IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of applications for resource consent by the Central Plains Water Trust and a notice of requirement for the designation of land by Central Plains Water Limited associated with the construction and operation of the Central Plains Water Scheme

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STATEMENT OF EVIDENCE OF RICHARD DE JOUX ON BEHALF OF THE NORTH CANTERBURY FISH AND GAME COUNCIL AND THE DIRECTOR GENERAL OF CONSERVATION

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1. INTRODUCTION

Qualifications and experience

1.1 My name is Richard Trevor de Joux. I am a hydrologist and hydrogeologist, and hold the qualifications of Bachelor of Science (Geology) and New Zealand Certificate of Engineering (Civil). I have had 33 years experience in surface water and groundwater hydrology, and prior to setting up my own Consultancy Company in 1994 was employed by Environment Canterbury and by the South Canterbury Catchment Board. 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.

1.2 I have experience in hydrological modelling of existing and proposed irrigation schemes including the Aoraki Water Trust (proposal to transfer water from Lake Tekapo to the Opihi Catchment), Opuha Dam Ltd (operation and effects of changed flow regimes), RDRML (proposal for upper Ashburton storage for irrigation and power generation) and South Canterbury Irrigation Trust (review proposal to raise Lake Opuha and to dam the Opihi River). My Company operates and provides flow monitoring services to a number of large irrigation schemes including Lower Waitaki, Morven Glenavy, Levels Plains, Opuha Dam, Totara Valley and Kakahu. I am therefore familiar with the manner in which water is scheduled and used within open race irrigation schemes supplied from run-of-river and from storage dams.

1.3 I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses (31 July 2006). This evidence is within my area of expertise, except where I state that I am relying on facts or information provided to me by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

1.4 My evidence provides a summary of the hydrology of the Rakaia and Waimakariri Rivers, and describes the changes in flow regimes that would occur if the Central Plains Water (CPW) Scheme becomes operational. I do not address the ecological or recreational impacts of hydrology, as this is dealt with by other witnesses for Fish & Game and the Department of Conservation.

1.5 In preparing this evidence, I have obtained hydrological flow information provided by Canterbury Regional Council (site 66401 - Waimakariri River at Old Highway Bridge, site 68502 – Rakaia at Gorge, site 68526 Rakaia at Fighting Hill). I was also provided with flow data from the Waimakariri Irrigation Company Limited (WIL) for their intake. In preparing the computer models, I had meetings and discussions with Canterbury Regional Council water resources staff (Graham Horrell and Suzanne Gabites) and held a number of meetings regarding confirmation of assumptions used for CPW irrigation requirements with Mr Cliff Tipler of URS, who provided me with a dataset of daily irrigation demands (including race losses) for CPW prepared by Aqualinc Research Ltd. I have used that dataset in the modelling of river flows detailed later in this evidence.

1.6 I have reviewed the evidence of the Applicant produced in February 2008, and the subsequent further submission dated 14 April 2008 dealing with impacts of Synlait having priority over CPW for Rakaia River water and CPW having priority over Ngai Tahu Properties Ltd for Waimakariri River water, and the section 42A reports, as they relate to my area of expertise.

1.7 I make the point here that it has been difficult to accurately predict the likely changes that might occur because of the general lack of specific detail or certainty provided by the applicant. For example, the proposal requests the taking of water at rates of up to 40 m^3/s from each of the Rakaia and the Waimakariri Rivers, and the proposed conditions refer to those flow rates. Mr Tipler in his evidence (para 82) refers to the Rakaia take being shared between the Ashburton Community Water Trust ("ACWT") and CPW. Mr Neal Borrie has prepared evidence on behalf of ACWT and in paragraph 26 of that evidence refers to a sharing agreement of 56% for CPW and 44% for ACWT. References are made by the Applicant that there is an agreement with ACWT such that CPW may take the total 40 m^3/s. However, the AEE presented in various publications refer to a take of only 20 m^3/s from the Rakaia.

1.8 While the split of water between CPW and ACWT is somewhat irrelevant in respect of cumulative effects on the Rakaia River (ie the net effect is a maximum of 40 m^3/s), the amount of water taken by CPW is relevant in regards to its effect on the Waimakariri River.

1.9 The first application (CRC 021091) is to take from the Gorge Bridge in the Waimakariri River. I understand that the second application (CRC 054601) is to enable the Waimakariri River take to be from above the Kowai River and is also for 40 m^3/s, but that this take cannot be exercised conjointly with the Gorge Bridge take such that the combined take exceeds 40m^3/s.

1.10 There are no proposed conditions that would limit the combined abstraction from both rivers to a maximum of 40 m^3/s. It is therefore possible that at times, the total take may exceed 40 m^3/s, especially at times when additional water can be taken from the rivers and placed into storage.

2. SUMMARY OF FINDINGS

2.1 According to information obtained from the Canterbury Regional Council in April 2008 there is presently at least 36.5 m^3/s allocated to out of river use from the Rakaia River. If CPW/ACWT hold priority over a consent application by Synlait then CPW/ACWT would have access to 33.486 m^3/s and could only abstract water when the Rakaia River was 73.03m^3/s above the specified monthly minimum flows. If Synlait retain priority over CPW/ACWT then CPW/ACWT would only have access to 27.486 m^3/s and could only abstract water when the Rakaia River was 85.03m^3/s above the specified monthly minimum flows.

2.2 Information obtained from the Canterbury Regional Council in April 2008 shows that the present “A” allocation authorised by consents is 23.665 m^3/s. If CPW are granted a consent to take water consistent with the WRRP and Ngai Tahu Property Ltd ("NTP") retain priority over CPW then CPW would only have access to “B” permit water and could not take any water until the unmodified flow of the Waimakariri exceeded 63 m^3/s. If CPW hold priority over NTP, then NTP would need to apply to change conditions of their consent, CPW would have access to 1.616m^3/s “A” permit water and the remainder would be “B” permit water.

2.3 The cumulative effects of the proposed CPW abstractions on the residual flow of the Rakaia and Waimakariri Rivers are similar irrespective of whether Synlait holds priority over CPW on the Rakaia River or whether CPW hold priority over NTP on the Waimakariri River. Changes in priority result in the average amount of water available to be abstracted by CPW reducing from 3.5 m^3/s to 3.3 m^3/s.

2.4 The cumulative effects of the abstraction of water from the Rakaia River will:

a. reduce the median summer river flow from an unmodified flow of 185.3 m^3/s to a post CPW flow of 156.4 m^3/s, which is a 16% reduction from the unmodified flow;

b. have no impact on flows less than the median flow because of the protection provided by the rules in the Rakaia River Water Conservation Order;

c. have no effect on the 7 day mean annual low flow (7dMALF), or increase the frequency at which the residual river flow would be at or below the median flow;

d. be similar regardless of who holds priority for water use.

2.5 The cumulative effects of the abstraction of water from the Waimakariri River will:

a. Reduce the pre CPW annual median flow from 81.5 m^3/s to 67.9 m^3/s, and reduce the unmodified median flow from 94.5 m^3/s to 67.2 m^3/s;

b. Have the greatest impacts on residual river flows between January and April, where the median flow is reduced continuously to the allowable minimum of less than 40 m^3/s;

c. Result in considerable periods when the residual river “flat lines” at or about the minimum flow. The abstraction will greatly reduce the duration of short term freshes;

d. Have only a small impact on the 7 day MALF, but causes changes in the time of year when the low flows will occur and increases the percentage of time when the residual river is at of below the unmodified 7 day MALF from 16% to 30 %;

e. Be similar in magnitude regardless of whether CPW hold priority over NTP or vice versa.

2.6 Potential impacts on the residual hydrology of the river can be reduced through the use of alternative abstraction regimes such as 1:1 flow sharing of “B” permit water, or raising the unmodified minimum flow for the CPW abstraction from 63 to 100 m^3/s.

3. FLOW MODELLING ASSUMPTIONS

3.1 The flow modelling that I have carried out includes effects on both the Rakaia and Waimakariri Rivers, and uses assumptions that have been discussed and agreed upon by Mr Cliff Tipler (URS) and Suzanne Gabites (Canterbury Regional Council water resources scientist). In particular, it has been agreed that the data series I prepared as the unmodified flow for the Waimakariri River has been accepted by both URS and the Canterbury Regional Council, and they have used that data in their respective models.

3.2 URS have supplied a data series of daily irrigation demand for the CPW scheme for the period 1 June 1967 to 31 May 2001. That data includes allowances for race distribution losses and I have used that data series in my models.

3.3 In light of the recent Court of Appeal decision regarding CPW having priority over NTP for Waimakariri water and the High Court decision giving Synlait priority over CPW/ACWT for Rakaia water, I have since been asked to consider the alternative priority scenarios. My evidence makes comments where appropriate of the implications of these changed priorities to the potential changes in flow regimes, storage requirements and cumulative effects later in this evidence.

3.4 The reduction in availability of Rakaia River water as a consequence of Synlait having priority over CPW could require the taking of water during Winter to replenish the CPW storage.

3.5 I have included descriptions of the assumptions and information used in creating the models and these are appended to my evidence (Appendix 1)

3.6 The flow modelling carried out for CPW by URS has been predicated on the ability of CPW to access water presently allocated to existing “A” permit holders from the Waimakariri River during winter months, and to access similarly allocated lower band water from the Rakaia. The intention being that if those flows are not being abstracted by the existing users the water would be available for CPW. While I agree that this could in theory potentially ensure an efficient use of the available water resource, there are a number of factors that make this assumption unlikely to occur. The legal implications of such a proposed arrangement have been outlined by Ms Crawford in her submissions. The technical limitations I address below.

3.7 The increasing use of automated flow monitoring equipment, combined with remote accessing (telemetry) make it technically practicable to monitor and manage water abstractions in the manner referred to in paragraph 96 of Mr Tipler’s evidence. This would be consistent with the interests of the Government, under the Sustainable Water Programme of Action, to devolve some aspects of water resource management to Water User Groups subject to agreement with Regional Councils and under the terms of the RMA.

3.8 Accessing Winter water from the Rakaia River would have limited benefit and be extremely expensive because the water would need to be pumped into storage. It is also more likely the Winter water available in the Rakaia River would be used by ACWT for power generation and I note that Mr Borrie (paragraph 26) carried out modelling for ACWT on the basis that CPW would not take any "non-irrigation season" water from the Rakaia River.

3.9 "A" band water within the Waimakariri is presently used for run-of river irrigation use, however I have been informed by Mr David Attewell, an irrigation consultant who acts or has acted for both Waimakariri Irrigation Ltd and NTP, that those schemes are seriously considering storage options to improve the reliability of water to their clients. I understand that these parties are submitters to the applications by CPW and will be presenting evidence on their position at the appropriate time.

3.10 There is no certainty that CPW will be able to access "A" band water from the Waimakariri River during the Winter months, especially if the existing "A" band users develop storage options. Because of that, I have prepared my base modelling regime on the assumption that CPW will not have access to Winter "A" band water from the Waimakariri River.

3.11 Evidence presented by Mr Cliff Tipler has included a number of options including a form of flow sharing for the Waimakariri "B" abstractions and/or limiting the abstractions such that there is no abstraction during weekends during the angling season.

3.12 I note that these concessions do not take account of other recreational year-round values that may be influenced by the rate of abstraction. This will be discussed further by other witnesses for Fish and Game and the Department of Conservation. While these are all possible options it appears that the preferred option for CPW is to take up to a maximum rate of 40 m^3/s from the Waimakariri River continuously. I have therefore used the 40 m^3/s option as my base model because that is consistent with the notified applications being considered at this hearing and represents a conservative assessment. I have also modelled the impacts of taking a lesser rate of flow from the Waimakariri River (consistent with Mr Tilper's 20/25/240 regime).

3.13 In terms of representing flow regimes and changes in flow regimes, I prefer to use median flow rates rather than mean (average) rates. This is because mean flow rates can be unduly influenced by the high flood flows. As an example, the mean flow of the Waimakariri River in March 1972 was 50.0 m^3/s, however this was influenced by a small flood flow of 120 to 180 m^3/s over a 3 day period. The median flow for that month was 39.7 m^3/s. The median flow provides a more relevant statistic because it is the flow rate occurring for 50% of the time. A visitor to a river on any given day is more likely to encounter flows in the median rather than the mean range. My evidence describes median flows, however when referring to potential effects on the Waimakariri River I have included mean flows to allow comparison with Mr Cliff Tipler's evidence.

3.14 In order to carry out the hydrological modelling, I requested updated confirmation from Canterbury Regional Council summarising the resource consents issued within the Rakaia River and Waimakariri River catchments, and their relative priorities. The information provided showed that as at 14 April 2007 a total of 37.314 m^3/s was considered to be allocated from the Rakaia River. That total includes 1.310 m^3/s for hydraulically connected groundwater takes and an allowance of 3.5 m^3/s for a Selwyn District Council (SDC) abstraction initially applied for in 1996 and still not processed. The total did not include 2.7 m^3/s referred to by Mr Leo Fietje in an email dated 19 March 2008 for existing allocations from stock water races that were not recorded in the database.

