

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

**STATEMENT OF EVIDENCE OF HUGH JASON PAUL CANARD ON
BEHALF OF THE NEW ZEALAND RECREATIONAL CANOEING
ASSOCIATION**

INTRODUCTION

1. My name is Hugh Jason Paul Canard
2. I have been kayaking since 1963 on the easier rivers and since 1978 on the harder rivers of the South Island. My early trips were in canvas canoes and home-made rafts on the Ashley, Hurunui and Waimakariri Rivers. I started getting interested in whitewater kayaking in the late 1970s when fibreglass kayaks became available and my interest grew until by the 1990s I was paddling up to Grade 4 rivers in New Zealand, the USA, Europe and Canada. I have done a number of first descents of South Island rivers. In 1992 I moved to Nelson and owned and ran a commercial sea kayaking business in the Abel Tasman which employed up to 20 people, and in the five years I owned it we introduced over 25,000 people to kayaking. In 1997 the business won a New Zealand Tourism Award. Since 1998 I have remained active in kayaking and rafting, but I am gradually attempting easier trips as I get older.
3. I was one of the founders of the Whitewater Canoe Club of Christchurch around 1979 and I have been at various times the Touring Officer, Conservation Officer, President and now Patron of the national association, now the NZRCA. I served on the Adventure Tourism Council for two years. I have a broad view of kayaking, canoeing and rafting as both an amateur and in a professional capacity.
4. I am an engineer by profession, having trained in what is now called environmental engineering, and my principal professional work for 25 years was in the field of industrial ventilation and building services. I mention this because I will cover some technical aspects relating to safety around man-made constructions in moving water. I do not claim expert status in hydraulic engineering, but I do claim to understand some of the basic physics involved as they relate to canoeing and kayaking, and I wish to connect my knowledge of

canoeing and kayaking to attempt to bridge to the safety and recreational aspects of CPW's Application.

Since 2000 I have been working as a consultant in tourism and economic development. I have graduate qualifications in economic development. My work in tourism is principally at the regional level advising on strategy, managing projects ranging from new walkways to destination management planning at iconic tourism destinations. I have done a number of assignments for central government on tourism and in regional economic development. My current work is as Project Manager on the West Coast Tourism Major Regional Initiative, working for a partnership of Development West Coast, Department of Conservation, Ngai Tahu and Tourism West Coast. I am a Head Judge for the New Zealand Tourism Awards.

5. I participated in the Canterbury Strategic Water Storage Study Stage 3, during which time I met and listened to the views of many Canterbury farmers and ecological experts. I am on two of the Reference Groups for the government's Sustainable Water Programme of Action process to develop National Environmental Standards and National Policy Statements.
6. Running rivers of all types and of a range of difficulties is very important to me and it has been my principal form of recreation and passion for 45 years. I enjoy the water and the challenges of whitewater and moving water, and the settings that range from dark narrow gorges to the wide expanses of Canterbury's braided rivers. I enjoy the little creeks, the heritage rivers of Europe and the Grand Canyon of the Colorado with equal enthusiasm, but the principal characteristics I seek are natural flow and natural character. A fundamental component of natural character is that the flow should fit the natural water course. I value the natural diversity of flows that make any river what it is.
7. In my evidence I will relate my experience of the Waimakariri River, my concerns about the inadequacy of the Application to consider future use of the river over the life of the CPW scheme by kayakers, and similarly based concerns about the potential dangers of the intake structures.
8. I have read the Code of Conduct for Expert Witnesses (Practice Note 2006) and agree to comply with it.

EXPERIENCE ON THE WAIMAKARIRI

9. I took my first trip down the Waimakariri on an inner tube from Arthurs Pass to the SH bridge sometime in the early 1960s. We took two days and I was young enough to think of the discomfort and minor injuries as a grand adventure. In home-made canvas canoes friends and I paddled from the Gorge Bridge to the sea on a number of occasions. We paddled the river if it was not discoloured and there was no NW weather forecast. In 1977 I paddled the flooded Kowai River into the Waimakariri, which was bank to bank with debris and was a constant rumble of water-borne boulders all the way to the Gorge Bridge.
10. Since then I have paddled the river from Klondyke to Woodstock many times, including the early Coast to Coast events as safety kayaker. For a number of years I instructed novice racing paddlers for the Coast to Coast race. I have rafted the river with my wife over two days, camping overnight. For the past 20 years, excluding the gap created by my time in Nelson I have trained and raced on the lower river from the Willows and Pylons and since 2002 I have been a safety boater for most of the Brass Monkey Races and some of the Waimakariri Classic Races.
11. The Rakaia River is also a river I have paddled many times, but all of this experience is above the Gorge Bridge, and is not directly relevant to this Application.
12. In my time on the WWCC committee and the executive of the NZRCA I have had extensive involvement with canoe and kayak racing, including managing World Cup teams overseas. I

have been race director, Olympic Selector and so on. I will comment on this aspect of the use of the Waimakariri below.

13. Others will give evidence about the current kayaking and racing and use of the Waimakariri and Rakaia rivers and the impacts of proposed takes. I will discuss two aspects related to kayaking and the CPW Application; viz;
 1. Potential future use of the river
 2. Safety associated with the scheme and its structures.

I support the Submissions of the NZ Recreational Canoeing Association Incorporated and the Whitewater Canoe Club Incorporated.

GROWTH OF KAYAKING

14. I have seen kayaking grow from a tiny minority sport where kayakers who saw another car with a kayak on the roof would stop to talk, because all of us knew everyone else who paddled, to nowadays where seemingly every 5th vehicle has a kayak rack. I had to build my first four or five kayaks, spray decks and paddles because there were no people making them. Now there are three specialist kayak retailers in Christchurch alone and chain stores sell kayaking gear. There are 5 manufacturers of racing kayaks operating in Christchurch.
15. Kayaking has become a mainstream outdoor activity.
16. In common with other forms of outdoor recreation like mountain biking, kayaking has a minority club membership and a much larger independent diaspora of adherents from dabblers to fanatics. You can learn to paddle through joining a club, but many choose to spend 4 or 5 times that cost using a commercial kayaking course. The parallel is the plateauing of ski club membership despite the growth of skiing in general. It is the clubs, however, that do all the work - organising races, advocacy, promoting safety standards, and presenting submissions.
17. Kayak racing has been the catalyst for the dramatic increase in use of the Waimakariri River. Prior to the Coast to Coast event the Waimakariri was used by a small number of principally canoe club paddlers. From the 1970s to the end of the 1980s the "Willows" was the most popular area for novice instruction on moving water, and after instruction there the group would run down to the SH bridge. The SH bridge itself was also used for instructing novices in moving in and out of eddies. An annual club trip highlight was an overnight trip through the gorge from Klondyke to the Gorge Bridge. The club would prepare members for this undertaking and it was used as a stepping stone to the highly valued Clarence River five day trip. Some of the early trips on the Waimakariri Gorge used the train for transport. Another popular run was from Woodstock to the Gorge Bridge, especially in Spring. Since the Coast to Coast event started, kayaking growth has probably exceeded even the growth in popularity of the Coast to Coast, and it has spawned a whole industry of multisport events, which in cooler New Zealand usually means that paddling replaces the swimming leg.
18. At one point the NZRCA attempted to measure this growth, but the task proved beyond our resources.
19. Others will talk about the current use of the river by paddlers. I would like to give a perspective on where I think future growth might head.
20. The general influences on future kayaking use and the likely impacts of these on the Waimakariri are;

	Influences	Potential Impact on growth in kayaking on the Waimakariri River
1	Continuing growth of outdoor recreation, including kayaking	The current use will hold and will track overall population growth.
2	Promotion of multisport events and growth in commercially motivated events for tourism purposes.	There will be more events each year, and there will be a trend towards events that target a broader spectrum of entrants.
3	The cost of personal travel – i.e. the cost of petrol and diesel relative to incomes. Emissions trading, carbon footprint and so on, will accelerate this trend..	The Waimakariri will experience growth as paddlers no longer can afford to travel to say, the Waitaki Basin for events.
4	Society is increasingly 'time poor'.	The Waimakariri can be paddled after work as it is so close to the city with good roading and easy access.
5	The aging demographic taking up and continuing with physical activity into their 40s, 50, 60s and beyond.	This phenomenon will continue.
6	The amenity and access to the river banks is being improved gradually by Ecan.	More attractive and safer access means greater use.
7	Availability of the means (the "toys") to enjoy outdoor recreation.	Kayaking will hold its 'market share'.
8	Greater awareness of outdoor recreation – pushed by magazines, internet, television, equipment manufacturers and event promoters	More of the younger demographic will take up outdoor recreation and related events.
9	Governments promote healthy lifestyles through better diet and exercise..	Increased participation or at least maintained.
10	Cultural trends in affluent economies around awareness of 'green' issues and so on.	Potential for human powered sports to steal market share from fossil fuel sports like jet skis, motocross etc.

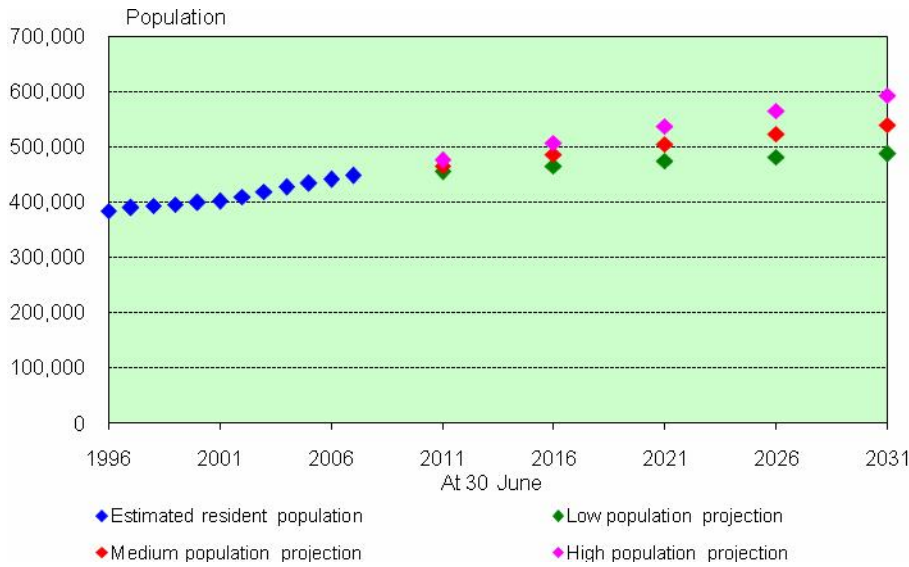
21. The potential negative influences are simply lack of flow, and man-made alterations in general, namely;

- Shallow channels which are frustrating to paddle on due to 'bottom drag' and damage to paddles and boats.
- Braids which expire, causing the paddler to have to exit their boat and carry it.
- Some dangers, such as willows, are exacerbated at low flows as the river tends to flow into and under the exposed roots and branches.
- The potential danger of man-made structures such as intakes and weirs, and machinery on the river bed.
- Further river "protection" works such as wire rope and concrete blocks studded with steel spikes
- Silt at low flows created by excavators and the like.
- Any pollution
- Junk such as car bodies in the river
- Restrictions on access to the river and its environs

I raced in the Brass Monkey as a competitor for about five years then participated as a safety boater. As a racer who was a competent whitewater kayaker rather than a super fit athlete, I had an advantage when the river was high, say over 100 cumecs. I preferred racing when the depth of water was over 1.5m in the braids. I have been on the river at flows between 80 and 35 cumecs, and I have little interest in being on the river below 60 cumecs. If I was

planning a trip from Woodstock down I would not bother if the flow was below 80 cumecs. One issue is the depth of water and the other is the scrape and drag nature of the river at below 60 cumecs which is simply frustrating and unrewarding to paddle. In my view, the Gorge Bridge to SH 1 section of the river is more dangerous at low flows because one gets forced into the willows more often and with narrow channels flowing through potential strainers. The combination of frustration and increasing danger becomes less attractive the lower the flow.

22. The Waimakariri's greatest asset for paddling is its proximity and ease of access for the urban population of greater Christchurch, combined with the river's powerful natural flow and spectrum of recreational paddling opportunities.
23. This asset will increase in value as the above influences continue. Ease of access, availability of equipment, opportunities for instruction, and proximity to the urban population, all add up to "convenience". If one accepts that most if not all the influences above will combine to drive recreational paddling use upwards, then it is highly likely that recreational and racing kayaking use of the river will increase faster than the increase in overall population.
24. The only threat to this growth and indeed current use, is that the flow will be too low for safe and enjoyable paddling, or that man-made structures create un-safe or disruptive situations. Both these characteristics are intrinsic to the CPW scheme, hence my concerns.
25. In the past 30 years of paddling on and observing the paddling activity on the Waimakariri I have seen usage grow from 40 or 50 active paddlers using the river 3-5 times a year each, to a few hundred using the river up to 10-20 or more times a year.
26. What growth could be expected? There are seven kayaking events of which I am aware on the Waimakariri at present. The numbers participating are increasing to the limits of safety and enjoyment on each event. The predictable net effect is that more events will emerge to cater for the demand. There are 'market opportunities' for new events that cater to the longer distance adventure racing adherents, and these will need to be held closer to the urban centres to keep the cost of travel down. The market demographics that these races appeal to are also relatively sensitive to green issues, so event promoters will need to keep the travel impacts down.
27. The life of the CPW Scheme is at least 100 years. Even if we use a shorter period, say 23 years, we can make some rough estimates, based on the following inputs and assumptions.
 - Population growth to Department of Statistics projections (medium)
 - Kayaking participation tracks population growth
 - The number of events to cater for kayaking will increase to cater for demand.
 - Takes no account of demographics and trends in recreation
 - Based on Christchurch City, Selwyn and Waimakariri Districts as "Greater Christchurch".



At 30 June	Estimated resident population	Projected population ⁽¹⁾			Kayak Events Medium series
		Low series	Medium series	High series	
1996	384,200				
1997	389,300				
1998	392,900				
1999	395,700				
2000	398,500				
2001	401,500				
2002	409,100				
2003	418,700				
2004	426,900				
2005	433,500				
2006	440,900				
2007	447,200				7
2011		454,600	465,000	475,400	7
2016		465,300	486,100	506,900	8
2021		474,000	505,100	536,500	9
2026		481,500	523,000	565,200	10
2031		487,300	539,600	593,100	13

(1) Subnational population projections, 2006 (base) – 2031, released December 2007.

Approximately 50,000 to 150,000 additional population surrounding the Waimakariri River has the potential to generate a significant number of additional paddle-sports adherents.

I am informed by a racing kayaking school owner¹ that his clients spend only 10% of their time actually racing, and the rest is taken up with training. Much of this training time is taken during the week, usually after or before work. The implication is that the races are the highlights, but people must enjoy the 90% of the time they invest in training otherwise they would not do it. This has implications if CPW's proposed takes alter the flow duration curves sufficiently that flows hover along the flat line zone during the week because the training portion of the

¹ Josh Stevenson, pers. comm..

padding experience will be diminished, and that will arguably have a greater impact on kayaking enjoyment and participation than low flows on the race days.

28. Ignoring the impact of changing influences noted above, we can expect a doubling of participation over the first 30 years of the CPW Scheme. CPW is starting to offer 'no take days' during this Hearing based on the current use as if it were a constant. Kayak racing has increased quietly over the past 30 years, so why would we not expect kayaking use to increase with population growth, and possibly faster if social demographics, cultural and other external influences continue to lift participation in outdoor recreation? As greater urban Christchurch expands northwards to new towns such as Pegasus, the convenience factor of the Waimakariri River for these new residents increases. Some of the marketing collateral for these new dormitories refers to the recreational opportunities of the water bodies within the developments and to the Waimakariri River close by, so it appears to be considered an amenity asset.
29. Environment Canterbury and others are building a large recreation park lands along both banks upstream of the SH bridge. The river and its environs are alive with all manner of recreation even now.
30. If the participation in kayak racing and related events grows, so too will kayak training and instruction activity. The Waimakariri River is the closest moving water to Christchurch and within a generation or two the population could conceivably be double the present level. This level of increase will at least double the pressure on recreational opportunities around the city. It is safe to assume that travel costs will increase faster than the general economy as oil is depleted. Accessibility will surely assume greater value as a consequence.
31. My view is that the amenity value of the Waimakariri River can only increase over time, and that the amenity value is highly dependent on maintaining flows that enable water-borne recreation and fishing to be maintained.
32. In years to come the Waimakariri will be the jewel in the crown for outdoor recreation for greater Christchurch.
33. Some of the discussions around possible mitigation by way of abstaining from abstractions to allow events to take place at natural flow, are, in my opinion, premature. We collectively lack detailed metrics, let alone forecasts, on the recreational use of the rivers close to Christchurch. The Application has barely touched on the current use, let alone potential future use. Since the CPW scheme will have a life that spans multiple generations, we owe it to those future generations to consider the impacts that abstractions might have on their heritage. There is simply insufficient information on what precisely is proposed in the Application, and no meaningful assessment of effects on kayaking for an interested layperson or kayaking expert to form an opinion. The kayaking community, fronted by the clubs and national association has been compelled to put some data forward in an attempt to lift the standard of information available to the Commissioners, and has become in the process de facto unpaid experts, when that is the responsibility of the Applicants, not the affected existing users.
34. What has occurred to date is *ad hoc* mitigation, not a considered process. At no time have kayakers explicitly opposed irrigation *per se*. Kayakers already enjoy and value the Waimakariri River. Kayakers are concerned about the abstractions from the river and some of the potentially lethal structures of the CPW scheme. Kayakers have been frustrated by paucity of information in trying to provide meaningful assessments of the impacts of the CPW scheme might have on their enjoyment of the river.
35. If it is accepted that kayaking participation will grow in line with growth in general, will CPW offer steadily increasing numbers of no take days as recreational interests grow?

SAFETY

36. The impact of the CPW Scheme on water safety is major for Canterbury as the CPW proposal introduces many kilometres of moving water in canals, siphons, ponds, lakes, intakes, screens and other structures to the landscape. This increases the potential exposure to risk to the community, both rural and urban. The intakes are potentially dangerous, but so is the irrigation system itself. The CPW scheme in total is two thirds the flow of Tekapo>Pukaki, the Waimakariri off-take similar to the Rangitata Diversion Race, and yet there is scant mention of safety of agricultural workers² or members of the public³. The sheer scale of CPW is significant in this context. I think the issues surrounding water safety demand far greater consideration than I have been able to detect in the Application, but for the purposes of my submission I would like to confine myself to those aspects that directly concern kayaking.
37. I would first like to address the issue of safety of human-powered craft in relation to man-made structures in moving water.
38. There are three situations that kayakers may find themselves in near intakes and structures.
- A Kayakers in control of their craft,
 - B Kayaks, often relative novices in moving water, with limited control of their craft, unsettled by wind gusts, and affected by exhaustion.
 - C Kayakers who have capsized and become "swimmers". "Swimmers" in this context are kayakers wearing buoyancy aids, helmets, layers of warm clothing, spray skirts and holding their paddle and sometimes their kayak.
39. There are potential hazards that apply to situations B and C in varying degrees. This section is included because I have been alarmed at what I consider the lightweight treatment of safety around moving water in the CPW evidence. The responses, by way of Supplementary Evidence and responses to Selwyn District Council staff questions by Mr Lewthwaite does address these issues further, but the devil is in the detail, and that detail is left to "if the project is approved we will carry out a comprehensive risk assessment". As a kayaker I am vitally concerned with these safety issues because I do not want to see anyone die because I was silent when I could have prevented a single death. From a purely personal viewpoint, the presence of the intakes as presented in the Application alarm me sufficiently for me to re-consider whether I would continue to paddle the affected sections if I was accepting any responsibility for the safety of others.
40. The following paragraphs look at intakes from a kayaker's point of view.
41. According to various references⁴ intake screens with stop logs and trash screens are designed in a range of 0.5 to 1.5m/s overall face velocity. The Waimakariri intakes appear to be designed for similar flow velocities.
42. To put some context on flow velocitiesⁱ.
- a. A world champion marathon kayaker can maintain 3.8m/s.
 - NZ Women's kayak sprint champion 1000m 3.4m/s
 - b. Average paddler back paddling 25% of this 0.95m/s

² Between 1997 and 2000, ten workers in Washington State drowned while performing agriculture-related work. Fatal Facts, US Dept of Labor, May 2002.

³ Children who live in agricultural areas or work on farms are also at especially high risk of drowning if water hazards are present. *ibid*

⁴ Guidelines for Design of Intakes for Hydroelectric Plants. By American Society of Civil Engineers Committee on Hydropower Intakes,

c.	The world record swimmer for men is 100m in 47.6 secs	2.1m/s
d.	A person swimming with a buoyancy aid and a paddle	0.3m/s or less
e.	The Tekapo-Pukaki canal flows at	1 m/s
f.	Environment Waikato maximum intake velocity	0.3 m/s

43. The first conclusion is that given the large flows, CPW's intakes will be large in area. The second conclusion is that any person out of their kayak is likely to be drawn into any intake likely to be built, and even a person in their boat will struggle to back paddle away from a typical large river off take, which to all intents and purposes is equivalent to a major braid of the river. They are not, however, in actual danger until they reach a screen.
44. Intakes usually require some form of intake screen to keep logs and branches from cluttering up the canals. It is these structures that are inherently dangerous to swimmers and even kayakers in their craft. Kayakers call such structures "strainers", because the water flows through the grid but the paddler does not, and is pinned to the screen by the force of the moving water. The grids themselves can be covered in branches and debris, increasing the risk to people who are unfortunate to be against the screens and in the water.
45. These force of moving water is very powerful and even low velocities produce large forces greater than most humans can overcome. The force increases at approximately the square of the velocity⁵.
46. At 0.5m/s the force from flowing water over a human body is approximately twice that of a buoyancy aid; at 1m/s it is around the same as the weight of the person; and at 1.5m/s around twice the weight of the person. Even if the paddler remains upright in their kayak the forces on the kayak hull either fully or partially submerged are 20-30% higher than the above. Kayakers who have been pinned or had their kayak pinned on rocks or logs are aware of just how powerful these forces are in practice. Kayak and rafting river rescue courses which are held regularly in Canterbury make paddlers very alert to the power of moving water in these circumstances.
47. There is no way that an unaided partially submerged person can extricate themselves from being pinned onto a strainer such as an intake screen or grid in moving water, even as low as 0.5m/s, and even in a kayak a novice paddler would be at risk in velocities over 1 m/s, more so if the screen was vertical. Even sloping screens are dangerous due to debris and the force holding one onto the screen.
48. There is some detail in the CPW information, and from what information is provided I have some serious concerns, and I will comment specifically where possible below.
49. This is not scaremongering. People are attracted to moving water and often have no idea of the potential danger it represents to the unwary. In the USA an eight year old and three adult members of her family who went to her rescue were drowned in a park when they were caught in a water intake and were trapped by the suction⁶.
50. In the Amuri scheme near Culverden I recall a case where a screen was located in a siphon and a person who fell in the canal was washed into the siphon and pinned against the screen and died. The Rangipo Intake on the Tongariro Scheme has drowned a kayaker. In the USA⁷ four SCUBA divers, two of whom went to the rescue of the other two, died in a siphon under a highway when they were trapped against a screen.
51. In a Memorandum⁸ to the Selwyn District Council Mr Cliff Tipler addressed the issue of safety at the diversion intakes. This document is worth referencing in some detail, as it is the only primary document I can find which specifically addresses safety for kayakers on the CPW

⁵ Theoretically it is proportional to the velocity squared. In practice there are other factors such as turbulence, the shape of the human body, clothing etc that may affect the mathematical purity of the theory.

⁶ http://www.usatoday.com/news/nation/2004-06-17-downtown-drownings_x.htm The point here is that people are often unaware of the dangers.

⁷ Fatal Facts, US Dept of Labor publication, May 2002

⁸ <http://www.selwyn.govt.nz/cpw/applications/No%2052.%20Public%20safety%20assessment.pdf>

scheme. There is other information if one trawls through the Supplementary Evidence and responses to staff questions. If I start with Mr Tipler's Evidence first.

Quoting the report

“Intakes

There are three intakes proposed for the scheme. The Upper Waimakariri River and the Rakaia River intakes have the same type of intake arrangement and therefore will be discussed together. The Lower Waimakariri Intake has a different arrangement, given that the intake will be located in a rock face on the upstream of the Waimakariri Gorge Bridge.

