Hydrological Summary
for the United Kingdom

March 2007

General
Overall, March was a mild, sunny and – after a very wet first week – a generally dry month punctuated by several notably cool and windy interludes. Winter half-year (Oct-Mar) rainfall totals were exceptionally high across much of the UK; for some parts of southern Britain March was the first month with below average rainfall since last July. Reservoir drawdown for flood alleviation purposes was common during the first week of March but, entering April, overall stocks for England and Wales remained above the monthly average, with most impoundments exceeding 90% of capacity (Colliford is an exception). Flood alerts were widespread early in the month but steep river flow recessions became established thereafter; seasonally low flows were reported for many responsive rivers by early April. Groundwater levels in March, responding to the heavy late-winter recharge, were considerably above the seasonal average in most aquifer outcrop areas. Correspondingly, the water resources outlook is very encouraging but a particularly notable hydrological characteristic of March was the rapid growth in soil moisture deficits, raising the possibility of an early termination to the 2006/07 aquifer recharge season in eastern and southern England.

Rainfall
March began in a very unsettled vein with damaging gales, in the west particularly and substantial rainfall over the first 6-8 days (Torquay 33mm on the 4th, Keswick 48mm on the 6th). Notwithstanding incursions of Arctic airmasses (with significant snowfall on high ground on the 18/19th and considerable transport disruption), high pressure dominated synoptic patterns thereafter. A few local thunderstorms (e.g. west of London) were reported around month-end but in many areas a notable dry spell extended well into April. From March 6th accumulated rainfall totals for some central southern locations remained below 10mm for over 38 days; the longest such sequence since early 1998 in Wallingford. Nonetheless, March rainfall totals were in the normal range, typically 80-120% average, across most of the country. Western Scotland was, again, particularly wet (some localities registering >140%) whilst totals fell below 40% in a few parts of north-east England. The recent dry spell makes for a dramatic contrast with longer term rainfall accumulations. Jan-Mar rainfall totals appreciably exceeded the average in all regions; more notably, winter half-year totals are exceptional over wide areas. The provisional Oct-Mar rainfall total for the UK is the highest on record – in a series from 1914. This primarily reflects exceptional precipitation totals across Scotland which exceeded its previous Oct-Mar maxima by a wide margin (with anomalies >50% in some northern and western area). 12-month rainfall accumulations also exceed the average in all regions, and for Scotland a new 12-month maximum (for any start month) has been established (in a 93-yr series).

River flow
In most areas, March witnessed a dramatic change in river flows through the month. In the first week modest floodplain inundations were very widespread (on the 7th the Wye registered its highest March daily flow for 60 years) but flows in many responsive rivers declined very briskly thereafter. This hydrological transformation is exemplified by the Forth which exceeded bankfull in early March but four weeks later established new early-April daily minima. By contrast, baseflows in some spring-fed streams continued to increase, resulting in notable March runoff totals – the highest in a 44-yr record for the Coln (in the Cotswolds). Flows were very healthy in many groundwater-fed southern rivers also (which was beneficial for the replenishment of a number of pumped-storage reservoirs). Northern England aside, most March runoff totals were above average, notably so for some western catchments (e.g. the Ewe and Warleggan). More exceptional however were the winter half-year runoff accumulations. Most Oct-Mar runoff totals were well above average; many were outstanding. The Tay, Cynon and Dart registered their highest 6-month runoff totals for *any* start month in series of around 50 years. Many other index rivers draining impermeable catchments, reported exceptionally high winter half-year runoff totals. Given the magnitude of the winter runoff, it is notable that very few extreme flood events were reported.

