Hydrological Summary
for the United Kingdom

November 2003

General

November was a mild month with large spatial variations in rainfall. The South East was exceptionally wet but drought severity increased across large areas of the Midlands and northern Britain where November rainfall was below average. Nationwide, regional rainfall deficiencies remain large but the drought is less spatially coherent than early in the autumn. Most regions saw modest but important increases in reservoir levels during November. Overall stocks for E&W now exceed those of early December 1995 - but remain around 20% below the early-winter average with some reservoirs particularly low (e.g. Kielder, Ardingly). Stocks are low in Scotland and Northern Ireland also. River flows picked up smartly in late November and significant groundwater recharge has begun in some areas. Generally, groundwater resource prospects have improved significantly – appreciable infiltration in December is expected across most outcrop areas. However, temporary drought-breaks are relatively common in the UK and the episodic nature of the 2003 drought may continue. Water resources prospects for summer 2004 will be heavily dependant on rainfall over the next three months; a wet spring – postponing the seasonal onset of runoff and recharge recessions – would be very beneficial.

Rainfall

High pressure continued to dominate synoptic patterns in the first half of November - increasing rainfall deficiencies across the country. Cyclonic conditions returned during the third week and one particularly slow-moving system generated rainfall totals of 40-80 mm across much of the South-East (Wisley, Surrey registered 95 mm in 96 hrs; some localities reported more rainfall than over the preceding three months). The, mostly moderate intensity, rainfall was very effective in reducing soil moisture deficits. Further rainfall over the following weekend contributed to November totals of twice the average in parts of the South-East. Well above average rainfall characterised parts of SW Scotland also. By contrast, rainfall was only 50-70% across the north Midlands and parts of the North East. Importantly, this was also true of some reservoir gathering grounds (e.g. in the Pennines, and in the South-West where the highest rainfall favoured coastal locations). Regional variability was large but the UK rainfall total was marginally above the November average. Nonetheless, the provisional Feb-Nov totals for E&W and Scotland rank third driest (after 1921 and 1959) in the last 116 years, and the lowest since 1955 respectively. Accumulated rainfall deficiencies exceed 20% in most regions of the UK. The drought remains very extensive but the November rainfall has changed its focus – the most severe deficiencies (over 10 months) are now found in northern England and eastern Scotland but within-region variations are also significant; severe drought conditions characterise parts of the Midlands for instance.

River flows

Despite some moderate spates triggered by late-October rainfall, mid-November daily flows were very depressed across most of the UK. Minimum November flows were closely approached in many rivers, and eclipsed in a few (including the Tay, in a 52-year record). Thereafter, recoveries were evident in most catchments – but their magnitude varied greatly. In the South-East, the Mimram peaked at its highest instantaneous November flow; localised flooding and Flood Watches were common in the English Lowlands. (The co-existence of ongoing drought conditions and significant flood risk is not especially rare during the late autumn). Notable spates were more widespread in Scotland where the Cree registered a new November max. flow on the 29th. Despite this very welcome upturn, November runoff totals were substantially below average in almost all index catchments; the Teme reported a new minimum runoff for November and some index rivers reported their 9th successive month with below average runoff. Correspondingly, the drought's severity (and the decline in water resources) is well captured in the runoff accumulations since January: the Spey, South Tyne, Exe and Yscir are amongst those river establishing new minimum 10-month runoff totals for *any* start month.

Groundwater

The 10 days beginning on the 21st witnessed a dramatic decline in soil moisture deficits over many aquifer outcrops, allowing infiltration to recommence in some areas where water-tables are most depressed (the southern Chalk especially). But soils remain seasonally very dry across parts of the Midlands, Yorkshire and East Anglia (coastal areas of NE Britain also). The full effect of the late-November infiltration has yet to register on the groundwater hydrographs but upturns, from a very low base, were recorded at index wells in the Jurassic Limestone, Magnesian Limestone and in the south-western Chalk. However, recessions continue across much of the Chalk - at Chilgrove, late November levels were the 3rd lowest in a continuous series from 1836. The degree of water-table depression is more modest to the north but, generally, levels in the Chalk are below any recorded since 1996 or 1997. This is also true of the more responsive Permo-Triassic outcrops but levels remain very healthy in over large areas, although spatial variations are large reflecting differing recharge patterns and aquifer characteristics. Overall groundwater resources are significantly healthier than at the same time in 1995 and 1996 – a reflection of the health of groundwater resources at the onset of the 2003 drought. Above average rainfall is now needed to generate a sustained recovery in levels through the winter.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Nov 2003	Aug 03-Nov 03	RP	Jun 03-Nov 03	RP	Feb 03-Nov 03	RP	Dec 02-Nov 03	RP
England & Wales	**mm**	**117**	**241**		**389**		**579**		**817**	
	%	**125**	**72**	**5-15**	**84**	**5-10**	**80**	**10-20**	**90**	**2-5**
North West	mm	109	265		427		719		956	
	%	89	56	35-50	67	30-40	75	20-30	79	10-20
Northumbrian	mm	59	177		293		461		654	
	%	68	56	35-50	66	30-40	67	70-100	77	20-30
Severn Trent	mm	54	150		275		443		611	
	%	75	56	30-40	73	10-20	73	20-30	81	5-15
Yorkshire	mm	62	185		329		513		709	
	%	77	63	15-25	79	5-10	78	10-20	86	5-10
Anglian	mm	72	144		276		394		563	
	%	125	68	10-20	88	2-5	80	5-15	94	2-5
Thames	mm	111	178		277		410		611	
	%	171	73	5-10	79	5-10	74	10-20	89	2-5
Southern	mm	139	227		320		458		696	
	%	164	78	2-5	81	5-10	74	10-20	89	2-5
Wessex	mm	113	196		321		491		701	
	%	137	65	5-15	79	5-10	75	10-20	84	5-10
South West	mm	108	254		435		699		973	
	%	86	61	15-25	78	5-10	78	10-20	83	5-10
Welsh	mm	129	303		480		797		1083	
	%	91	61	20-30	74	10-20	78	10-20	82	5-15
Scotland	**mm**	**157**	**362**		**517**		**855**		**1091**	
	%	**104**	**64**	**35-50**	**69**	**40-60**	**75**	**40-60**	**76**	**60-90**
Highland	mm	174	447		612		1033		1302	
	%	86	64	30-40	68	35-50	75	35-50	74	70-100
North East	mm	78	233		311		528		723	
	%	79	63	30-40	61	110-150	68	120-170	74	50-80
Tay	mm	147	261		398		697		916	
	%	122	57	35-50	65	30-45	73	30-40	74	30-45
Forth	mm	110	244		386		630		813	
	%	98	57	40-60	67	30-45	72	40-60	73	50-80
Tweed	mm	81	200		319		536		730	
	%	87	55	50-80	63	40-60	69	60-90	75	30-45
Solway	mm	195	355		536		880		1125	
	%	136	63	20-30	73	10-20	79	10-20	79	15-25
Clyde	mm	219	447		661		1055		1292	
	%	121	65	20-30	74	10-20	79	10-20	76	30-50
Northern Ireland	**mm**	**120**	**262**		**434**		**720**		**897**	
	%	**116**	**65**	**10-20**	**80**	**5-10**	**85**	**5-10**	**85**	**5-10**

RP = Return period

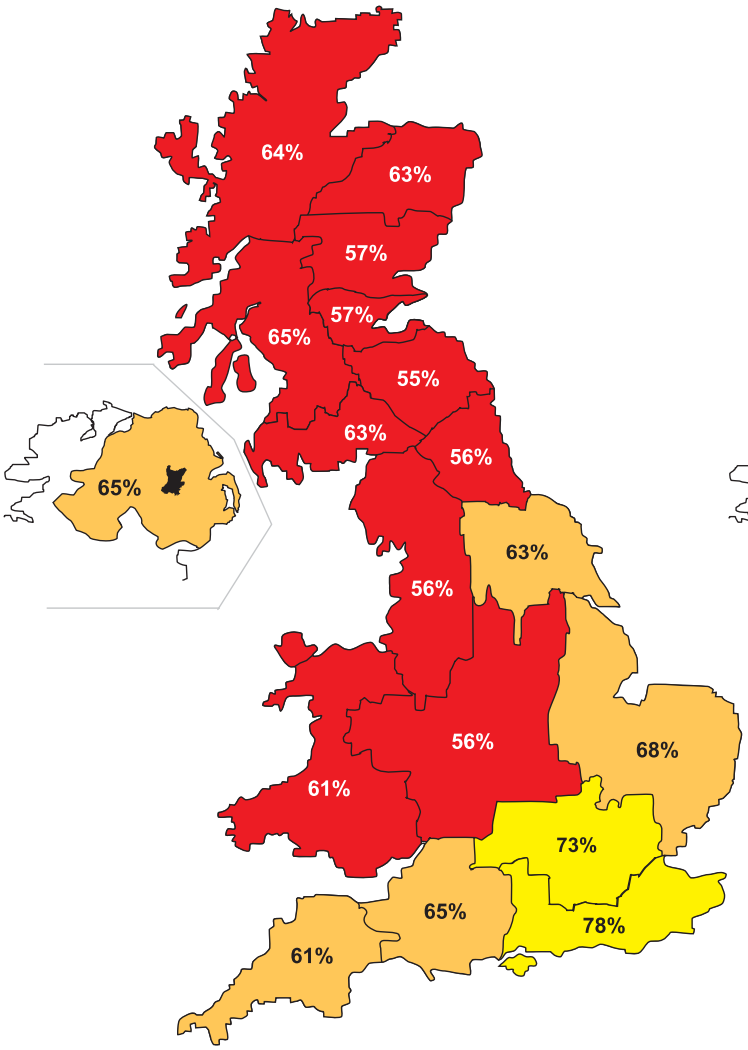
 All monthly totals since December 1998 are provisional (see page 12). The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used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

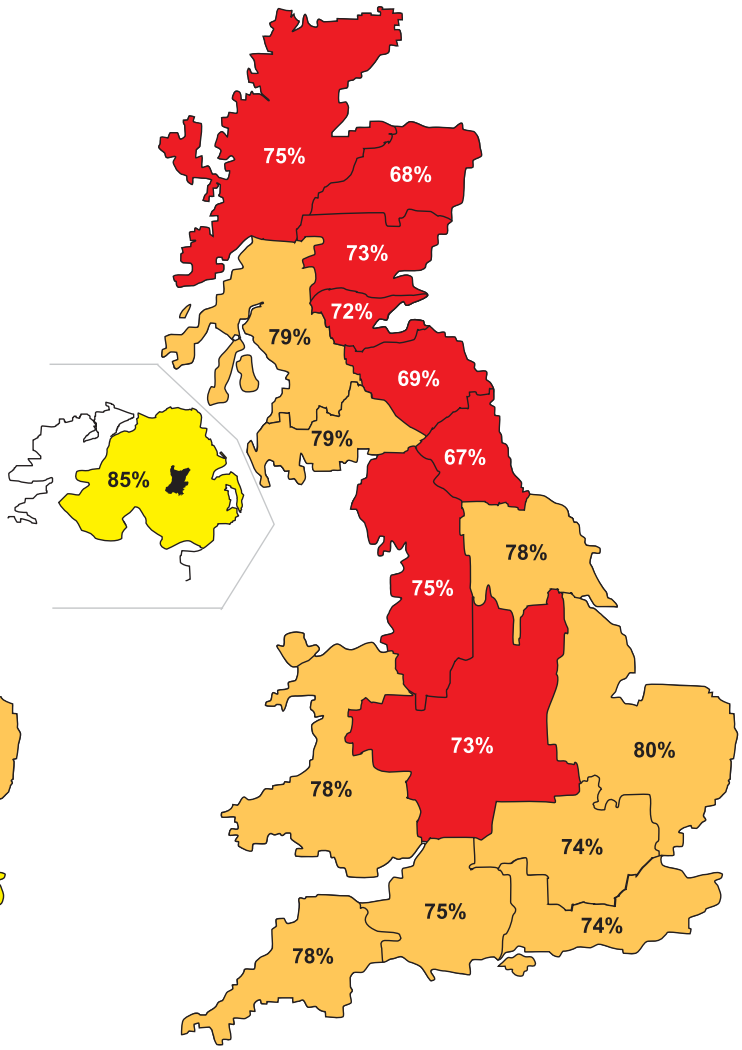
Rainfall . . . Rainfall . .

