Hydrological summary

for Great Britain

June 1999

General

June was generally cool but sunny month with rainfall unevenly distributed in time and space – nonetheless, monthly rainfall totals were above average for all regions. Reservoir replenishment was significant early in the month and overall stocks for England and Wales remain above 90% - notably high for the summer. Seasonally high flows characterised most northern rivers; in the English lowlands flow recessions - although punctuated by short-lived spates - were typical of the early summer. With groundwater levels mostly well within the normal range also, the water resources outlook remains healthy but a dry late summer would delay the onset of the seasonal recovery in runoff and recharge (and limit the length of the recharge season).

Rainfall

Rainfall was unusually distributed through June, especially in southern Britain where substantial rainfall at the beginning and end of the month was separated by a significant dry interlude. A hot and humid airmass moving north from France triggered widespread thunderstorms on the night of the 1st/2nd. Large areas of southern Britain recorded over 20 mm of rain in 24 hours, Heathrow recorded 48 mm (around the June average) and a number of particularly intense downpours were reported e.g. 20 mm in 15 minutes in Brent (north London) on the 1st and 22 mm in an hour at Southampton on the 2nd. Convectional storms were especially common in East Anglia - Danbury (Essex) recorded 17 mm in 10 minutes on the 7th and 47 mm in 6 hours on the 12th. Such localised storms resulted in local flooding, considerable transport disruption and some crop damage especially where hail occurred. A few parts of central England recorded < 5 mm of rain from the 7th-27th but a slow-moving frontal system again produced 24-hr totals (28/29th) in excess 20 mm over wide areas. As in May, the thundery weather conditions made for large spatial variations in monthly rainfall totals - for example some Essex coastal districts reported < 80% whereas in Suffolk some catchments area had well over 200%. Provisional June rainfall totals exceeded the 1961-90 average throughout most of Britain, the Scottish Highlands and parts of East Anglia being especially wet. Relatively dry pockets could be found in North Wales, Worcestershire and Kent. Britain as a whole registered its third successive notably wet June (though 1997 and 1998 were considerably wetter) and accumulated rainfall totals are very healthy across a broad spread of timespans. The provisional Scottish total for July-June ranks as the fourth highest in a series from 1869; the highest seven July-June totals all cluster in the post-1980 period.

River Flows

Differing catchment rainfall, geology and land-use patterns made for significant contrasts in flow variability during June. The normal summer shrinkage in the headwater stream network continued as recessions were maintained in many spring-fed Chalk streams (e.g. in north Kent) but brisk responses to storm rainfall typified rivers draining impermeable catchments. This was especially noticeable in urban areas where some local drainage systems were overwhelmed by the most intense rainfall events. In London, several Underground stations were closed on the 7th and a few amber flood warnings were issued e.g. on the Pinn. Minor spate conditions were more common in Scotland where monthly runoff totals were generally well above average. The June runoff for the Clyde was the third highest in a 36-year record and that for the River Naver (Highland Region) is unprecedented in a series from 1977. Flows were also above average in much of northern England - notably so in the North-East where the Leven almost matched last years June runoff record. In southern Britain, within-month flow variations were often large for the early summer but June runoff totals were mostly very close to the long term average. Accumulated runoff totals are appreciably above average for the year thus far in all but a minority of eastern index catchments. A few spring-fed rivers aside, runoff totals are also very healthy in the 12-month timeframe.

Groundwater

Despite cooler than normal conditions potential evaporation losses for June were close to the average and, generally, soil moisture deficits increased rapidly after the first week; the rainfall in late-June was too late to produce other than very localised infiltration. Except in a few areas (e.g. parts of the Norfolk Drift) groundwater level recessions continued in June. Levels throughout the Chalk outcrop are well into their seasonal recession with most close to, or above, average - but significantly below average in parts of the eastern Chalk. Groundwater levels in index wells and boreholes in the limestone aquifers are mostly very close to the mid- summer average. This is also true of the majority of Permo-Triassic sandstone outcrops; following several years with notably depressed summer levels in many northern outcrops, the early summer levels this year were well within the normal range except in the slowest responding boreholes.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Jun 1999	Apr 99-Jun 99	RP	Jan 99-Jun 99	RP	Jul 98-Jun 99	RP	Jul 97-Jun 99	RP
England & Wales	**mm**	**80**	**204**		**435**		**938**		**1932**	
	%	**123**	**108**	**2-5**	**105**	**2-5**	**105**	**2-5**	**108**	**2-5**
North West	mm	101	274		615		1339		2553	
	%	125	120	2-5	118	5-10	111	2-5	106	2-5
Northumbrian	mm	82	234		474		1008		1956	
	%	137	132	5-10	121	5-10	118	5-15	115	10-20
Severn Trent	mm	71	204		435		873		1708	
	%	121	118	2-5	122	5-10	116	5-10	113	5-15
Yorkshire	mm	86	227		461		902		1805	
	%	143	127	5-10	120	5-10	110	2-5	110	5-10
Anglian	mm	75	160		312		667		1341	
	%	148	110	2-5	112	2-5	112	2-5	113	5-10
Thames	mm	78	183		342		760		1523	
	%	141	113	2-5	105	2-5	110	2-5	111	5-10
Southern	mm	66	164		337		800		1698	
	%	122	102	2-5	94	2-5	103	2-5	109	2-5
Wessex	mm	71	210		421		921		1955	
	%	124	123	2-5	107	2-5	110	2-5	117	10-20
South West	mm	88	274		565		1289		2676	
	%	128	130	5-10	103	2-5	110	2-5	114	5-15
Welsh	mm	85	284		681		1482		2958	
	%	107	118	2-5	116	2-5	113	5-10	113	5-15
Scotland	**mm**	**110**	**327**		**805**		**1743**		**3193**	
	%	**128**	**132**	**10-20**	**129**	**30-40**	**121**	**30-50**	**111**	**10-20**
Highland	mm	128	381		1041		2086		3825	
	%	131	135	10-20	137	50-80	119	10-20	109	5-10
North East	mm	92	242		466		1098		2130	
	%	139	124	5-10	107	2-5	113	5-10	109	5-10
Tay	mm	82	294		702		1546		2796	
	%	113	135	5-15	124	5-15	126	30-40	114	10-20
Forth	mm	105	279		589		1453		2575	
	%	152	138	10-20	120	5-10	131	70-100	116	20-35
Tweed	mm	92	259		521		1120		2129	
	%	142	134	5-15	119	5-10	115	5-10	110	5-10
Solway	mm	111	353		791		1834		3300	
	%	132	144	20-30	128	10-20	129	50-80	116	20-30
Clyde	mm	118	350		904		2026		3663	
	%	127	131	5-15	125	10-20	119	10-20	108	5-10

RP = Return period

 All monthly totals since July 1998 are provisional (see page 12). Recent monthly rainfall figures for the Scottish regions have ben compiled using data provided by the Scottish Environment Protection Agency. 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, (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered). The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts in the England & Wales and Scotland rainfall series can exaggerate the relative wetness of the recent past. *See page 12.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

Above average

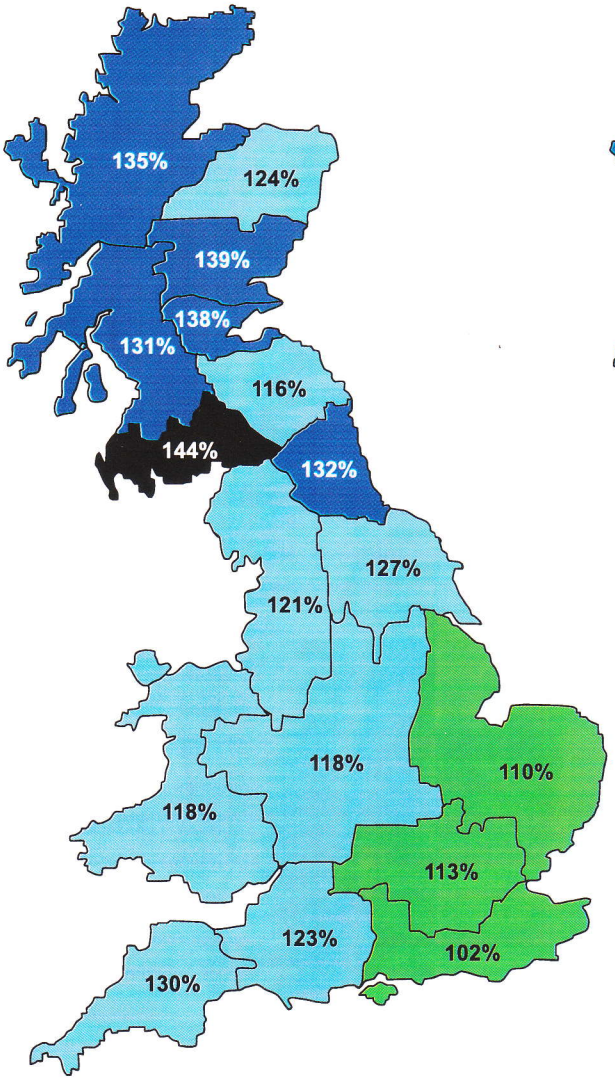
Normal range

Below average

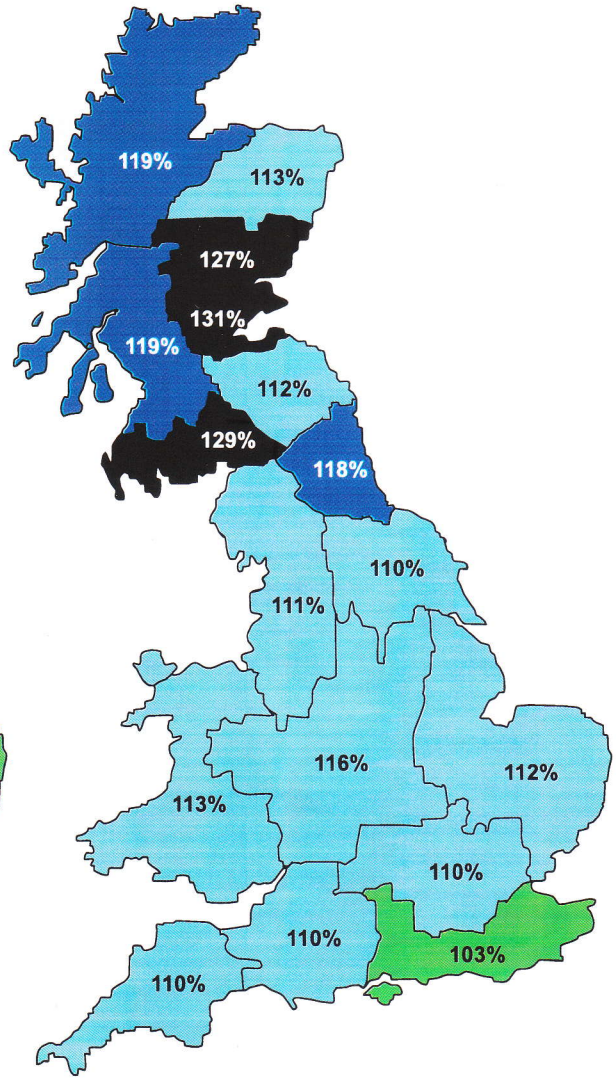
Substantially below average

Exceptionally low rainfall

Errata: The rainfall maps were printed prior to the revision of the June rainfall totals for the Tay and Tweed regions in Scotland. Please refer to page 2 for the amended accumulated totals. The Tweed region on both maps should be dark blue in tone.



April 1999 - June 1999

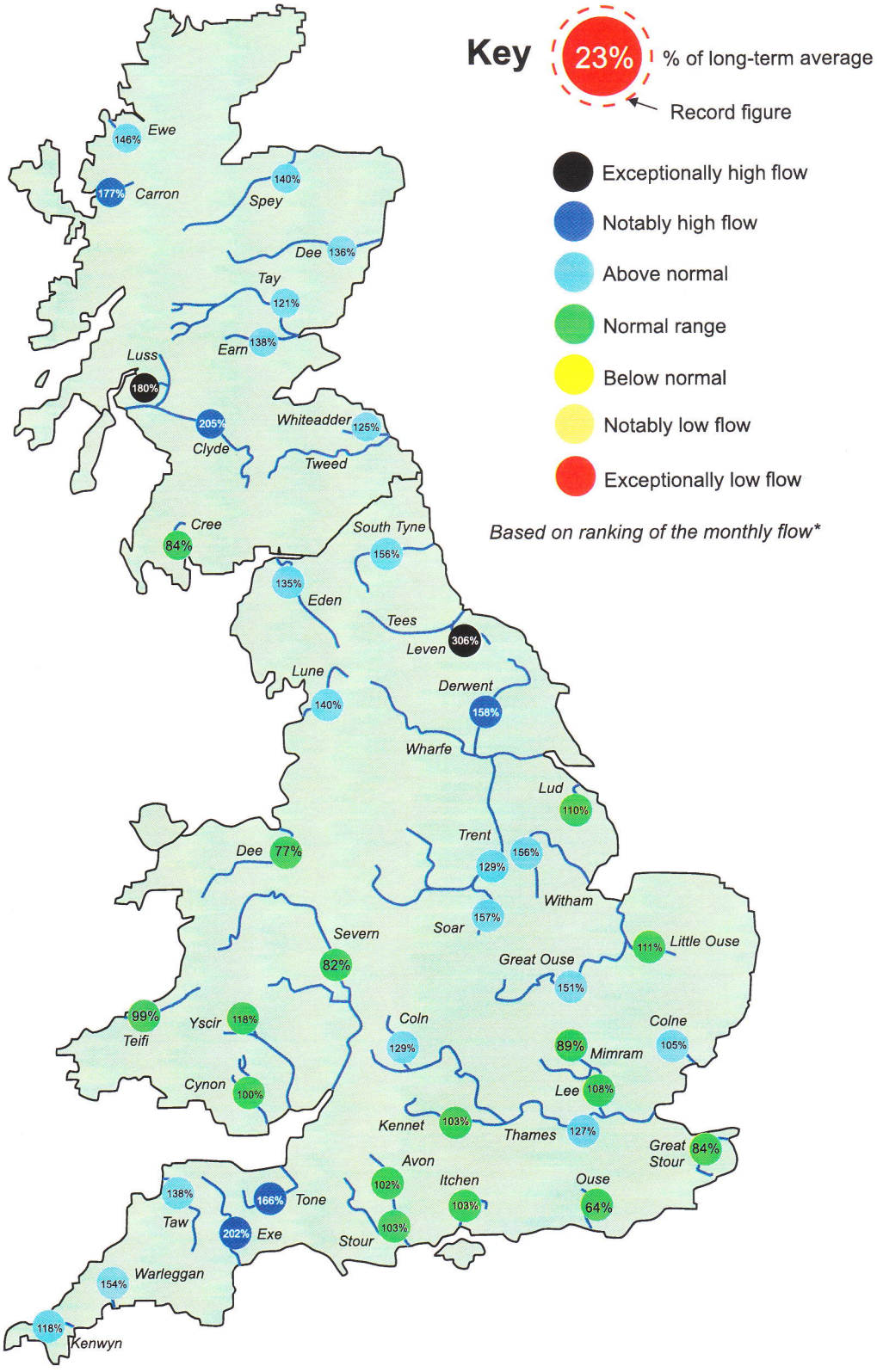


July 1998 - June 1999

Rainfall accumulation maps

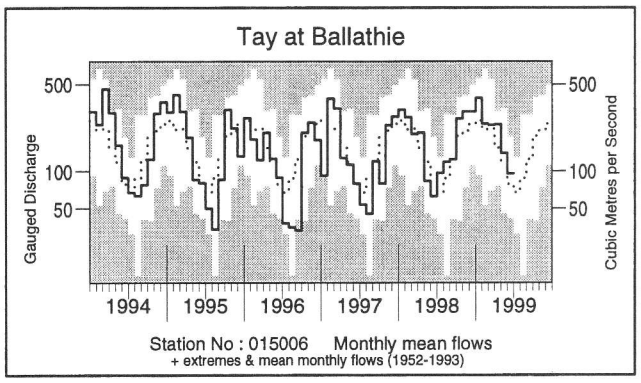
Provisional rainfall totals are above average for all regions in the January-June and July-June timeframes. The protracted nature and wide geographical extend of the current wet phase is confirmed by the 24-month rainfall total for Britain - ranking 8th wettest this century for July-June accumulations. This provides a notable contrast with the severe and persistent drought conditions which affected much of the country until the late spring of 1997.

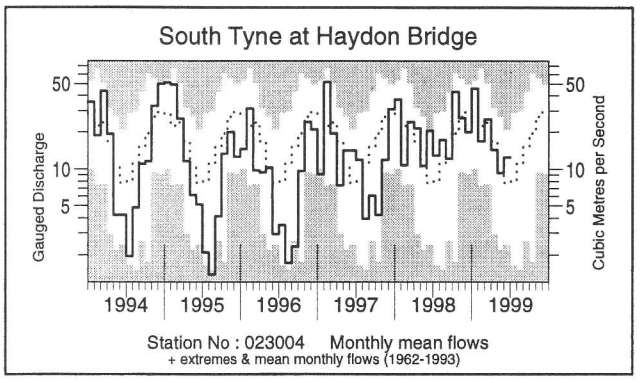
River flow . . . River flow . . .

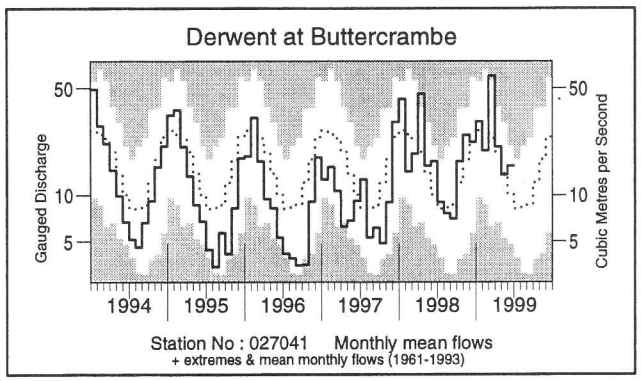


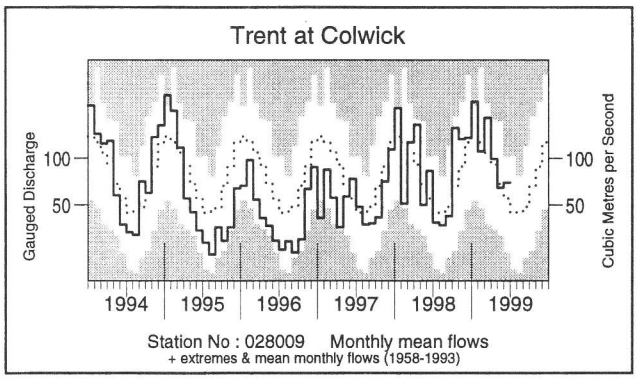
River flows - June 1999

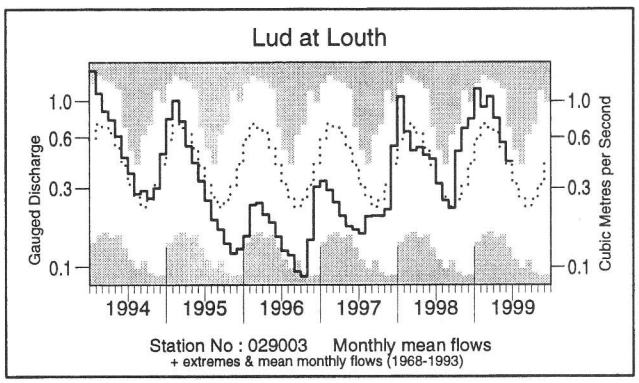
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

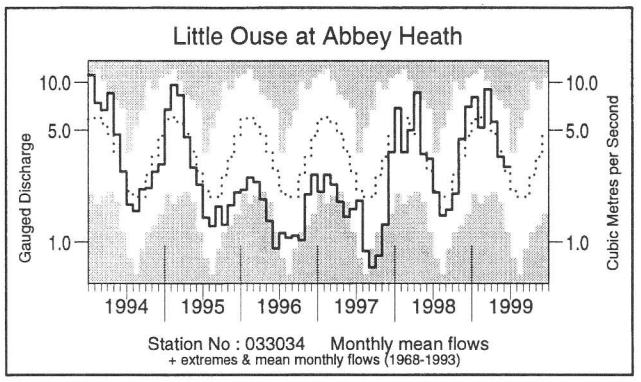


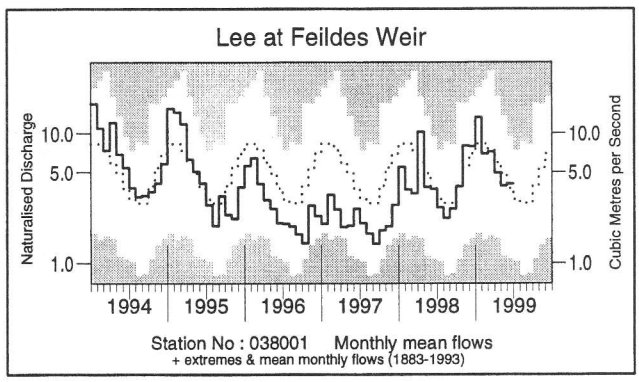


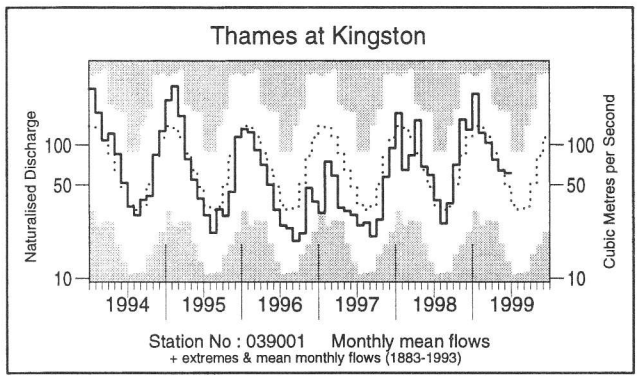








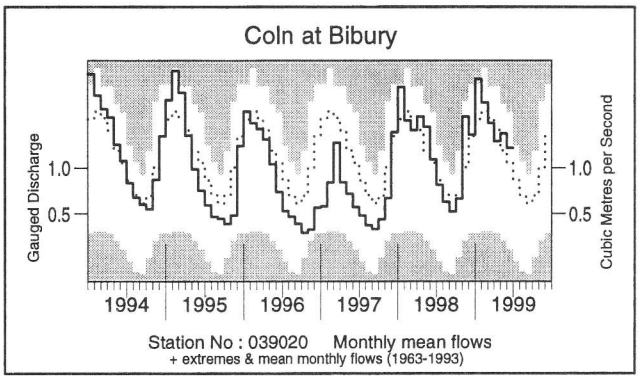


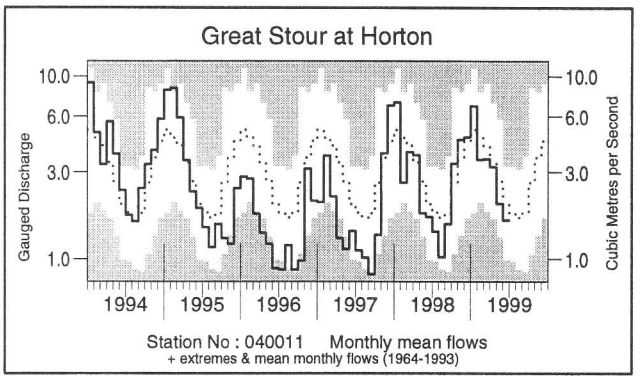


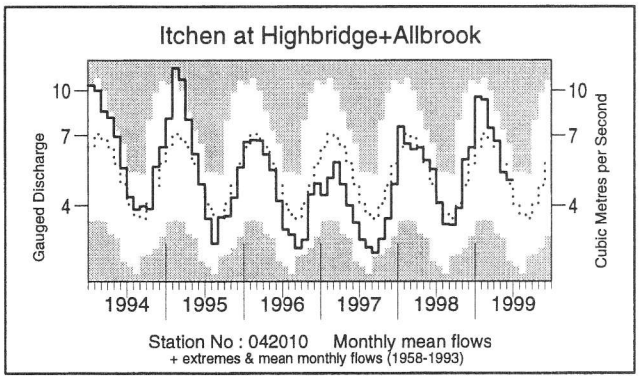
Monthly river flow hydrographs

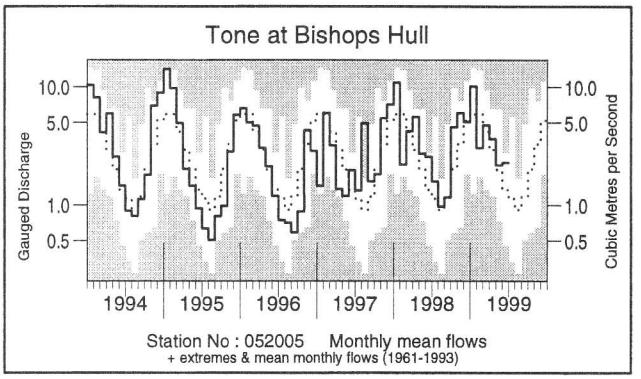
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1994 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

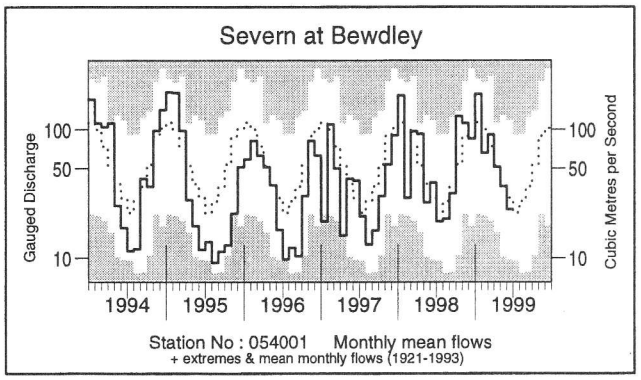
River flow . . . River flow . . .

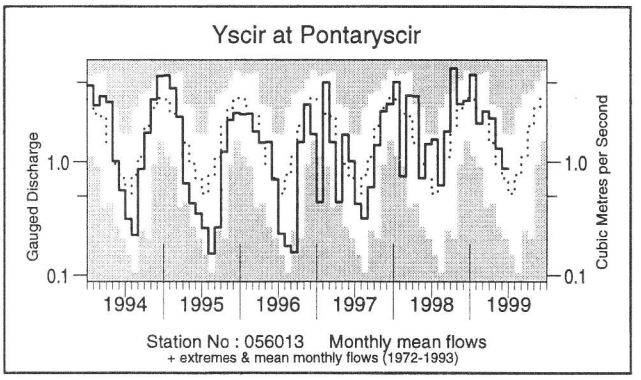


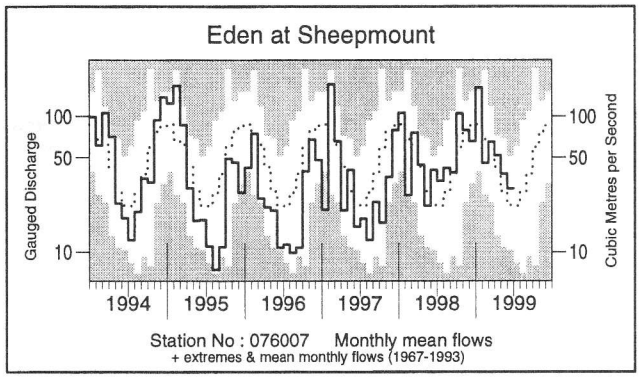


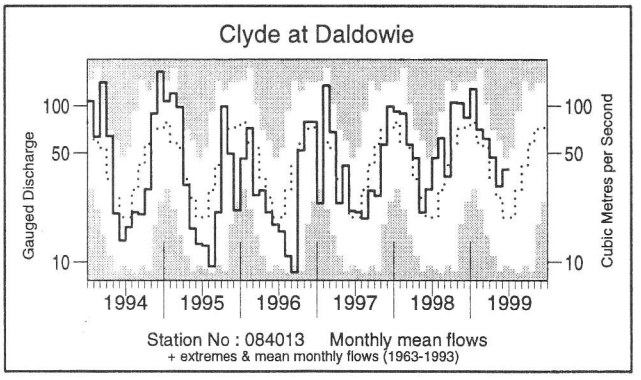












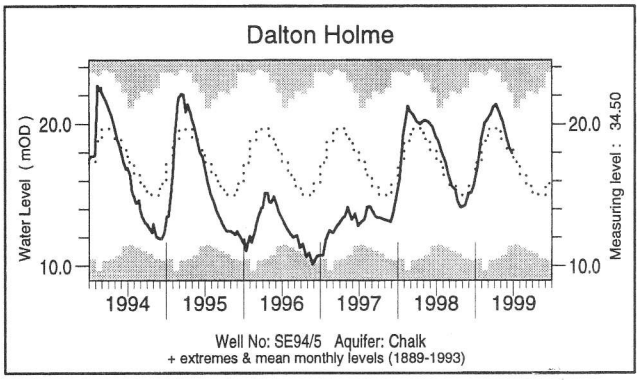
Notable runoff accumulations July 1998 - June 1999 (a); July 1997 - June 1999 (b)

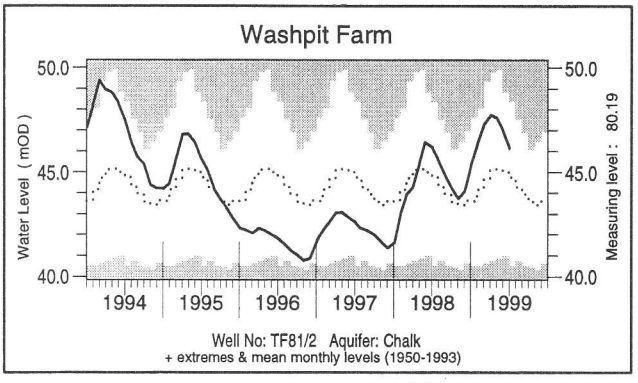
(a) River	%lta	Rank	River	%lta	Rank
Tweed	125	37/38	Cynon	134	39/39
Trent	131	37/40	Lune	128	35/37
Witham	166	37/40	Clyde	142	35/35
Exe	134	40/43	Carron	118	19/20
Warleggan	135	28/29	Naver	119	20/21
Yscir	140	26/26			

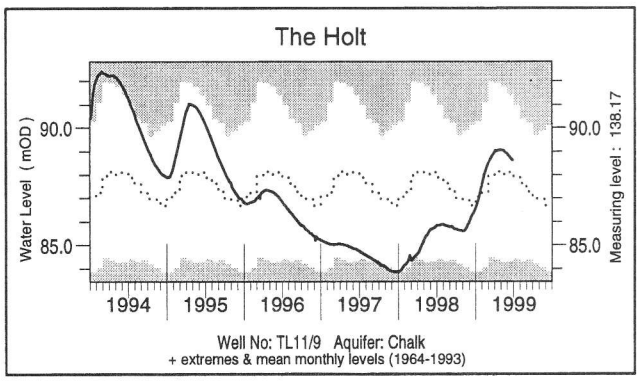
(b) River	%lta	Rank
Whiteadder	126	25/28
Witham	159	39/39
Exe	128	40/42
Tone	131	35/37
Teifi	121	38/39

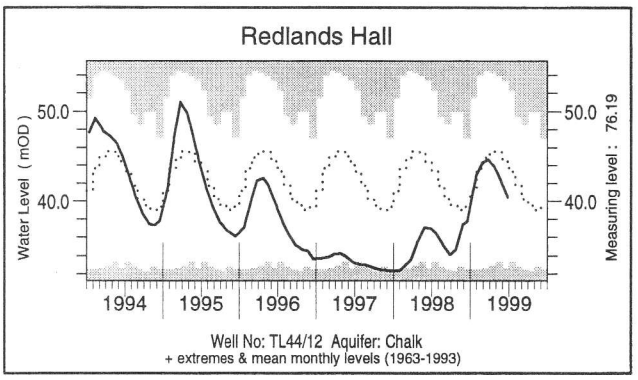
lta = long term average
Rank 1 = lowest on record

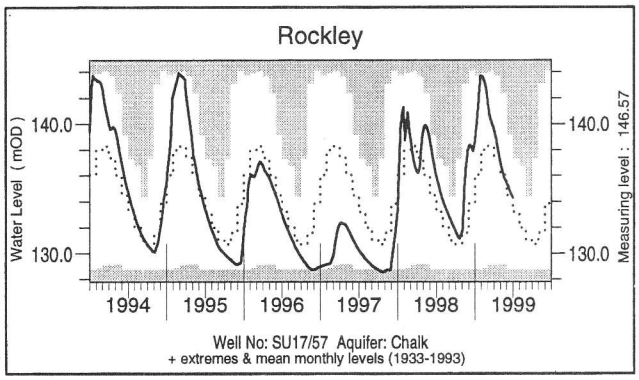
Groundwater . . . Groundwater

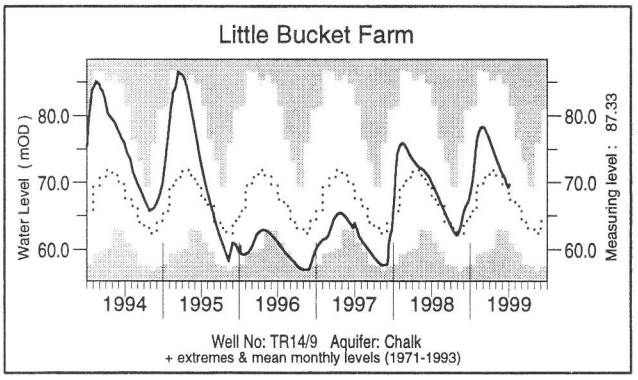


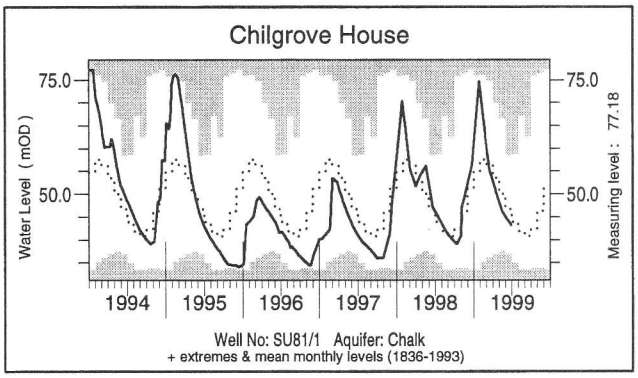


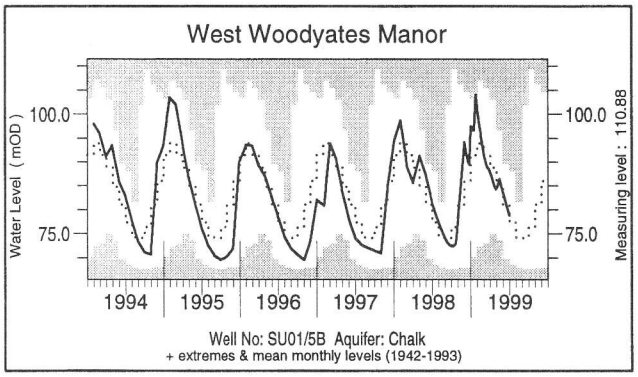








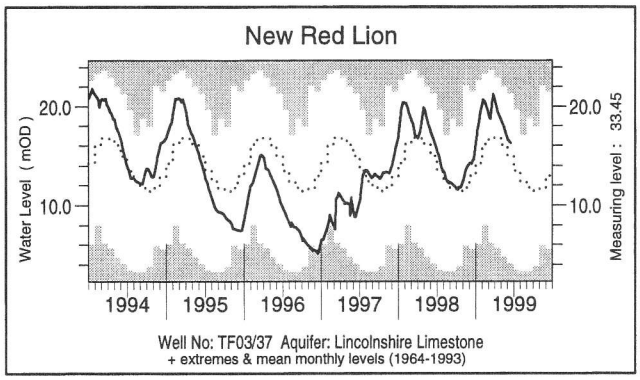


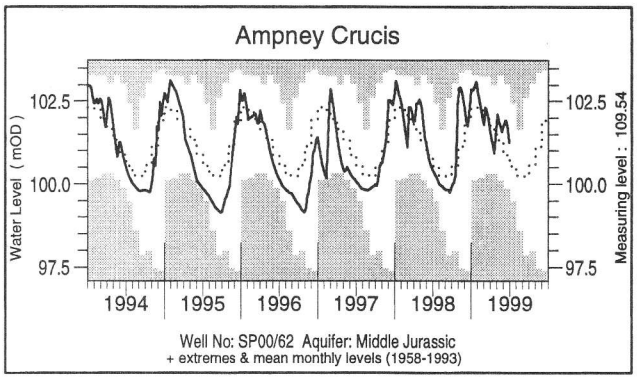


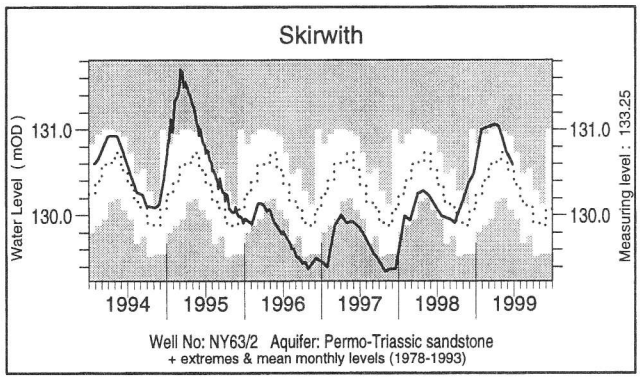
What is groundwater?

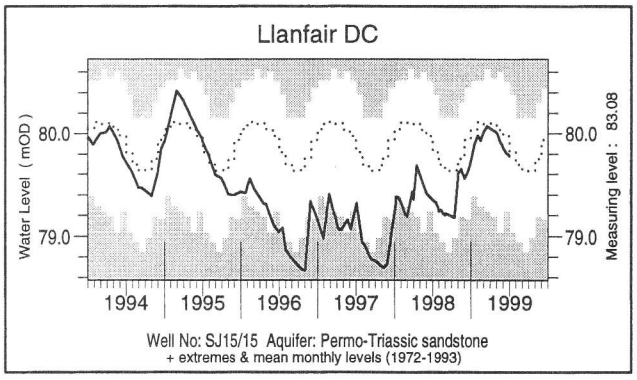
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment 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.

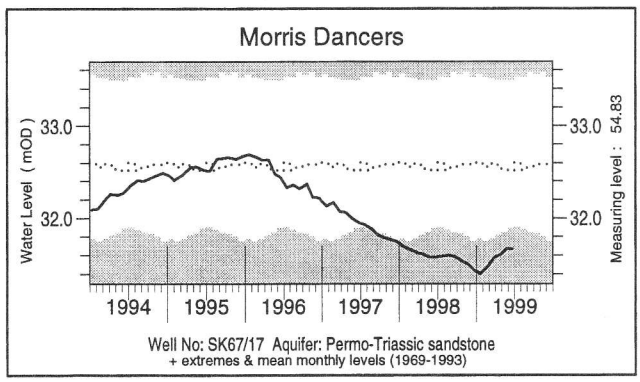
Groundwater . . . Groundwater

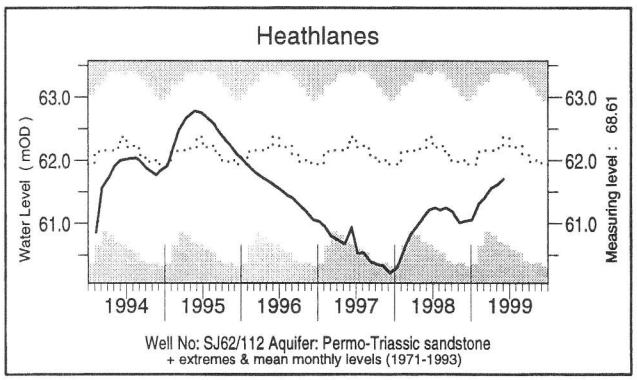


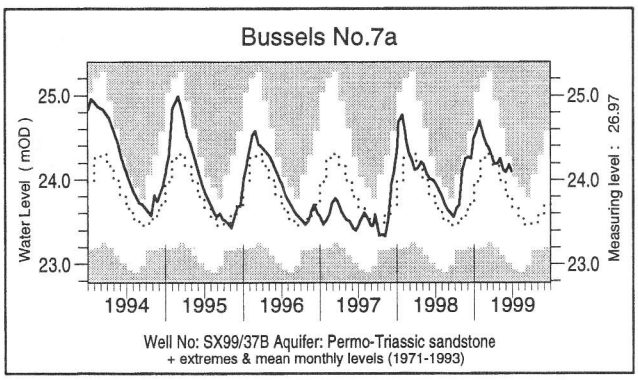


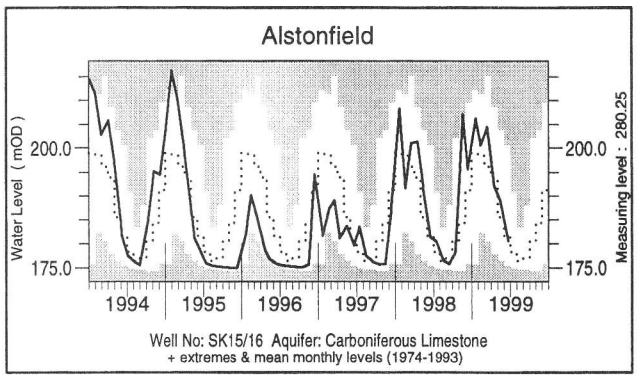












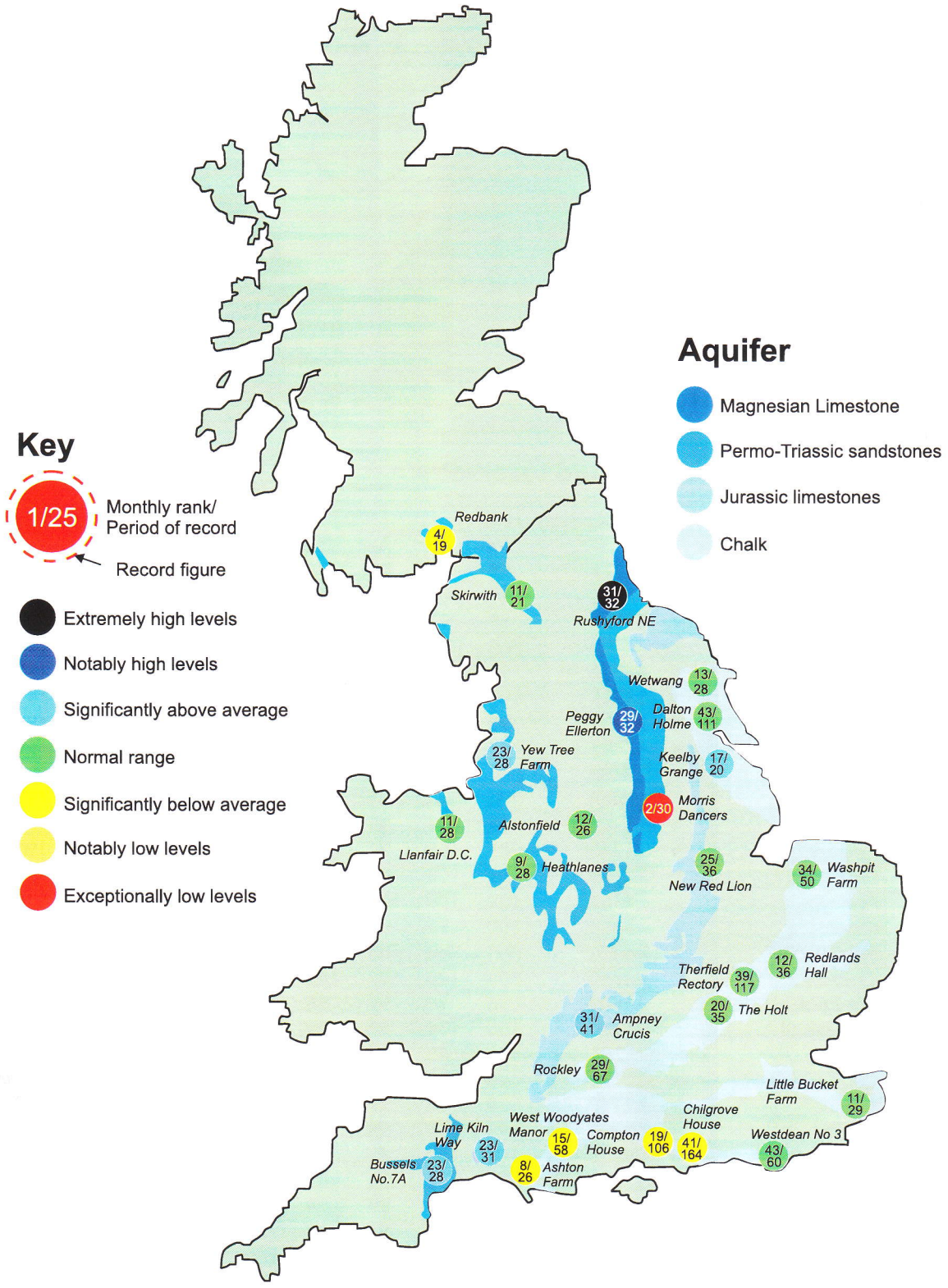
Groundwater levels June/July 1999

Borehole	Level	Date	Jun av.
Dalton Holme	17.92	26/06	18.11
Washpit Farm	46.14	02/07	45.09
The Holt	88.61	28/06	88.05
Redlands Hall	40.44	25/06	43.70
Ashton Farm	67.21	30/06	67.66
Little Bucket	69.76	05/07	70.98

Borehole	Level	Date	Jun av.
Chilgrove	43.12	29/06	45.98
W Woodyates	78.77	30/06	80.80
New Red Lion	16.26	15/06	14.58
Ampney Crucis	101.24	28/06	100.82
Skirwith	130.59	25/06	130.52

Borehole	Level	Date	Jun av.
Llanfair DC	79.78	01/07	79.04
Morris Dancers	31.67	23/06	32.44
Heathlanes	61.71	05/06	62.22
Bussels	24.10	29/06	23.83
Alstonfield	180.64	21/06	180.95

Levels in metres above Ordnance Datum

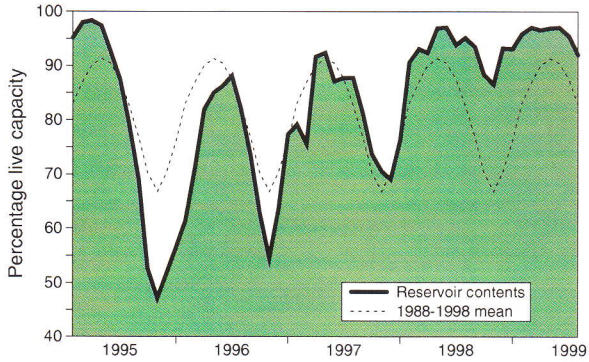


Groundwater levels - June 1999

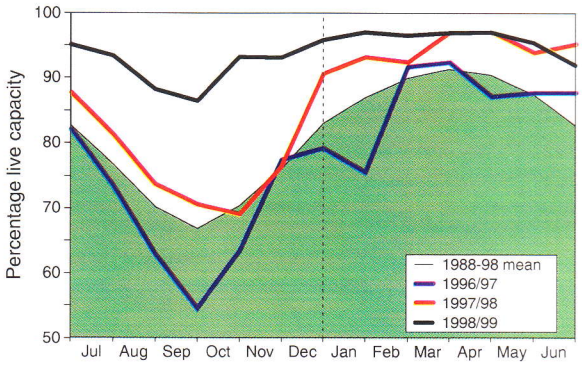
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record.

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)	1999 Feb	Mar	Apr	May	Jun	**Jul**	Min. Jul	Year* of min
North West	N Command Zone	• 133375	96	93	93	96	94	81	58	1995
	Vyrnwy	55146	99	100	97	98	96	87	65	1990
Northumbrian	Teesdale	• 87936	99	97	98	95	94	86	58	1989
	Kielder	(199175)	(97)	(95)	(95)	(95)	(95)	(93)	(71)	1989
SevernTrent	Clywedog	44922	91	93	94	99	99	98	72	1989
	DerwentValley	• 39525	100	100	100	100	95	90	53	1996
Yorkshire	Washburn	• 22035	99	98	96	98	96	92	63	1995
	Bradford supply	• 41407	98	96	96	98	94	90	54	1995
Anglian	Grafham	** (55490)	(91)	(93)	(98)	(98)	(96)	(93)	(70)	1997
	Rutland	**(116580)	(95)	(95)	(97)	(96)	(92)	(88)	(75)	1997
Thames	London	• 206399	94	94	98	95	93	95	85	1990
	Farmoor	• 13843	85	98	98	95	96	99	94	1995
Southern	Bewl	28170	99	100	99	98	92	84	52	1990
	Ardingly	4685	100	100	100	100	99	92	86	1996
Wessex	Clatworthy	5364	100	97	97	99	98	95	61	1995
	BristolWW	• (38666)	(97)	(98)	(98)	(97)	(91)	(88)	(64)	1990
SouthWest	Colliford	28540	100	100	100	100	100	99	51	1997
	Roadford	34500	98	94	95	96	93	93	49	1996
	Wimbleball	21320	100	100	99	100	100	99	63	1992
	Stithians	5205	100	99	99	99	98	96	53	1990
Welsh	Celyn and Brenig	• 131155	100	100	100	100	100	100	77	1996
	Brianne	62140	99	99	97	99	100	100	76	1995
	Big Five	• 69762	99	99	95	97	96	92	61	1989
	Elan Valley	• 99106	100	100	97	99	98	92	75	1989
East of Scotland	Edinburgh/Mid Lothian	• 97639	72	73	76	81	82	82	54	1998
	East Lothian	• 10206	100	99	99	99	97	98	81	1992
West of Scotland	Loch Katrine	• 111363	90	93	95	93	95	94	71	1995
	Daer	22412	99	100	100	97	100	91	62	1994
	LochThom	• 11840	100	100	100	97	93	89	77	1997

() figures in parentheses relate to gross storage
• denotes reservoir groups
* last occurence
** updated gross capacity

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 1988-1999 period only. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

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, Transport and the Regions, 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. The national rainfall figures for June, and the regional totals for England and Wales were derived by the UK Climate Studies Group at the Met. Office. In England and Wales other 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 discontinuation of the CARP system used by the Met. Office to provide more definitive regional rainfall assessments means that the recent MORECS figures have not been updated. Negotiations are continuing with the Met. Office to provide more accurate areal figures. Until the negotiations are concluded the regional rainfall figures (and the return periods associated with them) should be regarded as a guide only.

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The cooperation of all data suppliers is gratefully acknowledged.

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