

**BEFORE THE CANTERBURY REGIONAL COUNCIL
AND THE ASHBURTON DISTRICT COUNCIL**

In the matter of the Resource Management Act 1991

And

In the matter of resource consent applications by Rangitata
Diversion Race Management Ltd to the Canterbury
Regional Council and Ashburton District Council for
resource consents for the construction, operation and
maintenance of the Klondyke Water Storage Facility, its
associated water takes from and discharges to the
Rangitata River, and all associated activities

**BRIEF OF EVIDENCE OF IAN MCINDOE FOR
RANGITATA WATER LIMITED**

DATED 11 APRIL 2018

BRIEF OF EVIDENCE OF IAN MCINDOE

Introduction

- 1 My full name is Ian McIndoe. I am currently employed as Principal Water Resources Engineer of Aqualinc Research Ltd (Aqualinc).
- 2 Rooney Water Ltd (RWL) has engaged me to provide expert evidence with respect to the hydrological effect of the proposed Klondyke Water Storage Facility on the supply of irrigation water to the Rangitata South Irrigation Scheme (the Scheme).

Qualifications and experience

- 3 I am a Soil and Water Engineer and hold the qualifications of BE (Hons) from Canterbury University and Dip Bus Stud (Finance) from Massey University.
- 4 I have nearly 40 years' experience in hydrology, groundwater and irrigation related work. I have specialised in water allocation (surface and groundwater) for irrigation and the effect of water restrictions on irrigation reliability and performance.
- 5 From 1984-90, I was the Ministry of Agriculture's water resources specialist involved in surface and groundwater allocation and management, including preparing the Ministry of Agriculture submissions on several water plans in Canterbury and other areas in New Zealand. This included the first Rangitata River Water Management Plan.
- 6 I also prepared evidence for the Rangitata River Conservation Order Hearings for Canterbury Regional Council.
- 7 I am an expert in irrigation design and irrigation efficiency, and have provided information and recommendations to Canterbury Regional Council covering several subjects including seasonal allocations, irrigation efficiency and irrigation reliability to help Council formulate their Regional Plans.

- 8 More recently, I have completed reliability analyses for Mayfield-Hinds Irrigation Ltd, Valetta Irrigation Ltd, Ashburton Lyndhurst Irrigation Ltd, Central Plains Water Ltd, Amuri Irrigation Ltd, the proposed Hunter Downs Scheme and several others.
- 9 I provided advice on hydrological matters during completion of Stage 1 of the Canterbury Strategic Water Study.
- 10 I am a member of the NZ Hydrological Society and a Life Member of Irrigation New Zealand.
- 11 I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014, and confirm that I have complied with the code in the preparation of my evidence. I will comply with that code when giving this evidence.

Instructions and scope of this evidence

- 12 Consents CRC134810 and CRC134808 allow RWL to take Rangitata Diversion Race Management LTD (RDRML) water when RDRML are not 'fully' exercising their consent (CRC011237). Conversely RDRML can take RWL water when RWL are not 'fully' exercising their consents (CRC001229, CRC042094, CRC070924 and CRC134808).
- 13 RWL objected to the proposed take¹ on the basis that the proposal to put water into storage would amount to a derogation of the consent granted to RWL that enables RWL to take water authorised to be taken by RDRML when RDRML does not require that water to be taken.
- 14 RWL's key point was that it will miss out on water previously available to it because RDRML will be able to place that water into storage.
- 15 Another key point made by RWL in its submission (para 3.5 – 3.20) was that the proposed additional take had not been properly justified.

¹ RWL Submission 19 February 2018, paras 3.3 and 3.4

The point being made by RWL is that RDRML proposes to use the water for several purposes, and the use needs to be justified.

- 16 The use of the water was outlined in Mr Veendrick's evidence, as follows².
- 17 "Klondyke storage reservoir would allow for developing the currently consented RDRML irrigable area of up to 94,500 ha as well as have the ability to use water for 'other purposes' such as irrigation outside of the RDRML, Managed Aquifer Recharge (MAR) and Targeted Stream Augmentation (TSA). It would also enable RDRML to convert to an irrigation application rate that is closer to current and projected future evapotranspiration rates. The proposed 10 m³/s high flow take would reduce the required storage volumes or alternatively would ensure that sufficient water is available for these 'other purposes'."
- 18 I note that in Mr Veendrick's evidence (para 6.7) that the use of water beyond the consented 94,486 ha would require a separate use consent. Similarly a separate water use consent will be required should water be used for MAR, TSA or any other use. The resource consent applications for these uses are not part of this pond proposal.
- 19 My instructions are to comment on the potential for the storage facility to reduce the supply of water allowed to be taken from the Rangitata River to the Rangitata South Irrigation Scheme and therefore affect the reliability of the Scheme.
- 20 I have also been asked to comment on whether the proposed additional take has been justified.

Joint Witness Statement

- 21 I attended a Joint Witness conference on 15 March 2018. As summarised in the Hydrology Joint Witness Statement, I indicated that the taking of water into storage under the proposal has the

² Statement of evidence of Bas Veendrick on behalf of Rangitata Diversion Race Management Limited 28 March 2018, para 1.3.

potential to reduce the amount of water that can be taken under consent CRC134810.

- 22 The reason I gave for this is that RDRML is currently not always (fully) exercising their consent and with storage in place RDRML potentially (fully) exercises their consent more often, having the potential to reduce the water available for RWL under consent CRC134810.
- 23 I made the point that putting a large amount of storage into the head of the RDR scheme shifts the scheme dynamics to more of a volumetrically based scheme rather than the current flow rate (run-of-river) based scheme, which may affect existing users (i.e. RWL).
- 24 In my view, an assessment of the RDR system with storage should be compared to the RDR without storage to see what the differences are.

Response to derogation issue

- 25 I have read the evidence of Canterbury Regional Council (Section 42A Officer's Report), and RDRML (Bas Veendrick and Ben Curry) to see whether the potential derogation issue has been commented on.
- 26 This issue has not been addressed by Environment Canterbury at all.
- 27 Mr Veendrick refers in para 9.38² to consent CRC134810, which authorises Rangitata Water Limited (RWL) to take RDRML water when they are not (fully) exercising their consent (CRC011237). Conversely consent CRC134808 authorises RDRML to take RWL water when RWL are not (fully) exercising their consents (CRC001229, CRC042094, CRC070924 and CRC134808).
- 28 His view is that these consents are essentially 'secondary' consents and the amount of 'left over' water that can be taken is not guaranteed, and is only available if RDRML chooses not to abstract its full allocation under consent CRC011237.

- 29 Mr Currie, (para 8.8.8³) acknowledges that until now, only RWL has exercised the arrangement and this has occurred when the RDR has been fully shut down, and when it has only been taking part of its take.
- 30 Mr Currie (para 8.8.9) notes that going forward, water will still be available to RWL when the RDR is fully shut down. In respect of the partial water, he states that there is no guarantee that this will continue to be available (and he expects the volume of partial water available will decline significantly anyway) for a number of reasons, which he gives in para 8.8.9.
- 31 At the Hydrology Joint Witness Conference, the experts agreed that a review from a legal/planning perspective was required to resolve whether an assessment of the RDRML proposal on RWL needed to be completed.

Effect of storage

- 32 Introducing a large 53 million m³ storage into the system near the top of the RDR will allow scheme managers to take water into storage that they would have otherwise not been able to take.
- 33 Currently, the water supply is on a run-of-river basis at a maximum flow rate of 30.7 cumecs, and is supplied to existing irrigation, or continues through the RDR to Highbank power station on the true right bank of the Rakaia River. The flow rate that can be taken through to Highbank is limited to about 28 cumecs due to infrastructural matters such as the maximum capacity of a syphon.
- 34 Additional water is also able to be taken to replenish the Carew storage pond (6 million m³ maximum).
- 35 There are a number of on-farm storage ponds within the irrigation schemes that are primarily used to convert an open-race rostered flow that was used for border-dyke irrigation to a 24 hour flow used

³ Statement of evidence by Benedict Rodney Curry dated 28 March 2018

for spray irrigation. Where schemes have been piped (Valetta and part of Ashburton-Lyndhurst), water is delivered on a 24 hour basis. The on-farm ponds are not primarily used to increase capacity or improve reliability, so conceptually have a different purpose to the proposed Klondyke storage pond.

- 36 The surplus water available to RWL either comes from periods when the RDR is turned off for maintenance (typically in the first two weeks of May) or when it is not required for irrigation or able to be taken through to Highbank.
- 37 The availability of this water varies from year to year. Mr Currie notes that two-thirds of the available water occurs during RDR maintenance and one-third at times of partial takes.
- 38 The RWL flow rates taken under their normal consent and under the Water Exchange Agreement are monitored by NIWA. Based on the flow records provided by NIWA, Dr Ayaka Kashima, (Aqualinc engineer), looked at the amount of water taken. She analysed the measured data for a period between 1 June 2016 and 31 May 2017.
- 39 Dr Kashima found that in the 2016/17 year, 26% of the total RWL take was RDR water. This amounted to 32 million m³. Since the RDRML water was more than a quarter of the total RWL water take, its impact on supply reliability was significant in that year, increasing it from about 91% to close to 100%.
- 40 The RWL main storage ponds have 16.5 million m³ storage capacity, and, for reliable irrigation, need to be filled by the start of, or early in, the irrigation season.
- 41 While Mr Curry states that water will still be available when the RDR is turned off for maintenance, there is no guarantee that if the maintenance period was early May, sufficient water would be available to fill the RWL ponds. Our analysis shows that if RDR water availability was limited to early May, the RWL ponds would only be filled in 75% of years, and reliability would be increased by just 0.5%.

- 42 Also, as the current RDR system is primarily run-of-river, any maintenance carried out on the RDR requires the whole scheme to be turned off, which potentially releases water for RWL. With storage, water could still be run into that storage if maintenance was being carried out downstream of the storage pond.
- 43 Hydrologically, I have no doubt that adding 53 million m³ of storage into the RDR system will reduce the availability of water to RWL. While I am not in a position to make a call on whether this needs to be considered from a planning or legal sense, I am of the opinion that such an assessment could be carried out using historical RDR take data and consented data and comparing the situation with and without storage.
- 44 At this point in time, I cannot quantify the potential effect of RDR's proposal. However, my opinion is that there will be a difference in the amount of water taken under the storage proposal versus the current situation that could lead to an adverse effect on the availability of unused water for the Rangitata South Irrigation Scheme.

Reasonable Use

- 45 PDP have developed a model using MATLAB to assess the relationships between storage, supply rate (incorrectly referred to as application rate), and irrigated area. This is a separate model to the one used for assessing the effect of the proposed 10 m³/s take from the Rangitata River.
- 46 The MATLAB model was calibrated using data from five farms within the Barrhill Chertsey Irrigation Scheme⁴. The parameters derived from the data from the five farms were averaged and applied to the whole scheme.
- 47 Mr. Horrell (hydrologist auditing the application on behalf of ECan) reviewed the supply-demand assessment and agreed with the

⁴ Klondyke Storage Proposal – Hydrology Assessment, PDP July 2016.

MATLAB model assumptions and input data, model calibration, and model selection of final calibrated parameters.

- 48 The assumptions PDP have used for their MATLAB modelling will have a direct impact on the relationship between storage requirements, supply rates and irrigated area.
- 49 Some of the assumptions are surprising. For example, everything was assumed to be piped. While Valetta and part of Ashburton Lyndhurst are piped, Mayfield Hinds is not. Whether it will be piped is unknown. I would have thought that an allowance for some race losses would have been prudent. Where are the RDR losses?
- 50 On-farm supply rates (application rates) were increased to 0.52 l/s/ha and 0.6 l/s/ha, but there is no justification for the higher rates. I know from my own experience that 0.6 l/s/ha is not required to meet crop water demand in many parts of the scheme command area, and more particularly if the schemes are piped and using spray (centre-pivot) irrigation.
- 51 On-farm supply rates directly affect the storage requirements, the area able to be irrigated and the amount of water that needs to be taken from the Rangitata River, so it is important in my view to use supply rates that have been justified in terms of meeting crop water demand, rather than just applying 0.52 l/s/ha or 0.6 l/s/ha to everything.
- 52 Irrigation demand is sensitive to trigger levels, which are the percentages of soil water at which on-farm irrigation is initiated and stopped. This means that trigger levels have a direct impact on the relationship between irrigated area, storage and supply rates as they, with other parameters, determine the flow rates and volumes of water required for irrigation.
- 53 PDP, in the Hydrology report⁵, use a trigger level of 55% of soil water when irrigation water is applied and 95% for when irrigation is

⁵ Klondyke Storage Proposal – Hydrology Assessment, PDP July 2016, Section 5.3.2.

stopped. These trigger levels do not reflect how many irrigators operate, particularly on the higher PAW soils. For example, under those trigger levels, centre-pivots operating on medium soils (say soils holding 90 mm of water), would be applying 36 mm of water. In reality, they would be applying 20 or 25 mm.

- 54 I question whether applying the parameters from five farms from Barrhill Chertsey would truly represent irrigation demand for the full command area. There is a wide range of crops, soils, irrigation methods and climate in the command area, and it would be appropriate in my view to consider a range of parameters for the different situations.
- 55 The three supply rate scenarios (current, 0.52 l/s/ha and 0.6 l/s/ha) were modelled to predict maximum irrigated areas assuming current reliability, but no information is provided on current reliability and how it was obtained, other than to say it is based on annual supply/demand ratios.
- 56 It appears that the proposed changes to Ashburton River minimum flows have not been modelled. However, comment is made that the changes to minimum flows will lower RDR reliability and increase the need for storage. I am surprised that this has not been quantified.
- 57 I understood that Table 8⁶ predicted irrigable areas under the three scenarios for current reliability. Table 9⁷ provided storage volumes to irrigate 94486 ha with the same reliability. Para 5.5.3 provides volumes of water available for additional uses such as areas outside RDRML, and for Managed Aquifer Recharge and Targeted Stream Augmentation. However, I have not seen any information to support these other uses.
- 58 This analysis was on the basis that current reliability is to be fixed at the current level of reliability⁷. One of the consequences of having storage is that it increases reliability. In fact, it will be very difficult to

⁶ Klondyke Storage Proposal – Hydrology Assessment, PDP July 2016, Section 5.5.1.

⁷ Klondyke Storage Proposal – Hydrology Assessment, PDP July 2016, Section 5.5.2.

operate the scheme to not increase reliability. Therefore, additional water will be taken from the Rangitata River to increase reliability. That does not appear to have been considered.

- 59 Other than the graphs of model calibration in Appendix F, there is virtually no information on the overall model, its structure, how the scheme was divided up, climate data used, soils data used, efficiency factors, crop factors and so on. All that is listed are the final calibrated parameters. I have not seen Mr Horrell's report, but it appears that he only reviewed the calibration part of the modelling.
- 60 I cannot tell from the data presented whether the additional water applied for is justified, but I am certain that 0.6 l/s/ha would not be justified over the whole scheme. For me to be able to comment further on the justification of the additional take, I will need substantially more information on the MATLAB model than has been provided to date.



Ian McIndoe

11 April 2018