Hydrological Summary for Great Britain

MARCH 1995

Rainfall

In contrast with much of the preceding winter, March was cool (cold at times) and very sunny with a rich variety of weather conditions and precipitation types; fog-drip, hail, sleet, snow and rain all featuring. Anticyclonic conditions became established late in the month and precipitation totals over the latter half were generally modest, in southern Britain especially. Regional rainfall totals for March were mostly well within the normal range but some low-lying eastern areas of Scotland were again relatively dry as were some districts in central and southern England. Below average March totals in the latter areas terminated a protracted sequence of wet months - lasting from August 1994 in the Wessex region. For Britain as a whole, the March precipitation total was close to the mean but medium and long term accumulations remain exceptional. Provisional data indicate that the winter half-year (Oct.-Mar.) is the wettest in a series from 1869. The corresponding 1989/90 and 1992/93 totals were only marginally lower and winter rainfall over the last eight years is around 20% greater than the pre-1980 average. Over the same period, summer half-year rainfall has been very variable but the mean closely equates to the long term average. The impact of the prevalent westerly airflow over recent years is evident in the return period estimates given in Table 2. Accumulations are remarkable over much of southern Britain for periods up to around 30 months and exceptional both for the post-November 1994 period and timespans from 3-6 years (and longer) in western Scotland and the Highlands. *Note:* the associated return periods would be substantially moderated by including recent data in the regional analyses.

River Flow

A few minor flood alerts occurred in Scotland during March - mostly around the 11th - but rivers in southern Britain were characterised by extended recessions. March runoff totals were boosted by snowmelt in upland catchments and, in the English lowlands, by abundant groundwater outflow following very high winter recharge to most aquifers. Thus, despite below average rainfall in some catchments, record March runoff totals were established for many permeable catchments (see Table 3). Elsewhere, monthly flows were generally well above average apart from some sheltered catchments draining to the north-eastern coastline, for example, the Whiteadder where flows have been relatively depressed throughout most of the last 12 months. More typical are the exceptionally high, often record, accumulated totals established over a range of timespans and notable evaporation losses. Notwithstanding the recent brisk recessions, January-March runoff totals are without recorded parallel throughout most of southern Britain and in many rivers draining from the Pennines; the Severn and Welsh Dee (at Manley Hall) established new maxima in series from 1921 and 1937 respectively. Winter half-year runoff totals are exceptional, commonly for the third successive year. Much enhanced runoff rates have been a feature of the past decade in Scotland but the Clyde still established a new maximum 18-month runoff total (for any start month). Unprecedented 18-month totals are widespread in England and Wales also - e.g. on the Witham, Mimram, Exe and Hampshire Avon which eclipsed the pre-1994 maxima by a wide margin.

Groundwater

Soils remained at, or close to, saturation throughout March in most of western and northern Britain but soil moisture deficits began to develop in the English lowlands (see Figure 3a) and, by month-end, were around the seasonal average. The dry and warm start to April has probably brought an end to significant infiltration in parts of the eastern Chalk. Preliminary estimates of winter recharge indicate more than 50% above the average over wide areas of eastern and southern England. At this time of year when levels are changing rapidly, the apparent water-table behaviour can be heavily influenced by the frequency of level measurements but despite declines in the more responsive aquifer units, levels in the Chalk remain very healthy with record levels being approached in a number of localities (e.g. Little Bucket Farm). Peak levels have yet to be reached in some of the deeper boreholes (Washpit Farm and Therfield for example). High level springs in the South-East flowed very strongly in March and many cases of flooded fields, artesian flow at boreholes and localised domestic flooding were reported - an echo of January 1994. The groundwater resources picture is also encouraging throughout most of the Permo-Triassic sandstone aquifers - recessions have become established in the outcrop areas but steady recoveries continue in the confined zones.

General

Reservoir contents remained close to capacity throughout March and the resources outlook is very good. However, the last decade has seen remarkable seasonal contrasts in runoff and aquifer recharge rates and 1990 provides a recent reminder of the hydrological transformation which can occur over as little as 4-6 months.

Institute of Hydrology

British Geological Survey

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 by one of 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 range 0 - 0.325 m and 0.325 - 1.00 m at 0100 GMT on each day. These give a good representative picture of the variations, without the short-term changes introduced by the very shallow data dominating the picture.

Daily rainfall for the Wallingford meteorological station from Figure 3 is repeated here for comparison.

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 and Balquhidder (Central Region, Scotland). 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.

Note: A summary of significant hydrological events in the UK during 1994 is currently being compiled. Copies - free on application - are available through the National Water Archive Office.

* 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

Tel: 01344 856858 Fax: 01344 854024

Institute of Hydrology/British Geological Survey
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

13 April 1995

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

		Mar 1994	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 1995	Feb	Mar
England and	mm	96	74	62	36	47	72	105	95	84	139	157	101	64
Wales	%	133	123	97	55	76	95	136	112	93	148	178	160	89
NRA REGIONS														
North West	mm	165	107	35	70	70	103	108	113	124	204	210	141	108
	%	174	151	47	86	82	96	94	88	101	165	174	181	114
Northumbrian	mm	84	63	26	39	41	81	76	71	95	124	123	80	73
	%	120	113	42	65	63	100	104	93	110	153	146	136	104
Severn Trent	mm	75	57	54	24	44	56	127	66	74	115	128	89	49
	%	123	104	92	41	83	84	198	103	104	149	183	164	80
Yorkshire	mm	71	61	46	28	53	58	100	72	89	121	125	95	62
	%	104	103	77	47	90	78	147	99	111	146	158	163	91
Anglian	mm	53	51	51	25	41	57	90	69	32	58	98	61	49
	%	113	111	106	49	84	104	184	135	55	105	196	166	104
Thames	mm	51	57	79	25	21	50	75	84	53	90	136	78	51
	%	91	114	141	45	43	86	127	135	82	129	213	174	90
Southern	mm	57	77	91	39	29	68	91	119	68	123	163	104	58
	%	90	145	169	72	60	119	132	149	80	150	204	192	93
Wessex	mm	80	62	92	24	34	68	99	113	98	139	179	101	48
	%	114	117	151	42	65	103	138	143	118	149	206	156	68
South West	mm	125	94	99	32	49	103	132	140	127	213	230	142	84
	%	126	136	138	46	71	123	142	121	102	153	167	140	84
Welsh	mm	184	116	69	57	68	94	132	137	133	240	235	161	82
	%	172	145	84	72	88	93	115	100	94	157	164	165	77
Scotland	mm	250	133	29	110	67	101	103	109	150	240	225	203	192
	%	200	175	34	128	71	86	73	70	99	159	149	199	154
RIVER PURIFICATION BOARDS														
Highland	mm	341	185	36	148	62	112	153	117	162	297	293	258	262
	%	210	203	39	151	58	88	89	59	80	151	156	203	162
North East	mm	106	77	16	55	40	47	92	82	85	90	136	82	82
	%	136	128	23	83	55	54	106	85	86	97	137	126	105
Tay	mm	219	96	22	89	47	81	56	113	151	197	184	183	128
	%	201	155	27	122	61	86	49	87	125	155	128	193	117
Forth	mm	210	84	21	75	59	80	57	90	127	203	150	160	121
	%	223	142	28	109	79	85	52	78	113	185	127	203	129
Tweed	mm	124	72	19	52	46	71	58	74	120	171	127	99	95
	%	157	126	27	80	63	81	65	78	129	184	127	148	120
Solway	mm	195	124	29	79	106	121	77	116	177	243	219	215	200
	%	167	161	34	94	118	102	54	74	123	164	140	213	171
Clyde	mm	301	149	38	143	97	142	98	129	186	312	258	260	251
	%	205	177	42	154	89	106	55	67	103	174	137	220	171

Note: The monthly rainfall figures for the NRA regions for February and March 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 February and March 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

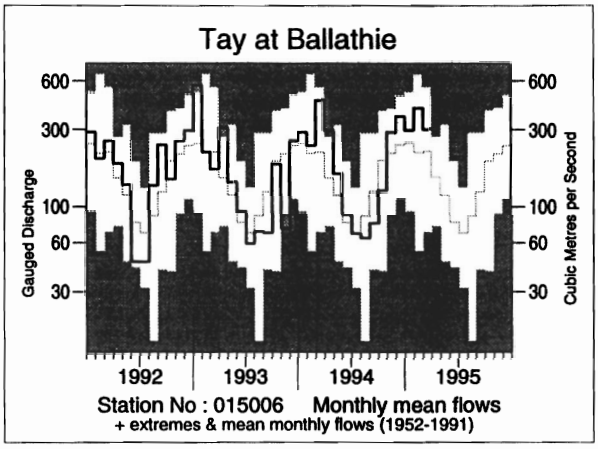
		Jan 95-Mar 95		Oct 94-Mar 95		Apr 94-Mar 95		Apr 93-Mar 95	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	322		640		1036		2165	
	% LTA	144	15-25	130	15-25	116	5-10	121	50-80
NRA REGIONS									
North West	mm	459		900		1393		2735	
	% LTA	156	35-50	135	20-30	116	5-10	114	10-15
Northumbria	mm	276		566		892		1970	
	% LTA	130	5-10	124	5-10	105	2-5	116	10-20
Severn Trent	mm	266		521		883		1853	
	% LTA	144	10-20	131	10-20	117	5-10	123	50-80
Yorkshire	mm	282		564		910		1935	
	% LTA	137	5-15	128	5-15	111	2-5	118	20-30
Anglian	mm	208		367		682		1490	
	% LTA	155	30-40	123	5-10	115	5-10	125	80-120
Thames	mm	265		492		799		1661	
	% LTA	161	30-40	136	10-20	116	5-10	121	25-40
Southern	mm	325		635		1030		2048	
	% LTA	165	35-50	143	30-45	132	35-50	131	>200
Wessex	mm	328		678		1057		2159	
	% LTA	148	10-20	142	30-40	126	15-25	129	120-170
South West	mm	455		935		1444		3089	
	% LTA	135	5-10	130	10-15	123	10-20	132	>200
Welsh	mm	478		988		1524		3138	
	% LTA	138	5-15	127	5-15	116	5-10	120	30-45
Scotland	mm	620		1119		1662		3216	
	% LTA	164	>200	134	50-80	116	10-15	112	10-20
RIVER PURIFICATION BOARDS									
Highland	mm	813		1389		2085		3771	
	% LTA	170	>200	129	20-35	119	10-20	107	5-10
North East	mm	300		557		884		2035	
	% LTA	124	5-10	105	2-5	91	2-5	105	2-5
Tay	mm	495		956		1347		2839	
	% LTA	142	10-20	132	15-25	110	2-5	116	10-20
Forth	mm	431		851		1227		2569	
	% LTA	148	30-45	136	35-50	111	5-10	116	20-35
Tweed	mm	321		686		1004		2241	
	% LTA	131	5-10	130	15-25	104	2-5	116	15-25
Solway	mm	634		1170		1706		3293	
	% LTA	170	>200	142	60-90	120	10-20	116	20-30
Clyde	mm	769		1396		2063		3885	
	% LTA	169	>200	139	60-90	122	20-35	115	15-25

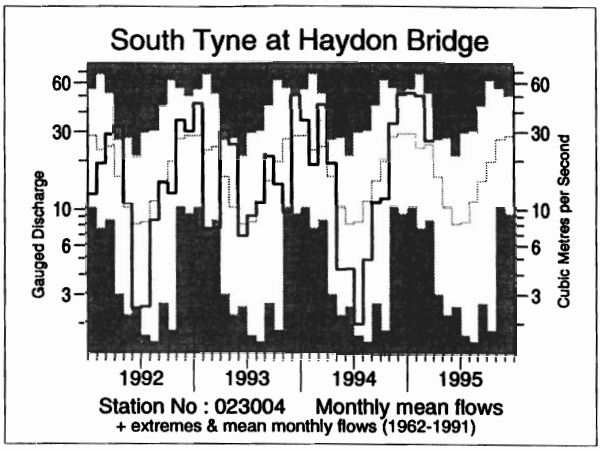
LTA refers to the period 1961-90.

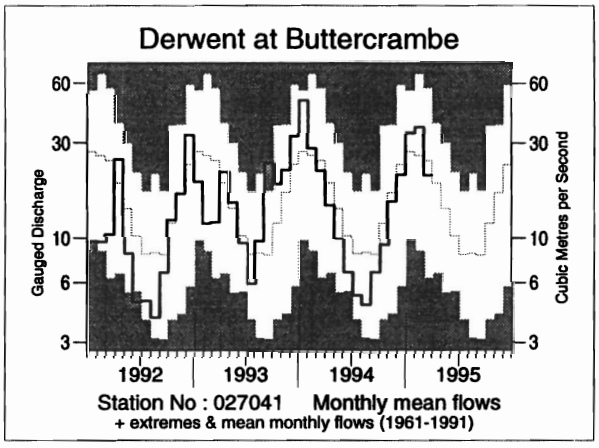
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to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

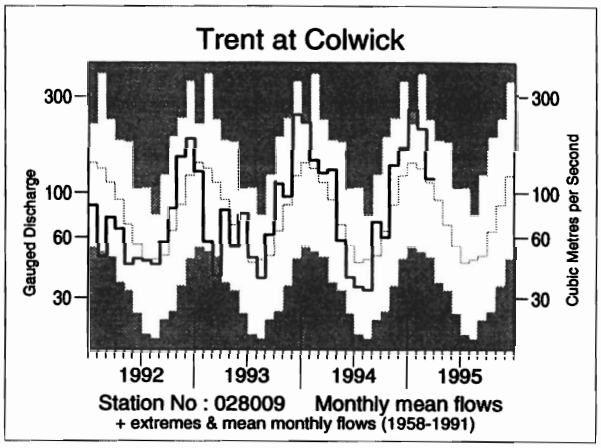
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

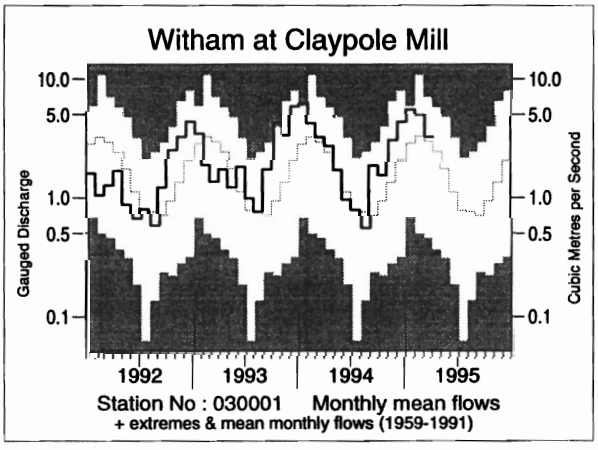
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

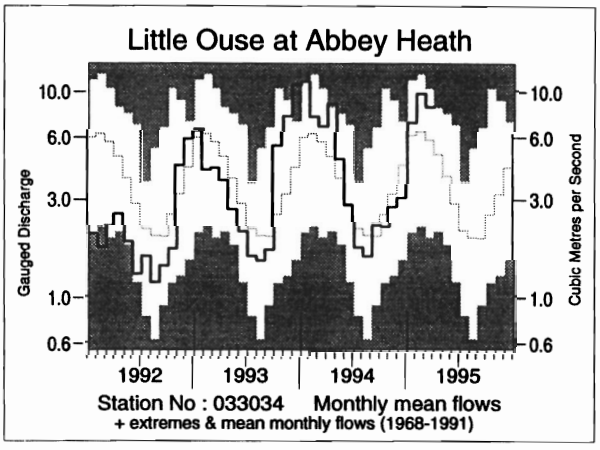


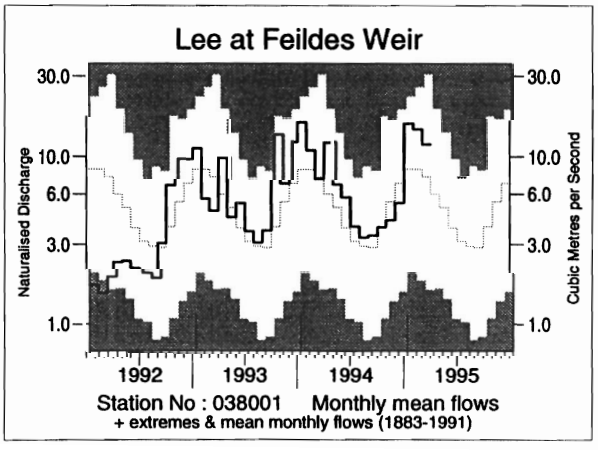


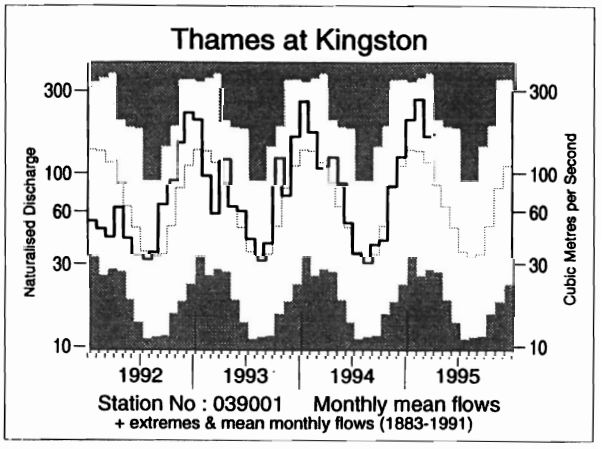


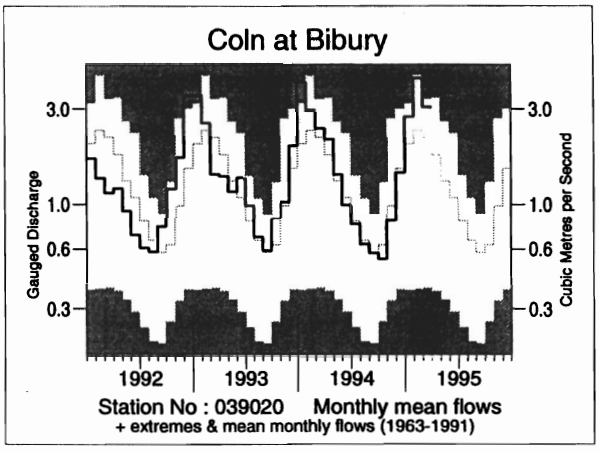


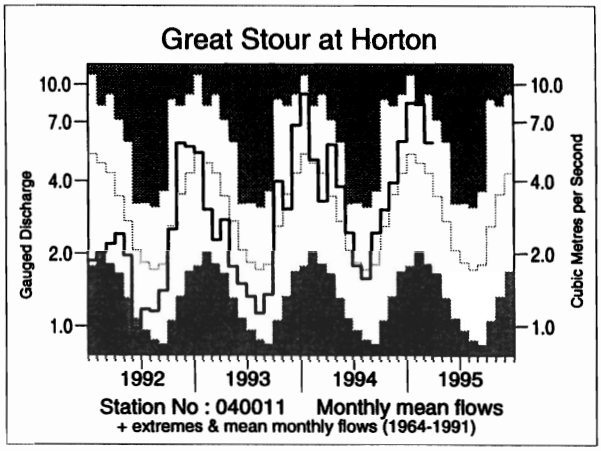


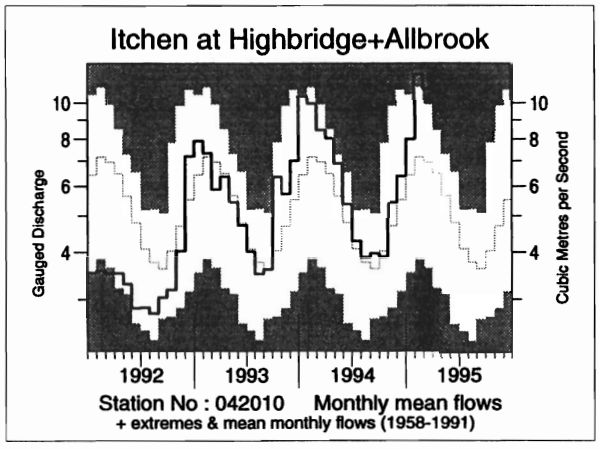


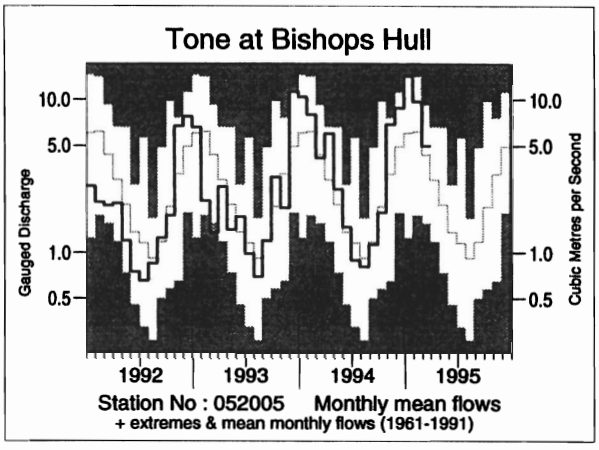


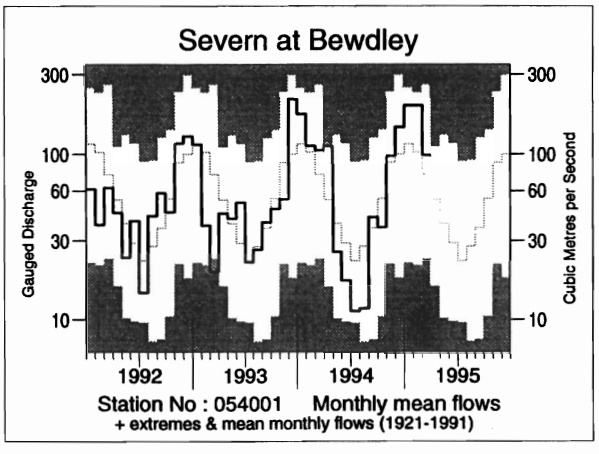


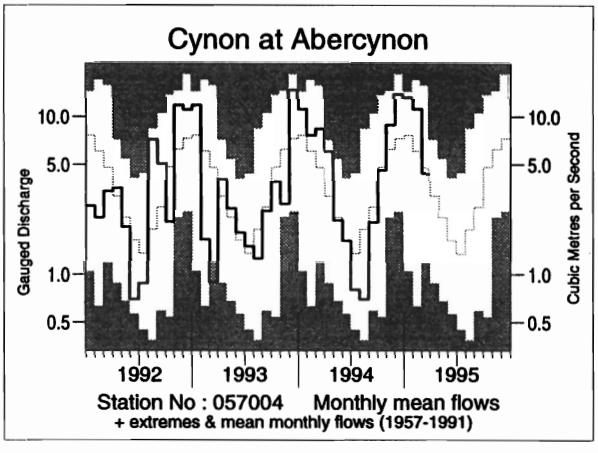

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1992
1993
1994
1995
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

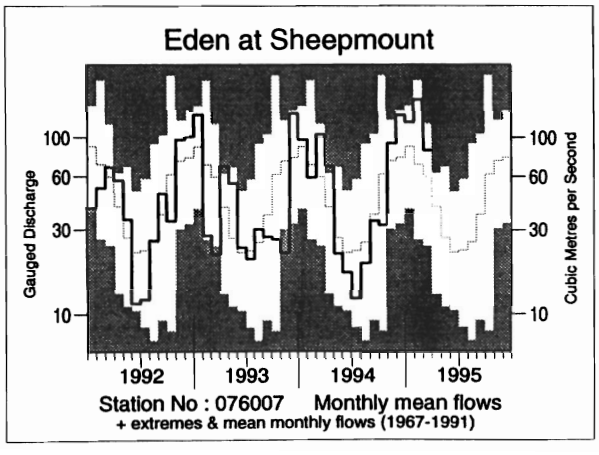

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1992
1993
1994
1995
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1991)


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
1992
1993
1994
1995
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1991)

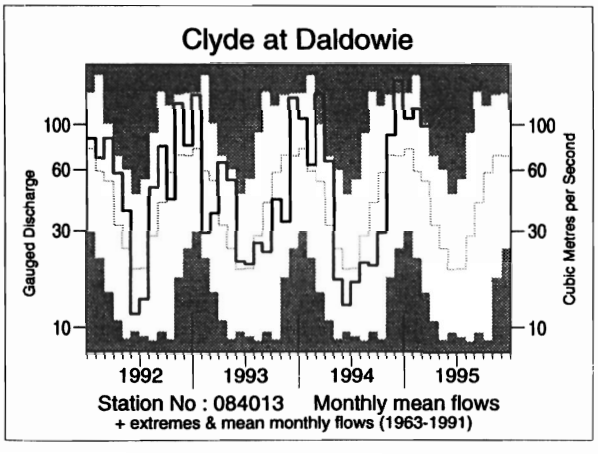

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1992
1993
1994
1995
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

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	Nov 1994	Dec	Jan 1995	Feb	Mar 1995		1/95 to 3/95		10/94 to 3/95		4/94 to 3/95		9/92 to 3/95	
	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	86 115	71 83	81 88	98 136	84 91	10 /23	263 101	12 /23	461 90	5 /22	685 87	6 /22	2216 104	12 /20
Tay at Ballathie	163 137	212 150	174 117	217 190	176 138	33 /43	567 142	40 /43	1015 131	40 /43	1446 126	39 /42	3812 122	39 /40
Tweed at Boleside	114 133	214 218	162 154	160 209	133 168	31 /35	455 169	34 /35	816 154	34 /34	1011 131	33 /34	2651 126	32 /32
Whiteadder Water at Hutton Castle	29 79	39 82	43 73	47 101	24 49	5 /26	114 74	7 /26	189 71	7 /26	258 66	6 /25	1067 100	11 /24
South Tyne at Haydon Bridge	114 123	179 172	181 179	158 215	92 108	20 /33	431 161	32 /33	765 143	33 /33	924 117	25 /31	2420 111	23 /27
Wharfe at Flint Mill Weir	113 143	136 137	163 166	152 203	91 121	29 /40	406 160	40 /40	702 142	39 /40	879 121	34 /39	2202 111	29 /37
Derwent at Buttercrambe	25 89	35 87	57 127	55 142	35 87	15 /34	146 117	24 /34	222 104	20 /34	301 92	16 /33	911 104	20 /31
Trent at Colwick	47 154	59 129	91 184	66 158	42 108	24 /37	199 150	36 /37	327 140	34 /37	453 127	31 /36	1152 120	33 /34
Lud at Louth	14 96	18 89	38 133	45 139	44 130	21 /27	126 129	19 /27	170 117	19 /27	306 121	17 /26	786 121	17 /25
Witham at Claypole Mill	26 204	38 192	49 196	40 156	28 113	23 /36	118 150	30 /36	195 161	30 /36	271 143	29 /35	738 150	34 /34
Little Ouse at Abbey Heath	10 81	12 67	27 119	34 160	32 150	23 /27	92 138	23 /27	122 115	20 /27	203 118	22 /27	543 123	22 /25
Mimram at Panshanger Park	10 117	11 112	15 128	19 165	24 181	43 /43	57 153	39 /43	89 139	38 /42	184 145	41 /42	449 140	40 /40
Lee at Feildes Weir (natr.)	10 77	14 75	41 189	34 174	31 157	98 /109	105 171	99 /109	139 135	87 /109	229 140	91 /107	602 139	97 /104
Thames at Kingston (natr.)	22 102	34 111	55 149	65 199	44 143	94 /113	165 162	104 /113	232 139	92 /112	327 133	94 /112	894 134	105 /110
Coln at Bibury	20 83	36 90	69 133	97 182	77 146	29 /32	242 149	32 /32	312 128	26 /32	473 119	24 /31	1312 125	28 /29
Great Stour at Horton	30 110	45 131	65 165	58 178	45 139	26 /31	168 157	29 /31	267 139	26 /30	401 136	25 /28	910 116	20 /25
Itchen at Highbridge+Allbrook	39 116	47 114	60 125	80 167	81 160	37 /37	221 147	37 /37	337 131	33 /37	574 124	34 /36	1405 118	32 /34
Stour at Throop Mill	73 232	73 127	120 202	122 216	70 142	18 /23	312 178	23 /23	474 161	21 /22	604 151	22 /22	1525 141	20 /20
Exe at Thorverton	165 170	200 148	239 185	171 169	101 122	29 /39	511 158	39 /39	957 151	38 /39	1210 144	37 /38	2961 127	37 /37
Taw at Umberleigh	143 156	181 152	208 180	145 174	85 128	26 /37	438 160	37 /37	826 150	36 /37	1017 144	34 /36	2605 133	34 /34
Tone at Bishops Hull	89 207	118 170	189 240	117 164	66 118	25 /35	372 175	34 /34	603 170	33 /34	770 161	34 /34	1746 133	32 /32
Severn at Bewdley	58 109	89 141	121 171	109 192	61 132	56 /74	291 166	74 /74	461 141	70 /74	594 132	69 /74	1472 118	68 /72
Teme at Knightsford Bridge	47 143	88 158	118 183	83 165	53 112	17 /25	254 152	24 /25	401 145	24 /25	484 131	24 /25	1191 118	22 /23
Cynon at Abercynon	218 142	351 182	334 173	257 192	111 94	22 /37	702 153	36 /37	1387 149	37 /37	1723 135	35 /35	4391 124	31 /31
Dee at New Inn	219 92	447 175	390 165	292 181	144 82	11 /26	825 140	25 /26	1649 129	24 /26	2150 118	23 /25	5363 107	19 /24
Eden at Sheepmount	105 127	157 166	143 138	172 238	99 144	19 /25	414 163	24 /25	713 142	24 /24	914 131	23 /23	2230 117	17 /19
Clyde at Daldowie	122 125	233 227	152 137	152 203	139 183	30 /32	443 163	31 /32	839 151	32 /32	1052 132	31 /31	2810 128	29 /29
Carron at New Kelso	229 81	420 122	383 120	445 205	289 102	9 /17	1117 133	14 /17	1896 110	10 /16	2737 106	10 /16	7079 98	6 /14
Ewe at Poolewe	214 81	336 121	379 140	369 197	274 137	20 /25	1022 151	23 /25	1789 123	20 /24	2553 118	22 /24	6612 110	17 22

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.

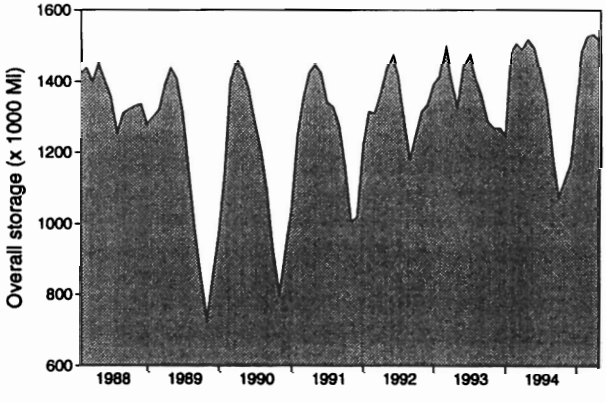
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO APRIL 1995

Area	Reservoir (R)/ Group (G)		Capacity• (Ml)	1994 Nov	Dec	1995 Jan	Feb	Mar	Apr	1994 Apr
North West	N.Command Zone[1]	(G)	133375	50	67	91	100	100	99	100
	Vyrnwy	(R)	55146	65	83	100	99	100	97	100
Northumbria	Teesdale[2]	(G)	87936	53	80	97	100	100	99	100
	Kielder	(R)	199175*	90*	91*	100*	100*	100*	97	96*
Severn-Trent	Clywedog	(R)	44922	82	83	100	100	94	97	99
	Derwent Valley[3]	(G)	39525	64	89	100	100	100	100	100
Yorkshire	Washburn[4]	(G)	22035	52	73	92	100	100	98	100
	Bradford supply[5]	(G)	41407	57	74	88	99	99	98	98
Anglian	Grafham	(R)	58707	89	95	93	92	93	95	91
	Rutland	(R)	130061	86	93	95	96	95	91	96
Thames	London[6]	(G)	207569	85	89	92	94	95	97	89
	Farmoor [7]	(G)	13843	99	96	95	95	96	97	98
Southern	Bewl	(R)	28170	83	85	89	96	99	99	100
	Ardingly	(R)	4685	80	90	93	100	100	100	100
Wessex	Clatworthy	(R)	5364	53	100	100	100	100	100	100
	Bristol W [8]	(G)	38666*	52*	71*	88*	99*	99*	99*	99*
South West	Colliford	(R)	28540	70	75	81	90	96	97	100
	Roadford[9]	(R)	34500	66	69	79	91	97	96	100
	Wimbleball[10]	(R)	21320	64	80	100	100	100	100	100
	Stithians	(R)	5205	50	66	77	100	100	96	100
Welsh	Celyn + Brenig	(G)	131155	75	86	100	100	100	100	100
	Brianne	(R)	62140	83	99	100	100	100	100	100
	Big Five[11]	(G)	69762	66	83	92	97	100	99	100
	Elan Valley[12]	(G)	99106	83	99	100	100	100	95	100
Lothian	Edin./Mid Lothian	(G)	97639	69	85	95	99	100	99	99
	East Lothian	(G)	10206	57	70	91	98	100	100	98
Strathclyde	Loch Katrine	(G)	111363	90	95	98	97	99	100	100
	Daer	(R)	22412	99	99	100	100	100	96	100
	Loch Thom	(G)	11840	83	94	99	100	100	100	99

• 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.

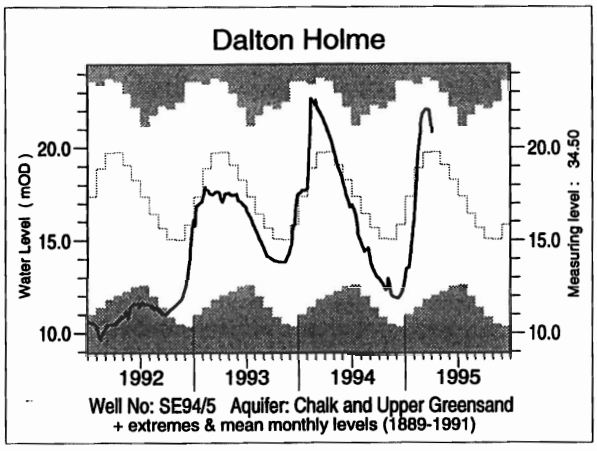
A GUIDE TO THE VARIATION IN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES

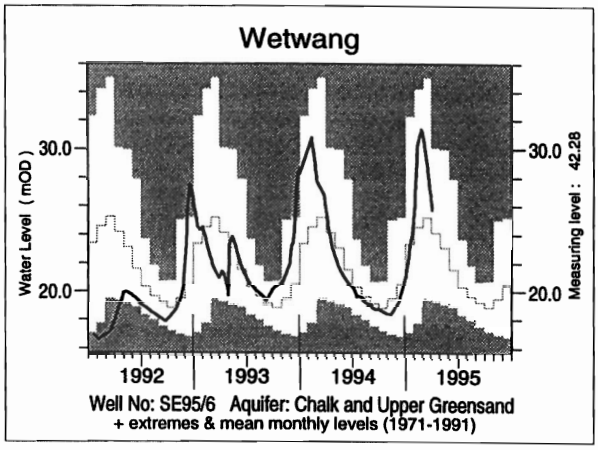


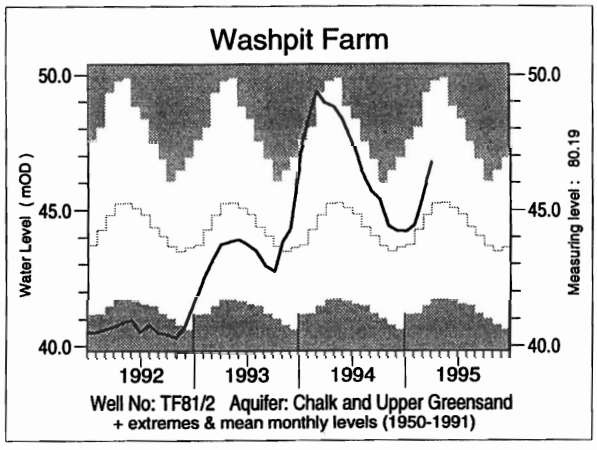
This plot is based on the reservoirs featured in Table 4 only.

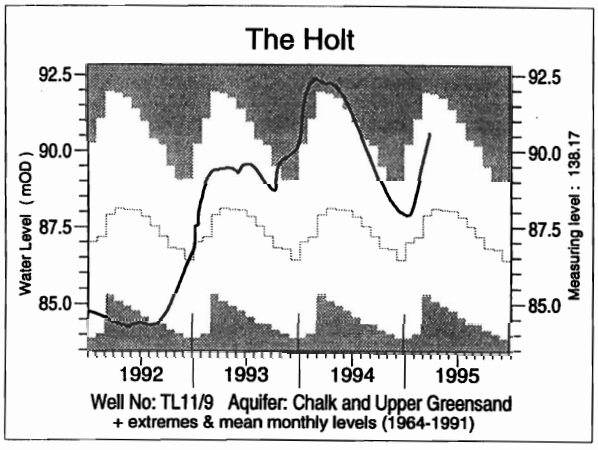
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient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

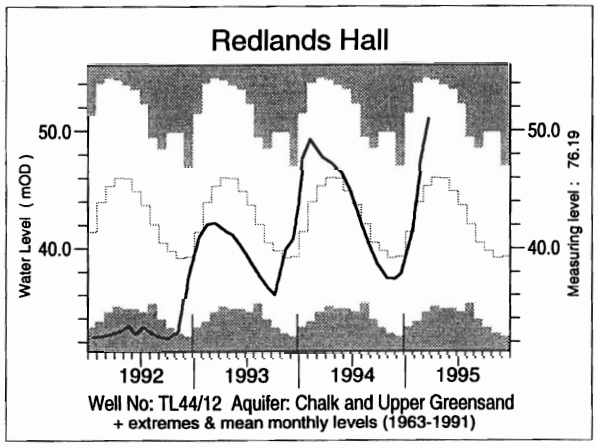
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

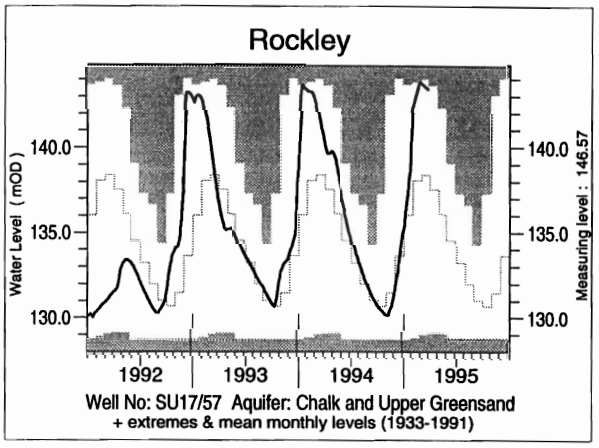


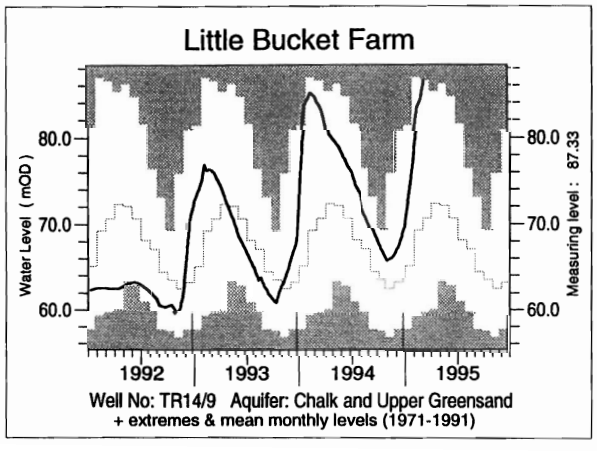


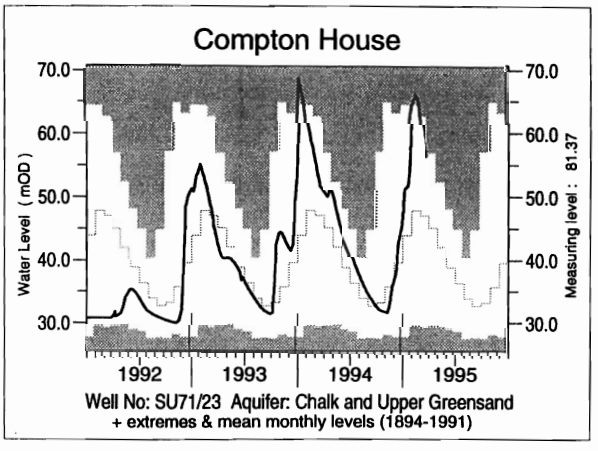


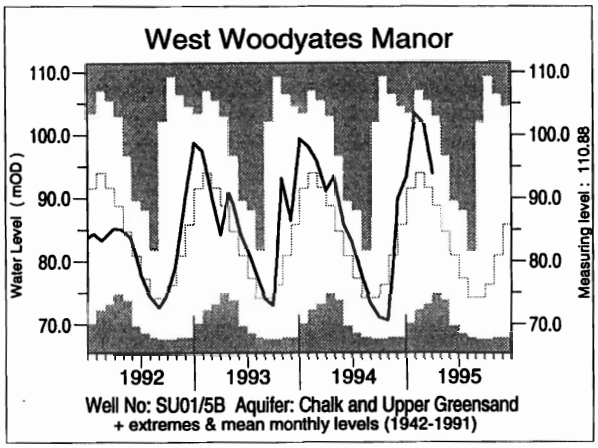


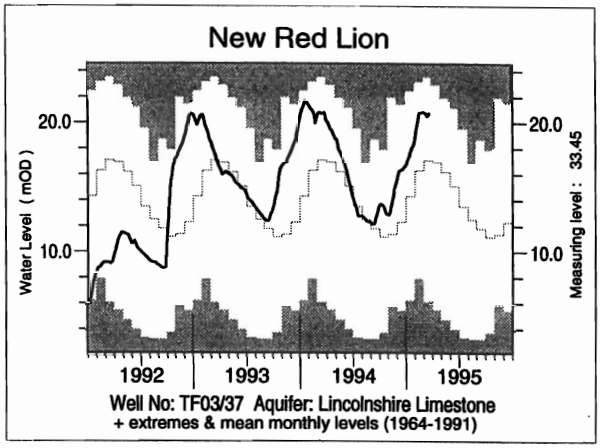


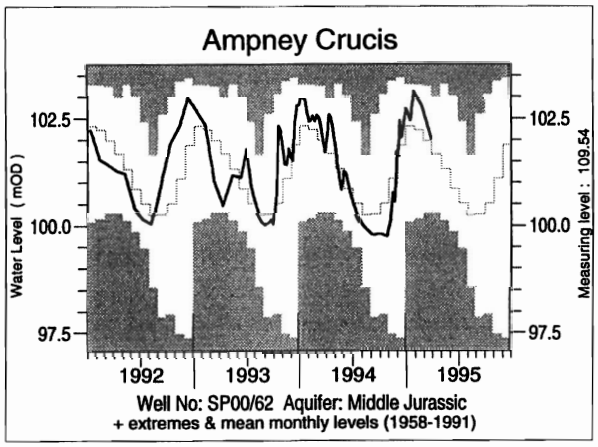


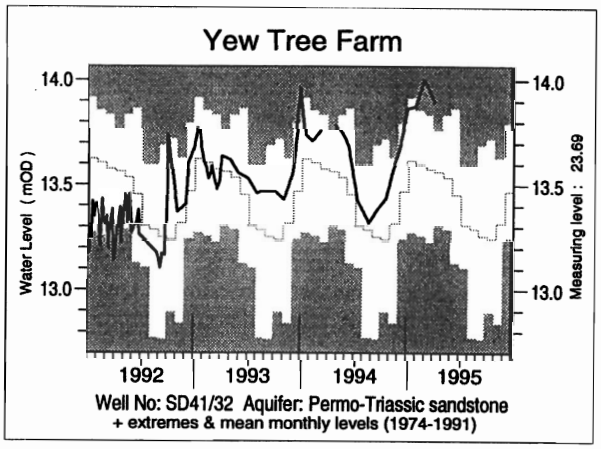


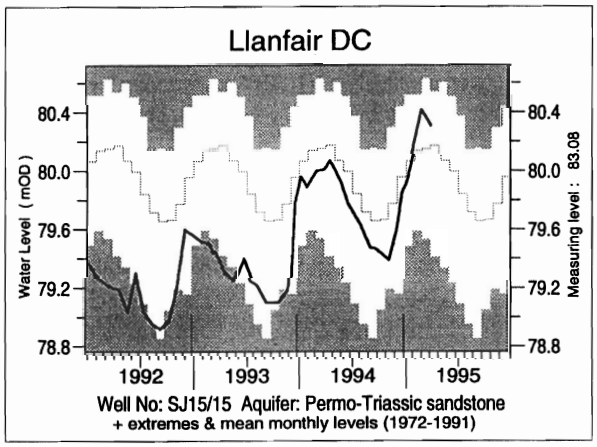


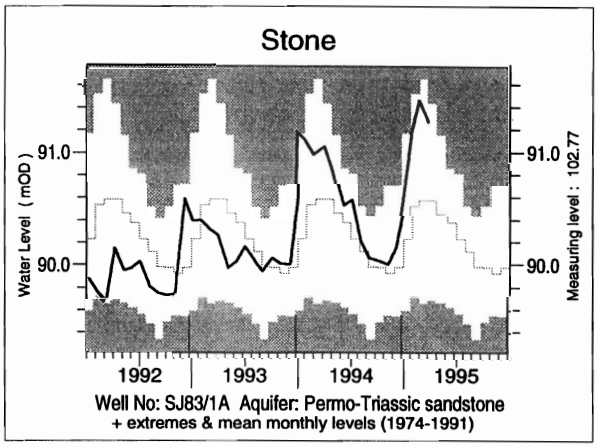

West Woodyates Manor
Water Level (mOD)
110.0
100.0
90.0
80.0
70.0
Measuring level : 110.88
1992
1993
1994
1995
Well No: SU01/5B Aquifer: Chalk and Upper Greensand
+ extremes & mean monthly levels (1942-1991)

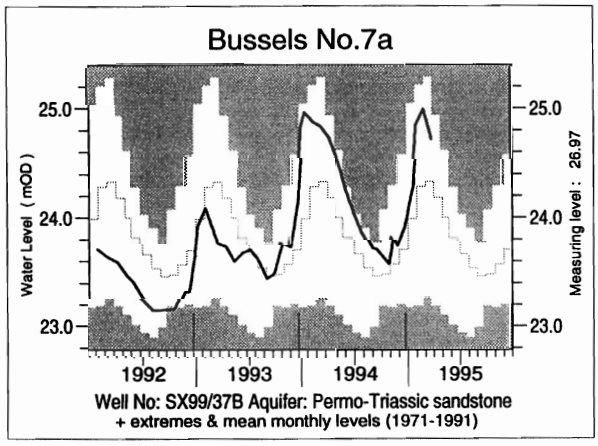

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)


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)


Yew Tree Farm
Water Level (mOD)
14.0
13.5
13.0
Measuring level : 23.69
1992
1993
1994
1995
Well No: SD41/32 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1991)


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)


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)

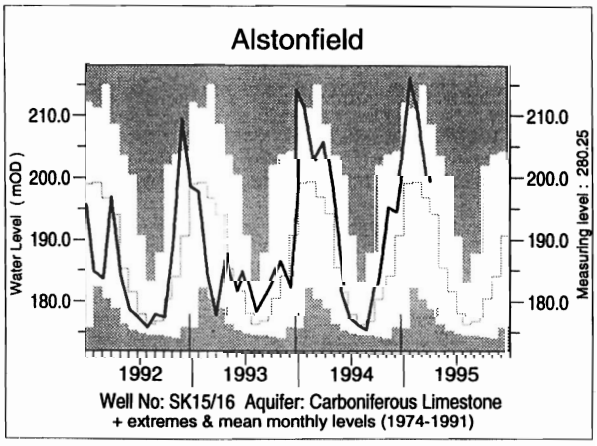

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

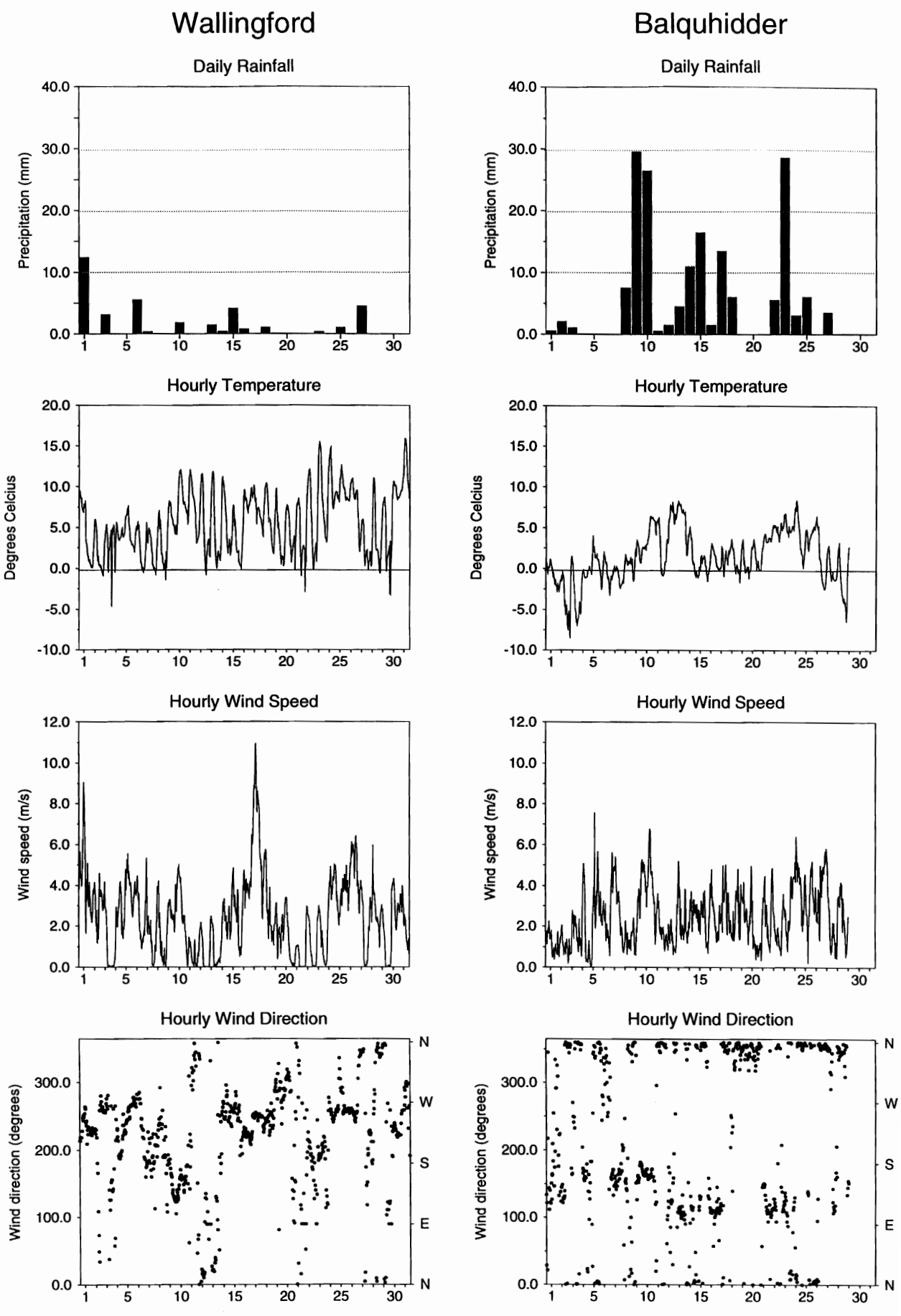
TABLE 5 A COMPARISON OF MARCH GROUNDWATER LEVELS: 1994 AND 1995

Site	Aquifer	Records commence	Minimum Mar	Average Mar	Maximum Mar	March 1994		Mar/April 1995	
			<1995	<1995	<1995	day	level	day	level
Dalton Holme	C & UGS	1889	10.34	19.72	23.82	25/03	21.53	24/03	20.83
Wetwang	C & UGS	1971	17.16	25.06	35.15	25/03	26.83	24/03	25.77
Washpit Farm	C & UGS	1950	40.61	44.93	49.39	31/03	48.97	03/04	46.79
The Holt	C & UGS	1964	84.47	87.79	92.34	27/03	92.25	30/03	90.62
Therfield Rectory	C & UGS	1883	dry <71.6	79.08	96.83	07/03	86.57	27/03	83.60
Redlands Hall	C & UGS	1964	32.62	44.19	54.50	23/03	47.77	24/03	51.00
Rockley	C & UGS	1933	129.10	138.39	144.06	27/03	140.60	30/03	143.43
Little Bucket Farm	C & UGS	1971	59.67	71.70	86.58	30/03	82.46	13/03	86.56
Compton House	C & UGS	1984	29.40	46.72	62.80	18/03	51.70	29/03	56.53
Chilgrove House	C & UGS	1836	35.97	55.74	74.68	18/03	60.31	29/03	65.65
Westdean No.3	C & UGS	1940	1.31	2.17	4.14	31/03	2.26	24/03	3.63
Lime Kiln Way	C & UGS	1969	124.07	125.44	126.23	24/03	125.86	22/03	126.48
Ashton Farm	C & UGS	1974	64.67	69.51	71.10	31/03	70.32	31/03	70.32
West Woodyates Manor	C & UGS	1942	73.18	90.60	105.44	31/03	91.13	31/03	93.81
Killyglen (NI)	C & UGS	1985	113.63	116.02	119.52	31/03	115.58	09/03	116.12
New Red Lion	LLst	1964	6.14	16.63	23.69	28/03	20.24	21/03	20.74
Ampney Crucis	Mid Jur	1958	100.29	102.03	103.26	27/03	101.70	30/03	102.02
Yew Tree Farm	PTS	1973	12.75	13.56	13.84	01/03	13.76	06/04	13.90
Llanfair D.C	PTS	1972	79.24	80.03	80.63	28/03	80.01	03/04	80.31
Morris Dancers	PTS	1969	31.78	32.50	33.51	08/03	32.18	13/03	32.47
Weeford Flats	PTS	1966	dry <88.61	89.84	91.61	01/03	89.73	03/04	90.71
Stone	PTS	1974	89.66	90.57	91.66	01/03	90.99	07/04	91.45
Skirwith	PTS	1978	129.95	130.66	131.00	31/03	130.92	03/04	131.49
Redbank	PTS	1981	8.01	8.06	9.45	31/03	8.86	04/04	7.72
Bussels No.7A	PTS	1972	23.26	24.30	25.28	16/03	24.83	30/03	24.71
Rushyford NE	MgLst	1967	65.59	72.53	76.97	29/03	76.78	21/03	76.55
Peggy Ellerton	MgLst	1968	31.64	34.51	36.93	17/03	33.60	20/03	34.65
Alstonfield	CLst	1974	180.54	195.56	215.15	01/03	202.82	01/04	199.39

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 - MARCH 1995

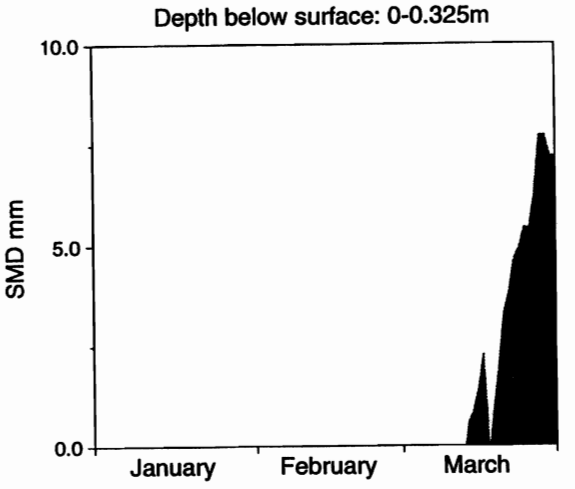


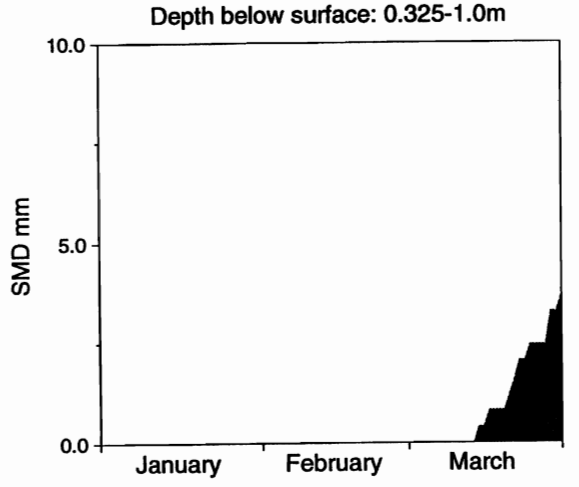
Altitude of sites : Wallingford 48m; Balquhidder (Kirkton Glen) 300m.

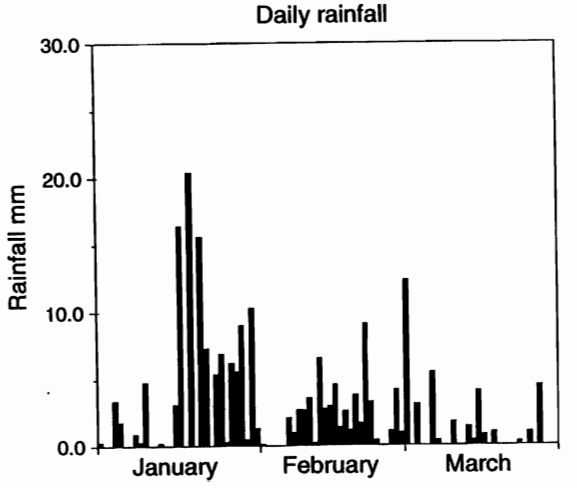
Balquhidder data only until March 29th. Some uncertainty with Balquhidder rainfall data due to snowfall in month.

Average snowline at Balquidder in March was 340m above sea level.

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 by one of 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 range 0 - 0.325 m and 0.325 - 1.00 m at 0100 GMT on each day. These give a good representative picture of the variations, without the short-term changes introduced by the very shallow data dominating the picture.

Daily rainfall for the Wallingford meteorological station from Figure 3 is repeated here for comparison.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS