Hydrological Summary for Great Britain

NOVEMBER 1996

Rainfall

November was a cold and, in most regions, a very sunny month. Unusually in these circumstances it was also notably wet. A number of upland areas in western and northern Britain recorded more than 15 mm of rain on each of the first six days and, entering the second week, the November average had been widely exceeded. Thereafter, temperatures declined as airflow from a northerly quadrant became dominant. Atlantic frontal systems continued to penetrate at intervals making for a very unsettled episode. In mid-month boisterous conditions - with gales and blizzards in the north (25 cms of snow fell at Balquhidder on the 21st/22nd) resulted in widespread transport disruption. The very varied November weather produced the full gamut of precipitation types in many areas - from fog-drip to significant snowfall. Below average November rainfall totals were registered for a few districts, mostly in north-west England, but most regions exceeded 120% of average; parts of the English lowlands registered more than twice the monthly mean. A second successive wet month in Scotland greatly reduced the 1996 rainfall deficiencies. In England and Wales, November was the wettest month since January 1995, boosting regional rainfall totals for the autumn well into the normal range and moderated medium term rainfall deficiencies - markedly in most regions. However, despite the wet November only 1933/34 has produced a drier 20-month sequence (ending in November) in the 230-year national rainfall series - but the accumulated rainfall total is now appreciably above the 20-month minima (for any start month) registered in the 1933/34 and 1975/76 droughts. Long-term rainfall deficiencies remain very large in parts of northern England - the north-west especially - and substantial in much of the eastern lowlands.

River Flow

November was a month of large spatial and temporal variations in river flows. With catchments close to saturation in western and northern Britain rivers responded briskly to the early-November rainfall - spate conditions were common around the 5th/6th and some minor flooding was reported, e.g. in the South-West. By contrast, the very dry soils in the English lowlands greatly reduced the hydrological effectiveness of the November rainfall and river flows remained very depressed over the first fortnight - only in 1990 have lower November flows been recorded on the Thames since 1947. Thereafter, recoveries gathered momentum but were sluggish in the Midlands and in most permeable catchments. NW Scotland apart, runoff totals increased substantially relative to October, and November mean flows were well above average in eastern Scotland, Wales and the South-West. Elsewhere, runoff totals were generally well within the normal range. For the Derbyshire Dove the monthly mean flow approached the average for the first time since April 1995 but in much of the drought affected region, long term runoff deficiencies have been moderated only to a limited degree; the May (95) - Nov (96) runoff totals remain the lowest on record in a significant minority of catchments (from the Ewe to the Great Stour).

Groundwater

The November rainfall distribution favoured the outcrop areas of the major aquifers - most recorded more than 50% above average - but the large late-autumn soil moisture deficits resulted in little lowland recharge before month end. In late November groundwater levels were rising briskly in most of the Permo-Triassic sandstones (the Midlands excepted). In the more northerly outcrops the recoveries began at around record minimum levels - in November the trace for Llanfair DC (N Wales) exceeded the long term minimum for the first time this year and, despite the recent upturn, levels at Skirwith (Eden Valley) were unprecedented for November. Recoveries are underway in the Middle Jurassic and Carb. Limestones but late autumn levels continued to decline in the Lincs Limestone and in much of the Chalk where recoveries will need to be generated from a very low base; November levels were exceptionally depressed at Rockley (near Swindon) and Dalton Holme (Yorkshire Wolds) registered its lowest autumn level in a 108-year record. As year-end approaches the outlook for groundwater resources is finely balanced - a dry December would greatly reduce the likelihood of Chalk levels returning to the average by the late winter.

General

High percentage rainfall totals in what is on average the second wettest month of the year significantly improved the water resources outlook. Heavy early November rainfall produced rapid increases in stocks of most gravity-fed reservoirs (particularly in the southern Pennines) and overall stocks for England and Wales are now marginally above the 1988-95 mean. Stocks are less healthy in some major lowland impoundments; this, together with the depressed groundwater levels in the Chalk, implies that careful monitoring of aquifer recharge and reservoir replenishment rates will be needed through the coming winter in order to assess resources prospects for next summer.

Institute of Hydrology

British Geological Survey

Data for this report have been provided principally by the regional divisions of the newly formed Environment Agency (England and Wales) and the Scottish Environment Protection Agency. For reasons of consistency and to provide greater spatial discrimination, the original regional divisions of the precursor organisations have been retained for use in the Hydrological Summaries. The majority of the areal rainfall figures have been provided 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 Environment Agency and, in Scotland, West of Scotland Water Authority and East of Scotland Water.

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, the Environment Agency, the Scottish Environment Protection Agency and the Office of Water Services (OFWAT).

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. The text of the monthly report, together with details of other National Water Archive facilities, is available on the World Wide Web: http://www.nwl.ac.uk:80/~nrfadata/nwa.html

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 raingauge 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 December 1996

TABLE 1 1995/96 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.

		Nov 1995	Dec	Jan 1996	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
England and Wales	mm	83	84	63	83	43	51	57	29	40	79	32	85	128
	%	92	89	72	132	60	85	89	45	65	104	42	100	142
North West	mm	76	42	53	105	36	77	56	45	58	84	52	141	146
	%	62	34	44	135	38	108	75	56	68	79	45	110	119
Northumbrian	mm	118	79	46	89	31	63	53	22	52	76	30	70	94
	%	137	98	55	151	44	113	85	37	80	94	41	93	110
Severn Trent	mm	65	81	44	67	41	50	48	30	33	68	20	74	91
	%	92	105	63	124	67	91	81	51	62	101	31	115	127
Yorkshire	mm	65	70	46	78	31	41	52	35	41	74	31	59	114
	%	81	84	58	134	46	69	87	58	69	100	46	80	143
Anglian	mm	42	69	33	50	20	15	23	18	41	75	16	47	92
	%	72	125	66	135	43	33	48	35	84	136	33	92	158
Thames	mm	64	96	50	64	35	36	34	15	38	60	20	46	103
	%	98	137	78	142	63	72	61	27	78	103	34	75	158
Southern	mm	65	95	67	68	40	23	51	16	31	78	33	55	137
	%	76	116	84	126	63	43	94	30	65	137	48	69	161
Wessex	mm	124	104	76	85	68	58	59	30	27	86	31	76	130
	%	149	112	87	131	97	109	97	53	52	130	43	96	157
South West	mm	134	126	156	119	72	79	99	35	31	97	49	118	183
	%	107	91	113	118	73	114	138	51	45	115	53	102	146
Welsh	mm	133	103	102	127	73	87	104	47	46	100	58	158	162
	%	94	67	71	131	68	109	127	59	60	99	50	115	114
Scotland	mm	126	55	89	141	60	108	77	65	77	69	62	226	205
	%	83	36	59	138	48	142	90	76	82	59	44	145	136
Highland	mm	160	48	58	152	55	111	83	83	91	78	80	241	309
	%	79	24	31	120	34	122	90	85	86	61	47	122	152
North East	mm	100	70	69	114	59	63	66	32	66	64	32	121	97
	%	101	75	70	175	76	105	96	48	90	74	37	125	98
Tay	mm	120	68	136	116	76	103	64	41	52	64	50	195	147
	%	99	54	94	122	70	166	77	56	68	68	44	150	121
Forth	mm	90	54	72	86	53	86	70	43	55	62	46	173	126
	%	80	49	61	109	56	146	95	62	73	66	42	150	113
Tweed	mm	97	64	68	103	30	79	63	31	53	64	29	144	111
	%	104	69	68	154	38	139	89	48	73	73	33	152	119
Solway	mm	113	52	135	160	74	133	80	75	70	68	56	324	165
	%	78	35	87	158	63	173	94	89	78	57	39	206	115
Clyde	mm	119	47	119	180	62	142	90	88	97	65	79	296	229
	%	66	26	63	153	42	169	99	95	89	49	44	153	127

Note: The monthly regional rainfall figures for England and Wales for October & November 1996 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, especially when snow is a significant component in the precipitation total. The figures for the Scottish regions (and also for Scotland) for October & November 1996 were derived by IH in collaboration with the SEPA regions. 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 ACCUMULATIONS AND RETURN PERIOD ESTIMATES

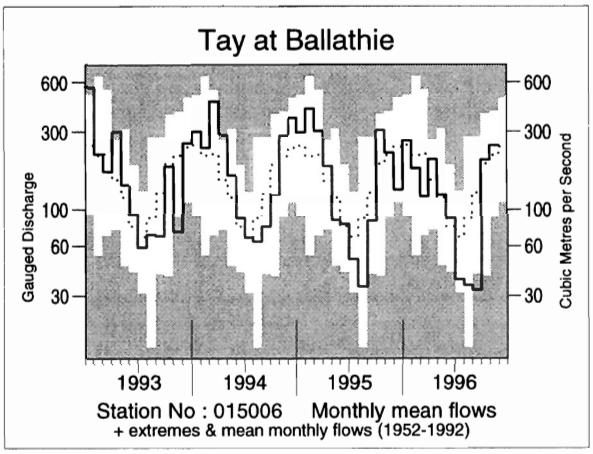
		Sep 96-Nov 96		Mar 96-Nov 96		Dec 95-Nov 96		Apr 95-Nov 96	
			Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years
England and Wales	mm	245		544		774		1177	
	% LTA	97	2-5	84	5-10	86	5-10	80	35-50
North West	mm	340		696		896		1389	
	% LTA	93	2-5	79	10-15	74	15-25	70	>>200
Northumbria	mm	195		492		706		1154	
	% LTA	83	2-5	78	10-15	83	5-15	82	20-35
Severn Trent	mm	184		454		646		970	
	% LTA	93	2-5	82	5-10	86	5-10	78	35-50
Yorkshire	mm	204		478		672		994	
	% LTA	92	2-5	79	5-15	82	5-15	73	110-150
Anglian	mm	155		347		499		761	
	% LTA	98	2-5	76	10-20	84	5-10	76	50-80
Thames	mm	169		387		597		918	
	% LTA	91	2-5	76	10-15	87	5-10	80	15-25
Southern	mm	225		464		694		1029	
	% LTA	96	2-5	82	5-10	89	2-5	80	15-25
Wessex	mm	237		565		830		1304	
	% LTA	101	2-5	95	2-5	99	2-5	96	2-5
South West	mm	350		763		1164		1725	
	% LTA	105	2-5	96	2-5	99	2-5	92	2-5
Welsh	mm	378		835		1167		1764	
	% LTA	96	2-5	91	2-5	89	2-5	83	15-25
Scotland	mm	493		949		1234		2100	
	% LTA	110	2-5	92	2-5	86	5-15	90	5-15
Highland	mm	630		1131		1389		2425	
	% LTA	110	2-5	91	2-5	79	30-45	85	15-25
North East	mm	250		600		853		1626	
	% LTA	88	2-5	84	5-10	88	5-10	101	2-5
Tay	mm	392		792		1112		1884	
	% LTA	107	2-5	92	2-5	90	2-5	95	2-5
Forth	mm	345		714		926		1579	
	% LTA	102	2-5	89	2-5	83	5-15	87	10-15
Tweed	mm	284		604		839		1395	
	% LTA	103	2-5	85	5-10	86	5-10	87	5-15
Solway	mm	545		1045		1392		2126	
	% LTA	123	5-10	103	2-5	98	2-5	92	2-5
Clyde	mm	604		1148		1494		2433	
	% LTA	109	2-5	95	2-5	88	5-10	88	5-15

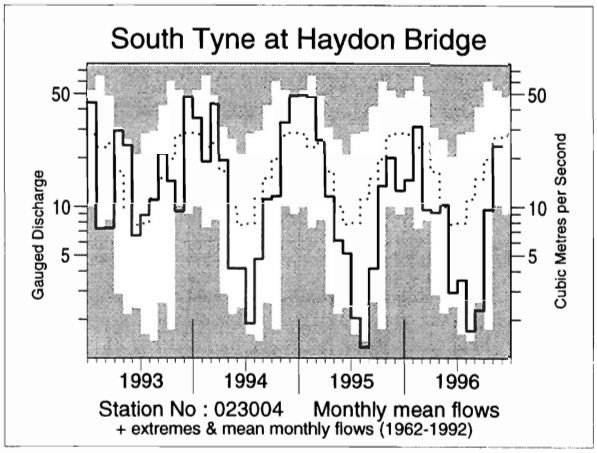
LTA refers to the period 1961-90.

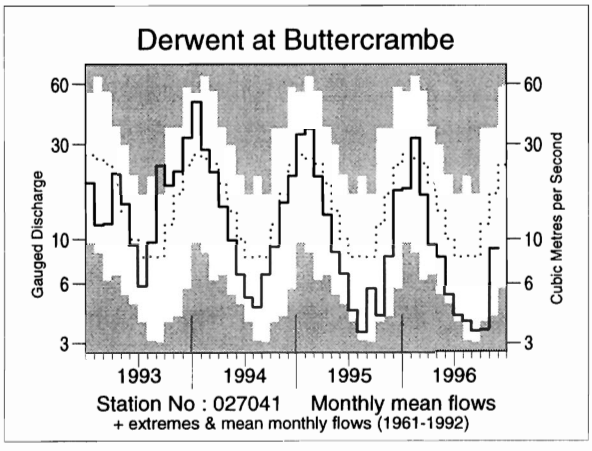
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to 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.

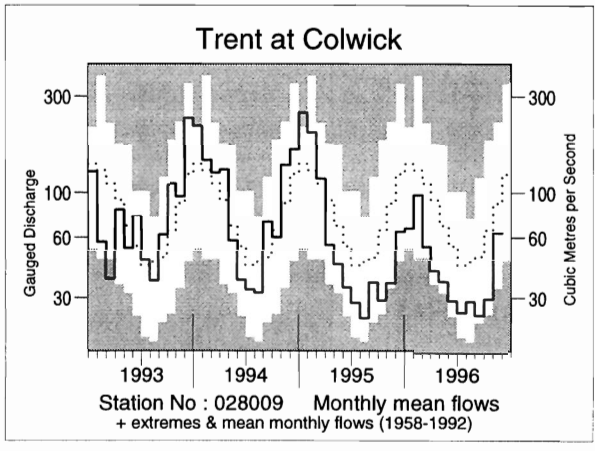
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

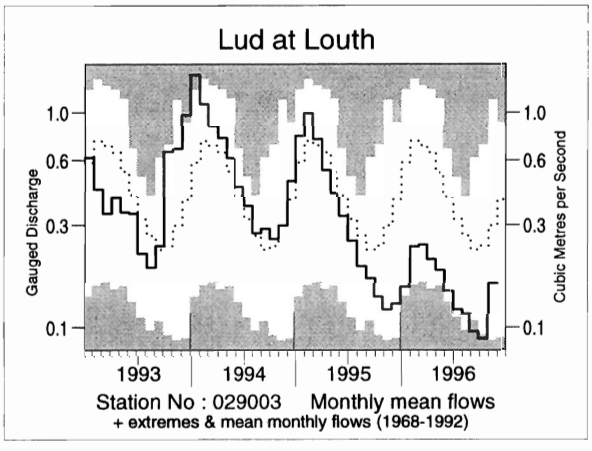
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

