IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications by Central Plains Water Trust to: Canterbury Regional Council for resource consents to take and use water from the Waimakariri and Rakaia Rivers and for all associated consents required for the construction and operation of the Central Plains Water Enhancement Scheme Selwyn District Council for resource consents to construct and operate the Central Plains Water Enhancement Scheme
AND	
IN THE MATTER OF	a notice of requirement by Central Plains Water Limited to: Selwyn District Council for the designation of land for works associated with the construction and operation of the Central Plains Water Enhancement Scheme

---

RESPONSE OF WALTER JAMES LEWTHWAITE
TO S42A OFFICERS' REPORTS
February 2008

BUDDLEFINDLAY
Barristers and Solicitors
Christchurch

Solicitor Acting: **Rachel Dunningham**
Counsel: **Dr E D Wylie Q C**
Tel 64-3-379 1747 Fax 64-3-379 5659 PO Box 322 DX WP20307 Christchurch

Qualifications and experience

1. My full name is Walter James Lewthwaite, and the basis on which I am preparing this brief is set out in my previous evidence for this hearing.

Scope of Evidence

2. I have prepared this supplementary evidence to address issues raised in the ECan and SDC s42A Officer reports, by Mr Fietje and Mr Boyes respectively, and their technical advisors. In each case I will provide reference to the relevant section of the Officer reports and/or their supporting technical evidence, and then provide my response.

ECAN S42A OFFICER REPORT

3. **Effects on public safety of taking water**. See #105 to #107 of Mr Fietje's s42A report and #14 to #18 of the supporting evidence of Ms Johnston. Mr Fietje and Ms Johnston raised concerns about the safety and navigability of intake structures particularly for non motorised river recreational users. That included expressing concern that one safety feature proposed by CPWT, namely steel grills, might be itself a hazard. They suggest further safety measures including but not limited to a buoy line, in addition to the signs and other measures proposed by CPWT.

4. For SDC, Mr Boyes also addresses this topic in #180 to 184 of his report, related to the upper and lower Waimakariri intakes. In relation to the upper intake he asks whether flow velocities would be sufficiently low to enable swimmers to exit the diversion channel. He considered that "in the least signs warning swimmers and other river users will be required in the vicinity of the entrance to the diversion channel and also nearer the approach to the intake structure itself". In relation to the lower intake he describes the recreational usage of the site, particularly by kayakers, including those who have fallen out of their kayaks and become swimmers. He addresses the likelihood of fatigue amongst kayakers at this site, especially as it is near the end of the Coast-to-Coast kayaking section. He concludes "In summary it is considered that CPW needs to provide greater assurance that the safety measures and mitigations proposed are sufficient to ensure that the increased probability of drowning at this location is within acceptable risk management parameters".

5. I agree fully with the need to address the topic of safety at the river intakes, particularly for the lower Waimakariri intake, and I addressed this in my evidence in chief in #69 to #76. I will add further details below.

6. Before addressing that I would like to change one statement in my evidence in chief. In #76 I stated that "as far as I have been able to ascertain, there have been no safety incidents at these intakes" (I was referring to the Rangitata Diversion Race intake and Amuri irrigation intake in the Waiau River, as the two Canterbury examples most similar to the proposed lower Waimakariri intake). Since writing that I have been informed of an incident on the Waiau intake to the Amuri scheme, where a kayaker passed through the intake structure and tunnel and emerged at the downstream end unharmed.

7. With regard to Mr Boyes' particular question about the upper Waimakariri intake, I consider that it cannot be guaranteed that velocities will be low enough for swimmers to readily exit the diversion channel. This is because the river's configuration changes frequently, and in conditions such as existed in late 2007 (see figure 5 in my evidence in chief) the intake structure will be almost on the main river braid. I agree with Mr Boyes that suitable signs should be erected upstream of and close to the intake structure. In my opinion, however, it would generally be impractical to erect signs in the vicinity of the entrance to the diversion channel as this location will change frequently with movements of the river braids, and a sign could itself become a navigation hazard. Instead I recommend a more comprehensive safety program as in my evidence in chief and as described below.

8. I would now like to expand on the discussion on intake safety that was presented in #69 to #76 of my evidence in chief in response to the concerns in the officer reports and in view of the breadth of interest they indicate.

9. Safety design at river intakes can be considered under six topic headings. These are:

    (i) Intake structure designs. Matters such as location of structure with regard to activities of people, velocity and direction of approach, sweep velocity past the gates, and size and shape of gate opening can have an effect on safety. For example intakes can be located where it is less likely that river users would be approaching directly towards them, or entries to intakes can be

flared to reduce approach velocity, or banks can be realigned to provide a strong sweep current, or intake openings faced downstream and away from the dominant direction of flow. At the upper Waimakariri and Rakaia intakes, being (in most circumstances) at the end of a diversion channel, and in an open part of the river where there is opportunity for users to exit, it is easier to achieve a low risk outcome. But for the lower Waimakariri tunnel intake I consider a range of other safety measures would be required to achieve an acceptable level of risk.

(ii) Escape devices. A range of devices can be considered including safety nets, life belts, hanging ropes and escape ladders. I consider that safety nets would be impractical because of the amount of debris that would be expected at all three sites. But I consider any or all of the other devices could have a place, particularly for the lower Waimakariri intake. For that intake the basic structure design should include consideration of escape devices. I consider the position of the face of the intake structure in relation to the rock face should allow for an escape ledge above water level, with fixed ladders or ramps to allow easy egress from the water. Or for the situation of a person who, despite other precautions, might pass through an intake there could be consideration given to tunnel design to provide an open water surface and possibly points of egress within the tunnel.

(iii) Physical restraining devices. Typically these include floating booms, guard rails, deflector grills and trash racks. For CPWES Ms Johnston in #18 of her evidence advocates “a buoy line”. However in my opinion buoy lines and floating booms are likely to be impractical because of the force of water and the amount of debris that will come down the rivers, especially during a flood, rendering them both difficult to maintain and ineffective. For that reason, while they might be worth trialling, I would not like to see them as conditions of consent. In my evidence in chief I showed (figure 13) a photograph of a safety grill over a culvert entrance in Christchurch city, as an illustration of the kind of protection that would be provided for the lower Waimakariri intake. As noted there the Waimakariri solution would be a more robust structure, fitting the needs of the site. This safety grill would be a key

element of safety assurance for that site, and the details of design should be thoroughly considered and integrated into the main structure design and escape device design.

(iv) Education and information programs. Another key element in safety assurance is to inform likely river users of the presence of potential hazards. For this kind of situation, where there are many potential users spread through the community, this education is normally done through recognised groups such as recreation clubs, local schools and community groups. This will be included in the CPWES Operation and Maintenance Plan, as outlined in my evidence in chief, #271 to #277.

(v) Warning devices. Warning devices can be visual or audible. Standard visual devices are signs, erected at such places as popular locations for people to enter a river, plus either on or immediately upstream from an intake. The use of signs is common at Canterbury irrigation scheme intakes, but they are not universal, and do not appear to be universal on other water intakes. For example the SDC has a stockwater intake tunnel at the Waimakariri Gorge Bridge, located immediately adjacent to the proposed CPWES lower Waimakariri intake, and apparently has not considered signs or any other safety features to be necessary. However, because the CPWES intake would be larger and would sometimes have a higher approach velocity, I consider signs would be good practice and I recommend they be used for all three CPWES intakes. They will need to be located in positions where at least one sign is clearly visible to river users who are approaching the intakes, and where they are not likely to be damaged by the river or vandals. Lights are sometimes used overseas, but to my knowledge they have not been used for New Zealand intakes. Audible warning devices such as horns have been used overseas. I am aware of one instance of an audible warning device in New Zealand, but I understand this was stopped due to complaints from nearby residents. I do not consider lights or audible devices to be required for CPWES.

(vi) Operation and maintenance procedures. Water intakes can have operation procedures that reduce risk, such as shutting the intake at key times, and by having maintenance routines that ensure safety features remain operational. CPWES has said it will close

the intake on the day of the annual Coast-to-Coast race, to eliminate completely any risk to the competitors. Regarding maintenance, this is a matter that would be developed in the Operation and Maintenance Plan (see my evidence in chief, #271 to #277).

In conclusion, in my opinion there is a large variety of safety features that can be incorporated into the design and operation of the CPWES intakes to reduce the risk to an acceptable level, including for the lower Waimakariri intake. The details are a matter for the final design stage, which will include a comprehensive risk analysis.

10. **Effects of bywash discharges on public safety**. See Mr Fietje's report, #108 to #111, #211 to #212, and #374, also Ms Johnston's technical evidence, #22 to #35, and Mr Duncan's evidence, #61 to #65. The concern is about the Selwyn River and its tributaries where is it rightly pointed out that emergency bywash flows would cause a larger proportionate increase over existing flows than in the Rakaia or Waimakariri. Concerns were expressed on behalf of "paddlers [and …] contractors", with an expectation that water levels might rise suddenly and erratically. Ms Johnston suggested that sirens could be considered in addition to the signs proposed by the applicant, and that possibly the rate of discharge be limited to 1.5 x the mean flow [I presume she meant the mean flow of the receiving river]. Ms Johnston expressed these concerns in relation to both normal operational flows and the possible emergency peak discharges. In contrast Mr Duncan appears to have expressed his concerns only in relation to the emergency flows, although from his discussion I am not completely clear on this. For example he has proposed consideration of border dyke irrigation areas as one way of dealing with excess operational bywash flows, with water being diverted into them instead of a bywash wetland. But he proposed no specific mitigation measures for emergency flows. Mr Duncan has provided some quantitative analysis of how bywash flows would operate, as discussed below.

11. I have addressed public safety in relation to bywashes in my evidence in chief, in #250 to #253. In #250 I presented a table (Table 2) of the proposed peak emergency discharges. In #252 I addressed the proposed approach to safety management in relation to these flows. In essence I proposed signs at all bywash locations plus evaluation, at detailed design stage, of the hydraulics and hydrology of emergency discharges. I also proposed consideration of measures to reduce peak emergency flows,

although this was more for ecological and cultural reasons than for safety, as Ngai Tahu and other parties have expressed a wish to avoid transfer of water between catchments.

12. I will correct some figures used by Ms Johnston. In her #25 and #27 she refers to flows of 10 m^3/s and 18 m^3/s, quoting from the AEE of November 2006. In a letter to ECan in March 2007 these figures were amended to those shown in my evidence, #250. Because of her concern about operational flows I will also repeat them here in a copy of the full table that I sent to ECan in March 2007:

River	Site map reference	Maximum operational flow (m^3/s)	Emergency peak flow (m^3/s)	River mean annual low flow (m^3/s)	River mean flow (m^3/s)	River annual flood (m^3/s)
Waimakariri	NZMS260 L35:477-496	n/a	9.0	40	122	1495
Waimakariri	NZMS260 M35:523-490	0.4	1.0	40	122	1495
Waimakariri	NZMS260 M35:539-488	0.4	3.0	40	122	1495
Hawkins	NZMS260 L36:394-330	0.4	3.0	Dry		~60-75
Hawkins	NZMS260 L35:281-574	0.3	2.5	Dry		~60-75
Waianiwaniwa	NZMS260 L36:351-358	0.2	2.0	Dry		~50-60
Selwyn	NZMS260 L36:456-301	0.8	7.0	~0.63	3.3	~156
Selwyn	NZMS260 L36:441-305	0.8	8.5	~0.63	3.3	~156
Selwyn	NZMS260 L36:350-345	0.4	2.5	~0.8	3.3	~79
Selwyn	NZMS260 L36:435-299	0.4	3.5	~0.63	3.3	~156
Selwyn	NZMS260 L35:289-421	0.4	3.0	~0.8	3.3	~79
Hororata	NZMS260 L36:337-	n/a	1.0	Dry		~70-90

	334					
Rakaia	NZMS260 L36:329-184	1.5	16.5	92	221	2514
Rakaia	NZMS260 L36:264-219	n/a	5.5	92	221	2514

These are the flows that should be addressed for this hearing.

13. I will also correct some figures used by Mr Duncan. In #61 of his evidence he lists both 30.5 m^3/s and 31.8 m^3/s as the flow that could discharge to the Selwyn River. I have had some correspondence with ECan about this and indicated in December 2007 that the peak emergency flows, as stated in the table above, are for each site on its own and are not cumulative. Rather there is some redundancy to give flexibility for future design, such as decisions about which races will supply each property, and whether flows would be routed towards the Selwyn or the Rakaia and Waimakariri. As pointed out in my email of December 2007, it would be impossible for the flows in Mr Duncan's evidence to discharge into the Selwyn as the peak inflow to the races feeding the Selwyn bywashes is substantially less than those, about 21 m^3/s. Mr Duncan also presents some analysis of times for water to drain from the races. Although his statements are not the full story, I accept them as being approximately correct as far as they go, and any concerns I have with them are of no consequence, as I will demonstrate below.

14. Notwithstanding those corrections I accept that 21 m^3/s is a large flow with significant safety implications if it were to arrive suddenly at a site in the Selwyn River during a sunny day, as implied by Ms Johnston. But I do not agree that this will happen, as discussed below.

15. I suggest avoidance and mitigation measures be considered under four topic headings. Firstly consider the magnitude of the flows. It is clear from my table above that the flows will be small compared with naturally occurring flood flows in the rivers. For example the cumulative normal operational discharge in the Selwyn, if all sites were running to their applied-for capacity concurrently, would be 3.7 m^3/s. This is similar to the mean flow in the river, and is a common event that people who use the river are familiar with. Even the combined peak emergency flow into the Selwyn of about 21 m^3/s, while substantial, is much less than the average annual flood of ~150 m^3/s (at the point at which the 21 m^3/s could occur). It is therefore a flow that people who use the Selwyn River know and can visualise.

