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

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EVIDENCE IN REPLY
WALTER LEWTHWAITE

SEPTEMBER 2008

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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 evidence to address engineering issues raised by the Commissioners and submitters, and in the revised Officer reports.

3. The topics I address are:

- Drainage in the lowland plains: general issues
- Gravel extraction and groundwater levels
- The Pines wastewater treatment plant
- Race leakage and bywash quantities
- Managing didymo with emergency discharges
- Fish screening
- Secret urupa and Selwyn River pa
- Flood events in Waianiwaniwa valley
- Location of intake works for lower Waimakariri intake
- Location of headrace along Waimakariri River terrace
- Flushing from sediment traps
- Selwyn District Council stockwater races
- Updated scheme cost estimate
- Feasibility of providing storage in on-farm dams
- Alternative canal routes through Homebush
- Extent of construction zone through downlands properties
- Individuals directly affected by scheme works
- Modifications to dam safety conditions
- Vehicle movements through Coalgate

Drainage in the lowland plains: general issues

4. In my second brief of evidence (February 2008) I described the likely impacts and potential range of solutions for effects of CPWES on drainage in the lower plains, generally between SH1 and Lake Ellesmere. With that I proposed several consent conditions, and these were carried through with some small modifications to clauses 20 to 26 of Schedule 2; Administrative conditions, attached to the CRC applications. I also addressed lowland drainage further in #53 to 58 of my response of February 2008 to the initial s42A reports, and in #8 of my supplementary brief of April 2008 in response to questions from the Commissioners.

5. The Commissioners expressed a preference for conditions that would give more certainty and invited the applicant to consider such devices as trigger levels and objectives for management plans. In addition a number of submitters and a range of expert advisers expressed concerns about the effects of the scheme and lack of certainty. I have read or heard the evidence of all these witnesses and have met with many of them prior to and during the hearing.

6. My evidence presents my opinions on the effects of CPWES on drainage needs in the lower plains, and on remedies and mitigations. It draws on the Aqualinc groundwater model, including its outputs regarding amount of flow in lowland streams and groundwater mounding, and the Commissioners should note the discussions that have taken place around that. My evidence assumes the model provides a useful basis for analysing the effects of CPWES on lowland drainage and for planning remedial works. On the other hand it is not totally dependent on the Aqualinc model as I have considered a range of flows including some in excess of the Aqualinc predictions, see e.g. #56 of my February response to the s42A reports. I stated earlier that I consider my analysis and proposed range of solutions would apply should the Aqualinc model be considered to understate the effects of CPWES. Having heard and read the presentations of others I still consider that to be the case as, from a consideration of water balances across the plains, the total amount of water that can enter the groundwater system must be reasonably close to the Aqualinc model predictions.

7. In developing these details it is important to recognise the function of the existing drains and streams in the lower plains. These provide ‘relief

valves' that in practice limit the level to which groundwater can rise, and this modifies the predicted rises that emerge from the Aqualinc model. I agree with Mr Weir's discussion of this in his evidence in reply when addressing overall accuracy (#13) and on the submission of Paul and David Birkett. See also his comments on why mounding is likely to be over-estimated in the lower plains area. But I also accept that some existing drains will need enlargement and some additional drains are likely to be required, as discussed earlier.

8. In my second brief of evidence (February 2008) I described some of the potential solutions for a higher water table in the lower plains. I have also considered the potential costs of these solutions. It is impossible to be precise as given the nature of groundwater we cannot predict exactly where the effects will manifest themselves in a way which requires remediation. However I consider the likely cost to CPWES will be in the range of $2 million to $6 million. These costs would be significant to the scheme but they would not be prohibitive (see my evidence later regarding scheme costs).

9. Therefore I reiterate my conclusion that it will be quite feasible for CPWES to remedy or mitigate the effects of a higher water table in the lower plains, considering both the practicability of physical solutions and the potential costs.

10. The discussions throughout the hearing have reinforced my opinion that it will be impossible to predict in advance the localised effects of CPWES, and therefore the appropriate local solutions. It is also clear that it will be difficult to predict in advance the appropriate responsibility for payment for remedial actions. Therefore a high degree of adaptive management will be required, and in my view that should be encouraged. So the challenge is to propose consent conditions that:

    - reflect the uncertainties inherent in localised impacts and solutions for groundwater, and

    - are sufficiently clear to give certainty to affected parties, including addressing the physical details of responses, their timing, and the financial responsibilities.

11. I have discussed this conundrum and developed my opinions in consultation with a number of people including Dr Vince Bidwell of Lincoln Ventures,

consultant to CRC. My conclusion is that a baseline survey should be the key tool for setting up further details. Therefore, should the scheme gain consent, my recommendation is to undertake the following steps:

- The first step will be to do a baseline survey as described in the earlier evidence and proposed conditions. This will be a substantial task that is not practicable to complete at the present time.

- Preparation of a Drainage Management Plan should follow the baseline survey. The primary objective of the Management Plan would be to ensure that lowland properties and facilities suffer no adverse effects from rising groundwater levels as a result of CPWES, except as agreed by lowland property owners. (I include that 'except' clause because many lowland irrigators will gain advantage from the higher water tables provided by CPWES, and might wish, on balance, to adopt a compromise solution. This compromise could be adopted individually or over a wider area as it could involve reducing groundwater levels over a number of properties, perhaps on the basis of small stream catchments.)

- A groundwater model (or models) should be set up, focused on predicting outcomes in the lower plains, and this model should as far as practicable follow from a specification developed in conjunction with the baseline survey. The purpose of the model would be to enable predictions of events before they occur, and identification of the effects of CPWES compared with other effects. It should operate during both the scheme setup phase and in on-going scheme operation.

- A network of monitoring wells should be established as one outcome of the baseline survey. It could be agreed now that monitoring will be done, and it could be indicated that (say) at least 10 wells should be monitored. However I consider the details of monitoring are best left until after the baseline survey, as that will help describe the localised variability that needs to be monitored, and therefore the intensity of the monitoring network and specific locations of monitoring bores. I consider at least two monitoring wells should be in the mid to upper plains, one on each side of the Selwyn River, as these will show more obvious responses to irrigation and will give advance warning of groundwater mounding. I consider that a good number of the wells should have records going back to 1970, as that will ensure they pick up the effects of the early 1970s drought, and the late 1970s wet period, both prior to significant irrigation.

- The baseline survey, with assistance from the model as required, will be able to lead to a set of trigger levels. These trigger levels will be likely to take a variety of forms as there will be different purposes, such as detecting trends in the mid to upper plains as an early warning, providing information to recalibrate a groundwater model, and initiating remedial works in the field. These purposes could vary from well to well.

Other steps should be as in the earlier material, i.e.

- monitoring should continue as outlined above and as described in my earlier evidence,
- a Drainage Technical Review Panel should be set up, with purpose and method of operation as stated earlier,
- a Drainage Disputes Resolution Board should be set up, with purpose as stated earlier,
- an annual report should be prepared as described in my earlier evidence.

Drainage in the lowland plains: gravel extraction and groundwater levels

12. Mr Peter Callander raised in his evidence for Christchurch City Council and for gravel extractors the issue of increased groundwater level affecting the ability of gravel extractors to access this resource. Mr Weir has commented on the extent of the potential increase in groundwater level at these locations. This ranges from no increase at McLeans Island quarries to a 1.5 metre increase at the western most quarries, although Mr Weir considers this to be conservative i.e. on the high side. I note that the conditions on existing gravel extraction consents refer to the maximum recorded groundwater level at the site, not an average. Mr Weir's estimated increases are for the groundwater levels in dry, average and wet year conditions.

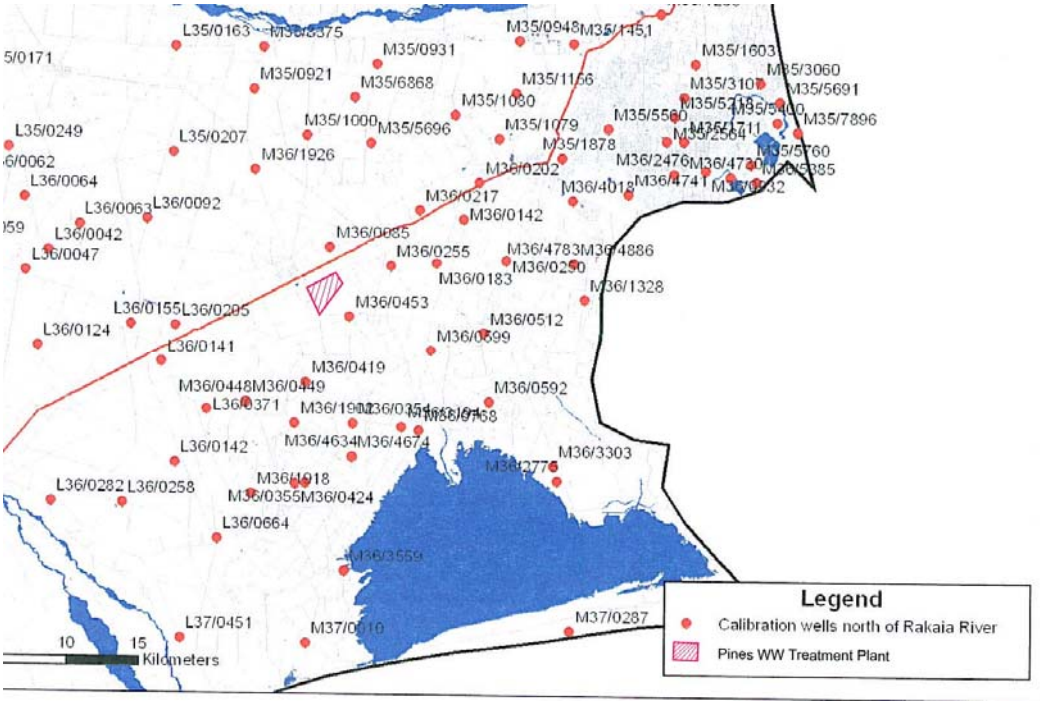
13. While it is logical that maximum levels will increase post CPWES, other issues such as the time this will occur, the rate of gravel extraction and the operational life of the existing pits mean that in practice the effect is likely to be limited, at worst. We estimate that it is likely to be at least 10 years before groundwater as a result of CPWES will reach its future equilibrium in this area taking into account the time to finally resolve the grant of consents, the time for arranging financing and then construction of the scheme, and the time before the scheme's effects, once fully operational,

will become evident. Ten years was stated in the evidence of Ms Keri-Davis Miller for CCC to be the likely life of the present gravel pits in the greater Christchurch area, and this view was reiterated in the evidence for the gravel extractors. I also note that statistically speaking it is unlikely that a peak climate circumstance will coincide with the first few years of the operation of CPWES.

14. The gravel extractors have acknowledged that within a few years they will need to obtain consents for new gravel pits, so at worst CPWES could bring the need for that forward in time. But given the timescales involved it seems unlikely that CPWES will have an adverse effect on existing gravel pits.

Drainage in the lowland plains: Pines wastewater treatment plant.

15. Mr Hugh Blake-Manson, Asset Manager Utilities for Selwyn District Council, raised concerns about the potential effect of raised groundwater on the intended wastewater treatment plant at the Pines, near Rolleston. His concern in part was a disconnect between the Aqualinc model outputs and his own knowledge of groundwater levels at the site (regarding this latter point see the evidence in reply of Mr Weir). See the plan below for the location of the Pines site.



16. Information from SDC shows groundwater levels were recorded at the site from 2004 to 2006, and fluctuated between 9 m and 17 m below ground level. To correlate this short term record with longer term events, particularly the extreme time of October 1978, we accessed ECan records for the two nearest long term wells, which are about equidistant up the plains and down the plains from the site. Averaging these we deduce that groundwater levels at the Pines could rise naturally about a further 10 m in wet periods, i.e. to about the ground surface. The Aqualinc model indicates that in the peak wet period of October 1978 CPWES would have caused the groundwater at this site to rise a further 3 m, so it would bring groundwater levels to the surface more frequently.

17. While acknowledging the limited period of site records it appears that there is the potential for a high groundwater level to occur naturally that might require SDC to take remedial action regardless of any effects from CPWES. And while acknowledging the approximate nature of the model outputs when it comes to site specific predictions it is also clear that CPWES has the potential to exacerbate adverse effects on operation of the Pines plant, particularly in times of naturally high groundwater levels. I consider this site should be included in the suite of sites to be monitored and assessed from time to time as in my previous recommendations and that CPWES should be prepared to contribute to remedial action if required, in keeping with the overall Drainage Management Plan. Such action could consist of a contribution to lowering of the groundwater table at critical times with cut-off drains or well point drainage. This would need to be part of a comprehensive plan for groundwater level management at the site developed by SDC.

Drainage in the lowland plains: race leakage and bywash quantities

18. **Race leakage**. Mr Ross Vesey, Regional Engineer with Canterbury Regional Council, proposed some conditions for limiting leakage from scheme races to groundwater. His concern was to limit the rise in groundwater levels in the lower plains. My response is as follows.

19. Firstly I am not persuaded that such a condition is necessary. CPWES will have its own strong economic driver to limit the loss of valuable water, and it will therefore be strongly motivated to achieve what Mr Vesey is asking for without having a consent condition.

20. Secondly if it is considered there should be a consent condition relating to leakage from the races, Mr Vesey and I have agreed that his proposed condition should be modified. In my experience leakage tends to be quite localised, so the sampling proposed by Mr Vesey would not necessarily achieve its aim, in that it could well give misleading answers from anomalous readings or miss key points of influence. Instead I propose that the following conditions would better achieve the aims of limiting leakage from the scheme races:

    - *The consent holder shall assess race leakage from both the headrace and distribution network within two years after the start of operation of the scheme, and at no more than five yearly intervals thereafter,*

    - *If leakage from the headrace and distribution races exceeds the modelled value of 1 m^3/s (average over the year) then the need for improved race sealing will be reviewed by the consent holder and reported to Canterbury Regional Council.*

    These conditions would:

    - trigger a review, rather than letting the matter lie,

    - allow consideration of losses other than from race leakage, i.e. assessment of the sum of all contributions to groundwater from the scheme,

    - allow, in considering potential remedial works, a review of the need for limiting groundwater recharge, including whether the interests of the whole area might be better served by further supplementation of groundwater ,

    - not prohibit or discourage the consent holder from conducting a review at other times if it so desired.

21. **Bywash limits**. Mr Vesey raised a concern about the amount of water that might pass through the distribution trace bywashes. His concern, as for race leakage, was to limit the rise in groundwater levels in the lower plains. My response is as follows.

22. I question the need and desirability of placing limits on operational bywashes for the same reasons as stated above regarding race leakage. However if it was considered necessary to place limits then there could be a condition

to ensure compliance with the design assumption of 10% loss (see my evidence in chief, #243), such as:

The consent holder shall monitor all bywash discharges and shall ensure that, on average over a season, and in total over the scheme, operational bywashes do not exceed 10% of the flows entering the distribution network.

Managing didymo with emergency discharges.

23. The Commissioners and others have asked about the applicant's intentions with regard to managing didymo when discharging from the emergency bywashes. (This is not an issue for normal operational bywashes as they will discharge to wetlands, i.e. to land, without a direct connection to water.) I have been unable to obtain a definitive ruling from BiosecurityNZ regarding the possibility of obtaining a permit for the emergency discharges. My opinion therefore is that, if at the time the scheme commences, there is still a risk of transfer from a didymo affected waterbody to a non-didymo affected waterbody, and CPW does not have approval from Biosecurity NZ to permit potential didymo transfer with its emergency discharges, then the disposal method will be altered. Practically, this would most likely require disposal to land, with ponding areas where flows in excess of what the wetlands can effectively take would be automatically diverted. This should occur in a number of locations over the lower sections of each race, and would require agreements from adjacent landowners. I would not expect difficulties with obtaining permission as the effects would be minor and not necessarily adverse.

Fish screening

24. I am responding mainly to the evidence of Mr Davor Bejakovich and Dr Adrian Meredith, and addressing requests for more explicit details of proposed mitigations.

25. I addressed this earlier in my evidence in chief #47 to 62 and in my response to the initial s42A officer reports #47 to 52. I would invite the Commissioners to re-read those sections. Refer also to CPW's proposed conditions 7 to 12 for the Waimakariri intakes (CRC061972), and conditions 5 to 9 for the Rakaia intake (CRC021091).

26. Essentially my interpretation of these remarks is that:

- There is no disagreement that it is necessary to provide fish screening at all three intakes to CPWES,
- For traditional fish screening all parties favour at this stage flat panels in a series of 'V' formations,
- It is agreed that the NIWA guidelines of 2007 are a useful source of information on both design processes and detailed parameters,
- Many of the detailed parameters are accepted by all parties.

However there is a difference of opinion on the process of design, some details of design, and on the appropriateness of specifying detailed solutions at this stage.

27. Firstly I would like to clarify my understanding of the status of the NIWA guidelines that we have all referred to, as Dr Meredith stated in his supplementary evidence (#36) that the guidelines had been "released". See also #48f in my evidence in chief. Firstly the guidelines were intended by NIWA to be just guidelines, as the report title says. Secondly the guidelines are explicit that they were intended to relate to intakes of up to 10 m^3/s capacity. Thirdly they have not been endorsed, other than as a collection of useful information, by the sponsoring agencies, i.e. the Fish Screen Working Party chaired by ECan, and ECan itself. Fourthly I understand further studies are being promoted by the Fish Screen Working Party into key underlying issues such as the needs of the salmon fishery, and these have not yet been undertaken. I accept, as stated in my s42A response, that the guidelines are a useful tool, but it is important to acknowledge they have no deliberative status and were not intended to have any.

28. I have found the evidence of Mr Bejakovich and Dr Meredith very helpful and informative and, as far as it is within my expertise, I agree with them on many points. Regarding the points of disagreement I found the following information helpful:

- I understand that Fish and Game (South Canterbury) endorsed or at least accepted the appropriateness of a process-based condition for fish screening on the Hunter Downs Irrigation on the Waitaki River, with the wording almost identical to what is proposed for CPWES (verbal evidence of Mr Bejakovich).

- The case history is that larger intakes require one-off designs and approaches to consenting, and this fits with the NIWA guidelines

- There are other examples of process based consent conditions being granted, as in the evidence of both Mr Bejakovich and Dr Meredith. In addition I am aware of the recent decision on the Wairau Trustpower case which has imposed fish screening conditions that require a design process similar to what is proposed for CPWES. So it is not uncommon, and it is possibly even the norm, for larger intakes to have consents granted with process based conditions.

- There is a variety of forms of screening that could provide at least a partial solution, and could potentially modify the details of a subsequent final screen, as described by Dr Meredith.

29. From all this information it is my opinion that, prior to specifying design details, there are three preliminary steps that should be taken:

    - Assessment of fishery needs. For example we should address the question: What loss of fishery could be sustained while maintaining a viable fishery (I understand this is the purpose of the RMA, as far as it relates to fishery interests). I have been informed that other avenues of loss include spawning losses, losses from unsuitable river conditions during transit to the coast, losses at sea during the years of growth, and losses from angler catching on the return journey up the river. My view is that the potential losses from entrapment at intakes need to be considered in the context of all losses, to enable development of suitable performance criteria at the intakes. This is particularly the case for large intakes where it is appropriate to make a more detailed assessment than for the small intakes that the NIWA guideline applies to.

    - Evaluation of alternative approaches to maintaining a sustainable fishery. For example would the most helpful contribution that CPWES could make to maintaining a sustainable fishery be by installing a fine screen mesh, or by addressing one of the other avenues of loss, such as enhancing rearing habitat near the spawning areas (see evidence of Mr Bejakovich). These two points taken together will provide the basis for a performance specification for subsequent detailed design.

    - Consideration of the form or forms of screening. For example the NIWA guidelines and Dr Meredith's evidence describe a range of forms of

screening that could provide a solution in whole or part to the fishery needs.

30. A process based solution is in my opinion the most realistic way ahead. I consider that to specify design details by way of condition is imposing solutions before the problem has been properly analysed, and is potentially binding CPWES to technology that could be inappropriate in two to three years when the final design of CPWES fish screens might be commissioned. In my opinion the process proposed already by way of condition by CPW fits the NIWA guidelines, is in tune with much current practice in Canterbury, and offers clarity, certainty and accountability.

Secret urupa and Selwyn River pa

31. Mr David O'Connell, General Manager Tribal Interests for Te Runanga o Ngai Tahu (TRONT), indicated in his evidence that there was a secret urupa in the vicinity of the Kowai and Waimakariri River confluences, and an additional pa site in the vicinity of the Selwyn River near Coalgate. He stated a willingness to reveal these locations and enable an assessment of the potential effect of CPWES on these sites.

32. From further discussion with Mr O'Connell it is now apparent that the location of these two sites is unknown (except that the urupa is understood to be on the south side of the Kowai) but TRONT is intending to engage the services of an archaeologist to identify their locations if possible. Therefore it is impossible to comment on the likely impact of CPWES.

33. I recommend that planning proceeds on the basis of the presently proposed standard conditions relating to cultural and heritage matters, i.e. conditions 11 and 12 of the SDC conditions common to the six consent applications, and conditions 11 and 12 of the proposed designation. In the event that these two items are within the footprint of the scheme works this will be identified in a survey prior to construction and steps to avoid or mitigate the potential effects on these sites will be taken as prescribed by those conditions.

Flood events in Waianiwaniwa valley

34. URS's dam design team calculated the probable maximum flood that could occur in the Waianiwaniwa valley and proposed a spillway that would safely pass that flow. However some submitters questioned the level of flood allowed for and the Commissioners asked me to report on the

design flood compared with floods that have occurred within the memory of residents of the valley.

35. The appropriate design flood for a dam such as the proposed Waianiwaniwa dam is what is called the Probable Maximum Precipitation event (PMP). In this case the PMP was calculated to be 450 mm in a 24 hour period.

