IN THE MATTER of the Resource Management Act 1991

AND

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

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SUPPLEMENTARY EVIDENCE OF JOHN HAYES ON BEHALF OF THE NORTH CANTERBURY FISH AND GAME COUNCIL

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1. INTRODUCTION

Qualifications and Experience

1.1 My name is John William Hayes. My qualifications and experience, and the basis upon which I prepared this second statement of supplementary evidence, are set out in my evidence in chief prepared for this hearing (dated May 2008).

1.2 I have been asked by Fish and Game to comment on two matters.

1.3 Firstly I understand the Commissioners made a verbal request to Fish and Game to consider the mitigation that an unmodified 80 m^3/s minimum flow on "B" permits (hereafter referred to as "80 m^3/s minimum flow") would provide for salmon angling, fish and aquatic invertebrate habitat in the Waimakariri River versus an unmodified 100 m^3/s "B" permit minimum flow (hereafter referred to as "the de Joux proposal"). I provided information on the latter option in my evidence in chief. To assist the commissioners in obtaining a complete picture I have also included birds in my analysis.

1.4 I have also been asked to provide comment on the supplementary evidence of Greg Burrell.

2. MITIGATION PROVIDED BY UNMODIFIED 80 m^3/s OPTION VERSUS DE JOUX PROPOSAL

2.1 The most expedient and cost effective way of undertaking this analysis was to assume linear relationships between flow and the various habitat and salmon angling variables originally modelled. In my opinion this is a fair assumption for braided rivers and given that indeed the WUA x flow, salmon angling lie x flow, and clarity x flow relationships for the Waimakariri River are largely linear, especially over the 80 – 100 m^3/s flow range (see Figures 1, 3, 5, 7, 10, 11, 12, and 16 in my evidence in chief).

2.2 Assuming linear relationships, the effect (positive or negative) of an 80 m^3/s permit minimum flow on any habitat variable is simply about half that which I have previously estimated for the de Joux proposal since 80 m^3/s is about midway

between the proposed unmodified 63 m³/s "B" permit minimum flow and an unmodified 100 m³/s minimum flow.

2.3 All of my calculations are for the proposed CPW 20/40/220 flow scenario and mainly address cumulative impacts referenced to habitat retained at monthly median flows.

Invertebrate, fish and bird instream habitat

2.4 The effects on invertebrate habitat are mixed, being positive or negative depending on season. In my evidence in chief I estimated that the de Joux proposal would increase the amount of invertebrate habitat (WUA) retained in summer relative to that post CPW (20/40/220; unmodified 63 m³/s minimum flow) by up to 14% (maximum gain being in January). An 80 m³/s minimum flow would approximately halve that gain (i.e., 7%). On the other hand the de Joux proposal would result in up to 6% habitat loss relative to post CPW in spring (maximum loss in September). An 80 m³/s minimum flow would halve that loss to 3%.

2.5 The de Joux proposal would increase the amount of adult brown trout habitat (WUA) retained in summer (December – March) relative to post CPW by up to 10%. An 80 m³/s minimum flow would halve that gain to 5%.

2.6 Similarly juvenile salmon summer habitat gains of up to 8% offered by the de Joux proposal would reduce to 4% with an 80 m³/s minimum flow.

2.7 Native fish summer habitat gains of 2 – 14%, depending on species, offered by the de Joux proposal would reduce to 1 - 7% with an 80 m³/s minimum flow.

2.8 The effects on spring – early summer (September – December) bird habitat (black fronted tern and wrybill) are mixed and depend on month. The de Joux proposal offers habitat gains of 1 – 4%, depending on species, in December, reducing to 0.5 – 2% with an 80 m³/s minimum flow. On the other hand the de Joux proposal would result in habitat losses of 3 – 4% in September, which would be halved (1.5 – 2 %) by an 80 m³/s minimum flow.

Salmon passage

2.9 In my evidence in chief I pointed out that the de Joux proposal would substantially reduce the duration of low flows compared with the post CPW (20/40/220; 63 m^3/s minimum flow) regime (i.e., reducing flat-lining), benefiting adult salmon passage which under the current flow regime is marginal in summer and will be made worse under the CPWS. An 80 m^3/s minimum flow will provide less mitigation of flat lining and therefore for adult salmon passage.

Salmon angling

2.10 In my evidence in chief I showed that the cumulative effects of the CPW (20/40/220; 63 m^3/s minimum flow) regime on salmon angling were large; in the order of 51 – 74% loss of habitat (WUA) relative to the naturalised flow regime. I estimated that the de Joux proposal offered the best mitigation of the mitigation options examined, as it reduced this loss by 12%. An 80 m^3/s minimum flow would offer less mitigation, reducing habitat loss by about 6%.

2.11 Before accepting this result some consideration should be given to water clarity. Figure 1 (see appendix) shows the relationship between water clarity and flow at the Waimakariri Gorge and is instructive because it represents natural flow conditions. The regression equation fitted to the data predicts that water clarity at 100 m^3/s will be 0.21 m and at 80 m^3/s will be 0.42 m. Water clarity less than about 0.4 m is generally thought to be too dirty for salmon angling. On the basis of the regression equation alone one might consider that an unmodified 80 m^3/s is a more appropriate choice of "B" permit minimum flow than an unmodified 100 m^3/s.

2.12 However, there is considerable scatter and uncertainty (see the 95% confidence intervals in Figure 1) about the regression line and the slope of the line is quite flat between 80 – 100 m^3/s. Notwithstanding the average relationship indicated by the regression equation, the figure shows that there will be plenty of occasions when the flow is at, or close to 100 m^3/s, when the water will be clear enough for salmon angling.

2.13 Also the information that I presented on preferred flows for salmon angling in my evidence in chief (paragraphs 6.36 – 6.37) and first supplementary evidence

(paragraph 3.1) supports the view that salmon anglers prefer conditions equivalent to naturalised (i.e. unmodified) flows in the vicinity of 100 m³/s. That analysis of angler effort showed most anglers prefer to fish at modified flows in the range 50 – 80 m³/s (measured at SH1 Bridge) and make most use of modified flows in the range 40 – 80 m³/s (see Figure 9 in my evidence in chief).

2.14 Allowing for about 10 m³/s natural flow loss from the Gorge to SH1 Bridge and about 20 m³/s loss to abstraction, plus adding back about 5 m³/s of flow contributed by the South Branch immediately above the SH1 bridge, a modified flow of 80 m³/s at SH1 Bridge might equate to a naturalised (or unmodified) flow of 105 m³/s at the Gorge.

2.15 Mr Dirk Barr, an expert angler, caught most of his fish when modified flows were in the range 50 – 89 m³/s (equivalent to unmodified flow range of 75 – 114 m³/s) and achieved his highest catch rates when the modified flow at SH1 Bridge was 80 – 89 m³/s (equivalent to unmodified flow range 105 – 114 m³/s).

2.16 Given the high level of angling usage of flows between flow 50 – 80 m³/s (at SH1 Bridge equivalent to about 75 – 105 m³/s at Gorge (i.e., unmodified), available angling habitat will be hotly contended so reductions in habitat are likely to limit angling opportunities during the best angling conditions.

2.17 In summary, this analysis of angler effort and catch rate indicates that unmodified flows in the vicinity of 100 m³/s produce optimal flow and clarity conditions for salmon angling and occur often enough that anglers prefer them and target their effort accordingly.

2.18 In my evidence in chief I reported estimates made by Mr de Joux of the effects of abstraction on the number of days that the modified flow is in the optimal range for salmon angling (50 – 80 m³/s). During November to March the number of preferred angling days will decline by 49% post CPW (20/40/220; unmodified 63 m³/s minimum flow) compared with pre-CPW, and by 59% as a result of cumulative abstraction. The de Joux proposal would increase the number of preferred salmon days from 24 days post CPW to 70 days (by 192%) (compared with 58 days under the naturalised flow regime). An unmodified 80 m³/s minimum flow would halve that gain to 12 days (i.e., 96%).

2.19 Note that the estimated number of salmon angling days under the abstracted flow regimes are inflated owing to the fact that water clarity was not accounted for in the analysis (see paragraph 8.48 of my evidence in chief). Some high flows that fall into the optimal range upon abstraction will be too dirty for salmon angling and so will not compensate for the loss of the lower flows from the preferred flow range. Therefore it is unlikely that the 12 day apparent "enhancement" in number of preferred salmon angling days offered by the 100 m^3/s minimum flow over the naturalised flow regime is real (i.e., 70 days for the 100 m^3/s minimum flow regime versus 58 days for the naturalised flow regime).

2.20 In my opinion, a more realistic conclusion is simply that the de Joux proposal offers a high level of mitigation for cumulative losses of preferred salmon angling days. Note that in the peak salmon angling months (February to March) the de Joux proposal would sustain 19 preferred angling days, compared with 14 under the post CPW (20/40/220; 63 m^3/s minimum flow) regime and 25 days under the naturalised regime (see Table 20 in my evidence in chief). An 80 m^3/s minimum flow might sustain 16.5 days.

2.21 In my evidence in chief I pointed out that abstraction when water clarity is in the range 1 – 2 m at the Gorge will adversely affect salmon angling downstream because the water will discolour less with distance downstream and therefore be too clear for salmon angling at the SH1 Bridge. This discolouring with distance downstream occurs only in the 1 – 2 m Gorge clarity range (see paragraphs 8.39 – 8.46 of my evidence in chief). I estimated that the de Joux proposal will reduce the adverse cumulative effect on water clarity for salmon angling by 25%. An 80 m^3/s minimum flow will reduce this mitigation to 12.5%.

2.22 Finally, with regard to the salmon angling variables that I have examined (angling habitat, preferred angling flows, water clarity), I note that the 80 m^3/s minimum flow would reduce the level of mitigation to that which could be obtained with 1:1 flow sharing of all B block abstraction (see paragraphs 11.17 – 11.19 of my evidence in chief).

3. GREG BURRELL'S SUPPLEMENTARY EVIDENCE

3.1 In paragraphs 8 – 9 of his supplementary evidence, Dr Burrell argues that floods, rather than habitat, limit invertebrate, fish and bird populations in braided rivers. The implication is that flow and related instream habitat can be reduced without adversely affecting these populations. I agree that floods are most likely limiting in braided rivers, but the obvious question is by how much flow and related habitat can be reduced before these populations become limited by habitat (e.g., in the extreme if there was no flow there would be no fish). The applicant has presented no data or argument to inform this question, although to be fair it is a very difficult question to answer. No one knows the answer to this question in any river, other than the general premise that the more that flow is reduced the more risk there is of an adverse effect on instream values.

3.2 Fish and Game's recommended mitigation options are made with respect to this key point (i.e, that reductions in flow should be conservative in the face of such uncertainty). Moreover, it is not just habitat that is at issue, food must also be considered. At the most basic level, reducing the wetted area of a braided river will reduce the total area growing periphyton which is the food for invertebrates which are the food for fishes and birds.

3.3 In paragraph 10 of his supplementary evidence Dr Burrell says he expects that the CPW1 base case scenario will result in a minor increase in periphyton biomass, along with a minor increase in the abundance of chironomid midge invertebrates and an overall increase in invertebrate productivity. He further expects that the CPW2 mitigation option to result in less periphyton accrual and less of a shift towards chironomids owing to that option reducing the length of inter-flood accrual periods relative to the CPW1 base case scenario.

3.4 Dr Olsen, in his evidence in chief (paragraphs 4.29 – 4.31), disagreed with Dr Burrell on this matter. He stated that he '… [does] not expect that such an increase in productivity [due to increased accrual time between floods] would compensate for the loss of available habitat area caused by the abstraction reducing flows relative to the natural flow recession.' He 'believe[ed that] the reduction in habitat area is likely to significantly reduce invertebrate productivity, while the predicted increase in accrual

time is likely to have only a minor beneficial effect, with the net result being a reduction in productivity rather than the gain that Dr Burrell suggests.'

John Hayes
20 August 2008

Appendix

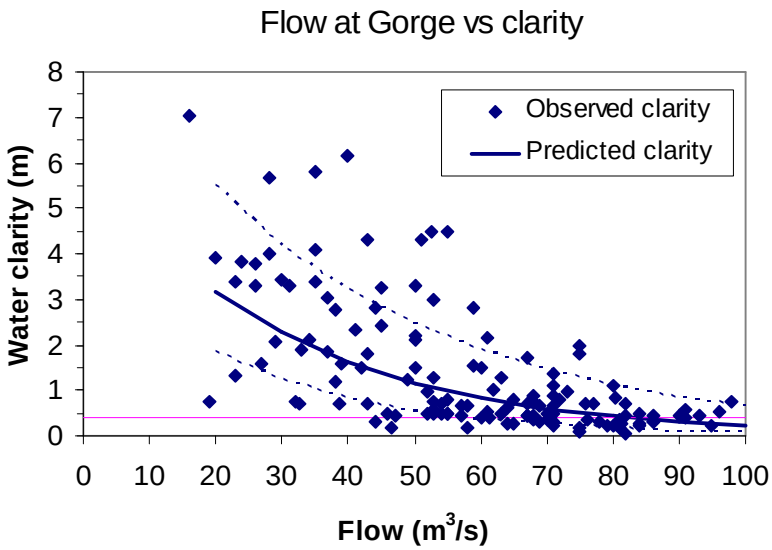

Figure 1 The relationship between flow and water clarity at the Waimakariri Gorge. Significant regression statistics: $R^2 = 0.43$, Clarity = EXP(1.8258-0.0336*Q), slope P<0.000. Dashed blue lines represent 95% confidence limits; pink horizontal line marks the 0.4 m minimum clarity threshold for salmon angling.