

**IN THE MATTER OF** the Resource Management Act 1991  
**AND**  
**IN THE MATTER OF** resource consent applications by various  
applicants to take surface water from the  
Lower Waitaki River

**Evidence of David Painter Related to**  
**Minimum Flow Regimes and Flow Averaging**

**A. INTRODUCTION**

1. My full name is David John PAINTER. I am a Water Resources Engineer with 37 years' experience. I hold BE(Hons)(Mechanical) and PhD (Civil Engineering) degrees conferred by the University of Canterbury. I am a Fellow of the Institution of Professional Engineers New Zealand and a Member of the Royal Society of New Zealand. I am a self-employed consulting engineer trading as David Painter Consulting [DPC] Ltd.
2. I have previously been employed for 13 years as a research and extension Soil and Water Engineer at the New Zealand Agricultural Engineering Institute [now Lincoln Ventures Ltd]; for 15 years as a university academic in Natural Resources Engineering at Lincoln University; for 5 years as Associate Professor of Natural Resources Engineering at the University of Canterbury; and for 6 years as a self-employed consulting engineer.
3. I have experience and expertise in [*inter alia*] surface hydrology and hydrological data interpretation and am a long-term member of the NZ Hydrological Society.
4. I acknowledge that I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note dated 31 March 2005. I have complied with it when preparing my written statement of evidence and agree to comply with it when giving oral evidence.

**B. PURPOSE OF THIS STATEMENT**

5. The statement reviews the relationship between various minimum flows in place or proposed, and the proposals for time averaging of flows, particularly in relation to possible effects on existing consent holders.

### **b. Key Points**

- i. A change from using “instantaneous” or “rolling hourly” mean flows to 24-hour moving mean flows for the purpose of determining compliance with a minimum flow regime would be advantageous for existing consent holders as well as new applicants for consents. There would not be a major increased benefit from changing to 72-hour moving mean flows.
- ii. The conclusion in i holds irrespective of which of the minimum flow regimes considered might be in place.

## **C. FACTS RELIED UPON**

6. This evidence makes use of: The Waitaki Commission Water Allocation Regional Plan (2005, revised 2006); Section 42A Officers’ Reports to this Hearing; and evidence of other witnesses as in §7 following.

### **Reliance on Other Witnesses**

7. I have relied in part on data and information supplied by other witnesses appearing for some of the applicants: particularly that of Ian McIndoe, of Aqualinc Research Ltd; and David Stewart of Raineffects Ltd.

### **Data used for this study**

8. I have obtained hydrometric time series data for river levels and rated flows from Environment Canterbury and the National Institute for Water and Atmospheric Research specifically for the present study. In particular, I have used data for the water level recorder site 71104 Waitaki at Kurow provided by Environment Canterbury.

## **D. MINIMUM FLOW REGIMES**

### **Acronyms and Abbreviations**

9. I have adopted for use a number of acronyms previously used in other evidence to this Hearing.

HDI            Hunter Downs Irrigation

MEL           Meridian Energy Ltd

MRNAG	Mid River new Applicants Group
NBT	North Bank Tunnel
SCIT	South Canterbury irrigation Trust
WCWARP	Waitaki Catchment Water Allocation Regional Plan

### **Effects on Existing Consent Holders**

10. As there is no certainty at this stage of the Hearing on what minimum flow regime will be adopted, nor when this might happen, I have considered four possible minimum flows:
- i. 100 m<sup>3</sup>/s [Dam to sea, Proposed by MEL and SCIT, HDI application]
  - ii. 120 m<sup>3</sup>/s [Current consent at Dam]
  - iii. 110-150 m<sup>3</sup>/s to a monthly table [MEL, NBT application]
  - iv. 150 m<sup>3</sup>/s [WCWARP]
11. In general terms, the lower the minimum flow regime adopted, the greater the reliability for existing consent holders. I have reviewed the evidence of David Stewart and Ian McIndoe related to reliability of supply and agree with the major conclusions.

### **E. TIME AVERAGING OF FLOWS**

12. David Stewart has proposed, on behalf of the MRNAG, that flow data for the purpose of minimum flow compliance, should be 24-hour rolling mean flows at the Waitaki at Kurow [ECan] recorder site. The proposal is put forward in the context of either:
- i. 100 m<sup>3</sup>/s minimum flow Dam to sea
  - ii. 110-150 m<sup>3</sup>/s to NBT monthly table minimum flow Dam to sea
13. Other time-averaging which has been considered is 48-hour and 72-hour averaging. Table 3 of the WCWARP (2005, 2006) has as Item xvii, related to the 150 m<sup>3</sup>/s minimum flow: “d. All flows in the Lower Waitaki River determined for the purpose of this item xvii are to be based on measurements at the Kurow recorder and based on 1-hour rolling averages.” Most previous analyses related to Lower Waitaki flows have used “instantaneous”, 1-hour rolling averages, or daily mean discharges.
14. I have reviewed the evidence of David Stewart and Ian McIndoe related to the difficulties of managing irrigation water supply with hourly-varying water availability and agree that 24 hours is an effective lower limit on which to base water availability [unless there is on-farm storage].
15. I have examined the effect on transgression of minimum flow requirements of adopting 24-hour, 72-hour and 7-day flow averaging of the Waitaki at Kurow [Site

71104] recorded data. I have done this in the context of the four minimum flow regimes in §10 above and for the time period 1 July 1979 to 31 December 2007. This period has the existing river/hydro infrastructure in place and includes recent data.

16. This table summarises the results:

**Waitaki at Kurow [71104]: Flows Below Minima with Various Averaging  
30 June 1979 to 31 December 2007**

Flows below* (m <sup>3</sup> /s)	150	120	100		140 JanDec	150 Feb	145 Mar	125 AprOct	120 MaySep	110 JunJulAug
Instantaneous	40	7	5		8	0	2	2	1	2
24-hour moving mean	14	1	1		0	0	1	0	0	1
72-hour moving mean	6	0	0		0	0	1	0	0	0
7-day moving mean	2	0	0		0	0	0	0	0	0
<b>* Numbers of occurrences are minima; multiple occurrences close together counted as one</b>										

Changing from ‘instantaneous’ to 24-hour moving mean makes a substantial difference; going out to 72-hour makes not much more, except for the 150 m<sup>3</sup>/s minimum. The 7-day moving mean is included as an extreme example to aid illustration; it is not realistic for compliance purposes.

17. The examples in the appendix merely illustrate graphically:

- i. The kind of data underlying the table results
- ii. Some of the tabulated data included in the evidence of David Stewart

The times below minimum flow of the transgressions have not been reported here. In most cases they are of order a few hours.

## **F. SUMMARY**

18. A change from using “instantaneous” or “rolling hourly” mean flows to 24-hour moving mean flows for the purpose of determining compliance with a minimum flow regime would be advantageous for existing consent holders as well as new applicants for consents. There would not be a major increased benefit from changing to 72-hour moving mean flows.

19. The conclusion in §18 holds irrespective of which of the minimum flow regimes considered might be in place.

## **G. REFERENCES**

20. Reference has been made herein to the following:

McIndoe, I. (2008) Evidence of Ian McIndoe in the matter of resource consent applications by the Lower Waitaki Mid Irrigators Group to take and use water from the Waitaki River, its tributaries or from groundwater.

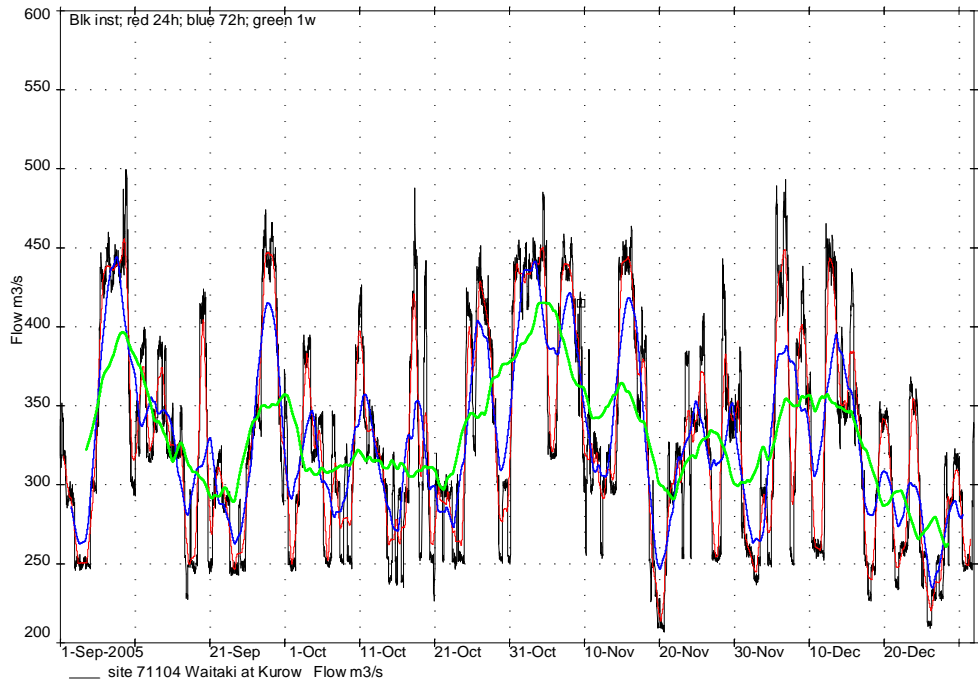
Stewart, D (2008) Brief of evidence of David Stewart in the matter of applications for water permits to abstract water, and associated activities for 17 applicants in the Lower Waitaki.

Waitaki Catchment Water Allocation Board (2005, incorporating amendments as directed by the High Court on 3 July 2006)  
Waitaki Catchment Water Allocation Regional Plan.

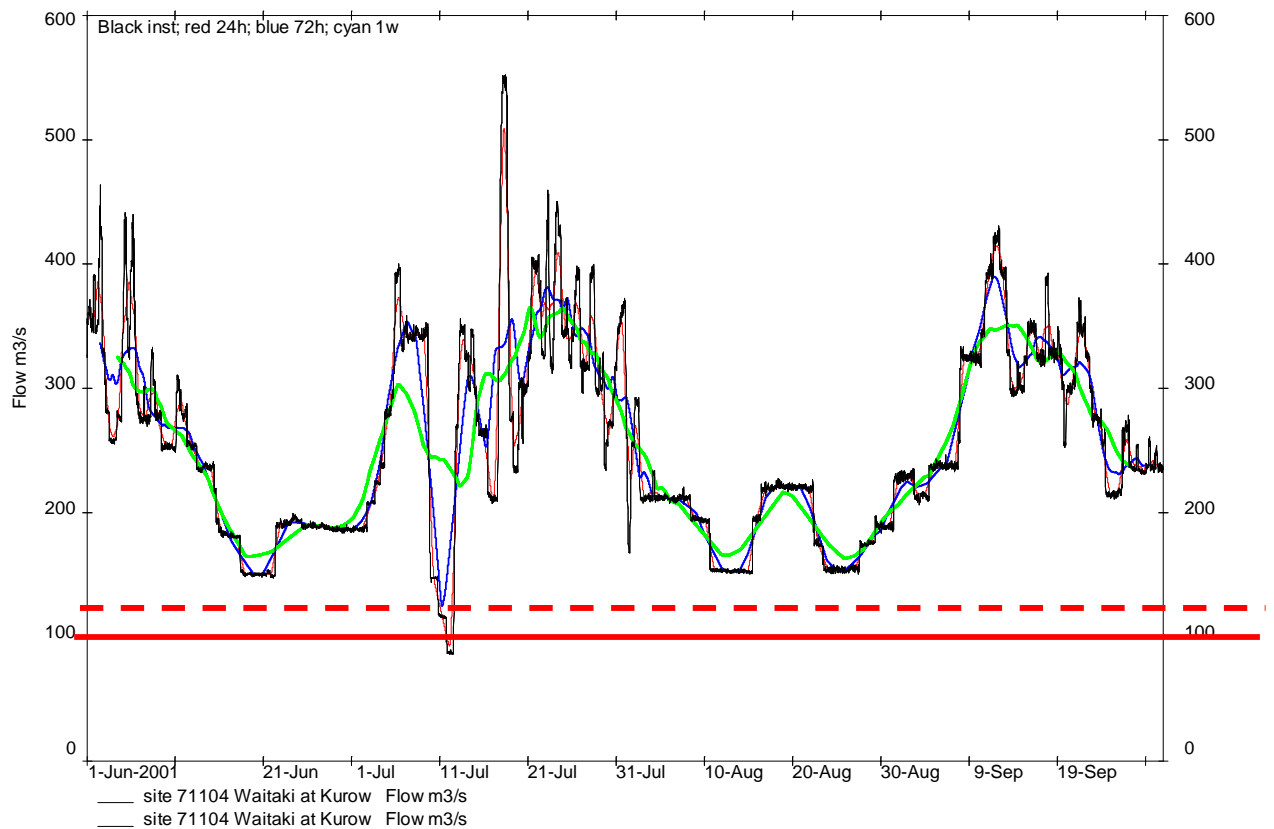
Dr David J. Painter F.IPENZ; MRSNZ  
David Painter Consulting [DPC] Ltd, Christchurch

DATE:

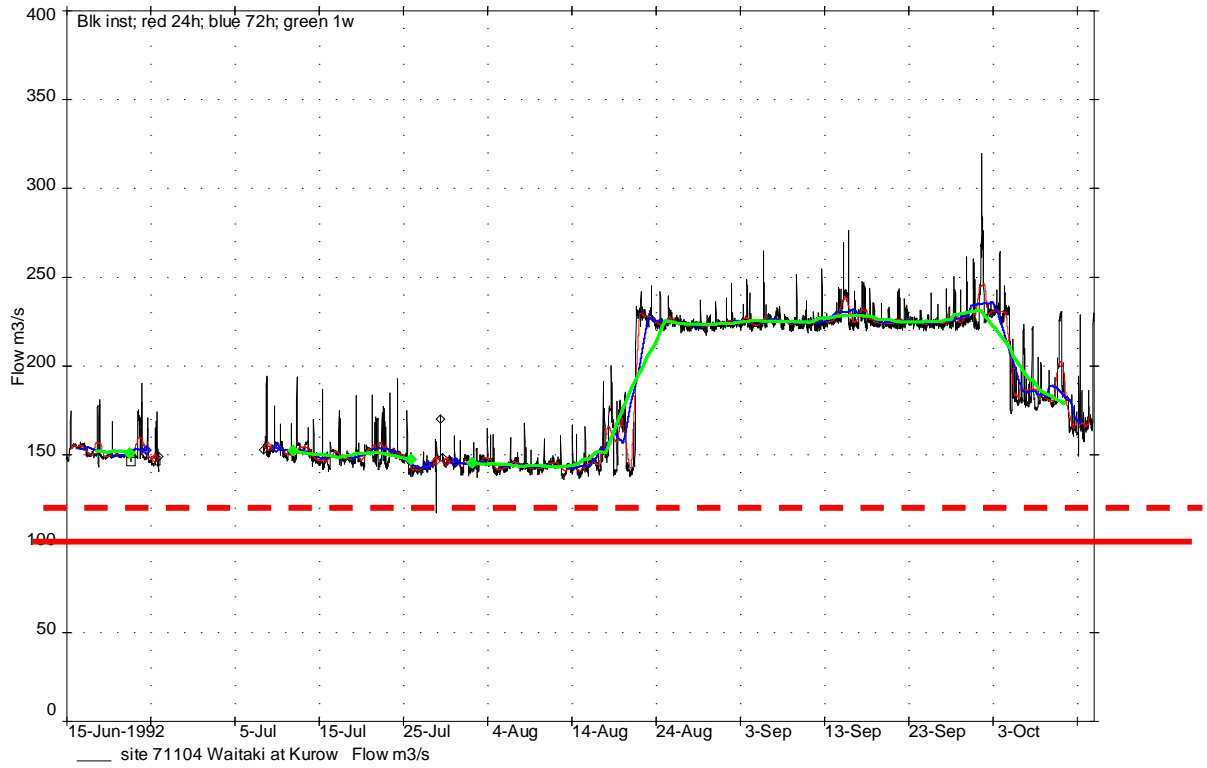
## **H. APPENDIX: EXAMPLES OF FLOW AVERAGING AND MINIMUM FLOW TRANSGRESSIONS**



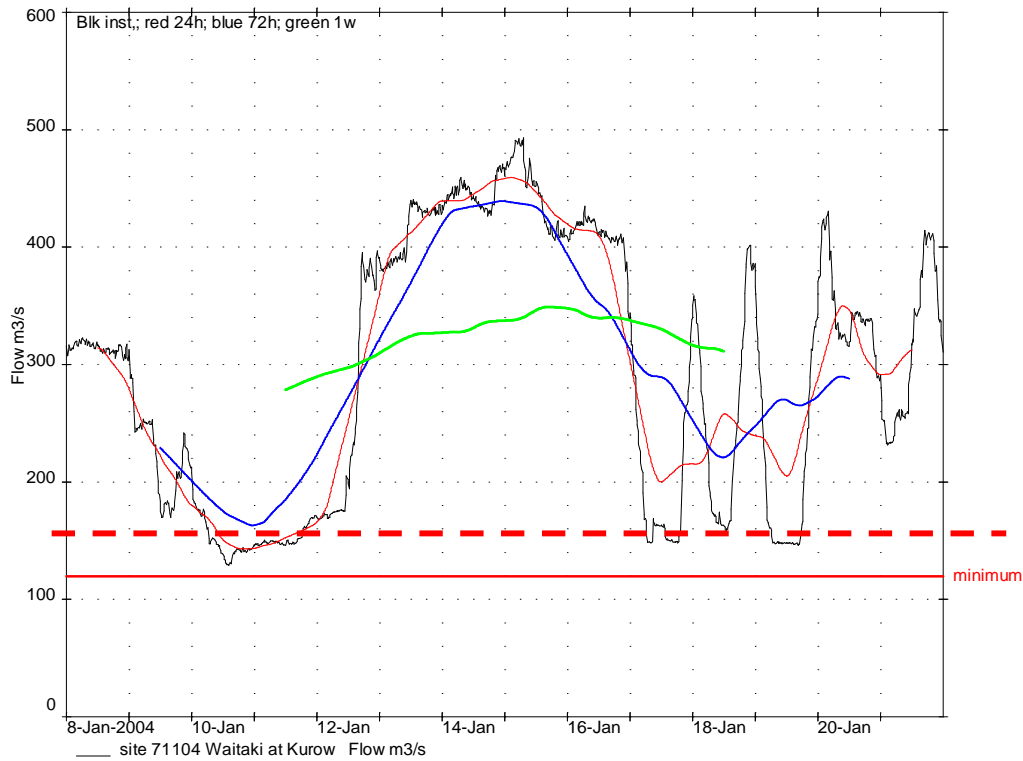
**A typical Spring/Early Summer period without transgressions**



**A transgression using “instantaneous” or 24-hour data, not if using 72-hour data**



**An unusual period of flow during the 1992 low-lake-inflows period**



**Illustrating Tables 2, 3 in the evidence of David Stewart**