to distinguish

between these different types of operations that are present in the horticulture sector.

4.12 This would have resulted in either an under or over estimation of the amount of this land use within the catchment with a corresponding over or under estimation of the contribution of this sector to the total amount of N leached.

4.13 This then raises doubt over the accuracy of the resultant model information. I believe that although this method of calculation may have been sufficient to guide the Zone Committee in its comparison between options I do not believe that it offers sufficient accuracy to allow the results of the exercise to be used in exercises such as the determining the amount of mitigation which is required.

OVERSEER Issues

4.14 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.*

4.15 The review came up with the following recommendations which are relevant to the horticultural sector:

4.15.1. 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.

4.15.2. 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.

4.15.3. 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.

4.16 OVERSEER is not what I would call being in a "steady state" as yet. I believe that it is a work in progress rather than an accurate modelling tool at present. I expect that as it improves by the rectifying of its current modelling errors and includes more sophisticated ways of more accurately calculating the N leaching performance of the various land uses we will gain much greater confidence in the results which it generates. Nevertheless it is the only freely available modelling tool available to us at present and therefore it is the best available tool.

4.17 Horticulture New Zealand are part of a team that is currently funding a research programme that is designed to determine which of two options to model N leaching results is the best for horticultural operators. They are comparing the operation and results of OVERSEER and an Australian modelling tool (which has had the necessary changes made to make it relevant for New Zealand soils and climatic conditions) called APSIM.

4.18 Limitations to the use in OVERSEER for Horticultural operations were identified in my work on modelling grower rotations in the Lower Waikato region (Appendix 1) and included:

4.18.1. The crops that can be modelled;

4.18.2. Working in monthly time steps;

4.18.3. Incorporating side dressings;

4.18.4. Inclusion of total area under crop;

4.18.5. Limited range of irrigation options;

4.18.6. Limited range of fertiliser options.

4.19 OVERSEER does provide inaccurate results at present. These causes of inaccuracy are twofold. The first is that there are still a number of bugs within the programme which mean that the results produced are inaccurate. Although many of these bugs are known to the programmers it takes some time before they are fixed. There are probably still unidentified bugs in the program that are affecting the results. The second factor is that there are a large number of assumptions and options that an operator can choose that have a significant impact on the nutrient emissions reported.

4.20 In order to get a degree of commonality in the way that OVERSEER is used the owners put out a protocol "The Overseer Best Practice Data Input Standards (August 2013)" which lists the recommended best practice options for entering data into OVERSEER. However it should be noted that many of these options have a number of choices of methods which are listed from first choice to last choice and give the operator a choice of which option that they choose.

4.21 In my experience most statutory requirements for rule setting used in other Regions which are connected to an OVERSEER result specify which version of OVERSEER that they are referring to. Presumably as the version of OVERSEER is updated the resultant figures are updated to reflect the newer more accurate result.

4.22 At present we know that there are quite major changes in the results that come out of the various versions of OVERSEER. This is as a result of corrections of known bugs in the programme and the inclusion of more accurate data and means of calculating the impacts of various options. Some of the changes in results can be quite extreme between different versions of OVERSEER.

4.23 For example, I carried out my analysis on the Lower Waikato growers in version 6.1.0 in February 2014. When I open up the same files in the latest version 6.1.3 which was released on Friday the 22nd August 2014 the results have almost doubled from those calculated earlier.

Table 1: N leaching results from different versions of OVERSEER

	V 6.1.0 February	V 6.1.3 August
Rotation 1	58	93
Rotation 2	65	105
Traditional market garden	73	123

4.24 Without looking deeply into the results it is impossible to be sure which result is the closest to the correct result or what changes have occurred inside the calculations within OVERSEER to cause the result to change so drastically.

Issues with determining the 'Nutrient Baseline"

4.25 In the Land and Water Regional Plan it is stated that the "nutrient baseline" figure for existing farms should be averaged over the four years from 2009 to 2013.

4.26 As I have reported already this creates problems with the version of OVERSEER that the historic data was calculated in. At the very least this would mean that the each of the budgets was updated to reflect what the latest version of OVERSEER results. I would also recommend that the budget was brought up to the standard of the Best practice Data Input standards.

4.27 My experience in carrying out 40 of these "nutrient baseline" exercises for Central Plains Water was that it was practically difficult to collect enough accurate information to do four years' budgets.

4.28 However in an explanatory document it states that "if the farm is in a steady state then just one budget covering the average situation during that period would be sufficient". In consideration of the fact that there was no absolute requirement to provide four years of data it was decided that it would be best to concentrate on providing one year's data which was seen to represent an average year.

4.29 This is particularly difficult for vegetable growers and arable farmers as their annual rotations vary significantly between years so it will be very difficult for them to do either a full four years' accurate calculation or provide for an average year in calculating their nitrogen baseline.

The results of OVERSEER modelling versus the Lookup Table results

4.30 Plant and Food Research has carried out OVERSEER modelling for Horticulture New Zealand on eight properties in Canterbury which represent the range of vegetable growers from intensive market gardeners on deep soils relatively close to the Lake to traditional arable farmers who incorporate some vegetable crops into their rotation on the medium depth soils across the plains.

4.31 In order to compare these actual farms with the theoretical values created in The Lookup Report I have listed the Lookup Table Report values across the soil types and climatic ranges

represented by the farms in Table 2. The values for the arable properties are taken from the section on Arable Seasonal- Precise Deficit Irrigation.

Table 2: N leaching values taken from The Lookup Table Report (kg N / ha)

	Vegetables Lincoln	Arable Lincoln	Arable Darfield
Medium Depth	19	8.7	9.2
Deep Soils	17	1.4	3
Poorly Drained Soils	8	0.7	1.6

4.32 The comparable results from the actual data gathered by Plant and Food are shown in Table 3.

Table 3: N leaching values taken from Plant and Food results. (kg N / ha)

	Vegetables Lincoln	Arable Lincoln	Arable Darfield
Medium Depth		22	26
Deep Soils	13	13	
Poorly Drained Soils	4		

4.33 What we can take from this comparison between the actual values and the theoretical values is that for vegetable production systems the actual values are less than the theoretical values. This is not surprising considering that the SPASMO modelling carried out to gain the theoretical values was based around a continuous rotation of a brassica using quite extravagant means of fertiliser application. For the Arable system the actual results are quite a lot higher than the theoretical values. Again this is not surprising considering the wide range of crops grown on the actual farms when compared against the relatively narrow range of crops able to be modelled in LUCI09.

4.34 What this means is that there is a tremendous amount of work yet to be done before the true nature of leaching results from the range of farmers represented here is able to be accurately calculated.

Good Management Practice and Mitigation

4.35 Policy 11.4.13(b) provides that from 1 January 2017 farming activities (over 50 ha in area and leaching more than 15kg/ha) will need to "meet the Good Management

Practice Nitrogen and Phosphorous Loss Rates for the property's baseline land use".

4.36 The Good Management Practice Nitrogen and Phosphorous Loss Rates are yet to be defined. The development of them is subject to an entirely separate work stream "the matrix of good management (MGM) practice".

4.37 The failure to describe what entails Good Management Practice makes it extremely difficult to comment on the inclusion of this policy in the plan. Presumably it has not been subject to any of the analysis required in the section 32 report therefore it is impossible to comment on its effectiveness or efficiency as a means to achieve the plans purpose.

4.38 Although Horticulture New Zealand are not opposed to the adoption of good management practice I believe that it would be better to wait until the MGM project had correctly defined what was required under good management practice and then incorporate them into the Plan at a later date.

4.39 In fact Horticulture New Zealand have invested a considerable amount into the development of a range of Good and Best Management Practices which are designed to achieve a number of objectives including limiting the leaching of nutrients into associated water bodies. Mr Chris Keenan covers this aspect in more detail and appends the guidelines to his evidence.

4.40 Policy 11.4.14 provides that from 1 January 2022 farming activities will need to make certain further percentage reductions in their nitrogen loss rates.

4.41 As I understand it after reading the document "Estimation of on farm mitigation requirements Draft 1" the levels of mitigation were calculated subject to all landowners being subject to the same level of costs to achieve that mitigation "The operator then iterates through different EBIT costs until the desired level of total N mitigation is achieved".

4.42 While I applaud the adoption of that approach I am concerned about the accuracy of how it has been calculated. This is a very important issue for farmers and I believe that the approach taken to the modelling was very

theoretical and deserves a far more robust method of calculation.

4.43 I have already discussed my views around the accuracy of the AgriBase information and adoption of the land use calculations in determining the land uses which were modelled here.

4.44 Therefore my concerns are about the scope of the activities modelled and the accuracy of the mitigation costs used. While I believe that the approach taken may have been appropriate to provide decision making options for the Zone committee to choose between I do not believe that they are appropriate to be used to set a percentage reduction across land uses.

4.45 The LWRP suggests that 7% mitigation for Arable farms is the appropriate level of mitigation and that 5% is appropriate for vegetable producers in order to meet the calculated maximum tonnage of N.

4.46 As I noted in my report on Selwyn Te Waihora:

> *"is the very low levels of N leaching from arable farm systems. This is due to the heavy soils that they are predominantly carried out on, the continuous nature of the cropping rotation, the adoption of minimum tillage techniques, the application of N and irrigation during the growing season (spring) of the crop, the application of N and irrigation at rates that meet the growing demands of the crop, the use of cover crops during the winter and the relative lack of animals on the property."*

4.47 This led me to the conclusion that the only mitigation techniques that were worth pursuing on Arable properties was the reduction of animals.

4.48 If we examine the table on reductions used for Arable we see that they list a range of mitigation options which I consider to be part of good management practice already, apart from the reduction of inputs by 15%.

4.49 I should note that there is no mention of considering vegetable growing in the mitigation table so it is not possible for me to conclude how that they determined the level of EBIT costs that would result from the adoption of any mitigation activities.

4.50 I have carried out a number of exercises looking at options to mitigate N leaching from vegetable cropping regimes

and have found every time that a reduction of about 10% in inputs to an arable farming system causes the whole operation to go into a deficit situation.

4.51 I note from this level of mitigations further into the table they state that the costs are unknown.

4.52 I do not then know how the modelling exercise can possibly determine that the appropriate level of mitigations from the arable sector should be 7% or the vegetable sector should be 5%. OVERSEER only reports N leaching performance in whole numbers so if the nutrient baseline number is less than 20 it is impossible to calculate or report it accurately using OVERSEER.

4.53 I therefore conclude that the analysis done to date on the issue of Good Management Practice and the provision of further reductions is a very academic and inexact exercise.

4.54 Therefore the mitigation amounts calculated are not an accurate reflection of the relative costs of mitigation by each sector and that they should not be included in the plan at present.

4.55 I believe that time should be taken between now and 2022 to develop a more accurate method to allocate the mitigation options, if there are any, that are open to growers.

The potential loss of land use flexibility

4.56 As it stands at present the calculated nutrient base line cannot be exceeded and if the rules related to Good Management Practice and the subsequent mitigation practices to be enacted in 2022 the allowable N leaching figures will remain with the property and may reduce even further.

4.57 In the case of Arable and Vegetable growers the nutrient baselines are relatively much lower than those calculated for other land uses such as Dairy farming and Dairy Support operations. The class of land which most of these operations are carried out on is highly flexible and is suitable, subsequent to some modification, to convert to those other land uses.

4.58 As the relative profitability of the various land uses changes in the future there will be real economic pressure for the land

use to change. As the rules stand at present it will not be possible to make the changes because the property has too low a nutrient baseline to be able to make the change to a higher N leaching land use.

4.59 This will create financial hardship for the individual who will be stuck with the land with the highest adaptive ability but the lowest baseline figure. Therefore there will be little if any demand to purchase the land by higher returning and higher leaching land uses. Therefore the value of the land will drop according to the returns that can be made by the land uses which are possible within the relatively low baseline figures.

4.60 There will also be a negative impact on the total economic output possible from within the Catchment because the land uses will be forced to remain at the lower economic land use because they have a low (but highly efficient) N leaching allowance.

4.61 As this situation has not occurred in New Zealand it is not possible for me to quantify the financial impacts on individuals or the economy as a whole.

4.62 I believe that there are two possible solutions:

4.62.1. The first is the adoption of a trading mechanism for N leaching, which I cover later in my evidence;

4.62.2. The second is the retention of some of the allowable N leaching within the catchment to be allocated as required.

4.63 Both of these options are highly dependent on the rules under which they operate which would have to be designed with extreme caution.

Commentary on the reliability of irrigation water

4.64 In this section I comment on the reliability of irrigation water with particular reference to the Reasonable Use Test in Schedule 10 of Variation 1.

4.65 The irrigated crops that I refer to in my evidence include the full range of vegetable crops which are grown in the catchment. In the rotation there are different times for planting and harvest. Irrigation demand depends on the time of planting and the time that a crop is in the ground.

Crops have different water demands at different times of the year with the highest occurring in the summer months of December through to March. However water demand can occur outside this time period.

4.66 These crops require irrigation of some sort during the periods when they are grown that coincide with the periods when evapotranspiration exceeds the available soil moisture. The irrigation is for two purposes. The first is to maintain the yield of the crop and the second is to maintain the quality parameters of the crop. Both elements are equally important in terms of the effect that they have on the economics of growing the crop. Without the yield component they are uneconomic to grow and without achieving the quality parameters they are uneconomic to grow. The availability of highly reliable Irrigation water is essential to the continued viability of growing these crops in the Canterbury Region.

4.67 For example, in the case of growing onions there is the important element of the grading criteria for the size of the onions. There could be up to double the value depending on the size grades that onions fit into. The objective is to get as many as possible into the desired range. This is set up by drilling but is maintained by irrigation. If irrigation is missed during a crucial growth period the crop will fail to meet the size requirement.

4.68 In relation to potatoes quality parameters are first influenced by the size of tubers that are grown but then quality is also influenced by the shape and the look of potatoes for the fresh market. For process potatoes there is a range of other attributes that are tested for to ensure that the processed product achieves the desired standards which are essential to meet the requirements of the processed product. All of these characteristics have a large influence on the price paid for the crop.

4.69 Unfortunately the cost of growing them is virtually the same if they meet the quality standards or not. Therefore any downgrading of quantity of yield and/or the quality of the crop can put the grower into the situation of making a loss on the growing of the crop.

4.70 The economics of growing carrots depends on achieving relatively high yields while also meeting tight specifications

as to carrot size. Missing one or two irrigations could mean that the specifications for the crop fall outside those required. At this point there is virtually no alternative use other than stock feed for the crop.

4.71 Greens are also subject to very tight specifications. Both retailers and consumers require a certain quality product as to size, taste and the look of the product. Failure to achieve these specifications means that the product is rejected from sale and there are very few alternative outlets for the crop. Certainly there are none that offer sufficient returns that would mean that the grower was able to make a profit on the inferior crop.

4.72 All of these crops have a dependence on irrigation for both yield and to meet stringent quality specifications. The amount of irrigation may not be large but it is absolutely vital to the continued growing of them as it is the difference between a profit and a loss. Therefore consideration of the need for reliability of access to irrigation water needs to be given to these horticultural crops.

4.73 There are three major types of efficiency of water use:

4.73.1. The first is **Technical Efficiency** which determines the rate at which resources, capital, labour are converted into goods. More goods produced for a given set of resources equates to higher technical efficiency.

4.73.2. The next is **Allocative Efficiency** in which resources are optimally allocated to the production of different sets of goods in such a way that the welfare of society is maximised.

4.73.3. The third is **Dynamic Efficiency** which allows use patterns to evolve over time.

4.74 Because of the nature of the crop rotations and the need to move areas cropped and irrigators from location to location they sometimes will not be as technically efficient as we would expect from say a centre pivot irrigator. Nevertheless many of the irrigation applications on horticultural crops are of a lower volume, and are generally applied more regularly than that for pastoral agriculture and therefore achieve a higher technical efficiency than most pastoral farming irrigation practices.

4.75 Horticulture is also very efficient when it comes to allocative efficiency. This relates to the value generated from the use of the water resource. This is generally measured as dollars generated per cubic meter of water used ($/m3). The combination of high Gross returns and the relatively low total amount of irrigation water used mean that Horticulture achieves measures three to eight times that of alternative uses of the water.

4.76 I would also point out that pastoral agriculture is not solely dependent on irrigation and has alternative means of providing for the feed to produce the gains made from irrigation. These range from purchasing or making hay and silage to introducing a range of alternative purchased feed sources such as molasses, grain meal, maize silage, palm kernel etc.

4.77 In terms of establishing priority to horticultural use I believe that there is good justification for horticultural use to be granted priority status at times of water shortages or low flows over all other users. The times when water is essential to crops coincide with times when water shortages occur. If water was shut off to those crops the growers could suffer a complete loss of revenue or at the least their revenue would be lower than their costs of production.

4.78 At present, as proposed, horticultural irrigators would need to cease irrigating along with pastoral irrigators once trigger levels are reached. As already explained the pastoral irrigators have alternative means to provide for the feed that they would lose. This would mean that the only people who would suffer financially would be the horticulturalists. Considering the high returns to horticulture per unit of water consumed this would cause considerable losses. I therefore believe that the horticulturalists should receive priority in terms of access to irrigation water over the pastoral uses. This would require pastoral users to lose access to water before horticulturists in times of water restrictions.

4.79 In my view the current proposed rule structure disadvantages horticultural land use as it treats horticultural irrigation rights the same as irrigation rights from all other land uses when it is obvious that their reliance on irrigation is much higher than other uses and their return to irrigation is much greater. I believe that there is no justification for this treatment of horticulture and believe that there is a strong

imperative to have horticulture elevated to a position of priority.

5. A REVIEW OF THE ECONOMIC EVIDENCE FOR THE COUNCIL

The adequacy of the Section 32 analysis.

5.1 Under the requirements of the RMA Amendment Act (2013) which was partially designed to improve the quality of section 32 evaluations, particularly for the assessments of benefits and costs, Councils are required to carry out:

> *An assessment under subsection (1)(b)(ii) must—*
>
> *(a) identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the provisions, including the opportunities for—*
>
> *(i) economic growth that are anticipated to be provided or reduced; and*
>
> *(ii) employment that are anticipated to be provided or reduced; and*
>
> *(b) if practicable, quantify the benefits and costs referred to in paragraph (a); and*
>
> *(c) assess the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions.*

5.2 I have reviewed the section 32 report which detailed the extent of analysis which was carried out on the options analysed in coming up with the proposed changes in Variation1.

5.3 I found that very little if any quantification of the benefits and costs has been carried out. In some instances numbers have been generated to describe the status quo situation and the preferred response then the various outcomes of the different options have just been commented on as a matter of opinion as to whether the outcomes could be better or worse than the status quo situation.

5.4 I believe that this approach tends to indicate that the preferred option was quantified and then the intermediate options were casually filled in in retrospect of the actual decision being made.

5.5 This is contrary to the purposes of the Act which required that if practical the costs and benefits should have been quantified.

The value of Transfers

5.6 In my opinion the opportunity to instigate emissions trading into the catchment is a valuable tool. In 2006 I wrote a paper "Options for efficiency gains through trading within a community irrigation scheme" for The Ritso Society which was a group of dryland farmers within the catchment of the Central Plains Water scheme. In that paper I examined the possibility of both water and emissions trading.

5.7 In that report I concluded that:

> *Market based instruments (MBI) are seen as a tool to achieve sustainable resource use goals through the use of market signals rather than through explicit directives (command and control regulatory mechanisms). The international experience is that MBI are a next step tool when Best Management Practices are unable or inadequate to achieve the desired efficiency outcomes from resource use. Basically they work on the concept that they are able to efficiently encourage behaviour towards total efficiency goals through operation of a market. Markets work best when access to the resource is constrained or emissions are capped or restricted therefore there is a degree of scarcity of the resource. They also work best where there are significant differences in the individual's opportunity costs of resource use or emission reduction (significantly different values).*

5.8 I believe that we are now in the situation where the three major considerations have been met; BMP is inadequate, the market is constrained and there are significantly different opportunity costs between users.

5.9 Therefore if a market can be set up which enables low emission operations to trade or transfer their unused credits to high emissions operations. In that way total emissions are capped but no one is necessarily restricted from carrying out high value land use options because of relatively high associated emissions levels.

5.10 One of the key outcomes of setting up the ability to trade is to incorporate resource use values and resource use efficiency thinking into the individual business decision making process at the individual enterprise level as well as at the total resource use level.

5.11 The advantages of market based instruments are:

5.11.1. They have the potential to reduce the overall cost of achieving a certain level of environmental outcomes because they drive resource use to the most efficient outcome economically by allowing individuals flexibility to strive for efficiency.

5.11.2. They stimulate the rapid development of innovation in resource use technologies or management practices that reduce use below regulatory standards. This advantage is driven by the response of resource users to understanding the value of the resource that they are using and therefore having an economic imperative to maximise the return from the resource. In command and control systems the achievement of the regulatory standard is seen as a satisfactory end point and when it is reached there is no incentive provided to continue development of innovation or achieving further levels of resource use efficiency.

5.11.3. Some of the market based instruments are able to raise revenues which can then be used to achieve environmental outcomes through investment in mechanisms outside the market.

5.12 Therefore from a practical perspective there are a number of trading scheme design issues to be considered.

5.13 Experience shows that markets work best where:

5.13.1. Scarcity of the resource to be used or limits to emissions;

5.13.2. There is adequate knowledge within the market participants about issues relevant to the market, scientific cause and effect and the range of individual values around the resource use;

5.13.3. There is a wide variety or range of opportunity costs related to resource use with clear economic benefits from movement or transfer within the market;

5.13.4. The rules of trading are simple and transactions are easy to implement;

5.13.5. There are a number of potential market participants. There is much discussion from overseas experience about "thin markets" and lack of trades or transfers in markets as a result of there being a small pool of potential players in the market;

5.13.6. There is opportunity to increase total economic activity through trading as a result of purchasers being able to achieve a higher level of output or profit as a result of the trade than the seller.

5.14 I believe that there is considerable opportunity to gain further economic activity out of allowing the trading of emissions rights within the catchment. However considerable effort will need to go into the important issue of design of the market and how it would operate.

5.15 Two of the most important aspects of market design that we can learn from overseas experience are that the market should have simple rules and low transaction costs and that there would need to be education and training programmes amongst the potential participants to allow free trading to occur.

Allocation of Rights to Emit

5.16 During the Zone Committee process I was a very strong supporter of an allocation system which recognised the inherent nature of the land resource to emit Nitrogen. This has been described in other exercises as the "natural capital" approach. My support and promotion of this approach was primarily because of the huge range of N leaching values across the catchment which are governed by the soil type and climatic location.

5.17 After much deliberation the Zone Committee's decision was to go for a grandparenting approach to the allocation of nutrients. This in effect allocates nutrients to a land use according to what is happening on that piece of land at present. In situations like the one that we are in whereby the total amount of emissions are capped and are inadequate for the total catchment grandparenting is seen as a satisfactory means to allocate emissions at the time it is brought in but it does not allow for the inevitable changes in land use which will be required in the future. In order to maximise the economic output from a Catchment and to

ensure that there is equity in land use values some sort of transfer mechanism needs to be put in place at the same time. That has not occurred in this case.

5.18 As has been outlined in the evidence of Chris Keenan, Horticulture New Zealand has agreed an approach to Nutrient allocation which incorporates the importance of land use flexibility, the need to move nutrients to higher value land uses over time, the incorporation of the natural capital approach and the user/beneficiary pays approach.

5.19 What is proposed under Variation 1 at present contravenes all of these principles.

5.20 Therefore you need to make the choice of allocating the emissions in a different means at present or to continue with the current allocation as an interim position and to make sure that some sort of transition is in place that will ensure that access to emissions are available in the future through a workable transfer or trading mechanism.

5.21 It would be possible to allow the current grand parenting approach to continue but at the same time require that the allocation system was able to transition over time to one in which the natural capital characteristics of the catchment determine the distribution of N emissions coupled by a means to transfer the emissions as require between the land uses.

5.22 In this way the catchment will be able to continue to adapt in its land use and fulfil its economic potential over time.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 The method used to calculate the N leaching performance in The Lookup Table is very theoretical in nature and does not indicate a very robust method of allocation. This is particularly so in light of the fact that there is the capability within OVERSEER to actually model the majority of the potential land uses and soil types.

6.2 The use of OVERSEER as the reporting tool at present requires a degree of caution because of concerns about the accuracy of results produced for horticultural operations.

6.3 The degree of changes in results from OVERSEER that occur as a result of version changes to OVERSEER mean that some sort of version control needs to be created.

6.4 Comparison of the results used in The Lookup Table Report and actual OVERSEER runs indicate that there is a tremendous amount of work yet to be done before the true nature of leaching results from the range of farmers represented here is able to be accurately calculated.

6.5 I believe that it would be better to wait until the MGM project had correctly defined what was required under good management practice and then incorporate them into the plan at a later date.

6.6 The mitigation amounts calculated are not an accurate reflection of the relative costs of mitigation by each sector and that they should not be included in the plan at present. I believe that time should be taken between now and 2022 to develop a more accurate method to allocate the mitigation options, if there are any, that are open to growers.

6.7 The current proposed rule structure disadvantages horticultural land use as it treats Horticultural irrigation rights the same as irrigation rights from all other land uses when it is obvious that their reliance on irrigation is much higher than other uses and their return to irrigation is much greater. I believe that there is no justification for this treatment of horticulture and believe that there is a strong imperative to have horticulture elevated to a position of priority.

6.8 I believe that there is considerable opportunity to gain further economic activity out of allowing the trading of emissions rights within the catchment. However considerable effort will need to go into the important issue of design of the market and how it would operate.

6.9 It would be possible to allow the current grand parenting approach to continue but at the same time require that the allocation system was able to transition over time to one in which the natural capital characteristics of the catchment determine the distribution of N emissions coupled by a means to transfer the emissions as require between the land uses.

Stuart John Ford

August 2014

Appendix One: Challenges related to modelling Horticultural crops in OVERSEER 6.1

The Foundation for Arable Research[1] 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.

The review came up with the following recommendations which are relevant to the horticultural sector:

> *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.*
>
> *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.*
>
> *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.*

The following list of challenges identified in this modelling exercise is not new as they have been identified in previous modelling of horticultural crops. The challenges are listed here to allow consideration of the impact of these issues on the modeller's ability to correctly model the practices undertaken by the growers. In some cases these practices are undertaken to improve the efficiency of use of N and P, the impact of which are not shown in these results.

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[1] FAR (2013) : A peer review of OVERSEER in relation to modelling nutrient flows in arable crops.

Crops that can be modelled.

OVERSEER has a reasonable range of crops that can be modelled, however this is limited from a horticultural perspective. This has meant that the rotations used in Rotation 2 and the Traditional Market Garden were somewhat compromised by the range of crops chosen. This has meant that the rotation does not represent what would actually be grown. However, we have chosen a similar crop both in terms of inputs and outputs so the end result may not be much different. However it may not appear to be logical from a growing perspective.

Monthly time steps.

OVERSEER works on monthly time steps of data entry for items such as cultivation, fertiliser applications and irrigation inputs. Horticultural operations work on much finer time steps which are unable to be incorporated into OVERSEER. Therefore the results would appear to be much more at a gross level than you would expect for horticulture.

Incorporating side dressings.

It is not possible to incorporate the application of fertiliser as a side dressing in OVERSEER. This is a horticultural practice which directly applies the fertiliser into the root zone of the plant, which are predominantly grown in rows. Therefore this practice results in more efficient plant uptake and reduces the total gross amount of fertiliser applied.

Inclusion of total area under crop.

It was not possible to select an option which would allow a lower proportion of the total area available being cropped at any one time as a result of an error in the programme. Once this error is fixed it will then be possible to represent the area cropped as a percentage of the total area available.

Limited range of irrigation options.

The choice of irrigation options is limited to those that are available for pastoral farming. This means that options that are available to horticulturalists such as soak mats etc. cannot be modelled. This can be overcome by selecting the actively managed option which means that the correct amount of irrigation required can be applied. However, this still would apply much more than would be applied if the alternative options were available which just apply water to the root zone of the crop.

Currently work being undertaken which will investigate and compare the way that irrigation is modelled in OVERSEER by including a daily time series for irrigation practice which will more accurately reflect the water balance of the soil.

Fertiliser options limited.

One of the mitigation options which we wished to test in this exercise is the use of slow release fertilisers. The range of fertiliser options available is limited to the standard range from each of the two major companies. Therefore it was not possible to test the impact of the application of slow release fertilisers. However, slow release fertilisers may not be able to adequately meet the crops requirement as there are certain times when vegetable crops have very high demand on N.