Hydrological Summary
for the United Kingdom

February 2004

General

February was mild and very wet initially but colder and much drier conditions dominated after the first week. The exceptional rate of reservoir replenishment in the early winter continued into February but stalled after the first week. Overall reservoir stocks for England and Wales have declined modestly in recent weeks but in early March still stood very close to the average for the beginning of spring. Flood risk was high over wide areas early in February and an extreme rainfall event triggered severe flooding in North Wales. Generally, river flows were in steep recession thereafter, and most runoff totals were close to the February average. Groundwater hydrographs mostly reflect the response to heavy January infiltration and the belated seasonal recovery gathered momentum in early February. However, a lengthy dry spell, extending into March, has raised concern that the recharge season may again terminate very early (as in 2003). As in many years, the water resources outlook – though generally healthy – will be heavily influenced by rainfall over the next 6-10 weeks. Above average March/April rainfall would be particularly useful in delaying the onset of the seasonal recession in runoff and recharge rates.

Rainfall

A sequence of vigorous frontal systems brought substantial rainfall to most regions in early February but a decisive change in synoptic patterns heralded colder and mostly dry conditions over the ensuing four weeks. In the context of the recent past, snowfall constituted a substantial proportion of total precipitation, in Scotland especially but blizzard conditions were also experienced in coastal areas of England (e.g. at Bournemouth on the 27th). A slow-moving frontal system produced a remarkable 260 mm rainfall total over 48 hours (4/5th Feb) at Capel Curig in North Wales – the corresponding return period exceeds 100 years. Substantial rainfall occurred across much of the UK on the 5th but, subsequently, some localities in central southern England reported only 2 mm over the three weeks up to March 2nd. Monthly precipitation totals for February exhibited wide spatial variability; North Wales was exceptionally wet and parts of northern Scotland reported >150% of the monthly average also. By contrast, parts of southern England (coastal areas particularly) registered <30%. Last year excepted, February was the driest since 1993 for the UK as a whole; provisionally Northern Ireland recorded its 2nd lowest February rainfall in 20 years. Notwithstanding the recent dry spell, winter (Dec-Feb) rainfall totals were close to, or above, average in all regions but long term deficiencies remain significant, particularly in the 13-month timeframe; the Feb-Feb total for the UK is the lowest since 1975/76.

Flows

With catchments saturated and snowmelt an exacerbating factor in the north, February began with many catchments very vulnerable to further rainfall. Flood warnings were very common during the first week. Moderate floodplain inundations characterised many river basins and several index rivers in western Britain (including the Wye and Severn) approached or exceeded previous maximum February peak flows. Flooding was severe in North Wales – particularly in the Conwy Valley (e.g. at Llanwrst and Trefriw). Thereafter, river flow recessions were exceptionally steep in many impermeable catchments; in some catchments period-of-record February minima were approached around month-end (e.g. on the Nith and Forth). The counterbalancing effect of these contrasting flow episodes resulted in monthly runoff totals that were well within the normal range (80-120% of average) throughout most of the UK. This was true of most winter (Dec-Feb) runoff totals also, but longer term runoff deficiencies remain large in many areas – eastern Scotland especially. The belated seasonal recovery of flows in groundwater-fed streams continued in February, but will stall if March rainfall is appreciably below average.

Groundwater

The February rainfall distribution was unfavourable for groundwater replenishment, in both spatial and temporal terms. Most aquifer outcrop areas reported significantly below average monthly totals and, although infiltration rates were high until early Feb, the subsequent dry spell saw modest soil moisture deficits develop in southern England - where a dry and warm March could signal the end of the recharge season. Groundwater levels for index boreholes reporting in early Feb reflect the heavy antecedent recharge but some reporting around month end show a late-winter recession (e.g. at Ampney Crucis and Chilgrove). Nonetheless, levels across almost the entirety of the Chalk aquifer (Killyglen is an exception) were within the normal late winter range. Similarly, levels in most index limestone wells are around the seasonal norm. In the Permo-Triassic sandstones, below average February levels typified most of the more responsive wells (Llanfair DC in N. Wales excepted) but healthy levels still characterise the slowest responding aquifer units – e.g. most outcrops in the Midlands. Levels in the minor aquifers of eastern England are also typical for the time of year. This is reassuring and overall groundwater resources are much healthier than early in many groundwater drought years (e.g. 1992, 1996 and 1997). However, a very early onset of the seasonal recession could herald levels substantially below average by the late summer.

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

Rainfall accumulations and return period estimates

Area	Rainfall	Feb 2004	Dec 03-Feb 04	RP	Aug 03-Feb 04	RP	May 03-Feb 04	RP	Feb 03-Feb 04	RP
England & Wales	**mm**	**50**	**275**		**516**		**727**		**845**	
	%	**77**	**110**	**2-5**	**88**	**2-5**	**93**	**2-5**	**86**	**5-10**
North West	mm	86	394		659		933		1112	
	%	110	122	2-5	83	5-10	90	2-5	87	5-10
Northumbrian	mm	57	275		452		646		736	
	%	96	123	5-10	84	5-10	89	2-5	81	10-20
Severn Trent	mm	40	219		369		561		662	
	%	73	109	2-5	79	5-10	88	2-5	82	5-15
Yorkshire	mm	53	251		436		656		763	
	%	91	114	2-5	85	2-5	95	2-5	87	5-10
Anglian	mm	33	172		316		501		566	
	%	90	121	2-5	89	2-5	100	<2	89	2-5
Thames	mm	30	187		366		513		597	
	%	66	105	2-5	86	2-5	88	2-5	81	5-15
Southern	mm	27	217		444		584		675	
	%	50	100	<2	88	2-5	88	2-5	81	5-15
Wessex	mm	44	258		454		634		749	
	%	68	105	2-5	83	2-5	89	2-5	83	5-10
South West	mm	66	365		619		880		1064	
	%	65	97	2-5	78	5-10	87	2-5	83	5-10
Welsh	mm	111	459		762		1055		1257	
	%	114	117	2-5	86	2-5	94	2-5	89	2-5
Scotland	**mm**	**109**	**475**		**837**		**1132**		**1331**	
	%	**106**	**118**	**5-10**	**86**	**5-10**	**92**	**2-5**	**86**	**5-15**
Highland	mm	172	654		1101		1441		1687	
	%	136	128	5-15	91	2-5	96	2-5	89	5-10
North East	mm	67	308		540		714		836	
	%	104	120	5-10	86	5-10	86	5-10	81	20-30
Tay	mm	68	348		609		866		1045	
	%	71	95	2-5	74	10-20	82	5-15	79	15-25
Forth	mm	67	324		568		810		954	
	%	85	106	2-5	77	10-20	85	5-10	80	15-25
Tweed	mm	61	285		486		707		822	
	%	91	110	2-5	78	5-15	85	5-10	79	20-30
Solway	mm	87	424		779		1090		1304	
	%	86	105	2-5	80	5-10	89	2-5	86	5-10
Clyde	mm	92	509		956		1337		1564	
	%	78	105	2-5	82	5-10	91	2-5	86	5-15
Northern Ireland	**mm**	**46**	**263**		**525**		**820**		**983**	
	%	**59**	**90**	**2-5**	**75**	**10-20**	**90**	**2-5**	**86**	**5-10**

RP = Return period

The monthly rainfall figures* are copyright of The Met Office and may not be passed on to, or published by, any unauthorised person or organisation. **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 Met 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

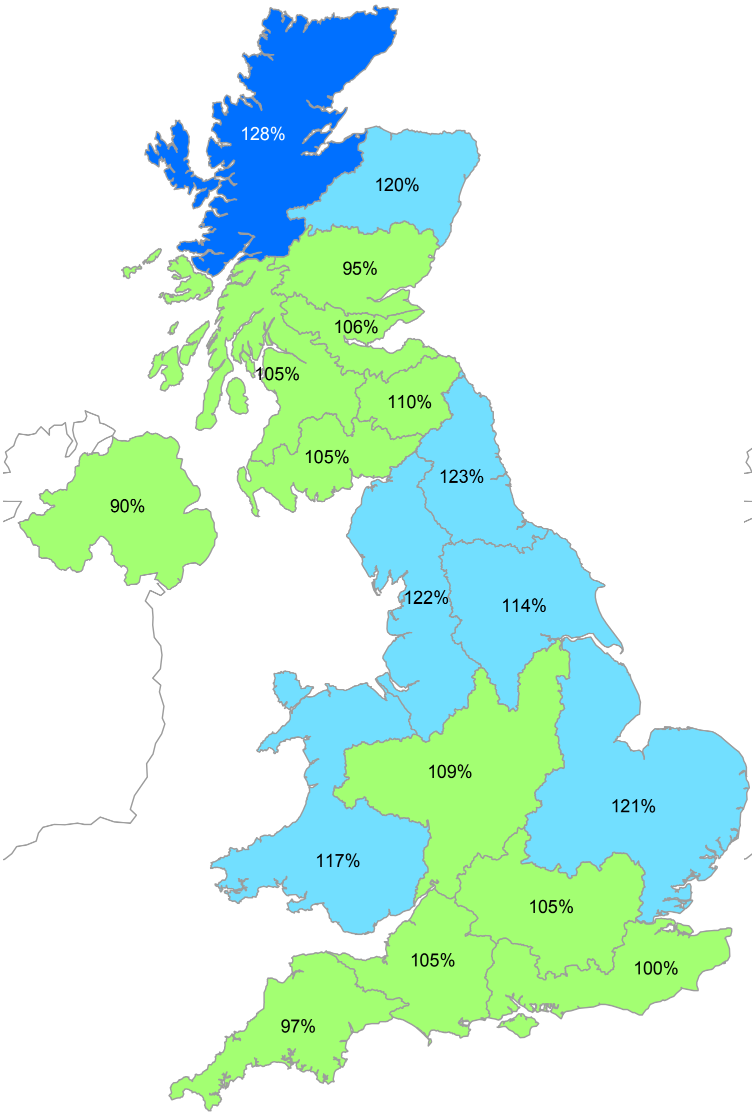
Above average

Normal range

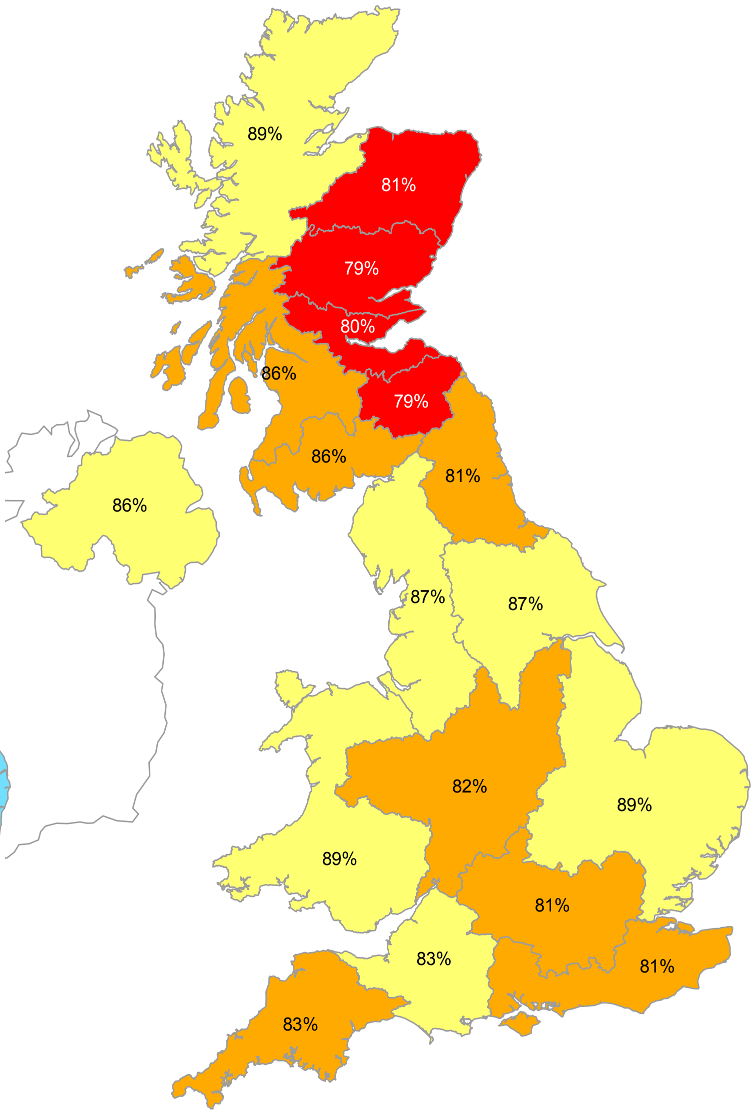
Below average

Substantially below average

Exceptionally low rainfall



December 2003 - February 2004

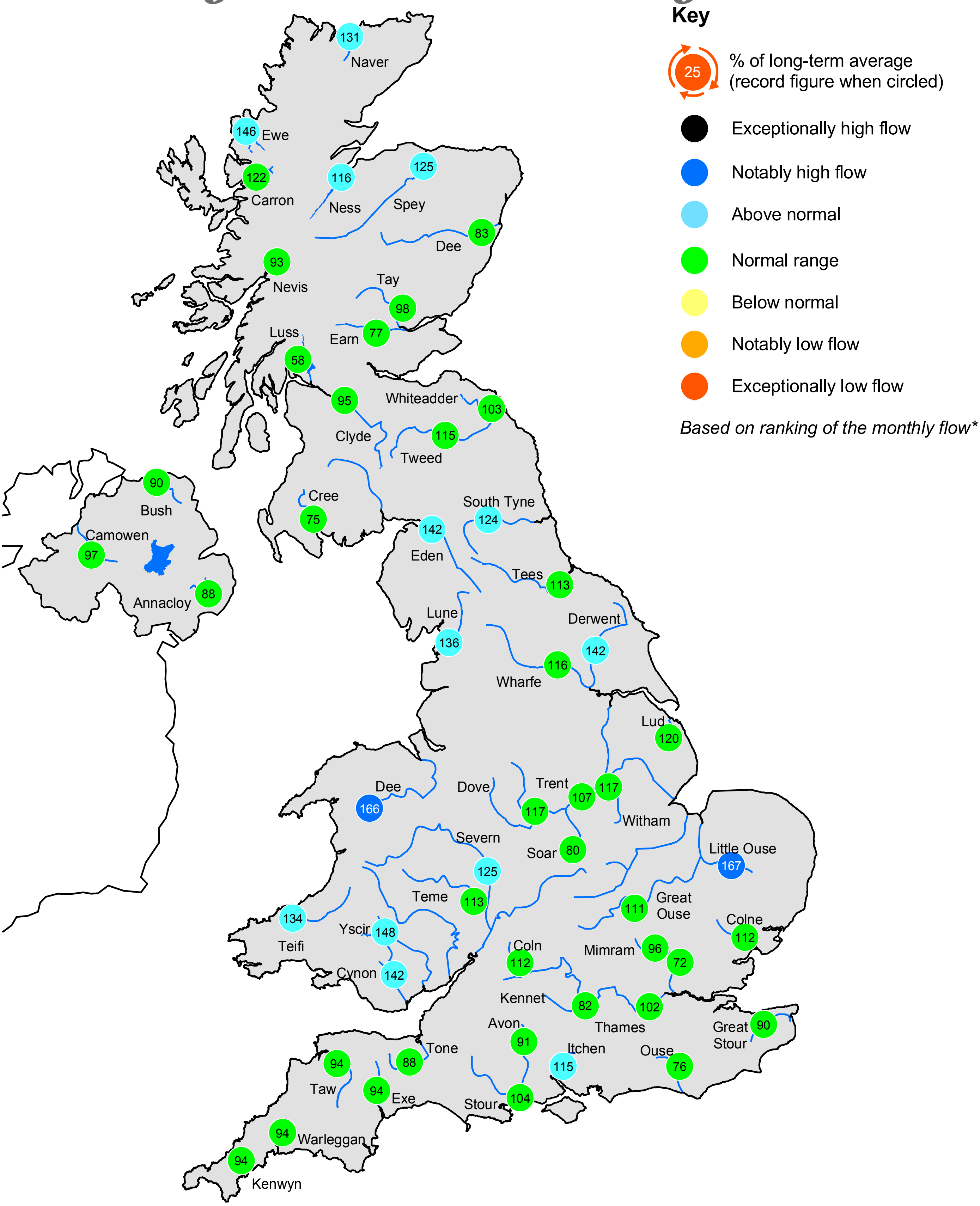


February 2003 - February 2004

Rainfall accumulation maps

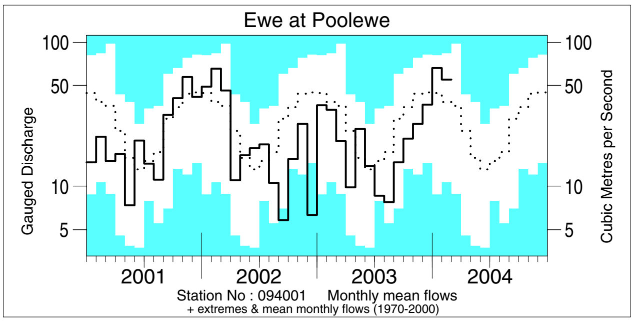
The Dec 2003 - Feb 2004 period added to a cluster recent wet winters for Great Britain as a whole; all but 2002/03 have been appreciably wetter than average. By contrast, regional rainfall deficiencies over the Feb 2003 - Feb 2004 period remain substantial (mostly in the 15-20% range). The largest percentage deficiencies are in eastern Scotland, but the most important in water resources terms are those across the aquifer outcrop areas of central and southern England.

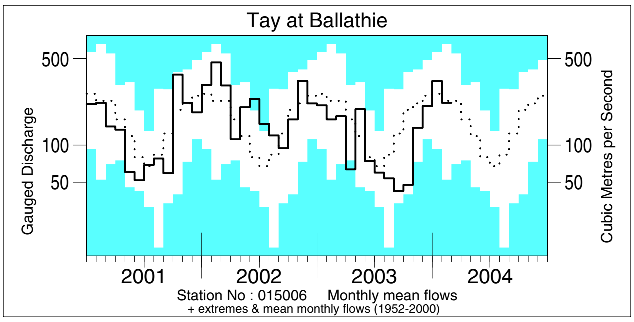
River flow . . . River flow . . .

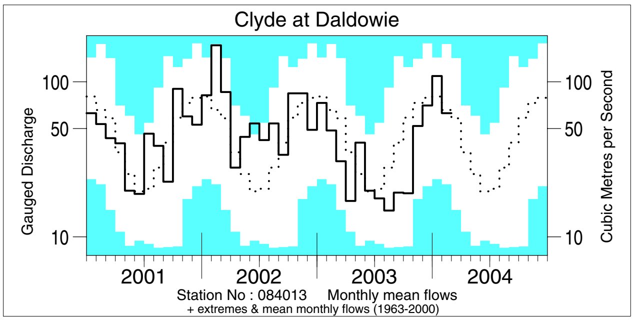


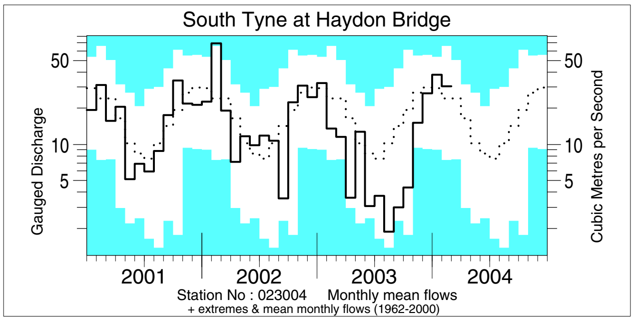
River flows - February 2004

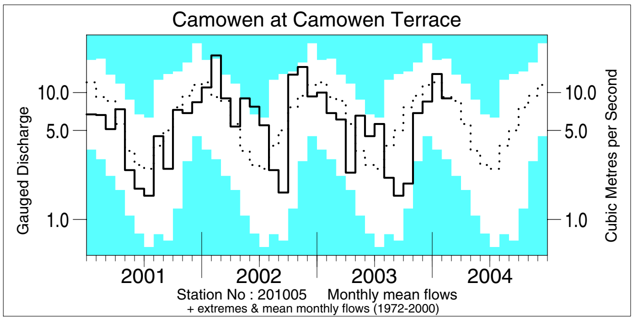
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

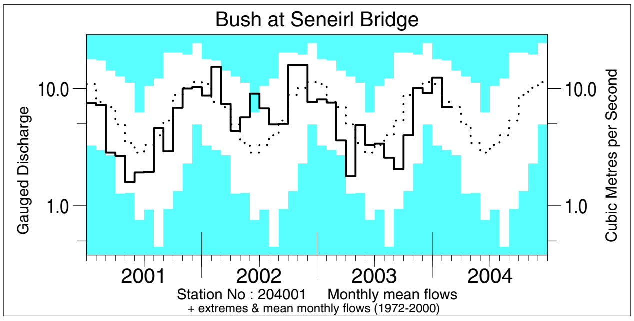


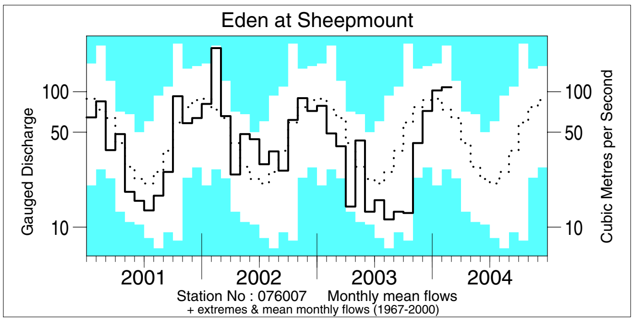


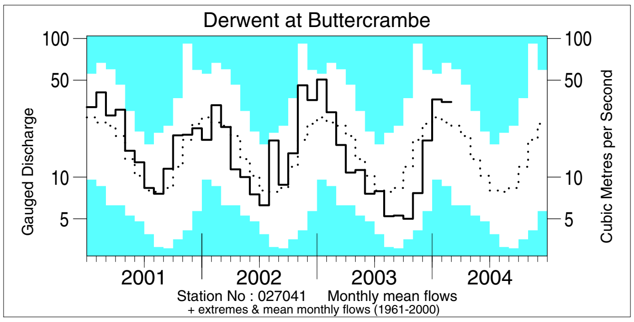


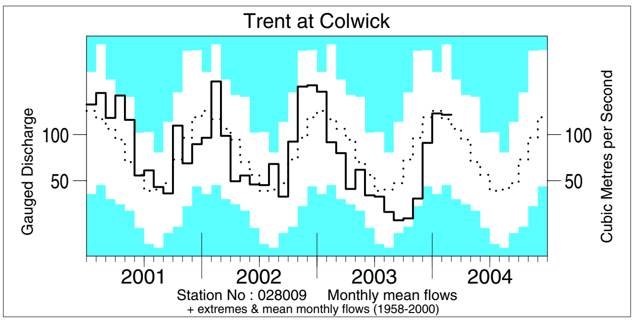


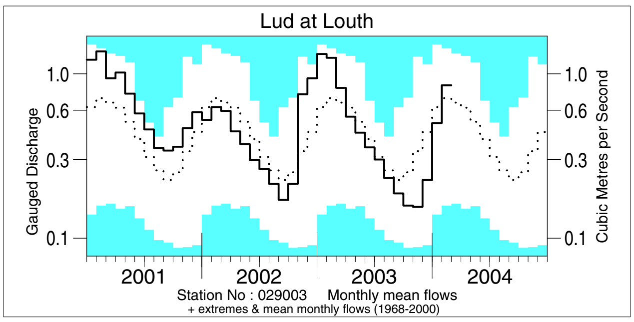








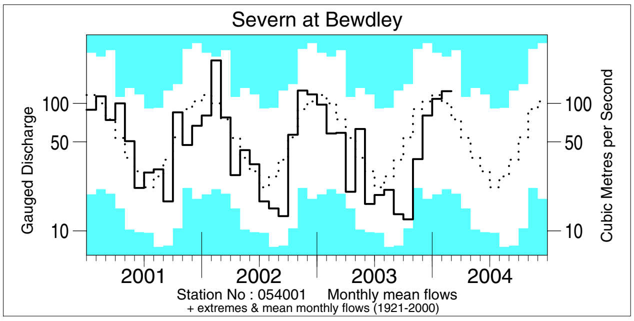


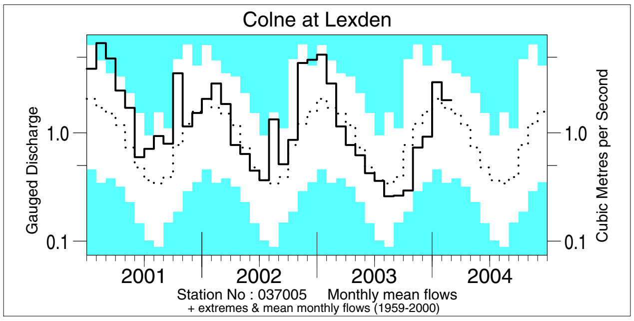


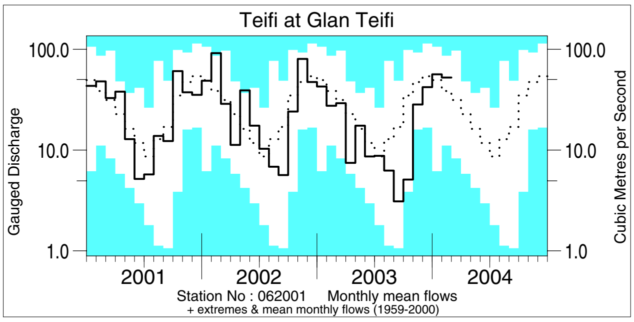
Monthly river flow hydrographs

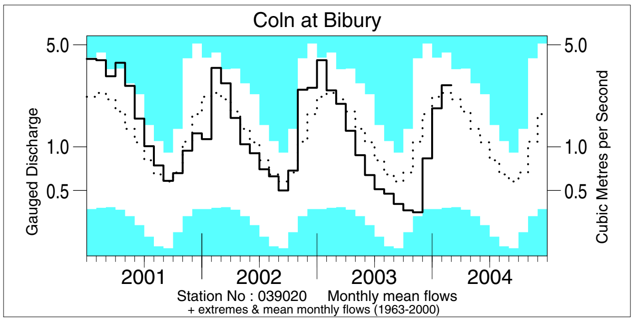
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2001 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

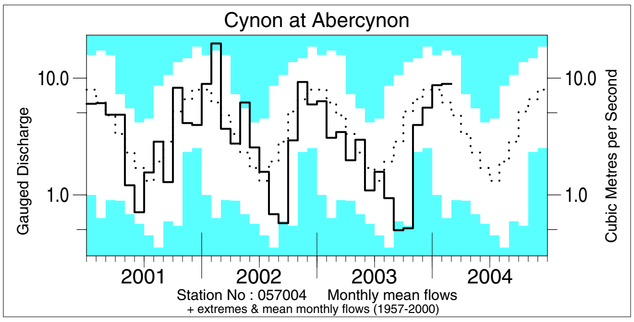
River flow . . . River flow . . .

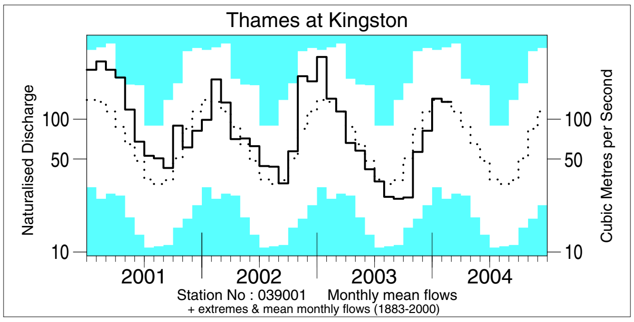


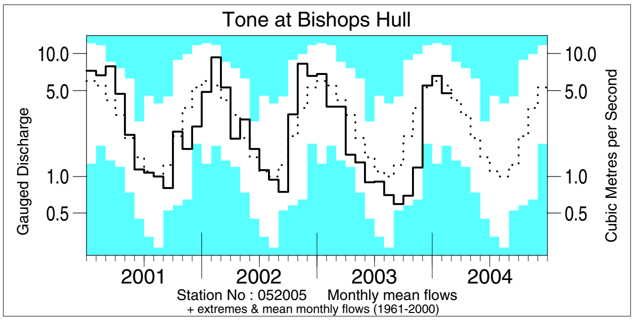


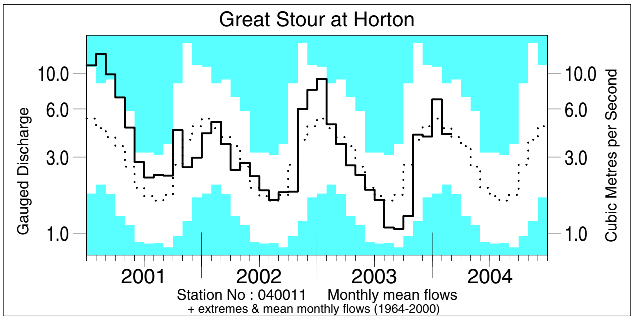


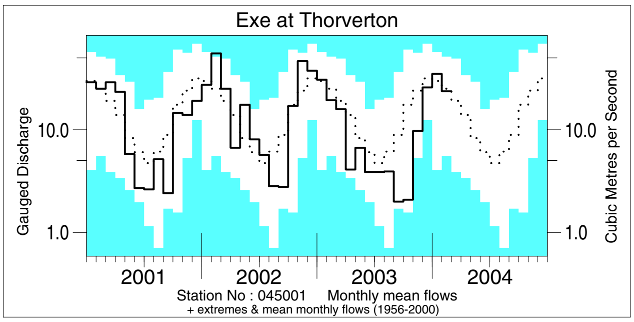


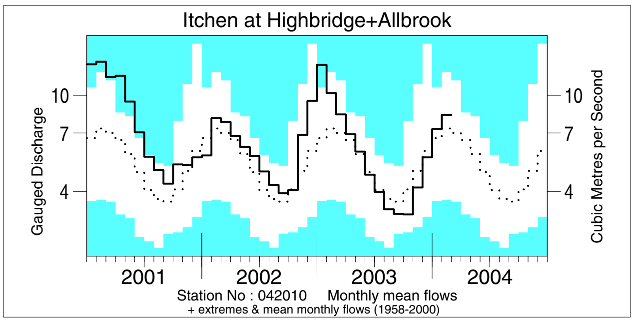












Notable runoff accumulations **(a) December 2003 - Feb 2004, (b) August 2003 - Feb 2004, (c) February 2003 - Feb 2004**

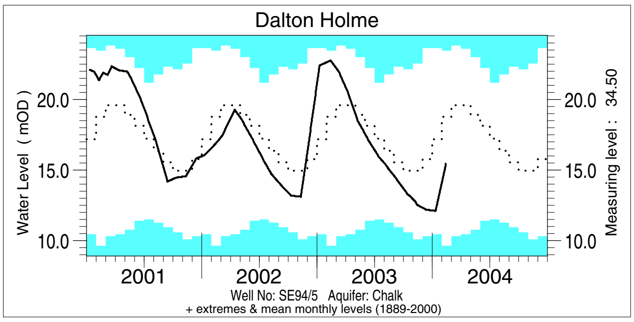
	River	%lta	Rank
a)	Dee (Woodend)	97	34/75
	Forth	75	5/23
	Soar	78	7/33
	Thames (Nat)	93	53/121
	Warleggan	87	8/35
	Severn	98	39/83
	Dee (Manley Hall)	111	43/67
	Faughan	81	6/28

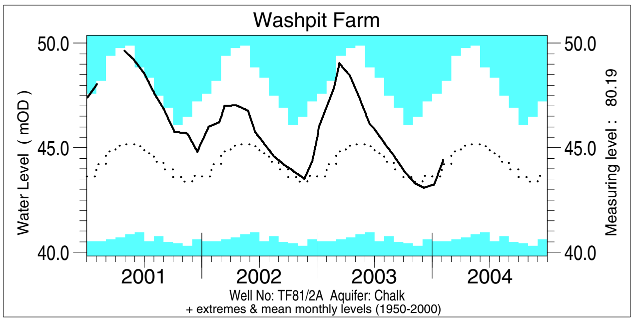
	River	%lta	Rank
b)	Dee (Park)	60	1/31
	Tweed (Norham)	69	3/44
	Forth	60	1/23
	Luss	66	2/25
	Faughan	62	1/27
	Lower Bann	70	2/24
	Annacloy	57	1/24

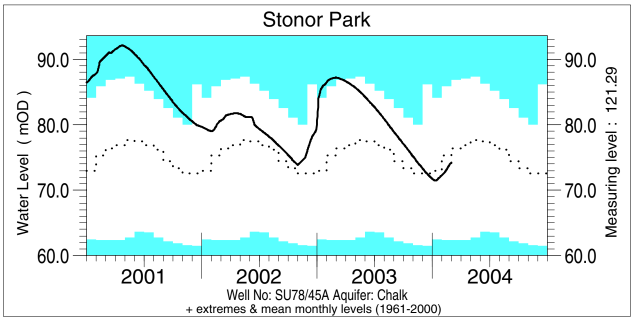
	River	%lta	Rank
c)	Dee (Woodend)	68	1/74
	S Tyne	68	2/40
	Luss	69	1/25
	Carron	73	2/25
	Camowen	82	2/28
	Mourne	78	1/21
	Lagan	72	2/29

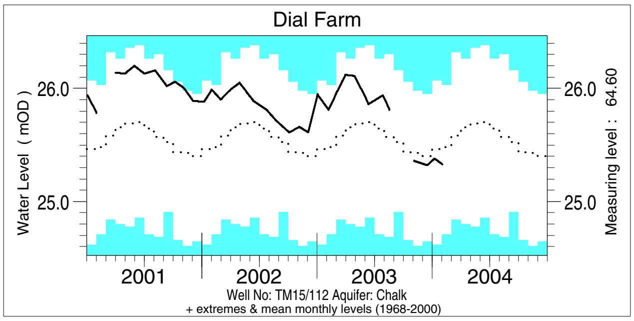
lta = long term average
Rank 1 = lowest on record

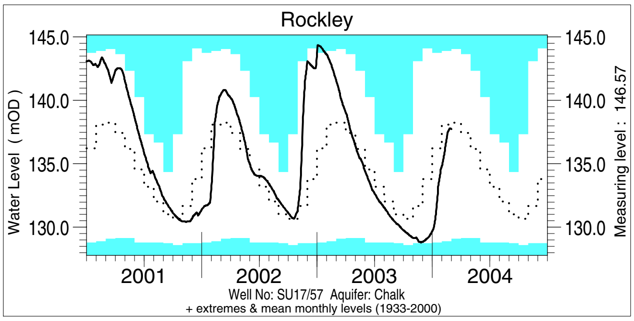
Groundwater . . . Groundwater

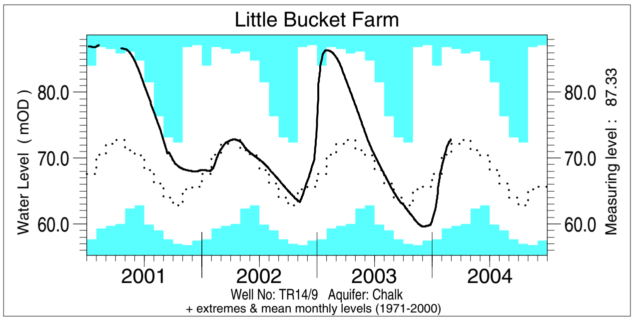


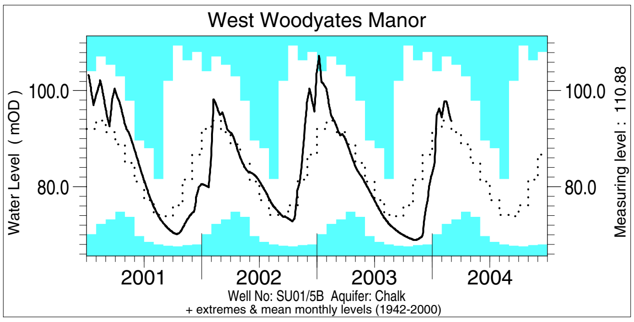


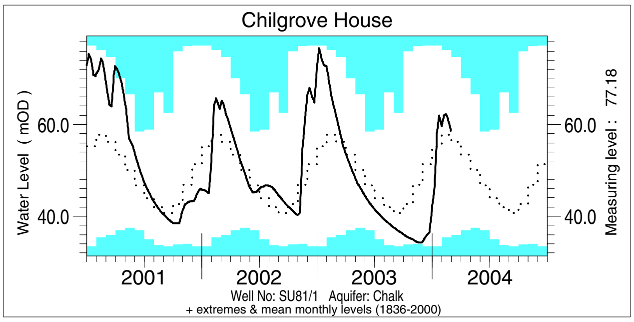


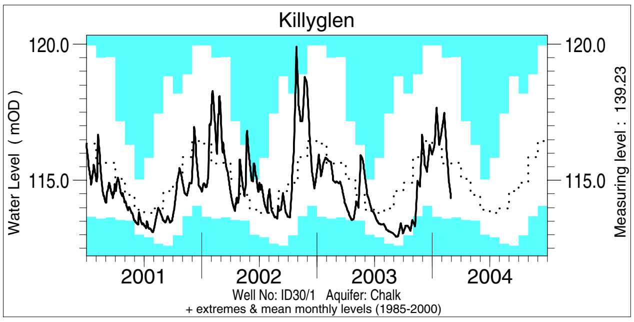


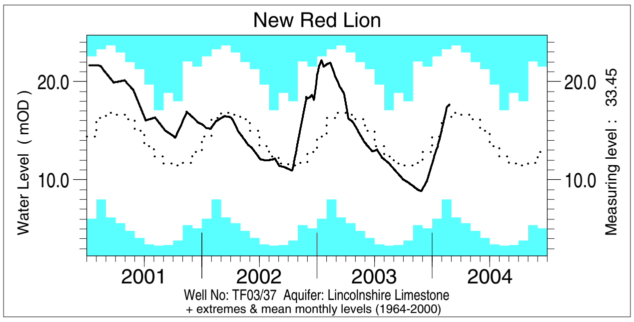






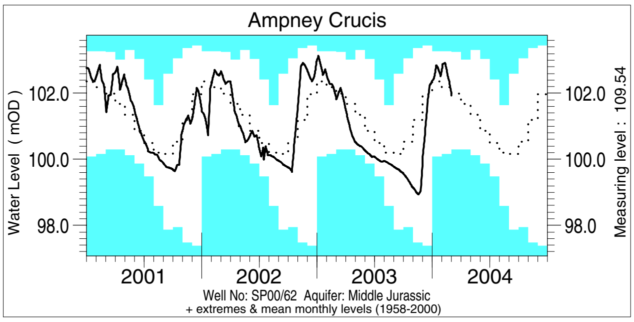


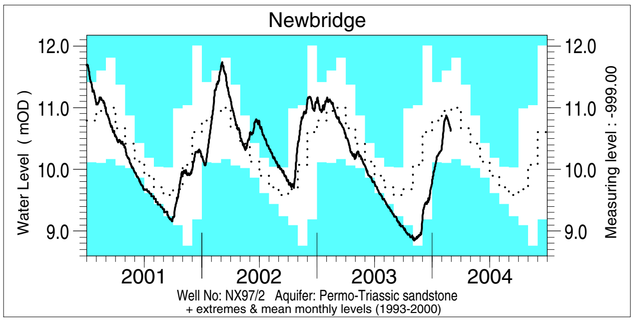


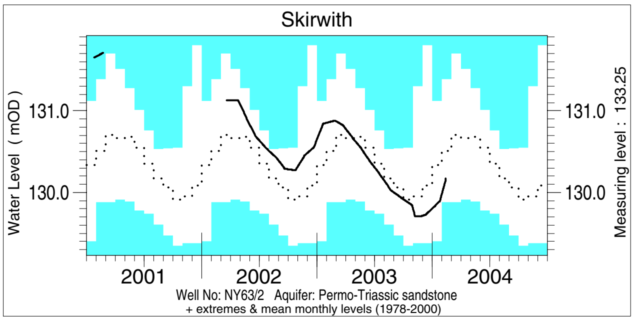


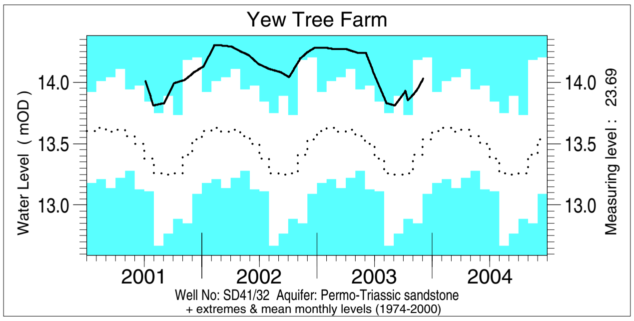
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

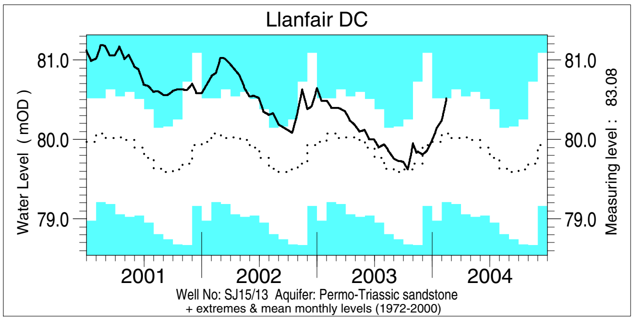
Groundwater . . . Groundwater

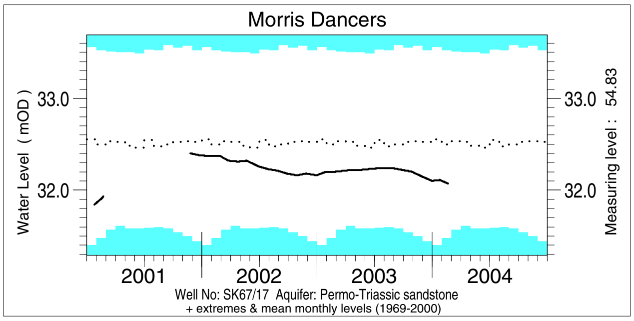


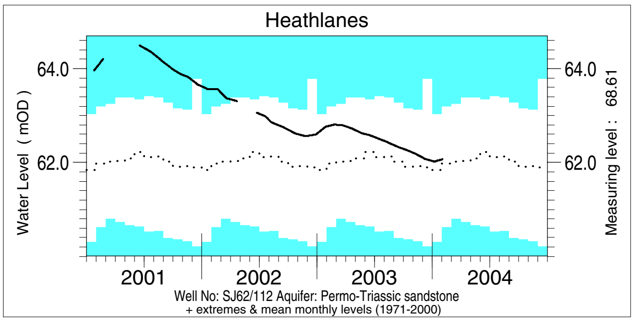


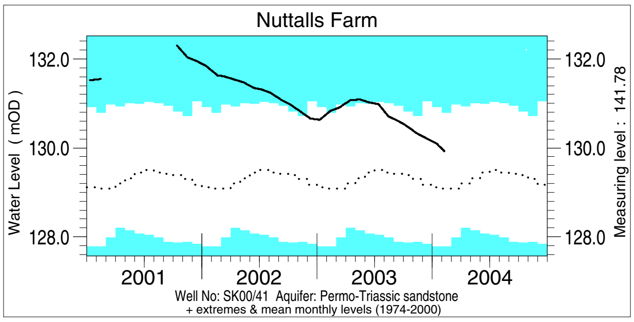


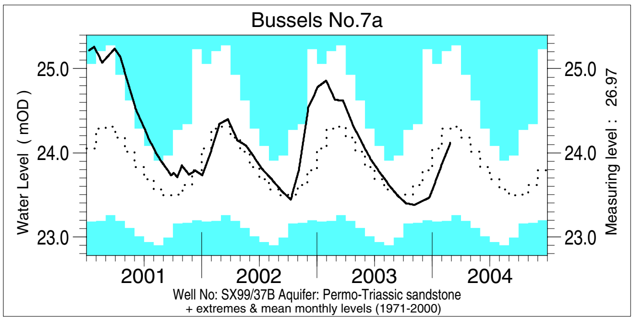


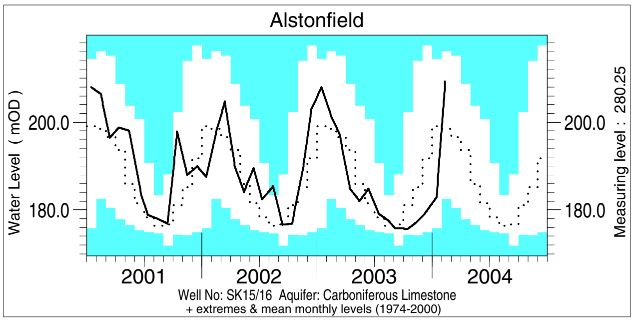










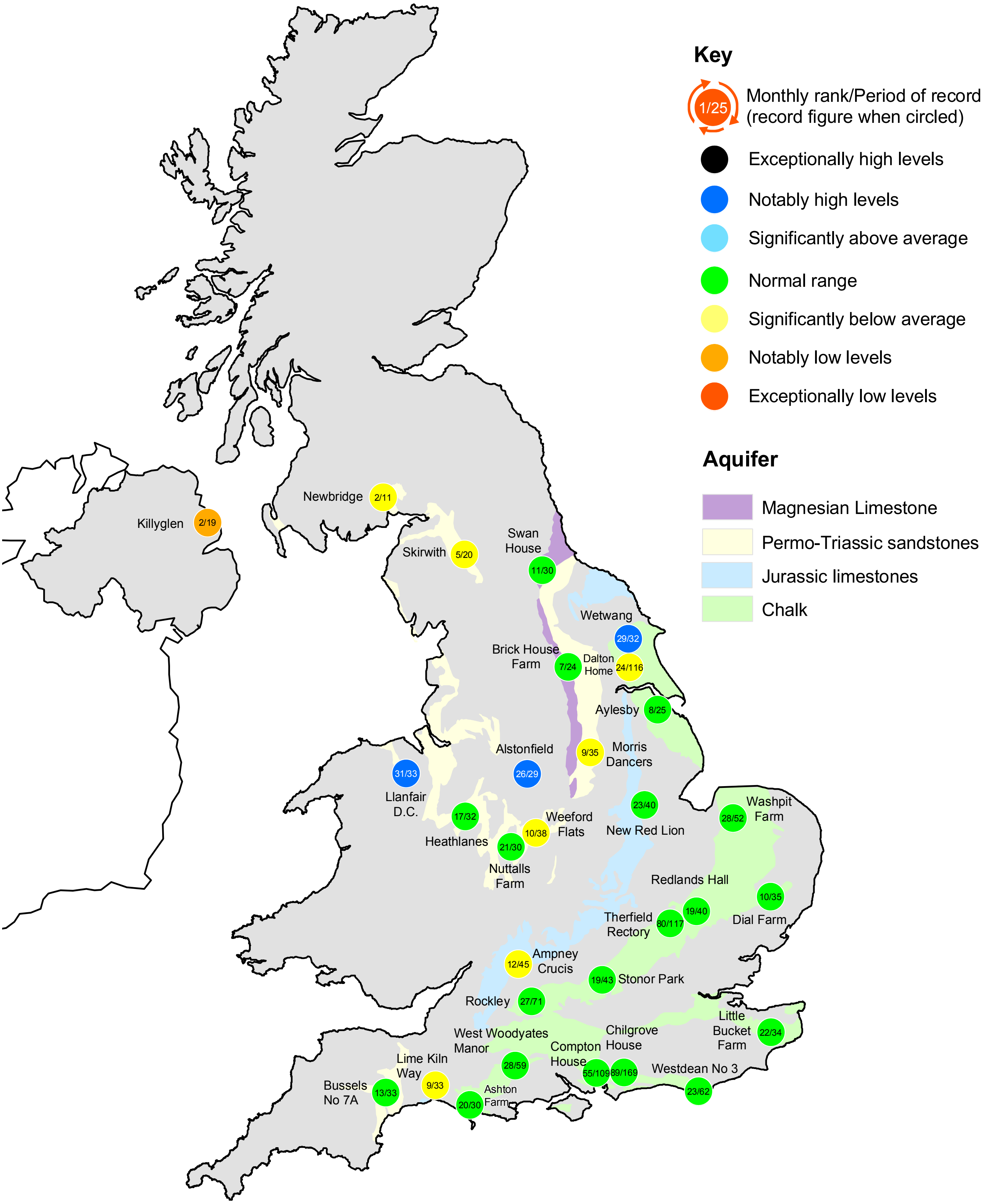


Groundwater levels February / March 2004

Borehole	Level	Date	Feb. av.	Borehole	Level	Date	Feb. av.	Borehole	Level	Date	Feb. av.
Dalton Holme	15.47	13/02	18.75	Chilgrove House	58.55	29/02	57.63	Llanfair DC	80.52	15/02	80.05
Washpit Farm	44.42	05/02	44.40	Killyglen	114.34	29/02	115.75	Morris Dancers	32.07	20/02	32.38
Stonor Park	74.25	02/03	76.02	New Red Lion	17.64	25/02	16.37	Heathlanes	62.07	02/02	62.05
Dial Farm	25.33	02/02	25.52	Ampney Crucis	101.93	02/03	102.23	Nuttalls Farm	129.92	09/02	129.46
Rockley	137.75	02/03	138.33	Newbridge	10.62	29/02	11.01	Bussels No.7a	24.12	27/02	24.33
Little Bucket Farm	72.79	29/02	70.63	Skirwith	130.17	13/02	130.62	Alstonfield	209.33	11/02	198.72
West Woodyates	93.87	28/02	93.25	Yew Tree Farm	14.03	03/12	13.73				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



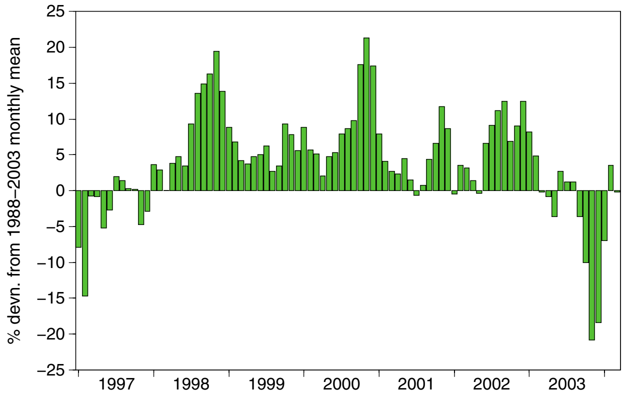
Groundwater levels - February 2004

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.

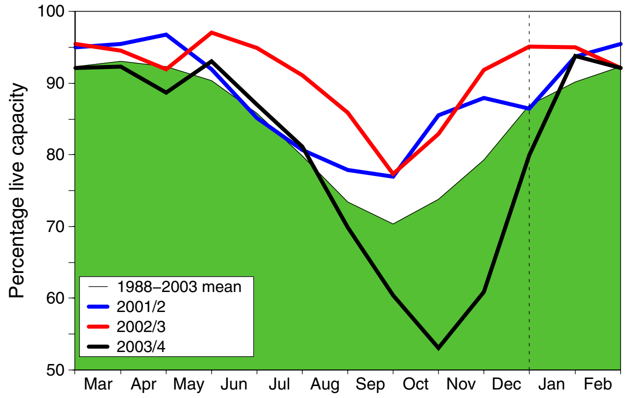
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. The Newbridge borehole supercedes Redbank (which was affected by groundwater abstraction). Yew Tree Farm levels are now received quarterly.

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.

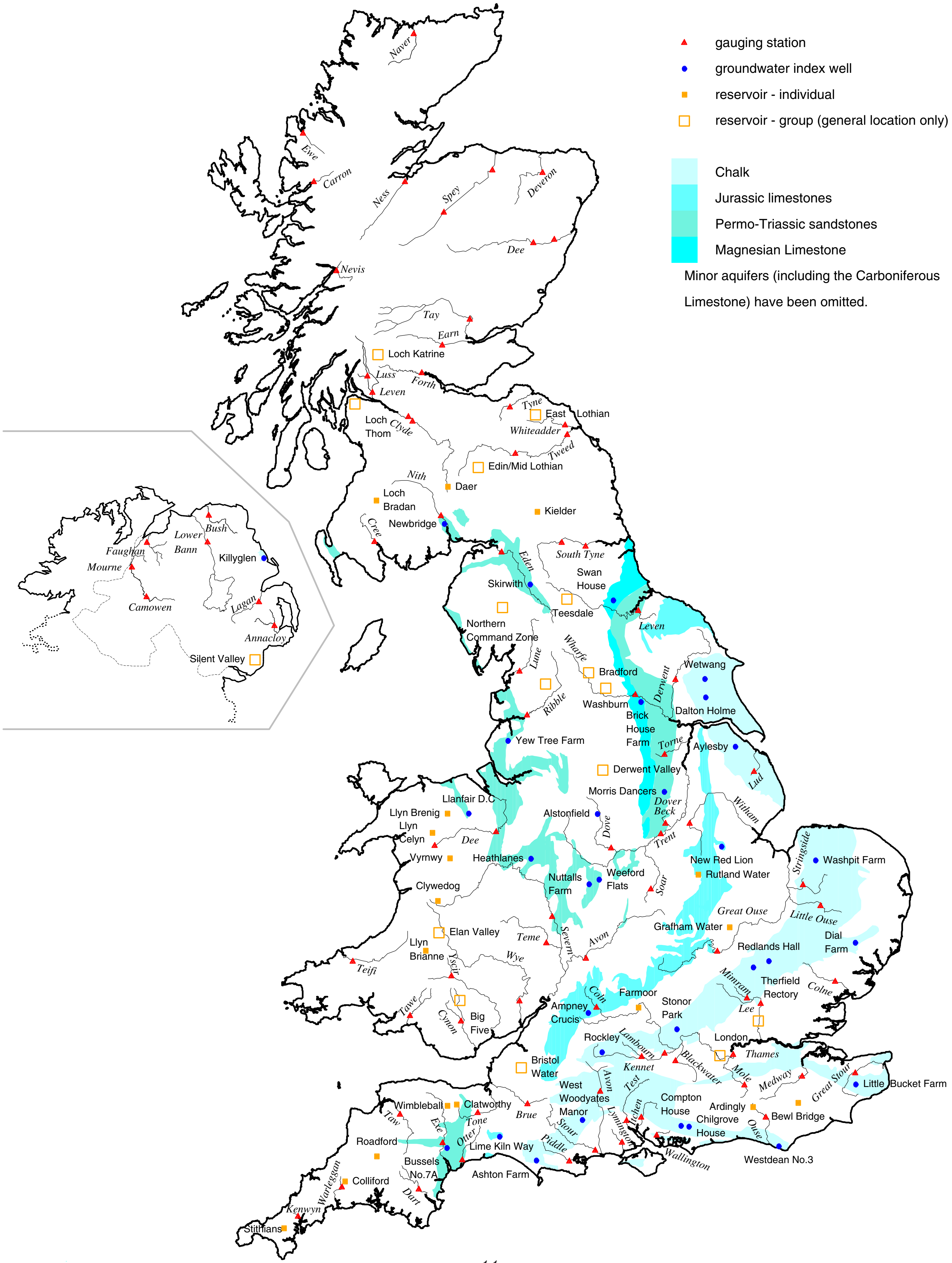
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Oct	Nov	Dec	2004 Jan	Feb	Mar	Min. Mar	Year* of min.
North West	N Command Zone	• 124929	37	33	59	83	99	**90**	78	1996
	Vyrnwy	55146	59	60	64	86	99	**92**	59	1996
Northumbrian	Teesdale	• 87936	38	39	48	72	92	**88**	72	1996
	Kielder	(199175)	(76)	(66)	(64)	(78)	(96)	**(90)**	(81)	1993
Severn Trent	Clywedog	44922	69	61	73	90	96	**90**	77	1996
	Derwent Valley	• 39525	40	29	37	65	100	**98**	46	1996
Yorkshire	Washburn	• 22035	58	46	49	69	97	**94**	53	1996
	Bradford supply	• 41407	51	42	54	72	89	**90**	53	1996
Anglian	Grafham	(55490)	(72)	(64)	(67)	(74)	(82)	**(88)**	(72)	1997
	Rutland	(116580)	(73)	(66)	(65)	(71)	(81)	**(91)**	(71)	1992
Thames	London	• 202340	58	49	62	91	97	**97**	83	1988
	Farmoor	• 13830	54	43	59	97	96	**92**	64	1991
Southern	Bewl	28170	55	48	51	63	96	**98**	50	1989
	Ardingly	4685	32	15	23	41	95	**100**	89	1992
Wessex	Clatworthy	5364	25	14	16	54	100	**100**	82	1992
	Bristol WW	• (38666)	(79)	(48)	(44)	(64)	(83)	**(91)**	(65)	1992
South West	Colliford	28540	64	59	59	54	71	**72**	57	1997
	Roadford	34500	63	53	51	64	65	**68**	35	1996
	Wimbleball	21320	46	34	36	72	95	**99**	72	1996
	Stithians	5205	57	50	46	57	81	**93**	45	1992
Welsh	Celyn and Brenig	• 131155	77	75	81	91	100	**99**	69	1996
	Brianne	62140	76	71	81	96	100	**92**	92	2004
	Big Five	• 69762	48	38	53	76	97	**96**	85	1988
	Elan Valley	• 99106	48	41	56	88	100	**94**	88	1993
Scotland(E)	Edinburgh/Mid Lothian	• 97639	56	48	45	65	77	**79**	73	1999
	East Lothian	• 10206	61	38	38	78	100	**100**	91	1990
Scotland(W)	Loch Katrine	• 111363	54	40	66	80	98	**88**	88	2004
	Daer	22412	55	42	73	85	100	**94**	94	2004
	Loch Thom	• 11840	71	69	72	90	90	**90**	90	2004
Northern	Total+	•	64	54	59	62	78	**81**	81	2004
Ireland	Silent Valley	• 20634	62	47	47	54	59	**64**	57	2002

() 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 1988-2004 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 Met 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

NATURAL ENVIRONMENT RESEARCH COUNCIL

03/04