

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Environment Canterbury (Transitional Governance Arrangements) Act 2016

AND

IN THE MATTER of submissions and further submissions by Rangitata Diversion Race Management Limited to Plan Change 5 to the Canterbury Land & Water Regional Plan

STATEMENT OF EVIDENCE OF REUBEN JOHN EDKINS

1.0 INTRODUCTION

1.1 My name is Reuben John Edkins. I am the Environmental Compliance Manager for Rangitata Diversion Race Management Limited (hereafter referred to as '**RDRML**' or '**the Company**'), and I have been employed in this role since June 2014. My responsibilities at RDRML include:

- a. Establishing and managing an Audited Self-Management programme for the approximately 400 shareholders (consisting of 438 shareholdings) of the three irrigation schemes supplied by RDRML (including Ashburton Lyndhurst Irrigation Limited, Mayfield Hinds Irrigation Limited and Valetta Irrigation Limited (hereafter referred to as '**the Irrigation Schemes**') and managed under RDRML's resource consent CRC121664¹;
- b. Establishing and managing the Environmental Management Plan required by conditions of resource consent CRC121664;
- c. Coordination and assistance with the preparation of a Farm Environment Plan ('**FEP**') for each property over 10 hectares in size within the Irrigation Schemes; and
- d. Coordination, preparation and collection of approximately 400² nutrient budgets, as required to report the annual nutrient load by conditions of resource consent CRC121664.

1.2 This evidence is in support of the submissions and further submissions lodged by RDRML, to Plan Change 5 ('**PC5**') of the Canterbury Land and Water Regional Plan ('**the LWRP**').

2.0 QUALIFICATIONS AND EXPERIENCE

2.1 I completed a Master of Commerce (Agricultural) from Lincoln University of Canterbury in 2005 and a Certificate of Completion in Advanced Sustainable

¹ Attached in full in **Appendix 1**.

² 379 is the number of FEP required of properties greater than 10 hectares in size if a one-to-one ratio of nutrient budgets to FEPs is assumed, but this may change a little as the nutrient budgets are finally tallied in September 2016 prior to reporting.

Nutrient Management from Massey University in 2014 (having achieved the Certificate of Completion in Sustainable Nutrient Management from Massey University in 2013).

- 2.2 I am a member of the New Zealand Institute of Primary Industry Management and have been since 2011.
- 2.3 I have been working in the nutrient management profession in New Zealand since October 2013.
- 2.4 I worked for a consulting engineering firm for 2 years and 7 months, working as an irrigation management consultant for most of this period.
- 2.5 I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses, as set out in the Environment Court's Consolidated Practice Note. I can confirm that this evidence is within my area of expertise, with the exception of where I confirm that I am relying on the evidence of another person. I am aware that in providing expert evidence my duty is to assist the Hearing Commissioners impartially and that I am not an advocate for my employer.

3.0 STRUCTURE AND CONTEXT OF MY EVIDENCE

- 3.1 My evidence will cover:
 - a. An overview of RDRML, the Rangitata Diversion Race ('RDR') and associated infrastructure and an overview of RDRML's existing consents and its operations in accordance with the same;
 - b. Description of RDRML's Audited Self-Management ('ASM') programme to date;
 - c. RDRML's nutrient load reporting requirements;
 - d. RDRML's Farm Environment Plans ('FEP') Audits;
 - e. Concerns with the current modelling proxies and the Farm Portal as proposed by PC5;
 - f. Concerns with the interpretation of the industry agreed Good Management Practices ('GMP'); and
 - g. A conclusion.

4.0 OVERVIEW OF THE RDRML AND ITS INFRASTRUCTURE

- 4.1 RDRML is a non-profit water supply company whose role includes abstracting, managing and supplying water for irrigation, generation and community stock water schemes.
- 4.2 The RDR takes water from the Rangitata and South Ashburton Rivers at a maximum rate of 35.4 cubic metres per second, and delivers it to the Ashburton District Council's stockwater network, two hydroelectric power stations and to the Irrigation Schemes to irrigate a total of 94,486 hectares, as follows:
 - a. The Mayfield Hinds Irrigation Scheme, which currently irrigates 36,000 hectares but has a contractual maximum of 44,900 hectares of land;
 - b. The Valetta Irrigation Scheme, which currently irrigates 11,000 hectares but has a contractual maximum of 13,245 hectares of land;
 - c. The Ashburton Lyndhurst Irrigation Scheme, which currently irrigates 28,000 hectares but has a contractual maximum of 36,341 hectares of land;

- d. The Montalto Hydroelectric Power Station, which has an installed generation capacity of 1.8MW and is owned by Trustpower Limited;
 - e. The Highbank Hydroelectric Power Station, which has an installed generation capacity of 25.5MW and is owned by Trustpower Limited;
 - f. The Ashburton District Council for stock water purposes; and
 - g. There is also an agreement in place with a fourth irrigation scheme, one that is not a shareholder in RDRML, Barrhill Chertsey Irrigation Limited ('BCI'). The agreement with BCI means that RDR facilitates the supply of water to BCI shareholders. BCI has its own consents, which authorises up to 40,000 hectares of land that can be irrigated within Mid-Canterbury.
- 4.3 At present, RDRML holds 32 Regional Council resource consents and five District Council resource consents associated with the RDR. The resource consent of relevance to my evidence is resource consent CRC121664.
- 4.4 Resource consent CRC121664 sets nutrient discharge limits on the 75,000 hectares of existing irrigated area³. Further irrigation development is allowed for under the terms of CRC121664. This development is limited to approximately 20,000 hectares, making for a total of 94,486 hectares irrigated⁴. There are also specific nutrient loading limits set for this new irrigated area⁵. This expansion is made possible through water use efficiency by converting from borderdyke to spray irrigation, and piping of water rather than conveyance through open channels. The area to which CRC121664 can be applied is all of Mid-Canterbury, bounded by the foothills and the Pacific Ocean, running from the Rangitata River to the Rakaia River. This is referred to as the 'expanded command area'⁶.
- 4.5 Resource consent CRC121664 brings with it a number of conditions that the Company must comply with. In summary, Condition 5 required that FEPs be established for all properties within the existing irrigation areas by the 1st of July 2016. Condition 5 also requires that FEPs be established prior to the RDRML supplying water to any new irrigated area. At least one third of all the FEPs are to be independently audited each year. Further, Condition 6 also required that the Company implement an Environmental Management Plan ('EMP') within 12 months of the consent being granted. In addition, Condition 7 set a number of nutrient limits that the Company must comply with within each of the three nutrient allocation zones.
- 4.6 This consent also promotes an ASM approach to managing nutrient loads and farming practices.
- 4.7 Prior to the granting of consent CRC121664, the Company had been primarily concerned with the management of water quantity, which, in my opinion, is comparatively simple as it is easily measured. In contrast, it is my understanding that since the granting of the resource consent, the management of the nutrient

³ Existing Irrigation Areas are "...the areas of land within the Existing Command Area that had water supply agreements in place with the consent holder (or its agents) and were being irrigated prior to December 2013."

⁴ In many cases, Irrigation Scheme water supplied to a property via RDR is not the only source of irrigation water, hence the sum of the area of properties receiving RDR water is greater than 75,000 hectares and potentially greater than 94,486 hectares.

⁵ New Irrigation Areas: are any area(s) of land within the Expanded Command Area that did not have a water supply agreement in place with the consent holder (or its agents) or were not being irrigated prior to December 2013 but are, or will be, irrigated under this consent.

⁶ Condition 1 of resource consent CRC121664.

aspects of the consent has presented a number of challenges for RDRML, which, in my opinion, is complex due to many variables. As a practice, the monitoring and management of diffuse nutrient losses, using an almost entirely modelled approach, is still developing in New Zealand. To assist with this, RDRML has hired new staff (including myself as a full time Environmental Compliance Manager) and contractors to help this process and successfully implement CRC121664.

- 4.8 To date, I understand that the Company has achieved Condition 5 by establishing FEP's for all properties within the *expanded command area* including both the existing irrigation area, as well as, *new irrigation areas*, prior to the RDRML supplying water to the same.
- 4.9 With regard to Condition 6, the EMP has been developed by RDRML and was approved by the Regional Council following meetings on the 11th and 17th of December 2015. The EMP provides details such as:
- a. The processes to be used for the FEP auditing including reporting of outcomes and following up on issues as necessary
 - b. Specifies responsibilities and lines of reporting between RDRML and the irrigation scheme.
- 4.10 In my experience, it is clearly understood by the Company that a reduction of nutrient loss below the root zone is required. In my opinion, the process by which this is best achieved, how to manage these processes and the time required for the same, are still being learnt. Given the variables and unknowns in undertaking an ASM approach to nutrient management and FEP's, the Canterbury Regional Council agreed with RDRML that a series of trial FEP audits would be conducted and the learning from this process be used to inform some of the, as yet, incomplete elements of the EMP. These trial audits were conducted using the Canterbury Certified FEP Auditor Manual (February 2016) and the associated FEP Auditing template, which are detailed in **Appendix Two** of my evidence. The outcomes of the FEP trial audits are discussed in paragraphs 7.4 to 7.12 of my evidence below.
- 4.11 Details of the Company's ASM programme are specified in paragraphs 5.1 to 5.3 of my evidence. I understand that this programme is designed to improve environmental outcomes of the properties involved, whilst also satisfying the reporting requirements of resource consent CRC121664. This programme includes a random portion of the RDRML FEPs being audited by independent contractors each year, and the outcomes reported to Council. In my experience, this provides visibility and reassurance to interested parties that the ASM programme is robust and transparent.
- 4.12 RDRML is also part of a Pilot ASM programme with the Regional Council. I understand that this process is about working together with Council staff to address and resolve the challenges that have arisen in the implementation of resource consent CRC121664. Reporting nutrient losses against nutrient load limits given the frequent change of OVERSEER versions, the limited longevity of nutrient budget loads post OVERSEER updates along with the scarcity of suitably qualified industry practitioners are examples of the issues being dealt with through this pilot.

5.0 DESCRIPTION OF RDRML'S AUDITED SELF-MANAGEMENT PROGRAMME TO DATE

- 5.1 In total, each of the Irrigation Scheme shareholders, being approximately 400, have completed a FEP that was developed and agreed with the Regional Council. For completeness, shareholders with properties larger than 10 hectares, being a total of 343 properties⁷, have completed an online version of the RDRML FEP, which was approved by the Regional Council as meeting Schedule 7 requirements in September 2014. Those shareholders with properties 10 hectares or smaller, being a total of 36 properties, have completed an online version of the Regional Council Lifestyle Block Management Plan⁸.
- 5.2 Based on land use information collected and processed at this stage, the mix of land uses within the RDRML land use consent are:
- a. Dairying: 51 percent
 - b. Dairy support: 20 percent
 - c. Arable: 9 percent
 - d. Sheep beef and Deer: 7 percent
 - e. Other⁹: 13 percent
- 5.3 Due to the location of properties subject to the terms of CRC121664, the most common environmental risks are, in my experience, inefficient irrigation and soils with limited water holding capacity. The RDRML ASM programme is trying to improve the associated on farm practices required to address these issues, such as soil moisture monitoring and nutrient management, to minimise leaching to groundwater.

6.0 RDRML NUTRIENT LOAD REPORTING REQUIREMENTS

- 6.1 Resource consent CRC121664 requires annual reporting of the annual average Nitrogen and Phosphorus losses. This is achieved by aggregating the average annual Nitrogen and Phosphorus losses of approximately 400 nutrient budgets prepared by the RDRML shareholders. The submission of an annual nutrient budget for the preceding season by all RDR scheme shareholders that have an irrigated area greater than 50 hectares and / or with more than 20 hectares of winter cattle grazing is a requirement of the RDRML water supply agreements. This is made up of approximately 379¹⁰ nutrient budgets supplied to support the FEP's of the larger properties, along with a set of representative nutrient budgets used to estimate the nutrient losses for the properties with less than 50 hectares and with less than 20 hectares of winter cattle grazing. The provision of nutrient budgets to RDRML began at the end of the 2015/16 season to support nutrient load reporting as part of the compliance reporting to the Regional Council due by the end of September 2016. The first complete set of nutrient budgets will not be received by RDRML until after this evidence has been submitted.

⁷ This number is still approximate, as until a spatial analysis is completed, the number of individual properties is unknown. For example, some small blocks of land are leased and operated as part of larger operations.

⁸ Lifestyle Blocks are those that are 10 hectares or smaller but are still required to measure the environmental footprint of activities undertaken on the land in accordance with the Lifestyle Block Management Plan prepared by Environment Canterbury.

⁹ 'Other' land uses include all blocks under 50 hectares for which a land use has not been formally assigned at this stage.

¹⁰ Refer paragraph 1.1 for further explanation.

7.0 RDRML FEP AUDITS

- 7.1 RDRML undertook trial audits in March and April of 2016, as agreed in the approved Company EMP. The Canterbury Certified FEP Auditor Manual (February 2016) and the associated FEP Auditing template were used as the basis for the FEP Auditing. The detail of each of this guidance is contained in **Appendix Two** of my evidence. In summary, the FEP auditing guidance requires each farm to be assessed on seven key management areas. These management areas are:
- a. Nutrients;
 - b. Irrigation;
 - c. Soils;
 - d. Collected Animal Effluent;
 - e. Waterbody Management (riparian areas, drains, rivers, lakes, wetlands);
 - f. Point source discharges (offal pits, farm rubbish pits, silage pits); and
 - g. Water use (excluding irrigation water).
- 7.2 Within each of these seven management areas there are a series of specific objectives and targets. In essence, the FEP Audit process is about determining a level of confidence (**'LOC'**) for each of these targets. A suitably qualified FEP Auditor must assign a High, Medium or Low LOC for each target. The LOC for each target is recorded for each management area, resulting in an overall FEP Grade of 'A', 'B', 'C' or 'D', as follows:
- a. A Grade = High LOC of meeting objectives for all Management Areas.
 - b. B Grade = Medium LOC of meeting the objectives for one or more Management Area(s) BUT on-track to meet the objectives.
 - c. C Grade = Medium LOC of meeting the objectives for one or more Management Area(s) BUT off-track to meet the objectives.
 - d. D Grade = Low LOC of meeting the objectives for one or more Management Areas.
- 7.3 In my opinion, a property that achieves an overall 'A' grade for their FEP Audit is the best available representation of a property performing in accordance with the industry agreed GMP narratives. As such, if the modelling proxies developed by the Matrix of Good Management (**'MGM'**) project and applied via the Farm Portal are generating an accurate numeric representation of industry developed and agreed GMP practices, then it stands to reason, in my opinion, that these properties should not have to significantly reduce Nitrogen loss to achieve GMP Loss Rates¹¹.
- 7.4 To confirm my understanding set out in the preceding paragraph (7.3), RDRML contracted the Agribusiness Group (**'TAG'**) to undertake the independent trial FEP Audits of its shareholders (specified by resource consent CRC121664 and introduced in paragraph 4.5 of my evidence). It is noted that the TAG Auditors are

¹¹ GMP Loss Rate means the average nitrogen loss rate below the rootzone, as estimated by Environment Canterbury's Online Farm Data Portal, for the farming activity carried out over the most recent four-year period, if operated at Good Management Practice.

highly experienced¹², having worked with other irrigation schemes for many years and conducted multiple FEP Audits during this time. Further to their experience and the training, the TAG staff used have also undertaken the training required to be an approved Regional Council FEP Auditor¹³ as set out in the Canterbury Certified FEP Auditor Manual February 2016.

- 7.5 In total, 28 properties were subject to the independent FEP Audit. I consider that these properties are a reasonable representation of RDRML irrigated land uses that are located within the area covered by the resource consent CRC121664. In summary, the properties were made up of the following land uses:
- a. 15 dairy properties;
 - b. 7 other land uses (including dairy support); and
 - c. 5 Arable properties
- 7.6 Of the 28 properties that had their FEPs audited by TAG, 18 received an overall 'A' grade and 10 received an overall 'B' grade, pending final confirmation of the assessment of the nutrient budgets within OVERSEER.
- 7.7 Each landowner of the 28 properties initially audited was asked to provide a nutrient budget prepared by a Certified Nutrient Management Advisor¹⁴ ('CNMA') for the purposes of this additional analysis. Each of the FEP audits undertaken by TAG, on behalf of the Company, involved determining the 'robustness' of the nutrient budgets provided to support the FEP, even though these nutrient budgets were prepared by suitably qualified people, all of whom are qualified as a CNMA. Notably, requiring a nutrient budget prepared by a CNMA requires the use of a scarce resource, which comes at a cost to the landowner. While RDRML subsidised the cost of preparing these nutrient budgets, only 18 nutrient budgets were prepared and released for further analysis as part of my evidence preparation.
- 7.8 Of the 18 properties that received an 'A' grade, only 8 produced nutrient budgets for use in the Farm Portal for my further analysis. Ten properties received a 'B' grade and these nutrient budgets were also analysed. The result of the further analysis undertaken by myself is summarised in paragraphs 7.9 to 7.11 below and in full in **Appendix Four and Appendix Five**.

¹² The TAG staff contracted to conduct the FEP Audits consisted of:

- David Leonard Lucock, B.Ag.Sci (Hons), Certified Nutrient Management Advisor, Environment Canterbury Approved Auditor, 6 years' experience in Audited self-management, 12 years consultancy and research and 22 years experience in pastoral farming.
- Katherine Ann McCusker, B.Ag.Sci, Advanced Sustainable Nutrient Management, Environment Canterbury Approved Auditor, 28 years' experience in farm consultancy and agricultural policy and 3 years' experience auditing farm environment plans.
- Susan Mary Cumberworth, B.Ag.Sci, Director, The AgriBusiness Group, FNZIPIM, Environment Canterbury Approved Auditor, Intermediate Sustainable Nutrient Management course, 10 years' assisting irrigation schemes develop and implement Audited Self-Management programmes which include FEPs and auditing, 6 years' experience in auditing FEPs and 30 plus years in agricultural consultancy, facilitation and research experience.

¹³ List of registered FEP Auditors: <http://ecan.govt.nz/our-responsibilities/regional-plans/lwrp/Pages/environment-plan.aspx>

¹⁴ CNMA is currently the highest level of qualification available with regard to the preparation of nutrient budgets and advice using OVERSEER.

- 7.9 The average Nitrogen loss reduction required for these 'A' grade properties to achieve the GMP Nitrogen loss, as determined by the Farm Portal is 39 percent, with a range from 15 percent to 63 percent.
- 7.10 For the properties that received an overall 'B' grade, the average reduction required to get the 'B' grade farms down to GMP levels of Nitrogen loss from current, was 47 percent, with a range from 32 percent to 62 percent.
- 7.11 Overall, the average reduction required to get the current Nitrogen losses from all 18 farms down to GMP Nitrogen loss is an average of 44 percent, with a range from 15 percent to 63 percent.
- 7.12 To better understand why the Nitrogen loss reductions required for each farm were so large, I ran these same OVERSEER files through the GMP Tool¹⁵ (with the result contained in **Appendix Six**). The reason for this is that the GMP Tool allows specific modelling proxies or sets of modelling proxies to be applied independently so that the nutrient loss estimate resulting from the application of just a single proxy or group of proxies can be determined. For completeness, the proxy or groups of proxies available to be applied are:
- a. Cultivation and cover crops;
 - b. Effluent and silage;
 - c. Fertiliser;
 - d. Irrigation; and
 - e. Soil compaction, stock access and runoff.
- 7.13 I note, for completeness, that when the whole suite of modelling proxies is applied, the GMP Loss Rates produced are identical to those estimated by the Farm Portal. This assumes that both the GMP Tool and Farm Portal systems are running on the same version of OVERSEER, which is not always the case, due to updates to the systems. This has occurred in the past, however, at the time of preparing my evidence, the systems were both running on the same version of OVERSEER.
- 7.14 By way of an example of using the GMP Tool, it is possible to apply just the Fertiliser proxy, which in turn will generate a GMP Loss Rate estimate resulting from adjusting only the Nitrogen fertiliser regime described in the OVERSEER file.¹⁶ This form of analysis is useful for determining which GMP modelling proxy or group of proxies is responsible for the largest portion of the required reduction. In turn this identifies the various OVERSEER 'inputs' or practices that could be varied within a farm system to better meet GMP.
- 7.15 The full result of the FEP audit analysis is presented in **Appendix Four, Five and Six of my evidence**.
- 7.16 It is my view that the key outcome of this analysis is that only the Irrigation modelling proxy and the Nitrogen fertiliser proxy have any consequential effect on

¹⁵ The GMP Tool is an interface that enables users to run their individual OVERSEER file against identified groups of GMP, which are known as proxy or groups of proxies. While it is considered quite similar to the Farm Portal, in that it takes in an OVERSEER file and applies the GMP modelling proxies to it to determine a GMP loss rate, the GMP Tool works on an individual OVERSEER file at a time. This attribute of the GMP Tool allows for the file-by-file and proxy-by-proxy analysis that I have undertaken and presented within my evidence.

¹⁶ As the Farm Portal only reports a Nitrogen loss number, no analysis on the effect of the GMP proxies on the loss rates of other nutrients was conducted.

Nitrogen loss for these farm systems. In my opinion, this emphasises the need for these proxies to be operating reliably, and in accordance with the intent of the industry agreed GMP narratives, before being applied as proposed by PC5.

8.0 MY CONCERNS WITH THE CURRENT MODELLING PROXIES AND THE FARM PORTAL AS PROPOSED BY PC5

- 8.1 My analysis illustrates that farms performing at or near GMP, as proven through achieving an overall 'A' grade through the FEP Audits, have lower Nitrogen losses (refer to **Appendix Five** of my evidence) and require a smaller reduction to achieve the GMP Loss Rates. However, within this overall trend, there is still significant variation in the Nitrogen loss reductions required of any one property. These differences are seemingly quite arbitrary. My assessment is that the modelling proxies currently used are unable to correctly address the different ways key parameters, such as irrigation management, can be entered into OVERSEER. Given this, it is my opinion that the modelling proxies, in their notified form in PC5, are not functioning reliably and should not be used.
- 8.2 I am of the opinion that the modelling proxies are not producing Nitrogen loss estimates that fairly represent the industry agreed GMP narratives and that the Farm Portal is not robust enough to support an application in a planning document.
- 8.3 Further, in my opinion, one of the reasons that significant Nitrogen loss reductions are required of properties to achieve GMP Loss Rates, when these properties are already considered to be performing at GMP as indicated by the 'A' grades achieved through the FEP Audit process, is because of the variation around the entering key parameters into OVERSEER. In my role with RDRML, I review a number of nutrient budgets from a range of sources and, based on my observations, even among highly proficient and well qualified OVERSEER users, there is significant variation in how key parameters such as irrigation and fertiliser are entered into OVERSEER. In my opinion, the conflict inherent in trying to enter farm system data from a single season into OVERSEER, which itself runs on a long-term average approach, is a cause of a lot of variation in how certain inputs are treated.
- 8.4 Therefore, when the uncertainty inherent in OVERSEER modelling is combined with, and even exacerbated by, conflicting with the current modelling proxies applied through the Farm Portal, I have very little confidence in the outcomes produced. Based on my experience, for the intended Farm Portal analysis to produce reliable and defensible outcomes, further guidance around entering key parameters into OVERSEER files for use in the Farm Portal is required and / or the Farm Portal needs to be adjusted so that it produces accurate outcomes, irrespective of how some parameters are entered into OVERSEER.
- 8.5 Overall, the following summarises what the application of the current GMP modelling proxies would mean for the RDRML:
 - a. CRC12164 uses an agreed methodology to produce a nutrient load limit for both the existing irrigated area, and the new irrigated area. For the existing irrigated area, this load is a proxy for the baseline N and P losses. Using this methodology, the Company is currently authorised by resource consent

CRC121664 to discharge an average of 97.2 kilograms of Nitrogen per Hectare per Annum ('kg/N/ha/yr')¹⁷ from the existing irrigated area.

- b. The 18 audited FEPs that I analysed are from properties spread throughout the Company's consented area and include a mix of land uses. I consider these properties to be a reasonable representation of farms that may become subject to PC5 policies. As such, 97.2 kg/N/ha/yr is a reasonable estimate of the current losses. On the basis of my analysis, these Nitrogen losses would have to reduce to 47.6 kg/N/ha/yr, in order to comply with the GMP Loss Rates as per the Farm Portal analysis.
 - c. Overall, this means that for the average farmer who receives irrigation water from the RDR, a reduction of 51 percent from current consent Nitrogen losses is required (noting that not all of the RDRML shareholder properties operate at these high levels of performance).
- 8.6 This suggests two things to me. Firstly, that the modelling proxies used in the Farm Portal are not working as a fair representation of the industry agreed GMP narratives. Secondly, that if reductions of this magnitude are in fact required to achieve GMP levels of Nitrogen loss, then a period of time much longer than currently proposed by PC5 will be required. Should PC5 be applied in its current form, given the issues with the functioning of the Farm Portal using OVERSEER analysis it would be, in my opinion, very difficult to apply and enforce.

9.0 MY CONCERNS WITH THE INTERPRETATION OF THE INDUSTRY AGREED GMP

- 9.1 Within the industry agreed GMP Booklet¹⁸, there are two GMP that relate to irrigation management:
- a. Manage the amount and timing of irrigation inputs to meet plant demands and minimise risk of leaching and runoff; and
 - b. Design, calibrate and operate irrigation systems to minimise the amount of water needed to meet production objectives.
- 9.2 Further, the GMP Booklet states that *"The intent of this irrigation management is to apply irrigation water efficiently to meet plant demands and minimise risk of leaching and runoff."*
- 9.3 Likewise, within the Canterbury Certified FEP Auditor Manual (February 2016), there are two management areas that I deem to be of primary significance with regard to farm management practices on the light soils of Mid-Canterbury¹⁹.
- a. These two Management Areas are Irrigation management and Nutrient management.
 - b. The objectives of each of these management areas and the associated targets within each are presented in **Appendix Two**:
- 9.4 In relation to irrigation, I interpret the industry agreed GMP guidelines and the FEP Audit Manual to mean that a farmer should only apply water, in an efficient

¹⁷ Determined using OVERSEER version 6.2.2

¹⁸ Page 16, Industry-agreed Good Management Practices relating to water quality dated 18th September 2015. (refer appendix Three)

¹⁹ As set out in my analysis of the files used in this evidence using the GMP Tool in paragraphs 7.12 to 7.16, each of the other three proxy groups has a less than 1 percent effect on the Nitrogen loss when comparing current farm system losses to GMP Nitrogen loss.

manner, when there is an identified need. Assuming that the scheduling regime in place ensures that water is only applied when a need is correctly identified, then efficiency should be viewed as achieving a high degree of uniformity of application. The GMP guidelines and FEP Audit targets relate to system maintenance, ensuring high levels of irrigation system performance and achieving high levels uniformity of application from the system in place. In my opinion, the GMP and objectives do not require a landowner to replace their existing irrigation system to achieve GMP. Within the 'implementation guidance' in the Canterbury Certified FEP Auditor Manual relating to irrigation, the requirements around new, upgraded or redeveloped systems is separate from how to manage a current system. This distinction is significant in my opinion because the current modelling proxies used to represent the industry agreed GMP narratives would force many farmers to immediately change their irrigation system to achieve GMP levels of Nitrogen loss. The agreed GMP guidelines simply require a system to be operated and maintained well, rather than system replacement or redevelopment to achieve GMP.

- 9.5 In my opinion, the current GMP modelling proxies as applied through the Farm Portal and GMP tool are more onerous than intended by the industry agreed GMP narratives. This is inappropriate in my opinion. Rather, I am of the view that the modelling proxies need to be changed to fairly reflect the intentions of the GMP narratives. Likewise, any replacement modelling proxies relating to irrigation need to be set at a level that reflects current systems run as well as they can be, rather than producing Nitrogen loss values that would require significant system change, as this is beyond, again in my opinion, the intent of the GMP narratives.

10.0 SUMMARY

- 10.1 Based on the analysis that I have undertaken (and discussed in paragraphs 7.9 to 7.16 of my evidence) using the current Farm Portal and the associated modelling proxies, the average reduction in Nitrogen losses required is in the order of 44 percent to achieve GMP Loss Rates.
- 10.2 The reduction in Nitrogen loss rates to achieve GMP levels of loss required of properties deemed to already be operating at or about GMP levels of on farm practice, based on the FEP Audit, was 39 percent.
- 10.3 In my opinion, the Farm Portal, as currently proposed by PC5, does not accurately estimate the GMP Nitrogen losses that could be expected from the farming activities as described in the OVERSEER analysis on which the Farm Portal operates.
- 10.4 As a result of the inaccuracies in the modelling proxies used in the Farm Portal and the uncertainty that results, I consider that the most appropriate outcome at this point in time is for the Regional Council, and submitters, to continue to work together to improve and validate the operation of the Farm Portal, to the point that both:
- a. The modelling proxies are producing GMP Nitrogen loss values in accordance with the industry agreed GMP narratives, and
 - b. The Farm Portal is reliably producing results that accurately reflect Nitrogen loss from farming operations based on the farm system information contained in the OVERSEER analysis on which it operates.

Reuben John Edkins

22 July 2016

11.0 APPENDIX ONE – RESOURCE CONSENT CRC121664:

26 May 2014

Rangitata Diversion Race
Management Limited
Attn To: Ben Curry
PO Box 61
Ashburton 7740



Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz
www.ecan.govt.nz

Dear Sir/Madam

NOTICE OF RESOURCE CONSENT DECISION(S)

RECORD NO: CRC121664

NAME: Rangitata Diversion Race Management Limited

The decision of Environment Canterbury is to grant your application(s) on the terms and conditions specified in the attached resource consent document(s). Your resource consent(s) commences from the date of this letter advising you of the decision. The reasons for the decision are:

1. Any adverse effects on the environment as a result of the proposed activity will be minor.
2. There are no persons considered to be adversely affected by this proposal.

For some activities a report is prepared, with officer recommendations, to provide information to the decision makers. If you require a copy of the report please contact our Customer Services section.

If you do not agree with the consent authority decision, you may object to the whole or any part. Notice of any objection must be in writing and lodged with Environment Canterbury within 15 working days of receipt of this decision.

Alternatively you may appeal to the Environment Court, PO Box 2069, Christchurch. The notice of appeal must be lodged with the Court within 15 working days of receipt of this decision, with a copy forwarded to Environment Canterbury within the same timeframe. If you appeal this decision, the commencement date will then be the date on which the decision on the appeal is determined. If you are in any doubt about the correct procedures, you should seek legal advice.

You can find online information about your consent document at <http://ecan.govt.nz/publications/General/YourConsentDocumentBooklet09.pdf> and also information regarding the monitoring of your consent at <http://ecan.govt.nz/publications/General/monitoring-your-consent-booklet.pdf>. These booklets contain important information about your consent and answers some commonly asked questions about what will happen next in the life of your resource consent. There is an Annual Compliance Monitoring Charge associated with every consent. For details of this, please refer to page 10 of the "Monitoring Your Consent" booklet.

Our Ref: CO6C/33056
Your Customer No: EC114929
Contact: Customer Services

Environment Canterbury takes every measure to improve both applications and processes, and we appreciate your feedback as an important component in ensuring this occurs. You can complete a consents survey on-line at <http://www.ecan.govt.nz/services/resource-consents/pages/surveys.aspx>. Alternatively, you can call our Customer Services Section on 0800 EC INFO who will be happy to complete the survey with you.

Charges, set in accordance with section 36 of the Resource Management Act 1991, shall be paid to the Regional Council for the carrying out of its functions in relation to the administration, monitoring and supervision of resource consents and for the carrying out of its functions under section 35 of the Act.

Thank you for helping us make Canterbury a great place to live.

For all queries please contact our Customer Services Section by telephoning (03) 353 9007, 0800 ECINFO (0800 324 636), or email ecinfo@ecan.govt.nz quoting your CRC number above.

Yours sincerely

A handwritten signature in black ink, appearing to be 'J. S.', written in a cursive style.

CONSENTS PLANNING SECTION

RESOURCE CONSENT CRC121664

Pursuant to Section 104 of the Resource Management Act 1991

The Canterbury Regional Council (known as Environment Canterbury)

GRANTS TO: Rangitata Diversion Race Management Limited

A WATER PERMIT: to use surface water

COMMENCEMENT DATE: 26 May 2014

EXPIRY DATE: 26 May 2019

LOCATION: Ashburton District, ASHBURTON

SUBJECT TO THE FOLLOWING CONDITIONS:

Definitions

- 1 *Existing Command Area:* are the three (3) areas indicated on plan CRC121664A on being coloured brown, orange and green, and labelled Mayfield/Hinds, Valetta and Ashburton/Lyndhurst respectively. The Existing Command Area totals 94,486 ha.

Existing Irrigation Areas: are the areas of land within the Existing Command Area that had water supply agreements in place with the consent holder (or its agents) and was being irrigated prior to December 2013.

Expanded Command Area: is the area bounded by the Rakaia River, the Rangitata River, the foothills of Mt Taylor and Mt Hutt and the Pacific Ocean (refer Plan CRC121664A).

New Irrigation Areas: are any area(s) of land within the Expanded Command Area that did not have a water supply agreement in place with the consent holder (or its agents) or was not being irrigated prior to December 2013 but are, or will be, irrigated under this consent.

Water Supply Consents: are any, or all, of the existing water permits held by the consent holder being resource consent numbers: CRC011237, CRC011245, CRC134808 and CRC133962 (or their subsequent respective replacements).

Consent Authorisation

- 2 Where the consent holder is supplying water in accordance with the *Water Supply Consents* this resource consent authorises:
- a. The use of water for
 - i. Irrigation of up to 94,486 hectares of crops and pasture in the *Expanded Command Area*; and
 - ii. Stockwater; and
 - iii. Hydroelectric power generation

- b. The use of land for farming; and
- c. The discharge of nutrients to water arising from the use of land for farming authorised in by clause (b) of this condition.

Irrigation Water Use

- 3 The use of water for irrigation, land use and discharge specified in condition 1 of this resource consent shall be limited to a maximum land area of 94,486 hectares located within *Expanded Command Area*.
- 4 All users of water for irrigation shall take all practicable steps to:
 - a. Ensure that the volume of water used for irrigation does not exceed that required for the soil to reach field capacity;
 - b. Avoid leakage from pipes and structures; and
 - c. Avoid the use of water onto non-productive land such as impermeable surfaces and river or stream riparian strips.

Farm Environment Plan

- 5
 - a. A Farm Environment Plan shall be prepared:
 - i. by the 1st of July 2016 for all properties within the *Existing Irrigation Areas* that have water supplied by the consent holder under the *Water Supply Consents*; and
 - ii. in advance of the consent holder supplying water (abstracted under the *Water Supply Consents*) to properties within the *New Irrigation Areas*.
 - b. All Farm Environment Plans prepared in accordance with this condition shall:
 - i. utilise the template which is attached to (as Annexure 2) and which forms part of this resource consent; or
 - ii. a subsequent version of the template or alternative template plan where the template has been approved (in writing) by the Canterbury Regional Council RMA Compliance and Enforcement Manager.
 - c. The consent holder shall ensure that each water user, that the consent holder supplies water to, maintains detailed records of fertiliser application rates, location and crop type (including winter feed/forage crops), cultivation methods, stock units by reference to type and breed, and all other necessary inputs to the OVERSEER^(TM) nutrient budgeting model. The records shall be made available to the Canterbury Regional Council on request.

Environmental Management Plan

- 6 The consent holder shall prepare and implement an Environmental Management Plan (EMP) within 12 months of the granting of this resource consent. The EMP shall be detailed and described in a report that is prepared by a suitably qualified and experienced person and that report shall be submitted to the Canterbury Regional Council. Once the Canterbury Regional Council has certified that the EMP is adequate and is consistent with the obligations set out in this resource consent, the consent holder shall implement it.
 - a.

- b. The consent holder shall audit all properties that it supplies water to at least once every three years with at least a third of the total number audited each year. The audits shall assess the:
 - i. compliance with conditions 4 and 5 of this resource consent; and
 - ii. compliance with the obligations and undertakings given in the Farm Environment Plan that applies to the property being audited.
- c. The audits required by this condition shall be undertaken by a suitably qualified and experienced auditor.
- d. The consent holder shall prepare an annual report describing the results of the EMP, which includes the audits that have been conducted each year. The report shall include:
 - i. A record of the audit compliance grading;
 - ii. The average annual loss of nitrogen and phosphorus for the preceding 12-month period (being from the 1st of August until the 31st of July) for:
 - a. The *Existing Irrigation Areas*; and
 - b. The *New Irrigation Areas*.
 - iii. The number of properties and the total area being irrigated in accordance with the requirements of this resource consent;
 - iv. Any incidence of non-compliance with the conditions of this resource consent, and/or with the requirements set out within the individual Farm Environment Plans;
 - v. The actions taken by both the consent holder and (as necessary) the water user(s) supplied by the consent holder to remedy or mitigate a non-compliance that is identified in accordance with (c)(iv) of this condition.
- e. A copy of the annual report shall be provided to the Canterbury Regional Council, Attention: RMA Compliance and Enforcement Manager by the 30th of September each year.
- f. A copy of each Farm Environment Plan and all associated audits shall be provided to the Canterbury Regional Council, marked for the attention of the RMA Compliance and Enforcement Manager upon request.

Nutrient Limits

- 7 a. The combined average annual amount of Nitrogen ('N') and Phosphorus ('P') lost to water as calculated from the individual Farm Environment Plans prepared in accordance with the conditions of this resource consent, shall not exceed the following totals (derived using version 6.0.3 of the OVERSEER^(TM) modelling software):
 - i. 6088 tonnes of N and 82.5 tonnes of P from the land within the *Existing Irrigation Areas* as ; and
 - ii. 263 tonnes of N and 6.82 tonnes of P from the land within the *New Irrigation Areas* located within Zone 1 as shown on plan CRC121664B.
 - iii. 52 tonnes of N and 1.36 tonnes of P from the land within the *New Irrigation Areas* located within Zone 2 as shown on plan CRC121664B.
 - iv. 211 tonnes of N and 5.46 tonnes of P from the land within the *New Irrigation Areas* located within Zone 3 as shown on plan CRC121664B.
- b. The consent holder may derive the N and P limits for the land that is the subject of this resource consent using a subsequent version of the OVERSEER^(TM) modelling

software, or an alternative model where the alternative model has been approved in writing by the Canterbury Regional Council RMA Compliance and Enforcement Manager. When deriving N and P limits, the consent holder shall calculate the losses using the following parameters:

- i. For the *Existing Irrigation Areas* the mixture of land uses and management practices modelled shall be consistent with the activities described in the report prepared by Stuart Ford, dated October 2013 and entitled "RDRML Land Use Consent Application: Calculation and Explanation of the proposed Nitrogen and Phosphorous Load and Limits", a copy of which is attached to (as Annexure 3) and forms part of this resource consent; and
 - ii. For the *New Irrigation Areas* the method used to determine the nutrient limit shall be consistent with the approach used in the report prepared by Macfarlane Rural Business dated 14 December 2013 and entitled "Hinds catchment nutrient and on-farm economic modelling, Final report (version 4), Volume 1 - Main report"
- c. Where alternative N and P limits have been calculated in accordance with (b) of this condition they (along with the supporting information) shall be submitted to an appropriately qualified independent person for certification. The person shall only issue the certificate if satisfied that the new limits have been derived using the parameters listed in (b)(i) and (b)(ii) of this condition. Once the limits have been certified, they shall apply to all land use and discharge activities authorised by this resource consent and those set out in (a) in this condition shall cease to have effect.
- d. A report, setting out any alternative limits that have been derived in accordance with (b) of this condition and certified in accordance with (c), shall be provided to the Canterbury Regional Council (marked for the attention of the RMA Compliance and Enforcement Manager) within five working days of the alternative limits being certified.

Review

- 8 The Canterbury Regional Council may, once per year, on any of the last five working days of May or November, serve notice of its intention to review the conditions of this consent for the purposes of:
- i. Dealing with any adverse effect on the environment which may arise from the exercise of this consent; or
 - ii. Reviewing the effectiveness of the conditions in avoiding, remedying or mitigating adverse effects on the environment from the exercise of this consent; or
 - iii. Reviewing the need to monitor the activities that are authorised by this resource consent (including the type and frequency of the monitoring that is undertaken by the consent holder); or
 - iv. Reviewing the N and P limits that apply to the discharge, in order to provide for sustainable management of the watercourses and water bodies including groundwater) within the New Irrigation Areas and/or the Existing Irrigation Areas.

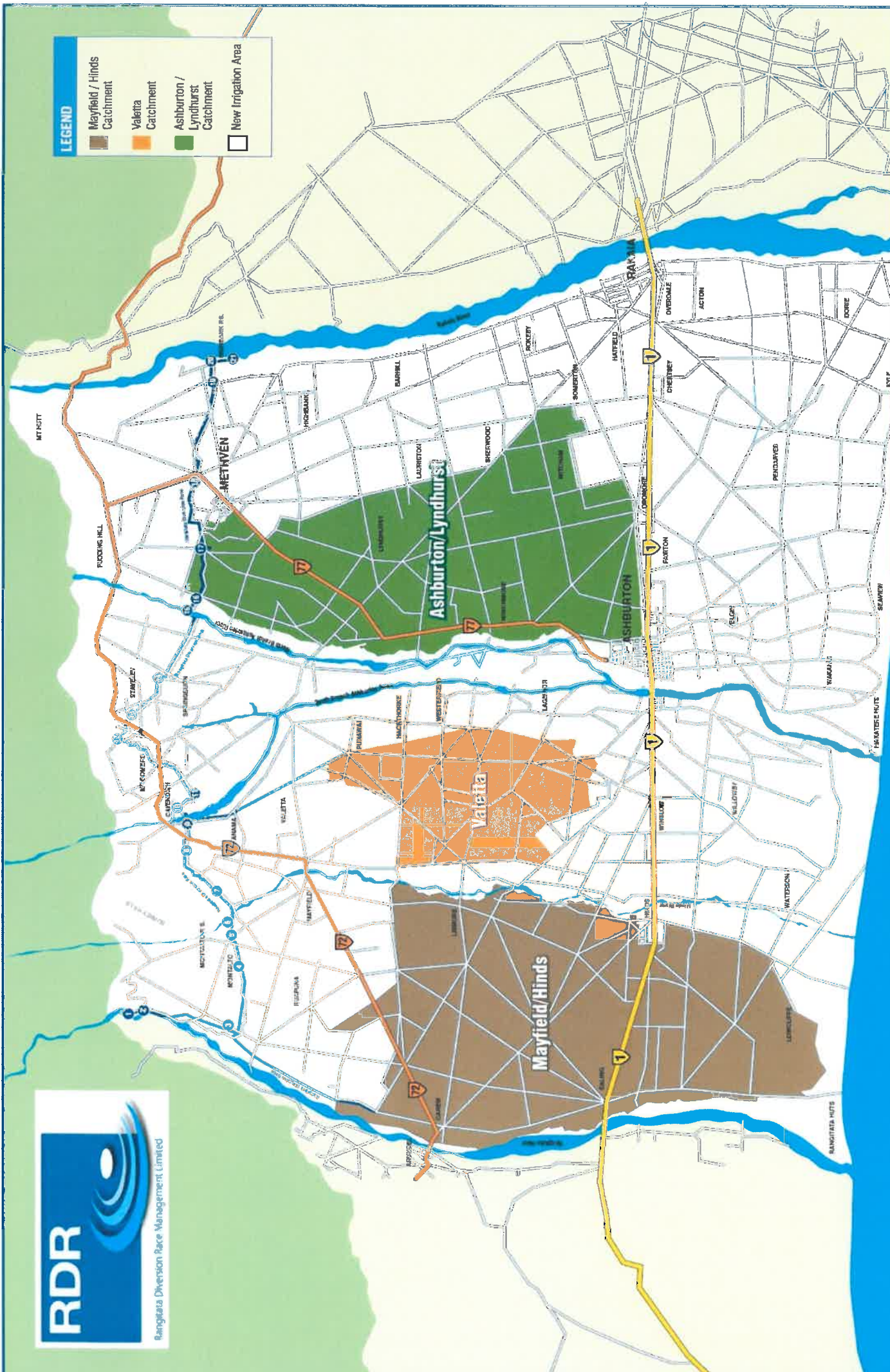
Issued at Christchurch on 26 May 2014

Canterbury Regional Council

RDR

Rangitata Diversion Race Management Limited

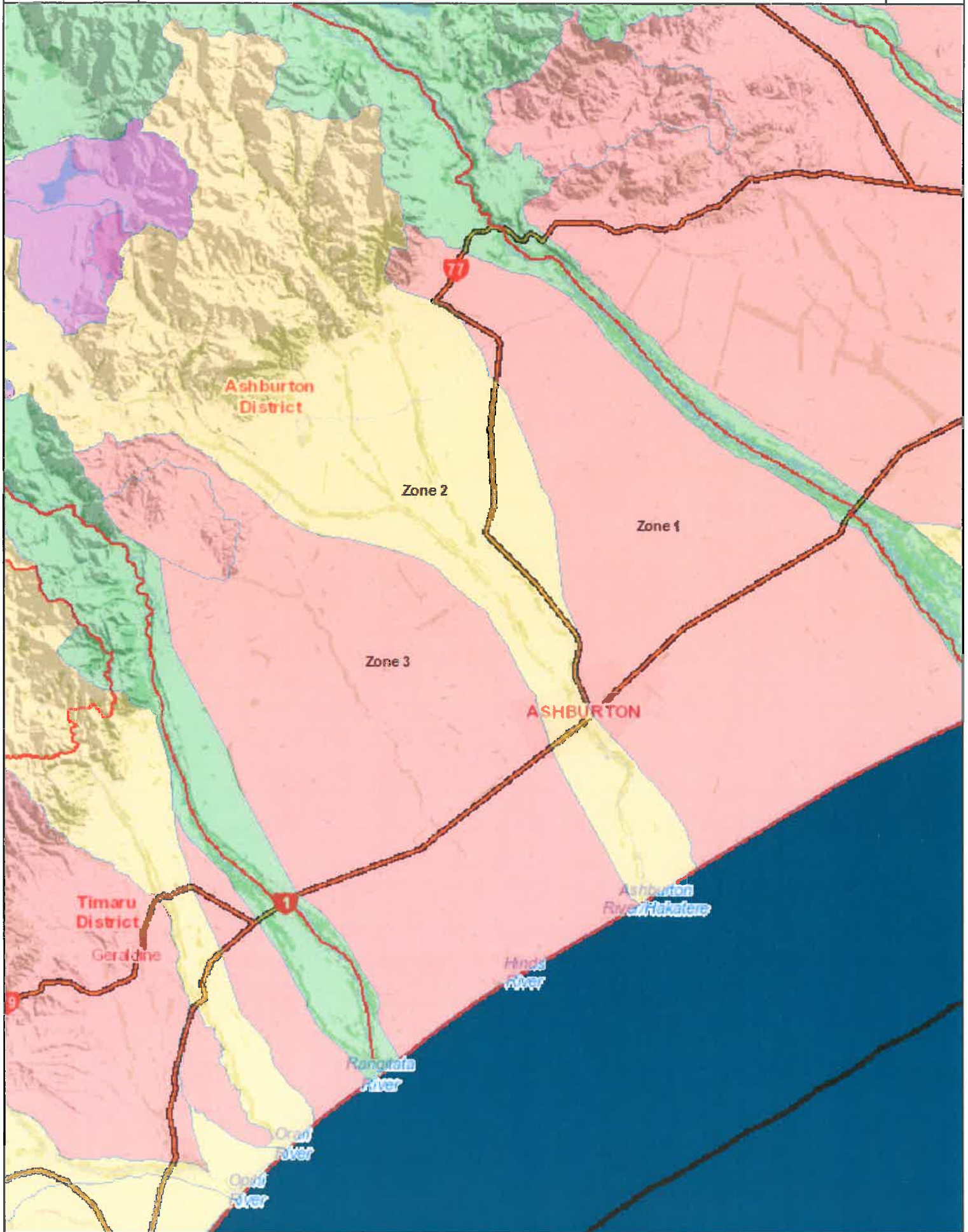
- LEGEND**
- Mayfield / Hinds Catchment
 - Valetta Catchment
 - Ashburton / Lyndhurst Catchment
 - New Irrigation Area



PLAN CRC121664A

RANGITATA DIVERSION RACE

Irrigation Schemes and Hydro Stations



0 2 4 8 12 16 20 24 Kilometres

Scale: 1:423,280

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Map created by hamish on 2:19:59 p.m.

12.0 APPENDIX TWO – The Canterbury Certified Farm Environment Plan (FEP) Auditor Manual (February 2016) – Page 58 and 59 Irrigation Management Areas

Page 58 of the Canterbury Certified Farm Environment Plan (FEP) Auditor Manual (February 2016)

Management Area: Irrigation	
Objective	
To operate irrigation systems efficiently ensuring that the actual use of water is monitored and is efficient.	
Objective Level Of Confidence (LOC)	
Likelihood that the objective has been met based on the practices and the evidence supplied at for each target at the time of the audit.	High Medium Low
Target 1	Target LOC
New irrigation infrastructure is designed, installed and operated in accordance with industry best practice standard	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Target 2	Target LOC
Existing irrigation systems are calibrated, maintained and operated to apply irrigation water at the optimal efficiency.	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Target 3 and 4 combined	Target LOC
All applications of irrigation water are justified on the basis of soil moisture data, climatic information and crop requirements.	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Target 5	Target LOC
Staff is trained in the operation, maintenance and use of irrigation systems.	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Required Actions	Timeframe
Beneficial Actions (A Grades or for High LOC Objective and Targets Only)	Timeframe
Notes/Comments	

Management Area: Nutrient	
Objective	
To maximise nutrient use efficiency while minimising nutrient losses to water.	
Objective Level Of Confidence (LOC) - Discrepancies between Nutrient Loss Calculations and GMP Loss Rates and Nitrogen Baselines (where applicable) and Non-Robust Budget will affect the LOC	
Likelihood that the objective has been met based on the practices and the evidence supplied at for each target at the time of the audit.	High Medium Low
Nutrient Losses Assessment - Aiding Target 1 LOC	
Consented Nutrient Discharge Allowance (NDA)	
GMP Loss Rate	
Current Nitrogen Loss	
Average of latest 4 year Nitrogen Losses if current Nitrogen Loss greater than consented NDA <i>If records of the latest 4 years losses are not available, the current year Nitrogen loss shall be compared to the GMP Loss Rate.</i>	
Is N Loss at or below GMP Loss Rate?	Yes No
OVERSEER [®] Version (Or equivalent model approved by the Chief Executive of Environment Canterbury)	
Nutrient Budget Type (Actual Required)	Actual, Predictive
Nutrient Budget Prepared By	
Date of Nutrient Budget	
Nutrient Budget Robustness Assessment - Aiding Target 1 LOC	
Is the Current Year Nutrient Budget Robust?	Yes No
Target 1	Target LOC
Nitrogen losses from farming activities are at or below Good Management Practice Loss rates for the property. <i>Please note that this target has high weighting</i>	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
<i>For situations where N losses > GMP loss rates but you still consider a High LOC for these reasons:</i>	
Target Reasons Against the Assessment	
Target 2	Target LOC
Phosphorus and sediment losses from farming activities are minimised.	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Target 3	Target LOC
The amount and rate of fertiliser applied do not exceed the agronomic requirements of the crop.	High Medium Low
Target Reasons For the Assessment	Target Objective Evidence
Target Reasons Against the Assessment	
Required Actions	Timeframe
Beneficial Actions (A Grades or for High LOC Objective and Targets Only)	Timeframe
Notes/Comments	

13.0 APPENDIX THREE – GUIDANCE AROUND IRRIGATION FROM INDUSTRY AGREED GOOD MANAGEMENT PRACTICES RELATING TO WATER QUALITY 18 SEPTEMBER 2015 – PAGE 16

Irrigation and water use

Our intent: To apply irrigation water efficiently to meet plant demands and minimise risk of leaching and runoff.

GMP: Manage the amount and timing of irrigation inputs to meet plant demands and minimise risk of leaching and runoff.

Implementation guidance:

There is a demonstrable reason why irrigation is to be applied, for example:

- to replace soil moisture deficit
- for the purpose of herbicide activation
- to prepare soil for cultivation
- frost protection
- for fertigation

GMP: Design, calibrate and operate irrigation systems to minimise the amount of water needed to meet production objectives.

Implementation guidance:

- Any new development, upgrade or redevelopment is consistent with irrigation industry codes of practice.
- The irrigation system is evaluated annually to demonstrate optimal performance using irrigation industry guidance.
- **Dairy:** Actual irrigation water take is measured with a water meter. Soil moisture levels are tracked throughout the season to justify irrigation events, e.g. using soil moisture balance calculations or soil moisture probes or tapes.
- **Dairy:** Actual annual irrigation use is evaluated for consistency with estimated agronomic needs for the season based on climatic data and pasture/crop requirements.
- **Dairy:** Dairy sheds will use no more water for dairy shed washdown and milk cooling than is necessary to produce hygienic and safe milk (Sustainable Dairying: Water Accord). Actual water use in the dairy shed is measured with a water meter.
- **Horticulture and Arable:** Water is applied to maintain soil between stress point and field capacity - knowledge of evapotranspiration, field capacity and use of soil probes can assist in achieving this.
- **Horticulture and Arable:** Volumes applied are informed by all relevant factors e.g. crop type, plant growth stage, soil type and field capacity.

14.0 APPENDIX FOUR – TABLE GG – RESULTS OF FARM PORTAL ANALYSIS OF 18 NUTRIENT BUDGETS PROVIDED TO RDRML

Farm Portal analysis					
	Current farm system Nitrogen loss		GMP N loss for same farm systems		<i>Reduction required</i>
All 18 files	1538.0	Total kg N	856.0	Total kg N	44%
18	85.4	Average kg N/ha/yr	47.6	Average kg N/ha/yr	
8 'A' graded farms	491.0	Total kg N	300.6	Total kg N	39%
8	61.4	Average kg N/ha/yr	37.6	Average kg N/ha/yr	
10 'B' graded	1047	Total kg N	555.6	Total kg N	47%
10	104.7	Average kg N/ha/yr	55.6	Average kg N/ha/yr	

15.0 APPENDIX FIVE – TABLE OF FARM PORTAL ANALYSIS

Identifier	FEP Audit Grading								N loss results		
	Overall Grade	Irrigation	Nutrient	Soils	Effluent	Waterbody	Point Source	Water Use	Current farm system N loss (kg N/ha/yr)	Current farm system GMP N loss (kg N/ha/yr)	Farm Portal N loss reduction to achieve GMP loss rates (%)
1	A	H	H	H	NA	NA	H	H	101	54	47%
2	B	M	H	H	NA	NA	H	H	103	45	56%
3	A	H	H	H	NA	NA	H	H	60	36	40%
4	B	M	H	H	M	NA	H	M	132	67	49%
5	B	M	H	H	H	H	H	H	148	95	36%
6	B	M	H	H	H	NA	M	H	114	72	37%
7	B	M	H	H	H	H	H	H	128	67	48%
8	A	H	H	H	NA	NA	H	H	73	45	38%
9	B	M	H	H	H	H	H	H	58	25	57%
10	B	M	H	H	H	H	H	H	68	46	32%
11	B	M	H	H	H	H	H	H	110	51	54%
12	A	H	H	H	NA	H	H	H	83	31	63%
13	A	H	H	H	NA	NA	H	H	23	19	17%
14	A	H	H	H	H	H	H	H	47	40	15%
15	B	M	M	H	H	NA	H	H	55	37	33%
16	A	H	H	H	NA	H	H	H	43	27	37%
17	A	M	H	H	H	H	H	H	61	49	20%
18	B	M	H	H	H	NA	H	H	131	50	62%

16.0 APPENDIX SIX – TABLE OF GMP TOOL ANALYSIS

Identifier	Overall Grade	Current farm system N loss (kg N/ha/yr.)	GMP N loss rate from Farm Portal (kg N/ha/yr)	Reduction required to achieve overall GMP loss rate (%)	Reduction required to achieve GMP loss rate for GMP proxy group 'Cultivation and cover crops' (%) reduction	Reduction required to achieve GMP loss rate for GMP proxy group 'Effluent and silage' (%)	Reduction required to achieve GMP loss rate for GMP proxy group 'Fertiliser' (%)	Reduction required to achieve GMP loss rate for GMP proxy group 'Irrigation' (%) reduction	Reduction required to achieve GMP loss rate for GMP proxy group 'Soil compaction, stock access and runoff' (%)
1	A	101	54	47%	-1%	0%	39%	13%	0%
2	B	103	45	56%	0%	0%	27%	41%	0%
3	A	60	36	40%	3%	0%	23%	15%	0%
4	B	132	67	49%	0%	0%	-3%	48%	0%
5	B	148	95	36%	0%	0%	-14%	43%	0%
6	B	114	72	37%	1%	1%	-7%	42%	0%
7	B	128	67	48%	0%	0%	0%	53%	0%
8	A	73	45	38%	3%	0%	30%	12%	0%
9	B	58	25	57%	0%	0%	-	28%	0%
10	B	68	46	32%	0%	0%	-1%	32%	0%
11	B	110	51	54%	0%	0%	-10%	55%	0%
12	A	83	31	63%	2%	0%	36%	49%	0%
13	A	23	19	17%	4%	0%	17%	9%	0%
14	A	47	40	15%	1%	0%	9%	6%	0%
15	B	55	37	33%	0%	0%	27%	13%	0%
16	A	43	27	37%	0%	0%	30%	21%	0%
17	A	61	49	20%	0%	0%	3%	18%	0%
18	B	131	50	62%	0%	0%	-2%	63%	0%