



Technical Memo

June 7, 2007

To: Bruce Reid, P.Eng.
Director, Watershed Sciences and Engineering Services

From: Ferdous Ahmed, Ph.D., P.Eng.
Senior Water Resources Engineer

Subject: **Low Flow Frequency Analysis
(Rideau at Carleton, Jock at Moodie Drive and Kemptville at Kemptville)**

Low flow frequency analysis at three log-term gage locations has been carried out using the LFA program of Environment Canada. The data and results are presented in this technical memo.

The gage stations are:

- Rideau River at Carleton (02LA004) – data from 1948 to 2005
- Jock River at Moodie Drive (02LA007) – data from 1970 to 2005
- Kemptville Creek at Kemptville (02LA006) – data from 1970 to 2005

The minimum daily, 3-day, 7-day, 15-day and 30-day values (1Q, 3Q, 7Q, 15Q AND 30Q) were computed from the daily flow data available in the HYDAT CD. The minimum value was taken for all water years. The water year was defined for each year as from May 15th to the May 14th of the next year. Tables 1, 2 and 3 show the extracted data. The yearly variation of 1Q, 3Q, etc. is shown in Figures 1, 2 and 3.

Frequency analysis of 1Q, 3Q, etc. was performed using the LFA program of Environment Canada. This program uses the Weibull (also known as Gumbel III) distribution to fit the data, which was found suitable and is therefore recommended for Ontario.

The results of the low flow frequency analysis for the three stations are shown in Tables 4, 5, and 6, and in Figures 4, 5 and 6.

Next step: This analysis will be used in low water response and will be put on WIS.

Staff Involved: Ferdous Ahmed and Adam McCreath

Thanks.

Table 1 Low Flow Values (in cms) of Rideau River at Carleton (02LA004)

Year	30Q	15Q	7Q	3Q	1Q
1948	9.1647	8.5007	7.9900	7.3167	6.4600
1949	5.9200	5.9200	5.9200	5.2667	4.5900
1950	7.6757	7.0527	6.5557	6.2700	5.8900
1951	10.8297	10.1700	6.8943	6.1267	4.9800
1952	10.8373	9.7580	9.6243	7.8067	7.0800
1953	7.6200	7.6200	7.6200	7.3167	7.0800
1954	10.6600	9.8200	9.7857	9.4000	9.4000
1955	7.2027	6.4053	5.8729	4.7367	4.5300
1956	7.9570	7.1220	6.1486	5.5600	3.3100
1957	4.2820	3.8740	3.7743	3.3200	2.9700
1958	7.0420	6.5273	6.2757	6.1900	5.8900
1959	7.7080	7.2240	6.5771	5.9067	4.8400
1960	3.6103	3.0813	3.0600	3.0600	3.0600
1961	4.4840	4.4380	4.4243	4.4100	4.3900
1962	5.6823	5.5847	5.4929	5.1567	4.7600
1963	6.1050	5.4600	4.9314	4.7567	4.5000
1964	3.8890	3.5493	3.4800	3.4800	3.4800
1965	6.0920	5.0853	4.8057	4.7300	4.6700
1966	6.0117	5.8707	5.4743	5.3333	5.2100
1967	8.7993	8.2947	7.9943	7.8533	7.7000
1968	7.8667	7.5853	7.4214	7.3300	7.3300
1969	7.8910	7.2460	6.4600	5.6733	4.3900
1970	7.2507	6.5820	6.3343	6.1167	5.9500
1971	7.3797	6.1107	5.3271	4.9633	4.8700
1972	9.2963	8.7000	7.6886	6.8433	6.5700
1973	7.9607	7.4200	6.5929	6.1600	5.9700
1974	6.8987	6.6620	6.4400	6.3167	6.2600
1975	5.5270	5.0707	4.7443	4.6433	4.5900
1976	6.0750	5.7160	5.5543	5.4733	5.4100
1977	5.2403	4.0927	3.4671	3.1433	2.7200
1978	4.5660	4.0180	3.8157	3.2200	2.9700
1979	5.7717	5.1733	4.2286	2.9867	2.7800
1980	6.8230	6.2240	5.0229	2.0167	1.7800
1981	15.1733	13.7693	10.2771	8.7800	7.3600
1982	9.5913	7.1227	6.1086	5.3633	4.5600
1983	5.1260	4.2520	4.0214	3.7633	3.4100
1984	5.8813	5.7353	5.1143	3.9233	2.1400
1985	3.9260	3.8927	2.3914	1.6667	1.4800
1986	18.8030	15.4933	10.3557	8.5967	7.6500
1987	7.0410	5.7440	5.0414	3.7000	3.3900
1988	5.6280	4.5887	3.6514	3.2433	3.1900
1989	6.1673	5.6227	5.5343	5.4500	5.4400
1990	6.0080	5.8353	5.5557	5.0333	4.8500
1991	4.7097	4.2260	4.1571	3.8933	3.6000
1992	8.7207	7.6020	6.5100	6.2000	5.4600
1993	8.8920	7.8773	7.4143	6.7900	6.3100
1994	7.4340	6.4767	6.2629	5.3367	2.9300
1995	3.5653	2.7333	2.6371	2.6133	2.5000
1996	7.3407	6.5053	6.1629	5.8067	5.2000
1997	5.9953	5.2213	4.4971	4.3033	3.9400
1998	10.0307	8.8407	7.2743	6.7900	5.4300
1999	5.3153	4.1493	3.9429	3.9167	3.9000
2000	9.6940	7.2500	6.5714	6.3033	5.2000
2001	2.7213	2.6327	2.5100	2.4933	2.4700
2002	6.8647	6.0220	5.3157	5.1333	4.2800
2003	9.8893	9.8519	9.0475	7.0120	6.3250
2004	10.5764	10.0453	7.8953	7.2600	6.9633
2005	6.0842	5.2406	4.5093	3.7263	3.5213

Table 2 Low Flow Values (in cms) of Jock River at Moodie Drive (02LA007)

Year	30Q	15Q	7Q	3Q	1Q
1970	0.1135	0.0890	0.0737	0.0623	0.0570
1971	0.1024	0.0765	0.0681	0.0553	0.0450
1972	0.6084	0.4920	0.4486	0.4227	0.4130
1973	0.2427	0.2108	0.1093	0.0907	0.0850
1974	0.0434	0.0367	0.0349	0.0330	0.0310
1975	0.0574	0.0534	0.0453	0.0387	0.0340
1976	0.3883	0.3813	0.3437	0.3000	0.2520
1977	0.0649	0.0414	0.0383	0.0330	0.0310
1978	0.0509	0.0431	0.0374	0.0320	0.0310
1979	0.0932	0.0638	0.0413	0.0340	0.0310
1980	0.1333	0.1107	0.0647	0.0523	0.0500
1981	0.7828	0.7772	0.6877	0.6233	0.6120
1982	0.2521	0.1219	0.0939	0.0790	0.0720
1983	0.0235	0.0200	0.0174	0.0153	0.0140
1984	0.0846	0.0689	0.0607	0.0530	0.0480
1985	0.0220	0.0148	0.0134	0.0123	0.0120
1986	1.6540	1.5667	1.2157	1.0933	1.0100
1987	0.4513	0.2935	0.2730	0.2613	0.2390
1988	0.0902	0.0599	0.0519	0.0440	0.0400
1989	0.0703	0.0627	0.0614	0.0600	0.0580
1990	0.3248	0.2869	0.2074	0.1487	0.1200
1991	0.0273	0.0225	0.0191	0.0180	0.0170
1992	1.0821	0.6591	0.4446	0.3210	0.3020
1993	0.2750	0.2449	0.1964	0.1940	0.1800
1994	0.6032	0.4660	0.4311	0.3777	0.3550
1995	0.2259	0.1844	0.1521	0.1323	0.1190
1996	0.2626	0.0861	0.0376	0.0307	0.0280
1997	0.0748	0.0589	0.0467	0.0413	0.0350
1998	0.0776	0.0530	0.0301	0.0253	0.0240
1999	0.0680	0.0145	0.0107	0.0103	0.0100
2000	0.5570	0.4566	0.4279	0.4127	0.4070
2001	0.0723	0.0542	0.0357	0.0340	0.0330
2002	0.0462	0.0433	0.0269	0.0237	0.0230
2003	0.3988	0.2278	0.1743	0.1529	0.1480
2004	0.4455	0.2652	0.2419	0.2070	0.2030
2005	0.1277	0.0992	0.0686	0.0567	0.0489

Table 3 Low Flow Values (in cms) of Kemptville Creek at Kemptville (02LA0)

Year	30Q	15Q	7Q	3Q	1Q
1970	0.2084	0.1429	0.1216	0.1150	0.1100
1971	0.0269	0.0241	0.0219	0.0197	0.0190
1972	0.3675	0.1674	0.0904	0.0850	0.0820
1973	0.0478	0.0441	0.0419	0.0407	0.0400
1974	0.0428	0.0417	0.0383	0.0370	0.0340
1975	0.0312	0.0273	0.0239	0.0227	0.0220
1976	0.4888	0.4611	0.4521	0.4510	0.4390
1977	0.0348	0.0283	0.0261	0.0247	0.0240
1978	0.0247	0.0231	0.0224	0.0207	0.0200
1979	0.0719	0.0689	0.0614	0.0560	0.0530
1980	0.1051	0.0926	0.0820	0.0773	0.0710
1981	1.2343	0.7445	0.4723	0.3203	0.3020
1982	0.8612	0.4897	0.2856	0.2490	0.2470
1983	0.0137	0.0095	0.0089	0.0073	0.0070
1984	0.0298	0.0281	0.0246	0.0220	0.0200
1985	0.0402	0.0349	0.0333	0.0327	0.0320
1986	1.5717	1.4707	1.1473	0.9237	0.9170
1987	0.0390	0.0302	0.0274	0.0240	0.0220
1988	0.0201	0.0172	0.0149	0.0137	0.0130
1989	0.1640	0.1101	0.0980	0.0943	0.0900
1990	0.0574	0.0414	0.0359	0.0330	0.0320
1991	0.0221	0.0201	0.0181	0.0163	0.0140
1992	0.1115	0.0991	0.0954	0.0917	0.0830
1993	0.1272	0.1165	0.0973	0.0817	0.0790
1994	0.0563	0.0449	0.0426	0.0290	0.0270
1995	0.0304	0.0283	0.0269	0.0253	0.0240
1996	0.1307	0.1170	0.1071	0.1000	0.0940
1997	0.0764	0.0582	0.0541	0.0503	0.0480
1998	0.5143	0.3649	0.2607	0.2260	0.2200
1999	0.0442	0.0393	0.0379	0.0350	0.0320
2000	0.5097	0.4372	0.4290	0.4240	0.4120
2001	0.0202	0.0197	0.0154	0.0137	0.0130
2002	0.0153	0.0134	0.0101	0.0093	0.0090
2003	0.0705	0.0549	0.0461	0.0423	0.0370
2004	0.8333	0.6477	0.4253	0.3312	0.3128
2005	0.1156	0.1081	0.1028	0.0973	0.0933

Table 4 Low Flow Frequency Analysis of Rideau River at Carleton (02LA004)

Flow (cms)	Return Period (Years)							
	2	5	10	20	50	100	200	500
1Q	4.687	3.310	2.688	2.243	1.829	1.606	1.438	1.277
3Q	5.221	3.763	3.071	2.558	2.059	1.778	1.559	1.340
7Q	5.674	4.163	3.507	3.053	2.643	2.430	2.274	2.129
15Q	6.172	4.396	3.710	3.275	2.920	2.752	2.639	2.544
30Q	6.884	4.869	4.081	3.576	3.159	2.960	2.825	2.710

Table 5 Low Flow Frequency Analysis of Jock River at Moodie Drive (02LA007)

Flow (cms)	Return Period (Years)							
	2	5	10	20	50	100	200	500
1Q	0.0700	0.0207	0.0131	0.0106	0.0096	0.0094	0.0093	0.0093
3Q	0.0756	0.0222	0.0138	0.0110	0.0099	0.0097	0.0096	0.0095
7Q	0.0877	0.0252	0.0150	0.0116	0.0102	0.0099	0.0098	0.0097
15Q	0.1080	0.0319	0.0196	0.0156	0.0139	0.0135	0.0134	0.0133
30Q	0.1570	0.0510	0.0314	0.0242	0.0210	0.0201	0.0198	0.0196

Table 6 Low Flow Frequency Analysis of Kemptville Creek at Kemptville (02LA006)

Flow (cms)	Return Period (Years)							
	2	5	10	20	50	100	200	500
1Q	0.0485	0.0135	0.0087	0.0073	0.0068	0.0067	0.0067	0.0066
3Q	0.0515	0.0144	0.0092	0.0077	0.0071	0.0070	0.0069	0.0069
7Q	0.0559	0.0159	0.0107	0.0092	0.0087	0.0086	0.0086	0.0086
15Q	0.0683	0.0180	0.0116	0.0099	0.0093	0.0091	0.0091	0.0091
30Q	0.0936	0.0258	0.0168	0.0142	0.0133	0.0132	0.0131	0.0131

Figure 1 Rideau River at Ottawa (02LA004): Yearly Variation of Low Flows

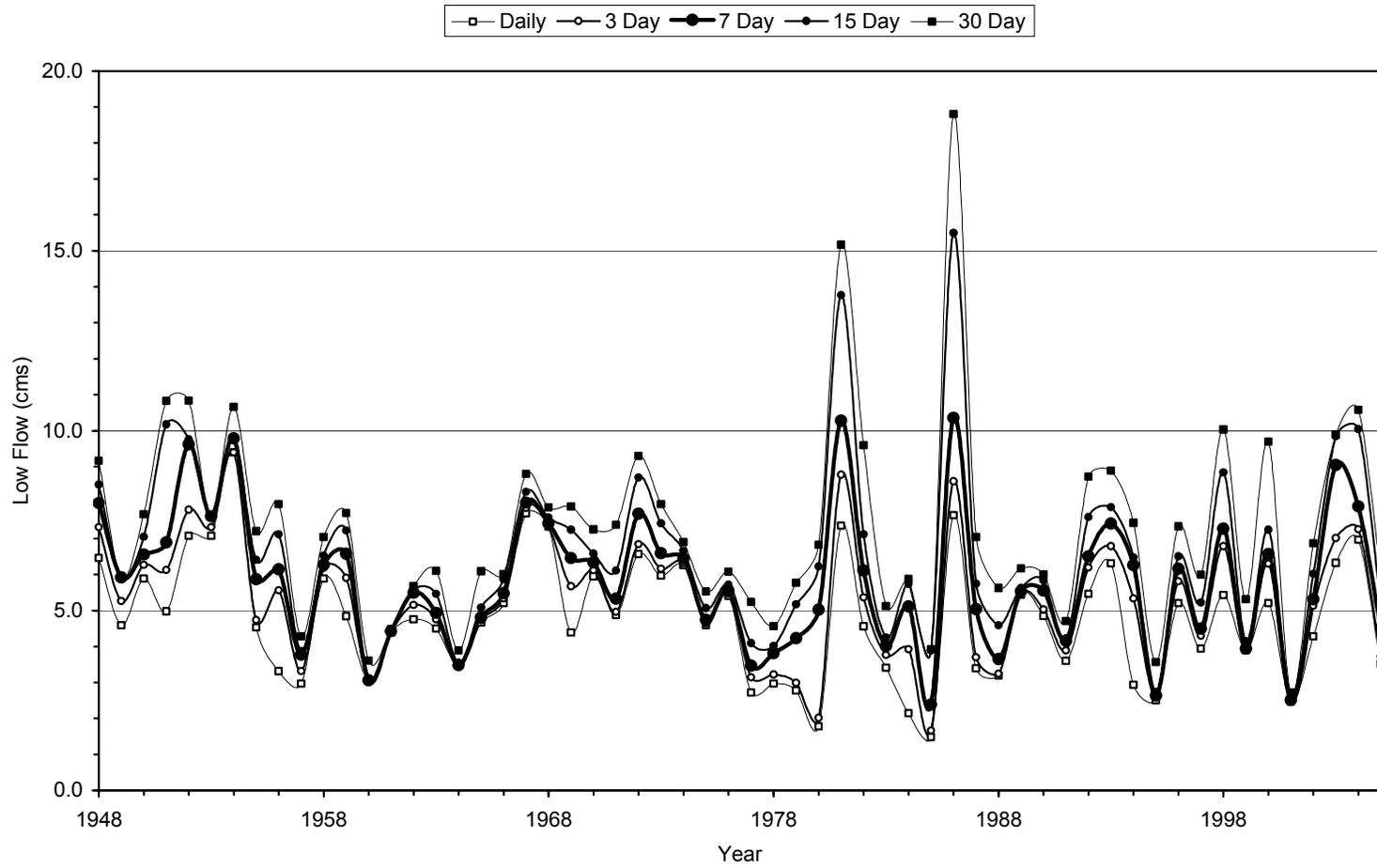


Figure 2 Jock River at Moodie Drive (LA007): Yearly Variation of Low Flows

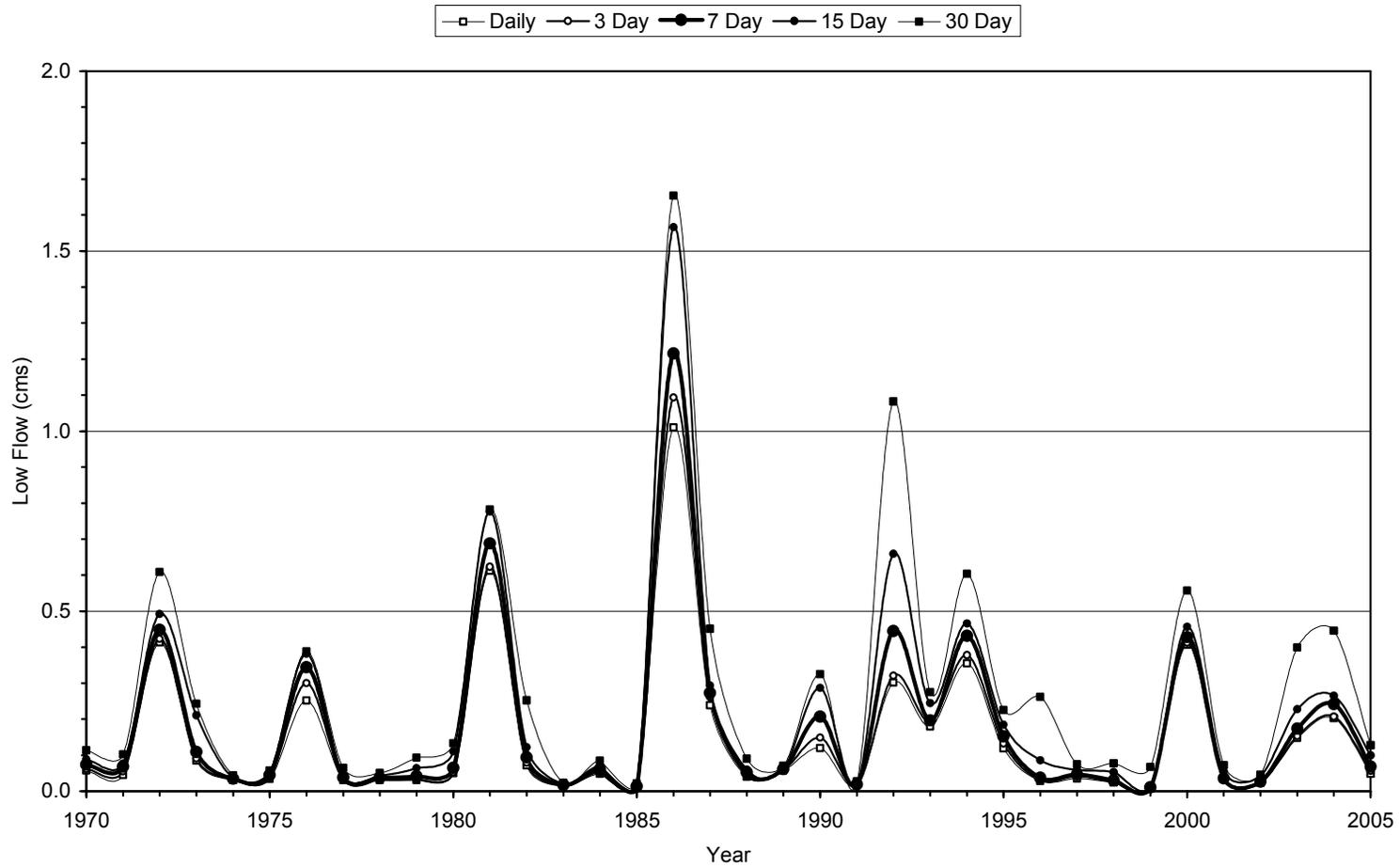


Figure 3 Kemptville Creek at Kemptville (LA006): Yearly Variation of Low Flows

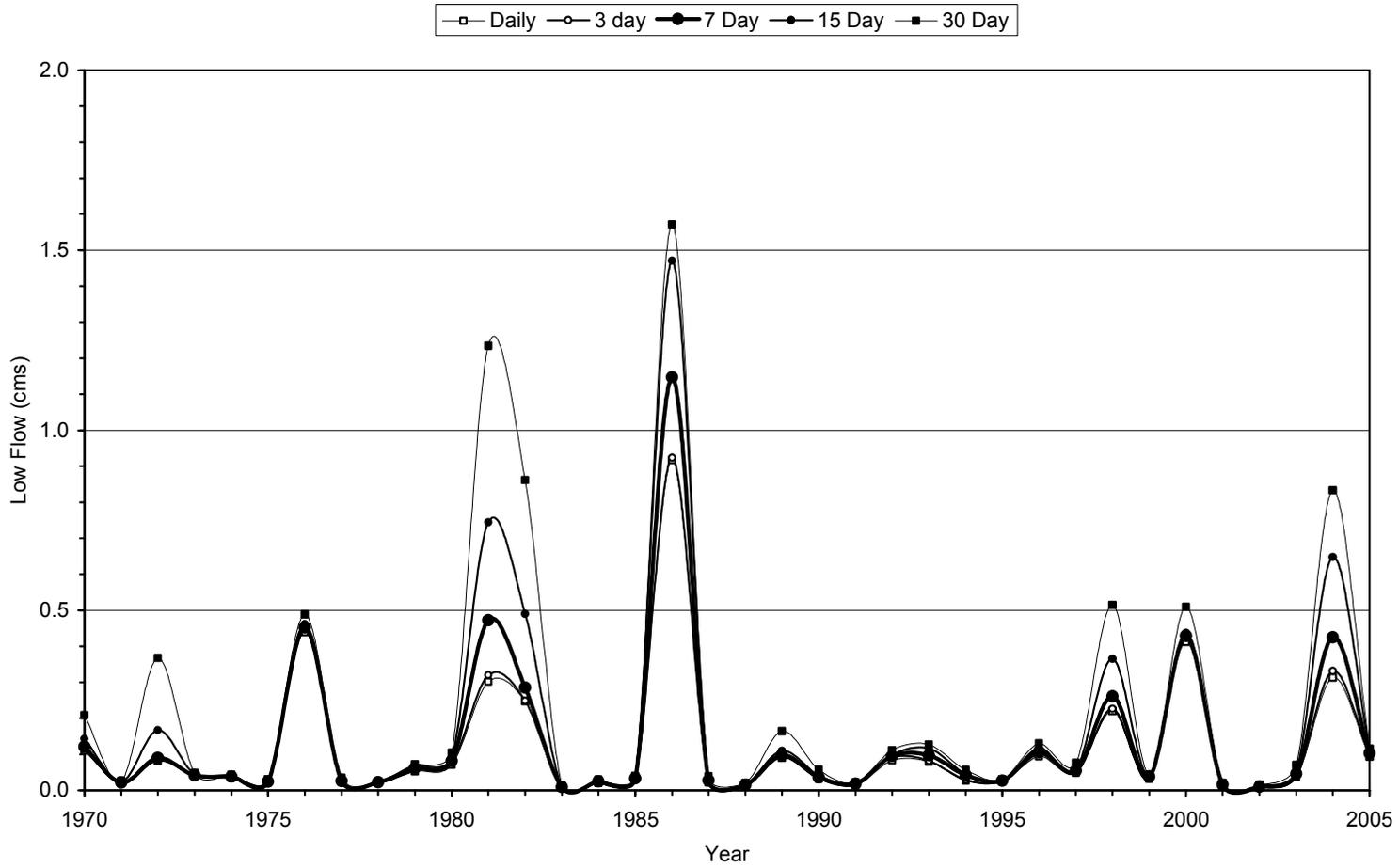


Figure 4 Rideau River at Carleton (02LA004)

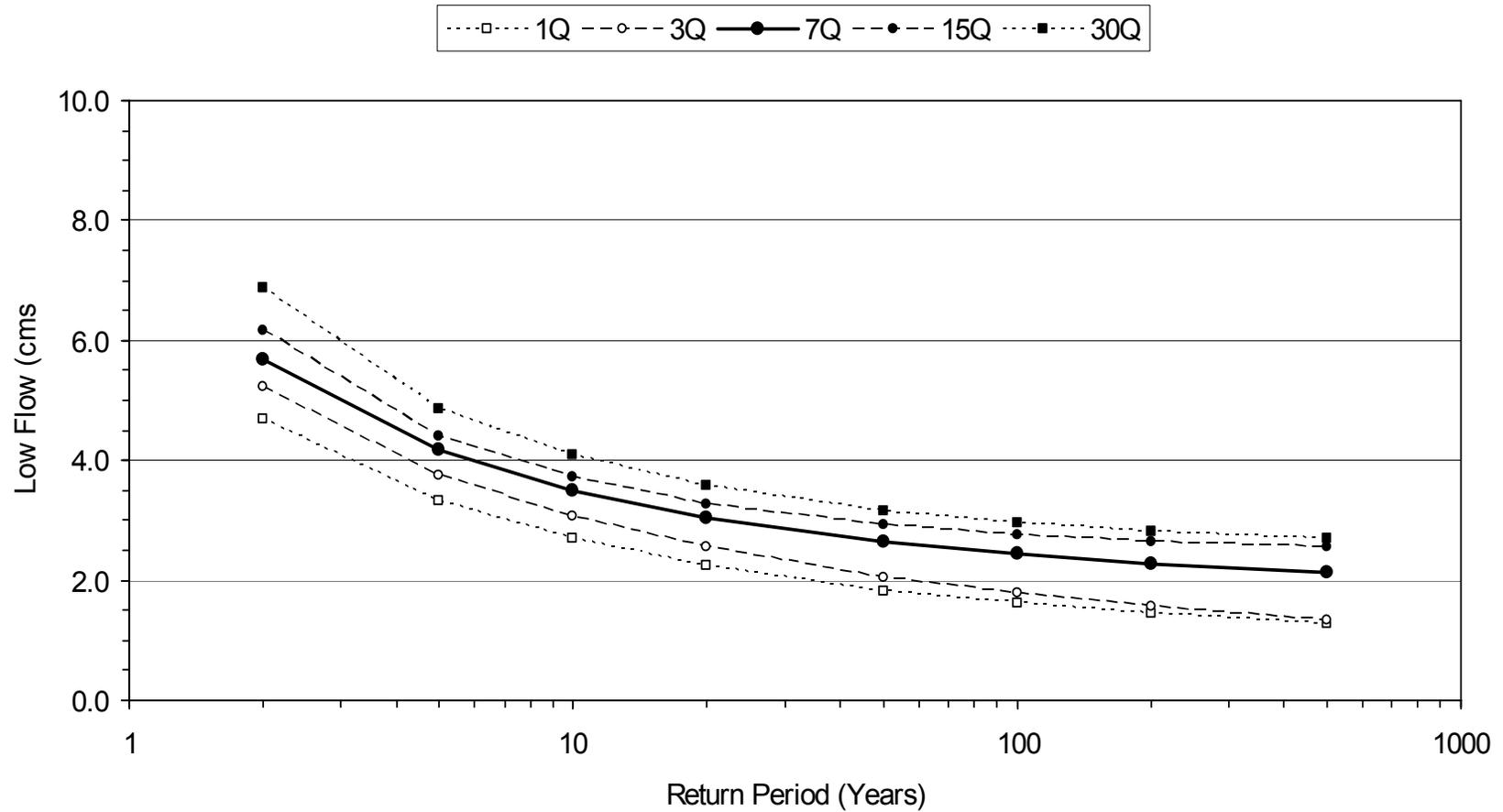


Figure 5 Jock River at Moodie Drive (02LA007)

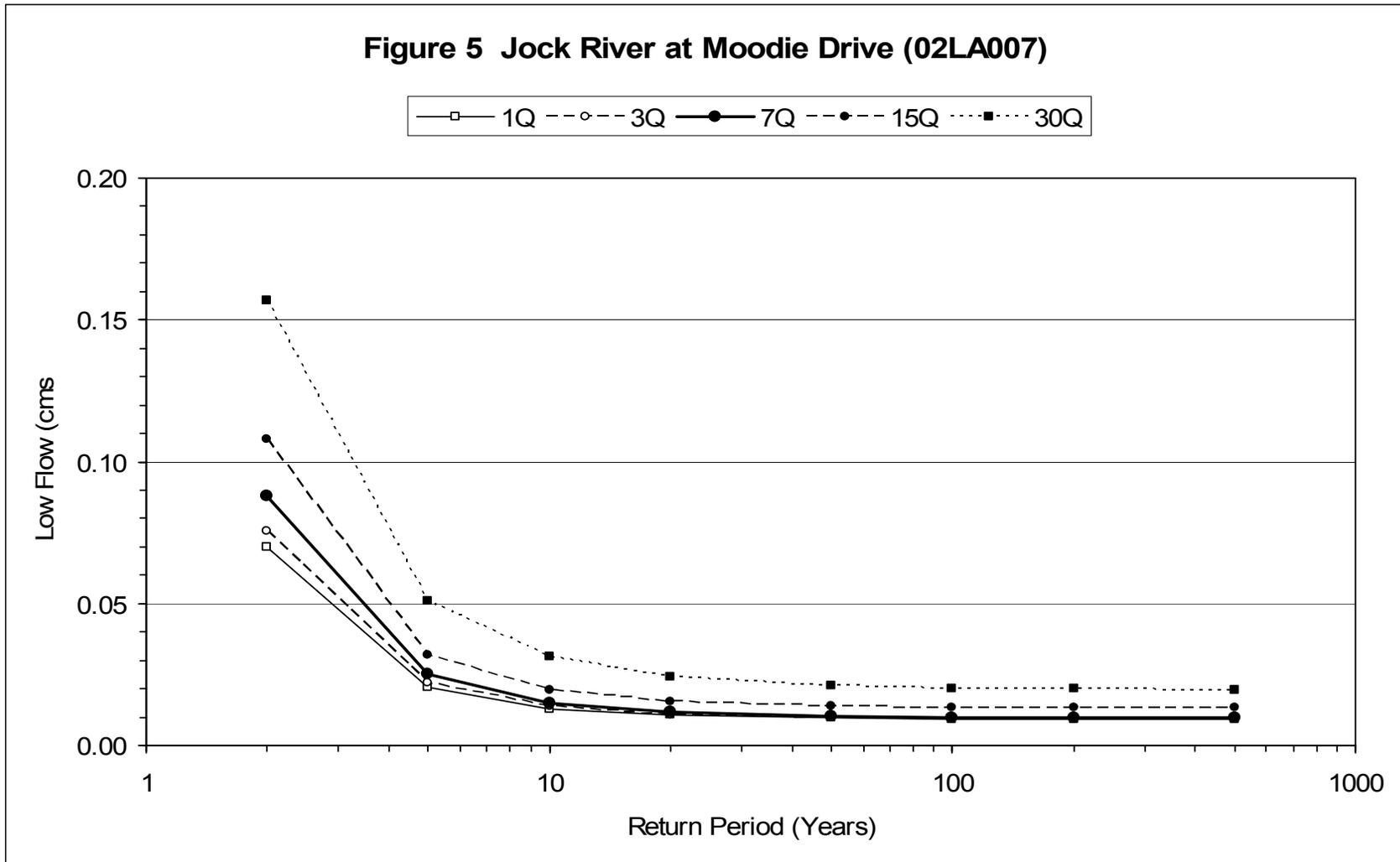


Figure 6 Kemptville Creek at Kemptville (02LA006)

