Hydrological Summary
for the United Kingdom

August 2006

General

With weather patterns showing a distinct autumnal complexion, August was an unsettled month; and a high frequency of thunderstorms contributed to unusually large spatial variations in rainfall totals. Well above average rainfall had a moderating impact on drought severity in the east but rainfall deficiencies continued to build in the South West. Modest late summer water demand helped slacken reservoir drawdown rates in many drought-affected areas and overall reservoir stocks for E&W are only modestly below the early autumn average. In the South-East, early September stocks were mostly in the normal range, and generally above corresponding levels in 2005. Stocks are, however, seasonally low in the South West (Colliford in particular). August river flows and groundwater levels were mostly below average but, with important exceptions, considerably above drought minima. The impact of long term rainfall deficiencies is most evident in the depressed groundwater levels across parts of the English Lowlands – with associated very low flows in spring-fed streams. In such areas in particular, notably dry soil conditions are likely to extend recessions well into the autumn and, given normal September and October rainfall, could sustain drought conditions into a 3rd successive winter.

Rainfall

Substantial rainfall on August 1st in northern and eastern Britain (Cromer reported 47.8 mm in 24 hrs) heralded a largely cyclonic month with considerable convective activity. High intensity rainfall events (10-20 mm/hr) were common and on the 13th severe thunderstorms developed along a narrow zone from Suffolk to Hants producing some remarkable storm totals – up to 100 mm, triggering severe local flooding. Frontal rainfall also generated notable 24-hr totals – Capel Curig (N. Wales) recorded 63 mm on the 30/31st. Regional and local variations in August precipitation totals were large but some clear regional patterns can be recognised. Much of south-western Britain was relatively dry (parts of South Wales reported <40% of average) but well above average totals characterised much of northern and eastern England; parts of Norfolk, Humberside and Herts were exceptionally wet. August rainfall for the UK was very close to the long term average but the summer (June-Aug) rainfall total for England and Wales is the lowest for a decade (25% below average). Summer was particularly dry in eastern Scotland, South Wales and, particularly, the South West which has the most significant regional rainfall deficiency for 2006 thus far. The drought now extends over 22 months; for much the greater part of this period it has had a strong regional focus. In much of the South East and central England accumulated rainfall deficiencies in this timeframe are the 2nd highest (after 1974-76) since 1932-34; overall deficiencies are also exceptional in much of Cornwall.

River Flow

August was a month of wide temporal and spatial variations in runoff patterns. Spate conditions were reported from many responsive catchments, in mid-month particularly, and localised – mostly urban – flash flooding was common (e.g. at Farnham and Bagshot on the 13th). Brisk, if temporary, flow recoveries were reported for a number of eastern catchments and on the 31st the Welsh Dee (at New Inn) registered its highest August daily flow since 1983. By contrast, summer recessions continued in most chalk streams in central and southern England and early August flows closely matched long term minima in some impermeable catchments in the Midlands (e.g. the Soar). August runoff totals exceeded the average for a few index rivers (notably in north-east England) but modest mean flows characterised most regions. In eastern Scotland, the Earn and Forth registered their 2nd lowest August runoff since the intense drought of 1984. Throughout much of the drought-affected regions in England, August runoff was similar to 2005, with depressed flows across most of the South; the River Wallington (Hants) recorded its 2nd lowest August runoff since 1976. The persistence, extent and severity of water resources stress is well indexed by overall runoff accumulations since late 2004. For most index rivers in the South East (parts of the South West and Midlands also) the 22-month runoff ranks 1st or 2nd lowest on record. The Medway, Test, Piddle and Kenwyn are among those rivers which established new minimum runoff totals in this timeframe. The particular lack of recent winter rainfall is most evident in Chalk streams – some registering <50% runoff over the last year; the very notable contraction in the stream network continues.

Groundwater

South-western Britain apart, rainfall in August favoured the outcrop areas of the major aquifers but late-summer rainfall rarely has any direct impact on groundwater resources. With exceptionally high soil moisture deficits at the end of July, the August rainfall produced minimal infiltration with useful recharge confined to a few thin-soiled outcrops (e.g. in East Anglia and restricted parts of the North Downs). The benefit of the late-spring recharge is evident in most well and borehole hydrographs and groundwater levels in about half the index network remain within the normal early autumn range. However levels are depressed in many aquifer outcrops in central southern England and the Midlands – regions with low winter rainfall and hence most vulnerable to successive dry winters. Groundwater levels are now very low in even the slowest-responding wells. At Redlands (in the Chalk of Cambridgeshire), the August level was the 2nd lowest in a 41-yr series whilst in the Permo-Triassic sandstones at Morris Dancers (where seasonal fluctuations are very muted), a new late summer minima was established – in a 37-yr series. The large spatial variations in soil moisture will be influential in determining the onset of the seasonal recovery of recharge rates. Soils were unusually wet at the end of August in parts of Norfolk but extremely dry in much of the Chalk outcrop in Dorset and Hampshire.

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Aug 2006	Jun 06- Aug 06	RP	Jan 06- Aug 06	RP	Sep 05- Aug 06	RP	Nov 04- Aug 06	RP
England & Wales	**mm**	**91**	**155**		**497**		**846**		**1442**	
	%	**118**	**76**	**5-10**	**90**	**2-5**	**93**	**2-5**	**88**	**5-15**
North West	mm	**128**	222		711		1186		2051	
	%	**117**	80	2-5	99	2-5	97	2-5	94	2-5
Northumbrian	mm	**97**	150		472		819		1490	
	%	**117**	71	5-10	86	2-5	95	2-5	94	2-5
Severn Trent	mm	**84**	139		420		713		1209	
	%	**121**	76	5-10	86	2-5	93	2-5	86	5-15
Yorkshire	mm	**131**	180		534		822		1399	
	%	**173**	90	2-5	101	2-5	98	2-5	92	2-5
Anglian	mm	**104**	153		380		574		987	
	%	**187**	97	2-5	98	2-5	95	2-5	89	5-10
Thames	mm	**64**	127		381		616		1017	
	%	**108**	77	2-5	86	2-5	88	2-5	80	20-35
Southern	mm	**63**	113		394		657		1111	
	%	**109**	70	5-10	84	2-5	84	5-10	78	30-45
Wessex	mm	**37**	128		420		758		1297	
	%	**55**	71	5-10	81	5-10	89	2-5	84	10-20
South West	mm	**60**	139		532		1039		1781	
	%	**69**	61	10-20	75	10-20	87	5-10	82	20-30
Welsh	mm	**97**	171		707		1304		2176	
	%	**91**	64	10-20	90	2-5	97	2-5	89	5-10
Scotland	**mm**	**96**	**241**		**800**		**1396**		**2696**	
	%	**83**	**81**	**5-10**	**94**	**2-5**	**95**	**2-5**	**102**	**2-5**
Highland	mm	**108**	282		967		1695		3422	
	%	**83**	84	2-5	98	2-5	97	2-5	110	5-10
North East	mm	**97**	195		541		964		1794	
	%	**107**	83	2-5	86	5-10	94	2-5	96	2-5
Tay	mm	**78**	201		675		1186		2225	
	%	**78**	78	2-5	87	2-5	92	2-5	96	2-5
Forth	mm	**70**	161		595		1042		2007	
	%	**72**	65	10-20	87	5-10	91	2-5	97	2-5
Tweed	mm	**88**	170		521		938		1680	
	%	**98**	73	5-10	84	5-10	94	2-5	93	2-5
Solway	mm	**92**	236		801		1380		2446	
	%	**76**	79	2-5	95	2-5	96	2-5	95	2-5
Clyde	mm	**115**	292		962		1618		3135	
	%	**81**	83	2-5	96	2-5	92	2-5	100	<2
Northern Ireland	**mm**	**88**	**196**		**619**		**1033**		**1859**	
	%	**92**	**82**	**2-5**	**93**	**2-5**	**94**	**2-5**	**94**	**2-5**

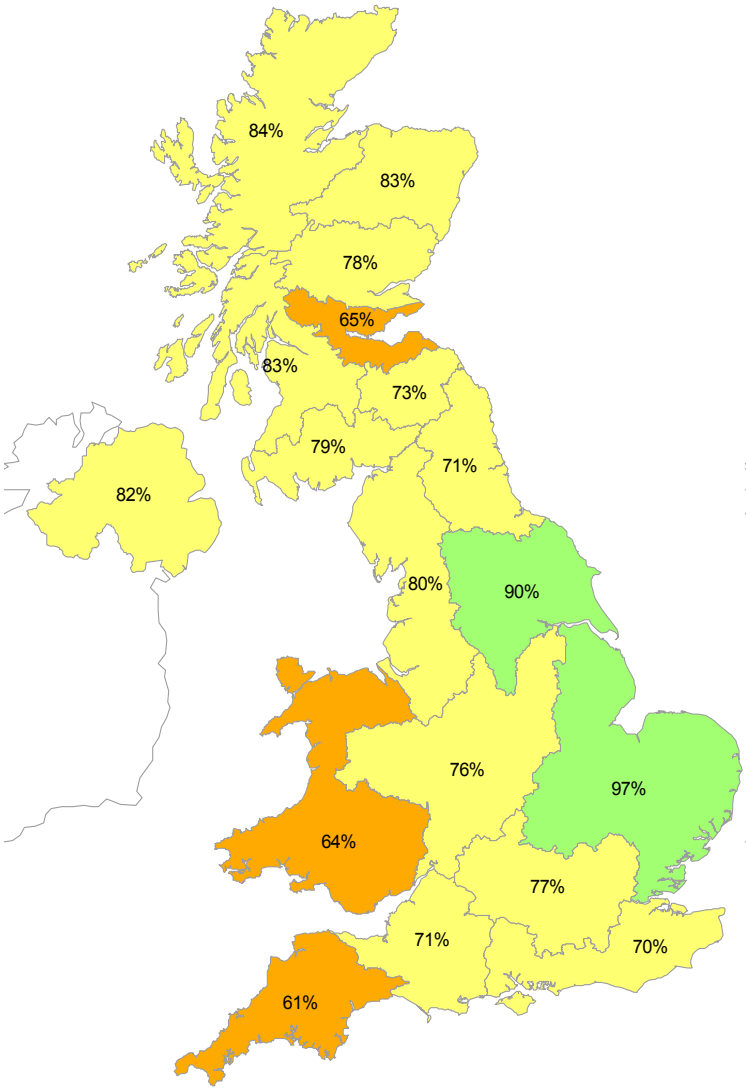
% = percentage of 1961-90 average *RP = Return period*

The monthly rainfall figures* provided by the Met Office (National Climate Information Centre) are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since March 2006 are provisional (see page 12).** 1961-2003 regional monthly totals were revised by the Met Office in 2004. 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. 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	Normal range
Very wet	Below average
Substantially above average	Substantially below average
Above average	Exceptionally low rainfall



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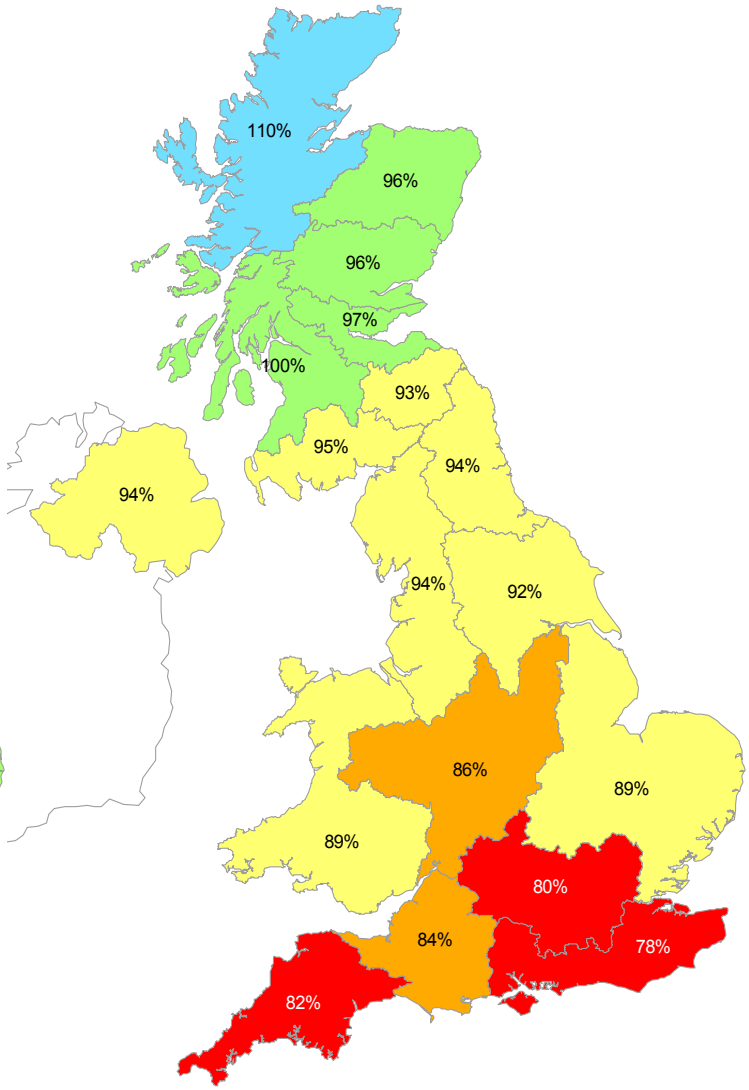
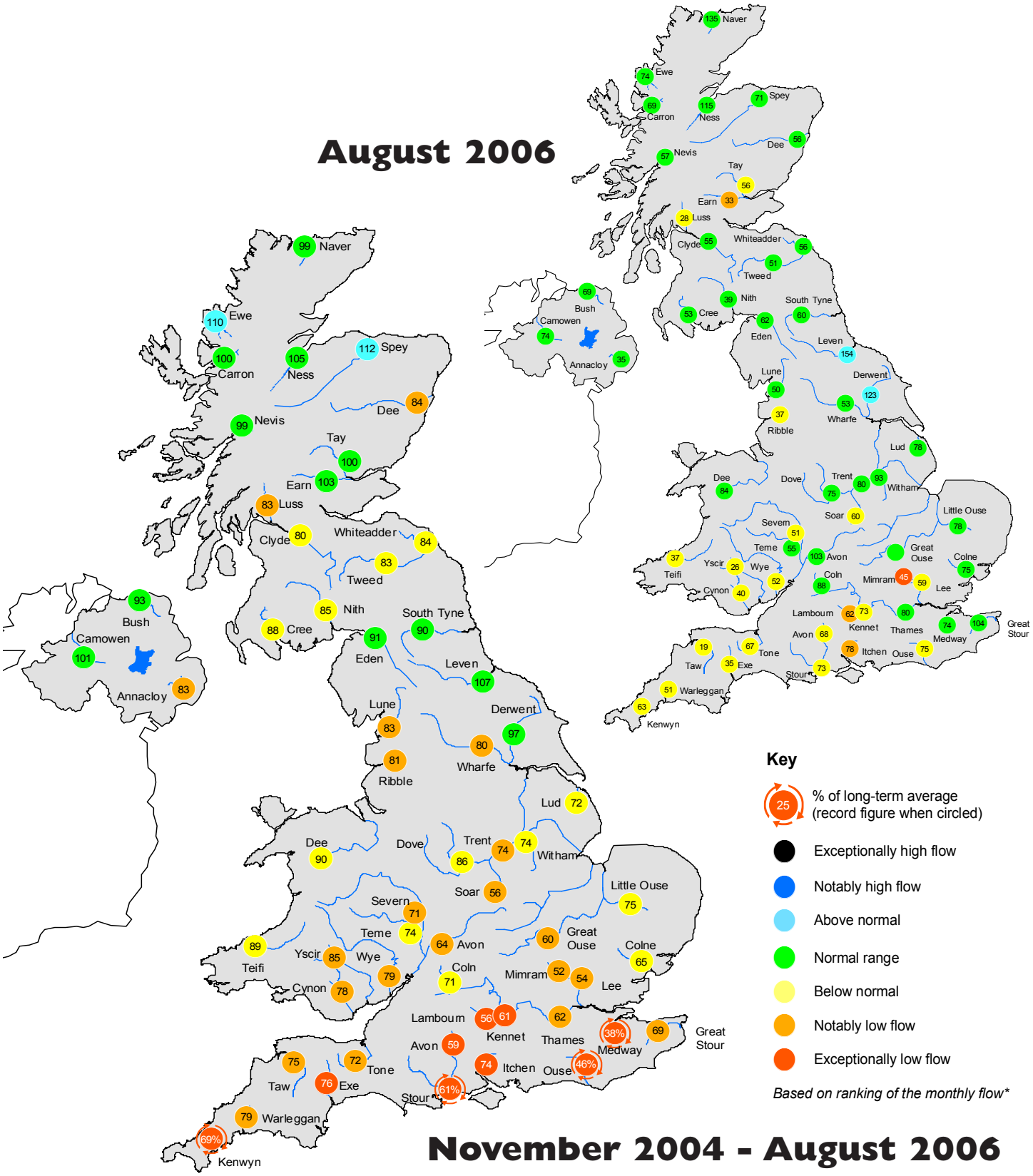


November 2004 - August 2006

Rainfall accumulation maps

Summer rainfall was below average throughout almost all of the UK, notably so in the South West (driest for 17 years) and the Forth basin (driest for 10). Most westerly frontal systems have favoured tracks remote from southern Britain over the last two years; this is reflected in the regional rainfall patterns since October 2004.

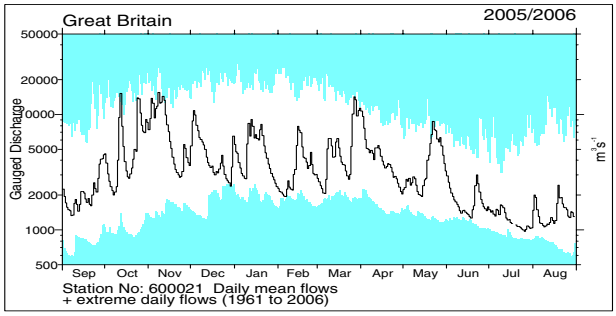
River flow . . . River flow . . .

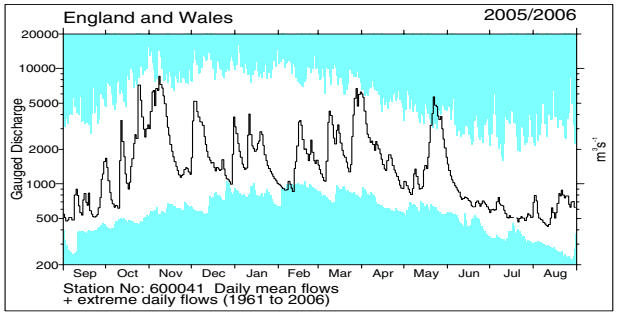


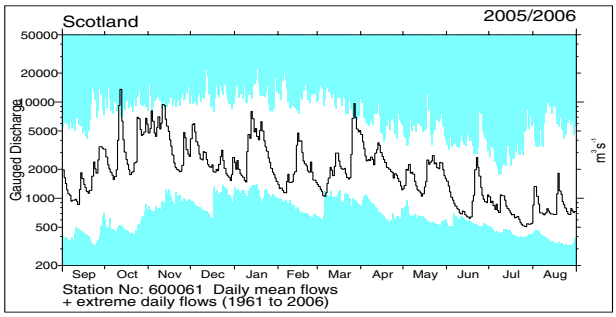
River flows

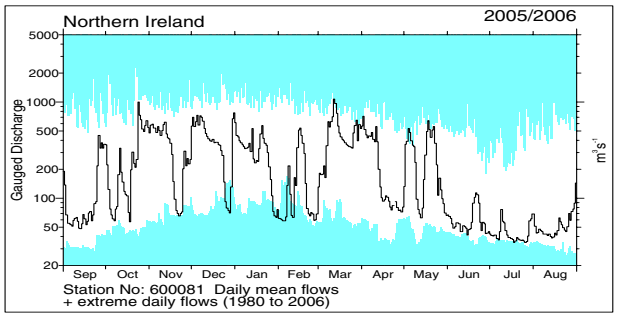
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

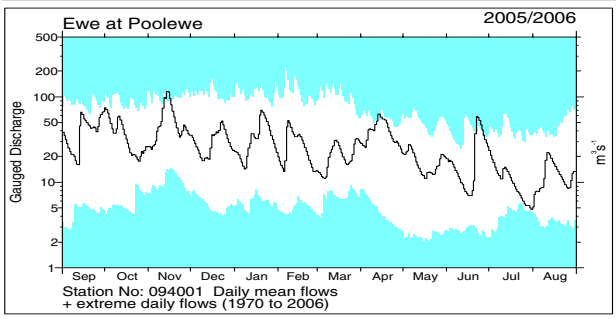
River flow . . . River flow . . .

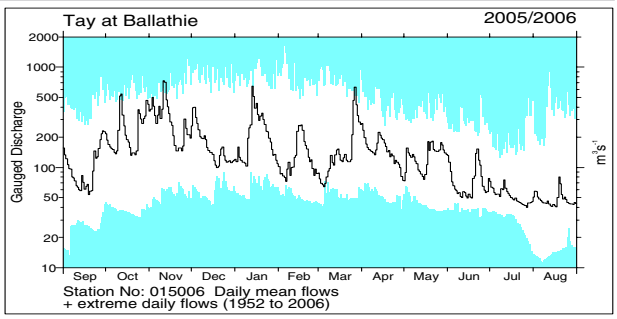


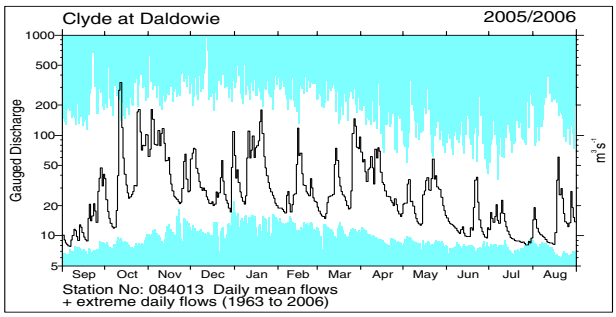


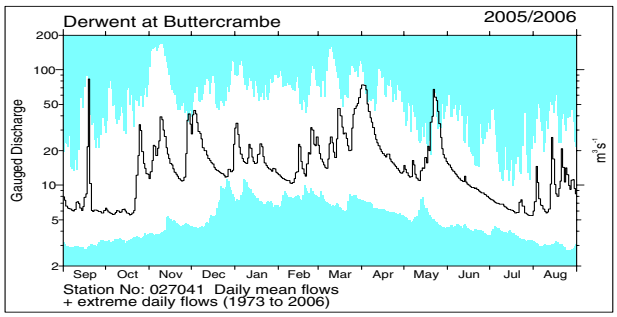


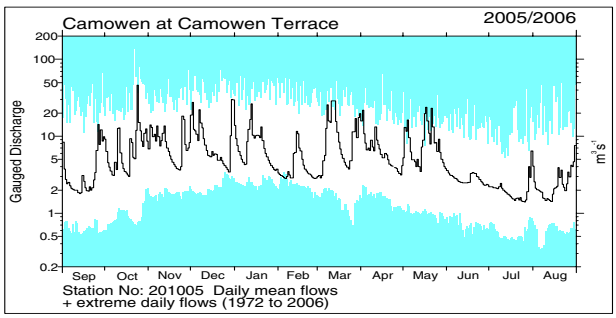


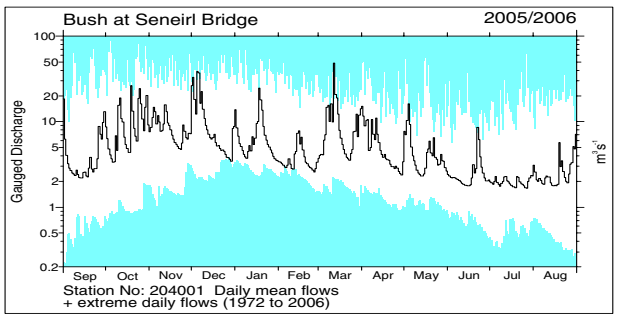








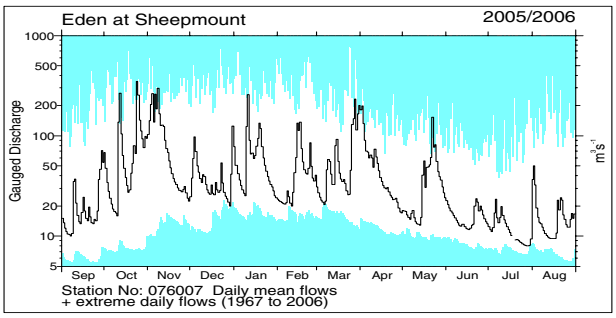


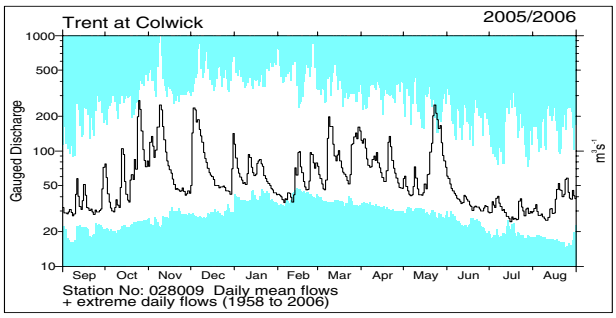


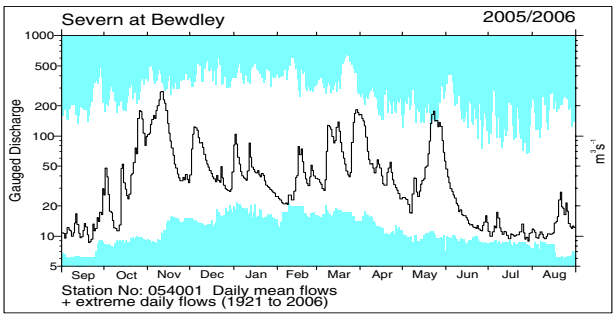
River flow hydrographs

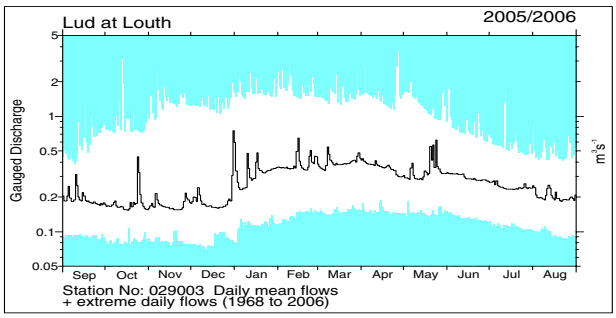
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2005 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

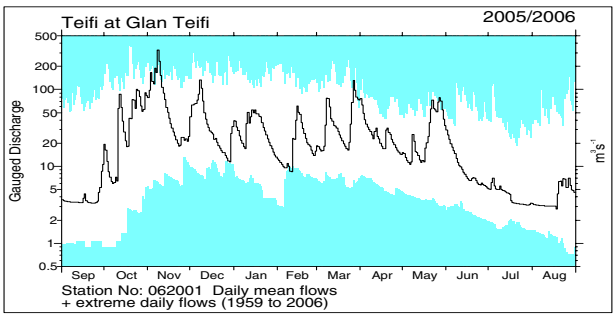
River flow . . . River flow . . .

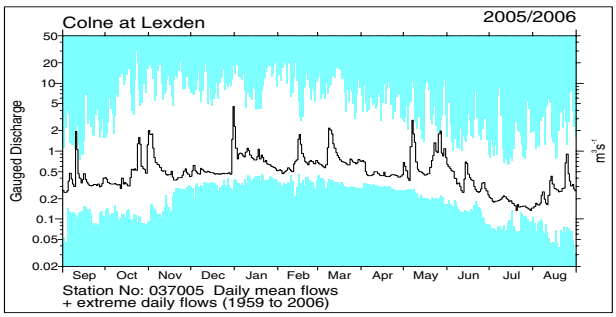


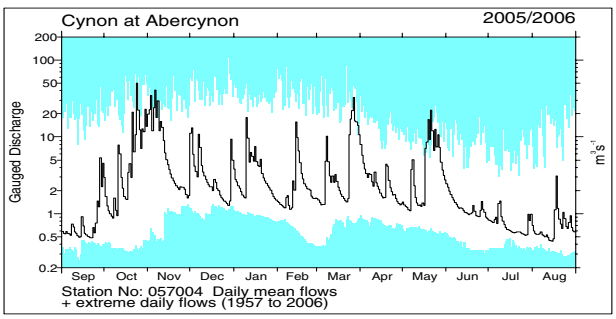


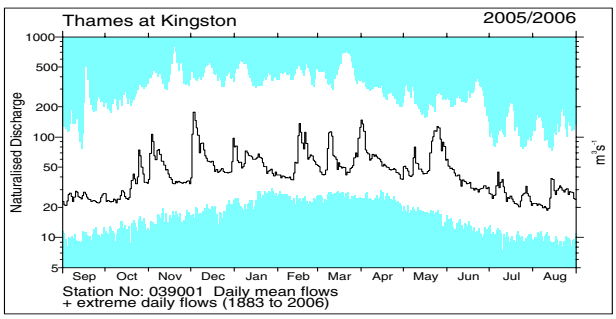


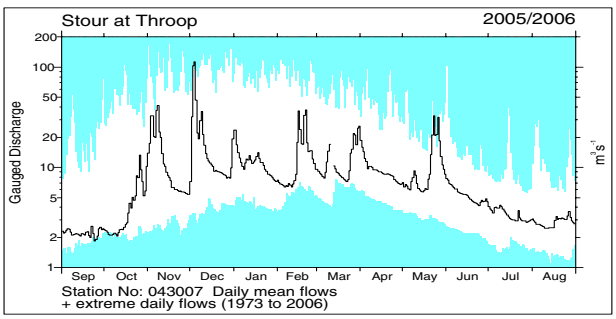


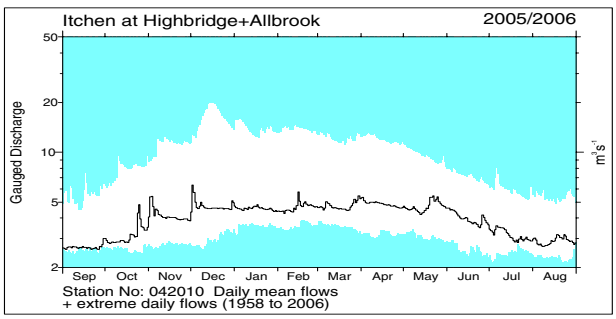










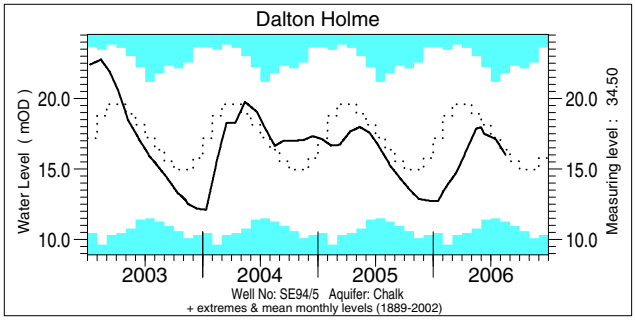


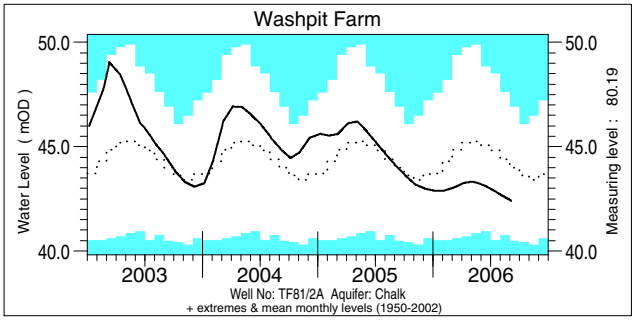
Notable runoff accumulations (a) January - August 2006, (b) November 2004 - August 2006

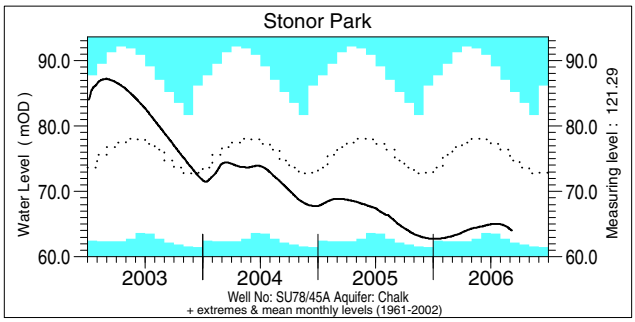
	River	%lta	Rank
a)	Spey (Boat o'Garten)	66	3/55
	Forth	68	3/25
	Tweed (Norham)	73	3/47
	Mimram	40	1/54
	Lee (nat)	48	11/120
	Luss	75	3/28
	Faughan	65	1/30
	L Bann	79	3/26
b)	Soar	56	2/34
	Thames (nat)	62	10/122
	Lambourn	56	2/43
	Mole	65	1/29
	Medway	38	1/41
	Ouse (Gold Bridge)	46	1/38
	Wallington	45	1/46
	Test	63	1/46
	Itchen	74	2/47
	Avon (Amesbury)	59	2/40
	Stour (Throop)	61	1/32
	Piddle	64	1/40
	Kenwyn	69	1/37
	Faughan	73	1/29

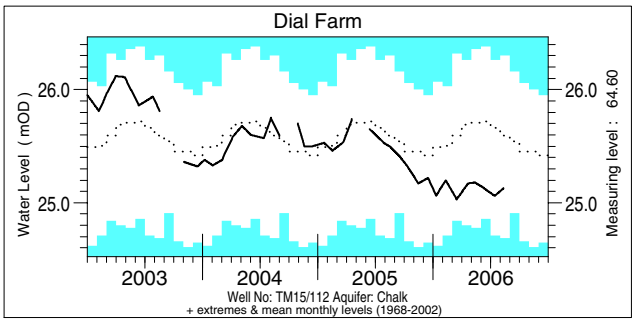
lta = long term average
Rank 1 = lowest on record

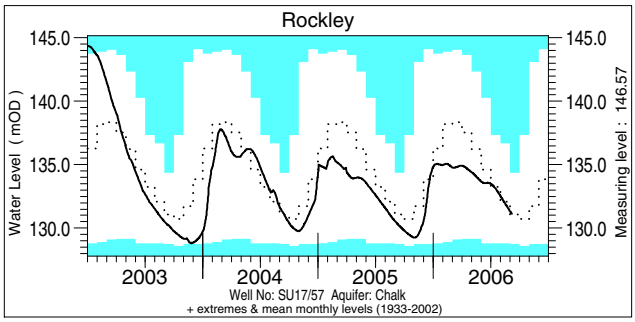
Groundwater . . . Groundwater

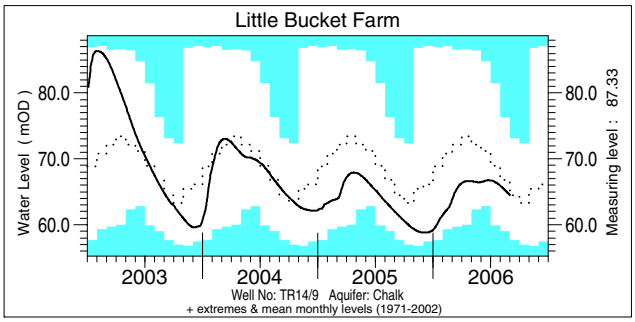


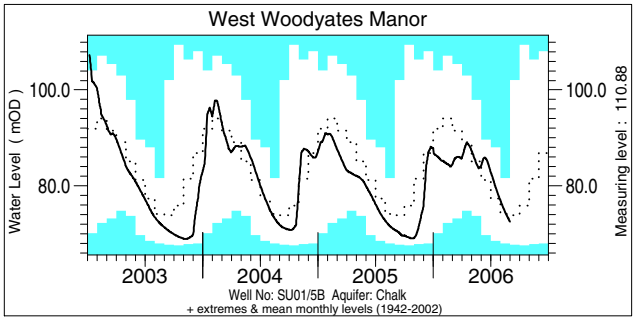


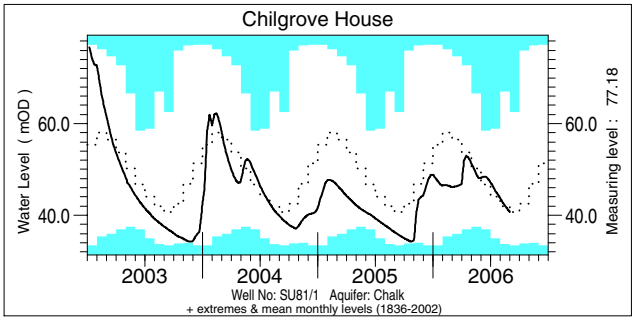


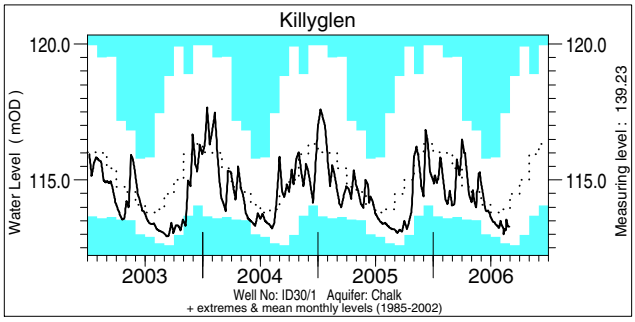


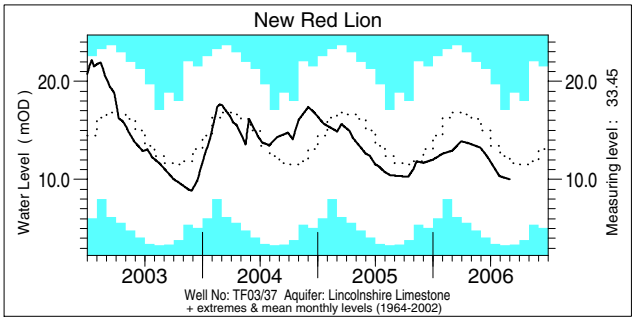






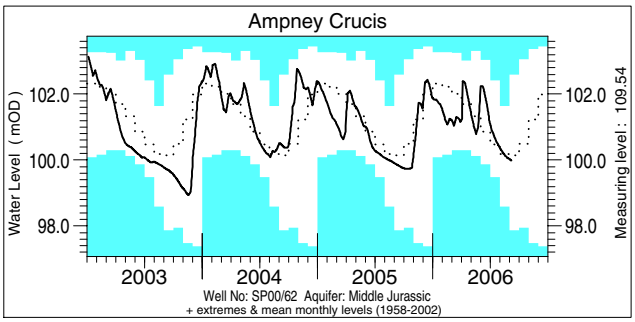


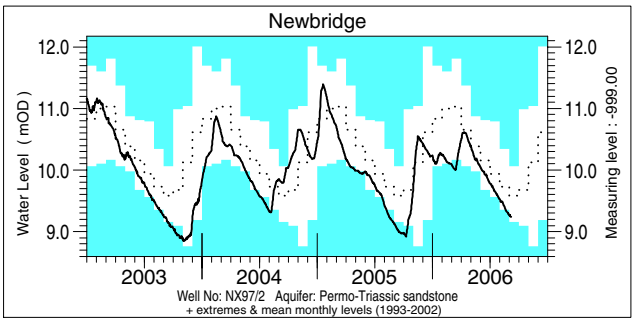


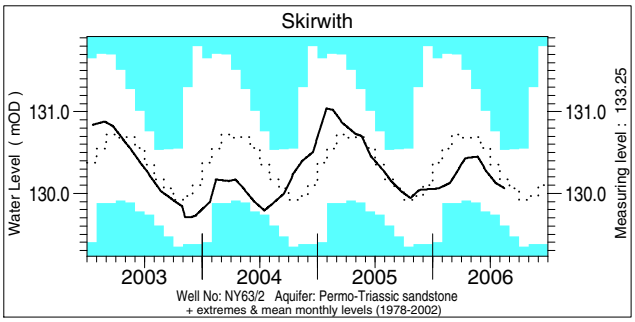


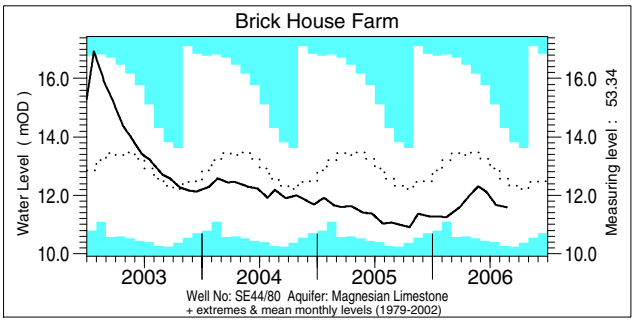
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month 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.

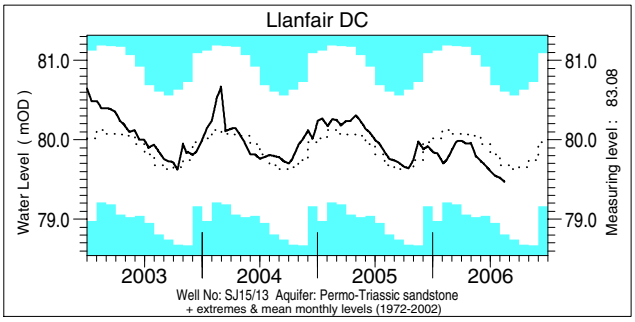
Groundwater . . . Groundwater

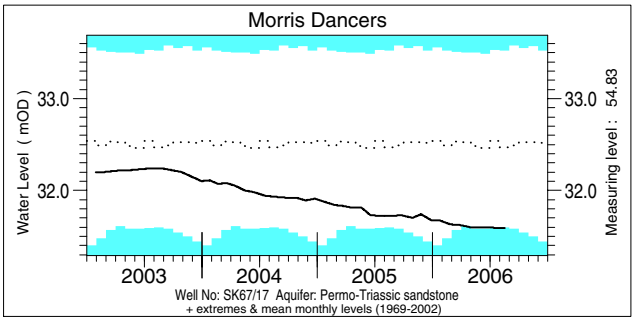


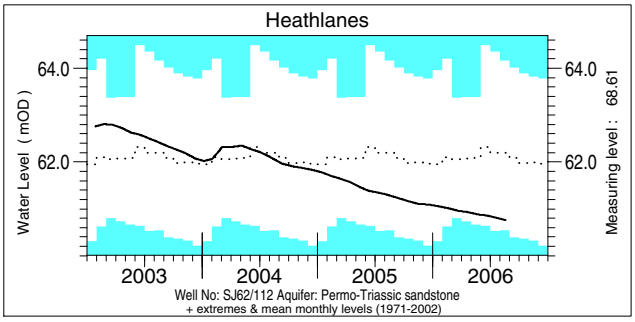


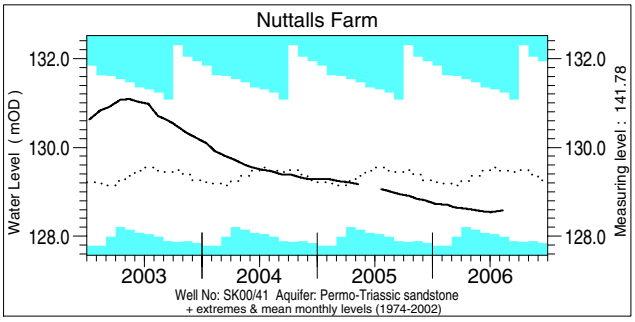


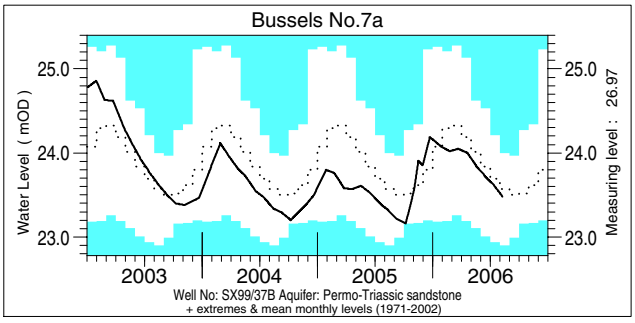


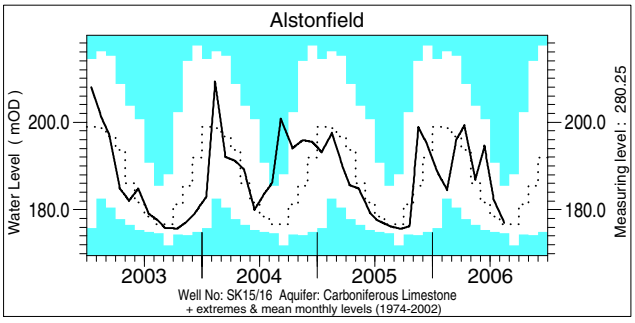










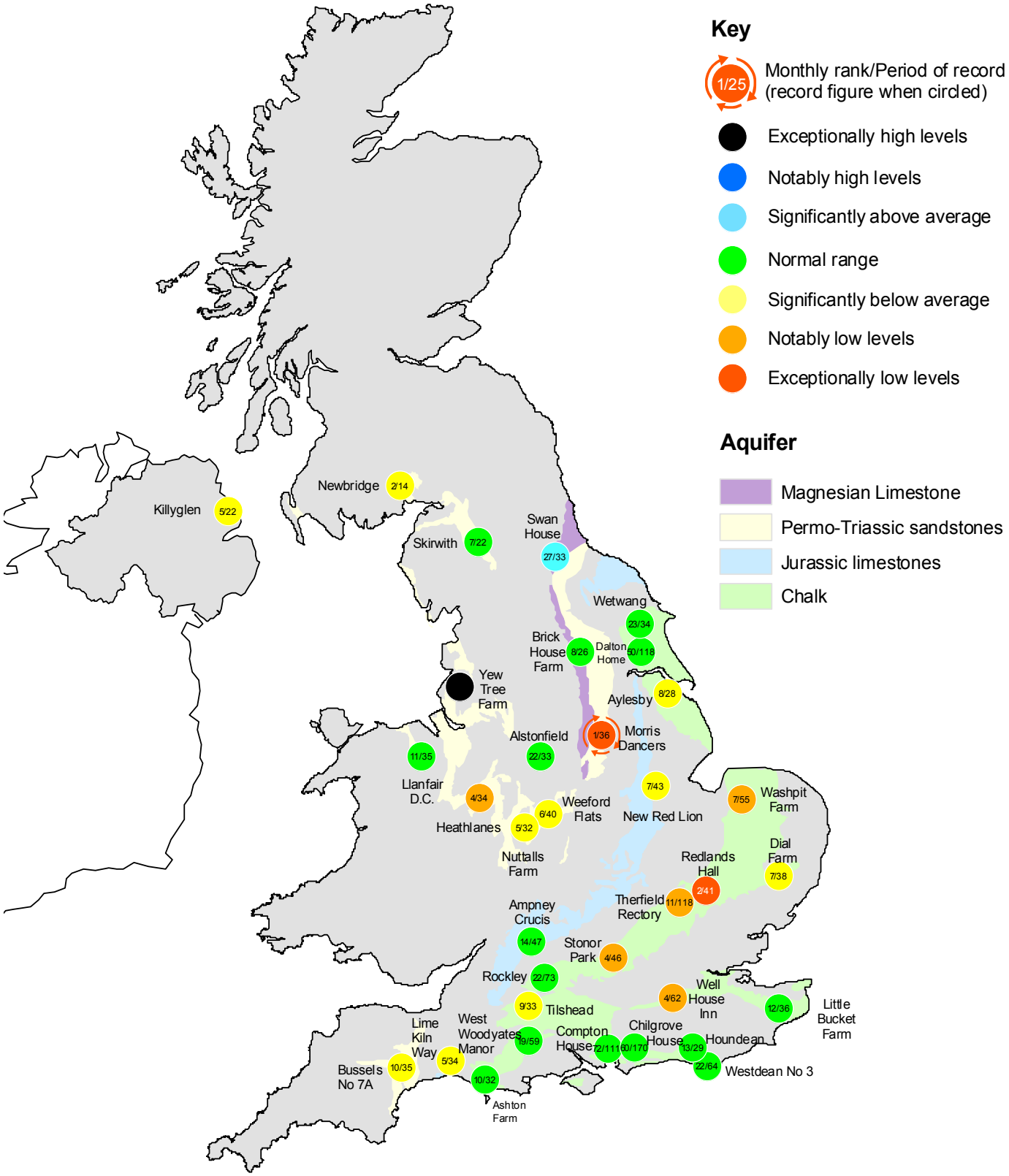


Groundwater levels August / September 2006

Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.	Borehole	Level	Date	Aug. av.
Dalton Holme	16.00	16/08	16.24	Chilgrove House	40.64	31/08	41.70	Llanfair DC	79.47	15/08	79.63
Washpit Farm	42.40	05/09	44.50	Killyglen	113.29	30/08	113.82	Morris Dancers	31.59	16/08	32.34
Stonor Park	64.03	06/09	76.01	New Red Lion	10.00	30/08	12.37	Heathlanes	60.76	18/08	62.14
Dial Farm	25.13	11/08	25.59	Ampney Crucis	99.98	06/09	100.16	Nuttalls Farm	128.58	11/08	129.61
Rockley	131.12	06/09	132.01	Newbridge	9.24	06/09	9.66	Bussels No.7a	23.48	08/08	23.58
Well House Inn	88.66	06/09	94.99	Skirwith	130.06	15/08	130.16	Alstonfield	177.05	14/08	177.42
West Woodyates	72.58	31/08	73.87	Brick House Farm	11.59	23/08	12.50				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



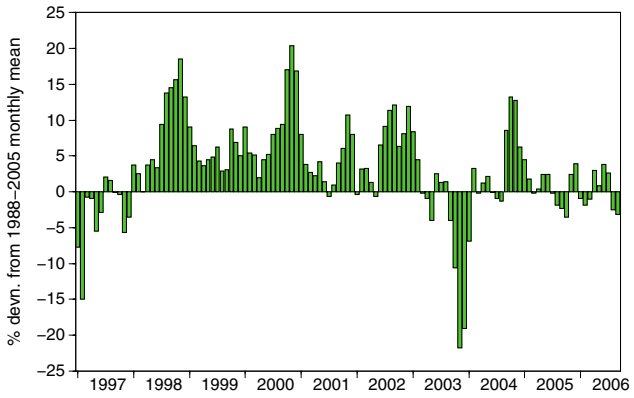
Groundwater levels - August 2006

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.

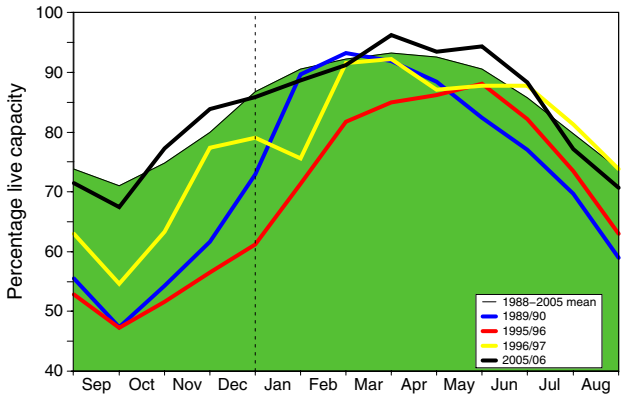
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

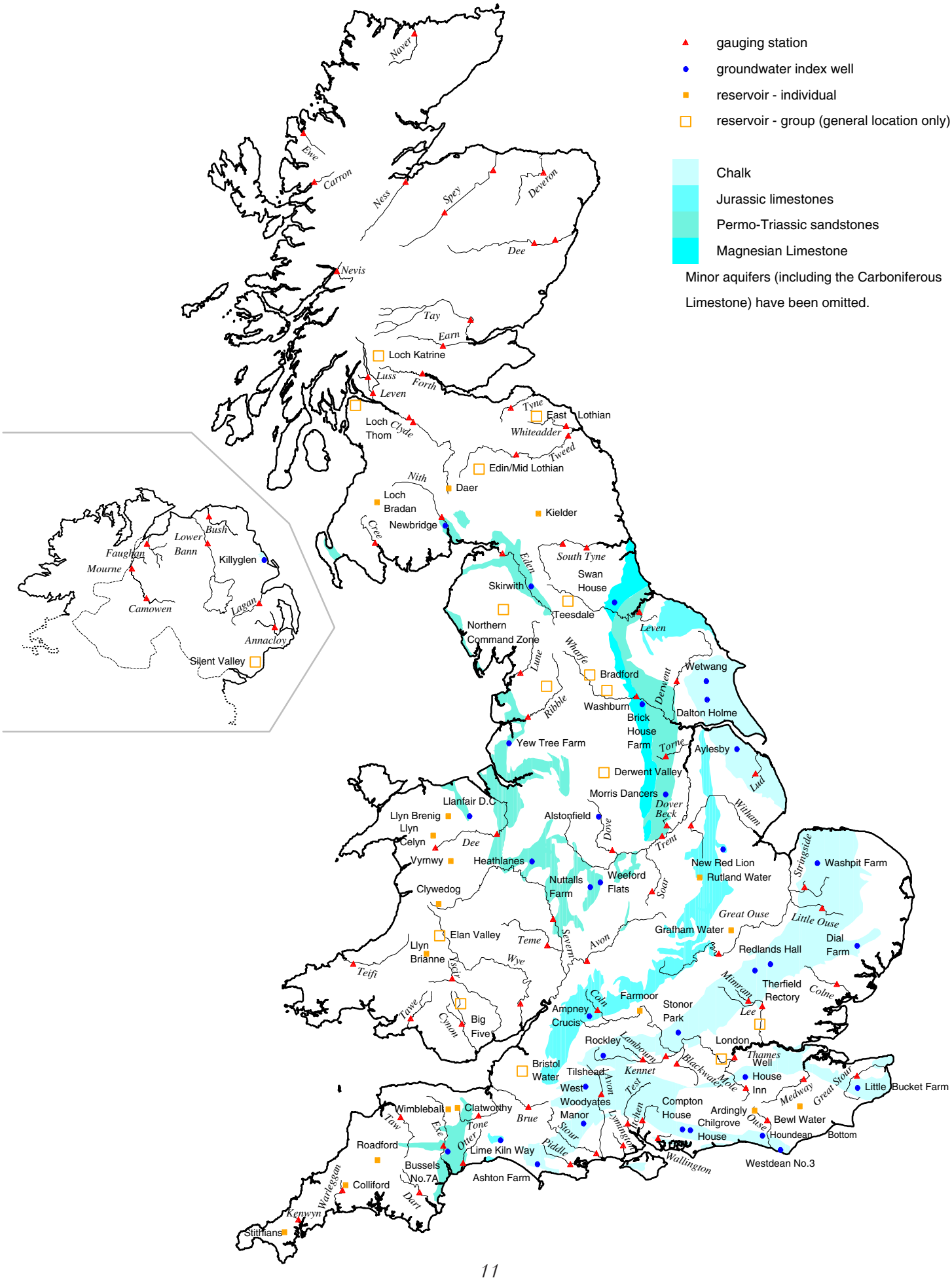
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2006 Jul	Aug	Sep	Sep Anom.	Min. Sep	Year* of min.	2005 **Sep**	Diff **06-05**
North West	N Command Zone	• 124929	77	64	**57**	4	24	1995	49	8
	Vyrnwy	55146	86	72	**64**	-5	36	1995	63	1
Northumbrian	Teesdale	• 87936	84	69	**65**	2	38	1995	69	-4
	Kielder	(199175)	(90)	(82)	**(82)**	-5	(66)	1989	(89)	-7
Severn Trent	Clywedog	44922	97	74	**62**	-13	38	1989	76	-14
	Derwent Valley	• 39525	88	71	**66**	1	34	1995	60	6
Yorkshire	Washburn	• 22035	87	78	**77**	12	34	1995	57	20
	Bradford supply	• 41407	85	69	**69**	6	21	1995	57	12
Anglian	Grafham	(55490)	(96)	(88)	**(83)**	-1	(59)	1997	(82)	1
	Rutland	(116580)	(88)	(81)	**(76)**	-5	(66)	1995	(82)	-6
Thames	London	• 202406	92	83	**77**	-2	62	1995	74	3
	Farmoor	• 13822	100	100	**99**	8	64	1995	98	1
Southern	Bewl	28170	85	76	**68**	0	38	1990	54	14
	Ardingly	4685	98	88	**76**	5	47	1996	56	20
Wessex	Clatworthy	5364	95	77	**62**	2	31	1995	66	-4
	Bristol WW	• (38666)	(92)	(84)	**(76)**	12	(43)	1990	(55)	21
South West	Colliford	28540	67	58	**46**	-24	43	1997	54	-8
	Roadford	34500	74	67	**55**	-16	40	1995	58	-3
	Wimbleball	21320	94	84	**71**	4	40	1995	74	-3
	Stithians	5205	77	64	**47**	-12	30	1990	54	-7
Welsh	Celyn and Brenig	• 131155	97	84	**75**	-4	49	1989	78	-3
	Brianne	62140	94	85	**78**	-6	55	1995	88	-10
	Big Five	• 69762	81	65	**52**	-15	29	1995	62	-10
	Elan Valley	• 99106	89	76	**65**	-10	46	1995	67	-2
Scotland(E)	Edinburgh/Mid Lothian	• 97639	87	80	**77**	2	45	1998	74	3
	East Lothian	• 10206	100	78	**69**	-12	63	1989	78	-9
Scotland(W)	Loch Katrine	• 111363	86	72	**63**	-5	50	2000	67	-4
	Daer	22412	91	83	**63**	-6	41	1995	69	-6
	Loch Thom	• 11840	100	82	**79**	1	58	1997	100	-21
Northern Ireland	Total+	• 67270	80	70	**68**	-4	40	1995	71	-3
	Silent Valley	• 20634	82	72	**66**	4	33	2000	65	1

() 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 1988-2006 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 and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office 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

NATURAL ENVIRONMENT RESEARCH COUNCIL

09/06