Hydrological Summary
for the United Kingdom

March 2005

General

March was characterised both by large temporal variations in temperature and substantial spatial variations in rainfall – but most regions of the UK registered significantly below average rainfall totals and drought conditions intensified in many areas. Provisionally, the Nov-March rainfall total for England and Wales is the third lowest since the very severe drought of 1933/34. Large 5-month rainfall deficiencies now extend across most regions of E&W; the most notable in the English Lowlands (extending into Yorkshire) and the South-West. Fortunately, most reservoir stocks remain relatively healthy – marginally above the early April average for E&W as a whole but, importantly, well below average in parts of southern England (and in Yorkshire also). River flows in early March were notably depressed over wide areas and March runoff totals were among the lowest on record for a number of southern catchments. Aquifer recharge totals for March, and the winter half year, were notably low also. Correspondingly, groundwater levels are well below average (in the south particularly) but in most areas considerably above the minima of the early- and mid-1990s. Accumulated rainfall deficiencies are the equivalent of more than two months average rainfall over wide areas – evidence of a severe but not extreme drought. With evaporation rates set to increase briskly, some drought stress is inevitable through the coming summer. Its extent and magnitude will be heavily dependant on rainfall over the next 4-6 weeks.

Rainfall

As with much of the preceding winter, anticyclonic conditions again dominated synoptic patterns during March. Rain-bearing Atlantic frontal systems were infrequent although a particularly slow-moving system generated very useful rainfall totals (15-30mm) across southern England on the 29/30th. This constituted >60% of the monthly total in some areas and, remarkably, was the first major storm (rainfall >10mm) since mid-October in some central catchments. Above average March rainfall totals were largely confined to the coastal fringe of eastern Britain (including parts of Kent) where snowfall was significant – and a zone from Shropshire-Wiltshire. More typically, March totals fell below 70% of average and some localities (including parts of southern Pennines) reported <35%. For the majority of E&W, March was the fifth successive month with below average rainfall. The area suffering severe rainfall deficiencies has extended, most notably in Yorkshire which registered its lowest Nov-Mar rainfall on record (in a series from 1961). The Severn-Trent region also eclipsed its previous minima and accumulated deficiencies in this timeframe exceed 40% across much of southern England. In the recent past only in 1976 and 1992 have 'winter' droughts of a similar magnitude been experienced.

River Flow

March was a month of seasonally low flows across much of the UK. Four exceptionally dry weeks (and frozen headwaters) resulted in very depressed mid-March flows in much of Scotland (parts of Northern Ireland also). The protracted recessions were smartly reversed around the 17th (rapid snowmelt contributing to the spates in many upland catchments). Welcome, but short-lived, recoveries were also widespread across southern England over the last few days of the month. March runoff totals exceeded the average in a number of responsive eastern catchments (from the Ness to the Gt Stour) but, to the west, most were substantially below average - with low flows triggering artificial flow augmentation in some areas (e.g. Dorset). Runoff was most depressed in southern England: the Otter and Coln reported their 2nd lowest March runoff in records of >40 years. More significantly accumulated runoff totals since last October are depressed across much of southern Britain – in Hampshire, the River Wallington reported its 3rd lowest Nov-Mar runoff (after 1976 and 1973) in a 51-year series; outflows from Northern Ireland have also been very moderate in this timeframe. The lack of a normal winter recovery is exemplified by the River Mimram where monthly mean flows have been sensibly identical over the last 5 months. In the absence of a very wet late spring, the seasonal recessions will gather momentum heralding depressed flows in the drought affected regions during the coming summer.

Groundwater

Across most major outcrop areas soil moisture deficits increased briskly through mid-month but were reversed in the final week. This provided some scope for further infiltration; nonetheless, recharge to the major aquifers was again less than half the March average over wide areas; a similar deficiency applies to recharge over the full winter-half year. Correspondingly, the groundwater resources outlook has deteriorated substantially since the very early onset of recharge in the autumn of 2004. However, only in limited parts of the Chalk, Permo-Triassic sandstones and Oolitic Limestone outcrops of southern England have resources declined to the levels reported during the most recent groundwater drought episodes (those of the early- and mid-1990s); at Ampney Crucis in the Cotswolds, March groundwater levels were the lowest, apart from 1976, in a 46-year series. In eastern England, groundwater levels are mostly below average but remain largely in the normal range as do levels in most major limestone and sandstone aquifers across the Midlands and northern England. Nonetheless, the moderating influence of groundwater resources on drought impact across the English Lowlands (which was well demonstrated in 2003) will be much less influential this year and with outflows from springs commonly at their lowest (for the time of year) since 1997, baseflow contributions to river flow are likely to be very modest throughout the summer.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Mar 2005	Jan 05-Mar 05	RP	Nov 04-Mar 05	RP	Oct 04-Mar 05	RP	Apr 04-Mar 05	RP
England & Wales	**mm**	**56**	**165**		**285**		**440**		**919**	
	%	**75**	**72**	**5-10**	**68**	**15-25**	**87**	**2-5**	**100**	**<2**
North West	mm	**54**	258		455		620		1275	
	%	**56**	87	2-5	83	2-5	92	2-5	105	2-5
Northumbrian	mm	**66**	222		311		463		975	
	%	**92**	103	2-5	81	5-10	101	2-5	112	5-10
Severn Trent	mm	**51**	134		218		340		793	
	%	**83**	72	5-10	65	20-30	84	2-5	103	2-5
Yorkshire	mm	**44**	162		240		368		862	
	%	**64**	79	2-5	65	20-30	83	5-10	103	2-5
Anglian	mm	**31**	97		168		260		643	
	%	**67**	72	5-10	67	10-20	86	2-5	106	2-5
Thames	mm	**47**	101		189		309		660	
	%	**84**	60	5-15	62	20-30	83	2-5	94	2-5
Southern	mm	**53**	117		216		343		698	
	%	**84**	59	10-20	59	30-40	77	5-10	89	2-5
Wessex	mm	**58**	134		239		392		762	
	%	**83**	59	10-20	59	30-40	80	5-10	89	2-5
South West	mm	**57**	191		359		561		1037	
	%	**56**	56	15-25	59	30-50	77	5-10	87	5-10
Welsh	mm	**81**	269		496		744		1329	
	%	**74**	76	5-10	76	5-10	94	2-5	99	2-5
Scotland	**mm**	**112**	**472**		**784**		**988**		**1742**	
	%	**88**	**121**	**5-10**	**112**	**2-5**	**115**	**5-10**	**118**	**20-30**
Highland	mm	**150**	661		1133		1345		2204	
	%	**95**	142	*5-15*	132	*10-15*	128	*10-15*	127	*40-60*
North East	mm	**71**	297		451		632		1205	
	%	**86**	117	2-5	99	2-5	113	2-5	117	10-20
Tay	mm	**94**	410		593		817		1550	
	%	**83**	114	2-5	96	2-5	108	2-5	120	10-20
Forth	mm	**93**	362		532		726		1368	
	%	**95**	121	5-10	101	2-5	112	2-5	119	10-20
Tweed	mm	**76**	270		380		574		1142	
	%	**93**	107	2-5	85	2-5	105	2-5	114	5-10
Solway	mm	**78**	359		602		804		1530	
	%	**66**	96	2-5	90	2-5	97	2-5	107	2-5
Clyde	mm	**124**	502		886		1107		2020	
	%	**82**	108	2-5	106	2-5	107	2-5	115	5-15
Northern Ireland	**mm**	**69**	**248**		**402**		**535**		**1054**	
	%	**76**	**86**	**2-5**	**80**	**5-10**	**86**	**2-5**	**96**	**2-5**

% = percentage of 1961-90 average *RP = Return period*

 All monthly totals since November 2004 are provisional (see page 12). Revised Met Office totals for 1961-2003 have been recently incorporated. 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. Most of 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 and those for the Highland region take account of ranking positions. 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

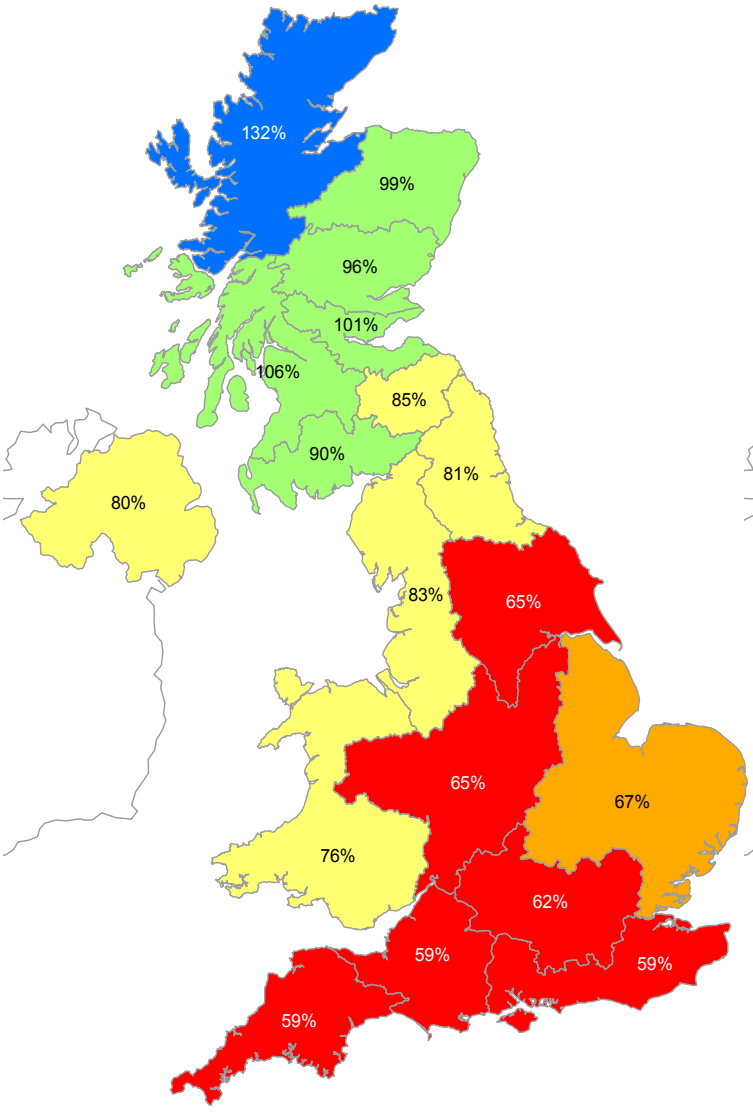
Above average

Normal range

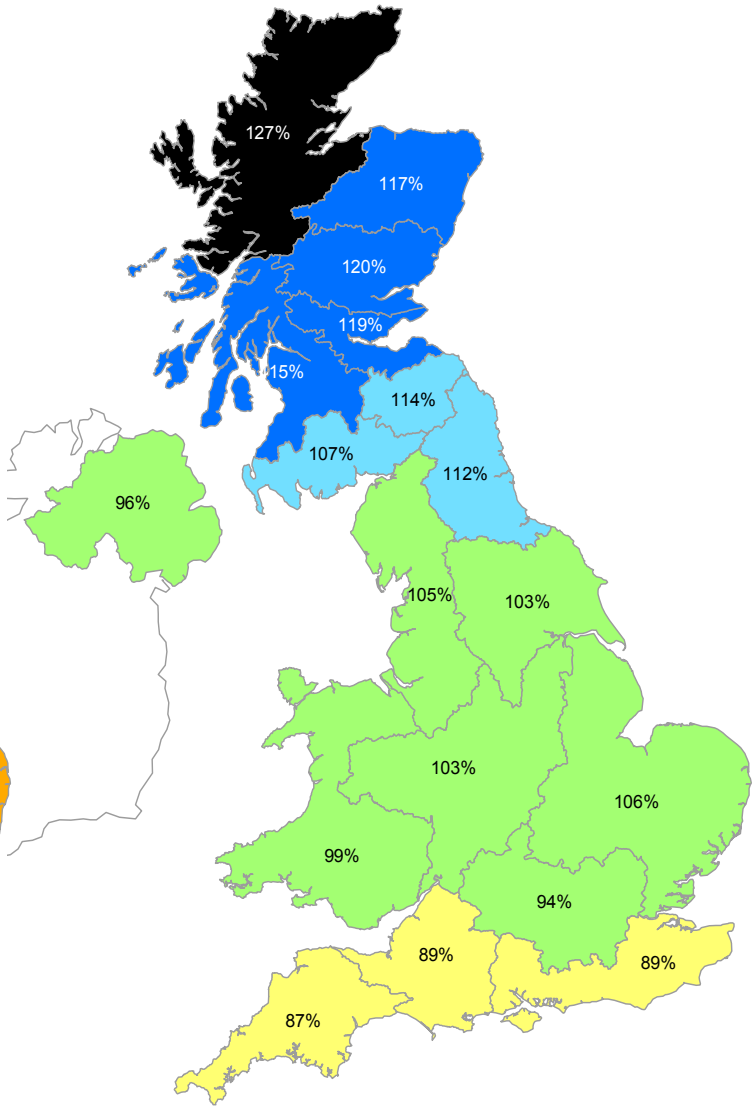
Below average

Substantially below average

Exceptionally low rainfall



November 2004 - March 2005

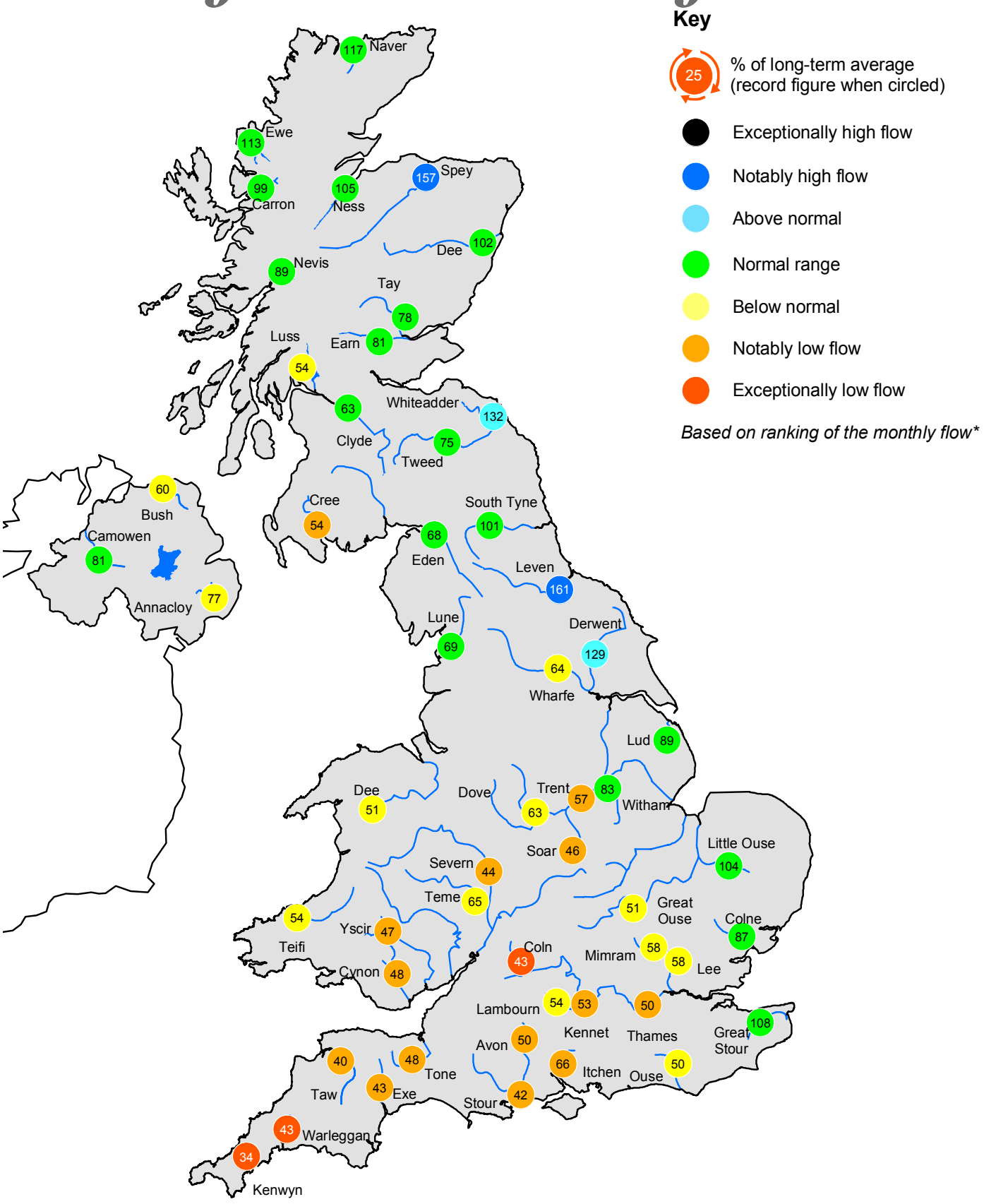


April 2004 - March 2005

Rainfall accumulation maps

The November-March rainfall total for the UK as a whole is, provisionally, the 2nd lowest (after 1995/95) since 1975/76. The regions with 5-month totals below 70% of average broadly define the area where drought conditions are most severe - generally, this corresponds to what are, on average, the driest parts of the country. Regional rainfall totals for the last 12 months reflect the preferred tracks of most rain-bearing frontal systems - with the Highland region registering its highest April-March rainfall total in a 46-year series.

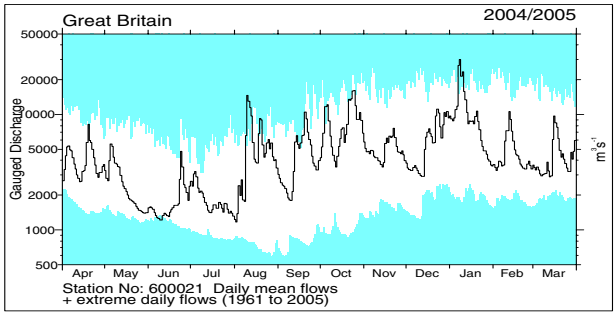
River flow . . . River flow . . .

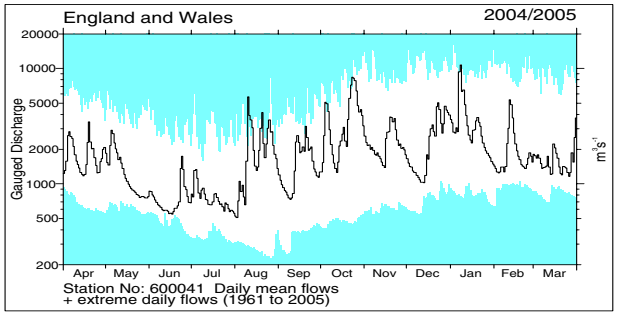


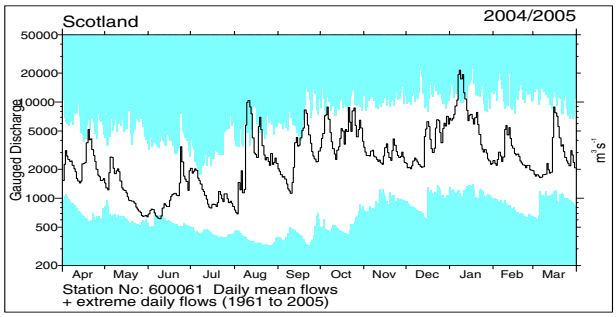
River flows - March 2005

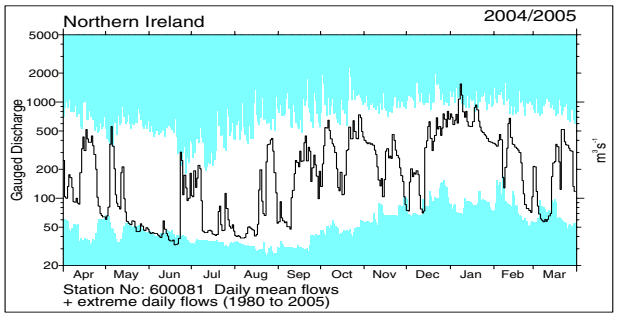
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

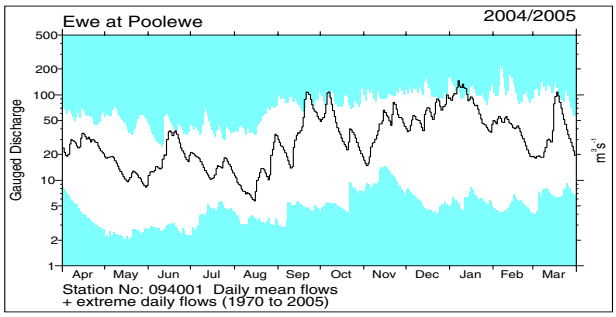
River flow . . . River flow . . .

