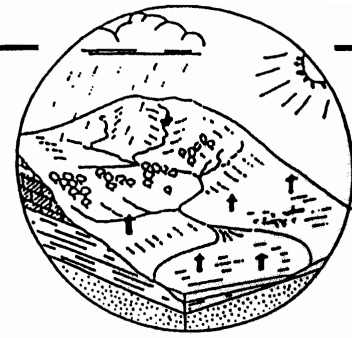
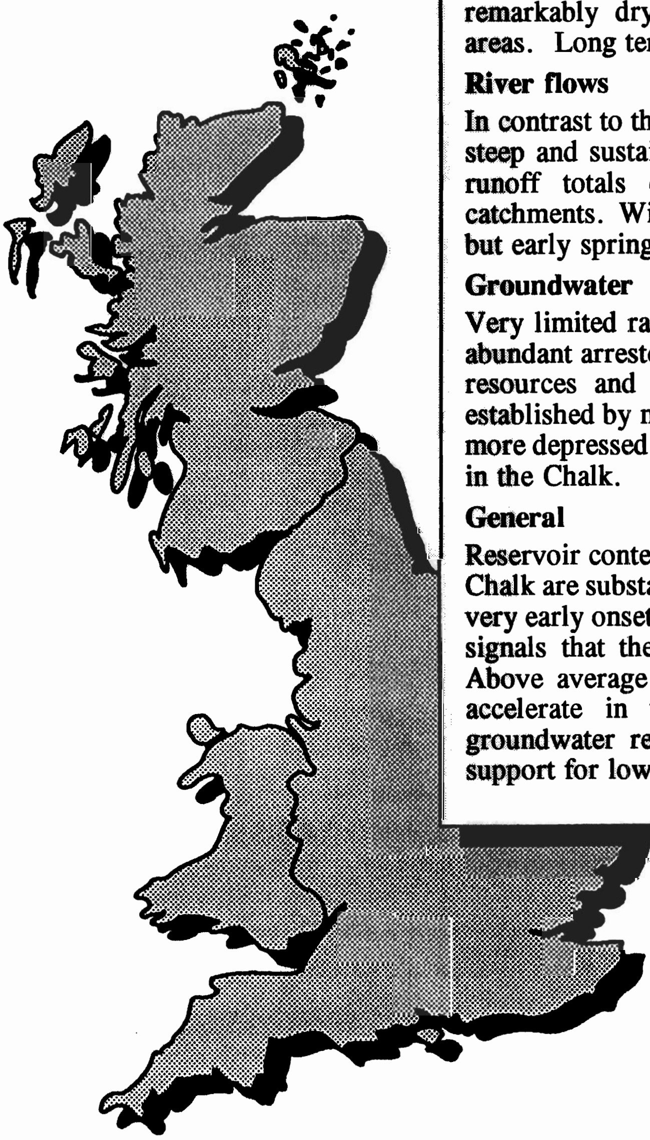
Hydrological Summary for Great Britain





FEBRUARY 1993

Rainfall

Around 40% of average for GB. Very dry south of the Scottish Highlands, many regions had less than a quarter of the February average. Central, southern England was remarkably dry with monthly totals < 10 mm over wide areas. Long term deficiencies remain moderate.

River flows

In contrast to the recent past, February was characterised by steep and sustained recessions with new minimum monthly runoff totals established in a few impervious upland catchments. Winter runoff totals are generally above average but early spring flows are notably low in some regions.

Groundwater

Very limited rainfall at a time when infiltration is normally abundant arrested the strong winter recovery in groundwater resources and water-table recessions had become widely established by month-end. Groundwater levels are generally more depressed in the Permo-Triassic sandstone aquifers than in the Chalk.

General

Reservoir contents are healthy and groundwater levels in the Chalk are substantially higher than a year ago. However, the very early onset of the seasonal decline in groundwater levels signals that the hydrological outlook is delicately poised. Above average rainfall is needed before evaporation rates accelerate in the late spring to moderate the current groundwater recessions and to ensure increased baseflow support for lowland rivers through the coming summer.

Institute of Hydrology

British Geological Survey

Institute of Hydrology / British Geological Survey
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - February 1993

Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothians Regional Council. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 3) is provided to assist in the location of the principal monitoring sites.

Rainfall

Mean temperatures for February were generally well within the normal range but the month was very cloudy and also exceptionally dry in most areas. In sharp contrast to the regular passage of active frontal systems earlier in the winter, weather patterns during February were dominated by high pressure systems. For much of the month an anticyclone extending from western Europe produced calm, overcast conditions over much of Britain. Towards month-end an Atlantic high became influential introducing a northerly airflow and wintry conditions - blizzards affected large parts of eastern Britain on the 21st (when tidal flooding was also widely reported) but, thereafter, precipitation was again very limited. Thus for Britain as a whole the wettest month in around three years was followed by the second driest in four.

With the exception of a couple of damp interludes in late February, a notable dry spell had lasted around six weeks over much of Britain by the second week of March. Over this period precipitation in large parts of central England has been restricted largely to light drizzle and fog-drip. In relation to water resource prospects, rainfall at this time of the year is of crucial importance - ordinarily runoff and infiltration rates are at their highest in the late winter. Following, typically, eight wet months in the preceding eleven, the remarkably dry February have served to underline how rapidly the hydrological outlook can be transformed by rainfall, or the lack of it, over the late winter and early spring. In the recent past for example, abundant rainfall at the beginning of 1988 and 1990 heralded only a sustained deterioration in hydrological conditions.

Provisional February rainfall totals for most regions are in the range 10-40% of the 1941-70 average and a large proportion of central and southern England registered less than 10 mm in February. For England and Wales as a whole there have been only two significantly drier Februarys (1932 and 1959) in the last 70 years and, considering all months, February 1993 ranks amongst the half dozen driest since 1960. The Thames Valley was especially dry - at the Wallingford (IH) meteorological station, the only wet day (>1.0mm) was the 25th and the February rainfall total - less than 4 mm - was appreciably below any previous monthly total in a 30-year record. Notably low February totals characterised wide areas - from close to the Severn Estuary through parts of the Pennines to the Central Lowlands of Scotland.

Winter (December-February) rainfall totals were generally significantly greater than their 1991/92 counterparts but still around 20-25% below average throughout much of England. With the exception of a few western areas, rainfall over the last twelve months has been above average and only moderate long term deficiencies can be identified at the regional scale. Despite the reassuring figures given in Table 2, the very dry February has refocussed attention on the need for above average rainfall over the period before accelerating evaporation rates and widespread soil moisture deficits render most of the lowland rainfall hydrologically ineffective. The water resources outlook for the summer and autumn of 1993 will reflect, in large part, rainfall amounts over the next two months.

Runoff

With the exception of the late winter/early spring of 1990 the transformation in runoff conditions between January and February this year has few recent parallels. Widespread spate conditions early in the year, with some notable flooding, has been succeeded by remarkably steep and sustained recessions. Apart from rivers draining permeable catchments, where baseflows generally remained healthy in February, late-winter daily flows were well below the normal seasonal range.

Apart from northern Scotland, and some southern Chalk rivers, catchment runoff totals for February were significantly below average for all index rivers. Flows on the South Tyne serve to illustrate the sharp contrast with January; for the latter month the runoff total was the second highest in a 31-year record whereas February established a new monthly minimum. An unprecedented February mean flow was also recorded on the Dee in north Wales and runoff totals were in the lowest quartile in most of Britain away from the South-East.

In most regions, winter (December-February) runoff totals were close to, or above average - notably so in Scotland and many baseflow dominated rivers in southern Britain. Substantial long term runoff deficiencies remain, particularly in the English lowlands; almost half of the runoff accumulations for the period beginning in November 1988 given in Table 3 are without precedent - a clear reminder of how unusual runoff patterns throughout Britain have been over much of the last five years. Considering the last 12 months, however, runoff accumulations are mostly well within the normal range. Nonetheless, a dry March - confirming that the 1993 recession in the lowlands has now become established - would herald a steep fall in baseflows with the prospect of further low flows later in the year.

Reservoir contents declined through February with substantial reductions in a number of upland impoundments in northern and western Britain. Nonetheless late-winter stocks were healthy in all regions. In most of southern Britain surface water resources are very much healthier than at the same period last year - reservoir stocks being typically around 10-20% greater.

Groundwater

Although soil conditions were conducive to infiltration throughout most of February the very limited rainfall served to arrest the winter recovery in groundwater levels except in some deep, slow-responding boreholes in the Chalk. At such sites the full benefit of the wet autumn and early winter is still to be felt. More generally, the lack of February rainfall is reflected in falling water-tables. Steep recessions characterise a number of monitoring sites in the older, fissured aquifers (see, for example, Alstonfield). In the Permo-Triassic sandstones of north Wales (Llanfair DC), the water-table has fallen below the pre-1992 late-winter minimum; in Scotland, the Redbank trace shows a somewhat similar pattern and the Weeford Flats borehole (in the Midlands) remains dry. By contrast, in southern Britain groundwater levels generally are close to, and in some districts well above, the seasonal means. In the Chalk particularly, levels are greatly above those registered at the same time in 1992; over wide areas the early-1993 peak was the highest for five years.

The rapid decline in levels in most western and northern aquifers has resulted in water-tables currently being significantly more depressed than in the majority of the Chalk outcrop where the drought achieved its most severe expression. Importantly, however, there remains a much greater potential for groundwater level rises during the spring in the older, more responsive aquifers than in the eastern Chalk.

Should the lack of rainfall be continued through the first half of March, there is some danger that soil moisture deficits may build to the point where no useful recharge may take place before the increased

evapotranspiration rates of early summer bring to an end any hope of further significant infiltration. In these circumstances, the summer recession will have already started. If, as in a number of recent years, the onset of the 1993/94 winter recharge is delayed until December, or even January, water-tables in the lowlands may again be notably depressed by the end of the year.

The central parts of the English lowlands remain the most sensitive areas. The water-table at Washpit Farm (Norfolk) has risen substantially above the 1950-1988 seasonal minimum and now stands at its highest since the spring of 1990 but is still significantly below the seasonal mean. Although the groundwater levels rose through February, due to the delayed response to autumn and early-winter rainfall, the downturn due to the lack of recent infiltration cannot be far distant. An extended 1993 summer recession would depress the water-table once again to an uncomfortably low level.

The much higher levels from which the summer recessions in the Chalk will commence (or, possibly, have commenced) this year provides considerable reassurance that no repetition of the exceptionally depressed levels of the summer of 1992 will recur. A caveat needs to be added: the recent past has provided ample evidence that any projections based upon historically characteristic seasonal variation in groundwater levels needs to be treated with considerable caution.

Institute of Hydrology/British Geological Survey
11 March 1993

TABLE 1 1992/93 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Feb 1992	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan 1993	Feb
England and	mm	47	85	75	49	45	87	126	103	90	135	75	98	18
Wales	%	72	144	129	73	74	119	140	124	108	139	84	114	28
NRA REGIONS														
North West	mm	100	142	89	62	31	72	137	114	128	163	107	135	22
	%	123	197	116	76	37	70	110	93	109	135	89	120	28
Northumbria	mm	45	107	103	31	19	61	104	108	84	99	69	78	17
	%	68	206	187	48	31	79	103	137	112	105	92	98	26
Severn-Trent	mm	31	67	50	59	55	87	117	72	73	111	60	77	10
	%	58	129	96	92	98	134	144	107	113	141	85	112	19
Yorkshire	mm	42	96	66	34	33	81	94	98	80	104	67	82	22
	%	66	170	118	56	57	116	104	136	115	116	90	107	34
Anglian	mm	17	63	43	48	34	89	82	92	72	86	40	54	17
	%	40	158	108	102	69	156	128	176	138	140	75	105	40
Thames	mm	25	52	65	60	39	77	107	89	76	112	57	82	6
	%	53	113	141	107	75	128	153	144	118	153	86	132	13
Southern	mm	33	59	84	30	26	75	105	73	81	132	70	85	9
	%	58	113	175	55	52	127	144	102	103	141	87	112	16
Wessex	mm	39	57	81	24	49	64	127	94	50	149	82	120	7
	%	66	98	150	35	91	103	155	119	61	153	91	143	12
South West	mm%	69	75	100	31	23	83	171	100	96	197	104	152	22
		77	89	141	37	35	99	169	96	85	147	77	118	25
Welsh	mm	80	129	91	80	48	93	212	112	100	196	124	168	23
	%	83	148	107	88	59	98	178	89	77	137	85	123	24
Scotland	mm	167	208	123	80	52	103	217	187	148	196	141	291	70
	%	161	226	137	88	57	92	168	136	99	138	90	212	67
RIVER PURIFICATION BOARDS														
Highland	mm	229	248	138	105	46	97	250	177	144	241	190	407	86
	%	172	218	121	102	42	76	169	112	78	143	101	248	65
North-East	mm	52	113	68	57	50	48	128	113	107	97	90	200	41
	%	70	182	111	74	71	52	120	130	110	94	88	220	55
Tay	mm	111	172	90	57	30	78	197	152	92	165	106	324	32
	%	121	210	120	60	36	76	167	132	76	153	79	274	35
Forth	mm	111	164	76	45	25	67	174	156	80	167	81	236	18
	%	144	238	112	54	33	68	150	144	75	155	74	238	24
Tweed	mm	70	138	98	52	27	60	151	126	80	123	75	139	13
	%	101	238	161	68	40	67	132	135	91	118	83	149	18
Solway	mm	140	206	144	66	30	99	214	166	114	190	119	200	22
	%	151	226	164	72	33	90	165	110	79	131	79	143	23
Clyde	mm	231	267	144	93	41	123	270	195	135	272	142	332	42
	%	204	254	140	96	40	95	190	111	74	163	76	206	37

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office; the provisional figures for England and Wales and for Scotland are derived using a different raingauge network. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

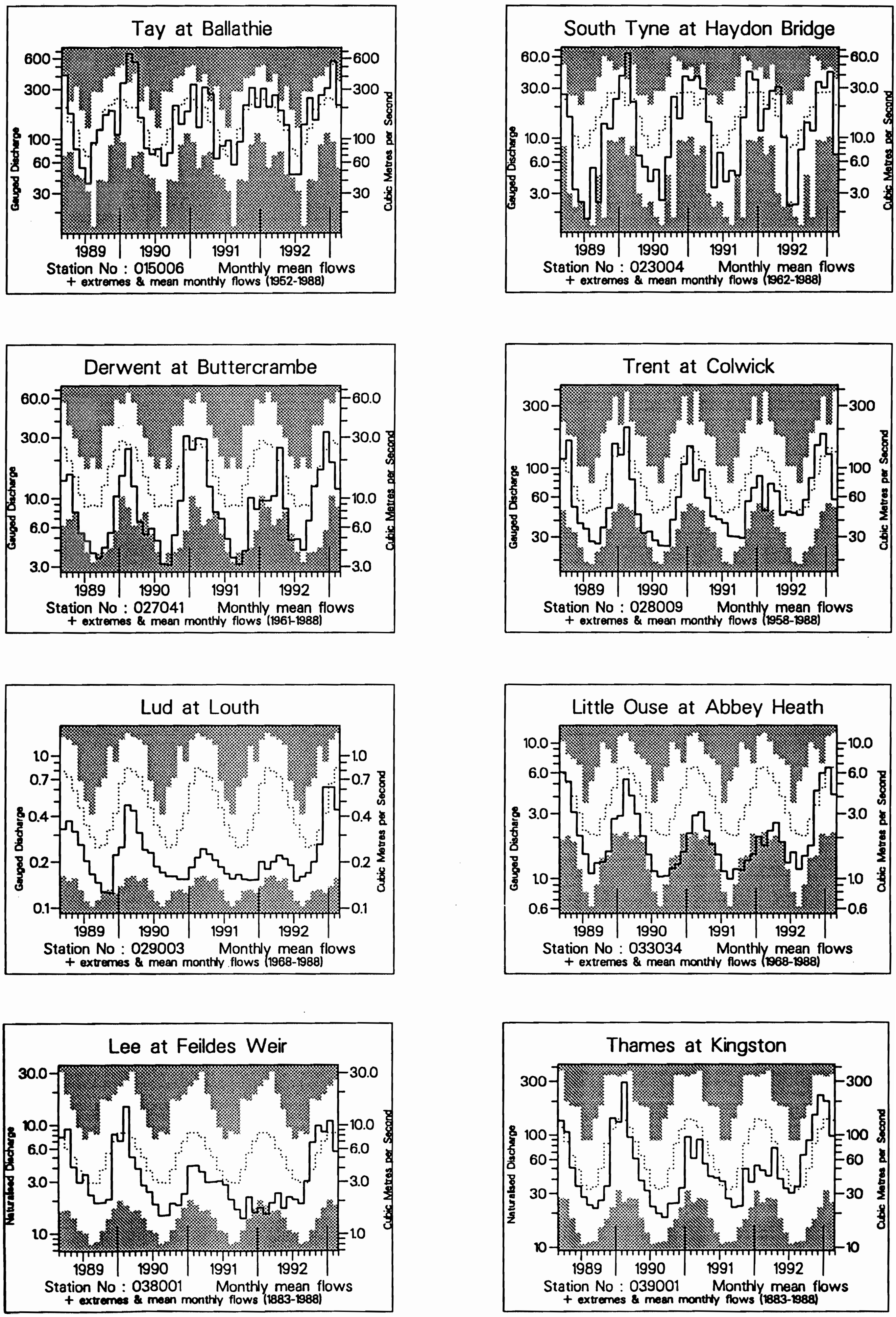
TABLE 2 RAINFALL FOR SELECTED PERIODS WITH CORRESPONDING RETURN PERIOD ESTIMATES

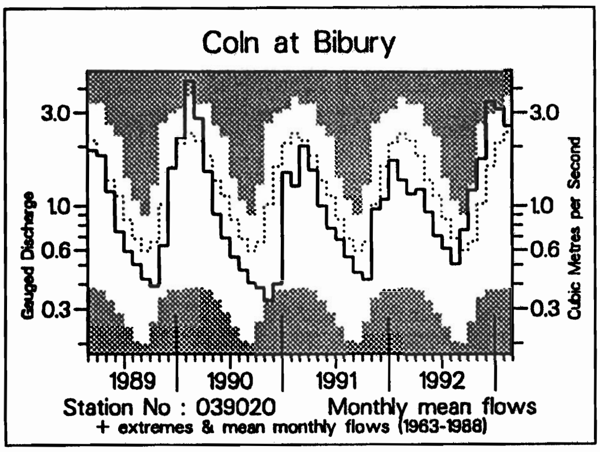
		Dec92-Feb93	Est Return Period, years	Mar92-Feb93	Est Return Period, years	Mar90-Feb93	Est Return Period, years	Aug88-Feb93	Est Return Period, years
England and	mm	191		984		2438		3860	
Wales	% LTA	79	5	108	<5	89	10-15	91	10
NRA REGIONS									
North West	mm	264		1203		3304		5330	
	% LTA	84	<5	99	<5	91	5-10	94	5
Northumbria	mm	165		881		2314		3530	
	% LTA	75	5-10	100	<5	90	5-10	88	20-30
Severn-Trent	mm	147		837		1985		3174	
	% LTA	76	5	108	<5	88	10-15	91	10
Yorkshire	mm	171		850		2094		3320	
	% LTA	79	<5	102	<5	86	15-20	88	20-30
Anglian	mm	111		719		1556		2413	
	% LTA	75	5-10	118	10	88	10-20	87	30-40
Thames	mm	145		822		1767		2827	
	% LTA	83	<5	117	5-10	86	15-20	89	10-20
Southern	mm	165		829		1955		3106	
	% LTA	77	<5	104	<5	85	15-25	86	30-40
Wessex	mm	208		903		2122		3499	
	% LTA	89	<5	104	<5	84	15-25	88	15-25
South West	mm	279		1155		2998		5003	
	% LTA	79	<5	97	<5	87	15	92	5-10
Welsh	mm	314		1375		3473		5730	
	% LTA	83	<5	103	<5	90	10-15	94	5
Scotland	mm	502		1816		4891		7671	
	% LTA	126	10	127	>100	117	>200	117	>>200
RIVER PURIFICATION BOARDS									
Highland	mm	683		2129		5948		9484	
	% LTA	139	20-25	124	40-60	120	>>200	121	>>200
North-East	mm	330		1111		2874		4325	
	% LTA	124	5-10	109	<5	97	<5	93	10
Tay	mm	462		1495		3884		6248	
	% LTA	134	10	119	10-20	107	5	110	15-25
Forth	mm	335		1289		3504		5541	
	% LTA	118	5	115	10	108	5-10	109	15-25
Tweed	mm	226		1081		2886		4407	
	% LTA	90	<5	108	<5	99	<5	96	<5
Solway	mm	340		1568		4254		6833	
	% LTA	88	<5	110	5	103	<5	105	5
Clyde	mm	516		2056		5778		9148	
	% LTA	112	<5	123	30-50	120	>200	120	>>200

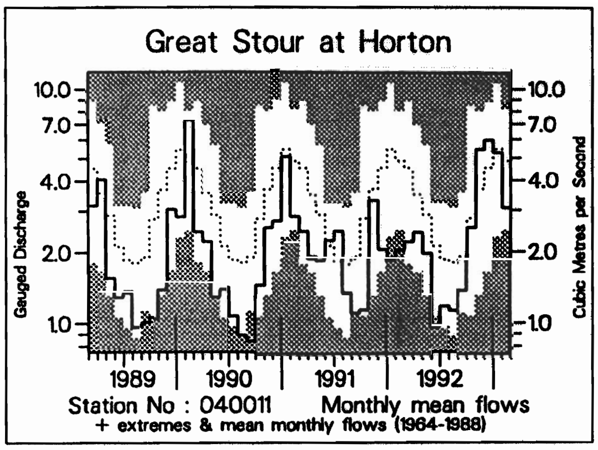
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

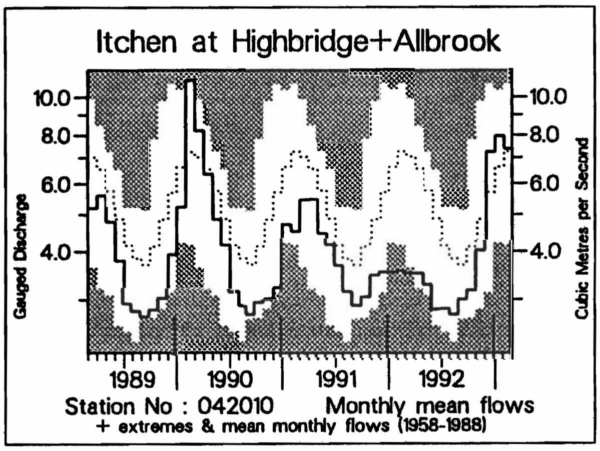
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

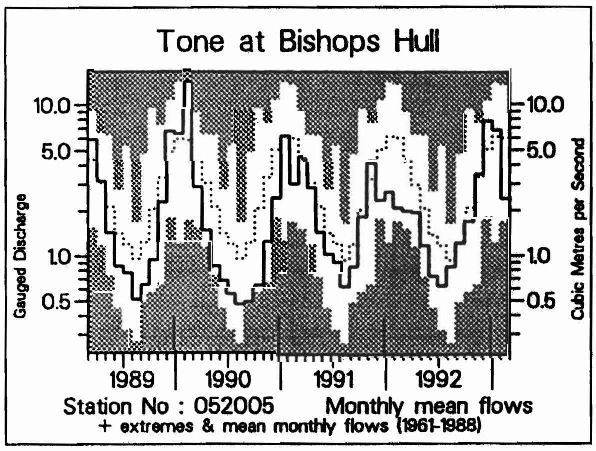
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

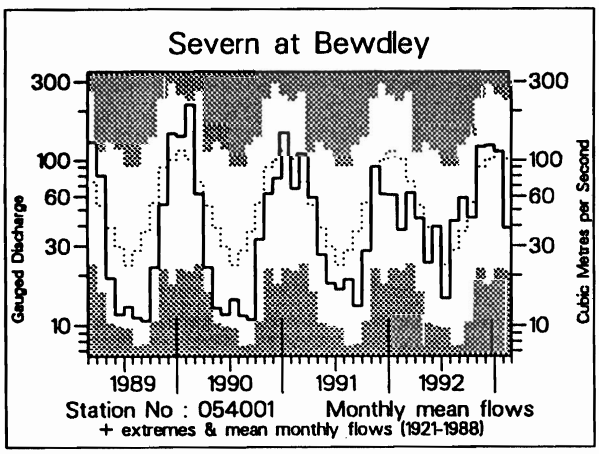


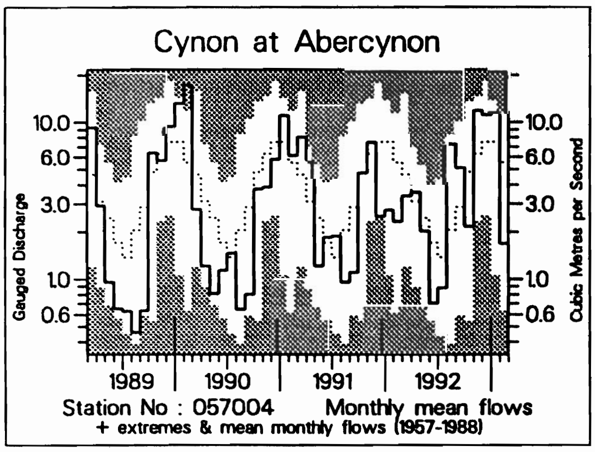

Coln at Bibury
3.0
1.0
0.6
0.3
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 039020
Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

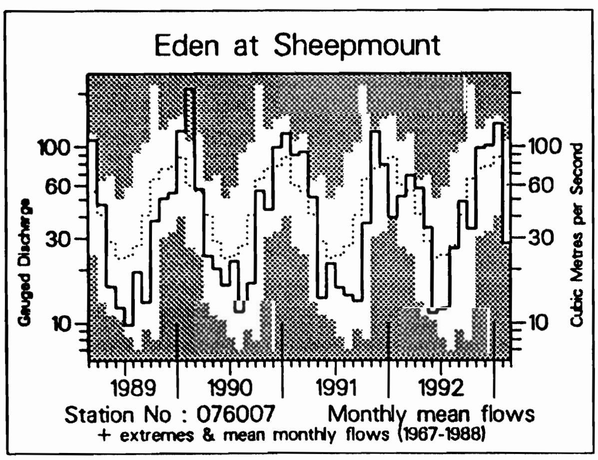

Great Stour at Horton
10.0
7.0
4.0
2.0
1.0
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 040011
Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
10.0
8.0
6.0
4.0
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 042010
Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


Tone at Bishops Hull
10.0
5.0
1.0
0.5
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 052005
Monthly mean flows
+ extremes & mean monthly flows (1961-1988)


Severn at Bewdley
300
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 054001
Monthly mean flows
+ extremes & mean monthly flows (1921-1988)


Cynon at Abercynon
10.0
6.0
3.0
1.0
0.6
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 057004
Monthly mean flows
+ extremes & mean monthly flows (1957-1988)


Eden at Sheepmount
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 076007
Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

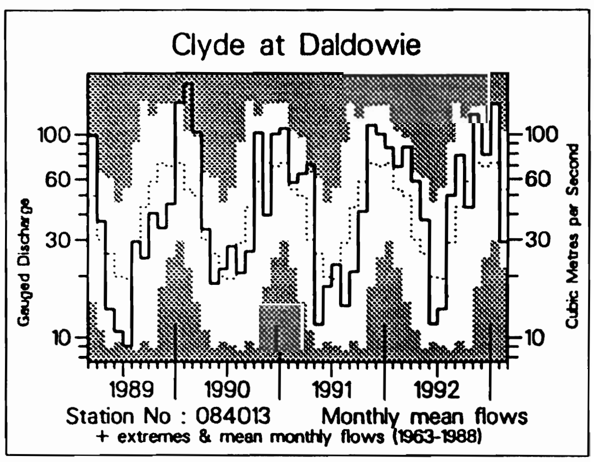

Clyde at Daldowie
100
60
30
10
Gauged Discharge
Cubic Metres per Second
1989
1990
1991
1992
Station No : 084013
Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Oct 1992	Nov	Dec	Jan 1993	Feb	Feb 1993	12/92 to 21/93		3/92 to 2/93		5/90 to 2/93		11/88 to 2/93	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at	61	90	80	155	75	14	310	19	799	12	2013	5	3047	2
Park	76	118	93	172	102	/21	124	/21	102	/20	92	/18	87	/17
Tweed at	54	144	118	169	34	3	320	23	954	30	2382	28	3673	22
Boleside	75	167	124	163	44	/32	115	/32	126	/31	112	/29	110	/28
Whiteadder Water at	32	48	46	53	20	3	119	8	384	11	1007	8	1352	5
Hutton Castle	118	129	102	90	41	/24	79	/24	99	/23	92	/21	76	/20
South Tyne at	41	117	107	152	22	1	281	17	771	17	2053	10	3164	5
Haydon Bridge	59	127	108	154	30	/31	104	/31	101	/29	95	/25	92	/23
Wharfe at	40	98	112	132	27	4	270	17	687	14	1763	4	2797	3
Flint Mill Weir	63	123	116	134	35	/38	100	/38	96	/37	87	/35	86	/34
Derwent at	21	27	55	32	18	5	106	12	260	8	641	3	944	1
Buttercrambe	105	97	139	70	45	/32	86	/32	80	/31	70	/29	64	/28
Trent at	30	52	65	46	18	3	129	16	344	19	767	2	1262	1
Colwick	130	173	149	92	42	/35	95	/35	98	/34	78	/32	79	/31
Soar at	26	46	49	40	11	3	100	10	260	12	522	3	862	1
Littlethorpe	206	265	151	103	31	/22	95	/22	107	/20	76	/16	77	/14
Lud at	10	12	30	30	19	6	79	12	164	5	356	2	591	1
Louth	84	85	159	102	56	/25	99	/25	66	/24	52	/22	53	/21
Little Ouse at	7	16	23	25	14	4	62	13	131	6	264	2	476	1
Abbey Heath	72	135	140	109	64	/25	103	/25	79	/24	57	/23	64	/21
Lee at	18	24	22	28	13	35	63	64	144	45	275	8	507	9
Feildes Weir (natr.)	182	178	122	129	66	/108	107	/108	89	/106	61	/103	70	/100
Thames at	18	33	55	51	19	31	125	90	214	61	319	4	585	1
Kingston	176	178	205	150	63	/111	138	/110	103	/110	55	/108	62	/106
Kennet at	17	31	61	60	37	18	158	32	297	18	601	2	1013	1
Theale	110	161	239	179	107	/32	167	/32	103	/31	75	/29	79	/28
Coln at	30	42	88	80	58	14	225	30	442	21	918	8	1489	5
Bibury	189	176	230	158	108	/30	156	/30	113	/29	85	/27	85	/26
Great Stour at	20	41	46	41	21	8	108	15	255	8	588	4	898	1
Horton	99	154	138	101	62	/29	101	/28	88	/26	72	/23	69	/19
Itchen at	24	29	54	59	49	17	162	30	374	4	978	1	1579	1
Highbridge+Allbrook	80	86	132	123	101	/35	118	/35	82	/34	77	/32	79	/31
Exe at	63	169	158	223	31	3	412	25	936	28	2084	8	3269	3
Thorverton	85	175	121	170	29	/37	113	/37	113	/36	89	/35	87	/33
Tone at	23	45	102	90	29	5	220	18	402	11	951	1	1698	1
Bishops Hull	87	107	156	113	39	/33	102	/32	86	/32	72	/30	78	/28
Severn at	28	72	76	69	22	8	167	24	440	33	1041	10	1739	5
Bewdley	84	135	122	97	38	/72	88	/72	98	/71	82	/70	85	/68
Cynon at	55	291	280	299	38	2	617	26	1532	28	3413	14	5612	15
Abercynon	45	191	151	154	27	/35	120	/35	122	/33	96	/29	99	/27
Dee at	123	302	232	275	30	1	537	9	1789	9	4464	4	7232	1
New Inn	62	124	95	115	18	/24	84	/24	99	/23	87	/21	88	/20
Eden at	40	110	118	157	30	2	305	15	753	14	1949	9	3128	7
Sheepmount	55	131	131	151	40	/23	113	/22	108	/21	100	/17	101	/14
Clyde at	61	174	111	197	37	6	345	22	1045	29	2628	26	4093	26
Daldowie	74	181	112	184	49	/30	121	/30	134	/29	119	/27	119	/26

Notes:
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1993.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO MARCH 1993

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Oct	Nov	Dec	1993 Jan	Feb	Mar	1992 Mar
North West	Northern Command Zone[1]	(G)	133375	66	64	79	88	98	84	80
	Vyrnwy	(R)	55146	93	81	88	89	86	87	88
Northumbria	Teesdale[2]	(G)	87936	68	79	95	90	98	91	89
	Kielder	(R)	199175*	89*	87*	77*	74*	90*	81*	94*
Severn-Trent	Clywedog	(R)	44922	92	86	92	84	96	87	85
	Derwent Valley[3]	(G)	39525	62	79	95	88	99	91	92
Yorkshire	Washburn[4]	(G)	22035	64	70	89	95	99	99	83
	Bradford supply[5]	(G)	41407	65	65	83	94	100	100	94
Anglian	Grafham	(R)	58707	94	95	94	94	96	93	88
	Rutland	(R)	130061	93	95	96	95	93	93	71
Thames	London[6]	(G)	206232	94	96	96	96	96	93	88
	Farmoor[7]	(G)	13843	99	99	95	96	92	96	97
Southern	Bewl	(R)	28170	68	69	72	82	91	91	54
	Ardingly	(R)	4685	79	81	100	100	100	100	89
Wessex	Clatworthy	(R)	5364*	40*	49*	70	100	100	94	80
	Bristol WW[8]	(G)	38666*	65*	61*	63*	94*	97*	93*	73*
South West	Colliford	(R)	28540	65	67	73	82	88	88	81
	Roadford	(R)	34500	72	76	85	90	92	83	87
	Wimbleball[9]	(R)	21320	50	55	71	90	100	99	77
	Stithians	(R)	5205	63	69	82	100	100	98	45
Welsh	Celyn + Brenig	(G)	131155	93	96	98	96	100	96	97
	Brianne	(R)	62140	99	100	100	99	100	96	100
	Big Five[10]	(G)	69762	86	87	91	94	99	91	92
	Elan Valley[11]	(G)	99106	100	100	100	98	100	88	100
Lothian	Edinburgh/Mid Lothian	(G)	97639	92	90	100	98	100	95	99
	West Lothian	(G)	5613	82	84	95	98	99	91	99
	East Lothian	(G)	10206	78	82	91	100	100	99	97

● Live or usable capacity (unless indicated otherwise)

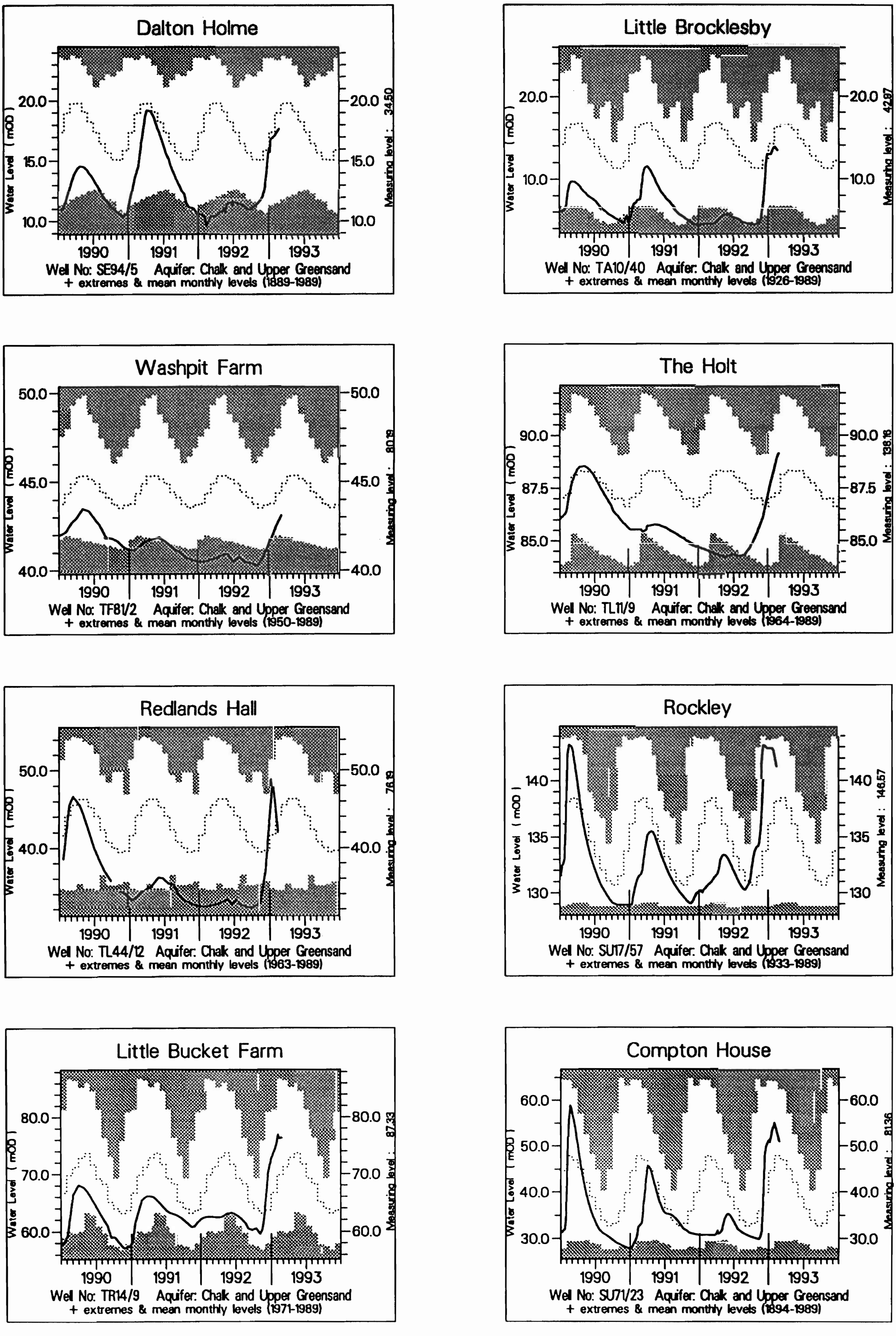
* Gross storage/percentage of gross storage

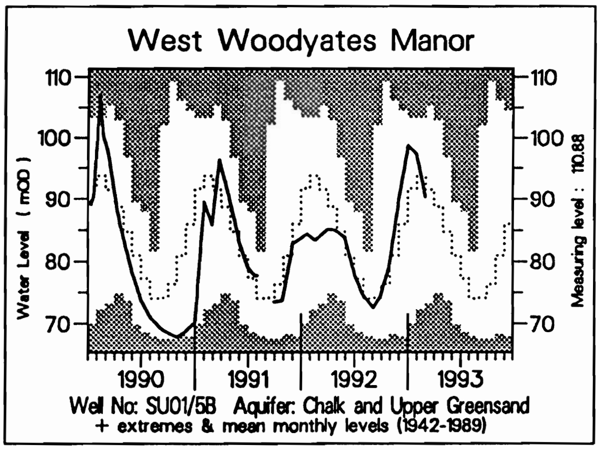
Kielder drawn down for ecological management

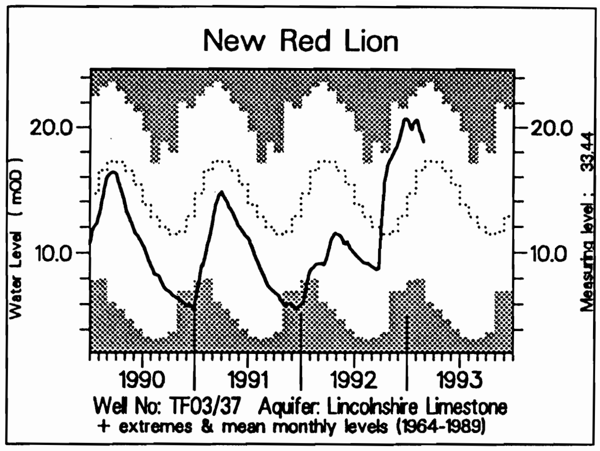
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups - pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.
9. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
10. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
11. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

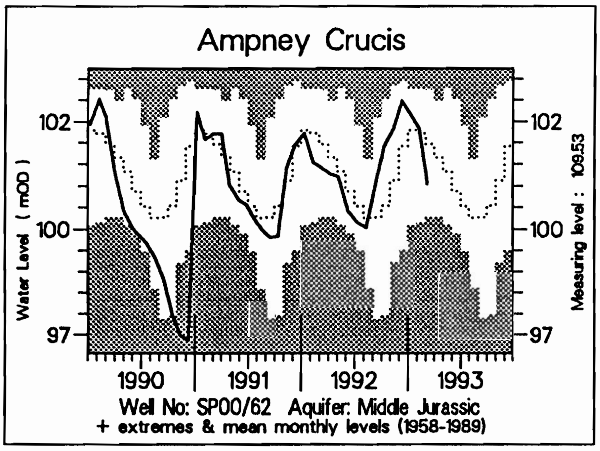
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsewhere in the report and the water resources situation.

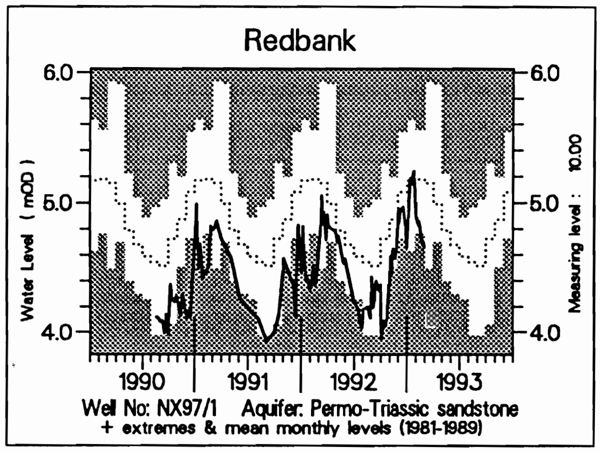
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

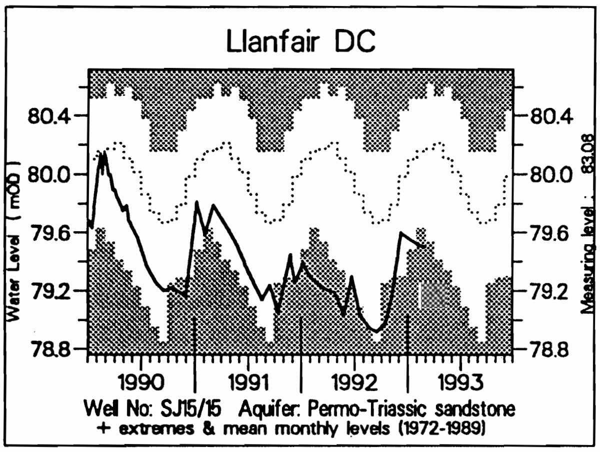


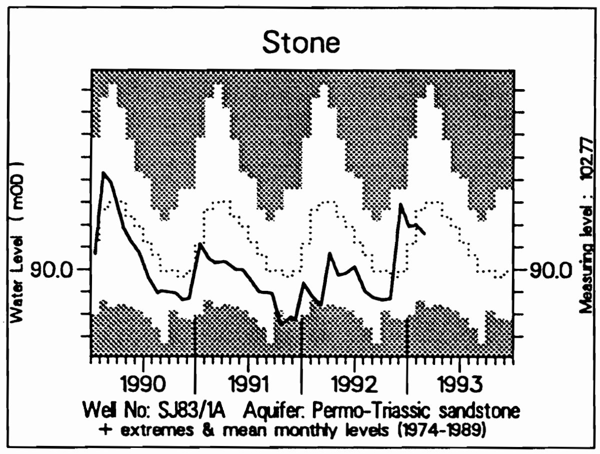

West Woodyates Manor
Water Level (mOD)
110
100
90
80
70
Measuring level : 110.88
1990
1991
1992
1993
Well No: SU01/5B Aquifer: Chalk and Upper Greensand
+ extremes & mean monthly levels (1942-1989)

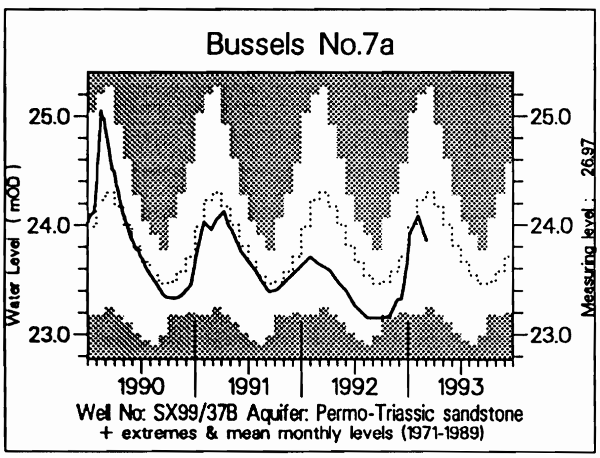

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.44
1990
1991
1992
1993
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1989)


Ampney Crucis
Water Level (mOD)
102
100
97
Measuring level : 109.53
1990
1991
1992
1993
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1989)


Redbank
Water Level (mOD)
6.0
5.0
4.0
Measuring level : 10.00
1990
1991
1992
1993
Well No: NX97/1 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1981-1989)


Llanfair DC
Water Level (mOD)
80.4
80.0
79.6
79.2
78.8
Measuring level : 83.08
1990
1991
1992
1993
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1989)


Stone
Water Level (mOD)
90.0
Measuring level : 102.77
1990
1991
1992
1993
Well No: SJ83/1A Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1989)


Bussels No.7a
Water Level (mOD)
25.0
24.0
23.0
Measuring level : 26.97
1990
1991
1992
1993
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1989)

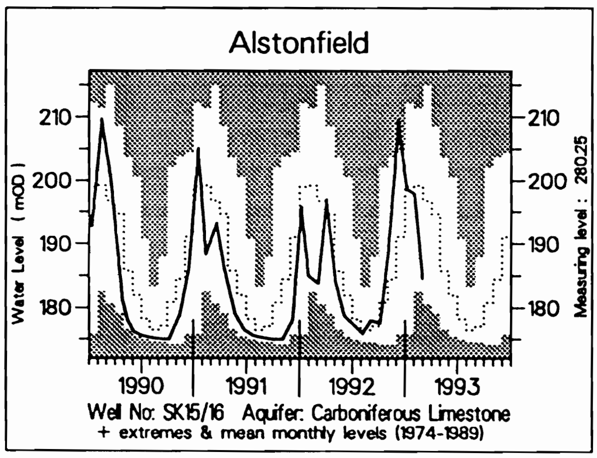

Alstonfield
Water Level (mOD)
210
200
190
180
Measuring level : 280.25
1990
1991
1992
1993
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1989)

TABLE 5 A COMPARISON OF FEBRUARY GROUNDWATER LEVELS: 1992 AND 1993

Site	Aquifer	Records commence	Average February level	February/March 1992		February/March 1993		No of years February level <1993	Least pre-1993 level
				day	level	day	level		any month
Wetwang	C & UGS	1971	26.19	07/02	16.66	19/02	23.04	7	16.66
Dalton Holme	C & UGS	1889	18.98	21/02	9.91	19/02	17.68	>10	9.64
Little Brocklesby	C & UGS	1926	15.36	11/02	4.69	15/02	13.38	>10	4.53
Washpit Farm	C & UGS	1950	44.61	03/02	40.51	01/03	43.11	>10	40.32
The Holt	C & UGS	1964	87.46	16/02	84.60	21/02	89.15	>10	83.90
Therfield Rectory	C & UGS	1883	78.69	23/02	dry	02/03	79.05	>10	dry <71.6
Redlands Farm	C & UGS	1964	43.91	25/02	32.47	12/02	42.01	>10	32.29
Rockley	C & UGS	1933	138.20	23/02	130.81	21/02	141.34	>10	dry <128.9
Little Bucket Farm	C & UGS	1971	70.04	26/02	62.58	25/02	76.32	>10	56.77
Compton House	C & UGS	1894	48.04	27/02	30.79	23/02	50.96	>10	27.64
Chilgrove House	C & UGS	1836	57.11	27/02	39.95	23/02	60.67	>10	33.46
West Dean No 3	C & UGS	1940	2.31	14/02	1.46	26/02	2.25	>10	1.01
Lime Kiln Way	C & UGS	1969	125.33	27/02	124.12	24/02	124.39	1	123.70
Ashton Farm	C & UGS	1974	67.69	17/02	67.70	01/03	70.36	>10	63.10
West Woodyates	C & UGS	1942	92.64	17/02	83.30	01/03	90.32	>10	67.62
New Red Lion	LLst	1964	16.34	25/02	9.16	24/02	18.77	>10	3.29
Ampney Crucis	Mid Jur	1958	102.27	09/03	101.42	08/03	101.04	8	97.38
Llanfair DC	PTS	1972	80.11	03/02	79.29	28/02	79.50	1	78.85
Morris Dancers	PTS	1969	32.61	10/02	32.06	16/02	31.90	1	30.87
Stone	PTS	1974	90.60	07/02	89.76	01/03	90.32	7	89.34
Skirwith	PTS	1978	130.57	29/02	130.11	05/03	130.57	6	129.44
Redbank	PTS	1981	5.25	19/02	4.36	01/03	4.66	2	3.93
Bussels 7A	PTS	1972	24.28	26/02	23.65	04/03	23.86	4	22.90
Rusheyford NE	MgLst	1967	71.75	04/02	74.75	17/02	74.94	>10	64.77
Peggy Ellerton	MgLst	1968	34.68	13/02	32.14	04/02	32.34	2	31.10
Alstonfield	CLst	1974	198.93	18/02	184.44	01/03	184.63	2	174.22

groundwater levels are in metres above Ordnance Datum

C & UGS	Chalk and Upper Greensand	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

FIGURE 3 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS