Hydrological Summary for Great Britain

JULY 1996

Rainfall

July was generally a warm and sunny month but, with the remarkably persistent Scandinavian high pressure cell continuing to influence synoptic patterns, rainfall was significantly below average in all regions. Unsettled weather, with substantial rainfall in some, mostly western, areas early in the month was superseded by lengthy sequences of dry days, in southern Britain especially. Locally, these rainless episodes were punctuated by several convectional interludes which produced some notable precipitation totals. Torrential rain and damaging hailstorms on the 23rd caused considerable traffic disruption in parts of eastern Britain. A remarkable 1-hour 50 mm precipitation total was reported for Whitwell (Hertfordshire) but most of the conventional downpours were very spatially restricted. The return of a westerly airflow towards month-end helped boost monthly rainfall totals. Nonetheless, most regional totals were 20-50% below average and some districts in southern England, which missed the thunderstorms, recorded only around 30% of average; parts of north-eastern Scotland were also relatively dry. For England and Wales as a whole, July was 14th month with below average rainfall in the last 16. The April '95 to July '96 total is the third lowest in the 230-year national rainfall series, only 1975/76 (substantially) and 1933/34 (marginally) were drier in this timeframe. Since February the drought has re-intensified; the March-July rainfall is the sixth lowest for England and Wales in the last 100 years. In large parts of northern England, the Midlands and East Anglia the post-March '95 rainfall deficiency is the equivalent of 4-6 months average rainfall. The most severe drought conditions continue to affect the southern Pennines but significant deficiencies extend across most regions of Britain. A guide to the spatial variations in regional drought intensity is provided by the return periods given in Table 2 (which should be interpreted in the light of the qualifying footnotes).

River Flow

Summer recessions continued throughout July interrupted by some minor spates in northern Britain (e.g. on the 4th) and transitory flow recoveries following thunderstorms in the English lowlands; mostly the latter provided only useful freshets but the Whitwell storm resulted in the highest flow on record (estimated return period >100 yrs) on the River Mimram. Generally the July recessions were less steep than in 1995 (1990 and 1976 also) but monthly runoff totals were amongst the lowest on record - for July - throughout much of Britain (notwithstanding the operation of river regulation and flow augmentation schemes in some of the most affected catchments). In eastern England only 1976 produced lower July flows at many of the index gauging stations - for a few (e.g. in Cambridgeshire and Kent) the May to July 1976 minima runoff totals were eclipsed. To the west and north, flows are mostly well above drought minima but still substantially below average. The protracted and extensive nature of the drought is emphasised by the 12-month runoff accumulations presented in Table 3. Away from the South-West, the August-July runoff totals are exceptionally low and for a few catchments (e.g. the Wharfe and Gt. Stour), 12-month totals ending in 1996 are unprecedented for any start month.

Groundwater

Groundwater levels continued their seasonal decline and - over most major aquifers - the late summer levels contrast dramatically with the outstanding maxima registered in the early spring of 1995. Groundwater resources are now very depleted in the eastern Chalk (parts of Yorkshire, East Anglia and Kent especially) but water-tables are mostly a little above the 1992 minima (often those of 1976 also). In the more westerly Chalk outcrops storage is generally much healthier. Levels in the Permo-Triassic sandstones of the South-West also remain within the normal range but the absence of significant recharge over the 1995/96 winter has resulted in very depressed levels in northern Britain: close to the lowest on record in parts of north Wales and the North-West. The protracted decline in levels has led to the failure of some shallow wells mostly in minor aquifers. Late July soil moisture deficits exceeded 120 mm throughout most of southern Britain - in the absence of well above average rainfall, groundwater levels will continue to decline throughout the autumn.

General

Relative to last year, the lower temperatures and higher rainfall has helped to moderate peak demands this summer. Overall reservoir stocks are appreciably greater than in the late summer of 1995 (and also exceed the corresponding totals for 1989 and 1990) but contents remain low in some areas (e.g. the Derwent Valley). Overall groundwater resources are much lower than a year ago and a continuation of drought conditions into the 1996/97 winter will produce exceptionally low river flows and a very fragile water resources outlook.

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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 13 August 1996

TABLE 1 1995/96 RAINFALL AS A PERCENTAGE OF THE 1961-90 AVERAGE

		Jul 1995	Aug	Sep	Oct	Nov	Dec	Jan 1996	Feb	Mar	Apr	May	Jun	Jul
England and Wales	mm	40	10	113	58	83	84	65	82	44	49	57	30	42
	%	65	13	147	68	92	89	74	130	61	82	89	46	68
North West	mm	65	18	97	105	76	42	55	105	36	71	56	48	62
	%	76	17	84	82	62	34	45	135	38	100	75	60	73
Northumbrian	mm	29	12	111	57	118	79	46	89	33	63	53	33	50
	%	45	15	152	75	137	98	55	151	47	113	85	54	77
Severn Trent	mm	35	9	94	39	65	81	45	66	42	49	48	30	33
	%	66	13	147	61	92	105	64	122	69	89	81	51	63
Yorkshire	mm	29	9	96	29	65	70	48	78	31	41	52	49	41
	%	49	12	141	40	81	84	61	134	46	69	87	82	70
Anglian	mm	25	8	101	15	42	69	34	49	20	15	23	19	41
	%	51	15	206	29	72	125	68	132	43	33	48	37	84
Thames	mm	31	4	117	34	64	96	52	63	35	35	34	18	42
	%	63	7	198	55	98	137	81	140	63	70	61	32	86
Southern	mm	31	5	140	33	65	95	69	70	42	23	51	18	42
	%	65	9	203	41	76	116	86	130	67	43	94	33	87
Wessex	mm	26	10	144	68	124	104	77	84	68	57	59	25	24
	%	50	15	200	86	149	112	89	129	97	108	97	44	47
South West	mm	47	16	136	104	134	126	157	118	73	78	99	34	31
	%	68	19	146	90	107	91	114	117	74	113	138	49	45
Welsh	mm	69	14	125	115	133	103	102	121	72	85	104	41	42
	%	90	14	109	84	94	67	71	125	67	106	127	51	54
Scotland	mm	86	34	198	228	126	55	90	140	59	107	77	57	62
	%	91	29	139	146	83	36	60	137	47	141	90	67	66
Highland	mm	101	45	251	246	160	48	61	149	55	110	83	65	76
	%	95	35	147	124	79	24	32	117	34	121	90	66	72
North East	mm	45	27	297	103	100	70	75	114	57	62	66	27	43
	%	62	31	341	106	101	75	76	175	73	103	96	41	59
Tay	mm	67	20	178	220	120	68	132	117	79	106	64	41	46
	%	87	21	156	169	99	54	92	123	72	171	77	56	60
Forth	mm	70	21	136	199	90	54	73	82	52	86	70	40	45
	%	93	22	124	173	80	49	62	104	55	146	95	58	60
Tweed	mm	43	23	123	134	97	64	72	104	30	78	63	29	44
	%	59	26	138	141	104	69	72	155	38	137	89	45	60
Solway	mm	79	23	102	249	113	52	134	157	73	133	80	80	62
	%	88	19	71	159	78	35	86	155	62	173	94	95	69
Clyde	mm	125	40	138	324	119	47	117	181	62	138	90	82	73
	%	115	30	77	168	66	26	62	153	42	164	99	88	67

Note: The monthly regional rainfall figures for England and Wales for June & July 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 June & July 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 RETURN PERIOD ESTIMATES

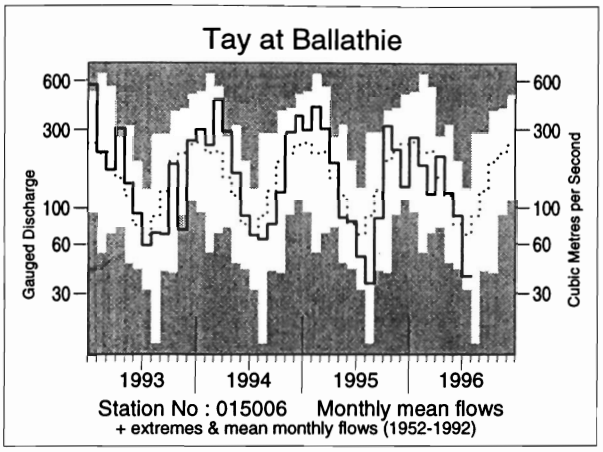
		May 96-Jul 96		Mar 96-Jul 96		Oct 95-Jul 96		Apr 95-Jul 96	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	129		222		594		856	
	% LTA	67	5-15	69	15-25	80	10-20	75	70-100
North West	mm	167		274		657		969	
	% LTA	69	5-15	67	15-25	67	70-100	64	>>200
Northumbria	mm	136		232		621		894	
	% LTA	73	5-10	74	5-15	89	2-5	82	10-20
Severn Trent	mm	111		202		498		718	
	% LTA	65	5-15	70	10-15	80	5-15	73	50-80
Yorkshire	mm	142		214		504		732	
	% LTA	79	2-5	70	10-20	74	20-30	69	>200
Anglian	mm	83		118		327		532	
	% LTA	56	15-25	49	120-170	67	60-90	67	>200
Thames	mm	94		164		473		696	
	% LTA	59	10-15	62	20-30	83	5-10	77	20-30
Southern	mm	110		175		507		744	
	% LTA	71	5-10	64	10-20	78	5-15	75	30-45
Wessex	mm	108		233		690		972	
	% LTA	64	5-15	80	5-10	99	2-5	92	2-5
South West	mm	164		315		954		1277	
	% LTA	78	2-5	83	2-5	96	2-5	88	5-10
Welsh	mm	186		343		917		1266	
	% LTA	78	2-5	81	5-10	84	5-10	78	30-45
Scotland	mm	196		362		1001		1513	
	% LTA	74	5-15	78	10-15	85	5-15	85	15-25
Highland	mm	224		389		1053		1683	
	% LTA	76	5-10	71	20-30	72	70-100	78	60-90
North East	mm	136		255		717		1287	
	% LTA	65	10-20	74	10-20	90	2-5	104	2-5
Tay	mm	151		336		993		1425	
	% LTA	65	10-15	83	2-5	97	2-5	94	2-5
Forth	mm	155		293		791		1155	
	% LTA	71	5-15	79	5-10	87	5-10	83	15-25
Tweed	mm	136		244		715		1040	
	% LTA	65	10-20	71	10-20	90	2-5	84	10-15
Solway	mm	222		428		1133		1505	
	% LTA	86	2-5	94	2-5	98	2-5	86	5-15
Clyde	mm	245		445		1233		1729	
	% LTA	84	2-5	85	2-5	89	2-5	83	15-25

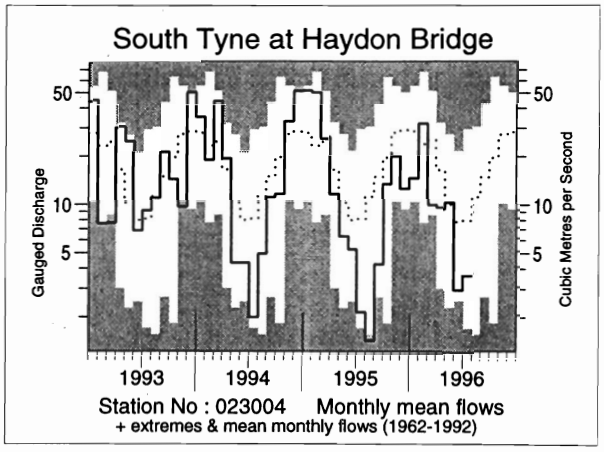
LTA refers to the period 1961-90.

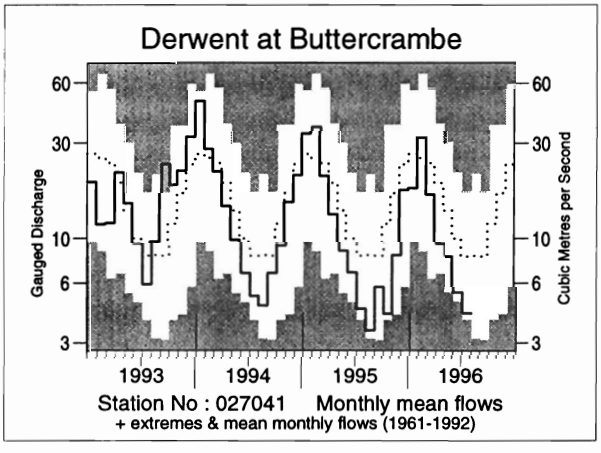
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to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

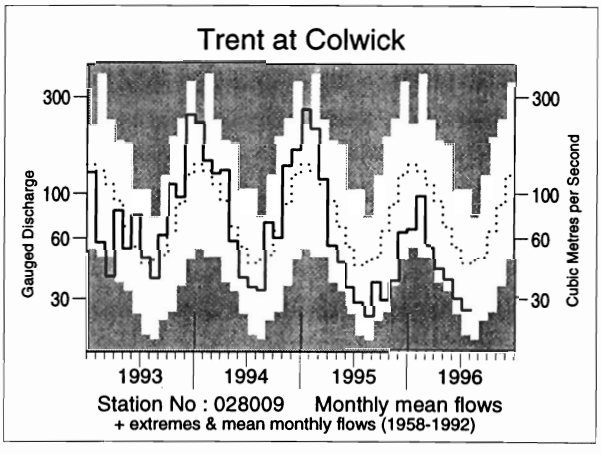
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

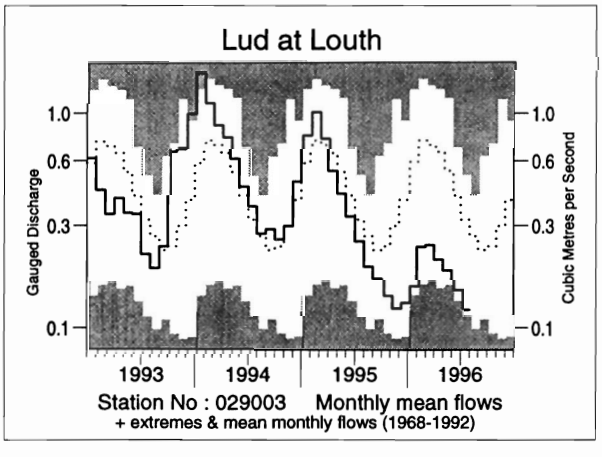
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

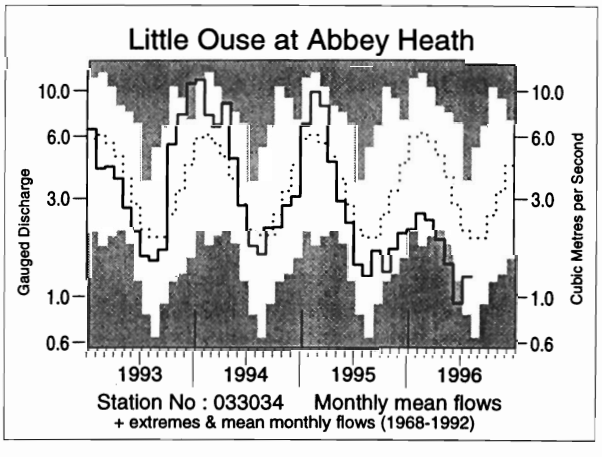


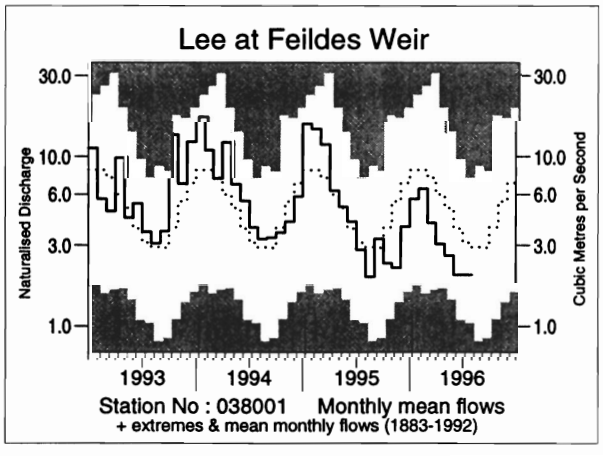


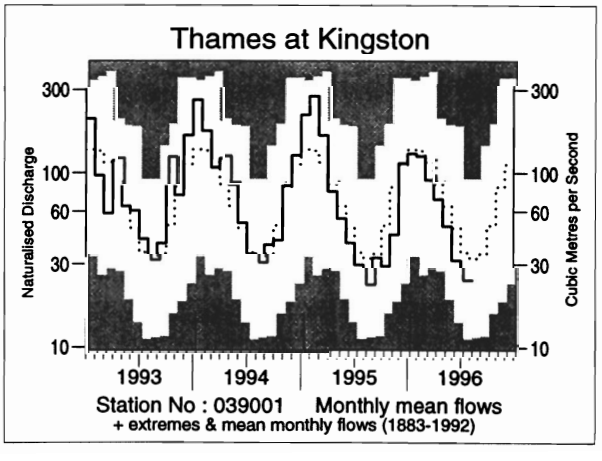


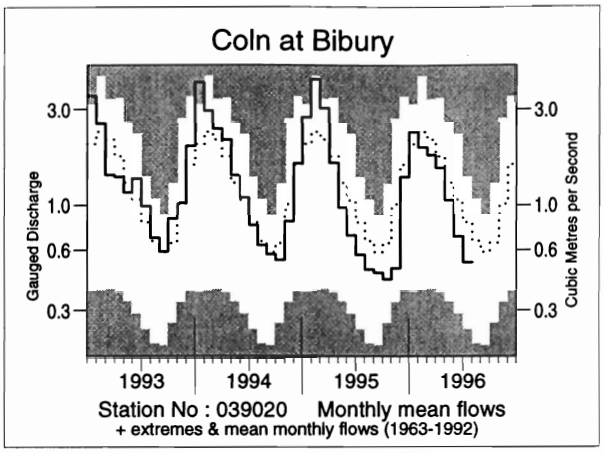


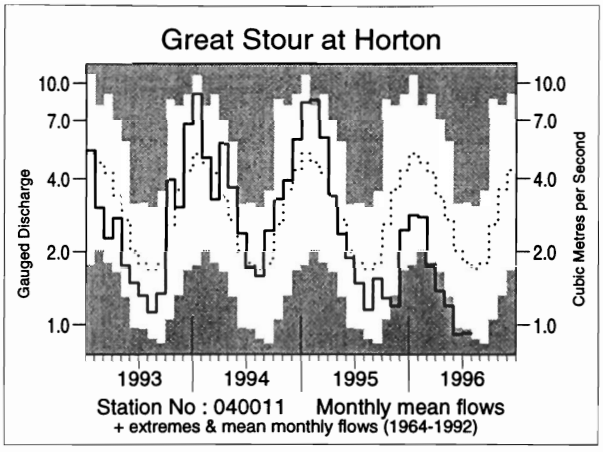


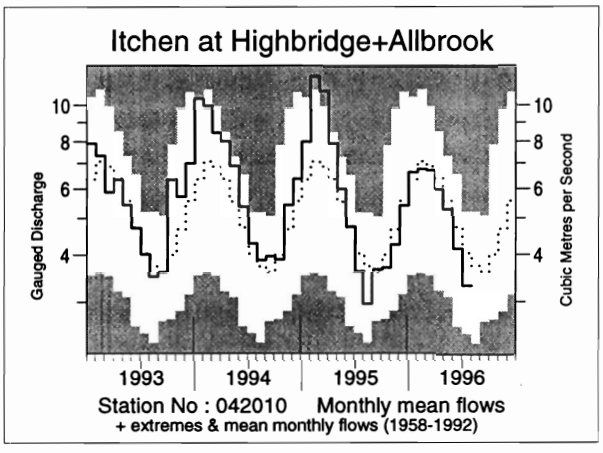


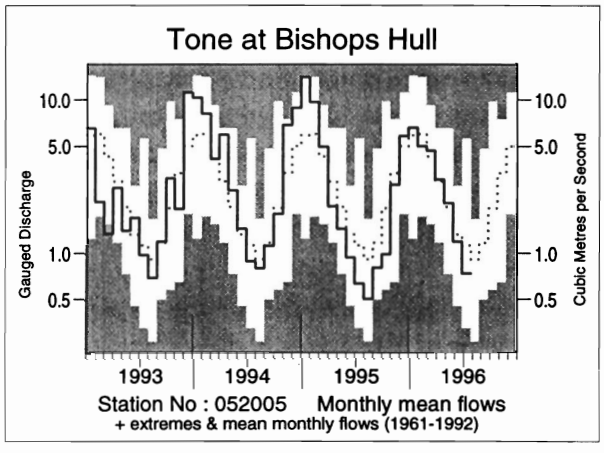


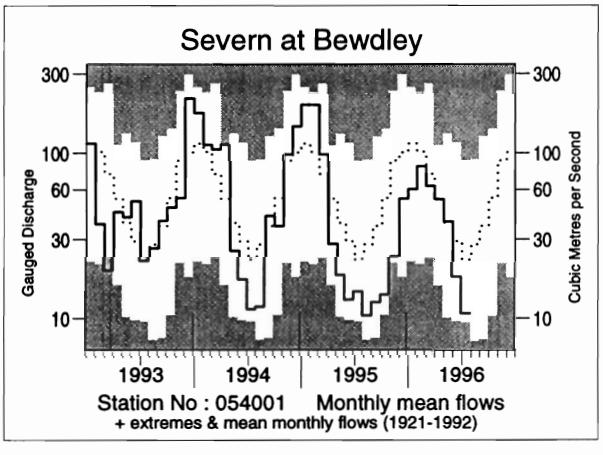


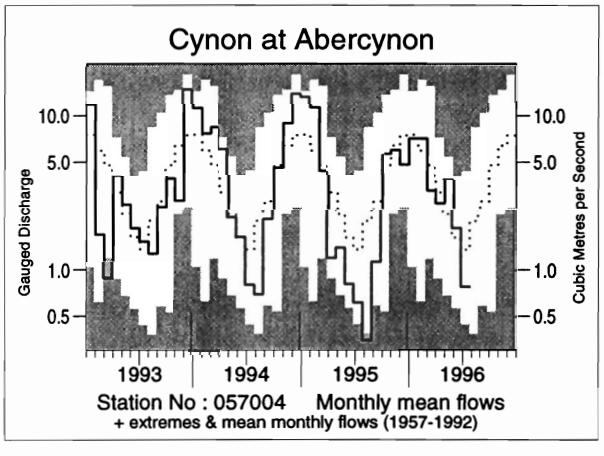

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1993
1994
1995
1996
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

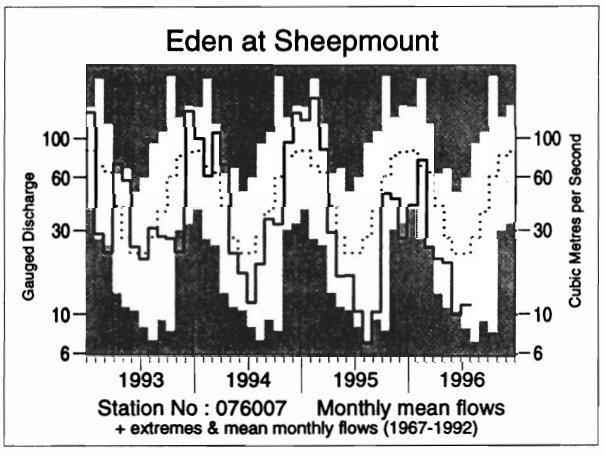

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1993
1994
1995
1996
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1992)


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
6
1993
1994
1995
1996
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1992)

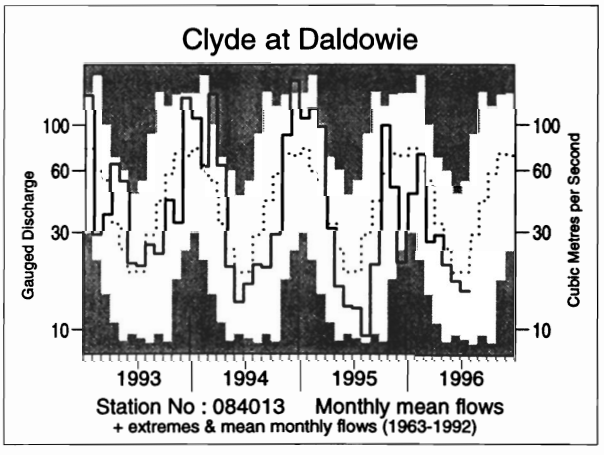

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1993
1994
1995
1996
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

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	Mar 1996	Apr	May	Jun	Jul 1996		*Minimum July runoff*		5/96 to 7/96		1/96 to 7/96		8/95 to 7/96	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	*mm* *%LT*	*year*	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at	71	114	49	28	19	10	*11*	*1984*	96	8	537	20	958	20
Park	74	143	78	78	71	/24	*41*		77	/24	114	/24	120	/23
Tay at	71	115	72	50	22	5	*18*	*1984*	144	21	584	15	1038	12
Ballathie	54	128	104	111	56	/44	*46*		94	/44	91	/44	91	/43
Tweed at	42	40	42	26	16	11	*11*	*1984*	83	17	368	10	626	5
Boleside	51	73	98	97	62	/36	*44*		88	/36	88	/36	82	/35
Whiteadder Water at	37	20	31	10	8	5	*7*	*1989*	49	16	223	10	333	8
Hutton Castle	77	53	116	63	64	/27	*55*		89	/27	91	/27	86	/26
South Tyne at	35	32	37	10	13	10	*6*	*1989*	60	12	283	3	464	1
Haydon Bridge	40	56	101	39	47	/33	*22*		68	/33	69	/33	60	/31
Wharfe at	23	20	30	10	13	11	*6*	*1976*	54	9	200	1	273	1
Flint Mill Weir	30	37	83	43	53	/41	*23*		63	/41	51	/41	38	/40
Derwent at	28	15	14	9	7	2	*7*	*1976*	30	2	154	7	219	7
Buttercrambe	71	50	60	54	53	/35	*49*		57	/35	75	/35	68	/34
Trent at	19	14	13	10	9	2	*7*	*1976*	33	2	122	2	190	2
Colwick	49	45	54	55	59	/38	*44*		56	/38	56	/38	54	/37
Lud at	12	10	9	7	6	3	*5*	*1976*	22	2	62	4	97	3
Louth	35	32	35	36	38	/28	*36*		37	/28	34	/28	39	/28
Witham at	16	10	8	4	3	3	*1*	*1976*	15	4	71	5	99	5
Claypole Mill	63	52	51	43	46	/38	*8*		48	/38	55	/37	53	/37
Little Ouse at	9	7	5	3	5	5	*3*	*1976*	13	1	47	1	77	2
Abbey Heath	42	38	38	33	59	/29	*39*		42	/29	41	/28	46	/28
Colne at	9	5	4	3	2	2	*1*	*1976*	9	4	49	7	72	7
Lexden	49	40	50	50	53	/37	*28*		51	/37	55	/37	53	/35
Mimram at	10	9	8	6	6	7	*3*	*1976*	20	7	59	7	101	7
Panshanger Park	77	69	64	55	64	/44	*34*		61	/44	71	/44	80	/43
Lee at	11	8	7	5	5	16	*3*	*1949*	17	12	65	18	100	22
Feildes Weir (natr.)	54	50	53	53	64	/111	*28*		56	/111	61	/110	61	/109
Thames at	25	18	13	8	6	24	*3*	*1921*	28	31	137	40	202	35
Kingston (natr.)	80	82	77	65	67	/114	*31*		71	/114	84	/114	82	/113
Coln at	45	37	27	17	13	2	*6*	*1976*	57	9	242	9	323	9
Bibury	83	87	83	65	64	/33	*30*		73	/33	86	/33	82	/32
Great Stour at	14	10	9	7	7	1	*7*	*1996*	23	1	90	1	149	1
Horton	42	40	45	46	52	/32	*52*		47	/31	50	/30	51	/29
Itchen at	50	43	39	30	25	6	*18*	*1976*	94	9	284	11	430	12
Highbridge+Allbrook	96	93	94	87	82	/38	*61*		89	/38	94	/38	93	/37
Stour at	49	33	21	12	9	7	*4*	*1976*	42	12	254	11	373	10
Throop Mill	97	93	91	82	79	/24	*37*		86	/24	98	/24	93	/23
Exe at	62	45	53	21	9	6	*5*	*1976*	83	26	388	8	639	5
Thorverton	73	79	144	86	46	/41	*25*		102	/41	84	/40	77	/40
Taw at	44	41	32	13	4	7	*3*	*1976*	49	19	293	6	470	3
Umberleigh	65	92	114	76	30	/38	*17*		83	/38	78	/38	67	/37
Tone at	63	39	28	15	10	9	*4*	*1976*	54	18	305	15	449	12
Bishops Hull	112	101	106	89	67	/36	*29*		92	/36	99	/35	94	/35
Severn at	39	31	24	11	7	6	*6*	*1976*	41	25	197	11	267	4
Bewdley	84	99	103	62	49	/76	*43*		76	/76	75	/75	59	/75
Teme at	48	36	24	10	5	6	*3*	*1976*	39	16	238	11	300	5
Knightsford Bridge	102	110	126	77	62	/27	*32*		97	/27	99	/26	82	/26
Cynon at	82	65	99	46	20	9	*11*	*1984*	164	28	658	18	1105	8
Abercynon	69	84	171	116	59	/38	*34*		125	/38	99	/38	87	/36
Dee at	68	74	112	42	29	10	*7*	*1984*	183	15	634	3	985	1
New Inn	37	68	166	72	44	/28	*10*		95	/27	71	/27	55	/27
Eden at	28	23	23	11	13	6	*10*	*1984*	48	5	230	2	389	1
Sheepmount	37	48	71	46	54	/29	*39*		59	/29	60	/29	56	/28
Clyde at	38	39	29	24	22	13	*13*	*1989*	75	13	312	7	591	4
Daldowie	46	83	82	92	82	/33	*47*		86	/33	77	/33	75	/32
Carron at	70	108	55	85	102	8	*41*	*1994*	242	6	619	1	1406	1
New Kelso	24	72	59	105	87	/18	*35*		84	/18	50	/18	56	/17
Ewe at	106	71	65	110	124	23	*48*	*1982*	300	20	634	2	1457	2
Poolewe	51	49	66	147	141	/26	*54*		114	/26	59	/26	68	/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.

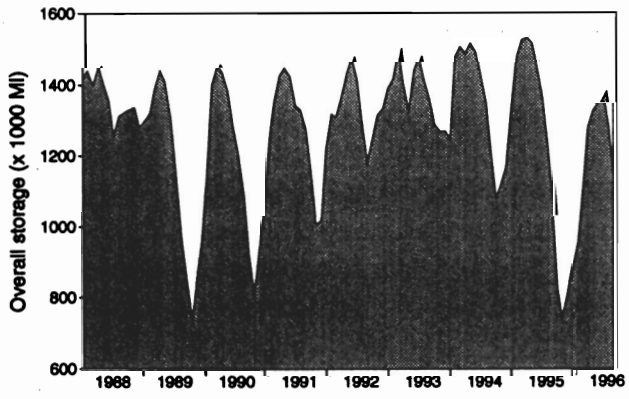
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO AUGUST 1996

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1996 Mar	Apr	May	Jun	Jul	Aug	1995 Aug
North West	N.Command Zone[1]	(G)	133375	78	78	80	80	75	64	44
	Vyrnwy	(R)	55146	59	64	70	74	66	56	59
Northumbria	Teesdale[2]	(G)	87936	72	77	81	81	68	62	59
	Kielder	(R)	199175*	95	96	93	96	91	89	87
Severn-Trent	Clywedog	(R)	44922	77	86	93	100	97	81	70
	Derwent Valley[3]	(G)	39525	46	54	54	56	53	43	52
Yorkshire	Washburn[4]	(G)	22035	53	70	76	87	82	75	50
	Bradford supply[5]	(G)	41407	53	59	60	70	63	56	38
Anglian	Grafham	(R)	58707	94	94	95	95	89	83	88
	Rutland	(R)	130061	82	92	94	93	88	83	74
Thames	London[6]	(G)	206399	94	94	95	95	88	77	82
	Farmoor [7]	(G)	13843	96	99	97	99	98	95	86
Southern	Bewl	(R)	28170	96	99	94	88	80	72	81
	Ardingly	(R)	4685	100	100	100	100	86	68	66
Wessex	Clatworthy	(R)	5364	100	100	94	97	89	70	44
	Bristol W [8]	(G)	38666*	86	95	97	95	87	76	67
South West	Colliford	(R)	28540	61	63	66	69	67	59	70
	Roadford[9]	(R)	34500	35	37	41	48	49	46	60
	Wimbleball[10]	(R)	21320	72	78	81	86	81	64	59
	Stithians	(R)	5205	100	99	97	98	93	79	45
Welsh	Celyn + Brenig	(G)	131155	69	72	75	82	77	66	79
	Brianne	(R)	62140	100	100	100	100	95	85	67
	Big Five[11]	(G)	69762	94	94	94	97	90	73	49
	Elan Valley[12]	(G)	99106	95	98	99	97	90	81	65
East of Scotland	Edin./Mid Lothian[13]	(G)	97639	100	96	98	98	95	89	79
	East Lothian[14]	(G)	10206	100	99	98	99	95	86	84
West of Scotland	Loch Katrine	(G)	111363	96	94	100	99	91	76	69
	Daer	(R)	22412	100	96	100	96	93	85	62
	Loch Thom	(G)	11840	98	98	97	94	90	82	72

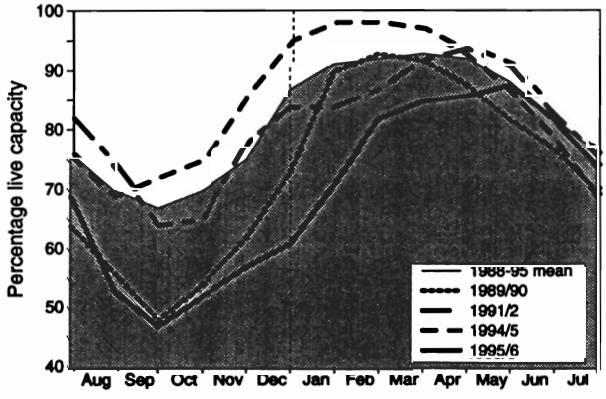
● Live or usable capacity (unless indicated otherwise) * Gross storage/percentage of gross storage

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



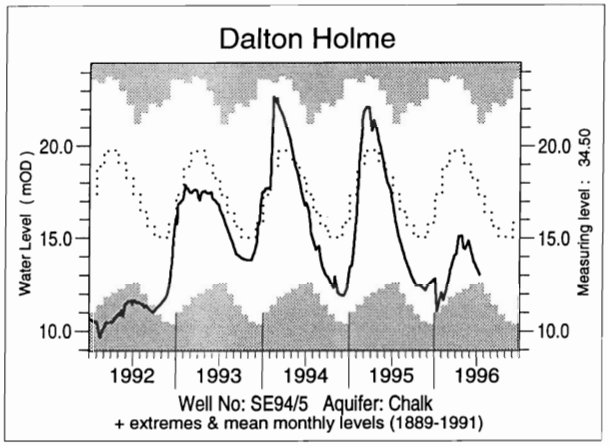
A COMPARISON BETWEEN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES IN RECENT YEARS

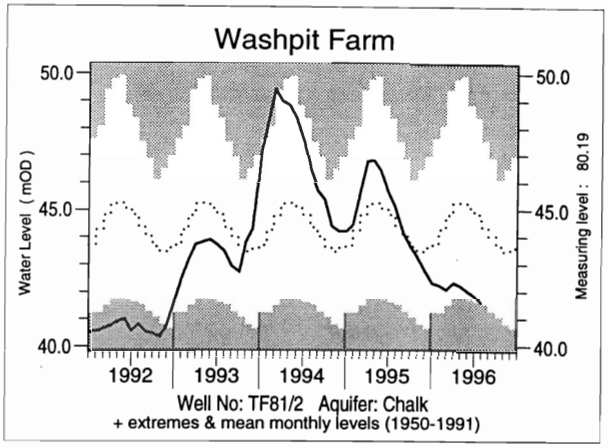


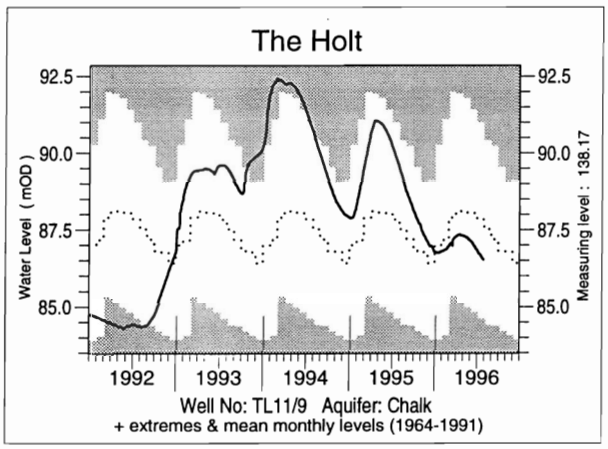
These plots are based on the reservoirs featured in Table 4 only

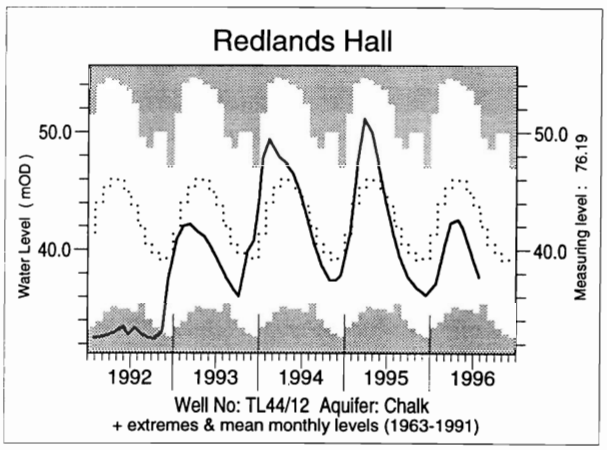
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient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

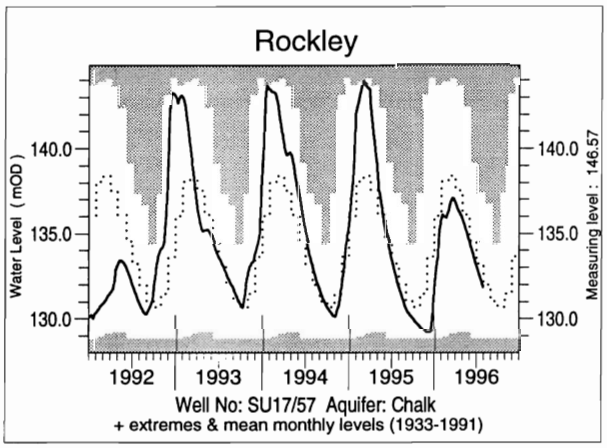
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

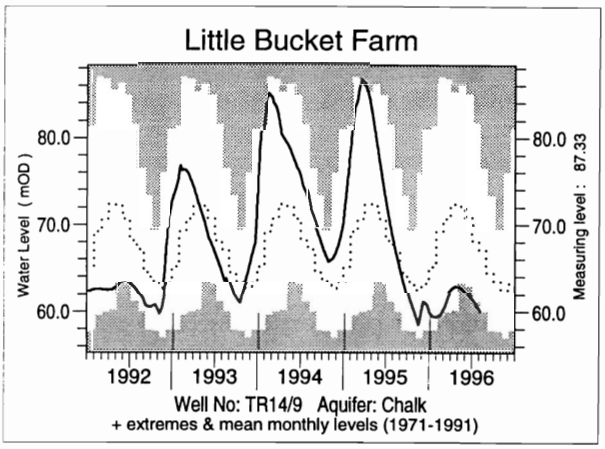


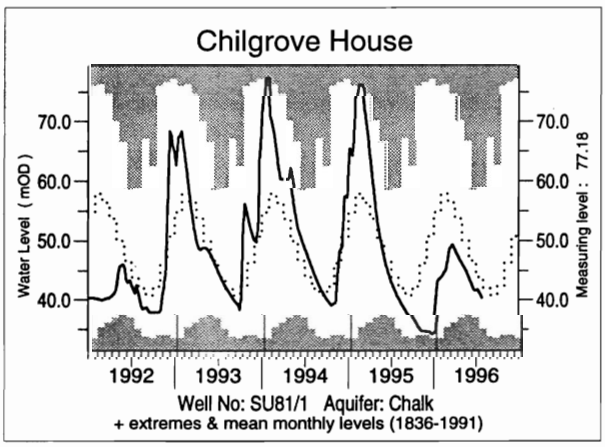


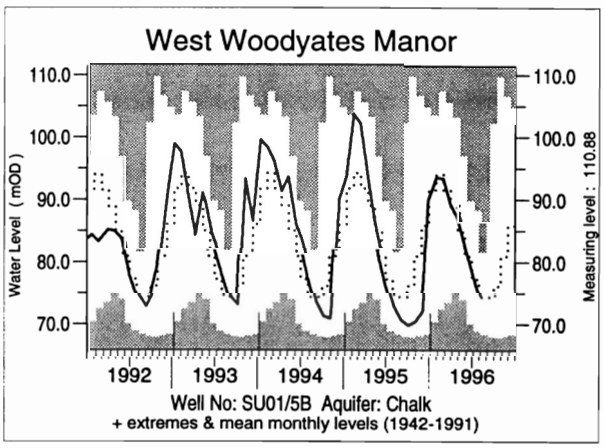


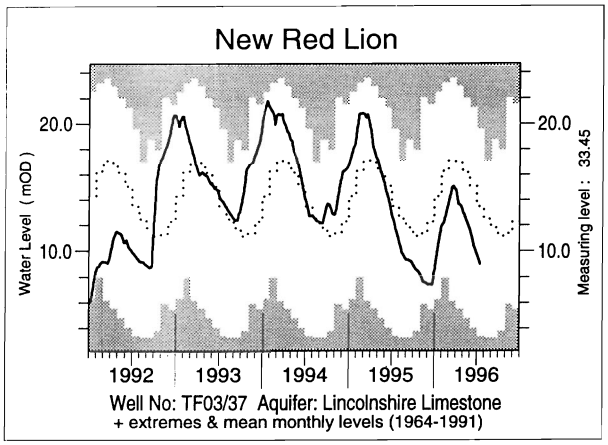


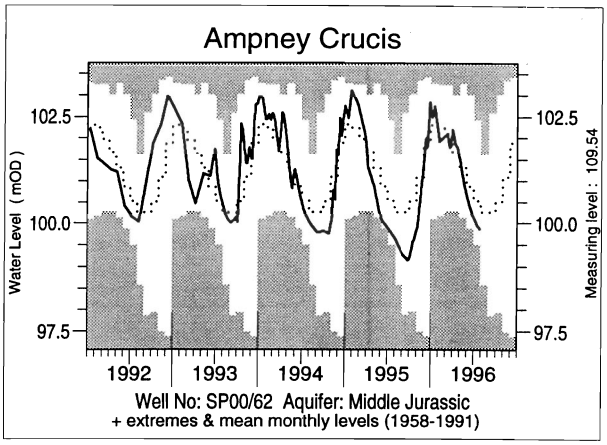


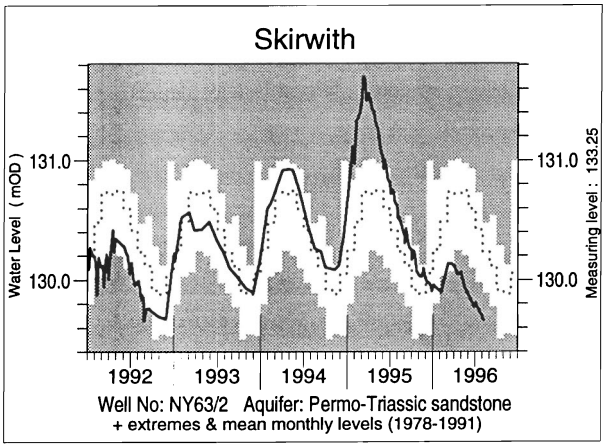


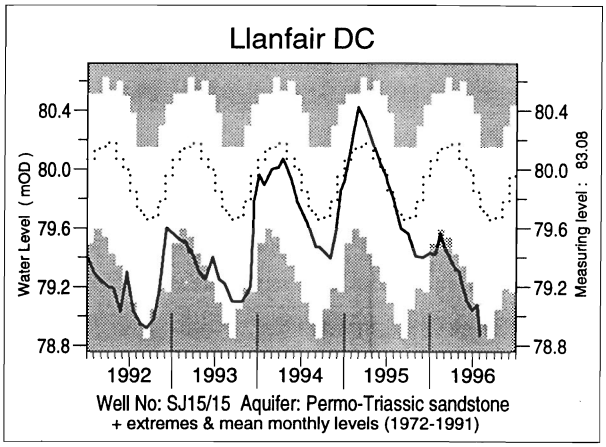


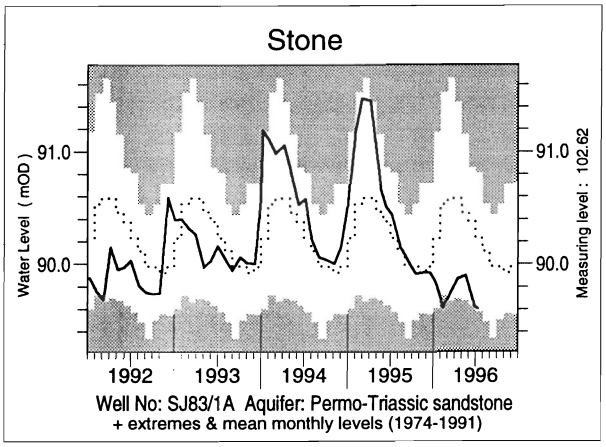


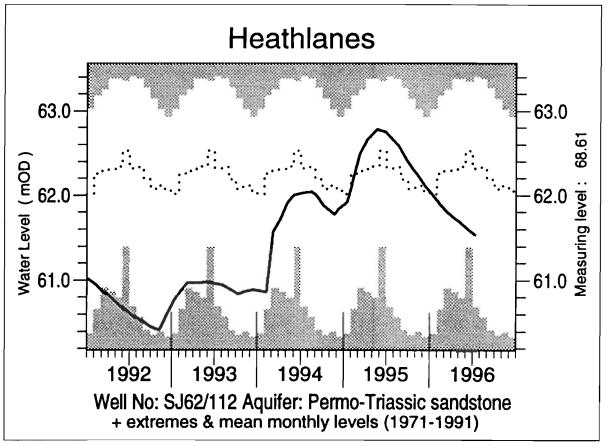

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
1996
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)

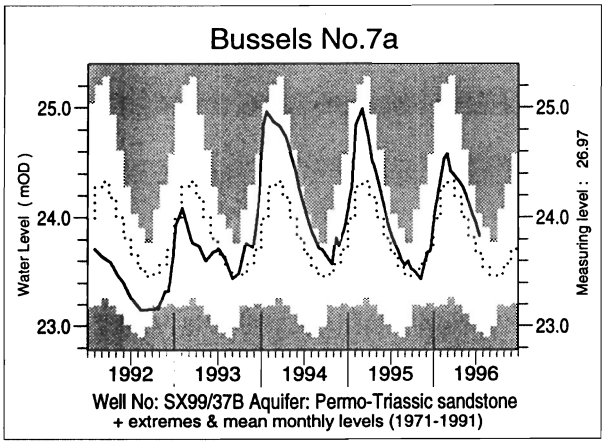

Ampney Crucis
Water Level (mOD)
102.5
100.0
97.5
Measuring level : 109.54
1992
1993
1994
1995
1996
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1991)


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)
80.4
80.0
79.6
79.2
78.8
Measuring level : 83.08
1992
1993
1994
1995
1996
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1991)


Stone
Water Level (mOD)
91.0
90.0
Measuring level : 102.62
1992
1993
1994
1995
1996
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
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)

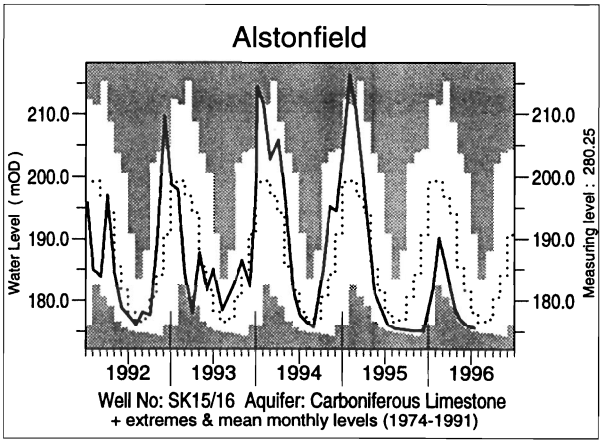

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
1996
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

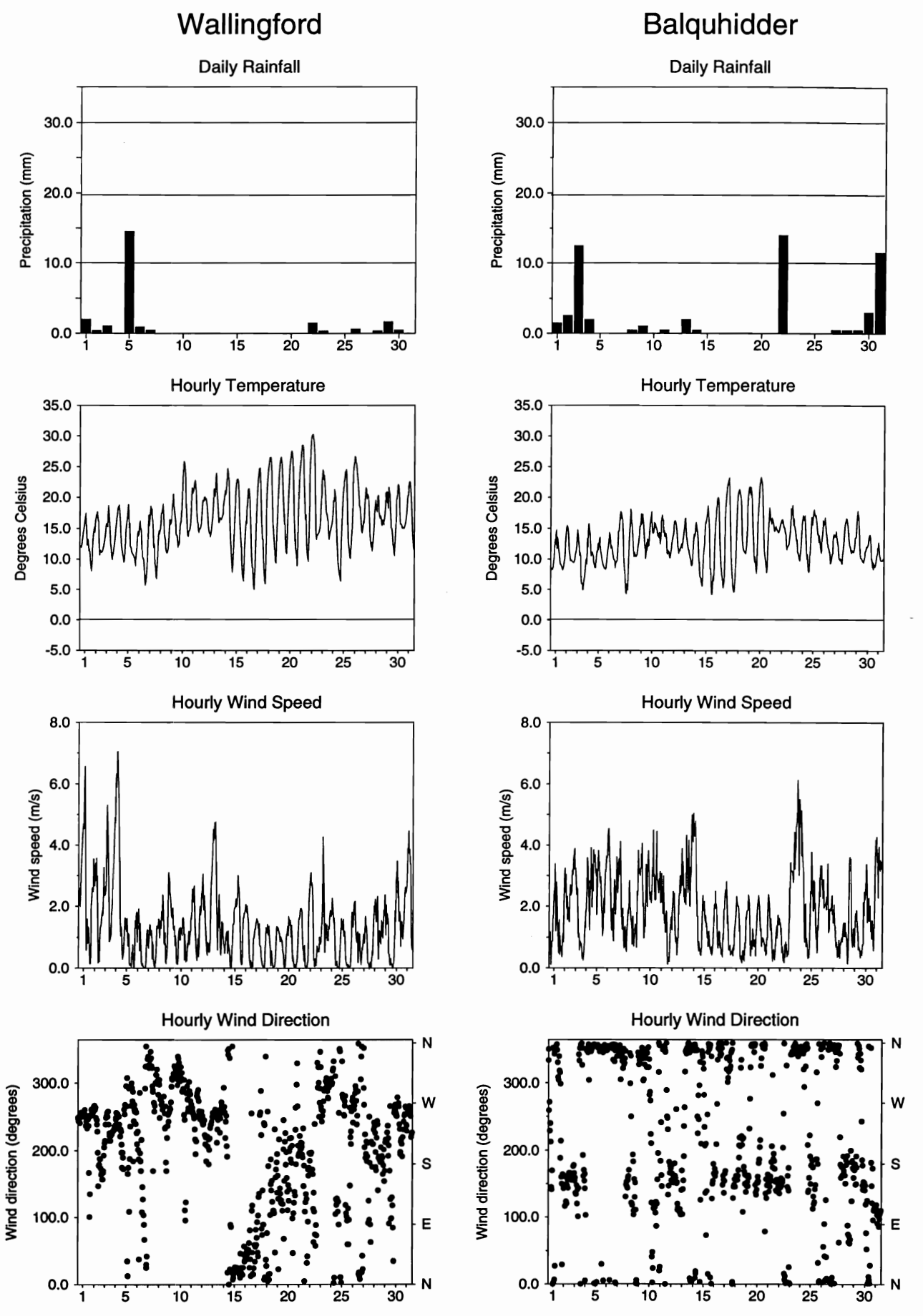
TABLE 5 JULY GROUNDWATER LEVELS 1996

Site	Aquifer	Records commence	Minimum July <1996	Average July <1996	Maximum July <1996	No. of years July/Aug level<1996	July/Aug 1996 day	July/Aug 1996 level
Dalton Holme	C & UGS	1889	11 .51	17.34	21.17	4	12/07	13 .04
Wetwang	C & UGS	1971	18.39	20.59	23.71	4	12/07	19.23
Keelby Grange	C & UGS	1980	3.62	11.48	15.73	1	30/07	5.22
Washpit Farm	C & UGS	1950	40.51	44.82	48.37	3	02/08	41.55
The Holt	C & UGS	1964	84.40	88.19	91.25	5	29/07	86.57
Therfield Rectory	C&UGS	1883	dry <71.60	81.71	99.05	>10	29/07	77.50
Redlands Hall	C & UGS	1964	33.28	42.91	52.30	5	26/07	37.67
Rockley	C & UGS	1933	dry<128.44	133.19	137.34	>10	29/07	131.86
Little Bucket Farm	C & UGS	1971	60.97	68.81	81.50	0	01/08	59.77
Compton House	C & UGS	1894	28.75	35.71	45.10	5	26/07	31.75
Chilgrove House	C & UGS	1836	34.95	43.68	58.83	>10	26/07	40.36
Westdean No.3	C & UGS	1940	1.06	1.50	2.02	5	26/07	1.21
Lime Kiln Way	C & UGS	1969	123.91	125.23	125.90	>10	09/07	125.82
Ashton Farm	C & UGS	1974	64.21	66.73	69.77	9	31/07	66.24
West Woodyates Manor	C & UGS	1942	68.56	77.00	88.07	>10	31/07	74.40
Killyglen (NI)	C & UGS	1985	112.92	113.75	115.25	3	21/07	113.30
New Red Lion	LLst	1964	3.42	13.42	19.69	1	15/07	9.04
Ampney Crucis	Mid Jur	1958	99.48	100.50	102.42	4	29/07	99.86
Redbank	PTS	1981	7.37	7.99	8.41	2	31/07	7.64
Skirwith	PTS	1978	129.96	130.34	130.76	1	05/08	129.67
Llanfair D.C	PTS	1972	79.04	79.72	80.38	0	01/08	78.87
Morris Dancers	PTS	1969	31.90	32.47	33.53	>10	16/07	32.33
Stone	PTS	1974	89.57	90.23	90.82	1	12/07	89.60
Heathlanes	PTS	1971	60.59	62.21	63.41	4	11/07	61.53
Bussels No.7A	PTS	1972	22.94	23.69	24.05	>10	17/07	23.83
Rushyford NE	MgLst	1967	65.19	72.83	76.55	>10	23/07	76.09
Peggy Ellerton	MgLst	1968	31.30	34.17	36.96	5	18/07	33.08
Alstonfield	CLst	1974	174.90	178.75	190.77	3	15/07	175.46

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

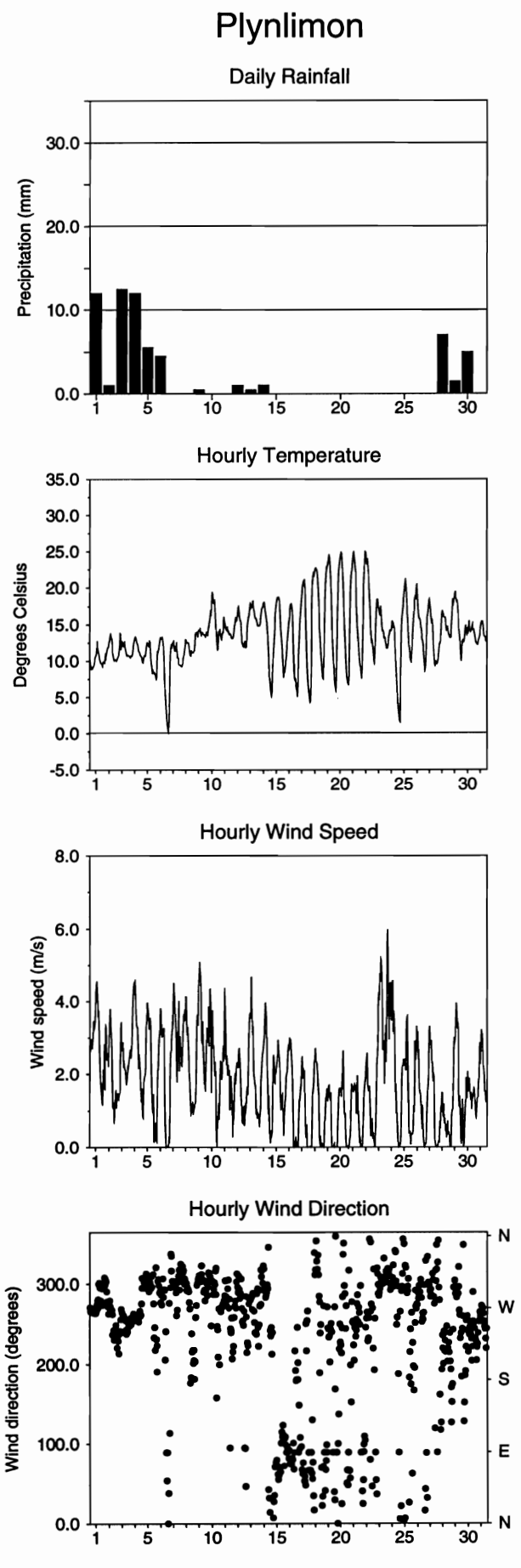
FIGURE 3 METEOROLOGICAL SUMMARY - JULY 1996



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

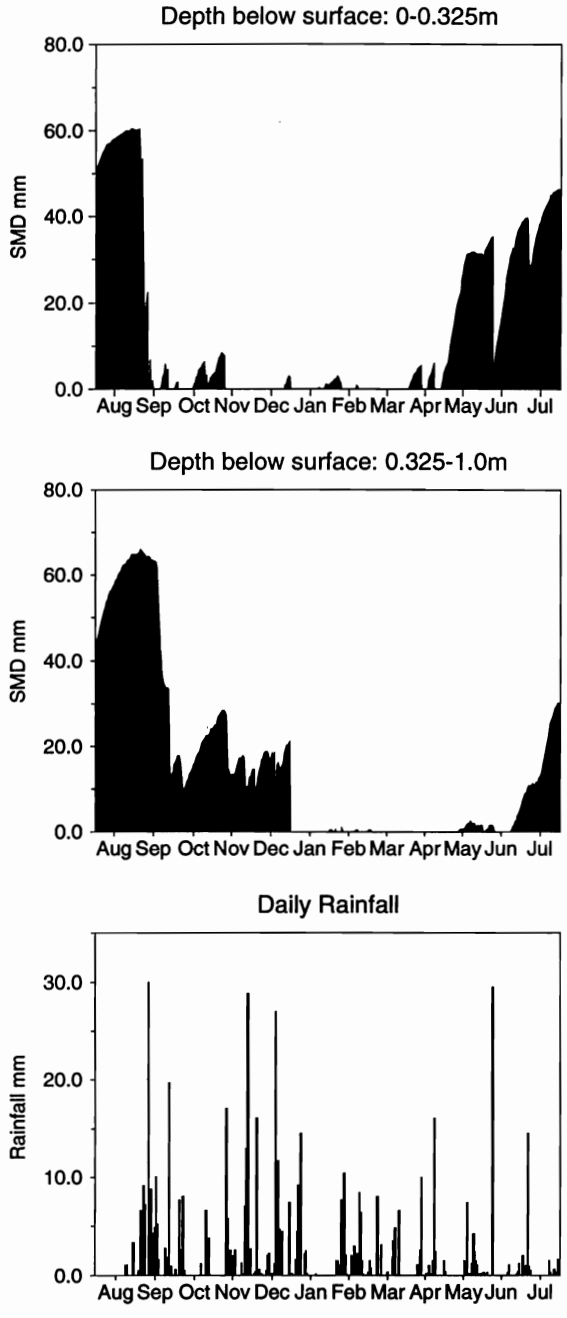
The Lower Kirkton automatic weather station (Balquhidder) occupies a relatively sheltered position at the mouth of the SSE trending Kirkton Glen. Station elevation is 270m aOD and average annual rainfall exceeds 2000mm; snow cover is expected for 10-30 days a year.

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 1995/6.



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 meteorological station from August 1995 is presented.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS