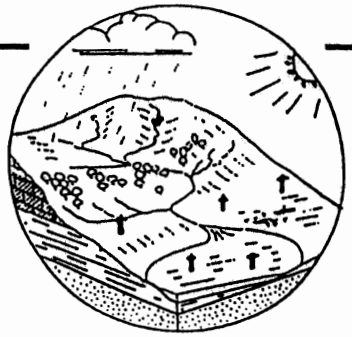
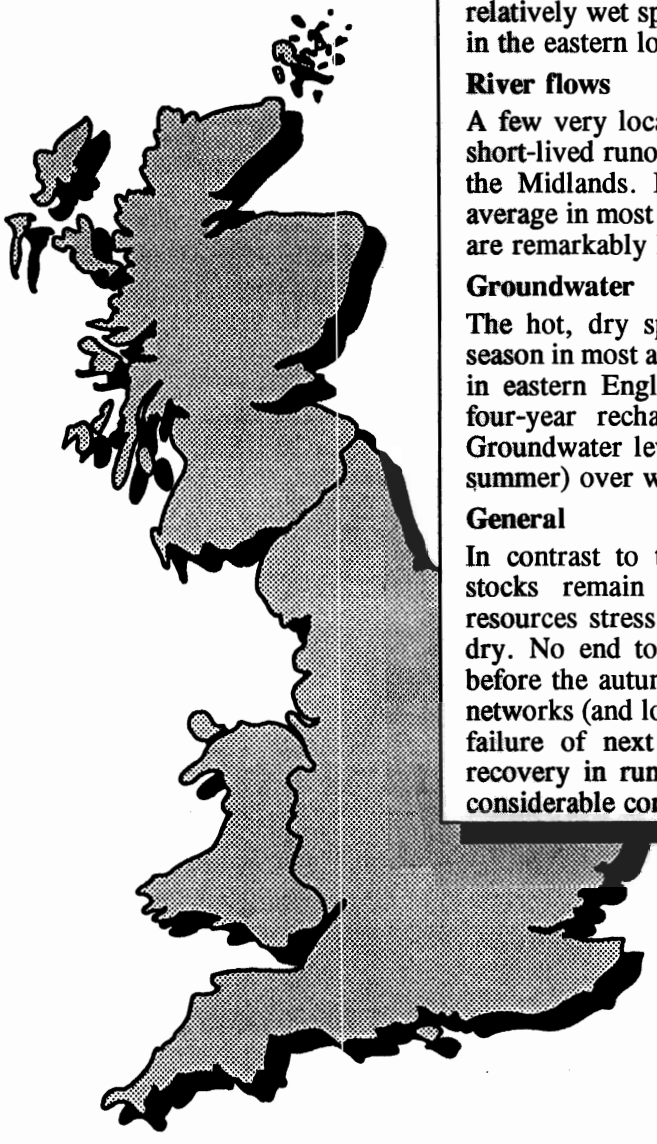
Hydrological Summary for Great Britain





MAY 1992

Rainfall

Despite considerable thundery activity in the South, the GB rainfall total was only around 80% of average; the South-West was particularly dry. The drought has extended westwards across southern England but, notwithstanding a relatively wet spring, long term deficiencies remain greatest in the eastern lowlands.

River flows

A few very localised flood events were reported and some short-lived runoff recoveries occurred in the South-East and the Midlands. However flows remain below 50% of the average in most lowland rivers and accumulated runoff totals are remarkably low.

Groundwater

The hot, dry spell in mid-month terminated the recharge season in most areas. 1991/92 recharge has been very modest in eastern England and the Midlands. More significantly, four-year recharge totals are commonly unprecedented. Groundwater levels are the lowest on record (for the early summer) over wide areas and set to decline further.

General

In contrast to the fragile groundwater outlook, reservoir stocks remain generally healthy but significant water resources stress will be unavoidable should the summer be dry. No end to the hydrological drought can be expected before the autumn and a further shrinkage in lowland river networks (and loss of aquatic habitats) is to be anticipated. A failure of next winter's rainfall to generate a sustained recovery in runoff and recharge rates will be a matter of considerable concern.

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HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - MAY 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

May was an exceptionally warm month with large spatial and temporal variations in rainfall totals. High pressure over Europe dominated weather patterns over most of the first three weeks and a southerly airstream brought very hot conditions around the third week. Lengthy dry spells, extending well beyond a fortnight in parts of the South were terminated by a very unsettled thundery episode towards month-end. Some notable rainfalls were recorded (average monthly totals were exceeded in three hours at Brize Norton and in two at Heathrow) but the rainfall showed little spatial coherence and regional totals over the last week of May were moderate apart from the South-East and a band extending through the Midlands to North Wales.

The provisional May rainfall totals are appreciably below average for England and Wales, and for Scotland. Regionally, the most favoured areas in rainfall terms were western Scotland and eastern and central England. By contrast, parts of the North-East, Wessex and the South-West were particularly dry with only one third or less of the average rainfall. Regional spring (March-May) rainfall totals are generally a little above average but, frustratingly from the water resources viewpoint, the growth of lowland soil moisture deficits between the wet interludes served to rob the rainfall of much of its hydrological effectiveness. Thus the moderation of the lowland drought in meteorological terms over the last three months is only partly reflected in an amelioration in hydrological conditions (see below).

Although below average throughout most of southern Britain, rainfall totals for 1992 thus far are mostly well within the normal range; western Scotland has, again, been notably wet. The relatively wet spring in the east has produced a shift of focus in relation to short term rainfall deficiencies. In the ten-month timeframe, the most significant meteorological drought extends across southern England (from Sussex to Cornwall) but longer term deficiencies remain greatest in the English lowlands.

For England and Wales as a whole, the period beginning in March 1990 is the driest, albeit marginally, for ANY 27-month accumulation since the 1850s. Over the longest timespans the drought is markedly more severe in the eastern lowlands. Notwithstanding the second wettest spring since 1983, estimated 27- and 46-month rainfall accumulations for the Thames Valley are the lowest in a record from 1883. Table 2 shows rainfall deficiencies and surpluses since the summer of 1988 expressed as a percentage of the annual average for each region. The figures provide compelling evidence of the accentuation in the normal rainfall gradient across Great Britain: rainfall totals for much of western Scotland are well over 1000 mm above average in this timeframe whilst the deficit in parts of the English lowlands exceeds three-quarters of a normal yearly rainfall.

It is now too late for rainfall to ameliorate the hydrological impact of the drought substantially before the autumn. A wet summer would however moderate demand and, by keeping soils relatively moist, increase the likelihood of an autumn recovery in runoff and recharge rates.

Evaporation and Soil Moisture Deficits (SMDs)

In some parts of the country, provisional data suggest that May 1992 was the warmest on record. Sunshine hours were also exceptionally high and potential evaporation losses were the highest in the MORECS series (from 1961) over large parts of Britain. Although constrained, for much of the month, by dry soils in the lowlands, actual evaporation (AE) losses were also very high. The May totals have boosted the total evaporation losses for 1992 to amongst the highest on record (rankings are typically first to third in the MORECS series) eclipsing the 1989 and 1990 figures in Scotland and northern England.

Reflecting the rainfall pattern, soil moisture conditions varied substantially through the month and local variations were also important. At month-end, however, SMDs were generally within 20 mm of the late-May average and, in many lowland areas appreciably below those obtaining in 1989 and 1990.

River Flows

The main feature of river flow patterns in May was a substantial recession beginning early in the month in southern Britain and extending in some eastern and southern catchments for over three weeks. Very depressed flows occurred from the 20-25th of the month. Some minor spates were reported from northern Britain around the 11th and, more notably, localised flooding accompanied the very heavy convectional rainfall towards month-end. Very brisk increases in runoff occurred, for instance, west of London and transport disruption was considerable.

May runoff totals were appreciably above average in western Scotland and well within the normal range throughout most of northern Britain, North Wales and in a few impervious catchments in the English lowlands. By contrast very meagre flows characterised many eastern and southern catchments particularly where river flow is derived largely from groundwater. The Mimram recorded its lowest May flow in a 40-year record and many gauging stations registered runoff totals amongst the three or four lowest on record (although, commonly greater than 1976). Relative to pre-1989 flows, the May runoff totals would qualify as noteworthy but throughout much of the drought affected area flows in 1990 and 1991 were similar or lower; testimony to the degree to which low flow regimes have been redefined in recent years.

The hydrological severity of the drought becomes more evident when accumulated runoff totals are considered. Commonly flows over the last six months are the lowest or second lowest on record (for the December-May period) for catchments south-east of a line from Humberside to the Bristol Channel and accumulated runoff totals in the 24-month timeframe are unprecedented in many catchments. Such is the case for the rivers Lud, Stour, Itchen and Tone; on the Little Ouse flows are the lowest on record for accumulations from 6 to beyond 36 months (flows have been below average for 37 successive months). The 110-year flow record for the River Lee suggests that comparable, or lower, 24-month flows occurred during the droughts of 1947-50, 1943-45, 1933-35 and 1901-03 but these historical minima may well be eclipsed before the end of 1992. With baseflows very modest and set to decline through the summer, significant surface runoff will be necessary to avoid record monthly minima by the early autumn. Further shrinkage in the river network over the next 4-6 months, with an associated loss of aquatic habitat, is to be anticipated.

Natural replenishment to most reservoirs in southern and eastern Britain was modest in May and the summer drawdown began typically, in mid-May. Nonetheless, stocks in the index reservoirs remain generally healthy and in eastern England similar to, or greater than, in early June 1991. This is especially true of Yorkshire where, as in much of the English lowlands the current contrast with groundwater resources is stark. Reservoir contents declined in May in the South-West (modestly) and Wessex (appreciably) and stocks are below those of the early summer of 1991.

Groundwater

Although the hot dry spell in mid-May appeared to signal a general end to the recharge season throughout most of England, the heavy convectional rainfall over the final week will have produced some patchy infiltration in a few areas (mostly where soil cover is thin) which implies some further modest increase in groundwater levels may be evident in June. It is clear nonetheless that, with few exceptions, the 1992 recessions will commence at lower levels than in 1991 - when the spring 'peaks' were commonly the lowest on record in much of eastern England and the Midlands.

Provisional estimates of recharge over the 1991/92 winter indicate that throughout much of the eastern Chalk (from Sussex to Humberside) recharge has been only around 25% or less of the long term average; in some parts (e.g. the eastern Chilterns, Cambridgeshire and adjacent to the Humber estuary) total recharge has been minimal. More significantly, accumulated recharge totals over the last three or four winters are extremely modest. Over the last four years, most of eastern England has received less than 50% of the 1961-88 average. At Washpit Farm, for example, recharge since the summer of 1988 is only a little over 20% of average - less than half the previous (pre-1989) minimum for a four-year period in a record from 1950. Similarly, the Dalton Holme four-year recharge (60%) is unprecedented in a series from 1889. Notably low long-term recharge totals are not confined to the Chalk. New minimum four-year recharge totals have been assessed for the Permo-Triassic Sandstones (e.g. Bussels; replenishment in the Lower Trent area has been very meagre also) and the Magnesian Limestone (Peggy Ellerton).

On the basis of incomplete evidence it appears that throughout much of eastern and central England groundwater levels are close to or below their pre-1992 lowest this century. Water-tables are especially depressed in a zone from the eastern Chilterns to Humberside but notably low levels characterise many western aquifers also. Early summer levels are unprecedented at Dalton Holme (in a 103-year record), Little Brocklesby (67 years) and Washpit Farm (43 years). Therfield Rectory levels are at their lowest for 70 years. Levels are below, albeit often only modestly, previous spring minima over very wide areas - especially where groundwater pumping has exacerbated the effect of the very protracted drought. With groundwater levels now declining, or about to do so, no replenishment can be expected before October 1992 (at the earliest) in the lowlands. Although recessions are likely to be shallow, by the autumn groundwater levels may be expected to have fallen appreciably below any registered prior to 1990.

Groundwater resources are in a very fragile condition and the impact on well yields of the fall of levels into uncharted territory is difficult to predict. Those dwellings and small-holdings dependent for water supplies on shallow wells are particularly vulnerable. There have already been instances in late 1991 and in 1992 of well failures; the expectation must be for substantially more.

By their nature groundwater droughts tend to be persistent and with water-tables in the most severely affected areas standing below the late-spring average by the equivalent of twice the range between the mean maximum and mean minimum monthly levels, no early termination is in prospect. An exceptionally wet winter is required to restore levels to within the normal (pre-1990) range; a further dry winter will be a matter of considerable concern.

Institute of Hydrology/British Geological Survey
10 June 1992

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

		May	June	July	Aug	Sept	Oct	Nov	Dec 1991	Jan 1992	Feb	Mar	Apr	May
England and Wales	mm	14	90	68	31	62	77	90	49	47	41	70	75	52
	%	21	148	93	34	75	93	93	54	55	64	119	129	77
NRA REGIONS														
North West	mm	18	105	67	65	69	125	169	118	54	97	139	89	59
	%	22	127	65	52	56	106	140	98	48	120	193	116	72
Northumbria	mm	22	69	53	37	42	75	109	78	32	46	106	103	29
	%	34	113	69	37	53	100	116	104	30	70	204	187	46
Severn-Trent	mm	11	74	77	21	54	55	68	39	58	31	67	50	64
	%	17	132	118	26	81	85	86	56	84	58	129	96	100
Yorkshire	mm	14	73	36	21	40	63	94	61	46	41	89	66	36
	%	23	126	51	23	56	91	106	82	60	64	168	118	60
Anglian	mm	13	77	38	18	63	26	54	23	45	17	62	43	52
	%	28	157	67	28	121	50	87	43	86	39	155	108	110
Thames	mm	13	96	79	19	52	36	66	16	28	25	51	65	61
	%	23	185	132	27	84	56	90	24	45	53	111	141	108
Southern	mm	17	125	88	15	51	51	81	23	18	33	59	84	35
	%	31	250	149	21	72	65	86	28	24	58	113	175	63
Wessex	mm	10	107	73	19	71	83	72	30	36	39	55	81	27
	%	15	198	118	23	90	101	74	33	43	66	95	150	40
South West	mm	9	127	90	32	85	123	112	52	44	68	75	100	30
	%	11	195	107	32	82	109	84	39	34	76	89	141	36
Welsh	mm	15	111	97	54	85	154	142	67	75	79	114	91	67
	%	16	135	102	45	68	119	99	46	55	82	131	107	73
Scotland	mm	41	122	91	67	131	165	222	143	132	165	208	123	78
	%	45	133	81	52	96	111	156	92	96	159	226	137	86
RIVER PURIFICATION BOARDS														
Highland	mm	63	125	105	86	182	193	305	173	180	225	250	138	105
	%	61	114	83	58	115	104	180	88	110	169	219	121	102
North-East	mm	46	131	57	34	58	120	133	50	67	51	119	68	62
	%	60	187	62	32	67	124	129	49	74	69	192	111	80
Tay	mm	23	135	93	41	111	155	154	91	109	106	159	90	67
	%	24	163	91	35	97	127	129	68	92	115	19	120	70
Forth	mm	18	110	97	38	103	111	124	109	108	110	129	76	63
	%	21	147	99	33	95	105	115	100	109	143	187	112	75
Tweed	mm	21	90	65	36	67	101	127	90	67	69	134	98	47
	%	28	132	73	32	71	115	122	100	72	100	231	161	61
Solway	mm	17	122	77	69	81	172	203	157	89	148	205	144	61
	%	18	136	70	53	54	119	140	104	64	159	225	164	67
Clyde	mm	33	129	108	87	157	193	274	209	165	234	274	144	101
	%	34	125	83	61	90	105	164	112	102	207	261	140	104

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.

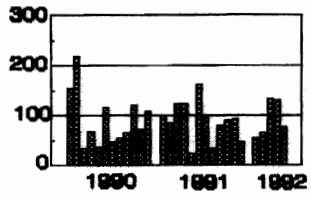
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		Aug 91 - May 92 Est Return Period, years		Mar 90 - May 92 Est Return Period, years		Aug 88 - May 92 Est Return Period, years		Deficit/surplus in mm from Aug 88	Deficit/surplus as % of 1941-70 average annual rainfall
England and	mm	594		1633		3047			
Wales	% LTA	76	20-30	81	60-90	87	30-50	-467	-51
NRA REGIONS									
North West	mm	984		2409		4397			
	% LTA	95	2-5	90	5-10	94	5	-285	-23
Northumbria	mm	657		1741		2959			
	% LTA	89	2-5	90	5-10	88	15-25	-419	-47
Severn Trent	mm	507		1387		2574			
	% LTA	78	10-20	81	35-50	87	15-25	-397	-51
Yorkshire	mm	557		1498		2726			
	% LTA	79	10-20	82	30-45	85	40-60	-478	-57
Anglian	mm	403		1033		1889			
	% LTA	80	5-15	77	120-170	81	150-250	-445	-73
Thames	mm	419		1180		2241			
	% LTA	71	20-30	76	80-120	83	50-80	-463	-66
Southern	mm	450		1374		2526			
	% LTA	66	40-60	79	40-60	82	70-100	-541	-68
Wessex	mm	514		1465		2845			
	% LTA	68	35-50	76	80-120	85	30-40	-515	-59
South West	mm	721		2151		4154			
	% LTA	69	40-50	82	30-40	90	5-15	-473	-40
Welsh	mm	928		2493		4746			
	% LTA	80	5-15	85	15-25	92	5-10	-413	-31
Scotland	mm	1434		3546		6323			
	% LTA	117	10-20	113	20-30	115	150-250	+803	+56
RIVER PURIFICATION BOARDS									
Highland	mm	1837		4376		8024			
	% LTA	124	30-40	115	30-45	121	>200	+1373	+80
North-East	mm	762		2086		3550			
	% LTA	88	5	93	5	90	10-20	-380	-37
Tay	mm	1083		2794		5157			
	% LTA	101	2-5	101	2-5	107	5-10	+322	+26
Forth	mm	971		2549		4599			
	% LTA	103	2-5	104	2-5	107	5-10	+304	+27
Tweed	mm	836		2134		3681			
	% LTA	99	<2	98	2-5	95	2-5	-174	-17
Solway	mm	1329		3174		5784			
	% LTA	109	2-5	102	2-5	105	2-5	+284	+19
Clyde	mm	1838		4301		7752			
	% LTA	128	40-60	118	60-90	121	>200	+1325	+80

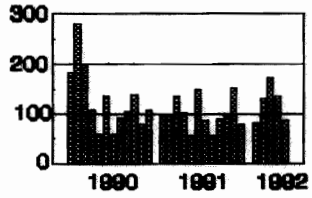
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less. "Wet" return periods underlined.
The tables reflect rainfall totals over the period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

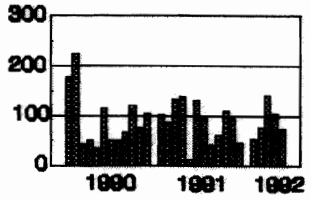
FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



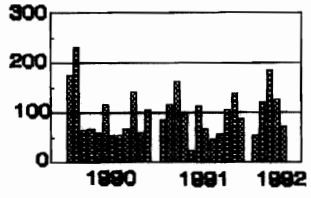
England and Wales



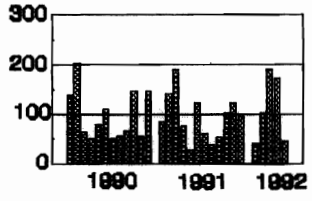
Scotland



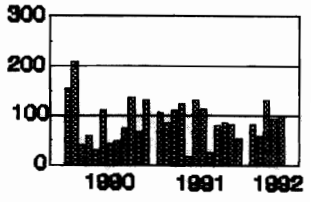
Welsh Region



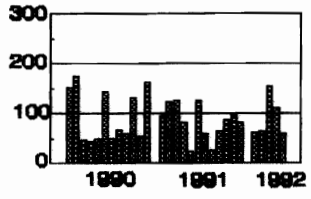
North West Region



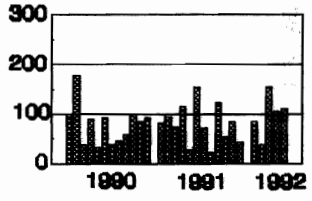
Northumbria Region



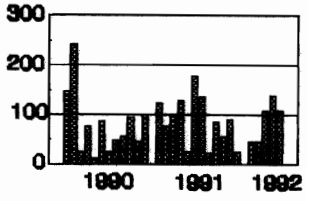
Severn-Trent Region



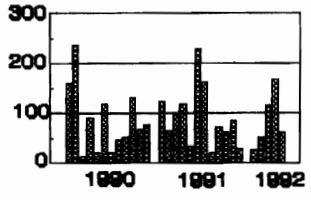
Yorkshire Region



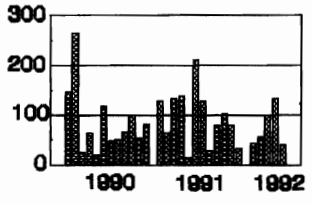
Anglian Region



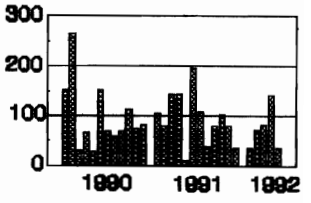
Thames Region



Southern Region

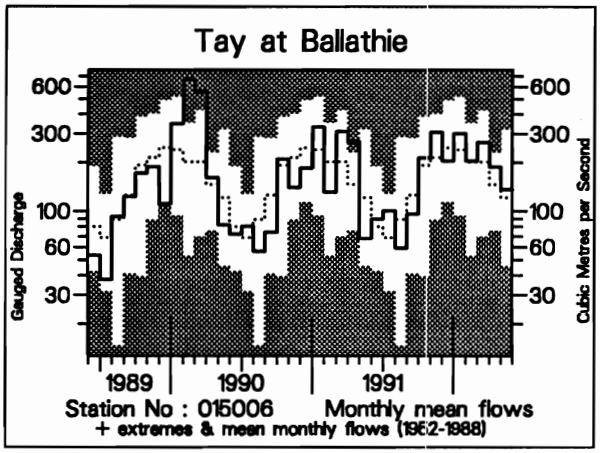


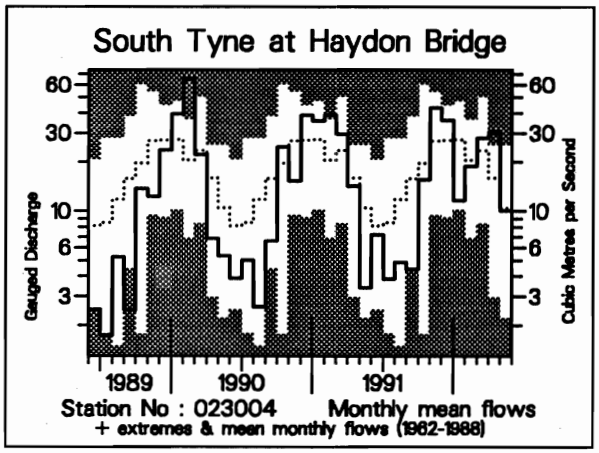
Wessex Region

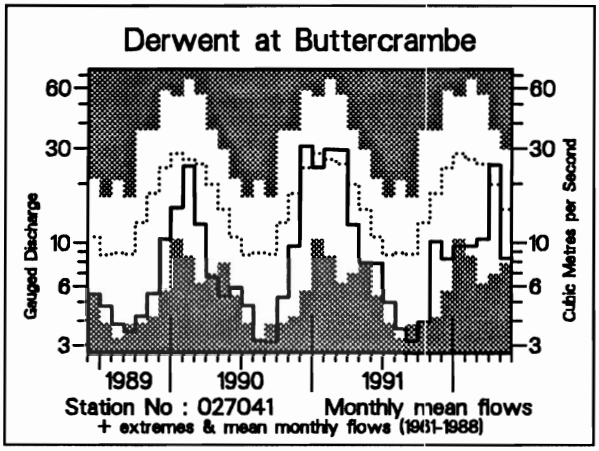


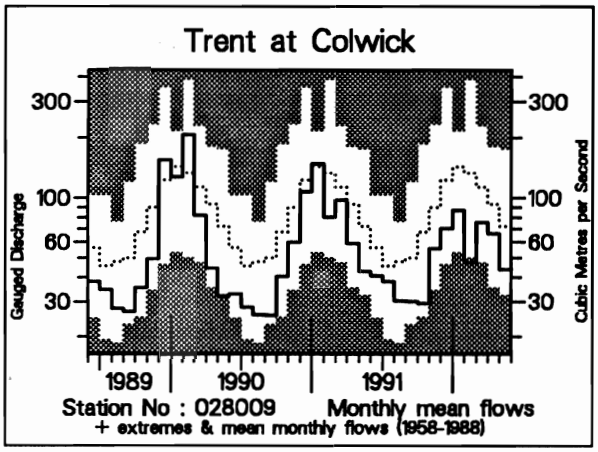
South West Region

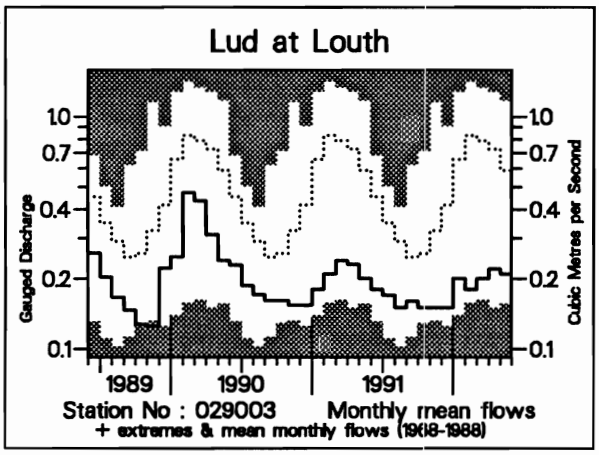
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

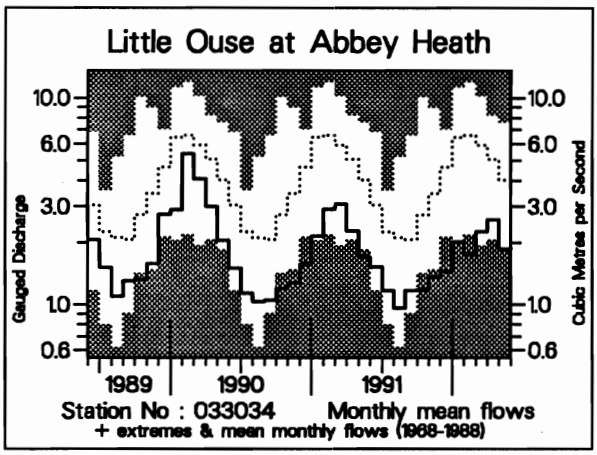


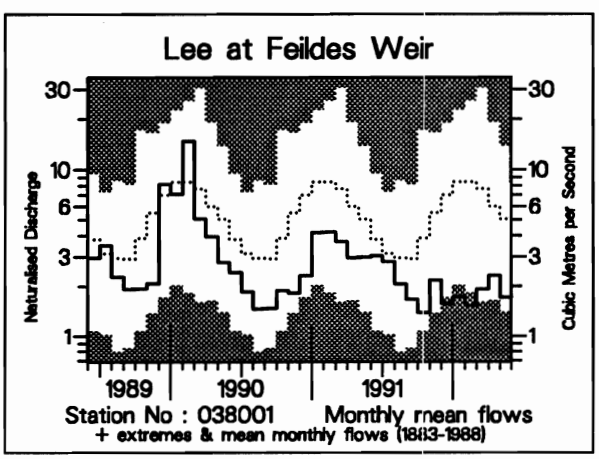


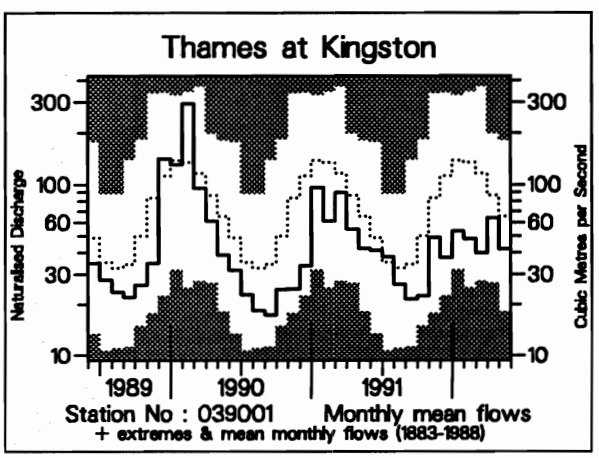


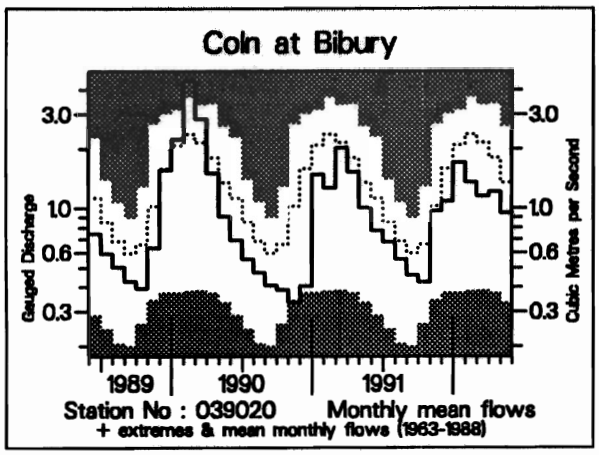


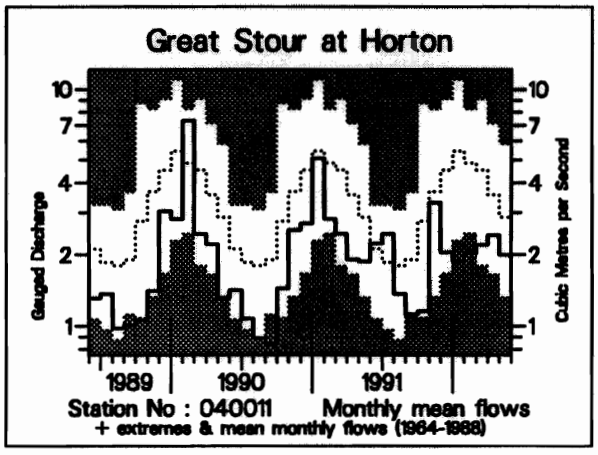


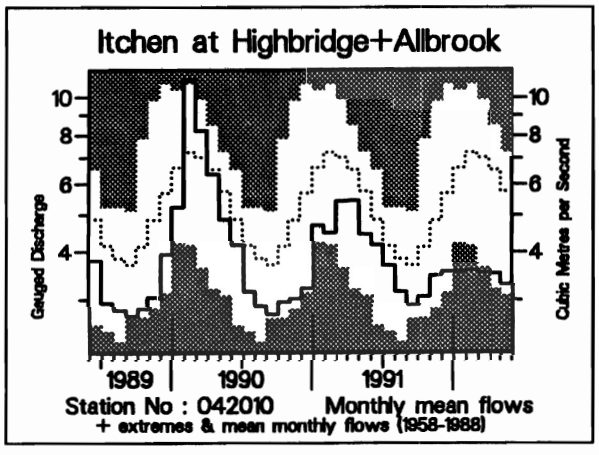


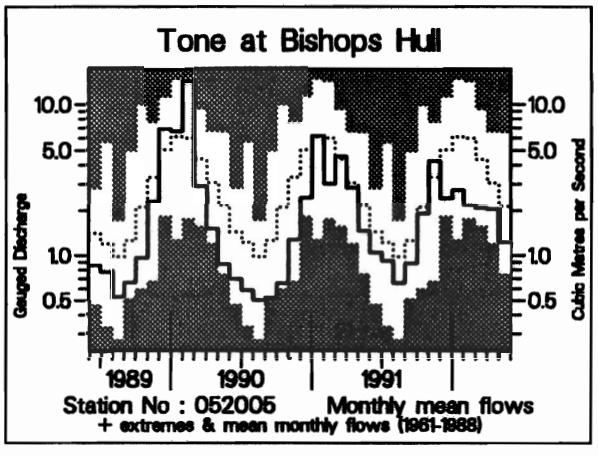


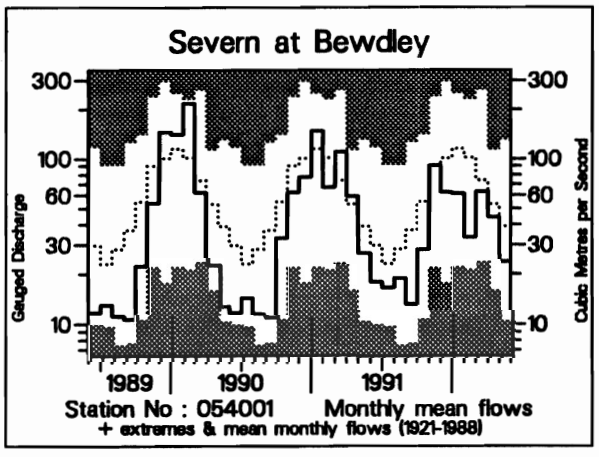


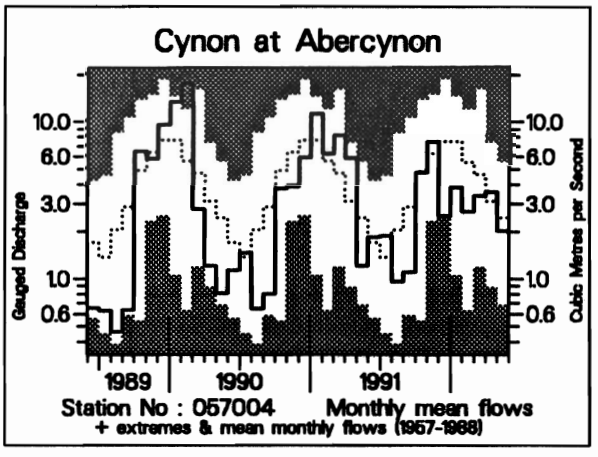

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1989
1990
1991
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

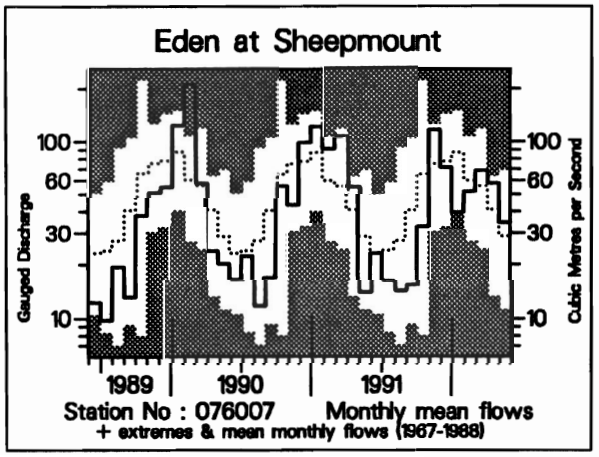

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10
7
4
2
1
1989
1990
1991
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


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)

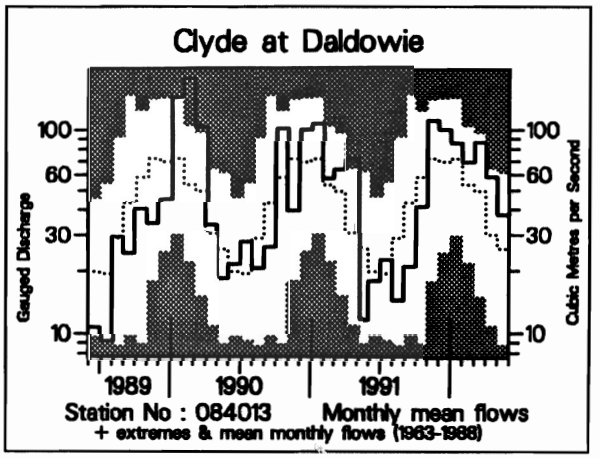

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1989
1990
1991
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

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	Jan	Feb	Mar	Apr	May		12/91 to 5/92		6/91 to 5/92		6/90 to 5/92		8/89 to 5/92	
	1992				1992									
	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	61 68	38 52	65 68	95 123	54 87	12 /20	356 74	3 /20	678 86	3 /19	1404 89	4 /18	1971 85	2 /17
Tay at Ballathie	176 122	111 97	154 121	106 125	79 115	28 /40	745 109	29 /40	1239 110	32 /39	2342 104	25 /38	3744 114	31 /37
Whiteadder Water at Hutton Castle	38 64	21 43	41 81	79 218	16 60	10 /23	226 85	7 /23	302 77	6 /22	752 96	8 /21	908 79	7 /20
South Tyne at Haydon Bridge	41 42	62 83	100 118	105 195	36 103	17 /30	472 106	20 /30	746 98	15 /28	1503 98	13 /26	2173 97	11 /24
Wharfe at Flint Mill Weir	61 62	49 64	96 126	64 118	32 86	20 /37	392 89	12 /37	617 85	8 /36	1252 86	10 /35	1810 85	3 /34
Derwent at Buttercrambe	16 35	15 38	18 44	40 129	14 59	6 /31	117 54	3 /31	173 53	3 /30	446 68	4 /29	595 62	1 /28
Trent at Colwick	31 62	16 37	27 67	23 72	16 64	7 /34	137 59	2 /34	215 61	2 /33	477 67	1 /32	749 73	1 /31
Lud at Louth	10 34	8 24	10 28	10 32	10 38	3 /24	55 32	2 /24	101 41	1 /23	210 42	1 /22	327 45	1 /22
Witham at Claypole Mill	15 59	9 34	11 42	9 43	8 51	7 /34	58 45	4 /33	90 50	3 /33	202 55	2 /32	335 63	3 /31
Little Ouse at Abbey Heath	8 35	6 27	9 41	10 55	7 48	3 /25	45 39	1 /24	72 43	1 /24	150 45	1 /23	244 50	1 /22
Colne at Lexden	7 31	5 27	8 44	7 53	5 58	5 /33	36 38	4 /33	60 45	4 /32	121 45	2 /31	218 55	1 /30
Lee at Feildes Weir (natr.)	4 18	4 20	5 25	6 40	4 31	4 /107	27 26	1 /106	60 37	2 /105	139 43	4 /103	263 56	5 /101
Thames at Kingston (natr.)	14 38	12 36	11 35	16 71	11 63	24 /110	75 44	6 /109	127 52	8 /109	263 54	3 /108	487 68	7 /107
Coln at Bibury	43 85	32 60	29 54	29 67	24 73	7 /29	183 68	5 /29	278 71	6 /28	536 68	2 /27	908 80	5 /26
Great Stour at Horton	15 37	15 45	17 51	18 69	15 71	10 /28	96 52	1 /26	184 64	2 /26	374 64	1 /24	550 65	1 /22
Itchen at Highbridge+Allbrook	26 54	25 51	26 50	25 54	24 57	2 /34	153 56	1 /34	303 66	1 /33	643 70	1 /32	1012 77	1 /31
Piddle at Baggs Mill	26 50	24 41	25 44	29 68	24 76	6 /29	156 57	2 /28	283 71	4 /27	564 70	1 /25	929 79	3 /23
Exe at Thorverton	48 37	37 35	68 80	53 94	36 97	22 /37	318 59	3 /36	587 71	2 /36	1293 78	3 /35	2012 82	5 /34
Taw at Umberleigh	41 35	34 39	45 66	40 91	28 97	21 /34	240 53	3 /34	449 65	2 /33	1068 77	3 /32	1737 86	4 /31
Tone at Bishops Hull	36 45	27 36	27 47	26 67	16 59	4 /32	163 48	2 /31	287 62	2 /31	607 64	1 /30	1081 78	1 /29
Severn at Bewdley	38 53	19 33	39 84	26 82	15 64	22 /72	176 60	5 /71	288 64	4 /71	671 74	6 /70	1087 82	8 /69
Wye at Cefn Brwyn	145 59	132 76	317 180	128 100	113 120	25 /38	1027 94	16 /37	1987 97	16 /33	3968 95	9 /28	5900 98	11 /25
Cynon at Abercynon	96 50	63 45	85 70	87 114	51 87	18 /34	446 58	3 /34	891 71	4 /32	2119 84	4 /30	3527 95	14 /28
Dee at New Inn	114 48	102 60	246 137	113 106	83 128	16 /23	848 85	5 /23	1480 82	3 /22	3094 85	3 /21	4713 89	4 /21
Eden at Sheepmount	46 44	57 76	80 112	65 140	40 126	18 /22	371 89	7 /21	620 90	9 /20	1369 100	10 /18	2055 103	9 /16
Clyde at Daldowie	120 112	90 119	121 161	79 182	53 155	23 /29	604 137	28 /29	917 119	26 /28	1811 117	26 /27	2691 119	25 /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 1991.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO JUNE 1992

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Jan	Feb	Mar	Apr	May	Jun	1991 Jun
North West	Northern Command Zone[1]	(G)	133375	79	70	80	94	93	86	72
	Vyrnwy	(R)	55146	95	86	88	100	100	94	85
Northumbria	Teesdale[2]	(G)	87936	88	88	89	96	97	89	64
	Kielder	(R)	199175*	99*	91*	94*	92	91	90	87
Severn-Trent	Clywedog	(R)	44922	87	88	85	99	99	97	98
	Derwent Valley[3]	(G)	39525	84	94	92	100	100	91	78
Yorkshire	Washburn[4]	(G)	22035	65	77	83	90	99	95	79
	Bradford supply[5]	(G)	41407	86	90	94	99	99	91	76
Anglian	Grafham	(R)	58707	88	90	88	95	96	96	96
	Rutland	(R)	130061	63	67	71	74	82	82	85
Thames	London[6]	(G)	206232	75	81	88	91	100	93	90
	Farmoor [7]	(G)	13843	99	99	97	84†	100	98	100
Southern	Bewl	(R)	28170	58	58	54	62	70	73	65
	Ardingly	(R)	4730	88	92	89	100	100	100	100
Wessex	Clatworthy	(R)	5364*	87	88*	82*	82*	85*	77*	84*
	Bristol WW [8]	(G)	36620	53	58	65	71	86	80	86
South West	Colliford	(R)	28540	83	82	81	80	82	80	91
	Roadford	(R)	34500	85	85	87	89	92	91	98
	Wimbleball[10]	(R)	21320	73	76	77	79	79	76	81
	Stithians	(R)	5205	37	38	45	52	65	69	83
Welsh	Celyn + Brenig	(G)	131155	94	93	97	100	100	100	96
	Brianne	(R)	62140	100	97	100	100	100	97	88
	Big Five[11]	(G)	69762	93	93	92	97	98	92	87
	Elan Valley[12]	(G)	99106	94	91	100	100	100	96	91
Lothian	Edinburgh/Mid Lothian	(G)	97639	95	92	96	100	100	98	86
	West Lothian	(G)	5613	90	82	91	94	85	76	81
	East Lothian	(G)	10206	95	98	98	99	89	91	94

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

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

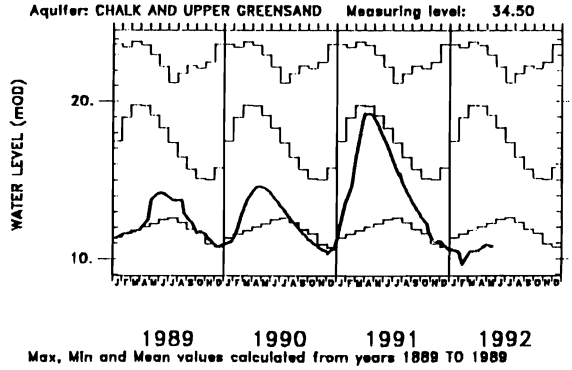
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. 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

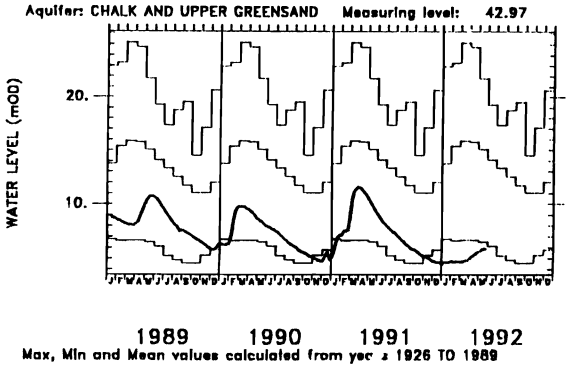
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

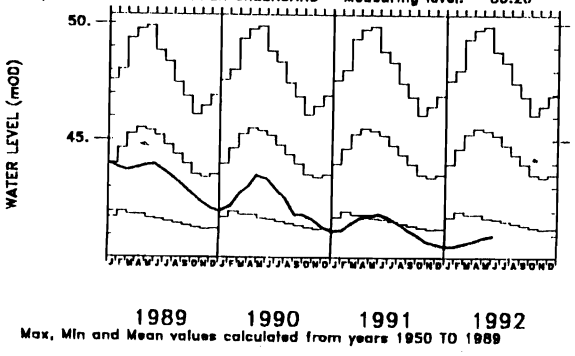
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



Max, Min and Mean values calculated from yea s 1926 TO 1989

Site name: WASHPIT FARM

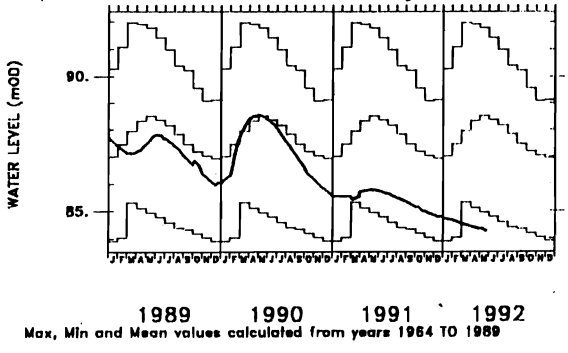
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



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

Site name: THE HOLT

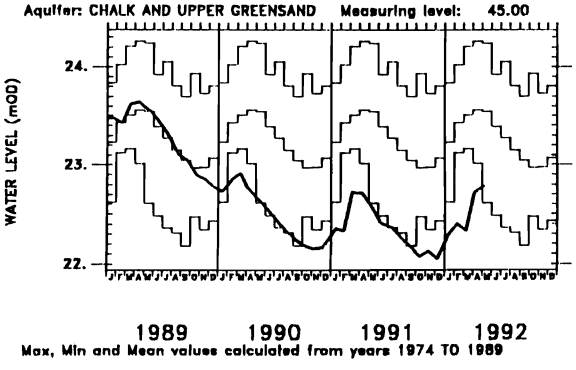
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



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

Site name: FAIRFIELDS

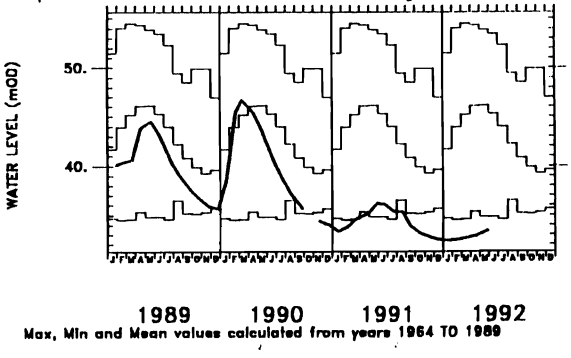
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



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

Site name: REDLANDS HALL,ICKLETON

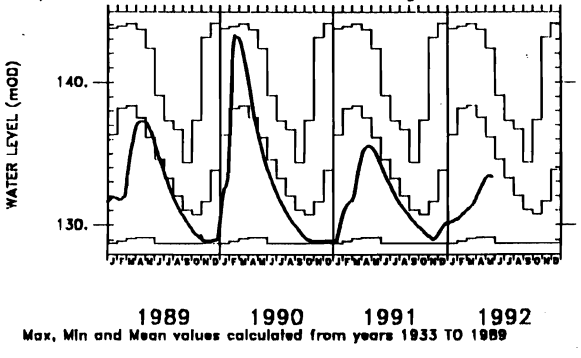
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19



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

Site name: ROCKLEY

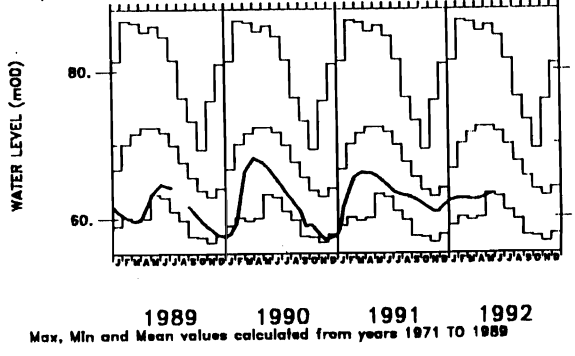
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57



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

Site name: LITTLE BUCKET FARM,WALTHAM

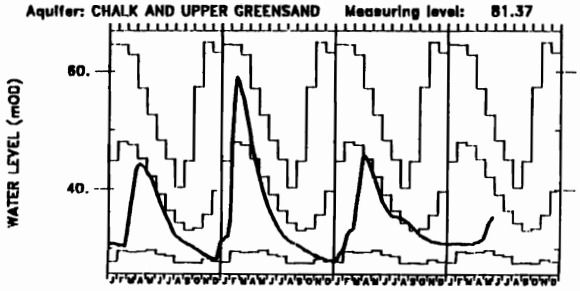
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



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

Site name: COMPTON HOUSE

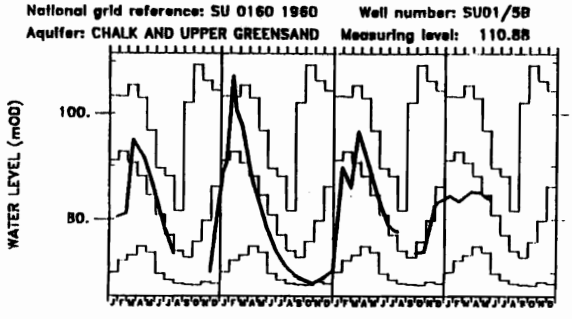
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



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

Site name: WEST WOODYATES MANOR

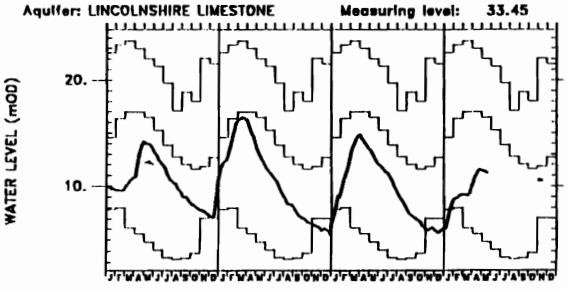
National grid reference: SU 0160 1960 Well number: SU01/58
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88



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

Site name: NEW RED LION

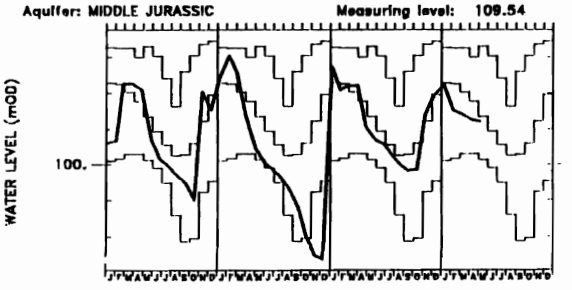
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



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

Site name: AMPNEY CRUCIS

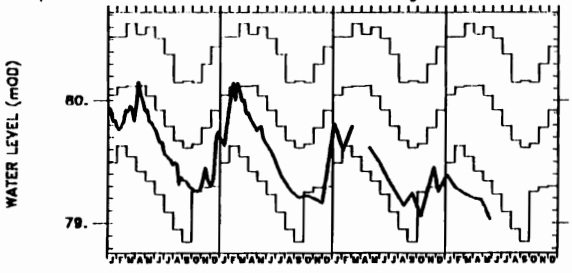
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



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

Site name: LLANFAIR DC

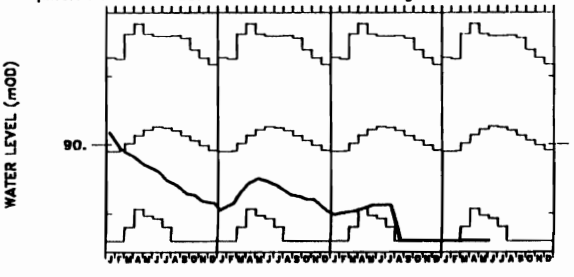
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08



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

Site name: WEEFORD FLATS,WEEFORD

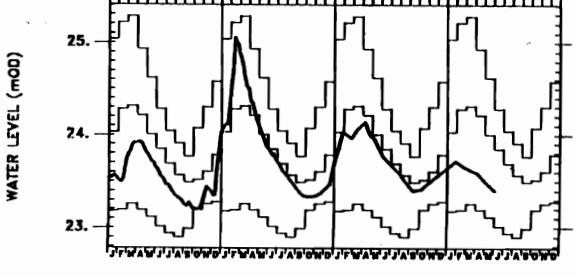
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



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

Site name: BUSSELS NO.7A

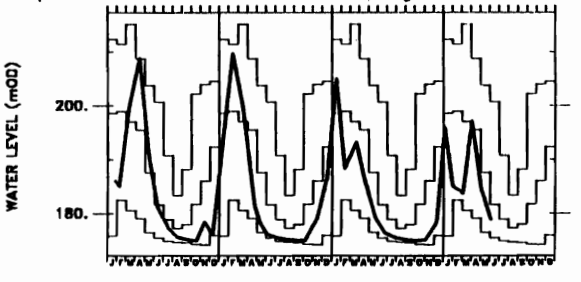
National grid reference: SX 9528 9872 Well number: SX99/378
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



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 MAY GROUNDWATER LEVELS : 1992, 1991 AND 1976

Site	Aquifer	Records commence	Average May Level	May 1976		May 1991		May and June 1992		No of years May/June levels <1992	Lowest pre-1992 level (any month)
				Day	Level	Day	Level	Day	Level		
Wetwang	C & UGS	1971	24.00	28/05	19.71	31/05	20.94	01/06	19.69	2	16.84
Dalton Holme	C & UGS	1889	19.13	29/05	14.00	30/05	17.84	22/05	10.77	0	10.34
Little Brocklesby	C & UGS	1926	15.07	06/05	6.50	31/05	9.17	26/05	5.84	0	4.54
Washpit Farm	C & UGS	1950	45.42	01/05	42.90	02/05	41.76	04/06	40.96	0	41.24
The Holt	C & UGS	1964	88.53	27/05	85.68	26/05	85.76	24/05	84.26	0	83.90
Therfield Rectory	C & UGS	1883	81.87	26/05	75.59	26/05	73.98	24/05	72.05	4	dry (below 71.60)
Fairfields	C & UGS	1974	23.54	25/05	22.96	13/05	22.57	07/05	22.78	3	22.05
Redlands Farm	C & UGS	1964	46.12	01/05	37.90	31/05	36.16	28/05	33.34	0	32.46
Rockley	C & UGS	1933	136.13	30/05	129.16	26/05	134.55	24/05	133.32	10	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	72.27	03/05	64.10	23/05	65.23	20/05	63.10	0	56.77
Compton House	C & UGS	1894	42.20	27/05	29.71	28/05	39.14	27/05	35.24	8	27.64
Chilgrove House	C & UGS	1836	50.08	29/05	37.52	28/05	47.37	27/05	46.06	>10	33.46
West Dean No 3	C & UGS	1940	1.89	28/05	1.42	31/05	1.40	29/05	1.50	11	1.01
Lime Kiln Way	C & UGS	1969	125.50	15/05	124.44	23/05	124.86	20/05	124.02	0	124.09
Ashton Farm	C & UGS	1974	68.75	26/05	65.29	29/05	68.30	27/05	67.90	3	63.10
West Woodyates	C & UGS	1942	84.60	01/05	73.83	29/05	84.10	27/05	83.80	>10	67.62
New Red Lion	LLst	1964	16.42	28/05	4.80	30/05	12.12	20/05	11.20	2	3.29
Ampney Crucis	Mid Jur	1958	101.35	30/05	100.12	31/05	100.68	07/05	101.21	>10	97.38
Dunmurry (NI)	PTS	1985	28.38	no	levels	28/05	28.01	29/05	28.12	3	27.47
Llanfair DC	PTS	1972	80.04	01/05	79.34	29/05	79.50	26/05	79.03	0	78.85
Morris Dancers	PTS	1969	32.58	25/05	31.96	08/05	32.06	08/06	31.95	2	30.87
Weeford Flats	PTS	1966	90.22	27/05	88.97	23/05	89.12	05/06	dry	0	dry (below 88.61)
Bussels 7A	PTS	1972	24.00	25/05	23.11	07/05	23.96	02/06	23.40	1	22.90
Rusheyford NE	MgLst	1967	76.27	25/05	65.76	17/05	75.54	07/05	74.79	>10	64.77
Peggy Ellerton	MgLst	1968	34.82	24/05	31.45	17/05	33.61	11/05	31.79	1	31.10
Alstonfield	CLst	1974	187.65	27/05	176.53	24/05	179.18	04/06	178.81	3	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