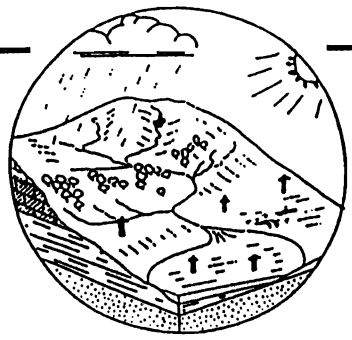
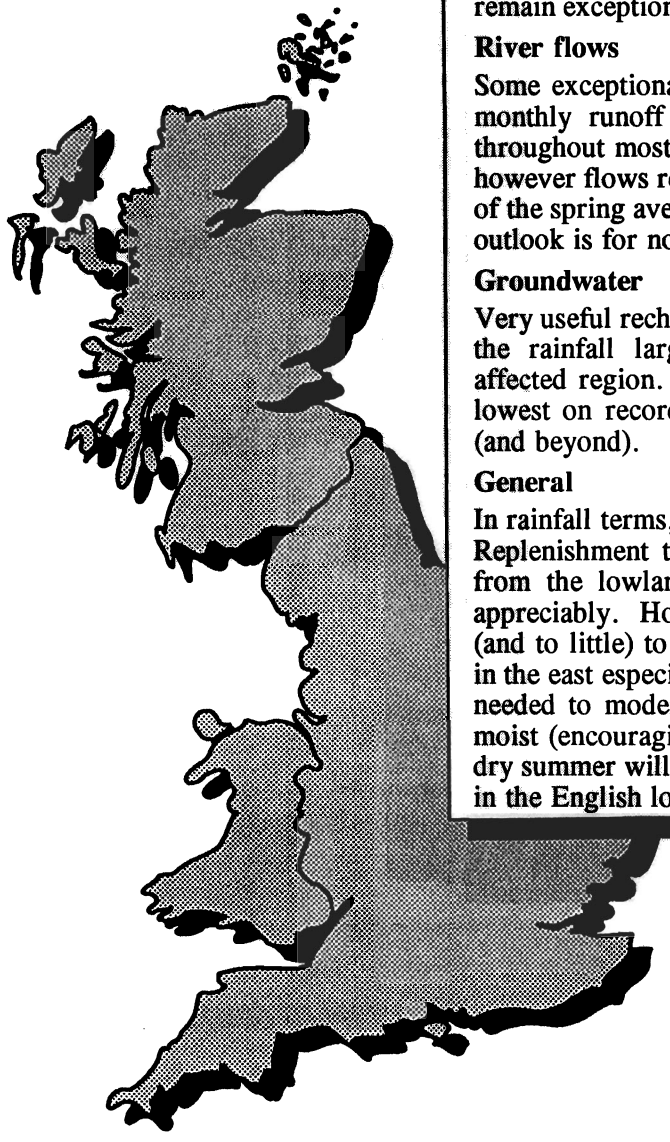
Hydrological Summary for Great Britain





APRIL 1992

Rainfall

A second successive wet month for GB as a whole (135% of average) but relatively dry in parts of the Midlands and eastern England. The very welcome spring rainfall has made only a modest impact on long term rainfall deficiencies, these remain exceptional throughout much of the English lowlands.

River flows

Some exceptional flood flows in north-eastern England and monthly runoff totals were close to, or above, average throughout most of GB. Where the drought is most severe however flows remain extremely low - commonly below half of the spring average and with baseflows very depressed, the outlook is for notably low discharge rates in the summer.

Groundwater

Very useful recharge in some areas but the dry soils rendered the rainfall largely ineffective in much of the drought affected region. The spring recession is commencing at its lowest on record over large parts of the English lowlands (and beyond).

General

In rainfall terms, the drought has moderated since February. Replenishment to reservoirs have been healthy, and away from the lowlands, runoff rates have generally increased appreciably. However, the spring rainfall has been too late (and to little) to generate substantial in groundwater levels, in the east especially. Above average summer rainfall is now needed to moderate demand and keep the soils reasonably moist (encouraging the early onset of autumn recharge). A dry summer will produce considerable water resources stress in the English lowlands.

Institute of Hydrology

British Geological Survey

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - APRIL 1992

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 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

April weather conditions were very varied in most regions, a typical mid-spring mix of cool and windy weather punctuated by several warmer interludes. A westerly airflow was dominant for much of the month and few protracted dry spells were reported. However, rainfall totals varied considerably depending largely on the tracks followed by the more vigorous low pressure systems. The Scottish Borders and north-eastern England were especially wet early in the month and an active depression brought substantial, and very welcome, rainfall to southern England on the 28th and 29th.

For Britain as a whole, provisional data suggest that the April rainfall was around 30-35 per cent above average. Regional rainfall totals were also mostly above average, particularly so in parts of Northern England, southern Scotland and southern England. Unfortunately, in some areas where the drought has achieved its greatest intensity, rainfall totals again fell below the monthly mean (e.g. in parts of East Anglia and the East Midlands).

The combined March and April (provisional) rainfall total for Great Britain ranks amongst the four wettest such periods in a record from 1869 and precipitation in 1992 thus far - allied to large spatial variations in soil moisture conditions (see below) - has further emphasised the regional nature of the drought. In Scotland, the very notable wet phase continues. The provisional January-April 1992 precipitation total was the third highest on record; 1989 and 1990 were both wetter and four of the five wettest such periods (in a 123-year series) have been recorded since 1987.

Drought severity remains greatest in the English lowlands, particularly the East Midlands, much of East Anglia and the South-East. In most of these areas the spring rainfall has made only a very modest impact on long term rainfall deficiencies. For the period beginning in the late summer of 1988 precipitation shortfalls in much of eastern, central and southern England reached 450-550 mm by the end of February 1992. Few districts have witnessed a decrease of more than 50 mm in this deficiency over the last two months. Notwithstanding the spring rainfall, the 26-month period beginning in March 1990 is the driest since the 1850s for England and Wales (for 26-month accumulations starting in **any** month). In East Anglia a few districts have recorded only three or four months with above average rainfall since the winter of 1989/90. Whilst the return periods for the longer timespan drought presented on Table 2 need to be treated with caution (not least because they are based on rainfall variability over the 1911-1970 period only) they do, nonetheless, emphasise the singular nature both of the current event and the general exaggeration in the normal rainfall gradient across Great Britain.

Any further moderation of the drought in rainfall terms through the late-spring and summer will have only a limited impact on river flows in the English lowlands and only a marginal effect on eastern aquifers. The principal benefit of above average rainfall over the coming months will be to moderate demand and constrain the growth of soil moisture deficits - thereby encouraging an early onset of recharge in the autumn.

Evaporation and Soil Moisture Deficits

In hydrological terms April is often a crucial month with the interplay of rainfall, evaporation and soil moisture conditions heavily influencing the length of the recharge season (and thus baseflow contributions to rivers over the ensuing summer).

Although temperature variations within the month were substantial, the average for April was close to the long term mean. It was again a dull month - sunshine hours have been below average since the autumn of 1991 - but windy conditions generally kept evaporation rates close to the long term mean, potentail evaporation totals being mostly in the range 45-60 mm. MORECS evaporation losses (for grass) during 1992 have generally not approached the record levels registered in 1990 but accumulated losses over the January-April period still rank, typically, among the highest half dozen in a 32-year record.

Soil moisture deficits in the lowlands displayed large regional, even local, variations especially in the South-East. Broadly speaking, April soils remained at, or close to, saturation in the west and north (greatly contributing to the amelioration in the modest droughts) whilst in much of eastern, central and southern England most of the April rainfall was rendered ineffective by the relatively dry soils. Generalisations are hampered however by some remarkable local contrasts. For example at the end of the month, parts of northern Kent were at field capacity whilst close to the Thames estuary deficits exceeded 90 mm (a record for certain MORECS squares).

The warm dry spell in early May almost certainly signals the end of the recharge season in large parts of eastern England.

River Flows

April was characterised by large temporal and spatial variations in runoff rates apart from some lowland rivers sustained largely from groundwater - in these, river flows have been depressed for lengthy periods (extending beyond three years) and monthly runoff totals have shown a remarkable consistency since the autumn of 1991. Mean river flows in April were above average, or within the normal range, throughout the great majority of Scotland, most of Wales and much of western and northern England.

Spate conditions in southern Scotland and north-eastern England continued from late March culminating in some notable discharge rates at the beginning of April. On the Coquet (Northumbria) the peak flow on the 1st appears - on the evidence of historical flood marks - to have been the highest since 1831. The flood flows early in the month were reflected in the monthly mean flows. On a number of rivers, including the Tweed and South Tyne, new April runoff records were established and very brisk increases in runoff were reported over a wider area - the Yorkshire Derwent, for example, recorded its first month with above average flows for over a year. The contrast with eastern, central and southern England was very conspicuous although tempered somewhat by the geological character of the lowland catchments. Steep flow increases occurred on largely impervious catchments (e.g. the Bedford Ouse and the Lymington in Hampshire) but monthly runoff totals on many Chalk streams remained exceptionally depressed, commonly less than 40 per cent of the April average. The April runoff total for the Mimram was the lowest in a 40-year record and for many rivers from the Lud (in Lincolnshire) to the Test (Hampshire) exceeded only the runoff for April 1976.

In the lowlands, the persistence and severity of the drought is best indexed by the longer term accumulated runoff totals. Flows for the period from October 1991 are commonly well below half of the long term average - notably so in the East Midlands, East Anglia and the eastern portion of the

Thames Valley. The seven-month runoff total for the Lee (Hertfordshire) - barely a quarter of the long term average - is the lowest in a record extending back to 1883. In the 24-month timeframe runoff totals are unprecedented over wide areas. On the Lud, Little Ouse and Itchen, for example, the May 1990 - April 1992 runoff is the lowest for any 24-month accumulation. Data for the River Lee provide a fuller historical perspective; only during the 1940s have lower 24-month runoff totals been recorded in the 110-year series. Flows on the Thames have been almost as depressed - lower accumulated totals being registered only during the droughts of 1890/91, 1901/03 and 1934/35[1]

Figures presented in Table 3 generally relate to catchments largely unaffected by major abstractions (or where the runoff figures have been suitably adjusted). Where groundwater abstraction is an exacerbating factor, the shrinkage of the drainage network and the associated loss of aquatic habitat has been more severe even than these data imply. Surface runoff has contributed usefully to many spring-fed streams in recent weeks but with baseflow so depressed (see below) the likelihood is for a further summer of low to very low flows punctuated by short-lived recoveries in response to storm rainfall.

Reservoir replenishment continued, somewhat erratically, through the month in most areas and by early May most major impoundments were at, or close to, capacity. Only in southern England are stocks lower than in early May 1991 (and then only modestly in most areas). Generally the onset of reservoir drawdowns will be relatively late this year (particularly in the context of recent years) and the healthy late-spring storages further underline the contrasting outlook compared to groundwater supplies.

Groundwater

Proportionally, the shortfall in groundwater replenishment since early 1988 is very much greater than that for rainfall. In much of the eastern lowlands, four successive years with modest recharge, separated by extended groundwater level recessions, have produced remarkably depressed water-tables. This is particularly true of much of the Chalk aquifer from Hertfordshire to Humberside where the accumulated recharge over the past four winters is generally less than 50 per cent of the long-term average. There is no modern parallel for such a shortfall and the spring groundwater levels are below the seasonal minima over wide areas. Although some benefit from the recent spring rainfall may be anticipated, recharge totals for 1991/92 remain below one third of the average in many eastern and central aquifer units; in some districts no discernible recharge has occurred - or is now likely to. The zone of limited 1991/92 recharge extends across the Midlands to Wales but the most notable groundwater depletions are generally to be found in East Anglia and adjacent areas where recharge in 1990/91 was minimal also (see, for example, the hydrograph traces for Washpit Farm and The Holt).

Groundwater levels are rising, albeit slowly, in many of the index observation sites in the eastern Chalk outcrop but levels continue to decline in some boreholes (e.g. The Holt). Despite the recent upturns, levels are still beneath the seasonal minima at Dalton Holme, Little Brocklesby, Washpit Farm, Fairfields, Redlands Hall and Therfield Rectory (The Holt also). In the Chalk of southern England and the Trias of south-west England, groundwater levels vary from below the seasonal mean to near the seasonal minimum; only in parts, of Hampshire are levels close to the seasonal mean (and significant late-April recharge should generate an appreciable upturn at Compton). Over most of the Midlands and north-east England, levels vary from below to well below the seasonal mean, and the Weeford Flats site remains dry. The groundwater level at Llanfair DC is not only falling, but it is also below the seasonal minimum; evidence from a rather unreliable site not far distant tends to

[1] Considerable differences in precision between the recent runoff between droughts figures and the historical data imply that comparisons should be made with caution.

confirm the depressed nature of the water-table. Near mean groundwater levels appear to be present in the Jurassic aquifers of the Cotswolds, and in the Welsh Borderlands and north-west England. Rising groundwater levels (near to the seasonal mean) appear to also characterise northern England and southern Scotland.

In the Chalk outcrop of eastern England and the lower Thames Valley, even where groundwater levels are rising, little if any further recharge may be expected until the onset of the autumn-winter recharge season. The summer recession will, therefore, start at very low, commonly unprecedented, levels. Relatively shallow recessions may be anticipated through the late spring and summer (as base levels are approached) but the expectation must be for the record autumn minima established last year, in the Chalk especially, to be widely eclipsed in the autumn of 1992. By then water-tables over large areas will be close to or below the minimum this century especially where large abstractions of groundwater are made. In those districts within this region that are wholly dependent upon groundwater some diminution of supply is a distinct possibility.

The water industry will be looking for an exceptionally wet winter to help restore groundwater levels to within their normal range by the spring of 1993.

Institute of Hydrology/British Geological Survey
13 May 1992

TABLE 1 1991/92 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Apr	May	June	July	Aug	Sept	Oct	Nov	Dec 1991	Jan 1992	Feb	Mar	Apr
England and Wales	mm	69	14	90	68	31	62	77	90	49	47	41	70	76
	%	119	21	148	93	34	75	93	93	54	55	64	119	130
NRA REGIONS														
North West	mm	67	18	105	67	65	69	125	152	118	54	97	139	97
	%	87	22	127	65	52	56	106	126	98	48	120	193	126
Northumbria	mm	41	22	69	53	37	42	75	105	78	32	46	106	95
	%	75	34	113	69	37	53	100	112	104	30	70	204	173
Severn-Trent	mm	67	11	74	77	21	54	55	69	39	58	31	67	62
	%	129	17	132	118	26	81	85	87	56	84	58	129	96
Yorkshire	mm	49	14	73	36	21	40	63	93	61	46	41	89	50
	%	88	23	126	51	23	56	91	104	82	60	64	168	111
Anglian	mm	45	13	77	38	18	63	26	53	23	45	17	62	42
	%	113	28	157	67	28	121	50	85	43	86	39	155	105
Thames	mm	63	13	96	79	19	52	36	66	16	28	25	51	64
	%	137	23	185	132	27	84	56	90	24	45	53	111	139
Southern	mm	56	17	125	88	15	51	51	81	23	18	33	59	80
	%	117	31	250	149	21	72	65	86	28	24	58	113	167
Wessex	mm	72	10	107	73	19	71	83	71	30	36	39	55	72
	%	133	15	198	118	23	90	101	73	33	43	66	95	133
South West	mm	100	9	127	90	32	85	123	112	52	44	68	75	101
	%	141	11	195	107	32	82	109	84	39	34	76	89	142
Welsh	mm	124	15	111	97	54	85	154	138	67	75	79	114	90
	%	144	16	135	102	45	68	119	97	46	55	82	131	105
Scotland	mm	123	41	122	91	67	131	165	222	143	132	165	208	123
	%	137	45	133	81	52	96	111	156	92	96	159	226	137
RIVER PURIFICATION BOARDS														
Highland	mm	131	63	125	105	86	182	193	294	173	180	225	250	131
	%	115	61	114	83	58	115	104	174	88	110	169	219	115
North-East	mm	62	46	131	57	34	58	120	129	50	67	51	119	76
	%	102	60	187	62	32	67	124	125	49	74	69	192	125
Tay	mm	110	23	135	93	41	111	155	147	91	109	106	159	85
	%	147	24	163	91	35	97	127	124	68	92	115	19	113
Forth	mm	90	18	110	97	38	103	111	112	109	108	110	129	88
	%	132	21	147	99	33	95	105	104	100	109	143	187	129
Tweed	mm	62	21	90	65	36	67	101	120	90	67	69	134	91
	%	102	28	132	73	32	71	115	115	100	72	100	231	149
Solway	mm	148	17	122	77	69	81	172	198	157	89	148	205	127
	%	168	18	136	70	53	54	119	137	104	64	159	225	144
Clyde	mm	184	33	129	108	87	157	193	274	209	165	234	274	135
	%	179	34	125	83	61	90	105	164	112	102	207	261	131

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

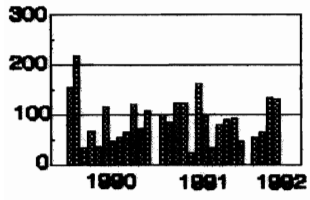
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		Jan - Apr 92		Aug 91 - Apr 92		Mar 90 - Apr 91		Aug 88 - Apr 92	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	234		543		1582		2996	
	% LTA	87	2-5	76	15-25	81	45-65	87	30-40
NRA REGIONS									
North West	mm	387		916		2341		4329	
	% LTA	113	2-5	97	2-5	91	5-10	94	2-5
Northumbria	mm	279		616		1700		2918	
	% LTA	110	2-5	91	2-5	91	5-10	88	15-25
Severn Trent	mm	206		444		1324		2511	
	% LTA	91	2-5	76	10-20	80	40-60	86	30-50
Yorkshire	mm	238		516		1457		2685	
	% LTA	95	2-5	80	5-10	82	30-40	85	40-60
Anglian	mm	166		349		979		1835	
	% LTA	95	2-5	76	10-20	75	150-250	80	>200
Thames	mm	168		357		1118		2179	
	% LTA	84	2-5	67	30-40	75	90-130	82	60-90
Southern	mm	190		411		1335		2487	
	% LTA	82	2-5	65	40-60	79	40-60	83	40-60
Wessex	mm	202		477		1428		2808	
	% LTA	79	2-5	70	20-30	77	60-90	85	20-35
South West	mm	288		692		2122		4125	
	% LTA	77	5-10	72	15-25	83	15-25	91	5-10
Welsh	mm	358		855		2420		4673	
	% LTA	88	2-5	80	5-15	85	10-20	92	5-10
Scotland	mm	628		1356		3468		6245	
	% LTA	148	150-200	119	10-20	114	30-50	115	150-250
RIVER PURIFICATION BOARDS									
Highland	mm	786		1714		4264		7901	
	% LTA	150	120-170	124	25-40	116	40-60	121	>200
North-East	mm	313		704		2032		3492	
	% LTA	109	2-5	90	2-5	94	2-5	91	10-20
Tay	mm	459		1004		2722		5078	
	% LTA	125	5-10	103	2-5	102	2-5	107	5-10
Forth	mm	435		908		2498		4536	
	% LTA	139	20-35	106	2-5	105	2-5	108	5-10
Tweed	mm	361		775		2080		3620	
	% LTA	128	5-10	101	2-5	99	<2	96	2-5
Solway	mm	569		1246		3096		5701	
	% LTA	138	20-30	110	2-5	102	2-5	105	2-5
Clyde	mm	808		1728		4191		7642	
	% LTA	168	>200	129	40-60	118	50-80	121	>200

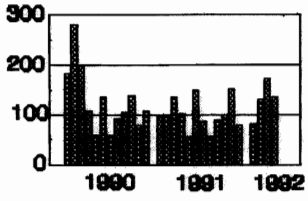
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less. "Wet" return periods underlined.
The tables reflect rainfall totals over the period 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 (HMSO).

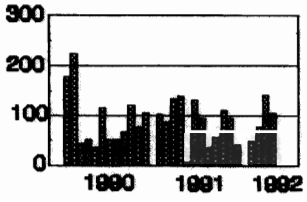
FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



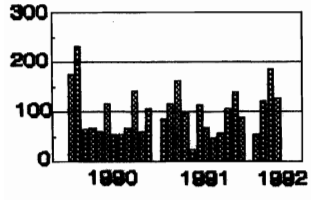
England and Wales



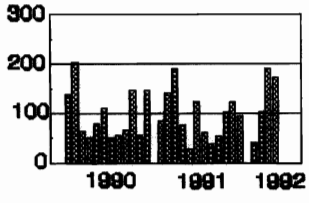
Scotland



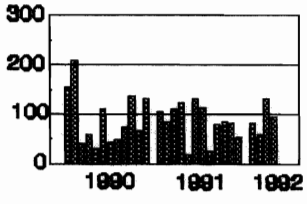
Welsh Region



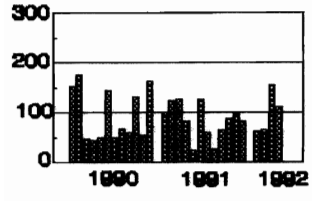
North West Region



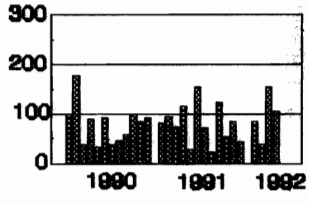
Northumbria Region



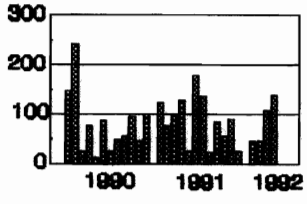
Severn-Trent Region



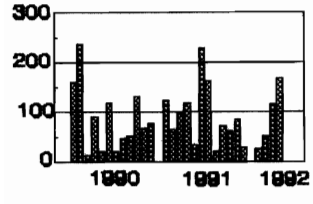
Yorkshire Region



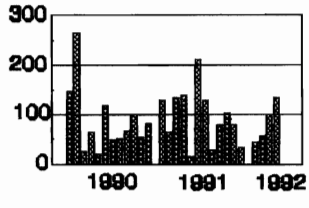
Anglian Region



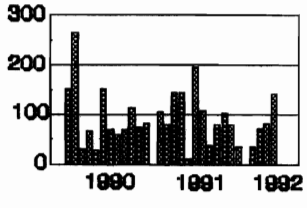
Thames Region



Southern Region

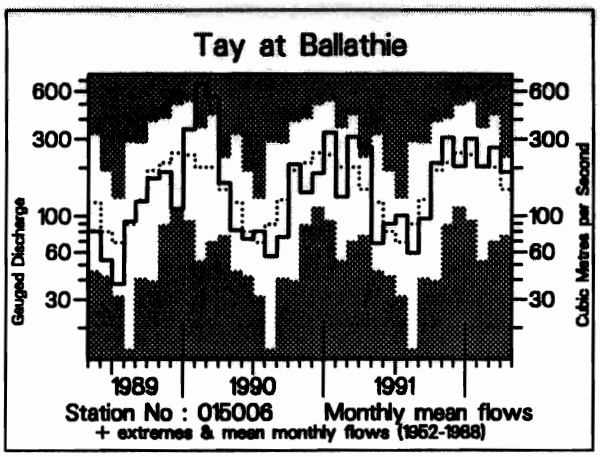


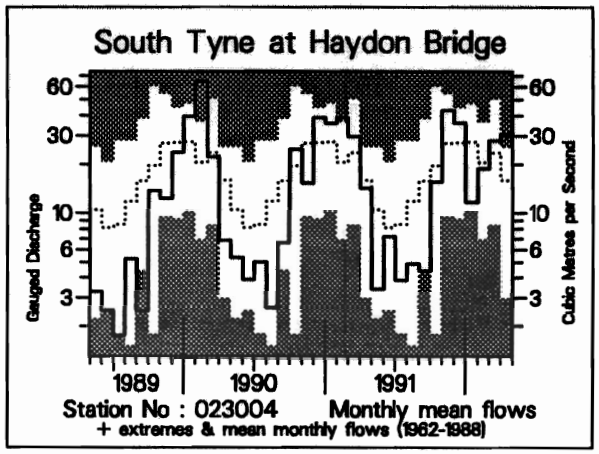
Wessex Region

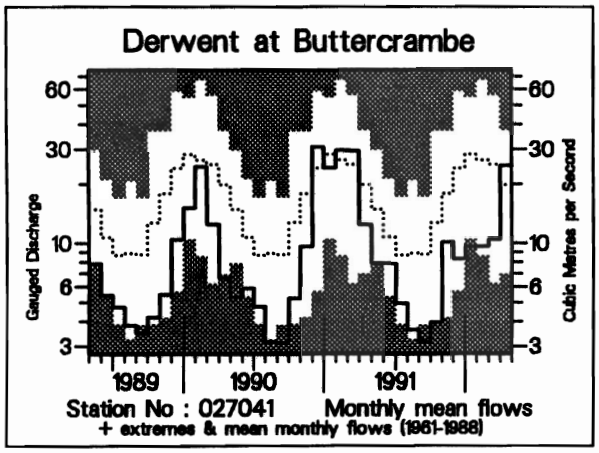


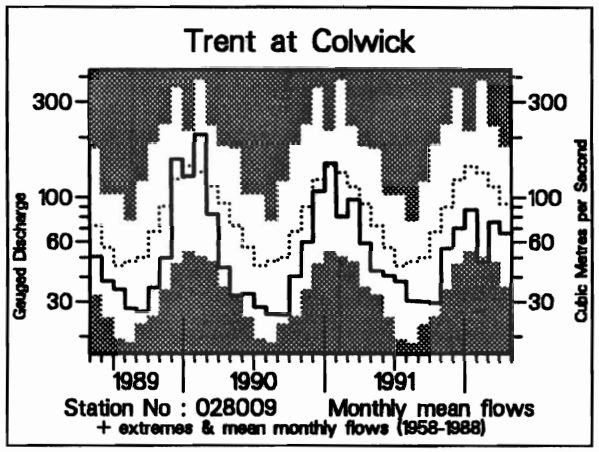
South West Region

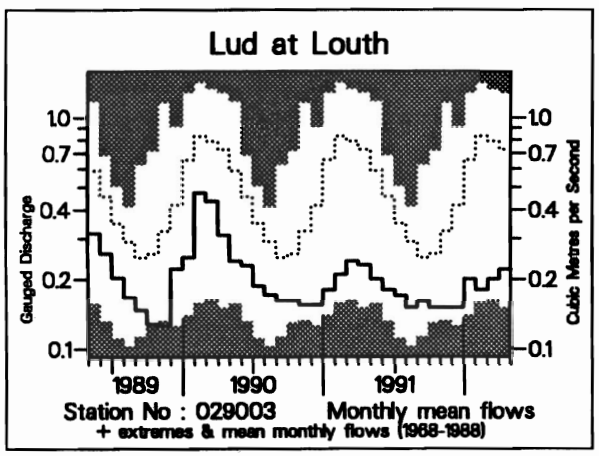
FIGURE 2 RIVER FLOW HYDROGRAPHS

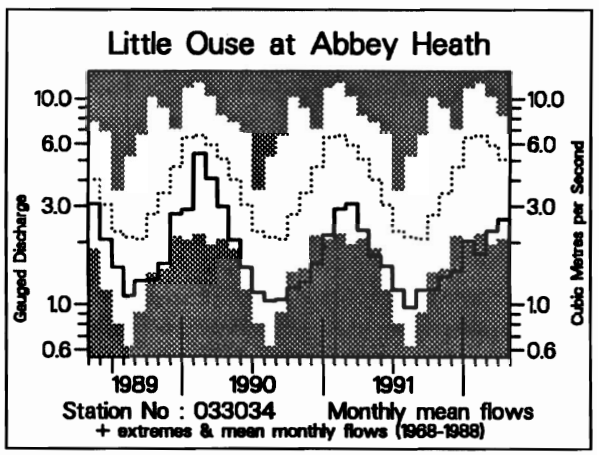


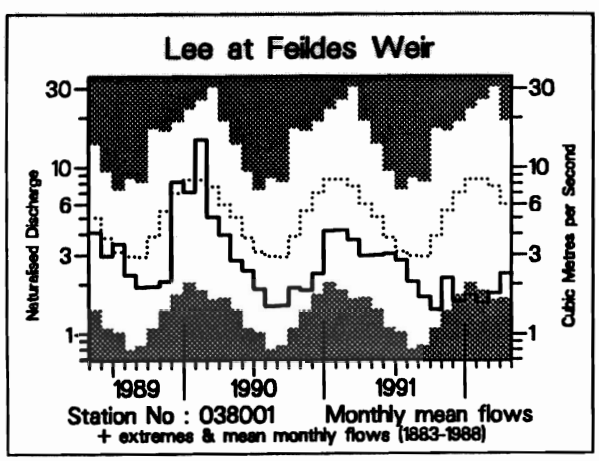


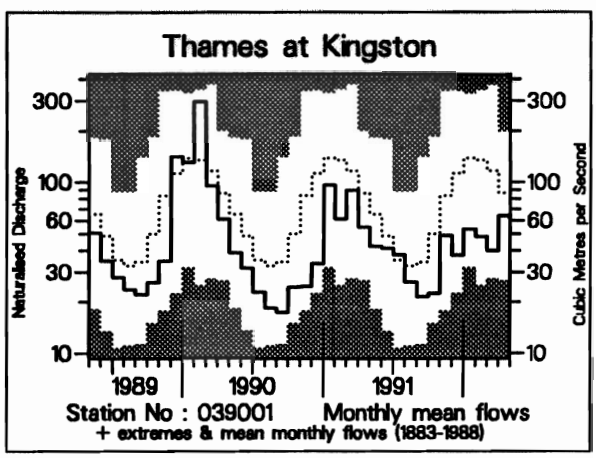


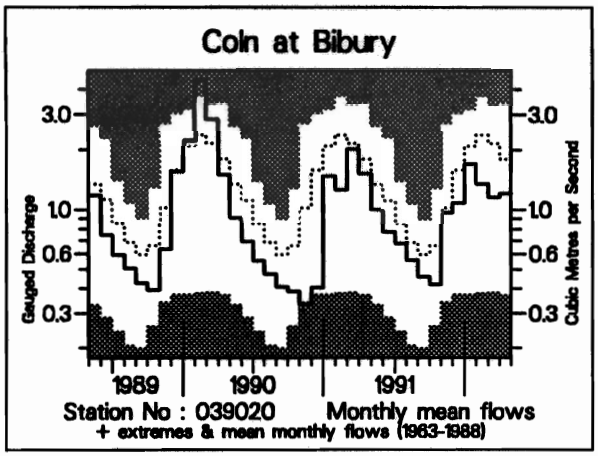


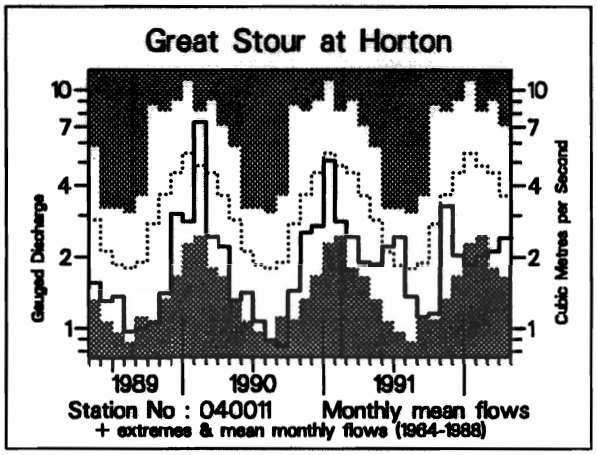


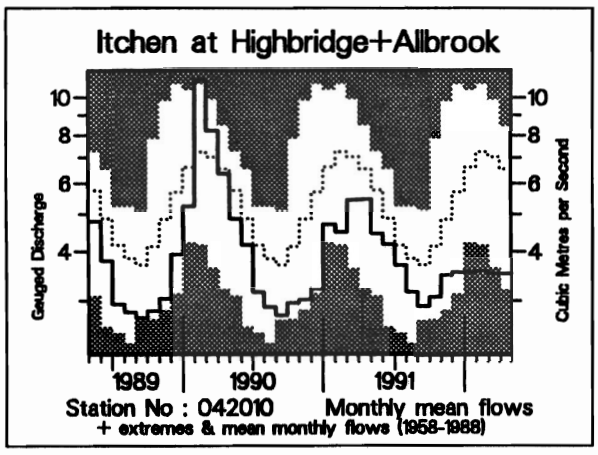


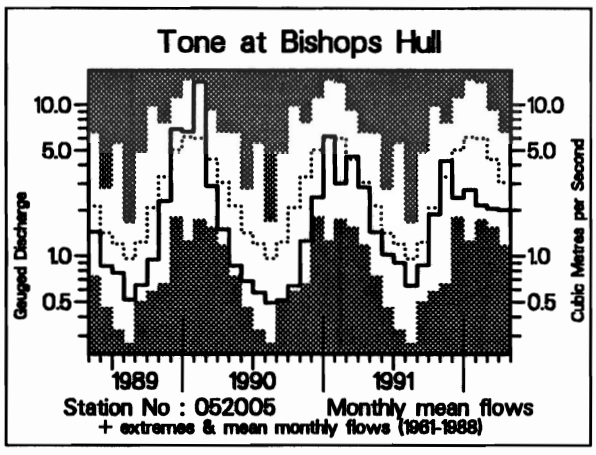


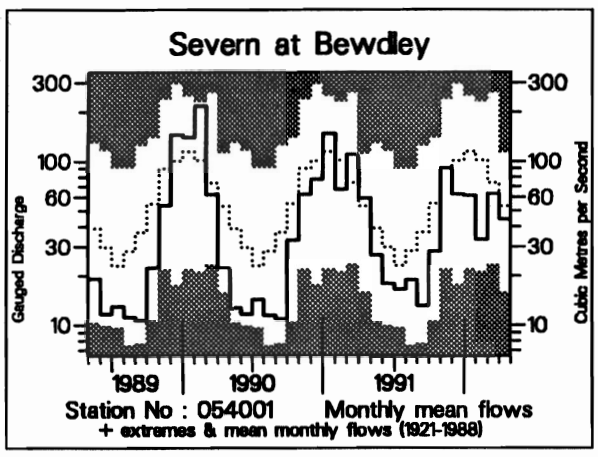


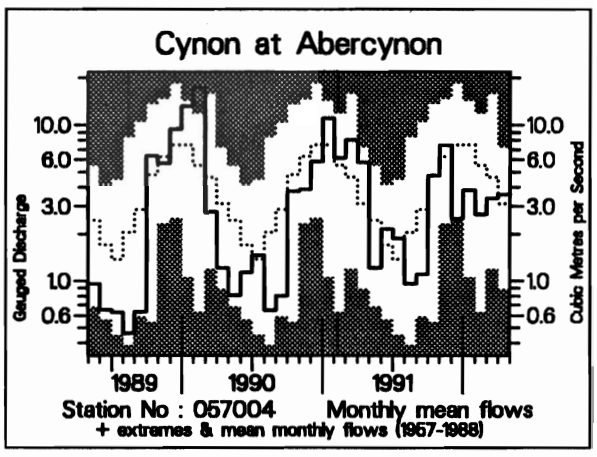

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1989
1990
1991
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

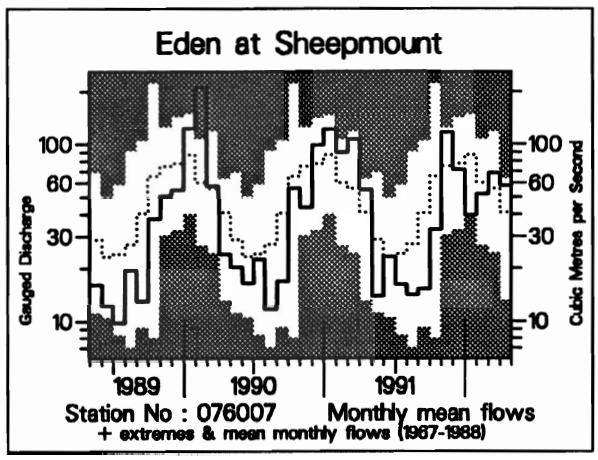

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10
7
4
2
1
1989
1990
1991
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1989
1990
1991
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


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


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


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


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

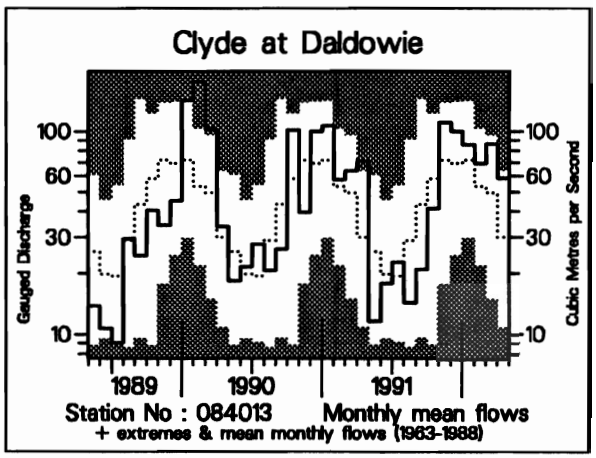

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

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	Dec 1991	Jan 1992	Feb 1992	Mar 1992	Apr 1992		10/91 to 4/92		5/91 to 4/92		5/90 to 4/92		8/89 to 4/92	
	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 Park	44 50	61 67	38 51	65 71	95 124	16 /20	494 84	3 /19	666 85	3 /19	1374 87	3 /18	1917 85	2 /17
Tay at Ballathie	118 84	176 124	111 96	154 122	106 127	33 /40	963 114	33 /40	1200 106	29 /39	2311 102	25 /38	3665 114	30 /37
Whiteadder Water at Hutton Castle	30 66	38 65	21 43	41 83	79 213	21 /23	254 84	6 /23	299 76	5 /22	744 95	8 /21	893 79	7 /20
South Tyne at Haydon Bridge	128 131	41 42	62 85	100 119	105 195	30 /30	640 112	24 /30	723 95	13 /28	1487 97	11 /26	2138 96	10 /24
Wharfe at Flint Mill Weir	91 94	61 62	49 64	96 127	64 118	23 /37	513 94	13 /37	598 83	7 /36	1237 85	7 /35	1778 85	3 /34
Derwent at Buttercrambe	14 35	16 35	15 38	18 44	40 128	23 /31	126 52	3 /31	172 53	3 /30	441 67	3 /29	581 62	1 /28
Trent at Colwick	25 56	31 62	16 37	27 67	23 71	11 /34	151 58	2 /34	215 61	2 /33	473 67	1 /32	733 73	1 /31
Lud at Louth	7 36	10 33	8 23	10 27	10 31	2 /24	60 35	2 /24	101 40	1 /23	211 42	1 /22	317 45	1 /22
Witham at Claypole Mill	7 38	15 59	9 34	11 42	9 43	4 /33	62 46	4 /33	91 50	3 /33	200 55	2 /32	327 64	3 /31
Little Ouse at Abbey Heath	6 36	8 34	6 27	9 40	10 54	5 /25	47 39	1 /24	72 42	1 /24	151 45	1 /23	237 50	1 /22
Colne at Lexden	5 30	7 30	5 27	8 43	7 52	8 /33	40 37	4 /33	60 45	3 /32	121 45	2 /31	213 56	1 /30
Lee at Feildes Weir (natr.)	4 22	4 18	4 20	5 25	6 40	6 /106	32 27	1 /106	63 39	2 /105	142 44	4 /103	259 57	6 /101
Thames at Kingston (natr.)	10 33	14 38	12 36	11 35	16 71	35 /110	82 44	7 /109	127 52	6 109	262 54	4 /108	476 68	6 /107
Coln at Bibury	27 70	43 84	32 59	29 53	29 67	5 /29	193 70	6 /29	279 72	6 /28	535 68	2 /27	885 80	5 /26
Great Stour at Horton	16 47	15 37	15 44	16 47	18 67	7 /27	113 53	1 /26	182 63	2 /26	368 63	1 /24	534 64	1 /22
Itchen at Highbridge+Allbrook	26 63	26 54	25 51	26 50	25 53	2 /34	177 59	1 /34	312 68	1 /33	655 71	1 /32	987 78	1 /31
Piddle at Baggs Mill	29 71	26 50	24 40	25 44	29 68	3 /29	185 63	3 /28	287 72	4 /27	564 70	1 /25	905 79	3 /23
Exe at Thorverton	75 57	48 37	37 35	68 80	53 94	21 /36	465 69	2 /36	573 70	2 /36	1270 77	1 /35	1976 82	3 /34
Taw at Umberleigh	53 45	41 35	34 39	45 66	40 91	17 /34	369 64	2 /34	439 64	2 /33	1047 76	3 /32	1709 85	4 /31
Tone at Bishops Hull	32 48	36 45	27 36	27 47	26 67	7 /32	227 60	2 /31	290 62	2 /31	602 64	1 /30	1065 78	1 /29
Severn at Bewdley	39 62	38 54	19 33	39 85	26 82	31 /72	233 66	6 /71	289 64	4 /71	664 74	5 /70	1072 83	9 /69
Wye at Cefn Brwyn	192 68	145 59	132 76	317 180	128 102	19 /38	1396 95	16 /37	1909 93	10 /33	3881 93	8 /28	5787 98	10 /25
Cynon at Abercynon	63 33	96 50	63 45	85 72	87 117	21 /34	697 71	5 /34	878 70	4 /32	2096 83	4 /30	3483 96	14 /28
Dee at New Inn	189 76	114 47	102 60	246 137	113 109	15 /23	1171 85	3 /23	1420 79	3 /22	3018 83	2 /21	4614 88	4 /21
Eden at Sheepmount	83 92	46 45	57 77	80 117	65 142	18 /22	501 93	10 /21	596 87	7 /20	1353 99	9 /18	2015 102	10 /16
Clyde at Daldowie	140 143	120 114	90 119	121 162	79 191	27 /29	760 130	27 /29	880 114	20 /28	1783 115	22 /27	2639 119	25 /26

Notes:
(i) Values based on gauged flow data unless flagged (natr.), when naturalised data has been used.
(ii) Values are ranked so that lowest runoff is rank 1.
(iii) %LT means percentage of long term average from the start of record to 1990. For the long periods (at the right of this table), the end date for the long term is 1992.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO MAY 1992

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Dec	Jan	Feb	Mar	Apr	May	1991 May
North West	Northern Command Zone[1]	(G)	133375	72	79	70	80	94	93	90
	Vyrnwy	(R)	55146	85	95	86	88	100	100	96
Northumbria	Teesdale[2]	(G)	87936	68	88	88	89	96	97	86
	Kielder	(R)	199175*	96*	99*	91*	94*	92	91	90
Severn-Trent	Clywedog	(R)	44922	82	87	88	85	99	99	97
	Derwent Valley[3]	(G)	39525	46	84	94	92	100	100	91
Yorkshire	Washburn[4]	(G)	22035	48	65	77	83	90	99	91
	Bradford supply[5]	(G)	41407	70	86	90	94	99	99	92
Anglian	Grafham	(R)	58707	81	88	90	88	95	96	91
	Rutland	(R)	130061	63	63	67	71	74	82	80
Thames	London[6]	(G)	206232	71	75	81	88	91	100	96
	Farmoor [7]	(G)	13843	97	99	99	97	84†	100	100
Southern	Bewl	(R)	28170	58	58	58	54	62	70	79
	Ardingly	(R)	4730	85	88	92	89	100	100	100
Wessex	Clatworthy	(R)	5364*	89*	87	88*	82*	82*	85	96
	Bristol WW [8]	(G)	36620	50	53	58	65	71	86	95
South West	Colliford	(R)	28540	83	83	82	81	80	82	94
	Roadford	(R)	34500	86	85	85	87	89	92	98
	Wimbleball[10]	(R)	21320	69	73	76	77	79	79	84
	Stithians	(R)	5205	34	37	38	45	52	65	96
Welsh	Celyn + Brenig	(G)	131155	84	94	93	97	100	100	99
	Brianne	(R)	62140	100	100	97	100	100	100	97
	Big Five[11]	(G)	69762	87	93	93	92	97	98	96
	Elan Valley[12]	(G)	99106	94	94	91	100	100	100	97
Lothian	Edinburgh/Mid Lothian	(G)	97639		95	92	96	100	100	96
	West Lothian	(G)	5613		90	82	91	94	85	91
	East Lothian	(G)	10206		95	98	98	99	89	97

