BEFORE THE CANTERBURY REGIONAL COUNCIL

In the Matter of	The Resource Management Act 1991
Between	CANTERBURY REGIONAL COUNCIL
And	RANGITATA DIVERSION RACE MANAGEMENT LIMITED Submitter & Further Submitter

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EVIDENCE OF RICHARD TREVOR de JOUX – HEARING THREE
ASHBURTON RIVER (SECTION 13)

Introduction

1. My name is Richard de Joux. I am a hydrologist and geohydrologist, and hold the qualifications of Bachelor of Science (Geology) and New Zealand Certificate of Engineering (Civil). I presently manage a Consultancy specialising in measuring and monitoring river flows, groundwater, irrigation abstractions, hydrological investigations and modelling, and preparation of resource consent applications. I have had 40 years' experience in surface water and groundwater hydrology, and prior to setting up my own business in 1994 was employed by Environment Canterbury and by the South Canterbury Catchment Board.

2. During my employment with the South Canterbury Catchment Board I collected, processed and analysed hydrological data and participated in the formulation of water management regimes during the preparation of Water Management Plans for the Ashburton River. Between 1973 and 1983 I was a field hydrologist and carried out many of the flow measurements and hydrological investigations within the Ashburton Catchment. Over time I have developed an understanding of the complex hydrology of the Ashburton Catchment.

3. Although this is a regional council plan hearing, I have complied with the code of conduct for expert witnesses contained in the Environment Court's Practice Note dated 1 November 2011 when preparing this evidence