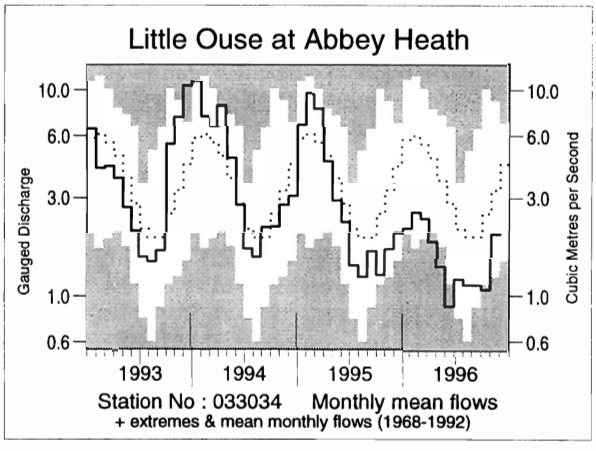


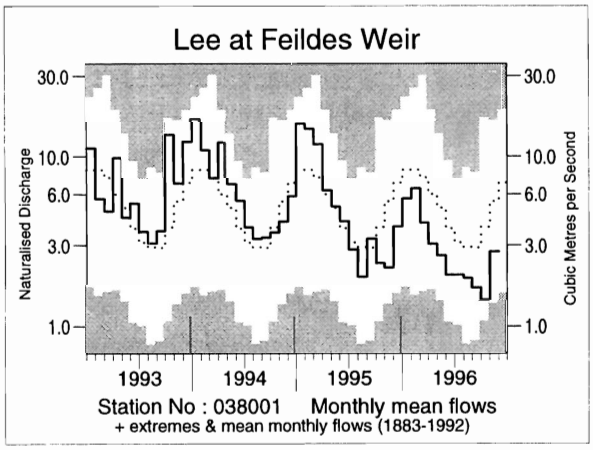


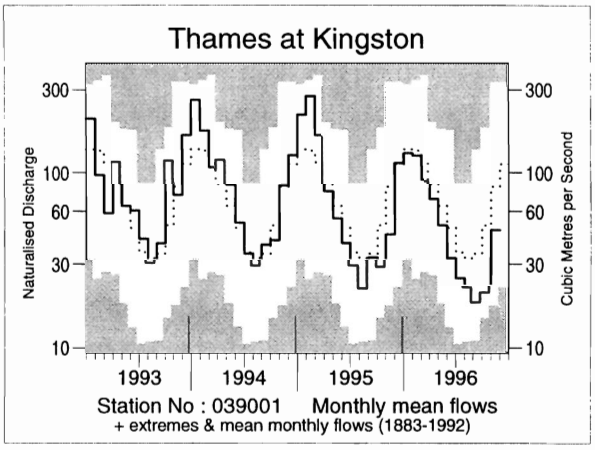


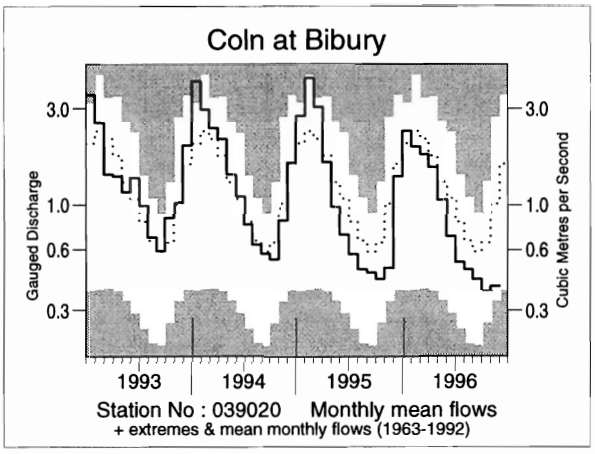


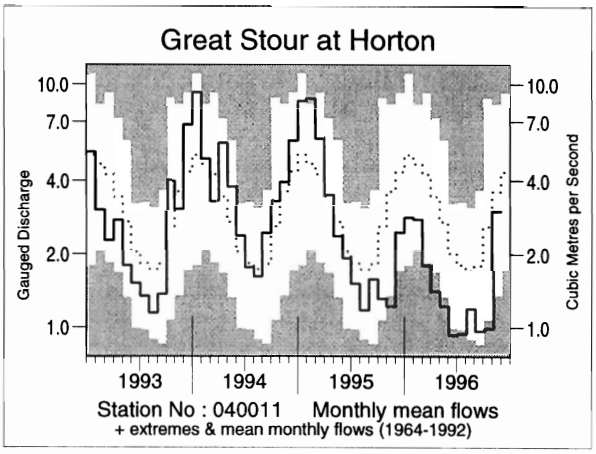


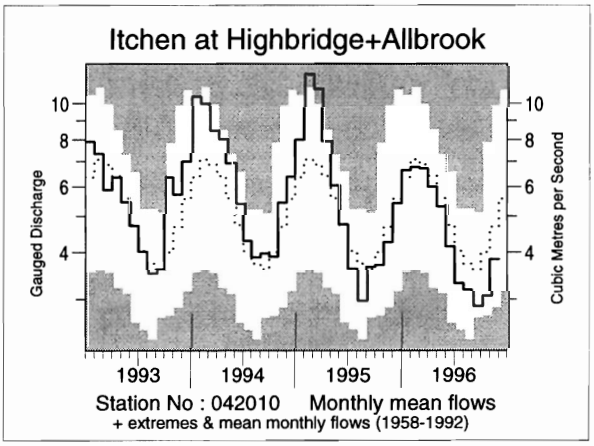


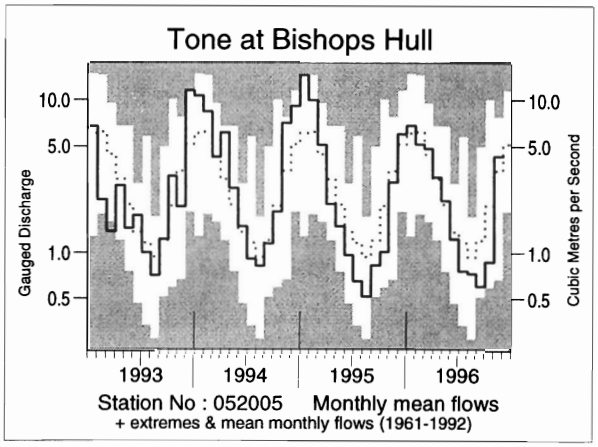


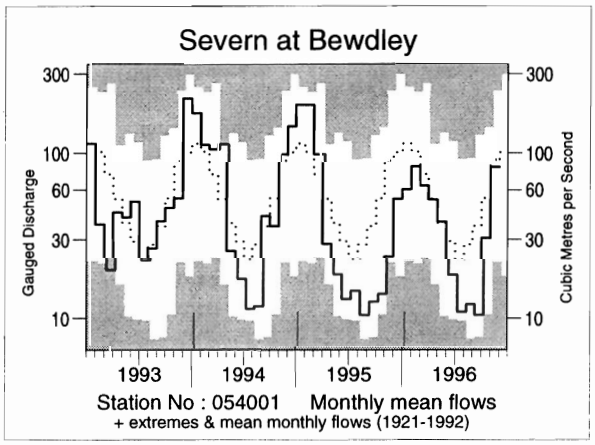


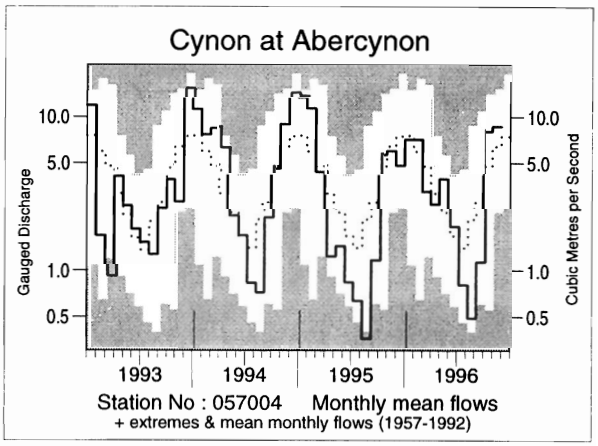

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1993
1994
1995
1996
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

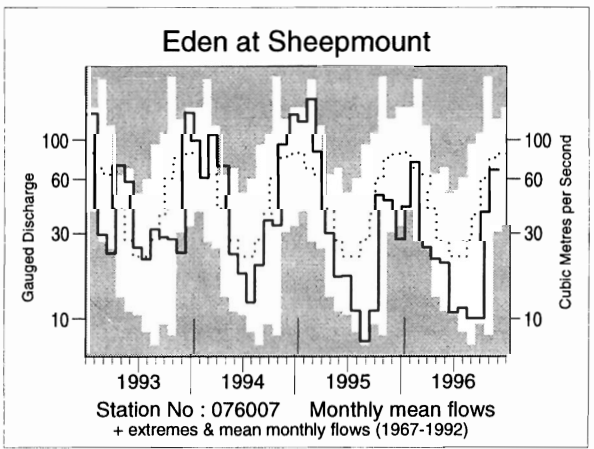

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1993
1994
1995
1996
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1992)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1993
1994
1995
1996
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1992)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1993
1994
1995
1996
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1992)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1993
1994
1995
1996
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1992)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1993
1994
1995
1996
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1992)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1993
1994
1995
1996
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1992)

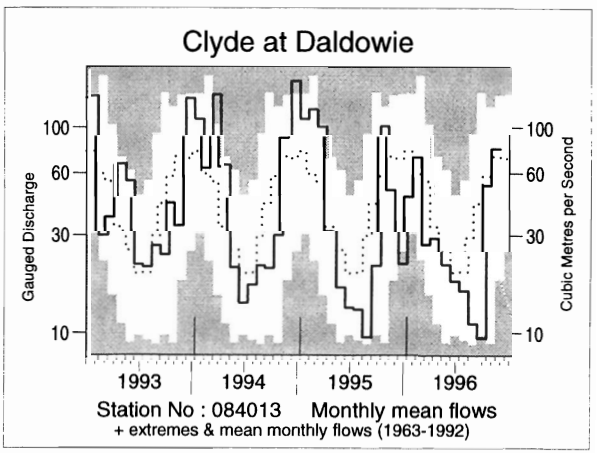

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1993
1994
1995
1996
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

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	Jul	Aug	Sep	Oct	Nov 1996		9/96 to 11/96		4/96 to 11/96		12/95 to 11/96		5/95 to 11/96	
	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	19	13	12	58	63	12	134	7	357	6	757	10	1221	12
Park	71	44	27	70	82	/25	66	/24	82	/24	96	/24	105	/23
Tay at	22	20	19	118	139	30	275	16	555	12	956	9	1459	9
Ballathie	56	41	27	105	115	/45	91	/44	93	/44	84	/44	88	/43
Tweed at	16	13	11	67	103	25	181	11	317	10	598	6	876	5
Boleside	62	35	23	93	118	/36	87	/36	81	/36	79	/35	80	/35
Whiteadder Water at	8	7	6	8	29	11	42	5	118	7	318	9	416	6
Hutton Castle	64	47	38	27	79	/28	54	/28	64	/27	83	/27	78	/26
South Tyne at	13	6	8	34	84	16	126	4	224	3	460	1	644	1
Haydon Bridge	46	16	16	50	91	/35	59	/33	57	/33	60	/33	58	/31
Wharfe at	13	22	18	39	79	23	136	9	233	4	375	1	465	1
Flint Mill Weir	53	58	41	64	102	/42	74	/41	65	/41	53	/41	46	/40
Derwent at	7	7	6	6	15	7	26	3	78	2	217	4	285	3
Buttercrambe	53	49	41	30	54	/36	44	/35	50	/35	68	/35	64	/34
Trent at	9	10	9	11	22	14	41	8	99	1	197	2	280	2
Colwick	59	66	51	46	71	/39	59	/38	57	/38	56	/38	56	/37
Lud at	6	6	5	4	8	8	16	2	53	2	90	2	168	3
Louth	38	44	42	35	53	/29	45	/29	40	/28	36	/28	48	/27
Witham at	3	3	3	4	6	13	12	5	41	2	97	2	132	2
Claypole Mill	46	49	39	37	47	/38	43	/38	47	/37	52	/37	53	/37
Little Ouse at	5	4	4	4	7	9	16	4	41	1	75	1	122	2
Abbey Heath	59	61	60	42	60	/29	55	/29	48	/29	45	/28	52	/28
Colne at	2	3	2	3	7	19	12	12	30	4	74	5	100	5
Lexden	53	77	56	33	58	/38	49	/37	50	/37	55	/36	56	/35
Lee at	5	5	4	4	7	28	15	12	44	9	95	15	151	18
Feildes Weir (natr.)	64	66	58	36	51	/112	48	/111	53	/110	58	/110	65	/109
Thames at	7	6	5	6	12	39	23	23	76	22	197	34	265	32
Kingston (natr.)	71	69	54	42	57	/114	52	/114	66	/114	80	/113	78	/113
Coln at	13	12	10	9	10	5	29	5	135	4	318	7	420	6
Bibury	64	73	74	58	40	/34	56	/33	71	/33	81	/33	77	/32
Great Stour at	7	9	7	8	23	17	37	9	80	1	155	1	239	1
Horton	52	71	53	37	85	/33	62	/32	54	/30	54	/29	58	/29
Itchen at	25	24	21	23	28	13	71	8	232	8	418	10	631	9
Highbridge+Allbrook	82	86	79	75	81	/39	79	/38	86	/38	91	/38	92	/37
Stour at	9	8	6	8	33	15	47	9	129	9	365	9	460	7
Throop Mill	79	78	54	36	98	/24	71	/24	81	/24	91	/23	87	/23
Exe at	9	12	9	53	133	33	194	22	334	15	719	12	887	4
Thorverton	46	46	24	72	135	/41	93	/41	89	/40	86	/40	77	/40
Taw at	4	6	4	28	134	30	166	21	262	15	564	9	663	2
Umberleigh	30	31	18	46	146	/39	94	/38	88	/38	82	/38	70	/37
Tone at	10	9	8	11	54	24	73	16	175	15	465	16	571	13
Bishops Hull	67	79	50	43	123	/36	86	/36	90	/36	97	/35	90	/35
Severn at	7	7	6	19	49	39	75	23	155	14	313	5	378	3
Bewdley	49	44	29	58	93	/76	70	/76	74	/76	70	/75	60	/75
Teme at	5	4	2	3	23	11	28	7	107	7	309	6	351	5
Knightsford Bridge	62	43	25	17	68	/27	47	/27	76	/27	85	/26	74	/26
Cynon at	20	12	27	203	211	29	441	26	683	26	1232	18	1628	11
Abercynon	59	24	41	170	135	/39	127	/37	113	/37	98	/37	91	/35
Dee at	29	41	69	255	282	18	605	18	903	10	1361	4	1788	1
New Inn	44	46	55	138	121	/28	111	/28	96	/27	76	/27	68	/26
Eden at	13	12	11	46	77	14	134	7	219	3	412	1	594	1
Sheepmount	53	38	27	68	88	/30	71	/29	63	/29	59	/29	59	/28
Clyde at	22	15	13	74	107	20	194	12	323	9	551	5	858	4
Daldowie	82	39	23	91	111	/34	84	/33	80	/33	71	/33	75	/32
Carron at	102	83	112	371	362	13	845	9	1279	8	1586	1	2577	1
New Kelso	87	53	45	148	130	/18	108	/18	93	/18	63	/17	69	/17
Ewe at	124	61	59	272	314	19	646	13	1078	10	1430	1	2396	1
Poolewe	141	56	32	124	121	/27	97	/26	91	/26	68	/26	75	/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 is rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1995. For the long periods (at the right of this table), the end date for the long term is 1996.

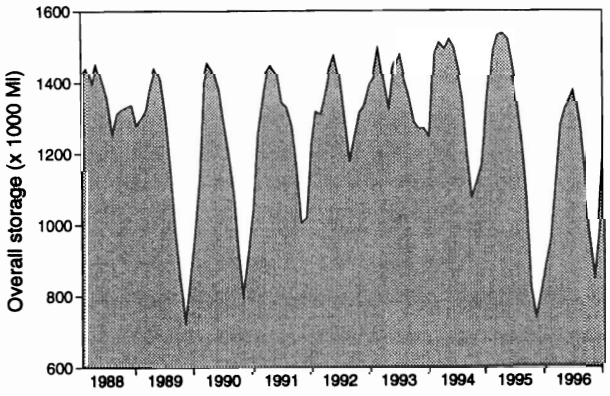
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO DECEMBER 1996

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1996 Jul	Aug	Sep	Oct	Nov	Dec	*1995 Dec*
North West	N.Command Zone[1]	(G)	133375	75	64	45	36	69	84	*57*
	Vyrnwy	(R)	55146	66	56	43	35	65	86	*33*
Northumbria	Teesdale[2]	(G)	87936	68	62	42	34	35	61	*39*
	Kielder	(R)	199175*	91	89	83	81	86	93	*91*
Severn-Trent	Clywedog	(R)	44922	97	81	67	46	66	80	*43*
	Derwent Valley[3]	(G)	39525	53	43	36	27	30	93	*9*
Yorkshire	Washburn[4]	(G)	22035	82	75	69	62	64	86	*16*
	Bradford supply[5]	(G)	41407	63	56	55	48	59	84	*20*
Anglian	Grafham	(R)	58707	89	83	78	71	67	68	*72*
	Rutland	(R)	130061	88	83	78	72	70	70	*57*
Thames	London[6]	(G)	206399	88	77	67	54	46	59	*71*
	Farmoor [7]	(G)	13843	98	95	97	91	92	100	*98*
Southern	Bewl	(R)	28170	80	72	65	58	52	59	*60*
	Ardingly	(R)	4685	86	68	47	37	33	55	*45*
Wessex	Clatworthy	(R)	5364	89	70	62	48	44	88	*63*
	Bristol W [8]	(G)	38666*	87	76	66	57	59	77	*43*
South West	Colliford	(R)	28540	67	59	52	43	42	50	*42*
	Roadford[9]	(R)	34500	49	46	42	38	40	51	*19*
	Wimbleball[10]	(R)	21320	81	64	53	43	42	60	*34*
	Stithians	(R)	5205	93	79	68	57	50	71	*31*
Welsh	Celyn + Brenig	(G)	131155	77	66	55	48	63	75	*50*
	Brianne	(R)	62140	95	85	77	63	87	100	*72*
	Big Five[11]	(G)	69762	90	73	54	46	64	77	*56*
	Elan Valley[12]	(G)	99106	90	81	67	57	82	99	*47*
East of Scotland	Edin./Mid Lothian[13]	(G)	97639	95	89	77	68	74	89	*91*
	East Lothian[14]	(G)	10206	95	86	76	67	63	79	*95*
West of Scotland	Loch Katrine	(G)	111363	91	76	62	56	90	97	*95*
	Daer	(R)	22412	93	85	66	53	89	100	*93*
	Loch Thom	(G)	11840	90	82	70	59	88	100	*97*

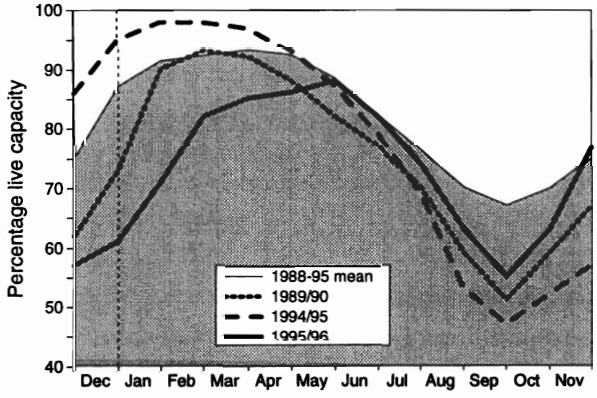
● Live or usable capacity (unless indicated otherwise) * Gross storage/percentage of gross storage

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



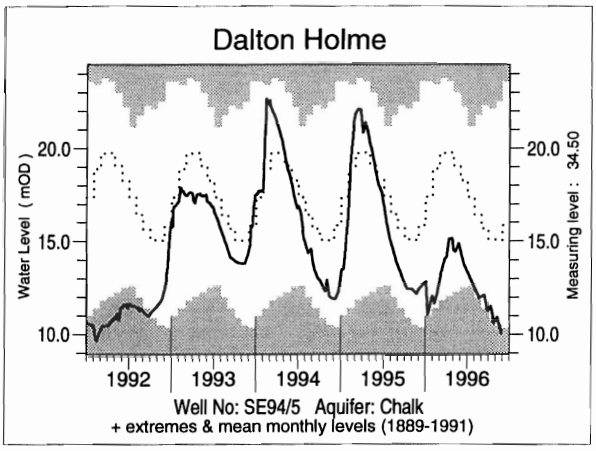
A COMPARISON BETWEEN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES IN RECENT YEARS

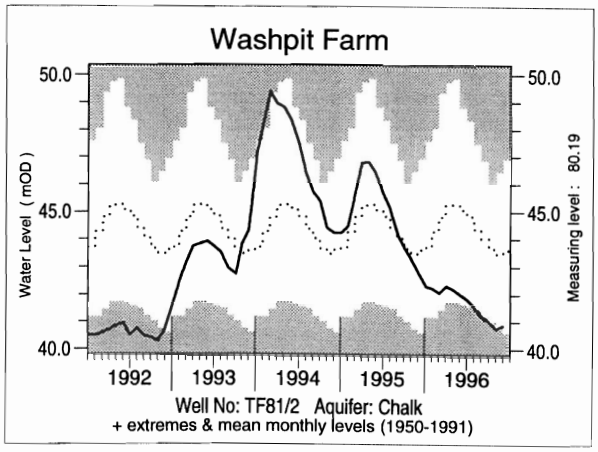


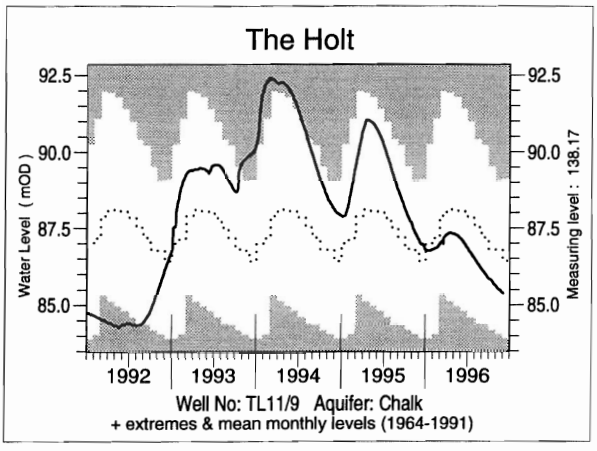
These plots are based on the reservoirs featured in Table 4 only

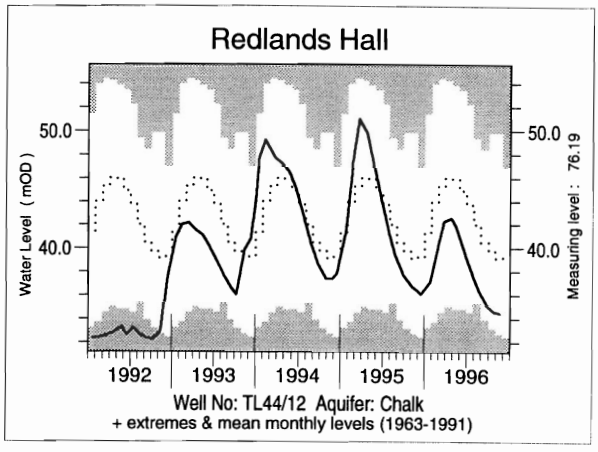
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 is intended to provide a link between the hydrological conditions described elsewhere in the report and the water resources situation. The reservoirs featured may not be representative of storage conditions across the individual regions; this can be particularly important during drought conditions (eg, in the Severn-Trent region during 1995/96).

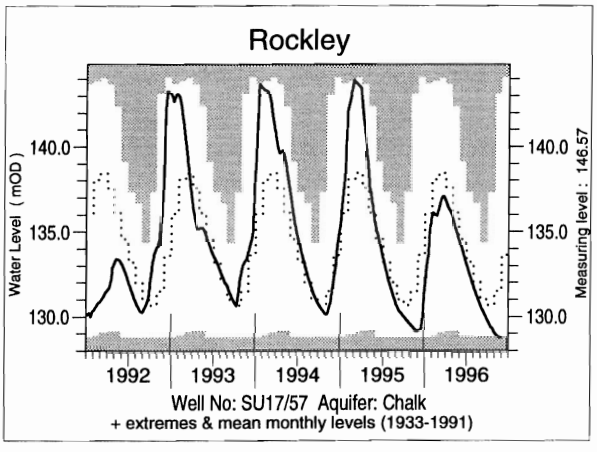
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

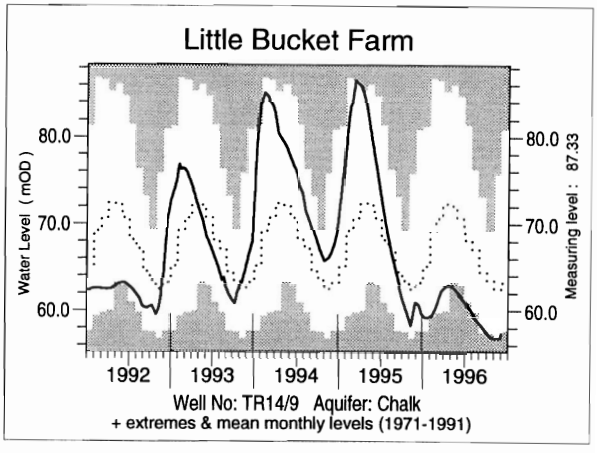


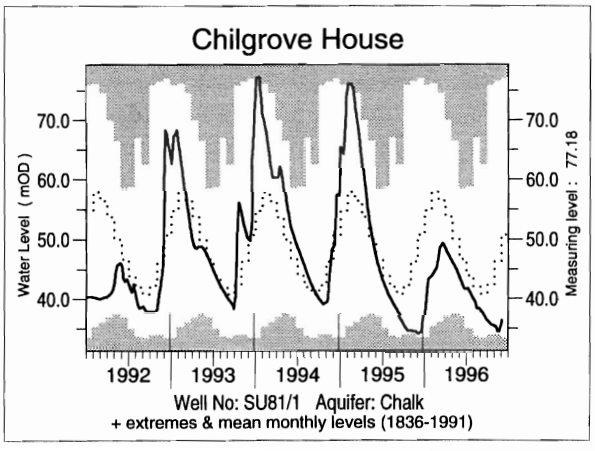


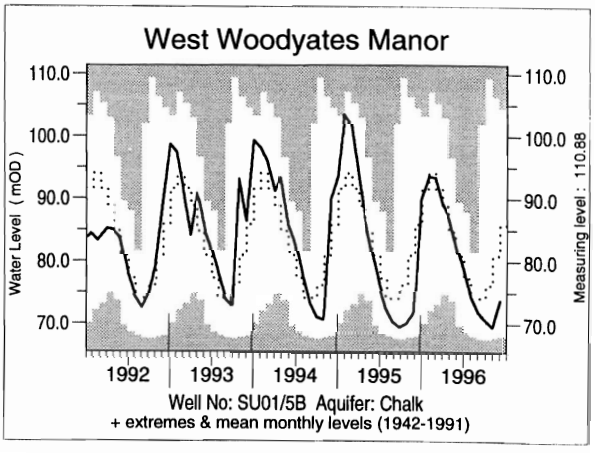


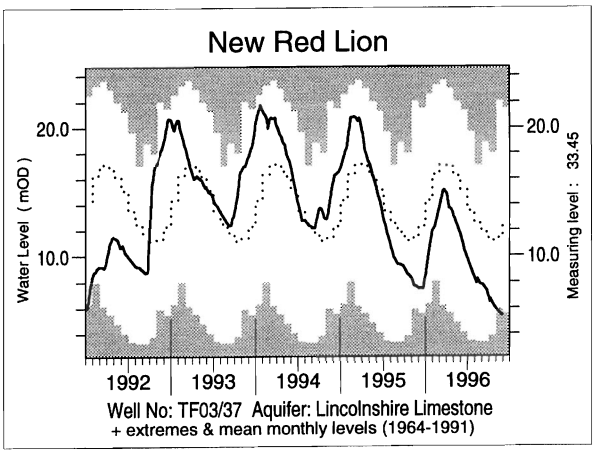


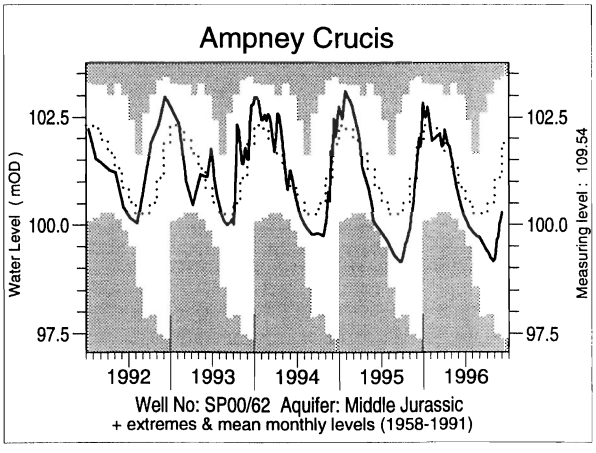


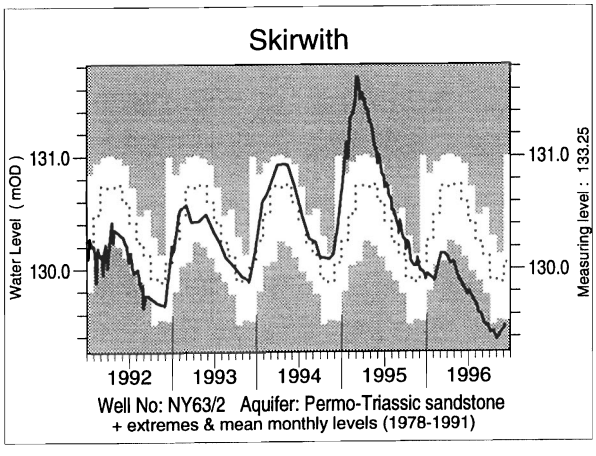


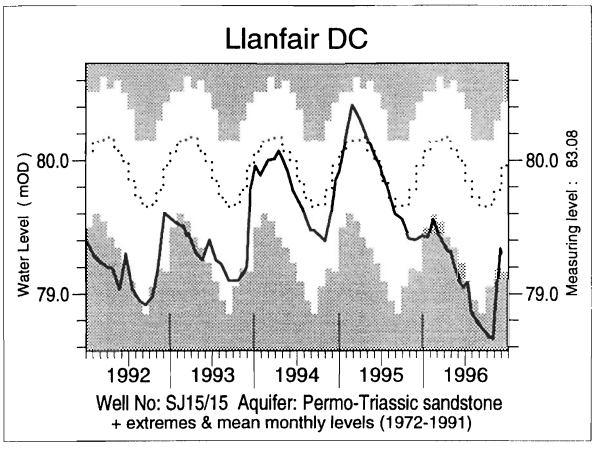


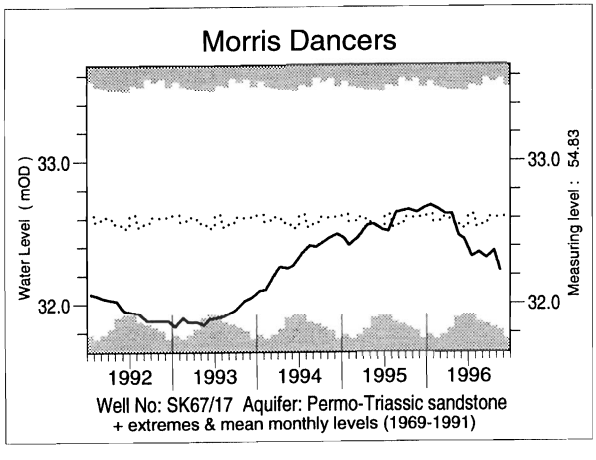


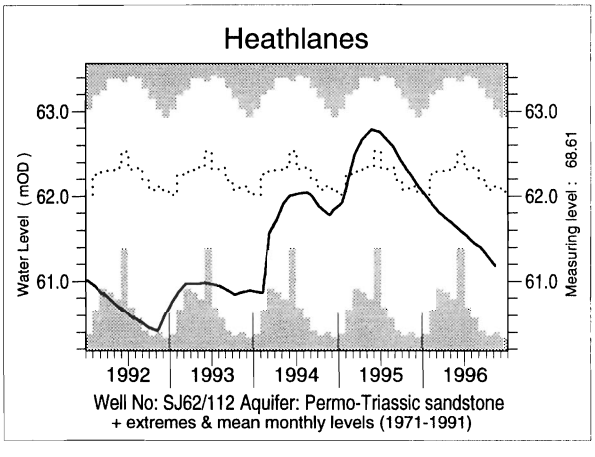

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
1996
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)

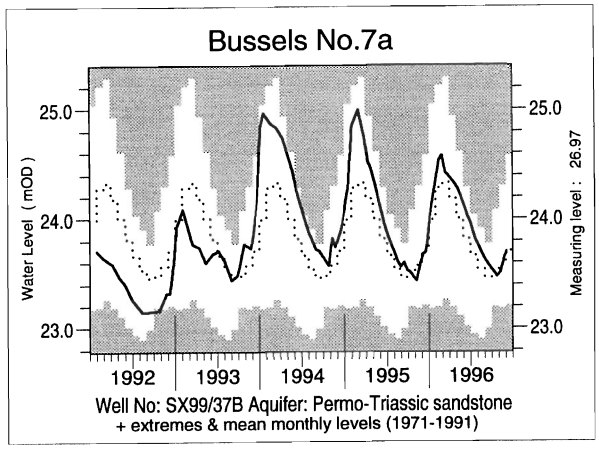

Ampney Crucis
Water Level (mOD)
102.5
100.0
97.5
Measuring level : 109.54
1992
1993
1994
1995
1996
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1991)


Skirwith
Water Level (mOD)
131.0
130.0
Measuring level : 133.25
1992
1993
1994
1995
1996
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-1991)


Llanfair DC
Water Level (mOD)
80.0
79.0
Measuring level : 83.08
1992
1993
1994
1995
1996
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1991)


Morris Dancers
Water Level (mOD)
33.0
32.0
Measuring level : 54.83
1992
1993
1994
1995
1996
Well No: SK67/17 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1969-1991)


Heathlanes
Water Level (mOD)
63.0
62.0
61.0
Measuring level : 68.61
1992
1993
1994
1995
1996
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
1996
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)

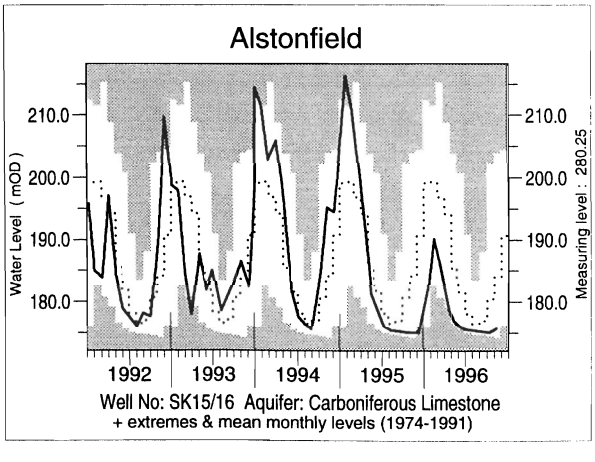

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
1996
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

TABLE 5 NOVEMBER GROUNDWATER LEVELS 1996

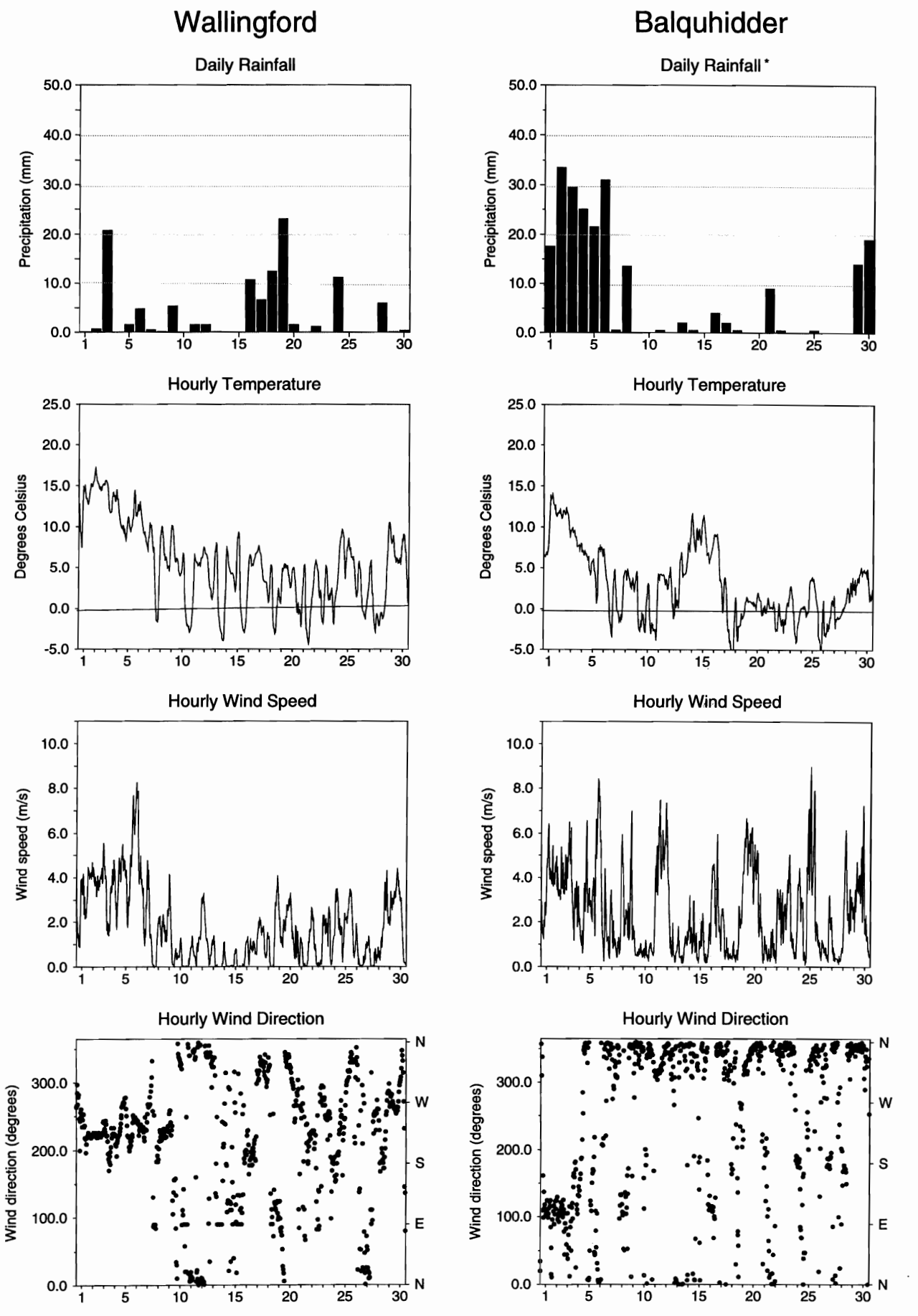
Site	Aquifer	Records commence	Minimum Nov <1996	Average Nov <1996	Maximum Nov <1996	No. of years Nov/Dec level<1996	Nov/Dec 1996 day	Nov/Dec 1996 level
Dalton Holme	Ck	1889	10.34	14.92	22.53	0	25/11	10.09
Wetwang	Ck	1971	17.01	19.71	25.11	2	25/11	17.46
Keelby Grange	Ck	1980	4.57	8.97	13.48	1	21/11	4.07
Washpit Farm	Ck	1950	40.3	43.26	46.47	3	02/12	40.88
The Holt	Ck	1964	84.04	87.03	89.87	4	02/12	85.36
Therfield Rectory	Ck	1883	70.72	78.43	96.42	21	02/12	73.83
Redlands Hall	Ck	1964	32.71	38.51	49.90	3	21/11	34.49
Rockley	Ck	1933	128.78	131.52	143.12	0*	02/12	128.76
Little Bucket Farm	Ck	1971	56.77	62.73	75.89	3	03/12	57.51
Compton House	Ck	1894	28.22	36.45	64.98	5	03/12	28.95
Chilgrove House	Ck	1836	33.97	45.80	76.51	15	03/12	36.46
Westdean No.3	Ck	1940	1.17	1.70	4.26	32	29/11	1.48
Lime Kiln Way	Ck	1969	123.7	124.80	125.40	23	27/11	125.31
Ashton Farm	Ck	1974	63.10	66.11	66.11	10	02/12	65.06
West Woodyates Manor	Ck	1942	67.90	80.66	106.35	25	02/12	73.84
Killyglen (NI)	Ck	1985	113.68	116.01	118.84	10	04/12	117.52
New Red Lion	LLst	1964	5.9	11.80	22.06	1	26/11	5.44
Ampney Crucis	Mid Jur	1958	97.48	101.13	103.45	15	02/12	100.28
Redbank	PTS	1981	7.54	8.17	8.72	5	01/12	7.87
Yew Tree Farm	PTS	1973	11.69	13.33	13.64	7	10/12	13.37
Skirwith	PTS	1978	129.55	129.91	130.13	1	04/12	129.50
Llanfair D.C	PTS	1972	78.18	79.60	80.30	5	02/12	79.30
Morris Dancers	PTS	1969	31.81	32.51	33.57	11	15/11	32.23
Heathlanes	PTS	1971	60.39	61.93	63.02	3	08/11	61.18
Bussels No.7A	PTS	1972	23.17	23.57	24.30	20	03/12	23.70
Rushyford NE	MgLst	1967	64.83	72.24	76.52	22	23/11	75.84
Peggy Ellerton	MgLst	1968	31.26	33.75	35.65	3	18/11	32.24
Alstonfield	CLst	1974	174.96	184.90	203.93	5	15/11	175.65

groundwater levels are in metres above Ordnance Datum

Ck	Chalk	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

* The borehole was deepened in 1992 (it had been dry during several notable droughts)

FIGURE 3 METEOROLOGICAL SUMMARY - NOVEMBER 1996

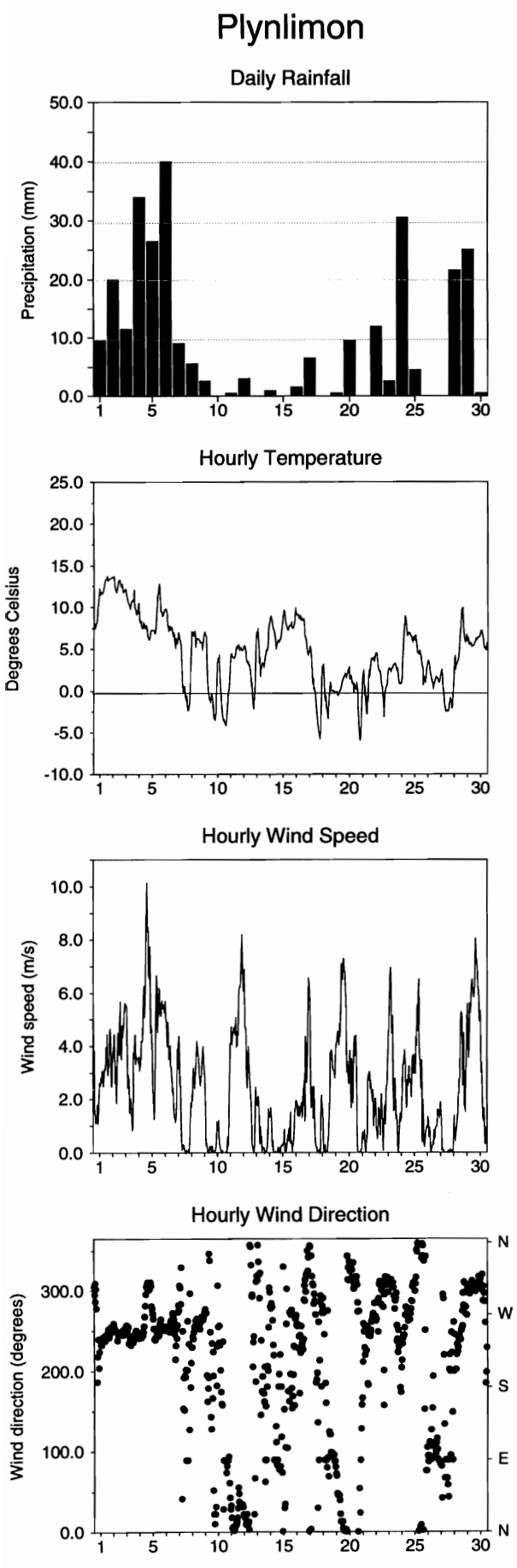


The Institute of Hydrology Meteorological Station occupies a relatively open site on the Thames floodplain about 5km NW of the Chilterns escarpment. Station elevation is 48m.

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.

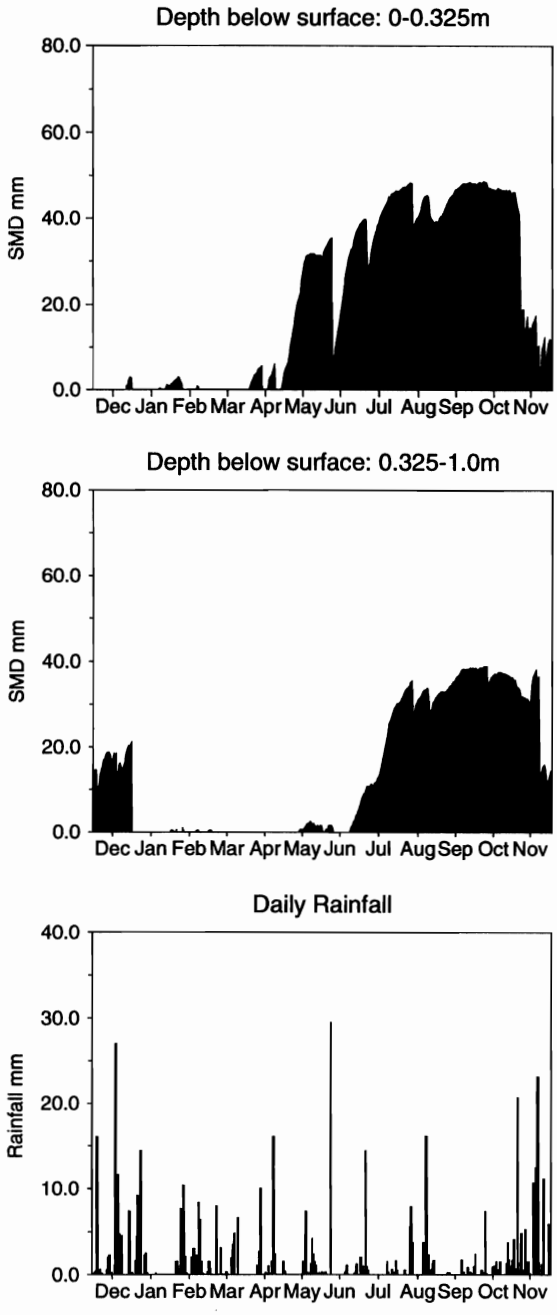
* Rainfall data from the 21/22 was affected by snowfall and should be treated with caution. Depth of snowfall was about 25mm and the estimated rainfall for November is 206.5mm.

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 300m aOD and average annual rainfall exceeds 2300mm.

FIGURE 3a. WALLINGFORD SMD DATA 1995/6.



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. Two automatic soil water stations (ASWSs) deployed at Wallingford, which use capacitance soil water sensors installed at depths of 5,15 and 50 cm, are the sources of the data. 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. At the end of January 1996, field capacity was re-estimated using recent data and the soil moisture deficit values for the previous months were recalculated accordingly.

Daily rainfall from the Wallingford met station from December 1995 is presented.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS