Hydrological summary

for Great Britain

April 1999

General

For most of Britain April is, on average, the driest month of the year and the amount of rainfall can be particularly important in determining the water resources outlook for the summer. Fortunately, after two relatively dry months in much of southern Britain, April was wetter than average – usefully extending the reservoir replenishment and aquifer recharge seasons. Groundwater levels remain low in a few areas but levels in most index wells and boreholes are well within the normal spring range and overall reservoir stocks – which have displayed remarkable stability in 1999 thus far - remain very healthy. Drying soils, in the east particularly, have triggered the normal seasonal increase in demand but the water resources outlook for the summer is good.

Rainfall

Following a dry start, April was distinctly unsettled - airmasses from many points of the compass made for a wide variety of weather patterns through the month. Overall, April was mild but featured a very cold interlude in mid-month with significant snowfall in parts of southern Britain (e.g. Bristol). This, together with the showery nature of much of the rainfall made for substantial local variation in rainfall totals. However, regional totals – boosted by persistent frontal rainfall from the 16th-26th – were generally above average, notably so in the South-West and parts of Scotland – totals exceeded twice the average at some raingauges in the Southern Uplands. By contrast, rainfall was less than 80% of the long term average in some English lowland catchments. Over a substantial proportion of the English lowlands rainfall totals for the last three months are also below average – notably so in parts of Hampshire and the lower Lee basin which registered its second driest February-April period in over 40 years. In this timeframe, exceptionally high rainfall has been recorded in much of western Scotland and the NW/SE rainfall gradient across the country has been exaggerated – a common feature of the recent past. Regional rainfall totals for the last six months are close to, or above, average in all regions. Longer term accumulations are notably high – provisional figures for Britain place the May 97-April 99 period amongst the six wettest (in this 24-month timespan) in a record from 1869 – this is directly reflected in the recovery from the drought conditions of the mid-1990s.

River flow

April was a month when rainfall patterns, geology and soil moisture conditions combined to produce significant local variations in runoff rates. Flow recessions were reversed in the third week when minor spates were common, and local flooding occurred in the South-West. In almost all western and northern index catchments, mean flows declined relative to March but by less than the seasonal norm, as a result April runoff totals exceeded the average – typically by 20-30%. A few rivers reported less healthy flows – e.g. the Whiteadder where flows have been modest in each of the last three months; the February-April accumulation being the third lowest since 1982. Below average April flows were more common in south-eastern Britain - most rivers reported April mean flows of 70%-90% but runoff for the Wallington catchment (Hampshire) was only a little above 50% – adding to the large cluster of low, or very low, April flows in the 1990s, a common experience in the English lowlands, for impermeable catchments especially. By contrast, accumulated runoff totals are again high in western Scotland. The Jan-Apr runoff total for the River Ewe is >30% above average – nine of the highest eleven on record now cluster into the post-1988 period. The very healthy reservoir stocks over the last year are mirrored by new maximum May-April runoff maxima for a few western catchments (e.g. the Cynon and Clyde); runoff is also notably high in the 24-month timeframe for many upland catchments.

Groundwater

Brisk late March/early April increases in soil moisture deficits effectively ended the recharge season in some eastern areas but northern and western aquifers benefited from significant infiltration during April, particularly late in the month. Levels are now declining in all but the slowest responding wells and boreholes – generally the 1999 recessions began at their highest levels since 1995. Water-tables are considerably above average in much of the eastern Chalk outcrop and well within the normal range elsewhere – but still significantly below average in a zone from London to Cambridgeshire where infiltration through the spring has been modest. Levels in the limestone aquifers are also typical for the late spring – albeit well above average in much of the Lincolnshire Limestone. This 'as normal' picture applies to a number of minor eastern aquifers also (e.g. the Norfolk Drift and Suffolk Crag) but there is much less spatial coherence across the Permo-Triassic sandstones outcrops: notably high levels in index wells from North Wales to the Vale of Eden but still depressed in some Midland outcrops e.g. the Sherwood Sandstone.

Institute of Hydrology

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Apr 1999	Feb 99-Apr 99	RP	Nov 98-Apr 99	RP	May 98-Apr 99	RP	May 97-Apr 99	RP
England & Wales	**mm**	**72**	**182**		**467**		**963**		**2001**	
	%	**119**	**93**	**2-5**	**100**	**<2**	**107**	**2-5**	**112**	**5-15**
North West	mm	84	247		649		1343		2563	
	%	118	101	2-5	106	2-5	112	5-10	107	2-5
Northumbrian	mm	63	192		459		1037		2019	
	%	113	104	2-5	105	2-5	122	10-20	118	20-35
Severn Trent	mm	73	185		435		881		1787	
	%	132	109	2-5	112	2-5	117	5-10	118	20-35
Yorkshire	mm	78	216		449		917		1868	
	%	133	117	2-5	105	2-5	112	2-5	114	5-15
Anglian	mm	48	132		324		674		1409	
	%	103	101	2-5	111	2-5	113	5-10	118	20-30
Thames	mm	56	122		348		770		1550	
	%	111	81	2-5	99	2-5	112	2-5	112	5-10
Southern	mm	65	137		394		830		1772	
	%	122	80	2-5	94	2-5	107	2-5	114	5-10
Wessex	mm	88	178		462		961		2007	
	%	166	95	2-5	102	2-5	115	5-10	120	20-30
South West	mm	127	273		691		1327		2750	
	%	184	101	2-5	103	2-5	113	5-10	117	15-25
Welsh	mm	120	304		775		1517		3044	
	%	150	107	2-5	107	2-5	116	5-10	116	10-20
Scotland	**mm**	**108**	**363**		**923**		**1694**		**3190**	
	%	**141**	**120**	**5-10**	**122**	**10-20**	**118**	**15-25**	**111**	**10-20**
Highland	mm	128	511		1197		2013		3789	
	%	141	134	10-20	124	10-20	114	5-15	108	5-10
North East	mm	83	221		500		1081		2235	
	%	138	109	2-5	101	2-5	111	5-10	115	15-25
Tay	mm	94	207		789		1487		2821	
	%	152	102	2-5	120	5-10	121	10-20	115	10-20
Forth	mm	72	228		668		1413		2599	
	%	122	98	2-5	117	5-10	127	40-60	117	30-40
Tweed	mm	74	185		543		1135		2209	
	%	130	91	2-5	111	2-5	117	5-15	114	10-20
Solway	mm	118	324		907		1796		3282	
	%	153	110	2-5	122	5-10	126	30-50	115	15-25
Clyde	mm	118	406		1072		1962		3587	
	%	140	116	2-5	120	5-10	116	5-15	106	2-5

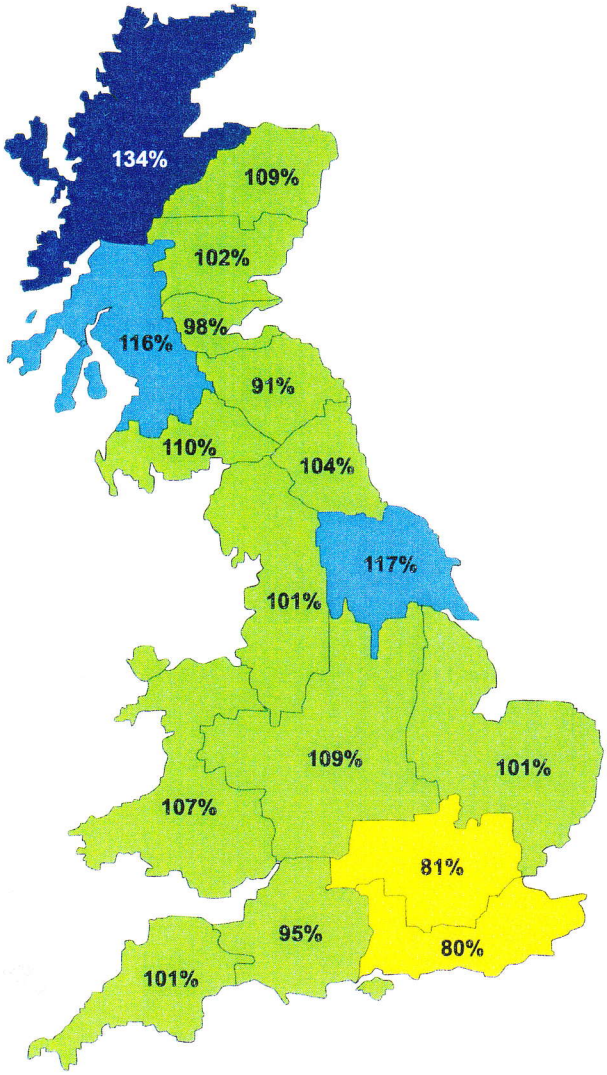
RP = Return period

 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.

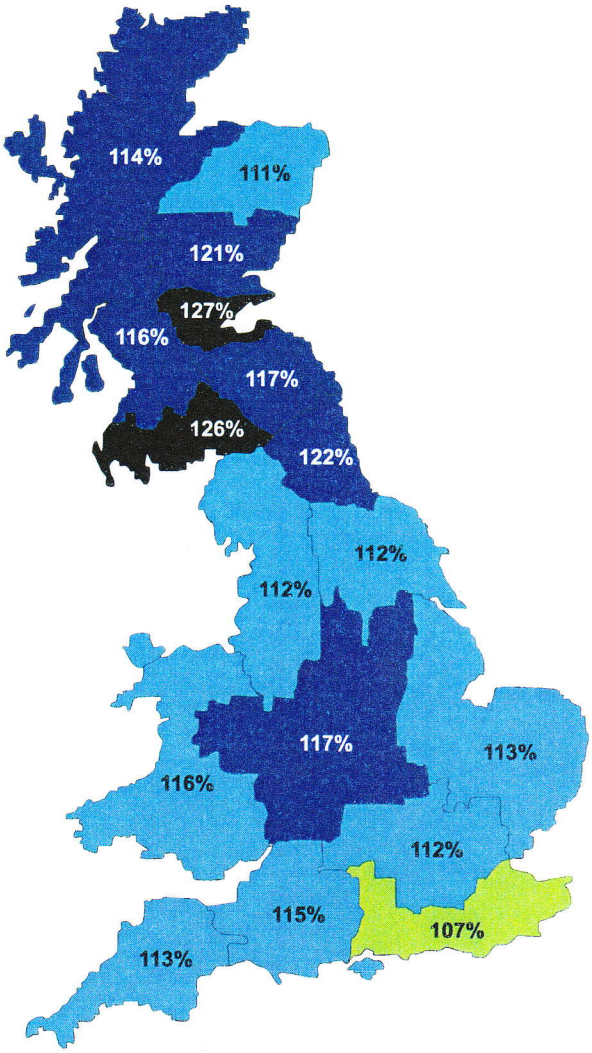
Rainfall . . . Rainfall . . . Rainfall

Key

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



February 1999 - April 1999

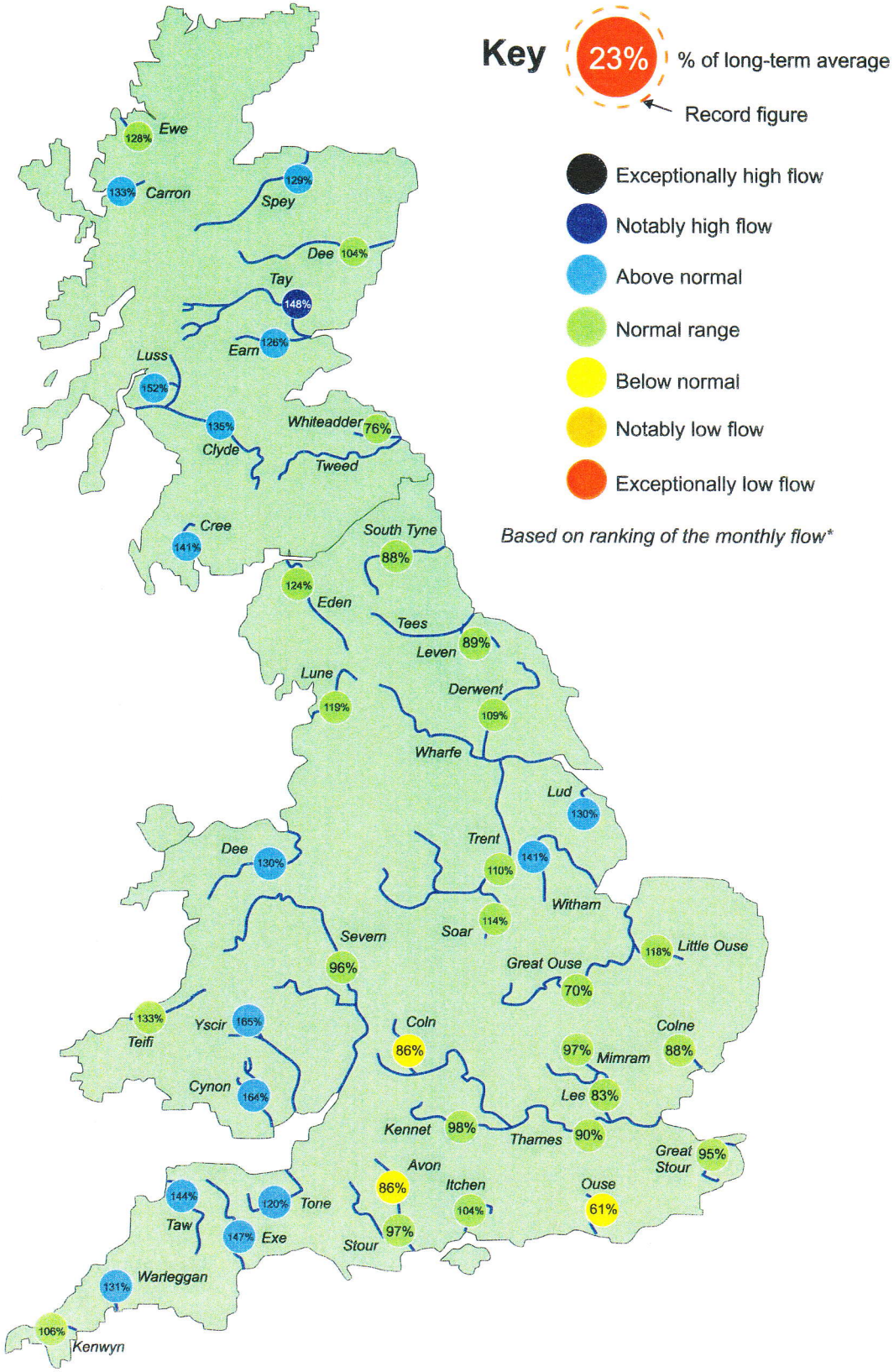


May 1998 - April 1999

Rainfall accumulation maps

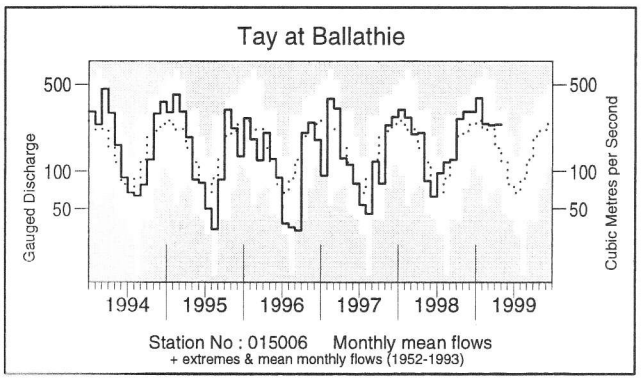
Although in a few southern localities rainfall in 1999 thus far is a little below average, Britain as a whole has registered a notably high January-April total - continuing (in this timespan) a wet phase which began in the late 1980s. The average January-April rainfall over the last twelve years is more than 20% greater than the preceding average.

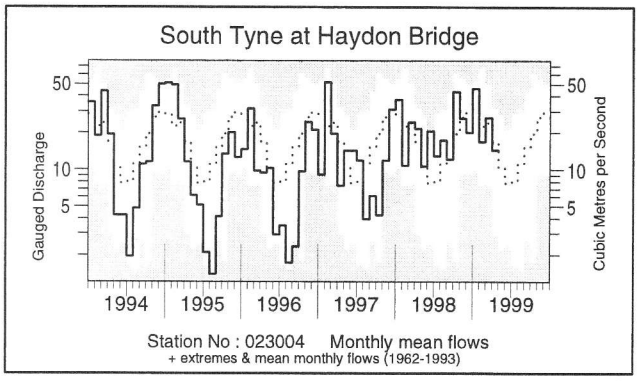
River flow . . . River flow . . .

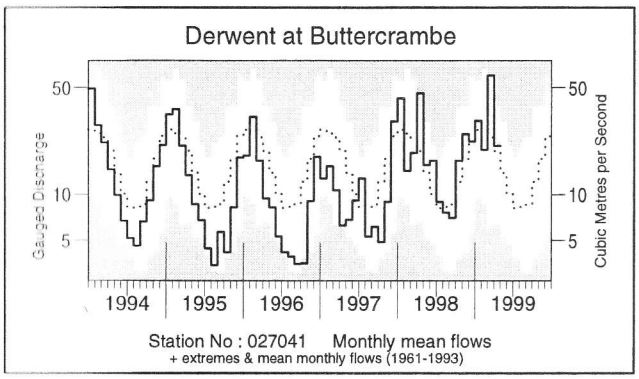


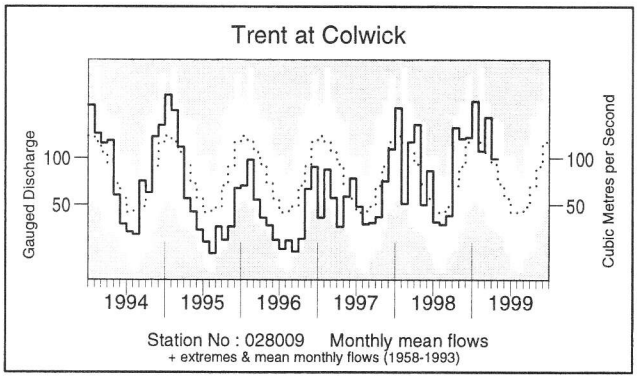
River flows - April 1999

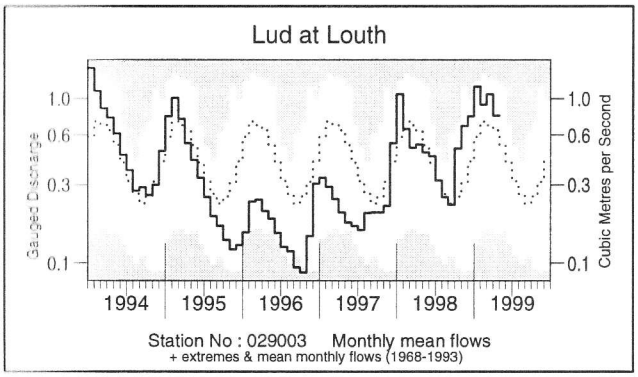
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

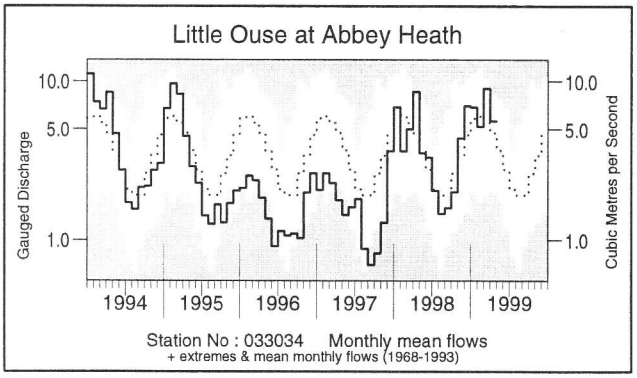


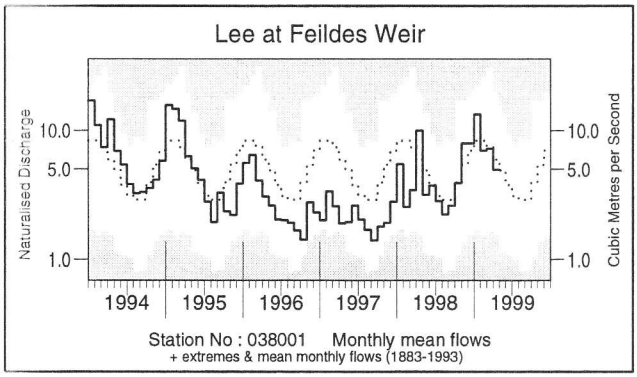


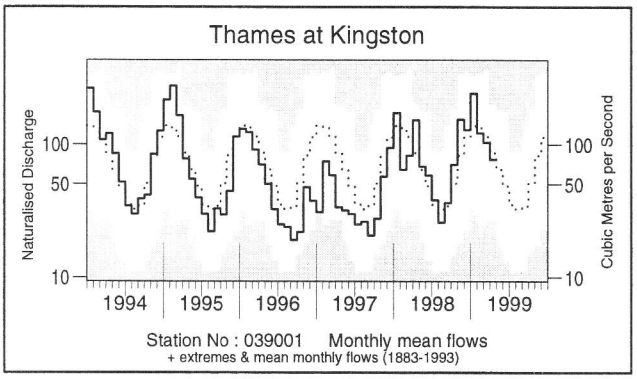








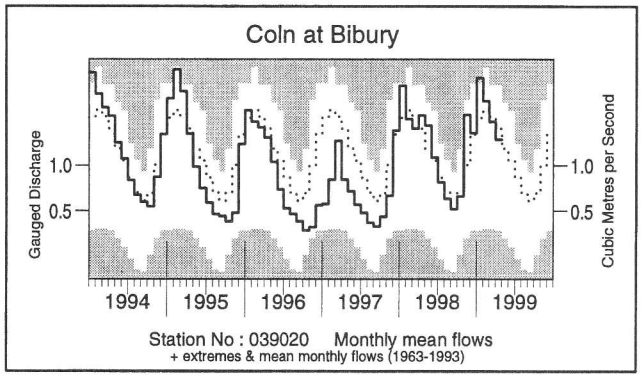


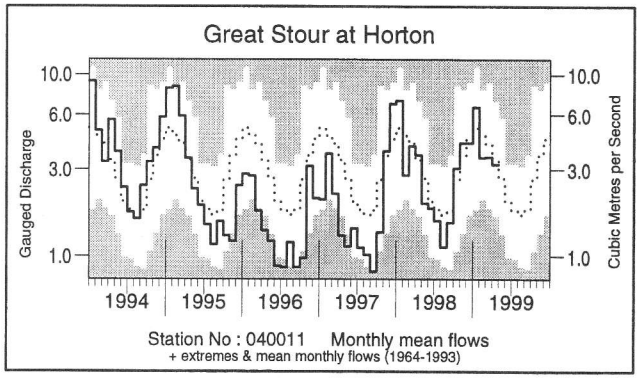


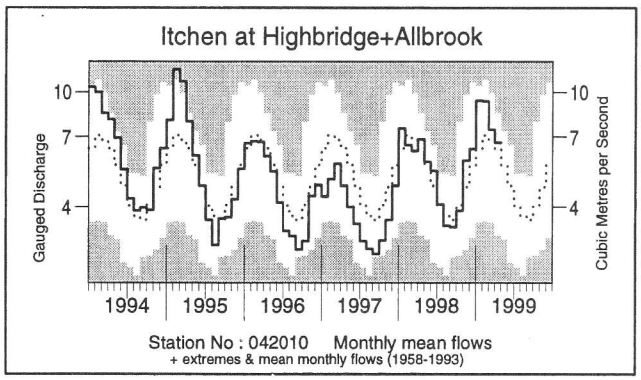
Monthly river flow hydrographs

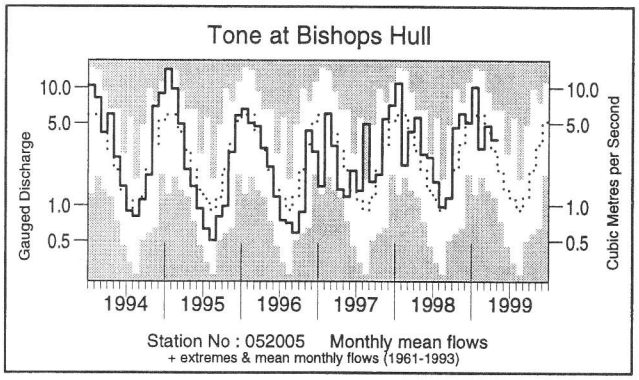
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1994 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

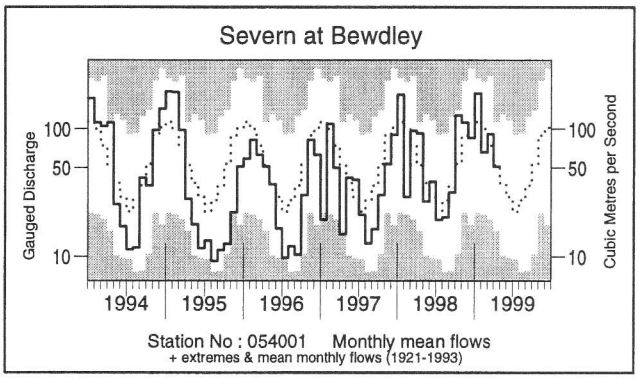
River flow . . . River flow . . .

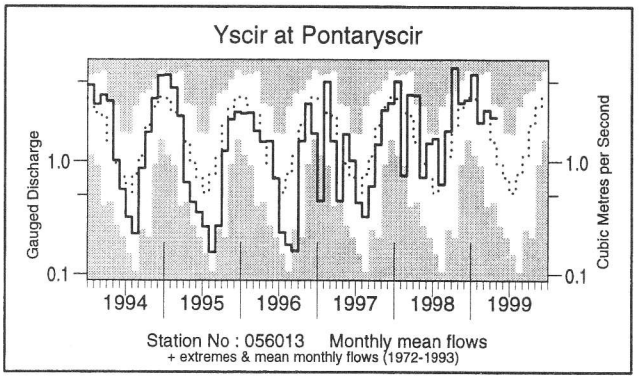


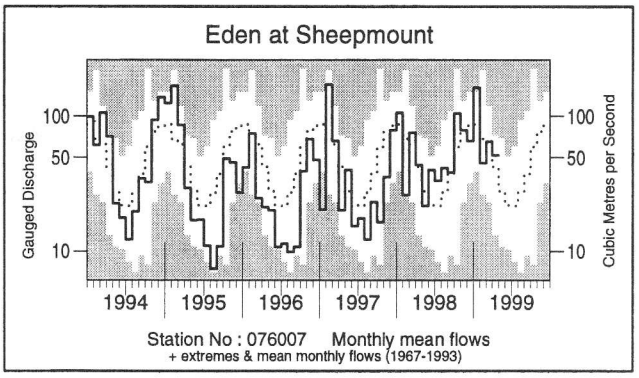


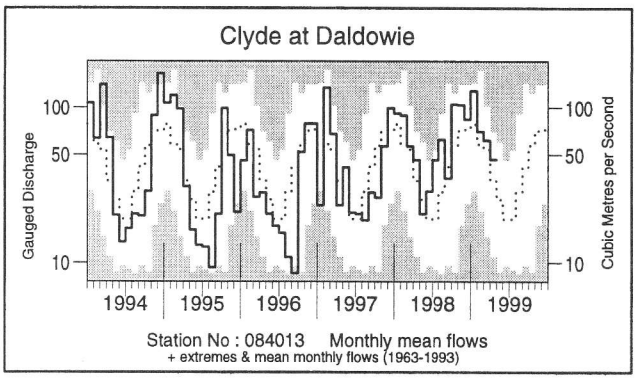










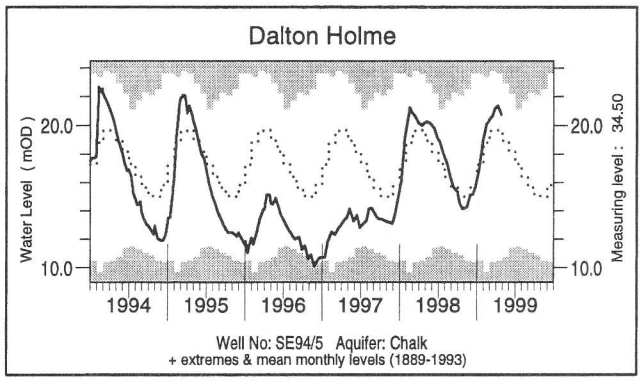


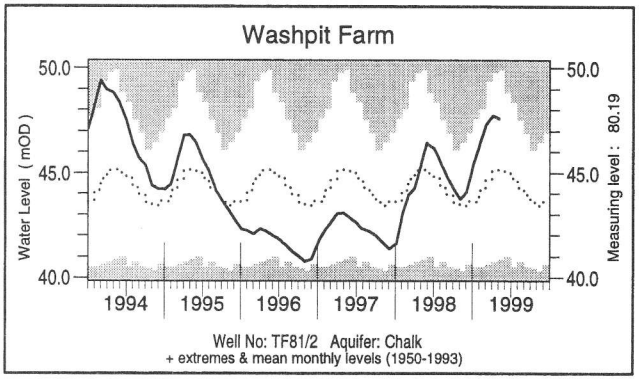
Notable runoff accumulations November 1998 - April 1999 (a); May 1998 - April 1999 (b)

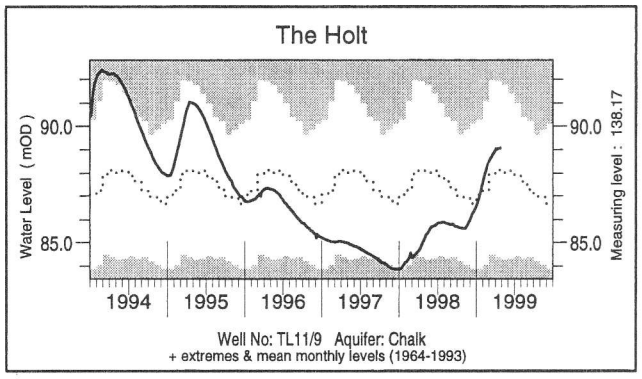
(a) River	%lta	Rank	(b) River	%lta	Rank	River	%lta	Rank
Trent	132	37/41	Tweed	126	36/38	Cynon	135	39/39
Witham	176	38/40	Witham	169	38/40	Teifi	126	38/39
Warleggan	129	28/30	Exe	135	41/43	Lune	127	35/37
Brue	139	33/35	Warleggan	134	28/29	Cree	124	33/35
Yscir	116	22/26	Taw	136	38/40	Clyde	138	35/35
Clyde	130	32/36	Yscir	140	26/26	Naver	115	19/21

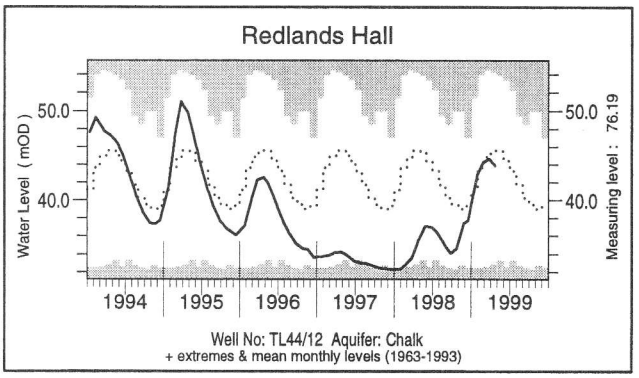
lta = long term average
Rank 1 = lowest on record

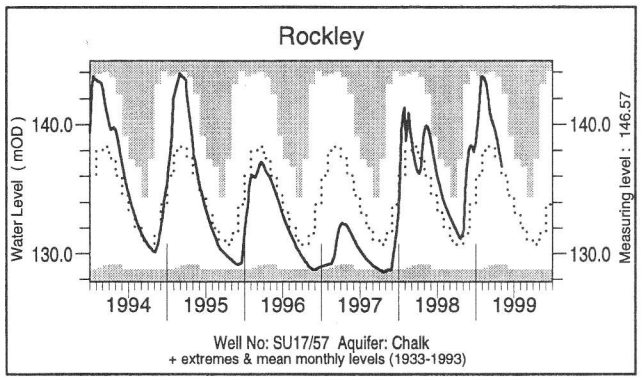
Groundwater . . . Groundwater

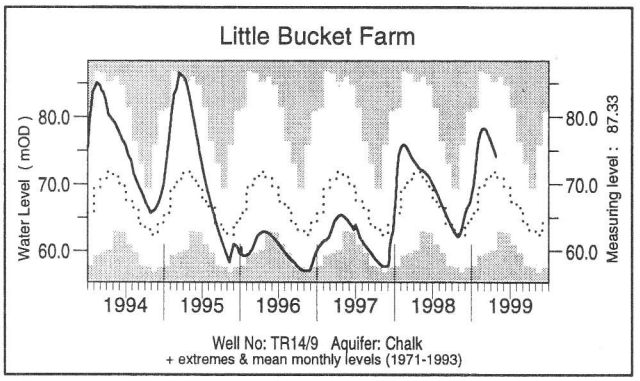


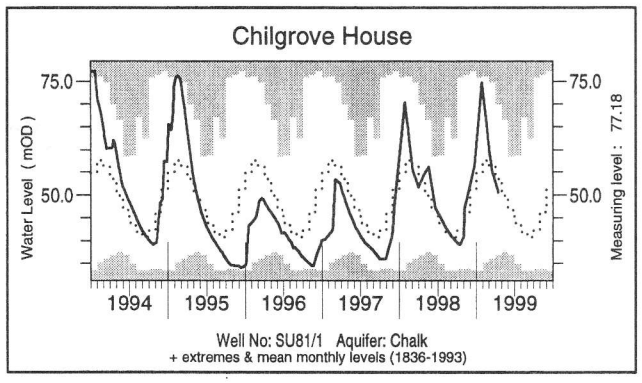


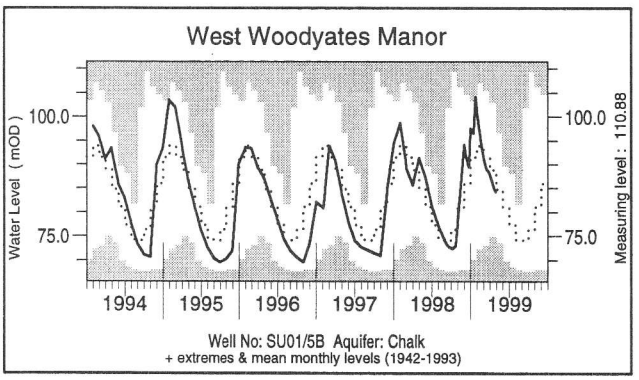








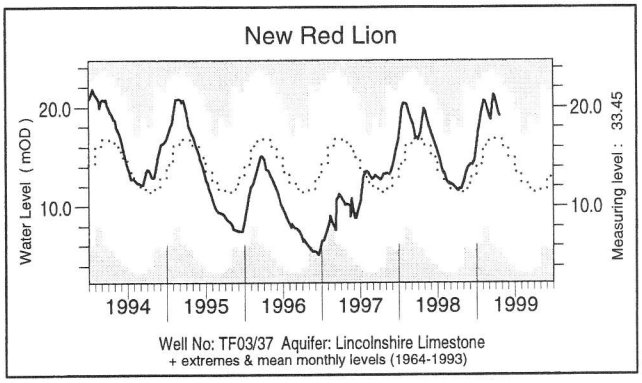


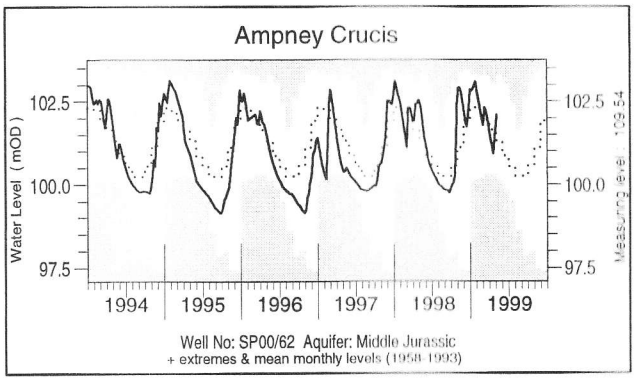


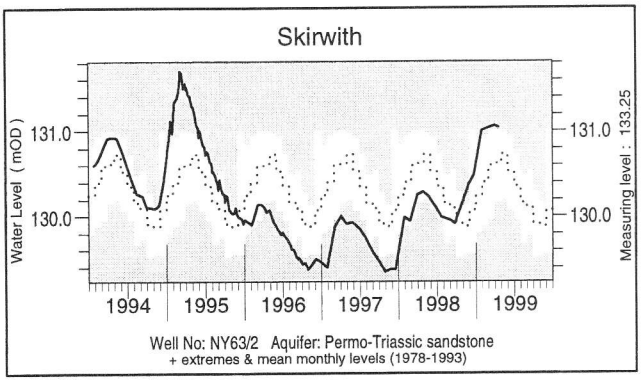
What is groundwater?

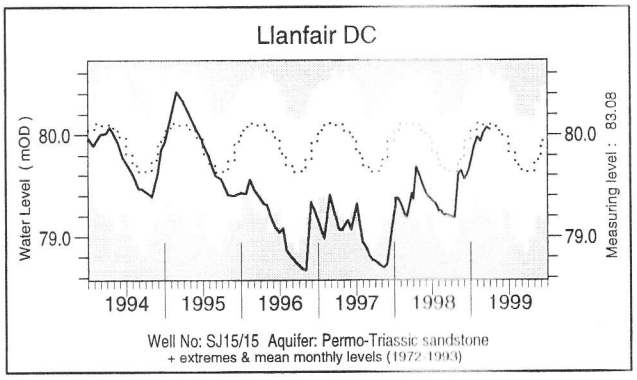
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

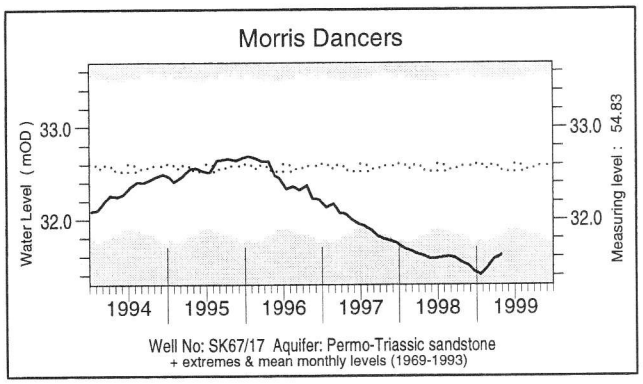
Groundwater . . . Groundwater

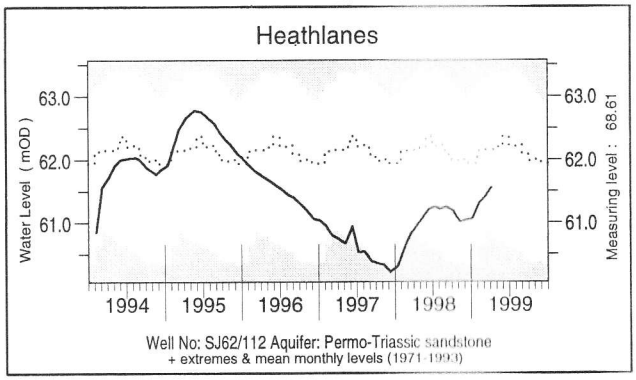


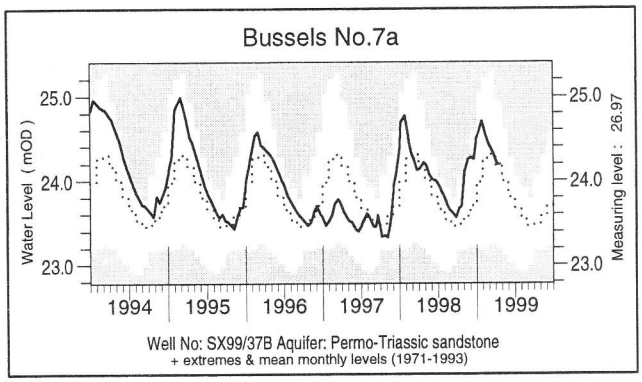


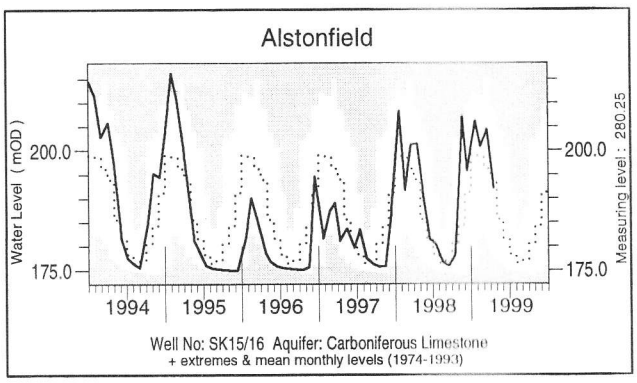












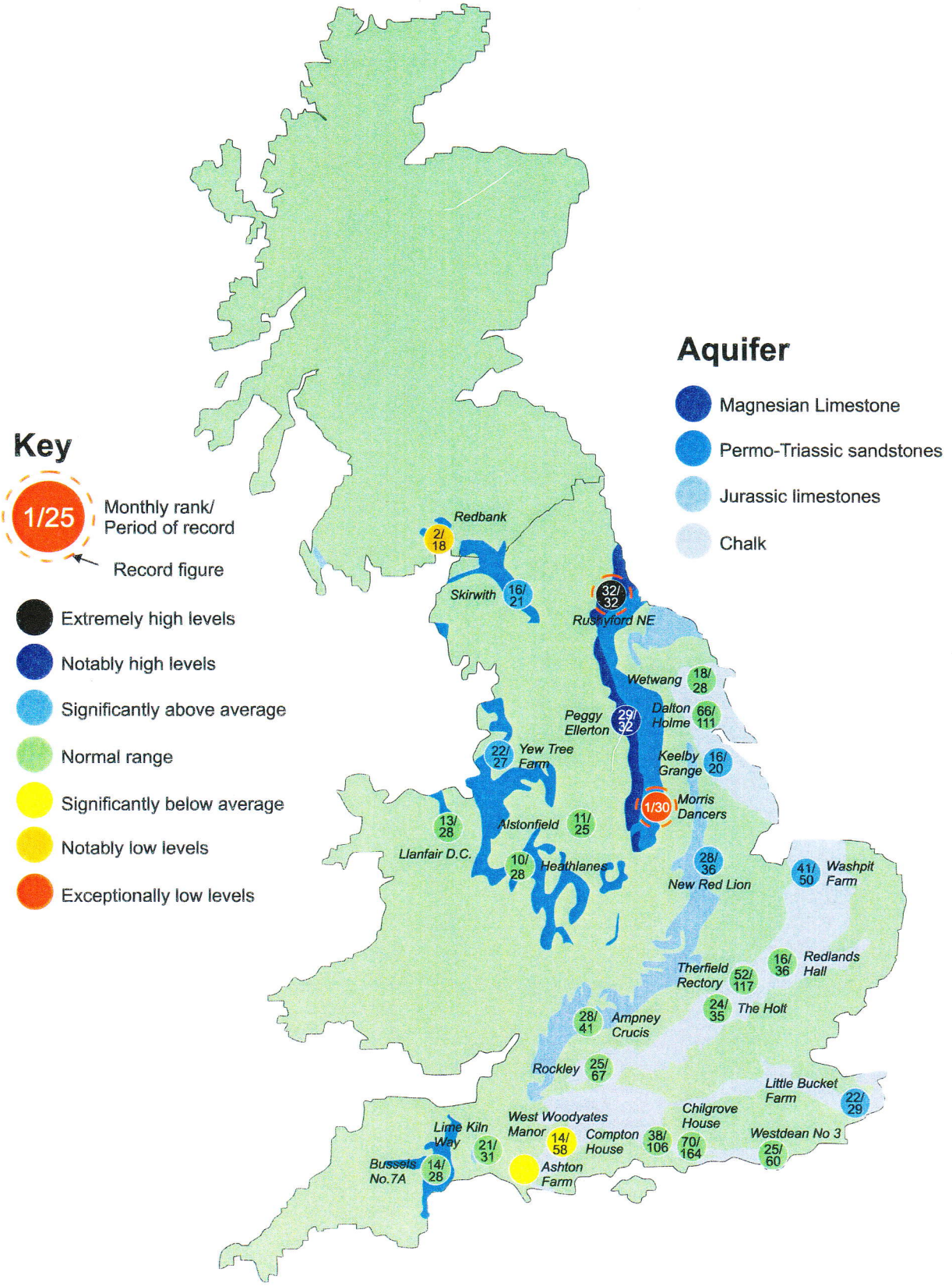
Groundwater levels April/May 1999

Borehole	Level	Date	Mar av.
Dalton Holme	20.73	26/04	19.50
Washpit Farm	47.59	04/05	45.17
The Holt	89.07	26/04	88.16
Redlands Hall	43.85	23/04	44.87
Ashton Farm	68.00	28/04	69.41
Little Bucket	74.16	26/04	71.69

Borehole	Level	Date	Mar av.
Chilgrove	50.63	14/04	52.21
W Woodyates	84.29	28/04	88.22
New Red Lion	19.14	21/04	16.44
Ampney Crucis	102.09	04/05	101.71
Skirwith	131.04	20/04	130.60

Borehole	Level	Date	Mar av.
Llanfair DC	80.05	01/04	79.97
Morris Dancers	31.61	27/04	32.48
Heathlanes	61.56	06/04	62.08
Bussels	24.19	22/04	24.15
Alstonfield	192.06	15/04	193.47

Levels in metres above Ordnance Datum

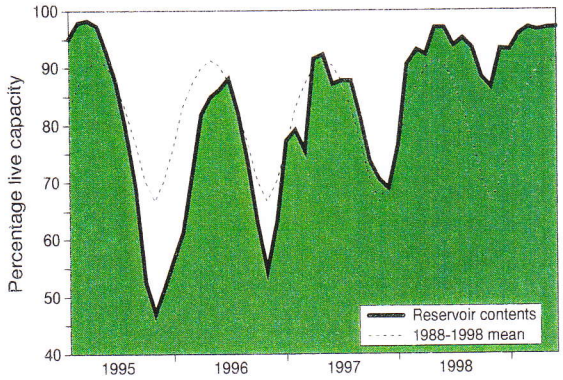


Groundwater levels - April 1999

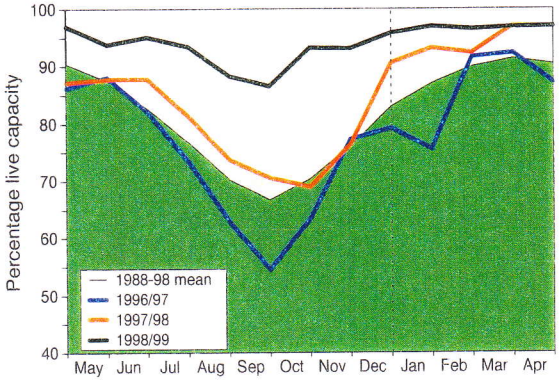
The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods 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)	1998 Dec	1999 Jan	Feb	Mar	Apr	**May**	Min. May	Year* of min
North West	N Command Zone	• 133375	93	98	96	93	93	96	80	1996
	Vyrnwy	55146	93	100	99	100	97	98	70	1996
Northumbrian	Teesdale	• 87936	98	98	99	97	98	95	81	1996
	Kielder	(199175)	(93)	(94)	(97)	(95)	(95)	(95)	(85)	1990
Severn Trent	Clywedog	44922	81	85	91	93	94	99	85	1988
	Derwent Valley	• 39525	99	100	100	100	100	100	54	1996
Yorkshire	Washburn	• 22035	96	99	99	98	96	98	76	1996
	Bradford supply	• 41407	99	98	98	96	96	98	60	1996
Anglian	Grafham	(55490)	(87)	(90)	(91)	(93)	(98)	(98)	(73)	1997
	Rutland	(116580)	(88)	(91)	(95)	(95)	(97)	(96)	(72)	1997
Thames	London	• 206399	92	94	94	94	98	95	86	1990
	Farmoor	• 13843	93	90	85	98	98	95	95	**1999**
Southern	Bewl	28170	87	92	99	100	99	98	63	1990
	Ardingly	4685	100	100	100	100	100	100	100	1999
Wessex	Clatworthy	5364	100	100	100	97	97	99	81	1990
	Bristol WW	• (38666)	(95)	(98)	(97)	(98)	(98)	(97)	(85)	1990
South West	Colliford	28540	89	98	100	100	100	100	56	1997
	Roadford	34500	98	100	98	94	95	96	41	1996
	Wimbleball	21320	100	100	100	100	99	100	79	1992
	Stithians	5205	100	100	100	99	99	99	65	1992
Welsh	Celyn and Brenig	• 131155	96	98	100	100	100	100	75	1996
	Brianne	62140	94	100	99	99	97	99	86	1997
	Big Five	• 69762	86	94	99	99	95	97	85	1997
	Elan Valley	99106	100	100	100	100	97	99	91	1997
East of Scotland	Edinburgh/Mid Lothian	• 97639	56	60	72	73	76	81	62	1998
	East Lothian	• 10206	100	99	100	99	99	99	89	1992
West of Scotland	Loch Katrine	• 111363	89	90	90	93	95	93	92	1995
	Daer	22412	100	100	99	100	100	97	91	1995
	Loch Thom	• 11840	100	100	100	100	100	97	92	1995

() figures in parentheses relate to gross storage

* last occurence

• denotes reservoir groups

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 1988-1998 period only. In some gravity-fed reservoirs (eg. 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 (but the figures for England and Wales are derived independently and may not equate to a combination of the MORECS figures). 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 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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