Hydrological Summary for Great Britain

SEPTEMBER 1995

Rainfall

The persistently anticyclonic conditions and accompanying heatwave, which dominated the weather over the latter half of the summer gave way at the end of August. Light rainfall over the Bank Holiday heralded a remarkably unsettled spell as the weather, and thence the landscape, took on a very autumnal complexion. Some areas recorded more rainfall over the first ten days of September than in the preceding ten weeks. Provisional data indicated that the second driest August for Britain (in a series from 1869) was succeeded by the second wettest September (after 1918). The 7-11th was particularly wet; the remnant of Hurricane Iris produced sustained rainfall in southern Britain and a near-stationary front over north-east Scotland added to already outstanding rainfall totals in the Grampian region (Kinloss >250 mm by the 11th and Tullynessle - in the Dee catchment - recorded a September total more than four times the average). The transformation in weather conditions echoes the dramatic terminal phases to the 1976 and 1984 droughts. Importantly however, the notable national September rainfall total was associated with substantial spatial variability. For much of the month the synoptic pattern was complex and rain-bearing frontal systems failed to penetrate to parts of northern England particularly. Whilst record September rainfall totals were established in north-eastern Scotland and much of the English lowlands registered around twice the monthly mean, below average rainfall totals were reported from a number of strategically important gathering grounds (e.g. Vyrnwy 56%, Haweswater 69%). Broadly, the lower rainfalls coincided with those areas where the water resources stress was most acute; April-September rainfall in parts of the Lake District was still below half the long term average. Over most of Britain however, return periods associated with regional post-March rainfall deficiencies have been greatly moderated, in southern regions especially, and regional rainfall totals for the year thus far are mostly within the normal range.

River Flow

In most regions soil moisture deficits declined steeply through September but they still exercised a major influence on runoff patterns. Localised urban flooding (e.g. on Merseyside on the 6th, Southampton on the 11th) and transport disruption (in the Grampian region especially) were common occurrences but river flows picked up only sluggishly in most regions. Exceptions included north-eastern Scotland where runoff rates climbed rapidly early in the month culminating in significant floodplain inundation in the second week; on the 10th the River Dee established a new maximum September flow rate in a 23-year record. Moderate recessions were re-established thereafter but monthly runoff totals for almost all index catchments were within the normal range, albeit mostly well below average. Particularly low flows were recorded in northern England - September runoff on the Eden and South Tyne was the second lowest on record - and in Wales. In the six-month timeframe runoff totals are depressed but - some rivers draining from the Pennines excepted - not remarkably so. A measure of the transformation over the water-year is provided by the notably high October-September runoff accumulations for most catchments.

Groundwater

By late September SMDs had been eliminated in northern and western Scotland but were still substantial (typically 50-80 mm) in the outcrop areas of the major aquifers. Generally, September saw groundwater level recessions continue but with a slackening of the rate of decline particularly in the more responsive south-western aquifers. In the Chalk, early autumn levels remain within the normal range although there are distinct regional contrasts - many southern boreholes are at their lowest since the 1988-92 drought whilst above average levels characterise a few, mostly deep, eastern wells. In the confined Permo-Triassic the benefit of recharge last year is still evident (e.g. at Morris Dancers) whereas levels remain depressed in Scotland. Groundwater resources are largely insensitive to spring and summer rainfall deficiencies and provided an important buffer to limit the drought's impact. However, a dry latter half of the autumn would result in recoveries having to be generated from a very low base.

General

Heavy September rainfall, declining evaporation losses and water demands have greatly moderated the immediate stress on water resources in most areas. The meteorological drought is much reduced in intensity but the water resources outlook remains fragile. Further depletion of stocks in September left some important reservoirs in northern England at well below 20% of capacity. In early October overall stocks stood at their lowest (but similar to the 1989 minimum) since national monitoring began. Above average rainfall is needed over the next two months to generate sustained recoveries in river flows, reservoir stocks and groundwater resources.

Institute of Hydrology

British Geological Survey

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. Figure 3 is based on weather data collected by the Institute of Hydrology at Wallingford, Balquhidder (Central Region, Scotland) and Plynlimon. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothian and Strathclyde Regional Councils. The most recent areal rainfall figures are derived from a restricted network of raingauges 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.

Financial support towards the production of the Hydrological Summaries is given by the Department of the Environment and the National Rivers Authority.

The Hydrological Summaries are available on annual subscription at a current cost of £48 per year - enquiries should be directed to the National Water Archive Office at the address below. No charge is made to those organisations providing data for the Summaries.

* For reasons of consistency and to provide greater spatial discrimination, the original ten regional divisions of the NRA have been retained for use in the Hydrological Summaries.

MORECS

Most of the recent monthly regional rainfall data featured in the Hydrological Summaries are MORECS assessments. MORECS is the generic name for The Meteorological Office services involving the calculation of evaporation and soil moisture routinely for Great Britain. Products include a weekly issue of maps and tables of potential and actual evaporation, soil moisture deficits, effective rainfall and the hydrometeorological variables used to calculate them. The data are used to provide values for 40 km squares - or larger areas - and various sets of maps and tables are available according to user requirements. Options include a day-by-day retrospective calculation of soil moisture at any of 4000 rain-gauge sites.

Further information about MORECS services may be obtained from: The Meteorological Office, Sutton House, London Road, Bracknell, RG12 2SY

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 11 October 1995

TABLE 1 1994/95 RAINFALL AS A PERCENTAGE OF THE 1961-90 AVERAGE

Note: The monthly rainfall figures are the copyright of The Meteorological Office.
These data may not be published or passed on to any unauthorised person or organisation.

		Sep 1994	Oct	Nov	Dec	Jan 1995	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
England and Wales	mm	106	97	86	142	161	115	64	27	48	22	39	15	126
	%	138	114	96	151	183	183	89	45	75	34	63	19	164
NRA REGIONS														
North West	mm	113	123	36	207	208	165	88	28	62	35	63	21	117
	%	98	96	111	167	172	212	93	39	83	43	74	20	101
Northumbrian	mm	77	71	97	124	121	108	60	38	53	31	29	15	114
	%	105	93	113	153	144	183	86	68	85	52	45	18	156
Severn Trent	mm	127	68	73	115	131	89	52	20	49	13	36	10	89
	%	198	106	103	149	187	165	85	36	83	22	68	15	139
Yorkshire	mm	101	73	89	123	133	100	65	26	44	22	29	13	111
	%	149	100	111	148	168	172	96	44	73	37	49	18	163
Anglian	mm	89	70	32	59	98	62	51	16	31	25	26	9	105
	%	182	137	55	107	196	168	109	35	65	49	53	16	213
Thames	mm	74	85	53	93	137	82	50	18	37	16	32	4	117
	%	125	137	82	133	214	182	89	36	66	29	65	7	198
Southern	mm	90	118	66	123	163	112	58	18	25	20	31	8	138
	%	130	148	78	150	204	207	92	34	46	37	65	13	200
Wessex	mm	99	115	96	139	184	111	57	34	53	14	26	12	136
	%	138	146	116	149	211	171	81	64	87	25	50	18	189
South West	mm	131	140	127	214	233	165	92	50	55	19	45	18	129
	%	141	121	102	154	169	163	93	72	76	28	65	21	139
Welsh	mm	134	139	134	255	238	182	84	36	72	26	67	18	123
	%	117	101	94	167	166	188	79	45	88	33	87	17	107
Scotland	mm	103	110	156	245	227	205	147	67	85	44	85	29	199
	%	73	71	103	162	150	201	118	88	99	51	90	25	140
RIVER PURIFICATION BOARDS														
Highland	mm	153	116	169	304	299	271	185	99	90	47	99	43	271
	%	89	59	83	154	159	213	114	109	98	48	93	34	158
North East	mm	89	87	89	93	134	83	72	65	79	54	46	20	262
	%	102	90	90	100	135	128	92	108	114	82	63	23	301
Tay	mm	56	115	154	196	184	185	125	38	99	32	69	15	179
	%	49	88	127	154	128	195	115	61	119	44	90	16	157
Forth	mm	56	90	134	210	154	171	91	33	69	32	69	15	133
	%	51	78	120	191	131	216	97	56	93	46	92	16	121
Tweed	mm	57	75	123	173	129	109	75	37	66	35	43	19	110
	%	64	79	132	186	129	163	95	65	93	54	59	22	124
Solway	mm	76	117	184	246	222	173	146	41	85	43	77	24	116
	%	53	75	128	166	142	171	125	53	100	51	86	20	81
Clyde	mm	98	128	189	322	257	251	192	65	81	45	124	32	137
	%	55	66	105	180	136	213	131	77	89	48	114	24	77

