Hydrological Summary
for the United Kingdom

October 2006

General

October was another exceptionally mild month with rainfall totals above average in almost all regions. Recoveries in reservoir stocks were notable in many areas (including the Thames basin) and overall stocks for England and Wales exceeded the early November average by around 5%. In most of the drought-affected areas, reservoir stocks are substantially healthier than last year; an exception is the South West where stocks are seasonally low, at Colliford particularly. Generally, river flows also recovered briskly – especially in northern Scotland which experienced a major flood event on the 24-27th; damage to a treatment works in Orkney triggered appeals for water conservation. October runoff totals were, however notably low in some southern spring-fed streams and rivers. Groundwater level recoveries are underway throughout most western and northern aquifers but shallow recessions continue in some parts of eastern England and the Midlands. In such areas the 2006/07 recoveries will need to be generated from an exceptionally low base. The significant improvement in the water resources outlook resulting from the 5th relatively wet October in the last six years is tempered by the knowledge that in 2004 and 2005 abundant mid-autumn rainfall heralded notably dry winter and early spring periods across much of southern Britain.

Rainfall

A dominant moist south-westerly airflow across much of southern Britain resulted in seasonally very high temperatures and brought a sequence of rain-bearing low pressure systems across the country. The mild and humid conditions triggered many localised convective storms (with flash flooding) and many notable rainfall events were reported – over a wide range of durations, e.g. 37mm in 2 hrs at Gloucester on the 1st; 32mm in an hour at Penzance (22nd); 83mm at Durkadale (Orkney) in 26 hrs (25/26th). October rainfall totals were exceptionally high in parts of north-eastern Scotland (Dingwall recording >300% of the lta) while most of E&W reported >120%. Only in western Scotland did significant areas register below average rainfall. For England, each of the last three months have recorded above average rainfall and much of eastern Britain – including most of the drought-affected region – was notably wet in this timeframe. Anglian Region registered its 2nd highest Aug-Oct rainfall in the last 20 years. With most regional rainfall totals over the last 6 &12 month periods within the normal range, the diminished, but continuing, drought conditions chiefly reflect rainfall deficiencies over 24 months. In the South East, current deficiencies would be expected on average once every 10-15 years. However, the disproportionate contribution of the limited winter rainfall to the overall deficiency implies a greater hydrological severity especially in relation to groundwater resources.

River Flow

A brisk decline in soil moisture deficits through October helped seasonal river flow recoveries gain momentum in most catchments. Localised flash flooding was common (e.g. in Shropshire on the 11th; Gt Yarmouth, Oxford and East London on the 12th), and widespread floodplain inundation accompanied a major flood episode in northern Scotland on the 26th – the River Halladale registered its highest flow in a series from 1976 and the provisional peak on the Thurso has an estimated return period of >100 yrs. The 3rd week also witnessed spate conditions in many responsive rivers across the English Lowlands (e.g. in the Mole and Gt Stour); the Thames briefly exceeded bankfull at Abingdon on the 12th. More significantly in the drought context, baseflows showed a modest increase over the month. With a few exceptions (including the Lee & Kenwyn), October runoff totals were well within the normal range, albeit considerably below average over wide areas (e.g. in the South West) and generally exceeded those for last year in the drought-affected region. However, runoff for most spring-fed streams was substantially below average – the Aug-Oct runoff for the River Test is the lowest in a 49-yr series. By contrast, in northern Scotland, the Naver registered its 2nd highest October runoff in a 30-year series. Contemporary flows provide very limited evidence of the drought's impact but long term runoff accumulations are more revealing. Runoff for the Mimram since April 2005 is the lowest, for *any* 18-month sequence, in a series from 1952 and, in the 2-yr timeframe (Nov 2004 - Oct 2006), unprecedented minima have been registered in a number of catchments across southern England.

Groundwater

Most aquifer outcrop areas received well above average October rainfall; totals exceeded170% of average in parts of the eastern Chalk (e.g. the Yorkshire Wolds). Soil moisture deficits were mostly below average at month-end, but spatial variability was large with substantial smds lingering in a few areas (e.g. the East Midlands). As is typical of the late autumn, seasonal recoveries in groundwater levels are underway in many of the more responsive aquifers, e.g. the Jurassic and Carboniferous Limestones. Level increases have also been registered in some aquifer units in the Chalk (e.g. at Rockley and Compton – both partly reflecting reporting dates late in the month) and the Permo-Triassic sandstones (e.g. at Bussels in the South West). October groundwater levels in the majority of index wells were in the normal range but concern for the resources outlook focuses largely on those areas where levels are lower than a year ago. These include some aquifer units in the eastern Chalk (at Redlands Hall only in 1992 have lower October levels been reported in a 41-yr series) and the Permo-Trias of the Midlands (where Weeford Flats is dry and levels at Heathlanes are at their lowest since February 1998). Modest autumn recharge has increased groundwater levels to above historical drought minima but to restore healthy groundwater resources in the regions of maximum depletion, above average rainfall is needed through the winter and early spring.

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

Rainfall accumulations and return period estimates

Area	Rainfall	Oct 2006	Aug 06- Oct 06	RP	May 06- Oct 06	RP	Nov 05- Oct 06	RP	Nov 04- Oct 06	RP
England & Wales	**mm**	**115**	**282**		**456**		**845**		**1632**	
	%	**133**	**117**	**2-5**	**106**	**2-5**	**93**	**2-5**	**90**	**5-10**
North West	mm	**158**	401		615		1198		2330	
	%	**123**	113	2-5	102	2-5	98	2-5	96	2-5
Northumbrian	mm	**103**	292		438		820		1689	
	%	**134**	125	5-10	103	2-5	95	2-5	97	2-5
Severn Trent	mm	**90**	243		405		711		1372	
	%	**137**	121	2-5	108	2-5	93	2-5	89	5-10
Yorkshire	mm	**110**	319		480		853		1588	
	%	**149**	145	10-20	119	5-10	102	2-5	95	2-5
Anglian	mm	**76**	245		379		579		1115	
	%	**149**	156	30-40	123	5-10	96	2-5	92	2-5
Thames	mm	**98**	240		397		656		1188	
	%	**154**	131	5-10	115	2-5	94	2-5	85	10-20
Southern	mm	**116**	246		391		702		1298	
	%	**145**	118	2-5	107	2-5	89	2-5	83	10-20
Wessex	mm	**114**	211		408		767		1469	
	%	**141**	95	2-5	104	2-5	90	2-5	86	5-15
South West	mm	**149**	272		476		1016		2010	
	%	**127**	91	2-5	93	2-5	85	5-10	84	10-20
Welsh	mm	**161**	338		571		1225		2408	
	%	**116**	93	2-5	94	2-5	91	2-5	89	5-10
Scotland	**mm**	**190**	**436**		**700**		**1411**		**3035**	
	%	**119**	**104**	**2-5**	**102**	**2-5**	**96**	**2-5**	**103**	**2-5**
Highland	mm	**253**	511		819		1722		3818	
	%	**132**	104	2-5	104	2-5	99	2-5	110	5-10
North East	mm	**163**	342		521		1019		2037	
	%	**159**	120	5-10	103	2-5	99	2-5	99	2-5
Tay	mm	**151**	392		629		1212		2533	
	%	**112**	110	2-5	105	2-5	94	2-5	98	2-5
Forth	mm	**120**	318		518		1025		2261	
	%	**100**	96	2-5	93	2-5	89	2-5	99	2-5
Tweed	mm	**110**	314		478		906		1907	
	%	**112**	112	2-5	96	2-5	90	2-5	95	2-5
Solway	mm	**162**	426		680		1352		2777	
	%	**103**	101	2-5	99	2-5	94	2-5	97	2-5
Clyde	mm	**182**	515		848		1645		3543	
	%	**93**	99	2-5	102	2-5	94	2-5	101	2-5
Northern Ireland	**mm**	**128**	**350**		**569**		**1076**		**2121**	
	%	**112**	**113**	**2-5**	**108**	**2-5**	**98**	**2-5**	**97**	**2-5**

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

Important note: Figures in the above table may be quoted provided that their source is acknowledged. See page 12. Where appropriate, specific reference must be made to the uncertainties associated with the return period estimates. Generally, the return period estimates are based on tables provided by the Met Office but those for Northern Ireland are based on the estimates for north-west England. The estimates relate to the specified span of months only (RPs may be an order of magnitude less if n-month periods beginning in any month are considered), they reflect rainfall over the period 1911-70 only, and assume a stable climate. (For further details see Tabony, R. C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37).

All monthly rainfall totals since June 2006 are provisional.

Rainfall . . . Rainfall . . .

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

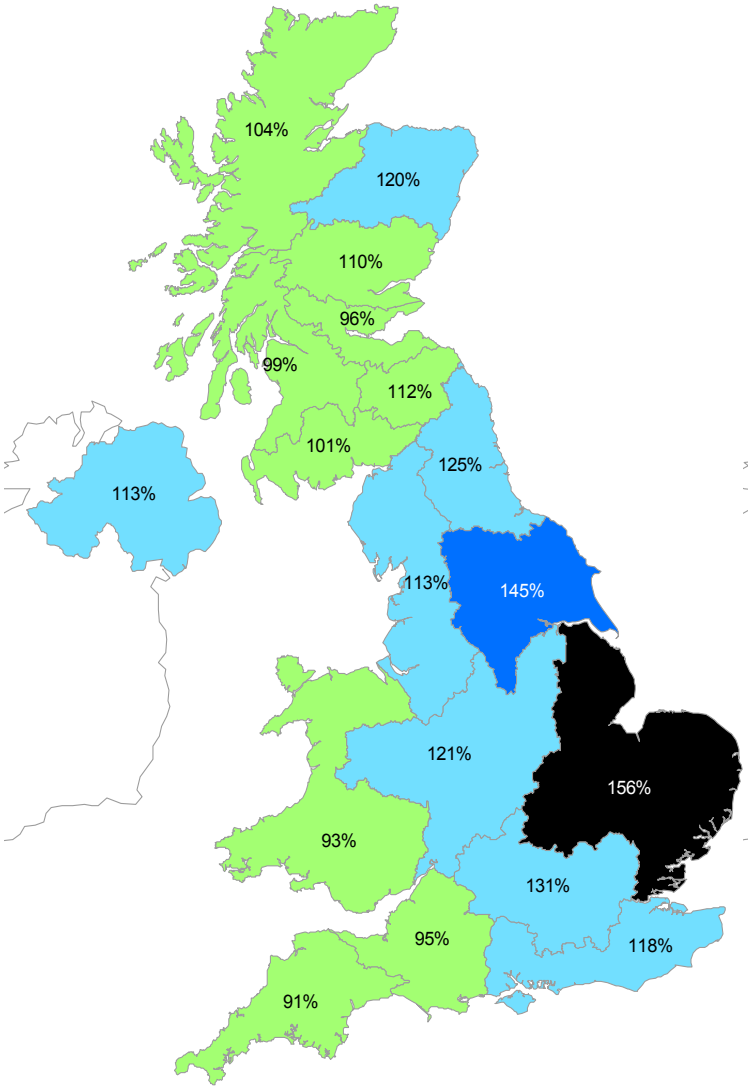
Above average

Normal range

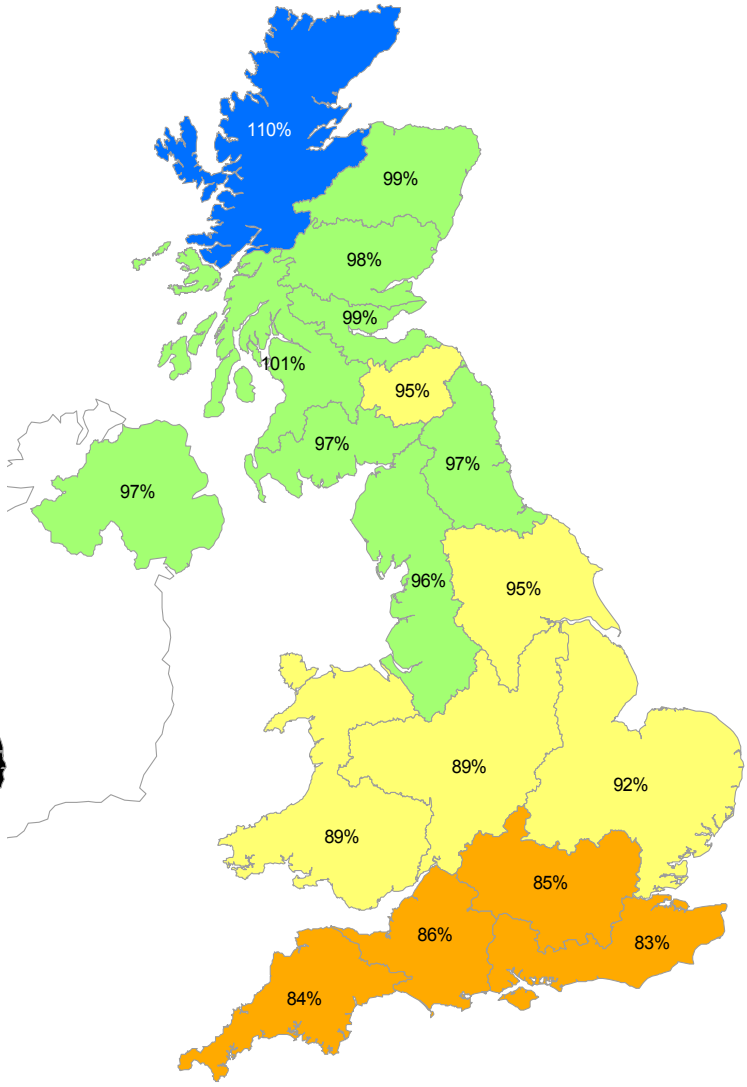
Below average

Substantially below average

Exceptionally low rainfall



August 2006 - October 2006

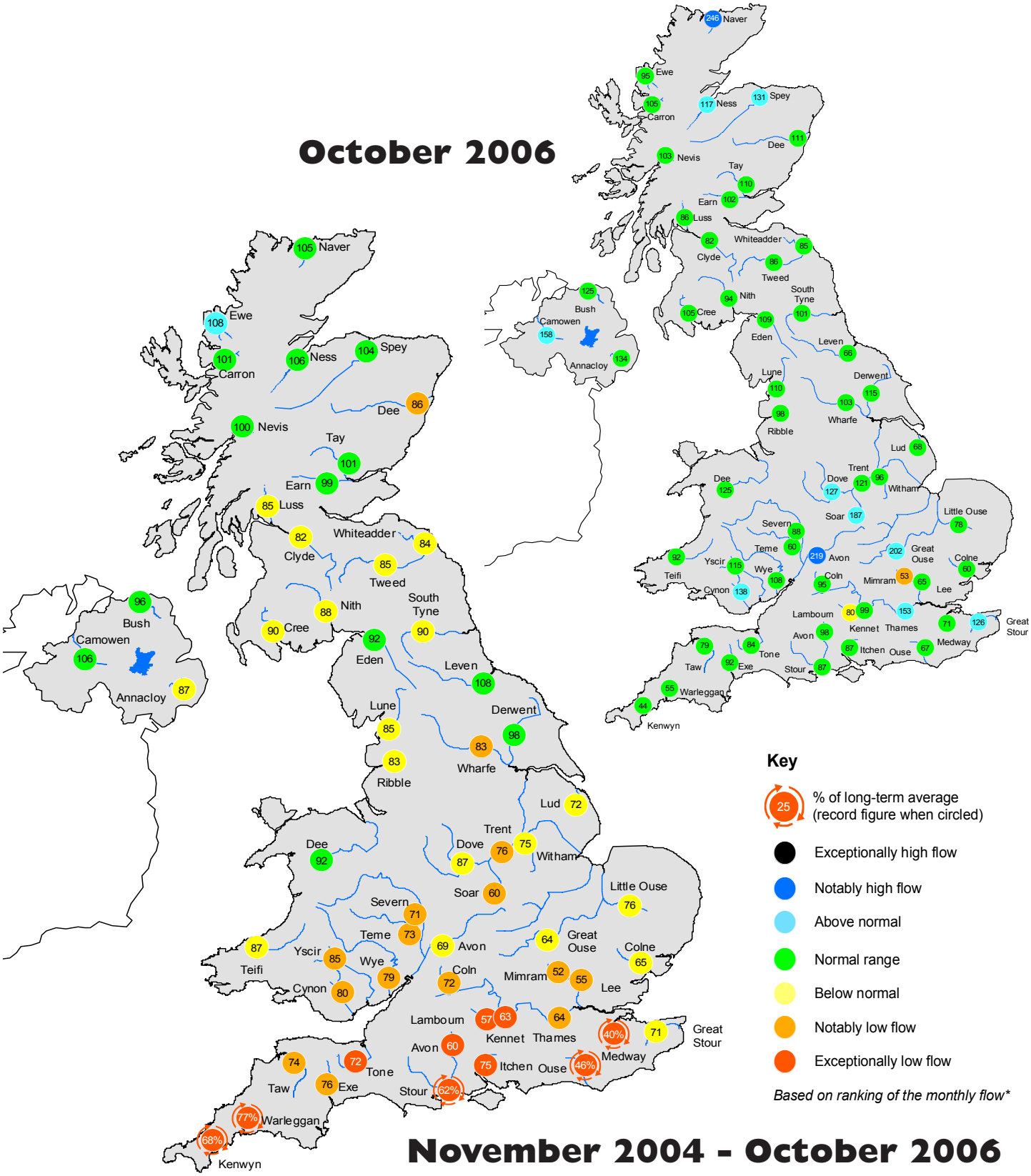


November 2004 - October 2006

Rainfall accumulation maps

The provisional UK rainfall total for August-October was around 13% above the 1961-90 average with the South-West and Wales the only regions to record appreciably below average rainfall. By contrast, only Highland Region has above average rainfall over the last 24-months and deficiencies remain substantial across much of southern Britain.

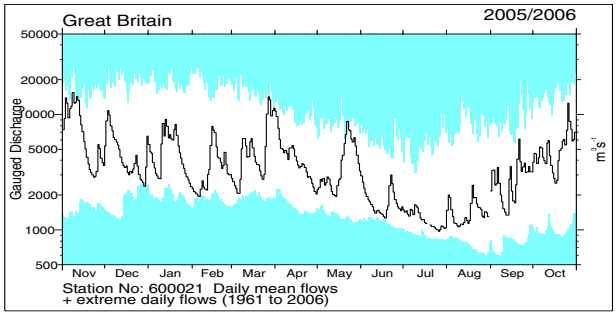
River flow . . . River flow . . .

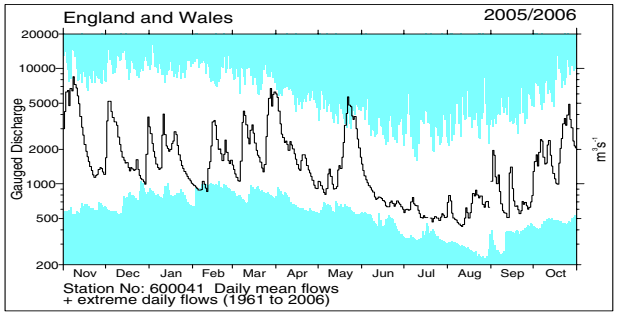


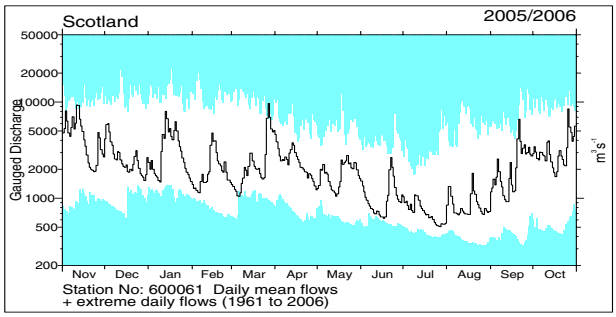
River flows

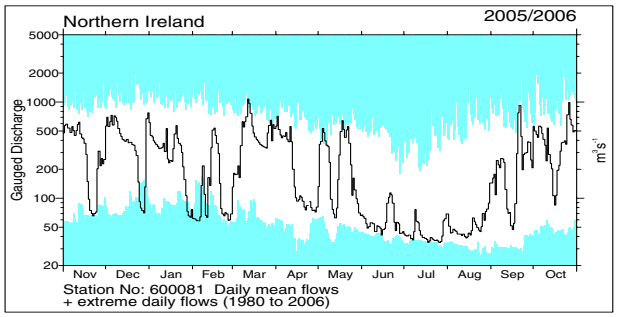
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

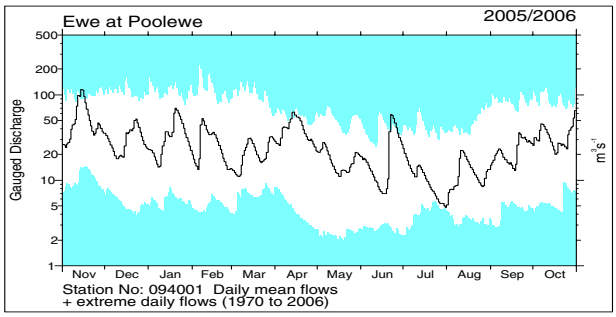
River flow . . . River flow . . .

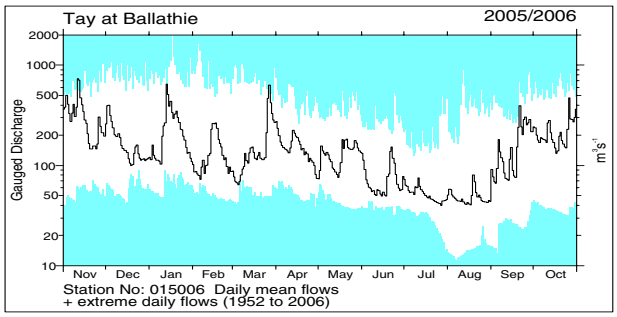


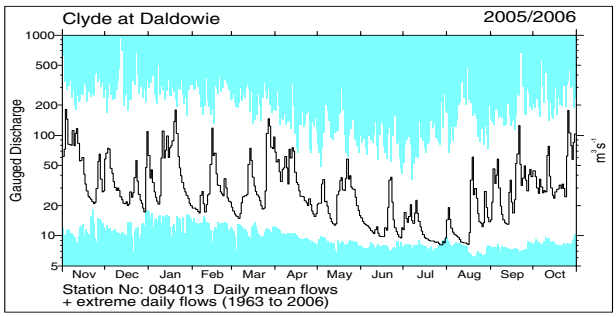


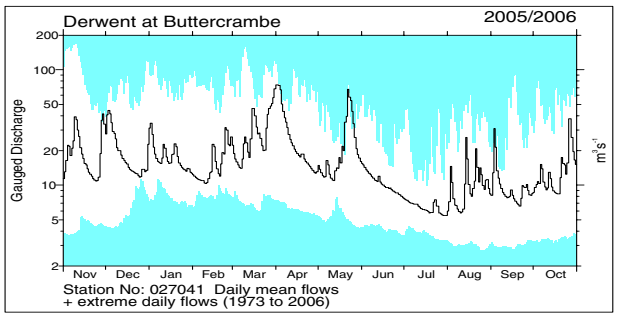


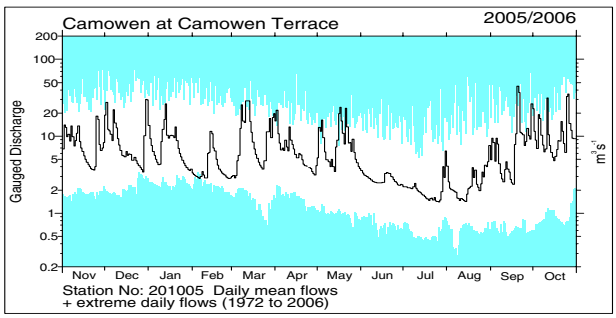


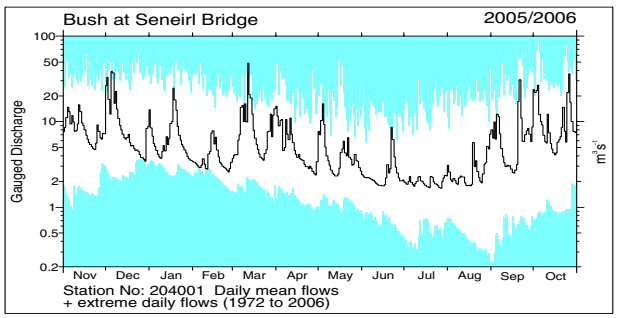








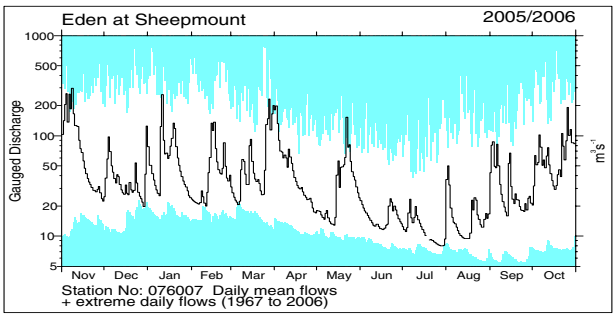


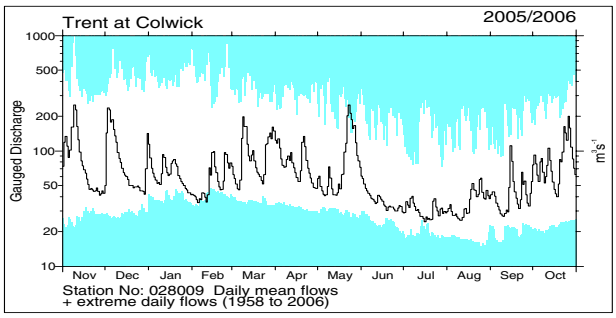


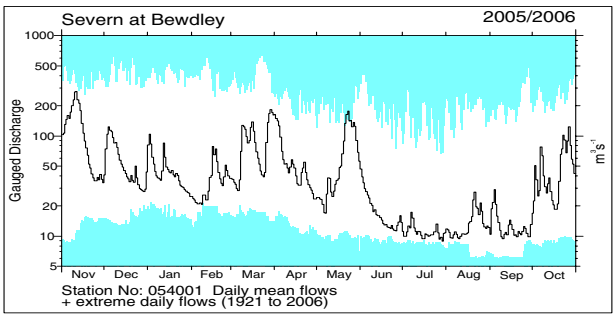
River flow hydrographs

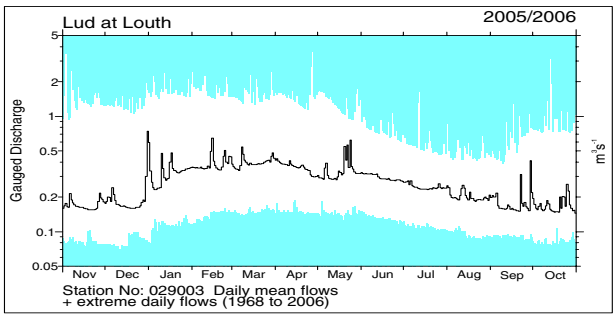
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to November 2005 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

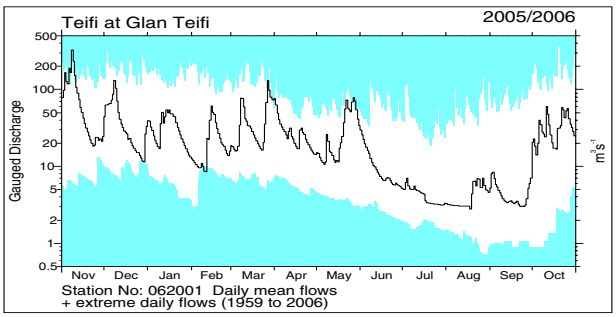
River flow . . . River flow . . .

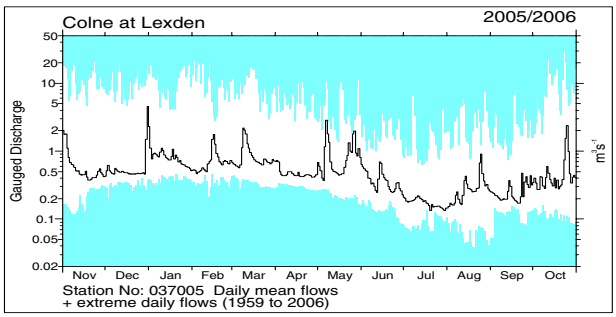


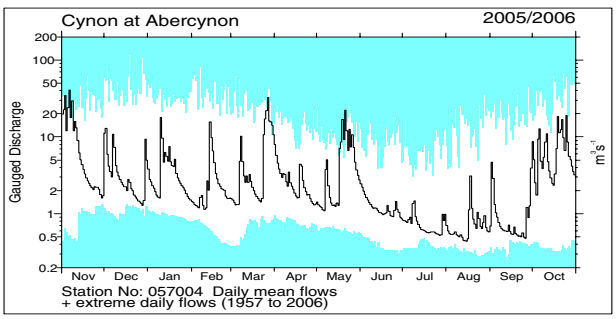


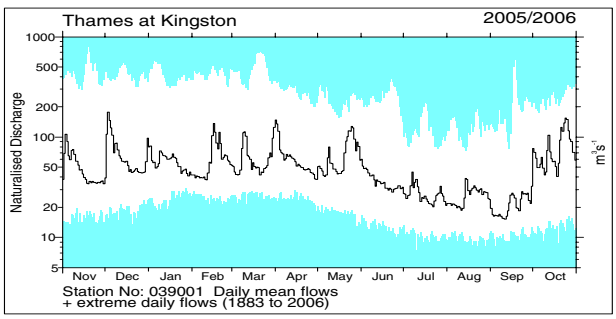


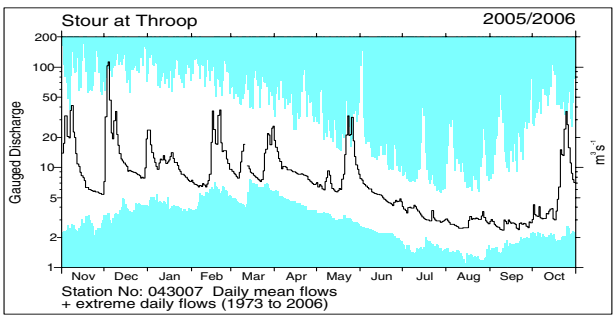


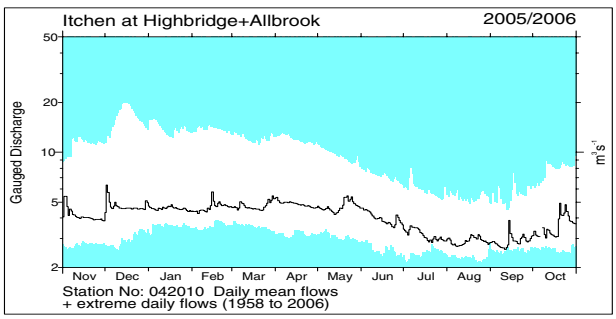












Notable runoff accumulations (a) August - October 2006, (b) November 2004 - October 2006

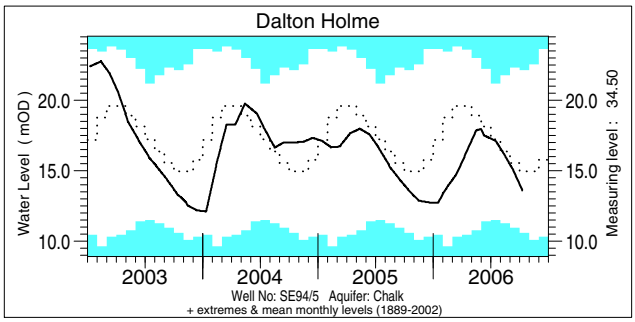
	River	%lta	Rank
a)	Ouse (Bedford)	165	62/74
	Mimram	48	3/54
	Test	62	1/49
	Avon (Evesham)	154	59/70
	Naver	168	29/30
	Camowen	152	32/35

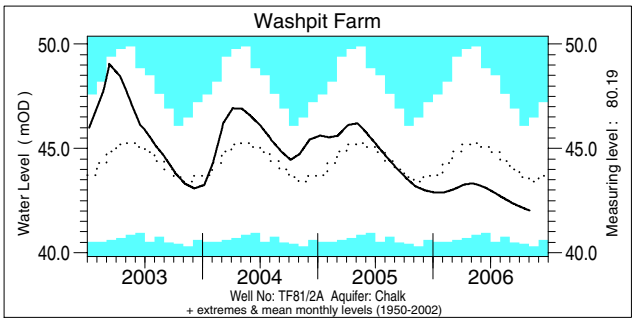
	River	%lta	Rank
b)	Dee (Park)	86	3/33
	Forth	86	4/24
	Soar	60	2/34
	Kennet	63	2/44
	Lambourn	57	2/43
	Mole	69	1/29
	Medway	40	1/40

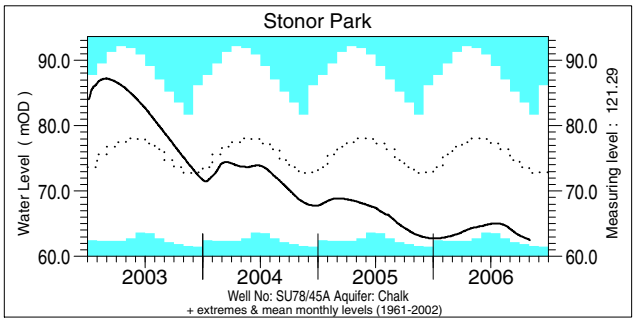
River	%lta	Rank
Ouse (Gold Bridge)	46	1/38
Avon (Amesbury)	60	2/40
Stour (Throop)	62	1/32
Piddle	65	1/40
Warleggan	77	1/36
Kenwyn	68	1/37
Faughan	73	1/29

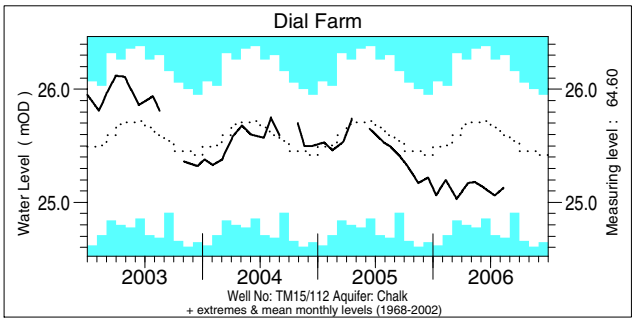
lta = long term average
Rank 1 = lowest on record

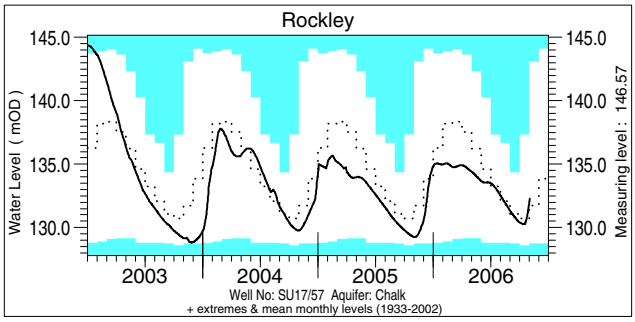
Groundwater . . . Groundwater

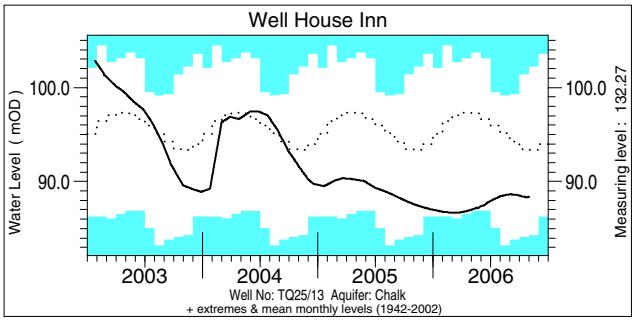


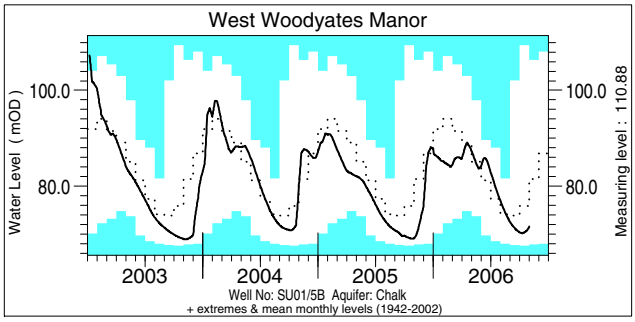


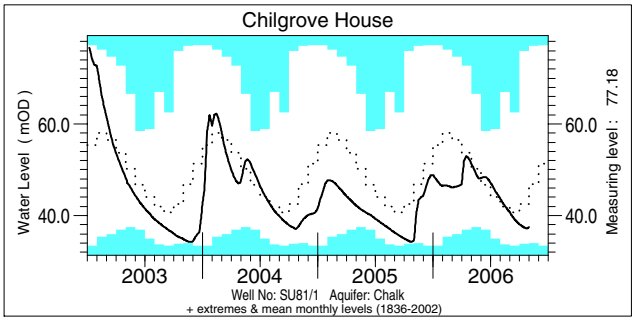


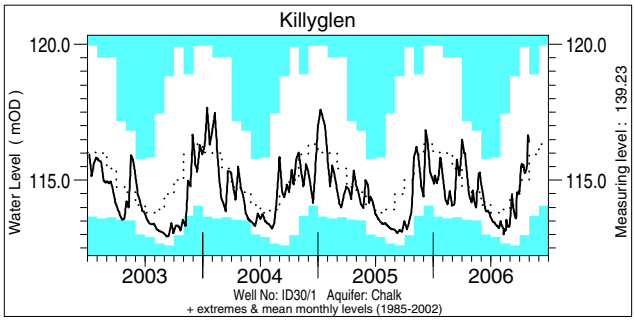


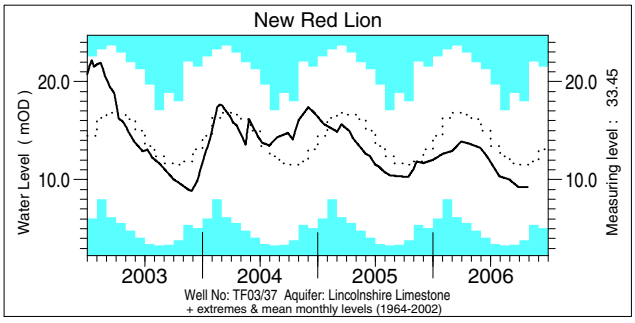






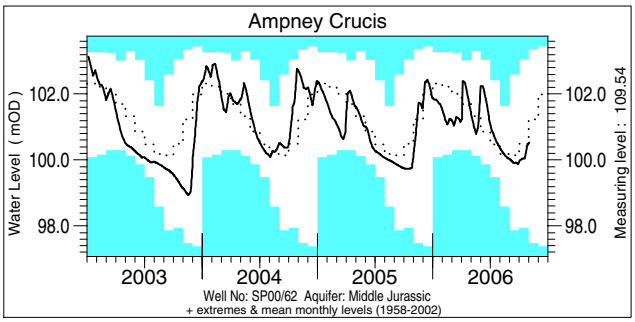


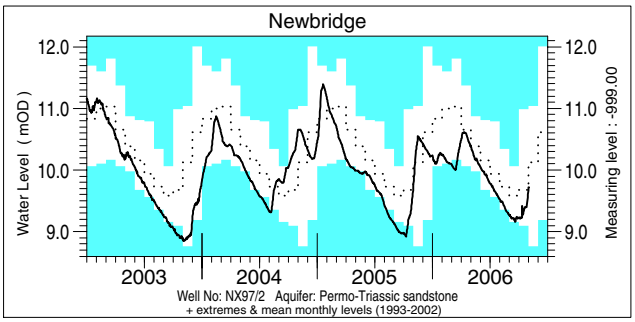


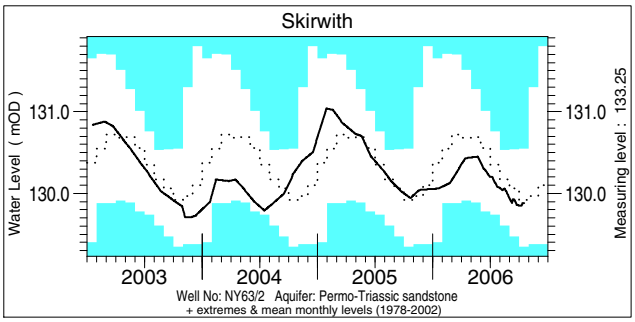


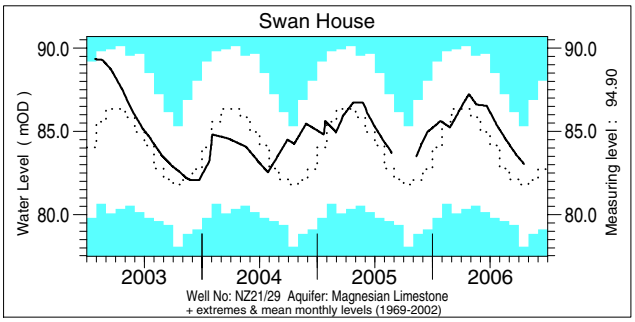
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

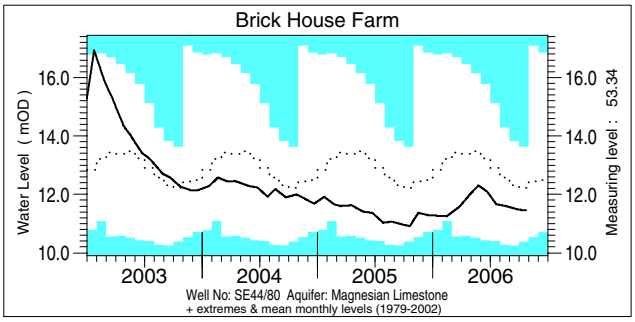
Groundwater . . . Groundwater

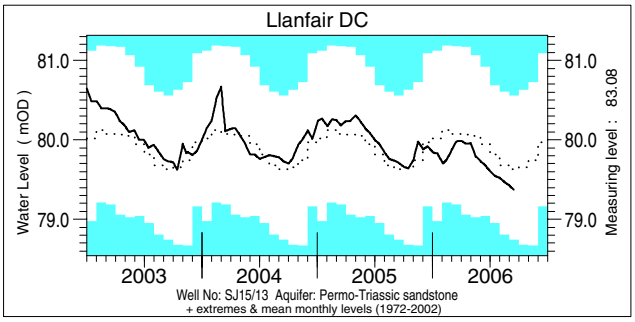


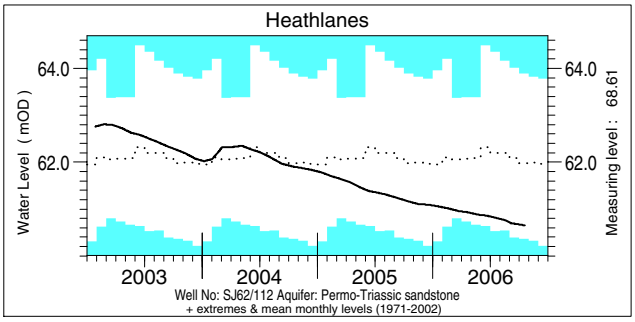


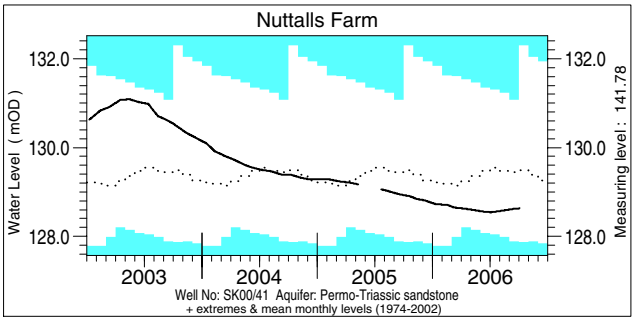


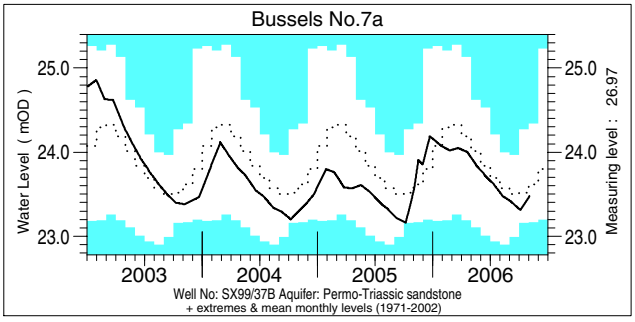


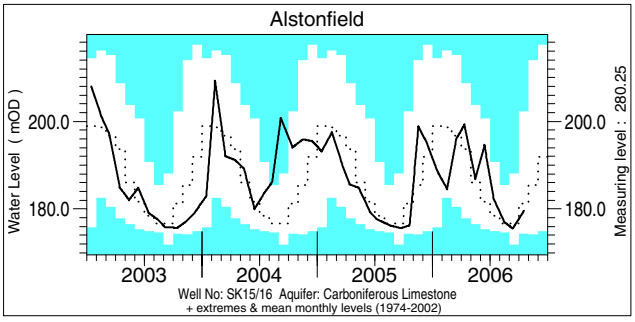










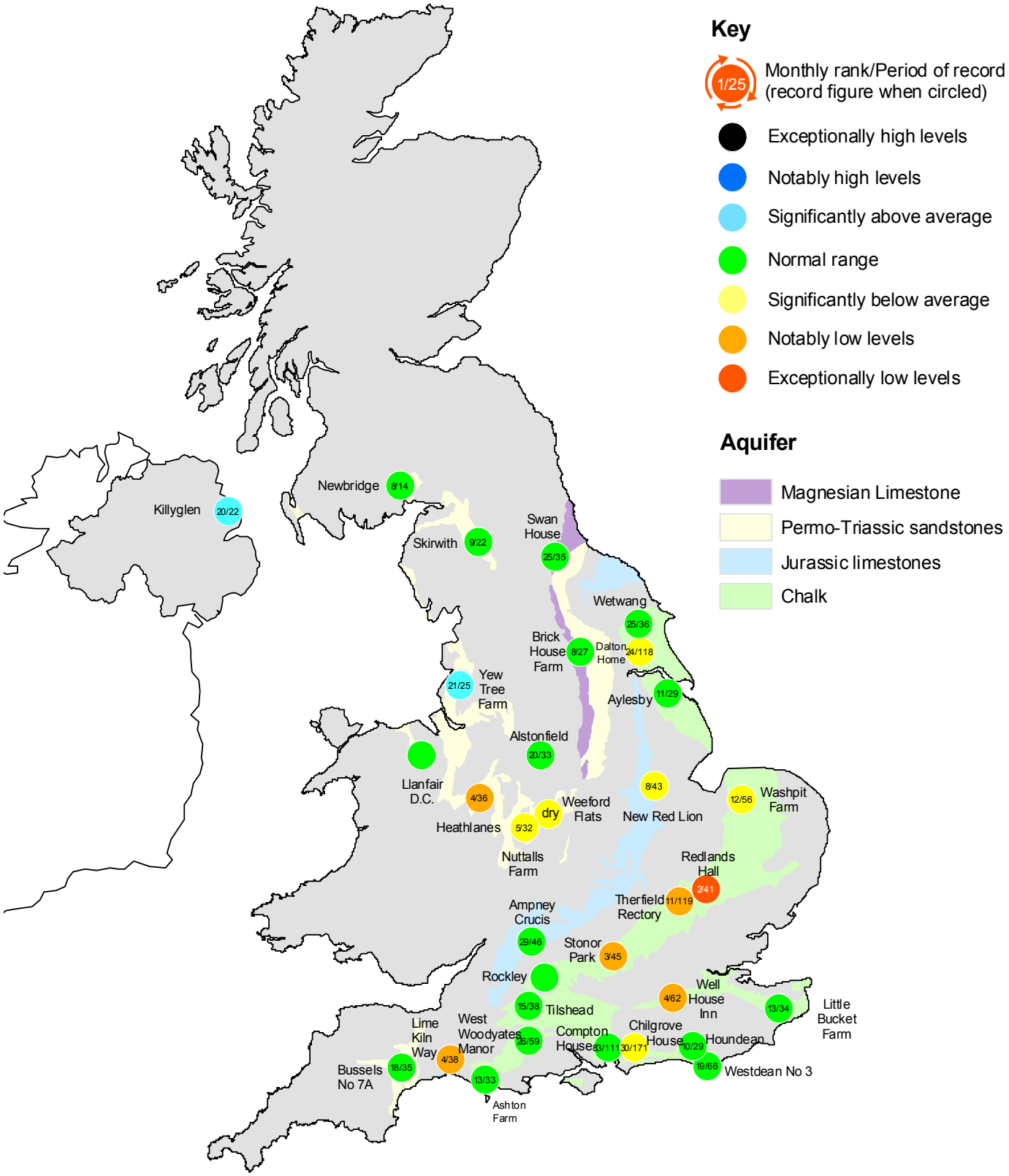


Groundwater levels October / November 2006

Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.
Dalton Holme	13.58	09/10	14.87	Chilgrove House	37.48	31/10	42.36	Brick House Farm	11.45	23/10	12.20
Washpit Farm	42.02	02/11	43.54	Killyglen	116.42	30/10	114.77	Llanfair DC	79.37	15/09	79.56
Stonor Park	62.52	01/11	73.25	New Red Lion	9.23	26/10	11.59	Heathlanes	60.65	19/10	61.96
Dial Farm	25.13	11/08	25.47	Ampney Crucis	100.54	01/11	100.42	Nuttalls Farm	128.63	02/10	129.61
Rockley	132.31	01/11	130.64	Newbridge	9.72	01/11	9.65	Bussels No.7a	23.48	02/11	23.51
Well House Inn	88.38	30/10	93.26	Skirwith	129.88	16/10	129.95	Alstonfield	179.65	16/10	181.25
West Woodyates	71.64	31/10	74.91	Swan House	83.03	16/10	82.11				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



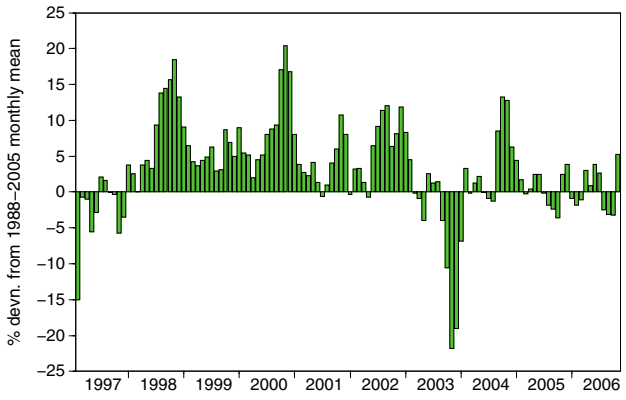
Groundwater levels - October 2006

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.

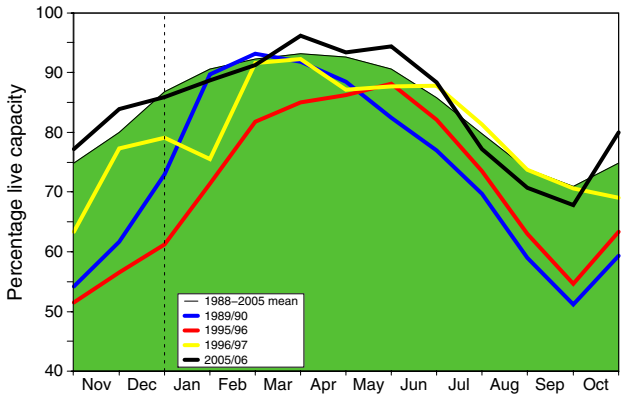
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.
iii. Data for Morris Dancers are currently under review.

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.

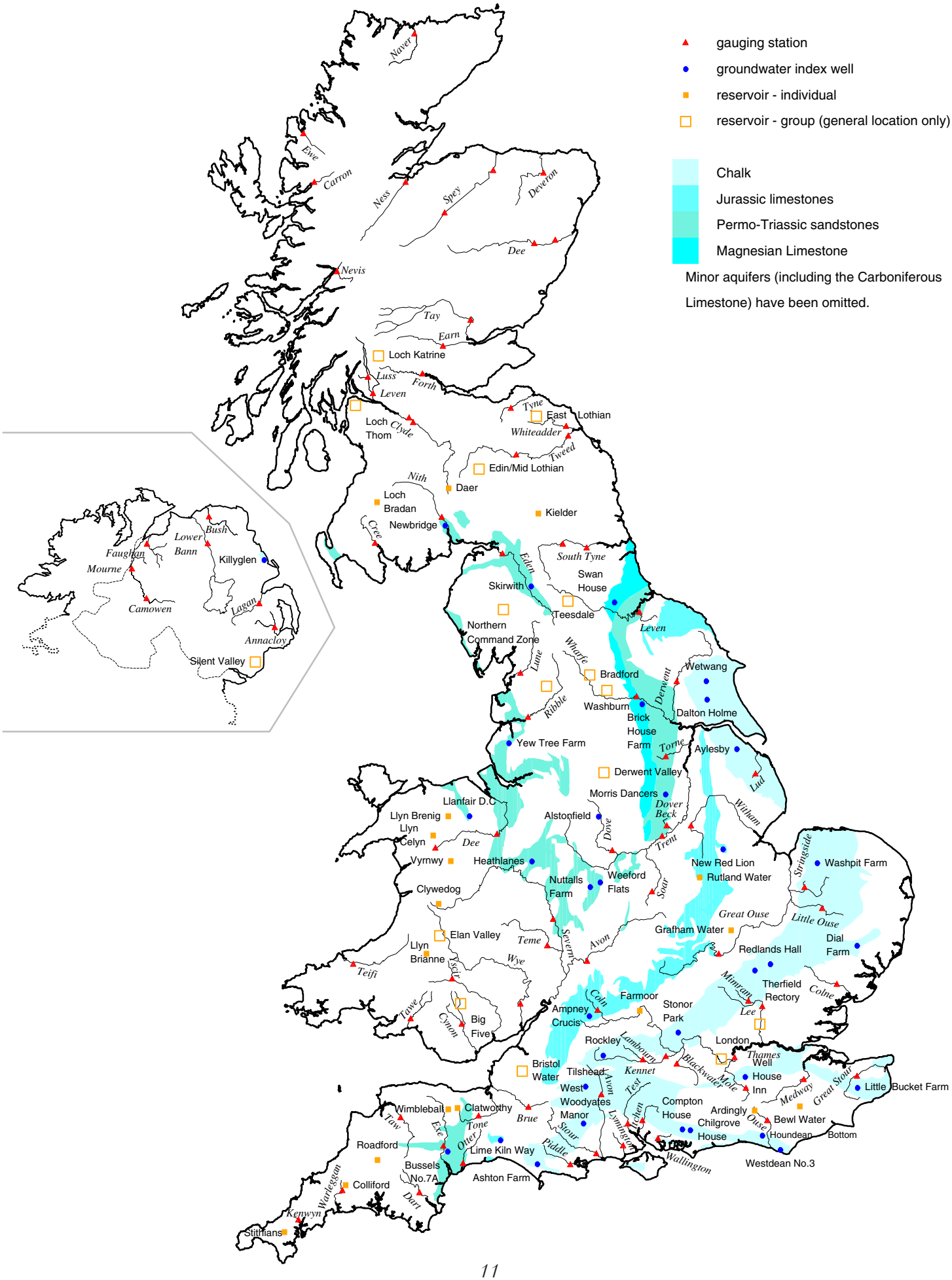
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2006 Sep	Oct	Nov	Nov Anom.	Min. Nov	Year* of min.	2005 **Nov**	Diff **06-05**
North West	N Command Zone	• 124929	57	58	**77**	15	33	2003	74	3
	Vyrnwy	55146	64	59	**77**	5	25	1995	82	-5
Northumbrian	Teesdale	• 87936	65	62	**82**	13	33	1995	85	-3
	Kielder	(199175)	(82)	(83)	**(89)**	3	(63)	1989	(98)	-9
Severn Trent	Clywedog	44922	62	51	**69**	-6	38	1995	82	-13
	Derwent Valley	• 39525	66	70	**90**	22	15	1995	75	15
Yorkshire	Washburn	• 22035	77	77	**89**	25	15	1995	69	20
	Bradford supply	• 41407	69	65	**78**	9	16	1995	65	13
Anglian	Grafham	(55490)	(83)	(80)	**(85)**	5	(44)	1997	(79)	6
	Rutland	(116580)	(76)	(71)	**(71)**	-7	(59)	1995	(73)	-2
Thames	London	• 202406	77	75	**92**	19	46	1996	65	27
	Farmoor	• 13822	99	98	**91**	4	43	2003	100	-9
Southern	Bewl	28170	68	61	**61**	-1	33	1990	39	22
	Ardingly	4685	76	66	**73**	8	15	2003	44	29
Wessex	Clatworthy	5364	62	49	**51**	-9	14	2003	55	-4
	Bristol WW	• (38666)	(76)	(69)	**(66)**	7	(24)	1990	(47)	19
South West	Colliford	28540	46	38	**38**	-30	38	2006	46	-8
	Roadford	34500	55	47	**48**	-21	18	1995	57	-9
	Wimbleball	21320	71	60	**59**	-6	26	1995	62	-3
	Stithians	5205	47	36	**33**	-21	18	1990	43	-10
Welsh	Celyn and Brenig	• 131155	75	76	**85**	4	48	1989	87	-2
	Brianne	62140	78	77	**95**	6	57	1995	99	-4
	Big Five	• 69762	52	44	**72**	1	38	2003	75	-3
	Elan Valley	• 99106	65	58	**80**	-4	37	1995	83	-3
Scotland(E)	Edinburgh/Mid Lothian	• 97639	77	79	**82**	4	48	2003	80	2
	East Lothian	• 10206	69	66	**66**	-14	38	2003	72	-6
Scotland(W)	Loch Katrine	• 111363	63	77	**94**	9	40	2003	95	-1
	Daer	22412	63	86	**99**	10	42	2003	100	-1
	Loch Thom	• 11840	79	94	**95**	7	69	2003	87	8
Northern Ireland	Total+	• 67270	68	76	**85**	8	39	1995	80	5
	Silent Valley	• 20634	66	72	**84**	17	34	1995	82	2

() 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.

NATURAL ENVIRONMENT RESEARCH COUNCIL

The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

*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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11/06