Hydrological summary *for Great Britain*

June 1997

General

June was a dull, cool and remarkably wet month — provisionally the wettest on record for Great Britain in a series from 1869. Most of the drought affected areas received more than twice the monthly average. This, together with seasonally low temperatures and modest evaporative losses, produced a substantial reduction in drought intensity — reinforced in water supply terms by the absence of any early summer surge in demand and healthy reservoir stocks. Groundwater levels remain depressed over wide areas but the steep decline in soil moisture deficits — particularly welcome for farmers and gardeners — has prepared the way for an autumn recovery, provided June does not prove to be another of the wet interludes which have punctuated the 1995-97 drought.

Rainfall

June was an unsettled month with low pressure dominant in most regions. Initially, damp weather produced only modest rainfall totals but from mid-month a sequence of slow moving low pressure systems produced protracted rainfall, often with heavy thundery showers in their wake. Rainfall totals for the last week of June were especially high and included several damaging thunderstorms (57 mm fell in three hours at Bognor on the 26th). Excepting some relatively dry localities in north-western Britain most regions recorded monthly rainfall totals over 170% of average; England and Wales registered its highest June rainfall total since 1860. Some districts (e.g. the North-East) reported three times average rainfall. The continued wet conditions from late spring have substantially moderated rainfall deficiencies in all regions. Rainfall totals so far for 1997 are now within the normal range, albeit still below average in much of eastern and central England. Over the longer time-frame the drought remains severe: the period from April 1995 to June 1997 is the driest 27-month sequence since the 1850s for England and Wales, although the 1990-92 period produced comparable deficiencies. Long term rainfall deficiencies remain greatest in north-west England (and the Pennines) and in the English lowlands.

River Flow

In common with much of this decade, 1997 river flow patterns have shown wide departures from the seasonal average. The steep seasonal recessions were reversed in most western and northern catchments in June, and at least arrested in much of the lowlands. Spate conditions towards month-end — accompanied by flood alerts in a few areas (e.g. rivers draining from Dartmoor) — boosted monthly runoff totals to well above average in much of western and northern Britain. Runoff totals were particularly high from the Tweed to the Tees basins; a new June record was established for the River Leven. The very dry soils in the lowlands moderated runoff rates; high runoff rates were restricted to urban catchments (e.g. flood warnings for Brent tributaries, London). Significant surface runoff contributed to river flows in impermeable catchments. Flows in the River Thames recovered from their lowest June value for nearly 50 years (1976 excepted) to around the seasonal average by the 28th but with baseflows still low, short recessions will resume without more heavy rainfall. Runoff rates remain depressed in rivers supported principally by groundwater. Only in 1976 have lower June runoff totals been recorded on the Coln and Hampshire Avon which, together with the Mimram, Kennet and Lud, recorded June runoff totals of half the average (or less). June runoff had little impact on long-term deficiencies in most drought affected regions.

Groundwater

The June rainfall exceeded actual evaporation losses in almost all areas — for the English lowlands this is unusual. Soil moisture deficits were effectively eliminated in many western and northern aquifers and significant infiltration was reported in late June, e.g. at Alstonfield, but levels remained notably low in the most Permo-Triassic sandstones index wells. Deficits across the major aquifers of eastern and southern England at month-end were still within the normal range. Consequently, recharge was limited and isolated (e.g. parts of the South Downs) and recessions continued in the greater part of the Chalk. Early summer levels in the Chalk were close to the lowest on record in parts of Suffolk and Essex and in the Berkshire and North Downs, the Chilterns and the Yorkshire Wolds; elsewhere water-tables in June were generally above corresponding levels in 1976 or 1992. The reduction in SMD during June implies that average rainfall until October should trigger a seasonal recovery. This will need to be generated from a very low base, in the eastern Chalk particularly, and the longer term outlook for groundwater will be heavily influenced by the volume of recharge over the 1997/98 winter — a third successive dry winter would be a matter of concern.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall.

Rainfall accumulations and return period estimates

Area	Rainfall	Jun 1997	Mar 97-Jun 97	RP	Dec 96-Jun 97	RP	Jun 96-Jun 97	RP	Apr 95-Jun 97	RP
England & Wales	**mm**	**73**	**129**		**315**		**717**		**1501**	
	%	**113**	**66**	***10-15***	**71**	***15-25***	**80**	***10-20***	**78**	***110-15***
North West	mm	110	324		615		1121		2038	
	%	135	101	2-5	95	2-5	93	2-5	77	110-15
Northumbrian	mm	138	264		494		824		1655	
	%	230	106	2-5	105	2-5	97	2-5	88	5-15
Severn Trent	mm	119	246		397		684		1369	
	%	201	105	2-5	91	2-5	91	2-5	81	30-50
Yorkshire	mm	158	276		487		803		1478	
	%	263	112	2-5	104	2-5	98	2-5	81	35-50
Anglian	mm	117	196		296		566		1056	
	%	230	102	2-5	89	2-5	95	2-5	79	50-80
Thames	mm	96	179		293		568		1221	
	%	174	82	2-5	74	5-15	82	5-10	79	35-50
Southern	mm	127	203		347		694		1389	
	%	235	91	2-5	79	5-10	89	2-5	81	30-45
Wessex	mm	90	208		369		744		1698	
	%	157	86	2-5	76	5-10	89	2-5	92	2-5
South West	mm	118	269		508		1025		2272	
	%	171	87	2-5	74	10-15	87	5-10	89	5-10
Welsh	mm	144	347		622		1180		2422	
	%	182	100	2-5	84	5-10	90	2-5	84	15-25
Scotland	**mm**	**101**	**410**		**830**		**1459**		**2921**	
	%	**118**	**110**	**2-5**	**107**	**2-5**	**102**	**2-5**	**94**	**2-5**
Highland	mm	105	517		1055		1822		3445	
	%	107	117	5-10	110	2-5	104	2-5	91	5-10
North East	mm	113	336		575		986		2234	
	%	171	123	5-10	108	2-5	101	2-5	104	2-5
Tay	mm	110	355		711		1221		2603	
	%	151	109	2-5	103	2-5	99	2-5	97	2-5
Forth	mm	119	331		679		1166		2282	
	%	172	112	2-5	113	2-5	105	2-5	94	2-5
Tweed	mm	126	299		630		1045		2038	
	%	194	110	2-5	118	5-10	108	2-5	96	2-5
Solway	mm	101	349		732		1348		2794	
	%	120	96	2-5	95	2-5	95	2-5	90	5-10
Clyde	mm	67	412		877		1624		3291	72
	%	99	2-5	97	2-5	96	2-5	90	5-10	

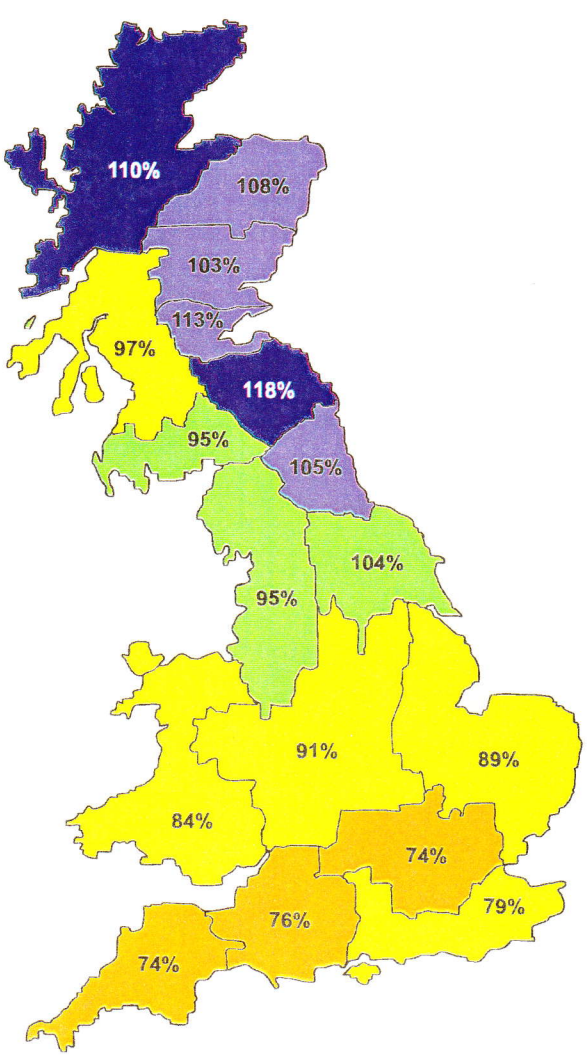
RP = Return period

 The table shows the actual rainfall (mm) for four periods with the corresponding percentage (%) based on the 1961-1990 average, and the estimated return period in years (the longer the return period the more unusual the event). The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only. The tables reflect rainfall over the period 1911-70 and assume a stable climate.

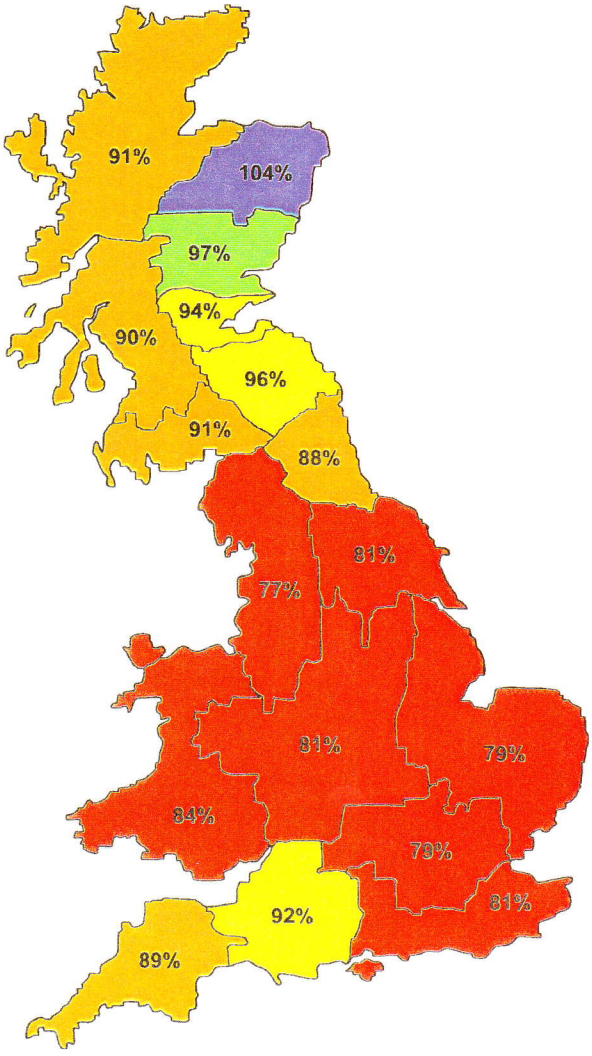
Rainfall . . . Rainfall . . . Rainfall

Key

00%	Percentage of 1961-90 average		Normal range
	Very wet		Below average
	Substantially above average		Substantially below average
	Above average		Exceptionally low rainfall



December 1996 - June 1997

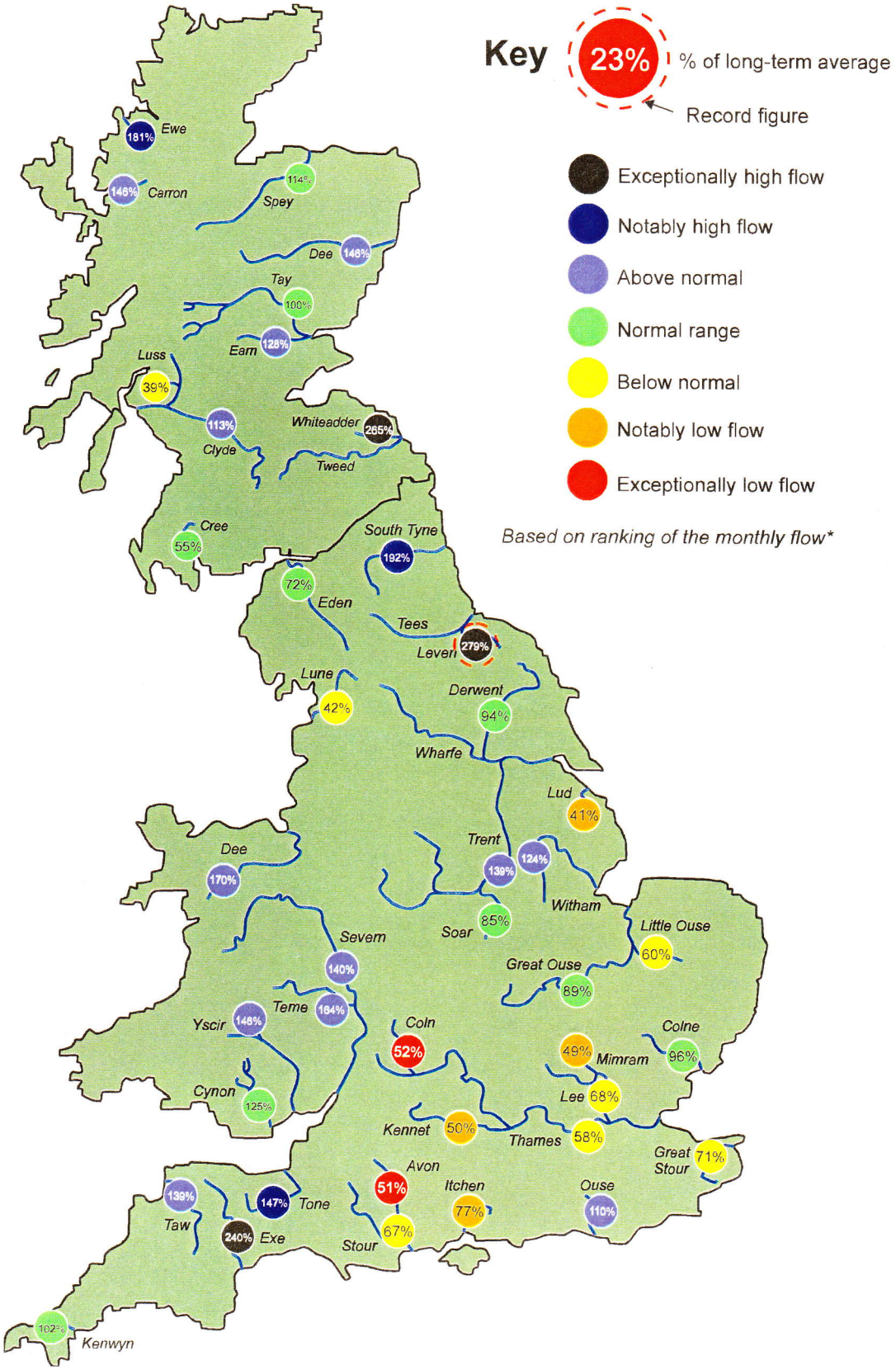


April 1995 - June 1997

Rainfall accumulation maps

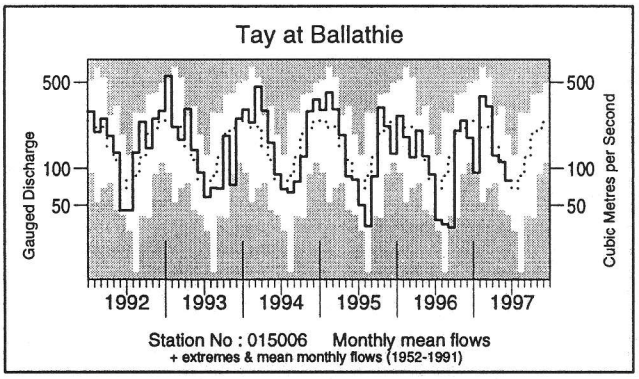
Provisional rainfall figures indicate that the combined May/June rainfall for England and Wales was the highest since 1879. The intensity of the drought during the spring is emphasised by the longer term rainfall accumulations. Despite the recent rainfall, the December June rainfall total is the fourth lowest in the last 20 years and deficencies for the period beginning in April 1995 remain large across most of England and Wales.

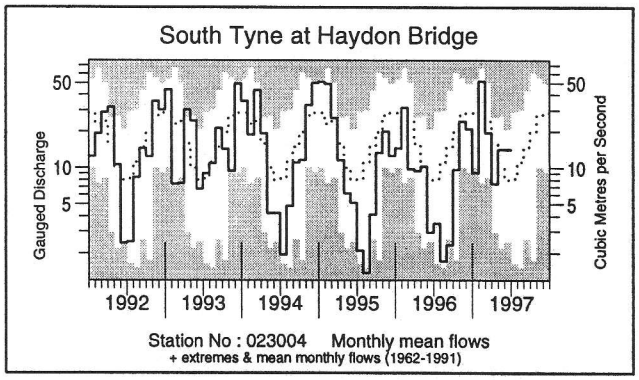
River flow . . . River flow . . .

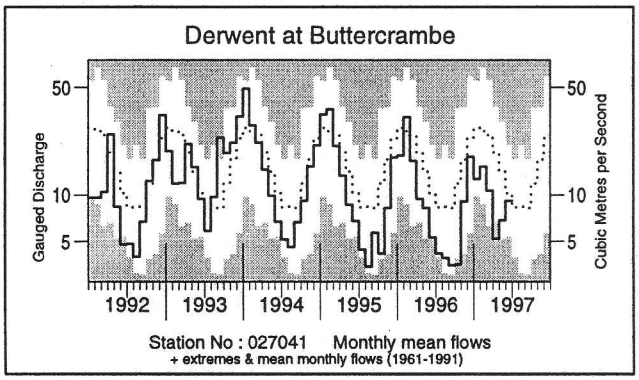


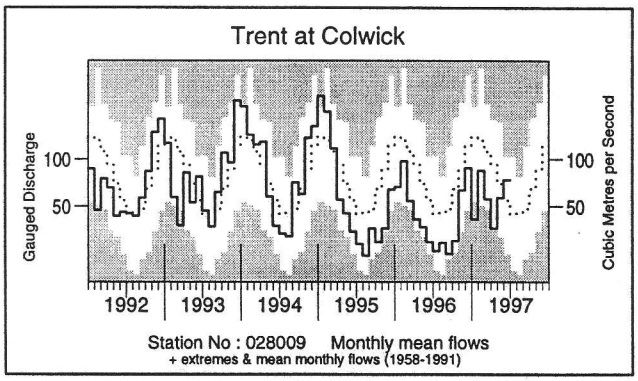
River flows - June 1997

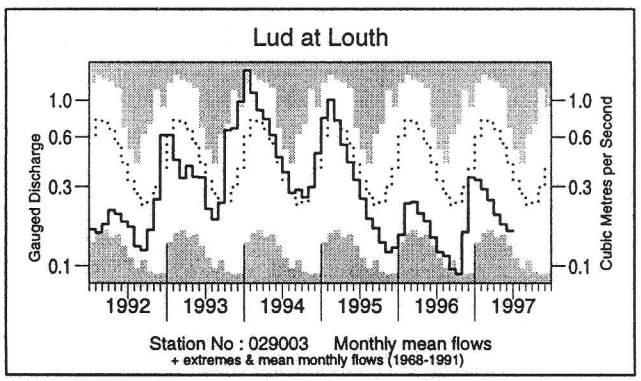
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater.

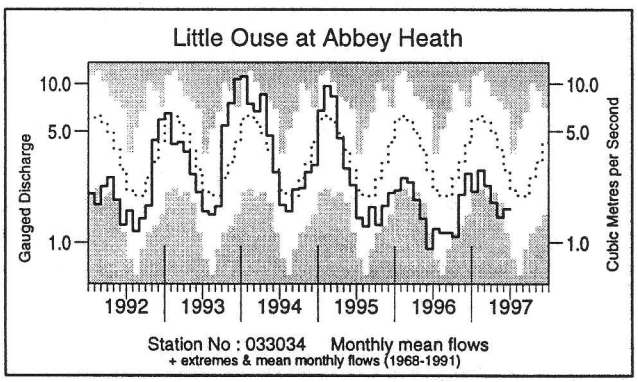


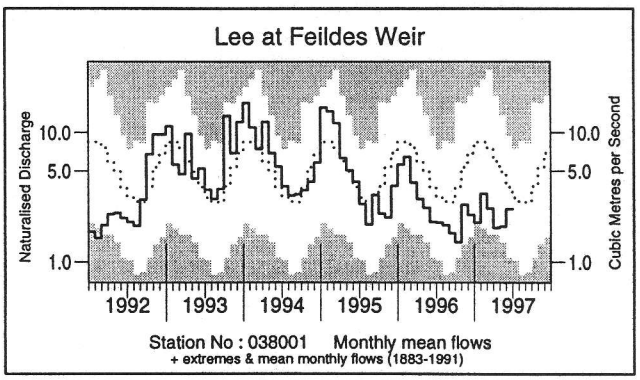


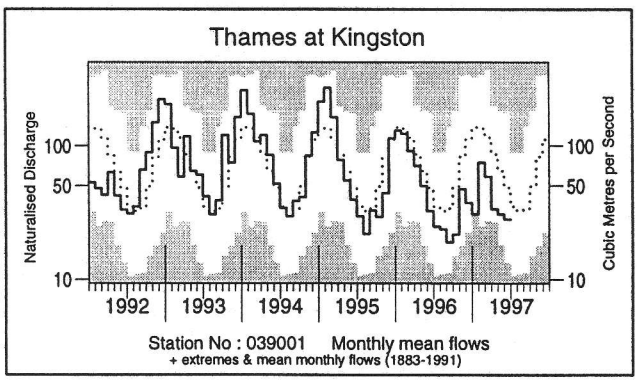








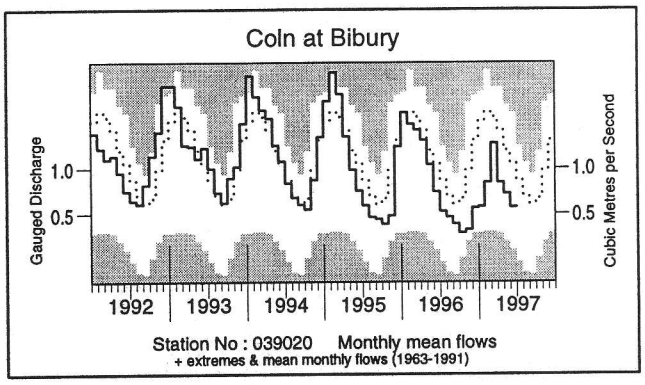


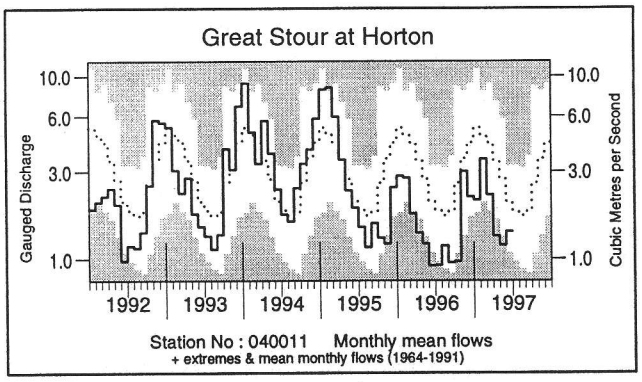


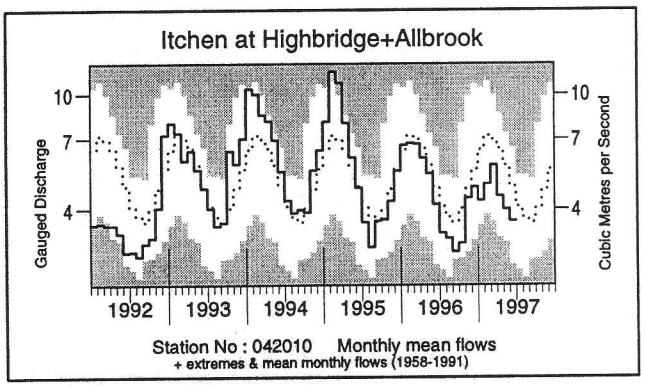
Monthly river flow hydrographs

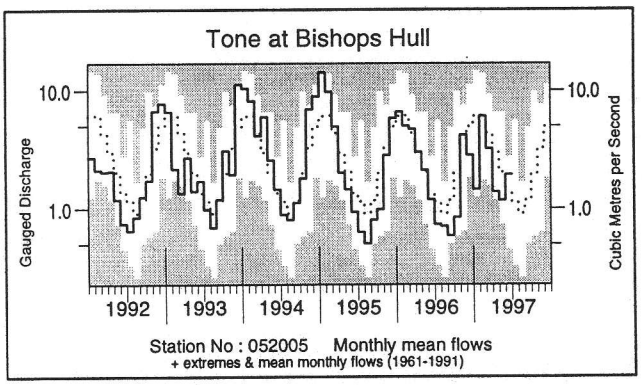
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

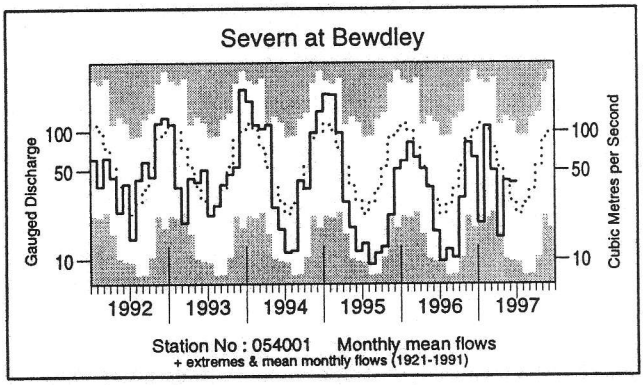
River flow . . . River flow . . .

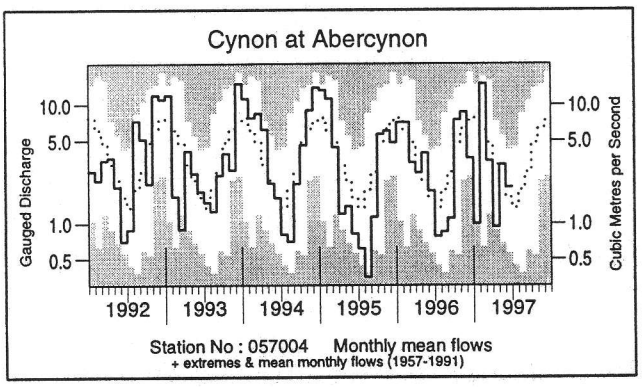


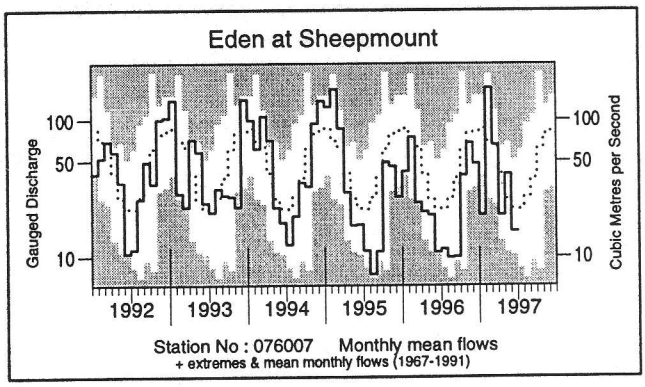


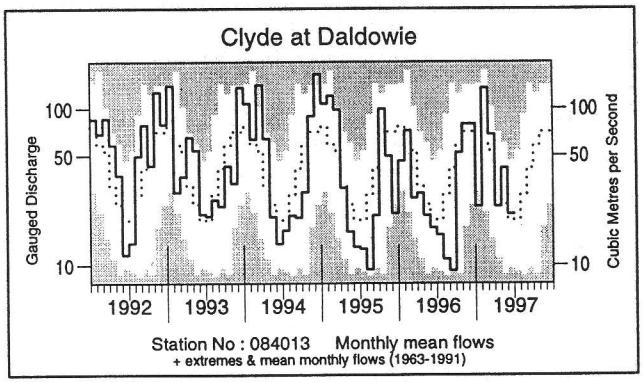










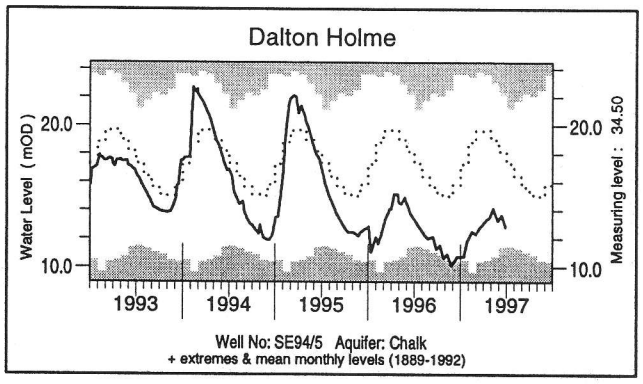


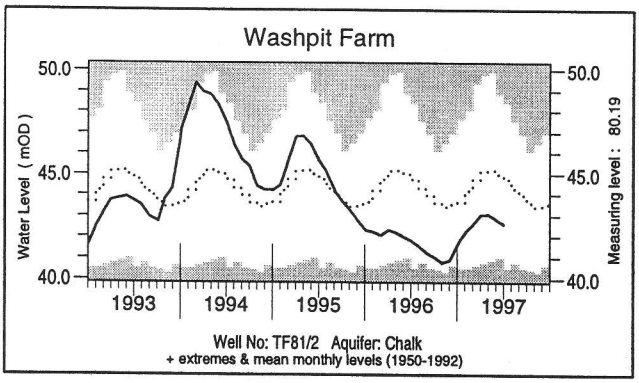
Notable runoff accumulations June 1996 - June 1997

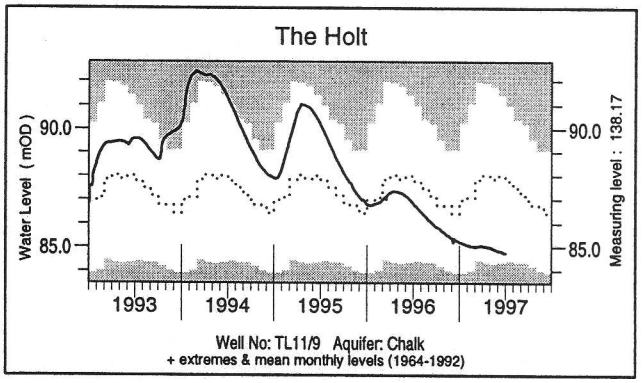
River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
Derwent (Y)	54	3/37	Coln	50	2/35	Severn	66	6/77
Witham	47	3/39	Gt Stour	57	2/34	Teme	58	3/28
L. Ouse	50	4/30	Ouse (S)	43	1/38	Yscir	77	2/26
Colne	40	4/39	Avon (H)	50	2/33			
Mimram	52	3/36	Kenwyn	63	2/30			
Kennet	55	3/37	Taw	69	3/40			

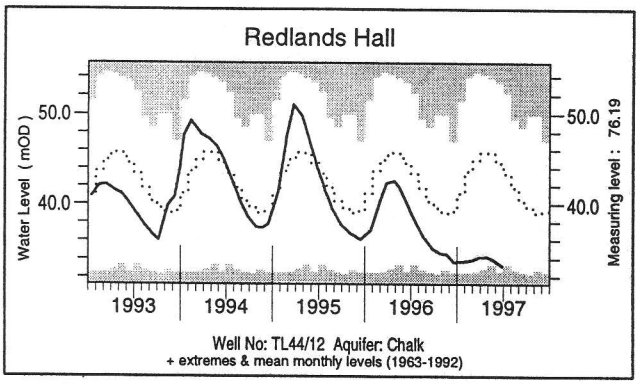
lta = long term average
Rank 1 = lowest on record

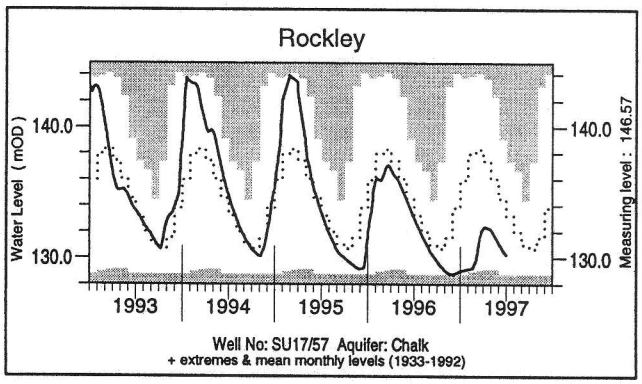
Groundwater . . . Groundwater

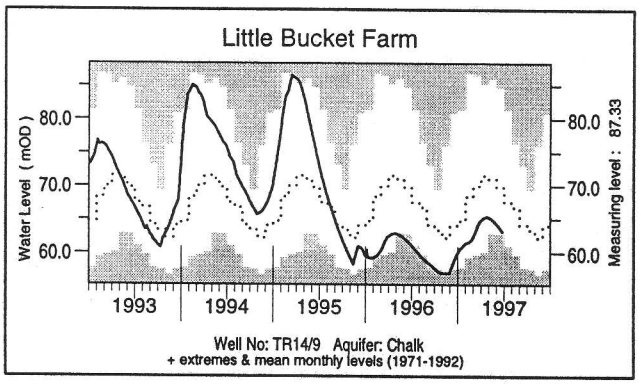


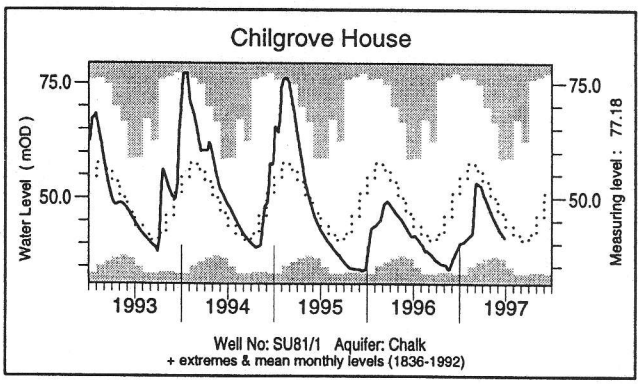


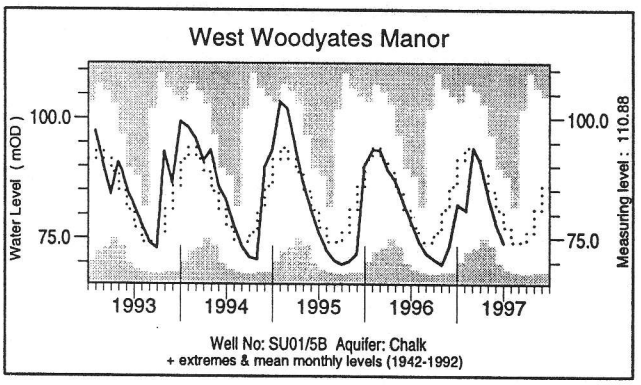








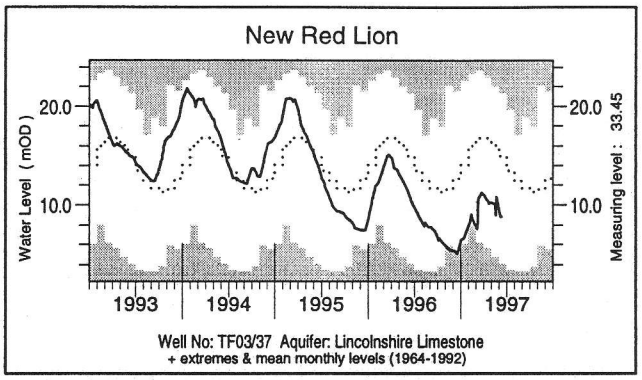


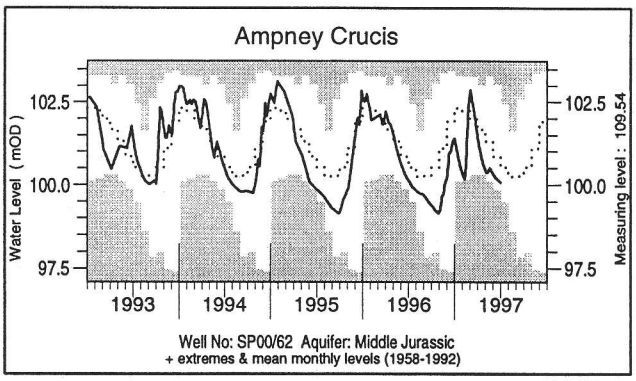


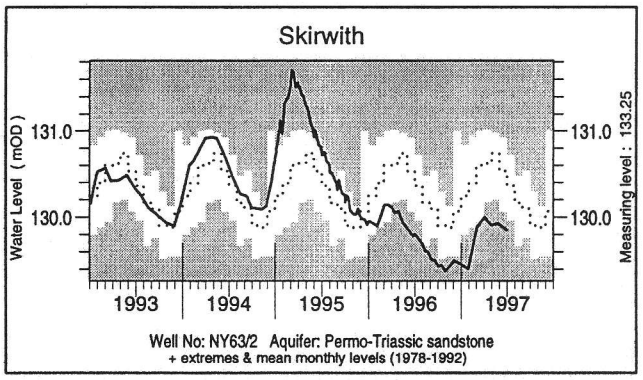
What is groundwater?

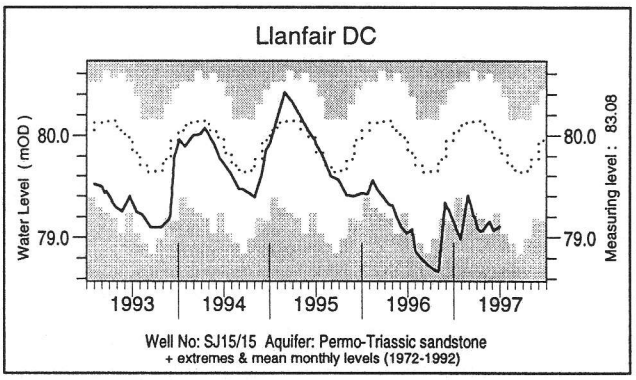
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly max., min. and mean levels are displayed in a similar style to the river flow hydrographs, note that most groundwater levels are not measured continuously — the latest recorded levels are listed overleaf.

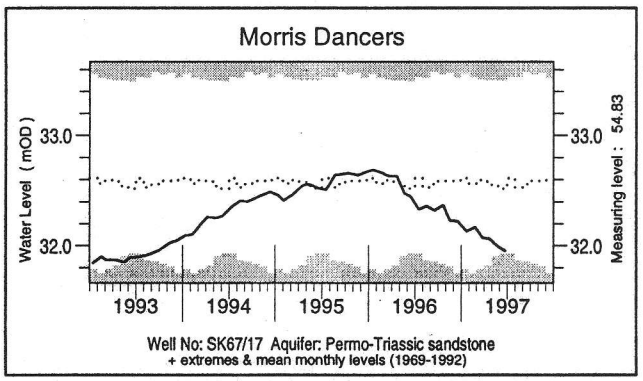
Groundwater . . . Groundwater

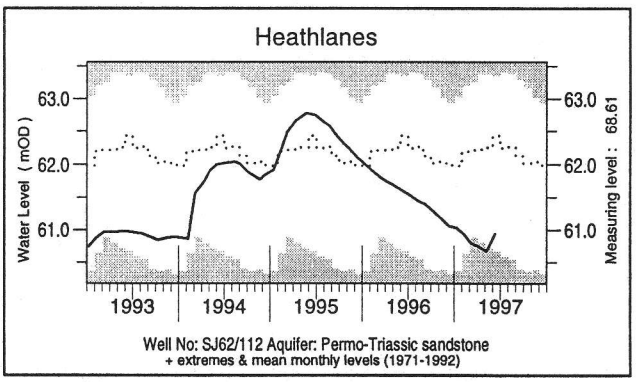


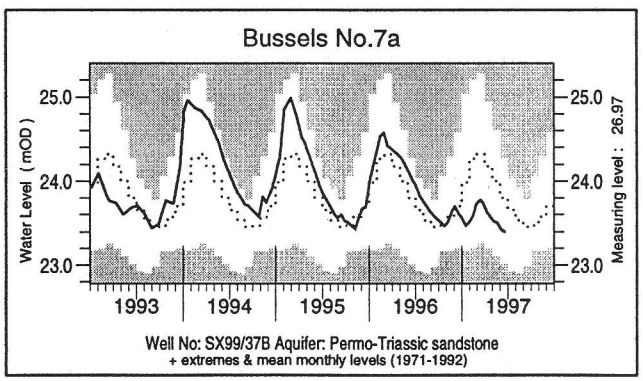


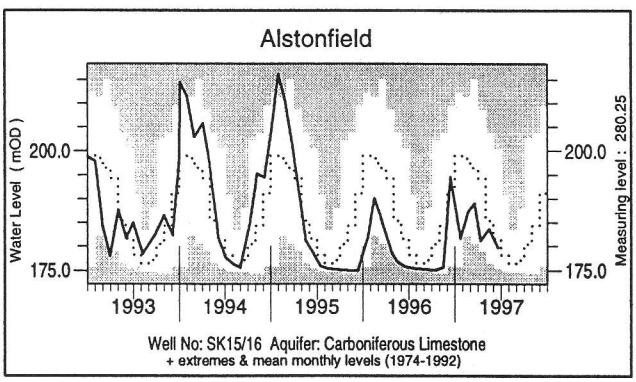












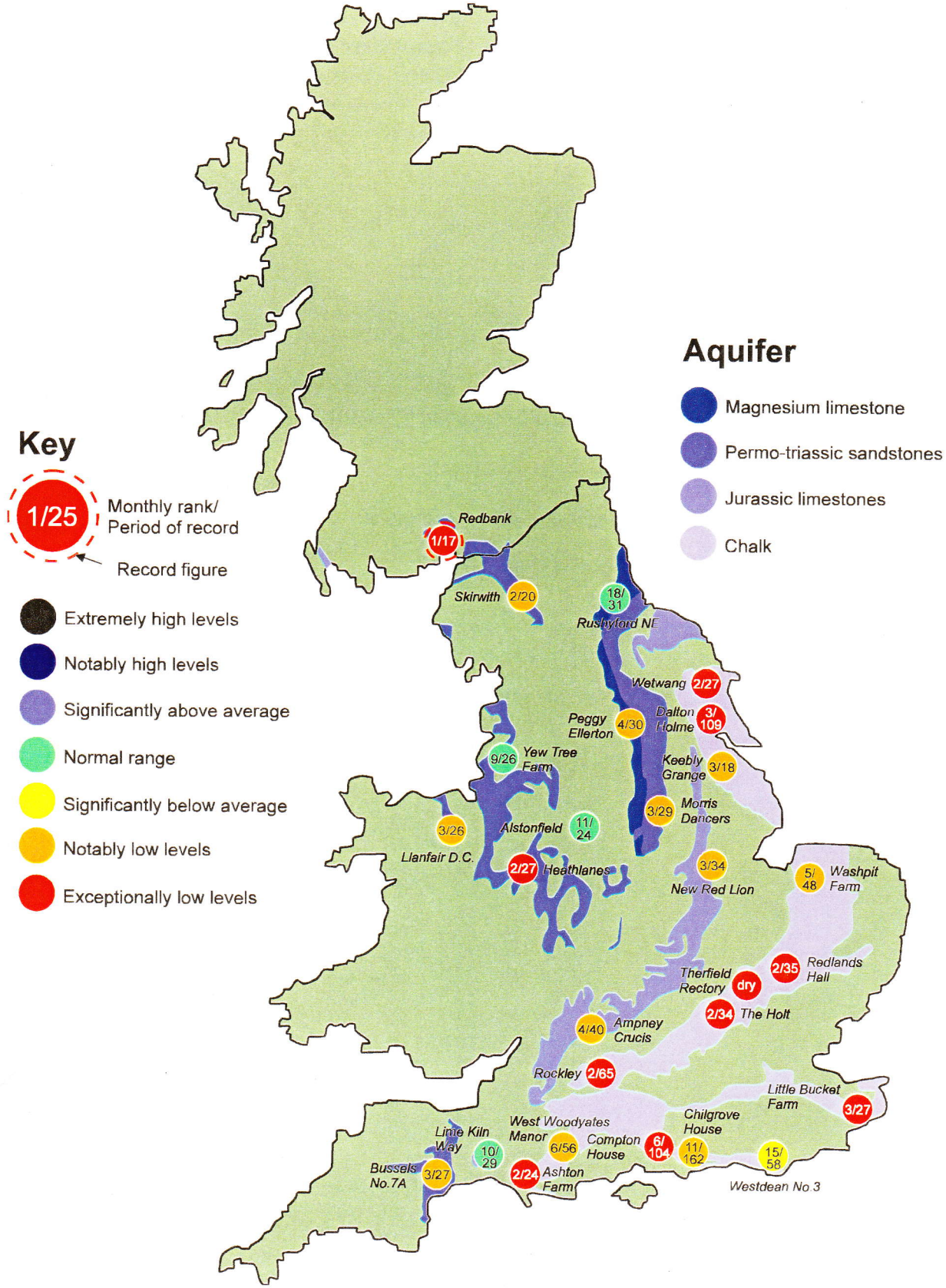
Groundwater levels June/July 1997

Borehole	Level	Date	June av.
Dalton Holme	12.83	26/6	18.1
Washpit Farm	42.61	01/07	45.1
The Holt	84.05	30/06	84.8
Redlands Hall	33.20	27/06	43.7
Rockley	130.28	30/06	134.5
Little Bucket	63.33	23/06	70.8

Borehole	Level	Date	June av.
Chilgrove	41.29	27/06	46.0
W Woodyates	74.10	30/06	80.8
New Red Lion	8.85	12/06	14.6
Ampney Crucis	100.08	30/06	100.8
Skirwith	129.9	01/7	130.5

Borehole	Level	Date	June av.
Llanfair D.C.	79.11	02/07	79.8
Morris Dancers	31.95	23/06	32.4
Heathlanes	60.94	10/06	62.2
Bussels	23.40	19/06	23.8
Alstonfield	179.6	19/06	180.1

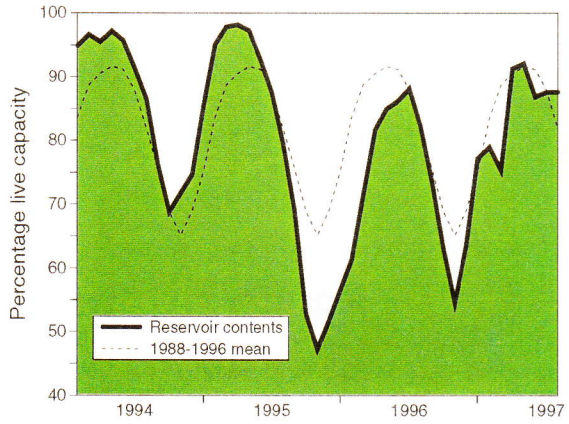
Levels in metres above Ordnance Datum



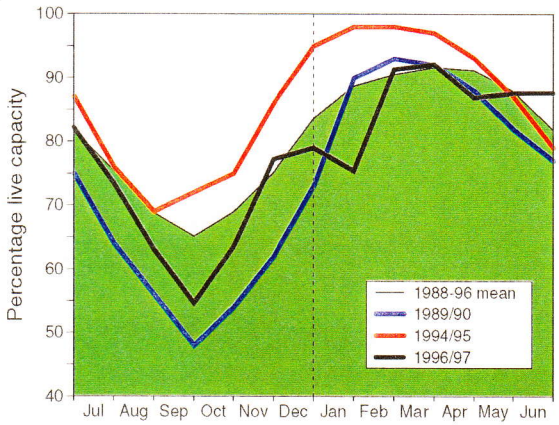
Groundwater levels - June 1997

Reservoirs . . . Reservoirs . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs

Area	Reservoir	Capacity (Ml)	1997 Feb	Mar	Apr	May	Jun	**Jul**	Min. Jul	Year of min *
North West	N Command Zone •	133375	66	100	97	87	88	78	58	1995
	Vyrnwy	55146	71	100	95	86	87	90	65	1990
Northumbrian	Teesdale •	87936	80	95	97	89	85	87	58	1989
	Kielder	(199175)	(89)	(100)	(93)	(90)	(92)	(94)	(71)	1989
Severn	Clywedog	44922	76	93	97	98	98	98	72	1989
	Derwent Valley •	39525	94	100	100	95	98	100	53	1996
Yorkshire	Washburn •	22035	86	98	93	86	89	99	63	1995
	Bradford supply •	41407	88	100	98	90	95	96	54	1995
Anglian	Grafham	58707	68	72	77	73	72	70	70	1997
	Rutland	130061	68	73	76	72	75	75	75	1997
Thames	London •	206399	70	85	94	93	88	88	85	1990
	Farmoor	13843	93	96	98	98	98	100	94	1995
Southern	Bewl	28170	65	85	98	91	84	79	52	1990
	Ardingly	4685	68	100	100	100	98	92	86	1996
Wessex	Clatworthy	5364	81	100	99	89	79	97	61	1995
	Bristol W •	(38666)	(74)	(96)	(95)	(92)	(88)	(85)	(64)	1990
South West	Colliford	28540	52	57	58	56	52	51	51	1997
	Roadford	34500	52	61	62	60	59	58	49	1996
	Wimbleball	21320	59	81	91	84	79	84	63	1992
	Stithians	5205	90	96	97	89	79	76	53	1990
Welsh	Celyn and Brenig•	131155	78	97	98	94	97	98	77	1996
	Brianne	62140	84	99	97	86	96	99	76	1995
	Big Five •	69762	67	96	95	85	88	88	61	1989
	Elan Valley •	99106	85	100	99	91	97	99	75	1989
East of Scotland	Edinburgh/Mid •	97639	91	100	100	94	94	92	72	1989
	East Lothian •	10206	100	100	99	98	100	100	81	1992
West of Scotland	Loch Katrine •	111363	85	100	100	96	94	82	71	1995
	Daer	22412	91	100	98	94	94	87	62	1994
	Loch Thom •	11840	96	100	100	94	95	77	77	1997

( ) figures in parentheses relate to gross storage • denotes reservoir groups * last occurrence

Details of the individual reservoirs in each of the groupings listed above are available on request. The featured reservoirs may not be representative of the storage conditions across each area; this can be particularly important during droughts. The minimum storage figures relate to the 1988-1997 period only.

Location map . . . Location map

Where the information comes from

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by the Institute of Hydrology (IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department of the Environment (DoE), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA) and the Office of Water Services (OFWAT).

River flow and groundwater levels

The National River Flow Archive (maintained by IH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

River flow and groundwater level data are provided by the regional divisions of the EA (England and Wales) and SEPA (Scotland). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoirs

Reservoir level information is provided by the Water Service Companies, the EA and, in Scotland, the West of Scotland and East of Scotland Water Authorities.

Rainfall

Most rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data are presented for the regional divisions of the precursor organisations of the EA and SEPA. The recent rainfall estimates for the Scottish regions are derived by IH in collaboration with the SEPA regions. In England and Wales the recent rainfall figures derive from MORECS. MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain. The provisional regional rainfall figures are regularly updated using figures derived from a much denser rainguage network. Further details of Met. Office services can be obtained from:

The Meteorological Office
Sutton House
London Road
Bracknell
RG12 2SY.
Tel. 01344 865858; 01344 854024.

The cooperation of all data suppliers is gratefully acknowledged.

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