Hydrological Summary
for the United Kingdom

April 2004

General

April rainfall commonly has a disproportionate influence on the resources outlook for the ensuing summer. It was certainly influential this year when, following a dry early spring, April was very unsettled across much the greater part of the UK with most areas reporting well above average rainfall; intense downpours triggered localised, mostly urban, flooding. With soils still generally moist, the hydrologically effective rainfall provided a welcome boost to reservoir stocks. Contents fell in a few reservoirs (e.g. in the South-West and Northern Ireland) but overall stocks for England and Wales increased modestly to stand appreciably above average in early May, and considerably above corresponding stocks in 2003. Generally, the April rainfall patterns favoured the major aquifer outcrop areas and the seasonally late infiltration was sufficient to moderate or reverse the early spring recessions. At month-end, groundwater resources were close to average in almost all areas. Substantial long term rainfall deficiencies remain but the water resources outlook for the summer is generally good.

Rainfall

Low pressure dominated synoptic patterns for much of last month and the proverbial April showers were decidely more vigorous than usual; widespread frontal rainfall also contributed to a provisional UK total for April which ranks amongst the wettest half dozen since 1966. The 18th was especially wet with much of eastern England and the Borders registering rainfall totals > 20 mm. Intense localised downpours were especially common over the final week. Following a short heat-wave, thunderstorms on the 26th and 27th resulted in some exceptional storm totals e.g. 43 mm in 2hrs at Bromsgrove (26th); 33 mm in an hour near Sheffield (27th). Further vigorous thunderstorms affected much of southern England as warm, moist air pushed up from France on the 27th. The showery nature of much of the April rainfall made for substantial local variability in the monthly totals but only a few areas – mostly in Wales and north-west England – reported below 75% of average; Anglesey was especially dry. By contrast, much of the Scottish Highlands registered around twice the average, with similar percentages characterising parts of the Midlands and the North-East. Regional rainfall deficiencies since January 2003 remain very substantial but the above average rainfall over the last 6 months has largely banished the spectre of drought.

River Flows

River flows in most catchments were seasonally depressed and in brisk recession entering April, but - counter to the normal seasonal trend – they increased over the month and in a few areas modest floodplain inundations occurred during the latter half of April. Heavy runoff from the North York Moors on the 18/19th provoked flood warnings on the Derwent and localised flooding was common on the 26th/27th (e.g in Worcester, Sheffield and London) as local drainage systems were overwhelmed. Flow patterns in the Thames typified many rivers with runoff rates increasing from considerably below to appreciably above through April. Correspondingly, April runoff totals were mostly well within the normal range but with significant variations reflecting both regional rainfall patterns and catchment geology. In Devon, the Taw recorded only around 40% of its April average whereas, in the North-East, the Leven reported >200%. Local contrasts where particularly evident in the English Lowlands where rivers draining impermeable catchments responded much more quickly to the April rainfall than spring-fed streams and rivers. Runoff over last six months (Nov-April) is appreciably below average across almost all of the UK and longer term accumulations – reflecting the impact of the 2003 drought – are depressed over wide areas. Many rivers (including the Trent, Exe and Medway) have registered only a single month with flows above the average since Jan 2003; in this timeframe the 15-month accumulations for the Exe and Medway rank as the 2nd and 3rd lowest, respectively, in records of almost 50 years. The late-spring return to more typical flow rates has therefore been particularly welcome.

Groundwater

April began with soil moisture deficits building across many eastern aquifer outcrop areas and, with evaporation losses accelerating, the prospect for further significant recharge was poor. In the event, the April rainfall was generally well distributed through the month and 30%, or more, above average across most major aquifer units; in the east, the frontal rainfall on the 18th was especially beneficial. This was sufficient to re-initiate infiltration and provide a seasonally late pulse of recharge. Though modest in magnitude, this generated an upturn in groundwater levels (e.g. at Ampney Crucis in the Jurassic Limestone and Rockley in the Chalk). April groundwater levels in the Chalk reflected the responsiveness of the aquifer to recharge and late-spring groundwater levels are now well within the normal range for almost all index sites. Despite steep declines in Feb/March, a similar pattern can be recognised in the other limestone aquifers. Spatial variation is much more evident in the Permo-Triassic sandstones where notably high levels at Yew Tree Farm contrast with relatively depressed water-table in southern Scotland, however, most PTs index sites registered typical spring levels. Overall groundwater resources were only a little below average at month-end with, in some areas, the likelihood of further modest recoveries before the summer recessions become firmly established.

Centre for Ecology & Hydrology
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British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Apr 2004	Feb 04-Apr 04	RP	Nov 03-Apr 04	RP	Aug 03-Apr 04	RP	Feb 03-Apr 04	RP
England & Wales	**mm**	**90**	**190**		**531**		**655**		**985**	
	%	**147**	**95**	**2-5**	**111**	**2-5**	**91**	**2-5**	**88**	**5-10**
North West	mm	74	225		663		824		1296	
	%	104	91	2-5	107	2-5	85	5-10	89	5-10
Northumbrian	mm	67	184		462		588		889	
	%	116	98	2-5	105	2-5	87	2-5	84	5-15
Severn Trent	mm	94	172		409		510		817	
	%	168	100	2-5	104	2-5	86	2-5	87	5-10
Yorkshire	mm	102	196		462		574		903	
	%	171	105	2-5	107	2-5	88	2-5	88	5-10
Anglian	mm	70	135		348		418		656	
	%	151	103	2-5	118	5-10	92	2-5	89	2-5
Thames	mm	82	154		431		496		725	
	%	162	100	2-5	121	5-10	92	2-5	85	5-10
Southern	mm	75	143		487		580		820	
	%	143	84	2-5	116	2-5	92	2-5	86	5-10
Wessex	mm	77	177		516		607		921	
	%	145	93	2-5	112	2-5	89	2-5	88	2-5
South West	mm	72	222		632		774		1221	
	%	104	82	2-5	93	2-5	79	5-15	83	5-15
Welsh	mm	84	271		756		926		1444	
	%	102	93	2-5	103	2-5	84	5-10	88	5-10
Scotland	**mm**	**121**	**326**		**853**		**1063**		**1562**	
	%	**150**	**104**	**2-5**	**109**	**2-5**	**88**	**5-10**	**87**	**5-15**
Highland	mm	139	426		1076		1351		1930	
	%	148	112	2-5	113	2-5	94	2-5	91	5-10
North East	mm	112	242		562		715		1021	
	%	165	110	2-5	107	2-5	88	2-5	82	20-30
Tay	mm	113	257		698		810		1265	
	%	165	92	2-5	101	2-5	78	10-20	81	15-25
Forth	mm	93	228		597		738		1149	
	%	151	94	2-5	101	2-5	80	10-20	83	10-20
Tweed	mm	89	220		528		664		1010	
	%	147	104	2-5	104	2-5	84	5-10	83	10-20
Solway	mm	120	320		855		1018		1550	
	%	152	107	2-5	114	2-5	87	5-10	89	5-10
Clyde	mm	131	341		988		1229		1845	
	%	147	94	2-5	107	2-5	85	5-10	87	5-15
Northern Ireland	**mm**	**76**	**208**		**540**		**681**		**1158**	
	%	**114**	**87**	**2-5**	**95**	**2-5**	**77**	**10-20**	**87**	**5-10**

RP = Return period

 All monthly totals since November 2003 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

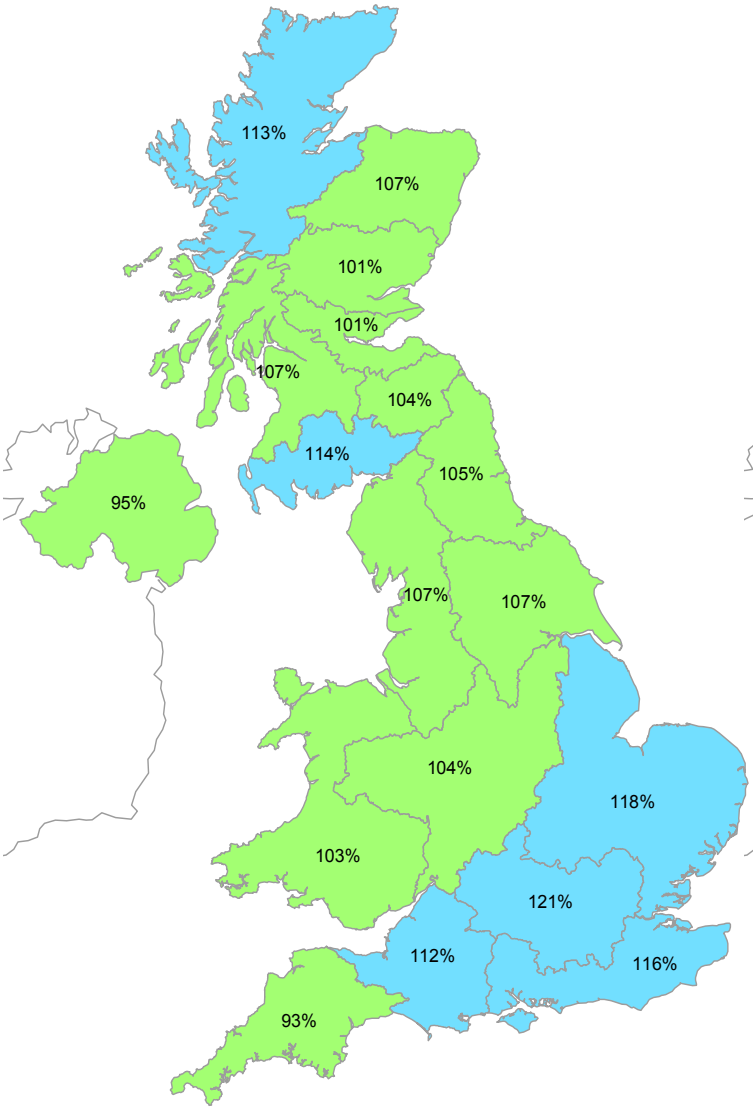
Above average

Normal range

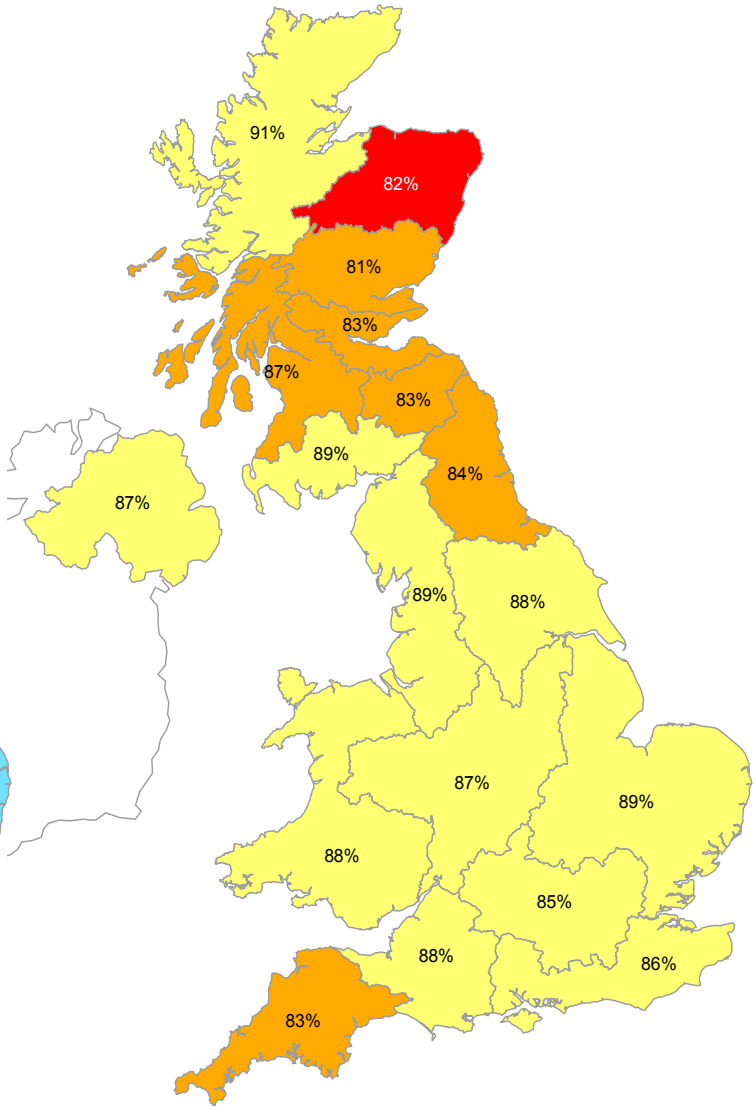
Below average

Substantially below average

Exceptionally low rainfall



November 2003 - April 2004

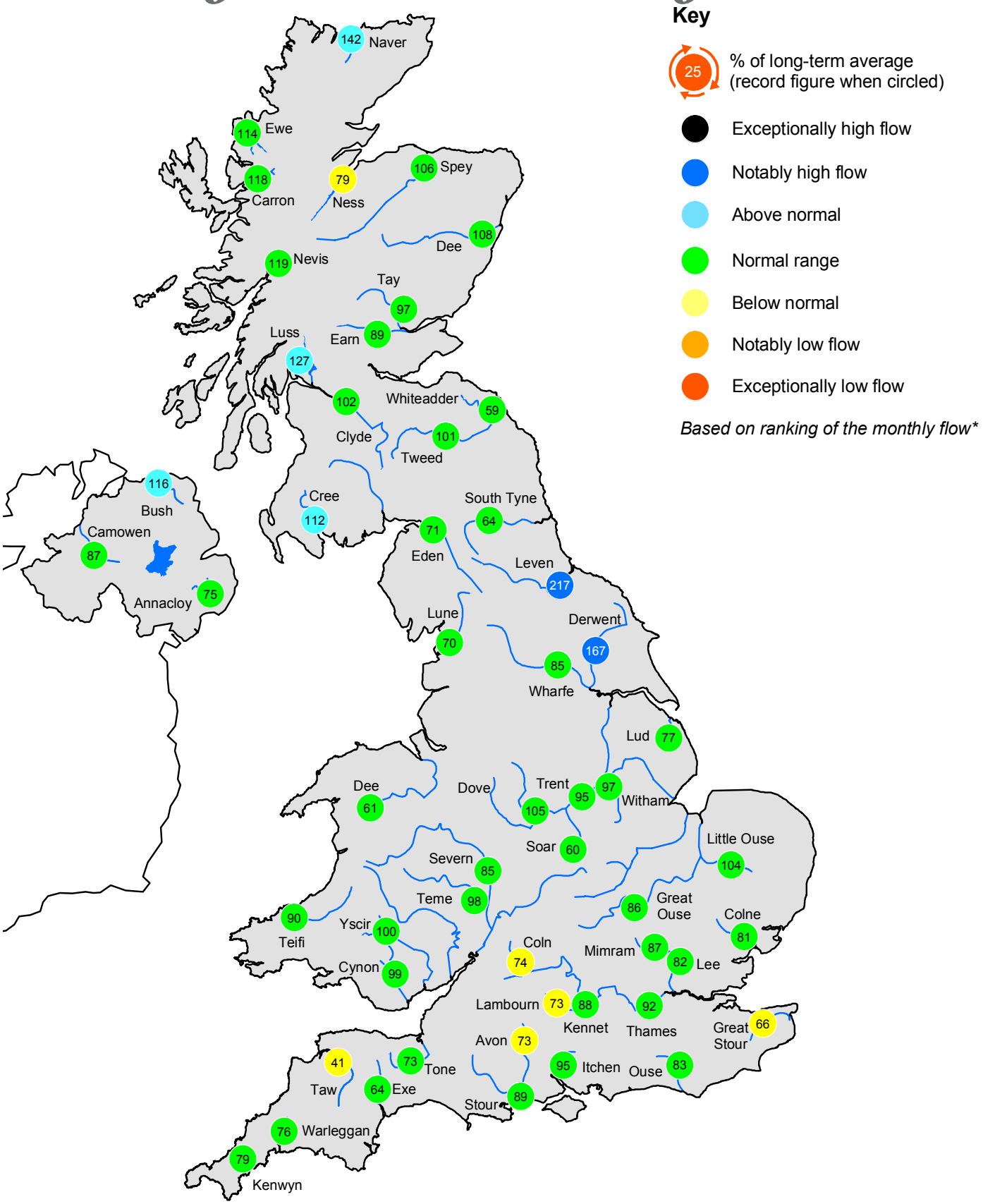


February 2003 - April 2004

Rainfall accumulation maps

A comprehensively wet April, except for the western fringes of EW and parts of the North West, has improved the GB water resources situation. Long term deficiencies are still significant, however, and the 15 month deficiencies, in both the Tay and Forth regions caused them to be