36. The closest recognised rain gauge to the Waianiwaniwa valley with a long term record is at Lake Coleridge, with daily rainfall records going back to 1913, i.e. 95 years. To check the applicability of this site we identified a short term rain gauge at Whitecliffs. This is the closest NIWA rain gauge site to the Waianiwaniwa valley, being about 6 km from the valley, just over a small ridge and in a similar location with regard to westerly rainfalls and proximity to foothills and plains. I consider that for the purpose of this exercise the Whitecliffs site would be reasonably representative of storm rainfalls in the Waianiwaniwa valley. The Whitecliffs gauge has 20 years of published records, from 1988 to the present. We compared the Lake Coleridge records with Whitecliffs and found that, while there was not a consistent correlation between the two sites for particular storm events, a statistical analysis shows almost identical estimates for 1-in-100 year events, etc. Therefore I have adopted the Lake Coleridge records as representing the rainfalls in the Waianiwaniwa valley adequately for the purpose of this exercise.

37. Over the 95 years of records at Lake Coleridge, the following are the 10 largest daily rainfalls, ranked in order of magnitude:

Date	**Daily rainfall[1] (mm)**	**Return period (years)**
20/04/1963	124	62
18/04/1951	113	43
22/07/1916	100	28
24/10/1942	89	17
6/05/1979	86	16
19/04/1951	79	11
31/08/1970	79	11
27/02/1999	78	11

[1] As stated above these do not necessarily match the rainfalls that fell in the Waianiwaniwa valley on that day.

15/04/1916	77	11
17/11/1967	73	9

38. Analysis of both the Lake Coleridge and Whitecliffs records produces an estimate for a 1-in-1000 year rainfall event of 253 mm and 252 in one day respectively.

39. As a further check, the HIRDS database produced an estimated 100-year rainfall of 140 mm for the Waianiwaniwa valley, matching very closely the Lake Coleridge and Whitecliffs individual estimates. (HIRDS stands for High Intensity Rainfall Design System, a database and software developed by NIWA from the wider available network of rainfall records, especially long term records, and is the standard tool in New Zealand for calculating design rainfalls for sites that do not have a long term rain gauge on location.)

40. I have therefore concluded that the design flood for the Waianiwaniwa dam is considerably in excess of any recorded floods in living memory.

Location of intake works for lower Waimakariri intake

41. Mr Ross Vesey, Regional Engineer for the Canterbury Regional Council, stated he would prefer that the scheme's headworks downstream from the intake tunnel exit, be shifted further away from the river's edge. The works cover a length of some 500 m, and include the race from the tunnel exit to the sediment trap, the sediment trap itself, and the controls and start of the overflow channel at the downstream end of the sediment trap. Mr Vesey stated he would like to see these works shifted some 200 m westwards, to follow the line of the SDC stockwater race and the line of a low terrace. From an engineering perspective I am not persuaded that this shift is needed for CRC interests, but it has no significant effect on CPWES and I consider it is therefore feasible. However it is outside the Notice of Requirement and therefore I propose that CPWES uses an alignment as far west within the NOR as possible.

Location of headrace along Waimakariri River terrace

42. Mr Vesey of CRC has firmly advocated shifting the headrace out of the riverbed when running alongside the Waimakariri River and sidling up the terrace below the proposed lower Waimakariri intake. This is to ensure

the integrity of river training and erosion protection works that have been established over a number of years. The area of concern covers about 2.5 km of the terrace face from what CRC calls the Kimberley Cliffs to Redmonds Road. In principle I support Mr Vesey's submission but I would like to leave open the possibility of CPWES's canal encroaching a short way into the riverbed, should there be a clear advantage to CPWES in doing so. This could be for reasons of cost, or to avoid adverse effects to the adjacent landowner – see next paragraph. Detailed site survey and design will be required to resolve this matter finally. CPW has proposed a condition that effectively gives CRC the power of veto (see amended conditions of July) should they disagree with a later proposition from CPWES, and I consider that should meet the requirements of Mr Vesey.

43. Counterbalancing Mr Vesey's preference is the effect of the terrace race on the property of Mrs Averil Bull, whose land occupies approximately the same length of terrace face that is concerning Mr Vesey. In my discussions with her Mrs Bull has stated a strong preference for keeping the terrace canal in the riverbed to reduce adverse effects on her land. We have drawn a plan showing the affected area using the limited survey information available at this point, and this is attached as Appendix 1.

44. Using this I consider it is feasible for CPWES to reduce its designated area through the property of Mrs Bull to the area shown on the plan. Further, I consider CPWES should offer, by way of condition, the following:

- Seek to minimise the width of canal construction on the property of Mrs Averil Bull as far as reasonably practicable while not jeopardising the stability of the terrace face,
- Pay for the relocation and rebuilding of any buildings that require removal,
- Securely fence the canal at the top of the reconstructed terrace face,
- Make all practical endeavours to re-establish a shelter belt along the top of the terrace as soon as practicable after the location of the reconstructed top of the terrace is known, and in advance of removal of the existing shelter belt as far as practicable, including fencing and irrigation of the trees, and maintenance and replanting (as required) for five years. This effectively reflects what is required under condition 7 to the designation.

45. This proposal package gives certainty to CRC. It also reduces the width of the designation band as far as practical at this time, and offers specific mitigations, to provide some assurance for Mrs Bull. A considerable amount of work will be required, should the canal proceed, to finally resolve the design issues as the design of the terrace canal will be sensitive to the outputs of detailed topographical and geotechnical surveys. These will need to extend over some kilometres of the headrace both upstream and downstream from the section in question to achieve an integrated design, and because of their extent it is not feasible to complete them at the present stage.

Flushing from sediment traps

46. Mr Vesey expressed further concerns about the passage of a flood wave down the Waimakariri River, after flushing the sediment settling traps. His concern was for safety of river users including ECan officers or contractors who could be in the river at times other than common recreation periods.

47. I addressed this in my evidence in chief, #78 to 89, and in my response to the s42A reports, #31 to 35. There I indicated that the maximum rise of water level would be about 180 mm at the point where the flushing channel merges with a main river braid, and that this would last for a few minutes at that site, and would attenuate rapidly as it passed downstream. See also the proposed conditions as modified in July.

48. For further information, our analysis of the attenuation showed that after 10 km of river, the rise in water level would be almost undetectable. Therefore I conclude that this is a small effect that will not cause risk to river users beyond the vicinity of the flushing point. This reinforces my recommendations in my earlier evidence, and the conditions proposed by the applicant. I believe Mr Vesey agrees with these conclusions.

Selwyn District Council stockwater races

49. Mr Hugh Blake-Manson, for SDC, expressed concerns about the effect of CWPES on the SDC stockwater scheme, including the practicality of having two open race reticulation networks across the plains, i.e. both the existing SDC stockwater races and the proposed CPWES distribution canals.

50. I addressed this briefly in my evidence in chief, #232 to 236. CPWES has promoted as a base case the construction of new irrigation supply channels as a separate and independent network. That assumes the continuation of the SDC stockwater races although the two race networks would often be in close proximity. This had initially been accepted by SDC.

51. In response to Mr Blake-Manson's concerns we have examined this proposition in more detail. Firstly we have considered the plains, with potentially two overlapping networks of open races. We identified an area with the help of Mr Blake-Manson that included all the types of interactions that we could foresee, and developed solutions, including cost estimates, for all the potential conflict points. The area concerned covered 6100 ha (gross land area) in the Darfield-Kirwee area.

52. The types of interactions were identified as crossings, canals running along the same alignment, and irrigation races blocking access by stock to the stockwater races. The solutions that we identified are shown in two plans in Appendix 2 and consist of siphons, pipes from the stockwater race to troughs, piping of sections of the stockwater races, and shifting the CPWES races slightly to avoid the stockwater races (while still being effectively in the same alignments as in the land use consent applications).

53. I consider this analysis demonstrates that practicable solutions are available to all the types of interactions that will be encountered by the two race networks.

54. Secondly we considered the special case of the Waimakariri River terrace below the Gorge Bridge, where the intake race for one of SDC's main stockwater networks occupies the space that CPW would like to use for its terrace canal. We proposed as a base case that CPWES and the stockwater race would be combined through the terrace race section, but that during CPWES's construction phase the stockwater race would be pumped up to the top of the terrace and piped by gravity along the terrace top to rejoin the existing stockwater race near Bleakhouse corner. It is assumed most of the pipes from this would be recovered at the end of the construction phase for reuse elsewhere.

55. Again I consider this to be a reasonable and practicable solution.

56. Therefore I conclude that it is practicable to implement CPWES's base case i.e. to have two independent networks of canals on the plains servicing separately the stockwater and irrigation supply needs of the central plains.

57. Note that this discussion is not intended to imply that the base case is the optimum solution. Rather it simply demonstrates one feasible solution that allows planning including consenting to proceed. I expect other solutions will be examined as CPWES proceeds, should it gain consents, and as SDC advances its own water supply planning. I am aware that SDC is currently considering a number of options for meeting stockwater needs in the future and it would clearly be advantageous if the two organisations eventually integrate their planning to achieve the best overall solution.

Updated cost estimate for scheme

58. **Capital costs**. I presented the estimated capital costs of the scheme in my evidence in chief, #257 to 261. The figure of $409.6M assumed a base date of early 2007, with a gravity supply to the reservoir via a tunnel, a single intake on the Waimakariri River, a reservoir capacity of 240 MCM, and an open race reticulation network.

59. The commissioners asked for an update on this and an indication of the effects of potential mitigations, also to comment on land purchase costs.

60. The cost estimate included a contingency allowance of about 25% of the total cost, i.e. some $82M. This contingency allowance was to cover unforeseen circumstances, recognising the preliminary stage of investigation and design of the scheme components, and mitigation activities. Mitigation activities were not identified as line items as the nature and extent of these were unclear, and still are.

61. The assumed land purchase cost in the 2007 estimate was $20 million. That has risen now to $59 million. Over the headrace and distribution works, that price assumes the purchase of all land that would be occupied by the scheme works, although it is recognised that landowners might prefer to lease many sections. Within the reservoir it assumes the purchase of all land that would be occupied by the reservoir, and assumes an additional 1000 ha to allow for those farmers who might want CPWL to purchase the whole of their properties, not just the area to be flooded. Note that some of this is likely to be on-sold later, recovering some of this cost.

62. Regarding the effect on the scheme of mitigations that have been offered, I have assessed the approximate costs of some potential items. I consider lowland drainage remedial works would cost in the order of $2M to $6M. I estimate that the cost of other suggested direct mitigations such as additional wells (if required to ensure drinking water quality standards of supply to households), mudfish habitat restoration and enhancement, and kayak bypasses at the Rakaia and upper Waimakariri intakes would all cost considerably less than remedial drainage works. These sums are relatively small compared with the total scheme cost, and at this stage of scheme planning it is appropriate to consider these to be included within the contingency allowance given above. By way of contrast, the extra cost of an increase in the height of the Waianiwaniwa dam, if this is required as a consequence of mitigating flows to be left in the Waimakariri River, could be up to $30M. (I have not allowed for compensation for Canterbury Coal as there has been no discussion as to what costs might be involved. I understand Canterbury Coal indicated a potential value of coal of some $20 million, and I presume that the compensation from CPWES would be much less than this, allowing for initial prospecting to establish the true scope of the mine, the costs of winning the coal, etc.)

63. The latest construction cost index from Statistics NZ's Producers' Price Index (this is the usual index on movements in construction costs) is 1445 at March 2008. This is an increase of 4.0% over the index of 1390 assumed for the cost estimate presented in my evidence-in-chief. On this basis, and adding separately the land purchase cost component, the scheme cost of $409.6M would have risen to $464M to the present time.

64. Based on this figure the capital cost per hectare irrigated, as used by Mr Macfarlane and Mr Donnelly in their economic evaluations, and assuming 60,000 ha irrigated from the scheme, will have risen from $6827 per hectare to $7736 per hectare.

65. I would like to emphasise that the main uncertainties in capital costs are not related to mitigations but rather to the factors presented in my evidence-in-chief. These factors were: whether the reservoir will have a tunnelled gravity intake from the Waimakariri or a pumped supply at Coalgate; whether there will be one or two intakes from the Waimakariri; what the final height of the dam will be (this might be affected indirectly by mitigations related to river take regimes); and whether there will be piped or open channel reticulation.

66. **Operation and maintenance costs**. I have updated the earlier estimates to provide an estimate of $4.6M per year for operation and maintenance activities, including pumping costs for areas above the headrace. This assumes a gravity supply to the reservoir, i.e. a tunnel from the upper Waimakariri intake. (I estimate the running costs for a pump station at Coalgate, it that were used instead of the gravity supply, would add about $1.8M per year in running costs plus up to $1.2M per year in maintenance costs.) This equates to $77 per ha per year if spread over 60,000 irrigated hectares.

67. Questions were raised by witnesses and the Commissioners about what the charges would be for irrigators to increase their reliability of supply from 90%, as for the basic share purchase in 2004, to the 98% or so assumed in scheme planning. That is an internal management matter that has not been decided. The CPWES operating company will want to recover its full operation and maintenance costs and will decide on a pricing structure that will enable that recovery. The bottom line is they will want to recover the actual costs, which I currently estimate at $4.6M, which would average $77 per hectare per year.

Feasibility of providing storage in on-farm dams

68. The Commissioners have asked for further information on the feasibility of providing CPWES's storage needs from on-farm dams instead of building the large Waianiwaniwa storage reservoir. The obvious advantage is that the storage ponds would be built on the land of those who use them and there would be no disruption to land and activities within the Waianiwaniwa valley.

69. I addressed this topic briefly in my evidence in chief, #14. See also the evidence in chief of Mr John Donkers, for the applicant, #35-38. A number of submitters have addressed this topic, generally advocating on-farm storage ponds.

70. I first investigated the viability of on-farm storage ponds in the central plains area in the 1980s, as a means of compensating for the run-of-river restrictions that resulted from the Rakaia Conservation Order. It was immediately clear from the time of the announcement of the Order that, in the long term, community based irrigation in the central plains would require buffer storage. My conclusion at that time was that technically on-

farm ponds could perform a useful function, and this should be one storage option to consider in developing scheme details.

71. To develop that information for CPWES and now compile information for this hearing I and my team have talked over the last few years with farmers, farm advisors, engineers, irrigation managers and construction contractors from mid and north Canterbury. We identified some nine case studies of constructed dams, summarised information on a wider range of dams from experienced contractors, and information from a further two ponds which were investigated in the Mayfield-Hinds area but never built. Three ponds which I investigated for this area in 1986 were also reviewed for a comparison of design methods, but were not included in the analysis as the cost parameters were out of date.

72. I have been informed by contractors and others that perhaps two hundred of these on-farm dams have been built around mid and north Canterbury in recent years. The typical on-farm storage pond is used to supplement run-of-river supply of scheme water or groundwater, to provide a higher reliability of supply. Commonly these ponds are built only for the benefit of the farm where they are located. Parameters include:

- Total capacity: 30,000 m^3 to 120,000 m^3
- Area of land supplied: 60 to 300 ha, for example a 80,000 m^3 will supply 140 ha with 4 mm per day for 14 days
- Capacity per hectare: 250 to 770 m^3 storage per hectare irrigated
- Lining: most lined with local topsoil using silty layers from the upper strata of soil, although a few have synthetic liners (these ponds are significantly more expensive). Typical depth of lining is 100 mm per metre depth of water.
- Depth of pond: often graded from zero depth at the uphill end to up to 2.5 m. This is commonly the maximum depth due to sealing issues, as ponds deeper than this will often require a synthetic liner which will significantly increase costs.
- Pond area: 2 to 8 ha
- Construction style: built in a balanced cut to fill operation generally from local in situ materials, although some have imported silts to help seal the

ponds. It is also common to import rip rap for erosion protection although in the Mayfield-Hinds area there are large stockpiles of rip rap material and therefore dam costs are reduced in these areas.

- Source of water supply: by gravity from a run-of-river scheme supply, although some are filled from groundwater
- Capital cost (adjusted to 2008): average capital cost for ponds installed in the last 4 years is 2.80/m^3, including the cost of land lost from irrigation for pond installation, and the costs of supply.
- Time to empty pond: 7 to 14 days at full flow rate, or double that time at half rate. A common design size is for 14 days storage at 4 mm per day

73. Other options can include larger multi-farm ponds, such as a storage reservoir being built in the Mayfield-Hinds scheme.

74. A significant feature of these on-farm ponds is that are being used to boost the reliability of supply in schemes that have a higher base reliability than CPWES. For mid Canterbury Mr Macfarlane's evidence is that the RDR-based schemes operate at well over 90% reliability without storage ponds (measured as the proportion of days that supply from the Rangitata River would be restricted or cut off), so farmers are boosting their supplies to close to 100% reliability. The RDR schemes can achieve that reliability because (a) there are fewer restrictions in taking water from the river, so there is less need for storage, and (b) the better availability of water allows more frequent topping up of the ponds when they have been emptied.

75. In WIL we have assessed the long term run-of-river reliability to be about 80% (on a volumetric basis) so the ponds have higher demands on them than in the RDR schemes – and conversely have a less reliable source of water for filling them. But they are still being installed in substantial numbers as farmers clearly feel they are both needed and useful. It is notable that the two largest ponds (per hectare irrigated) in the sample we compiled were in the WIL area. This is to be expected.

76. By way of contrast CPWES, by taking water from a high allocation band on the Rakaia and from Class B water on the Waimakariri[2] would be without run-of-river water frequently, having a reliability of some 55 to 60% from that source. Further this low run-of-river reliability also means that the

[2] If CPWES eventually has access to some Class A water the reliability of run-of-river supply will not be improved significantly as the amount of Class A water will supply only a small proportion of CPWES's needs.

storage ponds would be unable to access water for replenishment for long periods of time. These two factors combine to indicate a need for substantially more storage per hectare of land irrigated than for the RDR based schemes or WIL with its access to Class A water to achieve the reliabilities that people require.

77. Some relevant parameters proposed for CPWES, for comparison with the on-farm dams, include

- Total capacity 240 to 280 MCM (depending on terms of consent granted for takes from Waimakariri River)
- Area of land supplied: 60,000 ha
- Capacity per hectare: 3667 to 4667 m^3 per ha depending on terms of consent to take water from the Waimakariri River
- Lining: not needed because of impervious nature of reservoir
- Depth of pond: maximum of 50 m
- Pond area: 1200 ha
- Construction style: embankment dam across mouth of valley
- Source of water supply: Waimakariri River by tunnel, using run-of-river water
- Capital cost (adjusted to 2008): $280 million (dam $181 [at 240MCM capacity], plus cost of supply $112 million, less cost of intake works that would be required without dam $13 million).
- Time to empty reservoir: 64 days at continuous maximum demand

78. In summary then, I repeat my earlier conclusion that a large scale reservoir, such as proposed for the Waianiwaniwa valley for CPWES, is the only practicable way to provide the required storage capacity for a modern scheme such as CPWES. My key reasons are:

- The cost per hectare irrigated would be much lower. To provide the same storage per hectare as the common mid Canterbury ponds would cost $2.25 to $3.85 per m^3 of storage, compared with CPWES's $1.17 per m^3.

- The required water supply performance would be much easier to provide. To provide a reliability of supply of around 98%, as proposed for CPWES, on-farm storage would need to be enlarged from the 250 to 540 m^3 per hectare irrigated, typical of mid Canterbury, or higher figures for WIL, to between 3667 and 4667 m^3 per hectare irrigated, depending on the restrictions that might be imposed on takes from the Waimakariri River.

- From a simple extrapolation (this is a crude approximation provided for indicative purposes only) the cost for CPWES to provide its planned level of reliability by on-farm storage would cost between $12 and $55 per m^3 of storage, compared with Waianiwaniwa's $1.17, or a total of between $2.6 billion and $15 billion, instead of the $280 million for its present proposal.

- The efficiency of land used for storage would be much higher. The area of the proposed Waianiwaniwa reservoir is 1200 ha, whereas to provide the same reliability performance with on-farm ponds, with the typical mid Canterbury sized constructions, would take some 6000 ha. Or to express it another way, the ratio of land irrigated to land taken out of production for storage would be 50:1 for the proposed CPWES, whereas this would fall to 10:1 for on-farm-style ponds of the typical mid Canterbury size. The disparity would be substantially larger if the proposed CPWES reliability performance were to be provided by way of on-farm dams.

Alternative canal routes through Homebush

79. The Commissioners asked for information about alternative routes for the headrace through the Homebush property (of Mr James and Mrs Louise Deans). Specifically they asked for an illustration of routes that sidled along the face of the hillside or, alternatively that kept off the hillside altogether and were located on the flats between the homestead area and Homebush Road. I understand the concern related to the amount of land taken by the proposed canal and the visual impact of the canal.

80. I have been informed that the presently designated route was chosen in discussion with Mr James Deans to avoid disruption to the homestead area and in particular the historic buildings there. This was done before I became involved in the details of scheme planning in 2005.

81. A key criterion is that the race needs to be at an elevation of 235 m if it is to be able to run water in both directions. This is a key requirement of the

scheme concept for giving the flexibility to allow the most efficient and effective use of water from all sources.

82. With that criterion the plans in Appendix 3 show two locations of the canal as requested. They indicate the extent of construction in both plan and cross section. The location of the sidling canal was fixed by the criterion that it should be on the terrace face. The location of the canal on the flats shows one option that illustrates the key features of any flats location: the particular option shown was selected to avoid crossing the Waianiwaniwa stream. It is roughly midway between the hills and road. The plans show that a sidling canal on the hillside would vary in width from about 60 m to 150 m wide, would run close to or through the homestead facilities, would significantly change access patterns in that area, and would require removal of a large proportion of the trees on the hillside. A canal on the flat land towards the road would vary in height from about 7 m to 17 m, and in width from about 80 m to 130 m if it was to maintain the functional requirement of the 235 m level.

83. The canal route as designated would vary in width between about 50 m and 100 m with something more in the peak of the ridge where we lack survey information. It would avoid the homestead area altogether, and all the trees on the hillside by the homestead, and it would be largely invisible to the public as it would run through a valley that is behind a ridge, as seen from Homebush Road.

84. In my opinion the presently designated route is by far the best option.

Extent of construction zone through downlands properties

85. The Commissioners have asked for plans showing the likely width of construction for the headrace through the Homebush to Downs Road section. See the two plans in Appendix 4, which show on an aerial photograph base the designated band and the edge of construction batters.

86. It is important to note that this is an initial line and I am sure the exact location will change (within the designated band) during detailed topographical and geotechnical survey, and through final consultation and design. For now I consider it essential to maintain a designated width beyond the construction batter lines to allow for modifications to alignment

and construction needs, including stockpiling of material, construction of site offices and safe access routes for construction traffic.

Individuals directly affected by scheme works

87. **General: changes in headrace alignment**. The Commissioners asked for information on the changes that have taken place in the alignment of the headrace as the project details developed, and particularly the changes that had resulted from consultation. I have attached as Appendix 5 two plans showing a blue line and a red-shaded area. The blue line is the initial alignment that resulted from a topographical survey in late 2005, and it follows the chosen 235 m contour fairly closely. The red shaded area covers the current notice of requirement. The blue line was intended as an approximation to an ideal engineering line in that it would provide a balance of earthworks volumes, thus minimising costs. It was drawn in the office, taking little consideration of the practicalities of farming needs, and it formed a starting point for discussion with affected landowners and other parties from late 2005 through the first half of 2006. The changes from the blue line to the red-shaded area were primarily the results of consultation with landowners and other parties, with some adaptations in response to site inspections for engineering realities. That is not intended to imply that the red shaded areas were the preferences of all landowners as sometimes adjacent landowners' wishes were incompatible, and in other places I considered, in consultation with other advisors, that the landowners' preferences were impractical. But the red shaded areas were drawn in recognition of landowners' wishes, and followed their wishes as much as practical.

88. **Trevor and Heather Taege.** Apart from issues that I have addressed previously Mr Taege has raised a concern about the potential for CPWES to increase the erosion that occurs on the river bank adjacent to his property. I agree that there is the potential for river works to have effects on other properties and I consider the scheme should ensure that existing erosion is not exacerbated. For Mr Taege's reassurance we should note that CPWES will have a major vested interest in protecting its own assets and it is therefore likely that CPWES will in fact improve the security of the Taege property from erosion. The means are likely to consist of a selection of rock protection, river channel training, groynes and tree planting. There could be a need for some stopbanking, although at this stage I expect that will be provided by the scheme canal banks.

89. **Waimakariri Alpine Jet and other jet boating at upper Waimakariri intake.** A number of submitters have raised concerns and suggested conditions with regard to access to the riverbed, preferred locations of diversion channels, hours of work for management of diversions in the riverbed, and requirements for boating channels through the adjacent reach of the river. I refer the Commissioners again to my evidence of July 2008, section 4, and the need for a River Diversions Management Plan. That section described the objectives of such a management plan. I am satisfied that it will be possible to develop more detailed conditions that will satisfy the needs of submitters.

90. **Bevan and Kathy Mehrtens**. Mr Bevan Mehrtens, of The Nook, near the proposed upper Waimakariri intake, submitted that the scheme, if it proceeds, would need to provide at least three crossings over the headworks to provide access to the riverbed and the lower paddocks by the Kowai River. I agree. Subject to further consultation, I consider one should be at the intake structure, one at the control gate, and one by the downstream paddocks, possibly incorporated into the headwalls of a Kowai River siphon.

91. The Mehrtens have also raised a concern that CPWES could cause or increase erosion and flooding from the Waimakariri River. The remarks above regarding erosion on the Taeges' property apply also to the Mehrtens' property.

92. **Averil Bull and Bull Family Trust.** See my comments earlier regarding location of headrace along Waimakariri River terrace.

93. **Norman and Philip Thomas.** Within the areas of my responsibilities Mr Philip Thomas raised the following matters:

Issue	**Response**
1. Instability of headrace on Waimakariri terrace	See evidence of Mr Clive Anderson
2. Location of headrace through middle of property	As for Mr Judd (see below) a race along Bleakhouse Road could be considered. A change of designation or other legal device would be required.
3. Headrace to be piped	The cost of this would be extremely high as the canal is to be on a flat grade, allowing minimal

	headloss
4. Or headrace to run along boundary or road	See comments below about Mr Judd's property
5. Distributary canal D2 to follow Tramway Road	See comments below about Kimberley Residents submission

94. **Godfrey Judd, Westacre Farms.** Within the areas of my responsibilities Mr Judd expressed concerns about the matters below.

Issue	Response
1. Length of time the canal construction would affect farming operations	It is likely that construction in the area of Mr Judd's property would take a number of months through a summer. I expect financial arrangements would be negotiated as part of the total property compensation package.
2. Effect on operation of rotorainer irrigators	Mr Judd has raised valid concerns. However with the designation route shown the bank tops will be at the same level as the ground and there may be practical solutions. If he is still using rotorainers when CPWES is built his area then the scheme could consider helping to install different irrigators that would operate more readily around the headrace. That would be part of the total property compensation package as required under condition 7.
3. Alternative location for the headrace	Mr Judd's proposal is a variation to options we have discussed previously. Bleakhouse Road at the top end of the property is at a level of ~243 m. A headrace there, as proposed by Mr Judd, would have an invert ~12 m below ground and the construction width with a standard cross section would be up to 67 m. In my view this option is worth considering in the context of the total property compensation package, and in consultation with other affected parties, particularly Mr Philip Thomas. A change of designation or other legal device would be required.
4. Width of land taken by the designation	I consider the width of the designation is the minimum that is practical for construction, for reasons that I have stated previously. But I would not be opposed to that width being reduced once construction is completed.

95. **Cindy McKenzie**. Ms McKenzie raised a concern in submission that the headrace might pass through her property on Cullens Road, but this was not clear as the designation allowed for it be either in her property or her neighbours'. I have reported already to Ms McKenzie and the Commissioners on this, and have confirmed that, because of the road levels and the preference of SDC to maintain an even grade over canals where they cross roads, the headrace will be entirely in her property. I have indicated that the designated area can be removed from the neighbours' property as a consequence. A plan is attached as Appendix 6.

96. **Jocelyn and Philip Deans.** Within the areas of my responsibilities the Deans expressed concerns about the two matters below.

Issue	**Response**
1. Access across Deans Road	Details of access would be arranged with the Deans at the time of final design.
2. Affected houses, hence alternative headrace route	There are no houses on the Deans property affected by the proposed headrace route.

97. **Tim and Gilly Deans, Auchenflower**. The Commissioners asked for further details of my visit to the property of Mr Tim and Mrs Gilly Deans. The visit took place in April 2006, when Mr Klaus Ohlbock and I from URS met Messers James Deans (of Homebush) and Tim Deans (of Auchenflower) on site. As I recall it Mr James Deans was our main guide around both properties as Mr Tim Deans was busy. But we met Mr Tim Deans at his woolshed on Rowallan Road, and my notes state that we discussed with him the location of the headrace especially with regard to the woolshed, and we also discussed farm access lanes, storage of water in farm gullies, and possible land swaps between neighbours. Regarding the headrace, the preliminary headrace line had been drawn on the 235 m contour, which ran along the lower slopes of the hill, just behind or possibly through his woolshed, and Mr Deans indicated he preferred the headrace to be on the plains side of his woolshed rather than shifting further into the hill slopes. That is the location that became part of the Notice of Requirement. My recollection is that he accepted that would require shifting his sheep yards, and that the location he preferred would either

place some restrictions on the space left for his sheep yards or require access across the headrace from his woolshed to the new sheep yards.

98. **James and Louise Deans, Homebush**. See my comments earlier regarding alternative canal routes through the Homebush property.

99. **Farmers Group Southern Headrace**. Mr James Deans presented a submission on behalf of the Farmers Group, Southern Headrace. I can respond as follows;

Issue	**Response**
1. Consultation with landowners over race route	I see no difficulty with the condition proposed
2. Culvert designs	I see no difficulty with a condition along the lines of what is proposed
3. Discharge to north branch Waianiwaniwa River	I see no difficulty with a condition along the lines of what is proposed and I am seeking ecological advice as to how to word a suitable condition
4. Emergency discharges only to principal stems of Selwyn R at Coalgate and Hororata R at Hororata	It is possible to design the headrace so that discharges would be distributed in manageable flows to other streams. For example with average annual floods of over 50 m^3/s the Hawkins and Waianiwaniwa could also be suitable receptors. Further details would be part of final design as in #132 of my evidence in chief. In my view it is likely to be preferable and, overall, safer to make use of a wider range of streams.
5. Scheme boundary to be extended in north-east	From an engineering perspective I see no difficulty with supplying the flat land in the Deans Road/ Homebush Road area.
6. Access along headrace restricted to core irrigation activity	I have no difficulty with this. This would be part of the terms of sale or lease that would be negotiated with each property owner.
7. Double sided impoundments across gullies	In general I agree, for the reasons stated by Mr Deans. The only exceptions would be if individual farmers wanted to have access to the water, say for stock or other purposes, and a single sided embankment was mutually beneficial. Those situations would be rare, and if all members of the farmers' group want the condition suggested then I would have no objection.
8. Bridging standards –	I support the need for both an adequate

numbers and load baring capacity	number of bridges and that they should be built to highway non-impact loading standards
9. Fencing standards	This is covered by proposed condition 7
10. These commitments to be at CPWES expense	I agree

100. **John and Rosalie Austin**. In addition to supporting the Farmers Group Southern Headrace submission, the Austins expressed concerns about the matters below that are within the areas of my responsibilities.

Issue	Response
1. Canal route across property	The Austins prefer the canal would avoid the small triangular block of land to the north east of Aitkens Road: this would be difficult because of the steepness of the land and effects on adjacent properties. Through the middle of the property, while the Austins would prefer a headrace line that runs along a present boundary and fence lines, they also want to avoid the extra width of construction that would result: hence the wider designation band to allow some flexibility following detailed topographical survey and further consultation with the Austins. At the north western extremity of the proposed canal the Austins want the canal to run to the boundary and possibly remove a small ridge: the designated band would allow for that.
2. Bridging of canal within property	See comments above regarding Farmers Group, Southern Headrace
3. Deer fencing	This is covered by proposed condition 7
4. Gullies, ponding water against canal	See comments above regarding Farmers Group, Southern Headrace
5. Stock movements, areas for cropping etc	See comments above about bridging. Reduction of land area would be recognised in the total property compensation package.

101. **Ross and Margaret Manson and Rodney Booth.** On behalf of the group Mr Manson requested two assurances which I can respond to as follows:

Issue	Response
1. Access across headrace	I agree CPWES should provide at least one access across the headrace. The normal width would be 4.8 m, which has been found to be suitable in all other irrigation projects I have worked on; guide rails are generally required to ensure stock move effectively. I do not consider a 20 m bridge width is required.
2. Location (or piping) of distributary race TP2	Mr Manson has asked for two options for an amendment to be considered. I agree they should both be considered further at the time of final design in consultation with Mr Manson, and further options could also be considered.

102. **Kimberley residents**. Residents from the Kimberley area lodged a group submission expressing concern about the layout of proposed distribution races in the area between Darfield and the Waimakariri River. This is on map 3 in appendix D to my evidence in chief. See also the submission of Mr Philip Thomas, as noted above. The Kimberley group expressed a wish for Race D2 to run down Tramway Road instead of partly in Auchenflower Road, and for Race D3.1 to be eliminated. The locations shown in CPWES's proposals were my best endeavour to service the needs of the area, as far as they had been explained to me and my team over the first half of 2006. During that period I met with people from the Kimberley area a number of times, and I found it particularly difficult to obtain a consensus or even a clear majority view about race locations. One solution would have been to pipe many of the races using, probably, different locations from what is drawn, but that would have been more expensive and would have set a precedent for other areas that I did not have a mandate for. Another solution that a number of landowners supported in principle was to consider reconfiguring property boundaries, which currently create some disjointed areas of land, into more contiguous blocks. But this solution was not able to progress far enough in the time available. I am not sure that the alternative requested in the group submission would meet the needs and wishes of all property owners, including those beyond the group named in the submission, and some compromises will be required, should the scheme proceed. My opinion is that further consultation should be held with the landowners in the Kimberley area, using a mediator if necessary, to attempt to reach a consensus decision on the location of races before final plans are drawn I

note that this could lead to a consent variation or other legal device at the time of final design. It could also lead to at least some additional piping in the area, particularly in the vicinity of houses and domains.

103. **Carol Garland and John Pilbrow**. Ms Garland, Old West Coast Road at Courtenay, brought a submission that included concerns about the proposed location of the distributary race D2.1. The proposed location followed consultation with a number of property owners in that area, including Ms Garland. It included considerations of how to supply some properties further down the race that wanted water, and a wish to elevate the race, i.e. to build it on top of the terrace at the river edge of her property to keep it further out of the river floodplain. I see a number of potential solutions to Ms Garland's concerns. Firstly I would point out that the sketch attached to her submission was not accurate in that it did not recognise the planned bend in alignment near her shed so that the race would avoid her shed – albeit being very close to it. Other solutions could include piping the race past critical areas, and possibly shifting the race line. This needs consultation with others along the race line. I suggest a way forward similar to what I have proposed for the Kimberley group, i.e. grant the consent as applied for, but note a commitment to meaningful consultation.

Modifications to dam safety conditions

104. Mr Jeremy Eldridge, for SDC, proposed a number of minor alterations to the applicant's proposed dam safety conditions. I agree with most of these and will amend the proposed conditions accordingly.

Vehicle movements through Coalgate

105. Some submitters raised a question about movements of heavy vehicles through the town of Coalgate at night. Proposed condition 1.3 of the SDC applications (both land use consents and designations) would effectively restrict vehicle movements on construction sites within 200 m of a dwelling, and the question was raised regarding potential movement of vehicles to and from construction sites. These could be, e.g. heavy vehicles that might be transporting material to a construction site. In the unlikely event that a significant amount of material is to be sourced from outside the reservoir, then it would not be impractical for contractors to import that during daytime hours. Therefore if it was thought helpful I consider it could be covered by way of condition similar to the existing

proposal regarding hours of work, i.e. that “Movement of heavy construction vehicles through Coalgate shall be limited to 0630-2000, Monday to Saturday inclusive and excluding any public holiday, within 200m of any residential dwelling, except where agreed to by the applicable property owners.”

5 September 2008

Appendices

1. Proposed change to designated area on lower Waimakariri terrace
2. Effects on SDC stockwater network
3. Alternative headrace routes through Homebush
4. Widths of construction through downlands sections of headrace
5. Changes in headrace alignment through consultation
6. Proposed change to designation at Ms Cindy McKenzie's property

Appendix 1:

Proposed change to designated area on lower Waimakariri terrace

Appendix 2:

Effects on SDC stockwater network

Appendix 3:

Alternative headrace routes through Homebush

Appendix 4:

Widths of construction through downlands sections of headrace

Appendix 5:

Changes in headrace alignment through consultation

Appendix 6:

Proposed change to designation at Ms Cindy McKenzie's property