Key

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



August 2003 - November 2003

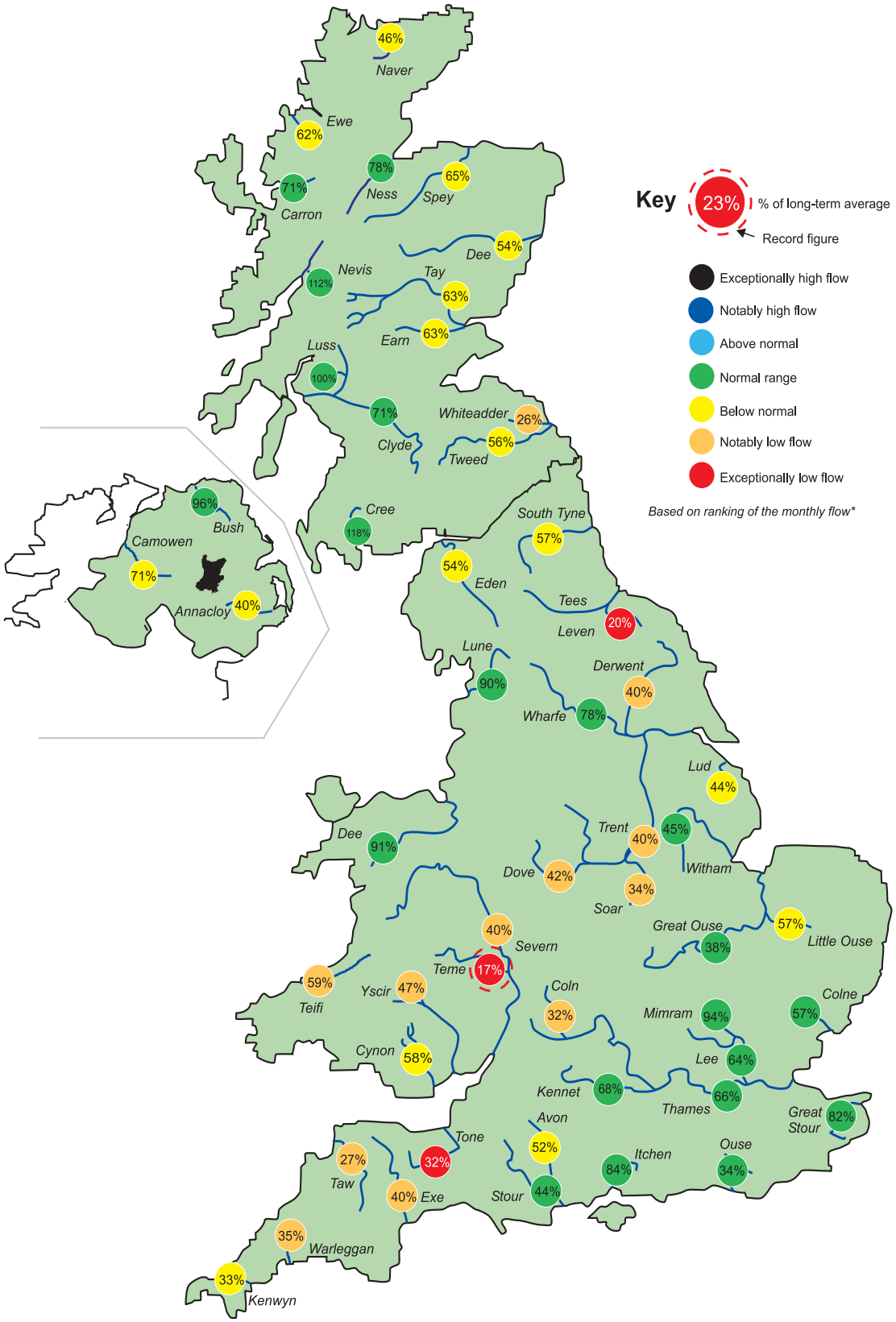


February 2003 - November 2003

Rainfall accumulation maps

Across the UK, several phases may be recognised in the 2003 drought. Generally, the most severe regional rainfall deficiencies are for timespans of four and ten months. Despite November's modest moderation in drought intensity, the August-November rainfall total for Great Britain was the 4th lowest in a record from 1869; the same ranking applies to the February-November rainfall (1921 was significantly drier) but the return periods associated with the 10-month deficiencies tend to be greater.

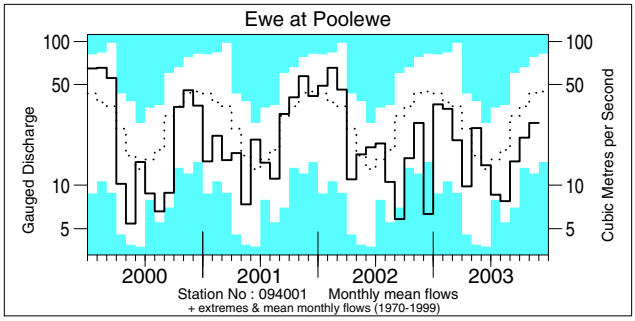
River flow . . . River flow . . .

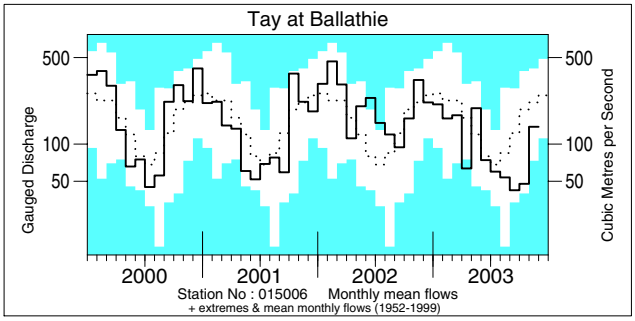


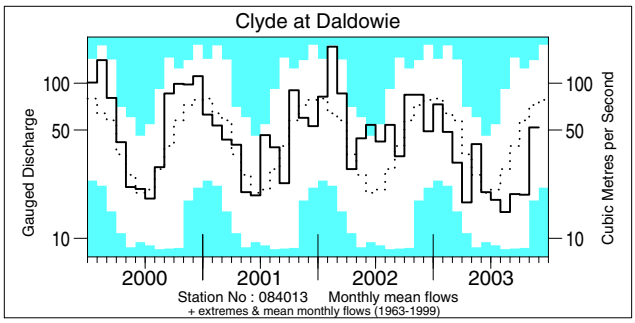
River flows - November 2003

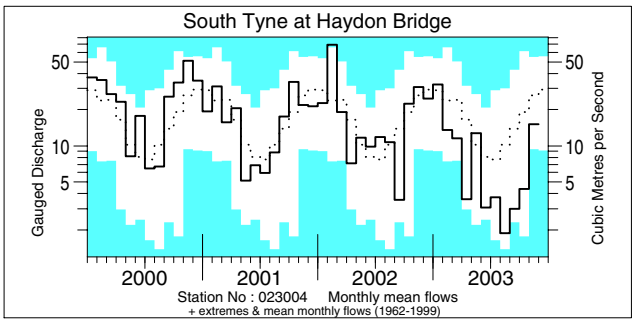
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

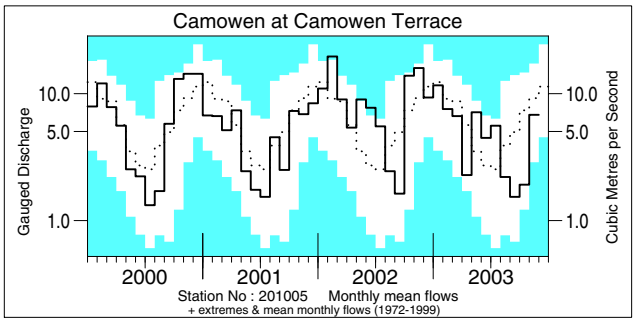
River flow . . . River flow . . .

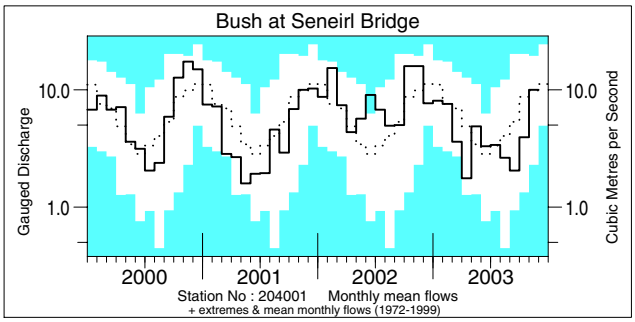


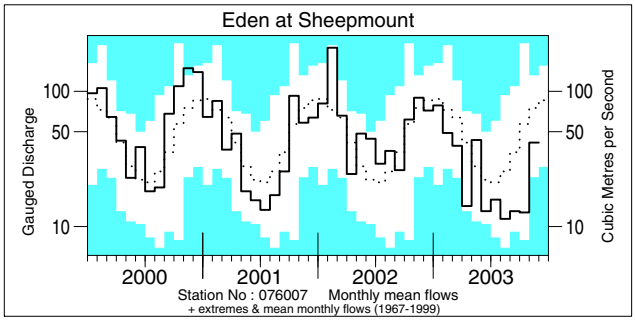


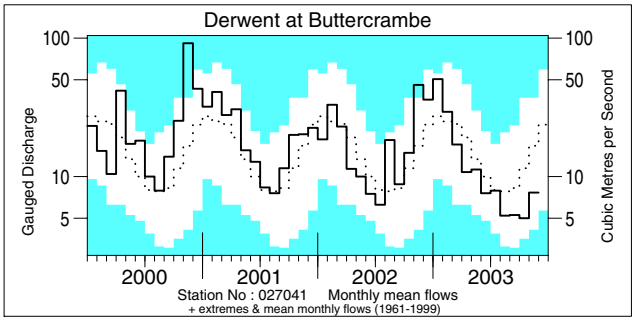


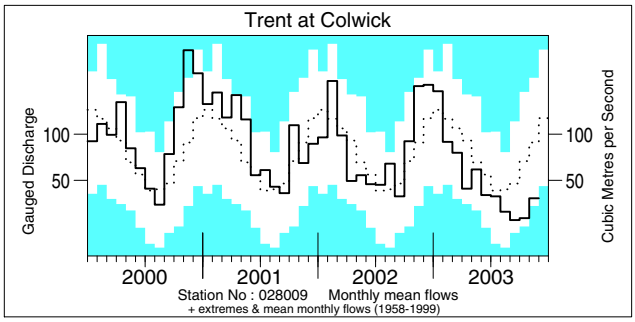


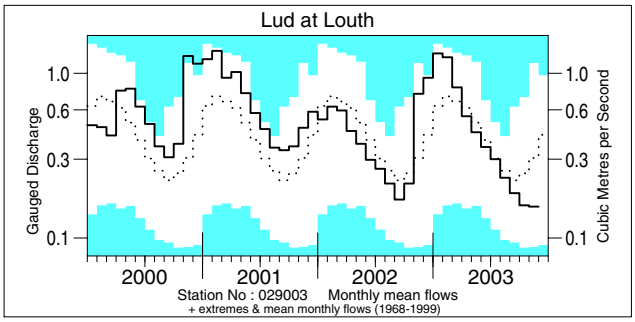








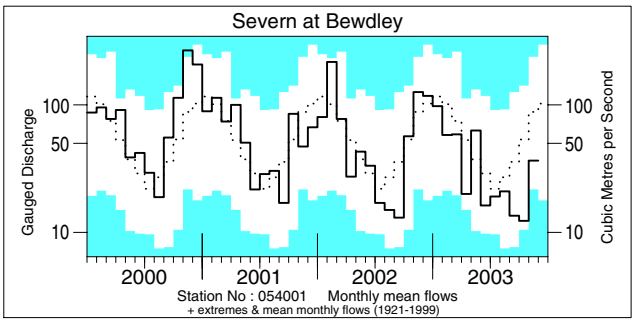


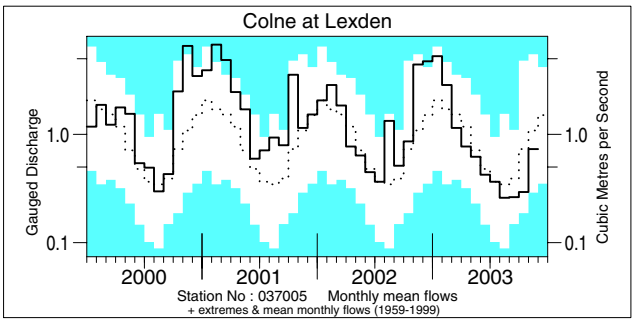


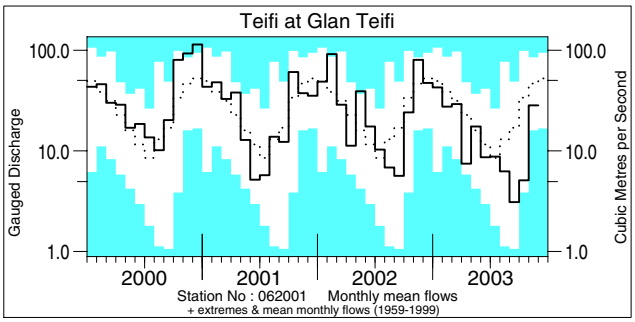
Monthly river flow hydrographs

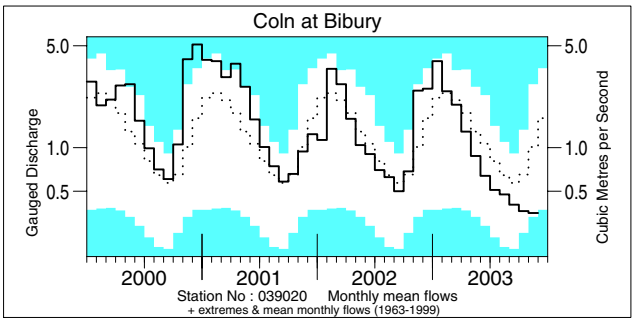
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

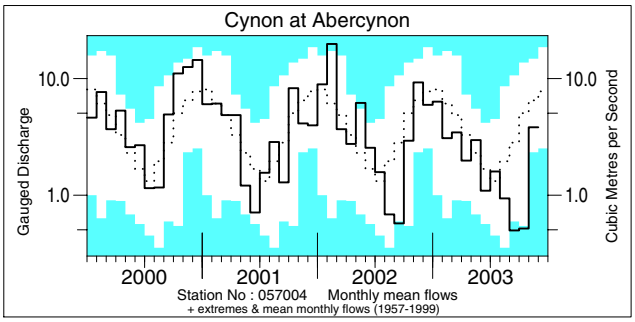
River flow . . . River flow . . .

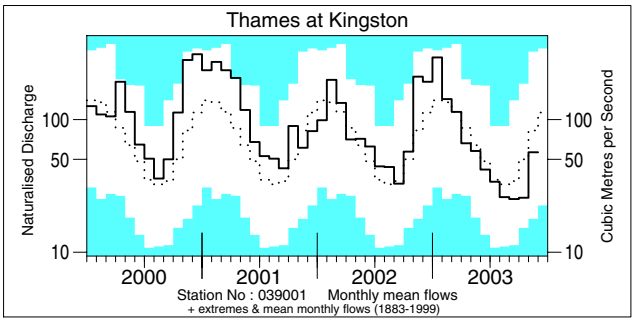


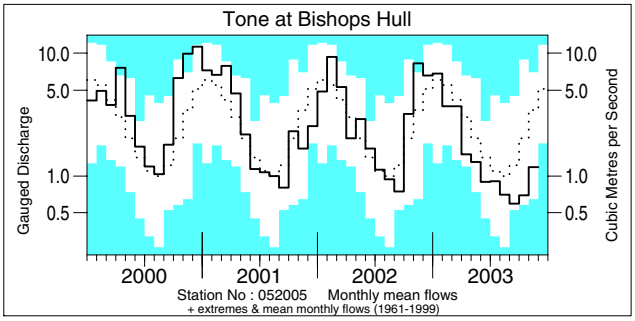


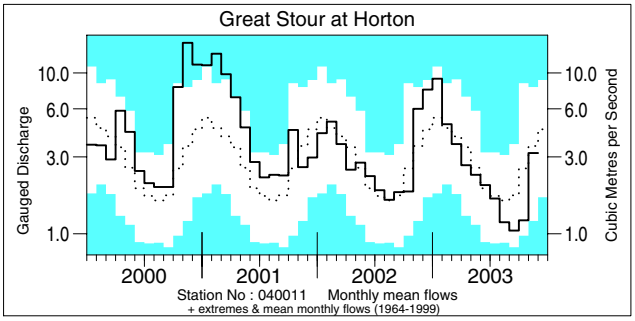


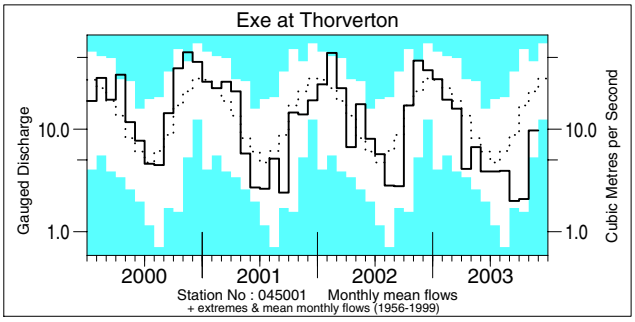


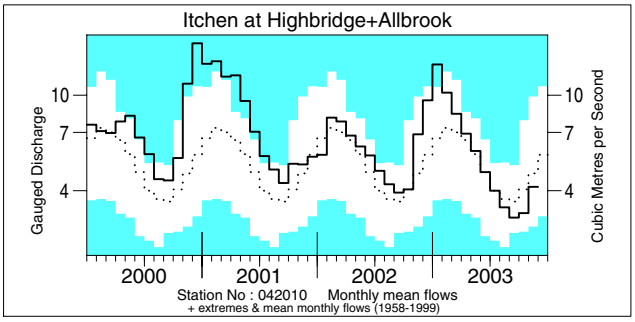












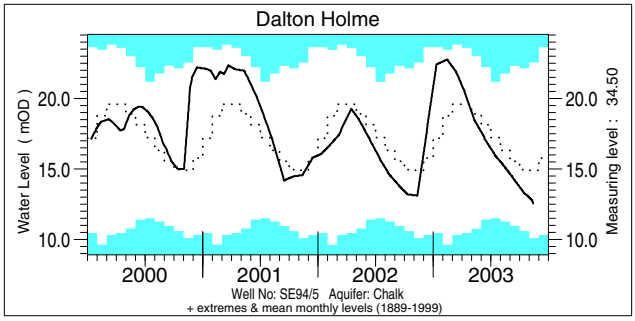
Notable runoff accumulations (a) August 2003 - November 2003, (b) February 2003 - November 2003

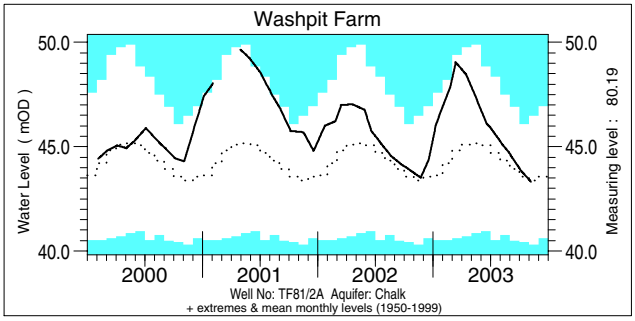
	River	%lta	Rank
a)	Dee (Park)	32	1/31
	Soar	37	1/33
	Coln	54	2/40
	Dart	40	2/45
	Cynon	35	1/44
	Eden	41	1/36
	Annacloy	24	1/24

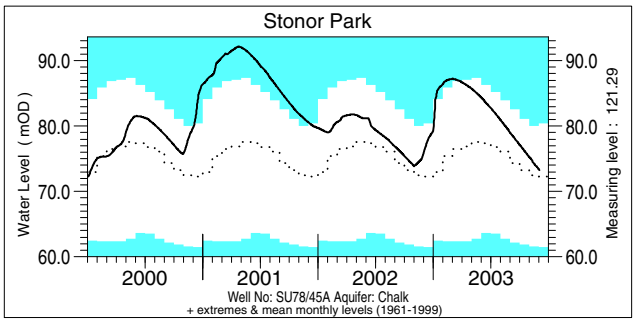
	River	%lta	Rank
b)	Spey (Boat o'Garten)	52	1/52
	Dee (Woodend)	58	1/74
	S. Tyne	45	1/40
	Exe	53	1/47
	Taw	41	1/45
	Brue	54	1/38
	Severn	61	4/82
	Teme	51	1/33
	Yscir	53	1/31
	Tawe	57	1/42
	Teifi	58	1/44
	Luss	65	1/25
	Nevis	67	1/21
	Carron	56	1/25
	Naver	59	1/26

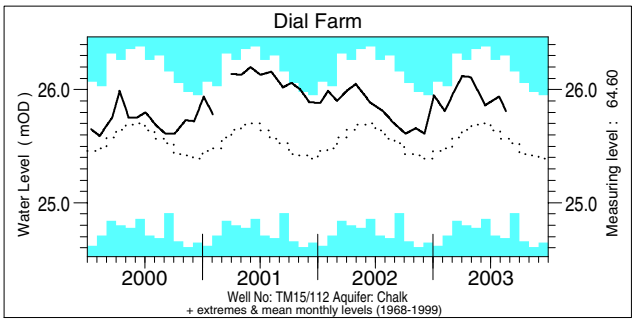
lta = long term average
Rank 1 = lowest on record

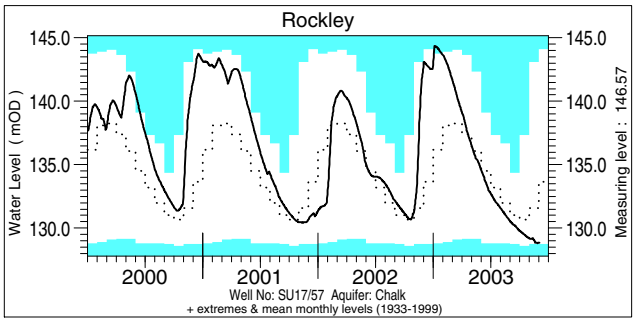
Groundwater . . . Groundwater

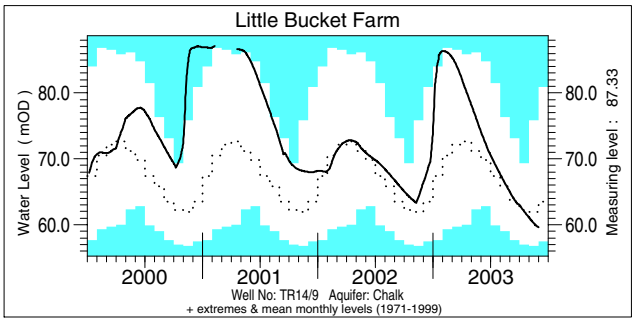


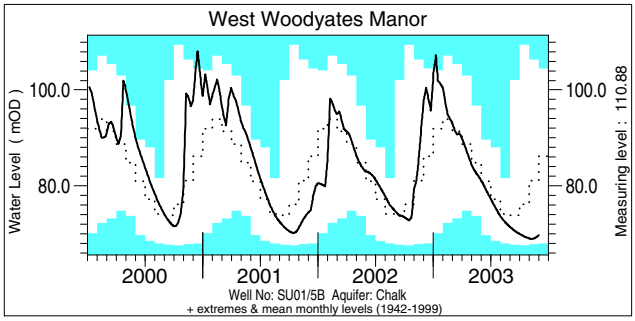


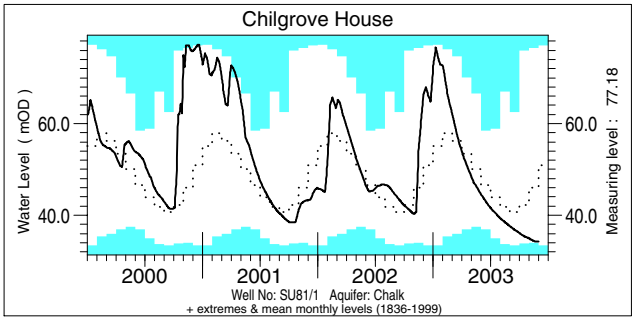


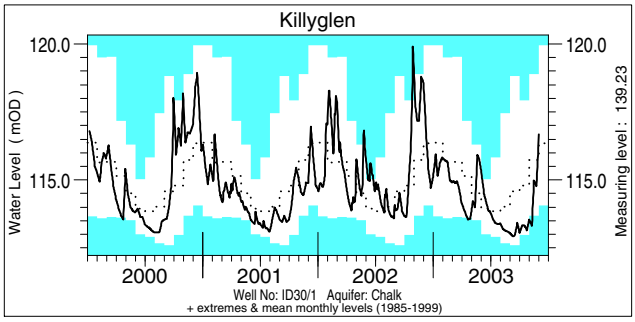


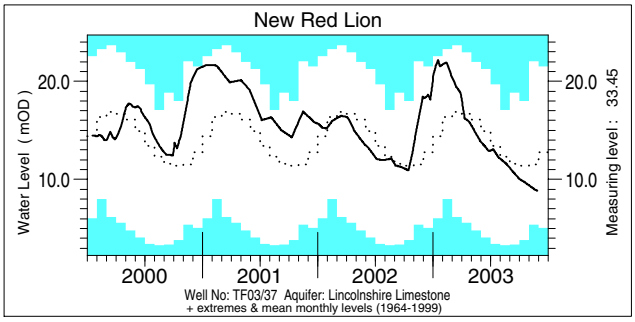






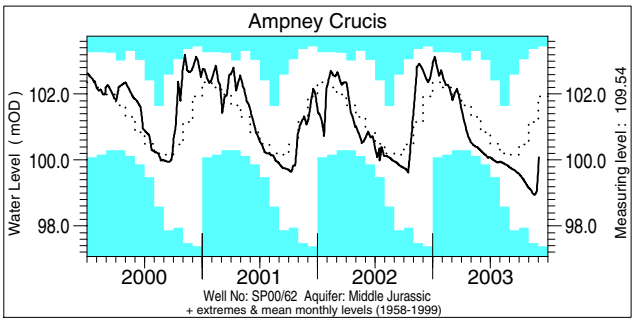


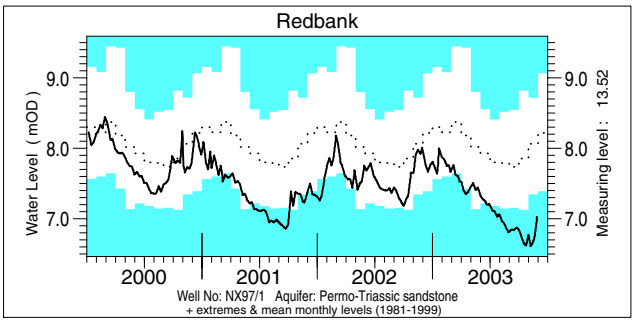


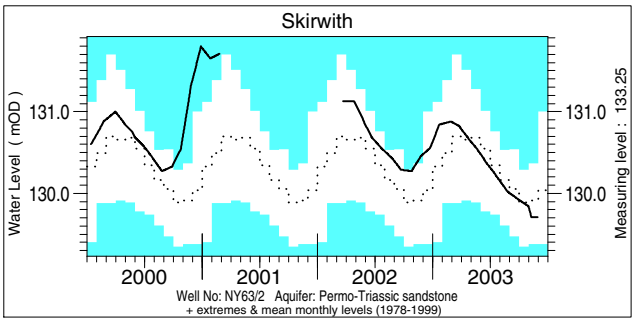


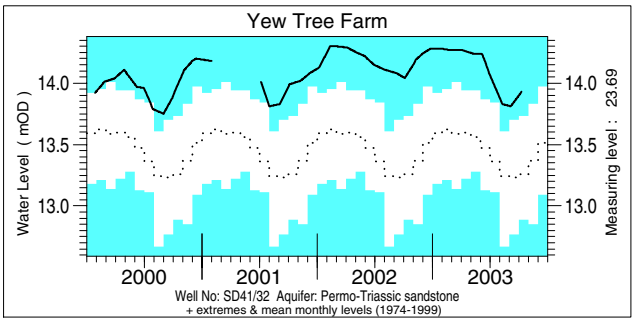
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

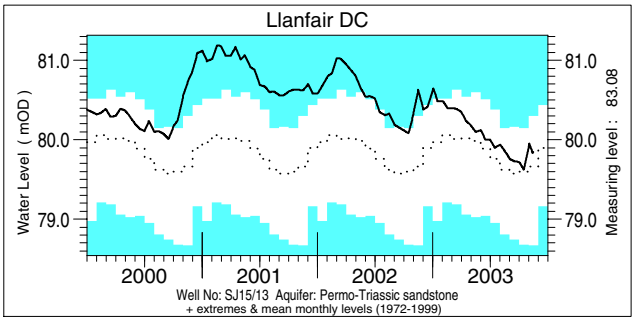
Groundwater . . . Groundwater

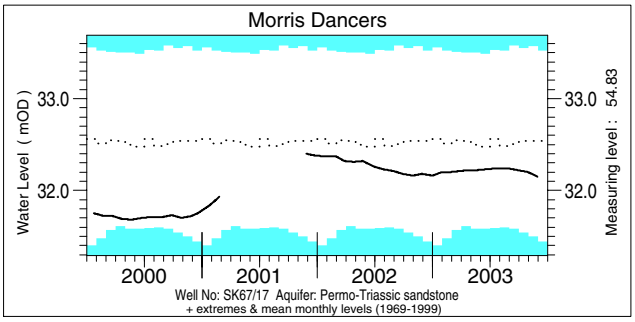


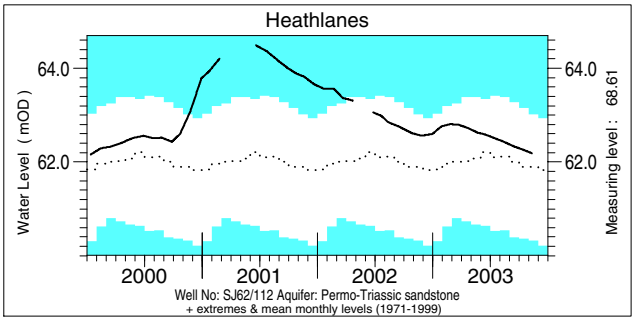


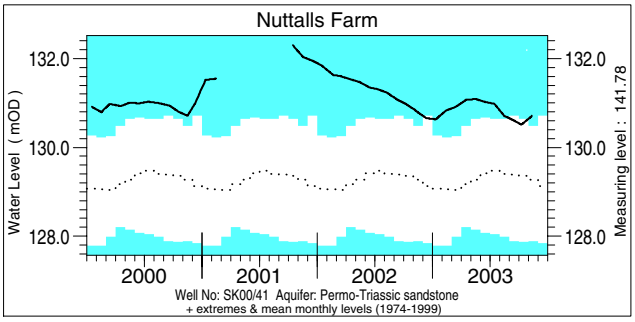


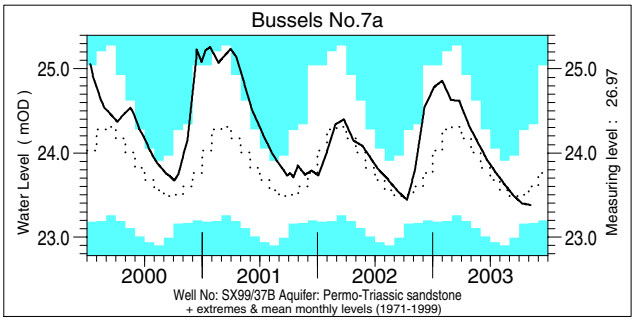


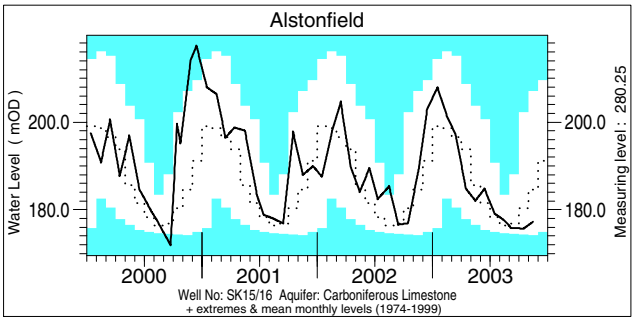










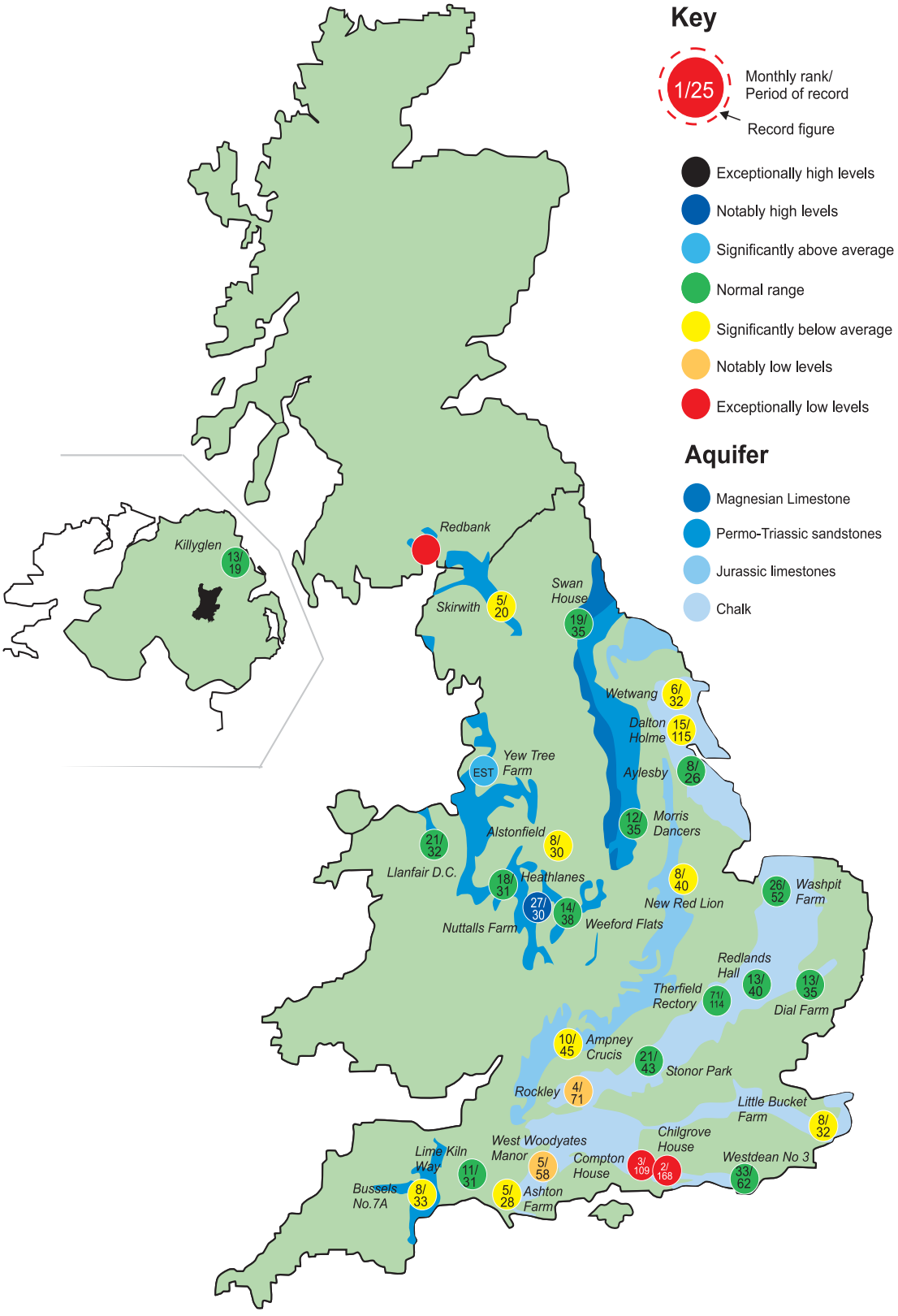


Groundwater levels November 2003 / December 2003

Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.
Dalton Holme	12.56	13/11	14.81	Chilgrove House	34.24	30/11	46.71	Llanfair DC	79.85	15/11	79.66
Washpit Farm	43.32	05/11	43.27	Killyglen	116.67	30/11	116.08	Morris Dancers	32.15	28/11	32.39
Stonor Park	73.27	02/12	72.66	New Red Lion	8.82	27/11	12.22	Heathlanes	62.18	11/11	61.95
Dial Farm	25.36	04/11	25.45	Ampney Crucis	100.08	02/12	101.22	Nuttalls Farm	130.71	10/11	129.56
Rockley	128.85	02/12	131.67	Redbank	7.03	27/11	8.00	Bussels No.7a	23.38	06/11	23.64
Little Bucket Farm	59.62	30/11	63.31	Skirwith	129.71	28/11	129.99	Alstonfield	177.32	14/11	186.47
West Woodyates	69.67	30/11	81.11	Yew Tree Farm	13.93	08/10	13.54				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

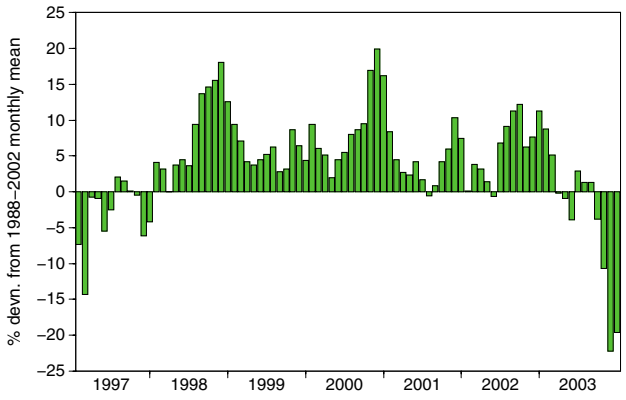


Groundwater levels - November 2003

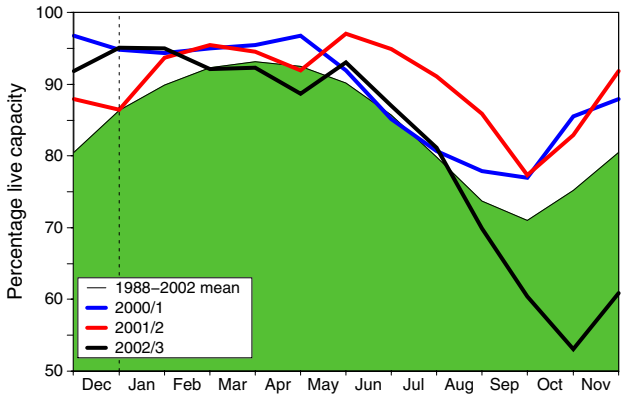
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

(Note: Redbank is affected by groundwater abstraction. Yew Tree Farm levels are now received quarterly.)

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.

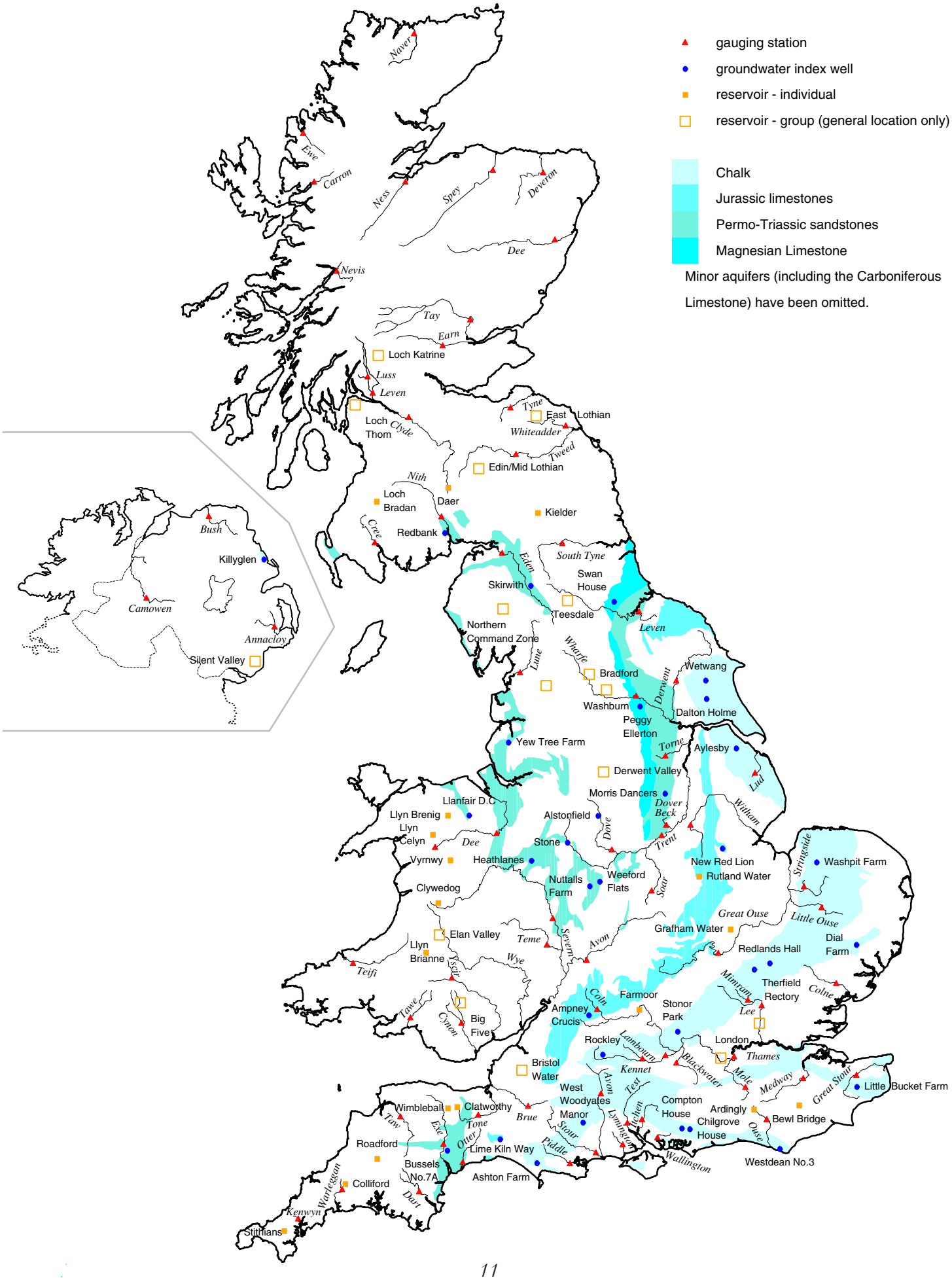
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Jul	Aug	Sep	Oct	Nov	Dec	Min. Dec	Year* of min.
North West	N Command Zone	• 124929	69	62	45	37	33	**59**	44	1993
	Vyrnwy	55146	87	82	70	59	60	**64**	33	1995
Northumbrian	Teesdale	• 87936	72	60	48	38	39	**48**	39	1995
	Kielder	(199175)	(91)	(86)	(81)	(76)	(66)	**(64)**	(64)	2003
Severn Trent	Clywedog	44922	97	95	82	69	61	**73**	43	1995
	Derwent Valley	• 39525	80	80	62	40	29	**37**	9	1995
Yorkshire	Washburn	• 22035	82	79	69	58	46	**49**	16	1995
	Bradford supply	• 41407	82	74	58	51	42	**54**	20	1995
Anglian	Grafham	(55490)	(95)	(89)	(79)	(72)	(64)	**(67)**	(47)	1997
	Rutland	(116580)	(91)	(87)	(79)	(73)	(66)	**(65)**	(57)	1995
Thames	London	• 202340	93	87	71	58	49	**62**	52	1990
	Farmoor	• 13830	95	89	71	54	43	**59**	52	1990
Southern	Bewl	28170	79	71	62	55	48	**51**	34	1990
	Ardingly	4685	92	77	53	32	15	**23**	23	2003
Wessex	Clatworthy	5364	65	55	43	25	14	**16**	16	2003
	Bristol WW	• (38666)	(79)	(79)	(79)	(79)	(48)	**(44)**	(27)	1990
South West	Colliford	28540	79	76	71	64	59	**59**	42	1995
	Roadford	34500	79	75	71	63	53	**51**	19	1995
	Wimbleball	21320	77	68	57	46	34	**36**	34	1995
	Stithians	5205	81	76	68	57	50	**46**	29	2001
Welsh	Celyn and Brenig	• 131155	98	93	84	77	75	**81**	50	1995
	Brianne	62140	94	95	85	76	71	**81**	72	1995
	Big Five	• 69762	87	79	64	48	38	**53**	49	1990
	Elan Valley	• 99106	89	76	62	48	41	**56**	47	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	84	76	67	56	48	**45**	45	2003
	East Lothian	• 10206	82	75	67	61	38	**38**	38	2003
Scotland(W)	Loch Katrine	• 111363	84	77	66	54	40	**66**	66	2003
	Daer	22412	70	74	66	55	42	**73**	73	2003
	Loch Thom	• 11840	85	85	77	71	69	**72**	72	2003
Northern Ireland	Total+	•	89	84	77	64	54	**59**	59	2003
	Silent Valley	• 20634	92	86	78	62	47	**47**	43	2001

() 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 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.

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100
Fax: 0870 900 5050
E-mail: enquiries@metoffice.com

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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