ranked the 5th driest Feb-Apr in 44 years. By contrast, the 6 month Nov- April rainfall accumulations exceeded 20% of average in parts of the SE (notably in the Thames region) ensuring a resource situation within the normal range.

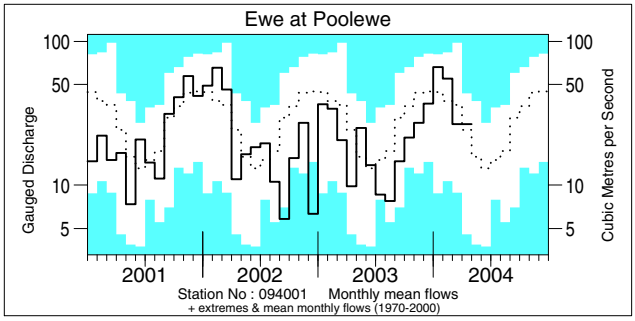
River flow . . . River flow . . .

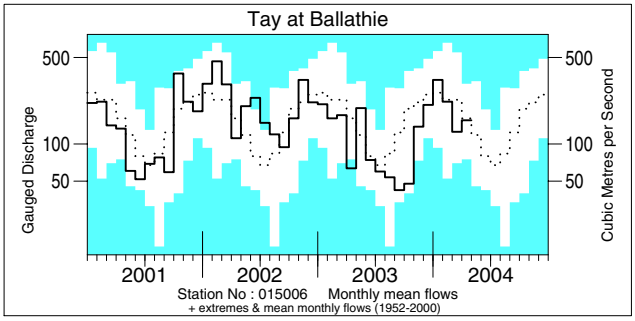


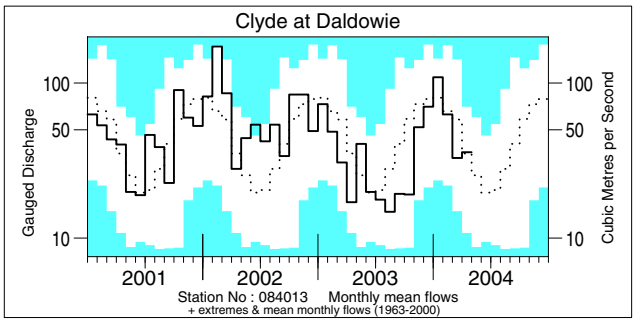
River flows - April 2004

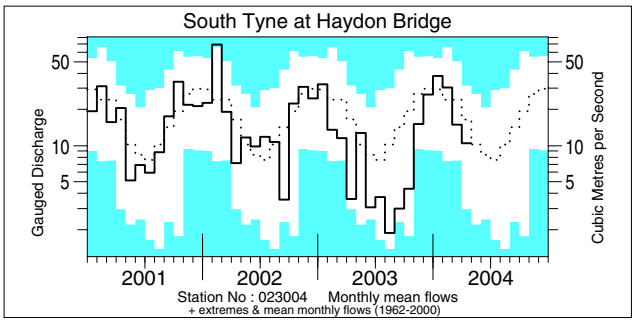
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

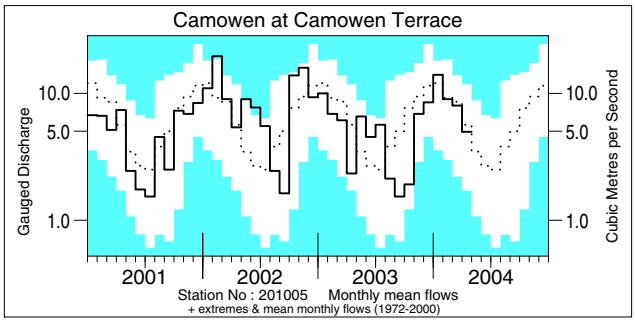
River flow . . . River flow . . .

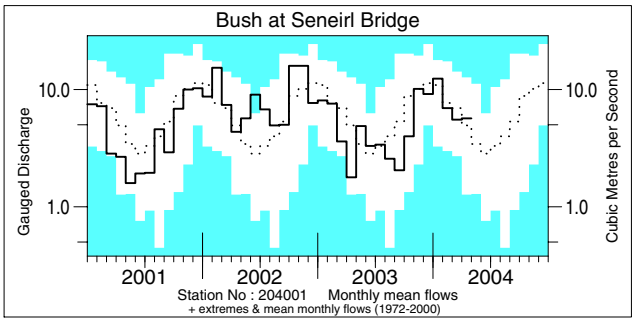


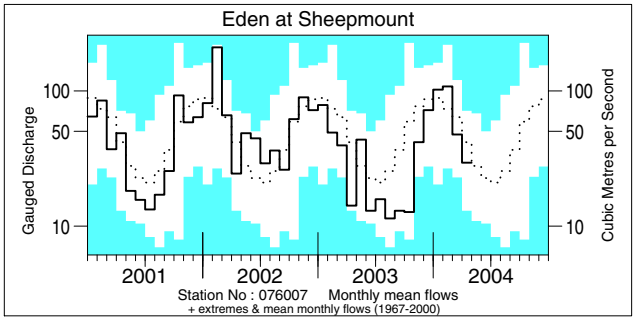


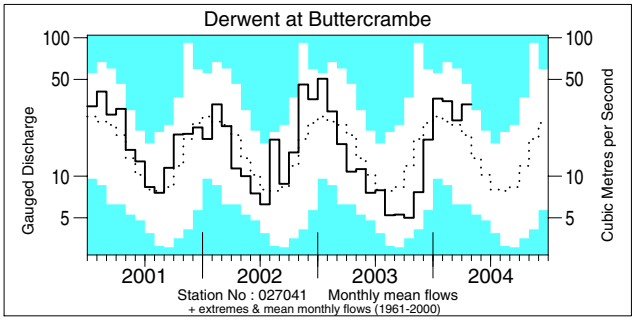


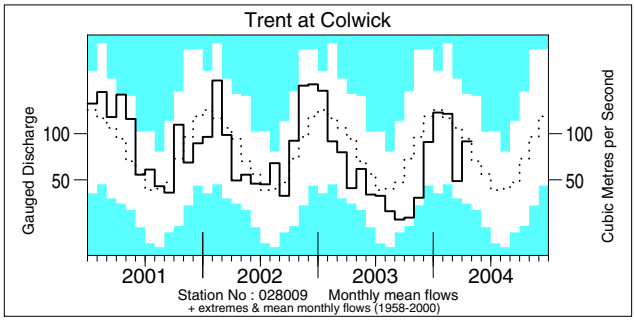


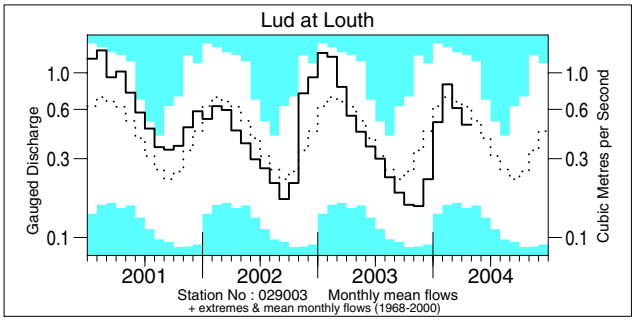








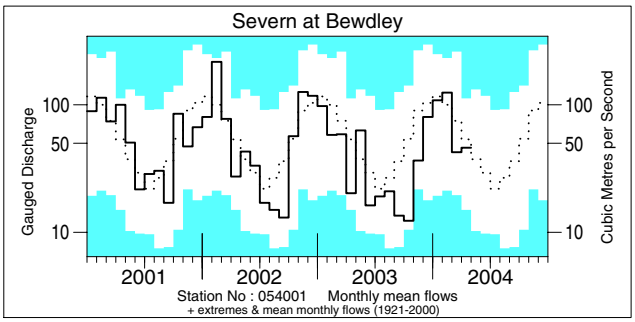


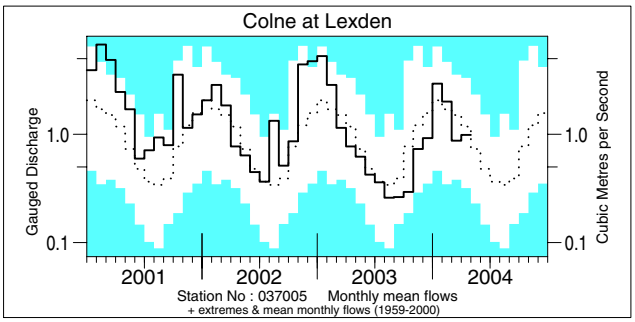


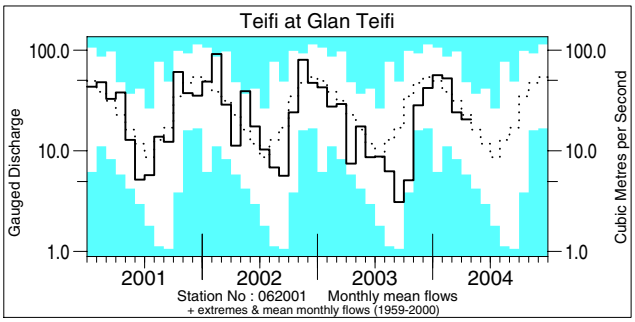
Monthly river flow hydrographs

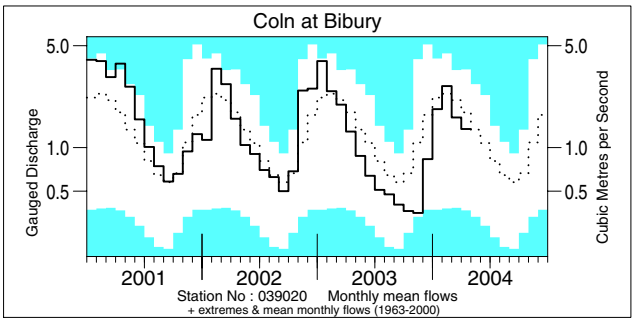
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2001 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

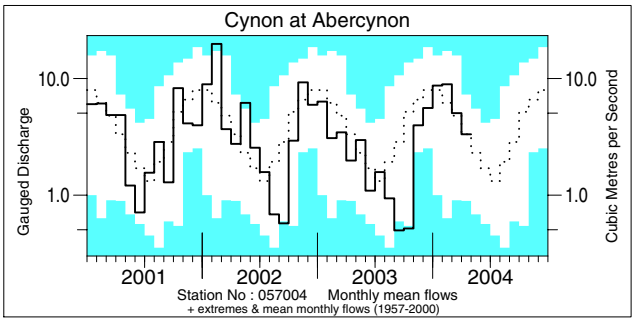
River flow . . . River flow . . .

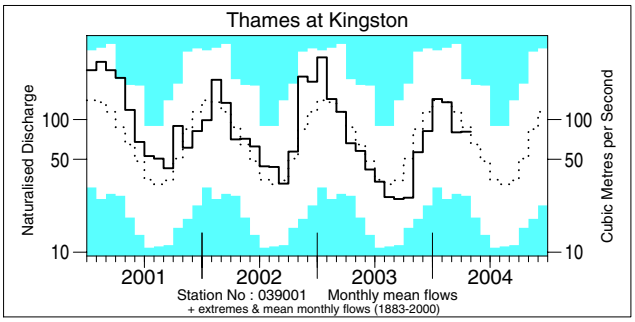


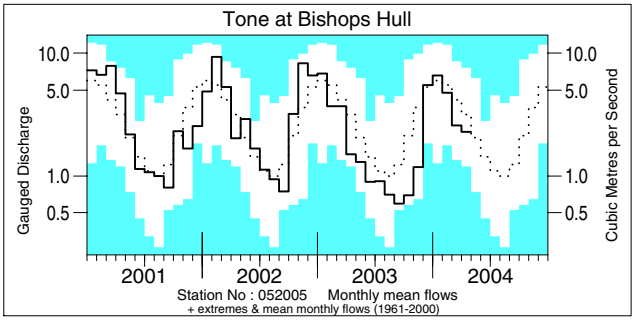


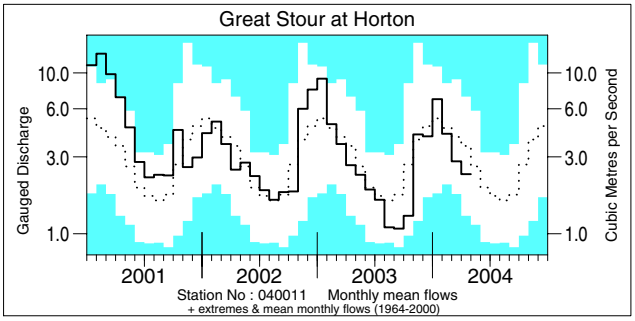


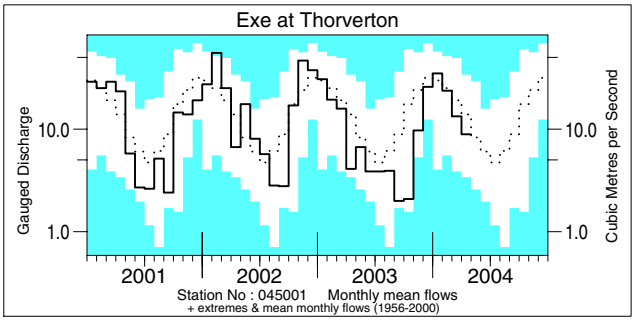


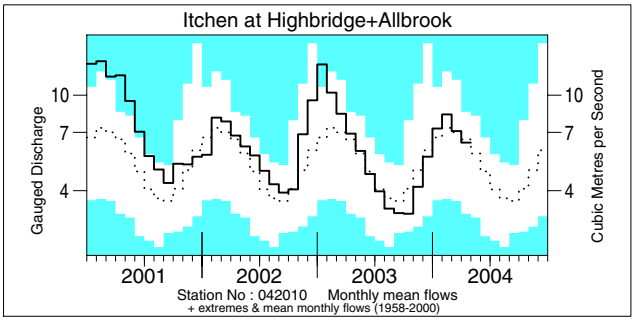












Notable runoff accumulations (a) November 2003 - April 2004, (b) February 2003 - April 2004

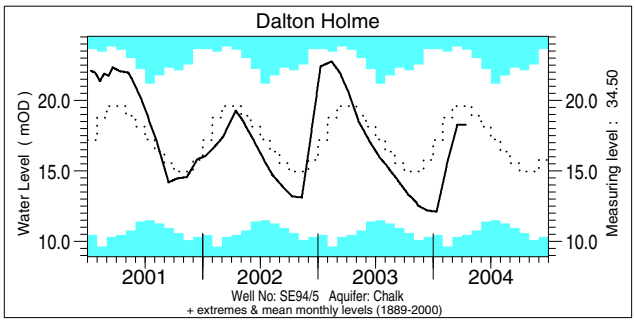
	River	%lta	Rank
a)	Forth	71	3/23
	Trent	77	9/46
	Thames	66	29/121
	Ouse (Sussex)	66	7/39
	Avon (Amesbury)	73	7/39
	Otter	75	6/42
	Avon (Evesham)	62	12/67
	Annacloy	71	2/24

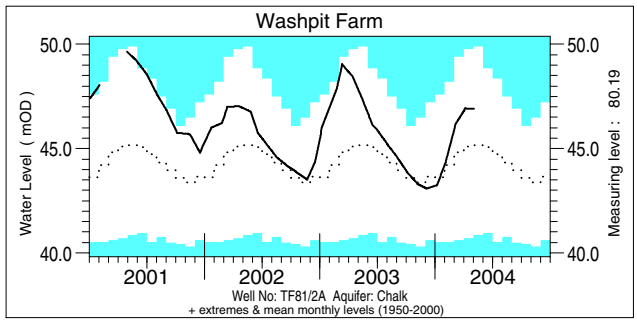
	River	%lta	Rank
b)	Ness	77	2/31
	Dee (Woodend)	72	1/74
	S Tyne	68	2/40
	Soar	58	2/32
	Medway	54	3/40
	Exe	71	2/47
	Taw	62	2/45

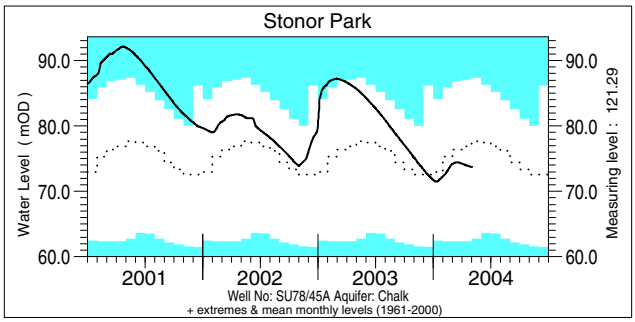
River	%lta	Rank
Luss	72	1/25
Carron	75	2/25
Naver	82	1/26
Mourne	79	1/21
Faughan	67	1/27
Lower Bann	72	1/23
Lagan	73	2/29

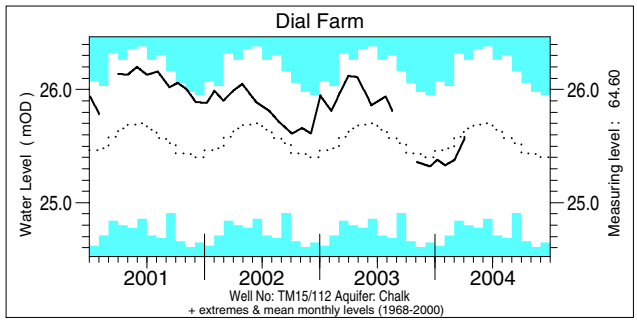
lta = long term average
Rank 1 = lowest on record

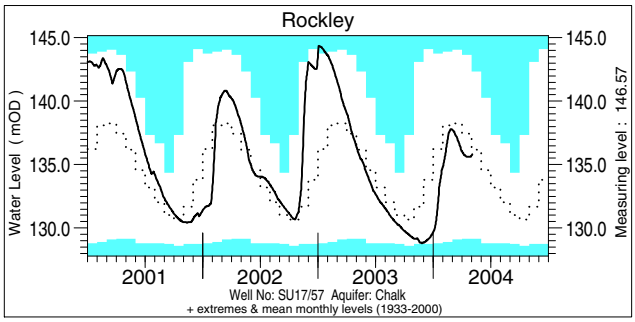
Groundwater . . . Groundwater

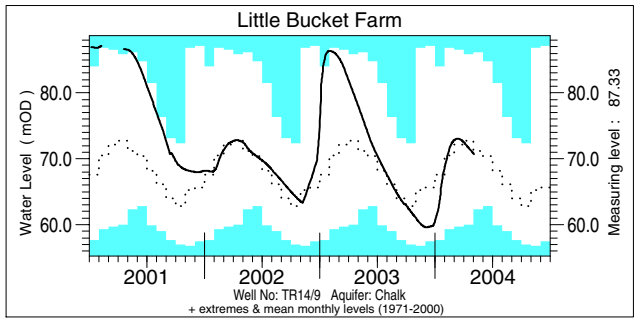


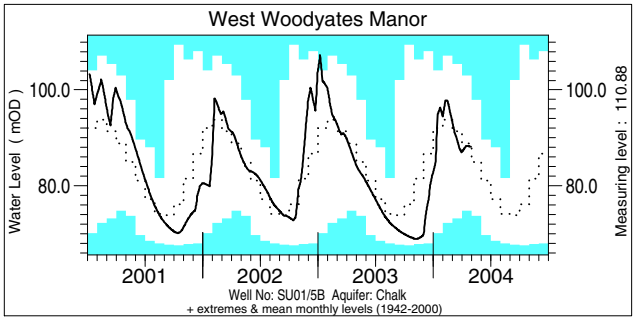


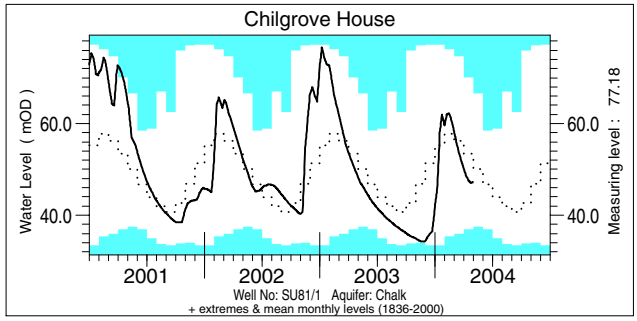


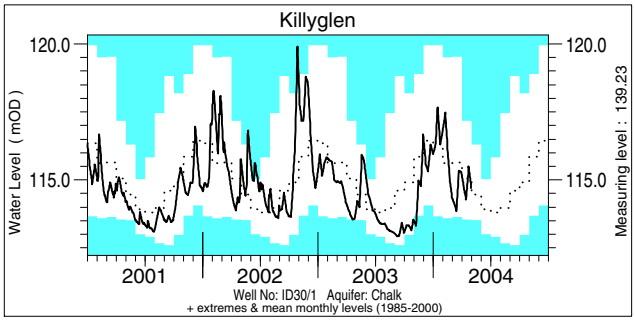


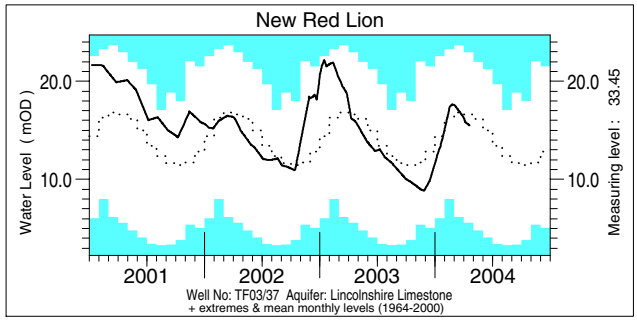






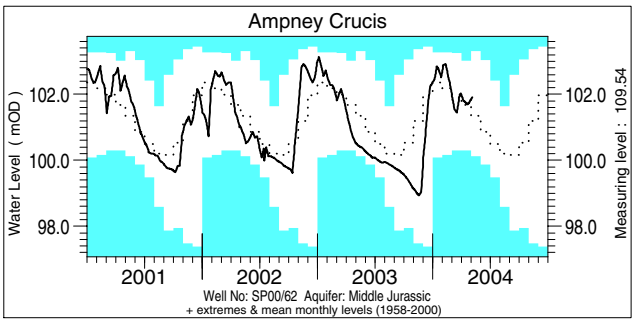


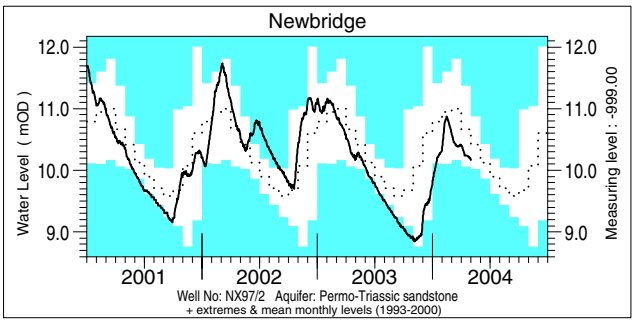


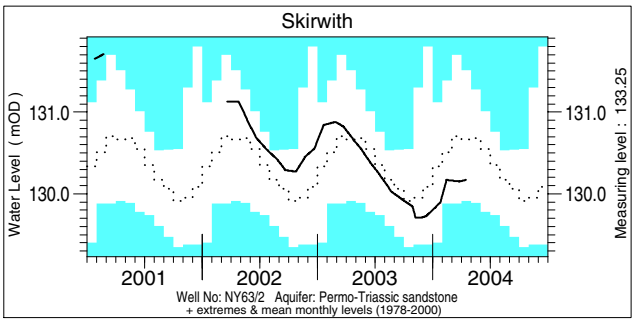


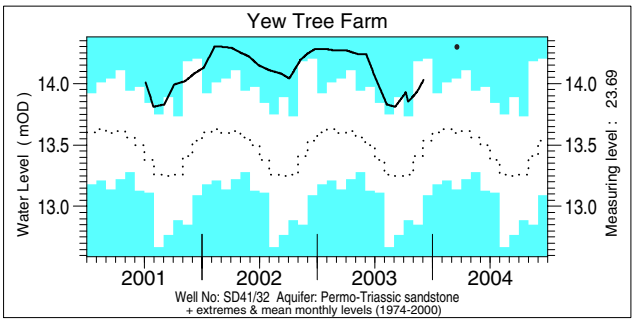
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

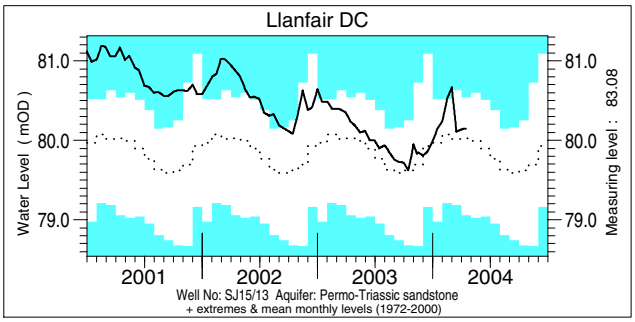
Groundwater . . . Groundwater

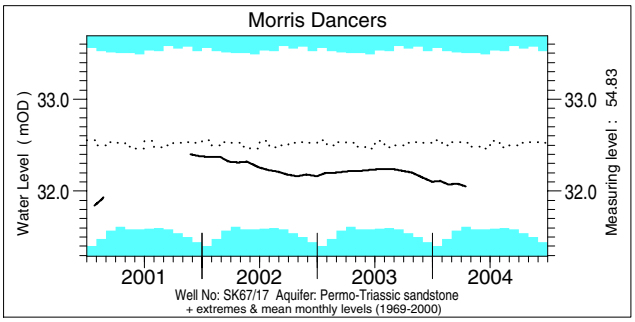


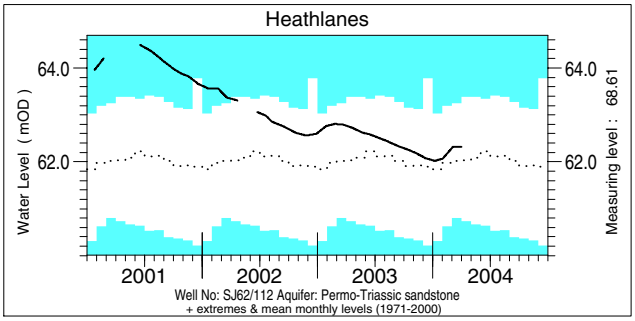


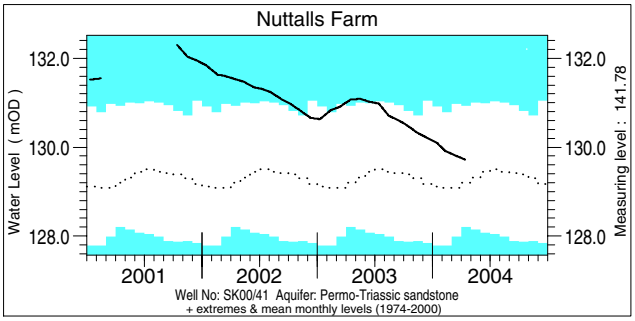


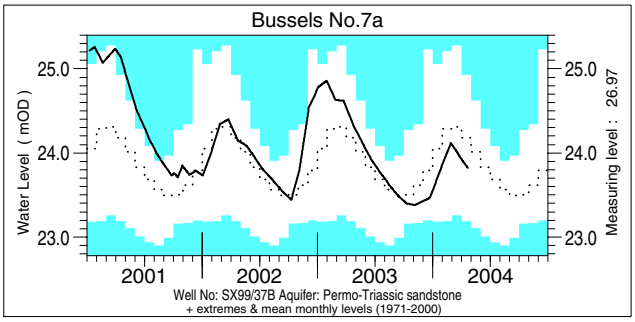


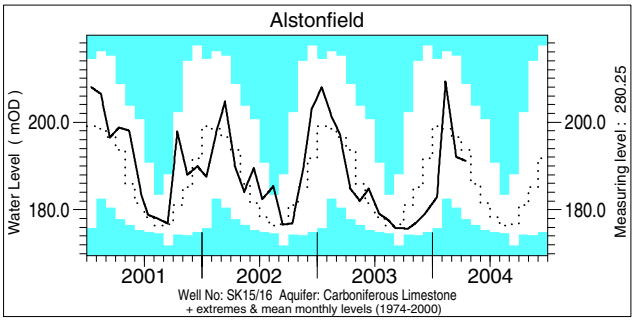










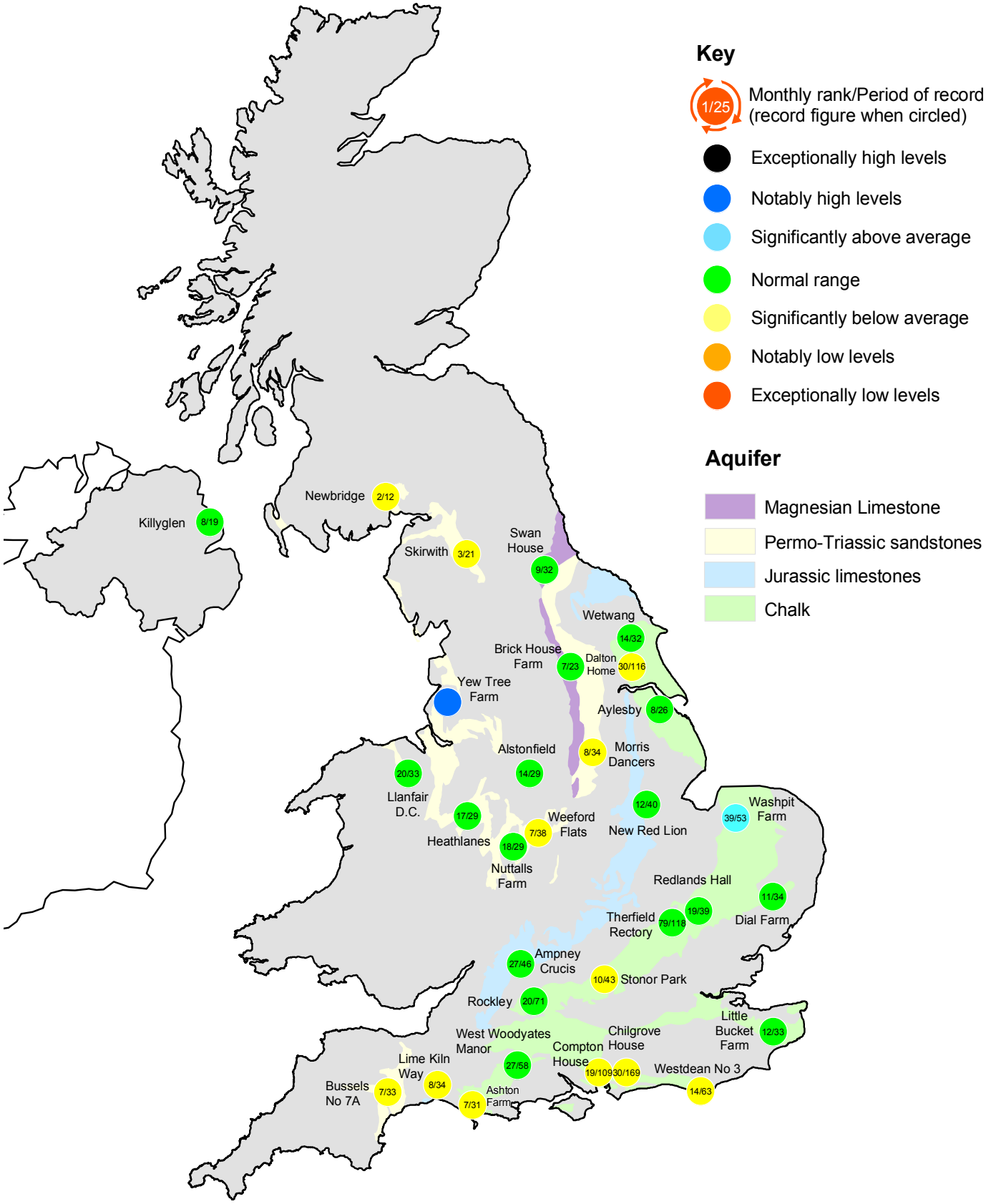


Groundwater levels April / May 2004

Borehole	Level	Date	Apr. av.	Borehole	Level	Date	Apr. av.	Borehole	Level	Date	Apr. av.
Dalton Holme	18.26	13/04	19.53	Chilgrove House	47.23	30/04	52.31	Llanfair DC	80.15	15/04	80.05
Washpit Farm	46.91	04/05	45.39	Killyglen	114.71	30/04	114.95	Morris Dancers	32.05	15/04	32.39
Stonor Park	73.73	04/05	78.03	New Red Lion	15.48	19/04	16.51	Heathlanes	62.32	01/04	62.10
Dial Farm	25.58	04/04	25.69	Ampney Crucis	101.91	05/05	101.72	Nuttalls Farm	129.72	13/04	129.51
Rockley	135.84	04/05	137.59	Newbridge	10.17	02/05	10.63	Bussels No.7a	23.82	21/04	24.20
Little Bucket Farm	70.74	03/05	72.64	Skirwith	130.17	15/04	130.65	Alstonfield	191.14	15/04	193.25
West Woodyates	88.14	30/04	88.47	Yew Tree Farm	14.30	19/03	13.72				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

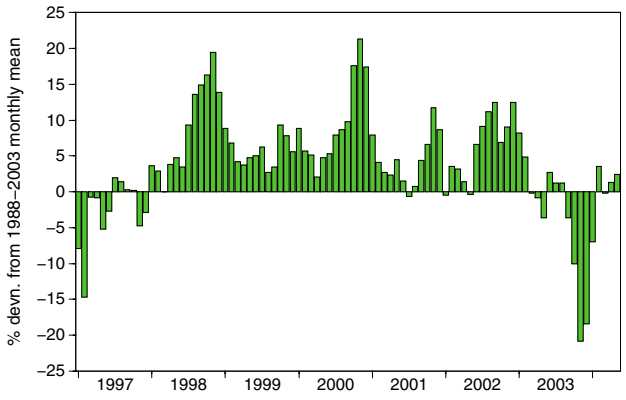


Groundwater levels - April 2004

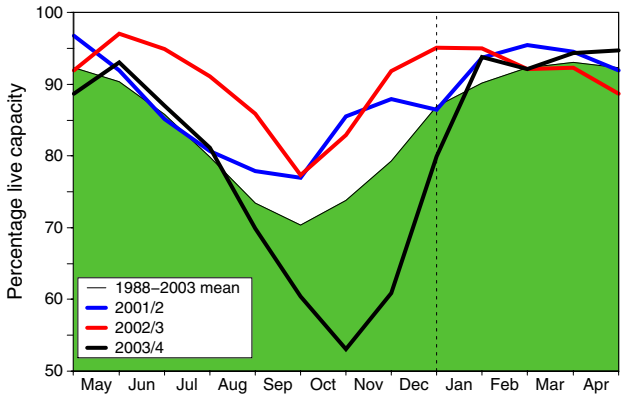
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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.

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.

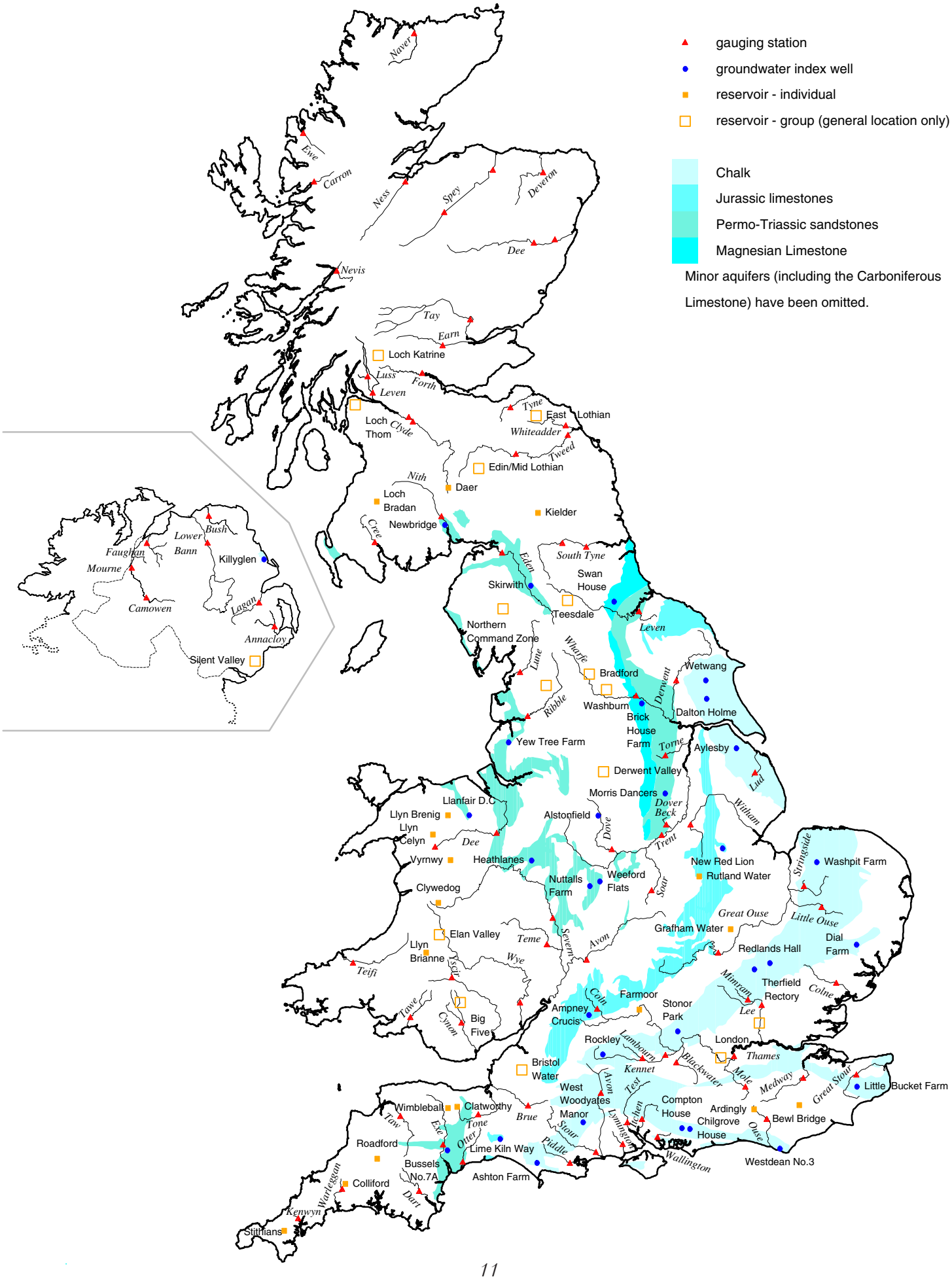
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Dec	2004 Jan	Feb	Mar	Apr	May	Min. May	Year* of min.
North West	N Command Zone	• 124929	59	83	99	90	88	**89**	74	2003
	Vyrnwy	55146	64	86	99	92	99	**95**	70	1996
Northumbrian	Teesdale	• 87936	48	72	92	88	96	**95**	74	2003
	Kielder	(199175)	(64)	(78)	(96)	(90)	(91)	**(92)**	(85)	1990
Severn Trent	Clywedog	44922	73	90	96	90	99	**100**	85	1988
	Derwent Valley	• 39525	37	65	100	98	96	**100**	54	1996
Yorkshire	Washburn	• 22035	49	69	97	94	92	**95**	76	1996
	Bradford supply	• 41407	54	72	89	90	92	**93**	60	1996
Anglian	Grafham	(55490)	(67)	(74)	(82)	(88)	(95)	**(98)**	(73)	1997
	Rutland	(116580)	(65)	(71)	(81)	(91)	(94)	**(97)**	(72)	1997
Thames	London	• 202340	62	91	97	97	97	**97**	86	1990
	Farmoor	• 13830	59	97	96	92	96	**100**	81	2000
Southern	Bewl	28170	51	63	96	98	100	**100**	63	1990
	Ardingly	4685	23	41	95	100	100	**100**		
Wessex	Clatworthy	5364	16	54	100	100	95	**100**	81	1990
	Bristol WW	• (38666)	(44)	(64)	(83)	(91)	(92)	**(92)**	(85)	1990
South West	Colliford	28540	59	54	71	72	75	**75**	56	1997
	Roadford	34500	51	64	65	68	68	**68**	41	1996
	Wimbleball	21320	36	72	95	99	100	**100**	79	1992
	Stithians	5205	46	57	81	93	97	**94**	65	1992
Welsh	Celyn and Brenig	• 131155	81	91	100	99	100	**99**	75	1996
	Brianne	62140	81	96	100	92	98	**99**	86	1997
	Big Five	• 69762	53	76	97	96	98	**99**	85	1997
	Elan Valley	• 99106	56	88	100	94	99	**95**	87	2003
Scotland(E)	Edinburgh/Mid Lothian	• 97639	45	65	77	79	80	**81**	62	1998
	East Lothian	• 10206	38	78	100	100	100	**100**	89	1992
Scotland(W)	Loch Katrine	• 111363	66	80	98	88	91	**93**	83	2001
	Daer	22412	73	85	100	94	100	**97**	89	2003
	Loch Thom	• 11840	72	90	90	90	94	**97**	88	2003
Northern Ireland	Total+	•	59	62	78	81	85	**84**	80	2003
	Silent Valley	• 20634	47	54	59	64	66	**64**	58	2000

() 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
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