Groundwater
Rainfall across most aquifer outcrop areas during March was concentrated in the first week when soils remained close to saturation; it was therefore very hydrologically effective. The March recharge helped to reinforce the recoveries in groundwater levels over the 2006/07 winter. In the southern Chalk, March levels were generally well above average and, commonly, the highest for at least four years. In the slower-responding Chalk of the Chilterns levels returned to the seasonal mean for the first time since late 2003 but levels are still below average in a few Lower Greensand outcrops (e.g on the Isle of Wight). Throughout the limestone outcrops March levels were generally well within the normal range but the Permo-Triassic sandstones continue to present a very spatially variable picture. March levels were very healthy in most northern outcrops, and in the South West but still depressed in many very slow-responding Midland outcrops. Levels are also relatively low in a few minor aquifers (eg. the Suffolk Crag). Overall groundwater resources are very healthy and a dramatic contrast to the early spring of 2006. However, during the dry latter half of March seasonal recessions became established in the more responsive groundwater units. With desiccating winds contributing to the brisk rise in soil moisture deficits (which continued well into April), an early end to the 2006/07 recharge season, in the east particularly, is an increasing possibility.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Mar 2007	Jan 07-Mar 07	RP	Oct 06-Mar 07	RP	Aug 06-Mar07	RP	Apr 06-Mar07	RP
England & Wales	**mm**	**65**	**273**		**629**		**794**		**1018**	
	%	**89**	**120**	**2-5**	**126**	**10-20**	**121**	**5-15**	**112**	**5-10**
North West	mm	**81**	326		864		1094		1383	
	%	**84**	111	2-5	128	10-20	121	5-15	114	5-10
Northumbrian	mm	**49**	243		556		733		913	
	%	**68**	113	2-5	121	5-10	119	5-10	105	2-5
Severn Trent	mm	**57**	229		507		664		878	
	%	**93**	122	2-5	126	5-15	124	5-15	114	5-10
Yorkshire	mm	**42**	223		522		724		938	
	%	**61**	108	2-5	117	5-10	122	5-15	112	5-10
Anglian	mm	**43**	168		354		514		687	
	%	**92**	124	5-10	118	5-10	127	10-20	114	5-10
Thames	mm	**53**	223		510		652		847	
	%	**94**	132	5-10	138	10-20	133	10-20	121	5-15
Southern	mm	**59**	247		587		719		908	
	%	**93**	124	2-5	131	10-20	125	5-15	116	5-10
Wessex	mm	**67**	275		638		756		981	
	%	**94**	121	2-5	131	10-20	121	5-10	115	5-10
South West	mm	**91**	393		839		959		1206	
	%	**91**	115	2-5	115	2-5	106	2-5	101	2-5
Welsh	mm	**107**	442		1031		1211		1516	
	%	**98**	125	5-10	130	10-20	119	5-10	113	5-10
Scotland	**mm**	**138**	**514**		**1208**		**1454**		**1824**	
	%	**107**	**132**	**10-20**	**140**	**>100**	**130**	**70-100**	**124**	**>100**
Highland	mm	**194**	685		1575		1835		2311	
	%	**122**	147	10-20	150	>100	136	>100	133	>100
North East	mm	**76**	288		686		854		1072	
	%	**92**	113	2-5	123	5-15	115	5-10	104	2-5
Tay	mm	**107**	454		1057		1288		1572	
	%	**94**	127	5-10	140	70-100	132	30-50	122	10-20
Forth	mm	**86**	372		831		1051		1312	
	%	**88**	125	5-10	128	10-20	122	10-20	115	5-10
Tweed	mm	**76**	290		685		903		1118	
	%	**93**	115	2-5	126	10-20	124	10-20	111	5-10
Solway	mm	**118**	438		1112		1372		1712	
	%	**99**	117	2-5	135	70-100	126	10-20	119	10-20
Clyde	mm	**155**	586		1439		1767		2221	
	%	**102**	126	5-10	140	>100	130	70-100	127	70-100
Northern Ireland	**mm**	**79**	**305**		**702**		**929**		**1220**	
	%	**87**	**106**	**2-5**	**113**	**2-5**	**114**	**5-10**	**111**	**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 region and 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 variability 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). The timespans featured do not purport to represent the critical periods for any particular water resource management zone and, normally, for hydrological or water resources assessments of drought severity, river flows and groundwater levels provide a better guide than return periods based on rainfall totals. *In some cases ranking positions of accumulated rainfalls are considered.

All monthly rainfall totals since October 2006 are provisional.

Rainfall . . . Rainfall . . .

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

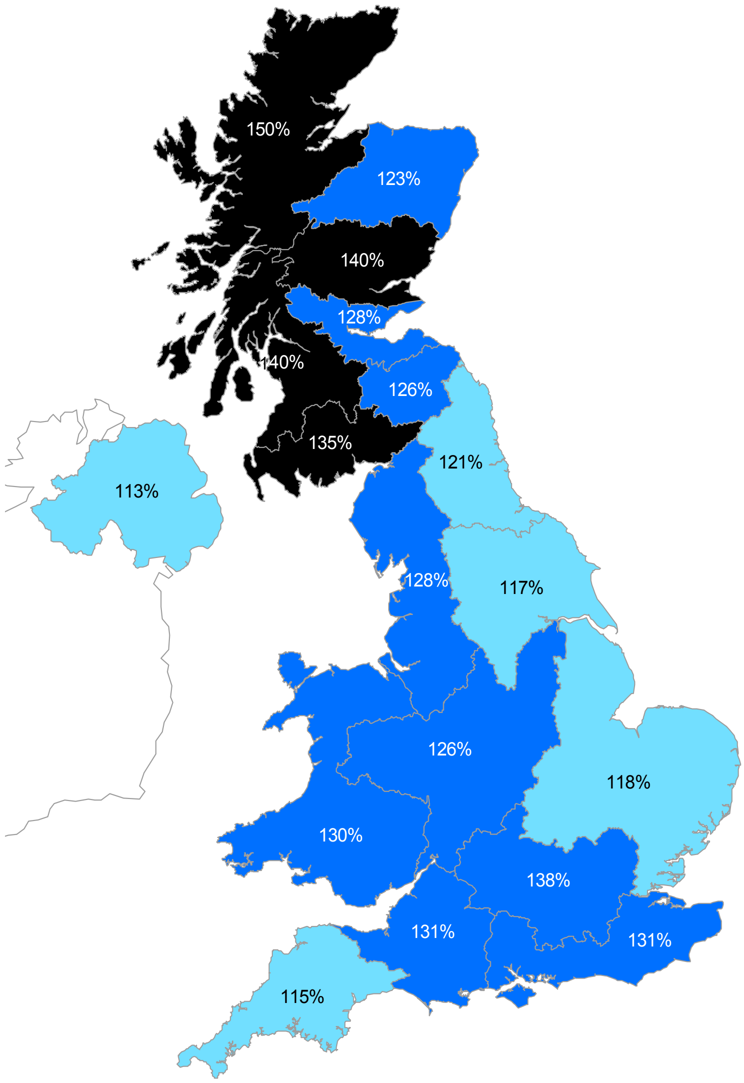
Above average

Normal range

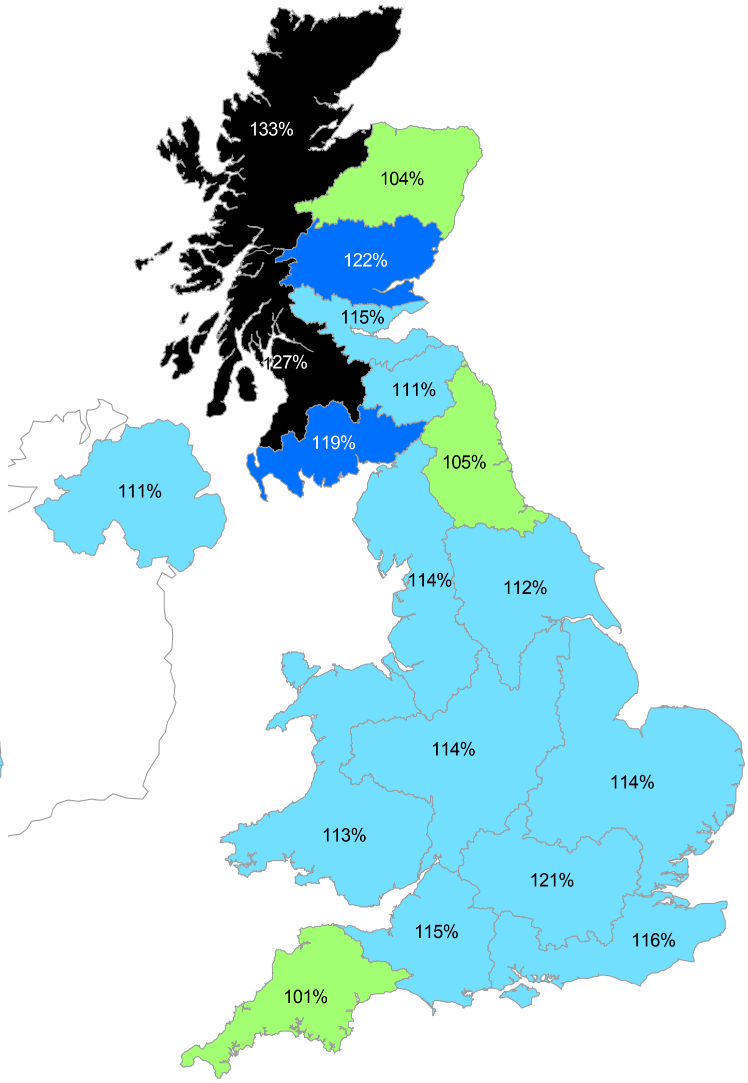
Below average

Substantially below average

Exceptionally low rainfall



October 2006 - March 2007

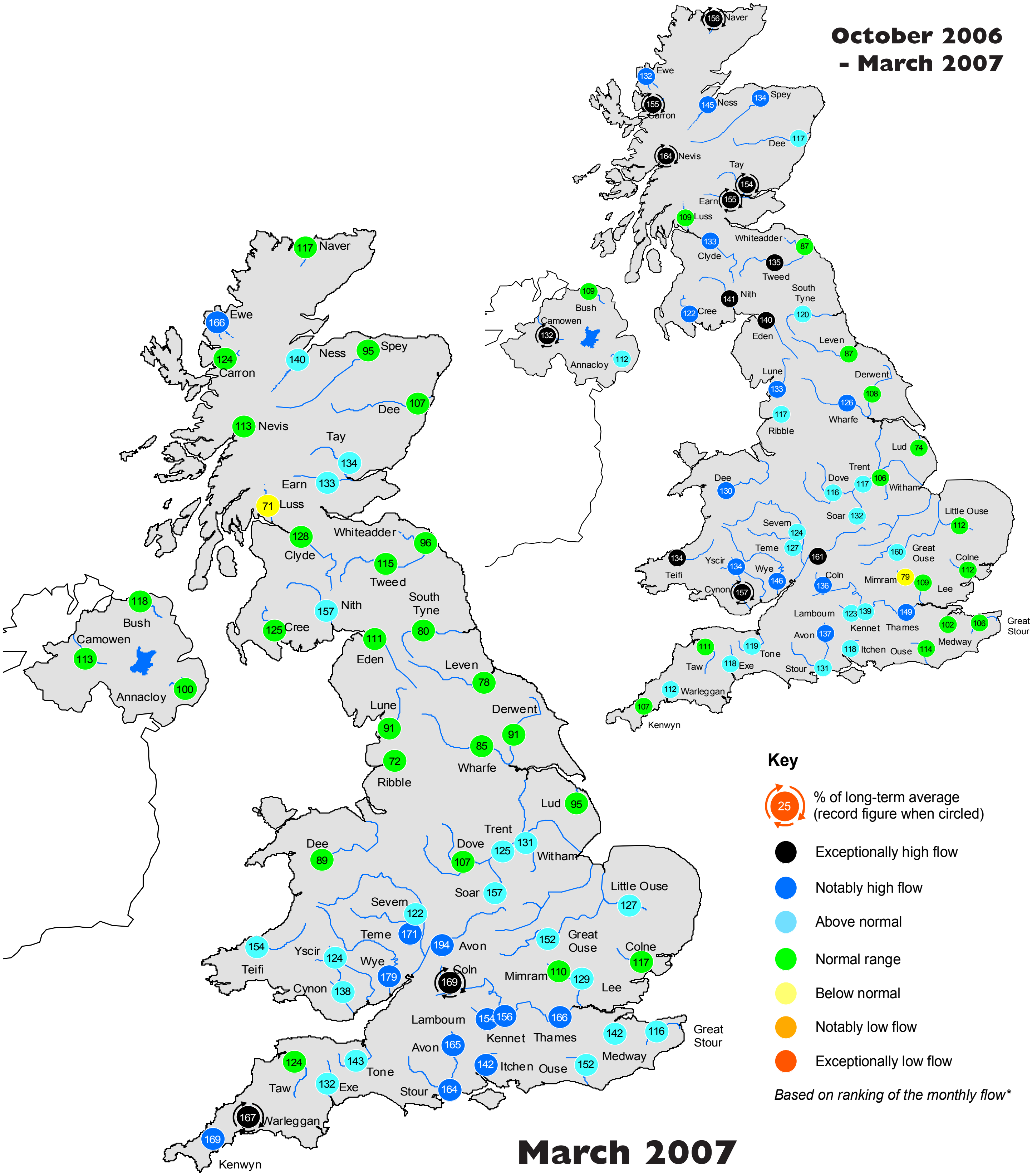


April 2006 - March 2007

Rainfall accumulation map

The winter half-year was notably wet across almost the entire country and for a few southern areas the Oct-Mar total approached the combined totals for 2004/05 and 2005/06. In the 12-month timeframe 10-11Scotland was exceptionally wet – much of western Scotland registered its highest April-March rainfall on record – but, in England, the South West Region only marginally exceeded the 1961-90 average.

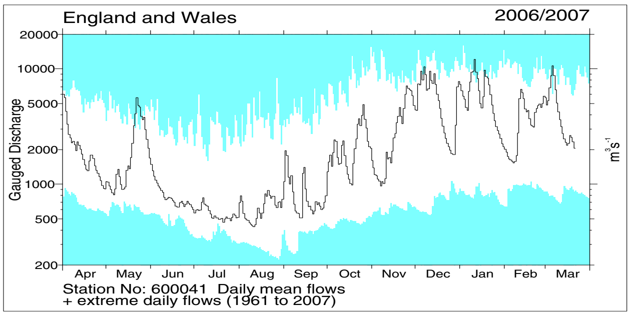
River flow . . . River flow . . .

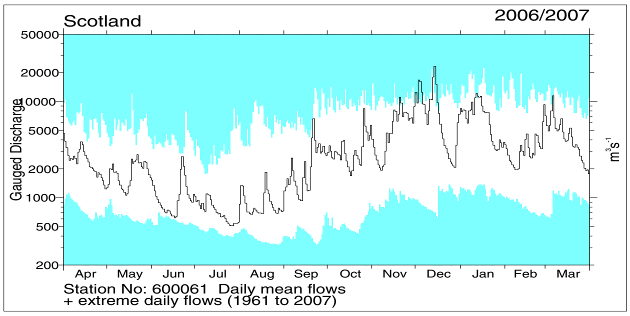


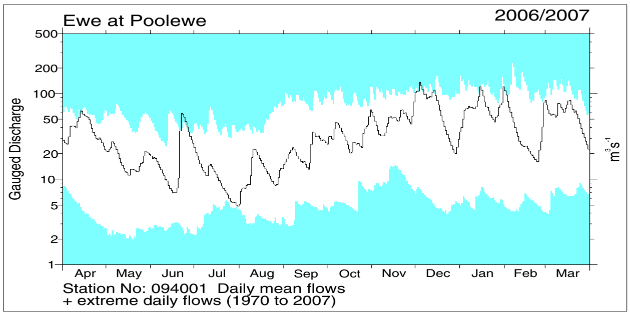
River flows

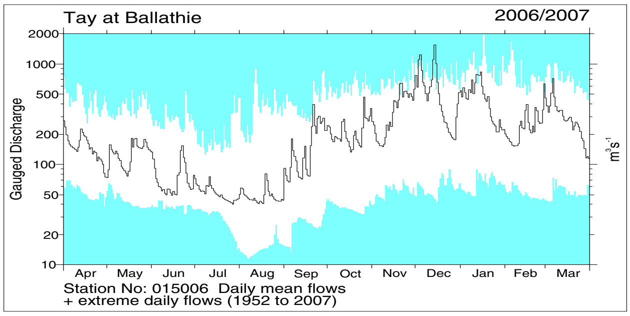
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

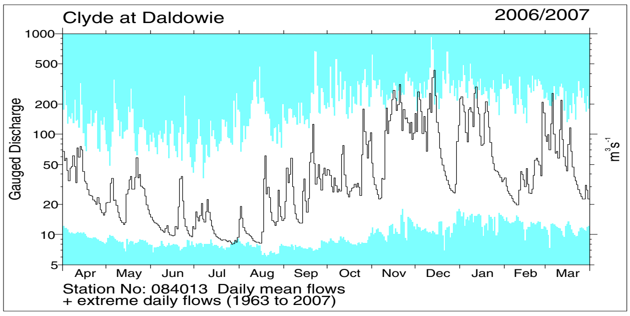
River flow . . . River flow . . .

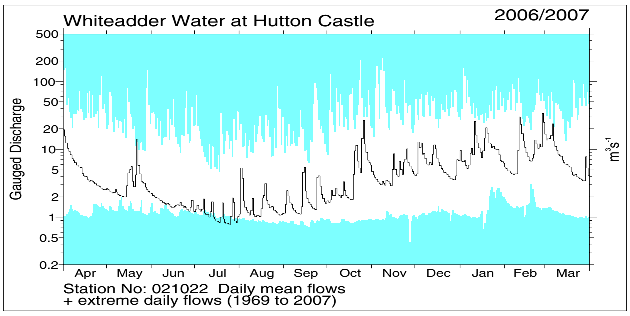


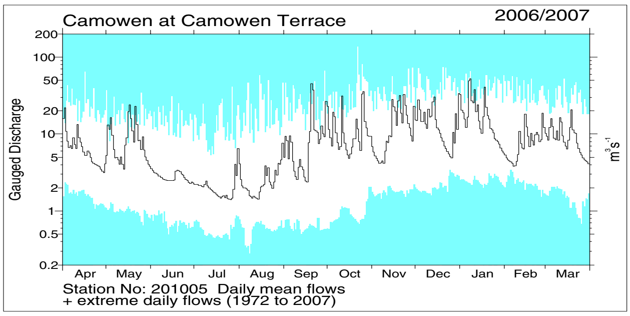


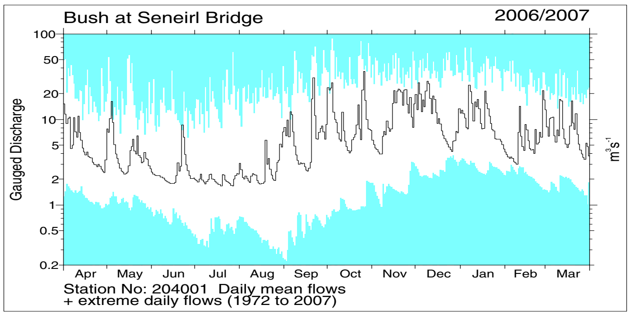


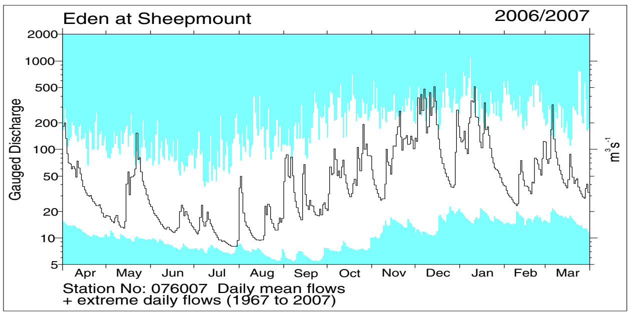


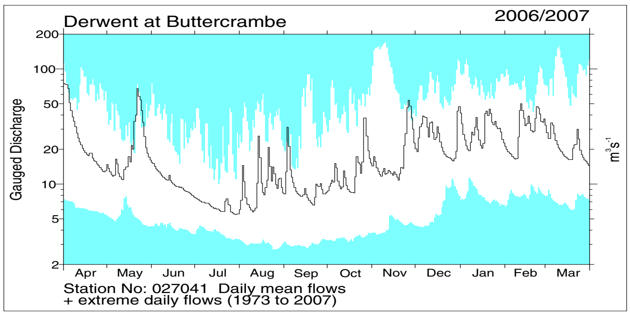






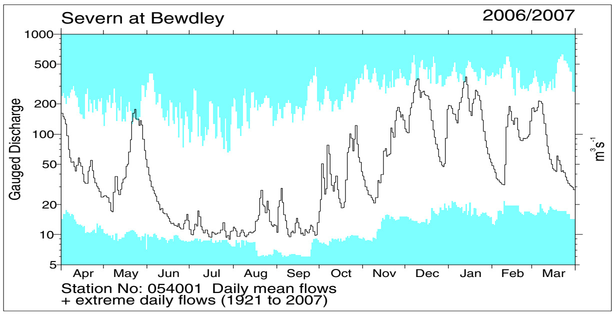


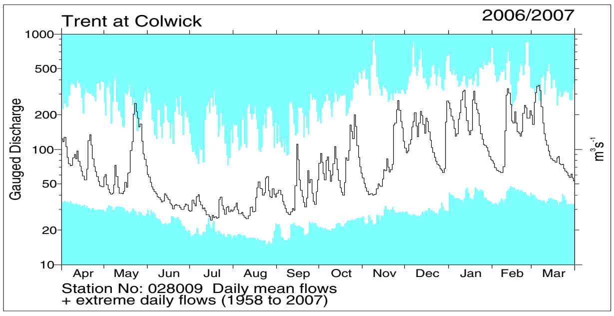


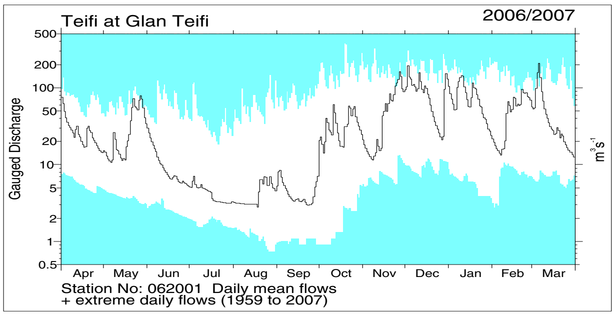


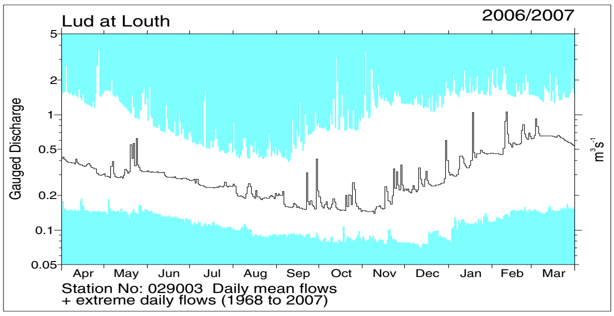
River flow hydrographs

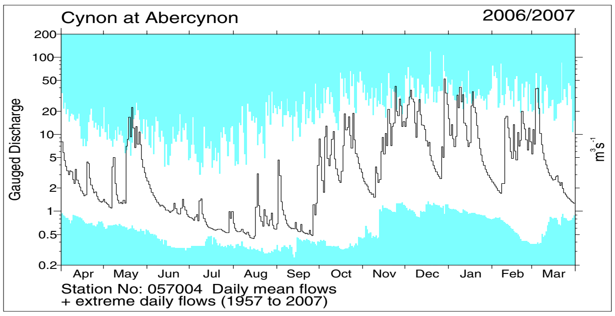
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to April 2006 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

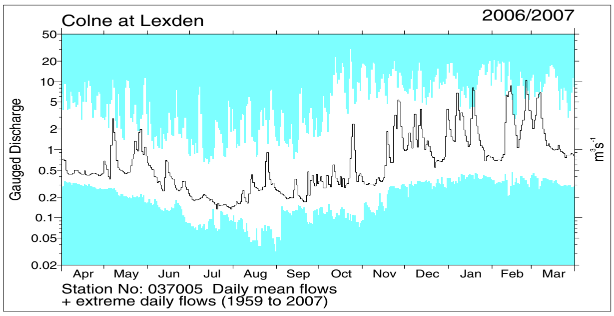


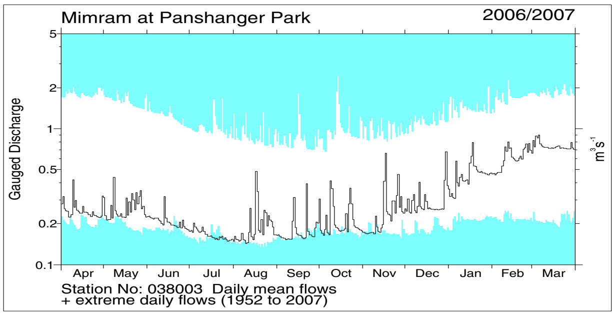


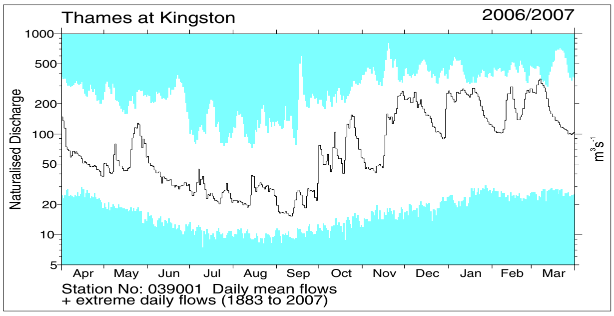


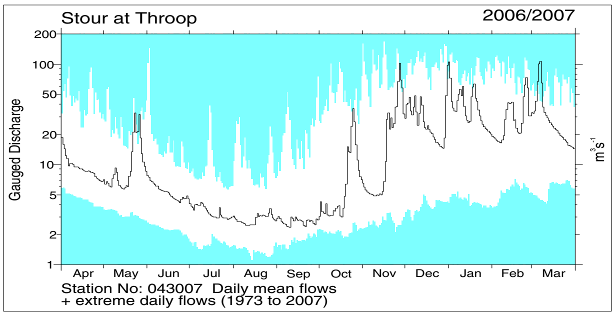


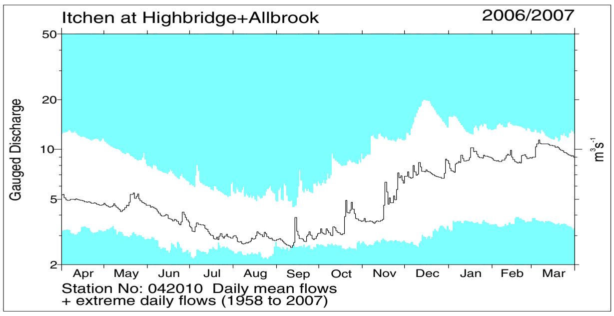












Notable runoff accumulations (a) October 2006 - March 2007, (b) April 2006 - March 2007

a)

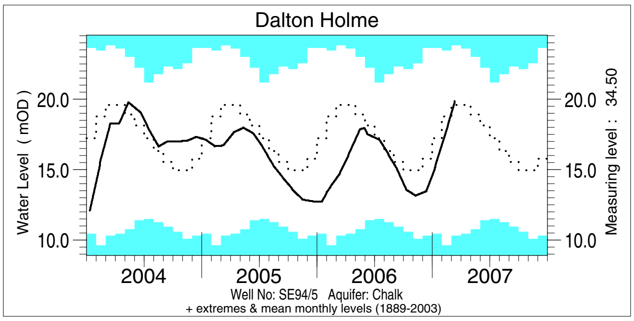
River	%lta	Rank	River	%lta	Rank
Ness	145	33/34	Dee (Manley Hall)	137	69/70
Tay	154	55/55	Eden	140	39/40
Earn	155	59/59	Nith	141	49/50
Tweed (Boleside)	135	45/46	Nevis	164	25/25
Dart	142	49/49	Carron	155	28/28
Cynon	157	49/49	Naver	156	30/30
Tawe	142	46/47	Camowen	132	34/34
Teifi	134	47/48			

