Hydrological summary

for the United Kingdom

December 2002

General

December witnessed an increase in the exceptional rainfall deficiencies in north western Britain and notably high rainfall across much of southern Britain – contributing to the third wettest October-December on record for England and Wales (2000 was significantly wetter). Flood events were common, culminating in widespread floodplain inundations across much of southern Britain in early January – adding to the post-1997 cluster of notable floods. In some areas – including much of the Thames basin – river levels were the highest since the snowmelt-generated flooding of March 1947 but, helped by the relatively even distribution of the rainfall, residential flooding was modest. Flood drawdown releases were again required in some gravity-fed reservoirs but overall stocks for E&W remain very healthy. Groundwater levels in most major aquifers increased rapidly through the month with, latterly, evidence of groundwater flooding in a number of vulnerable areas across the Chalk outcrop. The cold, dry interlude in early January provided a very welcome respite but the high risk of both fluvial and, in some areas, groundwater flooding remains.

Rainfall

Apart from a calm interlude caused by an extension of a Scandinavian high pressure cell, the series of vigorous frontal systems – which had been a feature of the late autumn – continued through December. The favoured track of most frontal systems was across southern Britain, continuing the recent reversal of the normal rainfall gradient across the UK. December rainfall in parts of the South East was five times greater than in much of the western Highlands – where some localities reported less than 10% of the monthly average. The current wet phase began in the second week of October and a few southern areas reported >55% of average annual rainfall over the ensuing 12 weeks; totals of 50-100 mm over the final week triggered widespread flooding. For England and Wales, the Oct-Dec total ranks behind only 2000 and 1929 in a series from 1766. In the same timeframe the Highland Region received around half of the 1961-90 average rainfall – substantially below previous minima – extending a remarkable deficiency in western Scotland which began in the late summer. Such areas aside, rainfall totals for 2002 exceeded the 1961-90 average by a significant margin. Northern Ireland registered its wettest year in a record from 1900 and England & Wales recorded its third wettest year since 1927 (2000 was sig. wetter); the post-1997 period is the wettest 5-year sequence in the 237-year national rainfall series.

River flows

December was a month of stark regional runoff contrasts. Very low flows characterised many Highland catchments – with notably depressed winter minima in mid-month and new minimum December runoff established over wide areas. Across much of southern Britain flows were also in recession early in December but increased rapidly thereafter. From mid-month local flooding was very common and flood warnings increasingly frequent – by early January around 300 were in operation. On the 28/29th flooding occurred at many flood-prone localities (from Elvington in N.Yorks to Yalding in Kent) – heralding an outstanding runoff episode in early January. With catchments saturated, natural storage exhausted and – in many catchments – baseflow contributions increasing rapidly, the sustained post-Christmas rainfall triggered exceptionally extensive and protracted floodplain inundations. Early January flows in the Thames exceeded the 2000 peaks and, in the middle reaches, were the highest since 1947. Recent additions to flood defences (e.g. temporary flood barriers at Bewdley on the Severn, the Jubilee River flood relief channel) helped to moderate flood risk but bankfull flows were exceeded in many catchments. Locally, urban drainage systems were overwhelmed and landslips were common (with major impacts on road and rail transport e.g. at Redhill, Surrey). Exceptional month-end flows contributed to notably high December runoff totals for rivers in eastern and southern Britain (a new December maximum was established for the Essex Colne). By contrast the River Ewe established a new December minimum, and runoff for the last 5 months is >20% below the previous minimum.

Groundwater

Rainfall patterns again favoured the major aquifer outcrop areas during December. Monthly totals exceeded 150% of the 1961-90 average over wide areas. With soils saturated and evaporative demands modest, the rainfall was especially hydrologically effective. Some localities in the eastern Chalk registered over three times the average December infiltration. Except in the slowest responding deep wells, the abundant recharge triggered an acceleration in the seasonal recovery of groundwater levels. At Chilgrove (in the South Downs) levels have risen 35 metres from their 2002 minimum and closely approached the surface in early January; in parts of Dorset, levels exceeded those reported in late 2000. Spring outflows also increased briskly and water-tables reached the surface in some areas (e.g. the Chilterns), providing a foretaste of more widespread, and protracted, groundwater flooding if the winter continues to be wet. Early January levels across the Chalk were approaching seasonal maxima (Killyglen in NI is an exception), a situation mirrored in most limestone aquifer units. The very exceptional nature of recharge over the post-1998 period is well illustrated by levels in the Permo-Triassic sandstones where, at some index sites, (including Yew Tree Farm and Nuttalls Farm) levels have remained above pre-2000 maxima for the last three years.

CEH Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS 1835 British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Dec 2002	Oct 02-Dec 02	RP	Jul 02-Dec 02	RP	Apr 02-Dec 02	RP	Jan 02-Dec 02	RP
England & Wales	**mm**	**145**	**465**		**674**		**857**		**1109**	
	%	**153**	**169**	**120-170**	**137**	**30-45**	**125**	**15-25**	**121**	**10-20**
North West	mm	139	455		711		1016		1429	
	%	112	121	2-5	104	2-5	112	2-5	119	5-15
Northumbrian	mm	107	345		542		728		1000	
	%	131	142	10-20	117	5-10	114	5-10	117	5-15
Severn Trent	mm	107	341		511		671		878	
	%	139	161	30-50	129	10-20	118	5-10	116	5-10
Yorkshire	mm	127	366		613		763		984	
	%	153	155	30-40	140	30-40	124	10-20	120	10-20
Anglian	mm	99	292		468		590		724	
	%	180	178	120-170	148	50-80	128	15-25	121	10-20
Thames	mm	122	366		510		685		883	
	%	174	186	120-170	140	20-30	131	15-25	128	20-30
Southern	mm	153	425		576		756		980	
	%	186	172	50-80	137	15-25	130	15-25	126	15-25
Wessex	mm	123	465		614		809		1066	
	%	132	182	110-150	138	20-30	131	20-30	127	20-30
South West	mm	174	567		716		973		1365	
	%	125	149	15-25	114	2-5	116	5-10	116	5-10
Welsh	mm	172	603		784		1088		1530	
	%	112	140	10-20	108	2-5	113	2-5	117	5-10
Scotland	**mm**	**69**	**398**		**658**		**983**		**1549**	
	%	**45**	**87**	**2-5**	**81**	**5-15**	**93**	**2-5**	**108**	**2-5**
Highland	mm	40	322		577		913		1624	
	%	20	54	50-80	58	>200	71	60-90	92	2-5
North East	mm	81	449		723		915		1201	
	%	87	155	50-80	135	30-45	125	20-30	123	30-40
Tay	mm	91	460		725		1054		1589	
	%	71	122	5-10	109	2-5	120	5-15	129	40-60
Forth	mm	70	390		639		944		1384	
	%	63	116	2-5	104	2-5	115	5-10	125	30-40
Tweed	mm	92	389		612		842		1204	
	%	99	139	10-20	115	5-10	116	5-10	124	20-30
Solway	mm	115	551		829		1242		1786	
	%	78	123	5-10	104	2-5	119	5-15	126	30-45
Clyde	mm	67	449		736		1165		1862	
	%	38	81	2-5	76	10-20	94	2-5	110	2-5
Northern Ireland	**mm**	**85**	**451**		**651**		**997**		**1349**	
	%	**82**	**141**	**10-20**	**113**	**2-5**	**128**	**20-30**	**127**	**30-40**

RP = Return period

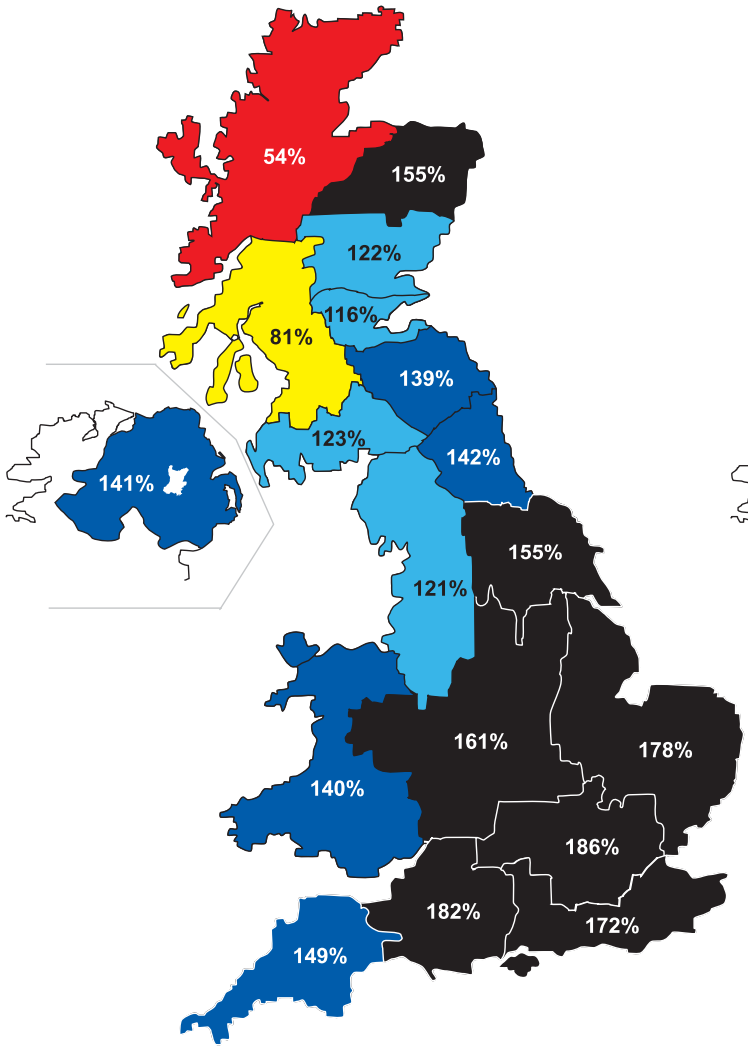
 All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used 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.

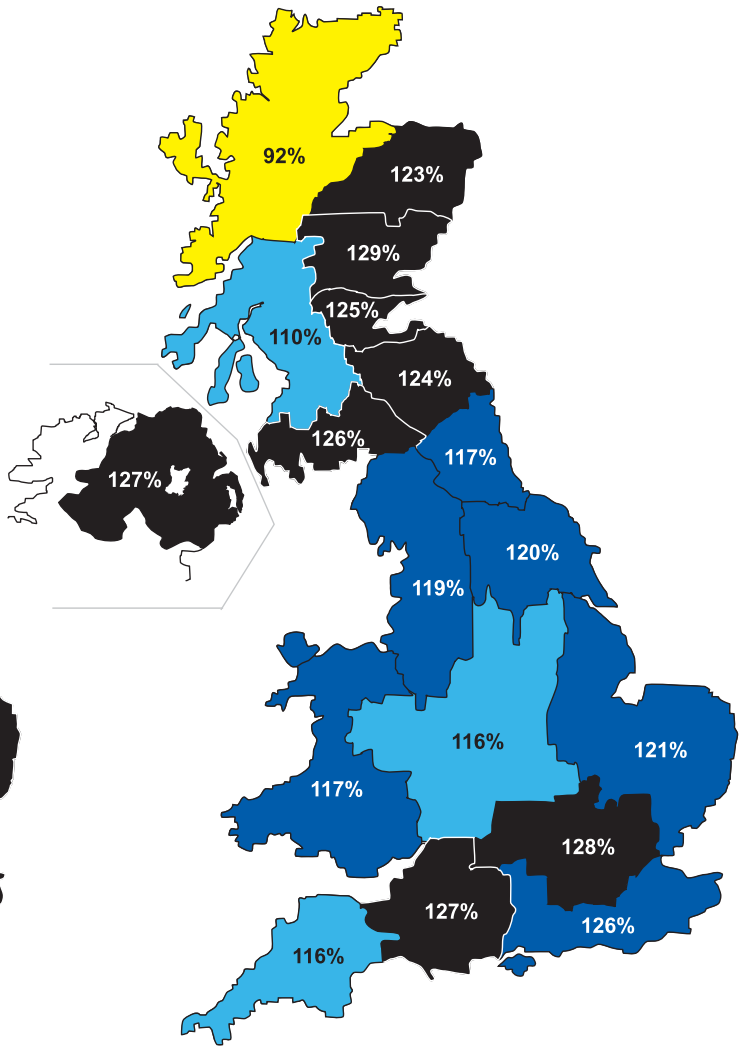
Rainfall . . . Rainfall . .

Key

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



October 2002 - December 2002

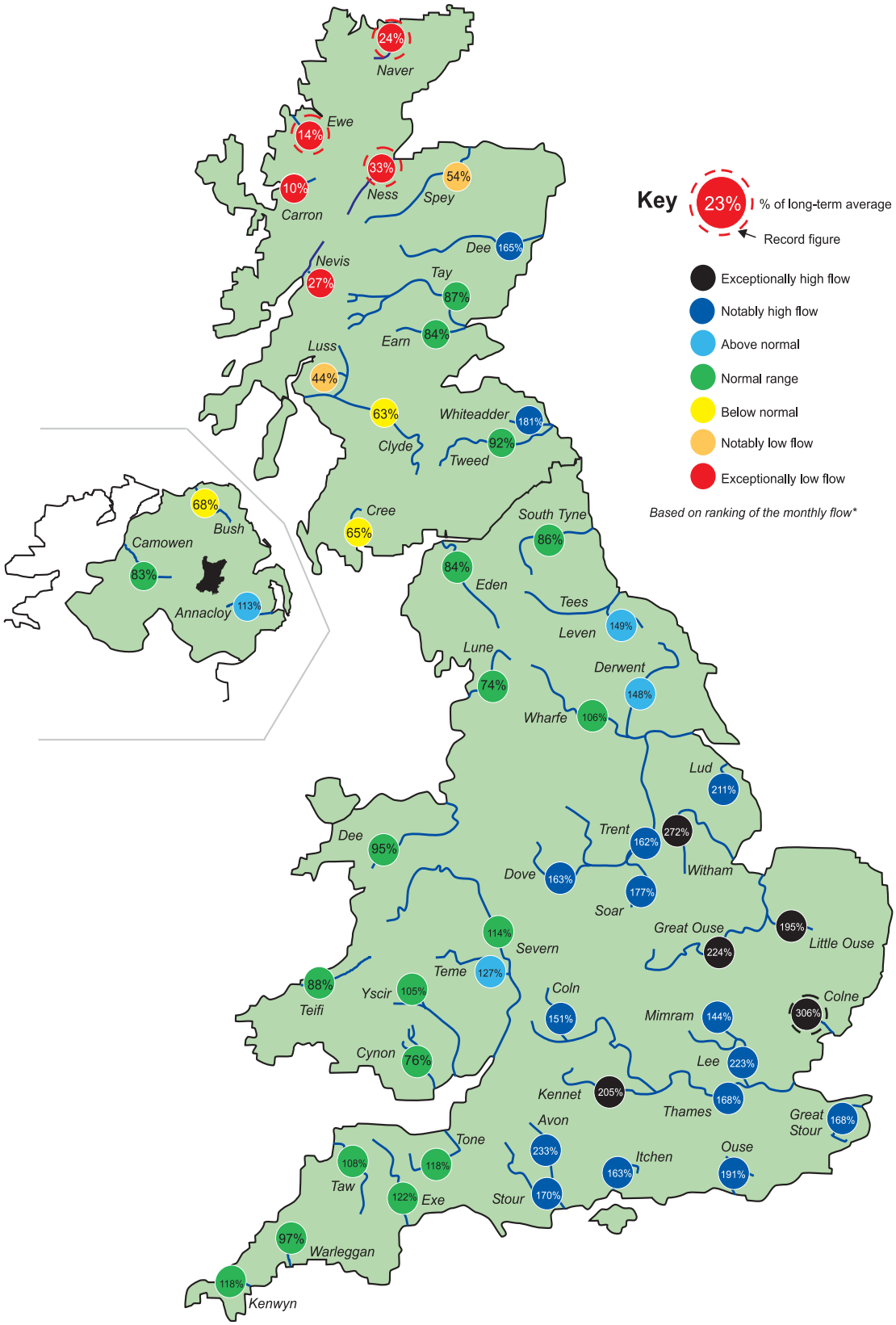


January 2002 - December 2002

Rainfall accumulation maps

For the sixth time in the last seven years the October-December rainfall was above average for England and Wales. All regions were relatively wet - the Anglian and Thames regions notably so. For 2002 as a whole the UK rainfall was well above average in all regions apart from the Highland Region, where rainfall since July 2002 has beeen remarkably low.

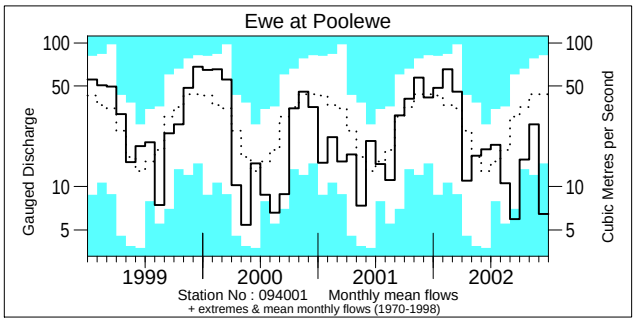
River flow . . . River flow . . .

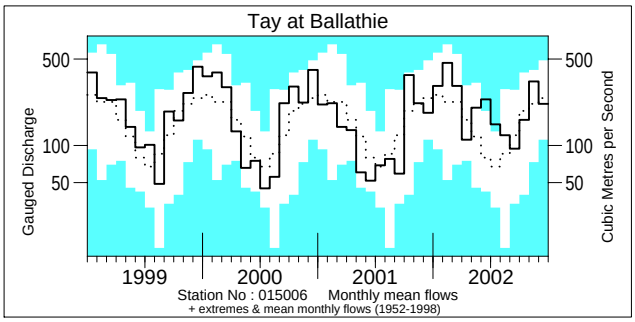


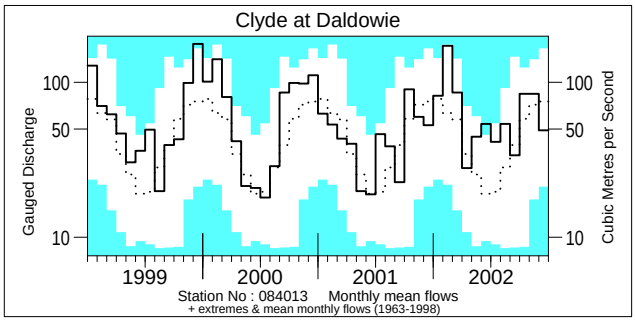
River flows - December 2002

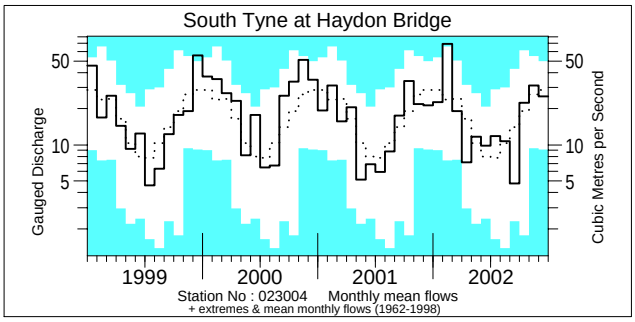
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

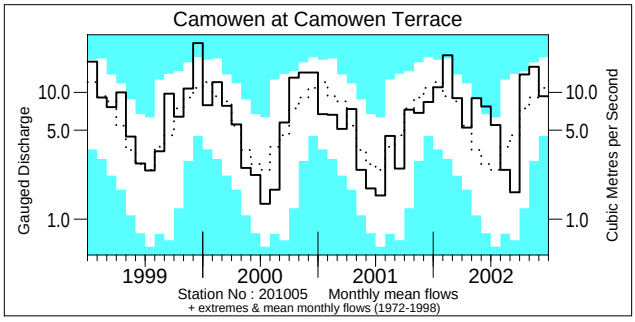
River flow . . . River flow . . .

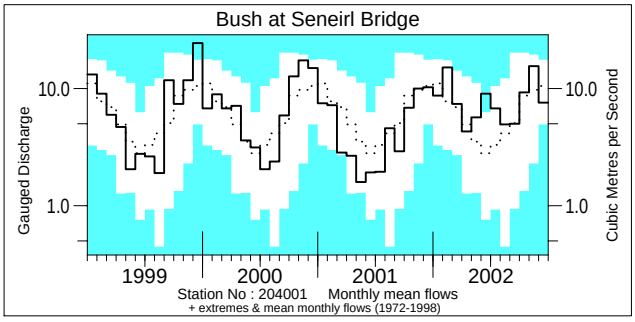


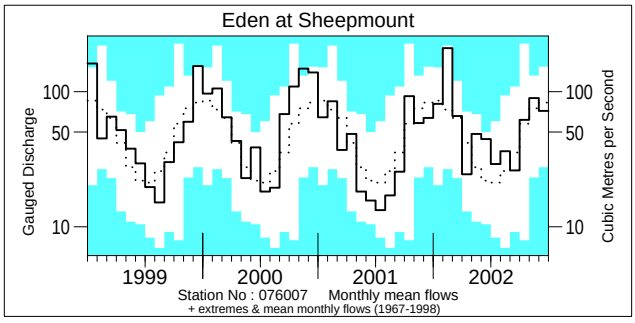


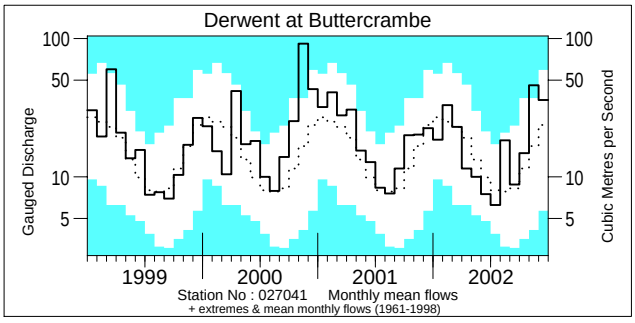


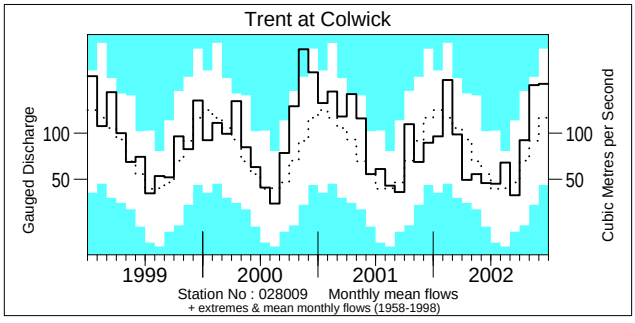


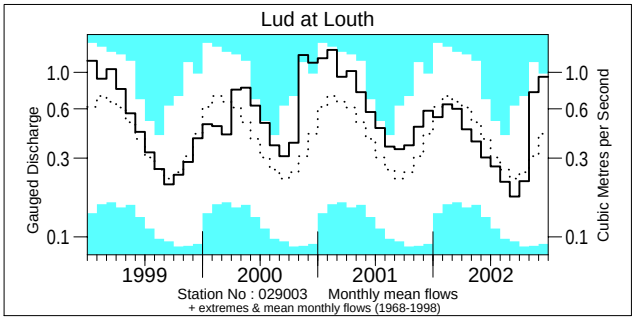








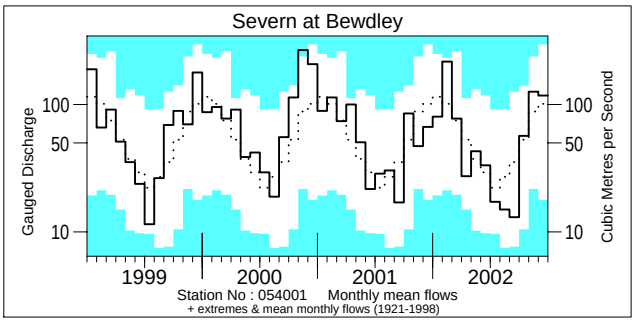


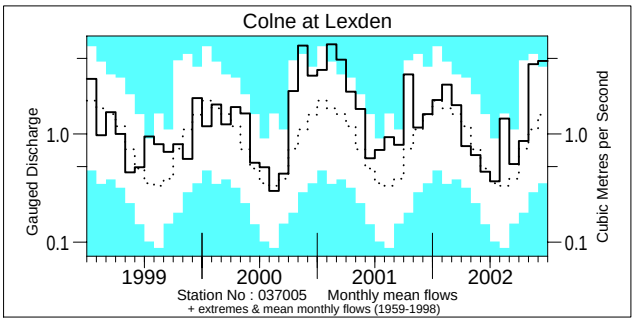


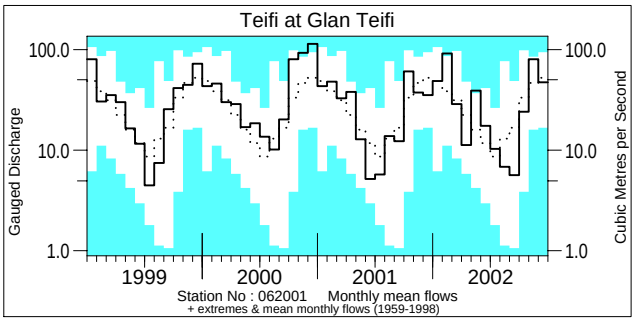
Monthly river flow hydrographs

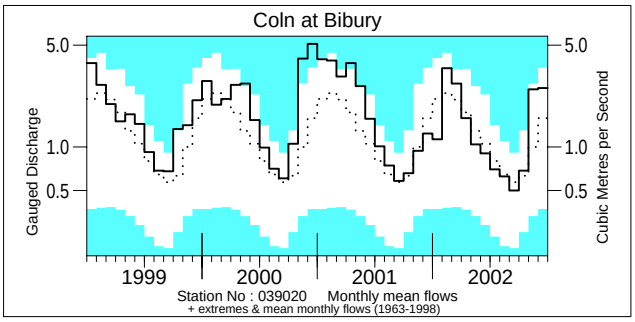
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1999 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

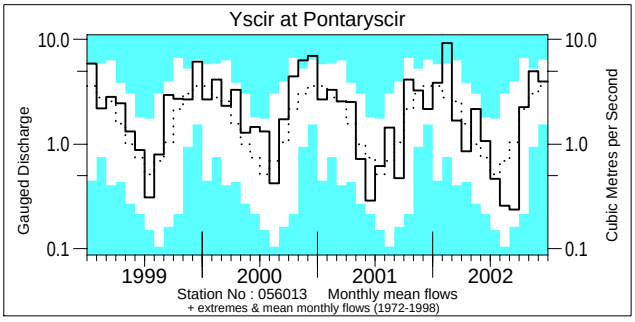
River flow . . . River flow . . .

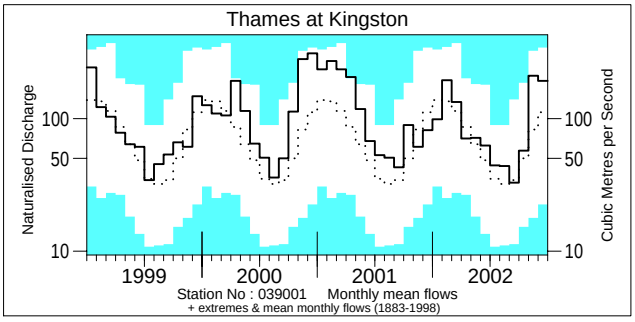


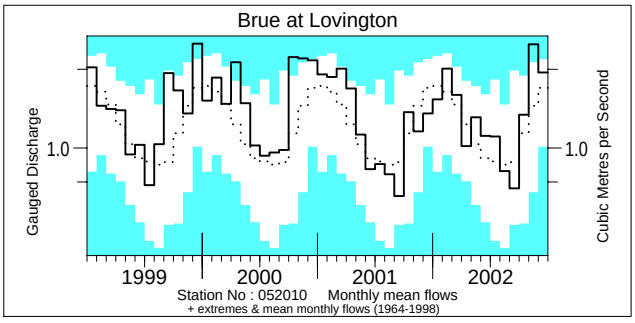


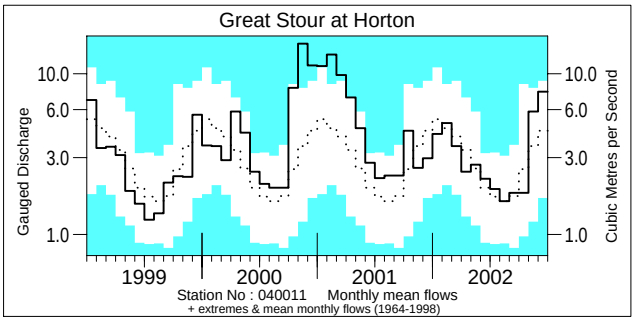


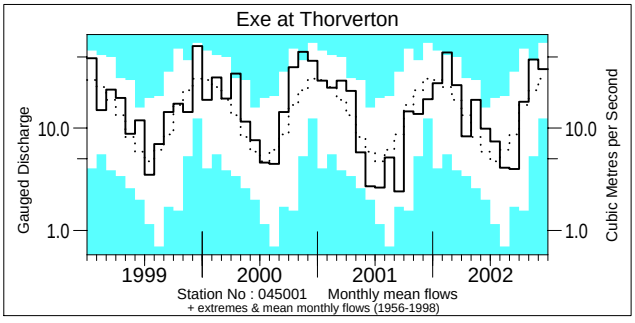


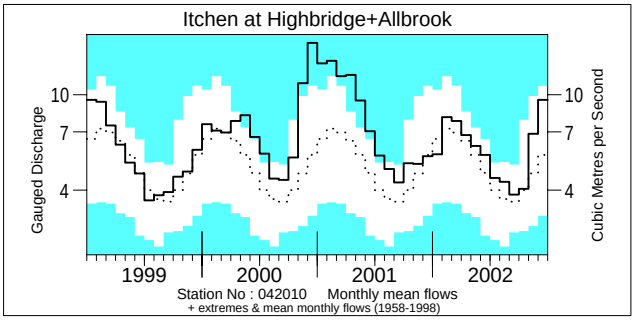












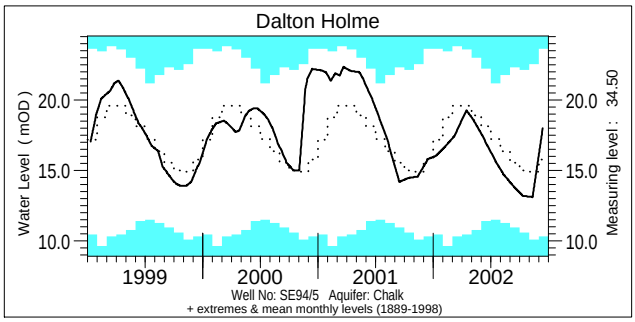
Notable runoff accumulations (a) October 2002 – December 2002, (b) January 2002 – December 2002

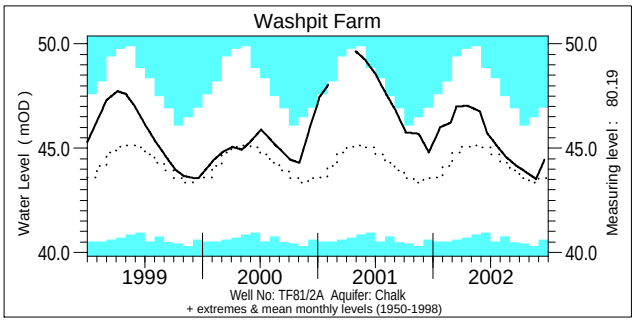
	River	%lta	Rank	River	%lta	Rank
a)	Ness	55	2/30	Piddle	207	39/40
	Deveron	212	42/42	Otter	188	40/41
	Dee	202	30/30	Brue	191	36/37
	Tyne (Lothian)	198	37/38	Nevis	53	1/21
	Whiteadder	249	34/34	Carron	34	1/24
	Torne	217	31/32	Ewe	39	1/32
	Stringside	258	37/37	Annacloy	210	23/23
	Kennet	192	41/42			
	Wilts. Avon	229	37/38			

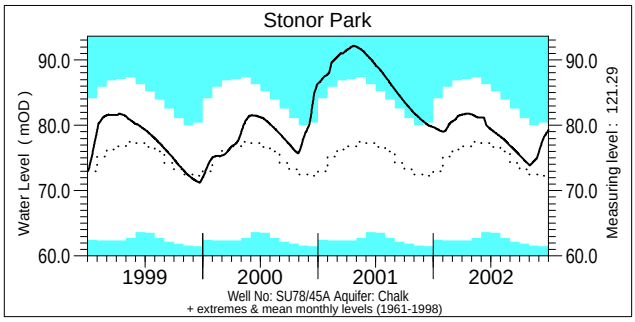
	River	%lta	Rank
b)	Tay	132	50/50
	Earn	141	55/55
	Tweed	129	41/42
	Lymington	172	39/40
	Stour (Dorset)	136	29/30
	Eden	125	34/35
	Clyde	137	38/39
	Camowen	133	28/28

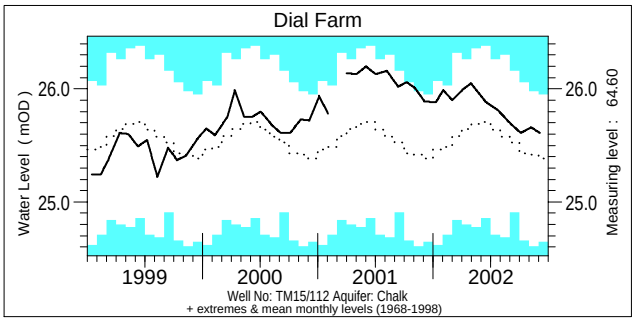
lta = long term average
Rank 1 = lowest on record

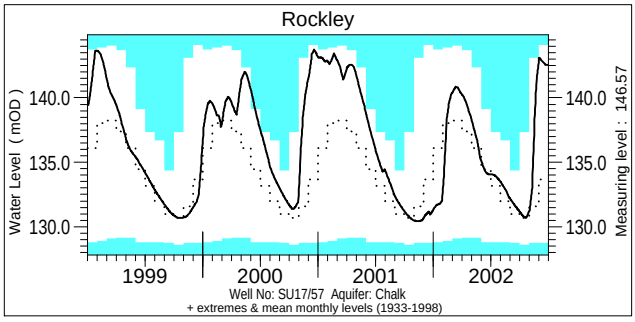
Groundwater . . . Groundwater

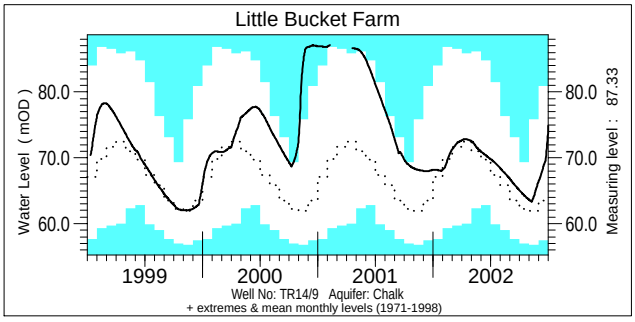


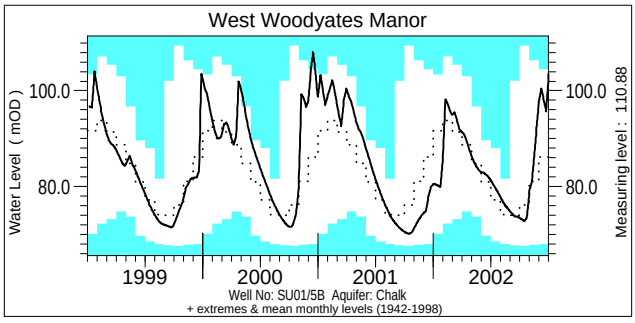


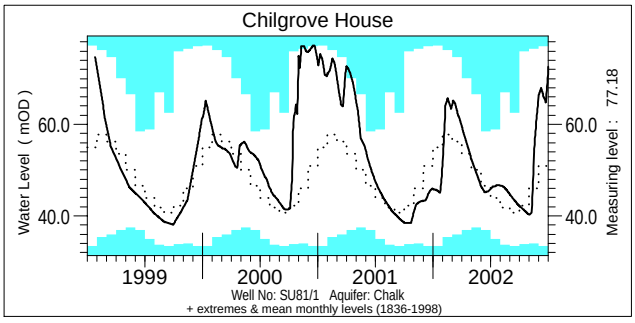


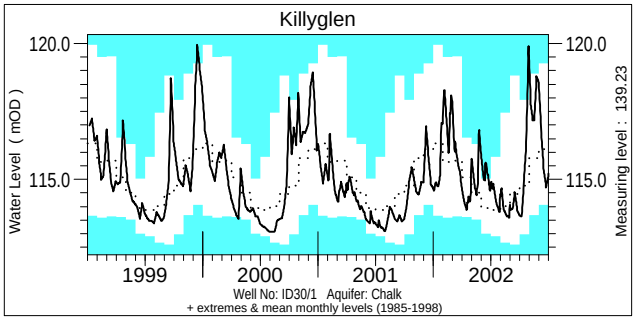


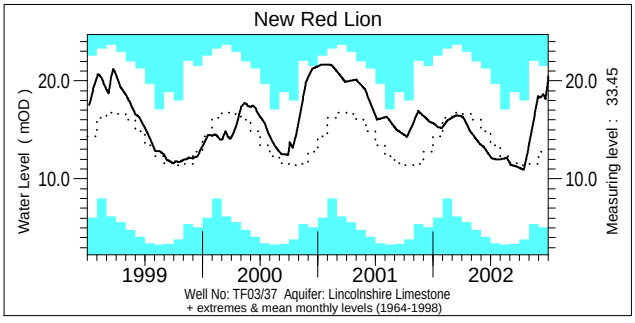






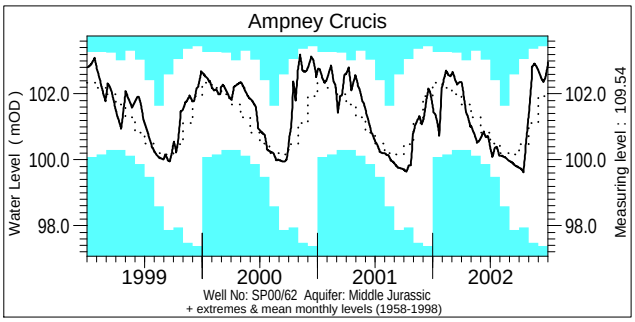


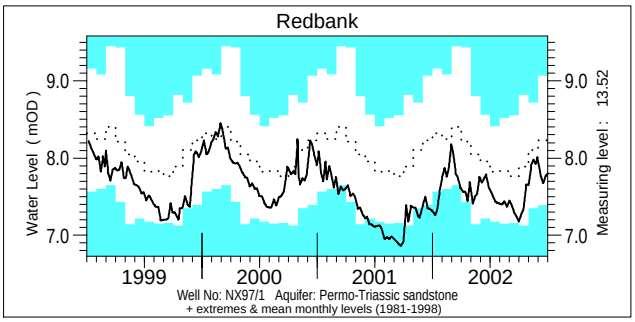


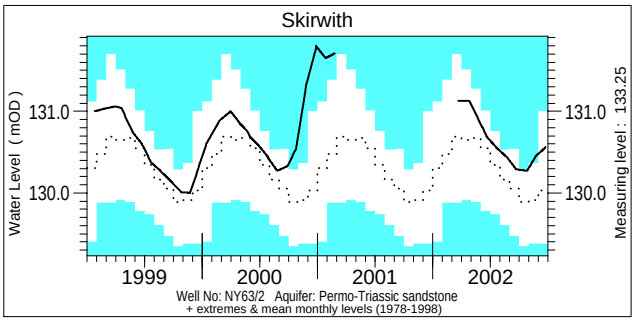


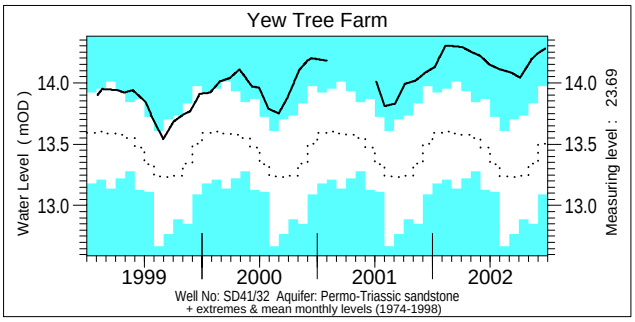
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

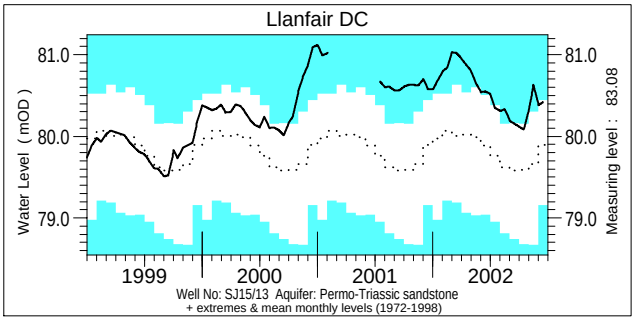
Groundwater . . . Groundwater

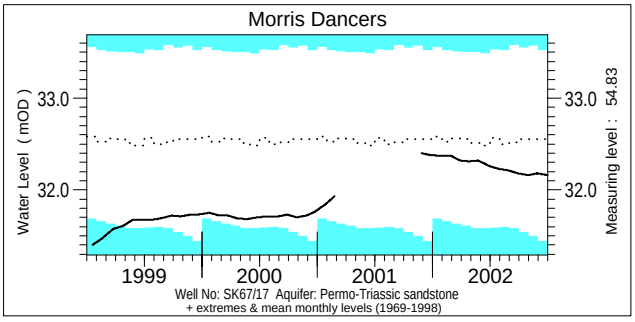


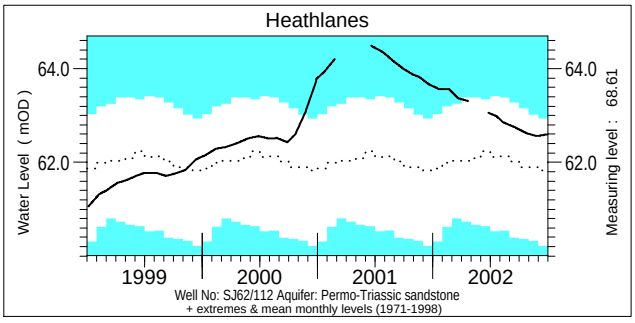


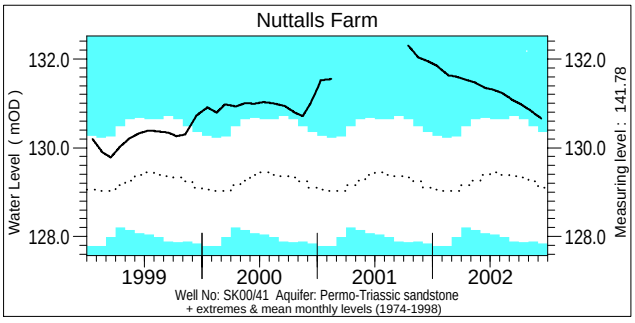


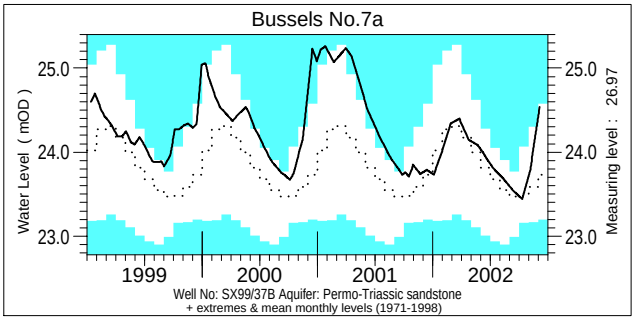


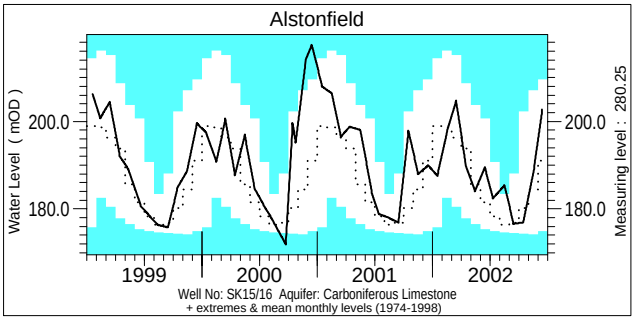










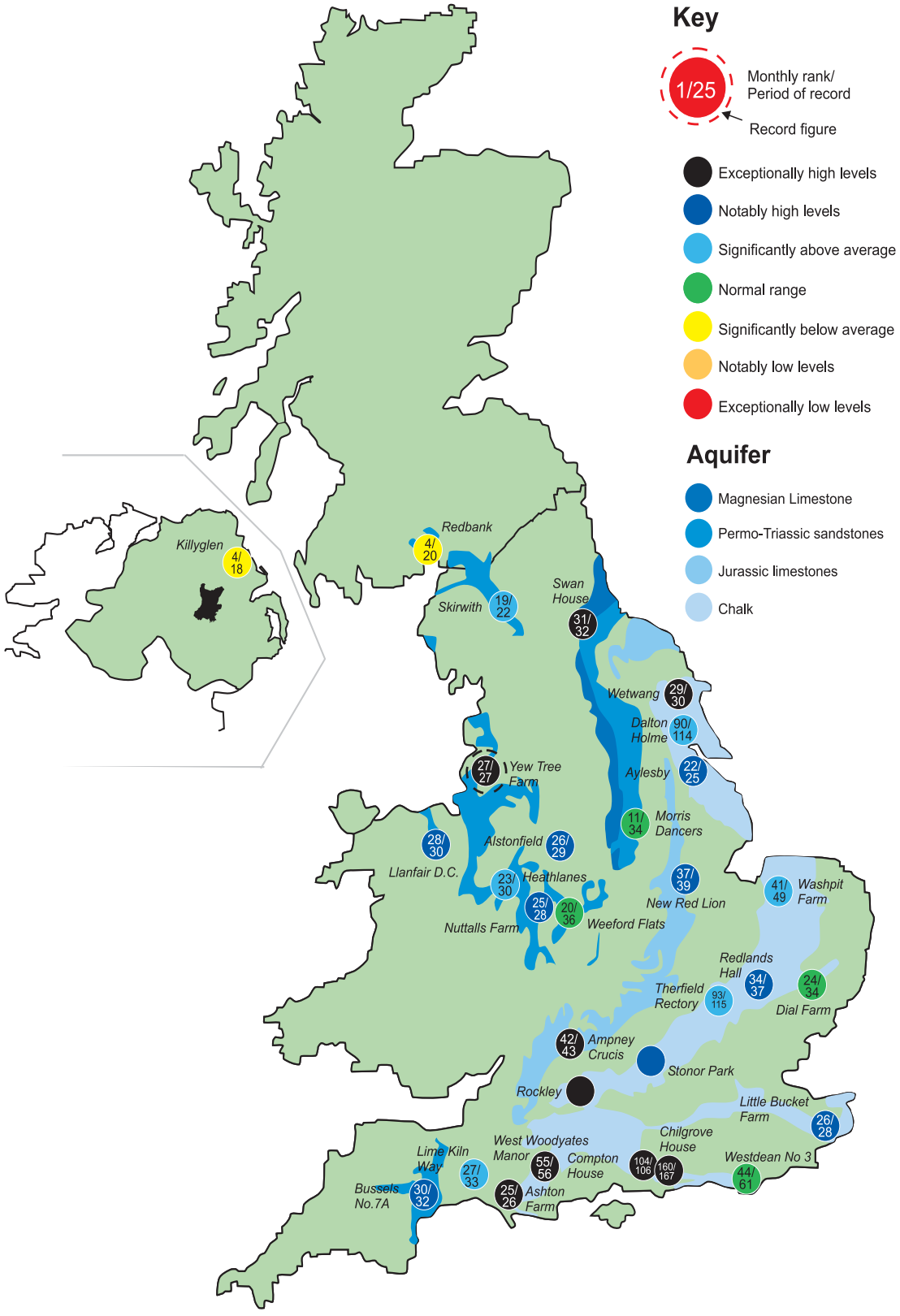


Groundwater levels December 2002 / January 2003

Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.
Dalton Holme	18.02	12/12	15.59	Chilgrove House	72.61	31/12	51.93	Llanfair DC	80.42	15/12	79.85
Washpit Farm	44.44	18/12	43.33	Killyglen	115.21	31/12	116.31	Morris Dancers	32.16	30/12	32.40
Stonor Park	84.02	06/01	72.75	New Red Lion	20.45	31/12	12.79	Heathlanes	62.60	30/12	61.92
Dial Farm	25.61	04/12	25.41	Ampney Crucis	103.13	06/01	101.90	Nuttalls Farm	130.66	10/12	129.44
Rockley	144.25	13/01	133.73	Redbank	7.71	08/01	8.16	Bussels No.7a	24.54	04/12	23.83
Little Bucket Farm	80.93	05/01	64.79	Skirwith	130.56	23/12	130.23	Alstonfield	202.79	13/12	192.55
West Woodyates	103.52	31/12	86.72	Yew Tree Farm	14.28	23/12	13.55				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



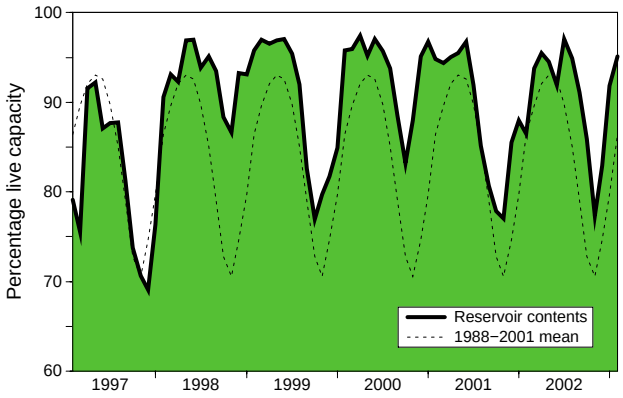
Groundwater levels - December 2002

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.

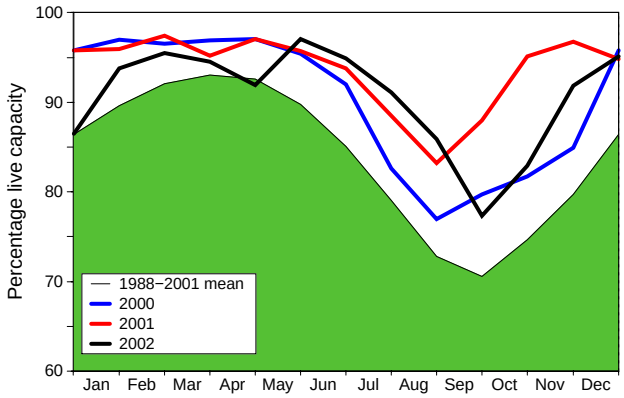
(Note: Redbank is affected by groundwater abstraction.)

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.

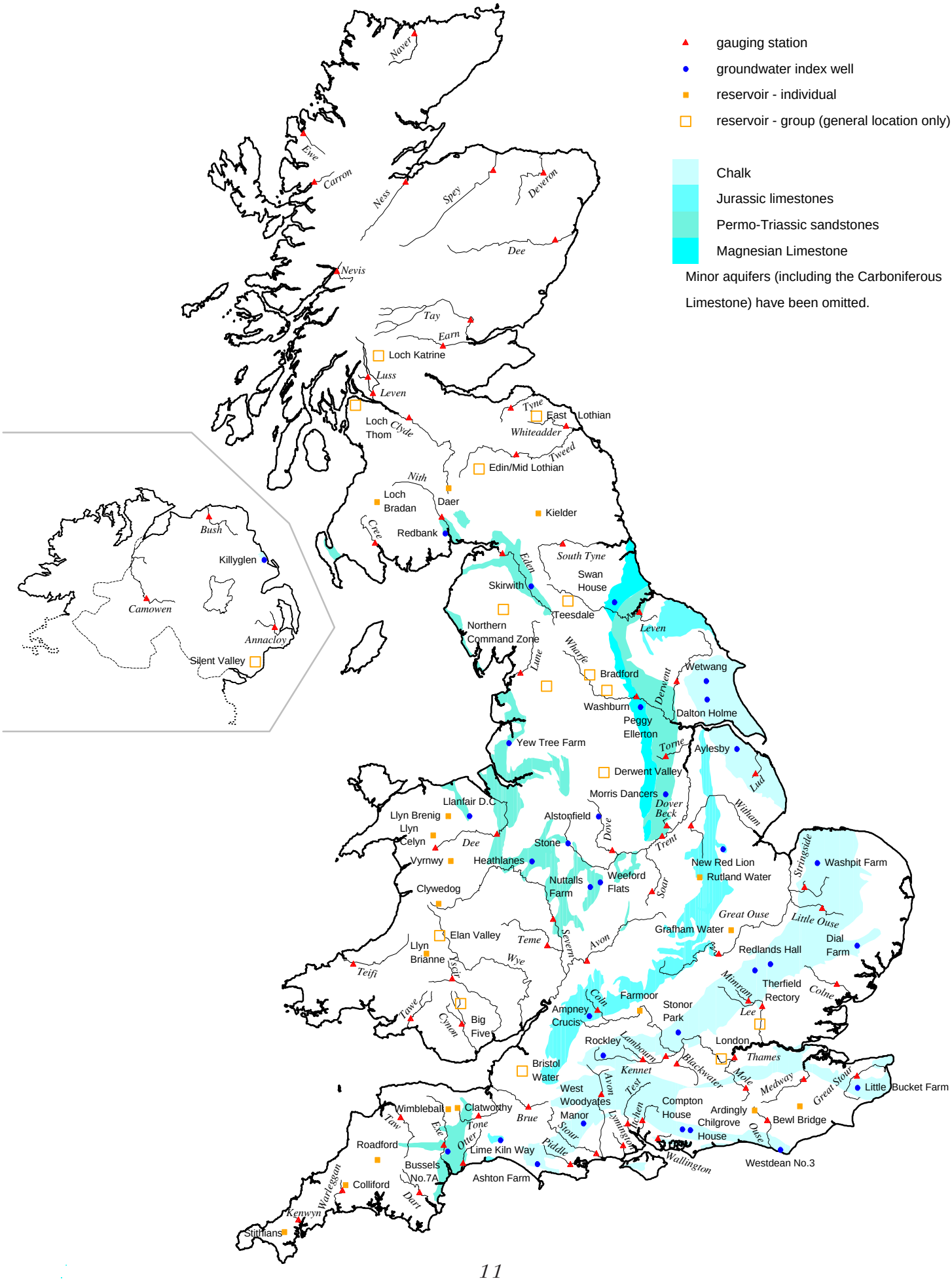
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2002 Aug	Sep	Oct	Nov	Dec	2003 Jan	Min. Jan	Year* of min
North West	N Command Zone	• 124929	88	78	68	66	79	**86**	51	1996
	Vyrnwy	55146	90	77	62	86	99	**99**	35	1996
Northumbrian	Teesdale	• 87936	88	87	77	89	92	**93**	41	1996
	Kielder	(199175)	(90)	(91)	(86)	(94)	(90)	**(99)**	(70)	1990
Severn Trent	Clywedog	44922	92	85	71	86	78	**88**	54	1996
	Derwent Valley	• 39525	80	84	78	95	99	**100**	10	1996
Yorkshire	Washburn	• 22035	81	84	75	89	90	**99**	23	1996
	Bradford supply	• 41407	93	92	83	95	100	**100**	22	1996
Anglian	Grafham	(55490)	(95)	(94)	(89)	(88)	(90)	**(89)**	(57)	1998
	Rutland	(116580)	(90)	(88)	(85)	(89)	(94)	**(93)**	(60)	1991
Thames	London	• 202340	94	92	81	84	96	**97**	60	1991
	Farmoor	• 13830	95	95	91	83	94	**91**	71	1991
Southern	Bewl	28170	89	85	78	73	80	**86**	38	1991
	Ardingly	4685	99	98	92	88	100	**100**	61	1990
Wessex	Clatworthy	5364	91	76	62	73	100	**100**	59	1989
	Bristol WW	• (38666)	(89)	(78)	(71)	(78)	(93)	**(99)**	(40)	1991
South West	Colliford	28540	80	74	63	63	71	**78**	46	1996
	Roadford	34500	97	90	83	82	91	**95**	23	1996
	Wimbleball	21320	94	86	73	80	98	**100**	46	1996
	Stithians	5205	76	68	54	55	84	**100**	33	2002
Welsh	Celyn and Brenig	• 131155	98	93	88	90	94	**96**	54	1996
	Brianne	62140	96	89	80	83	98	**99**	76	1996
	Big Five	• 69762	89	69	53	62	89	**96**	67	1996
	Elan Valley	• 99106	90	75	64	68	100	**100**	56	1996
East of Scotland	Edinburgh/Mid Lothian	• 97639	94	92	88	89	94	**95**	60	1999
	East Lothian	• 10206	89	96	92	100	99	**99**	48	1990
West of Scotland	Loch Katrine	• 111363	96	83	74	77	88	**89**	80	1996
	Daer	22412	99	97	94	100	100	**100**	83	1996
	Loch Thom	• 11840	95	94	87	100	100	**100**	93	2002
Northern Ireland	Silent Valley	• 20634	81	79	69	93	100	**98**	39	2002

() figures in parentheses relate to gross storage • denotes reservoir groups * 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 1988-2002 period only (except for West of Scotland and Northern Ireland where data commence in 1994 and 1993 respectively). 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 regional divisions of the EA (England and Wales) and SEPA (Scotland), data for Northern Ireland are provided by 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 (address 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; over the coming months further monthly raingauge totals will be included for selected regions. Until the access to these additional data has stabilised the regional figures (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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Bracknell
RG12 2SY
Tel.: 01344 856849
Fax: 01344 854906

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:

Hydrological Summaries
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
Tel.: 01491 838800
Fax: 01491 692424

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

NATURAL ENVIRONMENT RESEARCH COUNCIL

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