IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of submissions and further submissions by Rangitata Diversion Race Management Limited to the proposed Canterbury Land & Water Regional Plan

STATEMENT OF REBUTTAL EVIDENCE OF RICHARD TREVOR de JOUX (HEARING 3)

INTRODUCTION

1. My name is Richard Trevor de Joux. I am the Managing Director of Environmental Consultancy Services Ltd. My qualifications and experience were outlined in my evidence in chief ('EIC') for Hearing 3.

2. I repeat the confirmation given in my evidence in chief that I have read and agree to comply with, the Code of Conduct for Expert Witnesses, as set out in the Environment Court's Consolidated Practice Note. I confirm, for completeness, that I have complied with the code in preparing this brief of evidence.

SCOPE OF EVIDENCE

3. The purpose of this brief of evidence is to respond to the evidence of Mr Herbert Familton on behalf of the Director General of Conservation ('**DoC**') relating to the Ashburton River.

4. Mr Familton refers to the hydrology evidence of Mr John Waugh that was submitted in support of Forest & Bird during Hearing 1, stating that in his opinion, Mr Waugh's evidence gives better effect to the NPSFM and RPS policies than the status quo in Table 12.

5. My evidence comments on the 2 main issues of Mr Waugh's evidence relating to possible effects of climate change on river flows, and NES minimum flows.

Possible effects of climate change

6. Mr Waugh computed decadal mean flows for both the South Ashburton River at Mt Somers (site 68806) and the North Ashburton River at Old Weir (site 68810). Using the data, Mr Waugh calculated that for the period 1981 to 2010, the North Ashburton "has lost 2 cumecs of natural inflow", and the South Ashburton river has lost around 1 cumec of natural inflow between 1981 and 2010".

7. I have obtained flow data from ECan for the North Ashburton River and agree that the reported decade mean flows presented in Mr Waugh's evidence are correct. However I find the comment regarding the South Ashburton River flows to be somewhat selective because the decadal mean flows for that river actually increase from 10090 l/s (1971-1980), to 10730 l/s (1981-1990), and to 11640 l/s (1991-2000). It is only the period 2001-2010 where there is a decline in flow to 9740 l/s.

8. Mr Waugh concluded that "The most likely cause of this loss of natural inflows is the effect of climate change." It is my opinion that the period of record used by Mr Waugh is too short to be able to conclude the reductions in flow rates are a consequence of climate change, and it cannot be concluded that the river flows will continue to decline in the future.

9. It is well known that climate has changed over the years, and that there have been periods of wetter and dryer years. To illustrate this I have included Figure 1 to show the longer term change in rainfall recorded within the Ashburton – Rangitata Plains area. The graph shows the accumulated departure from mean monthly rainfall over the period 1913 to 1997. Periods of wetter than normal rainfall are shown as ascending lines whereas periods of lower rainfall are shown as declining lines.

10. Reference to Figure 1 shows that the period from 1945 to 1957 was considerably wetter than both the preceding period 1913-1944, and the following period from 1958 to 1976. The graph shows that changes in rainfall are cyclical and it cannot be inferred that rainfall will continue to decline into the future.

11. Declines in river flows over periods of time are not unique to the Ashburton River. They have been recorded in other rivers. Williams and Aitchison-Earl (2011) report[1] that pre January 1998 mean flows in the Opihi River (Rockwood), Tengawai River (Cave) and Opihi River (Saleyards Bridge) were 1256 l/s, 1093 l/s and 4672 l/s higher than the post December 1997 mean flows. It is noted that the Opihi River at Saleyards Bridge flow is now regulated by releases from the Opuha Dam and is therefore a modified rather than a natural flow regime.

12. To many people a simple statement such as "a river has lost 3 cumecs of natural inflow over 29 years" implies (whether intended or not) that a river will now have lower flows than in the past. I have used flow data supplied to me by ECan for the North Ashburton River to analyse the change in inflow, and to put the changes into perspective. The flow data is summarised in Table 1 of this evidence.

13. Figure 2 shows a plot of monthly mean flows for the North Ashburton River at the Old Weir site for the period 1982 to 2010. The plot clearly shows that there has been a reduction of larger flood events over time. Conversely, and more importantly, there is very little evidence to show that the lower monthly flows are declining.

14. Figure 3 shows a plot of the percentage of time when specified flow rates were equalled or exceeded. In hydrological terms, this is referred to as a flow distribution curve. The curve allows the distribution of flows over the specified time range. Figure 2 shows that the main change in flow distribution is within the higher flow range, with little change in the lower flow distribution.

15. I have also shown the median flow for the specified decades on Figure 2. The median flow is the flow that occurs for 50% of the time. It can be seen that although the decadal mean flow for the 1991-2000 period is 623 l/s lower than the 1981-1990 period, the median flow for the 1991-2000 period is actually 200 l/s higher. This shows that the simple use of "mean" flows does not provide an accurate picture of the actual changes on flow regimes over time.

[1] Table 3-1, page 15 of ECan report R11/31

16. In summary, I conclude that changes in river flows are cyclical and follow long term rainfall patterns. There is no reason to conclude that river flows will continue to decline into the future.

North Ashburton River minimum flow

17. Mr Waugh also included a table of Ashburton river flows, statistics and the proposed National Environmental Standard on ecological flows and water levels (NES).

18. Mr Bryce makes comment in paragraphs 6.8 to 6.10 of his evidence in chief for RDRML that the proposed NES for Ecological Flows has no legal status and it would be inappropriate, in his opinion, to apply this to a minimum flow regime, without the proposed regime being supported by a robust and detail assessment of the potential implications of setting this minimum flow.

19. Mr Waugh states that the NES minimum flow for the North Ashburton River at the South Ashburton confluence would be 2940 l/s. That flow rate is based on 80% of the estimated 7DMALF of 3680 l/s derived by Horrell (2004).

20. In my evidence in chief (EIC), I refer (paragraph 12) that Mr Horrell has refined his hydrological model and that the 7DMALF for the North Ashburton River at South Ashburton confluence has been amended to 1800 l/s. Subsequent to preparing my EIC, I note that the 7DMALF was amended to 2030 l/s. I have included the relevant calculations provided by Mr Horrell on this matter as Appendix 1 of this evidence.

21. Using the revised 7DMALF, a minimum flow based on the NES would be 1620 l/s rather than 2940 l/s.

22. Although I realise that Mr Waugh was relying on the previously published 7DMALF of 3680 l/s to calculate an NES minimum flow, this does reinforce my concerns expressed in paragraph 20 of my EIC that the “naturalised” hydrology presented in the modelling work gives an unrealistically high expectation that continuous flow will be restored to the North Ashburton River.

References:

Williams, H; Aitchison-Earl, P; 2011: The influence of recharge mechanisms on shallow groundwater in the Levels Plain, South Canterbury. Environment Canterbury Report No. R11/31 ISBN 978-1-927161-44-9, June 2011.

Table 1: North Ashburton at Old Weir – Monthly flows

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1982	6590	5612	5979	5402	5736	6817	3968	5901	8380	15742	32385	11465	9498
1983	6652	4243	2994	5643	10778	9629	13852	9057	13782	30100	13405	17336	11456
1984	8897	14034	15832	6980	6696	7633	13711	12940	6713	11065	12540	11864	10742
1985	6454	3731	2969	2669	3038	5384	6872	10416	13562	7762	7237	10859	6746
1986	5425	9825	15382	7807	6248	9876	12856	21032	16139	28442	19139	8138	13359
1987	4086	6468	19919	8039	8965	14389	5757	6784	6282	12332	7716	7040	8981
1988	5183	4275	3325	2844	5748	5693	9558	9645	12621	14286	11440	4150	7397
1989	4947	5113	3773	3382	4092	12308	4637	3741	5350	10262	5501	9200	6026
1990	6803	4234	3582	2960	9384	5248	6342	17414	10662	25694	10980	6408	9143
1991	5203	6527	4187	4738	7382	4254	4278	14433	10633	10108	11602	8434	7648
1992	5205	2853	2670	2312	3226	2466	8820	26244	6140	19403	22167	11617	9427
1993	6103	5040	3729	5471	7804	11683	4683	3660	7272	13352	9252	17985	8003
1994	9545	6024	15099	6040	6015	8363	10688	11496	12566	11836	18914	8471	10421
1995	6590	3475	3841	7627	7971	8800	5675	7516	19785	17187	10134	9171	8981
1996	6141	6668	6807	14629	10116	7561	7551	7237	13033	19870	9292	7087	9666
1997	9137	11720	7499	7826	5219	4488	8892	11416	8513	10057	6687	5695	8096
1998	3596	2677	5759	4635	3911	4447	10788	10373	8313	15358	7856	4630	6862
1999	2965	3139	4034	3665	4104	9848	8045	7085	7564	10303	12659	7612	6752
2000	8731	6428	7247	13651	7235	12746	8747	9542	21498	15129	8297	7008	10522
2001	4188	2733	2296	2034	2222	3452	4059	6603	6551	8155	9731	9609	5136
2002	27182	8333	4237	3774	4045	9002	6257	7005	8485	8035	10086	7130	8631
2003	4705	4880	4387	9470	9359	6213	7572	5878	11813	17004	9203	5105	7966
2004	3963	7582	6313	3127	8057	7326	5621	9085	11044	12220	8357	8257	7579
2005	5887	3920	4249	3986	3513	3354	3212	3450	5287	5097	4362	3719	4170
2006	3421	4828	3182	6881	8535	12925	9581	7262	12083	12637	18675	14736	9562
2007	11165	4214	3093	2597	3328	3743	4731	4612	4328	15997	6232	3482	5627
2008	2516	6677	3992	2765	3091	4422	9814	12601	21624	10691	6991	10241	7952
2009	5490	6486	5139	4953	17040	8241	5705	9577	11327	10972	9956	5275	8347
2010	7585	3875	3086	3146	12579	13719	7027	17912	12867	13919	10148	7009	9406
2011	6089	4603	4193	4756	8616	5473	5614	5194	7001	12442	11237	6993	6851
2012	3853	3744	6554	3658	3510	7111	8809	13829	10560	17411	12469	6871	8198
Mean	6590	5612	5979	5402	6696	7633	7540	9966	10702	14286	11440	8471	8360

Decade Mean	
1981-1990	9261
1991-2000	8638
2001-2010	7438

Figure 1 : Long term rainfall

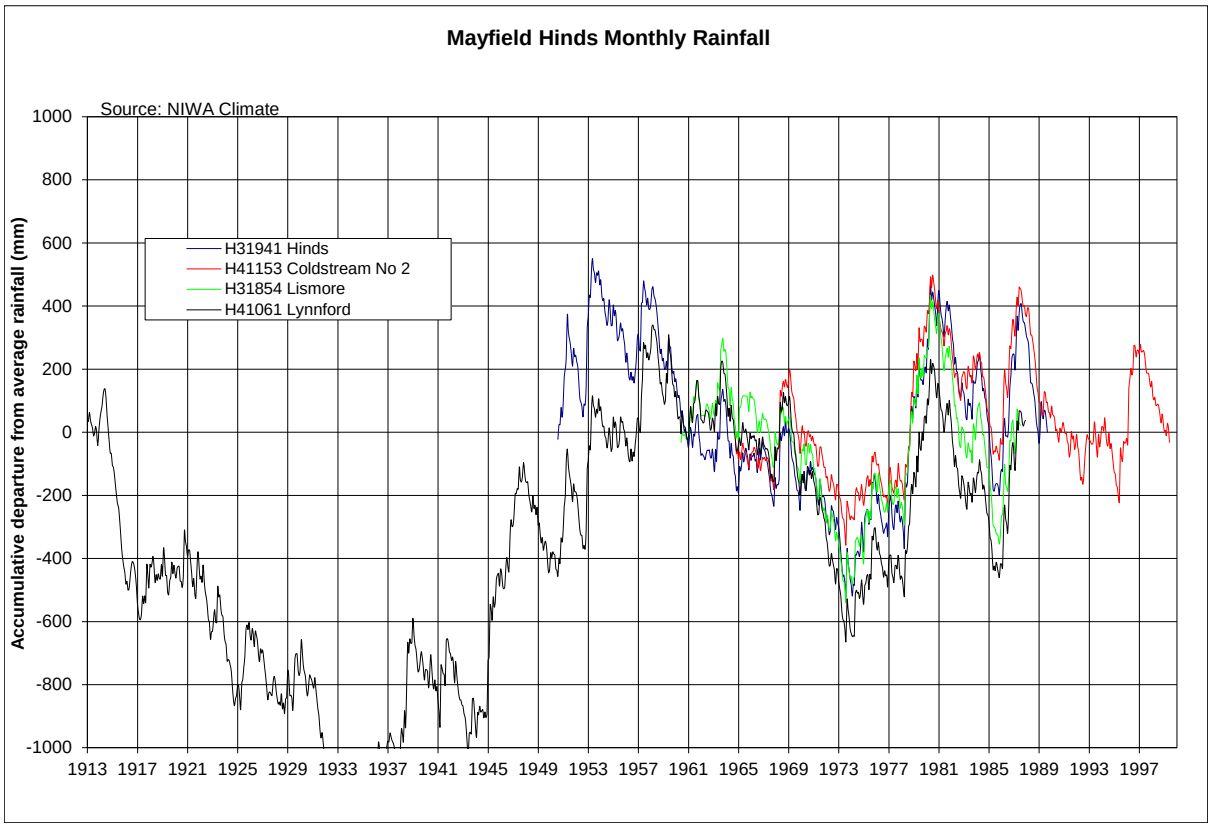


Figure 2 :

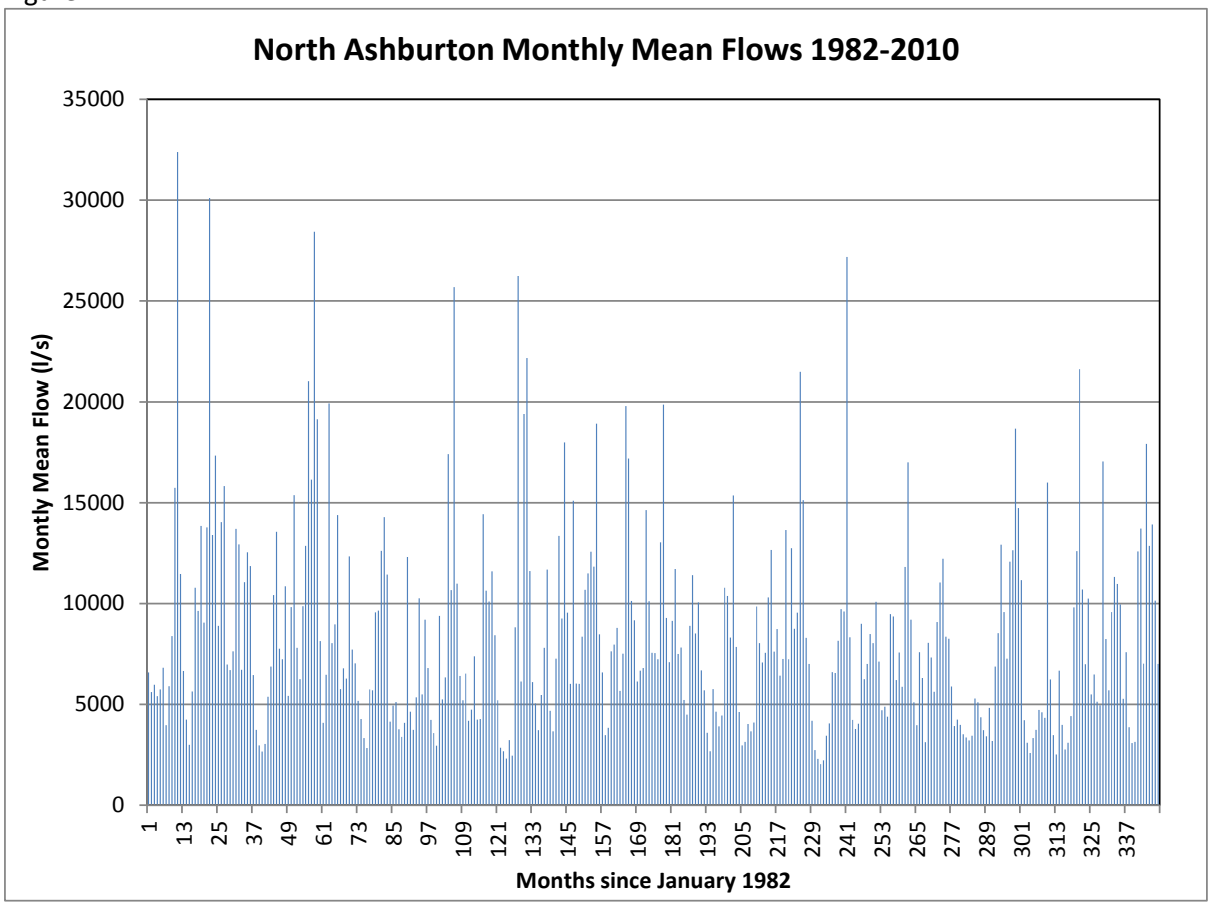
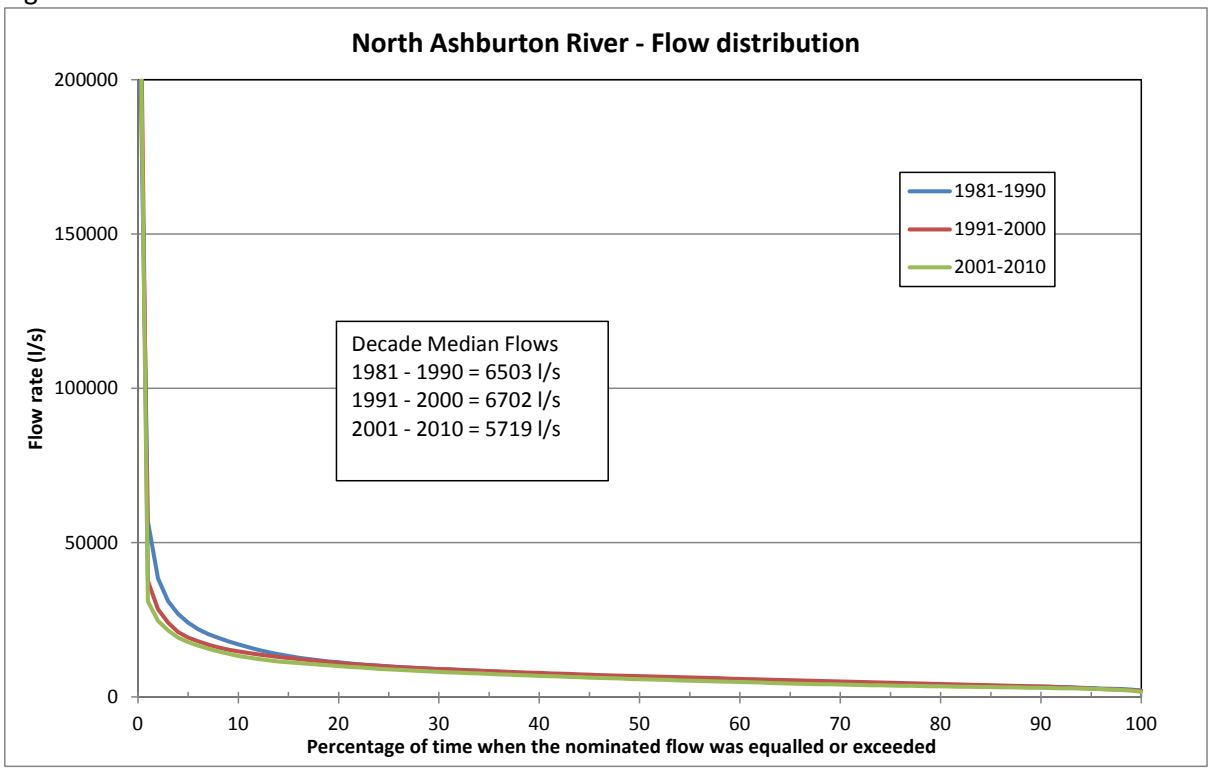


Figure 3:



Appendix 1 : North Ashburton River flow calculations provided by G Horrell – 5 November 2012.

North Ashburton at Confluence – leakage model

Table 1: model inputs and result

		percentage contribution from rain								slope	0.58		
		10%	10%							intercept	21.4		
	Old Weir	residual trib inflows			Total	Abstractions	Bywash	Net flow	actual	Net flow	leakage	Net	Net flow
	(6am)	O'Shea	Mt Harding	Pudding Hill	surface		Coniston	at confl.	measured	minus	model	flows	with leakage
				(tribs us of	inflows		removed	w/o	minus	actual	linear	with	minus
				Methven auxillary)				leakage	coniston	(leakage	residual	leakage	actual
										estimate	vs net		(residual)
24/06/1998	4080	44	131	581		1440	4		284				
5/10/1998	6041	39	954	1141	7281	2325	4	4960	2546	2414	2898	2062	-484
20/01/1999	2678	12	184	117	2815	2458	4	361	242	119	231	130	-112
29/01/1999	2631	588	416	86	2817	1973	4	848	170	678	513	335	165
5/02/1999	2693	31	261	122	2845	2469	4	380	184	196	242	138	-46
11/02/1999	2570	33	371	70	2681	2685	4	1	136	-135	22	0	-136
25/02/1999	2084	506	123	0	2147	1979	4	172	110	62	121	51	-59
9/03/1999	2288	34	398	21	2352	2313	4	43	115	-72	46	0	-115
23/03/1999	2738	58	436	515	3302	2457	4	849	207	642	514	335	128
26/03/1999	4790	255	693	1658		2438	4		1428				
21/12/1999	6659	24	775	1258	7997	2810	385	5572	2196	3376	3253	2319	123
29/02/2000	4646	19	733	140	4861	2646	540	2755	573	2182	1619	1136	563
												RMS error	234

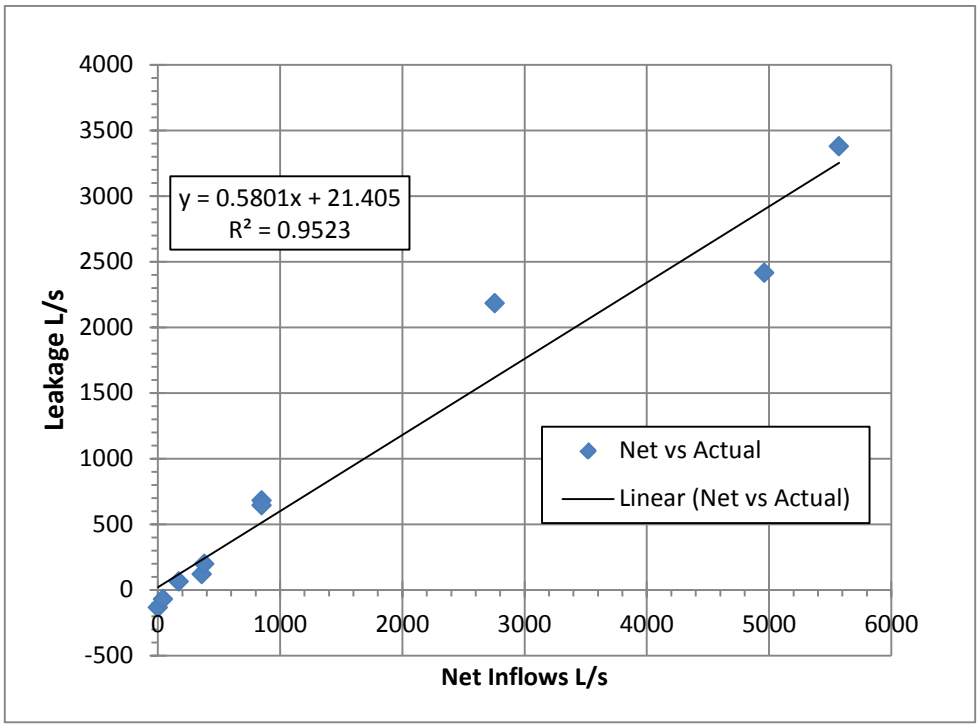


Figure 1: Net inflows at confluence without leakage vs leakage.

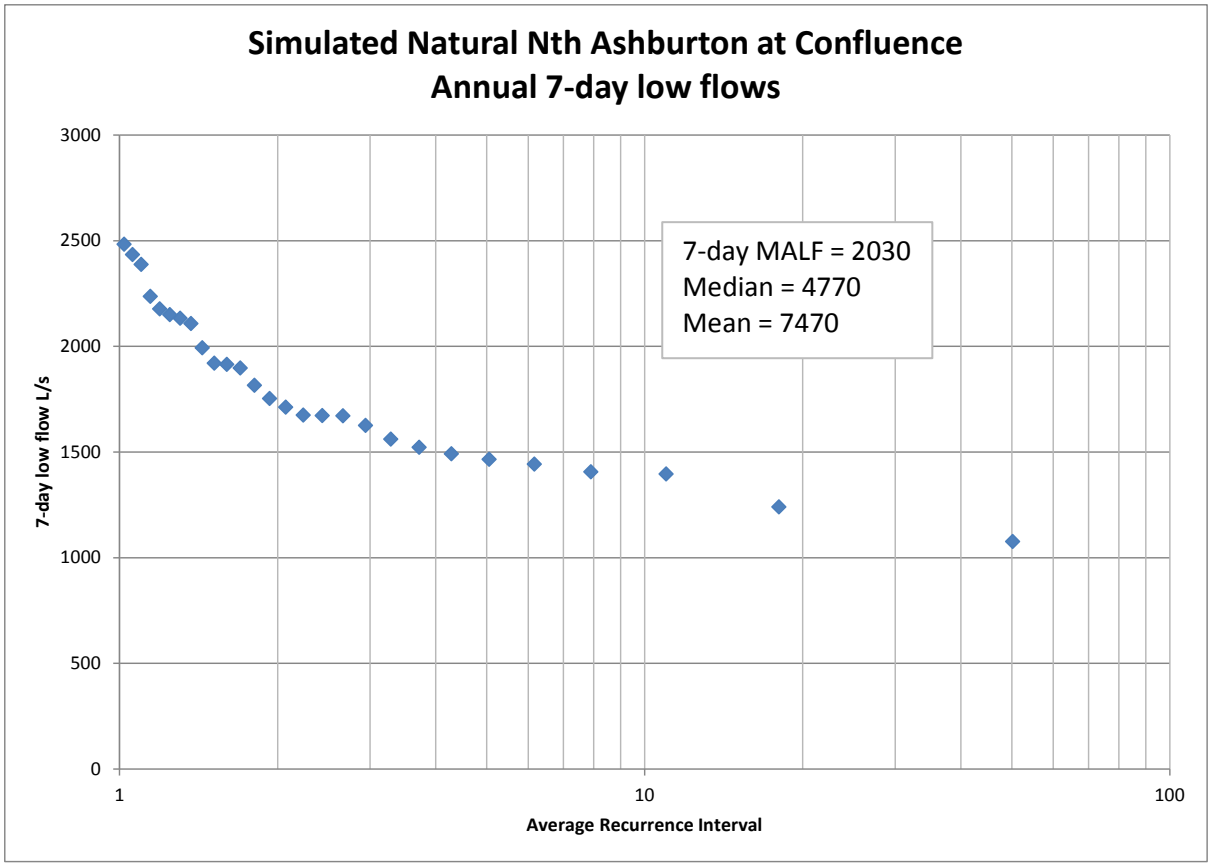


Figure 2: 7-day annual minima series of simulated natural flow. Leakage calculated according to the model in Figure 1.

Notes:

1984 removed as missing data through low flow period

winter data point removed (24/6/98)

data point (26/3/99) removed as wetting up after dry spell.