16. Secondly we need to consider the flow regimes, particularly the manner in which flows might rise towards their peak.

    (i) Operational flows, being the normal situation, would be fairly steady with little fluctuation and no surprises. Given that, and combined with their small magnitude, I consider they would not impose any safety hazard.

    (ii) Peak emergency flows will increase very gradually from the time they start. The most likely situation that would create the peak flows would be a district-wide power cut. This could cause a simultaneous cessation in irrigation pumping throughout the scheme, with the flows then passing down the distribution races to the bywash points. The first visible effect would be that the flow from the irrigation offtake nearest to the bywash point would arrive at the bywash a few minutes later, possibly starting to flow past the wetland into the adjacent river. Then the flow from the next irrigator would arrive in a further few minutes, and this process would develop progressively until all flow within a particular race would be discharging to the river. I have calculated that it would take at least 0.5 hours for the flow to build up to its peak at the smaller discharge points, and it would take 2 to 3 hours for the peak flow to be discharging from the longer races into the Selwyn, Rakaia or Waimakariri Rivers. Below those points there would be further slowing and attenuation of the flood hydrograph as it passed down the river and filled the riverbed in its passage downstream, or infiltrated into the riverbed and groundwater.

    I conclude therefore that there will be only minor fluctuations in the normal operational bywashes, and that the peak emergency flows, should they ever occur, will build up gradually to their peak in the riverbed over a period at least 2 to 3 hours.

17. Thirdly we need to be clear about the likelihood of these events occurring. The peak emergency flows that have been applied for, even without the mitigations discussed above, are for an event that might never occur in the life of the scheme. It assumes a simultaneous shut down of all irrigators when the scheme is operating at full capacity, no flow reduction measures in place, and the shutdown continuing for long enough (2 to 3 hours, as discussed below) for the full flow to arrive at the discharge points and pass

down the Selwyn River. In my opinion the risk, when considered as a combination of likelihood and impacts, is therefore at worst minor.

18. Fourthly there may be ways of reducing the peak flows, as addressed in my evidence in chief. These will be considered in the detailed design stage, including features, such as on-farm ponding areas, that might enable storage of excess flows on farmland. As indicated in my evidence that would require negotiation with landowners and other parties, and I consider it is not practicable to undertake that at this point in time.

19. Ms Johnston suggested in her evidence that sirens should be considered. In view of the information above, my opinion is that they are not needed.

20. Mr Duncan proposed consideration of border dyke irrigation areas as one way of dealing with excess operational bywash flows. Instead of that the scheme has proposed wetlands. I prefer the wetlands alternative, as proposed in the applications, as I have been advised that that would be desirable ecologically, and I consider it will be practical to build and maintain them.

21. In conclusion I consider the public safety risks from bywashes will be minor or less than minor, whether from normal operation or peak emergency events, and the prime mitigation should be signs at locations of public access to the rivers. I consider that this should be done for all rivers, not just the Selwyn and its tributaries, although the ECan reports seem to indicate their officers consider signs might not be needed in the Rakaia and Waimakariri. I consider that alternative ways of avoiding or mitigating emergency bywash flows should be considered, as much for ecological and cultural reasons as for safety, and that hydraulic and hydrologic analyses should be conducted in the detailed design phase as indicated in my evidence in chief

22. **Effects of bywash discharges on flood capacity and erosion**. See #112 to #114 of Mr Fietje's report, and #36 to #43 of Ms Johnston's evidence. Ms Johnston considered that where the discharges occur within a river rating district, the type of erosion protection incorporated into the discharge structures should be carried out in consultation and agreement with ECan's river engineering section. She went on to recommend four practices for where discharges occur outside a river rating district, regarding the type of erosion protection that should be provided. Her conclusion was that "given this [i.e. the consultations, agreements and practices mentioned above],

effects of the bywash discharges on flood carrying capacity and erosion and on artificial structures should be able to be mitigated".

23. I generally agree with those comments and conclusions. My reservation is with the list of practices in Ms Johnston's #42, where site specific design might show, for example, that it is not necessary to install riprap upstream of the discharge site. If Ms Johnston's statements were to be developed into conditions, I would like to see an item inserted into the list of practices, probably as a new item "c", namely "Alternatively, other works as specified by a suitably qualified engineer".

24. **Effectiveness of wetlands**. See Mr Duncan's #65 and Dr Meredith's #95. Mr Duncan states "it appears that they are much too small to infiltrate the flows they will receive", and Dr Meredith states "the area and capacity of most identifiable wetland options are grossly insufficient and are likely to functionally be direct discharges".

25. The AEE of November 2006 describes the wetland proposals, including their areas. Design will require case-by-case assessment of material permeability and site conditions, such as depth to water table. Construction might require selection of local materials to ensure the infiltration beds contain only small amounts of fine sands and silts. But, given those qualifications, I consider the areas proposed in the AEE will prove to be generally appropriate. In probably all cases the bywash water will be infiltrating into coarse sandy gravels in or near the berms of the rivers, and these are particularly free draining materials. To assess an appropriate infiltration rate we consulted a number of sources. Domenico and Schwartz[1] list, in Table 3.2, permeability coefficients for coarse sands ranging from $9x10^{-7}$ m/s to $6x10^{-3}$ m/s, and for gravels ranging from $3x10^{-4}$ m/s to $3x10^{-2}$ m/s. Freeze and Cherry[2] show in Table 2.2, permeability coefficients for clean sands ranging from $2x10^{-5}$ m/s to $1x10^{-2}$ m/s, and for gravels ranging from $1x10^{-3}$ m/s to 1 m/s. The Christchurch City Council's Waterways, Wetlands and Drainage Guide, Part B, 2003, indicates in Table 21-11 an ultimate infiltration rate of 15-20 mm/h ($4.2x10^{-6}$ to $5.6x10^{-6}$ m/s) for free draining soils such as Waimakariri River silt loams. I have been advised by stormwater designers that in the Christchurch urban area it is common to design for long term infiltration rates of 50-100 mm/hr ($1.4x10^{-5}$ to $2.8x10^{-5}$ m/s) for sandy soils. I expect infiltration in the coarse sandy

[1] Domenico, Patrick A and Franklin W Schwartz, 1990. Physical and chemical hydrogeology, John Wiley and Sons, New York
[2] Freeze R Allan and John A Cherry, 1979. Groudwater, Prentice Hall, New Jersey

gravels that are typical of the likely wetland sites in CPWES will be one to two orders of magnitude higher than in the sandy soils typical of the Christchurch urban area. Given these figures, we selected an infiltration rate of $3x10^{-4}$ m/s (or 1080 mm/h) for the design of CPWES wetlands. This in turn implies a wetland area of 3333 m^2 per m^3/s of water. This was used to establish the wetland areas as listed in the AEE of November 2006, section 3.12.

26. The wetlands will require maintenance from time to time to ensure effective long term operation, including removal of detritus from the wetland surface and possibly reworking of the infiltration beds after a few years. But for normal conditions the bywash flows of ~10% of intake flows will be generally conservative and I consider the areas specified allow a reasonable margin for practicalities of each site.

27. **Effects of construction activities on natural and physical resources, ecosystems, habitats and species in riverbeds**. See Ms Johnston's evidence, #44 to #69. Ms Johnston proposes a number of conditions in addition to those proposed in the CPWES application. The purpose of her additional conditions appears to be to protect ecosystems in the riverbeds. Her proposed extra conditions applicable to all rivers were:

    (a) Works do not occur within 100 m of nesting sites identified by the suitably qualified expert,

    (b) Vehicles, as far as practicable, shall not enter river channels containing flowing water,

    (c) There shall be no storage or refuelling of vehicles and machinery anywhere on the bed of the river,

    (d) Apart from structures constructed under this consent, on completion of works sites shall be as far as practicable be left in a state consistent with the surrounding natural riverbed.

    One additional condition was proposed for the Rakaia River:

    (e) All practicable measures shall be taken to minimise the discharge of sediment to the Rakaia River arising from the works.

    Ms Johnston concluded that "Provided works are carried out in accordance with the recommended conditions, effects on ecosystems are likely to be acceptable".

28. Condition (a) could impose an unworkable constraint on the construction and operation of CPWES. I have been advised by Dr Bishop that it is possible, although unlikely, that endangered birds could nest for some months at a time at or near locations where scheme works are required. Therefore during the construction phase the proposed condition could impose a serious constraint on construction timetables. And during scheme operations if, for example, works were required in the riverbed to divert water towards the intakes, the condition could lead to the scheme being without its water supply for a considerable period, with substantial economic consequences. Instead, on the advice of Dr Bishop, I recommend the following amended condition; (a) As far as practicable works will not occur within 100 m of nesting sites identified by the suitably qualified expert. Where this is not practicable the consent holder will arrange either relocation as recommended by and under the supervision of the expert, or alternatively offset mitigation of equivalent value to avifauna as recommended by the expert.

29. I endorse conditions (b), (d) and (e) fully.

30. Regarding condition (c) I would like to see an amendment to state “As far as practicable there shall be no storage or refuelling of vehicles and machinery anywhere on the bed of the river. Where it is not practicable storage and refuelling shall only be done with appropriate bunding or other spill control measures”. My amendment is to cover the practicalities for plant that are difficult to shift, such as diggers and pile drivers. I consider my amendment should achieve the desired outcome of Ms Johnston’s proposed condition.

31. **Flushing of sediment traps**. See Mr Fietje’s report, #115 to #118, presented in more detail in Dr Meredith’s evidence, #82 to #89. These raised a number of concerns, and I will address three of them, namely the preferred method of discharge, the river conditions at the time of discharge, and the path of a discharge. Other witnesses will address issues relating to river morphology and ecological effects. Dr Meredith was unclear as to whether the applicant proposes to remove sediments from the trap by flushing or by mechanical removal, and he expressed a preference for mechanical removal. Regarding river conditions at the time of discharge, if flushing were to be permitted, he considered that the conditions in the receiving river at the time of flushing should follow the RDR conditions, namely be (a) on a rising flood, (b) when river flows were considerable, (c) when the river was already discoloured (so there would be no conspicuous change in clarity), (d) monitoring would be required to ensure

subsequent sediment deposition did not become a problem in the discharge zone. Regarding the path of a desilting discharge, he recommended four conditions, namely (a) upstream fish passage, (b) fish stranding, (c) connection with an active braid so as to affect rapid mixing and sediment transport, and (d) no conspicuous change in colour or clarity of the receiving water.

32. Regarding the preferred method of discharge, I can confirm that it is preferred that the scheme flushes from the settlement pond. Mechanical removal is a more expensive operation that should only be used if flushing is not feasible technically or environmentally. It is expected that it should only be needed from time to time, for situations where sediments have consolidated excessively in the settlement basin.

33. Regarding river conditions at the time of discharge, see my evidence in chief, #78 to #89. The proposal has advanced from a version that Dr Meredith was referring to, and our present proposal is more in line with his recommendations, particularly in that I have proposed minimum river flows of 100 m^3/s and 300 m^3/s in the Waimakariri and Rakaia Rivers respectively. That is because these are the flows specified in other irrigation flushing consents on those rivers and, based on ECan sampling, the rivers will be conspicuously discoloured at those flows. That addresses his second and third proposals (regarding river flows being "considerable", and the river being already discoloured). But note that in my evidence in chief I have also suggested a modification should be considered if it can be established that there would be a benefit to fishing from discharging during low flows.

34. Regarding Dr Meredith's proposal for discharges to be on a rising flood, my understanding is different from his in that I can find no reference in the RDR consent conditions to a rising flood. His suggestion would be difficult to operate in practice for the following reasons. Firstly it would not always be clear whether a flood event had reached its peak or whether the river was still rising or had started falling. Also from a scheme operational point of view it would often be desirable to flush later in a flood when much of the sediment would have settled in the trap. This would enable more sediment to be removed at the time of the flood. Finally, one can also expect that the river will still be significantly discoloured during its falling stages, which I expect should satisfy Dr Meredith's key concern. For the scheme's operational performance I would prefer not to have the constraint of a rising flood.

35. Regarding the path of a desilting discharge, while I agree that Dr Meredith's proposals (his #88) have merit in principle, I would not like to see them become conditions as stated. The first proposal, regarding discouraging or preventing upstream fish passage, will be largely achieved without special effort, by having a settling pond bank and control gate. I consider any additional conditions could be difficult to implement. The second proposal, regarding fish stranding provisions, will be achieved as far as is practicable without special effort through the natural grade of the river bed, and I expect it will therefore largely achieve Dr Meredith's purpose. In my opinion any additional conditions, such as installing a discharge channel with a guaranteed even grade and no residual pools, could be difficult to implement, as natural events in the river would reshape frequently any such artificial channel. Regarding the third proposal of discharging into an active braid, this again will happen to a large extent naturally, as the flush will continue until it reaches a flowing braid. His fourth proposal (regarding no conspicuous change in colour or clarity of the receiving water) has already been addressed above by specifying minimum river flows at the time of discharge.

36. **Effects of discharging stormwater, sediment and hazardous substances to land and water during construction**. See Mr Fietje's report, #133 to #142, also Ms Johnston's evidence, #99 to #115. The implication of these reports is that there is the potential for effects to be only minor, provided sufficient mitigation is supplied. The concern essentially is that with regard to management of the effects of these matters, the application has placed too much reliance on management plans, which have not been prepared in detail. In #112 Ms Johnston gives examples of conditions, with an implication that these would make the application more definitive and, I presume, acceptable.

37. I have addressed environmental construction management plans (ECMPs) in detail in my evidence in chief, #262 to #270, and I attached there descriptions and outlines of a range of topical ECMPs as Appendix I. These include, relevant to the topic heading addressed here, a stormwater and wastewater management plan, a hazardous substances management plan, and a dewatering management plan. The intention was to go as far as is possible at this point in time towards the details of management plans. I pointed out that ECMPs are specific to each technical topic, such as dust, hazardous substances, etc. They are also specific to each part of the scheme and to each contractor or operator as there are often different ways

of achieving the standards. Therefore I did not provide full details of each plan. Instead the plans provide outlines of the required framework and processes that contractors and operators will be required to follow as part of the tendering process and job start-up. I listed 21 sources of requirements, standards and outcomes that would form the details specific to each ECMP. These sources cover a range of statutory plans, consent conditions and other legislation or plans.

38. The list of example conditions provided by Ms Johnston is helpful. However they are, as stated, examples only and they should not be adopted as conditions as they assume specific situations that will often not be applicable in each CPWES situation. Further they will in any case be superseded by the statutory plans, consent conditions and other legislation or plans that will inform the ECMPs.

39. I refer you also to the evidence-in-chief of Ms Robson, #3.7 to #3.9 regarding the necessity and appropriateness of using management plans as a tool for controlling environmental outcomes.

40. In conclusion, the level of detail about ECMPs that was provided in my evidence in chief is a development from the details provided with the application, and is likely to go a long way towards satisfying, if not fully satisfying, the concerns of Mr Fietje and Ms Johnston. Such ECMPs are the normal method of control of environmental outcomes from construction activities and I consider the details proposed are appropriate for this stage of development of CPWES.

41. **Effects of works on amenity values, people and communities**. See Ms Johnston's evidence, #90 to #98. Among other points Ms Johnston considered that conditions of consent should require CPWES to rehabilitate sites as soon as practicable after construction is completed. Her other points, regarding access to sites, have been addressed by Mr Whaley.

42. I agree, and I refer to my evidence in chief, #262ff regarding construction management plans, and to Appendix I, which includes a Landscape and Rehabilitation Plan. I consider that addresses Ms Johnston's concern.

43. **Effects on discharging contaminants, principally dust, to air during construction**. See Ms Johnston's #116 to #122. Ms Johnston proposes some mitigations in addition to an earlier version of the dust management plan, that she considers would ensure the effects of nuisance dust are minor.

44. I refer to my main evidence in chief, #262ff, regarding ECMPs, and the outline dust management plan in my Appendix I. These address most of Ms Johnston's points.

45. Ms Johnston's suggested conditions are generally acceptable, and they have been addressed in the outline dust management plan in a way that is more comprehensive and will be more widely applicable and more effective. I consider one specific condition is not appropriate, namely that "In wind speeds of greater than 10 km/hr, unsealed surfaces will be wetted at least hourly". While that could be an appropriate solution in some instances I consider there are other potential solutions, as listed in the dust management plan, that could be more applicable generally.

46. I therefore consider that the process and provisions in the outline dust management plan in my evidence in chief will achieve the aims of the witness more effectively

47. **Fish screening**. See Mr Fietje's report, #368 to #372, also Dr Meredith's evidence, #74 to #81. Mr Fietje considers there are significant technical challenges to the successful operation of fish screens in the Canterbury rivers, and appears to accept that there are no "off-the-shelf" solutions. He states that "Should Commissioners decide to grant consent, the setting of performance standards in conjunction with a review and certification process should be required". Dr Meredith gives a more detailed description of the points Mr Fietje raises. He also mentions the possibility of using the CPWES facilities as a fish habitat then states that in the absence of that being proposed by the applicant, it must be assumed the intention is to aim for "effectively total fish exclusion at intakes". As a consequence of that conclusion he says "screening systems would need to perform to the equivalent of a 2 mm slot …".

48. See my evidence in chief, #47 to #62, for my comments on fish screens. In that evidence I sought to demonstrate that there are feasible solutions to the generally accepted requirements of fish screens, and these would be developed in the detailed design stage. I also sought to establish that prior to developing solutions there will be a need to establish the performance criteria for fish screens, including fish protection objectives and requirements, site specific survey of fish activities, evaluation of engineering options, and costing. In this I considered I was in tune with a recent draft report of a Working Party on fish screens for water intakes on Canterbury rivers. To give confidence that solutions would be developed in a

professional and responsible manner I proposed that a team should be commissioned to lead the next stages of analysis and design, consisting of a suitably qualified fishery biologist with recognised expertise in salmonid fisheries, and a suitably qualified engineer with experience in the design and operation of fish screens and deflection barriers. This became the applicant's proposed consent condition.

49. I agree with Mr Fietje's view that there are no "off-the-shelf" solutions.

50. The process I have proposed for developing details of fish screening also fits readily with Mr Fietje's statement that "Should Commissioners decide to grant consent, the setting of performance standards in conjunction with a review and certification process should be required". I am assuming the setting of performance standards will be part of the detailed design process, following granting of any consent. For the recent Hunter Downs Irrigation Scheme hearing (this is for a proposal in South Canterbury) a similar level of detail and recommended process were provided to the consent hearing by the applicant, and these were supported by ECan in its s42A officer's report as being appropriate for granting a consent. While a decision is awaited on the outcome of that hearing, I consider the same level of information should be suitable for advancing Central Plains also.

51. I acknowledge Dr Meredith's suggestion that consideration be given to using CPWES facilities as a fish habitat, and would welcome input on that topic in the further development of objectives and needs of the fishery. But in the absence of that evaluation, and in line with commonly expressed preferences of the fishing community, CPWT has stated at this stage that fish should be excluded from CPWES.

52. But contrary to Dr Meredith's view, in my opinion this assumption implies neither total fish exclusion at the intakes, nor screening systems equivalent to a 2 mm slot. To draw those conclusions would be to presuppose the outcomes of the process of establishment of the appropriate performance criteria for fish screens, thus short circuiting the steps indicated in the draft report of the Canterbury Working Party on fish screens.

53. **Effects on land drainage.** See Mr Fietje's report, #400 to #403, also Mr Scott's evidence, #10 and #50 and Dr Williams' evidence #8 and #9, #23, #52 to #66, and #70 to #86. Mr Fietje states that "Without knowing the extent of reduced versatility in terms of area, duration and frequency [of a shallow water table] it is not possible to be confident the effect is minor". Mr

Scott considered that “the simulated effects [of groundwater mounding] should be viewed with some caution and should not be accepted as worst-case assessments”. He also acknowledged the difficulty of clearly distinguishing CPWES induced changes in groundwater levels from climate driven ones. Dr Williams has repeated all of those views and also provided more extensive comments relevant to my area of evidence, so for convenience I will generally focus my responses around his comments. He agrees with Mr Scott’s view that the modelled groundwater mounding should not be accepted as the worst case scenario. In #23 he quotes from a memo that I wrote in December 2007 that included an opinion that CPWES would approximately restore the groundwater to its situation in around 1990. Then from #52 onwards he addresses the effects of higher groundwater levels on land subdivisions, wastewater, stormwater and lowland waterways. This includes giving some suggested additional or amended mitigations beyond what was in my memo of December 2007. I will list in a later paragraph Dr Williams’ key points relevant to my areas of interest, with my responses.

54. Land drainage was the whole topic of my second brief of evidence, and I refer the Commissioners to that. In that brief I adopted and interpreted the outcomes of the Aqualinc modelling. Using that I attempted to demonstrate that on a broad areal basis, CPWES will not significantly alter the historic patterns and magnitudes of groundwater levels and movements in the lower plains, but that these will continue to be dominated by climatic variables and natural recharges which will not be altered significantly by CPWES. I therefore concluded that the post CPWES groundwater situation will be similar to what has occurred in the recent past and is reasonably well known. I indicated that this should give confidence in the ability of CPWES to propose feasible solutions to any adverse effects that might eventuate. I then described the likely effects on lowland utilities. I described the potential solutions that could be considered where CPWES might have caused adverse effects, and stated that I considered they would be small and feasible to implement. I stated that in my opinion it would be reasonable to expect CPWES to agree to remedy adverse effects of drainage in the lower plains that result from operation of the scheme. I recommended a monitoring program. Finally I recommended a two-tier process for deciding on responsibilities and activities for drainage works in the lower plains.

55. The evidence in that brief is slightly different from my memo of December 2007 that Dr Williams referred to in his evidence, the main difference being fuller detail.

56. I will not comment on the accuracy of the groundwater modelling, as that is Mr Weir's field. However I can state that the mitigations I have proposed are not particularly sensitive to the accuracy of that model. Rather the range of potential solutions I have noted demonstrates that there are feasible solutions over a range of drainage outcomes. By way of illustration I described the magnitude of works required to remedy two examples of increases in flow in the lowland drains, where there might have been a 20%, and alternatively a 50% increase in stream or drain flow from CPWES [see #23(ii) of my second brief of evidence]. Therefore I conclude that the remedies and mitigations recommended in my second brief of evidence, these being generally small scale, unobtrusive and inexpensive, could be applied over a reasonable range of groundwater mounding.

57. In my memo of December 2007 I indicated, as correctly quoted by Dr Williams, that CPWES would approximately restore the groundwater to its situation in around 1990. Since that date I have had further discussions with my colleagues, ECan officers and farmers in the lower plains and I now consider that it is difficult to ascertain precisely the rate of development of irrigation in the lower plains and reconstruct how groundwater levels have responded. So while it might well be that 1990 is a fair statement of a date for comparison, I have amended my opinion to a less precise "in the recent past" (see #7 in my second brief of evidence).

58. Regarding Dr Williams' more detailed comments, see the following table.

Dr Williams' comment	**My response**
1) It might be appropriate to ask CPWES to clear existing drains or provide additional drains	I agree. This will be a matter for the technical panel to address.
2) How will responsibilities for flooding be apportioned between CPWES and other causes?	This will be a matter for the technical panel to address.
3) There is disagreement	I disagree with this statement. The comment

between Mr Weir and me about uncertainties in mounding	that Dr Williams quotes from my memo relates to fine scale effects, not the broad scale modelling results that Mr Weir presents.
4) A drainage panel is a fall back position	I disagree with this statement. For decisions on avoiding, remedying or mitigating drainage needs there is no realistic alternative to on-going adaptive management. In my opinion a technical panel is the best tool for making decisions about both broad scale and localised solutions.
5) The Commissioners should be made aware of what the worst case conditions are likely to be and what the solutions would be	Mr Weir's evidence is that the Commissioners have been made aware of the realistic worst case conditions. But as pointed out in my evidence above I consider this is not a crucial question as the lowland streams and drains will be able to have the capacity to take water in excess of the modelled flows. Detailed solutions can only be developed on a case-by-case basis.
6) Future decision making processes should be able to act without delay	I agree
7) ECan should be represented on a drainage decision review panel	ECan should be represented on the main technical panel as this is where the bulk of the work will be done. It would not be appropriate for ECan to be on the review panel as that panel's purpose is arbitration, and its members must be independent of affected parties.
8) There should be an annual comprehensive report on water quantity (and quality)	I agree
9) The consent holder should bear the reasonable extra costs of monitoring and reporting made necessary by CPWES	I agree
10) Trigger levels will have to be set to manage unacceptable groundwater levels	This will be a matter for the technical panel to address.

11) Compensation where required would be a better solution than reduction in irrigation.	Compensation is not in mind for CPWES at this stage, but it could be considered if it was a better alternative than a physical solution.

SDC S42A OFFICER REPORT

59. **Arrangements for supplying races in the Sheffield area**. See #28 of Mr Boyes' report. Mr Boyes correctly points out that removal of an earlier proposal to supply the reservoir from the upper Waimakariri intake via a canal through Sheffield, has removed the planned source of supply for races SH1 and SH2 in the Sheffield area.

60. I have addressed this in my evidence in chief, see #214.2. That states that it is now intended to supply those races using one or more pump stations on the headrace.

61. **Landscape design of upper Waimakariri intake diversion channel**. See #114 of Mr Boyes' report, also Mr Craig's technical evidence, (Appendix A) #4.16 and #7, condition 5. Mr Craig recommends (condition 5) "That the (upper) Waimakariri diversion canal is realigned in accordance with the attached photograph". In #4.16 he adds the rider: "If it were technically feasible (apart from cost considerations)", and explains that the purpose of this recommendation is to better maintain "the river's natural character".

62. In my opinion the suggestion is not technically feasible. Firstly, I consider it would reduce safety. An obviously artificial channel, such as proposed by CPWL, would alert river users, especially kayakers, that they would be entering a man-made channel, and that there would be a danger of meeting the intake gates. Secondly I consider it would often be impossible to build the diversion channel as shown. The illustration given by Mr Craig is specific to the river configuration that existed when the photograph was taken and the river will often be in other locations, such as in figure 5 of my evidence. In other circumstances an S-shape would neither be possible nor necessary. Thirdly, it would be difficult to maintain the shape shown. In the circumstances where an S-curve could be built, it would require possibly frequent rebuilding after freshes in the river.

63. In conclusion I recommend that this landscape requirement should not be imposed on the river diversion works.

64. **Lowering of groundwater, and ground settlement, through tunnel excavation**. See #169 of Mr Boyes' report, and #5.4 and #5.5 of Mr Eldridge's report (Appendix G). The concern is that there is insufficient information about the effects of tunnel excavation on deeper groundwater, and possible consequent settlement of land. Mr Eldridge's report states that "there could be groundwater inflow to the tunnel", that the "exact clearance depth is not stated" to the Hawkins River, that "consideration of mitigation works, particularly where the tunnel passes below state highways, should be provided", and that details of additional tunnel staging areas are required for their environmental effect to be assessed.

65. Regarding ingress of water into the tunnel, CPWT has recognised this will occur and has applied for a consent (consent No CRC072762) to cover this. CPWES's proposed consent conditions include that a Dewatering Management Plan should be prepared at least one month prior to the exercise of the consent, outlining the construction and management practices and procedures to be adopted in order that compliance with the conditions of this consent can be achieved and that the effects of the dewatering activities are minimised to the greatest extent practicable. Further details of the proposed conditions are presented in Appendix C to Mr Tipler's evidence.

66. Mr Eldridge's evidence implies that there will not be a large discharge of water from interception of groundwater, particularly if an earth pressure balance shield TBM is used. While it is impossible to quote a precise flow figure, I agree with that implication. I note too that Dr Williams, in his evidence for ECan, does not consider the creation of the tunnel as an impediment to groundwater, providing best practice methods are adhered to during its construction (Dr Williams' evidence, #93).

67. In #200 of my evidence in chief I have addressed the concern about ground subsidence. Essentially avoidance relies on two features. Firstly, at the time of drilling a segmented precast reinforced concrete lining will be installed, which will have rubber gaskets between each section, and grout will be pumped in to fill the space between the soil and the concrete lining. Secondly there will be the arching effect of the ground itself. Contrary to Mr Eldridge's evidence my evidence does state the depth of cover over the tunnel. The minimum depth of cover will be 45 m at the state highway (and the railway) and 30 m at the Hawkins River, and these depths are considered to provide a large margin of safety against subsidence.

68. For your information I understand that Transit New Zealand (TNZ) has accepted the CPWES proposal, subject to conditions that have been agreed between the parties, and TNZ will inform the hearing of its position.

69. Therefore I conclude that Mr Eldridge's concerns about groundwater entering the tunnel, and ground subsidence over the tunnel, have been addressed adequately.

70. **Tunnel staging areas**. Mr Eldridge expressed a further question about the tunnel regarding "potential additional staging areas". The AEE that accompanied the application, and my evidence in #191 and #192, made it clear there will be only two staging areas, i.e. the main area at the downstream end in the Waianiwaniwa Valley, and the upstream end by the Kowai River. My evidence describes the activities planned for these areas. Should additional staging areas be required in the future that would be the subject of further consent applications, but that is not envisaged at this point in time.

71. **Dam safety**. See Mr Boyes' report, #161 to #165, also Mr Eldridge's evidence, sections 3 and 6.1. Effectively Mr Boyes and Mr Eldridge request some minor changes to the proposed conditions of consent to ensure "a transparent and robust process for the design, construction, commissioning and operation of the dam, in order to achieve the required safety criteria and mitigation of potential adverse effects" (from Mr Boyes' #165). These proposed conditions are listed in Mr Eldridge's section 6.1.

72. Generally I support Mr Eldridge's recommended changes, with minor editorial amendments. A revised set of conditions will be presented by Mr Tipler, as the applicant's proposed conditions for consent CRC061845 to erect, use and maintain the dam in the bed of the Waianiwaniwa River. Any significant differences are addressed below (In this list the first condition number is Mr Eldridge's proposed condition, and the condition number in brackets is the equivalent condition proposed now as the applicant's set of conditions):

    (i) Condition 2: Not included as this is unnecessary.

    (ii) Condition 3: (Condition 2). Mr Eldridge refers to "evidence" presented at the hearing. The proposed condition refers to "technical documents" which is more extensive than just the evidence.

(iii) Condition 5: (Condition 4). The supervision of the dam development will be under the responsibility of a “recognised engineer” as defined under the Building Act 2004 rather than “persons with appropriate experience”. This has been carried through a number of the following conditions.

(iv) Condition 6: (Condition 5). The internal Review Panel has been renamed the External Expert Review Panel. The Engineer has been changed to recognised engineer and 6(h) has been extended to include the lake filling process.

(v) Condition 7: (Condition 6). Reference to the quantity of material to be used has been removed as this is a contractual rather than a consenting issue.

(vi) Condition 12: This has not been included. In relation of the construction of a dam, it will be impossible to avoid stranding fish in ponds or river braids within the Waianiwaniwa Valley. The suggested condition would not be able to be complied with as it is too vague.

(vii) Condition 14: (Condition 12) A major flood is too difficult to define. The crucial aspect is that any reinstatement required by any flood should be covered by this condition.

(viii) Condition 15(d): (Condition 13(d)). The review period has been changed from weekly to monthly to align with the NZSOLD guidelines.

(ix) Condition 17: (Conditions 15 and 14). The monitoring report is recommended to be annually, as consistent with the NZSOLD guidelines.

73. **Canal safety**. In #4.1 of his evidence Mr Eldridge considers that a hazard assessment and risk analysis would normally be required prior to finalisation of consents. This concern relates to the potential for a breach of canal banks in locations where the canal is raised above ground level, for example where there is a sidling race up the Waimakariri and Rakaia River terraces, or where the headrace traverses a gully.

74. I have addressed this subject briefly in my evidence, see #132. Essentially I have acknowledged the need for this subject to be addressed and have indicated there will be analysis and solutions at the time of detailed design.

I indicated that safety measures will consist of a mix of geotechnical design features, isolation of sections of headrace by use of submerged weirs, and appropriate monitoring, maintenance and emergency action plans. As the canal will contain more than 20,000 m^3 of water and will, at least in places, have greater than 3 m height of embankment, it will considered to be a dam, and its design will be subject to the Building Act and will require a building consent from the Regional Council. Risk analysis will follow the relevant procedures in the various dam building guidelines.

75. As noted Mr Eldridge wished that these analyses should be done before consents are finalised. This would be difficult as the details of locations are not set for all sections of the headrace, and as there would be a large amount of work to provide the site specific solutions that will be required. I consider the lack of site specific analysis is not a matter for concern at this point of time as it is clear from the analyses done for the Waianiwaniwa dam, and the geological mapping and soil sampling that has been done in the central plains area, that there are solutions readily available. To keep this topic in perspective it needs to be clearly recognised that the consequences of a breach of canal banks would be very much less than for the Waianiwaniwa dam. I say this firstly because the volume of water that could be released in a breach of the banks would be limited, particularly with submerged weirs in critical locations. And secondly because the head of water that could cause a breach of the headrace banks will seldom, if ever, exceed 10 m. These figures contrast with a head of some 55 m for the Waianiwaniwa dam, and an active volume of stored water of 280 MCM.

76. Therefore in my opinion resource consents can be granted for the headrace in confidence that there are procedures in place and solutions readily available to ensure proper processes are followed for detailed analysis, approval and design regarding the risk of a breach of the canal banks.

77. **Public safety where distribution races run alongside roads**. In #178 of his report Mr Boyes asks for confirmation that CPWES intends to maintain boundary fences along the road reserve to discourage direct public access to the races from roads.

78. I confirm that is the intention of CPWES. However there might be site specific reasons to omit a fence, for example to encourage public access if, for example, a kayak launching facility is to be provided into the headrace.

79. **Safety at river intakes**. This was raised as a concern by Mr Boyes. See my comments above in #3 to #9.

80. **Economics of piped v open race reticulation**. In #221 to #223 of his report Mr Boyes notes that a piped distribution network could have advantages over an open race network, and that a benefit cost analysis of these alternatives has not been presented. He implies that this could be asked for as a requirement of the Fourth Schedule of the RMA. He also states that "In accordance with previous correspondence from CPW, presumably this information will be provided at the hearing". However in #223 he states that "it is considered that site specific consideration of alterative alignment and/or piping is required rather than consideration of alternatives to the distribution network per se."

81. I noted in #17 of my evidence in chief that the application proposes an extensive network of open canals to distribute water across the plains, but also assumes that a consent will allow either open races or piped systems to be installed in the locations shown. The descriptions in my evidence and the AEE concentrate on open races as these have a larger environmental effect and are assumed to imply a higher bar for consenting. Mr Tipler has addressed this in #69 to #76 of his evidence in chief, including reference to two studies that address the question of open race versus piped supply.

82. I agree with Mr Boyes and submitters that a piped distribution network could have advantages over an open race network. These were described by Mr Tipler. However the studies mentioned by Mr Tipler are inconclusive regarding the economics of piped v open races. One study was specific to CPWES and the other was intended to be generic, but used CPWES as one of its case studies. Both studies indicated there would be a considerably higher capital cost with a piped network, but that could be compensated to a degree by reduced pumping costs over parts of the scheme because a piped network could supply water to farms at a positive pressure. However both studies were based on some broad assumptions so that any conclusions could only be taken as indicative, and there was not a consensus about the whole-of-life economics. The more recent study, headed by Dr Heiler, provides a more comprehensive method and framework for comparing the two systems, but this has not been implemented for CPWES. To do so would require a large amount of work and any conclusions would depend on pricing and technology factors that could change between now and scheme implementation, potentially distorting any conclusions that might be drawn at this present stage.

83. In conclusion I consider it is best to leave any further evaluation of the comparative advantages of piped distribution networks until the detailed design stage. This opinion relates to both an evaluation of the distribution system as a whole, and to local case-by-case needs. I accept that installing an extensive piped network would require a more extensive reconsideration of locations of the network than retaining open races, and this in turn could require modifications to the consents that might be granted from this hearing.

84. **Heritage trees and sites**. See Mr Boyes' report, Appendix M, Proposed District Plan Listed Heritage Sites Potentially Directly Affected by the CPW Scheme. This appendix lists six heritage items and six trees.

85. It is a clear commitment from CPWL that the races will avoid farm buildings, so the five buildings in Mr Boyes' list are not in any danger.

86. We have obtained information from SDC giving a more precise location of the six listed trees. All are a considerable distance from any scheme works and they will not be affected by CPWES.

87. We have not been able to locate precisely the railway long drop other than knowing the property in which it is located (it is on SDC land) . We know that it is close to a proposed scheme race, and is possibly in the line of the race as shown at present. However it is clear there will be enough space in the property to avoid it by either re-routing the race by a small amount, or alternatively by piping the race at this point to reduce the width of construction. I attach a plan as Appendix 1 to show the location of the property.

88. **Noise and Vibration Management Plan**. I will attach an amended version of the Noise and Vibration Management Plan that was in Appendix I to my evidence in chief. This is to bring it in line with Dr Chiles' evidence and the conditions as presented by Mr Tipler.

[Name]

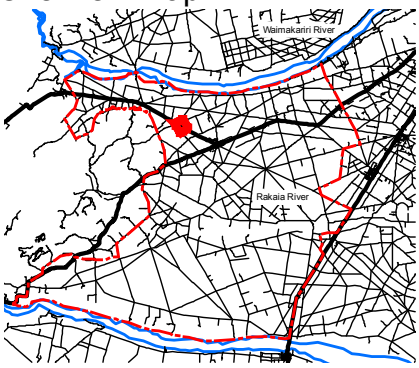
Appendix 1: Plan showing location of railway long drop, as identified in Mr Boyes' report, Appendix M

Appendix 2: Amended Construction Noise and Vibration Management Plan

APPENDIX 1

PLAN SHOWING LOCATION OF RAILWAY LONG DROP

Overview Map



Jenkins Alan John Estate

Selwyn District Council
Account To Be Deleted

BLEAK HOUSE ROAD

Eaves Eric Kelvin Estate

D219

Selwyn District Council

Morrison Peter Hugh

Lochinvar Farm Ltd

GUNNS ROAD

Gunn Graham Mason

AUCHENFLOWER ROAD

SH 2

WEST COAST ROAD

H143 Railway Long Drop (?)
area with buildings

H143

Lochinvar Farm Ltd

Selwyn District Council

Malvern Farm Ltd

Malvern Farm Ltd

Headrace Designation
no structure identified on aerial photos

H147

N

0 0.05 0.1 0.2 Kilometres

Cameron Roderick Lawton

APPENDIX 2

AMENDED CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

Management Objective:

To avoid, remedy and mitigate the impacts from construction noise and vibration.

Issues:

1) Blasting activities;
2) Concrete batching plant and transport of concrete to site;
3) Mobile machinery, including trucks, excavators, bulldozers and graders;
4) Workshops
5) Transformers and generators
6) Vibration from compaction of earth filled dam embankment
7) Vibration from the construction of headrace canal and distribution races
8) Vibration from piling and blasting;

Management Strategies:

All practicable measures shall be undertaken to reduce noise levels from plant, equipment and personnel operating on site to achieve compliance with any conditions of consent and construction standards to provide a safe working environment and to avoid undue disturbance to residents:

Noise management strategies include, but are not limited to the following:

1) Dwellings within 150 metres of the headrace, 250 metres of bridges/siphons/piling, 75 metres of the distribution network, and 500 metres of any blasting to be identified and specific assessment of noise and vibration conducted.
2) Blasting to occur at set times during the day and of limited duration with neighbours forewarned.
3) Batch plant to be fitted with noise screening – e.g. cladding if close to dwellings.
4) Aggregate processed and stockpiled as far as practicable during daylight hours.
5) Workshop(s) located away from dwellings or with appropriate sound mitigation measures.
6) Monitoring of noise level on and adjacent to the site.
7) Installation of a noise monitoring station between the dam and Coalgate.
8) Development of a complaints procedure including investigation within 24 hours of a complaint being made.
9) All practicable measures shall be undertaken to comply with the requirements NZS 6803:1999 Acoustics – Construction Noise.
10) Noise measurement shall be carried out in accordance with NZS 6801:1999 Acoustics – Measurement of Sound, utilising an independent noise expert. The results and conclusions of such assessments are to be submitted to Selwyn District Council and residents of Coalgate on a monthly basis

11) A Contingency Plan (in the event that noise limits are exceeded) to be developed.
12) The use of appropriately sized compaction equipment for the relevant structures.
13) Structural checks pre and post construction for any dwellings within vibration buffer distances.