Hydrological Summary
for the United Kingdom

September 2004

General
September rainfall was close to average for the UK as a whole but its distribution greatly favoured western and northern uplands. A large proportion of the east and south received less than half the monthly average; consequently soil moisture deficits increased considerably over the month and river flows declined substantially after the August spates. Despite a few flood drawdown releases (e.g. at Clywedog) levels in most western and northern reservoirs increased considerably through September and overall stocks for England and Wales were around 14% above average at month end. Stocks in some reservoirs in the South-West declined but remain well within the normal autumn range. Runoff totals were also fairly typical of September, although spatial variations were large. Recharge is underway in a number of the more responsive aquifers and September levels were mostly within the normal mid-autumn range, but appreciably below average in much of the southern Chalk. The resources outlook is generally good; rainfall amounts over the next six weeks will be very influential in initiating (in much of the lowlands) and consolidating the seasonal recoveries in river flows and groundwater levels.

Rainfall
In contrast to much of August, Indian Summer conditions characterised early September with exceptional high temperatures and predominately anticyclonic synoptic patterns characterising the first nine days – during which precipitation was restricted to fog-drip throughout much of the English Lowlands. Thereafter, incursions of low pressure systems were more common – particularly in northern Britain where frontal rainfall produced some notable storm totals (e.g. Lusa 51mm on the 14th, Sloy 77mm on the 20th, Capel Curig, 56mm in 12 hrs – also on the 20th), and many catchments in Northern Ireland registered 15-25mm on the 29/30th. The preferred tracks of the frontal systems are clearly reflected in the September rainfall totals. The uplands of western Britain mostly reported above average rainfall with parts of the Scottish Highlands reaching twice the average. By contrast, low-lying eastern and southern catchments were much drier with large areas of eastern Britain registering less than half the 1961-90 average; a few, mostly coastal, districts (e.g. in Kent) recording less than 30%. Rainfall throughout the summer half-year (Apr-Sept) has been erratic but all regional totals exceed the average – marginally so for the Southern region where for some localities (e.g. Havant) five of the last six months have been below average. The total for Anglian region is, provisionally, the highest since 1968 – and for some catchments it was the 7th above average summer half-year in the last eight. Appreciable long term deficiencies are still evident (e.g. in the South West from Jan. 2003) but rainfall totals for the year thus far are close to, or above, average for all regions.

River flows
The normal north-west/south-east contrast in runoff rates across the UK was strongly accentuated in September as heavy rainfall and near-saturated catchments promoted spate conditions in the NW whilst limited rainfall, mostly dry catchments and (in most areas) declining baseflow contributions resulted in modest flows in much of eastern and southern England. Notable spates were common in rivers draining the hills of northern Britain on the 19-21st – the Ness reported its highest September flow in a record from 1973. September runoff totals exceeded the average in most catchments from Wales to northern Scotland; both the Ness and Nevis eclipsed previous September maxima. Flows in the English Lowlands were typified by the Thames: flows began the month appreciably above average but ended it appreciably below, albeit well within the normal range. Recessions were most persistent in the more southerly catchments where runoff totals were commonly less than 70%; the Otter registered its 2nd lowest Sept. runoff. Accumulated runoff over the last six months broadly reflect the September pattern; April-Sept totals in the lower quartile are confined to a few catchments in central southern and south-west England (the Lower Bann in Northern Ireland also).

Groundwater
Most frontal systems followed tracks remote from the English Lowlands during September; as a consequence, rainfall across many major aquifers was less than 50% of average. In addition, evaporative demands were seasonally high throughout most of the UK – 20-30% above average across much of the southern Chalk outcrop. Thus, contrary to the normal seasonal pattern, soil moisture deficits increased in much of southern and eastern Britain; by month end they exceeded the average across the greater part of the Chalk outcrop. Recharge opportunities were therefore modest but early groundwater level recoveries (heralded by the exceptional August downpours) continued in some responsive aquifer units – notably in the Carboniferous Limestone where the September level at Alstonfield was the highest, by a considerable margin, in a 30-year record. Less dramatic recoveries were reported for other limestone index wells (e.g. in the Lincs. Limestone and the northern Chalk). Elsewhere in the Chalk, levels remain within the normal autumn range – but relatively depressed in the south-western outcrops. Levels in most of the Permo-Triassic sandstones outcrops are also healthy, notably so in some of the more northerly outcrops (Yew Tree Farm especially). More modest exceedance of the September average characterises most of the minor aquifers in East Anglia (e.g. the Norfolk Drift and Essex Gravels).

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Sep 2004	Jul 04-Sep 04	RP	Apr 04-Sep 04	RP	Jan 04-Sep 04	RP	Feb 03-Sep 04	RP
England & Wales	**mm**	**50**	**281**		**479**		**702**		**1372**	
	%	**64**	**129**	**5-10**	**117**	**5-10**	**110**	**2-5**	**94**	**2-5**
North West	mm	**128**	458		672		1000		1904	
	%	**109**	146	15-25	124	5-15	119	5-15	98	2-5
Northumbrian	mm	**45**	298		484		729		1308	
	%	**61**	133	5-15	119	5-10	117	5-10	93	2-5
Severn Trent	mm	**53**	252		433		610		1166	
	%	**81**	133	5-10	119	5-10	110	2-5	93	2-5
Yorkshire	mm	**31**	276		481		699		1290	
	%	**44**	133	5-10	123	5-10	117	5-10	95	2-5
Anglian	mm	**33**	250		404		555		999	
	%	**66**	161	30-40	133	15-25	126	10-20	101	2-5
Thames	mm	**29**	204		366		528		1013	
	%	**48**	121	2-5	111	2-5	106	2-5	89	5-10
Southern	mm	**30**	181		338		520		1101	
	%	**42**	103	2-5	100	<2	97	2-5	89	5-10
Wessex	mm	**47**	206		368		586		1215	
	%	**64**	106	2-5	101	2-5	99	2-5	90	5-10
South West	mm	**57**	294		480		817		1651	
	%	**61**	117	2-5	103	2-5	101	2-5	89	5-10
Welsh	mm	**126**	361		574		959		1937	
	%	**107**	119	2-5	104	2-5	106	2-5	92	2-5
Scotland	**mm**	**168**	**431**		**744**		**1158**		**2195**	
	%	**117**	**121**	**5-10**	**122**	**10-20**	**116**	**5-15**	**95**	**2-5**
Highland	mm	**240**	494		865		1414		2652	
	%	**143**	122	5-10	125	10-20	122	15-25	98	2-5
North East	mm	**68**	278		552		814		1471	
	%	**74**	107	2-5	117	5-10	112	5-10	89	5-10
Tay	mm	**117**	427		731		1018		1868	
	%	**97**	141	10-20	137	30-40	114	5-10	92	2-5
Forth	mm	**102**	343		614		885		1664	
	%	**90**	119	2-5	123	5-15	111	2-5	91	5-10
Tweed	mm	**71**	337		567		838		1513	
	%	**77**	131	5-15	124	5-15	118	5-10	94	2-5
Solway	mm	**171**	470		723		1118		2166	
	%	**119**	131	5-15	118	5-10	114	5-10	96	2-5
Clyde	mm	**213**	531		880		1365		2645	
	%	**116**	121	5-10	122	5-15	115	5-10	96	2-5
Northern Ireland	**mm**	**102**	**273**		**504**		**775**		**1604**	
	%	**102**	**102**	**2-5**	**105**	**2-5**	**101**	**2-5**	**92**	**2-5**

