Hydrological Summary
for the United Kingdom

June 2003

General

June was generally very warm with lengthy dry spells punctuated by showery or stormy interludes. Rainfall for the UK as a whole was close to the long term average but spatial variability was substantial. In much of southern England another relatively dry month contributed to the second lowest Feb-June rainfall in the last 40 years. However baseflows and minor spates helped to keep river flows above drought minima and June runoff totals were generally in the normal range (albeit often well below average). With the exception of a few pumped storage reservoirs, stocks fell throughout June – notably so in north-west England (parts of eastern Scotland also) but overall reservoir stocks for England and Wales remain marginally above the early July average. Groundwater levels in most major aquifers are also well within the normal summer range. Following five years of generally very healthy water resources across southern Britain the low rainfall and high evaporation losses in the spring and early summer has made for a less sanguine outlook. The dry soil conditions are likely to delay the seasonal recovery in runoff and recharge; correspondingly river flows – particularly in impermeable southern catchments – may be notably low by the autumn.

Rainfall

High pressure dominated synoptic patterns during much of June diverting most Atlantic low pressure systems to the west and north of the English Lowlands. However, the high temperatures triggered several thundery episodes. On the 1st, 39 mm fell in an hour at Shepshed (Leics) and 60 mm in around 2.5 hours was reported in St Leonards (East Sussex) early on the 2nd; both storms have return periods > 50 yrs. Storms on the 22nd were responsible for more than half the total June rainfall in some southern catchments. The showery and thundery nature of much of the rainfall made for substantial regional and local variability in the June totals. Sheltered parts of eastern Scotland (eastern Kent also) received <40% of average whereas a few parts of eastern England – which was very wet at month end – recorded > 200%. Rainfall for England & Wales and Northern Ireland was above average whilst Scotland was a little below. More significantly, rainfall deficiencies, which have built since the late January in many areas, moderated across much of the country but Feb-June totals are still well below average in all regions. Many catchments in a zone from Dorset to Essex reported their second lowest Feb-June rainfall – after 1976 – since 1962. Fortunately, rainfall over the preceding 4 months was two or three times greater (compare the maps on page 3); this is reflected in the current water resources situation.

Flows

Away from north-west Scotland (where modest spates were common) protracted seasonal recessions continued in most rivers. Thunderstorms generated short-lived events some of which overwhelmed drainage networks causing very localised flooding - around 30 properties where flooded following the St Leonards storm – and considerable transport disruption. Nonetheless, in most impermeable catchments flows were well below the June average by month end - the lowest since 1996 in a number of English catchments - triggering flow augmentation measures in some areas (e.g. in Dorset and Essex). Healthy June runoff totals typified catchments in NW Britain and parts of NI but, aside from a few spring-fed rivers, June runoff totals were generally well below average and notably low in a few catchments. In eastern Scotland, the Don (at Haughton) registered its lowest June runoff in a series from 1969. The sustained recessions are reflected in depressed Feb-June runoff totals: the South Tyne and Spey (at Boat of Garten) reported new minima in this timeframe and totals for many rivers are in the lowest quartile. By contrast, northern Scotland aside, runoff totals over the last nine months are mostly in the upper quartile – a consequence of abundant early winter runoff.

Groundwater

With evaporative demands well above average over wide areas most aquifer outcrop areas were exceptionally dry by late June; early July soil moisture deficits would, typically, be expected once every 5-10 years on average. Infiltration during June was largely confined to very localised episodes associated with notable storm rainfall totals (e.g. in the north Midlands; a modest increase in groundwater levels was reported for the Carb. Limestone at Alstonfield). Generally however the spring/summer recessions continued – by month-end levels in parts of the western Chalk (e.g. at Woodyates and Chilgrove), had fallen around 30 metres from their Jan. maxima, and are now appreciably below the early July average. But levels in the majority of index chalk wells remain well within the normal range. A similar generalisation can be applied to the limestone aquifers however, in the Cotswolds, late-June levels at Ampney Crucis were the lowest since June 1997. Following more than two years above previous seasonal maxima in some areas (e.g. north Wales), the 2003 recession has brought the Permo-Triassic sandstones back to the normal range, albeit still well above average in the northerly outcrops. Minor aquifers in eastern England are now also following a typical summer recession. Over wide areas, smds are currently >25 mm above average in much of southern England; the onset of the 2003/04 recharge season is likely to be delayed.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Jun 2003	Apr 03-Jun 03	RP	Feb 03-Jun 03	RP	Oct 02-Jun 03	RP	Jul 02-Jun 03	RP
England & Wales	**mm**	**72**	**188**		**265**		**824**		**1034**	
	%	**111**	**98**	**2-5**	**80**	**5-10**	**118**	**5-15**	**113**	**5-10**
North West	mm	73	248		365		917		1174	
	%	90	109	2-5	91	2-5	102	2-5	98	2-5
Northumbrian	mm	61	172		229		661		858	
	%	102	97	2-5	75	5-15	104	2-5	101	2-5
Severn Trent	mm	67	175		235		637		807	
	%	113	101	2-5	81	2-5	112	2-5	107	2-5
Yorkshire	mm	89	206		272		707		955	
	%	148	115	2-5	89	2-5	114	5-10	116	5-10
Anglian	mm	79	157		196		559		735	
	%	155	108	2-5	86	2-5	126	10-20	123	10-20
Thames	mm	47	131		180		626		769	
	%	86	81	2-5	69	10-20	120	5-10	112	2-5
Southern	mm	37	116		174		685		836	
	%	69	72	5-10	63	15-25	113	2-5	107	2-5
Wessex	mm	51	144		221		773		922	
	%	89	84	2-5	72	5-10	119	5-10	110	2-5
South West	mm	71	208		335		1002		1150	
	%	103	99	2-5	82	2-5	108	2-5	98	2-5
Welsh	mm	67	250		384		1101		1282	
	%	85	104	2-5	86	2-5	108	2-5	98	2-5
Scotland	**mm**	**76**	**273**		**415**		**980**		**1240**	
	%	**89**	**110**	**2-5**	**87**	**2-5**	**90**	**2-5**	**86**	**5-15**
Highland	mm	90	328		511		1063		1317	
	%	92	117	2-5	90	2-5	78	20-30	75	60-90
North East	mm	37	186		254		817		1091	
	%	56	95	2-5	75	10-20	113	5-10	112	5-10
Tay	mm	66	247		365		953		1218	
	%	91	113	2-5	86	2-5	101	2-5	99	2-5
Forth	mm	64	217		308		810		1059	
	%	92	107	2-5	82	5-10	98	2-5	95	2-5
Tweed	mm	44	187		262		753		976	
	%	68	97	2-5	77	5-10	105	2-5	101	2-5
Solway	mm	74	268		417		1099		1377	
	%	88	109	2-5	90	2-5	103	2-5	97	2-5
Clyde	mm	102	325		496		1115		1401	
	%	109	121	5-10	93	2-5	87	5-10	83	10-20
Northern Ireland	**mm**	**84**	**258**		**369**		**913**		**1112**	
	%	**118**	**125**	**5-10**	**99**	**2-5**	**114**	**5-10**	**105**	**2-5**

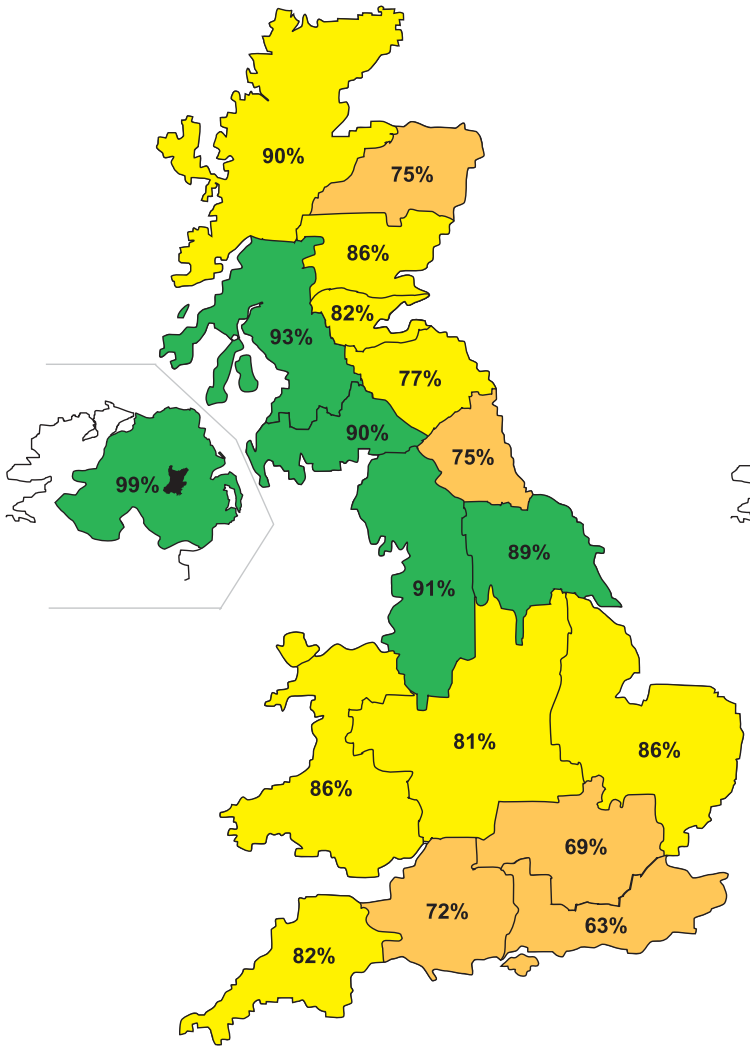
RP = Return period

 All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. 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); RP estimates for Northern Ireland are based on the tables for north-west England. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past.
*See page 12.

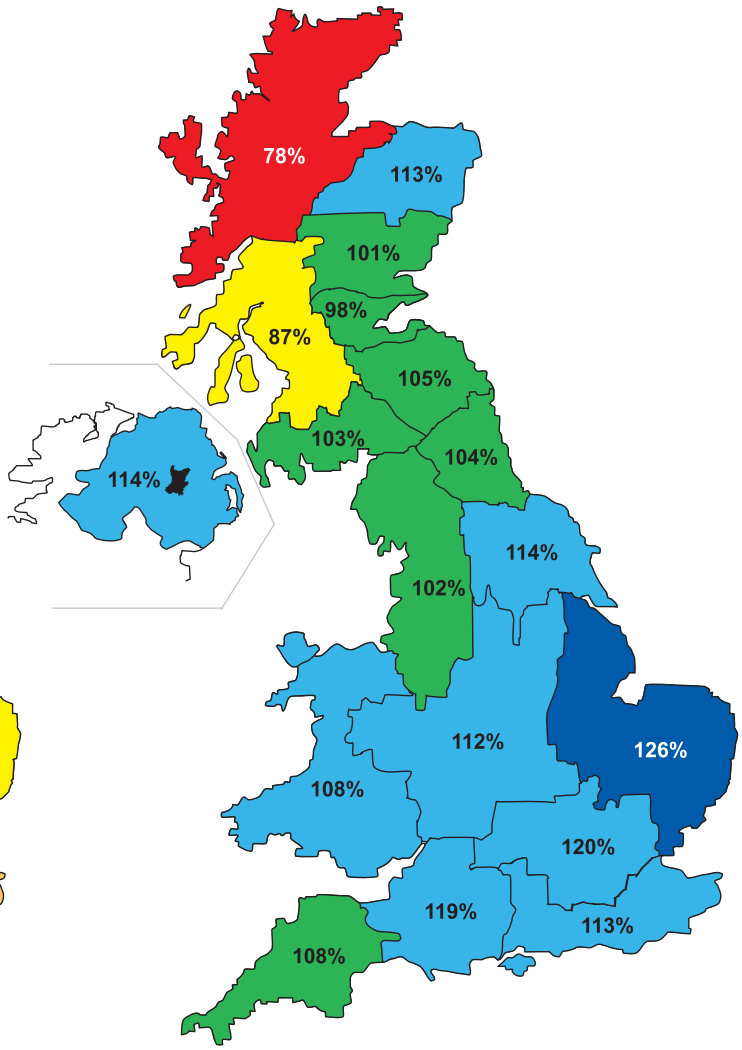
Rainfall . . . Rainfall . .

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 2003 - June 2003

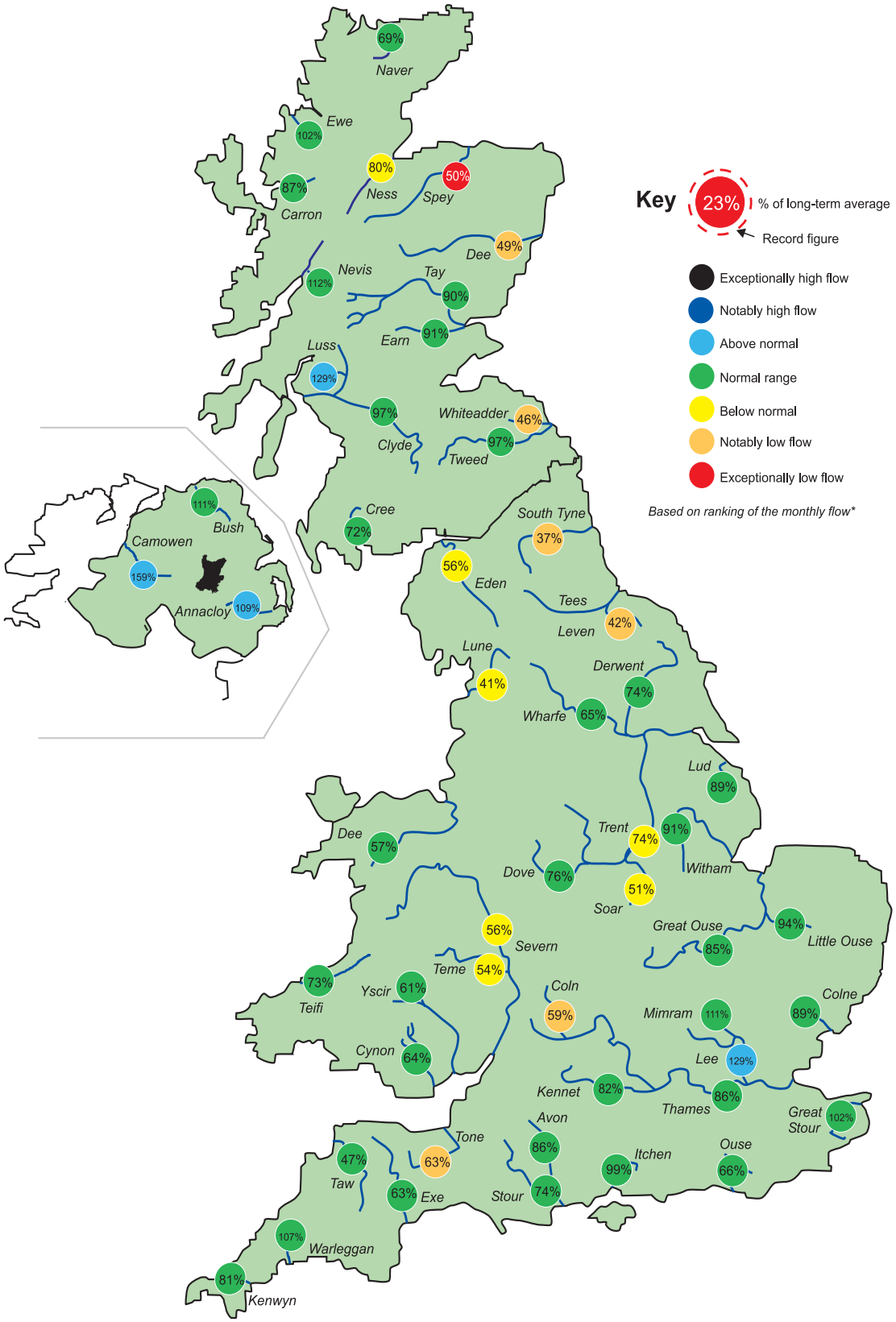


October 2002 - June 2003

Rainfall accumulation maps

The contrast in the predominant synoptic patterns pre- and post-January 2003 is dramatically reflected in the regional rainfall accumulations for southern Britain. England and Wales has experienced its second driest Feb-June since 1984 but, notwithstanding the spring/early summer drought, the Oct-June rainfall total ranks (provisionally) 10th wettest in the last 150 years. Over the wider timeframe, the rainfall deficiency in northern Scotland is still notable - but it water resources significance is limited.

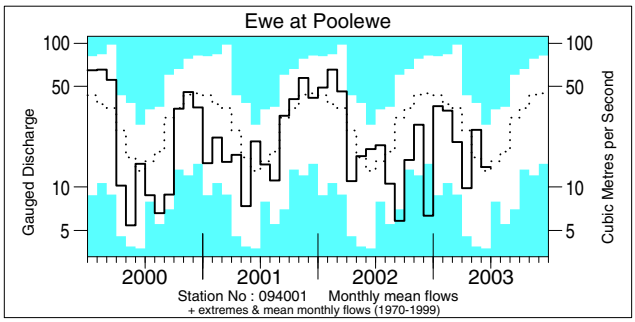
River flow . . . River flow . . .

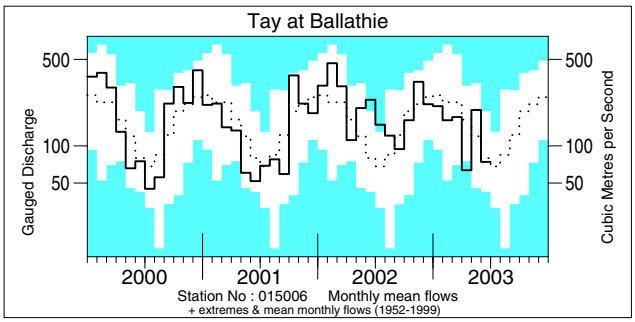


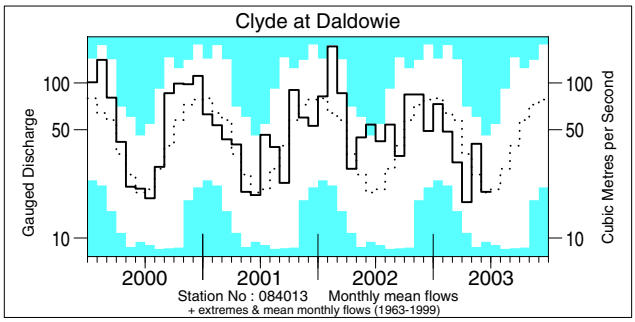
River flows - June 2003

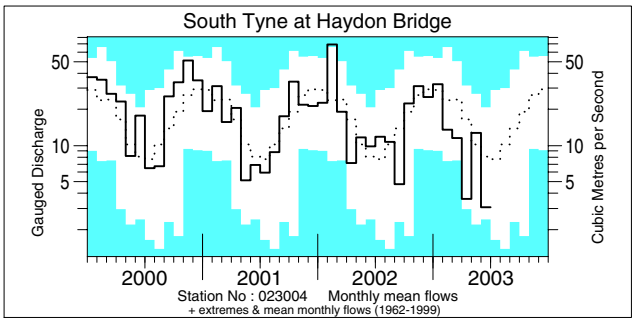
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station.

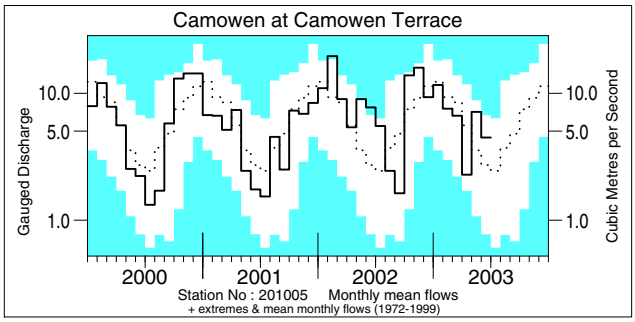
River flow . . . River flow . . .

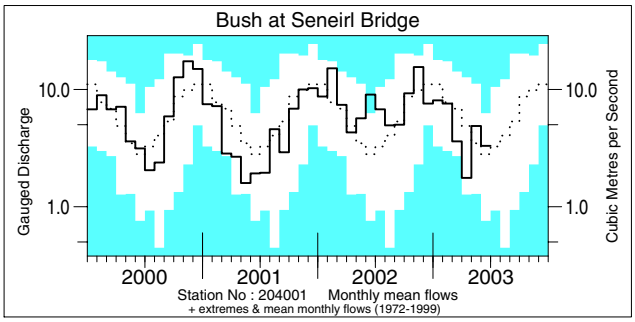


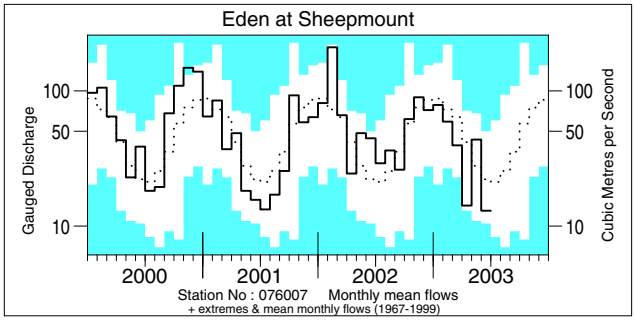


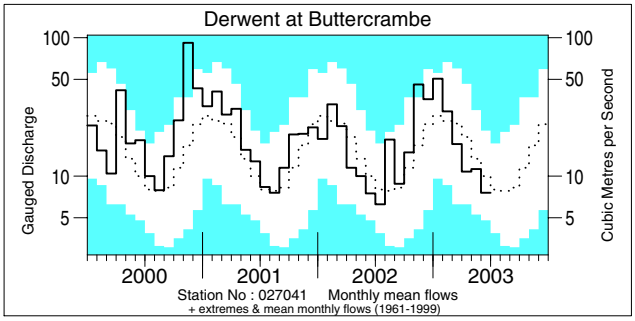


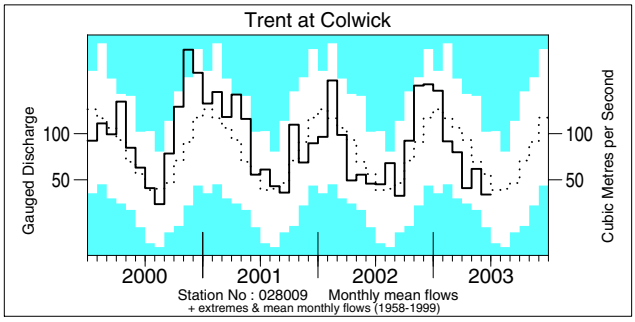


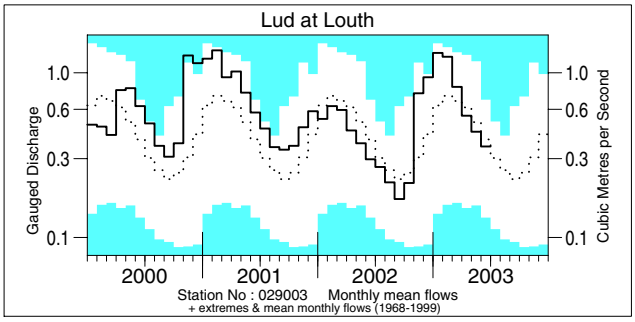








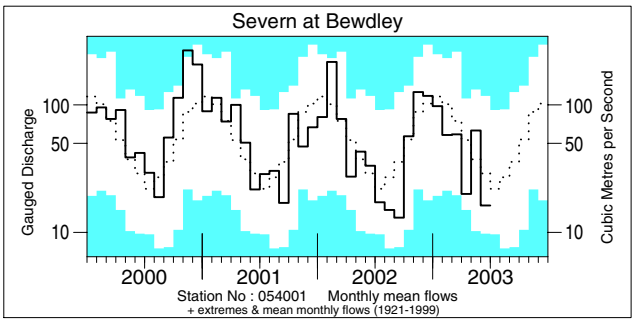


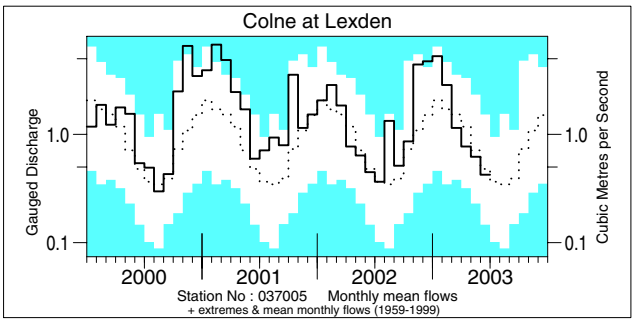


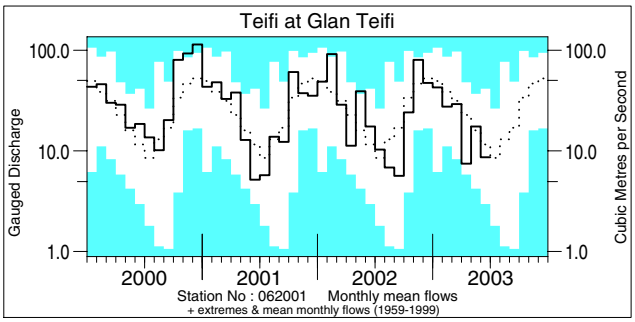
Monthly river flow hydrographs

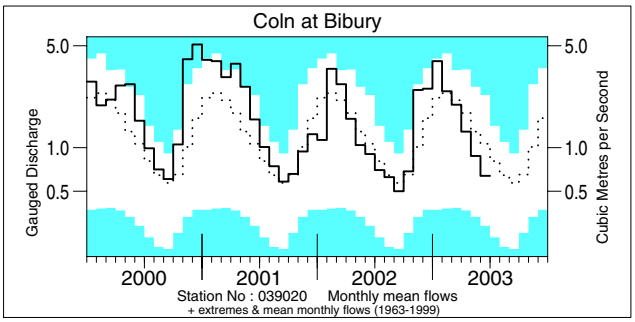
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

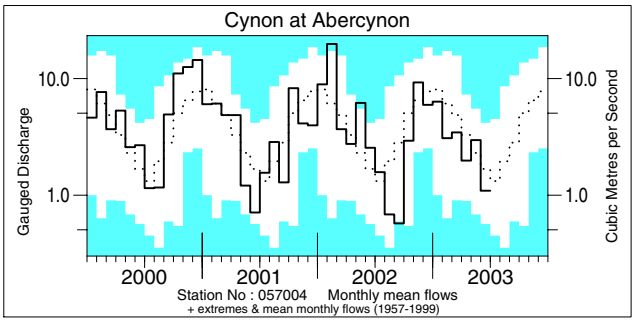
River flow . . . River flow . . .

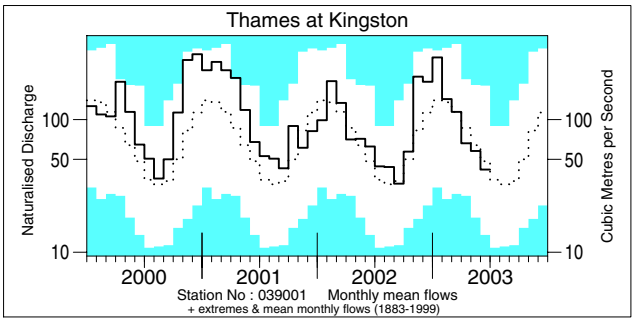


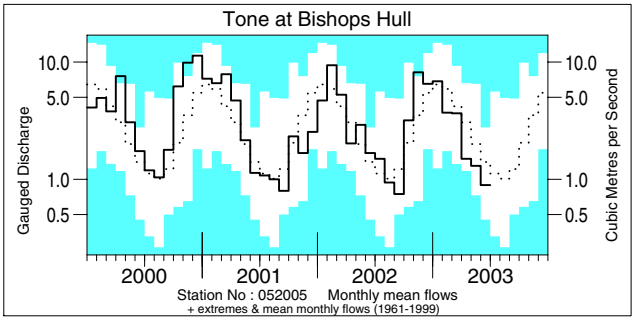


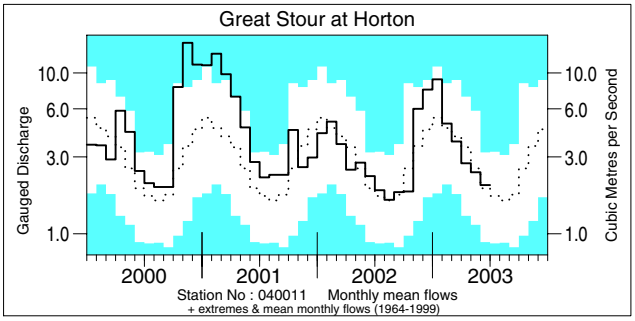


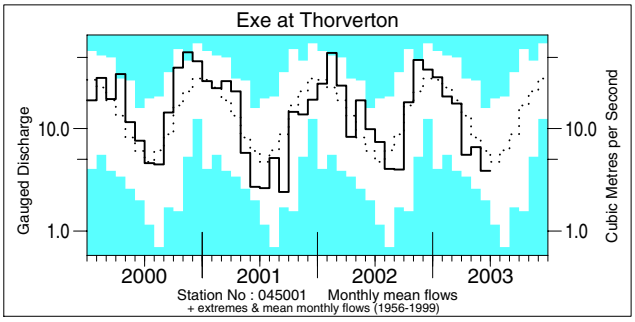


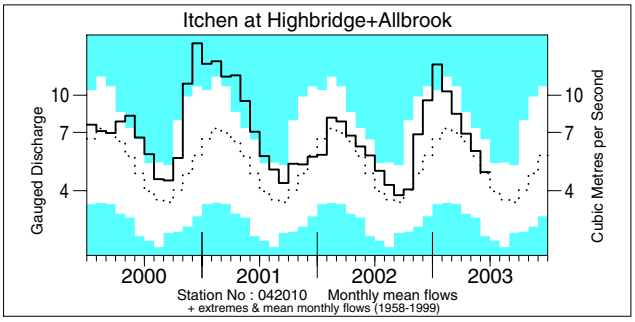












Notable runoff accumulations (a) February 2003 - June 2003, (b) October 2002 - June 2003

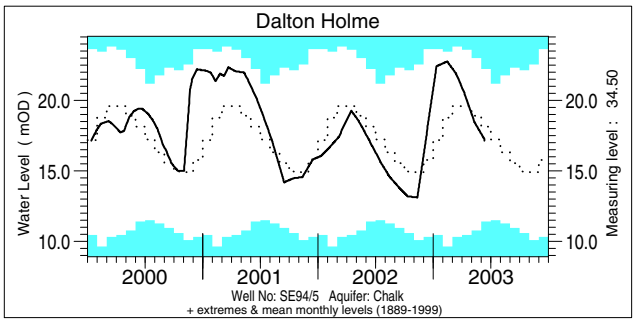
	River	%lta	Rank
a)	Spey(Boat o'Garten)	61	1/52
	Ness	58	2/31
	Scottish Dee	71	3/31
	Whiteadder	46	2/34
	South Tyne	54	1/41
	Taw	58	4/45
	Luss	72	3/25
	Carron	57	2/25

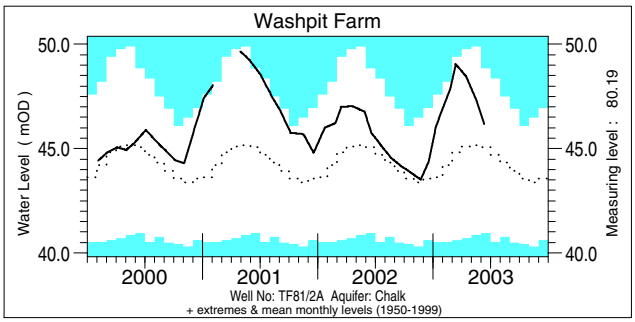
	River	%lta	Rank
b)	Deveron	133	39/41
	Dover Beck	149	25/27
	Stringside	169	36/37
	Colne	181	40/43
	Blackwater	145	50/51
	Kennet	144	41/42
	Lambourn	143	40/41

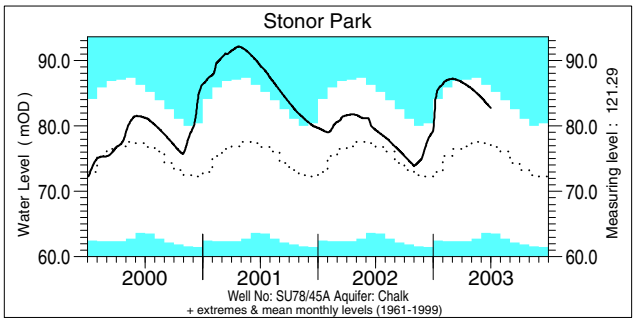
River	%lta	Rank
Lymington	163	40/42
Wilts. Avon	154	37/38
Otter	127	38/41
Cree	82	4/40
Nevis	68	2/21
Ewe	64	1/32
Naver	74	3/26
Annacloy	149	22/23

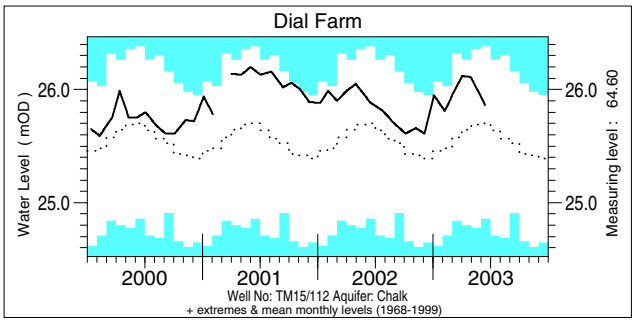
lta = long term average
Rank 1 = lowest on record

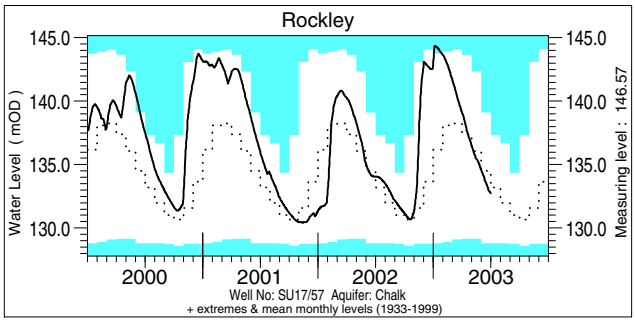
Groundwater . . . Groundwater

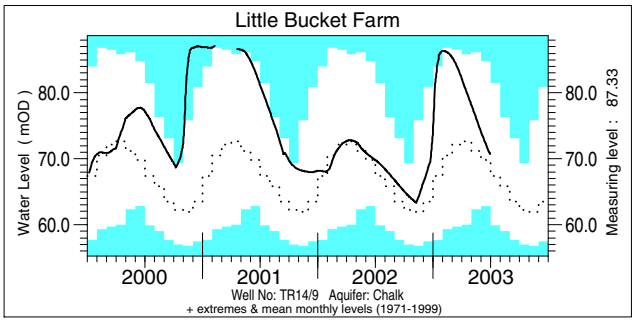


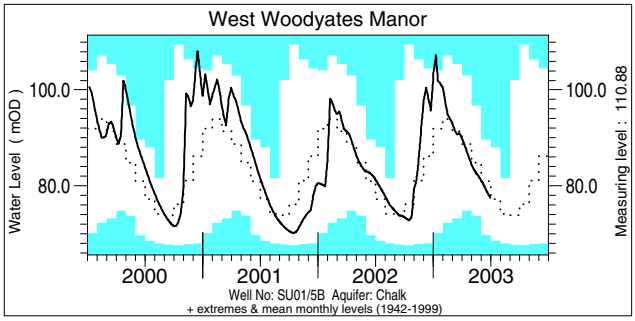


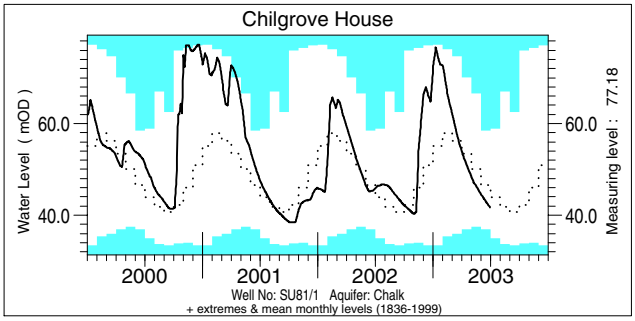


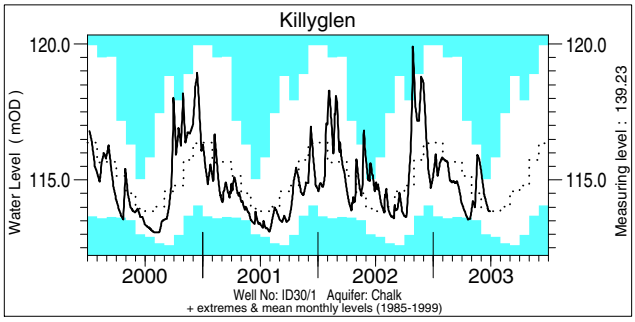


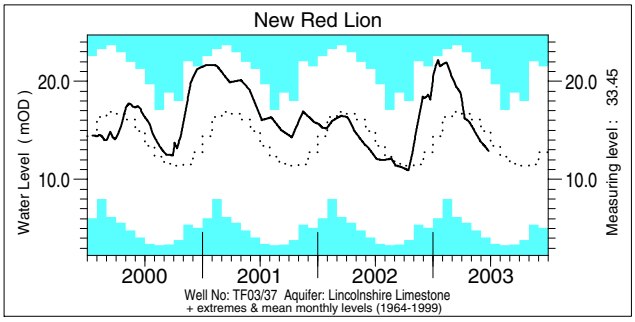






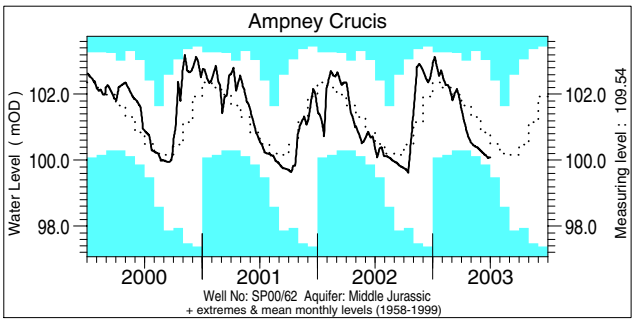


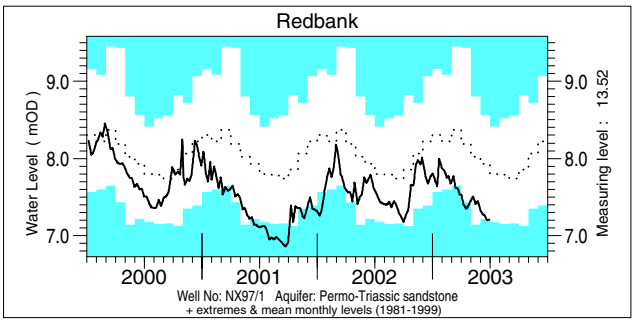


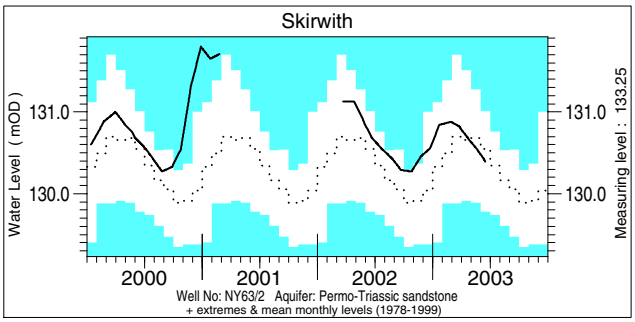


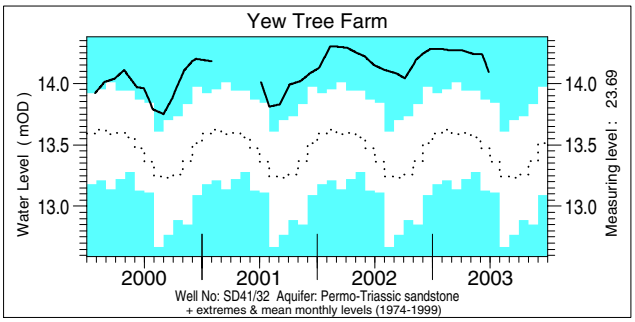
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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.

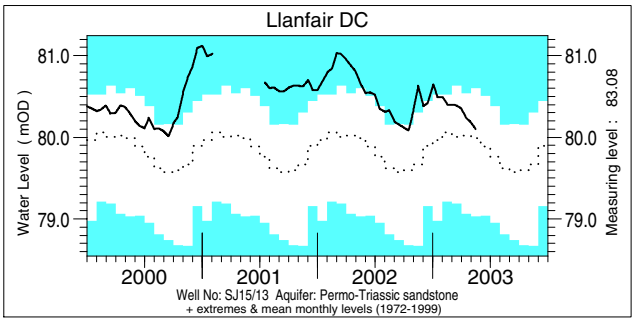
Groundwater . . . Groundwater

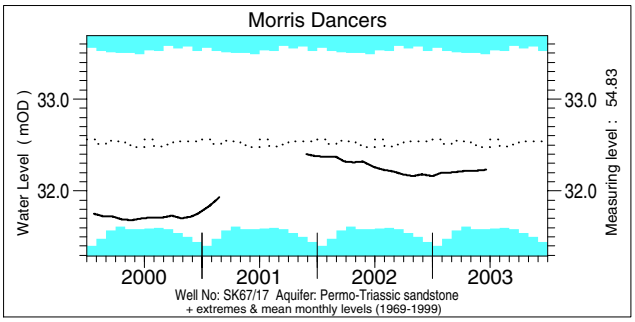


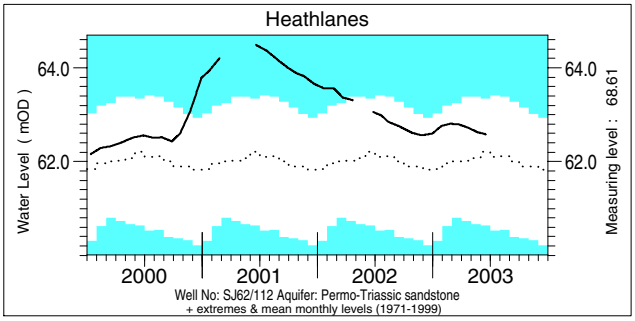


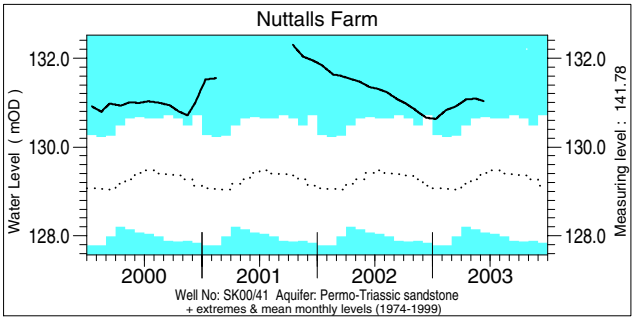


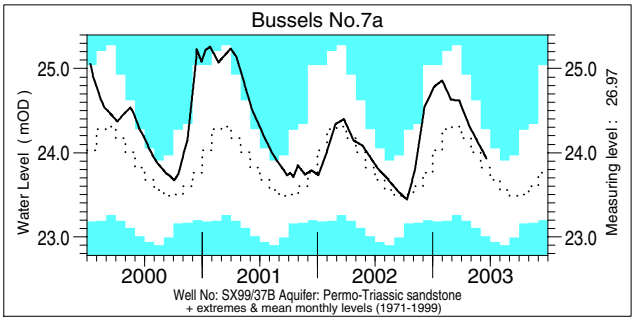


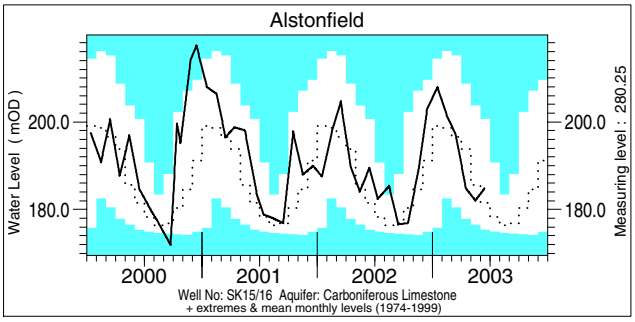












Groundwater levels June 2003 / July 2003

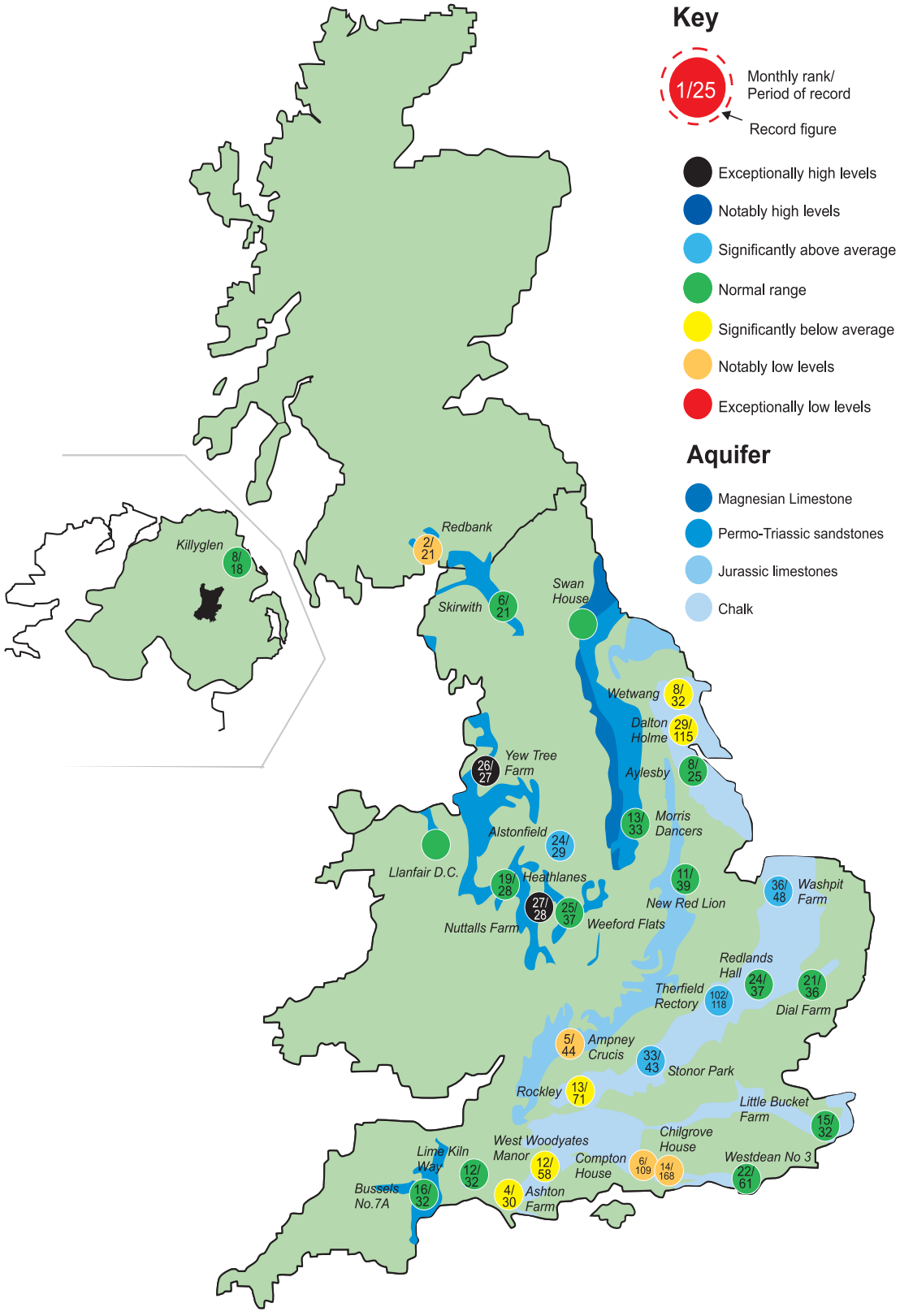
Borehole	Level	Date	Jun. av.
Dalton Holme	17.15	12/06	18.14
Washpit Farm	46.16	10/06	45.15
Stonor Park	82.77	01/07	78.20
Dial Farm	25.86	13/06	25.71
Rockley	132.73	01/07	134.60
Little Bucket Farm	70.67	30/06	71.52
West Woodyates	77.42	30/06	80.98

Borehole	Level	Date	Jun. av.
Chilgrove House	41.71	30/06	46.04
Killyglen	113.84	29/06	113.99
New Red Lion	12.88	25/06	14.71
Ampney Crucis	100.09	01/07	100.86
Redbank	7.21	29/06	7.90
Skirwith	130.39	16/06	130.54
Yew Tree Farm	14.09	27/06	13.57

Borehole	Level	Date	Jun. av.
Llanfair DC	80.10	15/05	79.83
Morris Dancers	32.23	19/06	32.36
Heathlanes	62.58	18/06	62.28
Nuttalls Farm	131.03	11/06	129.58
Bussels No.7a	23.93	19/06	23.88
Alstonfield	184.87	13/06	181.49

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

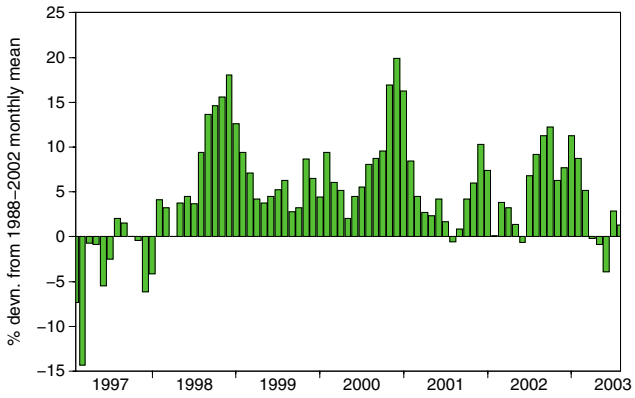


Groundwater levels - June 2003

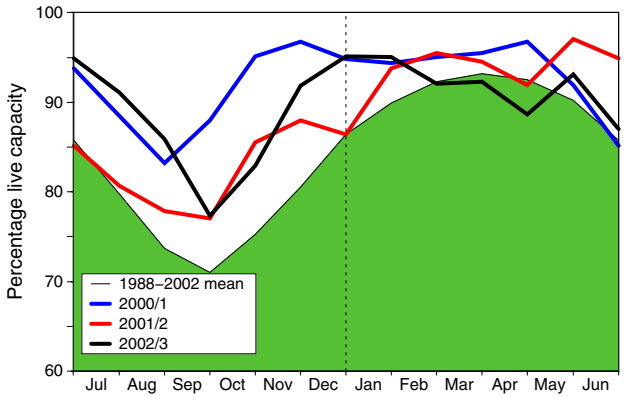
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction.)

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.

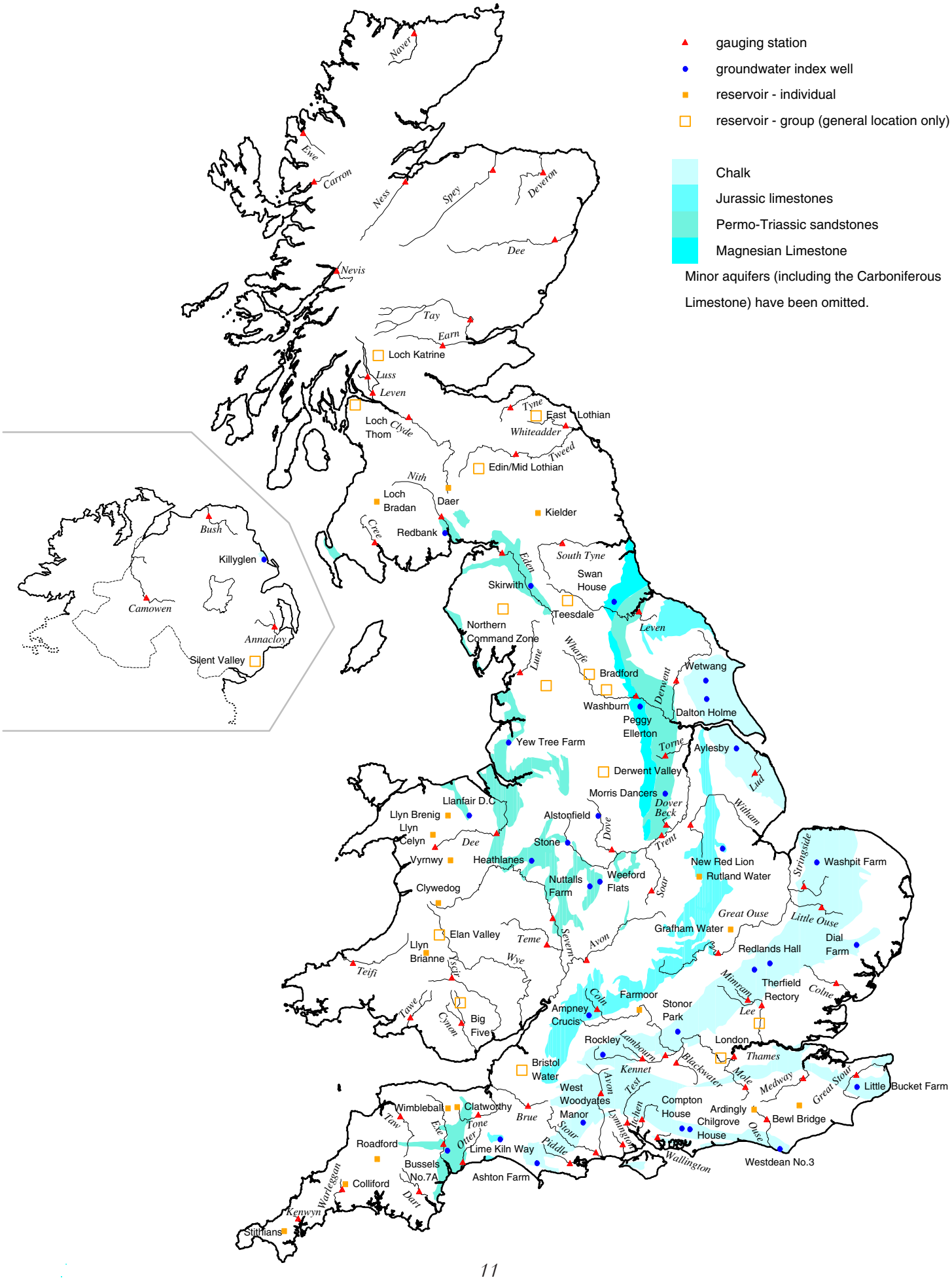
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Feb	Mar	Apr	May	Jun	Jul	Min. Jul	Year* of min.
North West	N Command Zone	• 124929	93	89	88	74	85	**69**	58	1995
	Vyrnwy	55146	94	92	94	90	97	**87**	65	1990
Northumbrian	Teesdale	• 87936	93	79	77	74	75	**72**	58	1989
	Kielder	(199175)	(99)	(91)	(90)	(92)	(97)	**(91)**	(71)	1989
Severn Trent	Clywedog	44922	81	85	96	97	99	**97**	72	1989
	Derwent Valley	• 39525	98	98	96	86	94	**80**	53	1996
Yorkshire	Washburn	• 22035	97	97	90	78	90	**82**	63	1995
	Bradford supply	• 41407	100	96	94	85	95	**82**	54	1995
Anglian	Grafham	(55490)	(84)	(86)	(91)	(94)	(97)	**(95)**	(70)	1997
	Rutland	(116580)	(90)	(87)	(93)	(95)	(94)	**(91)**	(75)	1997
Thames	London	• 202340	97	92	94	94	94	**93**	85	1990
	Farmoor	• 13830	91	93	93	94	91	**95**	94	1995
Southern	Bewl	28170	92	92	92	90	86	**79**	52	1990
	Ardingly	4685	100	100	100	100	100	**92**	86	1996
Wessex	Clatworthy	5364	100	100	99	86	79	**65**	61	1995
	Bristol WW	• (38666)	(98)	(97)	(96)	(91)	(88)	**(79)**	(64)	1990
South West	Colliford	28540	81	83	83	81	81	**79**	51	1997
	Roadford	34500	92	92	91	87	83	**79**	49	1996
	Wimbleball	21320	100	100	98	92	86	**77**	63	1992
	Stithians	5205	99	100	96	89	86	**81**	53	1990
Welsh	Celyn and Brenig	• 131155	96	99	98	94	100	**98**	77	1996
	Brianne	62140	99	97	95	88	100	**94**	76	1995
	Big Five	• 69762	99	98	95	86	96	**87**	61	1989
	Elan Valley	• 99106	100	99	96	87	99	**89**	75	1989
Scotland(E)	Edinburgh/Mid Lothian	• 97639	99	96	94	87	92	**84**	54	1998
	East Lothian	• 10206	100	98	96	95	91	**82**	81	1992
Scotland(W)	Loch Katrine	• 111363	97	95	89	87	88	**84**	61	2001
	Daer	22412	99	95	97	89	98	**70**	62	1994
	Loch Thom	• 11840	100	100	94	88	95	**85**	69	2000
Northern Ireland	Total+	•	98	96	94	80	93	**89**	65	1995
	Silent Valley	• 20634	98	92	93	79	95	**92**	54	1995

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence - see footnote

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 region; this can be particularly important during droughts. The minimum storage figures relate to the 1988-2003 period only (except for West of Scotland and Northern Ireland where data commence in the mid-1990's). 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



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology, Wallingford (formerly 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 for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Department of the Environment (NI). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and the Northern Ireland Water Service.

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

Rainfall

Most rainfall data are provided by The Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of The Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS*. Recent figures have been produced by The Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. An initiative is underway with The Met Office to provide more accurate areal figures and, since October 1999, to include more raingauges in the analysis. A significant number of additional monthly rainfall totals are currently being provided by the Environment Agencies. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.

*MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

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Selected text and maps are available on the WWW at
http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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