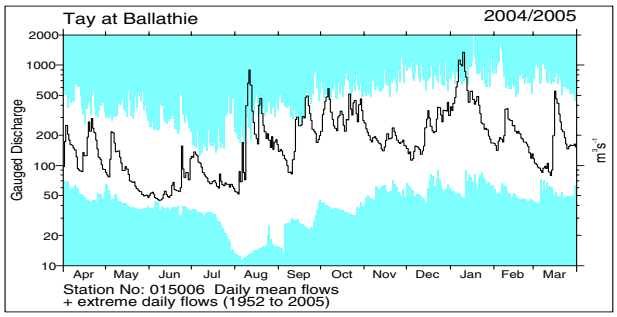


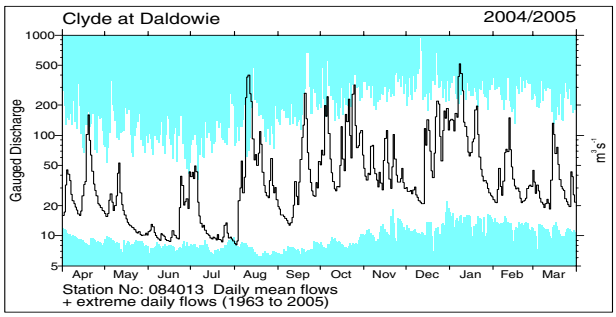


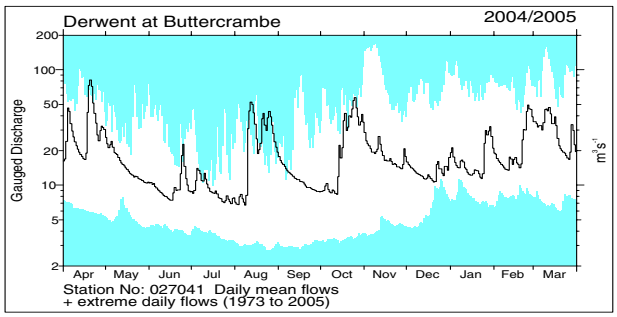


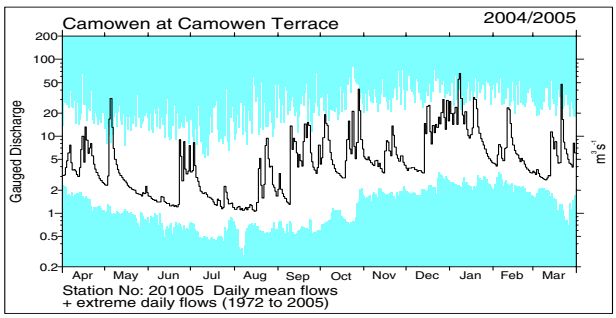


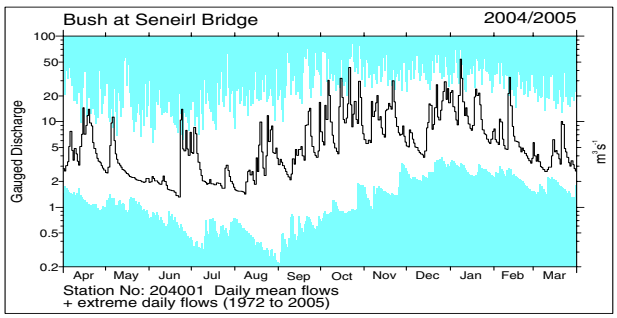








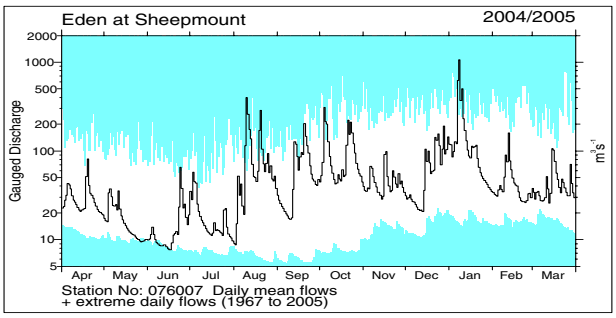


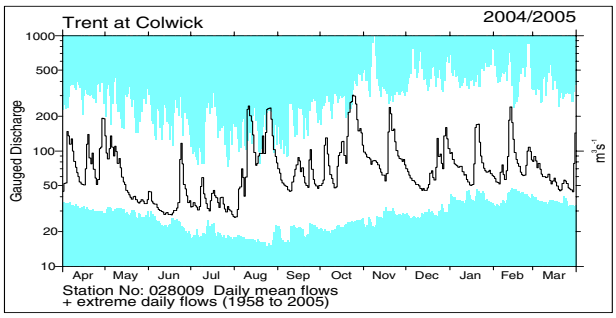


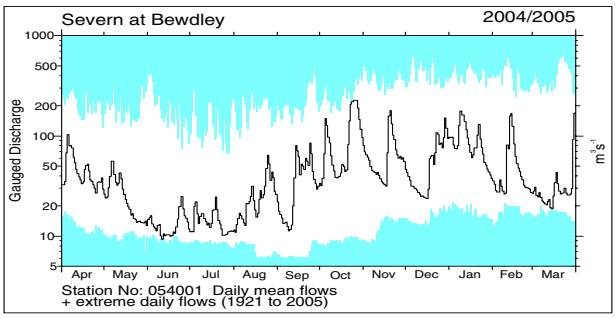
River flow hydrographs

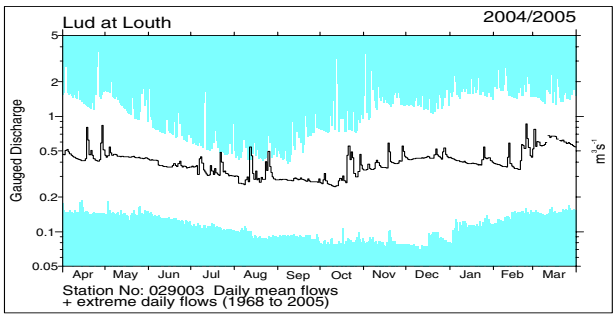
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2004 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The 'national' hydrographs are based on representative networks of gauging stations commanding relatively large catchments.

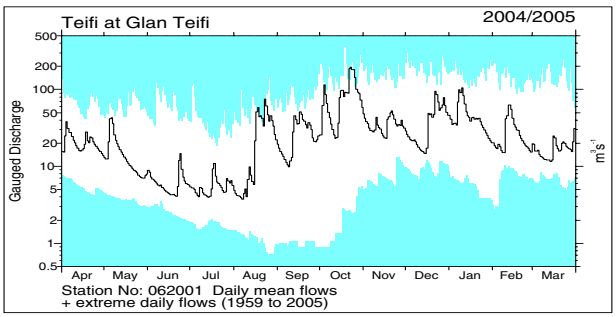
River flow . . . River flow . . .

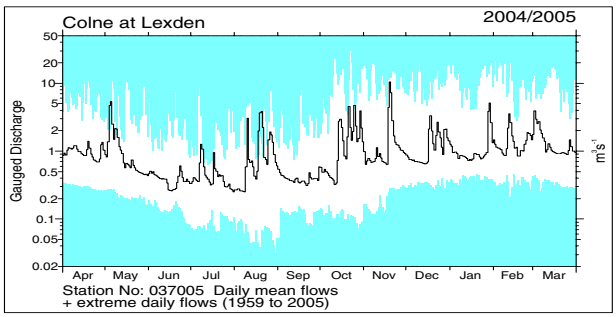


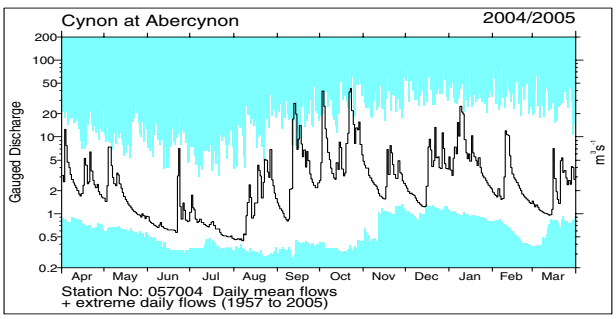


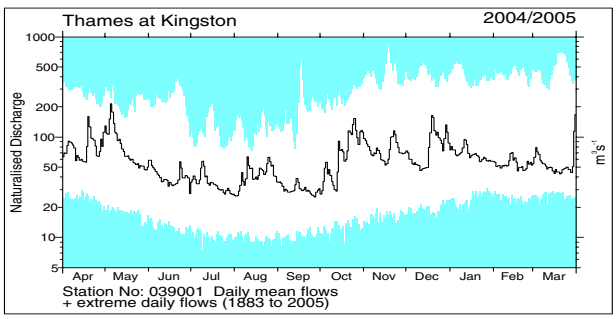


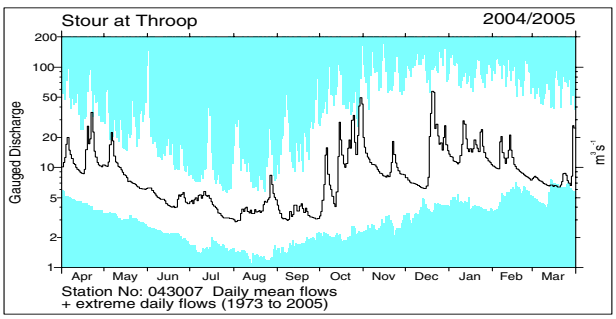


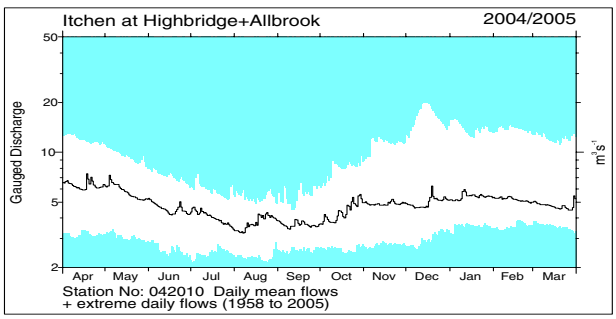










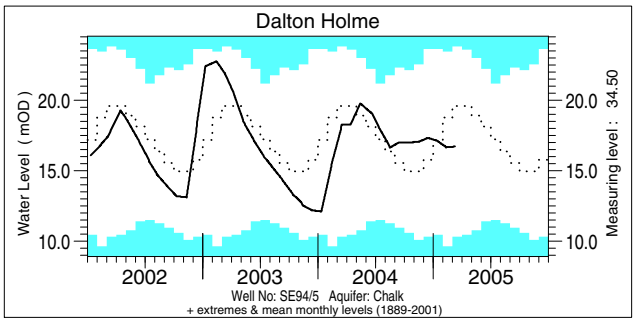


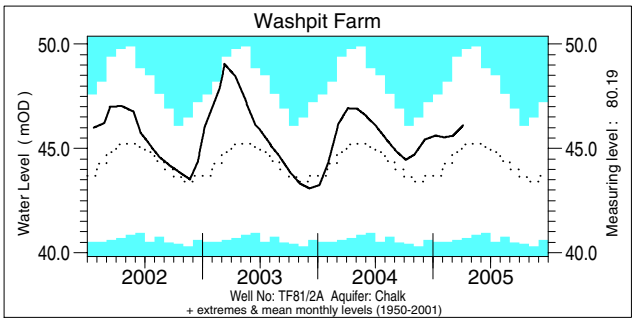
Notable runoff accumulations (a) November 2004 - March 2005, (b) April 2004 - March 2005

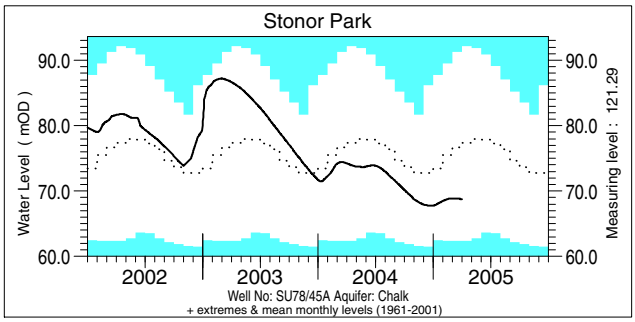
	River	%lta	Rank
a)	Soar	47	4/34
	Mole	47	2/30
	Medway	32	3/45
	Ouse (Gold Bridge)	37	1/42
	Wallington	38	3/52
	Exe	64	3/49
	Otter	46	2/43
	Dart	62	3/47
	Kenwyn	50	2/37
	Tone	60	3/44
	Severn	61	4/84
	Yscir	76	3/32
	Ewe	131	32/35
	Annacloy	67	2/25
	Spey (Boat o'Brig)	137	51/53
b)	Spey (Boat o'Brig)	134	52/52
	Deveron	139	42/44
	Otter	60	2/42
	Kenwyn	64	2/36
	Leven (Linnbrane)	122	37/40
	Ewe	127	33/34
	Naver	131	27/27

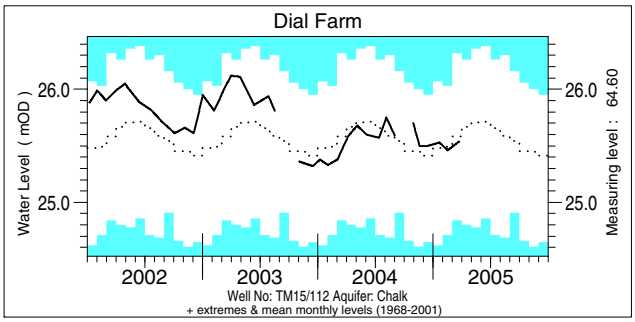
lta = long term average
Rank 1 = lowest on record

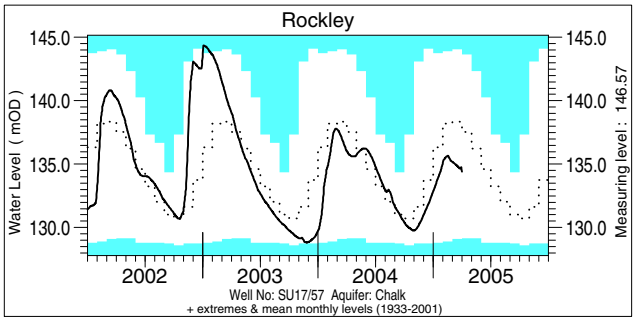
Groundwater . . . Groundwater

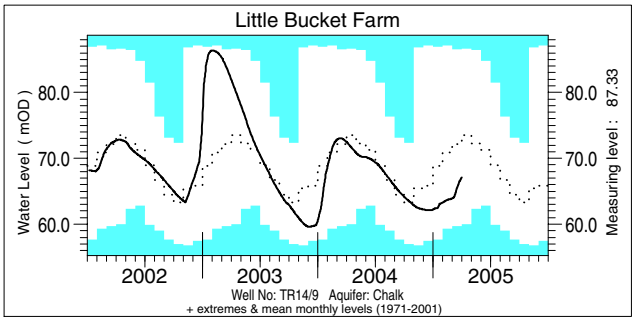


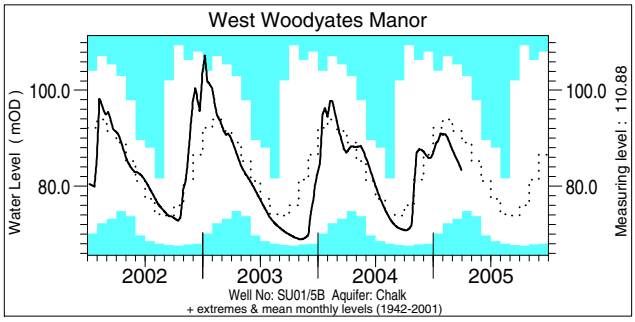


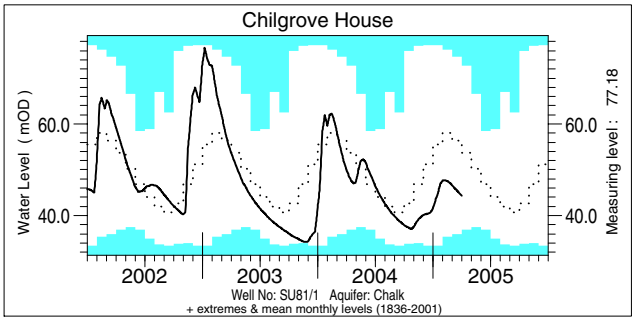


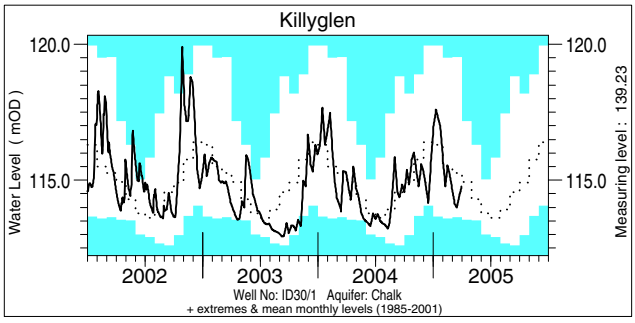


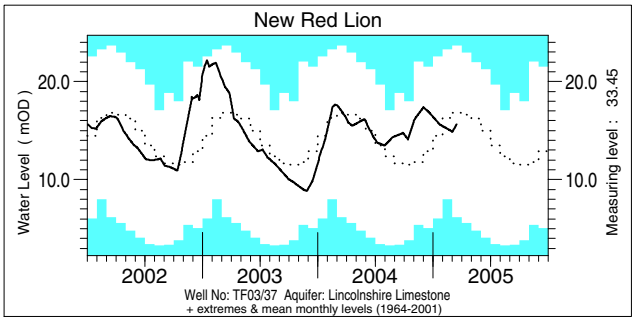






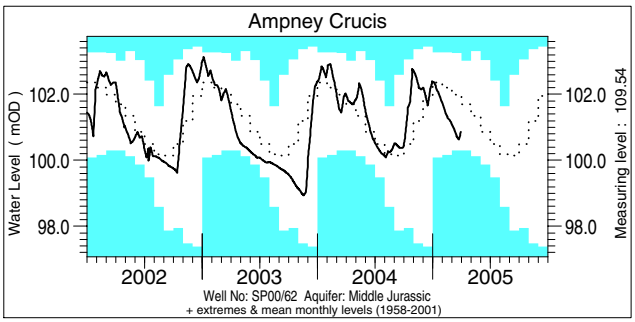


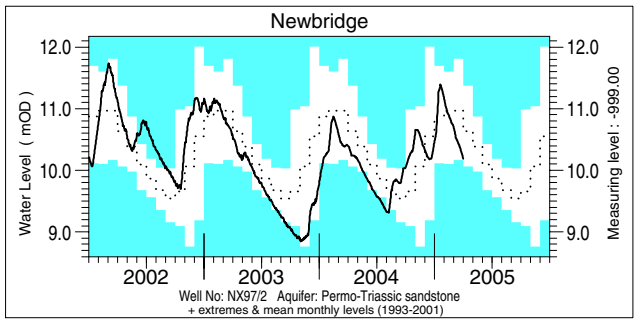


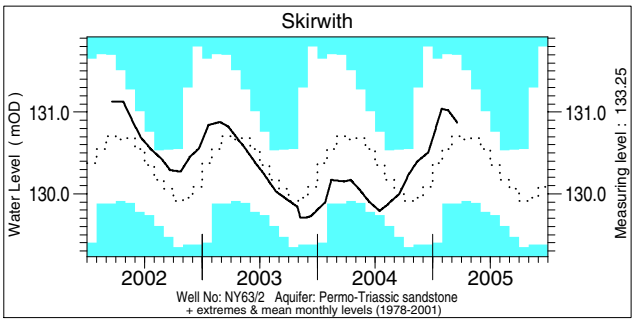


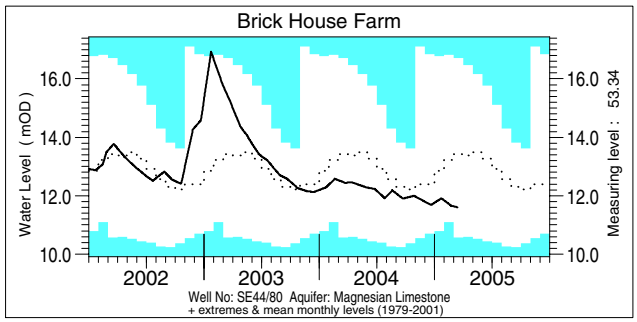
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

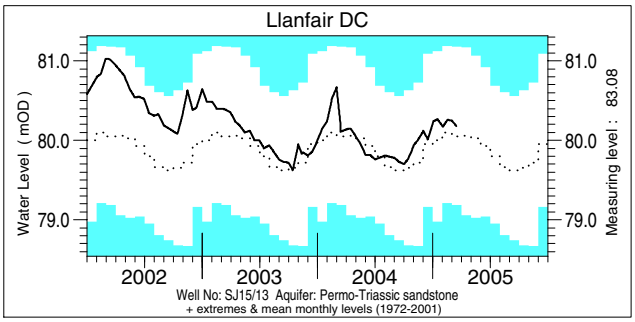
Groundwater . . . Groundwater

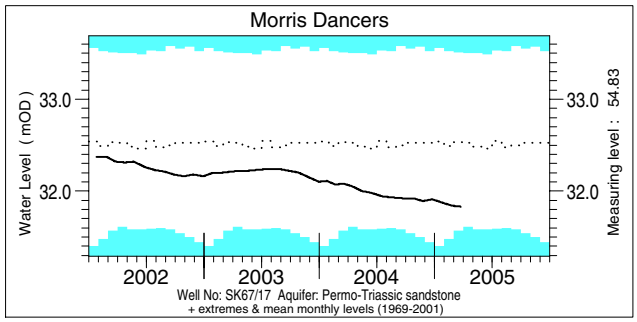


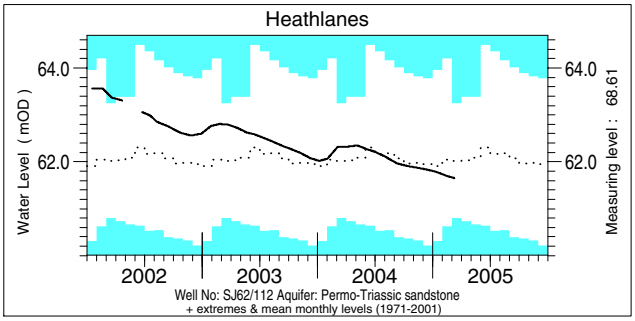


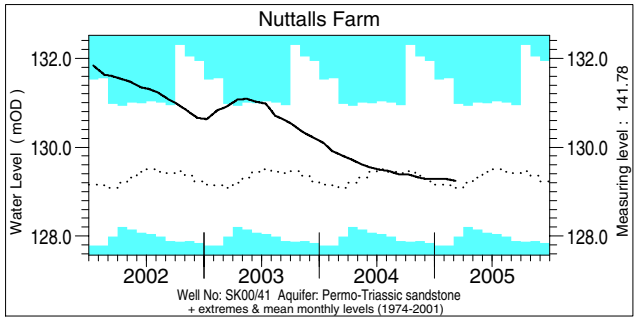


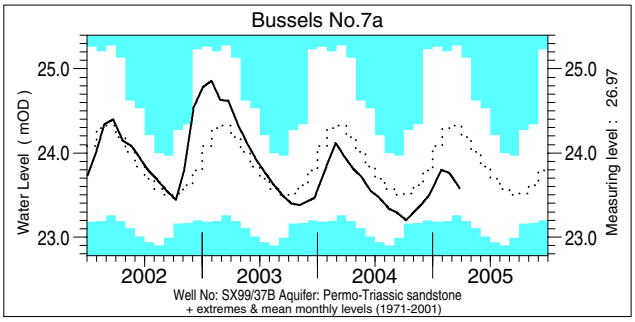


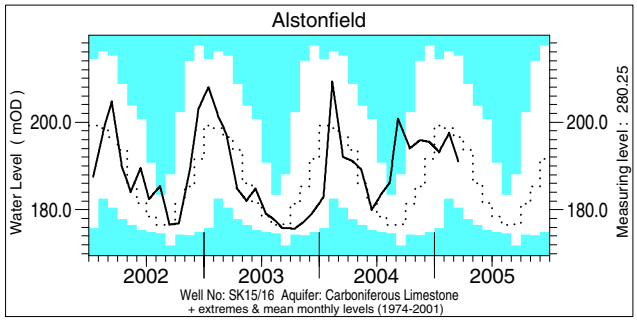










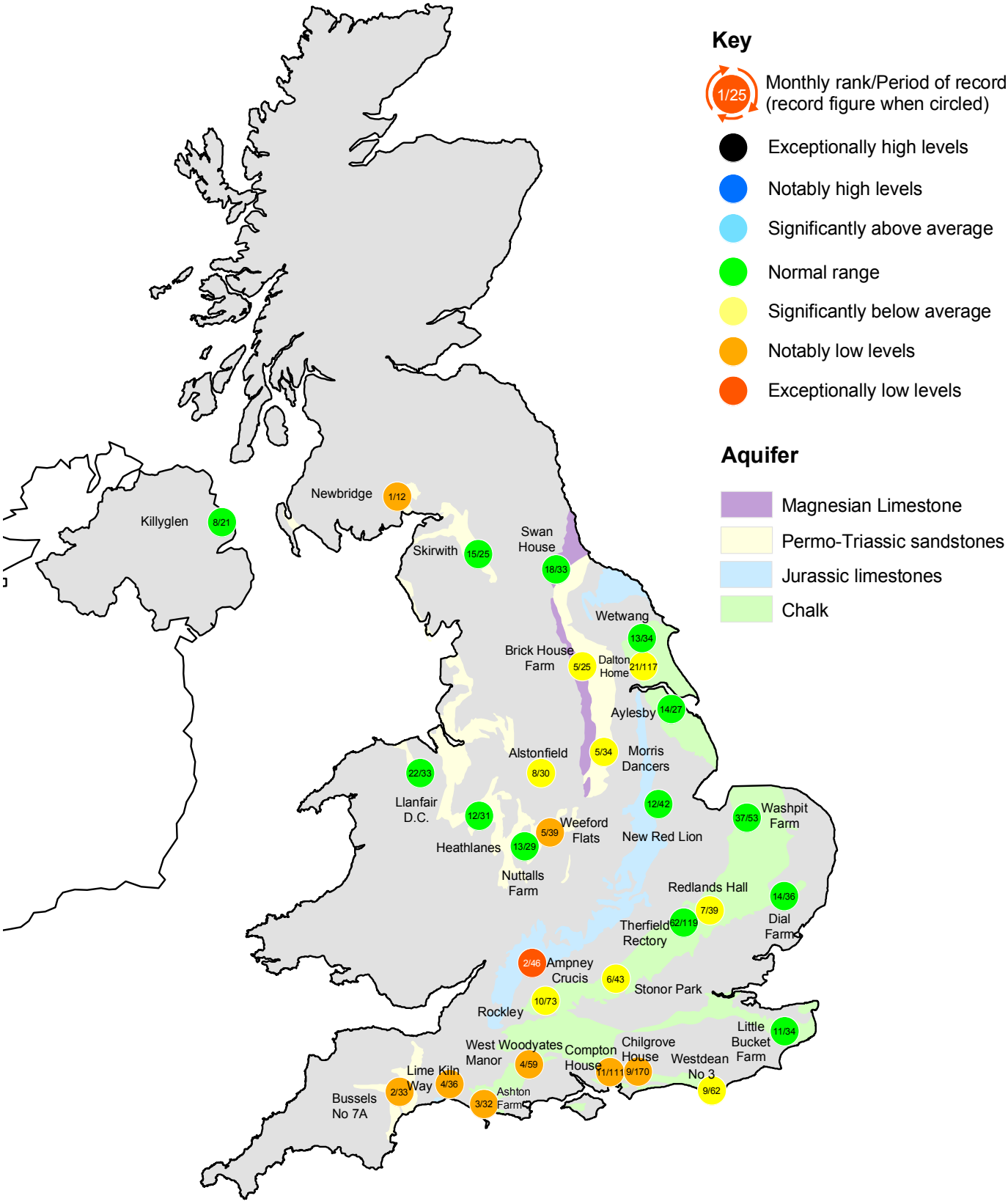


Groundwater levels March/April 2005

Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.
Dalton Holme	16.72	10/03	19.51	Chilgrove House	44.30	31/03	55.56	Llanfair DC	80.18	15/03	80.06
Washpit Farm	46.12	05/04	45.00	Killyglen	114.76	31/03	115.57	Morris Dancers	31.83	23/03	32.38
Stonor Park	68.75	01/04	77.11	New Red Lion	15.66	15/03	16.73	Heathlanes	61.65	10/03	62.06
Dial Farm	25.54	23/03	25.60	Ampney Crucis	100.87	30/03	102.03	Nuttalls Farm	129.24	07/03	129.41
Rockley	134.40	01/04	138.45	Newbridge	10.19	31/03	10.95	Bussels No.7a	23.58	25/03	24.33
Little Bucket Farm	67.12	31/03	72.21	Skirwith	130.87	18/03	130.66	Alstonfield	191.09	15/03	196.42
West Woodyates	83.31	31/03	90.76	Brick House Farm	11.60	14/03	13.43				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



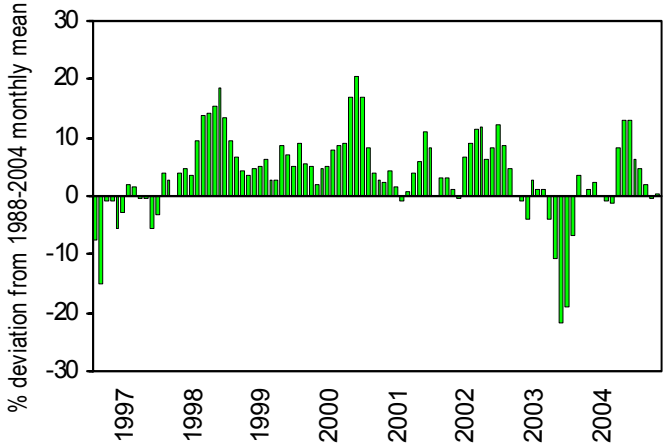
Groundwater levels - March 2005

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.

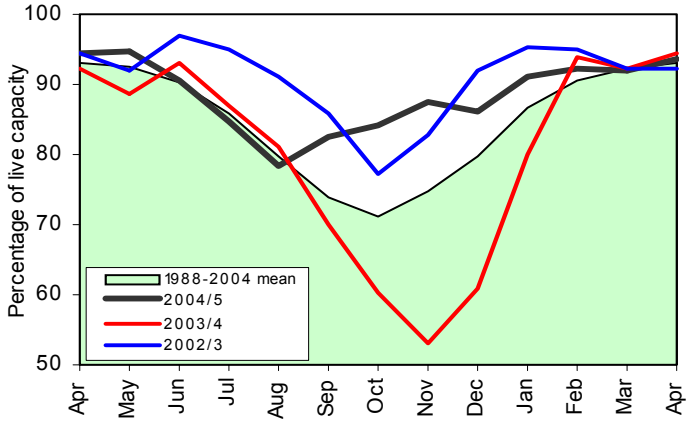
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

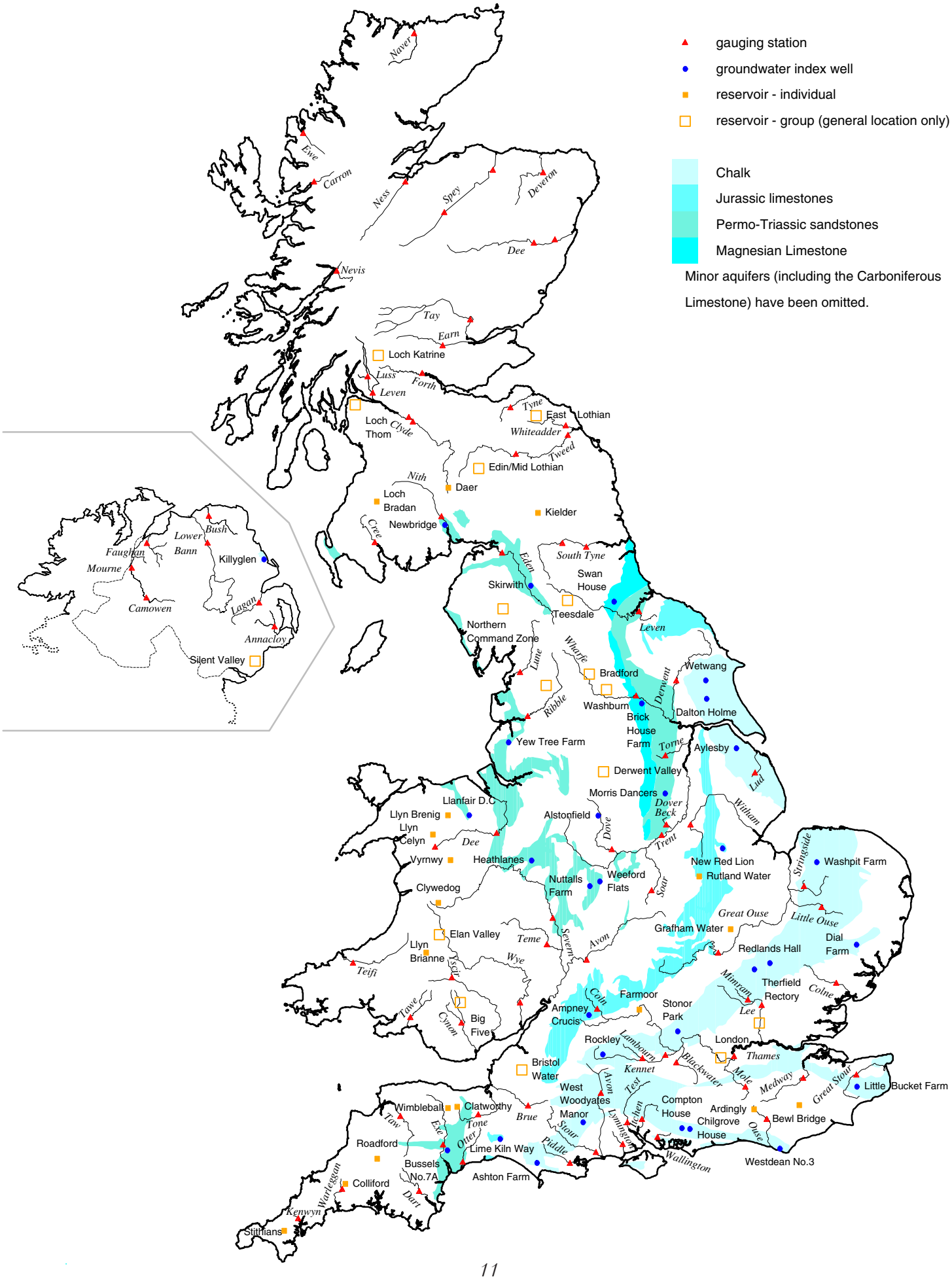
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2004 Dec	2005 Jan	Feb	Mar	Apr	Avg. Apr	Min. Apr	Year* of min.
North West	N Command Zone	• 124929	85	91	100	91	**90**	93	77	1993
	Vyrnwy	55146	85	100	99	97	**97**	95	64	1996
Northumbrian	Teesdale	• 87936	94	90	93	89	**95**	92	77	2003
	Kielder	(199175)	(86)	(98)	(91)	(90)	**(91)**	(92)	(81)	1993
Severn Trent	Clywedog	44922	78	83	79	89	**94**	94	86	1996
	Derwent Valley	• 39525	100	100	99	95	**99**	94	54	1996
Yorkshire	Washburn	• 22035	89	90	86	83	**80**	93	70	1996
	Bradford supply	• 41407	98	99	99	94	**98**	93	59	1996
Anglian	Grafham	(55490)	(86)	(92)	(92)	(94)	**(96)**	(90)	(77)	1997
	Rutland	(116580)	(86)	(93)	(95)	(94)	**(94)**	(90)	(74)	1992
Thames	London	• 202340	83	87	91	95	**96**	93	88	1990
	Farmoor	• 13830	92	98	99	98	**97**	95	84	1992
Southern	Bewl	28170	63	60	70	75	**86**	90	58	1989
	Ardingly	4685	60	69	79	83	**93**	100	93	2005
Wessex	Clatworthy	5364	89	100	100	100	**94**	97	82	1992
	Bristol WW	• (38666)	(58)	(64)	(77)	(83)	**(82)**	(94)	(71)	1992
South West	Colliford	28540	62	66	70	71	**70**	87	58	1997
	Roadford	34500	58	69	71	73	**72**	85	37	1996
	Wimbleball	21320	76	79	86	90	**96**	95	78	1996
	Stithians	5205	61	60	68	75	**78**	94	52	1992
Welsh	Celyn and Brenig	• 131155	95	97	97	98	**100**	97	72	1996
	Brianne	62140	93	98	94	96	**97**	98	90	1993
	Big Five	• 69762	92	97	98	96	**97**	95	78	1993
	Elan Valley	• 99106	99	100	99	98	**99**	98	89	1993
Scotland(E)	Edinburgh/Mid Lothian	• 97639	88	87	98	99	**99**	93	71	1998
	East Lothian	• 10206	100	100	100	100	**100**	99	95	1990
Scotland(W)	Loch Katrine	• 111363	94	100	89	86	**91**	95	88	2001
	Daer	22412	100	100	100	97	**95**	98	93	2001
	Loch Thom	• 11840	100	100	100	100	**100**	98	93	2001
Northern Ireland	Total+	• 67270	88	88	86	83	**84**	89	83	2002
	Silent Valley	• 20634	72	69	78	73	**73**	82	57	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 1988-2005 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 (NHMP) 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. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national ans regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available in 2004; these have been adopted by the NHMP. 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.

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:

Hydrological Summaries
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

Tel.: 01491 838800
Fax: 01491 692424
E-mail: nwamail@ceh.ac.uk

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

04/05