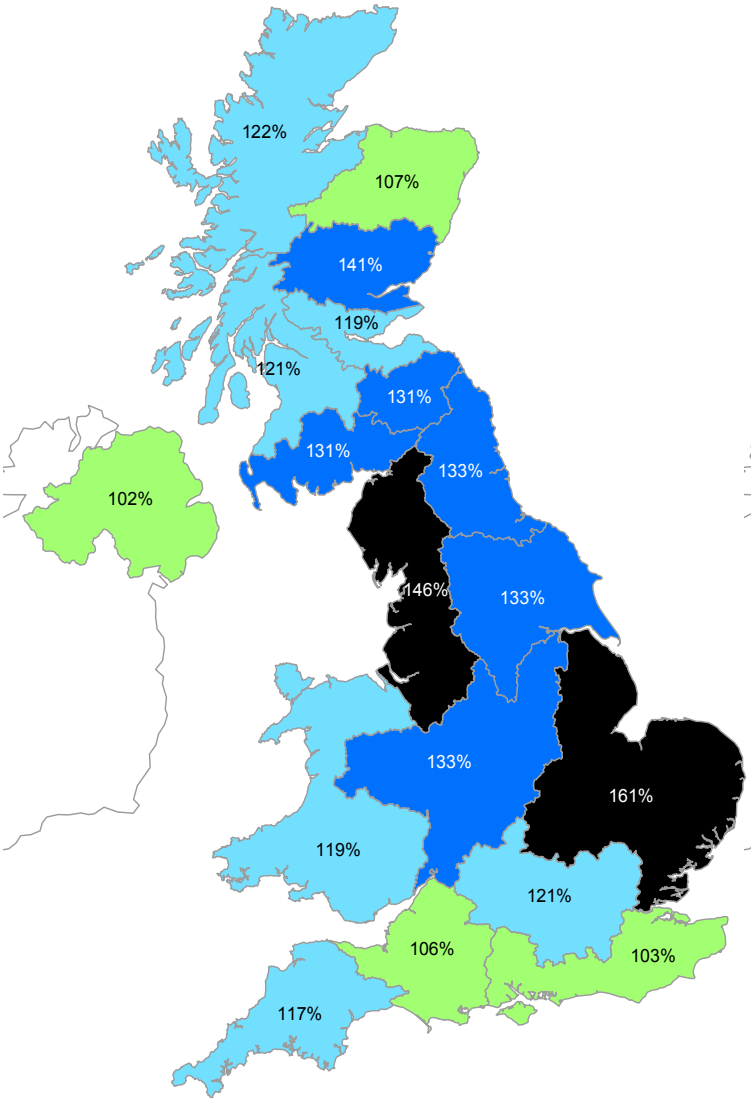
% = percentage of 1961-90 average *RP = Return period*

The monthly rainfall figures* provided by the Met Office are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since May 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. 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.

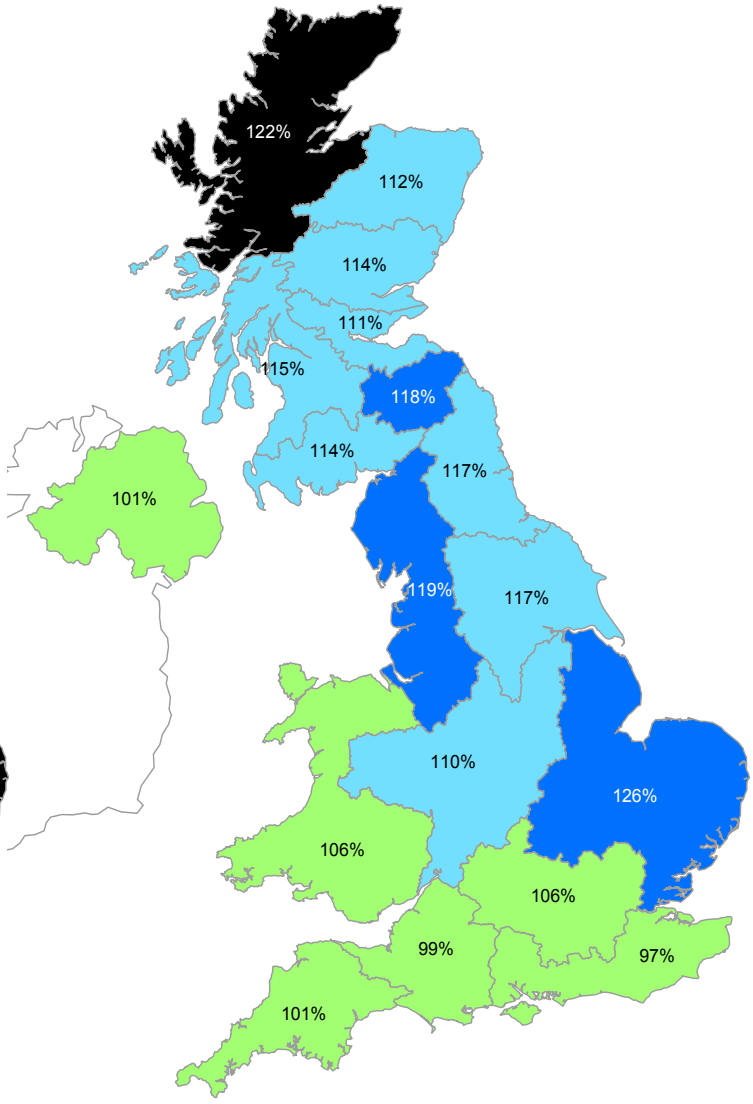
Rainfall . . . Rainfall . .

Key

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



July 2004 - September 2004

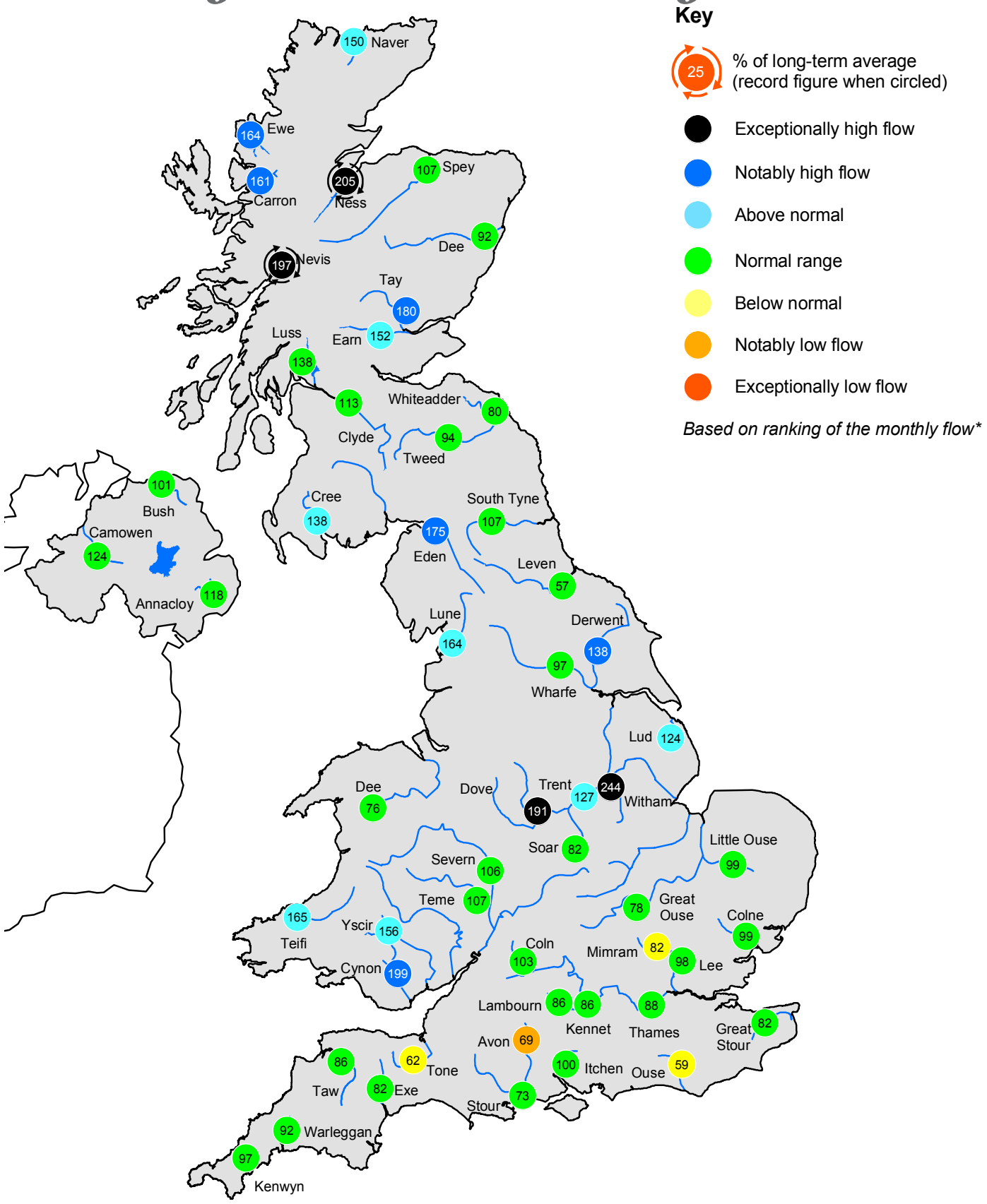


January 2004 - September 2004

Rainfall accumulation maps

The July-September period in 2004 was the 4th wettest since 1960 for the UK as a whole; Anglian region was exceptionally wet (recording the 2nd highest rainfall in the last 37 years) - note however that rainfall was below average for the Western and Northern Isles. In the 9-month timeframe, rainfall totals are also notably high - for the UK only 2002 and 1988 have been wetter since 1958 - but parts of southern England reported below average Jan-Sept rainfall totals.

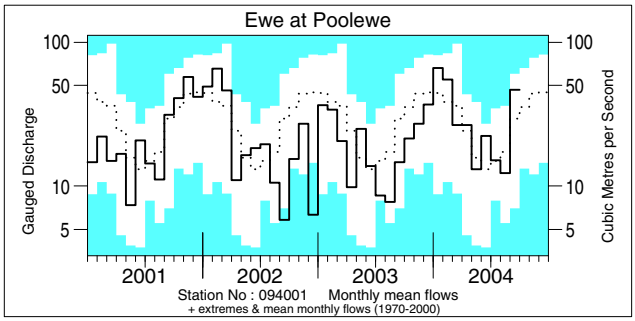
River flow . . . River flow . . .

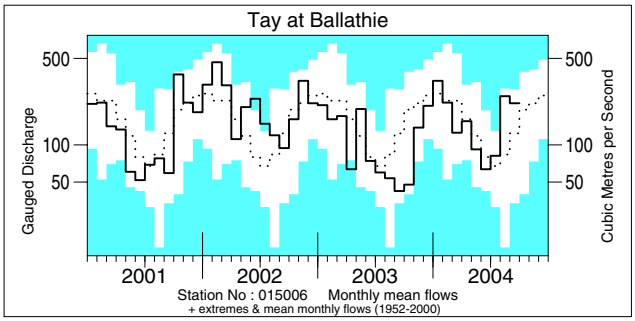


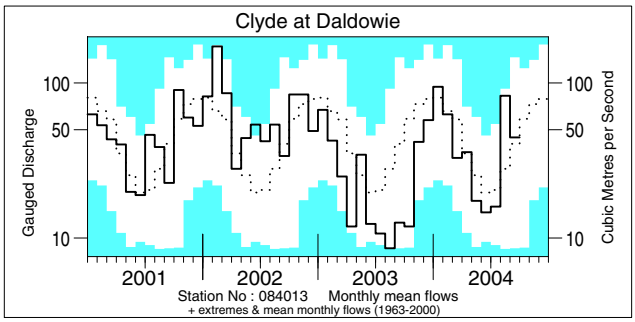
River flows - September 2004

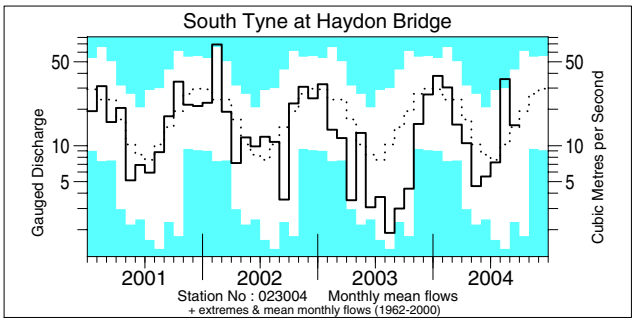
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

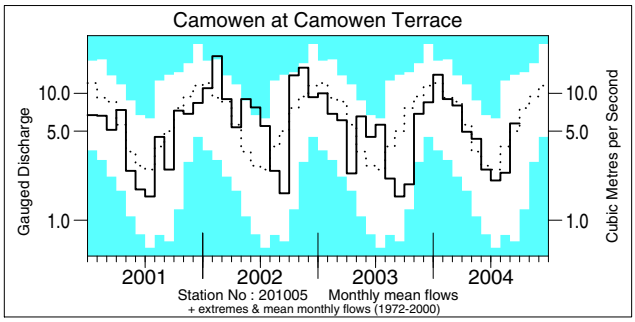
River flow . . . River flow . . .

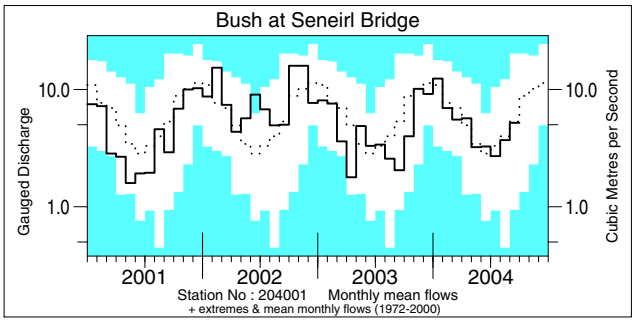


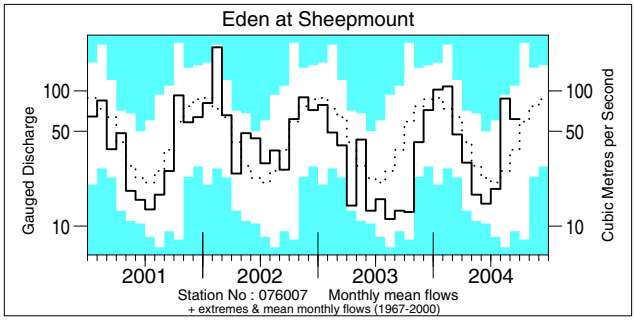


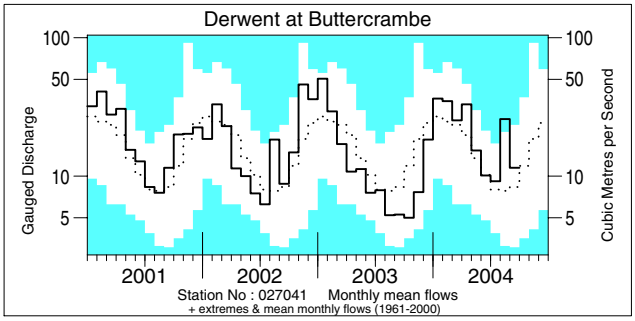


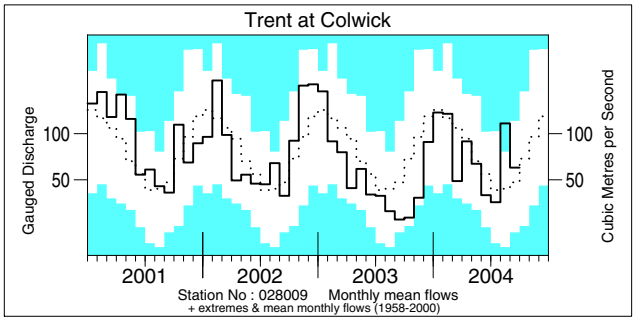


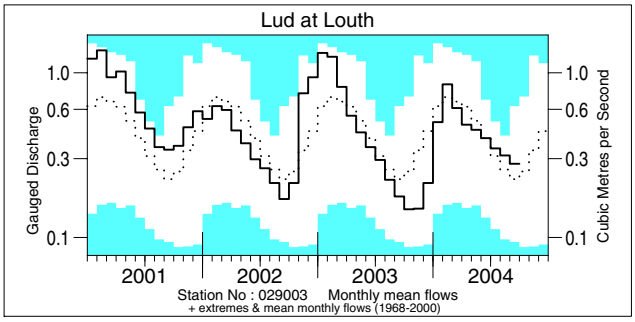








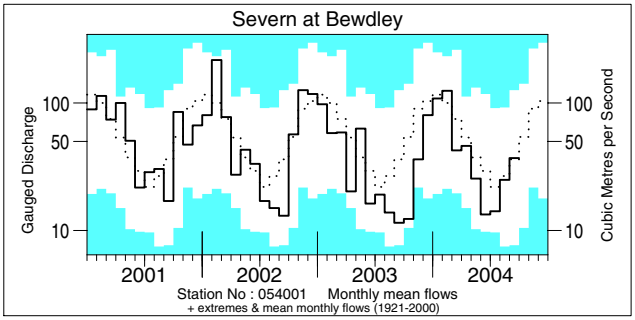


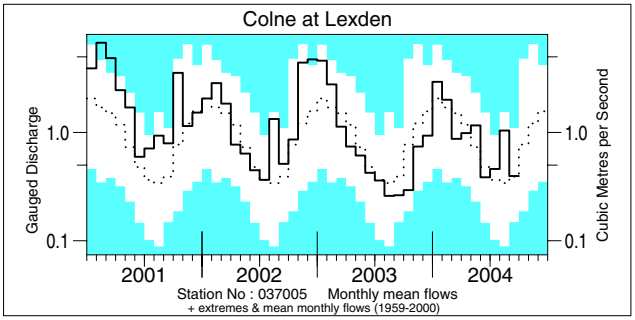


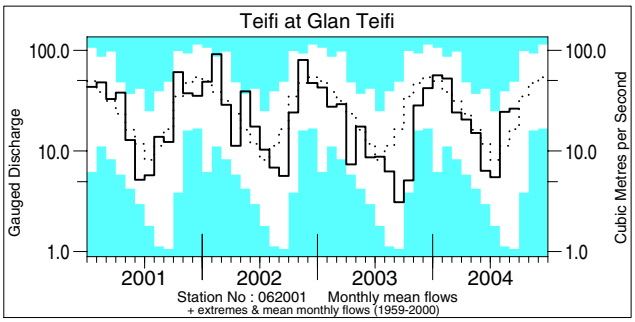
Monthly river flow hydrographs

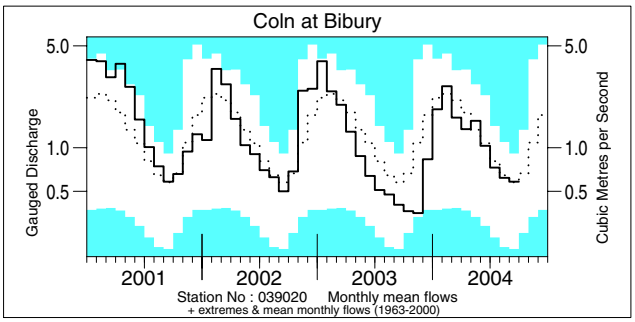
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2001 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

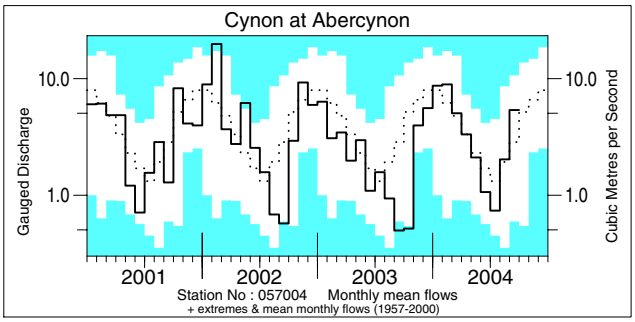
River flow . . . River flow . . .

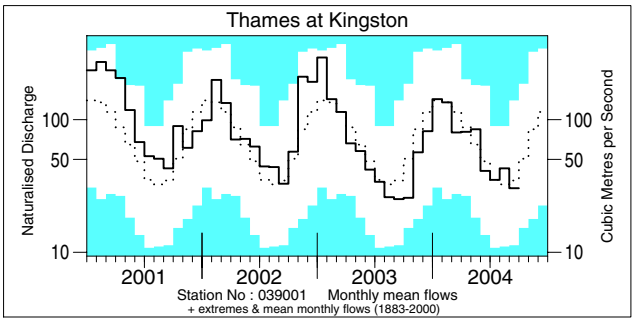


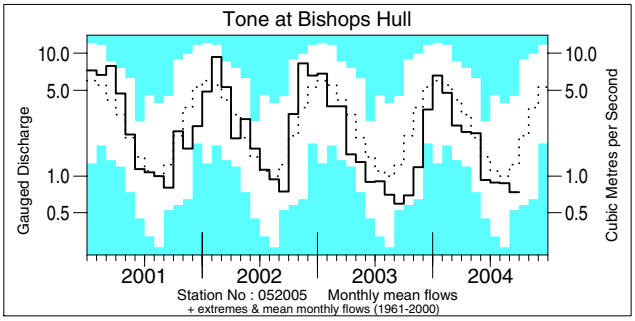


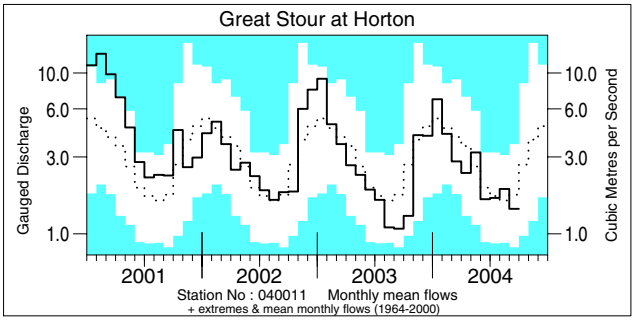


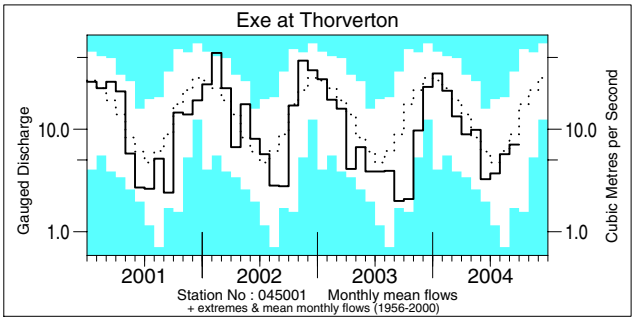


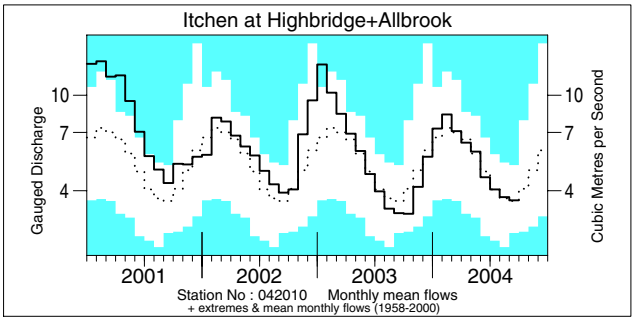










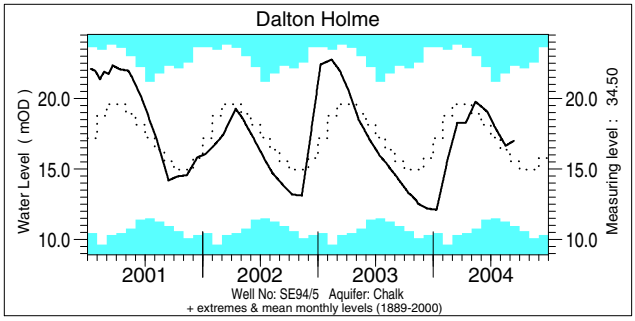


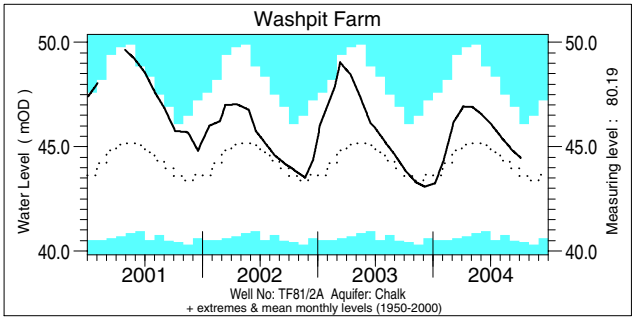
Notable runoff accumulations (a) July 2004 - September 2004, (b) April 2004 - September 2004

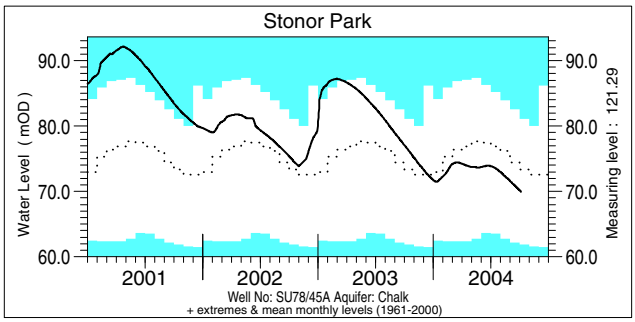
	River	%lta	Rank	River	%lta	Rank		River	%lta	Rank
a)	Ness	175	32/32	Torne	191	31/32	b)	Forth	122	19/23
	Tay	196	50/52	Dover Beck	213	28/29		Otter	72	4/42
	Tyne (Bywell)	185	44/46	Witham	296	46/46		Luss	121	22/26
	S Tyne	182	39/41	Eden	202	36/37		Nevis	127	19/22
	Derwent (Yorks)	187	43/43	Leven (Linnbrane)	171	39/41		Naver	157	27/27
	Trent	155	45/46	Annacloy	179	23/25		L Bann	69	4/24
	Dove	203	42/43							

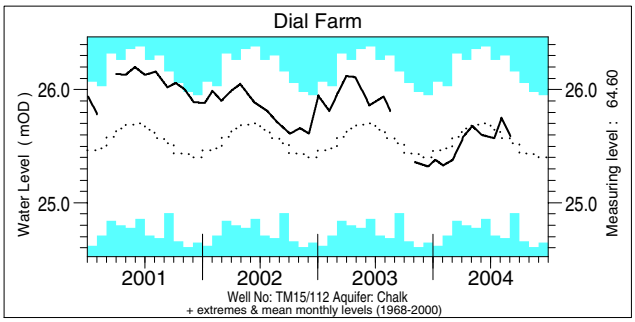
lta = long term average
Rank 1 = lowest on record

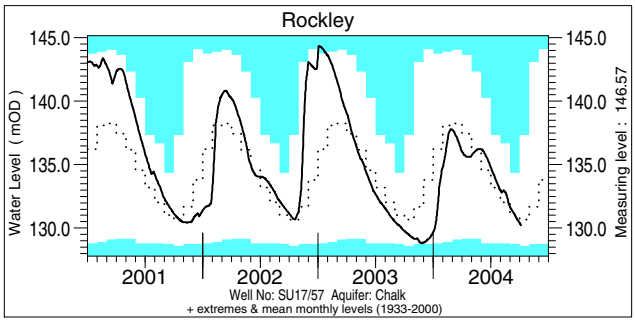
Groundwater . . . Groundwater

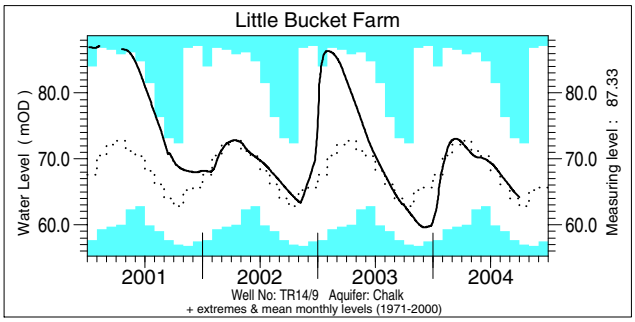


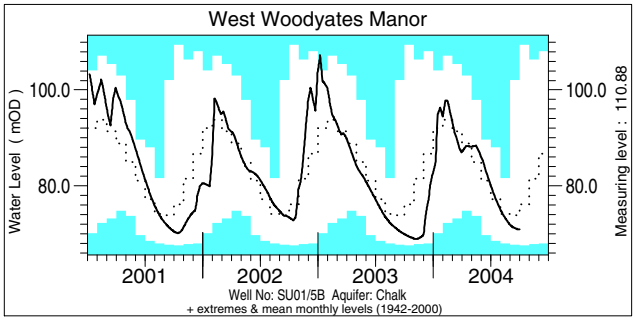


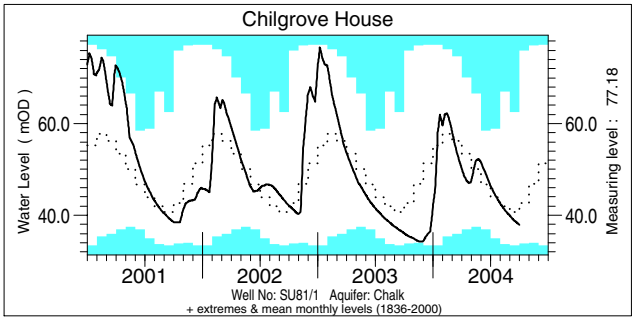


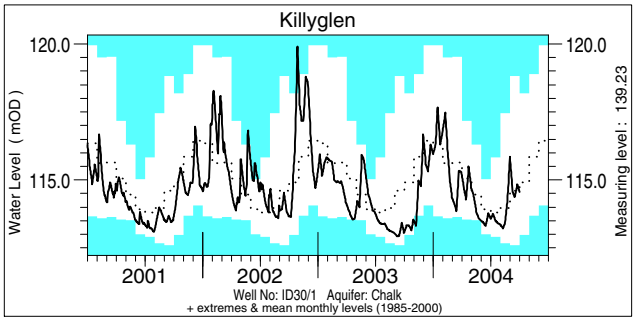


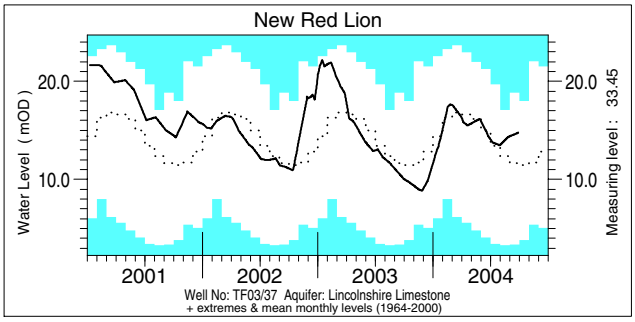






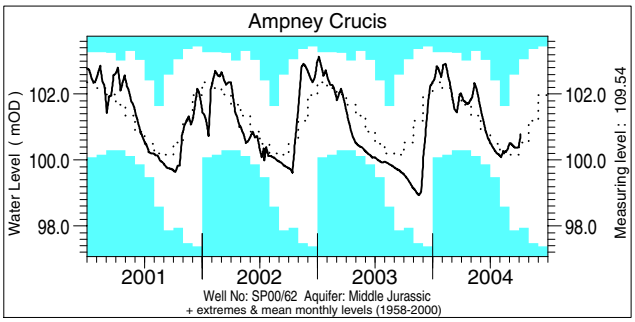


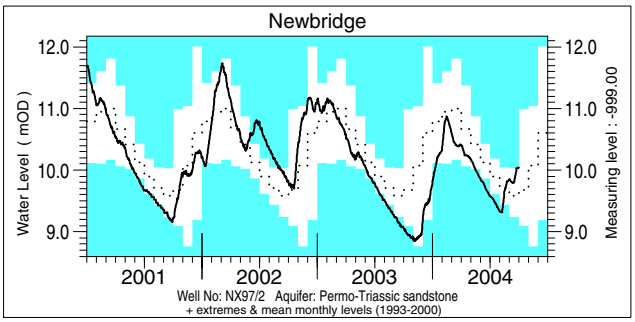


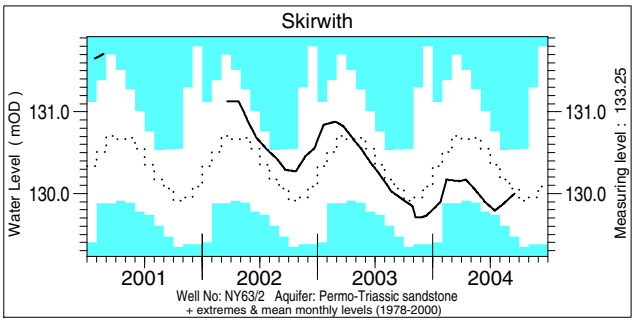


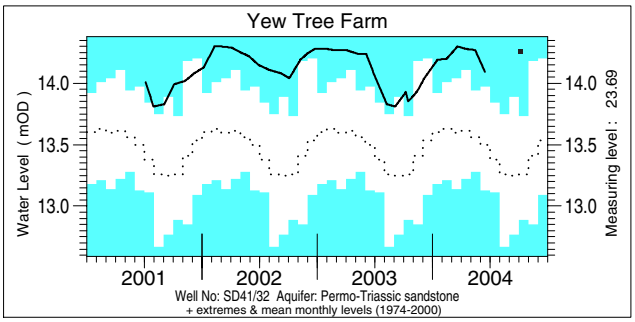
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

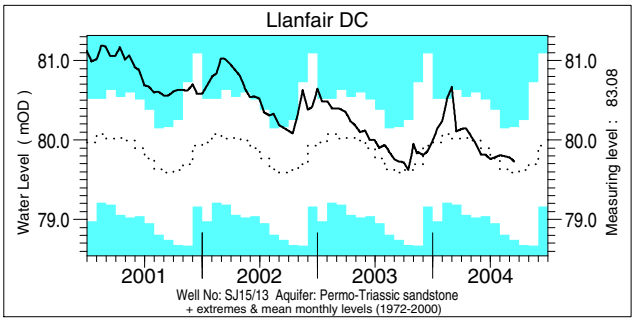
Groundwater . . . Groundwater

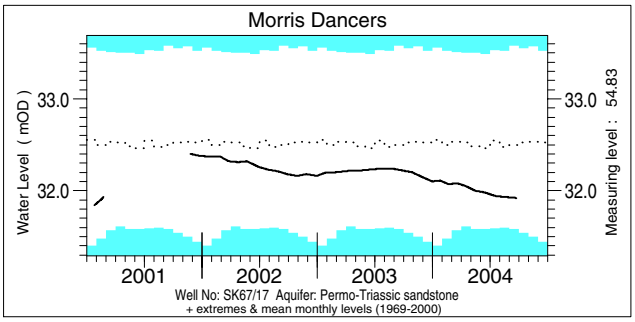


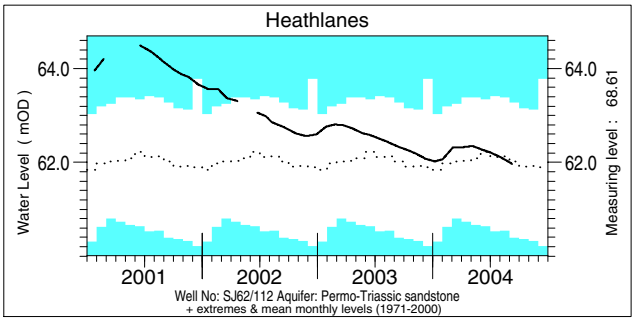


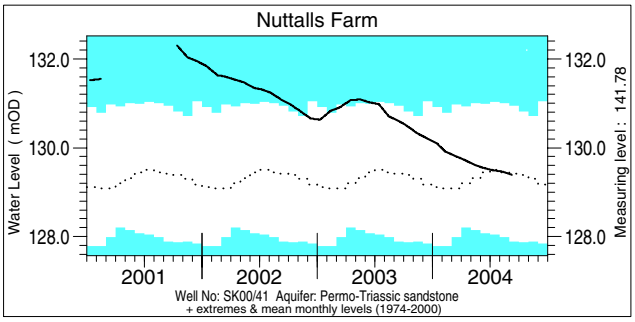


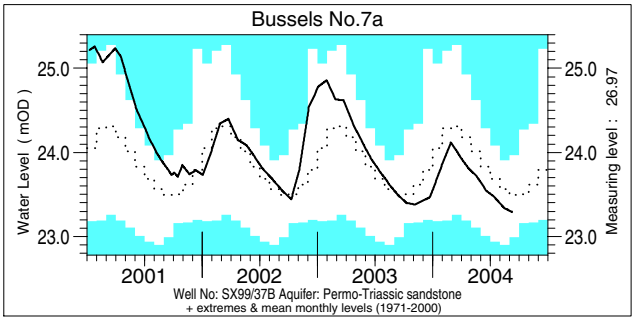


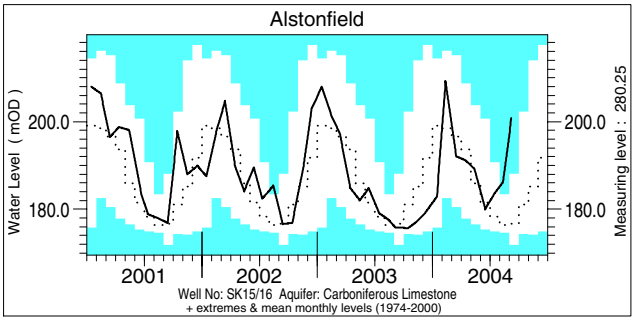










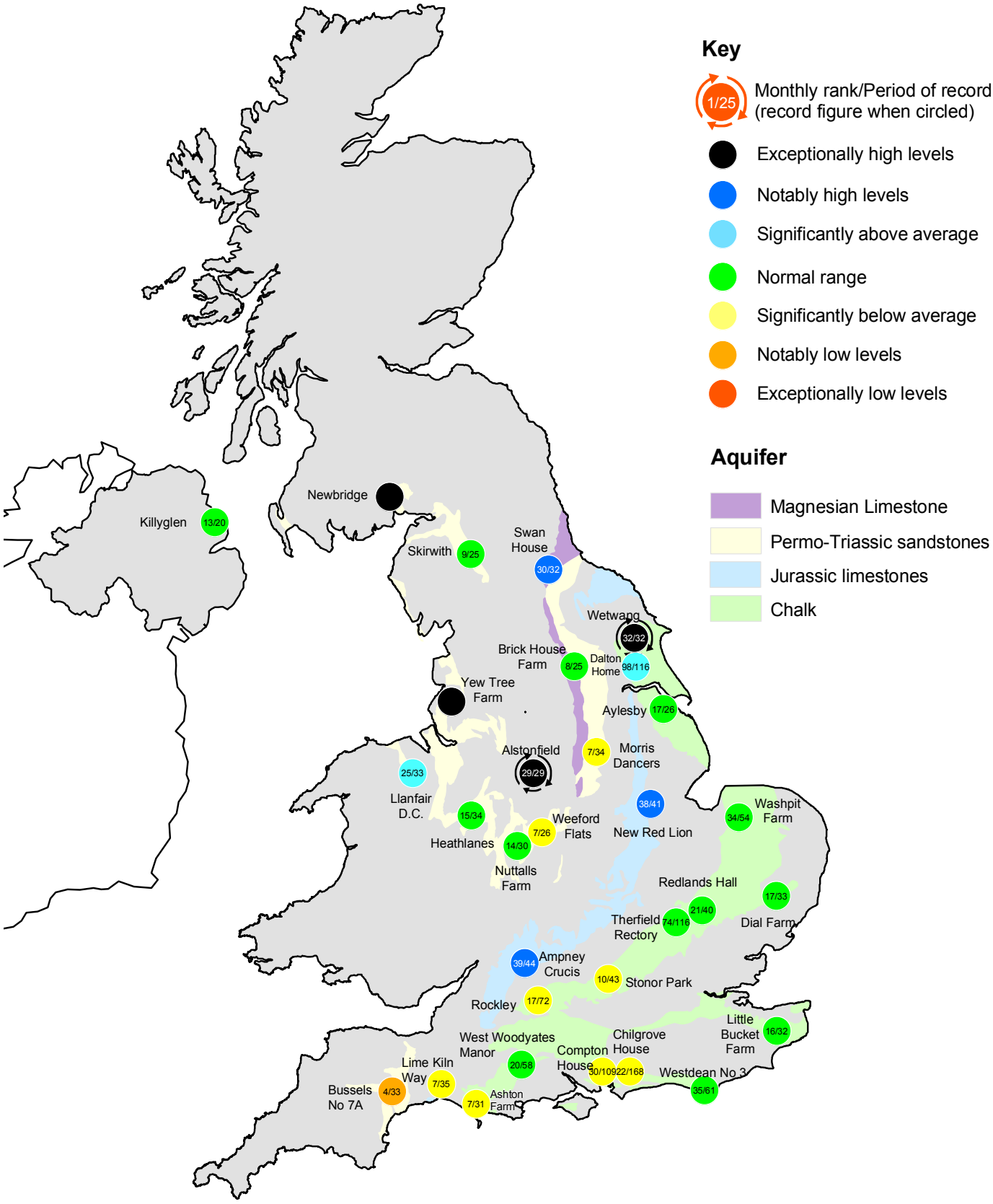


Groundwater levels September / October 2004

Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.
Dalton Holme	17.01	13/09	15.41	Chilgrove House	37.89	30/09	40.78	Llanfair DC	79.73	15/09	79.54
Washpit Farm	44.45	05/10	43.99	Killyglen	114.55	30/09	114.38	Morris Dancers	31.92	22/09	32.37
Stonor Park	69.96	05/10	74.93	New Red Lion	14.76	27/09	11.61	Heathlanes	61.97	08/09	62.06
Dial Farm	25.59	01/09	25.55	Ampney Crucis	100.79	05/10	100.07	Nuttalls Farm	129.39	08/09	129.60
Rockley	130.21	05/10	131.02	Newbridge	10.04	30/09	9.54	Bussels No.7a	23.29	09/09	23.52
Little Bucket Farm	64.17	30/09	64.81	Skirwith	130.00	16/09	130.08	Alstonfield	200.85	06/09	176.72
West Woodyates	70.85	30/09	72.99	Yew Tree Farm	14.27	06/10	13.41				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



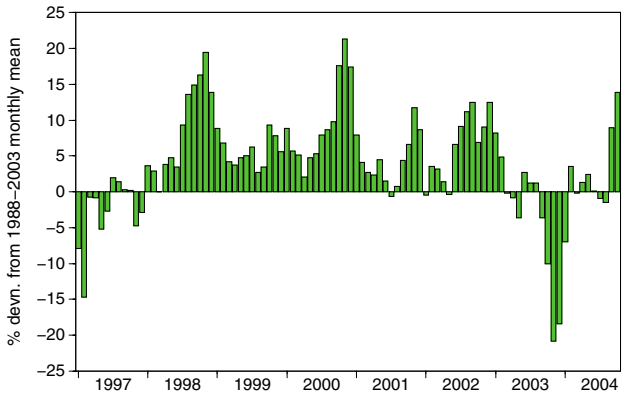
Groundwater levels - September 2004

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.

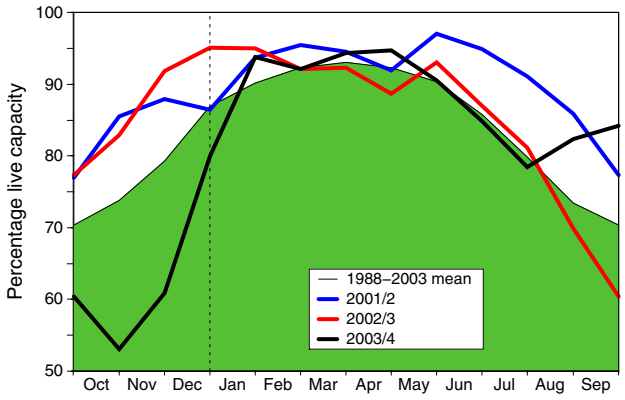
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

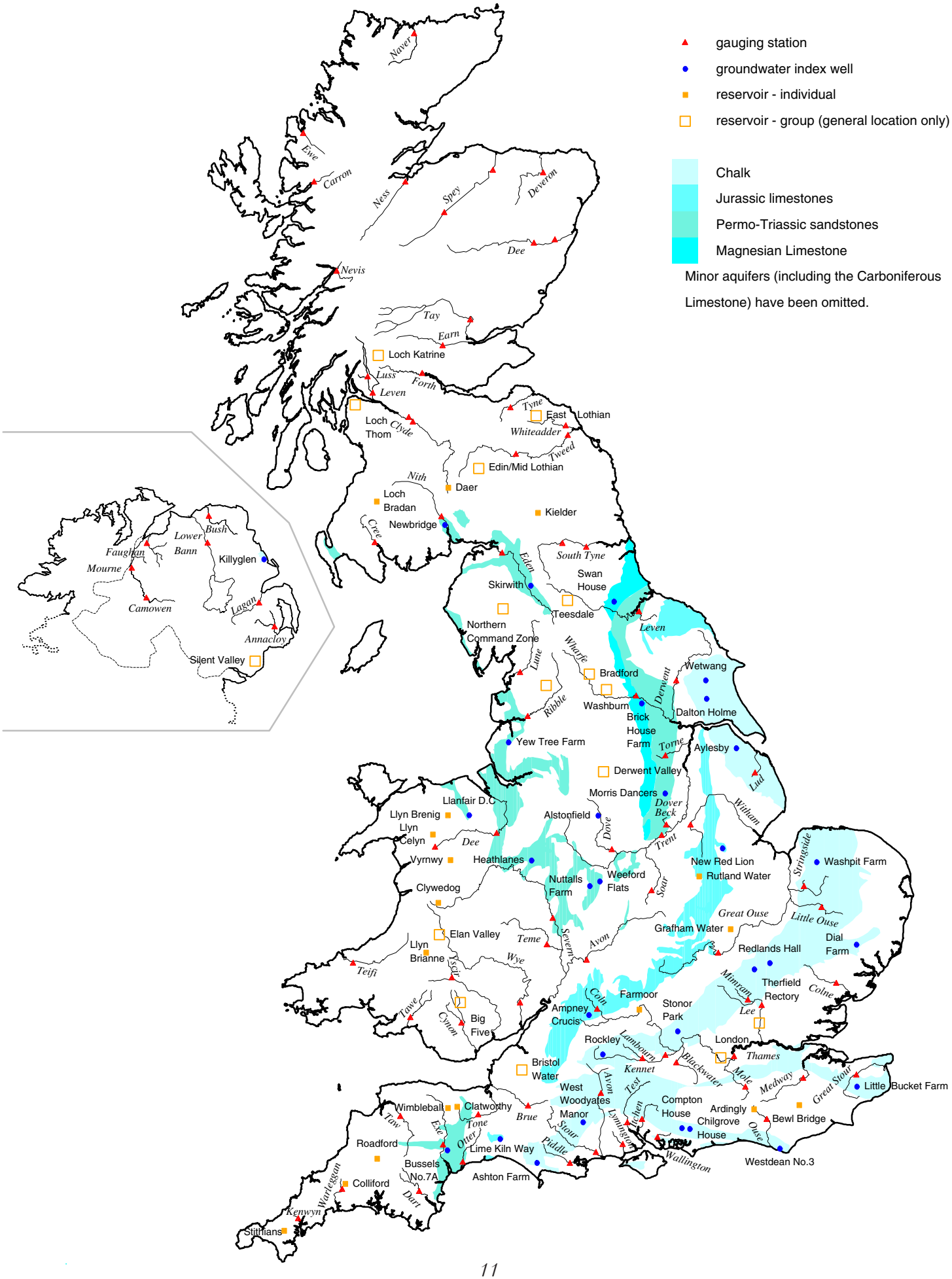
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2004 Jun	Jul	Aug	Sep	Oct	Avg. Oct	Min. Oct	Year* of min.
North West	N Command Zone	• 124929	76	63	55	73	**86**	50	13	1995
	Vyrnwy	55146	88	73	68	67	**78**	66	26	1995
Northumbrian	Teesdale	• 87936	83	79	68	97	**97**	60	31	1995
	Kielder	(199175)	(91)	(94)	(89)	(94)	**(93)**	(83)	(59)	1989
Severn Trent	Clywedog	44922	100	97	94	92	**80**	67	24	1989
	Derwent Valley	• 39525	92	91	83	98	**93**	59	24	1989
Yorkshire	Washburn	• 22035	89	84	79	95	**85**	60	24	1995
	Bradford supply	• 41407	85	75	67	90	**91**	61	15	1995
Anglian	Grafham	(55490)	(95)	(95)	(84)	(76)	**(74)**	(81)	(46)	1997
	Rutland	(116580)	(95)	(91)	(90)	(87)	**(81)**	(78)	(61)	1995
Thames	London	• 202340	94	89	84	84	**76**	74	53	1997
	Farmoor	• 13830	99	97	99	98	**99**	87	54	2003
Southern	Bewl	28170	99	92	87	81	**74**	63	32	1990
	Ardingly	4685	100	89	82	71	**60**	65	32	2003
Wessex	Clatworthy	5364	96	86	77	64	**56**	52	25	2003
	Bristol WW	• (38666)	(89)	(81)	(75)	(66)	**(57)**	(60)	(31)	1990
South West	Colliford	28540	73	67	60	55	**50**	69	43	1997
	Roadford	34500	67	62	56	51	**55**	71	26	1995
	Wimbleball	21320	97	87	79	69	**63**	61	30	1995
	Stithians	5205	88	78	68	57	**50**	54	22	1990
Welsh	Celyn and Brenig	• 131155	97	88	83	82	**92**	77	39	1989
	Brianne	62140	96	88	81	85	**100**	81	48	1995
	Big Five	• 69762	93	82	68	71	**82**	63	19	1995
	Elan Valley	• 99106	93	87	79	81	**100**	73	34	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	78	74	69	80	**94**	73	43	1998
	East Lothian	• 10206	98	100	97	100	**100**	77	52	1989
Scotland(W)	Loch Katrine	• 111363	84	74	66	74	**94**	69	43	1995
	Daer	22412	89	75	65	90	**100**	67	32	1995
	Loch Thom	• 11840	92	88	93	100	**100**	74	56	1995
Northern Ireland	Total+	•	74	72	62	72	**73**	68	29	1995
	Silent Valley	• 20634	58	56	48	58	**64**	59	27	1995

() 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 (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.

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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

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