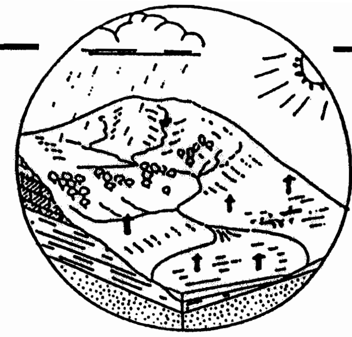
Hydrological Summary for Great Britain



AUGUST 1992

Rainfall

Over 150% of average for GB, the wettest month since February 1990. Very unsettled conditions produced abundant rainfall in most regions, some western areas were notably wet. In rainfall terms the drought has moderated appreciably since the early spring.

River flows

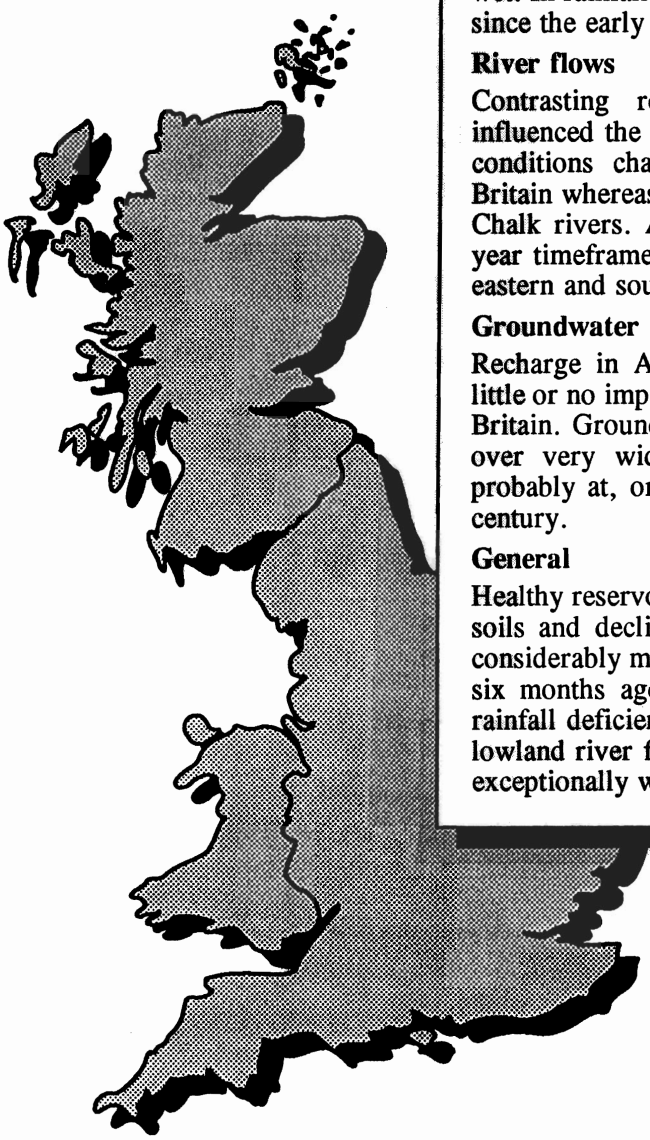
Contrasting regional soil moisture conditions greatly influenced the runoff response to the August rainfall. Spate conditions characterised some upland rivers in western Britain whereas flows continued to decrease in some eastern Chalk rivers. Accumulated runoff totals in the two-to-four year timeframes are without recorded precedent in parts of eastern and southern England.

Groundwater

Recharge in August was patchy and very modest making little or no impact on groundwater levels in most of southern Britain. Groundwater levels remain exceptionally depressed over very wide areas. In the eastern Chalk levels are probably at, or close to, their lowest since the turn of the century.

General

Healthy reservoir stocks, moderate demand, relatively moist soils and declining evaporation rates together constitute a considerably more encouraging water resources outlook than six months ago. Nonetheless, for the recent reduction in rainfall deficiencies to translate into a sustained recovery in lowland river flows and, especially, groundwater levels, an exceptionally wet winter half-year is still required.



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HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - August 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

August was a very unsettled and relatively cool month in most regions. From the end of the first week a succession of active frontal systems crossed the country on a westerly airstream. Dry days were few and far between especially in northern Scotland, South Wales and southern England where, in some central districts, rainfall was reported on all but one or two days in the 30-day period ending on 7th September. Whilst some days registered only a trace, daily totals in excess of 10 mm were common especially where thundery activity accompanied the passage of low pressure systems.

The prevalence of Atlantic frontal systems was reflected in the August rainfall distribution which favoured the west but produced monthly totals well above average in all but low-lying parts of north-east England. Eskdalemuir (Dumfries and Galloway) recorded its second wettest August in a record from 1911 and well over twice the August average was registered in the Hebrides, South Wales and parts of southern England. For Great Britain as a whole, August was the wettest month since February 1990. Most regions recorded between 20 and 80 per cent above average - in absolute terms this represents a considerable mount of rainfall, August normally being one of the wettest months of the year.

The provisional July/August rainfall total for England and Wales has been matched only once (in 1988) over the past 30 years and summer (June-August) rainfall was appreciably above average in most of the drought affected regions. Northern England was, however, relatively dry. Regional rainfall totals for 1992 thus far are well within the normal range and marginally above average in those areas where the drought has achieved its greatest intensity. In broad terms, the early spring of 1992 serves to partition the latest phase of the drought into episodes of increasing and decreasing severity. The meteorological transformation in much of the lowlands is well illustrated in the Thames Valley where the six months beginning in March were the fourth wettest, for this sequence, in the last 20 years - following directly on the third driest August-February period in a 110-year record. Compared to the rainfall deficiencies in early spring, the meteorological drought in eastern and southern England is now considerably less intense. Nonetheless accumulated rainfall deficiencies remain very notable over the longest timeframes - up to four years (see Table 2). By contrast, the remarkably wet phase in western Scotland continues. 1992 rainfall totals for the Clyde and Highland RPB areas are around 30 per cent above average and longer term accumulations testify to the persistence of extremely wet conditions.

Dull, wet conditions throughout much of the summer, and the associated reduction in water demand, has mitigated the drought's impact and provides the basis for a more encouraging water resources outlook. Nonetheless, the unsettled summer still needs to herald a notably wet winter half-year to generate sustained recoveries in runoff and recharge rates in (and beyond) the English lowlands.

Evaporation and Soil Moisture Deficits (SMDs)

In contrast to 1989, 1990 and 1991, August temperatures were below average - albeit marginally - in most regions. Sunshine hours were also a little below average, more so in southern Britain. The overcast conditions moderated evaporation losses but relatively high wind speeds, with a few particularly boisterous interludes, provided a counterbalance. MORECS potential evaporation (PE) losses were generally above average but within the normal range. Actual evaporation (AE) totals, reflecting the relatively moist soils, were above average - notably so in parts of eastern England and central Scotland. For 1992 thus far, PE losses have generally been somewhat above average, but modest by comparison with 1989 and 1990, whereas AE losses have been notably high except in a few areas (e.g. the lower Thames Valley) where persistently high SMDs have been maintained.

Soil moisture deficits declined steeply in much of western Britain during August. Substantial reductions also occurred in eastern areas although by month-end there was only limited spatial coherence in soil moisture terms; importantly, above average SMDs persisted near to eastern England's seaboard. Entering September, soils were at, or close to, field capacity away from the English lowlands where SMDs, though still substantial, were very considerably below those obtaining in 1989 and 1990. In these years, end-of-summer deficits were at the maximum for the MORECS model (125 mm for grass) throughout most of the lowlands; no MORECS square registered the ceiling value at the end of August this year. The relatively moist soils in most areas and declining evaporation rates provide grounds for optimism that the seasonal hydrological recovery will not be as inordinately delayed in the lowlands as in the past three years.

Runoff

The rainfall distribution and, as significantly, regional contrasts in soil moisture conditions produced large geographical variations in August runoff totals. Sustained rainfall on moderately wet catchments resulted in spate conditions in parts of Wales and Scotland. Brisk flow increases were also reported for some impervious catchments in the English lowlands. More generally however, the very welcome increase in surface runoff in eastern and southern England was insufficient to compensate for the continuing, if gentle, decline in baseflows. Late summer flows in many Chalk rivers were very depressed for the fourth successive year.

Throughout much of western and northern Britain, August mean flows were substantially above average with some notable summer flows reported. The daily mean flow for the Dee (at Park) on the 30th August was the highest of the year and successive minor spates on the Yscir in South Wales produced the highest August runoff total in a 20-year record. Although less clear-cut than in several recent summers, a strong accentuation in the normal west-to-east runoff gradient could be identified. August runoff was only a little above half the long term average in many lowland rivers sustained principally by groundwater. Nonetheless, except in a few eastern and southern catchments, August flows remained significantly above those registered during historical droughts (1976 especially) and often appreciably above those of 1991, 1990 and 1989.

The continuing decline in monthly flows in parts of lowland England emphasises the, as yet, very limited diminution in the severity of the hydrological drought. Medium and long term runoff deficiencies continue to provide evidence of a drought of exceptional severity. For many eastern and southern rivers, accumulated runoff totals in the one, two and four-year timeframes are unprecedented. The Lud, Little Ouse, Mimram (Hertfordshire) and Itchen are among those whose 24- and 48-month runoff totals (ending in August) are the lowest on record (for accumulations starting in ANY month). Over the period beginning in the late summer of 1990 mean flows are typically around half the long term average over wide areas from the Humber to Dorset. A longer perspective is provided by the naturalised flow series for the Rivers Lee and Thames which both commence in 1883. Direct comparisons with current conditions is hampered by the probable underestimation of early low flows. Unadjusted figures suggest that on a two- and four-year basis, the droughts of 1933-

35 and the very protracted events of the 1940s and around the turn of the century were more severe but the accumulated runoff differences (relative to the current event) are very modest.

Reservoir contents normally decline in August but sustained rainfall produced some valuable replenishment especially in Wales, the Thames Valley and East Anglia where storage in Rutland Water increased appreciably. Stocks are generally healthy and mostly well above those recorded for the early autumn in 1990.

Groundwater

The generally high rainfall of August has had little discernible effect on groundwater levels in central, eastern and southern England. Isolated and modest upturns were reported from a few areas but groundwater levels in the Chalk were typically similar to those of July. Indeed, the extremely limited impact on groundwater levels of above average rainfall in the lowlands since February graphically illustrates the difficulties of attempting to index drought severity using rainfall data alone.

The slight upturns in the hydrograph traces noted in July for the Washpit Farm and Redlands Hall sites have not been maintained and groundwater levels have again fallen, in the case of Washpit Farm yet again to an all-time low. Water-tables remain near to or below the seasonal recorded minima from the Chalk outcrop of eastern Kent through East Anglia and eastern Lincolnshire and into Yorkshire. Levels in those index wells in the zone of maximum drought severity have, typically, remained below the pre-1991 minimum for almost a year. Water-tables in the Chalk are less depressed to the west but still well below the seasonal average.

Very depressed water-tables still characterise the Permo-Triassic sandstones of the Midlands and north Wales. The Weeford Flats well remains dry and groundwater levels are still in decline at Llanfair DC - here, as at a few other sites, some recovery subsequent to the August level measurement may have occurred. In the extreme south-west, the site at Bussels shows a declining water-table not far from the seasonal minimum. In north-west England, the Triassic basins of southern Scotland and in Northern Ireland, groundwater levels are for the most part near to the seasonal mean and often rising; a recovery is also underway in the Carboniferous Limestone at Alstonfield (280 metres a.OD in the Pennines).

The sustained August rainfall has greatly reduced and in some western districts eliminated soil moisture deficits. As a consequence, some local rises in groundwater levels may yet take place in early September. However, in eastern Britain, and especially in the Chalk, water-tables are probably close to or at their most depressed since the turn of the century. Reports of failed springs and drying wells have come from as far west as Dorset. No substantial recharge can realistically be expected until October 1992 in lowland areas. The seasonal recovery will need to be generated from an exceptionally low base - the equivalent of around two years average recharge in many areas. This emphasises the need for an early onset of significant recharge. If the onset of the winter recharge is delayed, as in recent years, then a uniquely wet spring would be necessary to bring groundwater resources to something approaching a comfortable level by the start of the 1993 recession. Anything short of this would be a matter for serious concern, particularly in eastern England.

Institute of Hydrology/British Geological Survey
11 September 1992

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

		Aug	Sept	Oct	Nov	Dec 1991	Jan 1992	Feb	Mar	Apr	May	June	July	Aug
England and	mm	31	62	77	95	49	48	41	70	75	49	45	87	125
Wales	%	34	75	93	98	54	56	64	119	129	73	74	119	139
NRA REGIONS														
North West	mm	65	69	125	169	119	57	97	139	89	62	31	76	151
	%	52	56	106	140	99	51	120	193	116	76	37	74	121
Northumbria	mm	36	42	75	109	78	33	46	106	103	31	19	66	107
	%	36	53	100	116	104	41	70	204	187	48	31	85	106
Severn-Trent	mm	21	54	55	68	39	59	31	67	50	59	55	87	108
	%	26	81	85	86	56	86	58	129	96	92	98	134	133
Yorkshire	mm	21	40	63	94	62	47	41	89	66	34	33	86	99
	%	23	56	91	106	84	61	64	168	118	56	57	123	110
Anglian	mm	18	63	26	54	24	45	17	62	43	48	34	85	77
	%	28	121	50	87	45	86	39	155	108	102	69	150	120
Thames	mm	18	52	36	66	16	28	25	51	65	60	39	73	97
	%	26	84	56	90	24	45	53	111	141	107	75	121	138
Southern	mm	15	51	51	81	23	18	33	59	84	30	26	66	103
	%	21	72	65	86	28	24	58	113	175	55	52	112	141
Wessex	mm	19	71	83	72	30	36	39	55	81	24	49	70	130
	%	23	90	101	74	33	43	66	95	150	35	91	113	159
South West	mm	32	85	123	112	52	44	68	75	100	31	23	80	162
	%	32	82	109	84	39	34	76	89	141	37	35	96	160
Welsh	mm	54	85	154	142	65	76	79	114	91	80	48	92	208
	%	45	68	119	99	45	56	82	131	107	88	59	97	175
Scotland	mm	67	131	165	227	141	139	165	208	123	80	52	103*	227*
	%	52	96	111	160	90	101	159	226	137	88	57	92	176
RIVER PURIFICATION BOARDS														
Highland	mm	86	182	193	305	166	197	225	250	138	105	46	99	251
	%	58	115	104	180	85	120	169	219	121	102	42	78	169
North-East	mm	34	58	120	133	53	67	51	119	68	57	50	60	142
	%	32	67	124	129	52	74	69	192	111	74	71	65	132
Tay	mm	40	111	155	154	97	117	106	159	90	57	30	79	183
	%	34	97	127	129	72	99	115	194	120	60	36	77	155
Forth	mm	38	103	111	124	108	110	110	129	76	45	25	73	174
	%	33	95	105	115	99	111	143	187	112	54	33	75	150
Tweed	mm	36	67	101	127	92	63	69	134	98	52	27	68	146
	%	32	71	115	122	102	68	100	231	161	68	40	76	128
Solway	mm	69	81	172	203	162	91	148	205	144	66	30	87	203
	%	53	54	119	140	107	65	159	225	164	72	33	79	156
Clyde	mm	87	157	193	274	208	170	234	274	144	93	41	99	240
	%	61	90	105	164	112	106	207	261	140	96	40	77	169

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.

* Based on 13 raingauges; given the notable variation in summer rainfall across Scotland these figures should be treated with particular caution.

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

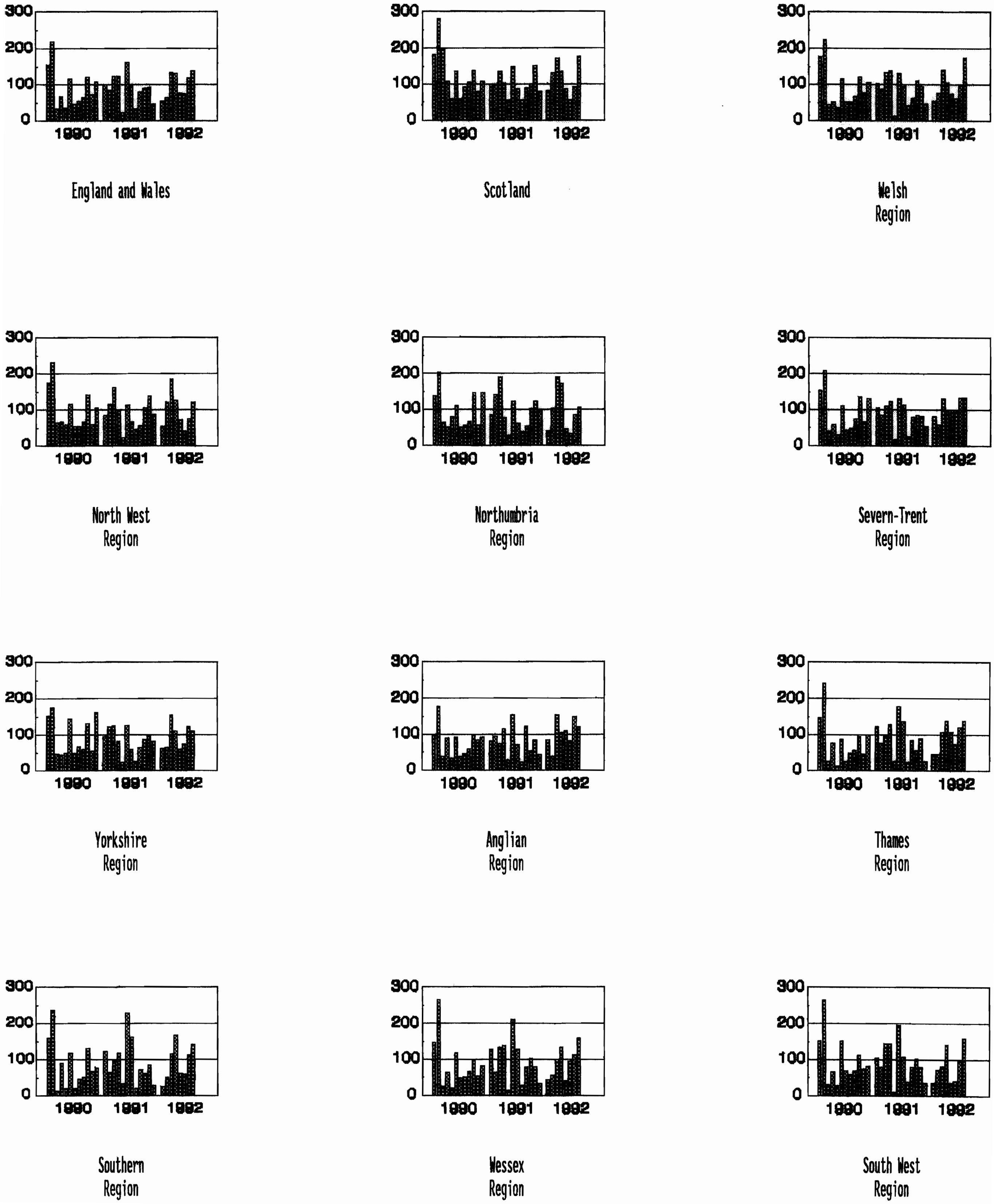


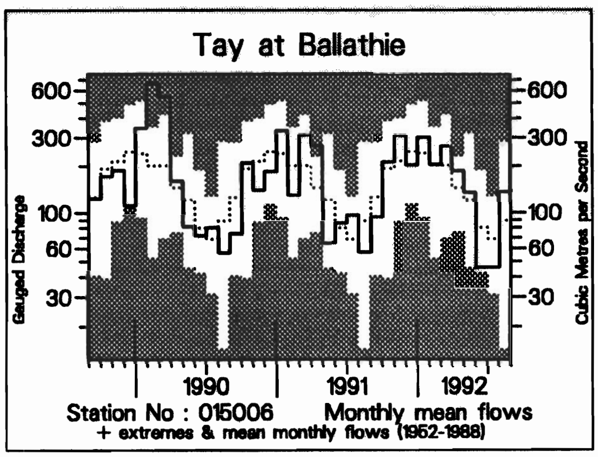
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

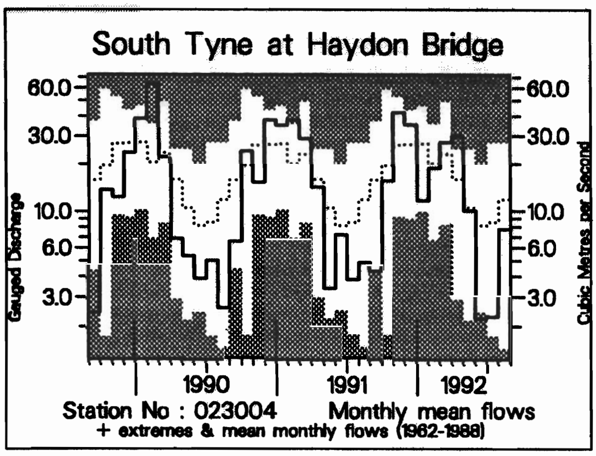
		Jan - Aug92	Est Return Period, years	Sep91-Aug92	Est Return Period, years	Mar90-Aug92	Est Return Period, years	Aug88-Aug92	Est Return Period, years
England and	mm	540		823		1893		3315	
Wales	% LTA	97	<5	90	<5	85	25-50	89	20-30
NRA REGIONS									
North West	mm	702		1184		2679		4705	
	% LTA	96	<5	97	<5	90	5-10	94	5
Northumbria	mm	511		815		1935		3151	
	% LTA	92	<5	93	<5	89	5-10	87	25-50
Severn Trent	mm	516		732		1633		2822	
	% LTA	105	<5	95	<5	85	15-25	89	10-20
Yorkshire	mm	495		754		1716		2942	
	% LTA	94	<5	91	<5	84	25-50	86	30-60
Anglian	mm	411		578		1226		2083	
	% LTA	105	<5	95	<5	81	40-80	83	70-140
Thames	mm	437		607		1386		2446	
	% LTA	100	<5	86	5	80	30-70	85	30-60
Southern	mm	419		625		1564		2715	
	% LTA	89	<5	79	10-20	81	25-50	84	40-80
Wessex	mm	484		740		1710		3087	
	% LTA	93	<5	85	5-10	81	30-60	87	20-30
South West	mm	583		955		2417		4422	
	% LTA	82	5-10	80	10-20	84	20-30	91	5-10
Welsh	mm	789		1235		2854		5111	
	% LTA	100	<5	93	<5	88	5-10	94	5
Scotland	mm	1097		1761		3940		6720	
	% LTA	130	40-80	123	30-70	114	25-50	115	>200
RIVER PURIFICATION BOARDS									
Highland	mm	1311		2157		4894		8430	
	% LTA	129	30-70	125	40-80	118	60-140	120	>>200
North-East	mm	613		977		2348		3799	
	% LTA	97	<5	96	<5	93	5	91	10-20
Tay	mm	820		1337		3087		5451	
	% LTA	107	<5	107	<5	101	<5	106	5-10
Forth	mm	742		1188		2817		4854	
	% LTA	108	<5	106	<5	103	<5	106	5-10
Tweed	mm	657		1044		2404		3925	
	% LTA	105	<5	104	<5	97	<5	95	<5
Solway	mm	974		1593		3539		6118	
	% LTA	117	5-10	112	5-10	103	<5	105	<5
Clyde	mm	1295		2127		4758		8128	
	% LTA	136	75-150	128	50-100	119	75-150	120	>>200

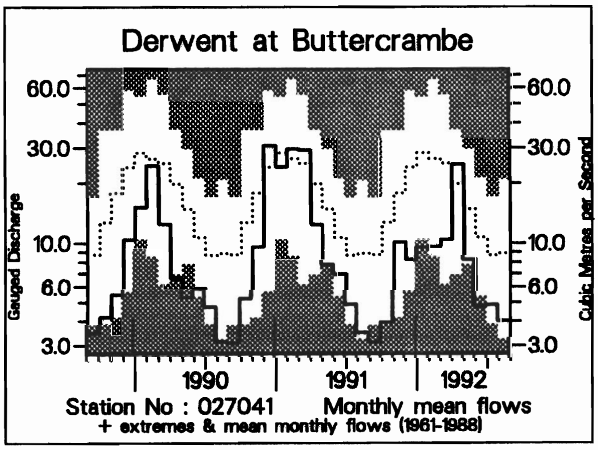
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods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

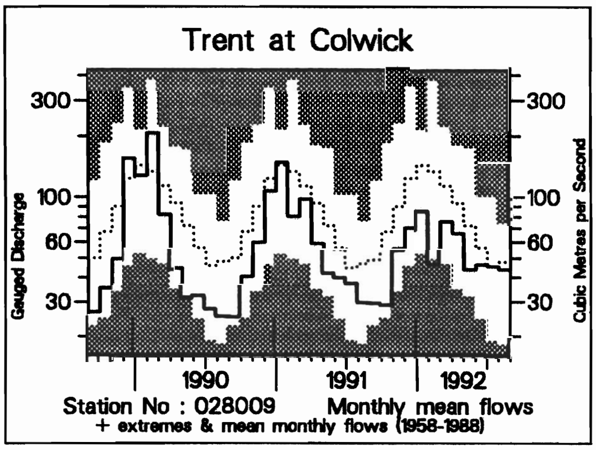
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

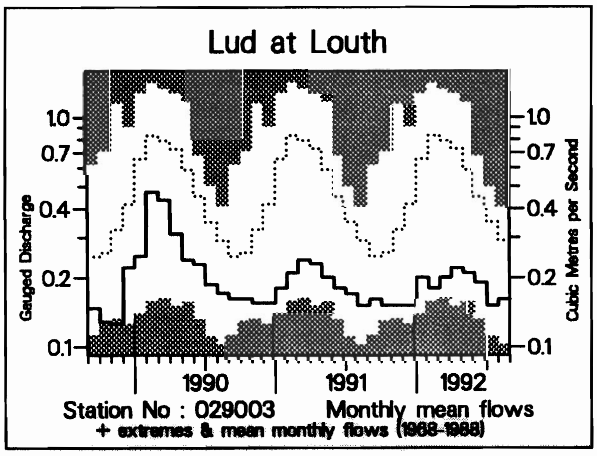
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

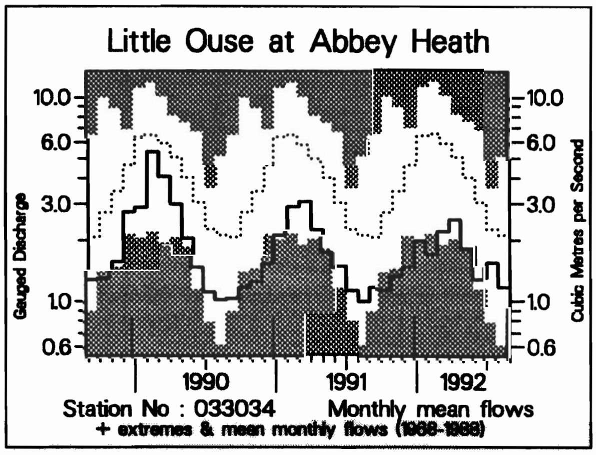


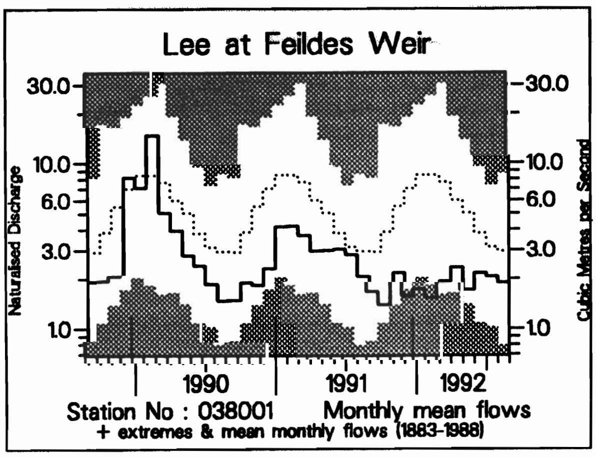


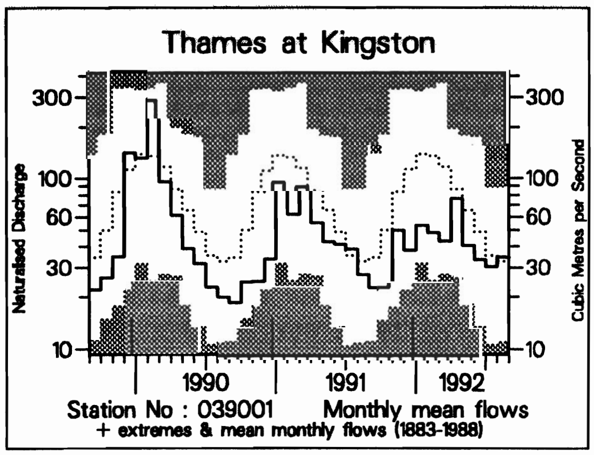


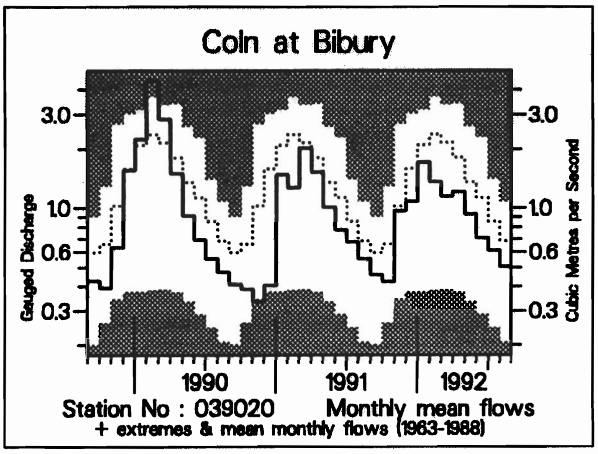


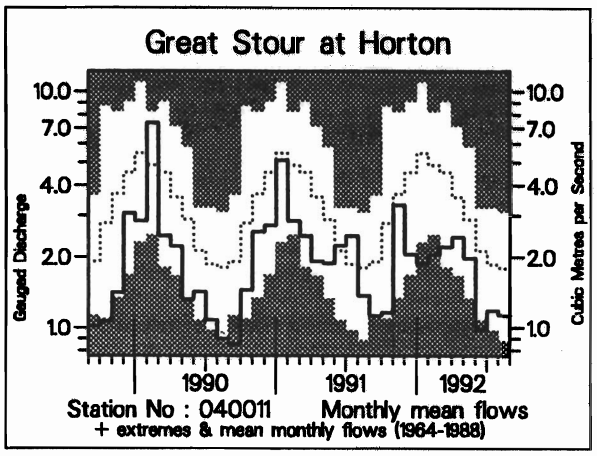


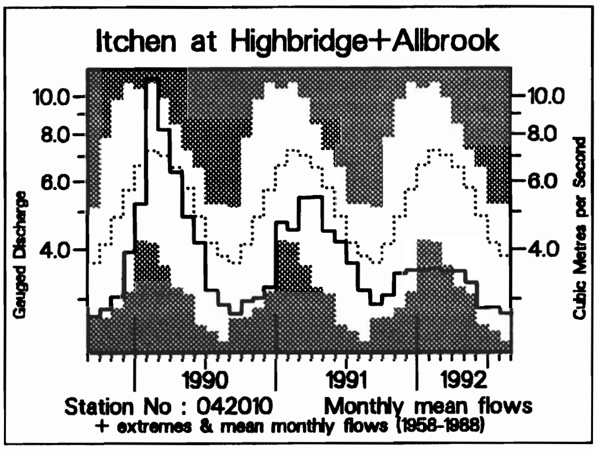


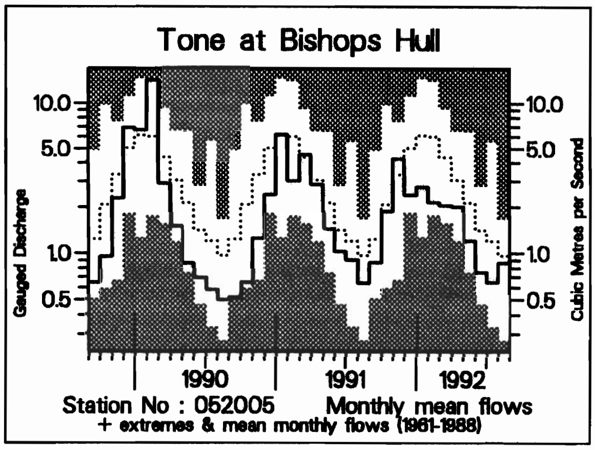


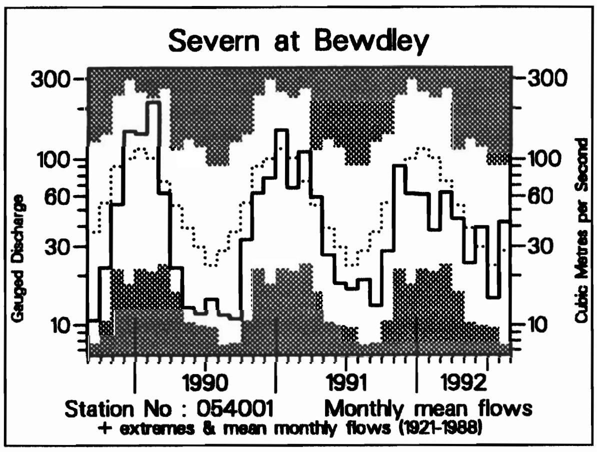


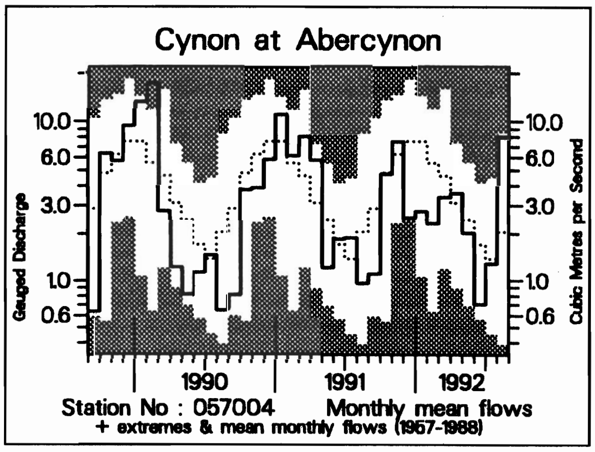

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1990
1991
1992
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

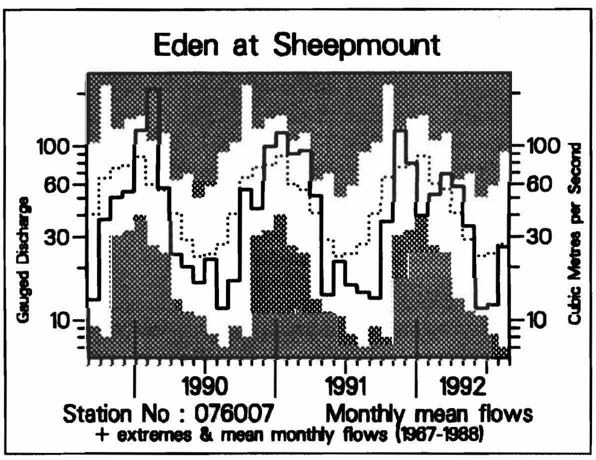

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1990
1991
1992
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10.0
8.0
6.0
4.0
1990
1991
1992
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
1990
1991
1992
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
1990
1991
1992
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
1990
1991
1992
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
1990
1991
1992
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

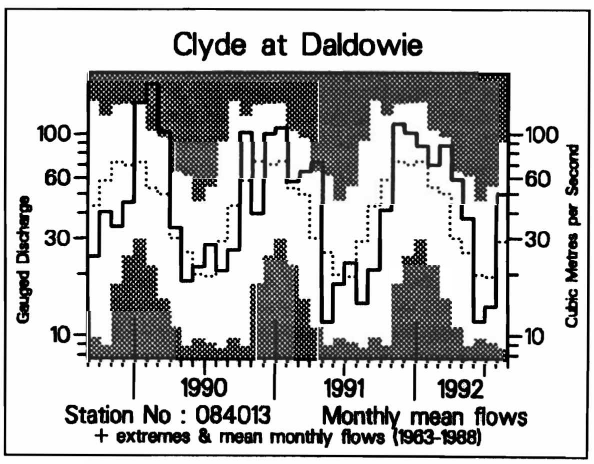

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1990
1991
1992
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

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	Apr 1992	May 1992	Jun 1992	Jul 1992	Aug 1992	Aug 1992	5/92 to 8/92	5/92 to 8/92	9/91 to 8/92	9/91 to 8/92	9/90 to 8/92	9/90 to 8/92	9/88 to 8/92	9/88 to 8/92
	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	95 123	54 87	15 40	14 49	42 134	15 /20	124 78	9 /20	634 81	3 /19	1391 88	4 /18	2708 84	1 /16
Tay at Ballathie	106 125	79 115	26 58	27 67	80 157	36 /40	211 103	23 /40	1226 109	32 /39	2349 104	25 /38	5280 117	33 /36
Whiteadder Water at Hutton Castle	79 218	16 60	9 53	8 63	12 78	14 /23	44 63	7 /23	305 78	6 /23	754 96	9 /22	1197 76	4 /20
South Tyne at Haydon Bridge	105 195	36 103	8 30	8 28	28 72	13 /29	79 63	8 /29	734 97	10 /27	1507 98	13 /25	2793 90	4 /21
Wharfe at Flint Mill Weir	64 118	32 86	10 40	11 41	26 65	17 /37	78 61	8 /37	605 84	8 /36	1247 86	11 /35	2482 85	3 /33
Derwent at Buttercrambe	40 129	14 59	8 48	8 57	7 49	5 /31	37 55	3 /31	168 52	3 /30	444 68	4 /29	817 61	1 /27
Trent at Colwick	23 72	16 64	16 85	16 101	16 97	16 /34	63 84	10 /34	225 64	2 /33	494 70	2 /32	1071 75	2 /30
Lud at Louth	10 32	10 38	9 45	7 44	8 60	4 /25	34 46	3 /24	101 40	2 /24	205 40	1 /23	507 49	1 /21
Witham at Claypole Mill	15 72	8 51	6 62	7 100	5 73	16 /34	26 67	10 /34	98 54	3 /33	212 58	2 /32	470 64	2 /30
Little Ouse at Abbey Heath	10 55	7 48	5 47	6 73	4 53	7 /25	22 55	5 /25	74 44	1 /24	152 45	1 /23	408 60	1 /21
Colne at Lexden	7 53	5 58	4 74	4 96	3 75	14 /33	15 70	6 /33	58 43	4 /32	124 46	2 /31	347 64	1 /29
Lee at Feildes Weir (natr.)	6 40	4 31	5 53	5 62	5 66	23 /107	20 53	6 /107	56 35	3 /105	140 43	4 /103	415 64	4 /99
Thames at Kingston (natr.)	20 89	11 63	9 71	8 84	9 103	72 /110	37 77	36 /110	130 53	9 /109	276 56	5 /108	694 70	5 /106
Coln at Bibury	29 67	23 70	17 64	15 72	13 78	7 /29	68 71	6 /29	273 70	6 /28	538 68	2 /27	1202 76	2 /25
Great Stour at Horton	18 69	15 71	7 45	9 63	9 67	6 /28	40 63	5 /27	163 56	1 /25	373 64	1 /23	747 63	1 /19
Itchen at Highbridge+Allbrook	25 54	24 57	20 58	21 69	20 71	2 /34	87 65	2 /34	284 62	1 /33	630 69	1 /32	1394 76	1 /31
Piddle at Baggs Mill	29 68	24 76	17 73	15 84	14 90	10 /29	70 80	6 /26	270 68	3 /27	571 71	1 /25	1229 76	1 /21
Exe at Thorverton	53 94	36 97	13 55	15 71	47 169	32 /37	110 100	22 /37	589 72	2 /36	1325 80	5 /35	2764 83	3 /33
Taw at Umberleigh	40 91	28 97	8 51	7 46	30 164	28 /34	73 93	16 /34	449 65	2 /33	1092 79	3 /32	2357 86	3 /30
Tone at Bishops Hull	26 67	16 59	10 57	8 52	11 90	13 /32	45 64	3 /32	283 61	2 /31	613 65	1 /30	1461 77	1 /28
Severn at Bewdley	26 82	15 64	24 138	9 64	26 152	62 /72	73 102	50 /72	316 70	7 /71	709 79	9 /70	1521 84	7 /68
Wye at Cefn Brwyn	128 100	113 120	41 48	44 40	214 149	33 /40	412 95	17 /38	1910 93	13 /35	4003 96	11 /30	7914 95	4 /20
Cynon at Abercynon	87 114	51 87	17 42	32 93	199 408	33 /34	299 161	30 /34	987 79	4 /32	2251 90	8 /30	4769 95	11 /26
Dee at New Inn	113 106	83 128	40 68	29 43	160 178	22 /24	312 109	15 /23	1526 85	4 /23	3172 88	3 /22	6512 90	2 /20
Eden at Sheepmount	65 141	40 126	13 51	14 52	31 104	16 /22	98 87	10 /22	633 93	8 /20	1357 100	10 /18	2750 101	7 /14
Clyde at Daldowie	79 182	53 155	16 61	19 69	70 176	26 /29	158 123	24 /29	946 122	27 /28	1819 118	26 /27	3578 117	25 /25

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 AUGUST 1992

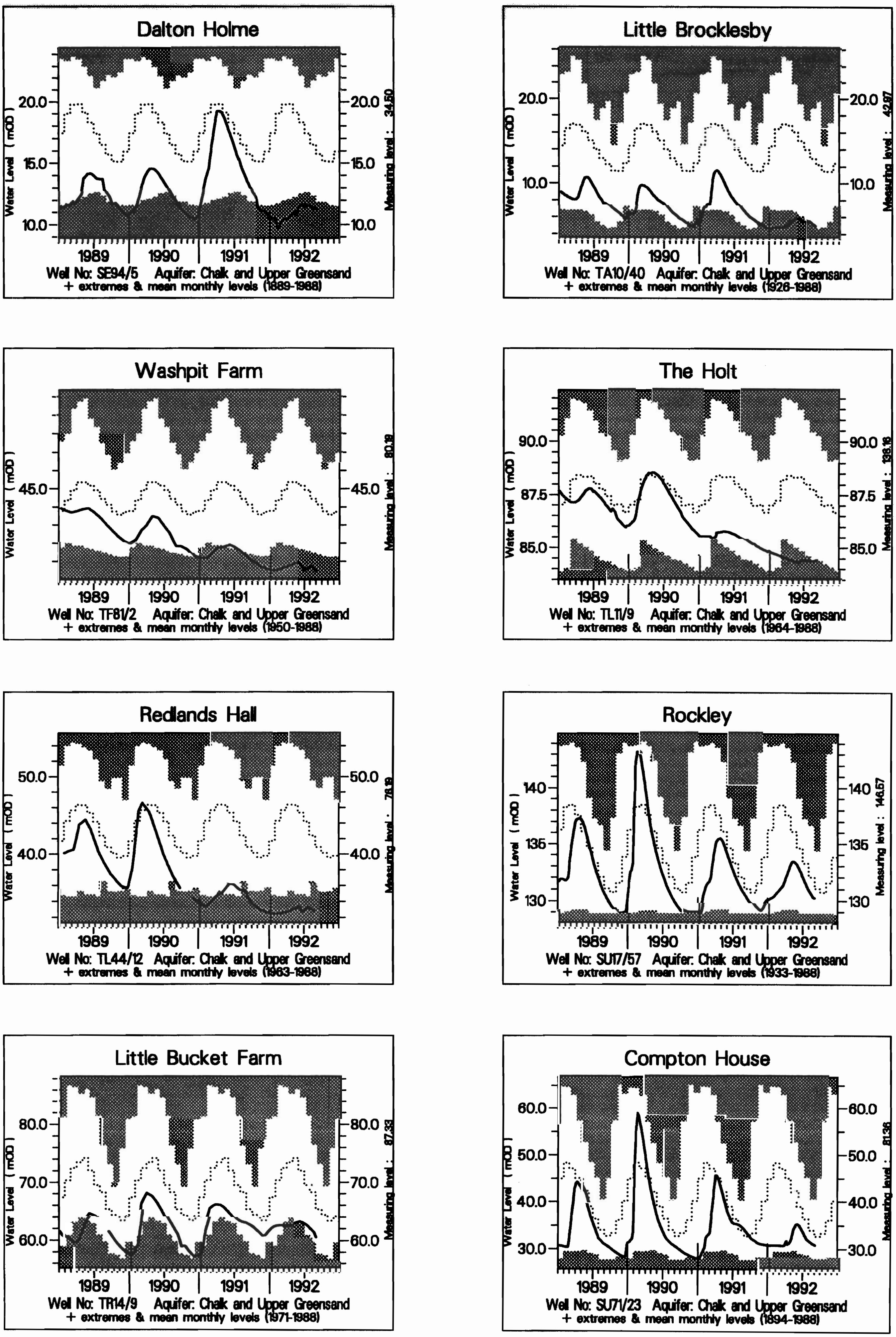
Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Apr	1992 May	1992 Jun	1992 Jul	1992 Aug	1992 Sep	1991 Sep
North West	Northern Command Zone[1]	(G)	133375	94	93	86	66	55	60	43
	Vyrnwy	(R)	55146	100	100	94	89	80	96	85
Northumbria	Teesdale[2]	(G)	87936	96	97	89	71	58	63	60
	Kielder	(R)	199175*	92*	91*	90*	86*	77*	84*	90*
Severn-Trent	Clywedog	(R)	44922	99	99	97	93	85	87	91
	Derwent Valley[3]	(G)	39525	100	100	91	79	73	66	53
Yorkshire	Washburn[4]	(G)	22035	90	99	95	85	72	64	46
	Bradford supply[5]	(G)	41407	99	99	91	76	58	56	49
Anglian	Grafham	(R)	58707	95	96	96	95	95	94	88
	Rutland	(R)	130061	74	82	82	81	81	86	70
Thames	London[6]	(G)	206232	91	100	93	86	85	89	80
	Farmoor [7]	(G)	13843	84	100	98	98	97	99	89
Southern	Bewl	(R)	28170	62	70	73	71	64	60	73
	Ardingly	(R)	4730	100	100	100	100	88	71	81
Wessex	Clatworthy	(R)	5364*	82*	85*	77*	65*	43*	35*	47*
	Bristol WW [8]	(G)	38666*	71*	86*	80*	71*	61*	58*	67*
South West	Colliford	(R)	28540	80	82	80	71	66	63	86
	Roadford	(R)	34500	89	92	91	83	75	70	89
	Wimbleball[9]	(R)	21320	79	79	76	63	53	48	63
	Stithians	(R)	5205	52	65	69	61	54	53	53
Welsh	Celyn + Brenig	(G)	131155	100	100	100	99	87	89	79
	Brianne	(R)	62140	100	100	97	88	77	90	92
	Big Five[10]	(G)	69762	97	98	92	77	66	83	92
	Elan Valley[11]	(G)	99106	100	100	96	91	87	100	85
Lothian	Edinburgh/Mid Lothian	(G)	97639	100	100	98	87	79	86	74
	West Lothian	(G)	5613	94	85	76	60	49	60	67
	East Lothian	(G)	10206	99	89	91	81	72	68	73

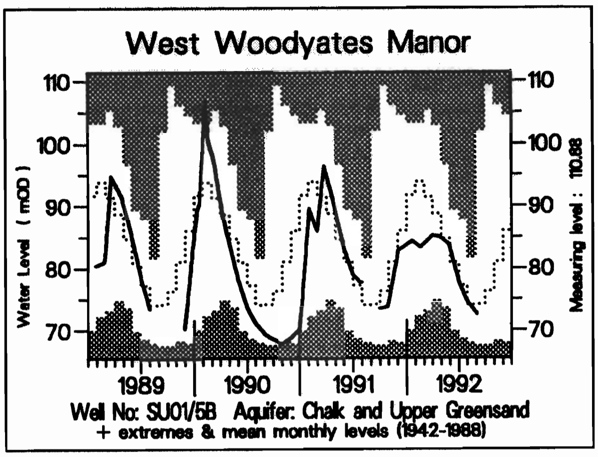
● Live or usable capacity (unless indicated otherwise)
* Gross storage/percentage of gross storage

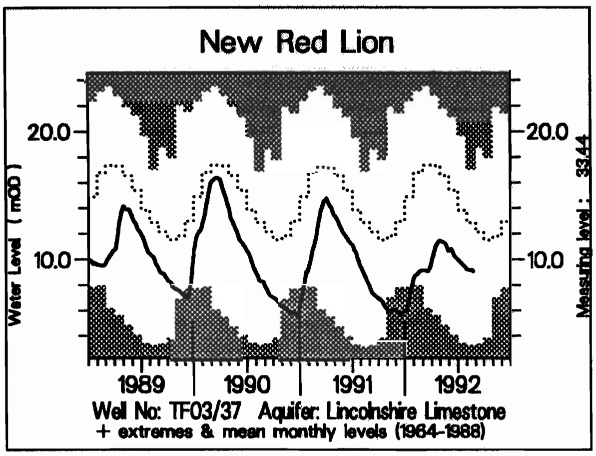
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6.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

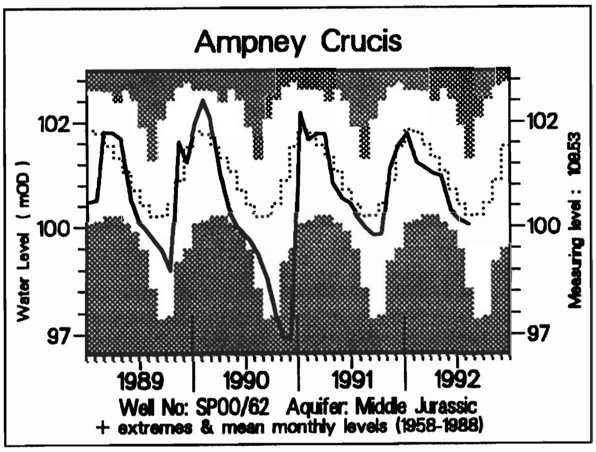
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient 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.

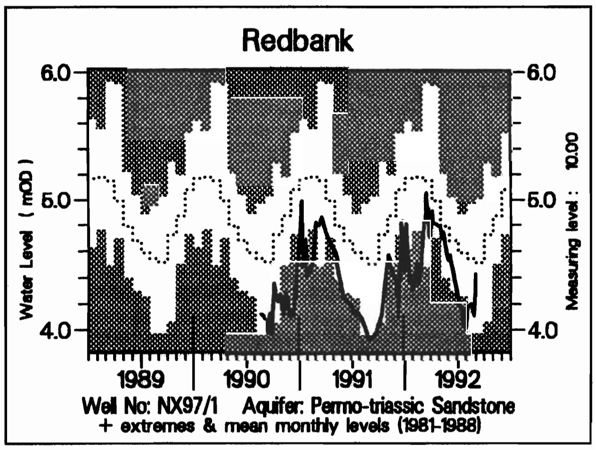
FIGURE 3 GROUNDWATER HYDROGRAPHS

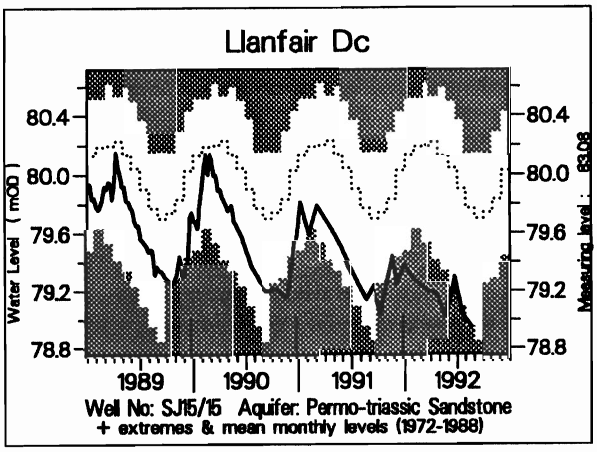


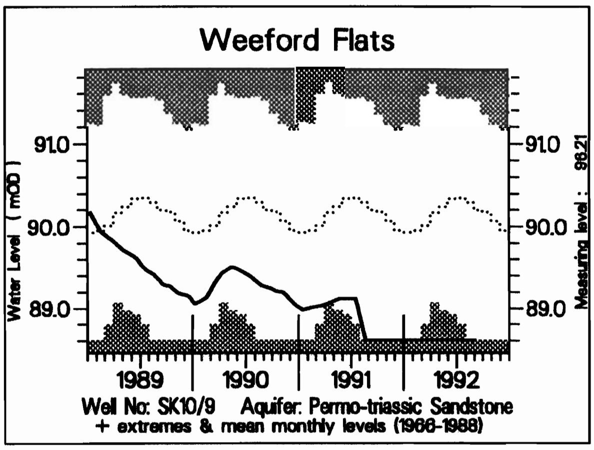

West Woodyates Manor
Water Level (mOD)
Measuring level : 110.88
110
100
90
80
70
1989
1990
1991
1992
Well No: SU01/5B Aquifer: Chalk and Upper Greensand
+ extremes & mean monthly levels (1942-1988)

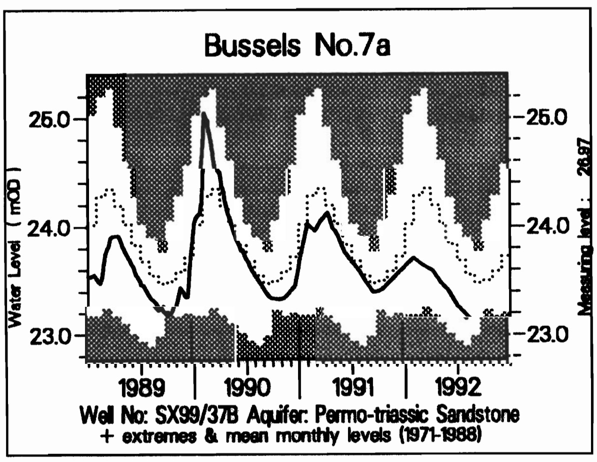

New Red Lion
Water Level (mOD)
Measuring level : 33.44
20.0
10.0
1989
1990
1991
1992
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1988)


Ampney Crucis
Water Level (mOD)
Measuring level : 109.53
102
100
97
1989
1990
1991
1992
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1988)


Redbank
Water Level (mOD)
Measuring level : 10.00
6.0
5.0
4.0
1989
1990
1991
1992
Well No: NX97/1 Aquifer: Permo-triassic Sandstone
+ extremes & mean monthly levels (1981-1988)


Llanfair Dc
Water Level (mOD)
Measuring level : 83.08
80.4
80.0
79.6
79.2
78.8
1989
1990
1991
1992
Well No: SJ15/15 Aquifer: Permo-triassic Sandstone
+ extremes & mean monthly levels (1972-1988)


Weeford Flats
Water Level (mOD)
Measuring level : 96.21
91.0
90.0
89.0
1989
1990
1991
1992
Well No: SK10/9 Aquifer: Permo-triassic Sandstone
+ extremes & mean monthly levels (1966-1988)


Bussels No.7a
Water Level (mOD)
Measuring level : 26.97
25.0
24.0
23.0
1989
1990
1991
1992
Well No: SX99/37B Aquifer: Permo-triassic Sandstone
+ extremes & mean monthly levels (1971-1988)

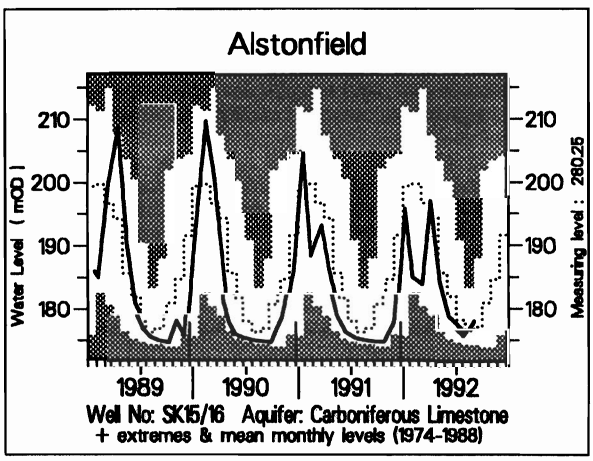

Alstonfield
Water Level (mOD)
Measuring level : 280.25
210
200
190
180
1989
1990
1991
1992
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1988)

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

Site	Aquifer	Records commence	Average August Level	August 1976 Day	August 1976 Level	August 1991 Day	August 1991 Level	August/ Sept. 1992 Day	August/ Sept. 1992 Level	No of years August/levels <1992	Lowest pre-1992 level (any month)
Wetwang	C & UGS	1971	20.04	17/08	18.57	29/08	18.74	01/09	18.26	1	16.84
Dalton Holme	C & UGS	1889	16.46	28/08	12.32	28/08	11.38	04/09	11.26	0	10.34
Little Brocklesby	C & UGS	1926	12.55	27/08	4.87	28/08	6.50	25/08	4.86	0	4.54
Washpit Farm	C & UGS	1950	44.38	01/08	41.70	01/08	41.51	01/09	40.49	0	40.61
The Holt	C & UGS	1964	87.82	09/08	85.00	25/08	85.38	01/09	84.38	0	83.90
Therfield Rectory	C & UGS	1883	80.71	29/08	74.22	25/08	73.50	01/09	dry	_	dry (below 71.60)
Redlands Farm	C & UGS	1964	42.22	01/08	36.50	21/08	35.29	14/08	32.73	0	32.46
Rockley	C & UGS	1933	132.01	29/08	dry	25/08	130.78	01/09	130.26	9	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	67.58	09/08	59.75	29/08	62.84	01/09	60.54	1	56.77
Compton House	C & UGS	1894	34.30	26/08	28.15	28/08	34.39	04/09	30.88	5	27.64
Chilgrove House	C & UGS	1836	42.45	28/08	33.68	28/08	43.97	04/09	38.74	>10	33.46
West Dean No 3	C & UGS	1940	1.45	24/08	1.21	30/08	1.49	28/08	1.44	>10	1.01
Lime Kiln Way	C & UGS	1969	125.20	15/08	124.21	15/08	124.58	11/08	123.86	0	124.09
Ashton Farm	C & UGS	1974	65.98	12/08	63.80	01/08	64.30	03/09	64.94	5	63.10
West Woodyates	C & UGS	1942	74.01	01/08	68.71	02/08	77.70	03/09	72.59	>10	67.62
New Red Lion	LLst	1964	12.77	24/08	3.29	27/08	8.16	24/08	9.06	4	3.29
Ampney Crucis	Mid Jur	1958	100.26	29/08	98.58	19/08	100.00	10/08	100.04	>10	97.38
Dunmurry (NI)	PTS	1985	28.05	no	levels	29/08	27.59	28/08	28.05	6	27.47
Redbank	PTS	1981	4.57	no	levels	06/08	4.11	31/08	4.43	6	3.93
Llanfair DC	PTS	1972	79.67	01/08	78.95	20/08	79.14	17/08	78.95	1	78.85
Morris Dancers	PTS	1969	32.58	26/08	31.87	19/08	32.03	11/08	31.93	1	30.87
Weeford Flats	PTS	1966	90.20	19/08	dry	22/08	dry	03/09	dry	_	dry (below 88.61)
Bussels 7A	PTS	1972	23.57	31/08	22.90	31/08	23.51	13/08	23.15	1	22.90
Rushyford NE	MgLst	1967	76.06	31/08	65.49	15/08	75.34	04/08	74.60	>10	64.77
Peggy Ellerton	MgLst	1968	34.42	23/08	31.17	12/08	33.19	11/08	31.38	1	31.10
Alstonfield	CLst	1974	177.30	12/08	174.70	08/08	175.47	02/09	178.06	>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