† Decrease in Farmoor storage due to intake closure for engineering works

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

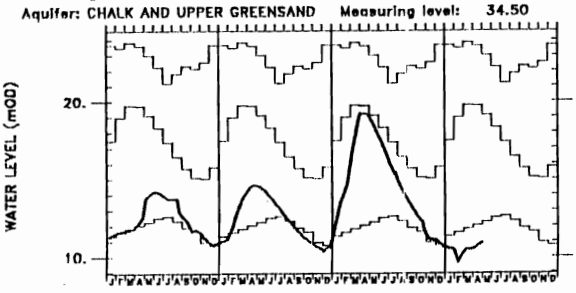
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. 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. The new Roadford reservoir was still filling after impounding.
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
12. 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 elsehwere in the report and the water resources situation.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

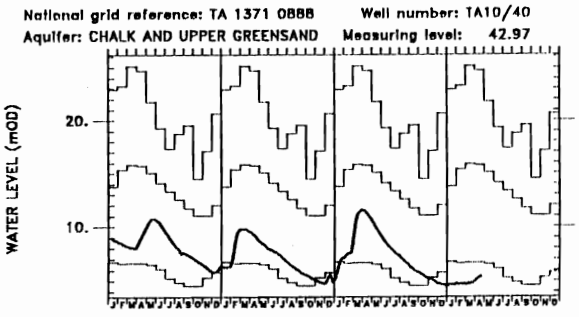
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



Max, Min and Mean values calculated from years 1888 TO 1989

Site name: LITTLE BROCKLESBY

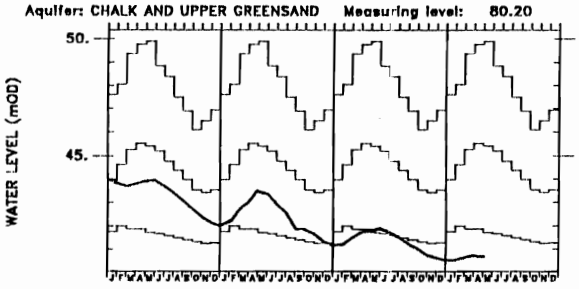
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

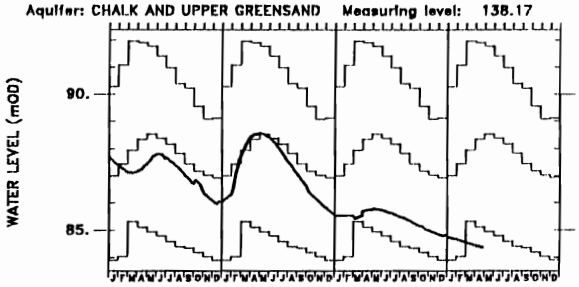
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: THE HOLT

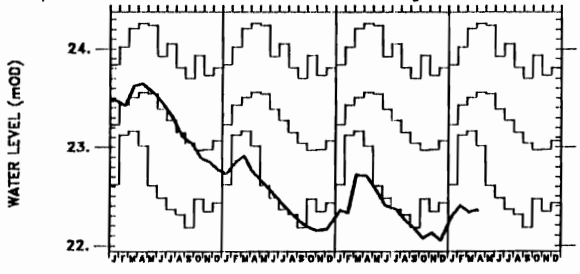
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: FAIRFIELDS

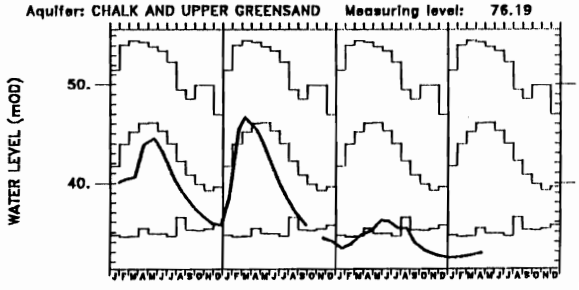
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



Max, Min and Mean values calculated from years 1974 TO 1989

Site name: REDLANDS HALL,ICKLETON

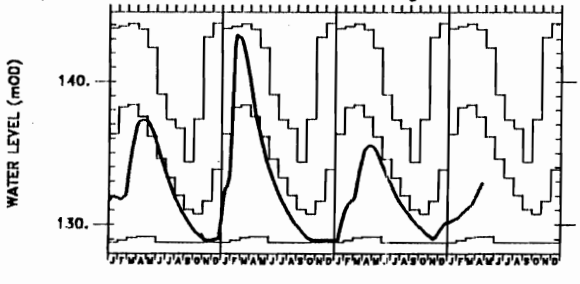
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: ROCKLEY

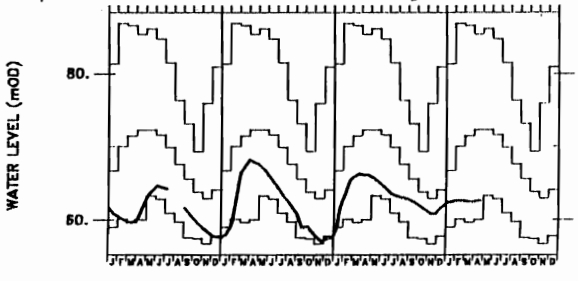
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 145.57



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

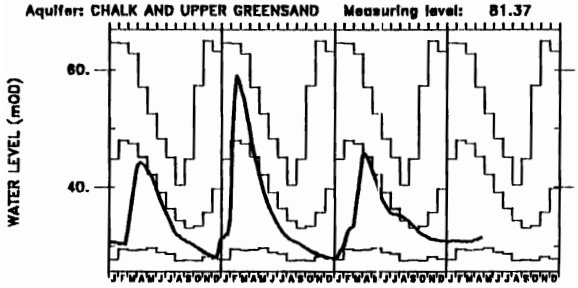
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

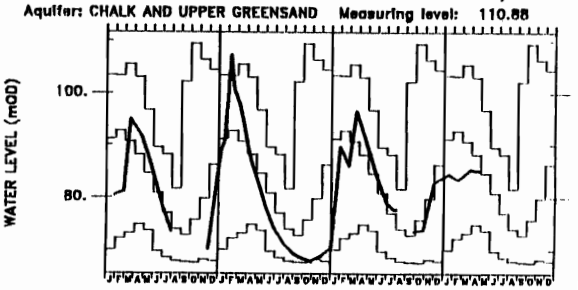
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST WOODYATES MANOR

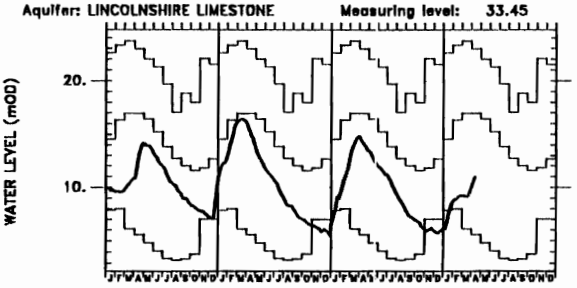
National grid reference: SU 0160 1960 Well number: SU01/5B
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88



Max, Min and Mean values calculated from years 1942 TO 1989

Site name: NEW RED LION

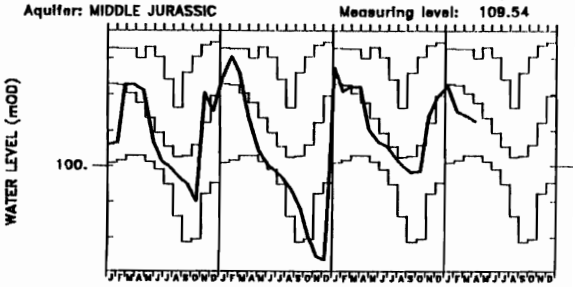
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

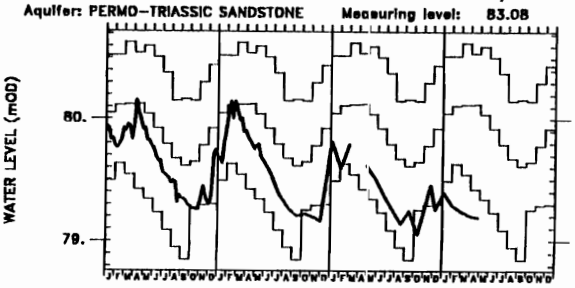
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

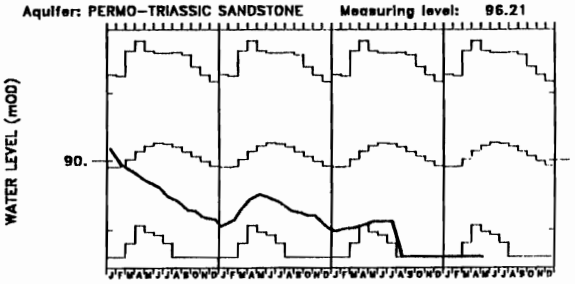
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: WEEFORD FLATS,WEEFORD

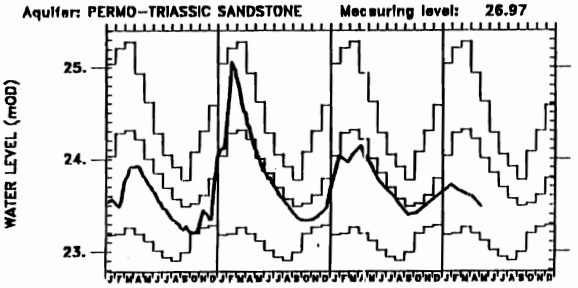
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



Max, Min and Mean values calculated from years 1966 TO 1989

Site name: BUSSELS NO.7A

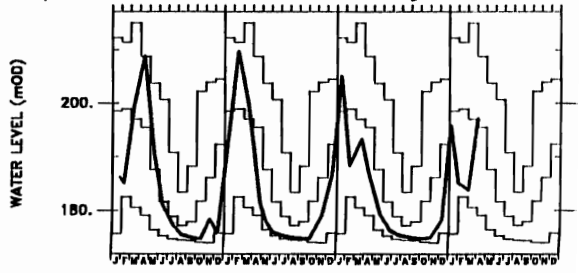
National grid reference: SX 9528 9872 Well number: SX99/37B
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 5 A COMPARISON OF APRIL GROUNDWATER LEVELS : 1992, 1991 AND 1976

Site	Aquifer	Records commence	Average April Level	April 1976		April 1991		April and May 1992		No of years April/May levels <1992	Lowest pre-1992 level (any month)
				Day	Level	Day	Level	Day	Level		
Wetwang	C & UGS	1971	24.78	28/04	20.28	30/04	23.12	07/05	19.88	3	16.84
Dalton Holme	C & UGS	1889	19.72	24/04	14.30	24/04	19.19	24/04	10.75	0	10.34
Little Brocklesby	C & UGS	1926	15.53	08/04	6.82	23/04	10.99	21/04	5.36	0	4.54
Washpit Farm	C & UGS	1950	45.53	01/04	42.80	04/04	41.71	05/05	40.66	0	41.24
The Holt	C & UGS	1964	88.33	29/04	85.99	28/04	85.74	27/04	84.37	0	83.90
Therfield Rectory	C & UGS	1883	81.11	28/04	76.15	28/04	73.95	27/04	71.70	5	dry (below 71.60)
Fairfields	C & UGS	1974	23.57	27/04	23.01	12/04	22.71	06/04	22.35	0	22.05
Redlands Farm	C & UGS	1964	45.64	01/04	38.40	26/04	35.04	22/04	32.85	0	32.46
Rockley	C & UGS	1933	137.56	25/04	129.18	28/04	135.50	27/04	132.86	5	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	72.29	01/04	65.42	24/04	66.06	22/04	62.59	1	56.77
Compton House	C & UGS	1894	45.24	29/04	29.97	30/04	43.36	24/04	31.45	2	27.64
Chilgrove House	C & UGS	1836	53.56	24/04	37.82	30/04	52.37	24/04	41.45	5	33.46
West Dean No 3	C & UGS	1940	2.09	30/04	1.47	26/04	1.69	24/04	1.51	5	1.01
Lime Kiln Way	C & UGS	1969	125.55	12/04	124.49	24/04	124.91	22/04	124.00	0	124.09
Ashton Farm	C & UGS	1974	69.36	29/04	65.48	30/04	71.10	27/04	67.90	1	63.10
West Woodyates	C & UGS	1942	88.05	01/04	74.86	30/04	89.90	27/04	85.00	>10	67.62
New Red Lion	LLst	1964	16.97	23/04	5.61	29/04	13.50	13/04	10.92	2	3.29
Ampney Crucis	Mid Jur	1958	101.78	25/04	100.29	29/04	101.04	09/04	101.27	10	97.38
Dunmurry (NI)	PTS	1985	28.67	no	levels	29/04	28.35	30/04	28.56	4	27.47
Llanfair DC	PTS	1972	80.12	01/04	79.42	30/04	79.61	26/04	79.19	0	78.85
Morris Dancers	PTS	1969	32.57	27/04	31.97	11/04	32.07	08/05	32.02	2	30.87
Weeford Flats	PTS	1966	90.06	29/04	89.07	15/04	89.06	08/05	dry	0	dry (below 88.61)
Bussels 7A	PTS	1972	24.21	27/04	23.19	26/04	23.99	05/05	23.48	2	22.90
Rusheyford NE	MgLst	1967	76.25	27/04	65.82	10/04	75.46	10/04	74.69	>10	64.77
Peggy Ellerton	MgLst	1968	34.97	26/04	31.46	15/04	33.61	09/04	32.00	1	31.10
Alstonfield	CLst	1974	194.42	29/04	179.14	17/04	186.55	03/04	197.02	10	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 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS