IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the submissions and further submissions by Rangitata Diversion Race Management Limited to Variation 2 to the Proposed Canterbury Land and Water Regional Plan

SUPPLEMENTARY STATEMENT OF EVIDENCE OF BENEDICT RODNEY CURRY

1 INTRODUCTION

1.1 My name is Benedict Rodney Curry. I am the Chief Executive Officer of Rangitata Diversion Race Management Limited ('**RDRML'** or **'the Company**'), and I prepared a statement of evidence dated 15 May 2015 which is before the Hearing Commissioners in this matter.

1.2 On 3 July 2015, during the presentation of RDRML's case, Commissioner van Voorthuysen asked what the equivalent limits would be in terms of:

a. kgN/ha/year; and

b. groundwater concentration;

if condition 7 of RDRML's resource consent CRC121664 contained such limits.

1.3 This supplementary statement of evidence responds to that question.

2 CRC121664 – CONDITION 7 (NUTRIENT LIMITS)

2.1 As the Commissioners are aware, resource consent CRC121664 limits the use of land for farming and the associated discharge limits through 'total load' limits in condition 7. This approach allows RDRML to effectively manage compliance with the resource consent at irrigation scheme level, and kgN/ha/year and/or groundwater concentration limits are likely to be more difficult to manage.

2.2 Further, given the way the resource consent is framed, it will be the total load that acts as the natural limit on further change in land use or intensification.

2.3 However, I endeavour to say what equivalent limits might have been if imposed.

kgN/ha/yr

2.4 Dealing firstly with kgN/ha/yr, while in theory it might be possible to say that an equivalent kgN/ha/year figure could be derived by adding the total load together and dividing it by the maximum permissible number of ha able to be irrigated, I have doubts that this would be reliable.

2.5 In addition, RDRML has taken a 'total load' approach to allocating the load amongst the irrigation schemes, and there is much greater variation within the irrigation schemes as to the total kgN/ha/yr that any given farmer is discharging. To my knowledge the actual on-farm range within the schemes varies between 28 and 135 kg N/ha/yr (reported in OVERSEER 6.2).

2.6 Condition 7 of the RDRML consent specifies two loads – one for existing irrigation areas, and one for new irrigation areas. These were calculated under different methodologies.

2.7 Mr Ford undertook reporting for RDRML in conjunction with the resource consent application for resource consent CRC121664. That report is referenced in condition 7.b.i of RDRML's resource consent and is attached as Exhibit A. It attributed an *average* kgN/ha to the existing irrigation areas of 81 kgN/ha and an *average* kgN/ha of 31 kgN/ha for the new irrigation areas.

2.8 In the event that a kgN/ha limit had been applied to consent CRC121664, given that condition 7.b.i references Mr Ford's report, I would have expected it to use the limit of 81 kgN/ha for the existing irrigation areas on an *average* basis as per that report.

2.9 In respect of the new irrigation areas, in the event that a kgN/ha limit were to be applied, I would have pushed for Mr Ford's figure of 31 kgN/ha on an *average* basis.

2.10 However I acknowledge that for new irrigation areas condition 7.b.ii references the Macfarlane Rural Business report dated December 2013 and entitled "Hinds Catchment Nutrient and On-Farm Economic Modelling" (Final Report (Version 4) Volume 1 – Main Report). This is one of the supporting reports to Variation 2 which is ECan Technical Report R13/109. My understanding is that ECan's view, at the time resource consent CRC121664 was processed, was that this report supported a figure of 27 kgN/ha/year for new irrigation areas. Thus, ECan might have applied that limit.

2.11 I say this because there were fairly protracted discussions between RDRML and ECan when the consent was being processed, particularly with reference to the Ford and Macfarlane Rural Business reports. These discussions extended for approximately a two year period and, to a degree, it was a process that was breaking new regulatory ground.

2.12 In the end, ECan accepted Mr Ford's calculations of the existing irrigation areas (6088tN) but staff did not accept Mr Ford's calculation for the new area (31kgN/ha). However, I would not like it to be thought that any significance would be placed on the use of the Mcfarlane Rural Business methodology for the additional land as this was agreed in the context of attempts by RDRML and ECan to find a workable solution to the consent.

Groundwater concentrations

2.13 Dealing secondly with groundwater concentrations, this was not dealt within the resource consent or Mr Ford's reporting. Accordingly, my thoughts on this aspect are more speculative.

2.14 However, my understanding is that N concentration in estimated drainage could theoretically be modelled for the current mix of land uses and where these land uses occur (noting that the mix of land uses and their spatial distribution are not constrained by the terms of the resource consent CRC121664).

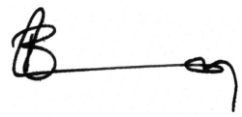
2.15 The closest thing I can think of is Mr Ford's modelled results (using OVERSEER 6.1.3 and 6.2) which are reproduced from Table 1 in his Statement of Rebuttal Evidence dated 29 May 2015 as follows:

Table 1: Results of modelling in two versions of Overseer.

	Total N (tonnes)	Average (kg N / ha)	N in drainage (ppm)
Overseer 6.1.3	5,625	47.3	10.3
Overseer 6.2	5,350	45.0	11.6

2.16 In theory, it might be possible to derive consent conditions stipulating average drainage N concentrations across the area covered by the RDR consent using a modelling approach, with reference to base reporting and taking into account mix of land uses and their spatial distribution, but this would be subject to many assumptions and great uncertainty.

2.17 My recollection is that when RDRML's consent application was being processed, ECan considered having the limit expressed in concentration but ultimately felt that unless a methodology was devised that tied the discharge back to land use and an individual's responsibility for the management of his or her property, the regulatory function of ECan would be difficult if not unachievable.



Benedict Rodney Curry

17 July 2015

RDRML Land Use Consent Application: Calculation and Explanation of the proposed Nitrogen and Phosphorous Load and Limits

Prepared for: Rangitata Diversion Race Management Ltd
Prepared by: Stuart Ford of the AgriBusiness Group
October 2013

Results

The results of our study show that the total level of N leaching in the 70,000 ha of the RDRML at present (2013) is 5,682 tonnes of N and the total level of P discharged is 77.34 tonnes.

For the proposed 24,000 ha of new irrigated land the total level of N leaching is 740 tonnes with 16.58 tonnes of P discharged.

1 Background

This report was commissioned by Rangitata Diversion Race Management Limited (RDRML) in order to support its application for a new 'land use and discharge' resource consent application for a 5 year term. The task was to create total annual leaching and discharge limits for Nitrogen (N) and Phosphorous (P) for the existing 70,000 ha of RDRML land and an estimate of the losses that are expected for an additional consented 24,000 ha of irrigable land. The calculation of the existing area is a best representation of what is occurring at present and the calculation of the additional area of irrigable land represents a rate of leaching and discharge which complies with current best[1] practice for irrigated land.

The RDRML supplies water to five shareholder users, of which three are independent community irrigation schemes, being;

- Mayfield Hinds Irrigation Limited (MHIL)
- Valetta Irrigation Limited (VIL).
- Ashburton Lyndhurst Irrigation Limited (ALIL).
- These 3 schemes collectively total to 70,000ha.

2 Methodology

The methodology adopted to calculate the N leaching and P discharge was agreed in discussions with ECan staff.

2.1 Determine the level of Leaching and Discharges

The methodology used was based on the use of existing OVERSEER modelling work carried out by Macfarlane Rural Business (MRB) for ECan in establishing the range of possible discharges in the Hinds Catchment. It was supported by work done by The AgriBusiness Group (2012) for Irrigation NZ and ECan for use by the Selwyn Te Waihora Zone Committee " Selwyn Te Waihora Nutrient Performance and Financial Analysis" and earlier work carried out by The AgriBusiness Group (2011) in an earlier version of OVERSEER on "Leaching Rates in the Waikakahi Catchment".

On review of the MRB modelling results it was decided that it would be wise to use the MRB work as a guide to the expected results and cross reference them with the results that came out of the Selwyn Te Waihora work. This is mainly because much of the MRB work is set up with each farm model representing a cross section of the area. This meant that many of the models had a combination of irrigation types; border dyke, centre pivot and other spray types of irrigation. On analysis we found that the combination of irrigation types did not match the data collected from RDRML of actual land use and irrigation types.

Also at the time that this work was carried out the MRB results were still under review and the final report was not available for use. The results from Selwyn Te Waihora had been peer reviewed, were in the final format and were directly applicable to some of the land use and irrigation types in the RDRML area.

[1] Best Practice is described as activities which are at the best possible practice at the time in terms of reducing N leaching and P runoff in a manner that is affordable and will not cause undue economic hardship.

The relationship between Border dyke and Spray irrigation has been taken from previous OVERSEER work carried out in the Waikakahi Catchment and has been taken as the leaching and discharges from border dyke being 1.4 times the equivalent spray levels.

2.2 Area of land use and irrigation type.

The data used in determining the land use and irrigation type is adapted from data supplied by RDRML.

For the Valetta scheme (VIL) the data was provided in the form of percentages of each land use with all of the irrigation being of spray type. For the Mayfield Hinds Irrigation scheme (MHIL) the data was provided in percentages for both land use and irrigation type. The area of land use was divided equally between the irrigation types (border dyke and spray). Ashburton Lyndhurst Irrigation scheme (ALIL) provided comprehensive data on each individual shareholding with information on the land uses and irrigation types from which the information was gathered.

Because of the large difference in leaching rates between the two major types of irrigation used in the area, border dyke and spray irrigation, they are identified separately.

The land uses were split into the following classes Arable, Sheep and Beef, Dairy, Dairy Support and Other. For MHIL and VIL the information was supplied as the core land use for each property being the most dominant and therefore defining all of the land use for the property. For ALIL the information was supplied in quite a lot of detail for each individual property and was therefore able to be classified as the individual property mix.

2.3 Determine the soil grouping.

The methodology selected for this exercise determines the leaching and discharge rates according to the soil group. The soil grouping is determined by the Profile Available Water (PAW). In the classification of soil grouping made available by ECan to determine the relationship between the soil groups the PAW classifications are given as Medium 110 – 150 mm, Light as 80 – 110 mm and Very Light as 50 – 80 mm.

In order to classify the soils the area split of soil grouping was taken by imposing a map of the irrigation schemes over the S-Map of the area. A map of the area of supply super-imposed on the S-Map is shown in Appendix 1. Where there was a split between the soil groups this was estimated. There is a discrepancy between the two methods of classification with the S-Map groupings being for a Moderate PAW soil classification having a PAW of 90 – 119 mm and for a Moderate to Low PAW classification having a PAW of 60 – 89 mm. It was decided to adopt the S-Map classifications as this is used in OVERSEER, and to show the relationship between this classification and the ECan classification. This relationship is shown in Table 1.

Table 1: Relationship between PAW classifications.

ECan PAW Classification Used in establishing relationships.	S-Map PAW Classifications
Medium	Moderate to High
110 – 150 mm	120 – 149 mm
Light	Moderate
80 – 100 mm	90 – 119 mm
Very Light	Moderate to Light
50 – 80 mm	60 – 89mm

2.4 Calculate the total annual rates of leaching and discharges.

The methodology adopted is based on the fact that not all of the farm or soil types have been modelled in OVERSEER. Therefore a relationship is used which is based on the known relationship between the soil groups in terms of their soil leaching characteristics. This relationship is used to fill in the gaps in the data. The relationship between the soil groups has been taken from the "Patch Report" which is an updating of "Estimating nitrate – nitrogen leaching rates under rural land uses in Canterbury" which was authored by Landcare. We have not been able to view a copy of this report as it is not yet released for public use but have relied on relationships information supplied by ECan[2]. Those relationships are for the Moderate soils to be at 1 and the Moderate to Light soils being 1.51 times the Light soils.

The "other" class of land use which represents lifestyle blocks, horticultural blocks etc has been taken as having the same level of leaching and discharges as the Sheep and Beef group.

The estimates were then multiplied by the land use figures to create the total N leaching and P discharge figures for the RDRML area.

2.5 New Area

The RDRML is, under its existing regime of resource consents, able to legally apply water to approximately 24,000 ha of 'new' land, which under the current Land Use Consent application could be anywhere within the Mid Canterbury District.

The percentage of land use has been developed by reference to the existing land use and known land uses on newly developed irrigation schemes and the soil types available in the Mid Canterbury region. This has been influenced by the relative profitability of the various land uses at present with some consideration of likely future trends. The allocation of soil group has been done by reference to the existing coverage of the schemes and the likely places where new irrigation capability will be developed.

There is one reference point for an OVERSEER exercise for this new land being the Arable option from MRB. The remaining land uses of Dairy and Dairy Support have been calculated as using the mitigation factors developed in the Selwyn Te Waihora work. The two mitigation factors are the use of DCD's and alteration of the irrigation practices to achieve active water management as defined in OVERSEER. Effectively it is using such techniques as soil moisture monitoring and managing irrigation practice to only apply what the soil requires. This includes allowing for the impact of rain events in the management of irrigation practice.

[2] Leo Feitje pers comm.

3 Results

The results in the following section are reported for the existing area of 70,000 ha. The existing area is made up of three irrigation schemes:

- Mayfield Hinds Irrigation Limited (MHIL) which has a contracted area of 36,400 ha.
- Valetta Irrigation Limited (VIL) which has a contracted area of 7,300 ha.
- Ashburton Lyndhurst Irrigation Limited (ALIL) which has a contracted area of 26,300 ha.

3.1 Area of land use and irrigation type.

The results of this analysis of the irrigation type and land use mix are shown in Table 2.

Table 2: Irrigation type and land use mix for RDRML (ha).

	Arable	Sheep and Beef	Dairy	Dairy Support	Other	Total
Valetta	110	350	5,066	1,570	204	**7,300**
Mayfield Hinds B / D	738	654	4,518	1,505	121	**7,537**
Mayfield Spray	2,778	2,460	16,997	5,664	457	**28,355**
Ash Lyndhurst B / D	1,337	3,312	2,315	2,891	34	**9,890**
Ash Lyndhurst Spray	3,299	812	9,833	1,439	62	**15,444**
Total	**8,262**	**7,589**	**38,729**	**13,069**	**878**	**68,526**

It is interesting to note that 17,427 ha (25%) of the irrigated area within the three schemes is in border dyke irrigation.

3.2 Soil Group

The split adopted for the soil grouping is shown in Table 3.

Table 3: Soil Grouping for PAW in RDRML.

	Moderate	Moderate to Low
Valetta	40%	60%
Mayfield Hinds		100%
Ashburton Lyndhurst	75%	25%

As can be seen in Table 3, the Valetta scheme is 40% in the Moderate Group and 60% in the Moderate to Low group, all of the Mayfield Hinds is in the Moderate to Low group and the Ashburton Lyndhurst scheme is estimated to by 75% in the Moderate group and 25% in the Moderate to Low group.

The areas of land use type were then allocated to a soil group based on their proportion of the total area. The results of this exercise are shown in Table 4.

Table 4: Land use type for PAW in RDRML.

	Moderate	Moderate to Low
Arable - B / D	1,003	1,073
Arable - Spray	2,518	3,668
Sheep and Beef - B / D	2,484	1,482
Sheep and Beef - Spray	749	2,873
Dairy - B / D	1,736	5,097
Dairy Spray	9,401	22,495
Dairy Support - B / D	2,168	2,228
Dairy Support - Spray	1,707	6,965
Other B / D	25	130
Other Spray	128	595

3.3 Estimate of N leaching and P discharge.

Table 5: Leaching and discharge estimates and relationships.

	Leaching (kg N / ha)		Discharge (kg P / ha)	
	Moderate	Moderate to Low	Moderate	Moderate to Low
Arable - B / D	38	57	0.4	0.6
Arable - Spray	27	41	0.3	0.5
Sheep and Beef - B / D	48	72	1.8	2.7
Sheep and Beef - Spray	34	51	1.3	2.0
Dairy - B / D	97	146	1.1	1.7
Dairy Spray	69	104	0.8	1.2
Dairy Support - B / D	63	95	0.7	1.1
Dairy Support - Spray	45	68	0.5	0.8

The known levels of leaching and discharges are highlighted yellow in the above Table 5. The figures used were taken from a combination of the MRB work (arable and sheep and beef), and by reference to the Selwyn Te Waihora results (dairy and dairy support). A table of the Selwyn Te Waihora results is in Appendix 2.

Note that the area modelled does not correspond precisely with the 70,000 ha so it has been multiplied up to reflect the total 70,000 ha.

Table 6: Total results for RDRML.

	N	P
Average(kg / ha)	81	1.10
Total Result (Tonnes)	5,682	77.34

The results as shown in Table 6 indicate that the total for the RDRML area for the present mix of land use and irrigation type are 5,682 tonnes of N and 77.34 tonnes of P.

3.4 New Area

The land use mix assumed is shown in Table 7 along with the soil groups selected.

Table 7: Land use mix and soil types for the new area of irrigation.

	Dairy	Dairy Support	Arable
Percentage of land use	60%	20%	20%
Area (ha)	14,400	4,800	4,800
Soil group	Moderate	Moderate to Low	Moderate to High

Table 8: Mitigation factors used in determining the leaching and discharges for new irrigation.

	DCD	Active Water Management	Total
Dairy	21%	28%	49%
Dairy Support	3%	40%	43%

The mitigation factors in Table 8 were used to determine the leaching and discharge factors (Table 9) to be used in the estimation of the total leaching and discharge performance of the new area of land to be irrigated (Table 10). Whilst the current use of DCD has been suspended, it is realistic that a replacement nitrate inhibitor will be available in the near future. If DCD's are not available in the future there is a raft of alternative mitigation techniques which could be used to achieve the same levels of reduction in N leaching. These techniques include reduced stocking rates, lower seasonal application of Nitrogen fertilisers, use of Liquid fertilisers, variable rate fertiliser application, the use of covered feed pads and wintering barns and limiting the amount of winter feed grown.

Table 9: Leaching and discharge factors used for new irrigation (kg / ha).

	Arable	Dairy	Dairy Support
N leaching	23	34	29
P discharges	0.30	0.39	0.32

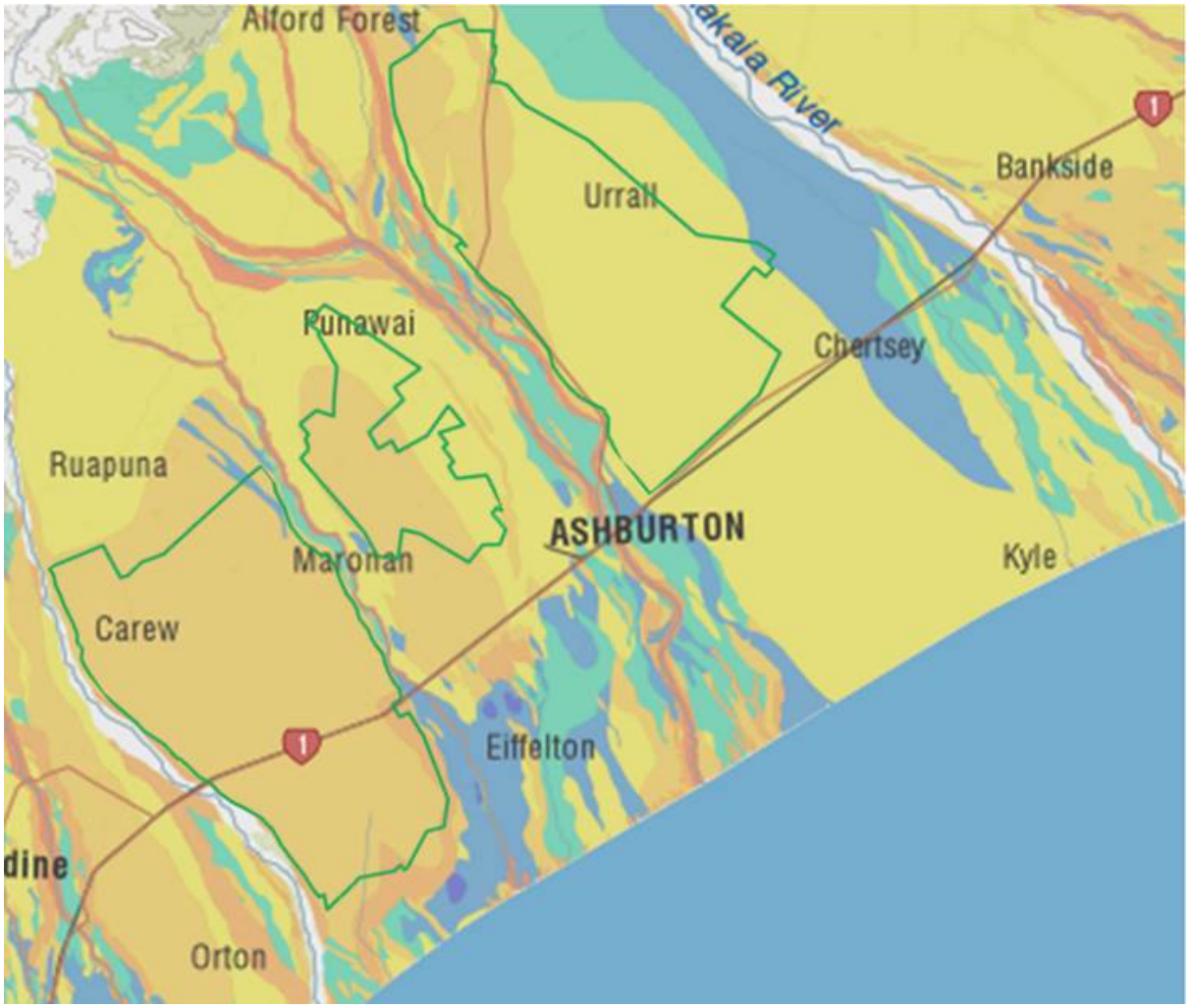
In Table 9 the one land use that has been modelled in OVERSEER has been highlighted yellow. The other two have been altered by a relationship factor. These factors were then multiplied by the areas assumed to get the following results in Table 10 for the new area.

Table 10: Total results for new irrigation area.

	N	P
Average (kg / ha)	31	0.7
Total Result (Tonnes)	740	16.58

We note, for completeness, that Barrhill Chertsey Irrigation Limited have estimated that the level of N leaching in the current pre irrigation state is 534 Tonnes of N / year which is calculated to occur in the same geographic region ie: from the foothills to the ocean, and between the Rakaia and the Rangitata River. In doing so they have made a number of estimates of the current land use and soil type classifications for the area and have then adapted the MRB estimates to calculate the level of leaching. This provides some context to the level of N losses that are presently being felt by the environment. To refine this number further, a considerable amount of detailed work would be needed. Given that the RDRML is focussed on achieving best practice in the new irrigation area, and capping the losses from its existing area, there is little to be gained from undertaking this work. Consequently, it has not been advanced.

Appendix 1: Existing RDRML Irrigation Schemes superimposed on S-Map Profile Available Water



Legend

Very Low
Very Low (< 30 mm)

Low
Low (30 - 59 mm)

Moderate to Low
Moderate to Low (60 - 89 mm)

Moderate
Moderate (90 - 119 mm)

Moderate to High
Moderate to High (120 - 149 mm)

High
High (150 - 249 mm)

Very High
Very High (> 250 mm)

Appendix 2: Results from OVERSEER modelling in the Selwyn Te Waihora catchment.

Farm Type	N leaching Kg n / ha/ year	Range Of N leaching	N conversion efficiency range	P runoff Kg P / ha /year
Irrigated Dairy – pasture based light soil type (3 farms)	69	65 -80	27 – 41	0.8 – 0.9
Irrigated Dairy – pasture based heavy soil type (3 farms)	22	15 - 31	27 – 34	1.0 – 1.3
Irrigated Dairy – High input light soil type (1 farm)	75		27	1.0
Irrigated Dairy – High Input heavy soil type (2 farms)	45		36	1.3
Irrigated Mixed Cropping – light soil type (1 farm)	22		36	0.7
Irrigated Mixed Cropping – heavy soil type (2 farms)	3	2 - 4	20 – 32	0.1
Irrigated Dairy support light soil type (2 farms)	45	40 - 52	36	0.3 – 0.5
Dryland Flatland arable and sheep. (2 farms)	28	11 - 39	41 – 48	0.2
Dryland Foothills sheep and beef (2 farms)	17	17 - 19	18 - 31	1.3 – 1.9