BEFORE THE ENVIRONMENT COURT **ENV-2020-AKL-00087**

AT AUCKLAND

I MUA I TE KŌTI TAIAO

I TĀMAKI MAKAURAU ROHE

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

AND

IN THE MATTER of the Proposed Plan Change 1 to the Waikato Regional Plan

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STATEMENT OF EVIDENCE OF STUART FORD (ECONOMICS AND FARM SYSTEMS) ON BEHALF OF HORTICULTURE NEW ZEALAND

28 JULY 2023

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EXECUTIVE SUMMARY

1. PC1 as proposed has the potential to negatively impact the production of fresh vegetables and, thus, the supply and the price of vegetables. It is my opinion that PC1 as proposed has the potential to lead to constraints on the supply of fresh vegetables through constraining the application of nitrogen which is essential to achieve marketable yields, not adequately providing for the area of land which is required for the growers to complete a rotation and not allowing for the expected increase in growth for demand.

2. The Deloitte report indicates that there is a need to start the conversation on food security around providing for the nation's future requirements for fruit and vegetables to at least maintain the current level of wellness within the population.

3. Dr Cleghorn came to the conclusion from her report into the health impacts of the Deloitte scenario that:

> *These small cumulative increases in the price of vegetables are likely to cause an important decrease in vegetable consumption in NZ over the next two decades. This is likely to lead to modest health loss to the NZ population and costs to the health system over time.*

4. The PerrinAg report indicates that the margins which the crops are grown on are on average very slim with the weighted average data indicating that the average annual profit of the weighted rotations is only approximately 10% of the revenue.

5. It is my opinion that PC1 has the potential to lead to the same scenario of a lack of supply and so a large increase in the cost of vegetables and therefore impacts on human health.

6. It is my opinion that the maintenance of the supply of fresh vegetables, now and in the future, should be an important consideration especially when you consider the relatively

small footprint of the sector compared to the pastoral sector as shown in the evidence of Mr Stuart Easton.

7. The results of the PerrinAg modelling are high on a per hectare basis, with a weighted average of 110 kg N/ha/year, compared to other fruit and pastoral sectors. Considering the very high volume of output from the CVP sector this is not surprising. However, HortNZ and the CVP sector are well aware of the need to minimise the risk of Nitrogen leaching and propose two means of handling this.

8. HortNZ propose that the CVP Risk Scorecard (**Scorecard**) can be used to prove that when growers move the place of growing, as they do quite regularly, that they haven't intensified their growing operation. The Scorecard can also be used as part of their Farm Environment Plan (**FEP**) to assist in demonstrating the effectiveness of the mitigations which they adopt.

9. It is my opinion that although the Scorecard is used for a different reason than the Fonterra Risk Score Card it compares very favourably with that score card because it incorporates three of the contaminants which are relevant to the CVP sector.

10. The area that is designated as being available for CVP production is required to be a multiple of the actual growing area at any one time.

11. If growers were provided the flexibility to rotate at the FMU scale, it would support the economic performance of businesses by managing the risk of pest and disease but would make very little difference to water quality at the sub catchment or FMU scale, because they are most likely swapping land with each other.

12. The mitigation which models improved sediment control has a significant impact on both phosphorous and sediment loss

in both the low and high slope scenarios with a relatively low negative impact on the profitability of the weighted average rotation. There is no doubt that the individual crops and rotations will vary greatly from the values shown here but I am of the opinion that it points to the considerable potential for growers to minimise the loss of P and sediment.

13. However, the three scenarios for reduction of fertiliser N applications, while making significant gains in the reduction of Nitrogen leaching completely destroy the profit of growing at the 2% level and then cause the finances to go into a negative return for the 5% and 10% reduction scenarios.

14. This is demonstrated by the weighted average rotation and there will, no doubt, be considerable variation across the sector which does offer the opportunity for growers to adopt the practices that are part of the Scorecard to minimise their impact.

15. These methods provide confidence that existing and new CVP activities will be subject to controls that will prevent intensification and drive the uptake of good management practices and maintained and improved water quality.

16. In my opinion, it is not realistic to expect that there is an offset of all four contaminants, but it is realistic to assess the net effect of the activity on the freshwater objectives as stated in Table 3.1-11 and granting consent if the assessment indicates that there would not be a net deterioration in those values.

17. It is my opinion that kiwifruit is a very well environmentally managed crop which has a low risk of N, P and sediment loss to water and therefore it is appropriately managed as a permitted activity.

INTRODUCTION

Qualifications and experience

18. 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.

19. 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.

20. I have spent over 40 years as a consultant in the agricultural industry, with the last twenty-five years specialising in agricultural and resource economics and business analysis.

21. I have extensive experience in the use of Overseer in the pastoral, arable and horticultural sectors throughout New Zealand and have undertaken training in the use of APSIM.

22. I have undertaken analysis of the nutrient (using Overseer) and financial performance of commercial vegetable growing (**CVG**) operations in South Auckland / Northern Waikato (which was used by the Waikato Regional Council in the production of the Healthy Rivers Wai Ora (**HRWO**) model), Hawkes Bay, Manawatu, Tasman, Canterbury and Southland for Horticulture New Zealand.

23. I have recently managed the provision of the APSIM modelling of the Commercial Vegetable Production (**CVP**)

sector for the Auckland Council[1] to inform their Freshwater Modelling Tool.

24. I have undertaken a wide range of economic impact and cost benefit assessments of proposed statutory planning proposals. My ability to carry out this economic modelling has been based on my extensive farm systems knowledge which has been built up during my career by modelling a vast array of farm systems including those of the commercial vegetable production sector.

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

Expert Witness Code of Conduct

26. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 January 2023. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Involvement in project

27. I have been involved in the Waikato Regional Council's (**WRC**) Plan Change 1 (**PC1**) process from its inception as the development of the Healthy Rivers Plan Change which culminated in the production of the proposed PC1.

28. I have been involved in meetings with WRC staff, expert conferencing on the proposed PC1 and have provided

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[1] Muller, C. and Inness, M. 2023. Horticulture Typology Modelling for the FWMT: a technical modelling report. A report prepared for Auckland Council and Horticulture New Zealand.

evidence in chief to Blocks one, two and three to the hearing commissioners. I have subsequently attended expert conferencing on the appeals on PC1 to the Environment Court and have provided advice on the mediation processes.

29. I have been engaged in this activity by both HortNZ and Wairakei Pastoral Ltd.

30. It is my opinion that this involvement gives me a very sound understanding of both the purpose and the practical implications of PC1 both on the health of the Waikato River and on the farming and horticultural operations that are carried out within its catchment and on the wider community.

Purpose and scope of evidence

31. I have been asked by HortNZ to provide evidence on:

(a) The economics of the fresh supply of vegetables to support human health;

(b) The potential for PC1 to constrain the production of vegetables;

(c) Farm level modelling water quality impact of CVP and methods of managing that impact;

(d) Farm level modelling water quality impact of fruit growing;

(e) The water quality impact of CVP; and

(f) The economic cost of offsetting for vegetable growing.

THE ECONOMICS OF THE FRESH SUPPLY OF VEGETABLES TO SUPPORT HUMAN HEALTH

32. PC1 as proposed has the potential to negatively impact the production of fresh vegetables and, thus, the supply and the price of vegetables. It is my opinion that PC1 as proposed has

the potential to lead to constraints on the supply of fresh vegetables through:

(a) Constraining the application of nitrogen, which is essential to achieve marketable yields;

(b) Not adequately providing for the area of land which is required for the growers to complete a rotation; and

(c) Not allowing for the expected increase in growth for demand.

33. In a report that was completed for HortNZ, Deloitte[2] identified that:

(a) The Pukekohe hub of vegetable production, which straddled both Auckland Council and the Waikato Regional Council boundaries, was experiencing increased negative pressure to keep up with the ever-increasing demand for fruit and vegetables from loss of highly productive land, increased legislation which is aimed at diminishing the ability to grow the crops at an economically maximum level of production and a loss of growers due to the increasing loss of margin in growing the crop;

(b) The growing of fruit and vegetables had a positive impact on the four capitals of Treasury's Living Standards Framework of Natural, Social, Financial and Human Capital;

(c) Under Deloitte's Base Case scenario by 2043 Auckland's population will have increased by 37%, based on 2018 predictions, which will result in the demand for fruit and vegetables increasing by 33%

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2 Deloitte (2018): New Zealand's food story: The Pukekohe hub.

and the growth of the production sector to meet that demand will be by 39%;

(d) Under Deloitte's Rigid constrained scenario which is described as "land scarcity is further constrained by land use restrictions" their modelling using the Deloitte Access Economics regional general equilibrium model, predicts that there will be, compared to the Base Case scenario, an annual economic loss of $1.1b, a loss of 4,500 FTE's, a decrease in production of 55% and a resultant rise in prices of 58%.

34. Although the Deloitte report is a theoretical exercise in predicting a likely future scenario it is robust enough to indicate that there is a need to start the conversation on food security around providing for the nation's future requirements for fruit and vegetables to at least maintain the current level of wellness within the population.

35. Following on from the Deloitte report HortNZ commissioned Dr Cristina Cleghorn of Otago University to investigate the health system impacts of the predicted increase in vegetable prices over time.[3]

36. In her report Dr Cleghorn modelled two scenarios where the price of vegetables increases each year for the next 23 years, firstly by 2% a year and secondly by 2.5% a year to match the expected price increase.

37. The 2% and 2.5% cumulative increase in New Zealand vegetable prices from 2020 to 2042 is predicted to result in a decrease in daily vegetable intake of 69 grams and 94 grams by 2042.

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[3] Cleghorn C (2020): The health and health system cost impacts of increasing vegetables prices over time.

38. The 2% cumulative increase is predicted to result in a 58,300 reduction in health adjusted life years (**HALY**) and $490 million in costs to the health system. The 2.5% price increase produced overall HALY losses that were 25% greater and costs to the health system that were 24% greater than the 2% cumulative price increase at 72,800 and $610 million.

39. Dr Cleghorn came to the conclusion from her modelling that:[4]

> *These small cumulative increases in the price of vegetables are likely to cause an important decrease in vegetable consumption in NZ over the next two decades. This is likely to lead to modest health loss to the NZ population and costs to the health system over time.*

40. A recently completed report for Auckland Council and HortNZ by PerrinAg[5] added to the reliability of the data being used by the Auckland Council to populate their Fresh Water Management Tool for the CVP and the kiwifruit sectors for the losses of the four contaminants. The report investigated the economic costs of a range of mitigation options in which they used the following financial data for the CVP sector, which was gained from the growers.

Table 1: The makeup of the profitability of a range of rotations commonly used in the Waikato Region ($/ha/year).

	Rotation 1	Rotation 2	Rotation 3	Rotation 4	Rotation 5	Weighted average
Average annual revenue	33,980	31,589	106,740	30,136	25,361	34,335
Average annual expenses	20,588	20,172	48,540	14,669	18,334	19,951
Average annual gross margins	**13,392**	**11,417**	**58,200**	**15,467**	**7,027**	**14,384**
Average annual overheads	11,004	10,972	11,225	10,037	10,401	10,645
Average annual profit (low slope)	**2,388**	**445**	**46,975**	**5,430**	**-3,374**	**3,740**

[4] Ibid.

[5] Muller, C. and Inness, M. 2023. Horticulture Typology Modelling for the FWMT: a technical modelling report. A report prepared for Auckland Council and Horticulture New Zealand.

41. What we can interpret from the data in **Table 1** is that the margins which the crops are grown on are, on average, very slim with the weighted average data indicating that the average annual profit of the weighted rotations is only approximately 10% of the revenue.

42. That is why over the last decade the growing of the crops has substantially congregated into the hands of approximately six large corporate growing entities that are very efficient in the growing and packaging of the crops and in the marketing of their crops either through their own brands or by the brands of the duopoly of supermarket retailers that control the sale of approximately 80% of the produce in Aotearoa.

43. However, the data in **Table 1** also shows the average returns for the growing of vegetables the market for vegetables is in fact very dynamic and responds very quickly to supply and demand. That is why we are, at the time of writing, experiencing extreme prices for vegetables as a result of the dual impacts of Covid limiting the productive capacity of the sector and then the impact of the two recent cyclones severely reducing the supply of vegetables.

44. Dr Cleghorn's research indicates that the current high price of vegetables forces many consumers to seek alternatives to vegetables that do not offer the same health benefits.

45. PC1 has the potential to lead to the same scenario of a lack of supply and so a large increase in the cost of vegetables and therefore impacts on human health.

THE POTENTIAL FOR PC1 TO CONSTRAIN THE PRODUCTION OF VEGETABLES

46. The potential to constrain the production of vegetables can occur in a number of ways:

    (a) If nutrient supply (i.e. nitrogen fertiliser) is reduced beyond that required to achieve marketable yields,

the economic viability of vegetable growing is threatened. Without viable businesses, there is no supply of vegetables. This point is further discussed in the grower evidence of Bharat Jivan, and discussed below, in paragraphs 80 to 85.[6]

(b) If crop rotations are not provided for, soil health will be harmed and pests will increase, reducing crop yields and vegetable supply. This point is further discussed in the grower evidence of Stuart Davis.[7]

(c) If rotations do not provide enough flexibility for growers to maintain cropping areas across sub-catchments, the vegetable growing area of individual businesses will contract, leading to reduced vegetable supply. This point is further discussed in the grower evidence of Brent Wilcox PVGA,[8] and in paragraph 67 to 79, below.

(d) If the expansion of vegetable growing to keep up with population growth depends on offsetting Nitrogen leaching, expansion of the CVP rotations is unlikely to be viable for most rotations. Growers will only choose to expand if it is viable. If growers do not expand, vegetable supply relative to population will be reduced, discussed in paragraphs 86 to 99 below.

47. It is my opinion that the maintenance of the supply of fresh vegetables, now and in the future, should be an important consideration especially when you consider the relatively small footprint of the sector compared to the pastoral sector as shown in the evidence of Mr Stuart Easton.

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6 Statement of Evidence of Bharat Jivan on behalf of PVGA, dated 28 July 2023.
7 Statement of Evidence of Stuart Davis on behalf of PVGA, dated 28 July 2023.
8 Statement of Evidence of Brent Wilcox on behalf of PVGA, dated 28 July 2023.

FARM LEVEL WATER QUALITY IMPACT OF CVP AND METHODS OF MANAGING THAT IMPACT

48. In 2014 I carried out nutrient modelling of three different vegetable production rotations as part of a report[9] for HortNZ and the Ministry of Primary Industries using Overseer.

49. In that report and through the PC1 process, I highlighted my concerns 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) Overseer is not currently capable of modelling all possible crop types therefore forcing the modeller to choose proxy crops to represent the crop;

    (e) 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;

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[9] Ford S (2014): Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers.

(f) In a paper written for ECan by Hume[10] 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.

50. While some of my concerns about the use of Overseer in the CVP sector have been overcome as a result of MPI's review of Overseer and the subsequent recommendation by MFE that Overseer is not appropriate to be used in a regulatory environment, the majority of them have not.

51. That is why I advocated very strongly for an alternative solution to allow the calculation of some proxy Nitrogen 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.

52. These leaching values would be listed in a look up table and then would be used by the CVP growers to estimate their N and P and sediment leaching values. 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, 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 of actions in their FEP.

53. We could not gain agreement with the WRC that this was an appropriate alternative way forward.

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[10] Hume E, Brown H, Sinton S, Meenken E. December 2015. Arable and horticultural crop modelling for the Matrix of Good Management - a technical summary. A Plant & Food Research report prepared for: Environment Canterbury. Milestone No. 65642. Contract No. 30084 var 2. Job code: P/421032/03. SPTS No. 12430.

54. I managed the provision of the APSIM modelling which was carried out for the PerrinAg report. While the individual crops Nitrogen leaching values varied greatly according to the time of year and the actual climatic conditions in the period when they were grown, the average of each rotation over the thirty year period that it was modelled across can be found in **Table 2**.[11] It is important to note that the results presented in the PerrinAg report are for catchment scale modelling and are not appropriate for farm level assessment of leaching.

Table 2: Average N leaching of the five rotations and the weighted average from the PerrinAg report (kgN/ha/yr)

	Rotation 1	Rotation 2	Rotation 3	Rotation 4	Rotation 5	Weighted average
Average N yield per year	111	113	182	95	105	110

55. The input of nitrogen that was used in the PerrinAg report shows a significant decline from the amount which I used in my 2014 report, which was guided by what growers indicated that they applied. It is my opinion that this decline in the input of nitrogen has come about for a myriad of reasons, but the overarching issue is that growers are now more aware of the negative impact that nitrogen leaching has on waterways and so they are adopting a range of mitigations that reduce the amount applied while maintaining a saleable yield.

56. It is difficult to compare these results with the results that I reported back in 2014 which were used in both the HRWO and the NIWA modelling. The main reason for the difference is the use of different models (Overseer vs APSIM). I acknowledged the fact that the Overseer results were uncertain in my Blocks 1, 2 and 3 evidence to the Commissioners. It is my opinion that

[11] The PerrinAg results have not as yet been put through a formal Peer Review process so they should be considered as interim results currently.

if the NIWA modelling relied on APSIM rather than Overseer, they would most likely show similar results.

57. Using estimated leaching numbers is a satisfactory means of exploring catchment level impacts as they are used to estimate the percentage changes between different interventions. It is the percentage change which is important not the absolute value of nitrogen leaching. I do not support the use of Overseer to determine regulatory thresholds.

58. As a result of the technical review of Overseer,[12] a review of the regulatory uses of Overseer was undertaken, and that work concluded that Overseer had many limitations, including recommending OverseerFM output numbers should not be used as absolute numbers.[13]

59. The results of the PerrinAg modelling are high on a per hectare basis, with a weighted average of 110 kg N/ha/year, compared to other fruit and pastoral sectors. Considering the very high volume of output from the CVP sector this is not surprising. However, HortNZ and the CVP sector are well aware of the need to minimise the risk of nitrogen leaching and propose two means of handling this.

60. The first means proposed is by establishing minimum standards, which match the same minimum standards as have been adopted by the pastoral sector, and cover stock exclusion, sediment and fertiliser application. The minimum standards are designed to set a bottom line for each of these elements in terms of mitigations which are possible.

61. The second means proposed by HortNZ is that the CVP Risk Scorecard (**Scorecard**), can be used to both prove that when

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[12] https://www.mpi.govt.nz/agriculture/farm-management-the-environment-and-land-use/overseer-a-nutrient-management-tool-for-farmers-and-growers/overseer-model-technical-review-reports-and-documents/

[13] https://environment.govt.nz/assets/publications/Freshwater/overseer-model-redevelopment-review-guide.pdf

growers move the place of growing, as they do quite regularly, that they haven't intensified their growing operation and it can be used as part of their Farm Environment Plan (**FEP**) as part of demonstrating the effectiveness of the mitigations adopted.

62. The measure of intensification is that the volume of the four contaminants, N, P, sediment and E Coli, isn't increasing. This is required because unlike the vast majority of pastoral land uses, they are not static in both the area that they operate across and the mix of crops that they grow from year to year.

63. HortNZ has searched for an appropriate means of carrying out a risk assessment and has adopted the Scorecard as a result of it being proposed to be used in Horizons PC2. We have added to it to incorporate three of the four contaminants and to reflect the fact that irrigation is prevalent in the Waikato Region. It has been set up along the same lines as the Fonterra Risk Score Card for both Horizons and the Waikato which is being promoted by WRC as an appropriate means to classify the pastoral sector in PC1.

64. It is my opinion that although the Scorecard is used for a different reason than the Fonterra Risk Score Card it compares very favourably with that score card because it incorporates three of the contaminants which are relevant to the CVP sector.

65. The important thing to recognise for both the Fonterra Risk Score Card and the HortNZ Scorecard is that in terms of what they consider and how they score the relative importance of each element is based on the science which underpins Overseer. However, the scoring and the results of the risk assessment are qualitative not quantitative as they are in Overseer.

66. Mr Andrew Barber provides more detail on how the Scorecard operates and is used in his statement of evidence.

CROP ROTATION

67. I have reported both the financial performance and the nitrogen leaching performance of the CVP sector on a rotation basis and not on an individual crop basis because the rotation of crops is a fundamental factor across the CVP sector.

68. A rotation is an essential element of a growing operation for two reasons:

    (a) Maintaining the sustainable nature of the soil resource by providing for depletive and restorative crops; and

    (b) Allowing for gaps between the growing of one crop to avoid the build-up of pests and diseases.

69. The structure of the soil is depleted by a continuous cropping regime with a reduction in the soil texture and in the amount of carbon in the soil which diminishes the productive capacity of the soil. There are crops, that are mostly non-productive from a CVP perspective, like cereal grains, catch crops and pasture crops which restore the structure of the soil. It is necessary to grow these two types of crops in conjunction with one another to maintain the soil resource in an optimum growing condition.

70. The continuous growing of a crop in the same ground leads to a build-up of the pest and diseases which have a negative impact on the productivity of the crop. Therefore, it is necessary to mix up the frequency of various crops in a rotation to avoid this build up occurring. For example, it is best practice to have at least five years between crops of potatoes in the same piece of ground.

71. It has been estimated that the large growers own about half the area that they crop and lease the rest. The land lease costs are a considerable cost to growers. In the PerrinAg study,

growers estimated they budget an average of $3,500 /ha for land lease costs.

72. Because of the requirement to rest the soil, growers are constantly changing the area that they lease. Some growers specialise in the growing of a few specific crops to maximise their investments in the harvesting, grading, packaging and marketing of those crops. This means that to maintain the production of those crops it is necessary for them to lease land, often off other growers that grow a different mix of crops. In terms of a rotation of crops on a piece of land it is quite often carried out by multiple entities over time.

73. This means that the area that is designated as being available for CVP production is required to be a multiple of the actual growing area at any one time.

74. The rotations found in the Lower Waikato differ from other regions in New Zealand, such as Ohakune, where growers rotate their crops on land owned by pastoral farmers, or in Canterbury, where vegetable growers rotate crops on land owned by pastoral and arable famers. In the Waikato it is most common for rotation to occur between vegetable growers who are the landowners or lease holders. Vegetable growers in the Waikato do not exclusively grow vegetable crops continuously; within their rotations they include fallow periods and cover crops.

75. The reason for the rotation of crops with other vegetable growers is related to the constrained amount of favourable soils and climate which support higher production in the Lower Waikato. It is also related to cost of land, which is relatively high in the Lower Waikato because the amount of favourable land is limited, driving the need for a higher economic return from land in the Waikato, with vegetables having a higher return per ha than grazing or arable crops.

76. The evidence of Mr Stuart Easton demonstrates that while individual businesses move the locations where they grow, the overall footprint of cultivated land at the FMU and sub-catchment is relatively static. My assessment is that this is because growers tend to rotate crops with each other by leasing valuable CVP land off each other.

77. If growers were provided the flexibility to rotate at the FMU scale it would support the economic performance of businesses by managing the risk of pest and disease, but would make very little difference to water quality at the sub catchment or FMU scale as they are most likely swapping land with each other.[14]

78. Similarly, if new CVP land is consented, that land is likely to remain in vegetable cultivation, and therefore the water quality assessment of that expansion can be undertaken at the sub catchment scale. However, the new land is likely to be used by different growers over time. Providing access to rotate onto the new land at the FMU scale, will provide more flexibility for the land to be used in the most efficient way to support soil and plant health, but would make very little difference compared with if the ability to rotate was only provided at the sub catchment scale.

79. That is why limiting growers to an area at the sub catchment level is too small to allow for the resting of the soil resource and will negatively impact the production of vegetables at a time when demand is only going to increase.

THE FARM LEVEL EFFECTIVENESS AND ECONOMIC IMPACT WATER QUALITY MITIGATIONS FOR CVP

80. The PerrinAg report traversed the range of possible mitigations to lessen the amount of sediment, N and P losses from both

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[14] Statement of Evidence of Stuart Easton, dated 28 July 2023, paragraph 18.

CVP and kiwifruit production. The report modelled the following mitigations:

(a) Increased vegetative buffer strips;

(b) Increased sediment retention ponds;

(c) Wheel track ripping;

(d) Fertiliser volume and rate;

(e) Irrigation application rate; and

(f) Soil moisture monitoring for irrigation scheduling.

81. The weighted average results on the rotations of the mitigations that were designed to lessen the impact of sediment and P loss along with the impact on profit are shown in **Table 3** and the results of the nitrogen mitigations are in **Table 4**.

82. What we can deduce from **Table 3** is that the mitigation which models improved sediment control has a significant impact on both P and sediment loss in both the low and high slope scenarios with a relatively low negative impact on the profitability of the weighted average rotation. There is no doubt that the individual crops and rotations will vary greatly from the values shown here but I am of the opinion that it points to the considerable potential for growers to minimise the loss of P and sediment.

83. The results that are shown in **Table 4** are favourable for the mitigation of improved irrigation scheduling reducing the Nitrogen leaching from 110 to 84 kgN/ha/yr, a 24% reduction for a comparatively low cost of -17%. However, the three scenarios for reduction of fertiliser nitrogen applications, while making significant gains in the reduction of nitrogen leaching, completely destroy the profit of growing at the 2% level and then cause the finances to go into a negative return for the 5% and 10% reduction scenarios.

84. This reinforces previous work which indicated that the CVP growing sectors productivity and profitability is completely reliant on the current level of use of nitrogen. Again, this is demonstrated by the weighted average rotation and there will, no doubt, be considerable variation across the sector which does offer the opportunity for growers to adopt the practices that are part of the Scorecard to minimise their impact.

85. These methods provide confidence that existing and new CVP activities will be subject to controls that will prevent intensification and drive the uptake of good management practices and maintained and improved water quality.

Table 3: The results of the mitigations tested in the PerrinAg model that were designed to mitigate the impact of sediment and P loss.

	Low Slope					High Slope				
	Base	Improved Sediment Control		Improved Sediment Control + WTR*		Base	Improved Sediment Control		Improved Sediment Control + WTR	
	No	No	%	No	%	No	No	%	No	%
P yield (kg P/ha/yr)	3.8	1.4	-63	1.2	-68	7.1	2.3	-68	1.7	-76
Sediment yield (t/ha/yr)	1.8	0.7	-61	0.6	-67	3.3	1.1	-67	0.8	-27
Average annual profit ($/ha/yr)	3,740	3,298	-12	3,030	-19	3,796	3,587	-5	3,338	-12

*WTR = Wheel Track Ripping

Table 4: The results of the mitigations tested in the PerrinAg model that were designed to mitigate the impact of N loss.

	Base	Improved irrigation scheduling (ISS)		ISS + Reduce N fertiliser on high N yield crops by 2%		ISS + Reduce N fertiliser on high N yield crops by 5%		ISS + Reduce N fertiliser on high N yield crops by 10%	
	No	No	%	No	%	No	%	No	%
N loss (kgN/ha/yr)	110	84	-24	76	-31	77	-30	73	%
Low Slope Profit ($/ha/yr)	3,740	3,096	-17	392	-90	-1,615	-143	-5,361	-34
High Slope Profit ($/ha/yr)	3,796	3,153	-17	449	-88	-1,558	-141	-5,304	-243

THE ECONOMIC COST OF OFFSETTING FOR VEGETABLE GROWING

86. I have calculated the financial impact of a grower adopting an offset as proposed by WRC.

87. Policy 5 provides two pathways for offset and compensation. Pathway 5a requires a reduction in four contaminants. Pathway 5b allows increases in non-priority contaminants provided there are decreases in other contaminants and results and benefits that outweigh the adverse effects of increases,

88. In my opinion, without pathway 5b there would be no ability for CVP to expand under PC1. This is because the economic cost of fully offsetting likely increases in nitrogen associated with CVP expansion are likely to be economically unviable as explained in my analysis below.

89. While the creation of an offset is a technically feasible alternative that would allow for a new area of CVP land to be achieved the financial impact of such an activity has not been considered by the Officers in their analysis.

90. There are three ways that an offset could be provided for:

    (a) De-intensifying the productive system;

    (b) An enterprise offset whereby additional productive land is purchased and it is converted to low leaching land use; or

    (c) An on-farm offset whereby an existing land uses high leaching activity is replaced with CVP production.

91. A brief explanation of how each option has been modelled is as follows.

92. De-intensification is modelled as the new CVP producer buying a new dairy farm and operating it at its existing

leaching value which means that there is a much higher proportion of the low leaching crop which is barley.

93. The enterprise example models a new CVP producer buying an existing dairy farm and planting as much of it as is required in forestry to ensure that the nitrogen leaching value is the same as the existing use.

94. The on-farm offset models a new CVP producer leasing land off a dairy farmer (the feed cropping block) and the dairy farmer winter grazing their cows elsewhere and the loss of some milksolids production.

Table 5: The cost of maintaining the current CVP gross margin in various offset scenarios.

	Deintensification	Enterprise	On farm
Additional area required per ha of CVP area.	1.74	1.05	-
Additional cost to maintain existing gross margin.	9,115	6,280	5,653*
Change in average crop revenue to maintain the existing gross margin.	50%	30%	16%

* includes the existing lease cost of $2,000 per ha.

95. The additional areas of land that would be required in each of the offset scenarios are 1.74 ha of additional land for every 1 ha of CVP land in the deintensification scenario and an additional 1.05 ha of land for every 1 ha of CVP land in the enterprise scenario. In the on-farm scenario there is sufficient spare nutrients from the crop area to allow for an additional 29.8 ha of dairy land to also be involved in the lease.

96. The additional cost to maintain the existing gross margin in the deintensification and enterprise scenario reflect the cost to the CVP grower of having to buy additional land to use as an offset. In the case of the on-farm scenario this figure has been calculated from the point of view of the lessor and reflects the amount that they would have to receive, at the minimum, to compensate them for the lost productivity of their land.

97. The final row of Table 5 is an approximation of how much the returns for each crop would have to rise to compensate the growers for the additional costs and maintain their existing gross margins. This is on the assumption that the CVP growers were price setters and that the market would respond by paying that price i.e.: that demand was inelastic. Neither of those two assumptions is true because CVP growers are price takers and demand for their product is very elastic according to the price of the produce on offer. We can see that just to maintain their present returns that the price of vegetables would have to increase by between 16 and 50%.

98. In relation to the on-farm scenario, this would mean that the commercial vegetable grower might only be accommodated within the dairy farm for 3 years of the 20 year consent of the dairy farm. While it would be technically possible for this to occur, a dairy farmer could apply for consent and submit their FEP and nutrient model to accommodate vegetable growing, but it would mean that the farmer would need to anticipate the desire of growers to come onto their land and obtain a (discretionary) consent to provide for that.

99. This has not occurred. The reason for that is the people who decide where the vegetable growing will occur are the growers rather than the landowner, and they need to be able to have consent for the land they lease rather than searching for land which has enough consented capacity to allow the CVP grower to grow their crops.

100. None of these scenarios are realistic in terms of offering new CVP growers the opportunity to offset their production. In my opinion, it is not realistic to expect that there is an offset of all four contaminants, but it is realistic to assess the net effect of the activity on the freshwater objectives as stated in Table 3.11.1 and granting consent if the assessment indicates that there would not be a net deterioration in those values.

THE FARM LEVEL WATER QUALITY IMPACT AND EFFECTIVENESS AND ECONOMIC IMPACT OF WATER QUALITY MITIGATIONS FOR FRUIT GROWING

101. In the PerrinAg report they report the results of work carried out by Zespri on the losses of the three relevant elements of a kiwifruit orchard in the Auckland Council and Waikato Regional area.

102. They report the methodology used as:

(a) SPASMO[15] was used to model two sites one in Pukekohe and one in Kumeu, and eight soil types were trialled in Pukekohe and three in Kumeu;

(b) The amount of green and gold kiwifruit varieties was weighted as to the actual amount in the area.;

(c) Contaminants in water runoff were taken from a trial on four orchards in the Bay of Plenty.

103. The results for kiwifruit orchards in the PerrinAg report are shown in **Table 6**.

Table 6: Results of the three relevant elements of the Kiwifruit Model from the PerrinAg report (kg/ha/yr)

Total suspended sediment.	194
Total nitrogen	24
Total phosphorus	0.56

[15] SPASMO (Soil Plant Atmosphere System Model) models the transport of water, microbes and solutes (e.g., nitrogen and dissolved phosphorus) through soils integrating variables such as climate, soil, water uptake by plants in relation to farm and orchard practices, and other factors affecting environmental process and plant production. A soil water balance is calculated by considering the inputs (rainfall and irrigation) and losses (plant uptake, evaporation, runoff and drainage) of water from the soil profile. The model includes components to predict the carbon, nitrogen and phosphorus budget of the soil. These components allow for a calculation of plant growth and uptake of both nitrogen and phosphorus, various exchange and transformation processes that occur in the soil and aerial environment, recycling of nutrients and organic material to the soil biomass, and the addition of surface applied fertiliser and effluent to the land.

104. As can be seen from **Table 6** kiwifruit is very low in terms of sediment loss and phosphorus and is relatively low in terms of Nitrogen loss compared to the pastoral sector on a per ha basis but is very low on an output basis.

105. The kiwifruit sector operates under the Zespri GAP system. Zespri have a programme where they are supporting all kiwifruit growers in the Waikato Region to develop FEPs which record the activities and practices that are used on the orchard to assess the risk of loss of the three contaminants and the mitigations that are used to minimise both the risk and the actual loss of those elements.

106. In investigating the potential mitigations for kiwifruit PerrinAg looked at the potential of reducing the amount of N fertiliser applied on the SPASMO model. In doing so they were aware of the very close relationship between N application and both fruit quantity and quality and so only reduced the amount of N applied from 105 kg N/ha/yr to 100, -5 kg, in Mitigation 1 and to 90, -15, in Mitigation 2.

107. The results of these mitigations are shown in **Table 7**.

Table 7: Results of mitigations modelled for Kiwifruit in the PerrinAg report.

	Base 105 kg	Mitigation 1 100 kg		Mitigation 2 90kg	
	no	no	%	no	%
N yield (kg N/ha)	24	21.5	-10	18.9	-21
Production (TE/ha)	11,106	10,986	-1	10,832	-2
EBITDA ($/ha)	44,389	38,029	-14	36,610	-18

108. What we can conclude from **Table 7** is that while the impact on Nitrogen leaching is quite significant with a 10% and 21% reduction the impact on production is minimal but the impact on EBITDA is also significant at a 14% and an 18% reduction. This reinforces the fact that the profitability of kiwifruit is closely related to the amount of N applied annually.

109. It is my opinion that kiwifruit is a very well environmentally managed crop which has a low risk of N, P and sediment loss to water and therefore it is appropriately managed as a permitted activity.

Stuart Ford

28 July 2023