3.15 Having reviewed the relevant information, I am of the opinion that the SDC 3.5 m^3/s is either not a consumptive use, or it is included in other existing consents, or that given the lack of progress on the application since its lodging it would not have priority over CPW. I was subsequently informed on 24 April by email from Dirk Brand, Environment Canterbury Team Leader Consent Investigations that "*Environment Canterbury consider the 3.5 cumec diversion application (CRC970986) as non-consumptive. It therefore will not be treated as a "take" and counted as allocated water.*"

3.16 The spreadsheet provided by Canterbury Regional Council only summarises consumptive takes from the Rakaia River, and does not include consents for diverting water. It is my understanding that the Rakaia Water Conservation Order (WCO) specifies that the flow in the river shall not be reduced by abstraction or diversion below the monthly minimum flows. I understand that other witnesses for Fish & Game will provide comments on how diversions should be dealt with in terms of the WCO. For the purpose of modelling effects on the residual flow of the river, I have only included abstractive takes, including the stream depletion effects of groundwater takes. I have assumed that the information provided to me by the Canterbury Regional Council is accurate, although I note some inaccuracies may exist as discussed by Mr Holland. The total consumptive allocation from the Rakaia River is 37.314 + 2.7 – 3.5 = 36.514 m^3/s. The WCO allows a maximum take of 70 m^3/s to be abstracted from the River. If CPW have priority over Synlait then CPW / ACWT would have access to 33.486 m^3/s. If it is assumed that Synlait have priority over CPW the allocation from the Rakaia River would become 42.514 m^3/s and the CPW / ACWT abstraction would be limited to 27.486 m^3/s.

3.17 The information provided by Canterbury Regional Council on 15 April 2008 indicated there was a total allocation of 20.049 m^3/s from the Waimakariri River. A total allocation of 0.565 m^3/s is for “B” permits, meaning there is 19.484 m^3/s allocated to “A” permits That total does not include a consent for an increase of 896 l/s for Selwyn District Council consent CRC012003, or for NTP consent CRC052033 for a take of 3.960 m^3/s. The decision to grant consent for NTP was based on the assumption that there was 2.720 m^3/s “A” allocation water remaining in the Waimakariri River, and condition 2 of that consent refers to a rate of 2.720 m^3/s as an “A” permit with the remaining 1.240 m^3/s being a “B” permit. If NTP retain their priority over CPW, and consent CRC012003 is granted, the “A” allocation for the Waimakariri River would be 23.100 m^3/s which exceeds the “A” allocation limit of 22.000m^3/s specified in the WRRP.

3.18 Copies of the allocations for the Rakaia River and Waimakariri Rivers (as supplied by the Canterbury Regional Council) are attached as Appendix 3 of this evidence.

4. RAKAIA RIVER HYDROLOGY

4.1 The hydrology of the Rakaia River has been widely reported in various Canterbury Regional Council publications. With approximately 91% of its catchment area of 2910 km^2 being located upstream of the Rakaia Gorge, the river is dominated by the climatic effects of the alpine catchment. The river has its highest flows during each spring and early summer (due to spring thaws and northwesterly rains), and lowest flows during each winter.

4.2 For the record period 1967 to 2001 inclusive, the Rakaia River has a mean, median and 7 day MALF of 213.0 m^3/s, 156.3 m^3/s and 87.4 m^3/s respectively.

4.3 Abstractions of water from the Rakaia River are controlled by the provisions of the WCO, which recognises and protects the outstanding characteristics and features of the river. Key points of the WCO are :

- The total rate of take from the River shall not exceed 70 m^3/s; and
- The taking of water shall not occur when the Rakaia River is at or below specified monthly flows; and
- Any water available at flows less than 140 m^3/s above the minimum flow is to be shared 1:1 between instream and abstractive uses.

4.4 I have previously referred to the present allocation of water from the Rakaia River. If CPW / ACWT hold priority over Synlait then the allocation pre CPW / ACWT abstraction would be 36.514 m^3/s. CPW / ACWT would have access to 33.486 m^3/s and could only abstract water when the Rakaia River flow exceeded the monthly minimum flows by 73.028 m^3/s. If Synlait hold priority over CPW / ACWT then the allocation pre CPW / ACWT would be 42.514 m^3/s. CPW / ACWT would have access to a combined rate of 27.486 m^3/s and could only abstract water when the Rakaia River flow exceeded the monthly minimum flows by 85.028 m^3/s. Table 1 summarises the monthly minimum flows applicable to CPW / ACWT under the two scenarios.

Table 1: Rakaia River monthly minimum flow rates

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rakaia WCO	124.0	108.0	105.0	97.0	95.0	96.0	91.0	92.0	90.0	106.0	129.0	139.0
CPW priority	197.0	181.0	178.0	170.0	168.0	169.0	164.0	165.0	163.0	179.0	202.0	212.0
Synlait priority	209.0	193.0	190.0	182.0	180.0	181.0	176.0	177.0	175.0	191.0	214.0	224.0

4.5 Golder Kingett Mitchell (2007) modelled the effects of the proposed abstractions from the Rakaia River. Section 2.5 of that report describes five flow scenarios. I note that this modelling was carried out prior to the recent High Court decision relating to Synlait's priority over CPW / ACWT for Rakaia River water. Scenario 1 is the recorded flow at the gorge and therefore represents the "unmodified" flow. Scenario 5 models the effect of a total 40 m^3/s abstraction as proposed by the combined CPW and ACWT abstractions. I consider that scenario 5 is the most relevant because that scenario shows the cumulative effect of the abstraction in combination with other takes on the river, however I note that the modelling was carried out assuming that 40 m^3/s would be abstracted from the River, and was carried out prior to the Synlait priority decision. Their modelled effects therefore overestimate the amount of water available to be abstracted from the Rakaia River.

4.6 I have modelled the proposed CPW and ACWT abstractions for the two scenarios using the assumptions referred to in paragraph 3.4 of my evidence. The flow sharing agreement between CPW and ACWT is on the basis of 56:44 and includes the proviso that the CPW take includes an allocation of approximately 2 m^3/s already granted as Band 5 water to the Glenroy Community Irrigation Scheme. Table 2 shows the maximum rates of take for CPW and ACWT that I have assumed under the two scenarios.

Table 2: Maximum rates of take from the Rakaia under different priority scenarios

	Total available	CPW share	ACWT share	CPW + Glenroy
CPW Priority	33.487	17.633	15.854	19.633
Synlait Priority	27.487	14.273	13.214	16.273

4.7 Whether the total water available to CPW / ACWT is abstracted by CPW, or in combination with the ACWT abstraction is irrelevant in terms of overall cumulative effects on the Rakaia River, but it does impact on the CPW demand for water from the Waimakariri River. I consider that the model provides a conservative approach because it assumes that all abstractions are fully exercised.

4.8 For the Rakaia River there is basically no change in residual flow from a cumulative effects perspective, because regardless of who has priority to the water the end result is that a total of 70 m^3/s will be abstracted. If Synlait hold priority then there is potentially a small reduction in water available for CPW (average abstraction rate reduces from 3.5 m^3/s to 3.3 m^3/s), which in turn will lead to an increase in demand from the Waimakariri River

4.9 The protection afforded by flow sharing, 70 m^3/s cap on abstraction, and monthly minimum flows provided by the WCO ensures that any impact of the proposed abstraction from the Rakaia River has little or no impact on flows less than the median flow. The proposal does not alter the 7 day mean annual low flow (7dMALF), or increase the frequency at which the residual river flow would be at or below the median flow. The effects on the median flows in the river are shown in Table 3 and Figures 1 and 2.

Table 3: Rakaia River median and mean monthly flows

RAKAIA RIVER FLOW DATA

MEDIAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Unmodified Flow	120.3	121.3	128.9	187.0	211.4	221.1	202.3	167.5	156.7	158.4	141.6	130.5	156.0
Pre CPW	120.3	121.3	121.9	168.8	178.5	184.6	165.8	139.4	133.3	141.6	141.6	130.5	144.0
Post CPW	120.3	121.3	121.9	167.8	176.8	182.5	163.1	139.4	133.3	141.5	141.6	130.5	144.0
% Pre CPW to unmodified	0.0%	0.0%	-5.4%	-9.7%	-15.5%	-16.5%	-18.0%	-16.8%	-14.9%	-10.6%	0.0%	0.0%	-7.7%
% CPW to unmodified	0.0%	0.1%	-5.4%	-10.3%	-16.4%	-17.5%	-19.4%	-16.8%	-14.9%	-10.7%	0.0%	0.0%	-7.7%
% Change Pre CPW to Post CPW	0.0%	0.1%	0.0%	-0.5%	-0.8%	-0.9%	-1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

MEAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Unmodified Flow	138.4	152.8	183.2	262.7	286.6	303.3	268.6	199.7	202.0	206.0	187.7	163.5	212.9
Pre CPW	138.4	152.8	172.0	241.8	253.9	267.6	234.3	172.4	177.0	187.6	182.2	163.5	195.3
Post CPW	138.2	153.7	173.0	232.1	238.4	250.8	222.9	168.2	172.8	182.1	186.5	163.1	189.9
% Pre CPW to unmodified	0.0%	0.0%	-6.1%	-8.0%	-11.4%	-11.8%	-12.7%	-13.7%	-12.4%	-9.0%	-2.9%	0.0%	-8.3%
% CPW to unmodified	-0.1%	0.6%	-5.5%	-11.6%	-16.8%	-17.3%	-17.0%	-15.8%	-14.4%	-11.6%	-0.6%	-0.3%	-10.8%
% Change Pre CPW to Post CPW	-0.1%	0.6%	0.5%	-3.7%	-5.4%	-5.5%	-4.2%	-2.1%	-2.0%	-2.7%	2.3%	-0.3%	-2.5%

4.10 The median summer river flow[1] reduces from an unmodified flow of 185.3 m^3/s to a post CPW flow of 156.4 m^3/s (16% reduction). This is similar to the values reported in Golder Kingett Mitchell (2007) (reduction from 187m^3/s to 155 m^3/s - a 17% reduction). The proposed abstraction reduces the median flows for October to January from their pre CPW values by 0.5%, 0.8%, 0.9% and 1.3% respectively.

4.11 Figures 3 and 4 show the effects of the proposed abstraction on the Rakaia River. The years shown reflect an average year (1981/82) and a dry year (1970/71. These years are the same ones selected and referred to by Golder Kingett Mitchell (2007). Because the Rakaia River is only affected by the CPW /ACWT abstraction when the river exceeds the minimum flows shown in table 1 of my evidence there is no impact on low flows. Flow variability is maintained because of the 1:1 flow sharing regime.

4.12 The impact of the proposed CPW/ACWT abstraction on the Rakaia River is less noticeable in dry years. This is because there is seldom sufficient flow available for

[1] As defined by Golder Kingett Mitchell (2007) – November to April

the required abstractions to occur. The greatest impact of the abstractions is in the "average" years, when more water is available for abstraction.

4.13 Trout and salmon angling is permitted all year round in the mainstem of the Rakaia below the Coleridge Tailrace confluence (Fish and Game, 2007). This is above the proposed intake, so in other words angling can occur year-round in the affected reach. I am informed by Fish & Game that most salmon angling occurs between November – April inclusive, although some salmon angling occurs either side of this period (i.e. in October and May). However for modelling purposes I have defined the salmon angling season for the Rakaia River as 1 November – 30 April.

4.14 Optimal flows for salmon fishing have been identified by Glova (1988) as being in the range 160 to 180 m^3/s. Mr Glova's evidence presented to the Commissioners in April discusses the effects of the abstraction of water up to the maximum 70 m^3/s allowed by the Rakaia WCO. It is my understanding that salmon fishability conditions are a mix of water clarity, temperature and flow rates. Mr John Hayes' evidence on behalf of Fish and Game considers there is no data on which to ascertain how water clarity will be affected by the proposed abstraction. Therefore any effect of the abstraction on salmon fishability has been based purely on flow rate analysis.

4.15 Table 4 summarises the average number of days when the residual Rakaia River flow would be within the flow range 160 to 180 m^3/s. These values are similar to those provided in Mr Glova's addendum dated 4 April 2008. Although the table indicates that there is a slight increase in post CPW average days it must be remembered that this analysis does not take account of the likely clarity of the water. Nor does it account for any changes to fishable area. Given that the CPW/ACWT abstraction will remove up to 27.5 m^3/s of flow it is most likely that the residual flow would have a higher turbidity than would be expected to occur naturally in that flow range.

Table 4: Fishable days based on flow rates.

	Season Nov - Apr incl			Season Feb - Mar incl		
Flow class	Unmodified	Pre CPW	20/40/220	Unmodified	Pre CPW	20/40/220
130 - 140	8.3	11.5	11.5	3.8	7.1	7.1
140 - 150	8.8	15.8	15.8	4.2	8.3	8.3
150 - 160	9.2	13.5	14.3	4.2	4.2	5.0
160 - 170	9.6	13.2	14.5	4.1	2.8	4.2
170 - 180	8.3	9.8	12.1	3.2	2.1	3.4
180 - 190	7.7	7.3	11.0	2.8	2.1	2.9
160 - 180	17.9	23.0	26.6	7.3	4.9	7.5

5. WAIMAKARIRI RIVER HYDROLOGY

5.1 The Waimakariri River catchment extends from the Main Divide to the coast where it has a catchment area of 3650 km^2. The River is a typically alpine fed braided river characterised by frequent floods and freshes, especially during October to January. Over 90% of the river flow is derived from precipitation in the upper catchment. Winter snow and ice is stored during Winter and released during spring thaws contributing to higher flows between October to November. The period of lowest flows occur in late summer (February and March).

5.2 The primary flow recording site for the Waimakariri River is sited at Old Highway Bridge ("OHB"), located approximately 5.5km from the coast. Records start in January 1967 and continue to the present. Water levels are affected at this site by tides, the effects of which need to be removed during the initial processing of the data. The site is subject to frequent floods and changes in bed shape, which necessitate regular flow gaugings to maintain adequate flow ratings at the site[2].

5.3 The recorded flow at OHB represents the residual (modified) river flow after all upstream abstractions have occurred. For reliable management of water allocations, it is preferable to record the total river flow available in a river upstream of any abstractions. A flow monitoring station located upstream of the Waimakariri Gorge Bridge would be preferable to the existing flow station located at OHB.

5.4 Concurrent flow measurements carried out by the Canterbury Regional Council show that within the flow range of 36 to 68 m^3/s at the Gorge, the flow at OHB (after allowing for tributary inflows) is consistently about 7.7 m3/s less than that measured

[2] Between 1967 and 2007 there have been 177 ratings changes. Some ratings are for less than 2 days duration. The longest stable rating period is 626 days (19/06/77 to 15/10/78). The median period between rating changes is 46 days.

at the Gorge Bridge[3]. Flow losses recharge the surrounding groundwater aquifers approximately 10-15 km upstream of OHB. After allowing for the uncertainties and gauging errors inherent in measuring multiple braided river channels, there does not appear to be any evidence to show that flow losses either increase or decrease with changing river flow. For the purposes of carrying out flow modelling a constant natural 7.7 m^3/s loss from the river has been assumed to be independent of the River flow, therefore the river flow at or near the Gorge can be considered to equal the "unmodified" flow at OHB plus 7.7 m^3/s.

6. THE WAIMAKARIRI RIVER REGIONAL PLAN AND CONSENTED WATER USE

6.1 The Waimakariri River Regional Plan (WRRP) sets out the regional council's policies objectives and rules for taking water from, and discharging contaminants into, the Waimakariri River and its tributaries. The WRRP became operative in October 2004. The key points relating to the taking of water are:

- A minimum flow of 41 m^3/s; and
- An "A" water allocation block of 22 m^3/s for abstraction when the "unmodified flow" exceeds 63 m^3/s; and
- All water in excess of the "unmodified flow" of 63 m^3/s is available for abstraction as a "B" block allocation.

6.2 The WRRP does not specify any sharing of river flows between instream and out of stream users.

6.3 The "unmodified" flow is defined in the WRRP as the rate of flow in the river calculated by the Canterbury Regional Council as if there were no abstractions. The minimum flow site is identified as being "below Woodstock" and the site for the assessment of the "unmodified" flow is at OHB. Woodstock generally refers to the section of the Waimakariri above the Gorge Bridge to the confluence with the Kowhai River.

[3] Sixteen flow measurements at flows between 36 and 68 m^3/s show flow losses between 3.3 and 11.3 m^3/s with a median loss of 7.7 m^3/s and an average loss of 7.4 m^3.s

6.4 Conditions on existing resource consents refer to the minimum flow (41 m3/s) as being the "unmodified" flow at OHB as opposed to the "unmodified" flow below Woodstock.

6.5 The existing "A" allocation was previously considered to comprise 4 m^3/s for stockwater and 18 m^3/s for irrigation use. However, consent CRC012003 was recently granted as an "A" permit for an additional 0.896 m^3/s of stockwater for SDC. Because stockwater is exempt from the WRRP flow restrictions, the residual flow in the river (assuming all "A" abstractions are fully exercised) can now reduce to 36.104 m^3/s rather then 41 m^3/s. The granting of CRC012003 now raises the question of how much "A" water can be used for irrigation. The WRRP states that the total "A" allocation is 22.0 m^3/s. With 4.896 m^3/s now granted for stock water, the irrigation "A" share should be reduced from the previous 18.0 m^3/s to 17.104 m^3/s, however the present "A" allocation authorised by consents is 23.665 m^3/s. Whenever the unmodified flow is at or above 63 m^3/s, any "B" allocation can be abstracted. As there are no flow sharing rules, the abstractions represent a continuum where the residual flow remains at or about 41 $m^3/$ within the flow range 63 m^3/s and 104 m^3/s. Under the terms of the WRRP, a "B" abstraction of 40 m^3/s will cause the residual flow in the Waimakariri River to be at or about 41 m^3/s until the unmodified flow exceeds 104 m^3/s.

6.6 To determine the likely impact that the proposed CPW abstraction will have on the hydrology of the Waimakariri River, it is necessary to first derive a time series of "unmodified" flows from which the effects of historic abstractions have been removed. Having derived the "unmodified" flows, it is then possible to model the impacts that both the existing and the proposed CPW abstractions will have on the hydrology of the River.

Table 5: Potential residual flows under WRRP rules

Unmodified flow	Stock takes	Less Stock takes	existing "A"	existing "B"	Pre CPW	Existing "A" + CPW "A"	Existing "B" + CPW "B"	Post CPW
39	4.9	34.1	0.0	0.0	34.1	0.0	0.0	34.1
41	4.9	36.1	0.0	0.0	36.1	0.0	0.0	36.1
43	4.9	38.1	2.0	0.0	36.1	2.0	0.0	36.1
45	4.9	40.1	4.0	0.0	36.1	4.0	0.0	36.1
47	4.9	42.1	6.0	0.0	36.1	6.0	0.0	36.1
49	4.9	44.1	8.0	0.0	36.1	8.0	0.0	36.1
51	4.9	46.1	10.0	0.0	36.1	10.0	0.0	36.1
53	4.9	48.1	12.0	0.0	36.1	12.0	0.0	36.1
55	4.9	50.1	14.0	0.0	36.1	14.0	0.0	36.1
57	4.9	52.1	15.5	0.0	36.6	16.0	0.0	36.1
59	4.9	54.1	15.5	0.0	38.6	17.1	0.0	37.0
61	4.9	56.1	15.5	0.0	40.6	17.1	0.0	39.0
63	4.9	58.1	15.5	0.0	42.6	17.1	0.0	41.0
65	4.9	60.1	15.5	0.6	44.1	17.1	2.0	41.0
67	4.9	62.1	15.5	0.6	46.1	17.1	4.0	41.0
69	4.9	64.1	15.5	0.6	48.1	17.1	6.0	41.0
71	4.9	66.1	15.5	0.6	50.1	17.1	8.0	41.0
73	4.9	68.1	15.5	0.6	52.1	17.1	10.0	41.0
75	4.9	70.1	15.5	0.6	54.1	17.1	12.0	41.0
77	4.9	72.1	15.5	0.6	56.1	17.1	14.0	41.0
79	4.9	74.1	15.5	0.6	58.1	17.1	16.0	41.0
81	4.9	76.1	15.5	0.6	60.1	17.1	18.0	41.0
83	4.9	78.1	15.5	0.6	62.1	17.1	20.0	41.0
85	4.9	80.1	15.5	0.6	64.1	17.1	22.0	41.0
87	4.9	82.1	15.5	0.6	66.1	17.1	24.0	41.0
89	4.9	84.1	15.5	0.6	68.1	17.1	26.0	41.0
91	4.9	86.1	15.5	0.6	70.1	17.1	28.0	41.0
93	4.9	88.1	15.5	0.6	72.1	17.1	30.0	41.0
95	4.9	90.1	15.5	0.6	74.1	17.1	32.0	41.0
97	4.9	92.1	15.5	0.6	76.1	17.1	34.0	41.0
99	4.9	94.1	15.5	0.6	78.1	17.1	36.0	41.0
101	4.9	96.1	15.5	0.6	80.1	17.1	38.0	41.0
103	4.9	98.1	15.5	0.6	82.1	17.1	38.9	42.1
105	4.9	100.1	15.5	0.6	84.1	17.1	38.9	44.1
107	4.9	102.1	15.5	0.6	86.1	17.1	38.9	46.1
109	4.9	104.1	15.5	0.6	88.1	17.1	38.9	48.1
111	4.9	106.1	15.5	0.6	90.1	17.1	38.9	50.1
113	4.9	108.1	15.5	0.6	92.1	17.1	38.9	52.1
115	4.9	110.1	15.5	0.6	94.1	17.1	38.9	54.1
117	4.9	112.1	15.5	0.6	96.1	17.1	38.9	56.1
119	4.9	114.1	15.5	0.6	98.1	17.1	38.9	58.1

6.7 I have prepared Table 5 to illustrate the potential impacts that abstractions of water from the Waimakariri River have in terms of the WRRP. The table shows what the residual river flow would be if all the abstractions were to be fully exercised in accordance with the WRRP. The proposed abstraction of water by CPW, in combination with existing abstractions, can cause the residual river flow to remain at the minimum of 41 m^3/s until the unmodified flow exceeds 101 m^3/s.

7. MODELLING THE "UNMODIFIED" FLOW

7.1 In order to determine any change in the hydrological flow regime as a consequence of the CPW proposal, it is necessary to first remove the effects of upstream abstraction from the OHB flow record. I have prepared a time series of the "unmodified"[4] flow at OHB using the assumptions described in Appendix 1 of my evidence. The time series has been reviewed by Canterbury Regional Council hydrological staff and has been accepted by them and by Mr Cliff Tipler as being a common base of factual data from which to prepare various flow models. This has been referred to in paragraph 101 of Mr Tiplers evidence.

7.2 Modelling of the unmodified flow of the Waimakariri River was carried out using time series of instantaneous flows for site 66401 Waimakariri River at OHB (period 01/01/67 to 21/02/07 supplied by Ecan) and site 66450 Waimakariri Irrigation Ltd (WIL) intake at Brown's Rock (period 19/02/99 to 21/02/07 supplied by WIL). Although the data extends to 2007, the daily irrigation demand data supplied by Aqualinc Research Ltd through URS is only for the period 1 June 1967 to 31 May 2001. For consistency, I have used this latter period for all flow statistics referred to in my evidence.

7.3 The unmodified flow was derived by adding the estimated and recorded upstream abstractions to the flow record at OHB. Assumptions used in the model are explained in Appendix 1 of my evidence.

7.4 The mean annual unmodified flow of the Waimakariri River at OHB is 125.5 m^3/s, and the median unmodified flow is 94.5 m^3/s. With the majority of the river flows being derived from precipitation in the upper catchment, the monthly flows are influenced by the impacts of winter snow and ice with consequential spring thaws.

7.5 Table 6 summaries the monthly flows of the Waimakariri River at OHB for both the unmodified and the actual recorded flows. For comparison, the monthly median flows for the Rakaia and the Rangitata Rivers (both similarly sourced from alpine catchments) are also shown. The data is shown graphically in figure 5 of my evidence.

[4] The "unmodified" flow is defined in the Waimakariri River Regional Plan as the rate of flow in the river calculated by Environment Canterbury as if there was no taking occurring.

Table 6 Median monthly Waimakariri river flows (values in m^3/s) 1967 to 2001

MEDIAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Waimakariri at OHB	79.8	94.0	112.3	137.1	125.7	108.0	79.3	62.1	62.2	73.0	78.3	84.1	89.7
Waimakariri "Unmodified Flow"	83.6	98.0	116.7	142.0	130.9	113.7	85.5	67.7	67.7	77.4	82.2	88.1	94.5
Rakaia at Gorge	120.3	121.3	128.9	189.1	216.1	226.0	202.3	167.5	156.7	158.4	141.6	130.5	185.9
Rangitata at Klondyke	52.3	54.2	56.4	97.8	108.9	123.0	112.5	87.4	76.9	73.2	63.1	60.7	77.9

MEAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Waimakariri at OHB	104.4	125.4	148.3	186.7	161.3	142.3	110.7	78.7	84.3	101.9	108.2	111.8	122.0
Waimakariri "Unmodified Flow"	108.6	130.1	154.1	192.3	169.9	148.5	116.9	84.3	89.3	106.4	112.4	115.7	127.4
Rakaia at Gorge	138.4	155.4	183.2	262.7	286.6	303.3	268.6	199.7	202.0	206.0	187.7	163.5	213.1
Rangitata at Klondyke	61.0	64.1	72.5	121.4	135.9	170.0	140.9	103.6	99.3	93.4	77.3	75.5	101.3

7.6 Monthly flows in the Waimakariri River are highest in October during spring thaw, progressively declining to a lowest flow in February. Median Winter flows (May to August) are all higher than the median flows in February and March. The monthly flow pattern differs from both the Rakaia and Rangitata Rivers, where the highest monthly flows occur in November to January and the lowest flows occur between June and August. In proportion to their respective highest monthly flow, both the Rakaia and Rangitata sustain proportionally higher flows between January and March than the Waimakariri River. A reason why this difference occurs may be because the length of the Waimakariri catchment bordering the Main Divide is approximately only one half that of the Rakaia River (G Horrell, pers comm).

7.7 The distribution of flow throughout the record period (1967 to 2001) is shown graphically in figure 6 of this evidence.

7.8 Low flows within rivers are typically referenced to their 7 day mean annual low flow (7dMALF). The unmodified flow data has been analysed using the Gumbel Type III method to derive the frequency at which lows flows occur.

Table 7: Low Flow frequency (Gumbel Type III) – Waimakariri River

	Unmodified flow	Recorded flow
7dMALF	44.2	39.5
1:5 year	35.2	30.8
1:10 year	31.0	26.8
1:20 year	28.0	23.9

7.9 Trout and salmon angling is permitted all year round in the mainstem of the Waimakariri below the Staircase Stream confluence (F&G, 2007). This is above the proposed upper intake, so in other words angling can legally occur year-round in the affected reach. I am informed by Fish & Game that the main salmon angling season occurs between November – April inclusive, although some salmon angling does occur either side of that period (i.e. in October and May). For modelling purposes I have defined the salmon angling season for the Waimakariri as 1 November – 30 April.

7.10 The unmodified flow at OHB is at or below the 7dMALF of 44.2 m^3/s for approximately 5% of the time on an annual basis. For the Salmon angling months between November and April, the river is at or below 7dMALF for approximately 7% of the time.

7.11 For the record period 1967 to 2001 (35 years), the 7 day low flows occur most frequently between February (6 times), March (9 times), April (5 times) and May (7 times each).

7.12 The unmodified median flow for the Salmon angling season November to April inclusive is 89.4 m^3/s, and the unmodified annual median flow for the Waimakariri River is 94.5 m^3/s.

8. MODELLING OF EFFECTS OF ABSTRACTIONS ON THE WAIMAKARIRI RIVER

8.1 I found that the accurate modelling of the impact of the proposed CPW scheme was difficult because there is either a lack of detail provided in the various reports prepared by the applicant on how the proposed scheme will operate, or in more recent times there has been a number of different flow regimes proposed.

8.2 I have met with Mr Cliff Tipler, Senior Principal of URS Ltd. Those meetings helped to clarify the assumptions used by URS to model effects of the proposed abstractions.

8.3 On the basis of those meetings, I have modelled the potential effects of the CPW proposal on the residual flow in the Waimakariri River. A description of the assumptions I have used is provided in Appendix 2 to this evidence. The assumptions allow for scenarios whereby either Synlait or CPW hold priority in the Rakaia River and either NTP or CPW hold priority in the Waimakariri River. I note that if CPW hold priority over NTP, then NTP cannot exercise their take from the Waimakariri unless they apply for a change of consent conditions.

8.4 The model has been prepared to allow for variable “A” winter and “B” irrigation season abstractions and variable reservoir storage, and the ability to allow for flow sharing of “B” permits.

8.5 Since the lodging of the original resource consents, the concept of the CPW scheme has changed in a number of ways. Recent suggestions included the use of a single upper Waimakariri intake with a capacity of 40 m^3/s; the option to use 1:1 flow sharing of the “B” allocation; and the option of not abstracting at weekends during the angling season. Various other options have been considered using combinations of reservoir storage volumes and maximum rates of take from both the Rakaia and Waimakariri Rivers. While these options have been reviewed by CPW, it appears that the preference is to proceed with the original option of taking up to 40 m^3/s from both the Rakaia River and the Waimakariri River in accordance with the minimum flow regimes in the Rakaia WCO and the WRRP.

8.6 The evidence presented by Mr Tipler on behalf of the applicant describes a number of flow scenarios. These are referred to in terms of flow rates from the Rakaia River and the Waimakariri River, and to the storage volume within the Waianiwaniwa reservoir. The “base” scenario referred to in Mr Tipler’s evidence is the 20/25/240 regime, meaning that it is based on a maximum take of 20 m3/s from the Rakaia river, 25 m3/s from the Waimakariri River and a reservoir storage volume of 240 million cubic metres (MCM). While I appreciate that this scenario is used to provide an illustration of potential effects of the proposal, the scenario does not resemble the one that the applicant has applied for. I therefore consider that the conclusions made by Mr Tipler regarding hydrologic effects of CPW abstractions on the Waimakariri River do not adequately reflect the potential effects of a 40 m^3/s take from the Waimakariri River

8.7 In my evidence, I shall use a scenario based on the CPW applications (ie 20/40/220) as a “base” scenario. For the reasons provided earlier in my evidence my “base” regime does not allow CPW access to any Winter “A” band water. I then look at any implications of using other scenarios, including the 20/25/240 scenario described in Mr Tipler’s evidence, the effects of 1:1 flow sharing, of “B” permits, the effects of allowing CPW to have access to “A” permit Winter water, and the effects of not allowing any CPW “B” permit abstraction until the unmodified flow in the river exceeds 100 m^3/s.

8.8 Mr Tipler limits his analysis of the effects of the proposed CPW abstraction to changes in residual flows that will occur with the existing abstractions (occurring at their maximum rates of take) and after the CPW abstraction. This analysis completely disregards the cumulative effect that the CPW abstraction will have on the residual flow within the Waimakariri River. My analysis of the effects of the CPW abstraction include a comparison of unmodified flow, pre CPW flow and post CPW flow.

8.9 I have previously referred to my preference for describing flow regimes in terms of median rather than mean flow. In the following evidence I concentrate on median flow rates, but also include mean rates to allow comparisons with the evidence presented by Mr Cliff Tipler for the applicant.

8.10 The following comments on potential effects of the proposed abstractions are based on a mathematical model that shows the residual flow rates that would have occurred over the period 1967 to 2001 **IF** all “A” permits were fully exercised **AND** the CPW proposal is fully operational. There are a number of factors that result in the modelled flows being considered to be the “worst case” scenario.

8.11 Firstly, the model assumes that all existing “A” permits are being fully exercised. In the past, this is unlikely to have occurred, however with increasing demand for water and the potential for existing users to utilise storage options, it is reasonable to assume the “A” permits will in future be more highly utilised than they are at present.

8.12 Secondly, the model assumes that any available water is immediately utilised by abstractions. Environment Canterbury’s present practice is that any flow restriction on abstractions is based on the average of the previous 24 hour flow rate at OHB. Unless that practice is changed, abstractors would not be able to take immediate advantage of increased flow rates. This will lead to more water being retained in the river, especially at the start of flood events. Delays in changing intake gate settings also reduce the theoretical impacts of abstractions.

8.13 Thirdly, the data is based on daily mean flow rates rather than instantaneous rates. Depending on the magnitude of a flood event, and the time of day when it occurs, it is possible for the actual peak flow rate to exceed the daily mean flow rate by up to 70%. I have prepared table 8 to show the differences in recorded peak flow rates and daily mean flows for the years 1967 to 1976.

Table 8: Waimakariri River at OHB – Annual peak flow and daily mean flow

Date	Peak flow	Daily mean	% difference
11-Mar-67	2052	651	32%
9-Mar-68	935	325	35%
25-Dec-69	1041	194	19%
23-Jan-70	651	379	58%
25-Nov-71	425	271	64%
7-Nov-72	548	503	92%
4-Nov-73	1012	718	71%
15-Nov-74	1128	688	61%
2-Apr-75	1772	1009	57%
6-Dec-76	850	505	59%

8.14 All of the above factors combine to provide a “worst case” scenario of actual and potential effects.

9. EFFECTS OF CHANGED PRIORITY OF USE BETWEEN SYNLAIT AND CPW, AND CPW AND NGAI TAHU PROPERTIES LTD.

9.1 I have modelled the effects of the CPW abstractions using scenarios whereby either Synlait of CPW have priority of water in the Rakaia River and whether CPW or NTP have priority in the Waimakariri River. The results of the modelling show that there is only a minor difference in residual river flows as a consequence of the changes in priority.

9.2 I have previously mentioned that any change in priority for the Rakaia River has little or no effect on the potential residual flow because regardless of who has access to the water the end result is that a total of 70 m^3/s will be abstracted. If Synlait hold priority then there is potentially an increase in CPW demand from the Waimakariri River.

9.3 For the Waimakariri River there is a small (up to 1 m^3/s) increase in irrigation season residual flow if CPW hold priority. This is a direct result of a decrease in NTP abstraction, which is partly offset by the increases in recent granting of “B” permits to

P&E Ltd. and Hunter plus increased "A" stockwater takes. There is a corresponding small decrease in residual flow during winter months to make up the increased demand to fill storage.

9.4 Unless otherwise specified, the following evidence refers to the Waimakariri River scenario where CPW have priority over NTP. The model presented includes updated allocations of water abstracted from the Waimakariri River, including "B" permits issued to P&E Ltd and Hunter.

10. EFFECT ON MEDIAN FLOW, MEAN FLOW AND FLOW FREQUENCY

10.1 Figure 7 shows the effects that the proposed abstractions have on the frequency distribution of residual river flows. The impact of CPW is evident throughout the flow range 40 to 300 m^3/s. In particular, the percentage of time when the river is held at or about the WRRP minimum flow of 41 m^3/s (3% for unmodified flow) increases from the pre CPW value of 13% to a post CPW value of ≈25%.

10.2 Kingett Mitchell Limited (2006) refer to the effects of the CPW take on the Waimakariri Flows. Section 3.2 of their report refers to a flow duration curve (Figure 3.2) which describes a "flat-lining" of the river at or around 63 m^3/s. The description does not specify whether the flow duration curve is for the entire record period or for the irrigation season, however the flat-lining represents a significant period of time between approximately 25% to 38% of the time. The impression gained from their Figure 3.2 is that there will be a notable period of time when the CPW abstraction will not have any impact on the residual river flows.

10.3 I have included Figure 8 in my evidence, showing the flow distribution of the residual river flows for the Winter months and for the Irrigation season months. On closer examination of the flow record, it can be seen that the flat lining at or about 63 m^3/s does in fact occur only during the Winter months. This is a consequence of CPW abstracting water to refill the Waianiwaniwa storage at times when irrigation takes have not historically been exercised. For the irrigation season months (October to April) there is no flat lining of the river at or about 63 m^3/s because the WRRP allows abstractions to occur up to the maximum allocations without any flow sharing or retention of water instream.

10.4 Tables 9 and 10 summarise the monthly median and mean residual river flows for the unmodified, pre CPW and post CPW flow regimes. I have included a number of flow regimes, including the results of the modelling carried out before the release of the Court of Appeal and the High Court decisions relating to priority. The tables show that there is only a small change in monthly flow between the “No NTP” and the “NTP” regimes as a result of changes in priority of water.

10.5 I have also included the mean residual flows presented by Mr Tipler in Table 5 of his evidence. The monthly values shown in Mr Tipler’s Table 5 and my 20/25/240 Winter “A” No Share No NTP are similar.

10.6 The impact of the CPW abstraction reduces the annual median flow from a pre CPW value of 81.5 m^3/s to 67.9 m^3/s, and the mean flow from 114.3 to 104.0 m^3/s. The greatest impacts on residual river flows are in the summer months, especially between January and April where the median flow is reduced to the allowable minimum flow continuously.

10.7 In terms of cumulative effects, the base 20/40/220 regime reduces the unmodified median flows for the months between November and April by 21%, 40%, 52%, 39%, 39% and 47% respectively. The changes between the pre CPW and post CPW median flows for the same months are 6%, 22%, 28%, 9%, 9% and 21%. These are not insignificant changes. The respective mean flows (as shown in table 7) for the same periods are 17%, 26%, 31%m 35%, 35% and 2% for the cumulative effects and 5%, 13%, 14%, 15%, 16% and 12% for the pre CPW to post CPW effects.

10.8 The differences in magnitude of values presented between Tables 9 and 10 illustrate how the use of mean values can tend to underestimate actual effects on flow rates.

10.9 Evidence presented on behalf of Fish and Game and the Department of Conservation by Mr John Hayes, Ken Hughey and others will comment on the significance these changes may have on fisheries and birdlife within the Waimakariri River and environs

Table 9: Monthly median residual flows

RESIDUAL MEDIAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Unmodified Flow	84.4	98.6	119.1	144.3	130.6	112.8	85.5	67.7	67.7	77.4	82.2	88.1	94.5
Pre CPW	79.6	93.7	114.2	123.9	110.3	92.4	65.1	47.3	47.3	57.1	77.3	83.2	81.5
Post CPW 20/40/220 No Winter "A" No NTP	72.5	89.0	111.2	119.4	102.8	68.0	41.0	41.0	41.0	41.0	60.1	72.4	67.9
Post CPW 20/40/220 No Winter "A", NTP	73.2	89.7	112.9	116.4	100.0	65.8	39.8	39.8	39.8	39.8	59.0	73.2	68.3
Post CPW 20/25/240 Winter "A" No Share No NTP	71.4	87.0	108.8	119.1	101.3	71.0	41.0	41.0	41.0	41.0	58.7	74.5	68.8
Post CPW 20/40/220 No Winter take, 1:1 "B" sharing, No NTP	72.1	84.1	104.1	118.3	100.8	68.8	52.3	43.4	43.3	48.5	67.1	75.9	69.0
Post CPW 20/40/220 "B" take above 100 m3/s No NTP	78.2	92.4	94.3	112.4	94.6	78.0	63.5	45.7	45.7	55.4	75.7	81.7	78.0

% Pre CPW to unmodified	-6%	-5%	-4%	-14%	-16%	-18%	-24%	-30%	-30%	-26%	-6%	-6%	-14%
% CPW to unmodified	-14%	-10%	-7%	-17%	-21%	-40%	-52%	-39%	-39%	-47%	-27%	-18%	-28%
% Change Pre CPW to Post CPW	-8%	-5%	-3%	-3%	-6%	-22%	-28%	-9%	-9%	-21%	-21%	-12%	-14%

Table 10: Monthly mean residual flows

RESIDUAL MEAN FLOWS

Regime	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Unmodified Flow	108.6	130.1	154.1	192.3	169.9	148.5	116.9	84.3	89.3	106.4	112.4	115.7	127.4
Pre CPW	103.7	125.2	149.2	172.0	149.6	128.2	97.0	67.2	72.4	88.9	107.5	110.8	114.3
Post CPW 20/40/220 No Winter "A" No NTP	98.1	120.8	144.8	167.8	141.3	109.5	81.0	54.4	58.3	76.3	95.5	100.7	104.0
Post CPW 20/40/220 No Winter "A", NTP	98.8	120.9	145.9	163.8	135.8	107.7	80.0	54.0	57.5	75.5	96.5	102.1	103.2
Post CPW 20/25/240 Winter "A" No Share No NTP	95.0	118.6	144.4	167.8	141.3	111.2	83.4	56.7	61.5	78.0	92.3	98.9	104.1
20/25/240 - Tipler Table 5	91.1	113.9	127.4	165.5	139.5	110.1	83.3	58.3	62.5	76.6	89.8	93.6	101.0
Post CPW 20/40/220 No Winter take, 1:1 "B" sharing, No NTP	96.1	119.2	142.3	167.2	141.8	111.7	83.9	57.5	61.0	76.9	94.6	100.8	104.4
Post CPW 20/40/220 "B" take above 100 m3/s No NTP	95.6	117.1	141.3	164.1	140.7	115.5	87.0	60.8	64.2	79.6	96.2	98.8	105.1

% Pre CPW to unmodified	-5%	-4%	-3%	-11%	-12%	-14%	-17%	-20%	-19%	-16%	-4%	-4%	-10%
% CPW to unmodified	-10%	-7%	-6%	-13%	-17%	-26%	-31%	-35%	-35%	-28%	-15%	-13%	-18%
% Change Pre CPW to Post CPW	-5%	-3%	-3%	-2%	-5%	-13%	-14%	-15%	-16%	-12%	-11%	-9%	-8%
% Change - Tipler Table 5	-7%	-5%	-3%	-2%	-5%	-12%	-13%	-14%	-14%	-14%	-13%	-9%	

11. EFFECTS ON LOW FLOWS

11.1 Figures 9, 10 and 11 show the effects of the proposed abstraction, in combination with existing consented uses on the Waimakariri River using the 20/40/220 scenario. The years shown reflect a typical year (1989-90), a dry year (1970/71), and a wet year (1995-96). These years are the same ones selected and referred to in Mr Tipler's evidence, and therefore allow a comparison to be made using my base regime.

11.2 The effect of the proposed CPW abstraction, in combination with the exercising of all other 'A' abstractions results in significant periods when the residual flow in the river remains at or near the minimum flow. In fact the river can recede to 36.1 m^3/s because irrigation abstractions can reduce the actual flow to 40m^3/s, allowing a further 4.9m^3/s to be abstracted unrestricted for stockwater uses. Reference to Figure 9 shows there is a considerable period of time during the irrigation season when the residual river remains "flat lined" at or near the minimum flow. It is however noted that not all of the "flat lining" during the irrigation season is caused solely by the CPW take. The full exercising of existing "A" permits cause considerable periods of flat lining between late February to early May. Conversely, this is offset by periods of flat lining at 63 m^3/s during winter months as a response to CPW abstractions to replenish the Waianiwaniwa storage.

11.3 A comparison of figures 9, 10 and 11 shows that the greatest impact of CPW abstractions occur in "typical" years. This is logical because CPW can only exercise their full take when there is sufficient water within the river. During dryer years and/or times of low flows, the CPW intake cannot operate and therefore any impacts on residual river flows are lessened. Irrigation demand is lower in wet years, therefore the main demand from the Waimakariri River will be to replenish the Waianiwaniwa storage.

11.4 In his evidence, Mr Tipler addresses the frequency and duration of low flow events. It is unclear in his evidence what flow rate was used as an indicator of "low flow periods", however his table 6 and figure 26 show the duration of low flow events before and after CPW. He concludes that "there will be no significant alteration to the low flow regime of the river". The rationale used is that the longer duration events are more significant in terms of their impacts on the ecological values of the river.

11.5 I do not agree that there is no significant alteration to the low flow regime. The information provided in Mr Tipler's table 6 and figure 26 show that there is a large reduction in the number of shorter duration freshes as a consequence of CPW abstractions. In a briefing report presented to the Canterbury Regional Council dated 29 November 2007, Mr John Glennie (Canterbury Regional Council Natural Resources Policy Manager) referred to small to moderate freshes, stating that "*These small freshes are important for the river's ecological health because they clean off undesirable slimy periphyton growths that can smother the gravel during mid-late summer when flows are lower and water warmer. Freshes also help to remove fine sediment that settles between the gravel, maintaining its suitability as habitat for aquatic insect larvae that birds and fish feed on*". Given that information, it is my opinion that the increase in short term low flow events is significant because it removes any beneficial effects of the more regular freshes with a magnitude of less than ≈100 m^3/s.

11.6 Another key issue is the recreational importance of flows around and just below the median. This is demonstrated in the evidence of Mr Hayes, who describes the direct and cumulative effect of the take on salmon angling, and in my fishable flow analysis. Other witnesses discuss the importance of these flows for other recreational purposes.

11.7 Dr Olsen also describes the importance of median flows for benthic invertebrate habitat.

11.8 In paragraph 142 of his evidence, Mr Tipler suggests that changes in duration and frequency of low flow events as a consequence of the CPW take could be mitigated by delaying the start of its take "by 2 days or until the modified (sic) flow in the river exceeded 100 m^3/s". I cannot see how this would provide mitigation – if the river is already in a low flow condition then CPW would not be able to take water. CPW cannot fully exercise their consent until the unmodified flow exceeds 104.2 m^3/s.

11.9 The percentage of time when the unmodified 7dMALF flow of 44.2 m^3/s increases from 16% pre CPW to 30% post CPW.

11.10 In general terms, there is little difference in terms of median residual river flow between an abstraction of 40 m^3/s and one of 25 m^3/s. The larger (40 m^3/s) intake has the ability to capture larger volumes of flood flows and can therefore replenish the storage in a shorter period of time, resulting in slightly higher Winter residual flows once the storage has been replenished. Basically, the smaller the intake the greater time is required to replenish the reservoir. There is virtually no difference in median summer flows because the proposal will abstract all the available water reducing the residual flow to the minimum. In terms of annual flow volume, the median residual flow in the Waimakariri River is marginally higher for a 25 m3/s intake (68.8 m^3/s) than it is for a 40 m^3/s intake (67.9 m3/s).

12. EFFECT ON CHANGE TO 7dMALF

12.1 Table 11 provides information on low flow (7dMALF) analysis for the unmodified, pre CPW and post CPW 20/40/220 flow regime.

12.2 The unmodified 7dMALF for the Waimakariri River at OHB is 44.2 m^3/s. This reduces to 34.9 m^3/s pre CPW and reduces further to 33.9 m^3/s post CPW. This post CPW reduction is in contrast to the statements made by Kingett Mitchell (2006) in their executive summary and in section 3.2 of their report.

12.3 A reduction in 7dMALF post CPW is possible because whenever the pre CPW 7dMALF for any year contains days when "A" permits are not restricted there is water available for “B” takes. Those “B” takes then reduce the pre CPW flows leading to a reduction in 7dMALF. This is illustrated using the 7 day period 21 to 27 January 1979. During this time there is sufficient flow in the River to allow the maximum pre CPW irrigation abstraction for 6 of the 7 days. A small reduction in pre CPW abstraction is required on the 7th day to maintain the 37 m^3/s at OHB. Because there are 3 days at the start of the period when water is available for “B” permits, the post CPW abstraction reduces the flow at OHB for those 3 days, causing a reduction in the 7 day average from 42 m^3/s to 39.4 m^3/s.

12.4 A reduction in 7dMALF as a consequence of post CPW abstraction occurs at times when the “A” allocation block is either unrestricted or only partly restricted during the 7 day low flow period. There are eleven occurrences in the 40 year record when this situation occurs, resulting in a reduction in the 7dMALF as a consequence of the CPW abstraction.

Table 11: 7 day mean annual low flow (7dMALF)

Unmodified		Pre CPW		Post CPW 20/40/220	
14-Jun-1967	44.3	26-Mar-1968	36.5	26-Mar-1968	**36.2**
10-Feb-1969	45.3	24-Jan-1969	36.1	23-Jan-1969	36.1
28-May-1970	44.1	12-Feb-1970	36.1	26-Nov-1969	36.1
03-Apr-1971	26.5	03-Apr-1971	21.6	03-Apr-1971	21.6
27-Feb-1972	31.5	27-Feb-1972	26.6	27-Feb-1972	26.6
25-Feb-1973	31.3	25-Feb-1973	26.4	25-Feb-1973	26.4
18-Jul-1973	37.7	18-Jul-1973	32.8	18-Jul-1973	32.8
09-Feb-1975	61.0	09-Feb-1975	40.6	08-Feb-1975	**38.7**
23-Apr-1976	41.0	23-Apr-1976	35.4	23-Apr-1976	35.4
30-Mar-1977	54.7	23-Mar-1977	36.1	22-Mar-1977	36.1
12-Mar-1978	31.9	12-Mar-1978	27.0	12-Mar-1978	27.0
21-Jan-1979	62.4	21-Jan-1979	42.0	21-Jan-1979	**39.4**
13-May-1980	61.4	22-Apr-1980	56.4	17-Feb-1980	**41.0**
27-May-1981	39.6	27-May-1981	34.7	27-May-1981	**34.2**
25-Mar-1982	41.9	24-Mar-1982	35.6	24-Mar-1982	35.6
04-Mar-1983	31.6	04-Mar-1983	26.7	04-Mar-1983	26.7
21-Apr-1984	50.2	17-Apr-1984	36.1	16-Apr-1984	36.1
10-Apr-1985	29.8	10-Apr-1985	24.9	10-Apr-1985	24.9
08-Feb-1986	46.9	06-Feb-1986	36.1	06-Feb-1986	36.1
08-Jan-1987	59.3	08-Jan-1987	38.9	08-Jan-1987	**37.4**
03-May-1988	39.0	03-May-1988	34.1	03-May-1988	34.1
14-May-1989	42.8	24-Apr-1989	36.1	16-Feb-1989	36.1
11-Apr-1990	36.7	11-Apr-1990	31.7	11-Apr-1990	31.7
18-Mar-1991	44.7	08-Mar-1991	36.1	07-Mar-1991	36.1
10-Mar-1992	38.1	10-Mar-1992	33.2	10-Mar-1992	33.2
02-Jun-1992	45.5	24-Mar-1993	36.7	23-Mar-1993	**36.2**
28-Aug-1993	44.3	01-Mar-1994	36.2	28-Feb-1994	**36.1**
04-Mar-1995	53.3	15-Feb-1995	36.1	13-Feb-1995	36.1
28-Mar-1996	58.1	28-Mar-1996	38.6	28-Mar-1996	**37.5**
14-May-1997	50.8	29-Jan-1997	42.0	30-Mar-1997	**39.7**
19-May-1998	60.0	28-Feb-1998	46.4	28-Feb-1998	**40.6**
20-Feb-1999	32.5	20-Feb-1999	27.6	20-Feb-1999	27.6
16-Jan-2000	51.4	12-Jan-2000	36.1	10-Jan-2000	36.1
21-Mar-2001	32.7	21-Mar-2001	27.8	21-Mar-2001	27.8
Average	44.2	Average	34.9	Average	33.9

Return period	Value	Return period	Value	Return period	Value
1.6	47.3	1.6	36.3	1.6	36.0
2.0	43.8	2.0	34.0	2.0	34.6
3.0	39.3	3.0	31.3	3.0	31.1
5.0	35.2	5.0	29.5	5.0	29.0
10.0	31.0	10.0	27.2	10.0	26.7
20.0	28.0	20.0	25.6	20.0	24.8
50.0	25.0	50.0	24.4	50.0	21.6

(shaded) = Changed month

Bold = Changed flow

13. EFFECT ON TIME OF YEAR OF LOW FLOWS

13.1 Table 11 also shows that the existing and proposed irrigation abstractions changes the time of year when the unmodified low flows would naturally occur. There are 8 occurrences when pre CPW abstractions cause the 7dMALF to change from winter months (May to August) to Summer months (January to April). The post CPW abstraction causes a further five changes in months, although the low flows generally remain within the "Summer" months.

13.2 Evidence presented by other witnesses called by Fish and Game will comment on the significance of these changes.

14. EFFECT ON DURATION OF FLOW AT 7dMALF

14.1 The percentage of time when the residual flow in the river is at or below the unmodified 7dMALF of 44.2 m^3/s increases from 16% for pre CPW to 30% post CPW.

15. EFFECTS ON SALMON ANGLING

15.1 Dr Hayes noted that salmon anglers fished a wide range of flows but that their preferred flow range was 50 – 80 m^3/s – which was calculated by dividing used by available flow frequencies (see Mr Hayes' evidence for an explanation of his methodology). It is my understanding that the river flows referred to by anglers were those obtained from the Environment Canterbury flow recorder at OHB, which are modified flows (the corresponding unmodified flow is approximately 70 – 100 m3/s).

15.2 I have prepared Table 12 showing the number of days when the residual flow in the river would be within specified flow bands under various flow regimes. The table is merely presented here for information. Although the information suggests that the unmodified 100 m^3/s B regime provides more days within the optimal angling flows, the clarity of water for some of the days within that range will be largely unsuitable for angling because the unmodified flow would have exceeded 120 m^3/s. In other words, little benefit is gained from artificially drawing the river below an unmodified flow of 100m3/s because those flows are too dirty for fishing. However considerable benefit is gained from preventing CPWT from taking water when it is naturally in that range. Evidence will be presented by other witnesses called by Fish and Game that discusses the significance of these flow changes on angling.

Table 12: Average days per season within specified flow class ranges

Flow class	Unmodified	Pre CPW	20/40/220	20/25/240	1:1 B share	100m3/s B
45-50	7.1	10.0	4.8	6.4	17.6	10.3
50-55	8.6	10.1	4.3	5.4	13.5	9.9
55-60	11.3	8.4	3.9	5.2	11.5	7.9
60-65	9.5	7.5	4.4	4.7	8.7	8.0
65-70	9.9	7.5	4.5	5.0	7.2	7.0
70-75	10.2	7.4	4.1	5.0	5.9	7.2
75-80	8.6	6.2	3.2	3.6	4.4	29.6
80-85	7.6	5.4	3.3	3.6	3.0	2.9
85-90	7.1	5.4	3.1	3.6	2.8	2.5
90-95	7.6	4.9	3.1	3.1	3.2	3.0
95-100	6.2	4.4	2.2	2.9	2.6	2.4
100-105	5.8	3.4	2.6	2.5	2.5	2.2
105-110	5.2	3.7	2.8	2.3	2.3	1.8
110-115	4.9	3.7	2.5	2.9	2.2	2.3
115-120	4.5	3.3	2.8	2.5	2.6	2.4
120-125	3.4	2.8	1.7	1.6	1.6	1.6
125-130	3.9	2.4	1.7	1.7	1.7	1.8
130-135	3.5	2.2	2.0	2.0	1.8	1.7
135-140	3.2	2.2	1.8	1.8	1.6	1.5
50 - 80	58.1	47.1	24.4	28.9	51.2	69.5

16. COMMENTS ON ALTERNATIVE FLOW REGIMES

I have modelled a number of regimes to compare the effects of the residual river flow. These regimes include the use of 1:1 flow sharing for "B" permit holders, and not allowing CPW having access to "A" permit water that is not being used by existing users during winter months. I have retained the base 20/40/220 regime and also used the 20/25/240 regime for comparison.

16.1 Current water management options usually comprise either a cap on total restrictions with a flow sharing regime, or a system of "A" and "B" permits where the "B" permits cannot be exercised until higher residual river flow is available. An example of the former is the Rakaia WCO, and an example of the latter is the Rangitata River WCO. The Rangitata WCO specifies an "A" allocation of 33 m^3/s, which can be fully exercised when the river is above 66 m^3/s. No "B" abstractions can occur until the river is at or above 110 m^3/s, leaving an additional 44 m^3/s to be retained in the River. I have previously referred to the fact that there are hydrological differences between the distribution of monthly flows within the Waimakariri River and the Rakaia and Rangitata Rivers. Both the Rakaia and Rangitata Rivers have a more pronounced snow melt influence with higher flows in November to February whereas the Waimakariri River has its peak flows in October to November and lower flows from December through March.

16.2 In its present form, the WRRP has no cap on abstractions and no flow sharing mechanisms. There appears to be a presumption taken by CPW advisors that because the abstraction complies with the rules in the WRRP that there will not be any adverse effects. Mr John Talbot, who was Director of Policy and Planning at the Canterbury Regional Council at the time of a consent hearing to determine NTP resource consents (CRC052033, CRC054498 & CRC054501), presented his evidence which referred to the fact that at the time of preparation of the WRRP, the assumption was made that any "B" water would not be reliable enough without storage. It was therefore assumed that there would be only limited demand for significant amounts of "B" permit water. A media release dated 29 November 2007 confirmed that the Canterbury Regional Council staff are presently reviewing the existing flow regimes specified in the WRRP with a view to setting allocation limits on "B" permit water. While I had no involvement in the development of the WRRP I believe that the matters referred to above indicate that the WRRP was never developed with the expectation that any significant abstractions of "B" permit water would occur.

16.3 I have also included a regime where "B" permits can not take until the unmodified flow exceeds 100 m^3/s (ie approximately the unmodified median flow, and the flow considered to be where turbidity limits salmon angling opportunity). This regime has been included for your consideration because it is similar in nature to the rationale used for the Rangitata WCO. Under that scenario flow sharing would not be required

16.4 Tables 9 and 10 provide a summary of median and mean flow statistics for the various options. I have also included table 13 which provides a comparison of reliability of water based on the percentage of time when the full irrigation demand for CPW can be attained. Figure 13 of my evidence shows the monthly median residual flows for various options. Figure 14 shows flow distribution curves for the period October to April of each year.

16.5 Figure 12 shows the residual river flows for the 20/40/220 regime with and without 1:1 flow sharing of "B" permits above the present 63 m^3/s minimum flow for the "typical" 1989-90 year. Considerably more residual river flow occurs in January, with minor increases in March, April and May. Residual river flows are correspondingly lower in July and August due to the longer time taken to replenish the storage.

16.6 Flow sharing also helps to maintain a more natural river hydrograph and reduces the frequency and duration of time when the river is at or near the minimum flow (commonly referred to as "flat lining"). Figure 12 shows four occurrences where freshes exceeding 50 m^3/s would be retained in the river as a consequence of flow sharing.

16.7 If the "B" minimum flow is raised to 100 m^3/s, the impact on flows below the median are lessened. The percentage of time when the residual flow in the river is at or below the unmodified 7dMALF of 44.2 m^3/s increases slightly from 16% for pre CPW to 18 % (cf 30% for the regimes where the B permit minimum flow is 63 m^3/s). The 7 dMALF is only marginally reduced from 34.9m^3/s pre CPW to 34.5 m^3/s Post CPW, and the median flow is reduced to 78.1 m^3/s (cf ≈ 69m^3/s for other 63m^3/s B minimum flow regimes).

16.8 The reliability in terms of the percentage of time when the full irrigation demand for CPW can be attained is shown for various options in table 13. Mr Tipler's evidence refers to a required reliability of supply for the CPW scheme of "at least 95%".

Table 13: Reliability of supply to CPW – various regimes

RELIABILITY	
Post CPW 20/40/220 No Winter "A" No NTP	96.6%
Post CPW 20/40/220 No Winter "A", NTP	95.6%
Post CPW 20/25/240 Winter "A" No Share No NTP	97.1%
Post CPW 20/40/220 No Winter take, 1:1 "B" sharing, No NTP	94.9%
Post CPW 20/40/220 "B" take above 100 m3/s No NTP	92.1%

17. CONCLUSIONS

17.1 In terms of modelling and presenting information on the potential effects of the proposed CPW abstractions, I consider that the following assumptions should be used:

a. CPW will not have access to any existing lower band water allocated to other users from the Rakaia River, or have access to any "A" band water allocated to existing users (with the possible exception of NTP) from the Waimakariri River

b. When assessing the impacts of the CPW proposal it is essential to compare the post CPW residual flows to the unmodified flows in order to adequately assess cumulative effects;

c. Changes in flow regimes should be expressed in terms of median flows rather than mean (average) flows;

17.2 In respect to the Rakaia River, I consider that the following assumptions should be used:

a. The maximum CPW rate of take from the Rakaia River is 20 m^3/s, which includes 2 m^3/s already taken by Glenroy Irrigation;

b. The potential effects of abstraction should be assessed in combination with the 17.7 m^3/s abstraction proposed by ACWT;

c. CPW will not obtain access to any lower band water from the Rakaia River;

d. Synlait has priority over CPW, together with any other abstractors whose applications were in a notifiable state and/ or ready for notification as at May 2007. For completeness, I have also addressed the contrary assumptions (ie, Synlait not having priority) as that formed the basis of the Applicant's evidence presented in February 2008.

17.3 The proposed abstraction, in combination with ACWT will have the following impacts on the Rakaia River:

a. The median summer river flow will reduce to 161.8 m^3/s, which is a 13.3% reduction from the unmodified flow;

b. The protection of flow sharing, 70 m^3/s cap on abstraction, and monthly minimum flows provided by the RCO ensures that any impact of the proposed abstraction of up to 35.7 m^3/s from the Rakaia River has little or no impact on flows less than the median flow.

c. The proposal does not alter the 7 day mean annual low flow (7dMALF), or increase the frequency at which the residual river flow would be at or below the median flow.

d. The cumulative effects of the abstractions on the residual flow of the Rakaia River are similar in magnitude regardless of whether CPW hold priority over Synlait or vice versa.

17.4 In respect to the Waimakariri River, I consider that the following assumptions should be used:

a. The maximum rate of take will be 40 m^3/s, and will comprise only "B" band water if NTP retain priority, or 1.616 m^3/s "A" band and the remainder "B" band if CPW retain priority;
b. CPW will not have access to existing allocated "A" band water during Winter months

17.5 Assuming that the CPW abstraction from the Waimakariri River is in accordance with the resource consent application (ie a 40 m^3/ intake) then, under my base 20/40/220 regime, the abstraction will:

a. Affect the flow distribution of the Waimakariri River throughout a flow range between 40 m^3/s and ≈300 m^3/s.;
b. Cause a reduction in pre CPW annual median flow from 81.5 m^3/s to 67.9 m^3/s, and reduce the unmodified median flow from 94.5 m^3/s to 67.9 m^3/s;
c. Have the greatest impacts on residual river flows between January and April, where the median flow is reduced continuously to the allowable minimum of less than 40 m^3/s;
d. Result in significant periods when the residual river "flat lines" at or about the minimum flow. The abstraction will greatly reduce the duration of short term freshes;
e. Have only a small impact on the 7 day MALF, but causes changes in the time of year when the low flows will occur. The percentage of time when the residual river is at of below the unmodified 7 day MALF increases from 16% pre CPW to 30 % post CPW;

17.6 The potential impacts on residual river flows would be reduced if alternative regimes such as 1:1 flow sharing or the raising of the minimum flow for the CPW take as described in this evidence were considered. These regimes would provide a reliability of supply to CPW in excess of 90%.

R de Joux
May 2008

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APPENDIX 1

Assumptions used to model the unmodified flow of the Waimakariri River at OHB

The "unmodified" flow is defined in the Waimakariri River Regional Plan as the rate of flow in the river calculated by the Canterbury Regional Council as if there were no abstractions. The minimum flow site is identified as being "below Woodstock" and the site for the assessment of the "unmodified" flow is at OHB. Woodstock generally refers to the section of the Waimakariri above the Gorge Bridge to the confluence with the Kowhai River.

Conditions on existing resource consents refer to the minimum flow (41 m3/s) as being the "unmodified" flow at OHB as opposed to the "unmodified" flow below Woodstock.

To determine the likely impact that the proposed CPW abstraction will have on the hydrology of the Waimakariri River, it is necessary to first derive a time series of "unmodified" flows from which the effects of historic abstractions have been removed. Having derived the "unmodified" flows, it is then possible to model the impacts that both the existing and the proposed CPW abstractions will have on the hydrology of the River.

To carry out the required modelling I received the following information:

Time series of instantaneous river flow – site 66401 Waimakariri River at OHB. Data for the period 01/01/67 to 21/02/07 supplied by Environment Canterbury; and

Time series of instantaneous intake abstraction – site 66450 Waimakariri Irrigation Ltd (WIL) intake at Brown's Rock. Data for the period 19/02/99 to 21/02/07 supplied by WIL.

Modelling the "unmodified" flow

The assumptions used in this model are as follows:

- Historic stockwater use is 4.0 m^3/s and is not subject to restriction at times of low River flows

- Prior to the WRRP becoming operative, resource consents for the abstraction of water for irrigation purposes were required to cease abstractions whenever the flow in the Waimakariri River at OHB was less than 37 m^3/s[5]. It is noted that this flow rate is the measured flow, not the "unmodified" flow.

- Maximum consented irrigation takes during the specified periods (from Ecan consent information) are shown in table

Table 1: Total irrigation demand

Season start	Maximum rate (m^3/s)
Pre 1968	Nil
1969-87	1.6
1988-92	1.8
1993-98	2.7
1999-07	2.7 + WIL Irrigation[6]

- Irrigation restrictions for the periods shown in table 1 are presumed to be applied pro rata in accordance with the historic 37 m^3/s minimum flow at OHB.

- Prior to the granting of the Waimakariri Irrigation Ltd intake consents there has been no requirement by the regional council for consent holders to record the rate and volume of take from the river. In order to model the unmodified flow at OHB, certain assumptions regarding the extent of historical abstractions had to be made.

- Irrigation demand varies from month to month throughout each irrigation season. Estimates of average monthly irrigation demand have been assessed by a number of authors and are shown in table 2

Table 2 Monthly irrigation demand

Source	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Attewell	0%	0%	0%	62%	78%	92%	100%	75%	58%	36%	0%	0%
Scarf	0%	0%	25%	60%	85%	100%	100%	85%	60%	25%	0%	0%
PDP	0%	0%	8%	25%	68%	80%	99%	76%	62%	16%	0%	0%
Aqualinc*	0%	0%	0%	37%	63%	90%	92%	97%	88%	65%	39%	0%
Modelled	0%	0%	25%	30%	70%	90%	100%	85%	60%	25%	0%	0%

*Aqualinc figures based on percentage of maximum monthly demands.

[5] Eg condition 1 of consent CRC916302B specifies "The taking of water in terms of this permit from the Waimakariri River shall cease whenever the flow in the Waimakariri River, as estimated by the Canterbury Regional Council, at the Old Highway Bridge recorder site (map reference M35:818-547) falls below 37 cubic metres per second."

[6] WIL consents allow for up to 2.1 m^3/s for Waimakariri District Council stockwater supply. The WIL intake abstraction less 2.1 m^3/s is assessed as being used by WIL for irrigation and/or augmentation.

Pattle Delamore Partners (PDP, 2006) presented evidence in support of resource consent applications by Ngai Tahu Properties Ltd. They describe monthly irrigation demand data for the period 1967 to 2004 based on soil moisture modelling for the WIL scheme. Although this provides a more realistic indication of the variability of demand from one year to another, unless the moisture deficit is calculated on a daily basis, the results will underestimate actual use. This is because the use of a monthly deficit estimate ignores the fact that the soils could be in deficit for long periods during the month before any rainfall occurs.

Although individual irrigators have the ability to regulate and schedule their abstractions in accordance with soil moisture deficits, it is extremely difficult to manage the application of water within a large irrigation scheme on the same basis. In the case where a scheme does not have the capacity to supply all farmers at the same time it is necessary to roster the water. This requires farmers to utilise water at times when soil moisture may not be in deficit. In such cases, the use of variable monthly irrigation demand figures for modelling purposes will produce an underestimation of the actual water usage.

For the purpose of the model I have used the values shown in the 5th row of table 2. For example, if the total consented irrigation take in October 1994 was 2.7 m^3/s then the assumed average demand would be 2.7 m^3/s x 30% = 0.81 m^3/s. This method was only applied to the unmeasured irrigation abstractions. The actual water usage from the WIL was used in the model.

APPENDIX 2

Assumptions used to model the impact of CPW abstractions on the Waimakariri River

The potential impact of the proposed CPW abstraction has been modelled by applying the rules of the Rakaia RCO and the WRRP on all existing abstractions, including CPW Trust using the following assumptions.

The modelling has allowed for options that take into account recent court decisions regarding the priority of Synlait over CPW/ACWT in the Rakaia River and CPW over Ngai Tahu Properties Ltd in the Waimakariri River.

The modelling also accounts for an updated assessment of existing allocations of water from the Waimakariri River as provided by Canterbury Regional Council staff in April 2007. It is noted that the present allocation of "A" permits in the Waimakariri River is 23.104m^3/s, which exceeds the allocation limit of 22 m^3/s specified in the WRRP.

- The minimum flow for irrigation takes is the "unmodified" flow of 41 m^3/s at OHB.
- Stockwater takes are not restricted (WRRP provisions). With the granting of the SDC consent CRC012003, there is now 4.896 l/s allocated for stock purposes.
- If Ngai Tahu Properties Ltd retain priority over CPW then Ngai Tahu Properties Ltd have 2.72m^3/s "A" allocation and 1.24 m^3/s "B" allocation. The CPW abstraction will be entirely "B" allocation and the maximum "B" abstraction under the above scenario is therefore 41.24 m^3/s.
- If CPW hold priority over NTP then NTP cannot exercise their consents. The present "A" allocation of 23.104 m^3/s will reduce by 2.72 m^3/s (ie the NTP "A" allocation), and CPW will be able to abstract 1.616 m^3/s "A" allocation to ensure that the WRRP limit of 22.0 m^3/s is not exceeded. If the total CPW demand is 40.0 m^3/s, the remaining 38.384m^3/s will be "B" allocation and will be shared pro rata with the existing 0.561 m^3/s "B" allocation granted to P & E Limited and to Hunter.
- Daily irrigation demand, including distribution race losses has been provided by URS and this has been used to determine the daily water demand required by CPW. it has been assumed that existing "A" takes will all take at their maximum rates at all times during each irrigation season. This is consistent with the approach taken by Mr Tipler in preparing their modelled river flows. While this will initially result in an overestimation of the "pre CPW" residual flows, I consider that this is a reasonable assumption to make,

especially as it is known that NTP and Waimakariri Irrigation Ltd intend to utilise storage options in the future.

- Water is taken in priority order from the Rakaia and Waimakariri Rivers and then from storage. Any water available to CPW that is not required for irrigation is placed into storage at a rate up to the maximum intake capacity from the Waimakariri River.
- An option has been included to allow up to 11.5 m^3/s of existing “A” allocation water from the Waimakariri River during Winter to replenish the Waianiwaniwa reservoir.

Appendix 3: Summary of consented "takes" from the Rakaia and Waimakariri Rivers provided by Canterbury Regional Council, April 2008.

RecordNo	HolderName	Band	Activities	Rate (l/s	Allocated rate (l/s	ECAN database l/
CRC000116	McLachlan	Band 1	Take Surface Water	30	30	30
NCY800538	ADC (Acton)	Band 1	Take Surface Water	680	680	680
NCY860218B	SDC (Headworks Rd)	Band 1	Take Surface Water	566	566	1130
NCY720286	SDC (Earlys)	Band 1	Take Surface Water	732	732	566
CRC970986	SDC (Te Pirita)	Band 1	Divert Surface Water	3500	3500	3500
	Total	**Band 1**			**5508**	**5906**
CRC990675.2	Rakaia Island Dairies Limited	Band 2	Take Groundwater	180	125	880
CRC990832.1	Mr William David George Brownlee	Band 2	Take Surface Water	400	400	R1waterrace
CRC970828	Mr Philip Gilmore Brown	Band 2	Take Surface Water	42	42	42
CRC940052	Mr & Mrs G G & B M Gilbert	Band 2	Take Surface Water	340	340	340
CRC940163	Ms Jane McKergow Pangborn	Band 2	Take Surface Water	450	450	450
CRC940169.1	Searlkinn Farm Limited	Band 2	Take Surface Water	450	450	450
CRC980976.2	Mr & Mrs M R & B A Inch	Band 2	Take Surface Water	30	30	R1waterrace
CRC990621.1	Alderbrook Farm Limited & Pineview Holdings Limited	Band 2	Take Surface Water	850	850	R1waterrace
CRC990979.2	Riverlands Partnership	Band 2	Take Surface Water	113	113	Snowdon waterrace
CRC990660	South Rakaia Irrigation Partnership	Band 2	Take Surface Water	1800	1800	1800
CRC991035	Northbank Irrigation Partnership	Band 2	Take Surface Water	1577	1577	1577
CRC990983.1	Fereday Irrigation Group	Band 2	Take Surface Water	2000	2000	2000
CRC930958B.1	The Fereday Island Company Limited	Band 2	Take Surface Water	320	320	320
CRC940050.2	Mr & Mrs Maw, Beverley Farm Limited & Mr Campion	Band 2	Take Surface Water	100	100	100
CRC990901.1	J P & F J Reardon Limited	Band 2	Take Surface Water	38	38	R1waterrace
CRC990980.1	Canterbury Grasslands	Band 2	Take Surface Water	140	140	0
CRC990851.1	North Rakaia Irrigation Association	Band 2	Take Surface Water	550	550	550
CRC991102.1	Ford Irrigation Limited	Band 2	Take Surface Water	450	450	0
	Total	**Band 2**			**9775**	**8509**
CRC990675.2	Rakaia Island Dairies Limited	Band 3	Take Groundwater	700	525	0
CRC940486.1	Ford Irrigation Limited	Band 3	Take Surface Water	450	0	450
CRC941177.3	Mr & Mrs J T & Mr & Mrs J B McCarthy & Monk	Band 3	Take Surface Water	900	900	450
CRC941161.2	Mr & Mrs G G & B M Gilbert	Band 3	Take Surface Water	450	450	450
CRC952433.2	Wendrum Farm Limited	Band 3	Take Surface Water	450	450	450
CRC941219	Mr & Mrs J M & M R Foster	Band 3	Take Surface Water	450	450	450
CRC990074.1	Mr and Mrs AD and SM Clemens	Band 3	Take Surface Water	120	120	120
CRC990136.1	L J & A M & C R & A C & G D & V Maw, Maw & Campio	Band 3	Take Surface Water	175	175	175
	Total	**Band 3**			**3070**	**2545**
CRC992181.1	Mr & Mrs M G & J A Holmes	Band 4	Take Surface Water	150	150	150
CRC990088	Barrhill Chertsey Irrigation Company	Band 4	Take Surface Water	17000	17000	17000
	Total	**Band 4**			**17150**	**17150**
CRC051803	Glenroy Community Irrigation Company Limited	Band 5	Take Surface Water	1400	1400	1400
CRC051802	Glenroy Community Irrigation Company Limited	Band 5	Take/Divert Surface V	560	560	;nowdon waterrace
CRC051415	Canterbury Grasslands Limited	Band 5	Take Surface Water	200	200	0
CRC050198	J P & F J Reardon Limited	Band 5	Take Surface Water	38	38	R1waterrace
CRC042529	Riverland Dairies One Ltd & Riverland Dairies Two Ltd	Band 5	Take Surface Water	192	192	R1waterrace
CRC051231.1	Mr & Mrs M R & B A Inch	Band 5	Take Surface Water	40	40	R1waterrace
	Total	**Band 5**			**2430**	**1400**
			Total		**37,933.00**	**35,510.00**
On database						
CRC050833.1	Grand Estates Limited		Take Surface Water		0	35
CRC062046	Kiwi Green Island Club Limited		Take Surface Water		0	4
CRC072619.2	Delhaven Farms Limited		Take Surface Water		0	70
CRC073867	Synlait Farms Limited		Take Surface Water		0	380
CRC940782B	Mt Hutt Riverbank Rural Water Supply Scheme		Take Surface Water		0	4
					0	**493**
			Total SWTakes		**37,933.00**	**36,003.00**
			Total GWTakes		**2,340.00**	**1,310.85**
			Grand total		**40,273.00**	**37,313.85**

Email correspondence regarding Rakaia River allocations

Hi Richard
Sorry I can confirm you are right, the spreadsheet sent on the 14th April had not been updated to reflect the 2.7m3/s.

Cheers,

Charlotte

From: Richard [mailto:ecstimaru@xtra.co.nz]
Sent: Friday, 18 April 2008 9:07 a.m.
To: Charlotte Blakey; 'Jen Crawford'; 'Jason Holland'
Cc: Cliff_Tipler@URSCorp.com; Leo Fietje; Don Vattala; Dirk Brand
Subject: RE: Inclusion of CRC970986 (3,500l/s)
Importance: High

Charlotte

The spreadsheet of Rakaia allocations you sent me attached to this email does not include the 2.7 m^3/s of water taken from water races referred to in Leo's email dated 19 March 2008. The spreadsheet is identical to one sent to me earlier this year – the only change is the 3.5 m^3/s for SDC take.

Please confirm that if the SDC take is included then the allocation is 33.813 + 2.7 + 3.5 = 40.013 m^3/s.

Richard de Joux
Environmental Consultancy Services Ltd
P O Box 952, Timaru, New Zealand
ph (03) 688 5522 cell (027) 435 4065
fax (03) 684 4785

From: Charlotte Blakey [mailto:Charlotte.Blakey@ecan.govt.nz]
Sent: Monday, 14 April 2008 4:56 p.m.
To: Richard
Cc: Cliff_Tipler@URSCorp.com; Leo Fietje; Don Vattala; Dirk Brand
Subject: Inclusion of CRC970986 (3,500l/s)

Dear Richard

Herewith the updated spreadsheet of consents as discussed.

The priority band for the 3500l/s is Band 1 (SDC application). I herewith confirm that it is 'new water'. An update of the Waimakariri River allocation will be forwarded to you tomorrow.

Regards

Charlotte Blakey
Consent Investigations Assistant

58 Kilmore St
PO Box 345
CHRISTCHURCH
Phone: (03) 372 7051
Fax: (03) 365 3194
****
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664 Waimakariri River Catchment Area
Report Generated 15/04/2008 1:59:23 p.m.

ConsentNo	FileNo	Activity		State	Permit Type	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
						average daily abstraction rate (l/s) / maximum abstraction rate (l/s)											
6640000	**Waimakariri River (below Woodstock)**																
CRC000018	CO6C/10936	GWTAKE	Mr & Mrs F R & L I Maginness	I2	A	2	2	2	2	2	2	2	2	2	2	2	2
						2	2	2	2	2	2	2	2	2	2	2	2
CRC000585.6	CO6C/16313	SWTAKE	Waimakariri Irrigation Limited	I2	A	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500
						10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500
CRC000589.1	CO6C/22001	SWTAKE	Messrs & Mesdames Spencer-Bower & Prattley	I2	A	0	0	0	616.67	616.67	616.67	616.67	616.67	616.67	616.67	0	0
						0	0	0	740	740	740	740	740	740	740	0	0
CRC000744	CO6C/16377	GWTAKE	Drumnacott Farms Limited	I2	A	125	125	125	125	125	125	125	125	125	125	125	125
						125	125	125	125	125	125	125	125	125	125	125	125
CRC001219	CO6C/15740	GWTAKE	Peckabok Farm Company Limited	I2		34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48
						34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48	34.48
CRC001636	CO6C/16737	SWDIVERT	Transit New Zealand	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC012006	CO6C/17910	SWTAKE	Selwyn District Council	I2	A	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
						1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
CRC012237.3	CO6C/24152	SWTAKE	Woodstock Farms Limited	I2	A	280	280	280	280	280	280	280	280	280	280	280	280
						280	280	280	280	280	280	280	280	280	280	280	280
CRC012907	CO6C/09133	SWTAKE	Waimakariri District Council, Rangiora	I2	A	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
						2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
CRC020351	CO6C/18551	GWTAKE	Mr C Murphie	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC020351	CO6C/18551	GWTAKE	Mr C Murphie	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC020351	CO6C/18551	GWTAKE	Mr C Murphie	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC020436.1	CO6C/18591	SWTAKE	Eagle Hill Partnership	I2	A	180	180	180	180	180	180	180	180	180	180	180	180
						180	180	180	180	180	180	180	180	180	180	180	180
CRC030246.1	CO6C/23961	SWTAKE	Colt Trustee Limited & Waifora Trustee Limited	I2	A	50	50	50	50	50	50	50	50	50	50	50	50
						50	50	50	50	50	50	50	50	50	50	50	50
CRC030622	CO6C/19870	SWDIVERT	Waimakariri District Council, Rangiora	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC041167	CO6C/22000	SWDIVERT	Waimakariri District Council, Rangiora	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC041662	CO6C/21491	SWDIVERT	Transit New Zealand	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC041691	CO6C/21247	SWDIVERT	Fulton Hogan Limited (Christchurch Office)	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC042150	CO6C/21768	SWDIVERT	The Isaac Construction Company Limited	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC042296.1	CO6C/21872	GWTAKE	Wrightco Limited	I2		94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
						94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
CRC042826	CO6C/02098	GWTAKE	Waimakariri Gorge Golf Club	I2	A	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
						12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
CRC054098	CO6C/23735	SWDIVERT	P & E Limited	I2		480	480	480	480	480	480	480	480	480	480	480	480
						480	480	480	480	480	480	480	480	480	480	480	480
CRC054098	CO6C/23735	SWTAKE	P & E Limited	I2	B	333.33	333.33	333.33	333.33	333.33	333.33	333.33	333.33	333.33	333.33	333.33	333.33
						480	480	480	480	480	480	480	480	480	480	480	480
CRC061311	CO6C/14999	SWTAKE	Mr & Mrs B D & K J Mehrtens	I2	A	0	0	0	51.42	51.42	51.42	51.42	51.42	51.42	51.42	0	0
						0	0	0	60	60	60	60	60	60	60	0	0
CRC061345	CO6C/15425-02	SWTAKE	Mr & Mrs M A & C F Hunter	I2	B	81.46	81.46	81.46	81.46	81.46	81.46	81.46	81.46	81.46	81.46	81.46	81.46
						85	85	85	85	85	85	85	85	85	85	85	85
CRC061819	CO6C/24344	SWDIVERT	R G Mannering and A Reid	I2		0	0	0	1000	1000	1000	1000	1000	1000	1000	0	0
						0	0	0	1000	1000	1000	1000	1000	1000	1000	0	0
CRC063981	CO6C/21690	SWDIVERT	Road Metals Company Limited (Oamaru)	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC940119	CO6C/02203	GWTAKE	Willowview Farm Limited	I2		5	5	5	5	5	5	5	5	5	5	5	5
						5	5	5	5	5	5	5	5	5	5	5	5
CRC940120.1	CO6C/02203	GWTAKE	Willowview Farm Limited	I2	A	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
						19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
CRC940911	CO6C/02203	GWTAKE	Willowview Farm Limited	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC952567.1	CO6C/09134	SWDIVERT	Waimakariri Irrigation Limited	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC960148	CO6C/09366	GWTAKE	Selwyn District Council	I2	A	24	24	24	24	24	24	24	24	24	24	24	24
						24	24	24	24	24	24	24	24	24	24	24	24
CRC960538	CO6C/09879	GWTAKE	Christchurch Ready Mix Concrete Limited	I2		0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	0
CRC972160	CO6C/00109	GWTAKE	Mr & Mrs G A & C E Banks	I2	A	11	11	11	11	11	11	11	11	11	11	11	11
						11	11	11	11	11	11	11	11	11	11	11	11

664 Waimakariri River Catchment Area

Report Generated 15/04/2008 1:59:23 p.m.

ConsentNo	FileNo	Activity		State	Permit Type	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
						average daily abstraction rate (l/s) / maximum abstraction rate (l/s)											
6640000	**Waimakariri River (below Woodstock)**																
CRC981333.3	CO6C/14194	SWTAKE	Mr C F Boys	I2	A	0	0	0	40	40	40	40	40	40	40	0	0
						0	*0*	*0*	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*0*	*0*
CRC981363.1	CO6C/01668	SWTAKE	Riverslea Partnership	I2	A	0	0	0	34	34	34	34	34	34	34	0	0
						0	*0*	*0*	*34*	*34*	*34*	*34*	*34*	*34*	*34*	*0*	*0*
CRC981893.4	CO6C/20455	GWTAKE	Westacre Farm Limited	I2	A	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6
						98.6	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*	*98.6*
CRC990421.1	CO6C/22001	SWTAKE	Messrs & Mesdames Spencer-Bower & Prattley	I2	A	0	0	0	1600	1600	1600	1600	1600	1600	1600	0	0
						0	*0*	*0*	*1950*	*1950*	*1950*	*1950*	*1950*	*1950*	*1950*	*0*	*0*
CRC990579	CO6C/12052	GWTAKE	Mr & Mrs G D & S C Bain	I2	A	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9	58.9
						58.9	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*	*58.9*
CRC990698	CO6C/01672	SWTAKE	Mr J M Robertson	I2	A	0	0	0	19.71	19.71	19.71	19.71	19.71	19.71	19.71	0	0
						0	*0*	*0*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*0*	*0*
CRC990770	CO6C/00376	GWTAKE	Christchurch Ready Mix Concrete Limited	I2		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CRC990771	CO6C/00376	GWTAKE	Christchurch Ready Mix Concrete Limited	I2		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CRC990926	CO6C/04509	GWTAKE	Waimakariri District Council, Rangiora	I2	A	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CRC990926	CO6C/04509	GWTAKE	Waimakariri District Council, Rangiora	I2	A	23	23	23	23	23	23	23	23	23	23	23	23
						23	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*
CRC990958.1	CO6C/18729	SWTAKE	Mr & Mrs P G & A C King	I2	A	0	0	0	32.08	32.08	32.08	32.08	32.08	32.08	32.08	0	0
						0	*0*	*0*	*35*	*35*	*35*	*35*	*35*	*35*	*35*	*0*	*0*
CRC991423	CO6C/03580	GWTAKE	Selwyn District Council	I2	A	63	63	63	63	63	63	63	63	63	63	63	63
						63	*63*	*63*	*63*	*63*	*63*	*63*	*63*	*63*	*63*	*63*	*63*
CRC991604	CO6C/03580	SWDIVERT	Selwyn District Council	I2		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
CRC991620.2	CO6C/15425	GWTAKE	Mr & Mrs M A & C F Hunter	I2	A	86	86	86	86	86	86	86	86	86	86	86	86
						86	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*
NCY800918	CO6C/03613	SWTAKE	Selwyn District Council	I4	A	374	374	374	374	374	374	374	374	374	374	374	374
						374	*374*	*374*	*374*	*374*	*374*	*374*	*374*	*374*	*374*	*374*	*374*
NCY800919	CO6C/03613	SWTAKE	Selwyn District Council	I4	A	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67	16.67
						60	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*
						18,241.84	18,241.84	18,241.84	20,635.72	20,635.72	20,635.72	20,635.72	20,635.72	20,635.72	20,635.72	18,241.84	18,241.84
						16,435.38	*16,435.38*	*16,435.38*	*19,317.38*	*19,317.38*	*19,317.38*	*19,317.38*	*19,317.38*	*19,317.38*	*19,317.38*	*16,435.38*	*16,435.38*
6640700	**Kowai River**																
CRC011465.2	CO6C/22130	GWTAKE	Kenley Farm Limited	I2	A	51	51	51	51	51	51	51	51	51	51	51	51
						51	*51*	*51*	*51*	*51*	*51*	*51*	*51*	*51*	*51*	*51*	*51*
CRC020876	CO6C/02825	SWTAKE	Benmore Graziers Limited	I2	A	0	0	0	38.33	38.33	38.33	38.33	38.33	38.33	38.33	0	0
						0	*0*	*0*	*40*	*40*	*40*	*40*	*40*	*40*	*40*	*0*	*0*
NCY800915	CO6C/03610	SWTAKE	Selwyn District Council	I4	A	500	500	500	500	500	500	500	500	500	500	500	500
						500	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*	*500*
NCY800916	CO6C/03610	SWTAKE	Selwyn District Council	I4	A	130	130	130	130	130	130	130	130	130	130	130	130
						130	*130*	*130*	*130*	*130*	*130*	*130*	*130*	*130*	*130*	*130*	*130*
NCY880430	CO6C/03588	SWTAKE	Selwyn District Council	I4	A	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
						10.5	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*
						691.50	691.50	691.50	729.83	729.83	729.83	729.83	729.83	729.83	729.83	691.50	691.50
						691.50	*691.50*	*691.50*	*731.50*	*731.50*	*731.50*	*731.50*	*731.50*	*731.50*	*731.50*	*691.50*	*691.50*
CRC012003	CO6C/17910	SWTAKE	Selwyn District Council	D4		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
						.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
						.00	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*
CRC991058	CO6C/03588	SWTAKE	Selwyn District Council	A1,H3	A	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
					Receipted	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*
						10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
						10.50	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*	*10.50*
						11	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*11*	*11*
						2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
						11.00	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*	*11.00*