Note: The monthly rainfall figures for the NRA regions for August & September correspond to the MORECS areal assessments derived by the Meteorological Office. In northern England these initial assessments may have a particularly wide error band associated with them. The figures for the RPB regions for August & September 1995 were derived by IH in collaboration with the RPBs. The provisional figures for England and Wales and for Scotland are derived using a different raingauge network. 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

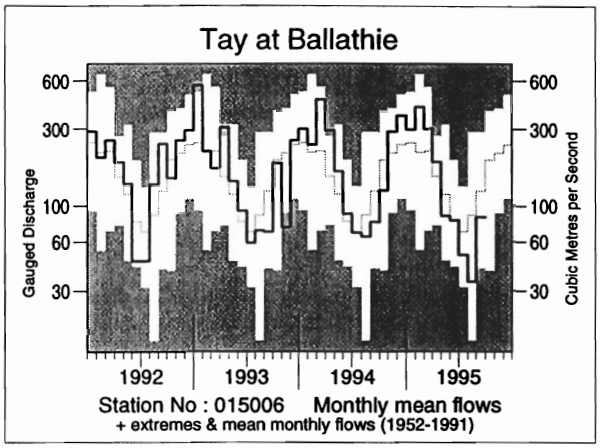
		Jul 95-Sep 95		Apr 95-Sep 95		Jan 95-Sep 95		Oct 94-Sep 95	
			Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years
England and Wales	mm	180		277		617		942	
	% LTA	84	2-5	69	20-35	98	2-5	105	2-5
NRA REGIONS									
North West	mm	201		326		787		1253	
	% LTA	65	5-15	61	50-80	95	2-5	104	2-5
Northumbria	mm	157		279		568		860	
	% LTA	72	5-10	70	15-25	93	2-5	101	2-5
Severn Trent	mm	135		217		489		745	
	% LTA	74	5-10	61	40-60	90	2-5	99	2-5
Yorkshire	mm	153		245		543		828	
	% LTA	76	5-10	64	30-40	93	2-5	101	2-5
Anglian	mm	139		211		422		583	
	% LTA	91	2-5	71	10-20	98	2-5	98	2-5
Thames	mm	153		224		493		724	
	% LTA	92	2-5	69	10-20	100	<2	105	2-5
Southern	mm	177		240		573		880	
	% LTA	101	2-5	71	10-15	108	2-5	113	2-5
Wessex	mm	174		275		627		977	
	% LTA	92	2-5	76	5-10	108	2-5	117	5-10
South West	mm	191		315		805		1286	
	% LTA	78	2-5	69	10-20	101	2-5	110	2-5
Welsh	mm	207		341		845		1373	
	% LTA	71	5-10	64	30-50	96	2-5	105	2-5
Scotland	mm	313		509		1088		1599	
	% LTA	89	2-5	85	5-10	111	5-10	111	5-10
RIVER PURIFICATION BOARDS									
Highland	mm	413		649		1404		1993	
	% LTA	102	2-5	95	2-5	121	10-20	113	5-10
North East	mm	328		526		815		1084	
	% LTA	133	10-15	119	5-10	119	10-15	111	5-10
Tay	mm	263		432		926		1391	
	% LTA	92	2-5	86	2-5	109	2-5	113	5-10
Forth	mm	217		351		767		1201	
	% LTA	78	5-10	73	10-20	99	2-5	108	2-5
Tweed	mm	172		310		623		994	
	% LTA	69	5-10	70	20-30	90	2-5	102	2-5
Solway	mm	217		386		927		1474	
	% LTA	62	10-20	65	40-60	95	2-5	104	2-5
Clyde	mm	293		484		1184		1823	
	% LTA	69	5-15	70	35-40	103	2-5	107	2-5

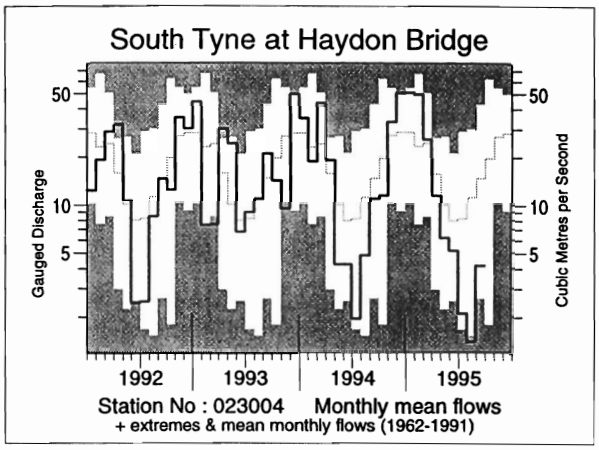
LTA refers to the period 1961-90.

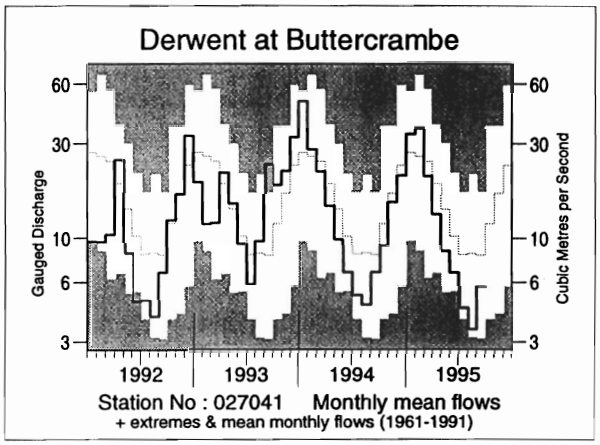
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined. The ranking of accumulated rainfall totals for England & Wales and for Scotland can be affected by artifacts in the historical series - on balance these tend to exaggerate the relative wetness of the recent past.

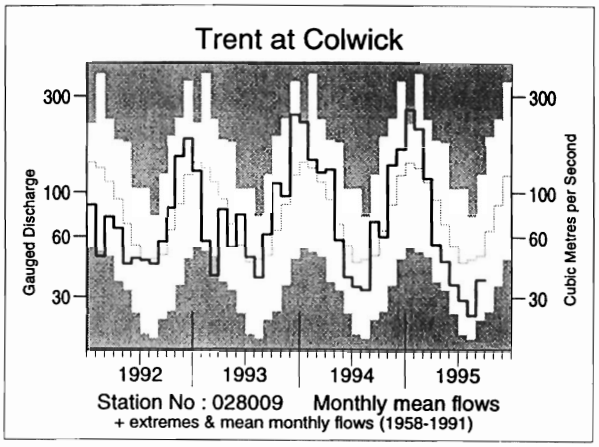
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

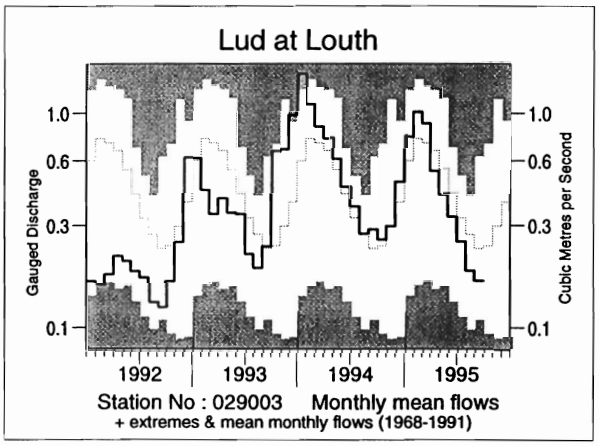
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

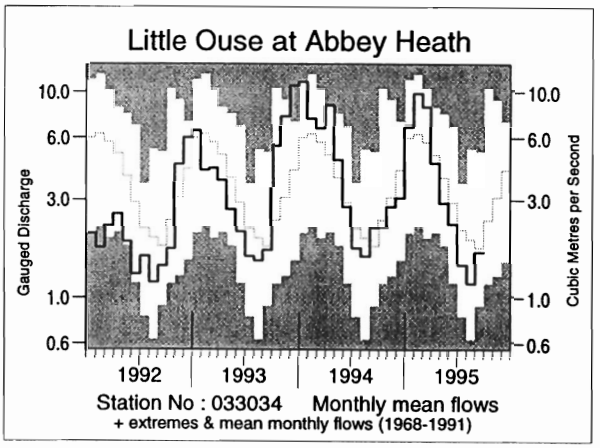


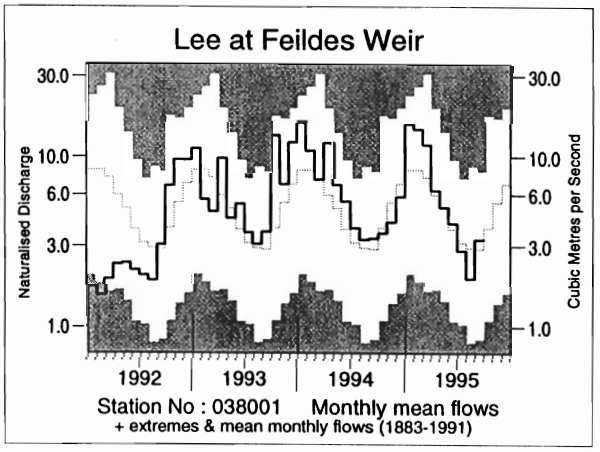


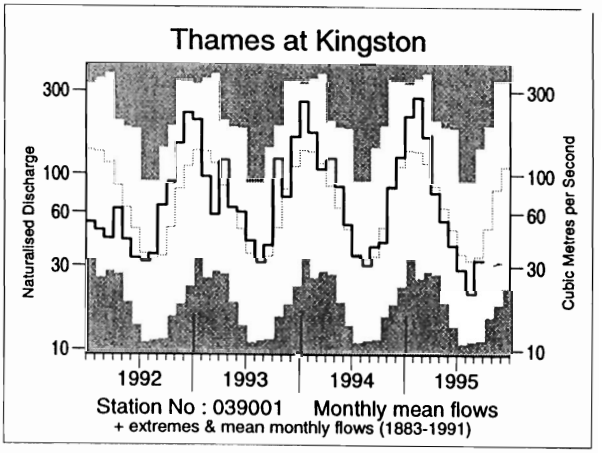


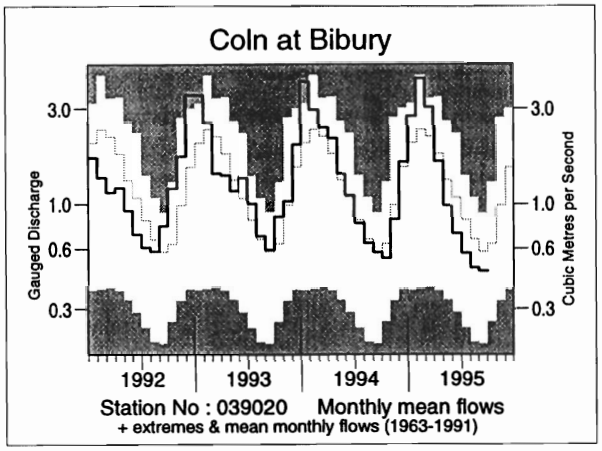


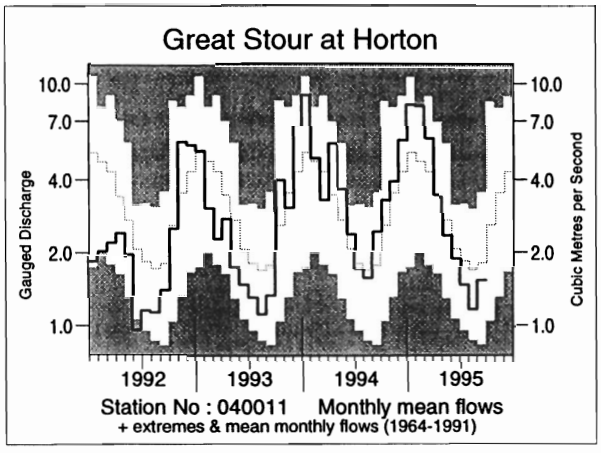


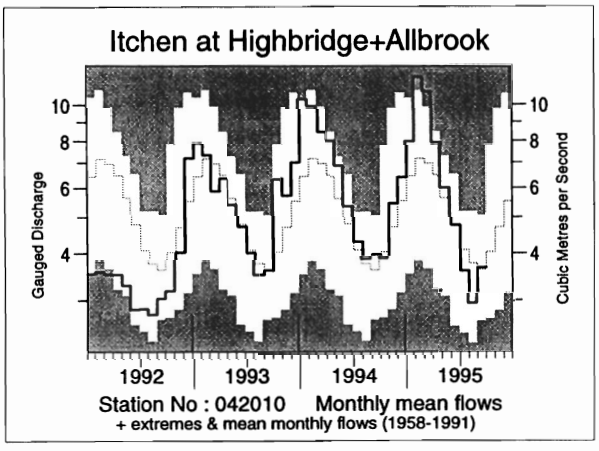


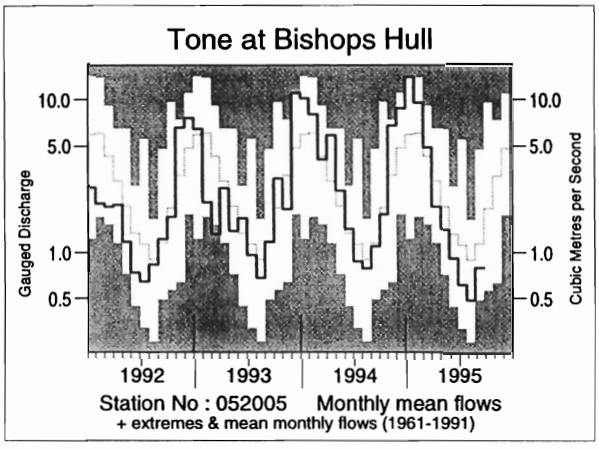


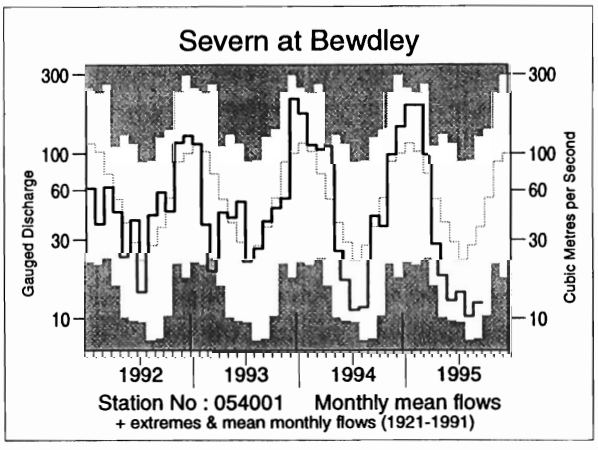


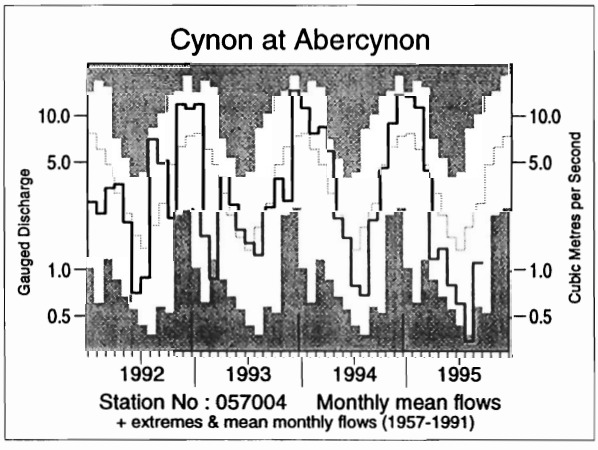

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1992
1993
1994
1995
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

