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 AND THE DIRECTOR GENERAL OF CONSERVATION

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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 supplementary evidence, are set out in my evidence in chief prepared for this hearing (dated May 2009). I have prepared this supplementary evidence to present relevant information on three points:

a. The relationship between flow, water clarity, and optimal days for salmon angling in the Waimakariri River that has come to light since lodging my evidence in chief.

b. An analysis of salmon angling catch records versus flow collected by Mr Dirk Barr.

c. The relative importance of flow and water clarity in stimulating salmon to run up-river and relevance to salmon angling.

2. RELATIONSHIP BETWEEN FLOW AND WATER CLARITY AND OPTIMAL DAYS FOR SALMON ANGLNG

2.1 In sections 8.40 – 8.46 and Figure 16 of my evidence in chief I presented information on the relationship between water clarity and flow in the Waimakariri River. In summary, I demonstrated a significant relationship between flow and proportional water clarity between Old SH1 Bridge and the Gorge (i.e., clarity at Old SH1 Bridge / clarity at the Gorge measured on the same day) when clarity at the Gorge is in the range 1 – 2 m. When water clarity is in this range at the Gorge clarity reduces (i.e., water gets dirtier) downstream at flows greater than about 40 m^3/s and the difference in clarity increases with increasing flow – potentially benefiting salmon angling.

2.2 Using this relationship I predicted that cumulative abstraction will increase clarity at old SH1 Bridge relative to clarity at the Gorge by 110% and abstraction by the CPW Scheme alone will increase proportional clarity between these locations by 27% (i.e. the clarity will decrease less downstream and so become less suitable for salmon angling).

2.3 Since lodging my evidence Mr de Joux has calculated the effect that these increases in proportional water clarity will have on the number of days that water clarity is in the optimal range for salmon angling at the SH1 Bridge (0.4 – 1 m). The rationale for this analysis is that the reduction in clarity with distance downstream benefits salmon angling when clarity at the Gorge is in the 1 – 2 m range because clarity at some flows will fall into the optimal range (0.4 – 1 m) by the time the water reaches SH1 Bridge, and this benefit should increase with increasing flow.

2.4 However, Mr de Joux's analysis shows that the mean effect of abstraction on optimal angling days is small – only 2 days difference between the naturalised and other flow regimes (Table 1). Moreover, the predicted adverse effect is confined to "A" permit abstraction (cf. naturalised versus pre-CPW in Table 1) because the water clarity versus flow regression equation predicts that the 1 – 2 m clarity range is associated with flows between 32 and 55 m^3/s (i.e., below the minimum flow for "B" permit abstraction (63 m^3/s) (Figure 1).

2.5 Note however, the variation in the data and that there are some occasions when clarity is 1 – 2 m at flows > 63 m^3/s so the CPW abstraction will adversely affect clarity for salmon angling on such occasions. Furthermore, the effect of "A" permit and cumulative abstraction will not be confined to optimal days for salmon angling. The natural reduction in clarity downstream with increasing flow within the 1 – 2 m clarity range will not be as great with abstraction and this will adverse affect salmon angling in these clearer water, lower flow conditions. In other words although reducing clarity from the 1 – 2 m to the 0.4 – 1 m clarity is best for salmon angling even a reduction from say 1.8 to 1.2 m should be beneficial.

3. RELATIONSHIP BETWEEN FLOW AND SALMON CATCH RATE

3.1 Mr Dirk Barr, an expert salmon angler who has presented evidence to this hearing, provided Fish & Game with salmon catch data he recorded in his fishing dairies between 1984 and 2006. His catch and effort versus flow data for the Waimakariri River upstream of SH1 Bridge are presented in Figure 2 (he fished mainly between the SH1 bridge and the Pylons – i.e., the Cout's and McLean's Islands area). Mr

Barr caught most of his fish over the 50 – 89 m^3/s flow range (Figure 2). Figure 3 presents the data as catch rate versus flow, where the catch data is divided by the days fished in each flow category (i.e., no. salmon hooked / day). The two peaks in catch rate on the right hand side of Figure 3 at 110 – 119 m^3/s and 150 m^3/s, when the river would have been too dirty for salmon angling (>~ 100 m^3/s) are anomalies. Mr Barr informed me that he caught those salmon in holes dug by gravel extractors, adjacent but connected to the main channel, that were running clear with seep water when the river was in flood. Under normal conditions Mr Barr's catch rate was highest at 80 – 89 m^3/s.

4. RELATIVE IMPORTANCE OF FLOW AND WATER CLARITY IN STIMULATING SALMON TO RUN UP-RIVER AND RELEVANCE TO SALMON ANGLING

4.1 I understand that there has been some interest from the commissioners in understanding the importance of flow versus water clarity in stimulating salmon to run up-river.

4.2 To my knowledge no research has been aimed specifically at this issue in New Zealand but it is well known from overseas literature that salmon and trout are stimulated to run up river in response to increase in flow and decrease in water temperature – as usually occur during floods and freshes. While water clarity declines in most rivers during floods it is unlikely that this is the primary factor to which fish are responding because it would bestow only secondary benefit on migrating fish. Dirty water would provide visual isolation from predators and so make fish feel more secure and hence willing to move. But if this was so important salmon would continue to run strongly at night in low clear water. The experience of staff who man salmon and trout traps in the headwaters of New Zealand rivers is that while both salmon and trout migrate upstream at night in clear water conditions the bulk of a season's run migrates on floods and freshes – both day and night.

4.3 By contrast increase in flow clearly bestows benefit on migrating fish by providing deeper water and thus easing passage upstream – especially into shallow spawning tributaries. While adequate passage depths may be present even at low flow in the

mainstems of larger rivers, salmon and trout have no way of knowing this so they continue to respond to their innate programming to migrate mainly during floods and freshes.

4.4 The relevance of this to salmon angling is that, as I said in my evidence in chief, a flood stimulates salmon to migrate and be active. This increases anglers' chances of encountering salmon, and as the water begins to clear over the early stage of the flow recession salmon can be easily caught in the slightly discoloured water, before it becomes too clear at lower flow.

John Hayes
16 May 2008

Appendices

Table 1 Number of days that water clarity at the Waimakariri SH1 Bridge is predicted to fall into the optimal range for salmon angling (0.4 – 1 m) during the salmon angling season (November – April) and peak months (February – March) under the naturalised and pre-CPW flow regime and various post-CPW flow scenarios. Analysis undertaken by Mr de Joux.

	No. days	
	Nov-Apr	Feb-Mar
Naturalised	39	20
Pre CPW	37	18
Post CPW 20/40/220	37	18
Post CPW 20/40/220 1:1 flow share	37	18
Post CPW 20/25/240	37	18
Post CPW 20/40/220 + 100 m^3/s min flow for B permits	37	18

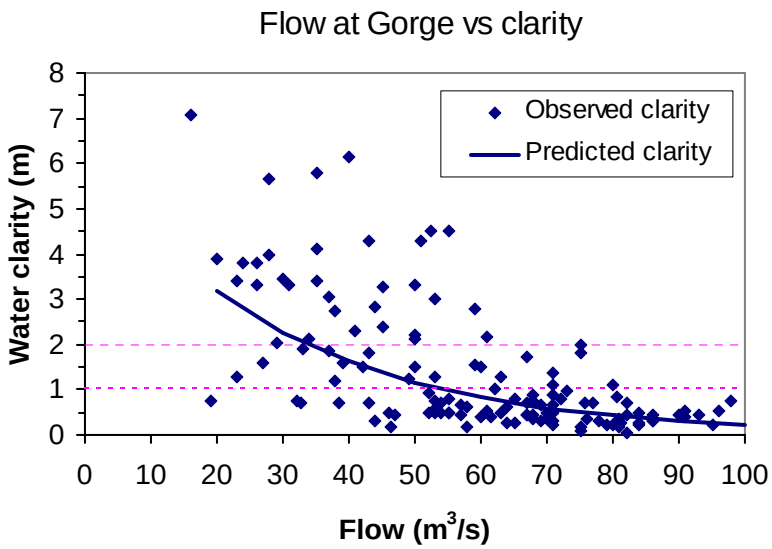

Figure 1 The relationship between flow and water clarity at the Waimakariri Gorge. Significant regression statistics: R^2 = 0.43, Clarity = EXP(1.8258-0.0336*Q), slope P<0.000.

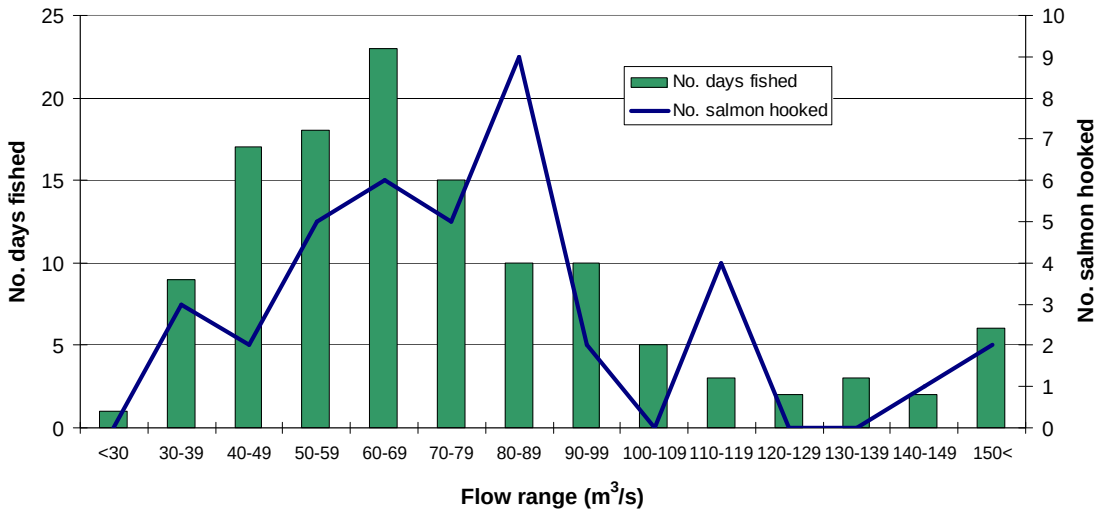

Figure 2 The relationship between salmon catch and effort versus flow in the Waimakariri River upstream of SH1 Bridge (Mr Dirk Barr's data).

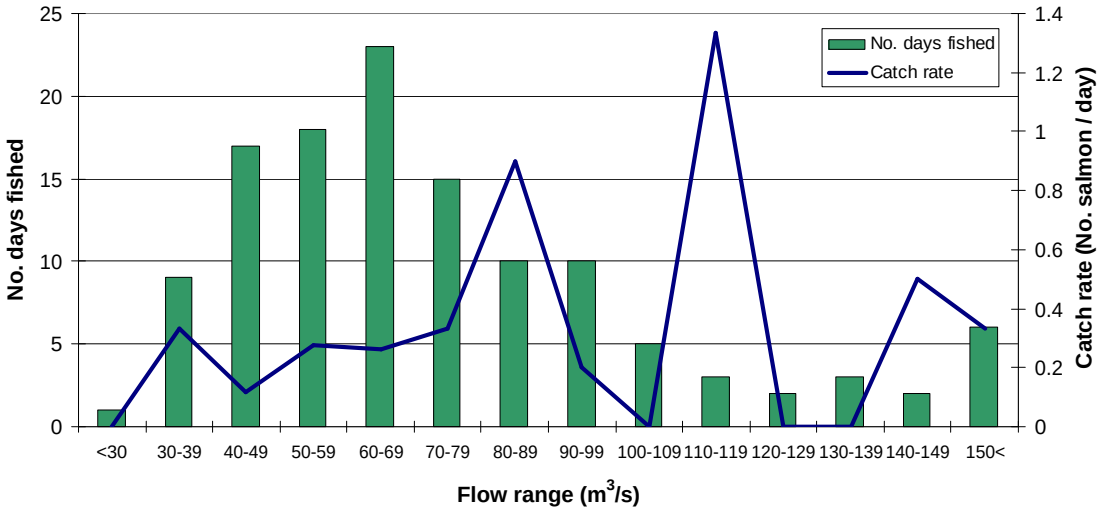

Figure 3 The relationship between salmon catch rate (no. salmon hooked per day) and flow in the Waimakariri River upstream of SH1 Bridge (Mr Dirk Barr's data).

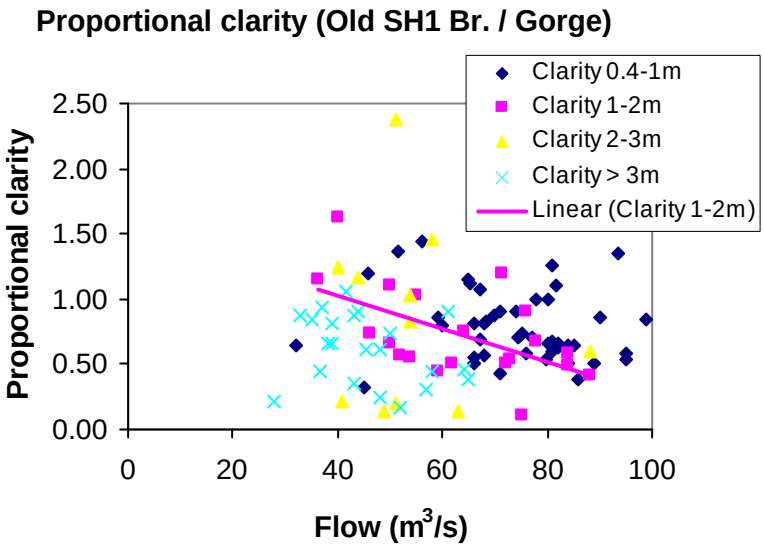

Figure 16 (from Hayes Evidence in Chief).

The relationship of flow at the Waimakariri Old SH1 Bridge versus proportional water clarity between Old SH1 Bridge and the Gorge (i.e., clarity at Old SH1 Bridge / clarity at the Gorge measured on the same day) for four water clarity categories at the Gorge. Data from NIWA's National River Water Quality Network (NRWQN) monitoring.

Significant regression statistics:

clarity 1-2m $R^2 = 0.30$, Y=0.1.523-0.013X, slope P=0.012.