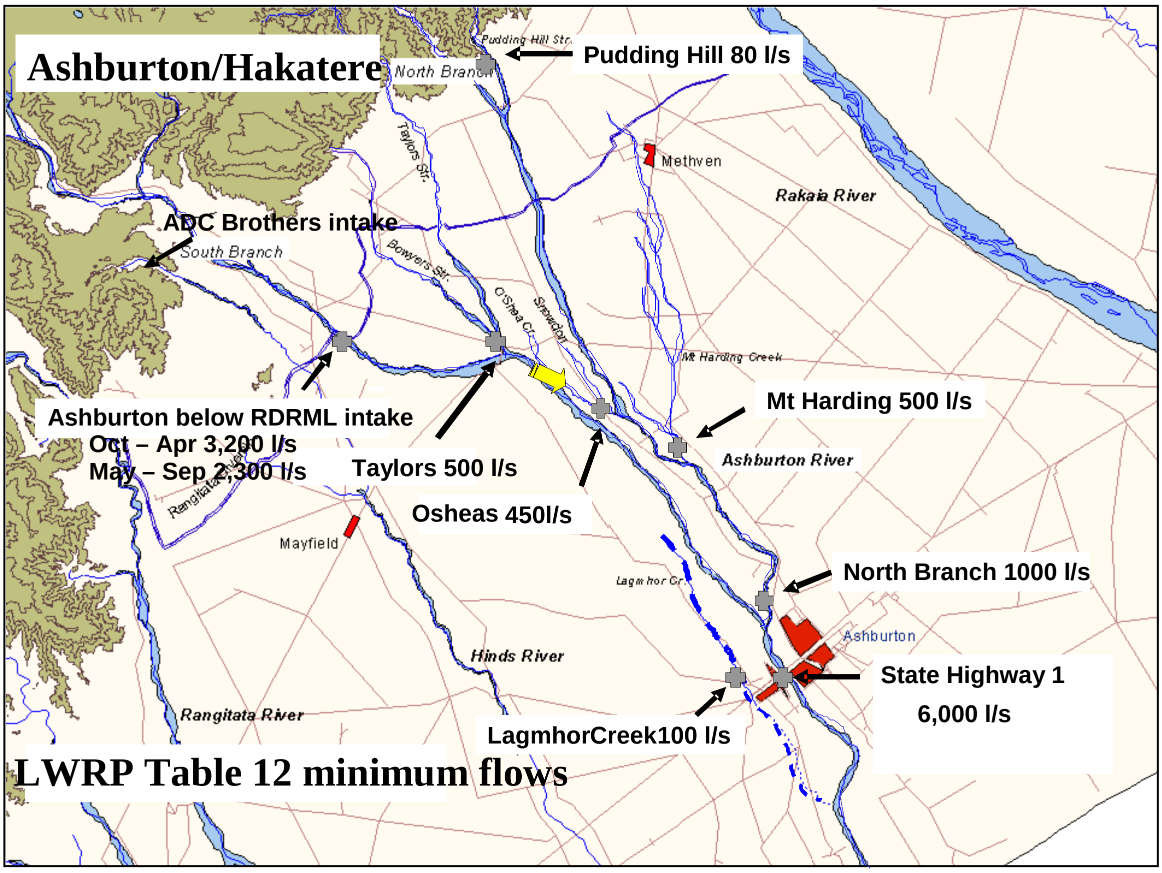
Scope of evidence

4. I have been asked by Rangitata Diversion Race Management Limited ("RDRML") to review and present information in relation to the flow modelling carried out for ECan to compare water management scenario modelling, and to provide comments on relevant policies and rules that affect RDRML'S reliability of supply.

Background

5. For the sake of clarity, I have included Figure 1 in my evidence to show the location of the various tributaries and minimum flow sites within the Ashburton Catchment. The figure has been modified from that provided by Environment Canterbury during a public presentation of the minimum flow regime proposed in the Natural Resources Regional Plan (NRRP) held in Ashburton in June 2008.

FIGURE 1 : Location of Ashburton Catchment minimum flow sites



7. The hydrology of the Ashburton catchment is extremely complex. There are 4 main tributaries (South Branch, Taylors, Bowyers, North Branch) and a number of smaller springfed tributaries (Mt Harding Creek, O'Sheas Creek, Laghmor Creek). Each tributary has a distinct hydrological regime and different flow pattern. The South Branch has considerable hydrological storage within the upper Ashburton Lakes; the North Branch has proportionally more of its catchment in the sub alpine zone; the smaller creeks are fed from groundwater. Each tributary has different reliabilities of supply.

8. The proposed minimum flow regime within section 13 of the proposed Canterbury Land and Water Regional Plan (LWRP) is based on previous work by Horrell hydrological modelling and Ashburton River low flow regime (Horrell, 2001, 2004, 2009, 2012). The proposed flow regime is predicated on the following:

8.1 That the naturally occurring flows within the Ashburton River tributaries are those provided in table 4.3 of Horrell (2004). This includes estimated 7 Day Mean Annual Low Flows of 4210 l/s for South Ashburton at Valetta, 1080 l/s for Taylors Stream, 9170 l/s for South Ashburton above North confluence, and 3870 l/s for North Ashburton above South confluence.

8.2 That the North Ashburton River (North Ashburton) rarely if ever goes dry "naturally", rather it is dry only because of abstractions. Horrell (2004) states "In conclusion naturally occurring low flows in the foothills do not necessarily equate to zero flow at Digby's Bridge, owing to the high influence groundwater levels on tributary flow in the middle reaches of the North Branch, during these periods."

9. I have previously provided Environment Canterbury with a review and comment on that analysis (reported in Appendix 2 of Horrell (2004)), and I remain unconvinced of the dependability of the assumption. A major concern that I had about the calculation of "naturalised" flows was the practise of adding all of the upstream abstractions back into the measured flow at specified downstream reaches. Many of the reaches lose surface flow to the surrounding groundwater, therefore a portion of any abstracted water would either be permanently lost and would not have remained within the river, or would be intercepted by springs and re-enter the river at a downstream location. This fact has been recognised by other authors. Scarf (2003) noted that *"clearly a portion of that water would be permanently lost to adjacent unconfined groundwater and springfed streams"*. Scarf used proportional corrections to account for abstractions within the Orari, Temuka and Ohapi Stream catchments.

10. Scarf's reference to permanent loss to groundwater is particularly relevant to the Ashburton River. Piezometric contours prepared by Environment Canterbury staff clearly show a strong flow of groundwater away from the North Ashburton to the surrounding aquifer. Losses occur continuously from Thompsons Track to below Digby's Bridge. These flows are permanently lost from the River, however this has not been taken into account in the modelled "naturalised" flows presented by Horrell (2001, 2004).

11. Mosley (2001) referred to the 2001 Horrell report, stating "This table [appendix 3, table 5 of Horrell (2001)] is based on some quite severe assumptions, and should only be taken as indicative of the "median" effect of abstractions on the natural flow regime."

12. The North Ashburton minimum flow of 1000 l/s was set on the assumption that the 7DMALF was estimated to be 3870 l/s. Following a technical meeting in August 2012 between myself, Graeme Horrell and Dr Tim Davies (Environment Canterbury Surface Water Resources & Ecosystems Manager), the model used to predict surface flows was revised and updated (Horrell 2012). The resulting revised regression for the North Ashburton provided an estimated 7DMALF of 1800 l/s. This is similar to the value calculated by Young (1992).

13. This dramatic reduction in estimated 7DMALF for the North Ashburton River has not been highlighted in either the section 32 report or in the section 42A report prepared by the officer and introduces considerable uncertainty on the efficacy of the model.

14. On 11th April 2013 I sent an email to Dr Tim Davie which in part stated "Given this large reduction in estimated MALF, has there been any intention to re-visit what the North Branch minimum flow should be? I would have thought that if the 1000l/s minimum flow was based on an estimated MALF of 3870 l/s, then surely the minimum flows needs to be re-visited." Dr Davie responded on 2nd May 2013 that "I don't see any need for looking at them again in light of a revised MALF."

15. It is my opinion that the significant change in estimated 7DMALF for the North Ashburton River warrants a re-assessment of the proposed flow regime "package", which is predicated on maintaining a minimum flow of 1000 l/s in the North Ashburton upstream of the South Ashburton confluence.

Proposed flow regime for RDRML

16. RDRML hold a suite of resource consents to operate the Rangitata Diversion Race ("RDR"). Consent CRC011245[1] authorises the taking from the South Ashburton River of up to 7,100 litres per second, such that the combined take with that from the Rangitata River does not exceed 35,400 litres per second. If RDRML can fully exercise its abstraction from the Rangitata River, the maximum rate of take from the South Ashburton River will be 4,700 l/s.

17. Consent CRC011245 requires RDRML to cease taking water whenever the flow in the South Ashburton River below the RDRML intake is at or below 2300 l/s. The consent also requires the abstraction to reduce or cease depending on the monthly residual flows in the Ashburton River at SH1 Bridge shown in table 1.

Table 1 : Consented minimum flow (litres per second) at State Highway 1 Bridge.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4500	3500	3500	5000	5000	5000	5000	6500	8000	8000	6500	5000

[1] This consent was granted by consent order in April 2008.

18. The implementation strategy within the pLWRP proposes that RDRML reduce their "A" permit to a maximum take of 5100 l/s (the remaining 2000 l/s being classed as a "B" permit), and that the existing minimum flow of 2,300 l/s below the RDRML intake is increased to 3,200 l/s for the months between October and April of each following year. Until 1 August 2022, RDRML would not be subject to the State Highway 1 minimum flow specified in table 12.

Comments on the hydrological model and flow sharing regimes

19. The minimum flows at various sites rely significantly on the presumption that a continuous flow can be achieved within the North Ashburton. Based on my personal knowledge of the hydrology of the Catchment, and in combination with my reservations over the irreversible hydrological impacts of land use change and river control works, I do not believe that permanent continuous flow can be achieved within the North Ashburton River – especially during summer months.

20. I believe that the "naturalised" hydrology presented in the modelling work gives an unrealistically high expectation that continuous flow will be restored to the North Ashburton River.

21. From personal observations, there have been numerous occasions when the North Ashburton River has been dry at Digby's Bridge for long periods of time even during winter months when there are no irrigation abstractions occurring.

22. Although RDRML are not directly affected by flow restrictions downstream of their intake until 1 August 2022, there is still considerable uncertainty whether the predicted minimum flows and reliability of supply will actually be achieved.

23. The modelling of reliability carried out by Horrell is based on the flow distribution for each of the tributaries. I do not believe that this provides a realistic estimate of reliability because it does not look specifically at the flow rates in the various tributaries in every year. Rather, the analysis is based on the flow frequency distribution for the entire record.

24. This approach may be adequate in the catchment where all the tributaries have similar flow patterns, but the differing flow regimes within the Ashburton Catchment means that while one tributary might be at (for example) its 80 percentile flow on a certain day there is no guarantee

that a different tributary will also be at its 80 percentile flow on the same day. The flow distributions don't account for timing of flows, but the modelling assumes that this will happen.

25. A more reasonable approach would have been to model the daily time series for the record so that a better assessment of reliability can be attained.

26. The modelled results are an amalgam of the entire record period. As such, the reported reliabilities are averages. The analysis does not identify the number of consecutive days when restrictions would be required; the time of year when restrictions will occur; the number of days between successive periods of restriction; or the reliability during dryer years when impacts on reliability will be greater. All of the above are essential when attempting to describe the impacts on reliability of supply.

Impact of proposed flow regime on the RDRML intake

27. The introduction section of Chapter 13 of the pLWRP states that "In achieving these outcomes changes are to occur over time so as to have minimal impact on existing activities."

28. The proposal to increase the minimum flow from 2,300 l/s to 3,200 l/s for the months of October to April of each following year is part of the "integrated package" referred to in section 9.1 of the S42A report. The regime depends on the implementation of the package within specified timeframes. An integral part of "the package" is the reduction in the total take from the Ashburton River by the District Council (ADC) stockwater system.

29. Policy 13.4.1 of the notified pLWRP states "The taking of water for community stock water supplies from the Hakatere/Ashburton River from 1 July 2015 will not exceed 2,900 l/s in total."

30. From reading the various planning documents, It appears to be intended that the total abstraction from ADC intakes will be reduced to 2900 l/s, and that this will assist in maintaining the existing (or similar) reliability for abstractions and also to compensate for higher minimum flows required by RDRML.

31. Although Policy 13.4.1 refers to the reduction in total stock water supplies, any reduction is not site -specific and there is no rule or indication within Table 12 that provides any certainty for RDRML that the total ADC abstraction upstream of the RDRML intake will be reduced. In theory, ADC could reduce their abstractions from the North Ashburton River and other tributaries while

still abstracting the full existing consented flow upstream of RDRML intake (Brothers Intake, Stoney Creek (sometimes referred to as Woolshed Creek) intake.

32. To maintain the existing reliability of RDRML, in simplistic terms the ADC intakes upstream of RDRML would need to be reduced by 900 l/s to offset the RDRML higher minimum flow.

33. The modelling undertaken by Graeme Horrell for the South Ashburton River reduces the total abstraction from ADC intakes upstream of the RDRML intake by 30%. The model assumes a total reduction of 544 l/s (510 l/s reduction from Brothers Intake, 34 l/s reduction from Woolshed Creek intake). A reduction of that magnitude is still less than the 900 l/s increase in the minimum flow proposed for RDRML.

34. I note here that Horrell does not attempt to show the impact on reliability of the RDRML abstraction, and simply notes that it is difficult to describe the impacts on the RDR take. This appear to be a contradiction to section 9.2 of the S42A report which states that modelling undertaken by Graeme Horrell (2012) indicates that the increase in flows will work **to maintain or, in some cases improve** [my emphasis] the existing reliability.

35. The impact on reliability of supply to RDRML has been modelled by Mr Dave Boraman of Boraman Consultants Ltd (BCL). BCL are ECan approved providers for flow monitoring (open channel and pipe flow), data hosting and reporting, and operate all of RDRML's flow monitoring systems.

36. Using flow data from the South Ashburton at Mt Somers recorder site and the RDRML intake, the existing reliability of supply has been compared to the proposed regime with and without a reduction in ADC stockwater race abstractions. The results are shown in table 2.

Table 2 : Changes in existing reliability of supply for RDRML of proposed LWRP flow regime 1979 – 2010 inclusive (Flows in litres per second)

Regime	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Current regime - min flow 2300 l/s, max take 7,100 l/s	5446	4212	3505	3370	3827	4436	5043	5767	6160	6616	6458	6249	5091
pLWRP minumums with no ADC cutback	4870	3481	2840	2881	3287	4436	5041	5767	6160	6388	6169	5845	4764
Percentage change	-11	-17	-19	-14	-14	0	0	0	0	-3	-4	-6	-7
pLWRP minimum flow, ADC reduce by 560 l/s	5233	3938	3244	3141	3613	4726	5351	5990	6329	6536	6356	6105	5047
Percentage change	-4	-7	-7	-7	-6	7	6	4	3	-1	-2	-2	-1

37. It can be seen that if RDRML are required to meet the pLWRP minimum flows and there is no reduction in ADC takes upstream of the RDRML intake, the average reliability of supply to RDRML is dramatically reduced by a maximum -19% in March.

38. With a reduction in ADC take of 560 l/s (slightly higher than the 544 l/s modelled by Horrell), the average reliability during the irrigation season is still 7 percent less than the current reliability.

39. It should be noted that the numbers shown in table 2 above are averages over the entire record period. The year 2005 was a dryer than normal year, and it is in the dryer years that the magnitude of changes in reliability will be felt. The relevant values for 2005 are shown in table 3.

Table 3 : Changes in existing reliability of supply for RDRML of proposed LWRP flow regime
Year = 2005 (Flows in litres per second)

Regime	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Current regime - min flow 2300 l/s, max take 7,100 l/s	6153	3871	3255	2687	1917	1267	735	1433	3792	3540	2049	1900	2716.6
pLWRP minumums with no ADC cutback	5718	3021	2483	1833	1042	1267	735	1433	3791	2640	1183	1026	2181.0
Percentage change	-7	-22	-24	-32	-46	0	0	0	0	-25	-42	-46	-20
pLWRP minimum flow, ADC reduce by 560 l/s	6002	3552	2965	2361	1577	1827	1291	1992	4231	3200	1709	1565	2689.3
Percentage change	-2	-8	-9	-12	-18	44	76	39	12	-10	-17	-18	-1

40. The modelled effect of the proposed regimes shows that if there is no reduction in ADC takes upstream of RDRML, the change of reliability of supply in 2005 would be -42% in November, -46% in December, -24% in March and -45% in May.

41. With a reduction in ADC take of 560 l/s, the change in reliability of supply in 2005 would be -16% in November, -18% in December, -9% in March and -18% in May.

42. Although the impact on reliability of the proposed flow sharing regime will be less than those shown in Table 2 during wetter years, this is not considered to be particularly relevant because, as referred to above, it is in the dryer years that the magnitude of changes in reliability become important.

43. In order to ensure there is "minimal impact on existing activities", or to "maintain or in some cases improve the existing reliability", it is essential that any increase in minimum flow for RDRML occurs at the same time as a comparable reduction in take from ADC Brothers intake. I have seen the rule proposed by Mr Bryce and believe that this will achieve the required outcome.

August 2022 Minimum flow

44. Table 12 refers to a minimum flow of 10,000 l/s at State Highway 1 for ALL abstractions (including RDRML). Given the lack of reliable flow and water usage data at this time, it is not possible to quantify the likely impact on reliability of supply for abstractive uses.

45. In simple terms, raising the minimum flow at State Highway 1 Bridge from 6,000 l/s to 10,000 l/s from August 2022 will, in my opinion have a substantial impact on reliability of supply for all abstractions because the additional 4000 l/s to be retained within the River must come from a reduction abstractions.

46. The Horrell flow model shows that the recorded (residual) flow for the Ashburton River at State Highway 1 Bridge for the period June 1996 to November 2011 was at 6000 l/s for 54% of the time and was at 10,000 l/s for 37.5% of the time, a difference in time of 16.5%. Although detailed modelling would be required to confirm the change in reliability, it seems that a reduction in the order of 16% may be required.

Possible Alternative Options to improve residual flows

47. I consider that there may be other options available to help improve residual flows within the River, and that those options could be investigated in more detail.

48. The possible use of the RDR to distribute stock drinking water has been raised in the past. This would obviously require co-operation between RDRML, Ashburton District Council and ECan, but should result in a reduction of existing ADC abstractions from the River.

49. Although not directly affecting RDRML, it should be possible for Greenstreet Irrigation Society to discharge the full O'Sheas Creek flow into the lower Nth Ashburton River at Rawles Crossing Road rather than into the North Ashburton river (which is usually dry downstream of the Creek confluence). This would ensure that the full flow of O'Sheas Creek would enter the North Ashburton immediately upstream of the Nth/Sth Confluence rather than being lost to groundwater.

Summary

50. In summary, I conclude that:

50.1 There is considerable doubt whether the proposed minimum flow regimes will maintain a continuous flow in the North Ashburton River, or that the implementation strategy will achieve the desired minimum flows at SH1 Bridge.

50.2 A rule is required to ensure that the ADC stockwater intakes upstream of the RDRML intake reduce their total takes by 900 l/s to ensure the reliability of supply to RDRML is not reduced. The rule will also need to specify when the reduction has to take place and that this coincides with the increase in minimum flow requirement for RDRML. I have seen the rule proposed by Mr Bryce and believe that this will achieve the required outcome.

50.3 Any changes to the existing flow regime should be staged over periods of time to allow careful monitoring to ensure that the predicted benefits in flows are actually achieved. Advancing to the next stage of restrictions should only occur once the benefits have been proven.

50.4 There may be other opportunities to provide higher flows within the River. These include RDRML to provide stock water that is presently supplied by Ashburton District Council stock water races, and the discharging of O'Sheas Creek directly into the North Ashburton River via the Greenstreet Irrigation Society discharge race below Rawles Crossing Road.

References:

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