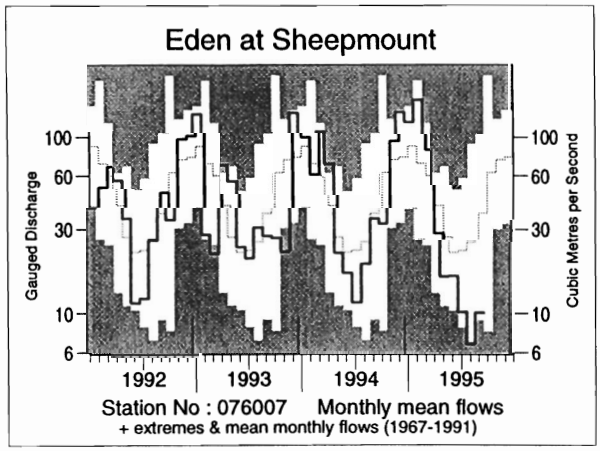

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1992
1993
1994
1995
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1991)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1992
1993
1994
1995
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1991)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1992
1993
1994
1995
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1991)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1992
1993
1994
1995
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1991)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1992
1993
1994
1995
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1991)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
6
1992
1993
1994
1995
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1991)

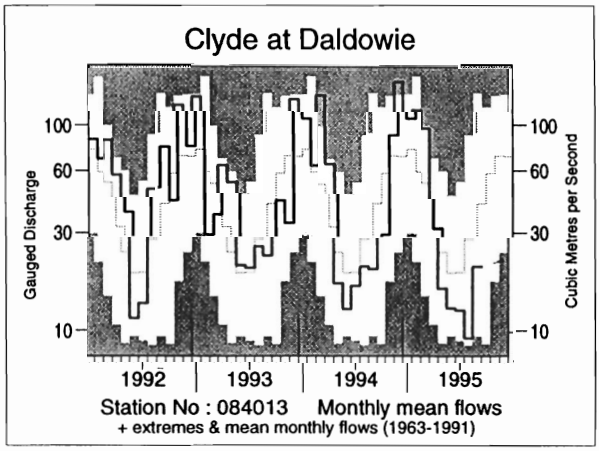

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1992
1993
1994
1995
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

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	May 1995	Jun	Jul	Aug	Sep 1995		7/95 to 9/95		4/95 to 9/95		1/95 to 9/95		10/94 to 9/95	
	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	55 88	46 126	16 59	9 30	136 332	23 /23	161 159	21 /23	329 118	19 /23	599 110	15 /23	802 100	11 /22
Tay at Ballathie	50 72	46 102	29 73	20 39	48 69	13 /43	97 61	6 /43	298 82	8 /43	865 113	34 /43	1314 116	37 /43
Tweed at Boleside	24 55	19 72	14 52	12 32	23 48	9 /35	49 44	4 /35	128 55	3 /35	584 116	28 /35	931 121	33 /34
Whiteadder Water at Hutton Castle	13 48	13 79	7 59	5 36	11 70	14 /27	23 56	7 /26	68 56	7 /26	182 66	5 /26	258 66	6 /26
South Tyne at Haydon Bridge	22 60	18 67	7 27	5 13	14 28	2 /32	27 23	1 /32	107 45	1 /32	538 107	19 /32	872 113	25 /32
Wharfe at Flint Mill Weir	13 35	11 44	10 39	7 17	11 25	3 /40	28 26	2 /40	78 35	1 /40	476 100	20 /40	773 108	30 /40
Derwent at Buttercrambe	15 63	11 68	7 55	6 42	9 66	8 /34	23 55	4 /34	70 63	4 /34	216 92	15 /34	292 90	12 /34
Trent at Colwick	16 66	12 63	10 65	9 54	13 74	12 /37	32 65	6 /37	79 64	3 /37	278 108	22 /37	405 114	27 /37
Lud at Louth	20 80	15 80	12 80	9 70	8 71	8 /28	29 77	8 /27	90 80	9 /27	216 103	14 /27	266 103	14 /27
Witham at Claypole Mill	9 59	6 58	3 48	3 51	4 63	11 /37	11 55	5 /37	40 60	5 /36	157 109	22 /36	234 125	25 /36
Little Ouse at Abbey Heath	11 77	8 82	5 68	4 62	6 95	14 /27	16 75	8 /27	52 82	10 /27	144 110	16 /27	174 105	15 /26
Mimram at Panshanger Park	17 136	13 125	11 112	9 98	10 119	32 /43	29 109	27 /43	78 124	33 /43	135 135	38 /43	167 132	37 /42
Lee at Feildes Weir (natr.)	13 102	10 108	7 90	5 67	8 114	81 /110	21 90	47 110	60 100	54 /109	165 136	92 /109	200 122	77 /109
Thames at Kingston (natr.)	15 84	10 81	8 82	6 63	8 94	61 /113	22 80	38 /113	67 84	40 /113	236 130	95 /113	303 123	81 /112
Coln at Bibury	24 75	17 66	14 69	12 72	11 79	8 /32	38 73	4 /32	119 78	8 /32	361 115	24 /32	435 110	18 /32
Great Stour at Horton	18 87	14 94	12 83	9 70	12 87	14 /31	32 81	8 /31	91 89	10 /29	260 124	25 /29	361 123	23 /28
Itchen at Highbridge+Allbrook	45 107	34 100	27 89	22 79	26 101	19 /37	75 90	7 /37	211 102	21 /37	432 121	34 /37	548 118	31 /37
Stour at Throop Mill	16 70	10 64	6 57	4 45	9 75	8 /23	20 61	4 /23	72 68	5 /23	384 137	20 /23	545 136	20 /22
Exe at Thorverton	20 54	12 51	8 41	6 22	15 39	9 /40	30 35	2 /40	91 45	4 /39	602 115	31 /39	1048 126	37 /39
Taw at Umberleigh	11 39	6 34	4 27	3 15	6 25	7 /37	13 23	1 /37	51 35	4 /37	490 116	30 /37	878 126	34 /37
Tone at Bishops Hull	19 72	12 70	8 56	7 55	10 69	12 /35	26 61	5 /35	83 67	3 /35	455 135	32 /34	686 144	33 /34
Severn at Bewdley	11 49	8 44	9 65	6 38	7 34	11 /75	23 44	6 /75	59 47	4 /75	350 116	54 /74	521 115	55 /74
*Teme at Knightsford Bridge	9 47	5 37	4 48	2 19	3 29	2 /26	8 32	1 /26	36 40	2 /26	297 116	19 /25	443 121	24 /25
Cynon at Abercynon	35 60	20 50	15 46	9 17	28 41	9 /37	52 35	3 /37	136 42	2 /37	838 107	22 /37	1524 121	33 /37
Dee at New Inn	45 67	31 52	69 107	9 9	37 29	5 /27	114 41	3 /27	229 44	2 /26	1054 95	12 /26	1878 104	15 /26
Eden at Sheepmount	19 58	19 76	12 47	8 26	12 28	2 /25	31 33	1 /25	102 51	1 /25	516 113	21 /25	823 117	19 /24
Clyde at Daldowie	23 64	18 69	18 66	13 33	28 50	9 /32	59 49	4 /32	143 62	2 /32	586 116	27 /32	981 125	31 /32
Carron at New Kelso	61 64	49 61	89 75	29 18	164 65	3 /17	282 54	1 /17	580 69	1 /17	1697 100	11 /17	2519 98	8 /16
Ewe at Poolewe	92 93	78 104	63 71	33 29	145 77	8 /25	240 63	3 /25	631 90	7 /25	1653 120	22 /25	2421 112	18 /24

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 is rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1992. For the long periods (at the right of this table), the end date for the long term is 1995.

* 1994 data under review

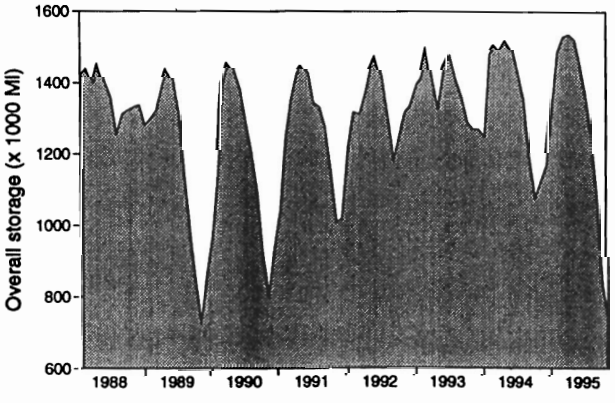
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO OCTOBER 1995

Area	Reservoir (R)/ Group (G)		Capacity ● (Ml)	1995 May	Jun	Jul	Aug	Sep	Oct	1994 Oct
North West	N.Command Zone[1]	(G)	133375	86	73	58	44	24	13	55
	Vyrnwy	(R)	55146	89	81	69	59	36	26	69
Northumbria	Teesdale[2]	(G)	87936	95	89	70	59	38	31	51
	Kielder	(R)	199175*	89*	90*	91*	87*	85*	82*	89*
Severn-Trent	Clywedog	(R)	44922	96	96	86	73	48	43	70
	Derwent Valley[3]	(G)	39525	97	86	72	59	44	36	53
Yorkshire	Washburn[4]	(G)	22035	88	78	63	50	34	24	42
	Bradford supply[5]	(G)	41407	89	70	54	38	21	15	48
Anglian	Grafham	(R)	58707	96	95	94	88	71	72	88
	Rutland	(R)	130061	87	83	80	74	66	61	87
Thames	London[6]	(G)	206399	95	96	93	82	62	66	83
	Farmoor [7]	(G)	13843	97	97	94	86	64	76	97
Southern	Bewl	(R)	28170	97	94	88	81	72	69	86
	Ardingly	(R)	4685	100	99	97	66	48	46	82
Wessex	Clatworthy	(R)	5364	85	69	61	44	31	30	48
	Bristol W[8]	(G)	38666*	94*	86*	79*	67*	48*	44*	55*
South West	Colliford	(R)	28540	93	88	80	70	54	47	69
	Roadford[9]	(R)	34500	92	85	76	60	40	26	65
	Wimbleball[10]	(R)	21320	95	89	74	59	40	30	57
	Stithians	(R)	5205	86	77	61	45	31	27	50
Welsh	Celyn + Brenig	(G)	131155	100	96	87	79	57	48	71
	Brianne	(R)	62140	97	85	76	67	55	48	71
	Big Five[11]	(G)	69762	86	79	65	49	29	19	62
	Elan Valley[12]	(G)	99106	99	90	80	65	46	34	67
Lothian	Edin./Mid Lothian[13]	(G)	97639	98	90	88	79	69	64	71
	East Lothian[14]	(G)	10206	100	96	91	84	71	72	56
Strathclyde	Loch Katrine	(G)	111363	92	85	71	69	50	43	83
	Daer	(R)	22412	91	85	73	62	41	32	58
	Loch Thom	(G)	11840	92	84	77	72	59	56	80

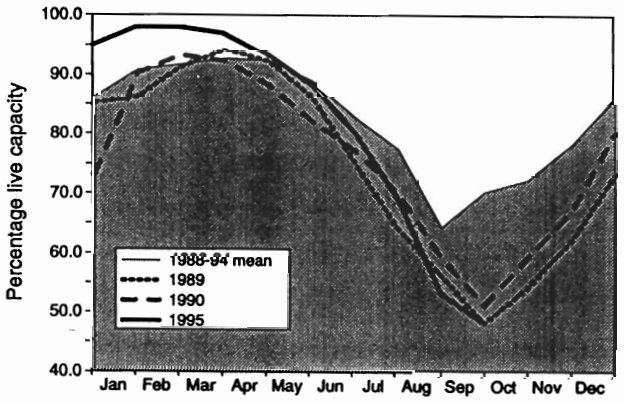
● Live or usable capacity (unless indicated otherwise) * Gross storage/percentage of gross storage

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. Roadford began filling in November 1989.
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped stroage), Taf Fechan, Taf Fawr.
12. Claerwen, Caban Coch, Pen-y-garreg and Craig Goch.
13. Megget, Talla, Fruid, Gladhouse, Torduff, Clubbiedean, Glencorse, Loganlea and Morton (upper and lower).
14. Thorters, Donolly, Stobshiel, Lammerloch, Hopes and Whiteadder

A GUIDE TO THE VARIATION IN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES



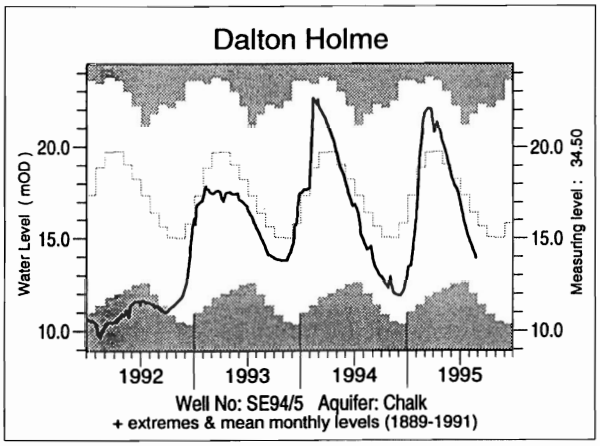
A COMPARISON BETWEEN OVERALL RESERVOIR STOCKS IN RECENT DROUGHT YEARS

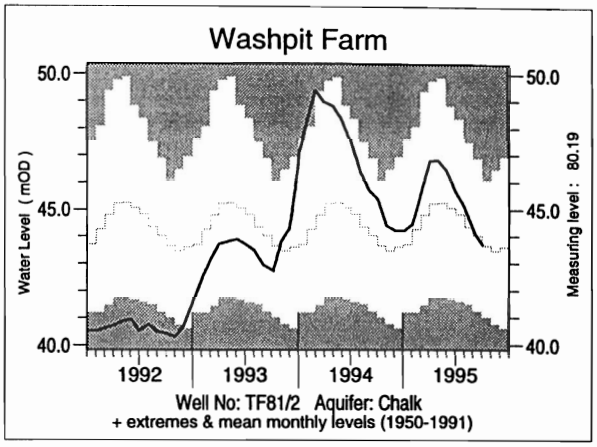


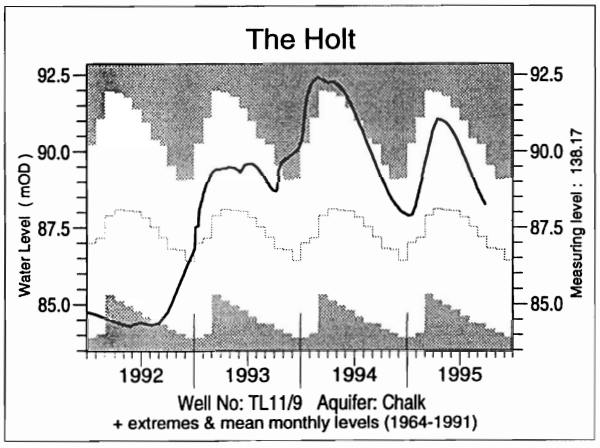
These plots are based on the reservoirs featured in Table 4 only

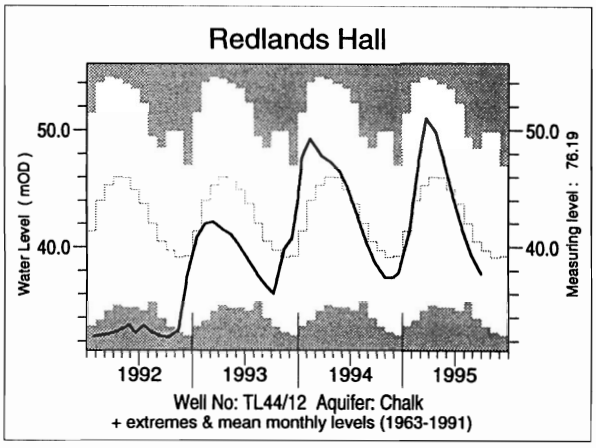
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient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

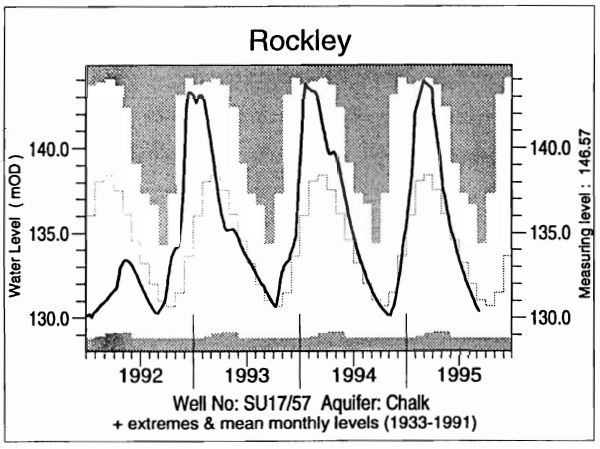
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

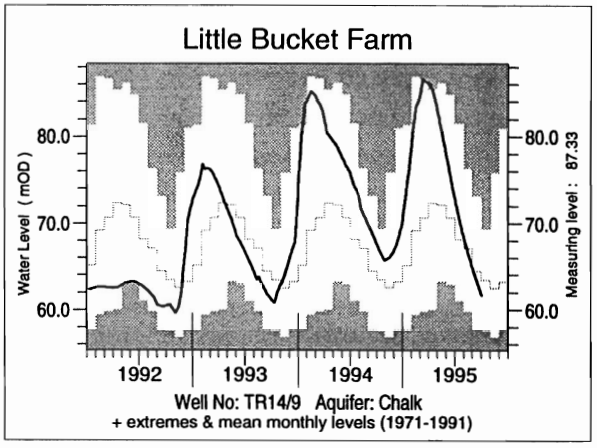


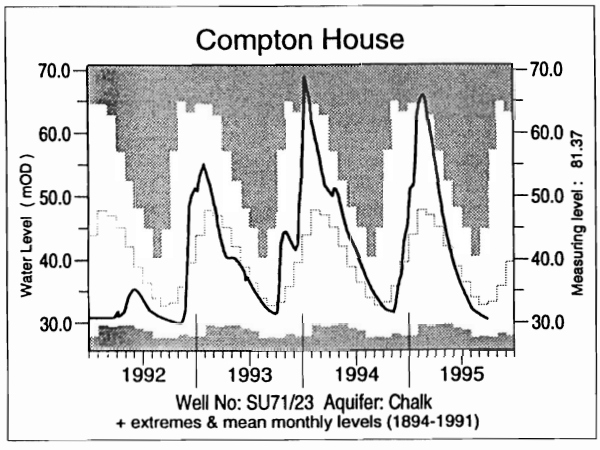


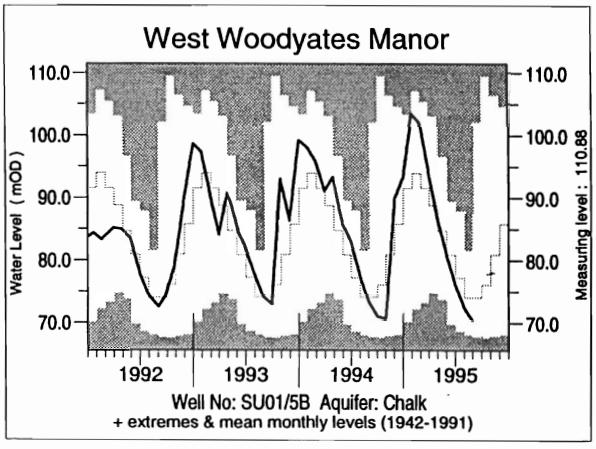


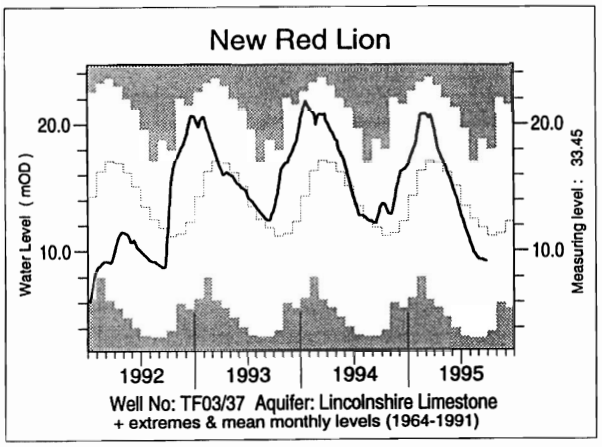


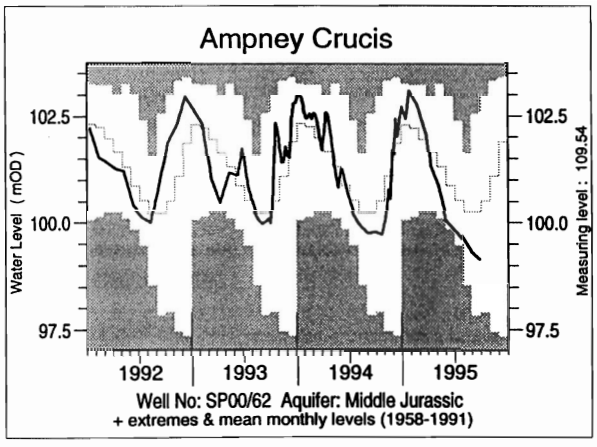


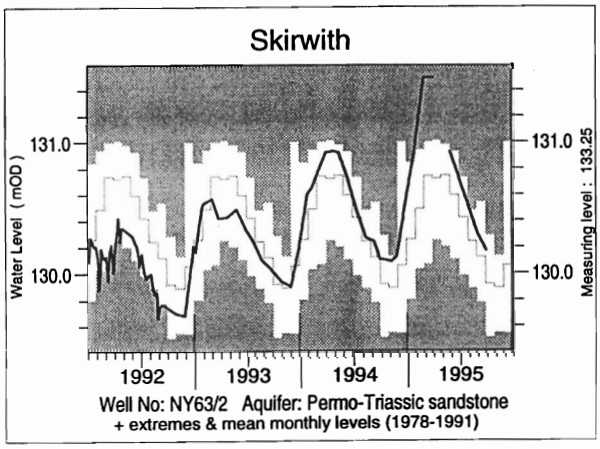


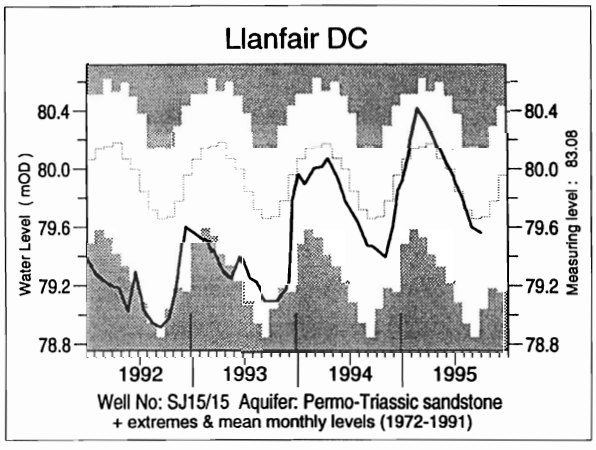


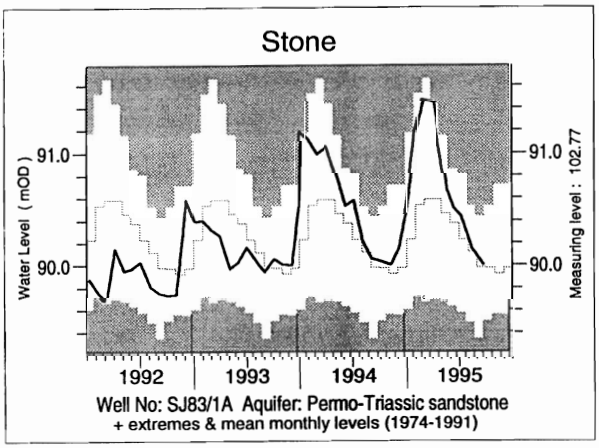


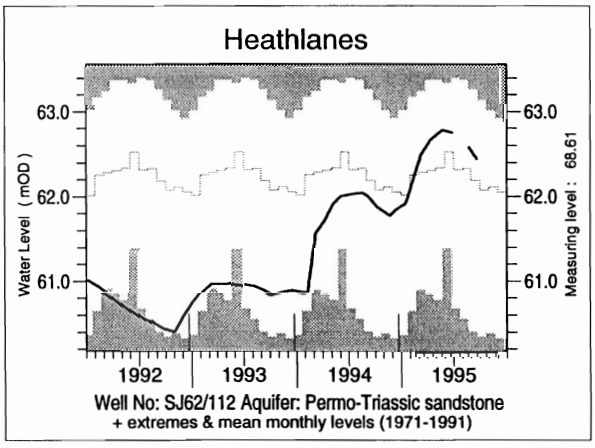

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)

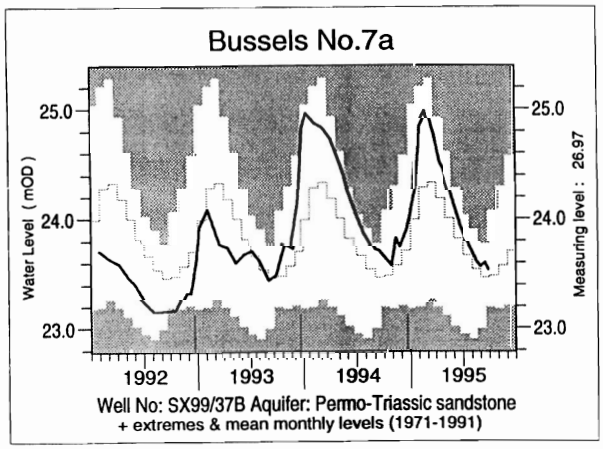

Ampney Crucis
Water Level (mOD)
102.5
100.0
97.5
Measuring level : 109.54
1992
1993
1994
1995
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1991)


Skirwith
Water Level (mOD)
131.0
130.0
Measuring level : 133.25
1992
1993
1994
1995
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-1991)


Llanfair DC
Water Level (mOD)
80.4
80.0
79.6
79.2
78.8
Measuring level : 83.08
1992
1993
1994
1995
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1991)


Stone
Water Level (mOD)
91.0
90.0
Measuring level : 102.77
1992
1993
1994
1995
Well No: SJ83/1A Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1991)


Heathlanes
Water Level (mOD)
63.0
62.0
61.0
Measuring level : 68.61
1992
1993
1994
1995
Well No: SJ62/112 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)


Bussels No.7a
Water Level (mOD)
25.0
24.0
23.0
Measuring level : 26.97
1992
1993
1994
1995
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)

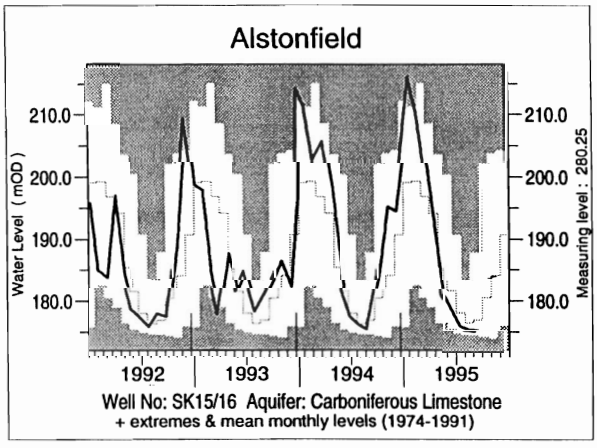

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

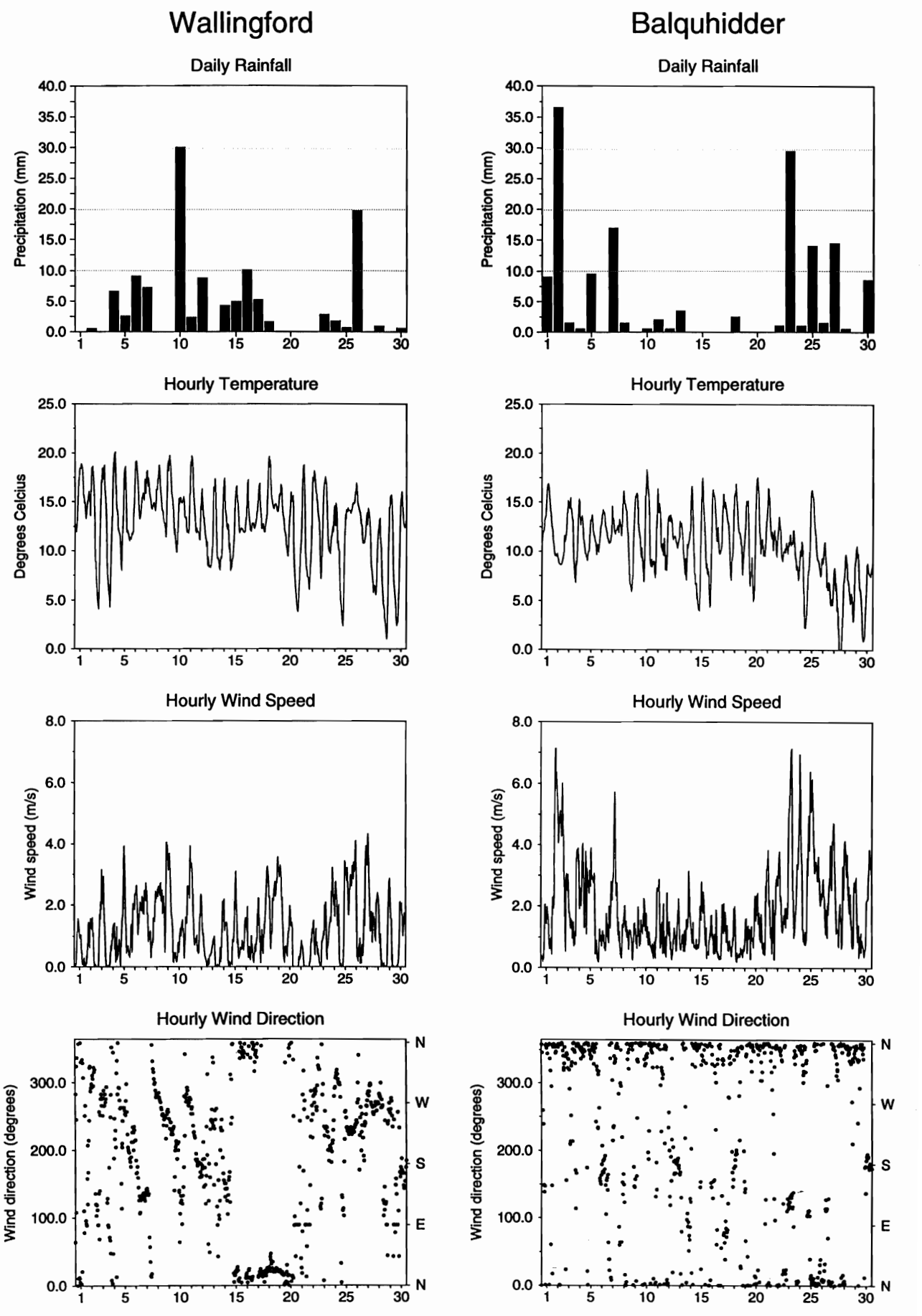
TABLE 5 SEPTEMBER GROUNDWATER LEVELS 1995

Site	Aquifer	Records commence	Minimum Sept <1995	Average Sept <1995	Maximum Sept <1995	No. of years Sept/Oct level<1995	Sept/Oct 1995 day	Sept/Oct 1995 level
Dalton Holme	C & UGS	1889	10.98	15.60	22.30	6	22/09	12.98
Wetwang	C & UGS	1971	17.61	19.34	20.73	6	22/09	18.65
Keelby Grange	C & UGS	1980	3.50	10.13	13.60	6	27/09	9.92
Washpit Farm	C & UGS	1950	40.49	43.95	46.90	>10	02/10	43.70
The Holt	C & UGS	1964	84.34	87.45	90.22	>10	25/09	88.25
Therfield Rectory	C & UGS	1883	dry <71.6	80.08	98.51	>10	25/09	81.02
Redlands Hall	C & UGS	1964	32.40	39.97	48.49	9	29/09	37.74
Rockley	C & UGS	1933	dry <128.44	131.02	134.38	>10	08/09	130.39
Little Bucket Farm	C & UGS	1971	57.64	64.98	73.12	6	02/10	61.69
Compton House	C & UGS	1984	27.72	32.90	44.90	7	28/09	30.53
Chilgrove House	C & UGS	1836	33.48	40.83	62.48	3	28/09	36.37
Westdean No.3	C & UGS	1940	1.10	1.46	1.90	>10	29/09	1.40
Lime Kiln Way	C & UGS	1969	125.63	124.99	123.85	>10	05/09	125.65
Ashton Farm	C & UGS	1974	63.23	65.24	67.07	3	29/09	64.17
West Woodyates Manor	C & UGS	1942	67.67	73.26	102.09	9	29/09	69.54
Killyglen (NI)	C & UGS	1985	113.26	114.71	118.82	2	05/10	113.42
New Red Lion	LLst	1964	3.37	11.67	18.84	6	25/09	9.16
Ampney Crucis	Mid Jur	1958	97.87	100.20	102.60	2	25/09	99.14
Redbank	PTS	1981	7.45	7.94	8.55	0	02/10	7.34
Skirwith	PTS	1978	129.75	130.12	130.54	>10	02/10	130.17
Yew Tree Farm	PTS	1973	11.08	13.24	13.75	2	09/10	12.91
Llanfair D.C	PTS	1972	78.85	79.52	80.16	10	30/09	79.56
Stone	PTS	1974	89.34	90.00	90.44	10	22/09	90.00
Heathlanes	PTS	1971	60.41	62.00	63.28	>10	20/09	62.44
Bussels No.7A	PTS	1972	22.99	23.47	23.77	>10	26/09	23.53
Rushyford NE	MgLst	1967	64.89	72.50	76.40	>10	21/09	75.95
Peggy Ellerton	MgLst	1968	31.10	33.98	36.73	10	21/09	33.88
Alstonfield	CLst	1974	174.56	177.31	188.14	6	14/09	175.21

groundwater levels are in metres above Ordnance Datum

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

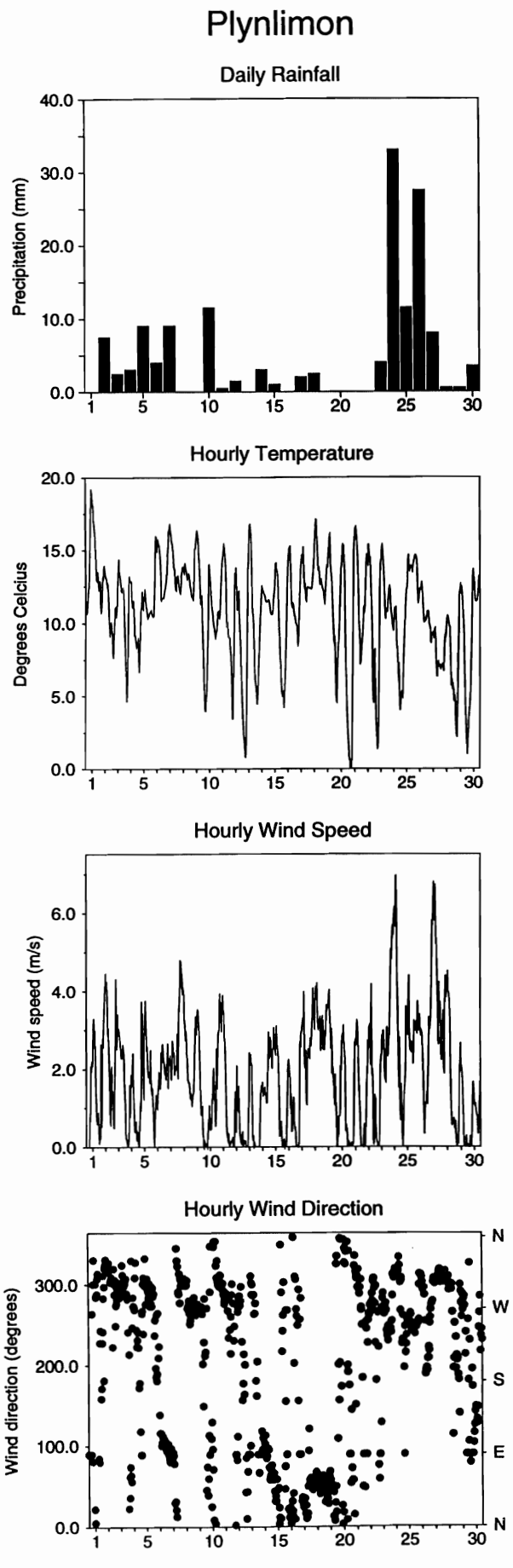
FIGURE 3 METEOROLOGICAL SUMMARY - SEPTEMBER 1995



The Institute of Hydrology Meteorological Station occupies a relatively open site on the Thames floodplain about 5km NW of the Chilterns escarpment. Station elevation is 48m

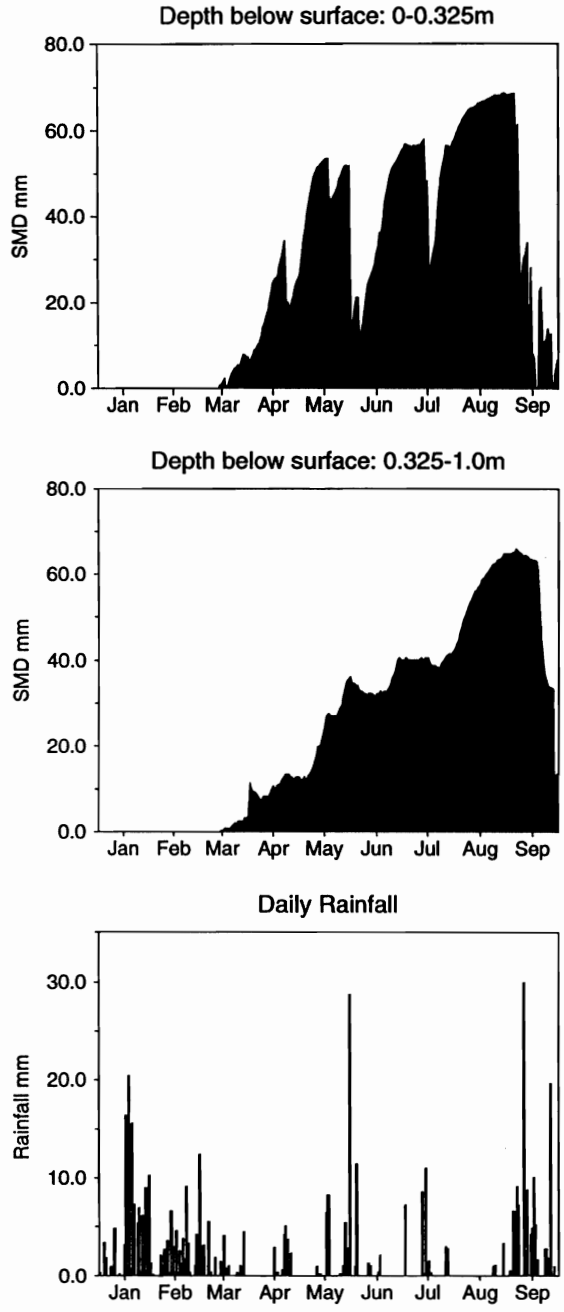
The Lower Kirkton automatic weather station (Balquhidder) occupies a relatively sheltered position at the mouth of the SSE trending Kirkton Glen. Station elevation is 270m aOD and average annual rainfall exceeds 2000mm; snow cover is expected for 10-30 days a year.

FIGURE 3 (continued)



The Dolydd automatic weather station at Plynlimon is sited in an exposed field with a forested area to the south. Surrounding land reaches a peak height of around 400m. Station elevation is 270m aOD and average annual rainfall exceeds 2300mm.

FIGURE 3a. WALLINGFORD SMD DATA 1995.



Note

Soil moisture deficit is defined as the amount by which the water stored in the soil is below the quantity held at field capacity. The data presented here are calculated from readings taken at the two automatic soil water stations (ASWSs) at Wallingford. They employ capacitance soil water sensors installed at depths of 5, 15 and 50 cm. Figure 3a shows deficits calculated from one of the stations for the depth ranges 0-0.325m (15cm probe) and 0.325-1.0m (50cm probe) at 0100 GMT on each day; slight discontinuities in the SMD trace can occur when switching between the ASWSs. The data presented give a good representative picture of soil moisture variations - avoiding the short term changes that can be dominant close to the surface.

Daily rainfall from the Wallingford meteorological station from the start of 1995 is presented.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS