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CALENDAR YEAR Versus WATER YEAR
ESTIMATING 100-YEAR FLOODS

A.G. Smith
Water Survey of Canada

May 1979

Inland Waters Directorate
Pacific and Yukon Region
Vancouver, B.C.

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A.G. SMITH

MAY 1979

WATER SURVEY OF CANADA
INLAND WATERS DIRECTORATE
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Introduction

All high flows on the coast of British Columbia are caused by either rain storms or rain on snow. These storms usually occur during the fall and winter period from October to February.

Since 1967 the Water Survey of Canada has used the calendar year as the basis for determining the annual series for all runoff characteristics. Recent studies on peak flows have been carried out using this division. The calendar year division has been adopted because of the ease and convenience of handling the mass of data.

We have been criticized in the past for using the calendar year series instead of that extracted on the water year basis. This is a valid criticism for a few stations where a flood event has occurred on the December-January split and has been interpreted as two independent events.

Purpose and Scope

The purpose of this study is to determine which series are best suited for flood analysis on streams originating in the coastal area of British Columbia. The statistics used to make this assessment are the means, standard deviation and the 100-year return period estimate. Four distributions have been employed to obtain the 100-year estimate; Gumbel I, Log-Normal, Three Parameter Log-Normal and Log-Pearson Type III. The maximum likelihood method has been used to fit these distributions. The method of moments has also been applied to obtain a fit for the Log-Pearson Type III.

Quality of Data

All the flow data in the report are not of equal accuracy. Some stations have shifting controls and the quality of measurements varies from station to station depending on the uniformity of the cross-section used. Most rating curves are undefined at the upper end because of the difficulty in obtaining high flow measurements. Stations operated with staff gauges are subject to gauge readings (although taken at the same time each day) which do not regularly represent the mean for the day. This could be a cause of outliers at

some stations because the reading may be near the instantaneous peak.

Analysis of Data

Maximum daily mean flows, for both the calendar and water years, were extracted for those stations with ten or more years of record located on Vancouver Island. Of these, five stations were omitted because of intensive diversion and regulation. It was noted during the extraction that the flows at the upper end of the arrays were the same for both methods. The differences appeared in the middle and lower ranges of flows.

Figure 1 shows the difference in mean values for the two series and the percentage difference in numerical and graphical form.

Figure 2 shows the difference in the standard deviations of each series and the percentage difference in numerical and graphical form.

The data were also analyzed to determine if anyone of the above mentioned distributions would consistently give higher estimates of the 100-year event for the water year series particularly those with higher means and higher standard deviations.

Figures 3,4,5,6 and 7 show the differences for the two series of the estimates for the 100-year event as calculated from the four distributions. Also shown are the percentage differences in numerical and graphical form.

Using calendar year data for four stations, a comparison of the 100-year estimate was made between the long term value and the values obtained for each year greater than ten years. The percentage differences are shown in numerical and graphical form on Figures 8, 9, 10, and 11. The standard deviation (calculated in the same manner) is also shown on the graphs.

Figures 12, 13, 14 and 15 show, for the same data, the variation between the long term value and the values obtained for each year greater than ten years for the mean, standard deviation, coefficient of skew and coefficient of kurtosis. These comparisons are shown in both numerical and graphical form.

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

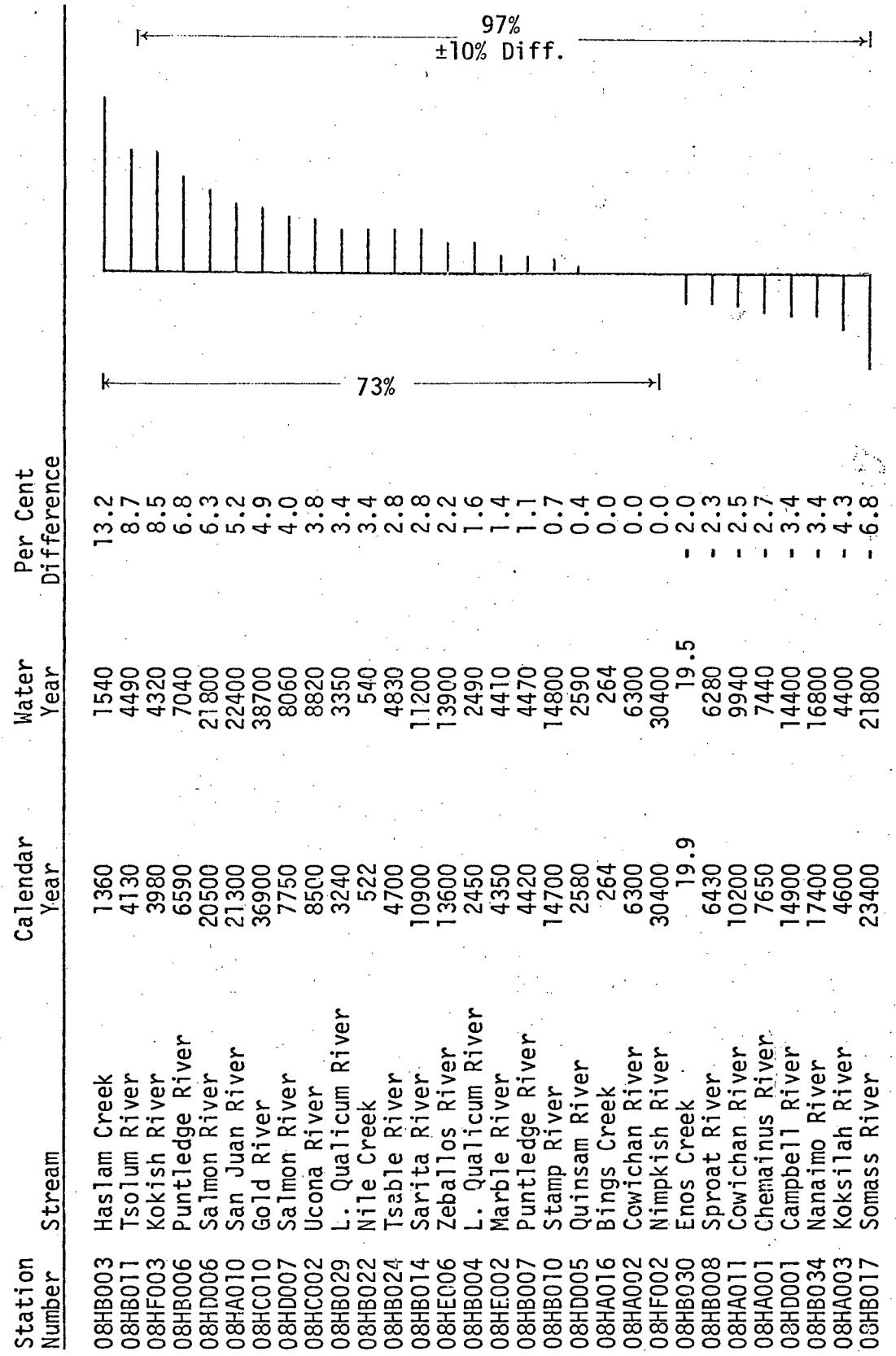


Figure 1. Arithmetic Mean in Cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) VS. WATER YEAR

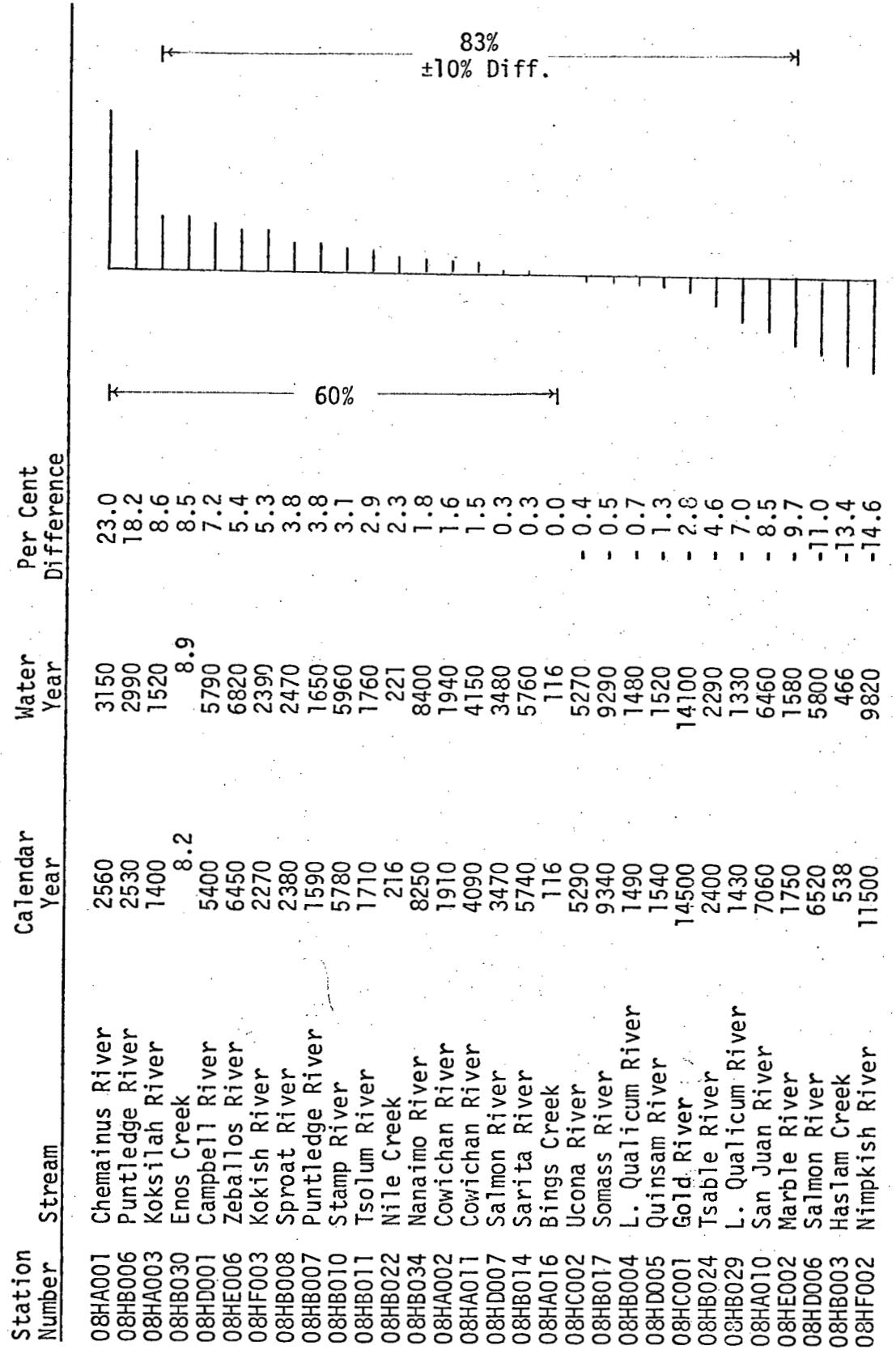


Figure 2. Standard Deviation in Cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

Station Number	Stream	Calendar Year	Water Year	Per Cent Difference
08HA001	Chemainus River	15000	17600	17.3
08HF003	Kokish River	8900	10100	13.5
08HE006	Zeballos River	31800	35100	10.4
08HB011	Tsolum River	9930	10800	8.8
08HB006	Puntledge River	15600	16600	6.4
08HA016	Bings Creek	578	611	5.7
08HB010	Stamp River	32700	34300	4.9
08HB030	Enos Creek	47	49	4.3
08HB014	Sarita River	26500	27500	3.8
08HB004	L. Qualicum River	6320	6550	3.6
08HA002	Cowichan River	12300	12700	3.3
08HD007	Salmon River	19000	19600	3.2
08HD001	Campbell River	29800	30700	3.0
08HC001	Gold River	80200	82400	2.7
08HB008	Sproat River	14200	14500	2.1
08HC002	Ucuna River	23100	23400	1.3
08HB022	Nile Creek	1110	1120	0.9
08HB003	Haslam Creek	3010	3020	0.3
08HB024	Tsable River	12000	12000	0.0
08HB034	Nanaimo River	40500	40200	-0.7
08HE002	Marble River	9700	9620	-0.8
08HB029	L. Qualicum River	7860	7710	-1.9
08HA003	Koksilah River	9820	9620	-2.0
08HB007	Puntledge River	9160	8930	-2.5
08HA011	Cowichan River	22500	21800	-3.1
08HB017	Somass River	53500	51600	-3.6
08HD005	Quinsam River	6340	6080	-4.1
08HA010	San Juan River	42700	40100	-6.1
08HF002	Nimpkish River	69400	60400	-13.0
08HD006	Salmon River	42800	36800	-14.0

Figure 3. Gumbel I - 100-Year Flood Estimates in cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

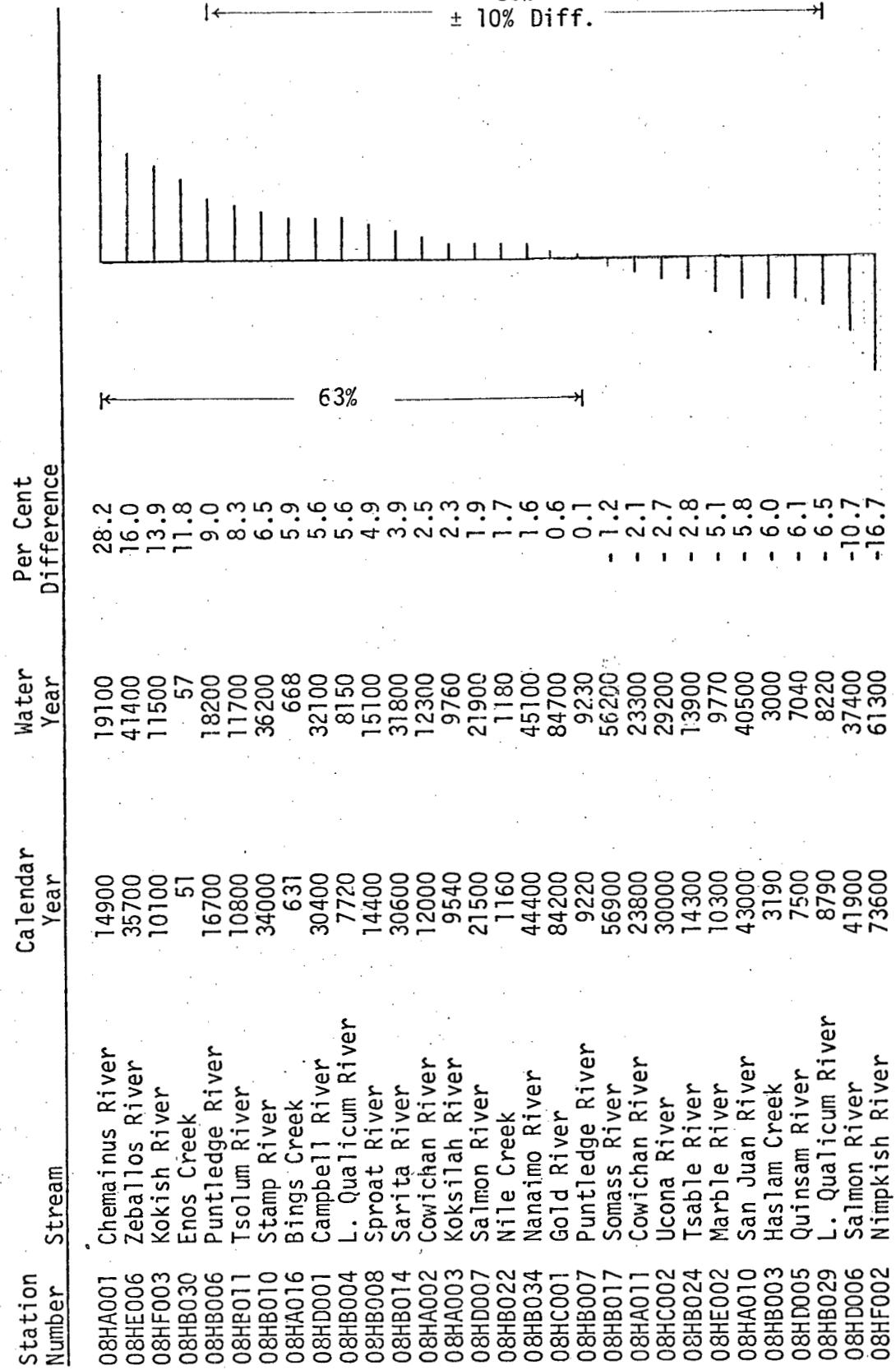


Figure 4. Log-Normal 100-Year Flood Estimates in cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

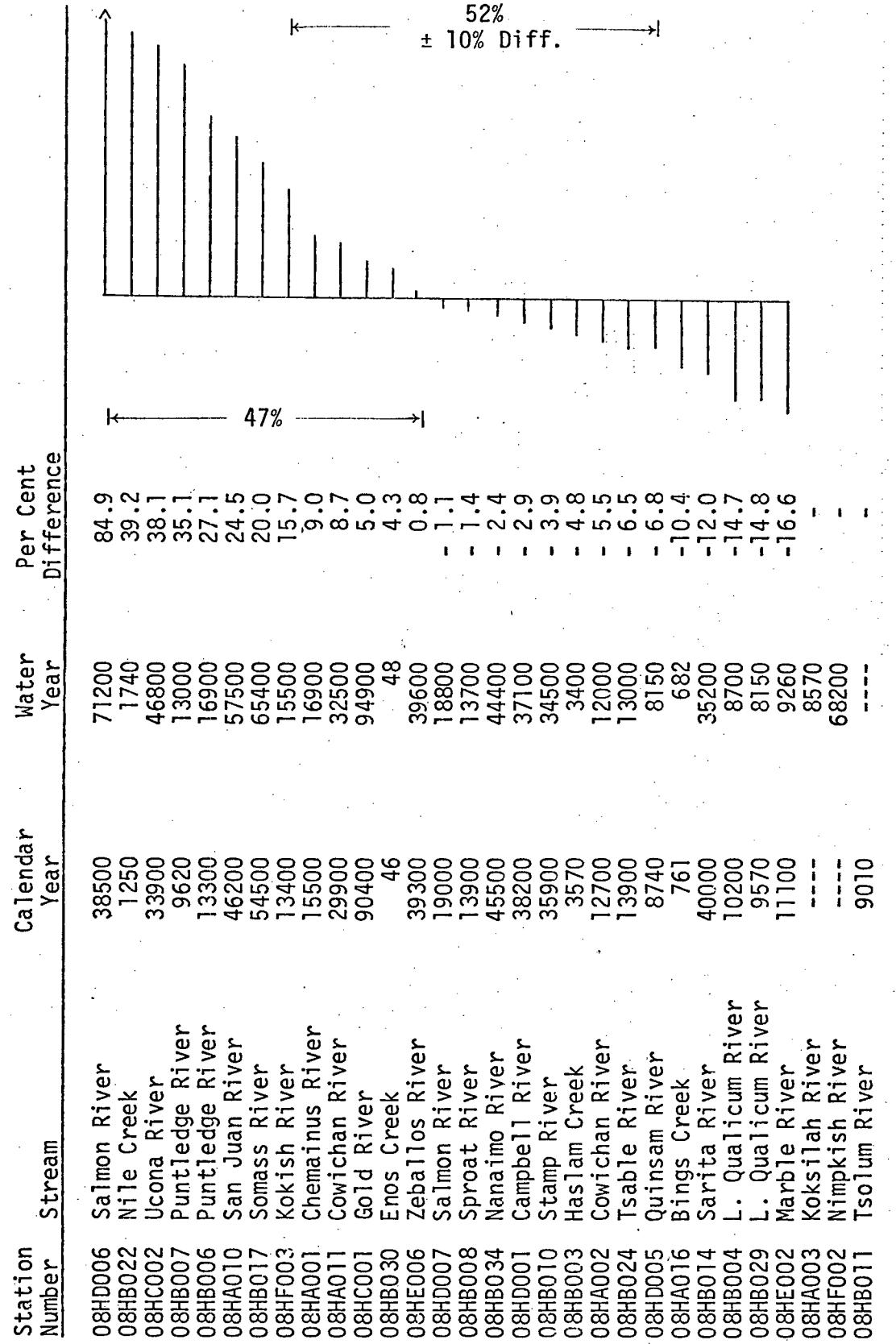


Figure 5. Three Parameter Log-Normal 100-Year Flood Estimates in cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

Station Number	Stream	Calendar Year	Water Year	Per Cent Difference
08HC002	Ucuna River	32700	56700	73.4
08HB022	Nile Creek	1230	1860	51.2
08HB007	Puntledge River	9630	13800	43.3
08HA011	Cowichan River	29000	36200	24.8
08HF003	Kokish River	13900	16300	17.3
08HB006	Puntledge River	12500	14500	16.0
08HA001	Chemainus River	15400	16400	6.5
08HC001	Gold River	88300	89500	1.4
08HB008	Sproat River	13300	13100	-1.5
08HD005	Quinsam River	8490	8200	-3.4
08HB017	Somass River	45300	43700	-3.5
08HB034	Nanaimo River	45100	43100	-4.4
08HD001	Campbell River	39800	37800	-5.0
08HA002	Cowichan River	12600	11700	-7.1
08HB024	Tsable River	11100	10200	-8.1
08HA016	Bings Creek	755	621	-17.7
08HB014	Sarita River	41800	34300	-17.9
08HB004	L. Qualicum River	11200	8580	-23.4
08HB030	Enos Creek	39	---	---
08HB003	Haslam Creek	---	3170	---
08HA003	Koksilah River	---	---	---
08HB029	L. Qualicum River	---	---	---
08HE002	Marble River	---	8650	---
08HF002	Nimpkish River	---	65500	---
08HD007	Salmon River	---	---	---
08HD006	Salmon River	37600	---	---
08HA010	San Juan River	45200	---	---
08HB010	Stamp River	---	30300	---
08HB011	Tsolum River	---	---	---
08HE006	Zeballos River	38500	---	---

↑ ±10% Diff. ↓

Figure 6. Log-Pearson III (Maximum Likelihood) 100-Year Flood Estimates in cfs

COMPARISON OF FLOOD SERIES
CALENDAR YEAR (BASE) vs. WATER YEAR

Station Number	Stream	Calendar Year	Water Year	Per Cent Difference
08HB006	Puntledge River	12400	16500	33.1
08HD006	Salmon River	36800	43600	18.5
08HA003	Koksilah River	8050	8990	11.7
08HB007	Puntledge River	9670	10700	10.7
08HB022	Nile Creek	1290	1400	8.5
08HB030	Enos Creek	46	49	6.5
08HA011	Cowichan River	24600	25500	3.7
08HC002	Uconia River	31400	32500	3.5
08HD001	Campbell River	34400	35400	2.9
08HB011	Tsolum River	9390	9630	2.6
08HF003	Kokish River	13800	14100	2.2
08HA010	San Juan River	44800	45700	2.0
08HD005	Quinsam River	8630	8790	1.9
08HB017	Somass River	53200	53900	1.3
08HA001	Chemainus River	16200	16300	0.6
08HD007	Salmon River	18400	18500	0.5
08HC001	Gold River	86900	86000	-1.0
08HE006	Zeballos River	38100	37700	-1.0
08HB010	Stamp River	34200	33700	-1.5
08HB034	Nanaimo River	45800	44800	-2.2
08HB008	Sproat River	13700	13400	-2.2
08HB014	Sarita River	34400	33300	-3.2
08HA002	Cowichan River	12400	11900	-4.0
08HF002	Nimpkish River	65800	62900	-4.4
08HB024	Tsable River	13200	12500	-5.3
08HB003	Haslam Creek	3230	3010	-6.8
08HB029	L. Qualicum River	8300	7710	-7.1
08HA016	Bings Creek	715	657	-8.1
08HB004	L. Qualicum River	9160	8380	-8.5
08HE002	Marble River	10400	9160	-11.9

83%
+ 10% Diff.

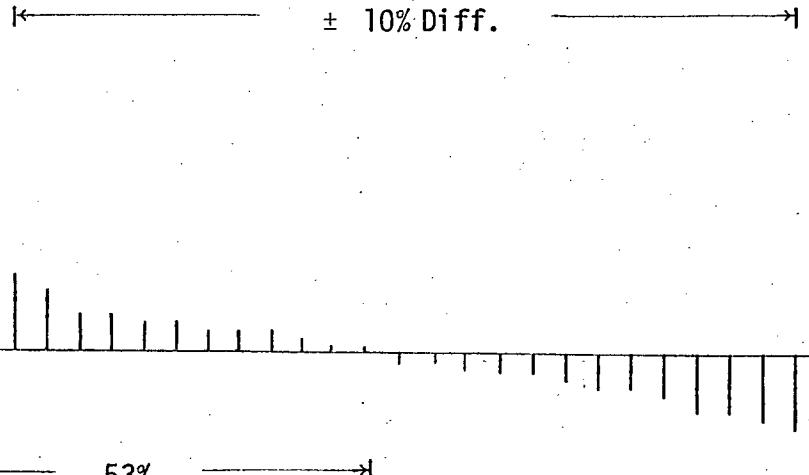


Figure 7. Log-Pearson III (Moments) 100-Year Flood Estimates in cfs

100 - YEAR FLOOD ESTIMATES IN CFS

Years of Record	Gumbel I	Three Parameter			Log-Pearson III					
		Log- Normal	% Diff.	Log-Normal	% Diff.	Max. Likelihood	% Diff.	Moments	% Diff.	
10	528	- 8.7	598	- 5.2	808	+ 6.2	801	+ 6.1	769	+ 7.6
11	551	- 4.7	610	- 3.3	776	+ 2.0	766	+ 1.5	721	+ 0.8
12	547	- 5.4	593	- 6.0	706	- 7.2	688	- 8.9	679	- 5.0
13	526	- 9.0	567	-10.0	673	-11.6	661	-12.5	666	- 6.9
14	578	0.0	631	0.0	761	0.0	755	0.0	715	0.0

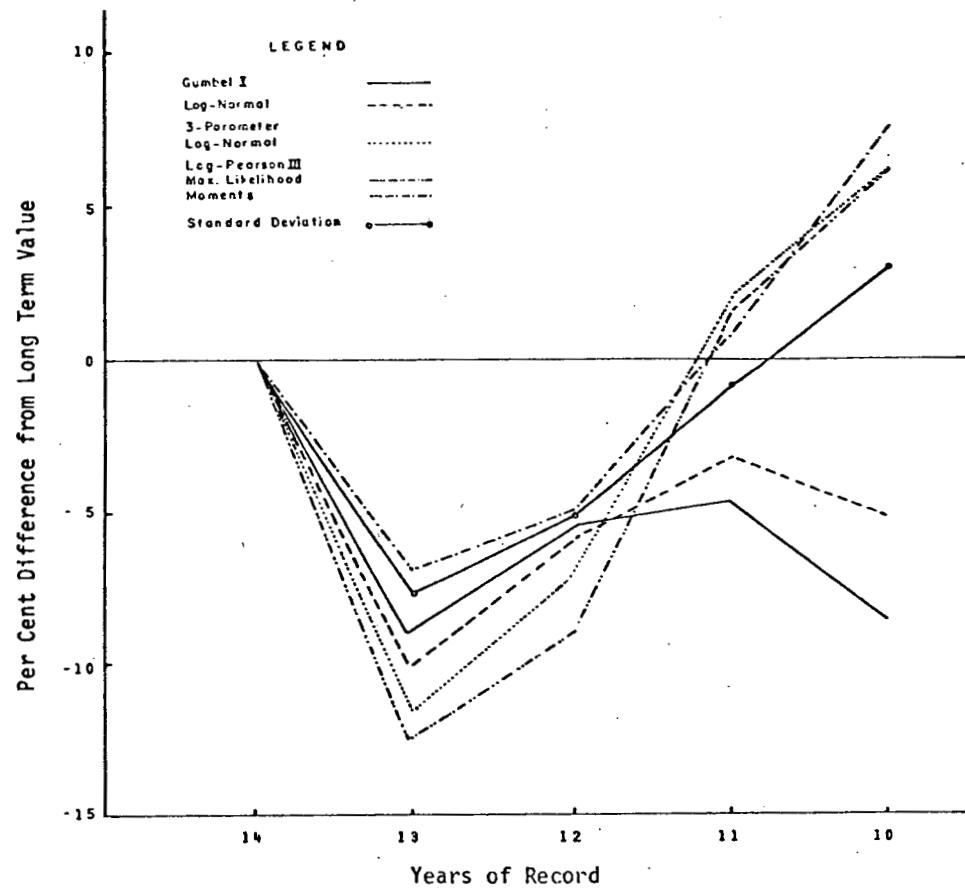


Figure 8. 08HA016 Bings Creek near the Mouth

100 - YEAR FLOOD ESTIMATES IN CFS

Years of Record	Gumbel I	% Diff.	Log- Normal	% Diff.	Three Parameter Log-Normal	% Diff.	Max. Likelihood	% Diff.	Log-Pearson III Moments	% Diff.
10	30200	+ 1.3	31000	+ 2.0	35700	- 6.5	34400	-13.6	35300	+ 2.6
11	30300	+ 1.7	30500	+ 0.3	33300	-12.8	32200	-19.1	33400	- 2.9
12	29300	- 1.7	29600	- 2.6	34300	-10.2	33500	-15.8	33600	- 2.3
13	29300	- 1.7	29200	- 3.9	32400	-15.2	31500	-20.9	32200	- 6.4
14	29300	- 1.7	28800	- 5.3	30800	-19.4	30100	-24.4	31100	- 9.6
15	28600	- 4.0	28000	- 7.9	30100	-21.2	29400	-26.1	30600	-11.0
16	28000	- 6.0	27300	-10.2	29300	-23.3	28800	-27.6	30200	-12.2
17	28300	- 5.0	27300	-10.2	28800	-24.6	28300	-28.9	29500	-14.2
18	28200	- 5.4	27000	-11.2	28100	-26.4	27700	-30.4	28800	-16.3
19	27600	- 7.4	26500	-12.8	27800	-27.2	27500	-30.9	28700	-16.6
20	27200	- 8.7	26000	-14.5	27400	-28.3	27100	-31.9	28500	-17.2
21	27000	- 9.4	26030	-14.5	27800	-27.2	27500	-30.9	28500	-17.2
22	26600	-10.7	25600	-15.8	27500	-28.0	27200	-31.7	28300	-17.7
23	26300	-11.7	25500	-16.1	28000	-26.7	27700	-30.4	28300	-17.7
24	26000	-12.8	25100	-17.4	27400	-28.3	27200	-31.7	28000	-18.6
25	27600	- 7.4	27400	- 9.9	31200	-18.3	-----	-	31500	- 8.4
26	27600	- 7.4	27400	- 9.9	31900	-16.5	-----	-	31300	- 9.0
27	27400	- 8.1	27100	-10.9	31000	-18.8	31000	-22.1	30900	-10.2
28	27300	- 8.4	27100	-10.9	31700	-17.0	32000	-19.6	30800	-10.5
29	29200	- 2.0	29800	- 2.0	37000	- 3.1	38300	- 3.8	35100	+ 2.0
30	29300	- 1.7	29600	- 2.6	36000	- 5.8	36700	- 7.8	34600	+ 0.6
31	30100	+ 1.0	30400	0.0	36800	- 3.7	37600	- 5.5	34800	+ 1.2
32	30300	+ 1.7	30600	+ 0.7	36100	- 5.5	36400	- 8.5	34600	+ 0.6
33	30400	+ 2.0	30800	+ 1.3	35800	- 6.3	36000	- 9.5	34400	0.0
34	31100	+ 4.4	31500	+ 3.6	36300	- 5.0	36300	- 8.8	34500	+ 0.3
35	30700	+ 3.0	31200	+ 2.6	37000	- 3.1	37500	- 5.8	34600	+ 0.6
36	30500	+ 2.3	31100	+ 2.3	38300	+ 0.3	39500	- 0.8	34600	+ 0.6
37	30200	+ 1.3	30800	+ 1.3	39000	+ 2.1	40900	+ 2.8	34600	+ 0.6
38	29800	0.0	30400	0.0	38200	0.0	39800	0.0	34400	0.0

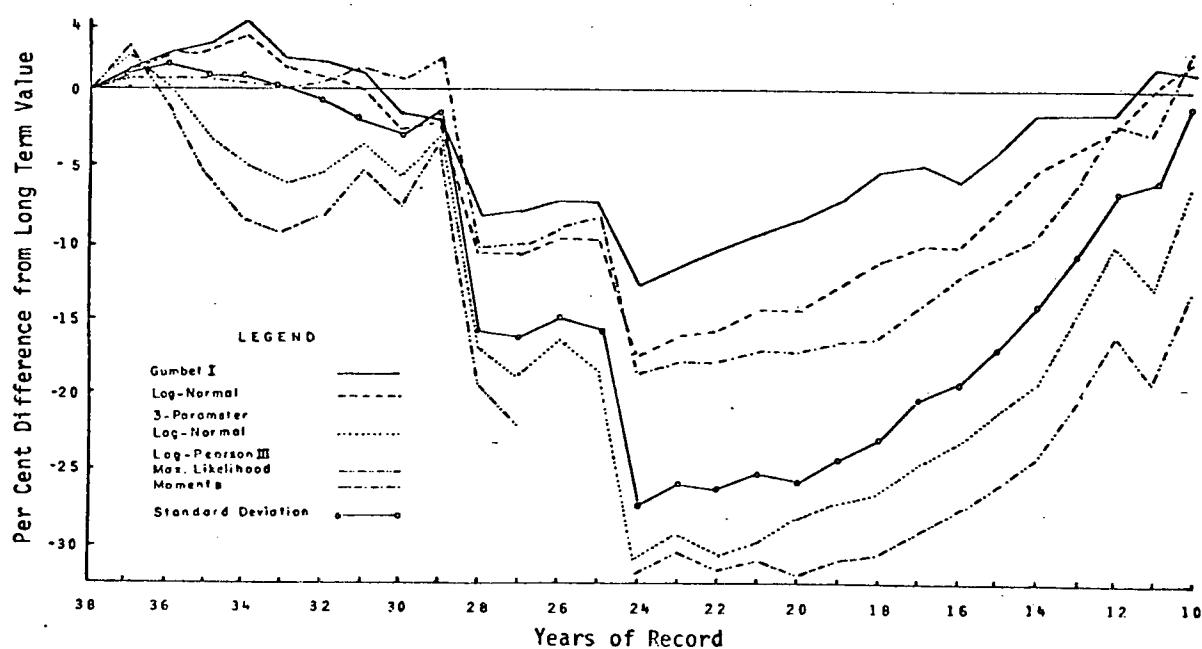


Figure 9. 08H001 Campbell River at Outlet of Campbell Lake

100 - YEAR FLOOD ESTIMATES IN CFS

Years of Record	Gumbel I	% Diff.	Log- Normal	% Diff.	Three Parameter Log-Normal		% Diff.	Max. Likelihood	% Diff.	Log-Pearson III	
										Moments	% Diff.
10	11000	-27.7	11600	-22.1	17300	+11.6	---	-	10400	-35.8	
11	11900	-20.7	12300	-17.4	19400	+25.2	---	-	14700	-7.4	
12	12300	-18.0	12400	-16.8	18800	+21.3	---	-	14100	-13.0	
13	12500	-16.7	12400	-16.8	17900	+15.5	---	-	13700	-15.4	
14	12100	-19.3	12200	-18.1	17900	+15.5	---	-	13700	-15.4	
15	11900	-20.7	11900	-20.1	16600	+7.1	---	-	13500	-16.7	
16	11900	-20.7	11800	-20.8	15900	+2.6	15600	+1.3	13200	-18.5	
17	11700	-22.0	11600	-22.1	15100	-2.6	14700	-4.5	13000	-19.8	
18	13500	-10.0	14300	-4.0	20800	+34.2	---	-	18600	+14.8	
19	14800	-1.3	15000	+0.7	15800	+1.9	15700	+1.9	17200	+6.2	
20	14600	-2.7	14700	-1.3	15400	-0.6	15400	0.0	16900	+4.3	
21	14700	-2.0	14600	-2.0	15200	-1.9	15200	-1.3	16500	+1.9	
22	15200	+1.3	15100	+1.3	15600	+0.6	15600	+1.3	16500	+1.9	
23	15000	0.0	15000	+0.7	15700	+1.3	15600	+1.3	16500	+1.9	
24	15000	0.0	14900	0.0	15500	0.0	15400	0.0	16200	0.0	

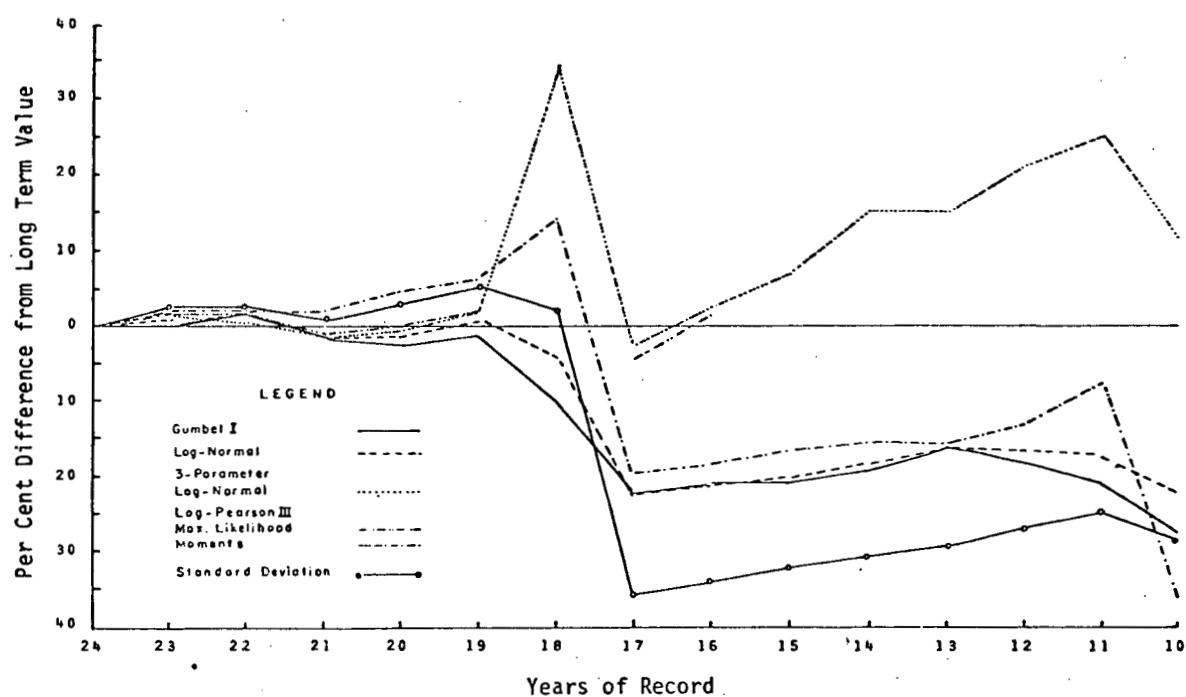


Figure 10. 08HA001 Chemainus River near Westholme

100 - YEAR FLOOD ESTIMATES IN CFS

Years of Record	Gumbel I	% Diff.	Log- Normal	% Diff.	Three Parameter Log-Normal			Max. Likelihood	Log-Pearson III		
					% Diff.	Moments	% Diff.		% Diff.	Moments	% Diff.
10	9960	-19.0	9840	-18.0	10800	-15.0	10400	-17.5	10100	-18.5	
11	9910	-19.4	9630	-19.8	9990	-21.3	9630	-23.6	9660	-22.1	
12	10000	-18.7	9580	-20.2	9400	-26.0	8790	-30.2	9320	-24.8	
13	10200	-17.1	9610	-19.9	8980	-29.3	8420	-33.2	9080	-26.8	
14	10000	-18.7	9390	-21.8	8830	-30.5	8430	-33.1	8890	-28.3	
15	10800	-12.2	10400	-13.3	10400	-18.1	9880	-21.6	10200	-17.7	
16	10700	-13.0	10200	-15.0	10000	-21.3	4320	-65.7	9970	-19.6	
17	10800	-12.2	10100	-15.8	9770	-23.1	9490	-24.7	9740	-21.5	
18	10600	-13.8	9940	-17.2	9620	-24.3	9400	-25.4	9580	-22.7	
19	11200	-8.9	10600	-11.7	10400	-18.1	10000	-20.6	10300	-16.9	
20	11400	-7.3	10700	-10.8	10300	-18.9	9940	-21.1	10300	-16.9	
21	11600	-5.7	10900	-9.2	10200	-19.7	9750	-22.6	10200	-17.7	
22	11400	-7.3	10700	-10.8	10300	-18.9	9860	-21.7	10200	-17.7	
23	11200	-8.9	10500	-12.5	10200	-19.7	9900	-21.4	10200	-17.7	
24	11300	-8.1	10500	-12.5	10100	-20.5	-----	-	10000	-19.4	
25	11100	-9.8	10400	-13.3	10100	-20.5	9820	-22.1	10100	-18.5	
26	10900	-11.4	10200	-15.0	10100	-20.5	3340	-73.5	10100	-18.5	
27	11500	-6.5	11100	-7.5	11500	-9.4	11500	-8.7	11500	-7.3	
28	11400	-7.3	11000	-8.3	11400	-10.2	11300	-10.3	11400	-8.1	
29	11500	-6.5	11000	-8.3	11200	-11.8	11200	-11.1	11200	-9.7	
30	11400	-7.3	10900	-9.2	11100	-12.6	11100	-11.9	11100	-10.5	
31	11300	-8.1	10700	-10.8	11000	-13.4	-----	-	11100	-10.5	
32	11700	-4.9	11200	-6.7	11700	-7.9	11600	-7.9	11700	-5.6	
33	11600	-5.7	11100	-7.5	11500	-9.4	11500	-8.7	11600	-6.5	
34	12100	-1.6	11800	-1.7	12600	-0.8	12600	0.0	12700	+ 2.4	
35	12100	-1.6	11800	-1.7	12700	0.0	12700	+ 0.8	12700	+ 2.4	
36	12000	-2.4	11900	-0.8	12800	+ 0.8	12800	+ 1.6	12700	+ 2.4	
37	11900	-3.3	11700	-2.5	12800	+ 0.8	12800	+ 1.6	12700	+ 2.4	
38	12100	-1.6	11900	-0.8	12900	+ 1.6	12800	+ 1.6	12700	+ 2.4	
39	12100	-1.6	11900	-0.8	12800	+ 0.8	12700	+ 0.8	12600	+ 1.6	
40	12200	-0.8	12000	0.0	12700	0.0	12600	0.0	12500	+ 0.8	
41	12400	+ 0.8	12100	+ 0.8	12700	0.0	12600	0.0	12400	0.0	
42	12400	+ 0.8	12100	+ 0.8	12800	+ 0.8	12700	+ 0.8	12500	+ 0.8	
43	12300	0.0	12000	0.0	12700	0.0	12600	0.0	12400	0.0	

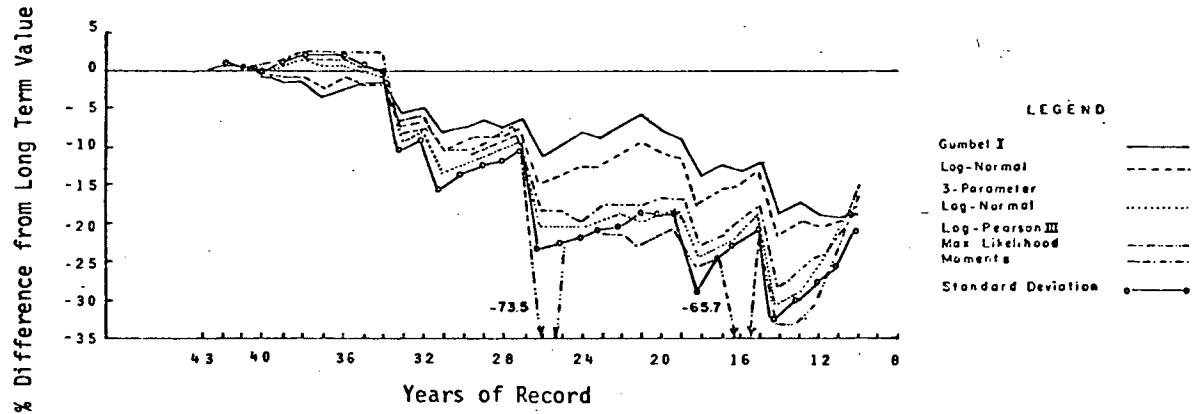


Figure 11. 08HA002 Cowichan River at Lake Cowichan

S A M P L E F L O O D S T A T I S T I C S

Years of Record	Mean (Arithmetic) in cfs	% Diff.	Standard Deviation in cfs	% Diff.	Coefficient of Skew	% Diff.	Coefficient of Kurtosis	% Diff.
10	246	- 6.8	119	+ 2.6	1.669	+47.6	7.092	+59.8
11	253	- 4.2	115	- 0.9	1.412	+24.8	6.162	+38.8
12	254	- 3.8	110	- 5.2	1.413	+24.9	6.304	+42.0
13	250	- 5.3	107	- 7.8	1.537	+35.9	6.626	+49.3
14	264	0.0	116	0.0	1.131	0.0	4.438	0.0

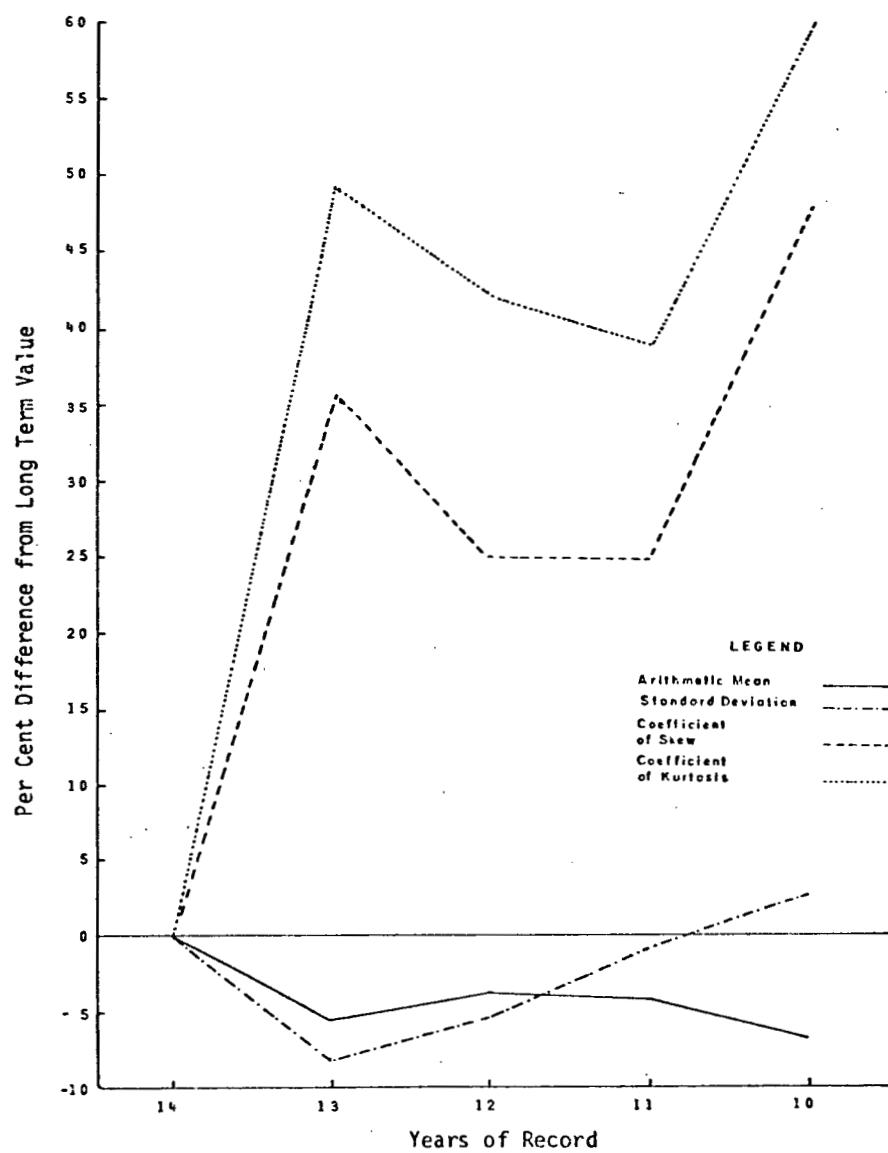


Figure 12. 08HA016 Bings Creek near the Mouth

S A M P L E F L O O D S T A T I S T I C S

Years of Record	Mean (Arithmetic) in cfs	% Diff.	Standard Deviation in cfs	% Diff.	Coefficient of Skew	% Diff.	Coefficient of Kurtosis	% Diff.
10	15700	+ 5.4	5340	- 1.1	1.469	+15.3	7.318	+56.0
11	15800	+ 6.0	5090	- 5.7	1.389	+ 9.0	7.195	+53.4
12	15400	+ 3.4	5030	- 6.9	1.475	+15.8	7.174	+52.9
13	15500	+ 4.0	4830	-10.6	1.428	+12.1	7.199	+53.5
14	15600	+ 4.7	4650	-13.9	1.402	+10.0	7.314	+55.9
15	15500	+ 4.0	4510	-16.5	1.505	+18.1	7.659	+63.3
16	15400	+ 3.4	4380	-18.9	1.602	+25.7	8.011	+70.8
17	15500	+ 4.0	4280	-20.7	1.494	+17.3	7.760	+65.4
18	15600	+ 4.7	4160	-23.0	1.488	+16.8	7.950	+69.5
19	15400	+ 3.4	4090	-24.3	1.567	+23.0	8.147	+73.7
20	15300	+ 2.7	4000	-25.9	1.646	+29.2	8.468	+80.5
21	15100	+ 1.3	4050	-25.0	1.589	+24.7	8.127	+73.2
22	15000	+ 0.7	3980	-26.3	1.661	+30.4	8.384	+78.7
23	14800	- 0.7	4000	-25.9	1.647	+29.3	8.209	+75.0
24	14700	- 1.3	3920	-27.4	1.709	+34.1	8.515	+81.5
25	15200	+ 2.0	4540	-15.9	1.566	+22.9	6.340	+35.2
26	15000	+ 0.7	4590	-15.0	1.533	+20.3	6.245	+33.1
27	15000	+ 0.7	4500	-16.7	1.561	+22.5	6.441	+37.3
28	14800	- 0.7	4530	-16.1	1.534	+20.4	6.351	+35.4
29	15300	+ 2.7	5300	- 1.9	1.555	+22.1	5.685	+21.2
30	15400	+ 3.4	5220	- 3.3	1.535	+20.5	5.721	+22.0
31	15600	+ 4.7	5290	- 2.0	1.367	+ 7.3	5.033	+ 7.3
32	15400	+ 3.4	5350	- 0.9	1.331	+ 4.5	4.979	+ 6.1
33	15200	+ 2.0	5410	+ 0.2	1.297	+ 1.8	4.924	+ 5.0
34	15400	+ 3.4	5460	+ 1.1	1.168	- 8.3	4.462	- 4.9
35	15300	+ 2.7	5460	+ 1.1	1.196	- 6.1	4.504	- 4.0
36	15100	+ 1.3	5480	+ 1.5	1.203	- 5.6	4.508	- 3.9
37	15000	+ 0.7	5460	+ 1.1	1.234	- 3.1	4.568	- 2.6
38	14900	0.0	5400	0.0	1.274	0.0	4.691	0.0

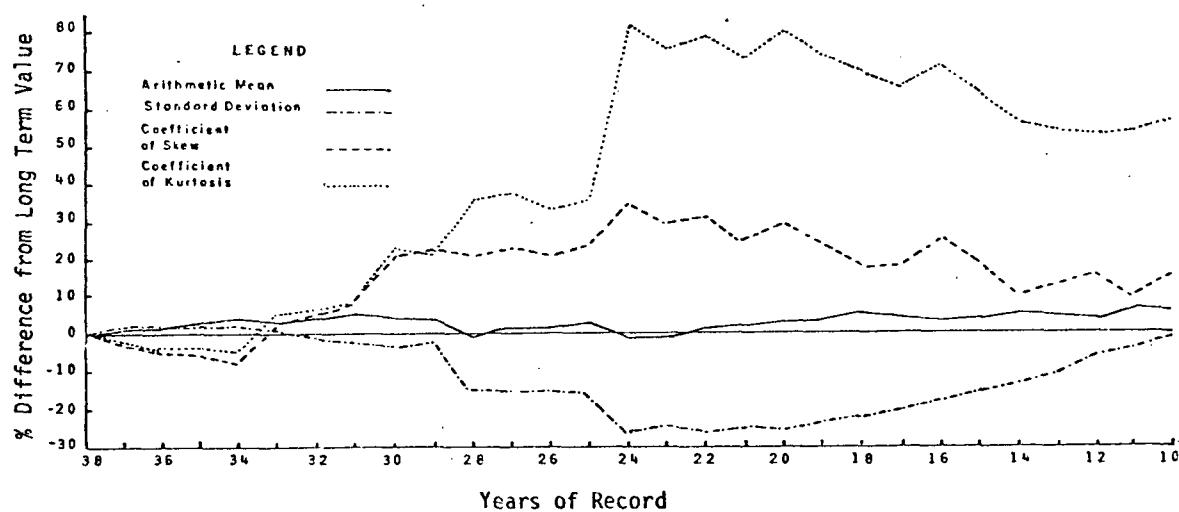


Figure 13. 08HD001 Campbell River at Outlet of Campbell Lake

S A M P L E F L O O D S T A T I S T I C S

Years of Record	Mean (Arithmetic) in cfs	% Diff.	Standard Deviation in cfs	% Diff.	Coefficient of Skew	% Diff.	Coefficient of Kurtosis	% Diff.
10	7000	- 8.5	1830	-28.5	1.822	+12.2	7.315	- 3.4
11	7250	- 5.2	1910	-25.4	1.262	-22.3	4.664	-38.4
12	7360	- 3.8	1860	-27.3	1.046	-35.6	4.106	-45.8
13	7440	- 2.7	1810	-29.3	0.880	-45.8	3.777	-50.1
14	7340	- 4.1	1790	-30.1	0.994	-38.8	3.902	-48.5
15	7290	- 4.7	1730	-32.4	1.091	-32.8	4.129	-45.5
16	7330	- 4.2	1680	-34.4	1.031	-36.5	4.102	-45.8
17	7290	- 4.7	1630	-36.3	1.115	-31.3	4.319	-43.0
18	7780	+ 1.7	2610	+ 2.0	2.154	+32.6	9.111	+20.3
19	7570	- 1.0	2710	+ 5.9	1.867	+15.0	8.410	+11.1
20	7540	- 1.4	2640	+ 3.1	1.930	+18.8	8.776	+15.9
21	7590	- 0.8	2580	+ 0.8	1.894	+16.6	8.805	+16.3
22	7740	+ 1.2	2610	+ 2.0	1.648	+ 1.5	7.574	+ 0.02
23	7620	- 0.4	2610	+ 2.0	1.650	+ 1.6	7.507	- 0.9
24	7650	0.0	2560	0.0	1.624	0.0	7.572	0.0

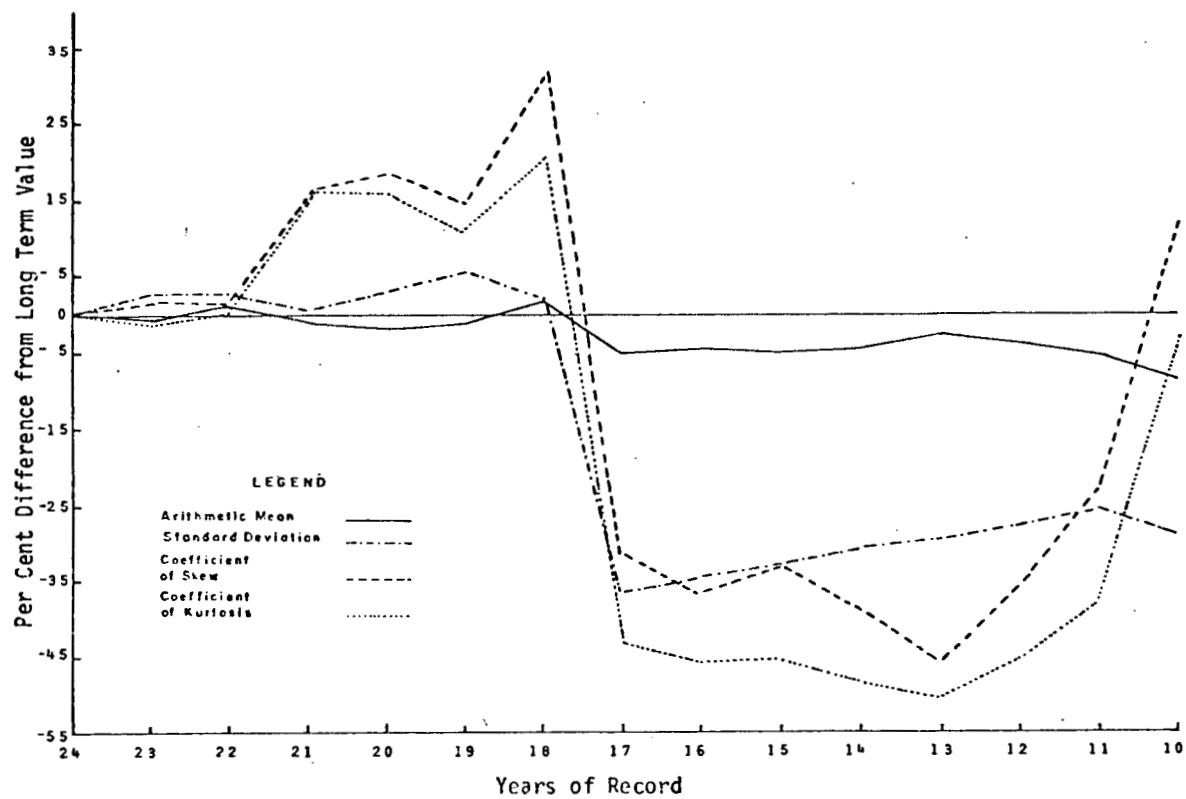


Figure 14. 08HA001 Chemainus River near Westholme

S A M P L E F L O O D S T A T I S T I C S

Years of Record	Mean (Arithmetic) in cfs	% Diff.	Standard Deviation in cfs	% Diff.	Coefficient of Skew	% Diff.	Coefficient of Kurtosis	% Diff.
10	5330	-15.4	1500	-21.5	0.543	-36.6	3.618	-2.8
11	5360	-14.9	1420	-25.7	0.488	-43.1	3.663	-1.6
12	5420	-14.0	1380	-27.7	0.336	-60.8	3.521	-5.4
13	5500	-12.7	1340	-29.8	0.165	-80.7	3.336	-10.4
14	5490	-12.9	1290	-32.5	0.204	-76.2	3.476	-6.6
15	5720	-9.2	1540	-19.4	0.558	-34.9	3.854	+3.5
16	5730	-9.0	1490	-22.0	0.538	-37.2	3.971	+6.7
17	5770	-8.4	1450	-24.1	0.465	-45.7	3.987	+7.1
18	5760	-8.6	1410	-26.2	0.504	-41.2	4.154	+11.6
19	5920	-6.0	1550	-18.8	0.527	-38.5	3.607	-3.1
20	6010	-4.6	1550	-18.8	0.386	-55.0	3.289	-11.7
21	6080	-3.5	1550	-18.8	0.265	-69.1	3.090	-17.0
22	6030	-4.3	1540	-19.4	0.351	-59.0	3.095	-16.9
23	5990	-4.9	1510	-20.9	0.418	-51.2	3.173	-14.8
24	6030	-4.3	1490	-22.0	0.348	-59.4	3.149	-15.4
25	5980	-5.1	1480	-22.5	0.421	-50.9	3.146	-15.5
26	5940	-5.7	1460	-23.6	0.490	-42.8	3.188	-14.4
27	6120	-2.9	1720	-9.9	0.934	+9.0	4.365	+17.2
28	6120	-2.9	1690	-11.5	0.954	+11.3	4.501	+20.9
29	6150	-2.4	1670	-12.6	0.902	+5.3	4.466	+20.0
30	6140	-2.5	1640	-14.1	0.927	+8.2	4.603	+23.6
31	6120	-2.9	1620	-15.2	0.974	+13.7	4.732	+27.1
32	6240	-1.0	1740	-8.9	0.939	+9.6	4.130	+10.9
33	6230	-1.1	1710	-10.5	0.973	+13.5	4.254	+14.3
34	6380	+1.3	1910	0.0	1.089	+27.1	4.277	+14.9
35	6320	+0.3	1930	+1.0	1.083	+26.4	4.250	+14.2
36	6240	-1.0	1950	+2.1	1.068	+24.6	4.215	+13.2
37	6210	-1.4	1940	+2.1	1.109	+29.4	4.293	+15.3
38	6260	-0.6	1940	+2.1	1.019	+18.9	4.044	+8.6
39	6290	-0.2	1930	+1.0	0.965	+12.6	3.960	+6.4
40	6330	+0.5	1910	0.0	0.906	+5.7	3.859	+3.7
41	6380	+1.3	1920	+0.5	0.829	-3.3	3.669	-1.5
42	6320	+0.3	1930	+1.0	0.827	-3.5	3.637	-2.3
43	6300	0.0	1910	0.0	0.857	0.0	3.723	0.0

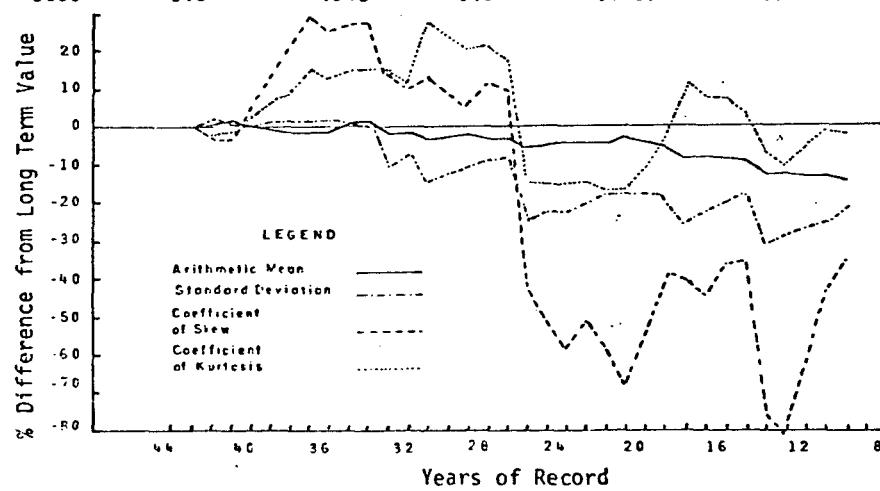


Figure 15. 08HA002 Cowichan River at Lake Cowichan

Conclusions

Analysis of the means and standard deviations of the flood series indicates that the data extracted on the water year basis will produce higher mean values and have higher standard deviations for the majority of stations. The differences in the values, however, are relatively small with few being greater than ± 10 per cent.

The distributions of Gumbel I, Log-Normal and Log-Pearson III (fitted by moments) were successful in fitting all of the data series. The following conclusions, therefore, are drawn from the results of these three distributions:

- (a) Those stations with higher means split fairly evenly in producing higher 100-year estimates.
- (b) The number of stations with higher standard deviations producing higher 100-year estimates ranged from 60 to 90 per cent depending on the distribution.
- (c) Over 80 per cent of the stations had differences in the 100-year estimates within the range of ± 10 per cent.

Comparison between the standard deviations and the 100-year estimates based on length of record indicates that for periods where the standard deviations are greater than or less than the long term value the 100-year estimates are also greater than or less than their long term value.

Based on the above findings it would appear that there is a slight advantage (in the form of a higher estimate) to be gained in using the water year for the annual flood series as opposed to the calendar year. Another advantage in using the water year is that more statistical independence can be maintained as there is less likelihood of using the same flood event twice. However, from a practical point of view, considering ease of extraction, handling and accuracy of the basic data there is little to be gained by changing to the water year method of data extraction for the coastal area.