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Gartcosh CCGT Water Resources Availability Study

- Final Report -

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Principal objective

To quantify the water available from the North Calder Water for supplying the proposed Gartcosh CCGT Powergen site on the Monkland's canal and to determine the drought flows of given return periods.

Summary of requirements

In order to quantify the water available from a catchment, the naturalised flow should be determined. Naturalised flow is the flow which would occur without artificial influences such as reservoir releases, abstractions and effluent returns. This can be determined by taking the actual gauged flow in the river and removing the artificial influences, providing these can be quantified. Where regulating reservoirs are present within the catchment, both the inflow and releases from the reservoirs must be known. For small catchments, such as for the North Calder Water, a naturalised flow series gives a much better idea of the behaviour of a catchment for yield estimation than does a synthetically generated flow series which cannot take into account the high temporal variability of runoff.

The North Calder Water catchment is located in the headwaters of the Clyde river some 25 km East of the centre of Glasgow. There are three reservoirs/lochs above the Hillend gauging station (see Figure 1). The catchment area above Hillend gauging station is 19.9 km2, and the area upstream of Calderbank gauging station is 60.6 km^2. A structure upstream of Calderbank diverts flow from the North Calder Water into the Monklands canal when needed and the Monkland canal feeds the Forth-Clyde canal. There are three flow gauging stations on the Monklands canal.

Data amalgamation and interpolation

Hydrological data for various sites and stations was requested and that received presented in Appendix A. Where the data series is not complete, flows during the missing period must be estimated. Using this data, naturalised flows were derived for the gauging stations at Calderbank and Hillend.

Reservoir holdings

The levels of all three reservoirs (Black Loch, Lilly Loch and Hillend) are measured on Thursday of each week. These readings are then converted to reservoir contents using simple depth-capacity curves. Black Loch and Lilly Loch both feed into Hillend reservoir. To obtain daily change in reservoir contents from the weekly readings, a simple linear interpolation was assumed for each of the reservoirs. The sum of the difference in reservoir holdings from day to day and for all three reservoirs is a measure of how much the reservoirs affect the naturalised flow at both Hillend and Calderbank. Rough Rigg reservoir which is also located on the catchment is unregulated and ungauged and therefore not considered in the naturalisation procedure. This assumption probably results in a slightly pessimistic rather than optimistic naturalised flow series being generated.

Canal flows

Gauged flow data on the Monkland canal is available at three sites (Woodhall, Blair Bridge and Pinkston). Unfortunately the channel downstream of the gauging station at Woodhall is highly affected by weeds during the summer months and the measured flows are thus unreliable. The data at Pinkston is sporadic and only commences in 1993. Furthermore, the Pinkston gauge is at the far end of the Monkland canal and thus is affected much more by seepage, evaporation and spillage losses as well as gains to the canal which are difficult to quantify. The Blair Bridge gauge is recommended by British Waterways because the site is not affected by weeds, not prone to vandalism or blocking and the weirs are of good quality. The site also has the advantage of being very close to the abstraction site for the proposed PowerGen site.

The canal at Blair Bridge forms two channels and the flow is measured in each channel (and summed to arrive at the total flow). For the days in which flow data is missing, again, a simple linear interpolation was performed. Data from the Woodhall site was on occasions so significantly different on the days surrounding the missing block of data from Blair Bridge that it was decided not to infill using the Woodhall gauged record.

The analysis of flows in 1984 on the Monkland canal by British Waterways suggests that the total losses are of the order (telephone communication with BW on 20/05) :

Winter	: 1.03 Ml/km/wk (weeks 1-13)
Spring	: 0.90 Ml/km/wk (weeks 14-26)
Summer	: 1.05 Ml/km/wk (weeks 27-39)
Autumn	: - 0.96 Ml/km/wk (weeks 40-52) *i.e.* a net gain in the autumn.

To calculate the flow being diverted into the Monkland canal using the Blair Bridge data, it is necessary to take into account these losses. The distance between the North Calder Water diversion into the Monkland canal and the Blair Bridge site is approximately 6km. If we make the assumption that the losses are of the order 1.05 Ml/km/wk for any week in the 1990 to 1995 period, then this amounts to 0.90 Ml/day losses from the canal between the diversion and the Blair Bridge site.

Although there is known to be an overflow channel at Sykeside, downstream of the Woodhall gauge and some diverted flow returns to the North Calder Water by this channel, the quantitative record is very patchy and when flow is measured, it is zero for every year except isolated cases in 1993. Koorosh Mofazzali at British Waterways has inspected this site and it is thought that the flows are generally minimal. For the purposes of this analysis, it is assumed that these flows are zero, and this assumption produces a conservative estimate of the naturalised flow at Calderbank.

Flows at Calderbank and Hillend

Calderbank gauged flows for 1968 to 1995 (1979-1984 not available) were obtained from the Institute of Hydrology (IH) archive. Gauged flows for 1996 at Calderbank were received from PowerGen. The missing flows in the 1985 to 1995 period were originally infilled using a constant value equivalent to the Q95 as contained in the licence at Calderbank (0.195 cumecs). Again this is a conservative assumption particularly as most of the missing values occur in the winter when the flows would be expected to be higher. At Hillend, missing values were filled in using the Micro Low Flows suggested Q95 at this site (0.0483 cumecs). Problems with the naturalisation of flows occur when the reservoirs are being drawn down when both the Calderbank and Hillend gauges are not in operation. Fortunately, the Hillend and Calderbank gauges are both inoperative only once in the 1990 - 1995 period, and then only for a short period of time (31/12/91 to 12/01/92). In the flow series presented to British Waterways and PowerGen, missing values have been infilled using an appropriate multiplier (based on catchment area) and the naturalised flow at the station where data exists. A quick comparison between the two methods for infilling showed that there is very little difference in the water availability between the two methods.

The flow naturalisation procedure

With knowledge of the gauged daily flows, the quantities of water being retained or released by the reservoirs and amounts diverted into the canal, the flows at both Calderbank and Hillend can be naturalised. Because the record at Blair Bridge only commences in 1990, as do the reservoir holdings data, a naturalised flow series was generated from that date. IH do not hold gauged flow data yet for 1996 at Hillend, and so a six-year series (1990-1995 *incl.*) was generated.

Mean flows generated using this procedure were 138.1 Ml/day (1.60 cumecs) and 34.22 Ml/day (0.396 cumecs) for Calderbank and Hillend respectively. These are significantly higher than the mean flow suggested by the Micro Low Flows software package (see Appendix B) and so it was decided to look at the trend in rainfall and runoff in this part of Scotland over the last few years.

Mean annual catchment rainfall (1964-1995) for the catchment above Daldowie on the river Clyde is shown in Figure 2. As can be seen there appears to be a trend in increasing rainfall with the last six years of the series being wetter than any other six year series. To a lesser extent, a similar trend is seen in Edinburgh (Figure 3) however this site is quite far from the catchment and the average rainfall in Edinburgh is much lower than on the North Calder Water catchment (665mm and 955mm respectively). Increased rainfall does not necessarily translate into increased flow of the same order of magnitude. This is because catchment antecedent conditions are not constant and high rainfall on a very dry catchment does not produce as much runoff as the same rainfall on a wet catchment. Similarly, rainfall on a permeable catchment does not produce as much runoff as on an impermeable catchment.

Monthly flows on rivers near North Calder Water are shown in Figure 4 (trend lines as fitted by Microsoft Excel), and significant results presented in Table 1. All four catchments are within hydrometric area 84 (The Clyde basin, IH Hydrometric Register and Statistics reference manual) and two of the catchments are supposedly unaffected by artificial influences (sites 84022 and 84016).

Table 1 - Trends in gauged flows of catchments near North Calder Water.

	84016*	84017	84020	84022*
Catchment area (km^2)	33.9	103.1	51.9	110.3
1969-95 average (cumecs)	0.89	4.71	2.03	3.13
1990-95 average (cumecs)	1.00	5.43	2.36	3.75
% difference	12.03	15.39	16.39	20.02

* These are the two most 'natural' catchments.

Results from this review would suggest that the flows on North Calder Water for the period 1990-1995 are some 16% higher than the long term average (1969 - 1995). Analysing the summer flows separately from the winter flows gives somewhat different trends (Tables 2a and 2b) and is probably a truer representation of what is happening in the river on a seasonal basis. Consequently the naturalised flow series for both the Hillend and Calderbank sites have been adjusted downwards by 4% for the summer and down by 21% for the winter. This adjustment brings the mean flow for both sites well within the confidence limits of the Micro Low Flows estimated mean flow (see Appendix B). The IH report "An Evaluation of Low Flow Estimation in Scotland" (Young *et al.*, November 1996) suggests that 6 years of flow data produce better estimates of runoff statistics than do models based on catchment characteristics such as the Micro Low Flows software package, and hence we believe that the flow estimates derived from this flow naturalisation exercise provide the best set of data for estimation of catchment yield.

Table 2a - Trends in summer gauged flows of catchments near North Calder Water.

	84016*	84017	84020	84022*
Catchment area (km^2)	33.9	103.1	51.9	110.3
1969-95 average (cumecs)	0.49	2.63	1.22	1.73
1990-95 average (cumecs)	0.48	2.85	1.26	1.85
% difference	-2.15	8.37	3.50	6.98

* These are the two most 'natural' catchments.

Table 2b - Trends in winter gauged flows of catchments near North Calder Water.

	84016*	84017	84020	84022*
Catchment area (km^2)	33.9	103.1	51.9	110.3
1969-95 average (cumecs)	1.29	6.79	2.84	4.50
1990-95 average (cumecs)	1.52	8.06	3.49	5.61
% difference	18.08	18.68	22.92	24.57

* These are the two most 'natural' catchments.

Each of the 6 years of naturalised flow has been adjusted so that the mean flow for that year is equal to the 6 year mean - *i.e.* we now have 6 years of naturalised flows, each year having the same mean flow. Of course following this normalisation procedure, we can no longer claim that the flows are a true representation of the 1990-1995 flows, rather they are representative average naturalised flows for a 6 year period with different variability of flows for each year. The mean naturalised flow for this period is however believed to be a good estimate of the long term naturalised flow of the North Calder Water catchment. Each of the years of flow will produce slightly different reservoir drawdown curves because of the different temporal distribution of rain and flow in each year. Despite a very wet winter and spring, the summer of 1994 was particularly dry, especially in terms of the water resources requirements from the reservoirs. It is not known what the return period of this summer drought is.

The daily naturalised flow data have been provided to British Waterways. The British Waterways model works on a weekly time step and so it was necessary to sum the flows on a weekly basis. The model now produces a realistic estimate of the likelihood of water shortage under certain demand and drought conditions. The naturalised and normalised flow series produced for for Hillend and Calderbank gauge sites are presented in Appendix C.

Return period adjustments to the flow

A drought can be defined as a decrease in water availability in a particular period and over a particular area. In practice, a drought is measured in terms of its impact on social and economic activity or environmental concerns.

To test the likelihood of the natural runoff from the North Calder Water catchment and of the Hillend reservoirs failing to meet the PowerGen and Forth-Clyde demand, we need to calculate the River Calder low flows for a set of return periods. The Low Flows report (IH report number 108) provides us with a set of equations, procedures and statistics for doing this. These are based on analysis of a large number of gauging stations throughout the UK, using the MAM(D) (Mean Annual Minimum for a given duration, D, in days) statistic as a basic scaling index. The procedure is as follows :

Use the following equation to calculate GRADMAM (Gradient of the MAM curve).

$$GRADMAM = (2.12\times10^{-3})(MAM(7))^{-1.02}SAAR^{0.629} \qquad \text{page 76 of Report 108.} \qquad (1)$$

where SAAR is the Standard Average Annual Rainfall (1941-1970) in mm, its spatial distribution being quantified for the whole of the UK in the IH Flood Studies Report maps

Then use the following equation to derive the mean annual minimum flow of duration D hours, MAM(D) :

$$MAM(D) = \{1+(D-7)GRADMAM\}MAM(7) \qquad \text{page 77 of Report 108.} \qquad (2)$$

Table 7.2 in Report 108 provides the appropriate curve number for chosen duration, and then the appropriate factor for deriving the 1 in *n* year event. It is important to remember that the return period must be associated with a particular duration. From the model which IH have compiled, it appears that this system of reservoirs are between 6 month and two year critical - *i.e.* the period of drought causing shortage of resources is possibly more than one year duration, with the reservoirs not always filling up during the first winter of the drought and consequently failing during the second summer. It is therefore important to look at, for events of a given return period, the drought of two year duration as well as the one year and 6 month summer drought.

The return period adjustment factors calculated using these procedures are presented in Table 3. These factors must be applied to river flow values for chosen periods of time within the normalised flow series for 1990-1995, derived earlier, for Calderbank and Hillend. These factors have been presented to British Waterways for application to the naturalised flow series and water resources model. The 180-day drought (summer) must always be applied from the start of April to the end of September for one summer over the normalised flow series period 1990-1995. The 1-year or 2-year drought factors would be applied to either one 365-day period or one 730-day period respectively, starting on the first of January of any year, within the normalised flow series period 1990-1995.

Table 3 - Return period adjustment factors for the naturalised flow at Hillend and Calderbank.

	180 day drought	1 year drought	2 year drought
1 in 50 year event	0.160	0.269	0.49
1 in 30 year event	0.176	0.296	0.56
1 in 10 year event	0.228	0.383	0.69

Catchment yield

The yield of a system is a function of the water available over a period of time. Quantifying the yield is difficult if the demand is not constant on a year to year basis, or if the demand is confined to a few months in the year, or even if the demand is for a short period of time only. If the demand is exclusively during the wet season for example, it follows that the yield of the system would be somewhat higher than if the demand were in the dry season only. The same problem occurs when the demand varies in time throughout the year (as it does for this particular water use scenario). Changes in demand may depend on such variables as cooling tower operational mode and any dilution flow required to meet statutory water temperature requirements and the demand for the Forth and Clyde canal. Presenting a figure for the "yield" of this system is not very useful unless it relates to a particular demand variation profile. In the Gartcosh proposal, with a given demand profile, it would be possible to test if there will be water shortage under certain drought conditions, however it is not clear how much demand can be met for the drought of a given return period. If there are insufficient water resources for the proposed demand, it is not obvious what shape the reduced demand scenario profile will take; it is unlikely to be a simple percentage of the currently proposed monthly demands. Having said this, it is a very simple procedure to "plug in" a different demand scenario into a spreadsheet water resources model to test whether this scenario will cause water shortage under various drought conditions.

Determining the demand met at Gartcosh using the North Calder Water system *without* the effect of the catchment downstream of Hillend is also a simple procedure and can be estimated using only the naturalised flow of the catchment above Hillend and neglecting the additional runoff seen in the Calderbank naturalised flow series.

Summary

This report gives an overview of the procedure for naturalising the flow on the North Calder Water catchment given the limitations of the data. Results are compared to the Micro Low Flows outputs. From earlier work undertaken by IH for the Scottish water industry, it is known that five or six years of flow data gives a better idea of the runoff of a catchment than the Micro Low Flows results even with data of marginal quality. Six years of naturalised flows have been provided to British Waterways for inclusion in their water resources model, although this short record has been scaled to agree with longer 30 year rainfall and flow records in the region. These flow estimates provide the best data set for yield estimation.

The water available to the Monkland canal under different duration and return period drought scenarios can be derived by applying the appropriate adjustment factor. These have been derived using the procedure suggested in IH report 108 and supplied to British Waterways.

References

Gustard, A, Bullock, A and Dixon, J.M. 1992. Low Flow Estimation in the United Kingdom. IH report no. 108.

Hydrological Data United Kingdom, Hydrometric Register and Statistics. IH report.

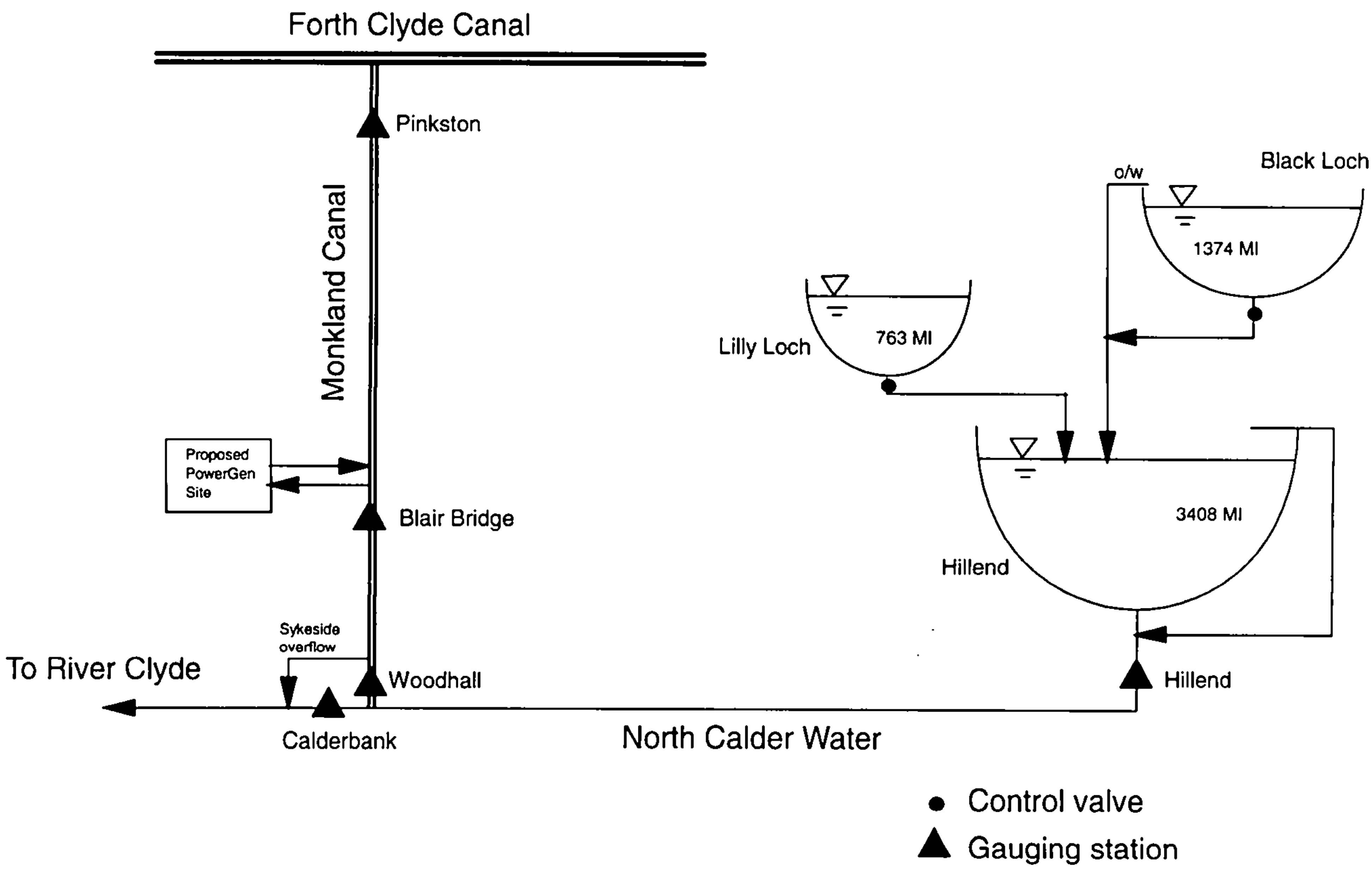
Mawdsley, J, Petts, G and Walker, S. 1994. Assessment of Drought Severity. BHS Occasional Paper No. 3.

Mofazzali, K. (date unknown) PowerGen Proposed Abstraction at Gartcosh. Monkland Canal Water Resources. Report prepared by British Waterways.

NERC, 1975. Flood Studies Report, in V volumes. Institute of Hydrology.

Young, A, Round, C and Croker, K. 1996. An Evaluation of Low Flow Estimation in Scotland. IH report prepared under contract to Edinburgh Hydro Systems Ltd.

Figure 1 North Calder Water and Monkland Canal System Diagram.



Note : Reservoir volumes denoted in their useable capacities.
Figure adapted from BW Gartcosh report.

Figure 2 - Catchment Average Areal Rainfall above Daldowie on the River Clyde

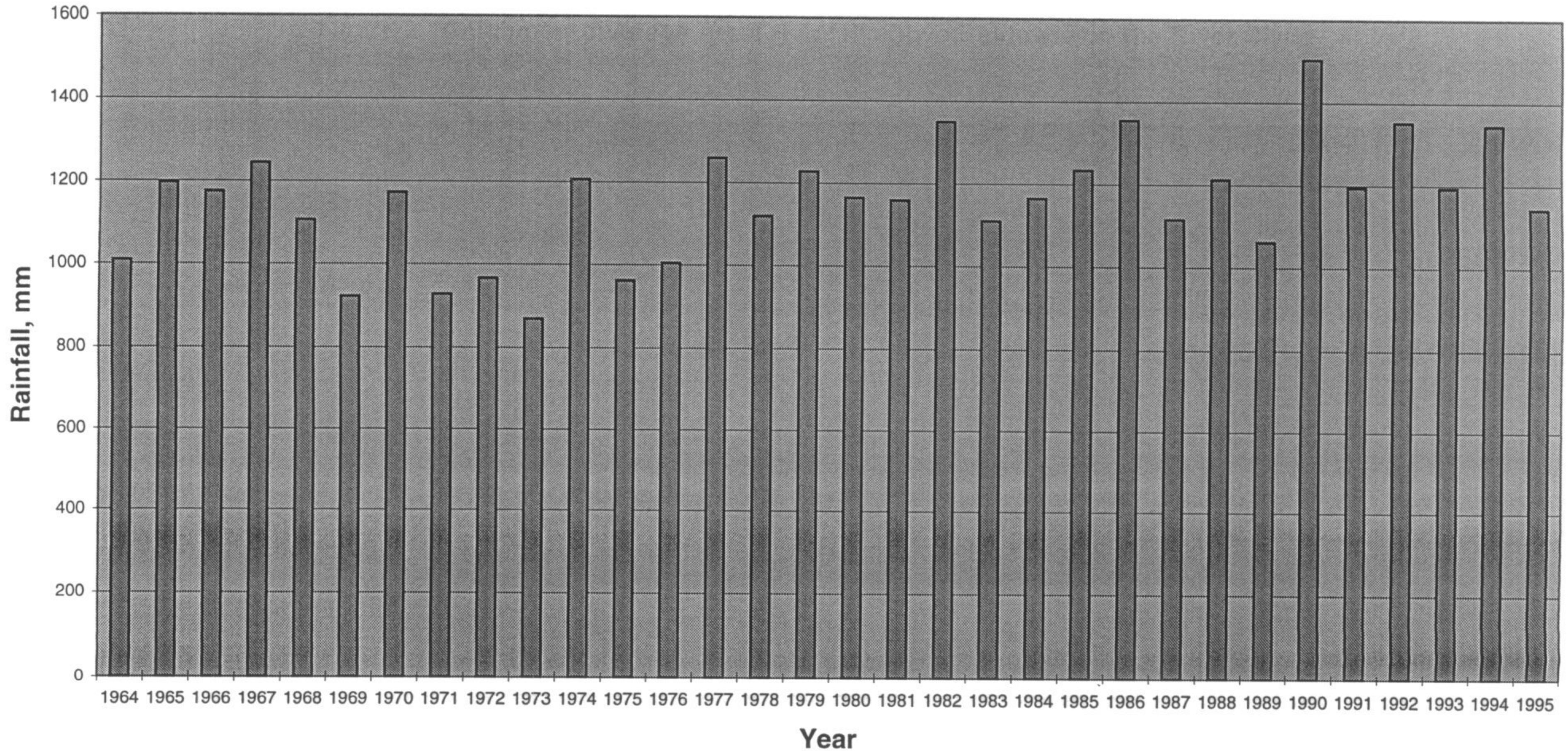


Figure 3 - Annual Rainfall at Edinburgh

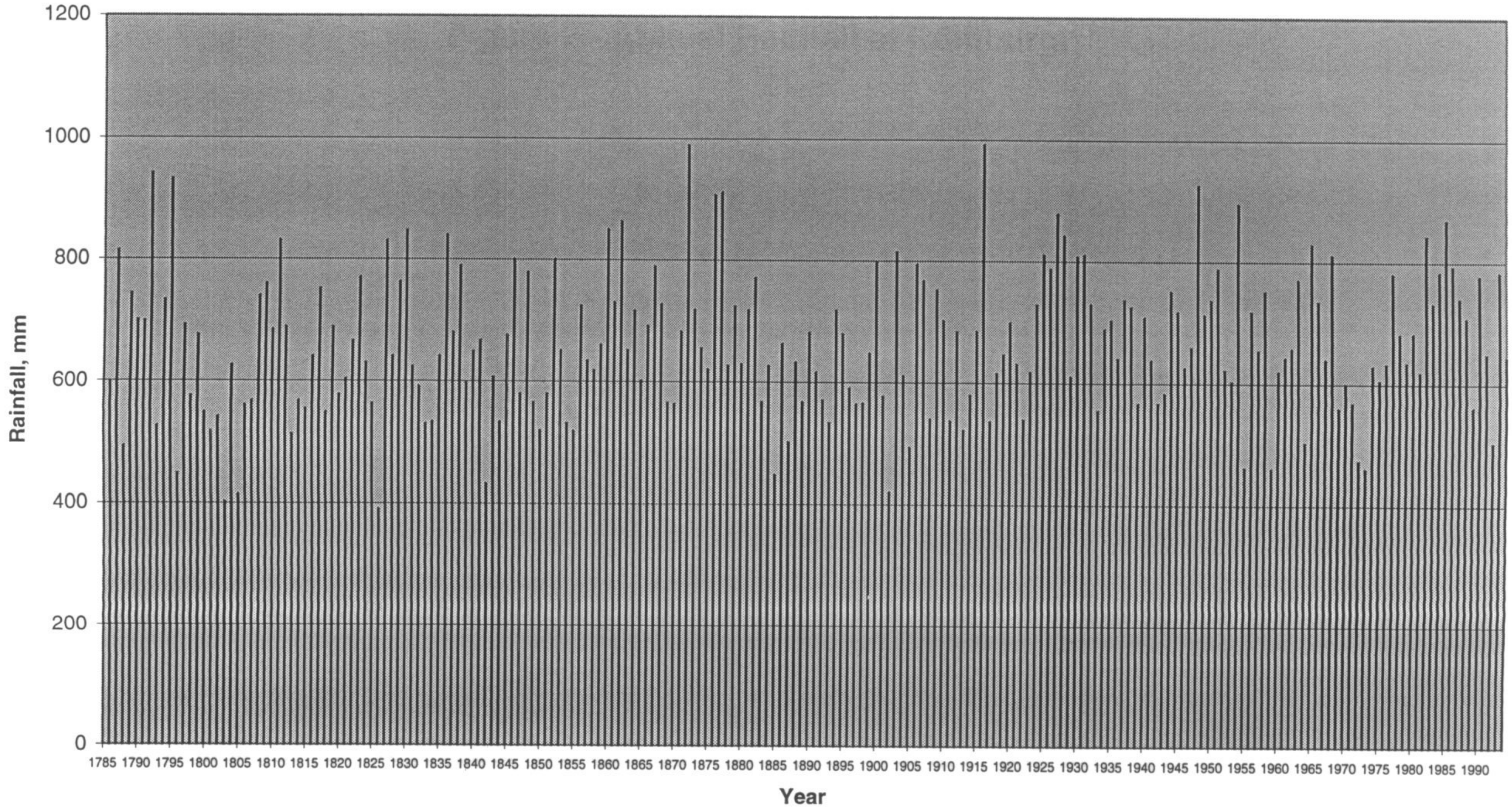
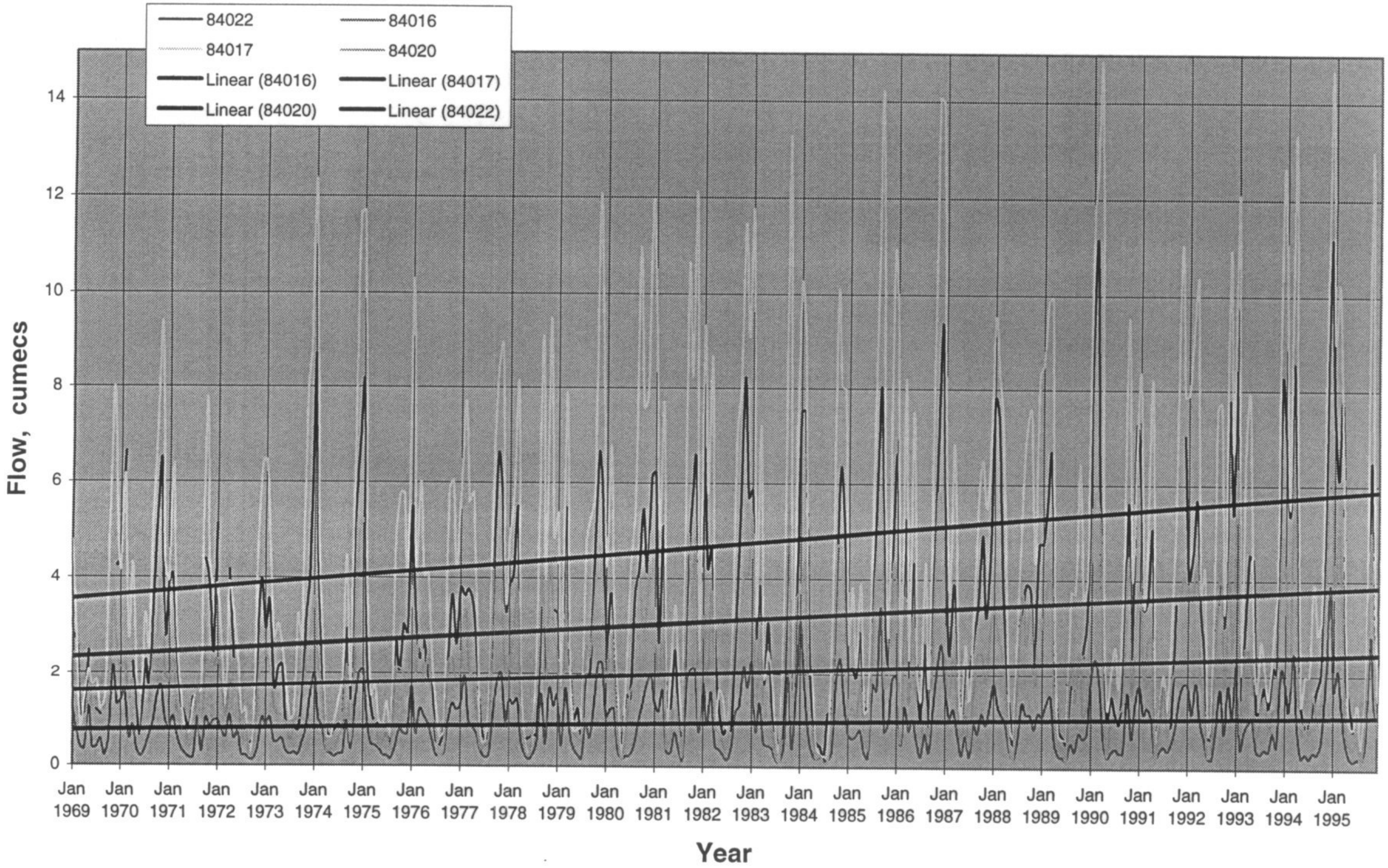


Figure 4 - Monthly flows on catchments near North Calder Water



Appendix A - Data received

Reservoir contents : 1990-1996 for Hillend, Lilly Loch and Black Loch. From Koorosh Mofazzali at British Waterways.

Reservoir depth - capacity curves for Hillend, Lilly Loch, Black Loch. From Koorosh Mofazzali at British Waterways (printout).

Hillend on North Calder Water, below the reservoir (station no. 84024) gauged daily flows. 1972-1995. From IH archive. Some data missing.

Calderbank on North Calder Water, below the Monkland canal diversion (station no. 84027) gauged daily flows. 1968-1995 (1979-1984 missing). From IH archive. Some further missing data. 1996 data has been provided by PowerGen.

Woodhill on the Monkland canal. Gauged daily flows. Jan '78 to Dec '96. From Eddy Jow, SEPA.

Blair Bridge on the Monkland canal. Gauged daily flows for both channels. 1990-1996. From Koorosh Mofazzali at British Waterways.

Pinkston on the Monkland canal. Gauged daily flows. March '93 to April '97. From Eddy Jow at SEPA.

SEPA contact :	Eddy Jow (tel: 013552 38181).
British Waterways contact :	Koorosh Mofazzali (01923 201439).
PowerGen contact :	Ian Todd (01203 424954).

R/3003/01/cor/ga/CEL

30th January 1996

Table 1. Hillend Reservoir - Depth v Useable Holdings (megalitres)

Depth (m)	Megalitres	Depth (m)	Megalitres
0.0	3408.6	1.8	1237.0
0.05	3340.8	1.85	1185.1
0.1	3273.1	1.9	1133.2
0.15	3206.6	1.95	1082.5
0.2	3140.0	2.0	1031.8
0.25	3074.6	2.05	982.5
0.3	3009.2	2.1	933.1
0.35	2945.0	2.15	885.4
0.4	2880.8	2.2	837.6
0.45	2817.9	2.25	791.6
0.5	2754.9	2.3	745.5
0.55	2692.7	2.35	701.1
0.6	2630.5	2.4	656.7
0.65	2568.8	2.45	613.9
0.7	2507.1	2.5	571.1
0.75	2445.8	2.55	530.4
0.8	2384.5	2.6	489.6
0.85	2323.7	2.65	451.4
0.9	2262.8	2.7	413.1
0.95	2202.4	2.75	377.4
1.0	2142.0	2.8	341.6
1.05	2082.3	2.85	308.3
1.1	2022.5	2.9	275.0
1.15	1963.6	2.95	244.2
1.2	1904.7	3.0	213.4
1.25	1846.7	3.05	185.5
1.3	1788.7	3.1	157.5
1.35	1731.6	3.15	132.9
1.4	1674.4	3.2	108.3
1.45	1618.1	3.25	87.0
1.5	1561.8	3.3	65.6
1.55	1506.6	3.35	47.7
1.6	1451.3	3.4	29.5
1.65	1397.2	3.45	14.8
1.7	1343.0	3.5	0
1.75	1290.0		

MONKLAND CANAL
Black loch depth capacity table

DEPTH mm	CAPACITY Ml	capacity from formula Ml.	difference
0	1373.696	1385.978	12.282
50	1349.147	1359.710	10.563
100	1324.770	1333.697	8.927
150	1300.563	1307.938	7.375
200	1276.527	1282.433	5.906
250	1252.662	1257.182	4.520
300	1228.965	1232.185	3.220
350	1205.437	1207.443	2.006
400	1182.077	1182.954	0.877
450	1158.884	1158.720	-0.164
500	1135.858	1134.740	-1.118
550	1112.999	1111.015	-1.984
600	1090.305	1087.543	-2.762
650	1067.776	1064.326	-3.450
700	1045.411	1041.363	-4.048
750	1023.210	1018.654	-4.556
800	1001.173	996.199	-4.974
850	979.298	973.999	-5.299
900	957.585	952.052	-5.533
950	936.034	930.360	-5.674
1000	914.643	908.922	-5.721
1050	893.452	887.739	-5.713
1100	872.498	866.809	-5.689
1150	851.781	846.134	-5.647
1200	831.299	825.713	-5.586
1250	811.051	805.546	-5.505
1300	791.036	785.633	-5.403
1350	771.251	765.974	-5.277
1400	751.696	746.570	-5.126
1450	732.370	727.420	-4.950
1500	713.271	708.524	-4.747
1550	694.397	689.882	-4.515
1600	675.748	671.494	-4.254
1650	657.322	653.361	-3.961
1700	639.117	635.482	-3.635
1750	621.133	617.857	-3.276
1800	603.368	600.486	-2.882
1850	585.820	583.369	-2.451
1900	568.489	566.507	-1.982
1950	551.373	549.898	-1.475
2000	534.470	533.544	-0.926
2050	517.806	517.444	-0.362
2100	501.404	501.599	0.195
2150	485.262	486.007	0.745
2200	469.379	470.670	1.291
2250	453.751	455.587	1.836
2300	438.378	440.758	2.380
2350	423.256	426.183	2.927
2400	408.385	411.863	3.478
2450	393.761	397.796	4.035
2500	379.382	383.984	4.602
2550	365.288	370.426	5.138
2600	351.517	357.123	5.606

DEPTH mm	CAPACITY Ml	capacity from formula Ml.	difference
2650	338.100	344.073	5.973
2700	324.926	331.278	6.352
2750	312.099	318.737	6.638
2800	299.580	306.450	6.870
2850	287.364	294.417	7.053
2900	275.449	282.638	7.189
2950	263.829	271.114	7.285
3000	252.502	259.844	7.342
3050	241.528	248.828	7.300
3100	230.964	238.066	7.102
3150	220.803	227.558	6.755
3200	211.037	217.305	6.268
3250	201.658	207.306	5.648
3300	192.659	197.561	4.902
3350	184.031	188.070	4.039
3400	175.766	178.833	3.067
3450	167.858	169.851	1.993
3500	160.297	161.123	0.826
3550	153.055	152.649	-0.406
3600	146.084	144.429	-1.655
3650	139.394	136.463	-2.931
3700	132.973	128.752	-4.221
3750	126.816	121.294	-5.522
3800	120.919	115.654	-5.265
3850	115.274	111.312	-3.962
3900	109.877	107.054	-2.823
3950	104.722	102.879	-1.843
4000	99.803	98.788	-1.015
4050	95.085	94.780	-0.305
4100	90.530	90.855	0.325
4150	86.136	87.014	0.878
4200	81.900	83.256	1.356
4250	77.820	79.581	1.761
4300	73.892	75.990	2.098
4350	70.114	72.482	2.368
4400	66.482	69.058	2.576
4450	62.994	65.716	2.722
4500	59.647	62.459	2.812
4550	56.430	59.284	2.854
4600	53.333	56.193	2.860
4650	50.354	53.185	2.831
4700	47.491	50.261	2.770
4750	44.740	47.420	2.680
4800	42.100	44.662	2.562
4850	39.569	41.988	2.419
4900	37.145	39.397	2.252
4950	34.824	36.890	2.066
5000	32.606	34.465	1.859
5050	30.487	32.125	1.638
5100	28.467	29.867	1.400
5150	26.543	27.693	1.150
5200	24.712	25.602	0.890
5250	22.973	23.595	0.622
5300	21.323	21.671	0.348
5350	19.760	19.830	0.070
5400	18.282	18.073	-0.209

DEPTH mm	CAPACITY Ml	capacity from formula Ml.	difference
5450	16.885	16.399	-0.486
5500	15.568	14.808	-0.760
5550	14.329	13.301	-1.028
5600	13.164	11.877	-1.287
5650	12.072	10.537	-1.535
5700	11.051	9.280	-1.771
5750	10.097	8.106	-1.991
5800	9.209	7.015	-2.194
5850	8.385	6.008	-2.377
5900	7.621	5.085	-2.536
5950	6.916	4.244	-2.672
6000	6.268	3.487	-2.781
6050	5.667	2.814	-2.853
6100	5.105	2.223	-2.882
6150	4.582	1.717	-2.865
6200	4.095	1.293	-2.802
6250	3.645	0.953	-2.692
6300	3.228	0.696	-2.532
6350	2.844	0.523	-2.321
6400	2.492	0.432	-2.060
6450	2.169		
6500	1.876		
6550	1.610		
6600	1.370		
6650	1.154		
6700	0.962		
6750	0.793		
6800	0.643		
6850	0.514		
6900	0.402		
6950	0.307		
7000	0.227		

MONKLAND CANAL
Lilly loch reservoir depth capacity table

Depth below spillweir mm	Capacity from table Ml	Capacity from formula Ml	difference
0	762.909	764.316	1.407
50	752.900	753.860	0.960
100	742.931	743.478	0.547
150	733.003	733.170	0.167
200	723.116	722.935	-0.181
250	713.269	712.774	-0.495
300	703.463	702.687	-0.776
350	693.697	692.674	-1.023
400	683.971	682.735	-1.236
450	674.286	672.869	-1.417
500	664.640	663.078	-1.562
550	655.035	653.360	-1.675
600	645.469	643.716	-1.753
650	635.944	634.146	-1.798
700	626.458	624.649	-1.809
750	617.012	615.227	-1.785
800	607.605	605.878	-1.727
850	598.238	596.603	-1.635
900	588.911	587.402	-1.509
950	579.622	578.275	-1.347
1000	570.374	569.221	-1.153
1050	561.185	560.242	-0.943
1100	552.080	551.336	-0.744
1150	543.056	542.504	-0.552
1200	534.114	533.746	-0.368
1250	525.253	525.061	-0.192
1300	516.473	516.451	-0.022
1350	507.774	507.914	0.140
1400	499.155	499.451	0.296
1450	490.616	491.062	0.446
1500	482.156	482.747	0.591
1550	473.775	474.505	0.730
1600	465.472	466.338	0.866
1650	457.248	458.244	0.996
1700	449.102	450.224	1.122
1750	441.034	442.278	1.244
1800	433.042	434.406	1.364
1850	425.128	426.607	1.479
1900	417.290	418.882	1.592
1950	409.528	411.232	1.704
2000	401.842	403.655	1.813
2050	394.239	396.151	1.912
2100	386.727	388.722	1.995
2150	379.305	381.366	2.061
2200	371.974	374.085	2.111
2250	364.732	366.877	2.145
2300	357.579	359.743	2.164
2350	350.514	352.682	2.168
2400	343.537	345.696	2.159
2450	336.647	338.783	2.136
2500	329.844	331.944	2.100
2550	323.127	325.179	2.052
2600	316.495	318.488	1.993

Depth below spillweir mm	Capacity from table Ml	Capacity from formula	difference
2650	309.948	311.871	1.923
2700	303.486	305.327	1.841
2750	297.108	298.857	1.749
2800	290.813	292.462	1.649
2850	284.601	286.139	1.538
2900	278.471	279.891	1.420
2950	272.423	273.717	1.294
3000	266.457	267.616	1.159
3050	260.569	261.589	1.020
3100	254.758	255.636	0.878
3150	249.024	249.757	0.733
3200	243.365	243.952	0.587
3250	237.782	238.220	0.438
3300	232.274	232.562	0.288
3350	226.841	226.979	0.138
3400	221.481	221.469	-0.012
3450	216.195	216.032	-0.163
3500	210.982	210.670	-0.312
3550	205.841	205.381	-0.460
3600	200.772	200.166	-0.606
3650	195.774	195.026	-0.748
3700	190.848	189.958	-0.890
3750	185.992	184.965	-1.027
3800	181.205	180.046	-1.159
3850	176.488	175.200	-1.288
3900	171.840	170.428	-1.412
3950	167.261	165.730	-1.531
4000	162.749	161.106	-1.643
4050	158.303	156.555	-1.748
4100	153.920	152.079	-1.841
4150	149.601	147.676	-1.925
4200	145.345	143.347	-1.998
4250	141.151	139.092	-2.059
4300	137.019	134.911	-2.108
4350	132.948	130.803	-2.145
4400	128.938	126.769	-2.169
4450	124.989	122.810	-2.179
4500	121.100	118.924	-2.176
4550	117.270	115.111	-2.159
4600	113.499	111.373	-2.126
4650	109.787	107.708	-2.079
4700	106.134	104.118	-2.016
4750	102.538	100.601	-1.937
4800	98.999	97.158	-1.841
4850	95.517	93.788	-1.729
4900	92.091	90.493	-1.598
4950	88.722	87.271	-1.451
5000	85.407	84.124	-1.283
5050	82.158	81.050	-1.108
5100	78.984	78.049	-0.935
5150	75.884	75.123	-0.761
5200	72.857	72.271	-0.586
5250	69.902	69.492	-0.410
5300	67.018	66.787	-0.231
5350	64.205	64.156	-0.049
5400	61.462	61.599	0.137

Depth below spillweir mm	Capacity from table Ml	Capacity from formula	difference
5450	58.787	59.115	0.328
5550	53.680	54.370	0.690
5600	51.270	52.108	0.838
5650	48.971	49.920	0.949
5700	46.788	47.805	1.017
5750	44.710	45.765	1.055
5800	42.735	43.798	1.063
5850	40.861	41.905	1.044
5900	39.084	40.086	1.002
5950	37.402	38.341	0.939
6000	35.813	36.670	0.857
6050	34.294	35.072	0.778
6100	32.824	33.548	0.724
6150	31.402	32.098	0.696
6200	30.028	30.722	0.694
6250	28.700	29.420	0.720
6300	27.418	28.191	0.773
6350	26.181	27.037	0.856
6400	24.988	25.956	0.968
6450	23.838	24.949	1.111
6500	22.731	24.016	1.285
6550	21.666	23.156	1.490
6600	20.642	22.371	1.729
6650	19.657	21.659	2.002
6700	18.713	21.021	2.308
6750	17.806	20.457	2.651
6800	16.938	19.967	3.029
6850	16.106	19.550	3.444
6900	15.311	19.208	3.897
6950	14.551	18.939	4.388
7000	13.825	18.744	4.919
7050	13.129	18.623	5.494
7100	12.457	18.575	6.118
7150	11.810	18.602	6.792
7200	11.186	18.702	7.516
7250	10.586	18.876	8.290
7300	10.008	19.124	9.116
7350	9.453	19.446	9.993
7400	8.919	19.842	10.923
7450	8.407	20.311	11.904
7500	7.916	8.085	0.169
7550	7.446	7.615	0.169
7600	6.996	7.169	0.173
7650	6.566	6.748	0.182
7700	6.154	6.351	0.197
7750	5.762	5.978	0.216
7800	5.388	5.630	0.242
7850	5.032	5.306	0.274
7900	4.694	5.007	0.313
7950	4.372	4.732	0.360
8000	4.067	4.482	0.415
8050	3.778	4.256	0.478
8100	3.503	4.054	0.551
8150	3.243	3.877	0.634
8200	2.996	3.724	0.728
8250	2.762	3.595	0.833

Depth below spillweir mm	Capacity from table Ml	Capacity from formula	difference
8350	2.334	3.411	1.077
8400	2.139	3.356	1.217
8450	1.955	3.325	1.370
8500	1.783	3.319	1.536
8550	1.622		
8600	1.472		
8650	1.332		
8700	1.203		
8750	1.082		
8800	0.972		
8850	0.870		
8900	0.777		
8950	0.691		
9000	0.614		
9050	0.543		
9100	0.478		
9150	0.419		
9200	0.364		
9250	0.314		
9300	0.269		
9350	0.229		
9400	0.193		
9450	0.160		
9500	0.132		
9550	0.107		
9600	0.085		
9650	0.067		
9700	0.051		
9750	0.037		
9800	0.027		
9850	0.018		
9900	0.011		
9950	0.006		
10000	0.002		

Appendix B - Micro Low Flows

Micro LOW-FLOWS is a microcomputer-based package for estimation of low flow statistics at locations throughout the UK. The software incorporates procedures developed by the Institute of Hydrology for estimating firstly, natural flow statistics at the ungauged site, and secondly, the impact of catchment artificial influences on those natural statistics. Micro LOW-FLOWS is widely used by the UK water industry, and is one of their principal water resource operation and planning tools.

Natural flow statistics are estimated using relationships between these flow statistics and physical and climatic characteristics of the catchment. The statistics incorporated within the software include:

MF	Mean daily flow (cumecs);
Q95	Mean flow (cumecs) exceeded 95 % of the time on average (derived from 1-day flow duration curve;
MAM7	Mean annual 7-day minimum flow (cumecs).

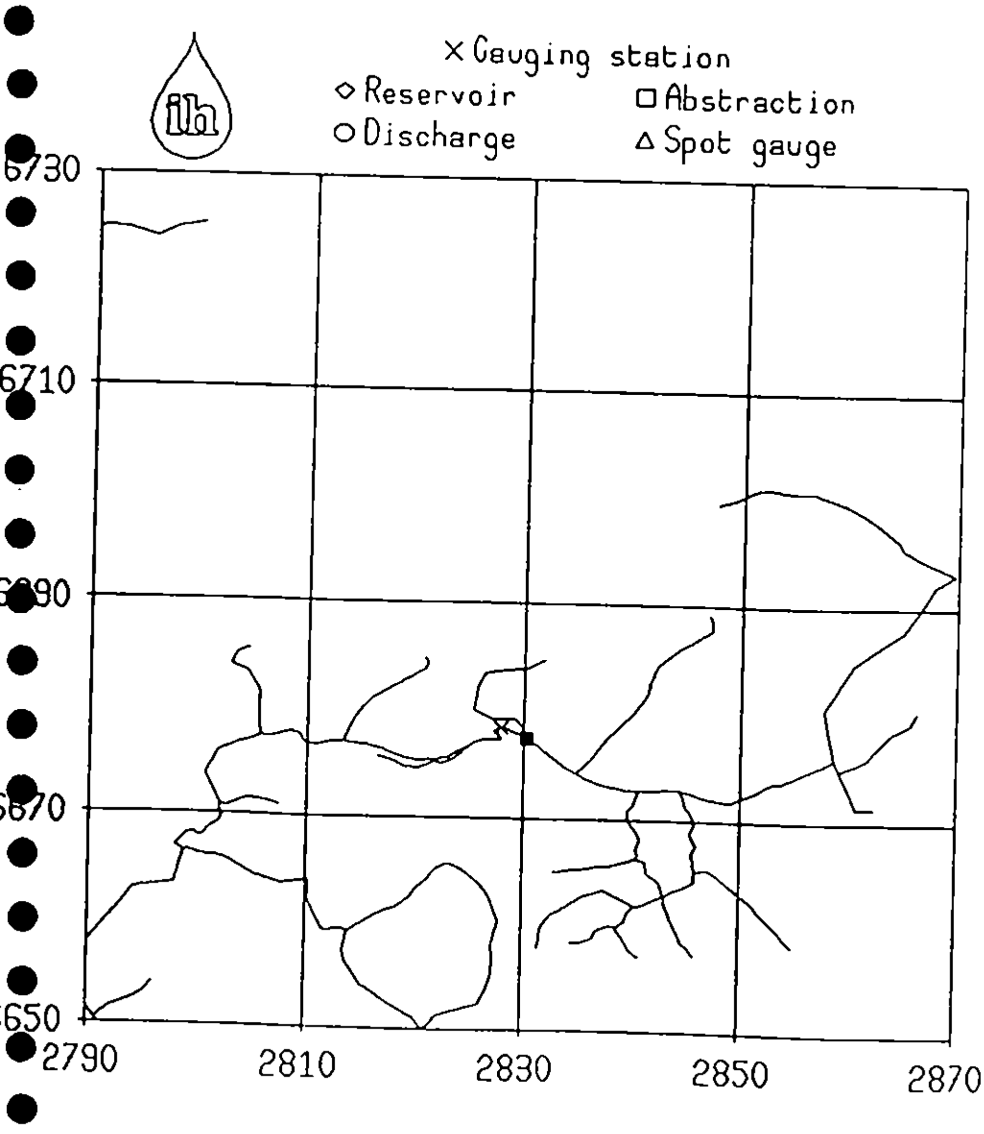
The catchment characteristics include rainfall, evaporative losses and hydrological response e.g. SAAR is the average annual rainfall (mm) over the standard period 1941-70. Procedures for incorporating the impacts of artificial influences are based on the estimation and combination of monthly flow statistics and monthly influence profiles.

Micro LOW-FLOWS allows the user to undertake fast and consistent estimation of flow statistics. Proven through rigorous testing and operational use, it has been shown to reduce the time required to service requests for low flow information dramatically. In operation, the user enters the name of the river, and is then presented with a graphical display of that rivers network. The user can roam interactively around the tributaries of this network, aided by a mouse-driven cursor, to access different river reaches. Upon selection of a reach, the system displays the statistics generated for that site on a split-screen display. The user can then analyse the stretch further using flow duration and flow frequency analysis options.

The Micro Low Flows package describes the catchment to Calderbank as principally Low Flow HOST Grouping LFHG7. This is one or many of the following hydrogeological units. It is not known which category dominates (if any) the North Calder Water catchment above Calderbank.

2 Weathered/fissured intrusive/metamorphic rock
6 Hard coherent rocks
7 Hard but deeply shattered rocks
8 Soft shales with subordinate mudstones and siltstones
9 Very soft reddish blocky mudstones (marls)
11 Very soft bedded loams, clays and sands
12 Very soft bedded loam/clay/sands with subordinate sandstone
18 Colluvium
20 Coverloam
21 Glaciolacustrine clays and silts
22 Till, compact head
23 Clay with flints or plateau drift
25 Loamy drift
27 Disturbed ground
35 Cryogenic

Appendix B - Micro Low Flows outputs for Hillend And Calderbank catchments

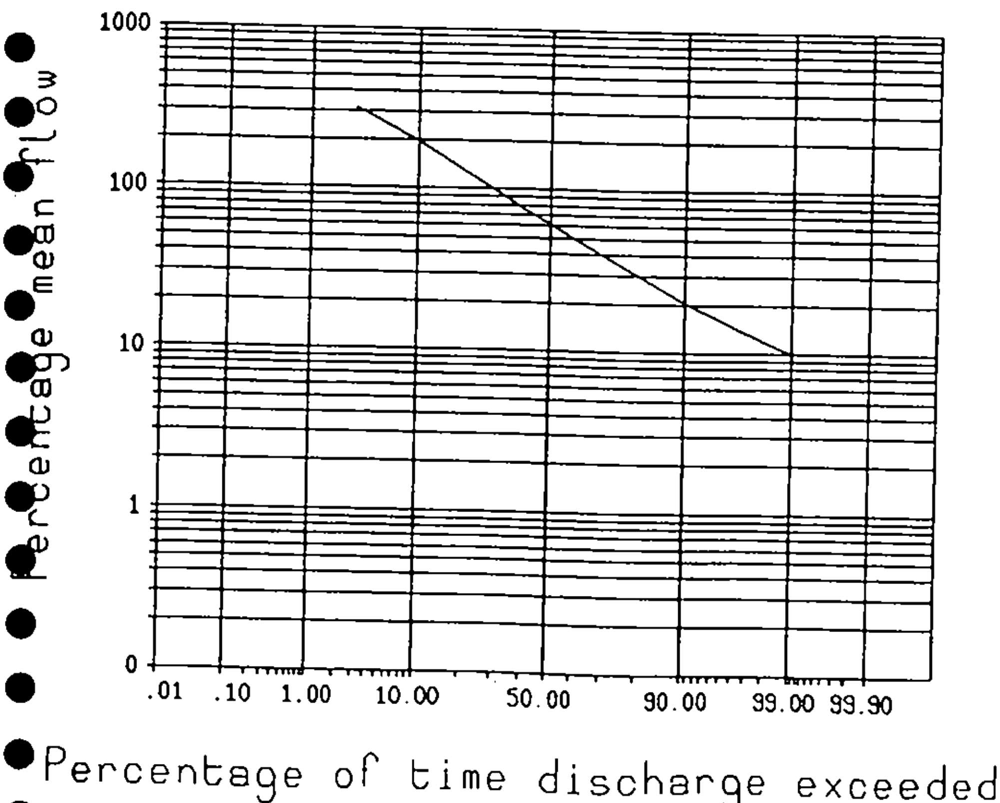


Hillend

Estimates at ■ :

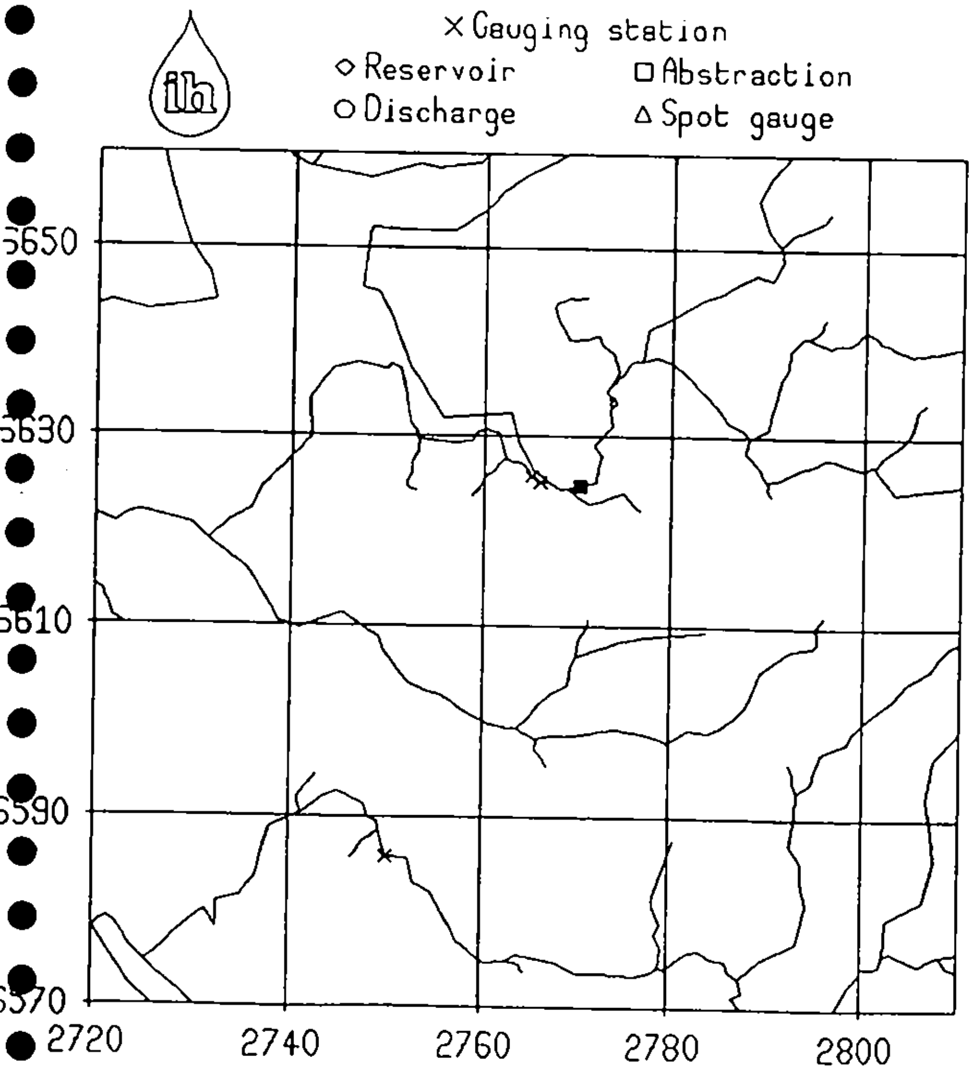
Easting	2830
Northing	6677
Line ID (LID)	4253
Area (sq.km)	17.000
SAAR (1941-70)(mm/yr)	1011
Actual evap. (mm/yr)	449
MF (cumecs)	.303 e= .046
Q95 (cumecs)	.0483 e= .024
MAM7 (cumecs)	.0471 e= .028
Q95 (%MF)	15.91 e= 1.22
MAM7 (%MF)	15.53 e= 1.38
User MF	n.a. e= n.a.

Estimated flow duration curve



Hillend

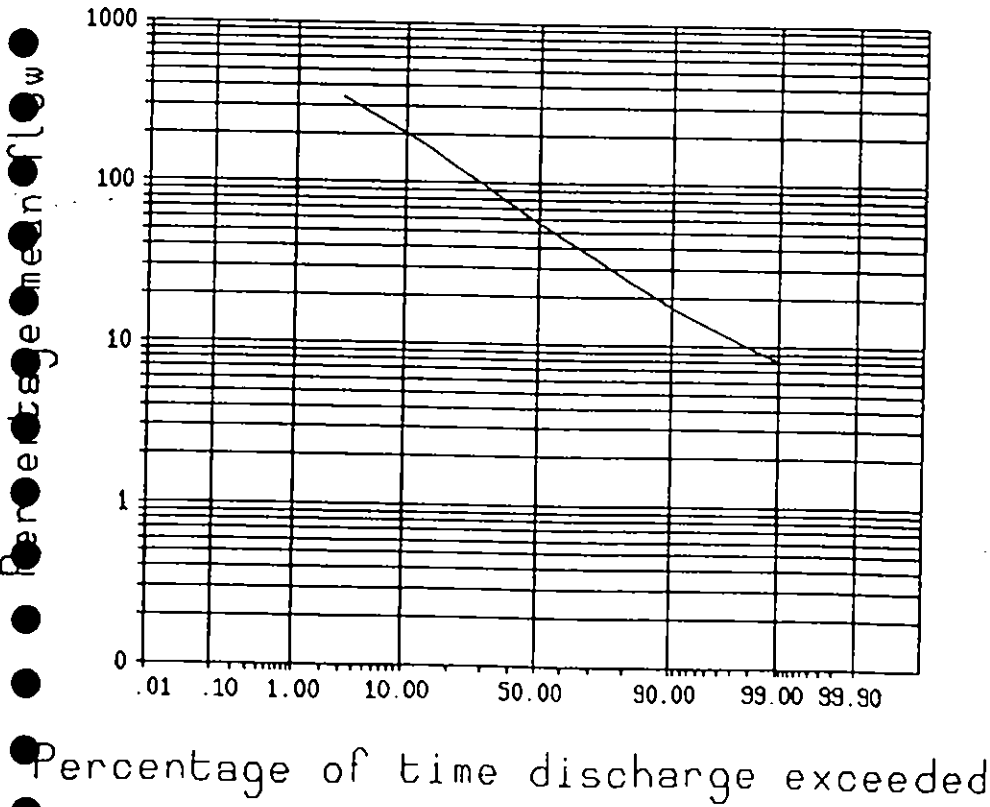
Easting	2830
Northing	6677
MF (cumecs)	.30348
Q95 (cumecs)	.048280



Calderbank

Estimates at ■ :	
Easting	2770
Northing	6625
Line ID (LID)	3952
Area (sq.km)	62.750
SAAR (1941-70)(mm/yr)	965
Actual evap. (mm/yr)	449
MF (cumecs)	1.026 ± .170
Q95 (cumecs)	.135 ± .082
MAM7 (cumecs)	.141 ± .094
Q95 (%MF)	13.17 ± 1.01
MAM7 (%MF)	13.70 ± 1.22
User MF	n.a. ± n.a.

Estimated flow duration curve



Calderbank

Easting	2770
Northing	6625
MF (cumecs)	1.0257
Q95 (cumecs)	.13507

Appendix C - Naturalised and Normalised Flow Data

Naturalised and normalised flows at Hillend in 1990. All values in Ml/day.

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	18.98	80.58	57.67	20.52	13.11	16.28	74.01	2.81	10.46	33.43	78.97	-2.93
2	23.37	67.51	43.69	25.76	12.51	4.79	74.26	2.72	10.55	3.16	64.99	-2.66
3	32.89	57.85	40.63	23.60	11.84	4.88	8.87	2.97	10.63	3.09	54.01	-2.86
4	39.71	82.53	45.08	15.57	10.91	4.96	11.66	2.55	15.81	4.41	47.33	-10.90
5	36.44	72.80	62.47	13.54	10.49	7.24	28.30	2.97	15.73	21.44	43.23	-10.69
6	34.08	98.33	86.57	16.42	10.82	6.73	29.40	3.14	15.56	169.40	20.45	-10.69
7	31.43	81.57	95.54	14.22	11.08	7.24	29.49	18.05	15.81	162.86	19.75	-11.94
8	28.31	64.89	92.83	12.61	11.25	7.32	30.84	17.96	15.31	103.69	18.23	-14.10
9	26.53	56.82	109.31	11.60	11.00	7.24	32.53	17.79	15.48	67.41	32.90	-16.67
10	45.79	45.35	135.66	13.52	10.74	7.24	22.83	17.71	15.81	59.97	20.80	-20.08
11	43.91	46.81	101.31	13.26	11.33	7.15	20.05	17.45	14.01	53.29	19.20	-31.78
12	38.63	51.33	70.72	14.62	11.42	-20.04	17.68	17.29	14.35	46.27	19.20	27.66
13	33.76	50.20	53.11	13.86	11.08	-19.96	15.32	9.01	14.35	36.54	26.22	32.04
14	35.29	49.85	43.65	12.59	11.67	-19.70	11.51	28.95	14.18	27.78	26.50	35.94
15	61.43	44.49	48.80	12.67	-1.23	-19.88	9.57	28.87	14.35	32.99	18.99	40.60
16	78.44	39.07	45.11	15.21	-0.80	-19.70	7.96	28.78	14.60	12.88	11.42	48.59
17	86.99	111.31	36.98	20.87	-1.90	-19.62	-7.51	29.80	14.26	11.56	9.82	55.68
18	88.52	103.59	30.09	24.59	-1.99	-19.96	-8.44	29.46	15.75	12.11	9.12	83.00
19	109.24	81.97	24.32	37.17	-1.90	12.17	-9.12	29.46	15.75	8.43	9.61	84.95
20	106.67	71.54	22.19	41.31	-2.24	12.00	-8.86	29.29	16.00	2.17	-8.97	67.36
21	77.19	70.36	23.30	33.46	-2.41	12.25	-8.35	12.15	15.92	1.34	-7.79	56.09
22	68.57	56.04	25.94	26.44	-12.25	12.34	-8.19	12.49	16.09	-2.62	-6.54	8.75
23	87.87	55.69	25.73	21.97	-11.91	12.42	-8.69	12.66	16.17	3.81	-7.44	0.61
24	87.18	116.11	37.62	22.81	-11.49	12.00	-7.47	12.24	16.34	3.88	-4.73	23.21
25	75.22	118.20	37.34	21.88	-11.65	12.25	-4.60	12.24	40.29	5.13	-5.15	59.93
26	72.02	115.42	29.77	19.77	-11.99	74.60	-4.77	12.07	40.37	2.49	-4.87	48.74
27	79.11	92.71	22.79	16.73	-12.08	74.43	-4.51	12.24	40.12	2.76	-6.13	56.80
28	69.93	78.80	18.41	15.04	-11.74	74.26	-4.85	10.13	39.70	17.71	-2.31	37.20
29	94.96		15.91	14.28	5.72	74.26	-5.02	10.63	40.62	33.36	-3.14	40.26
30	100.47		15.28	13.43	5.47	74.18	-5.27	10.38	40.62	102.40	-3.00	61.46
31	85.10		15.15		6.31		2.72	10.47		96.63		73.49

Naturalised and normalised flows at Hillend in 1991. All values in Ml/day.

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	57.64	5.07	0.77	34.74	3.25	10.88	22.27	4.75	0.42	36.72	44.86	14.02
2	38.49	5.13	-6.04	28.20	3.09	2.52	17.96	4.75	0.42	36.86	45.00	8.43
3	54.06	5.20	-9.61	24.43	2.92	2.20	17.96	4.83	2.09	36.86	45.00	13.67
4	50.42	5.20	-3.14	17.30	3.66	5.91	17.80	4.83	1.84	37.06	45.06	13.67
5	47.59	-2.69	19.69	10.25	3.50	5.99	17.80	4.91	2.01	36.92	23.59	13.67
6	61.75	-2.76	19.96	8.53	3.09	6.16	17.80	4.92	1.92	36.79	23.19	13.60
7	80.09	-2.76	19.48	6.56	0.65	6.07	17.55	4.92	1.92	36.92	23.45	13.54
8	81.28	-2.83	26.43	9.10	-0.67	5.99	17.39	4.92	1.93	22.26	23.66	13.47
9	90.99	-2.83	25.96	19.31	-0.67	5.99	16.42	4.92	1.92	22.33	23.66	13.40
10	90.45	-2.83	21.58	33.65	-0.58	5.75	16.67	4.92	39.49	22.33	23.66	48.41
11	74.47	-2.89	16.05	39.96	-0.42	6.61	16.67	4.84	39.49	22.33	23.25	48.54
12	77.51	7.29	48.94	123.46	-0.42	6.37	16.42	5.01	39.58	22.33	-7.09	48.34
13	96.05	7.29	52.72	122.15	-0.34	6.37	16.59	4.57	39.49	22.26	0.86	48.21
14	111.18	7.35	51.91	79.13	4.59	14.81	16.67	4.74	39.41	22.26	-7.16	48.21
15	104.19	7.42	53.46	54.63	4.67	15.14	16.75	4.65	39.74	14.87	-3.18	48.00
16	111.07	7.49	55.62	59.04	4.76	14.81	1.96	4.74	39.17	14.26	26.69	47.94
17	114.24	9.71	60.47	47.73	4.76	13.74	2.04	4.65	59.81	14.87	48.67	70.35
18	107.76	17.33	108.41	41.34	4.84	15.90	2.04	4.57	59.65	15.01	47.86	70.42
19	99.20	30.43	49.22	37.82	4.67	15.98	2.12	4.57	60.06	15.07	33.25	70.55
20	92.19	70.08	29.54	33.64	3.85	15.90	2.12	2.58	60.06	15.07	29.88	85.52
21	94.62	74.87	16.39	35.52	-0.97	15.98	2.12	2.75	60.06	15.07	28.80	88.08
22	102.47	98.06	8.29	30.85	-0.72	16.06	2.20	2.74	59.90	23.63	28.93	121.73
23	107.53	132.12	1.62	22.21	-0.72	16.06	5.06	2.66	59.65	23.63	28.80	172.57
24	111.84	115.39	-0.81	17.70	-0.81	16.14	5.06	2.66	32.20	23.63	28.53	78.48
25	115.55	74.40	-0.94	14.01	-0.64	21.86	4.90	2.58	32.53	23.70	28.46	73.89
26	117.85	28.15	16.39	11.64	-0.56	21.94	4.90	2.66	32.61	23.63	43.49	74.57
27	118.72	15.81	15.71	10.41	-0.48	22.19	4.82	1.08	32.61	23.63	27.58	74.70
28	125.20	11.22	16.86	10.82	-1.82	22.19	4.90	1.00	32.53	23.63	24.27	74.09
29	115.92		18.00	14.67	-1.57	22.19	6.45	0.91	32.45	44.93	22.05	63.10
30	14.30		62.98	6.45	-1.49	22.19	5.07	1.00	32.20	44.86	14.29	48.30
31	5.07		111.13		10.47		4.91	1.16		45.00		29.16

Naturalised and normalised flows at Hillend in 1992. All values in Ml/day.

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	26.67	23.55	31.10	114.41	24.31	8.62	1.45	14.81	73.42	35.24	54.62	45.11
2	25.62	22.85	30.78	104.62	24.70	-2.93	1.37	14.81	73.73	35.30	66.64	58.53
3	26.76	23.04	41.54	74.01	24.47	-2.93	1.60	14.65	73.65	35.62	31.46	66.97
4	25.20	18.97	40.19	53.66	24.78	-2.85	1.60	44.35	73.65	36.00	40.92	69.01
5	24.96	25.87	40.19	41.62	29.85	-2.77	1.52	44.20	73.81	35.62	42.45	62.75
6	25.16	29.45	40.19	33.15	19.51	-2.77	1.76	44.43	74.35	32.72	42.52	56.10
7	-6.94	29.52	40.32	6.49	16.64	-2.77	0.64	44.51	96.49	12.90	42.84	54.25
8	-5.09	29.58	40.32	0.20	16.80	-2.77	0.64	44.59	54.83	7.91	42.84	8.75
9	-6.22	29.51	40.32	20.40	17.11	-2.08	0.64	44.43	47.53	7.91	55.05	16.11
10	-7.28	29.52	56.70	16.20	17.18	-2.08	0.72	44.27	42.87	7.98	26.91	22.56
11	-7.51	59.81	69.68	15.04	17.11	-2.16	0.72	25.69	40.23	7.91	28.89	29.08
12	-7.76	61.54	81.51	14.80	28.78	-2.24	0.64	25.69	40.38	7.85	29.02	27.49
13	5.70	62.50	83.68	14.88	29.25	-2.24	0.56	25.84	40.46	12.74	28.95	27.55
14	17.37	62.69	83.81	21.79	29.17	-2.24	4.74	25.84	40.30	12.74	28.96	26.65
15	14.92	62.37	83.81	20.47	15.73	-2.16	4.90	25.92	59.86	12.74	28.89	26.06
16	14.18	62.75	23.27	20.24	13.48	-8.45	4.74	25.92	60.33	12.81	28.70	25.74
17	13.07	62.69	23.72	19.77	13.40	-8.60	4.66	25.84	60.41	12.81	72.06	26.63
18	12.24	4.81	23.84	21.25	13.09	-8.52	4.74	36.51	60.41	12.81	70.27	35.01
19	1.01	4.68	23.20	22.65	-0.68	-8.52	4.74	36.43	60.41	12.81	69.24	32.13
20	1.01	3.47	23.40	22.65	-0.60	-8.53	4.82	36.04	60.56	22.49	69.63	25.99
21	16.33	2.00	23.52	49.13	-0.60	-8.52	2.17	36.12	60.72	20.45	69.69	21.07
22	18.02	2.12	23.72	49.21	-0.60	-8.45	2.25	36.12	69.29	20.45	69.76	20.98
23	18.71	4.36	23.91	40.35	-0.53	-13.17	2.40	36.12	62.06	20.45	69.76	18.80
24	19.35	4.62	60.89	38.49	-0.60	-6.49	2.25	36.04	60.59	20.38	56.49	20.27
25	18.42	30.90	60.76	38.49	-0.76	-6.18	2.17	56.73	60.59	20.38	56.68	18.17
26	19.41	31.03	60.96	38.49	8.54	-6.10	2.09	57.04	61.52	20.32	56.61	15.03
27	19.57	31.03	60.89	38.41	8.54	-6.03	1.94	57.04	79.15	54.62	56.60	11.32
28	23.54	30.97	60.83	15.92	8.62	-5.95	14.89	57.04	78.92	54.62	57.96	8.32
29	23.98	31.10	60.89	23.92	8.62	-5.95	14.89	57.20	28.14	54.62	62.94	17.86
30	24.05		51.94	24.39	8.62	1.60	14.89	56.97	41.42	54.68	61.79	15.88
31	24.54		13.73		8.54		15.04	88.58		54.55		14.60

Naturalised and normalised flows at Hillend in 1993. All values in Ml/day.

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	16.00	19.87	4.67	13.82	7.94	12.91	-11.98	39.78	-1.26	58.83	11.09	-51.99
2	14.91	17.36	16.91	13.16	11.34	18.13	-12.40	39.86	-1.02	58.83	32.11	-14.85
3	17.79	16.13	16.84	15.40	8.85	13.65	-11.90	16.16	8.11	58.76	32.04	19.41
4	16.96	21.59	16.64	13.74	6.05	12.41	-12.40	16.24	7.94	58.83	32.11	21.12
5	18.12	18.59	16.71	12.09	6.13	10.59	-12.89	16.24	7.94	53.88	32.11	20.44
6	20.03	16.88	16.77	20.88	5.63	9.01	39.09	16.16	7.86	54.08	32.11	19.35
7	20.99	15.31	16.64	20.88	5.80	7.68	44.73	16.24	0.56	54.08	32.11	76.96
8	30.81	13.88	16.57	27.93	8.45	5.72	44.81	16.24	0.48	54.08	32.11	78.26
9	66.72	15.51	24.10	50.99	8.70	16.67	44.81	16.16	0.15	54.36	13.62	78.94
10	70.68	14.28	17.82	46.35	11.35	26.04	44.89	7.18	-0.26	54.36	13.62	78.26
11	60.44	12.44	12.22	39.05	13.61	23.39	45.06	7.34	-0.43	54.42	13.62	77.64
12	51.36	11.48	12.41	28.51	16.93	15.84	45.14	7.26	-0.60	7.09	13.62	77.03
13	60.24	11.48	14.64	22.28	26.39	11.69	1.93	7.34	-0.68	7.09	13.62	76.35
14	82.01	10.94	12.91	16.88	121.86	9.95	2.18	7.51	-19.14	7.09	13.62	69.57
15	160.44	10.53	12.73	13.65	192.70	7.63	2.26	7.51	-19.23	7.09	13.62	68.96
16	143.51	-0.42	47.63	14.73	169.22	7.21	3.34	7.51	15.28	7.09	40.34	68.41
17	111.91	-0.42	13.15	16.80	158.94	7.96	6.49	0.24	20.09	7.02	40.34	67.53
18	115.52	-0.69	31.03	39.20	107.01	10.86	6.32	0.32	19.59	10.16	40.34	65.34
19	130.30	-0.56	27.82	74.87	62.72	15.51	4.42	0.32	19.35	-3.44	57.75	64.46
20	121.77	-0.49	24.82	78.05	47.12	14.18	-6.67	0.24	19.18	-3.37	62.32	64.39
21	112.08	-0.15	22.77	83.53	38.41	11.11	-7.24	0.32	51.79	-3.30	62.19	99.09
22	97.54	-0.08	20.45	68.84	33.44	-11.35	-7.49	0.49	51.63	-3.30	62.12	98.34
23	116.45	4.05	26.39	54.58	30.95	-13.34	-7.66	0.57	51.38	-3.30	49.86	41.14
24	126.28	4.12	27.89	42.72	26.99	-14.76	-7.66	-5.60	50.55	-3.30	49.93	9.68
25	85.25	4.26	23.93	42.72	32.56	-14.42	-7.74	-5.52	50.38	-3.44	50.75	4.08
26	67.10	4.26	19.91	34.34	20.53	-14.84	-7.58	-5.52	50.22	10.88	49.72	4.08
27	52.63	4.26	16.29	27.59	8.42	-16.00	29.82	-5.43	49.88	10.88	49.58	4.08
28	46.15	4.33	14.92	20.13	4.77	-16.33	37.70	-5.52	125.41	10.95	49.45	185.39
29	36.18		16.83	15.90	7.67	-10.16	39.86	-5.35	73.57	10.88	49.31	185.32
30	29.70		14.58	9.43	7.67	-10.16	39.78	-5.35	71.41	10.88	-51.58	185.53
31	24.31		13.56		6.59		39.78	-1.35		11.02		185.60

	Naturalised and normalised flows at Hillend in 1994. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	171.44	18.74	41.00	47.08	11.98	-2.60	-10.01	1.39	22.51	7.17	43.51	49.26
2	171.44	19.12	41.06	41.48	12.21	-2.53	-11.62	-4.24	22.51	7.17	43.57	49.26
3	169.48	19.24	41.19	44.09	7.10	-2.60	-20.28	-4.24	22.59	7.17	43.57	49.07
4	-68.90	19.05	41.38	50.98	6.41	-2.60	-15.91	-4.40	22.51	5.64	43.57	49.26
5	-68.78	19.12	55.69	67.31	6.49	-2.60	8.72	-4.32	22.51	5.58	43.57	49.07
6	-68.71	19.05	84.95	65.39	6.57	-2.68	8.56	-4.24	23.90	5.45	43.51	55.82
7	-68.71	19.05	107.65	75.74	6.57	0.50	8.56	-4.17	23.98	5.64	43.51	55.82
8	-68.71	21.31	109.47	80.33	6.64	0.58	8.56	-4.17	22.37	5.70	55.21	55.76
9	-68.65	21.25	97.87	69.84	6.64	0.73	8.56	1.48	22.22	5.70	55.27	55.82
10	-68.65	21.44	83.69	50.91	-5.10	0.81	8.56	1.56	21.99	-1.11	55.27	71.39
11	2.98	21.44	70.32	35.89	-4.49	0.88	8.57	1.79	22.14	7.75	55.27	231.48
12	2.85	21.38	60.42	23.72	-4.79	0.88	-11.24	1.79	22.22	8.26	55.27	225.93
13	2.73	21.31	88.92	17.43	-4.87	1.73	-11.24	1.79	12.92	10.08	54.89	134.55
14	87.03	21.19	146.11	13.53	-4.49	8.22	-11.24	1.79	4.42	17.59	54.89	83.10
15	92.95	66.51	92.39	11.23	-3.57	8.45	-6.26	1.79	4.03	18.09	38.61	53.66
16	92.13	39.84	64.52	8.62	-7.09	8.53	-6.10	20.92	4.03	18.16	38.74	39.72
17	90.94	39.27	53.81	7.47	-1.45	8.30	-6.11	20.84	4.03	18.28	72.47	50.06
18	71.67	39.33	55.44	6.78	-1.38	8.07	-6.03	20.84	3.88	33.27	124.74	53.66
19	67.83	39.33	50.97	8.94	-1.22	8.38	8.71	20.54	3.88	33.40	118.50	73.08
20	67.20	39.39	43.34	9.47	-0.92	8.38	9.17	20.61	5.31	33.40	118.12	61.10
21	67.01	39.39	36.28	9.63	-0.76	8.22	9.17	20.69	5.23	33.21	30.35	41.87
22	67.07	74.04	49.30	9.78	-0.84	7.99	9.17	20.77	5.16	33.02	23.20	30.26
23	67.39	74.04	135.93	9.63	-1.22	8.30	9.25	26.31	5.16	32.96	23.20	26.04
24	67.45	74.04	110.52	9.47	2.09	8.30	9.32	26.24	5.31	32.26	23.20	30.45
25	55.62	74.10	73.26	9.63	2.17	8.15	9.25	26.08	5.08	23.85	23.20	31.97
26	55.30	74.23	48.86	11.44	2.17	7.99	1.24	25.93	4.77	24.23	23.26	38.78
27	56.88	74.23	37.76	11.36	2.10	7.92	1.16	25.78	0.37	24.23	23.26	39.66
28	57.45	74.29	32.21	11.44	2.17	1.63	1.32	25.85	-0.09	33.88	23.33	89.03
29	56.69		39.12	11.75	2.17	-1.58	1.40	25.93	0.06	35.26	49.20	89.91
30	57.13		45.99	11.90	1.79	-4.88	1.39	22.59	8.26	35.33	49.14	77.99
31	57.38		43.66		-2.68		1.47	22.66		35.14		57.38

	Naturalised and normalised flows at Hillend in 1995. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	48.34	123.49	113.00	34.32	0.88	1.07	4.98	31.81	12.03	27.22	44.11	12.67
2	33.74	94.85	79.89	30.24	9.18	1.07	4.98	31.72	12.03	27.78	34.30	11.48
3	24.81	118.94	55.88	27.24	8.98	1.07	2.17	31.81	12.03	20.13	27.20	12.43
4	22.26	109.93	45.83	24.23	7.92	1.17	65.98	31.82	12.03	20.05	20.74	14.11
5	27.52	84.16	54.77	51.09	6.85	1.07	65.88	31.81	19.13	20.45	16.27	21.11
6	29.99	80.65	52.45	50.89	6.46	-10.60	64.91	31.62	19.13	20.84	14.36	19.59
7	34.06	61.42	47.31	42.17	5.69	-10.60	64.71	31.52	19.13	20.68	14.20	18.00
8	35.58	42.20	39.41	31.02	4.91	-10.50	64.81	-4.88	19.13	20.68	14.04	16.72
9	80.81	31.67	47.23	24.53	9.87	-10.50	64.91	-4.97	19.13	21.24	12.68	16.16
10	85.20	24.17	46.75	20.45	11.03	-10.50	65.01	-4.97	19.13	54.87	13.24	16.88
11	63.50	59.19	36.62	18.32	9.48	-10.40	5.49	-4.97	19.23	55.19	30.95	16.72
12	43.72	85.36	29.12	15.70	24.80	-8.08	5.30	-4.97	17.35	54.79	33.66	10.69
13	35.74	73.63	24.58	12.99	27.61	-20.20	5.40	-4.97	17.35	53.60	23.85	10.69
14	32.79	77.56	26.43	10.76	22.57	-19.62	5.69	-5.07	17.45	53.52	22.42	9.65
15	31.11	72.06	26.51	9.11	18.11	-20.01	5.69	10.72	17.35	54.55	74.11	13.80
16	57.52	64.00	42.07	7.37	10.06	-20.30	5.69	10.72	17.45	53.20	100.75	19.46
17	70.20	56.10	89.61	9.89	4.15	-20.39	5.59	10.82	17.55	56.07	67.01	12.92
18	62.46	52.27	93.28	3.67	2.21	-20.39	-24.69	10.82	17.55	61.65	44.83	10.77
19	55.44	64.80	74.37	1.93	9.87	-20.30	-24.78	10.82	17.55	63.89	32.95	10.21
20	48.74	62.00	54.35	1.54	8.80	-50.85	-24.78	10.72	17.35	63.17	27.84	8.85
21	54.56	66.76	37.72	1.93	6.96	-50.75	-24.88	10.62	17.35	62.85	21.34	9.65
22	88.15	127.71	28.87	19.47	6.28	-50.75	-24.78	18.67	17.35	154.03	17.75	19.30
23	96.36	138.16	39.56	22.09	4.18	-50.65	-24.88	18.57	17.06	202.32	22.77	31.67
24	70.12	93.72	48.10	24.03	6.02	-50.65	-24.78	18.47	17.06	103.46	42.72	29.99
25	51.37	65.64	48.09	19.30	4.27	-50.66	-24.04	18.57	16.59	77.38	37.61	23.93
26	37.97	46.42	49.21	6.50	4.28	-50.65	-23.85	18.57	34.34	219.77	43.60	17.95
27	19.38	55.75	44.74	1.56	4.37	8.47	-23.85	18.57	34.53	208.29	38.49	15.56
28	55.44	106.70	38.21	3.50	4.28	8.57	-23.85	18.67	34.73	136.81	30.94	15.48
29	67.81		29.99	2.14	4.18	5.47	-23.85	12.03	34.82	82.01	24.72	15.48
30	55.28		27.52	0.98	0.97	5.08	-23.76	11.94	34.15	60.31	23.20	15.48
31	109.45		28.64		0.97		-23.75	12.03		53.93		14.28

	Naturalised and normalised flows at Calderbank in 1990. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	52.31	389.03	173.82	105.82	24.76	24.91	120.69	6.69	23.40	43.34	188.24	20.59
2	107.77	340.66	50.79	52.25	21.59	16.29	96.18	6.48	33.34	311.78	154.93	19.98
3	358.61	406.10	102.43	43.36	21.99	15.70	31.60	7.09	56.30	207.59	128.74	19.21
4	108.17	432.91	147.18	37.45	20.99	11.17	362.50	6.08	44.77	51.00	112.83	11.06
5	64.72	437.00	474.10	36.51	21.05	14.18	208.97	7.09	40.27	349.92	103.05	10.01
6	59.80	510.09	461.49	39.93	22.26	39.02	55.37	7.49	53.16	1058.49	48.75	58.75
7	58.03	391.87	432.45	36.51	23.54	27.82	64.30	43.02	43.36	99.03	47.09	127.47
8	59.12	381.35	488.05	33.15	22.60	27.89	63.09	42.82	32.89	34.67	43.44	33.18
9	240.95	331.75	582.02	34.36	23.07	24.27	59.06	42.41	28.32	200.87	78.41	156.86
10	325.40	305.04	512.22	38.77	30.32	21.96	46.99	42.21	25.84	373.42	49.58	40.21
11	136.95	396.01	364.82	34.54	23.67	16.20	40.07	41.61	23.27	354.03	45.76	255.89
12	59.42	360.32	146.11	35.27	21.52	-8.64	33.57	41.20	22.04	132.90	45.76	69.74
13	56.21	386.71	51.74	35.08	19.78	-9.44	29.47	21.47	21.02	47.78	62.51	32.69
14	241.73	354.34	77.59	34.20	20.79	-9.71	25.59	69.02	19.74	48.79	63.17	31.05
15	399.44	319.86	80.29	38.37	23.09	-9.78	27.07	68.82	20.31	229.83	45.27	29.86
16	431.94	364.56	43.04	53.34	24.57	-9.44	22.41	68.61	21.97	39.63	27.21	27.59
17	455.05	533.86	40.71	55.55	16.98	-9.24	9.02	71.03	20.83	68.81	23.40	24.18
18	431.61	417.27	39.89	52.33	12.95	-8.84	7.46	70.23	42.03	28.88	21.74	35.45
19	524.86	382.08	38.45	59.92	9.87	16.42	6.11	70.23	65.00	20.09	22.90	33.76
20	396.31	377.93	40.93	55.75	9.37	16.42	6.34	69.83	56.54	5.18	-21.39	54.73
21	338.24	345.89	47.20	47.63	7.22	20.56	7.30	28.97	57.61	3.19	-18.58	202.99
22	446.93	98.91	47.71	41.66	1.79	20.89	7.42	29.78	41.10	-6.26	-15.59	621.63
23	414.72	455.65	78.66	37.90	-0.76	19.22	6.83	30.18	37.40	9.07	-17.75	507.28
24	403.12	528.53	183.08	37.70	-1.03	23.32	2.05	29.17	35.12	9.24	-11.28	350.40
25	447.90	521.62	47.17	37.49	-0.76	17.48	3.05	29.17	50.66	12.22	-12.28	463.68
26	500.75	437.53	40.52	34.98	-1.50	72.90	2.51	28.77	45.89	5.93	-11.61	493.44
27	469.91	447.27	36.71	31.20	0.58	72.62	3.07	29.17	43.74	6.59	-14.62	394.54
28	441.88	357.28	34.34	29.13	0.45	68.01	5.31	24.14	46.63	42.22	-5.50	630.76
29	498.61		35.15	26.57	15.19	82.95	7.32	25.35	58.91	79.51	-7.49	442.94
30	436.67		38.62	24.84	13.18	328.73	8.06	24.74	64.82	244.09	-7.16	394.81
31	388.80		38.58		19.94		20.09	24.95		230.34		348.29

	Naturalised and normalised flows at Calderbank in 1991. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	989.46	41.04	25.33	74.06	22.91	20.47	251.53	26.91	9.67	68.09	227.57	42.13
2	855.79	40.42	19.63	54.98	23.56	42.49	65.76	23.40	9.90	64.67	265.15	42.79
3	636.58	40.53	15.78	42.35	25.52	24.01	47.47	22.42	11.50	80.75	192.07	48.17
4	850.34	36.77	17.53	37.33	25.15	19.38	41.97	23.27	11.40	216.64	96.84	46.04
5	758.55	25.89	44.78	34.72	25.79	18.81	38.61	27.21	11.31	79.46	65.18	44.91
6	591.04	24.89	42.09	32.76	27.94	18.72	36.65	24.49	11.31	69.93	350.82	43.15
7	497.72	25.28	43.73	34.53	21.90	18.72	44.86	19.49	11.31	77.58	274.88	42.49
8	117.27	27.70	174.73	35.09	18.15	23.67	77.28	43.95	11.22	60.21	179.90	41.57
9	102.10	26.84	58.00	47.56	16.28	30.11	110.21	50.27	18.12	50.01	228.92	39.89
10	528.73	25.79	51.77	56.05	17.30	20.78	51.73	26.91	67.82	48.47	75.42	78.49
11	685.11	24.69	45.45	168.71	17.21	35.48	57.14	17.28	51.04	46.09	69.14	77.53
12	351.40	34.44	86.47	1848.53	18.23	47.34	73.75	15.29	51.08	43.40	35.70	80.21
13	95.13	34.54	143.65	1752.51	23.55	38.09	73.47	14.51	51.17	41.85	368.53	80.69
14	85.35	44.41	91.98	1463.40	22.54	28.30	91.58	14.88	59.05	39.36	342.35	81.21
15	62.08	115.08	97.55	1174.90	22.45	45.84	195.29	14.42	55.01	36.22	392.71	90.16
16	60.39	60.42	156.48	75.14	22.45	37.44	176.89	14.89	57.55	55.96	220.11	163.79
17	67.76	54.64	216.77	61.85	22.35	31.19	48.09	14.23	74.88	51.16	61.47	240.37
18	303.99	56.55	569.77	57.44	22.26	51.84	43.99	14.61	75.34	38.79	250.99	240.59
19	84.95	343.49	622.63	56.60	22.13	44.84	32.60	16.19	84.34	35.17	155.25	241.06
20	238.66	537.45	471.58	55.20	19.94	35.42	25.98	11.69	75.75	33.94	55.57	292.20
21	78.00	498.81	269.41	57.34	14.35	37.94	27.47	11.87	109.65	32.31	60.04	300.96
22	73.77	728.57	48.89	54.26	14.37	76.76	32.70	20.83	133.49	46.52	37.00	415.92
23	70.90	775.78	40.55	47.96	14.46	61.54	43.49	14.49	344.75	45.25	32.77	589.64
24	66.86	644.07	36.23	46.08	14.37	48.02	30.63	11.97	565.31	44.57	31.66	268.14
25	62.37	443.46	31.50	39.01	14.27	58.44	25.97	12.90	100.48	44.36	32.79	252.47
26	60.88	51.81	47.07	33.97	14.10	47.06	22.77	11.87	73.94	44.00	48.02	254.78
27	60.13	31.59	43.57	31.45	13.18	43.51	20.93	10.44	66.28	43.58	43.48	255.24
28	57.56	34.34	42.46	36.53	10.92	39.97	41.83	9.82	55.69	42.43	42.35	253.16
29	43.16		43.45	34.89	11.07	45.19	47.83	9.88	55.71	70.14	42.51	215.61
30	43.38		43.66	26.83	16.50	46.69	45.14	9.65	60.77	84.64	42.13	165.03
31	41.73		44.66		19.50		27.44	9.63		449.52		190.44

Naturalised and normalised flows at Calderbank in 1992. All values in Ml/day.

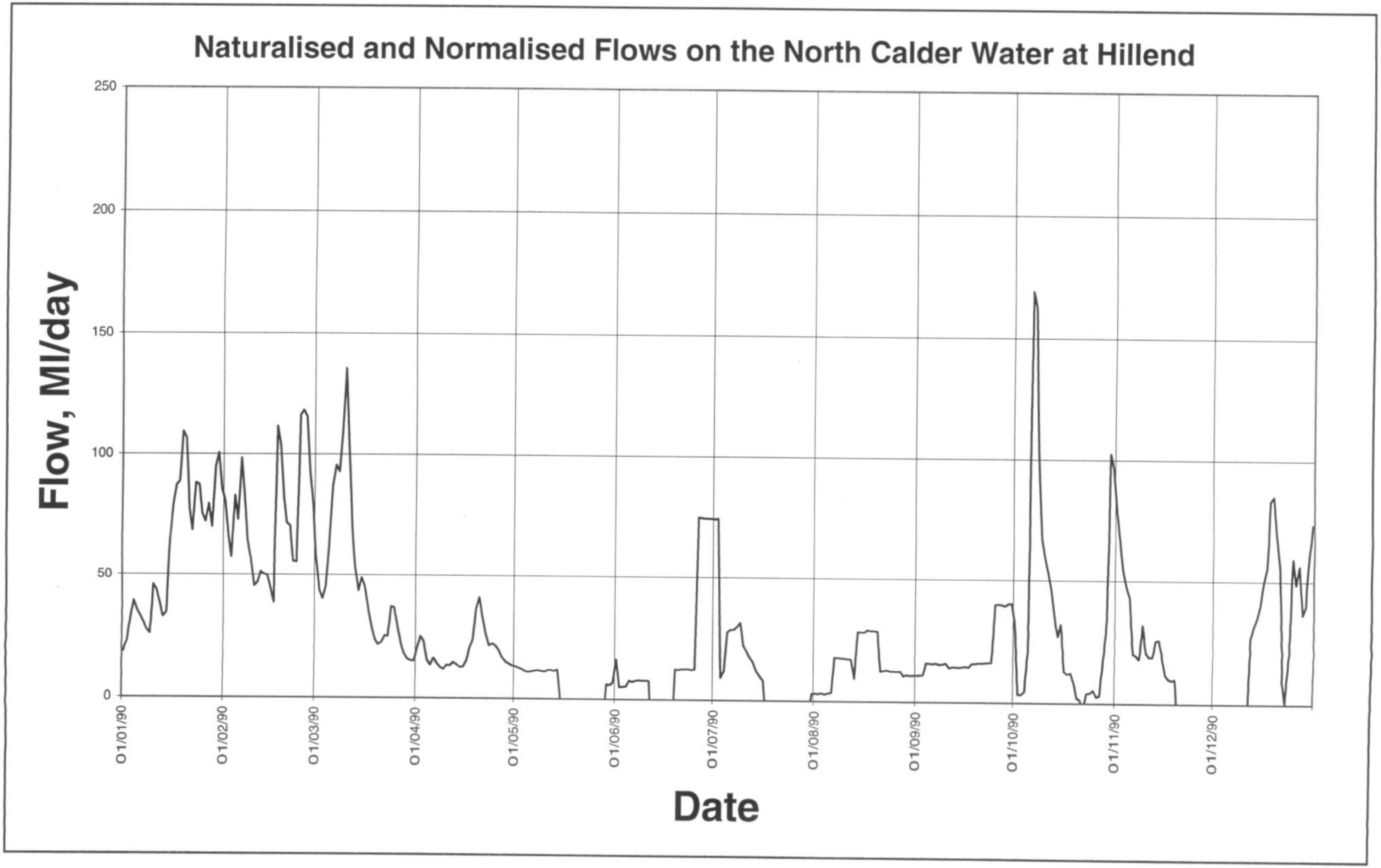
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	173.79	74.69	82.75	902.78	62.32	36.02	20.10	29.89	106.61	209.45	441.11	430.28
2	173.79	66.23	72.07	410.86	54.64	18.95	19.80	31.20	590.44	447.38	635.54	564.11
3	173.79	54.47	96.02	84.89	51.54	19.72	28.43	31.82	140.01	342.04	111.08	495.15
4	173.79	48.81	166.99	76.29	53.65	18.92	18.84	72.81	96.68	46.00	249.37	496.80
5	173.79	55.89	388.22	68.79	59.84	18.80	15.45	68.19	93.41	39.71	118.72	424.36
6	173.79	58.47	86.21	64.02	61.66	19.25	16.83	57.21	682.84	45.45	80.88	403.13
7	-129.56	60.09	85.58	36.84	64.44	19.25	10.23	57.89	654.06	33.89	79.89	421.00
8	-129.56	60.66	269.06	32.33	155.64	18.60	8.79	62.56	518.23	29.44	74.90	83.99
9	-129.56	56.23	111.72	41.15	61.17	23.99	11.62	105.47	227.41	28.17	447.89	43.20
10	-129.56	48.99	55.01	39.73	54.91	19.38	11.64	79.37	45.29	28.61	285.59	47.40
11	-129.56	71.20	229.17	39.26	187.30	19.38	16.35	65.52	380.98	27.29	477.24	50.77
12	-129.56	70.22	268.07	39.05	79.79	18.80	10.92	372.53	235.14	27.37	175.90	44.04
13	18.42	69.25	275.22	37.54	70.21	19.99	6.79	155.19	277.94	32.60	51.73	47.54
14	54.63	62.76	275.64	349.42	64.65	18.51	11.97	67.17	387.43	31.52	51.03	41.51
15	47.01	63.93	275.64	61.53	53.68	15.83	12.16	84.46	564.20	30.79	56.51	39.74
16	44.72	70.35	76.53	50.03	47.44	9.06	12.30	76.74	97.31	29.18	157.30	42.40
17	41.29	72.25	78.00	56.59	42.77	7.27	13.16	203.35	67.17	30.09	98.05	87.59
18	38.70	6.80	65.05	54.78	41.09	7.18	19.17	83.00	66.05	29.83	100.00	115.13
19	3.13	8.38	61.69	49.01	24.74	6.73	17.38	68.54	236.05	28.05	101.47	105.67
20	3.13	2.96	62.14	51.40	31.38	6.65	16.04	65.40	627.48	42.88	279.38	85.49
21	51.39	7.05	67.52	77.68	55.05	6.56	11.38	58.62	271.77	37.64	405.30	69.30
22	56.63	-0.73	63.16	78.30	31.36	6.56	11.27	84.09	341.39	38.14	589.87	68.99
23	58.79	-1.33	56.71	75.83	28.06	2.72	20.09	95.09	84.86	50.92	464.55	61.85
24	60.78	34.87	94.77	78.69	26.96	4.20	9.70	82.92	424.67	45.54	318.24	66.68
25	57.89	70.38	94.84	100.75	167.17	7.11	12.56	119.24	193.01	45.19	479.39	59.74
26	60.97	69.09	92.42	534.46	59.61	8.95	15.14	125.44	282.69	49.12	497.09	49.44
27	61.45	64.43	91.68	107.13	43.05	9.40	13.26	534.41	546.81	247.28	602.62	37.25
28	73.77	76.25	91.42	59.11	38.71	9.35	22.43	133.35	95.62	153.39	466.17	27.36
29	75.15	83.39	91.98	55.90	36.35	7.69	22.56	110.84	120.34	101.27	300.28	58.75
30	75.36		90.47	350.51	35.06	25.16	24.62	502.21	669.24	93.59	253.87	52.23
31	76.88		806.73		35.40		28.45	540.08		188.92		48.03

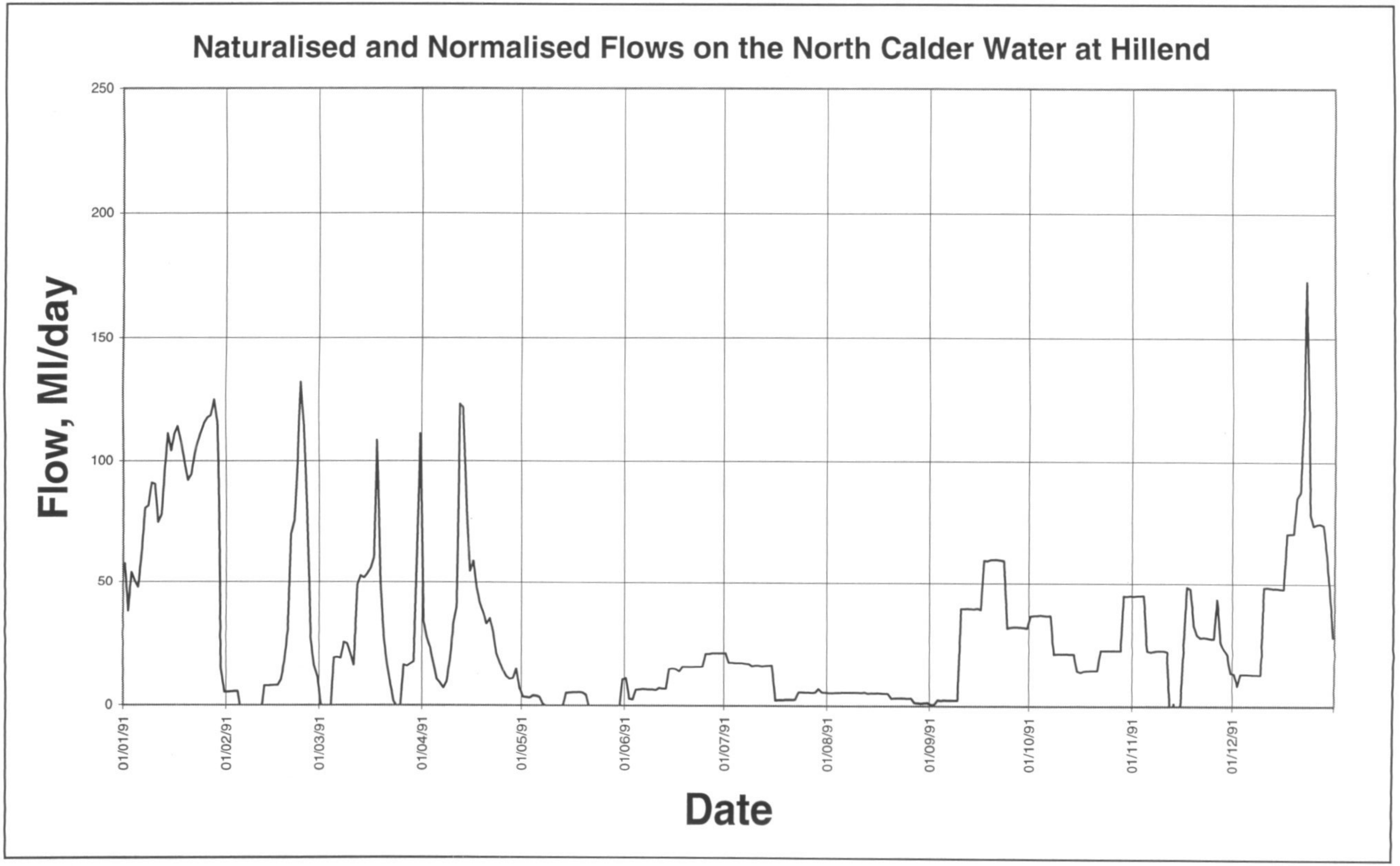
Naturalised and normalised flows at Calderbank in 1993. All values in Ml/day.

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	47.95	50.80	31.64	50.25	46.66	43.57	5.47	53.24	4.19	68.79	22.61	34.04
2	44.68	50.04	44.60	43.70	54.65	53.00	8.70	60.16	3.45	92.14	44.96	416.64
3	53.30	48.16	46.88	45.28	44.00	42.54	13.09	35.65	10.21	98.18	68.19	572.21
4	50.81	48.77	46.58	38.98	36.75	35.07	7.15	39.37	12.55	102.69	67.68	420.38
5	54.29	55.71	46.19	89.09	34.47	30.49	5.04	61.30	12.55	200.56	50.39	354.21
6	60.02	50.59	43.88	207.80	32.97	40.67	57.22	42.05	12.63	340.45	49.86	345.95
7	62.88	45.89	41.90	64.80	33.38	34.18	60.08	42.63	4.85	469.21	67.84	458.39
8	66.01	46.09	37.88	408.91	33.24	26.08	68.85	39.16	17.19	125.37	72.08	695.50
9	257.41	44.80	43.70	580.82	26.32	181.81	61.05	43.13	9.90	604.15	123.99	519.58
10	526.52	45.25	40.83	135.49	25.45	59.34	59.05	22.87	28.29	170.43	55.80	470.14
11	504.43	43.35	36.88	73.89	28.24	49.38	57.47	53.35	41.43	102.55	43.54	432.53
12	347.33	37.47	37.42	64.84	29.70	41.33	57.30	37.22	21.05	43.66	56.85	493.13
13	212.10	32.25	44.04	58.74	149.44	39.14	13.89	24.30	14.97	37.18	55.21	575.90
14	507.40	32.42	38.92	53.97	948.51	39.75	16.54	38.96	3.29	32.05	50.29	500.89
15	623.17	37.58	38.38	49.51	797.67	30.60	25.24	35.20	1.34	29.00	46.20	489.50
16	801.82	28.34	141.64	55.74	700.28	24.72	238.00	31.77	14.98	22.63	88.19	392.89
17	677.99	30.19	564.48	107.71	708.36	32.98	41.90	15.38	22.21	21.33	75.72	388.02
18	576.86	33.23	214.80	572.90	273.45	42.78	29.05	13.77	22.85	25.50	69.41	478.00
19	686.97	31.75	61.39	631.76	74.64	55.38	21.10	10.68	143.77	10.87	73.44	471.27
20	681.83	30.23	55.94	561.26	64.25	40.73	7.38	10.39	56.67	14.90	76.75	282.19
21	335.84	26.53	53.49	613.78	59.31	30.44	5.41	8.08	160.55	8.23	75.85	81.09
22	292.27	23.89	51.30	314.44	56.24	7.34	6.15	7.32	60.13	6.66	75.03	232.88
23	348.93	29.69	201.64	205.23	53.67	4.44	5.23	5.57	56.36	9.42	60.71	63.90
24	378.38	29.40	63.99	80.72	47.65	3.96	10.28	0.49	58.20	0.89	60.12	48.19
25	457.42	33.36	53.21	194.28	51.97	12.31	7.55	-0.20	56.19	-6.18	67.53	40.65
26	473.38	35.19	47.55	77.76	44.69	8.41	5.81	-0.34	55.56	18.57	65.62	34.88
27	340.53	32.46	44.01	66.75	31.47	3.86	47.22	0.57	53.16	27.01	63.82	33.10
28	170.66	30.62	41.42	60.16	28.76	3.53	49.92	-0.23	128.12	24.65	64.77	314.37
29	68.97		45.03	54.14	32.43	7.04	63.82	7.57	95.16	24.29	67.26	666.76
30	63.69		47.15	48.39	39.87	8.62	54.93	0.56	82.73	22.33	-28.02	244.65
31	54.55		44.28		33.80		54.52	2.92		21.69		230.22

	Naturalised and normalised flows at Calderbank in 1994. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	199.21	535.59	430.53	70.98	34.04	26.69	19.35	12.71	35.27	8.46	70.58	68.50
2	211.32	194.76	536.55	65.43	32.72	20.74	17.89	5.23	31.81	23.21	66.49	88.68
3	343.96	47.75	556.80	172.19	30.38	25.64	9.72	13.37	49.94	25.37	131.26	91.11
4	-16.01	47.24	485.46	81.08	29.37	15.07	15.68	9.07	48.00	10.12	74.48	86.18
5	274.29	44.02	430.81	505.63	47.32	16.22	40.87	5.33	37.02	17.08	78.90	87.72
6	413.07	41.58	449.89	443.58	45.22	16.24	51.58	5.05	40.46	17.06	70.48	100.76
7	65.74	39.36	464.40	523.55	43.04	20.78	43.42	5.73	38.49	16.07	65.37	134.31
8	-18.06	43.49	584.35	552.29	42.04	20.18	40.64	6.13	47.52	16.08	74.85	522.26
9	-16.77	43.49	489.54	404.60	39.58	20.18	49.46	11.57	63.36	15.34	78.96	151.65
10	-20.43	40.55	439.07	73.67	14.88	19.38	58.28	11.38	62.71	12.00	83.62	784.56
11	46.34	39.44	400.17	60.25	19.22	17.56	49.95	11.35	63.14	19.01	81.68	1375.52
12	150.86	37.69	402.83	50.11	19.22	17.04	42.00	10.26	63.36	19.36	133.75	780.33
13	294.44	36.47	535.19	45.01	18.57	16.81	24.96	9.97	36.85	19.05	492.39	449.38
14	460.87	35.64	623.95	41.95	18.06	9.98	15.14	9.93	26.26	22.83	552.13	118.86
15	383.02	78.31	403.89	39.92	17.82	27.22	9.37	9.91	21.15	25.69	342.67	52.73
16	312.63	68.53	346.02	37.73	15.97	30.51	8.00	28.54	19.11	33.54	237.94	47.08
17	72.40	66.61	423.09	35.73	20.90	28.17	7.78	28.68	18.84	30.91	410.60	231.06
18	140.58	66.43	419.15	34.83	21.62	29.66	7.55	30.14	18.79	39.99	586.14	57.23
19	94.36	66.31	311.32	36.55	21.52	31.80	16.22	33.81	20.01	33.56	490.52	398.91
20	94.38	64.88	61.66	30.79	21.30	24.05	17.49	28.83	22.73	42.60	464.31	56.41
21	90.59	65.06	103.64	32.02	21.36	24.76	20.55	28.43	21.64	41.11	151.23	44.94
22	210.23	97.87	307.14	35.81	20.80	27.51	18.08	32.36	20.25	78.22	73.15	39.46
23	271.18	97.93	694.23	36.65	20.56	27.07	17.57	42.20	20.09	133.17	64.62	41.48
24	200.95	98.41	460.98	32.83	23.00	25.83	21.06	38.83	20.01	57.30	58.85	45.90
25	515.99	99.01	259.16	41.42	22.77	28.21	18.51	37.75	20.04	49.52	64.28	48.51
26	524.17	188.26	55.97	40.52	22.79	24.69	16.69	37.48	19.96	67.12	69.89	151.41
27	449.24	554.71	52.35	34.73	22.79	24.00	10.35	43.61	15.64	49.66	62.92	82.10
28	109.06	533.14	52.78	40.12	22.71	21.71	9.52	439.12	3.61	60.37	55.71	575.18
29	233.61		59.95	39.95	34.15	20.40	9.74	87.63	0.96	231.41	74.53	312.58
30	232.19		126.18	35.39	38.37	20.26	9.88	56.76	5.84	89.04	70.56	334.49
31	108.76		95.07		33.90		15.02	41.36		308.45		52.65

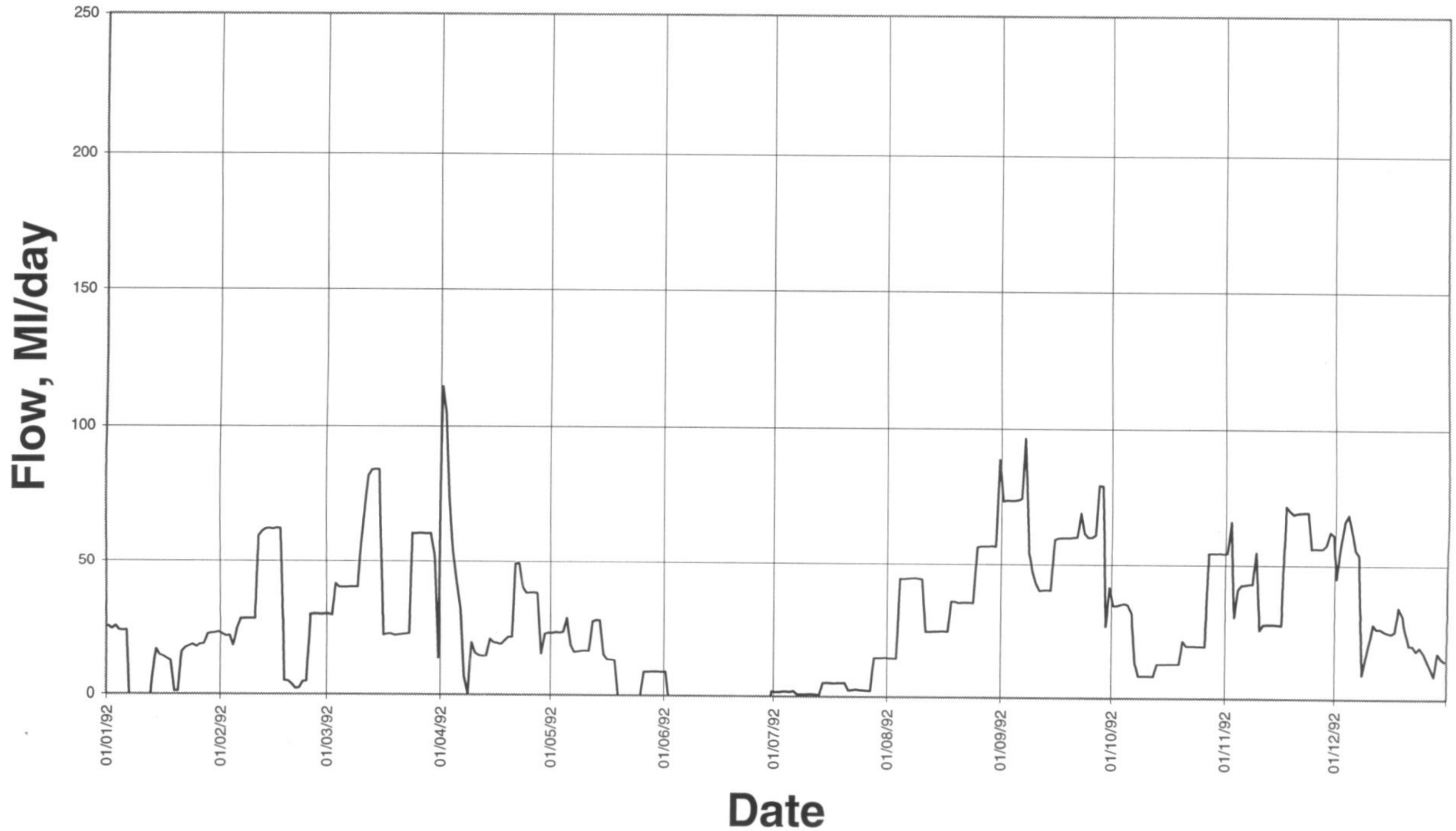
	Naturalised and normalised flows at Calderbank in 1995. All values in Ml/day.											
	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
1	62.60	650.34	586.30	62.07	34.09	34.76	47.84	77.09	158.79	83.68	60.03	57.36
2	54.05	303.56	89.13	57.23	45.29	31.93	51.76	73.36	484.02	233.32	67.52	55.13
3	49.62	739.08	68.44	54.25	41.68	41.48	46.84	75.89	98.72	187.70	66.25	56.58
4	46.28	370.51	65.40	55.63	38.64	30.95	113.38	82.60	79.78	92.70	64.34	56.32
5	61.40	377.38	313.07	189.30	37.04	27.90	124.90	85.88	106.24	100.48	64.16	62.59
6	54.29	139.66	72.75	73.54	39.24	14.89	124.45	84.06	87.14	201.77	63.17	60.19
7	63.49	70.18	68.41	64.78	42.35	14.07	116.22	84.43	87.72	98.16	50.28	57.77
8	58.80	58.54	67.51	55.16	36.88	11.69	113.72	46.38	83.70	88.06	50.70	54.18
9	694.90	51.20	79.68	51.51	45.54	13.11	120.04	45.04	71.36	77.05	50.43	55.08
10	384.42	47.59	68.67	48.00	47.01	11.72	121.33	48.27	71.11	107.06	51.42	48.32
11	71.71	630.02	60.16	44.85	41.36	11.02	54.46	57.92	85.05	110.40	175.16	50.58
12	57.24	331.98	52.89	66.54	70.89	10.91	17.87	64.29	79.11	252.55	66.39	44.07
13	56.77	293.68	49.25	67.84	64.24	-5.22	18.20	64.60	70.23	417.80	57.88	45.86
14	53.33	374.27	55.25	66.30	58.14	-4.24	19.18	64.56	63.04	131.68	55.18	46.60
15	54.82	85.62	68.40	67.53	52.25	-4.78	19.18	83.39	59.36	129.56	776.59	56.74
16	555.69	141.21	282.24	60.71	44.63	-1.08	19.18	84.04	58.27	123.85	580.48	66.39
17	86.95	75.60	648.60	70.99	35.91	1.86	18.85	90.58	56.61	349.01	83.54	56.94
18	80.02	126.42	558.54	62.59	36.78	-0.53	-83.25	98.81	55.42	128.77	69.53	52.17
19	75.23	90.16	88.63	42.11	38.46	11.21	-83.57	98.76	54.11	124.01	70.51	50.38
20	75.14	87.05	69.41	43.13	37.88	-30.55	-83.58	95.69	53.34	123.55	68.41	49.63
21	432.20	268.39	57.24	59.51	38.66	-35.20	-83.90	91.85	53.34	142.50	63.54	45.77
22	688.08	875.14	50.66	86.55	35.78	-36.40	-83.58	80.01	53.67	961.83	65.12	84.17
23	516.22	684.31	77.80	65.57	31.85	-37.05	-83.90	75.33	77.77	545.17	71.95	83.15
24	77.53	268.16	75.08	59.57	43.74	-36.51	-83.58	57.66	80.31	79.89	88.01	72.24
25	58.58	71.65	75.23	50.22	33.92	-37.83	-81.08	90.13	70.34	192.16	76.00	73.40
26	48.89	58.94	78.42	42.81	32.47	-38.98	-80.44	203.93	86.11	1503.81	84.00	320.11
27	47.87	417.47	64.94	37.47	36.31	27.48	16.61	79.34	91.99	707.72	72.44	521.86
28	470.57	810.98	61.33	36.60	32.38	27.62	33.13	77.50	82.78	200.36	71.95	521.78
29	126.49		53.23	35.62	47.79	33.20	34.74	71.93	80.97	61.91	68.82	521.78
30	219.14		52.12	34.64	32.15	40.77	24.26	66.76	85.45	68.01	64.53	521.78
31	754.25		51.56		35.06		18.03	65.16		74.02		520.43

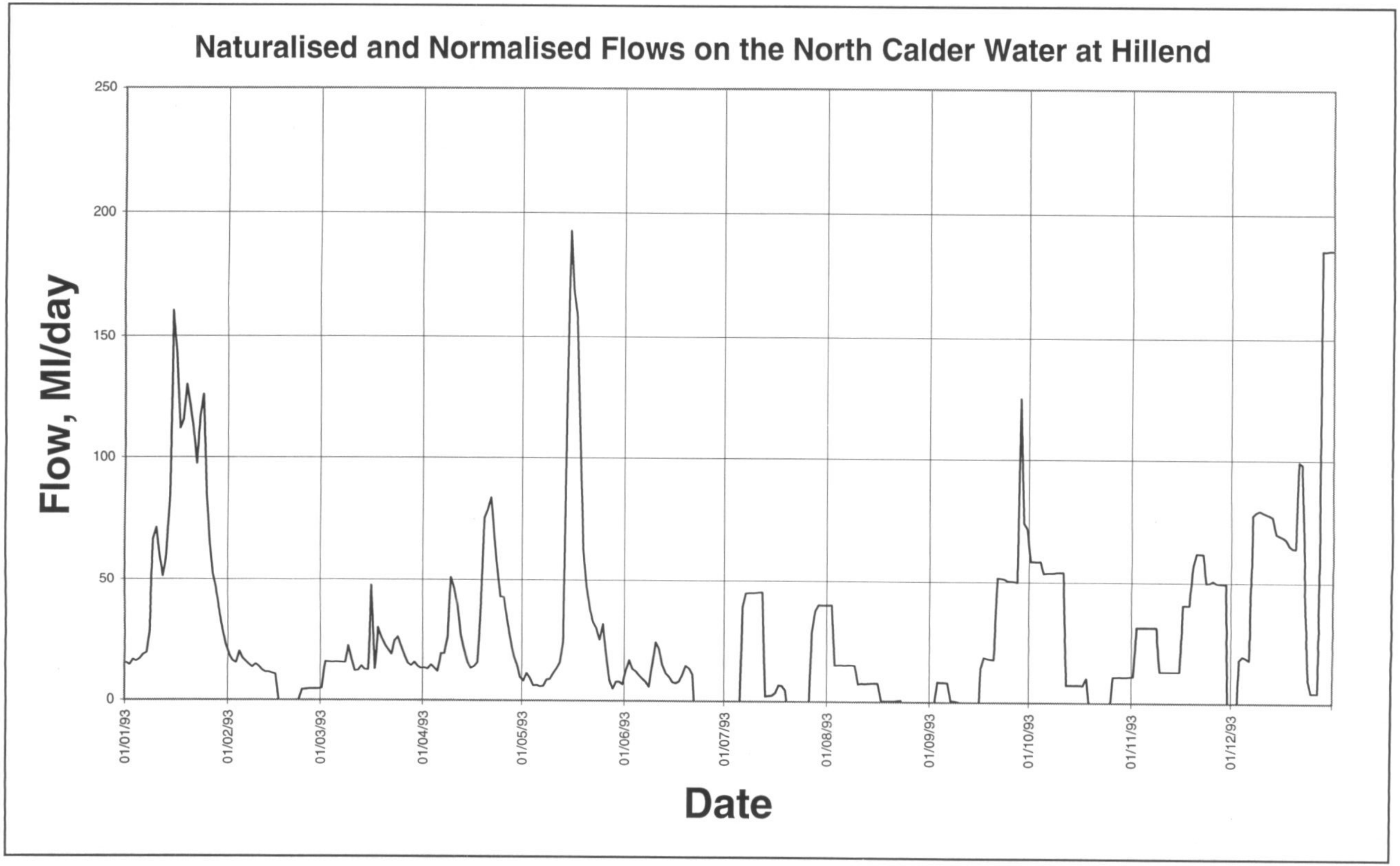

Naturalised and Normalised Flows on the North Calder Water at Hillend
Flow, Ml/day
250
200
150
100
50
0
01/01/90
01/02/90
01/03/90
01/04/90
01/05/90
01/06/90
01/07/90
01/08/90
01/09/90
01/10/90
01/11/90
01/12/90
Date

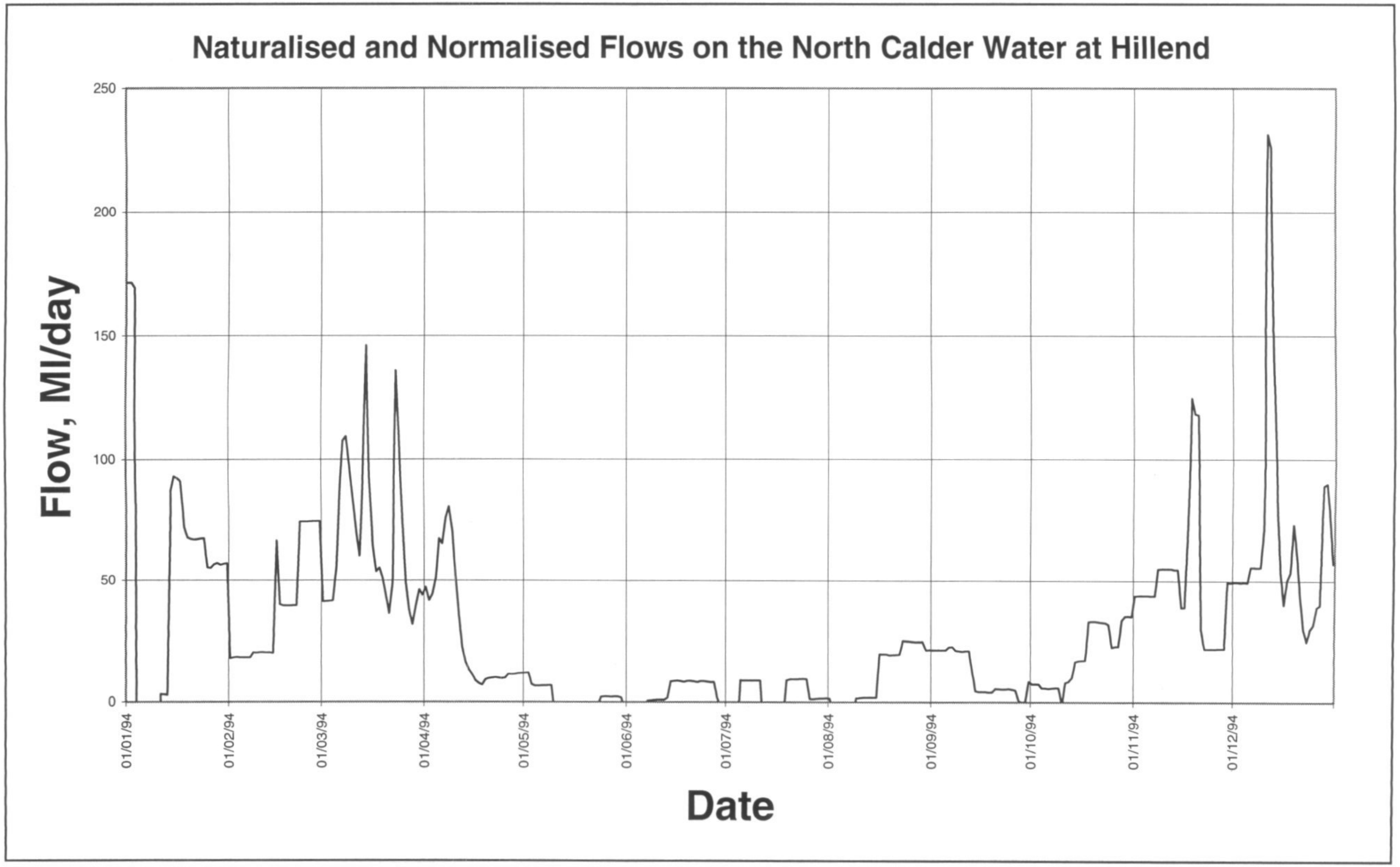


Naturalised and Normalised Flows on the North Calder Water at Hillend
Flow, Ml/day
250
200
150
100
50
0
01/01/91
01/02/91
01/03/91
01/04/91
01/05/91
01/06/91
01/07/91
01/08/91
01/09/91
01/10/91
01/11/91
01/12/91
Date

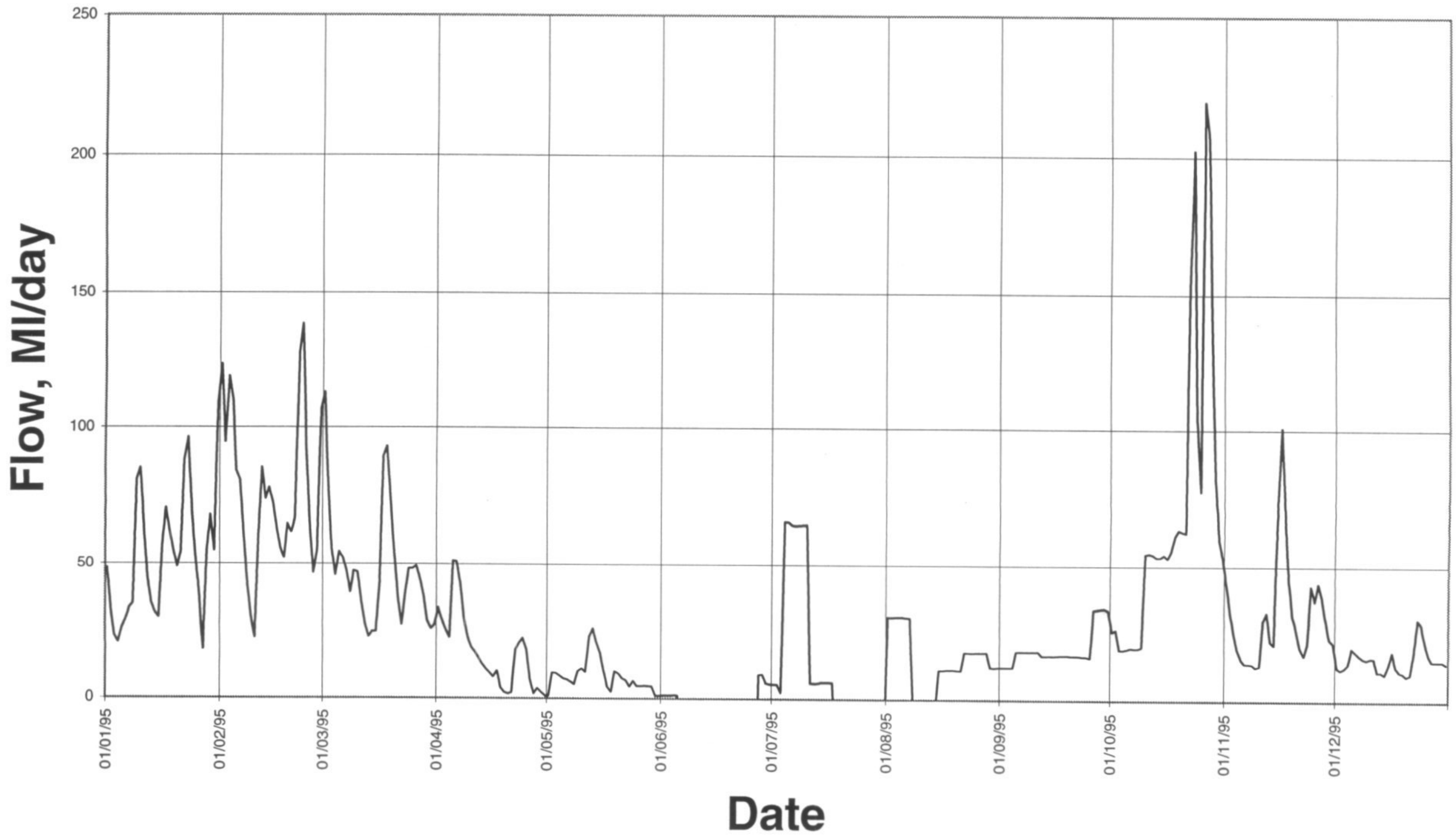
Naturalised and Normalised Flows on the North Calder Water at Hillend

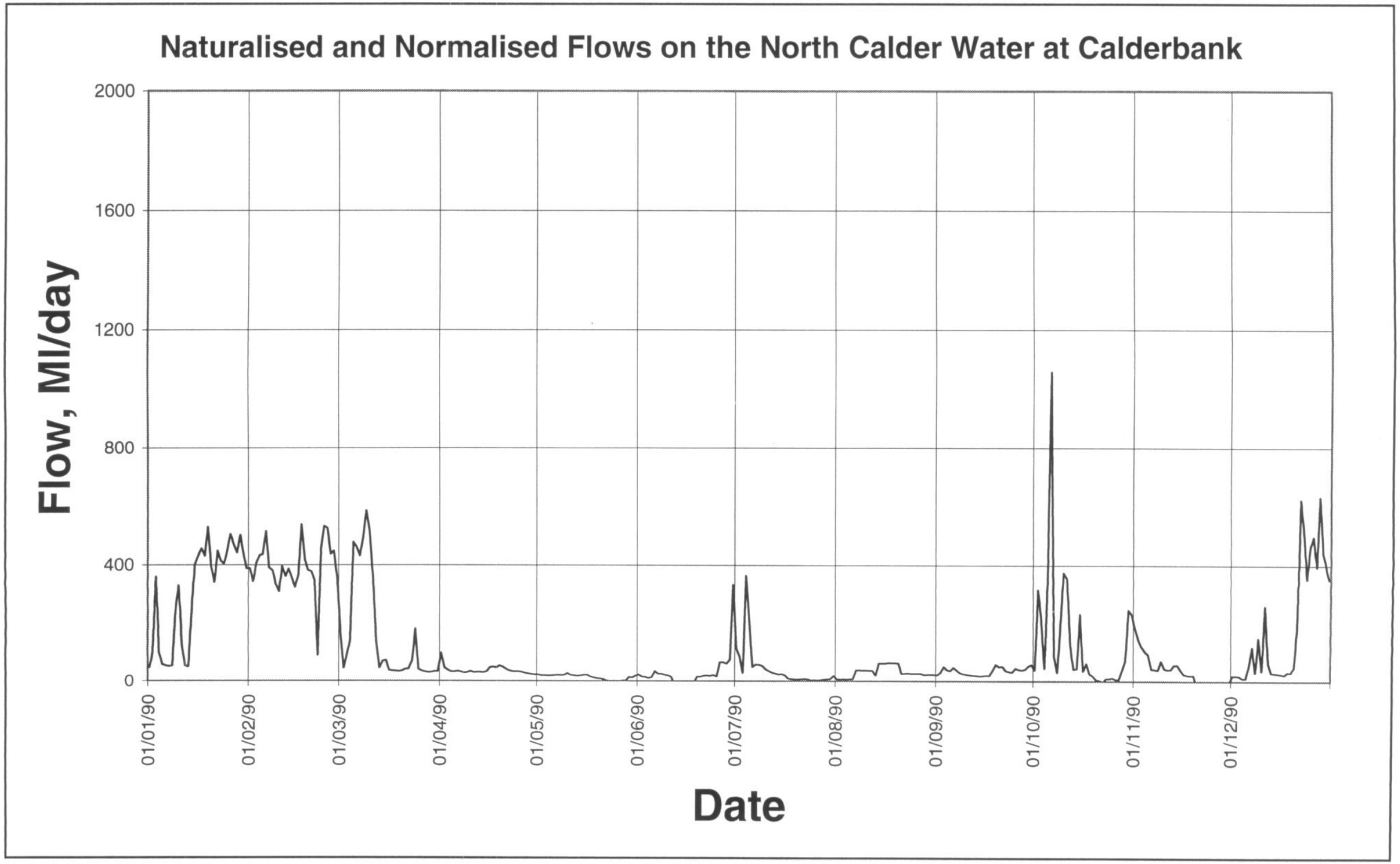



Naturalised and Normalised Flows on the North Calder Water at Hillend
Flow, Ml/day
250
200
150
100
50
0
01/01/93
01/02/93
01/03/93
01/04/93
01/05/93
01/06/93
01/07/93
01/08/93
01/09/93
01/10/93
01/11/93
01/12/93
Date

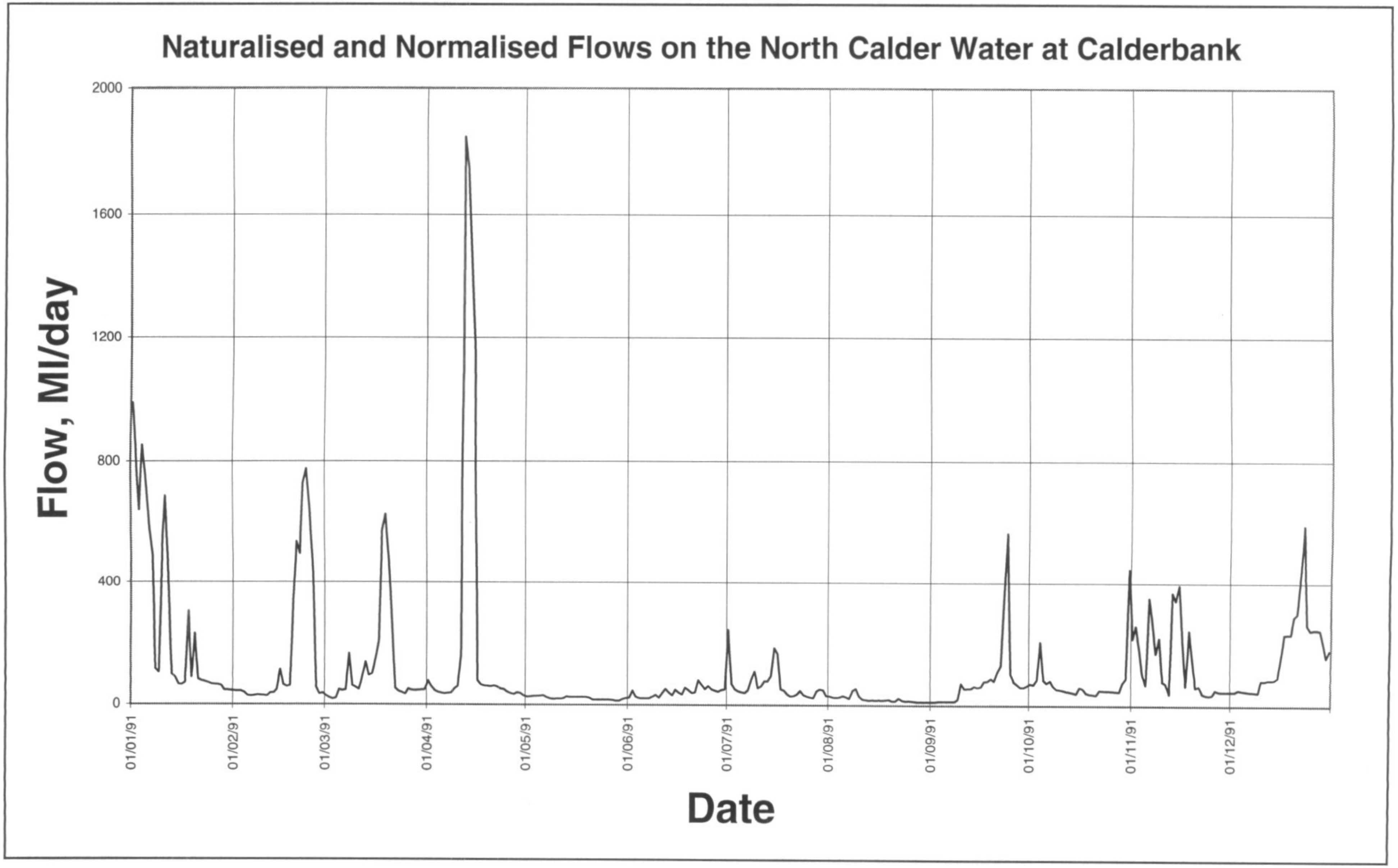

Naturalised and Normalised Flows on the North Calder Water at Hillend
Flow, Ml/day
250
200
150
100
50
0
01/01/94
01/02/94
01/03/94
01/04/94
01/05/94
01/06/94
01/07/94
01/08/94
01/09/94
01/10/94
01/11/94
01/12/94
Date

Naturalised and Normalised Flows on the North Calder Water at Hillend



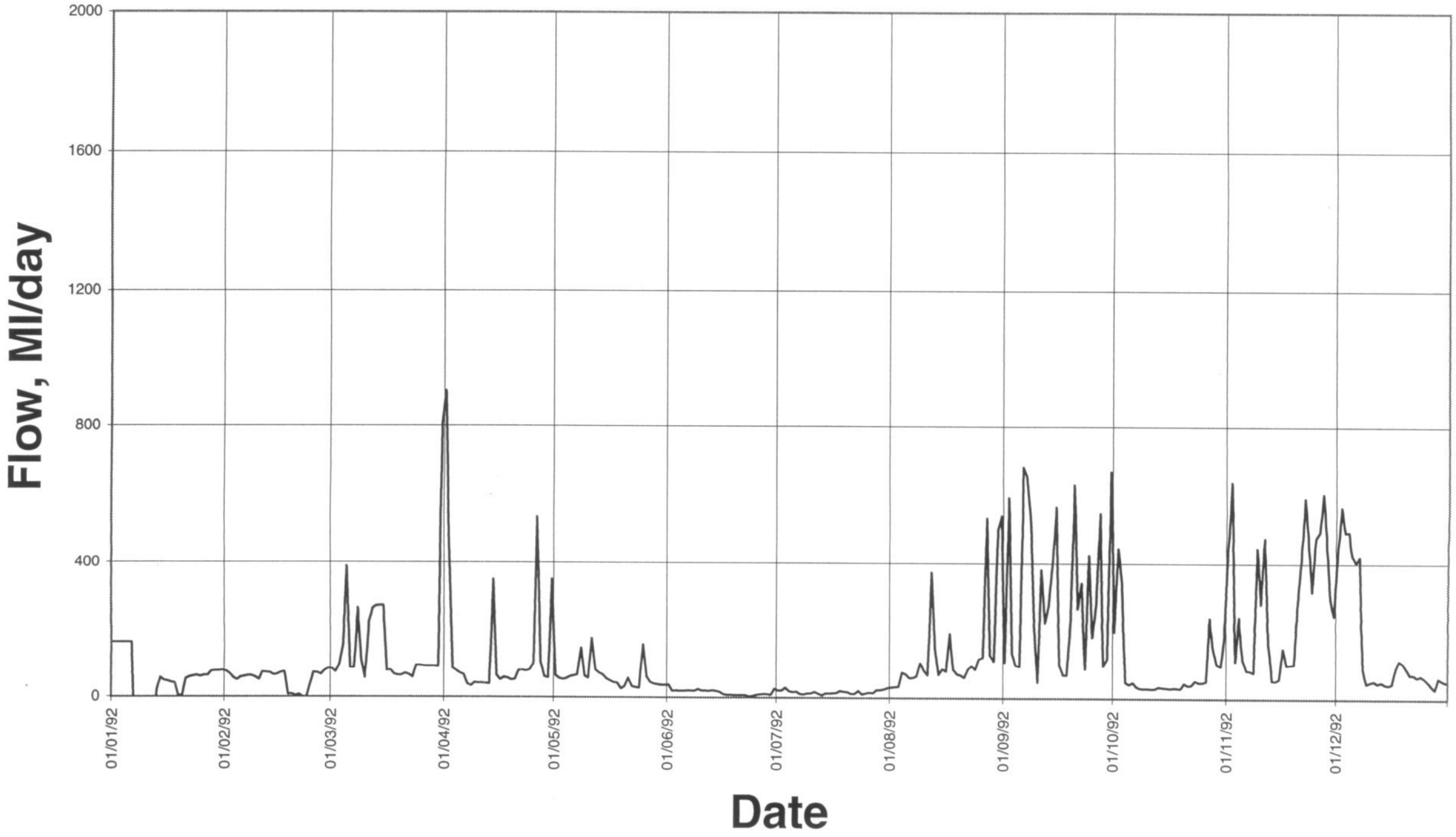


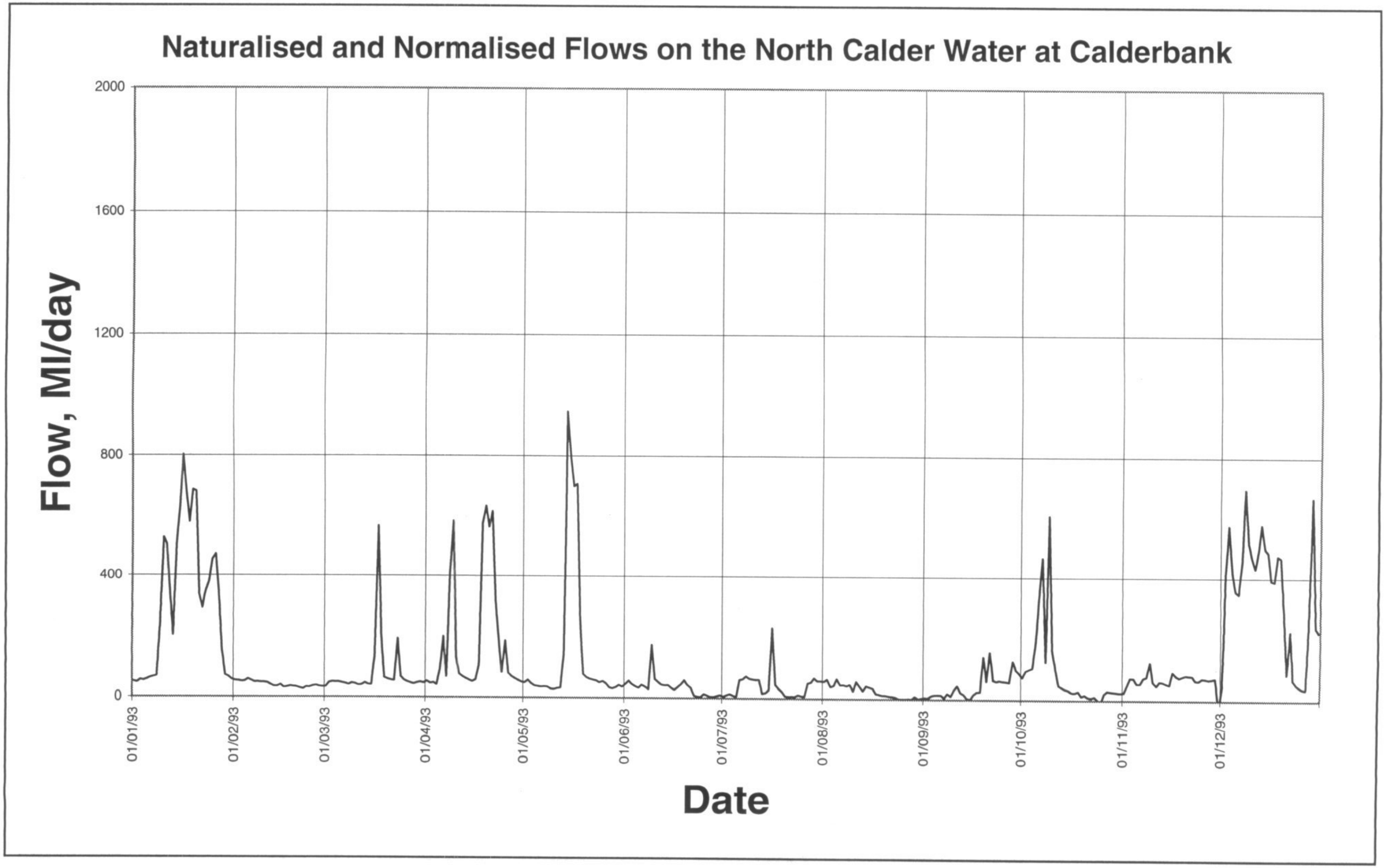
Naturalised and Normalised Flows on the North Calder Water at Calderbank
Flow, Ml/day
2000
1600
1200
800
400
0
01/01/90
01/02/90
01/03/90
01/04/90
01/05/90
01/06/90
01/07/90
01/08/90
01/09/90
01/10/90
01/11/90
01/12/90
Date

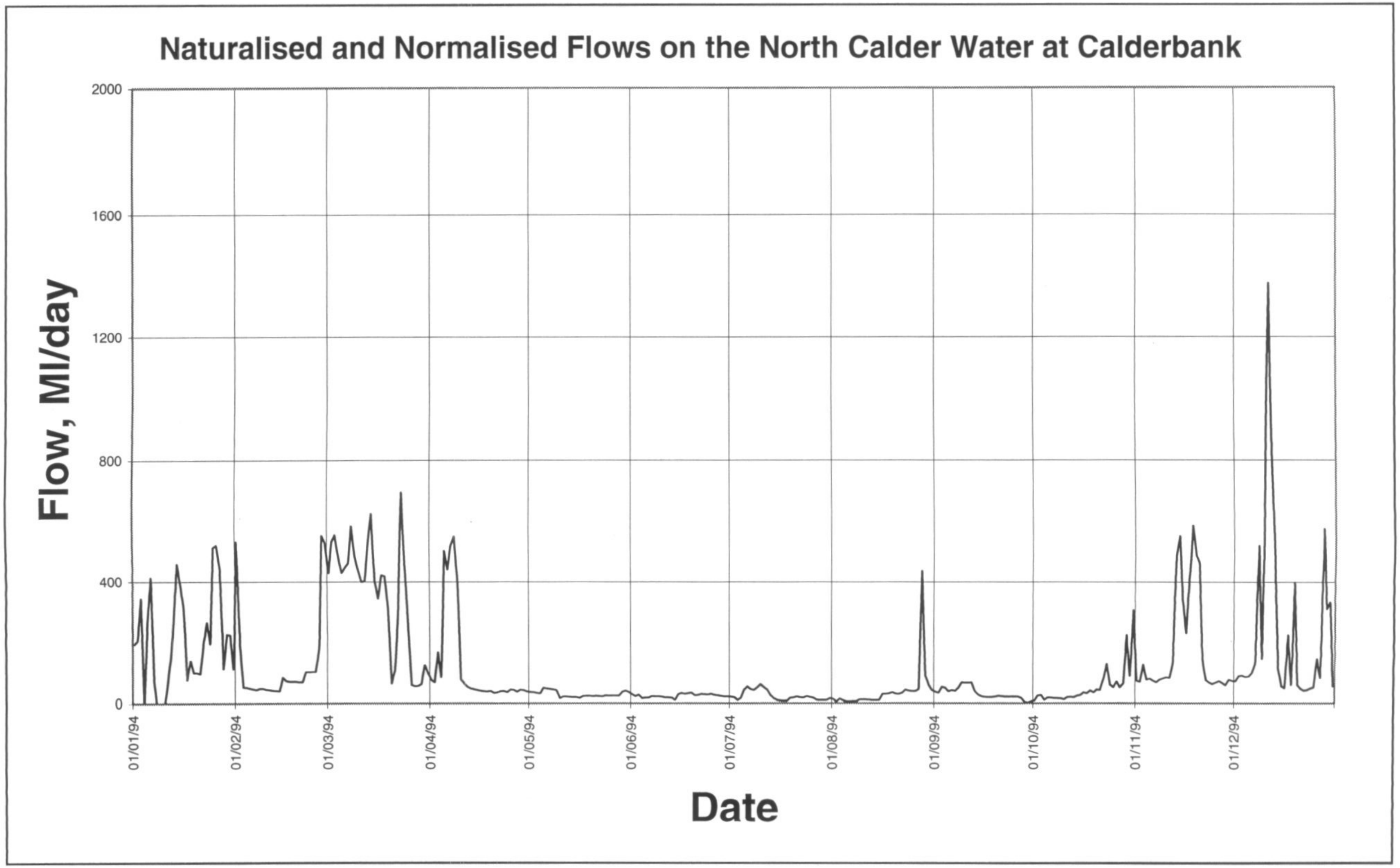


Naturalised and Normalised Flows on the North Calder Water at Calderbank
Flow, Ml/day
2000
1600
1200
800
400
0
01/01/91
01/02/91
01/03/91
01/04/91
01/05/91
01/06/91
01/07/91
01/08/91
01/09/91
01/10/91
01/11/91
01/12/91
Date

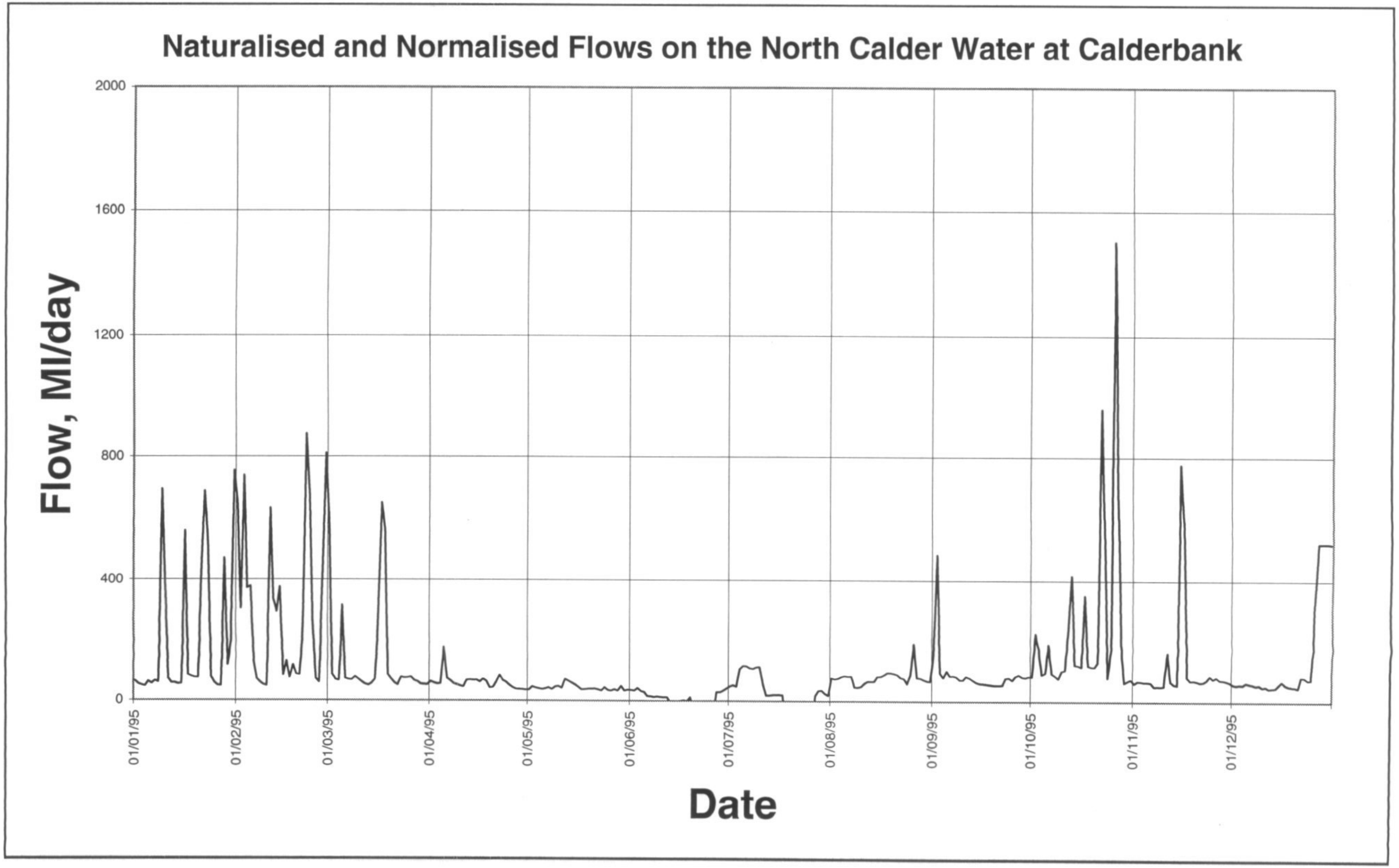
Naturalised and Normalised Flows on the North Calder Water at Calderbank




Naturalised and Normalised Flows on the North Calder Water at Calderbank
Flow, Ml/day
2000
1600
1200
800
400
0
01/01/93
01/02/93
01/03/93
01/04/93
01/05/93
01/06/93
01/07/93
01/08/93
01/09/93
01/10/93
01/11/93
01/12/93
Date



Naturalised and Normalised Flows on the North Calder Water at Calderbank
Flow, Ml/day
2000
1600
1200
800
400
0
01/01/94
01/02/94
01/03/94
01/04/94
01/05/94
01/06/94
01/07/94
01/08/94
01/09/94
01/10/94
01/11/94
01/12/94
Date



Naturalised and Normalised Flows on the North Calder Water at Calderbank
2000
1600
1200
800
400
0
Flow, Ml/day
01/01/95
01/02/95
01/03/95
01/04/95
01/05/95
01/06/95
01/07/95
01/08/95
01/09/95
01/10/95
01/11/95
01/12/95
Date