The Upper Waimakariri River and the Rakaia River intakes involve a diversion channel that diverts river water from the nearest appropriate river braid towards an intake gate structure. These diversions will carry up to 40 m³/s and therefore may attract kayakers who travel downstream thinking this was a main stream channel. While this is unlikely, it remains a possibility. The highest site of kayaker activity is on the Waimakariri River as a consequence of the Coast-to-coast race. The awareness of these kayakers of the intake sites will be high and therefore the most likely kayakers to enter the diversion races would be uncontrolled recreationalists. In the event that a kayaker does enter a diversion, they will very quickly become aware that they are moving towards an intake structure. The length of these diversions are likely to be in the hundreds of metres and therefore there is both time and distance to move to the side and exit their kayaks. Flow velocities will not be high in these channels and the side banks will not be steep, therefore exiting the channel will pose no real difficulties.

The risk to public safety is therefore assessed to be less than minor.

The Lower Waimakariri River intake is to be situated in the upstream face of the rock abutment to the Gorge Bridge. This structure will provide a submerged intake as detailed in the application. The most likely risk in this instance is that a kayaker may be drawn toward the intake and become stuck on the intake structure and at worst drawn underwater and held there. The intake is submerged by approximately 500mm and therefore floating material will not enter the intake. There will be a trash rack over the entire width of the intake to prevent debris from entering the submerged intake gates. The intake gates are typically 3 m wide and 1 m high and therefore the approach velocity will be in the order of 1.5 m/s at peak abstraction rates. This velocity would create difficulties for a person if they were drawn against the trash rack. Therefore there needs to be an additional safety barrier to the intake. This will be in the form of large inclined bars over the intake that would divert large objects such as logs, kayaks and people upwards towards the surface and provide a secure place for kayakers who are in difficulties to exit the river.

The following figure shows the intake in the Rangitata River which has a 30 m³/s capacity and has submerged intake ports much as conceived for the Lower Waimakariri River intake. No safety protection mechanisms are provided for this intake.

Figure 1: Rangitata Diversion Race Intake (30 m³/s)



The following figure shows the trash rack over the Highbank Power Station intake on the Rangitata Diversion Race. This intake does not have the same level of protection as proposed for the Lower Waimakariri River Intake, however it is recognised that there will be many more kayakers in the Waimakariri River situation and the RDR canal will not have the logs or debris expected on the Waimakariri River. The Highbank intake has a flow capacity of 30 m³/s and is therefore a realistic portrayal of the size and scale of the intake at the Lower Waimakariri Intake site, albeit that the Waimakariri intake will be lower and longer.

Figure 2: Highbank Intake on RDR canal.



52. These statements by Mr Tipler are challenged.
- (a) Some of these design details, such as sloping bars are not mentioned or shown in the drawings submitted.
 - (b) It is likely that some paddlers will be either attracted to the canal, or are forced into it through a combination of river currents and lack of ability.

- (c) Coast to Coast paddlers are often unaware of and under-estimate the difficulties of the kayak section of that event, despite the promoter's best efforts on safety and certification. Some paddlers are simply not competent. For some Coast to Coast paddlers, the race itself is their first time down the river. Therefore there will always be some paddlers at risk of getting into the diversion regardless.
- (d) I agree that the most likely risk is that a kayaker/swimmer will be drawn onto the intake structure, but I disagree absolutely with Mr Tipler when he maintains that the person will not be drawn under because the intake is 500mm below the surface. For swimmer, that is around one's chest, with ones legs and mid-section pinned against the intake.
- (e) 1.5m/s can generate a substantial force on a submerged stationary body, sufficient to pin any kayaker.
- (f) The floating trash referred to adds to the danger.
- (g) The length of the Waimakariri intake increases the risk to kayakers for reasons explained below.
- (h) Exiting deep water smooth walled canals actually does present some difficulties, especially in tippy racing kayaks. Falling in is quite possible. Due to a phenomenon called helical flow⁹, the effect on the surface is for water to rise up the channel banks and flow away from the banks to the centre of the flow. This makes it difficult for swimmers to reach the bank of even slow moving bodies of water. It is particularly an issue in smooth regular channels where eddies are absent. Helical flows on bends are more powerful and more marked, and I will refer to these below when discussing the lower of the two intakes.

In this context the statement by Mr Tipler "*The risk to public safety is therefore assessed to be less than minor*" is in my opinion, the most irresponsible statement on water safety around man-made structures in moving water that I have ever read or heard. The risk can be mitigated and managed but it will never be "minor"

53. Canterbury kayakers are aware of irrigation intakes on the Rangitata at Klondyke, the Hurunui at Balmoral, the Waiau at Leslie Hills, and the lower Waimakariri. These intakes are relatively easily avoided by most kayakers with any skills and training but could still be fatal if one ventured into them. Each of these intakes has some factor which reduces the risk.

- Klondyke – the river is very wide and the current is very slow, and the main flow is on the opposite side of the river from the intake. Paddlers in this zone are skilled whitewater paddlers capable of Grade 4 whitewater. Grade 2-3 paddlers and the occasional racing paddlers paddling the lower Rangitata enter the river on the right bank well away from the left bank intake.
- Leslie Hills – the intake is below the get out point and paddlers habitually get out 100m above the intake. Also most paddlers on this section are intermediate whitewater kayakers with whitewater kayaks and moderate skills. A kayaker has been sucked through the Leslie Hills intake and the ensuing tunnel and luckily survived.
- Balmoral – not safe, but the run is used mostly by Grade 2-3 level paddlers in manoeuvrable boats, and who are capable of avoiding the intake
- The lower Waimakariri Irrigation intake, (pictured below) which is around 25% of the proposed upper Waimakariri intake is in a wide part of the river, not on a bluff. I understand¹⁰ that novices do have problems with this intake.
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⁹ http://www.oxbowriver.com/Web_Pages/Stream_Ecology_Pages/Ecology_Aquatic/Ecology_Helical.html

¹⁰ Josh Stevenson, VOK Kayaks, pers.comm.



- The Selwyn stockwater intake, approximately 40 km from Christchurch, has a diversion canal and a weir. This intake has lured in novice racing paddlers who follow the canal and subsequently come to grief on the weir. There are signs, but these get shot down by vandals. The weir is too dangerous to play on in whitewater boats and will damage a racing craft that runs it. The picture below (looking downstream) is where the intake is taken from the river bed. An excavator is apparently permanently stationed here. The “Danger” sign is seen on the left bank of the canal.

Note that the remaining flow in the natural river is quite diminished and is flowing into willow trees downstream.



54. Competent kayakers avoid any temptation to venture near to strainers in moving water.
55. The next potential danger occurs when excess or bypass water is returned to the main flow. This is quite likely to be paddled by kayakers if the intake is the dominant route choice for various reasons. In some flows the intake channel may be the only choice. There is always a drop in water level at this point. (otherwise the water would not be flowing) At this drop hydraulic jumps occur. Kayakers call these features “stoppers” or “reversals” as they are capable of trapping a kayak or swimmer and subsequently drowning them. Low head dams

and weirs are commonly called “drowning machines”¹¹ and there are many references on this aspect. The case studies are full of examples, including where rescue personnel also died in the rescue attempt. It is possible to design out some of the danger, but the Application is silent on this.

56. Design decisions by engineers made in ignorance of kayaking and swimming considerations have caused fatalities in irrigation canals internationally and in New Zealand.

This extract from a Civil Engineering publication¹² sums it up well.

Dangerous flow patterns

Most civil engineers are unaware that low-head dams can present a danger to the general public. A review of the civil engineering literature on the topic finds very little written about the safety concerns of low-head dams. Conversely, canoeing and kayaking literature is replete with articles about the hazards of these small hydraulic structures. Fortunately, the dangers are easily evidenced to civil engineers once the flow patterns are examined in light of some fundamental hydraulic principles.

- 57.



The weir (Selwyn stock-water intake bypass) seen above is, like all weirs, more dangerous than it appears to a novice paddler. The view is of the final drop. Any paddler trapped sideways in the hydraulic will usually require assistance to escape the whitewater. Racing kayaks can break in two on this weir. Swimmers will suffer abrasions and bruises. An adult cannot stand in the flow despite it being only about 150- 200mm deep above the final drop. After freshes and floods this whole area has trees and debris trapped in various places, adding to the risk of entrapment.

¹¹ These drowning machines are low-head dams that can, under certain flow conditions, create dangerous flow patterns on the downstream side of the dam. For example, at least 18 people died at the Glen Palmer Dam on the Fox River in Yorkville, Ill., during the last 25 years. Dangerous dams. *Michael Robinson, Ph.D., P.E.; Robert Houghtalen, Ph.D., P.E.*

¹² CENews.com Cover Story | Posted: Thursday, February 01, 2007. Dangerous dams. *Michael Robinson, Ph.D., P.E.; Robert Houghtalen, Ph.D., P.E.*

This intake is only a fraction of the 40 cumec intakes planned for the Waimakariri River for CPW. The increased scale represents a greatly increased danger.

Part of the problem with man-made intrusions into otherwise natural rivers is that the intrusions are often “out of character”. A Grade 1 or 2 river will be unlikely to present any surprises to a novice paddler. A man-made structure is worse than a Grade 4 rapid because novices are neither capable of recognising the risk in the first place, or avoiding that danger if they do. This ‘out of character aspect’ is what raises the risk factor for novices and sometimes more experienced kayakers. The Selwyn stock-water intake is safe enough until they reach the weir, at which point they are confronted with a hard double drop with potential negative consequences. There is nothing remotely similar to this weir elsewhere on the natural water course.

- 58. Once again we do not know what is proposed at the bypasses, except for non-specific assurances given in response to the Commissioners’ general questions about the intakes that CPW’s engineers will design something “safe”. It is not unreasonable for kayakers to think that if CPW has not consulted properly with kayakers’ representatives, has given no details, has hardly mentioned safety except to offer to erect “Danger”¹³ signs; that we are right to be sceptical about such assurances. Alerting the public to a potential danger does not mitigate the danger itself. The danger remains.
- 59. The two intake designs in Mr Lewthwaite’s Appendix (copied here as an appendix for easier reference) have a number of potentially fatal design features.
- 60. The upper Waimakariri diversion channel has the following sequence.

	Feature	Potential danger
1	Open channel	Very low risk. Depends on design flows and what might be expected in higher flows. There is no way at present, on the information provided, to assess the risk that kayakers might be drawn into the channel by local currents on the sharp bend in the river at this point. Being drawn into this channel is simply the first ‘domino’ that falls. I have referred above to the dangers inherent in trying to exit the channel itself.
2	Intake structure with bypass channel to river	<ul style="list-style-type: none"> a. High risk of being sucked into opening in the vertical concrete intake dam. The localised face velocity appears to be 1.7m/s which is sufficient to pull a swimming kayaker under. If there were screens here the person would be pinned under water. If there are no screens, then the person is drawn into the intake channel, see 3, 4 below. b. Alternately - risk of being caught in any hydraulics in the Bypass chute. Applies to swimmers or kayakers.
3	Intake structure discharge	If a person was washed into the chamber immediately behind the intake, either through the intake or over the top of the ‘dam’ itself, the turbulence and hydraulics in this chamber would be a threat, depending on the flow.

¹³ Two farmworkers drowned in an irrigation canal. A 17-year-old orchard worker was working near an irrigation canal and fell into the canal or side chute of the main canal. The canal was on a moderate slope, made of concrete and was 3 feet wide with 2-½ foot vertical walls and had about a foot of fast moving water in it. He was swept down the chute into a pool with 16-inch high cement pillars whose purpose was to slow the speed of the water. A 31-year-old orchard worker tried to rescue him, they both drowned.

4	Concrete channel, presumably with higher flow velocities.	With vertical walls, higher velocities and depth, any person in this type of channel would be unable to get out. Insufficient information to assess fully.
5	Sediment trap, which creates a low velocity zone.	This is a positive feature as it provides an opportunity to exit.
6	Fish screen	This appears to be a dangerous feature for swimmers, but most, assuming they were conscious, would be able to exit at the sediment trap.
7	Bypass chute	The drop back to the river will be greater and longer than the first bypass, and may contain hydraulic jumps, increasing the risk.

61. The lower of the two tunnel intakes is of real concern. The Applicant's expert witnesses appear to agree with me that this intake represents greater risk to swimmers. The location is understandable from an engineering standpoint, but it is the most likely place for a capsized or swimming kayaker to be drawn to at a range of flows. The drawings supplied show a big steel vertical screen fronted with concrete 'stop logs'. This is a very frightening structure if you are a kayaker. Even competent kayakers will want to avoid this intake by a wide margin. These competent paddlers, however, are not the problem. The problem is that this corner, coming as it does at the end of a long period on the river when paddlers are tired, has naturally occurring powerful eddies and vortices immediately above it, which can capsize the unwary or novice paddler.

Note that the flow on the outside of the bend in the diagram is going down. This assists the forces that will draw a swimmer down onto the intake grid.

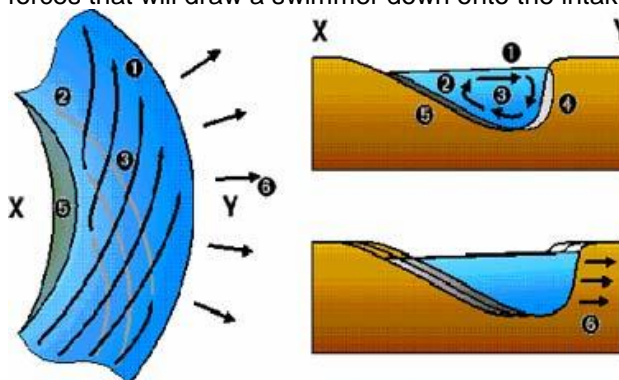


Diagram showing helical flow on a bend. It is this helical flow that creates meanders or braids in shingle river beds by scouring out material and depositing it on the inside of bends.

62. This meeting of counter currents varies in power and difficulty with flows and generalised statements cannot be offered. At higher flows the main flow sometimes sweeps around the outside of the final bend, and at some lower flows also. It depends on build up of gravel and sediment. Bluffs are somewhat different. On the lower of the two intakes, a kayaker/swimmer can be swept along the face of the bluff on the true right and will end up in the danger zone around the proposed intake.

I have read Mr Lewthwaite's Supplementary Evidence, where he stated that the intakes could be either for 40 or 20 cumecs, but that only the width would change as a result. I do not consider this is material to my observations that follow, except that the smaller the exposure the better. This applies in some measure to the lower intake, where a smaller width of intake lessens the chance that the river will push a person onto the bluff at the point where the intake is drawing water. Every other factor remains relevant.

	Feature	Potential danger
1	Intake structure, comprising concrete 'stop logs' and metal? screen.	Even in a kayak and upright, the stop logs will be a menace as you could scrape along the grid if it was flat, and then escape downstream. Imagine trying to get downstream around all those concrete columns in a decent flow in a long racing kayak boat or worse, if you were in the water. A short whitewater kayak (<2m) would also be liable to be pinned against the screen <u>between</u> the stop logs. This situation would be highly lethal.
2	Flow patterns on bluffs	The helical flow pattern on bluffs can be upwards or downwards, depending on many factors. The proposed structure will be drawing a significant proportion of the flow, so one can assume that a lot of water will be going downwards at this intake. This increases the chance that a person in the water will be pulled down and then is at high risk of being pinned firmly underwater against the intake screen.



Example of concrete 'stop logs' in an irrigation channel. These are sloped which is better than vertical for swimmers and paddlers. The cross bars are a desirable addition as one might use these to climb up the grid, although there is a high risk of going through the grid into the tunnel beyond..

63. There has been some discussion about exit ladders and the like at the intakes. These might help, but only as a secondary influence. If one is pinned by the force of moving water, one is pinned. Rescuers might use the ladders to assist a rescue, or more likely a recovery.
64. Floating ropes, cables, and buoys in a swift flow are a menace and will simply drown a swimmer before they reach the intake.

65. From my knowledge of both these areas I think there will be a danger at both intakes. Many multisport racers in kayaks are poor at maneuvering around bluffs and most capsizes occur at bluffs. At the lower intake the whole force of the river hits that bluff at times. The river can form two large eddies which flow clockwise and anti-clockwise. Paddlers can get into either of the two eddies and go around a few times in higher flow. Ultimately they have to get past the bluff itself where the intake is planned.
66. This intake will be dangerous any time CPW is drawing water, and less dangerous but still will constitute a hazard when no water is being taken.

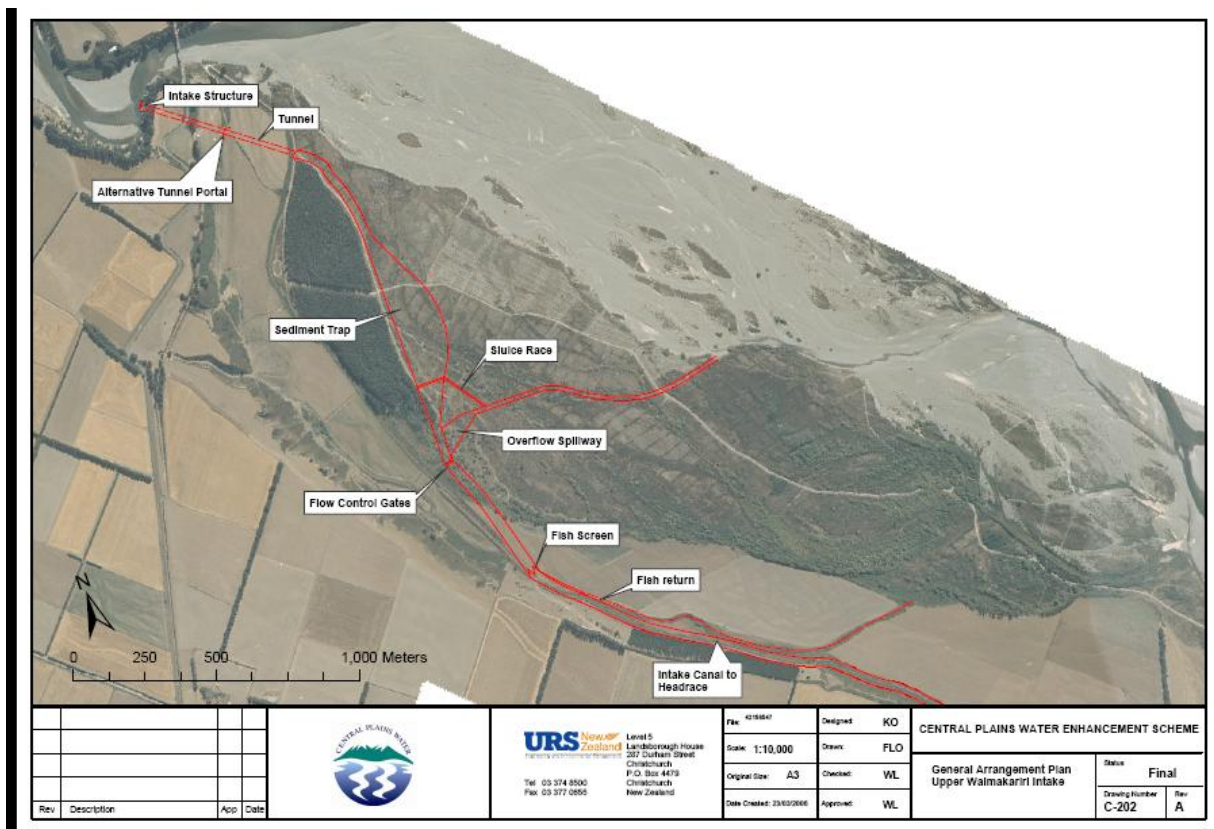
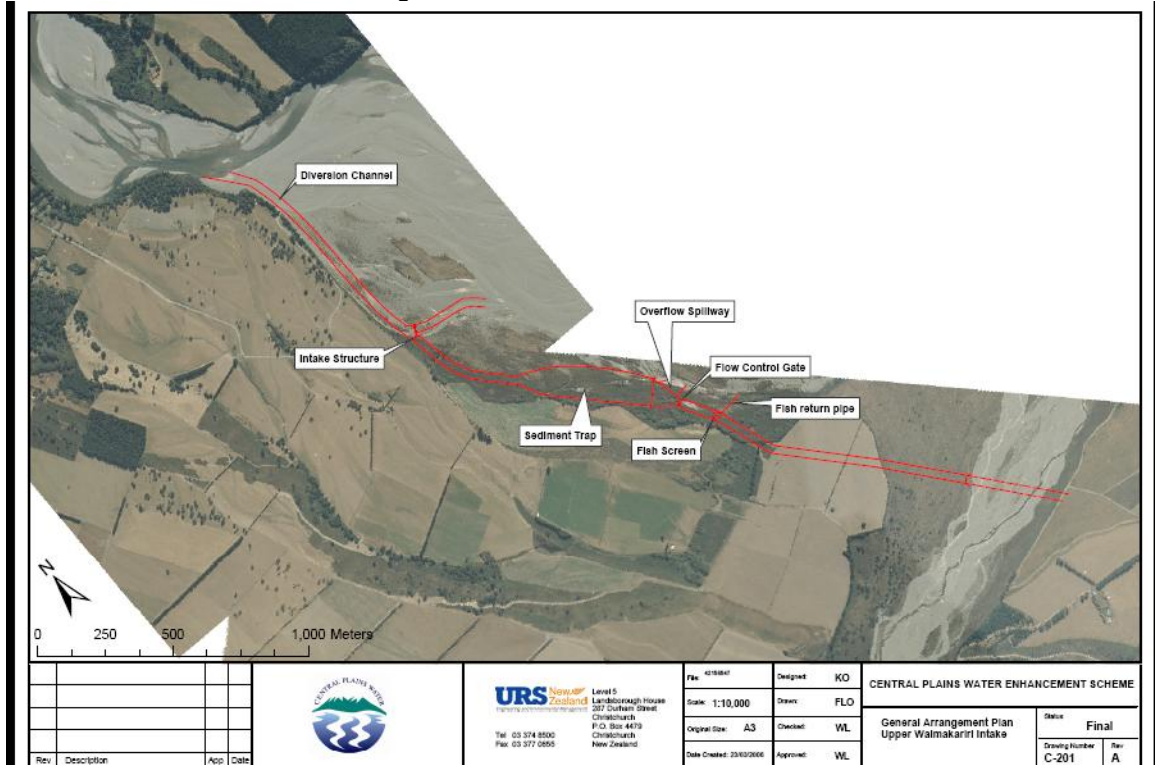
Summary

67. The CPW scheme Application has not taken the effects on kayaking sufficiently into account, has offered no meaningful mitigation, and has a number of potentially fatal safety issues that have not been adequately addressed.
68. Kayaking is a long-standing use of the river, enjoyed by increasing numbers of Canterbury and visiting kayakers, and in my opinion, this use will increase steadily over the life of the proposed scheme.
69. Abstractions that reduce the flow below the present levels will diminish the navigability for kayaking, and will deny many kayakers, present and future, the amenity of the Waimakariri River that exists today.
70. I request that the Application be Declined.

Hugh Canard

6 June 2008

APPENDIX
CPW intake schematics and designs



a.	ⁱ A world champion marathon kayaker can maintain	3.8m/s.
	NZ Women's kayak sprint champion 1000m	3.4m/s
b.	Average paddler back paddling 25% of this	0.95m/s
c.	The world record swimmer for men is 100m in 47.6 secs	2.1m/s
d.	A person swimming with a buoyancy aid and a paddle	0.3m/s or less
e.	The Tekapo-Pukaki canal flows at	1 m/s
f.	Environment Waikato maximum intake velocity	0.3 m/s

Reference or methodology

- (a) The World ICF Marathon races typically are 41 km and are completed by the winners in times down to 3 hours to 3h15m. If one discounted the assistance from river current, this is similar to the speed that kayakers on the Coast to Coast can achieve.. Most paddlers, by definition, are slower than 3.8m/s. NZ Women's sprint kayak time is 4m:52s over 1000m
- (b) I took a boat out and measured my own performance over a short distance.
- (c) Olympic website and Google search.
- (d) I checked my own performance in a swimming pool.
- (e) Information board on canal access road.
- (f) Environment Waikato website.