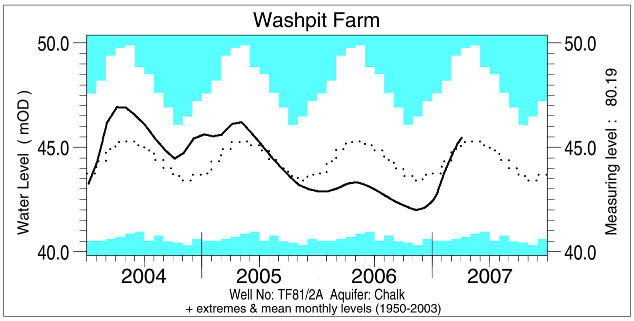
b)

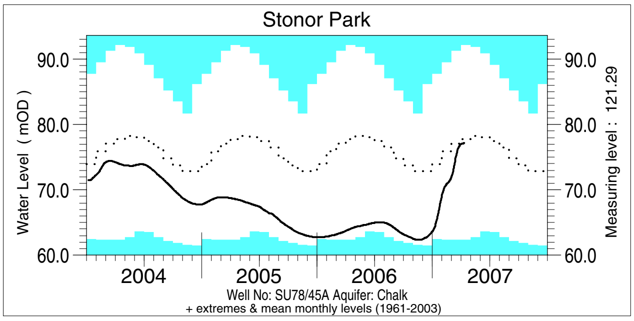
River	%lta	Rank
Mimram	60	6/53
Wye	134	66/70
Yscir	123	30/34
Dee(New Inn)	119	33/37
Lune	120	40/45
Eden	129	37/39
Faughan	86	6/30

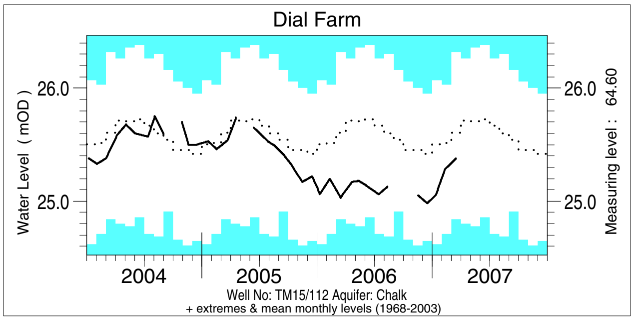
lta = long term average
Rank 1 = lowest on record

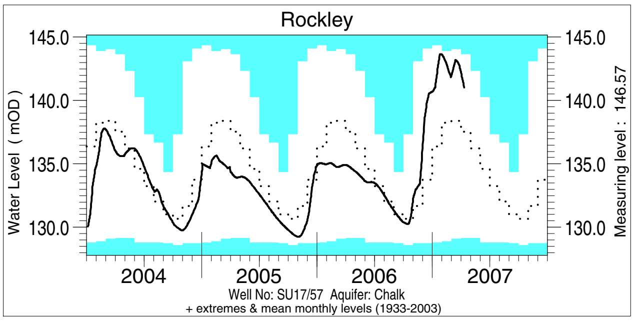
Groundwater . . . Groundwater

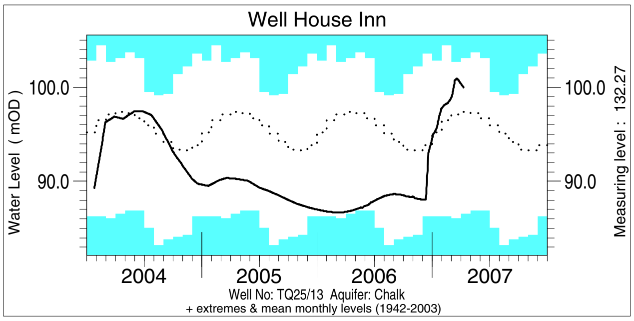


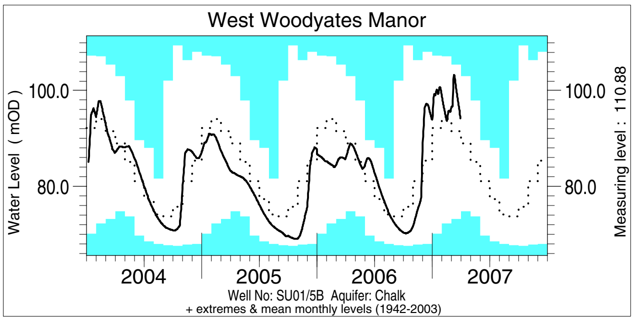


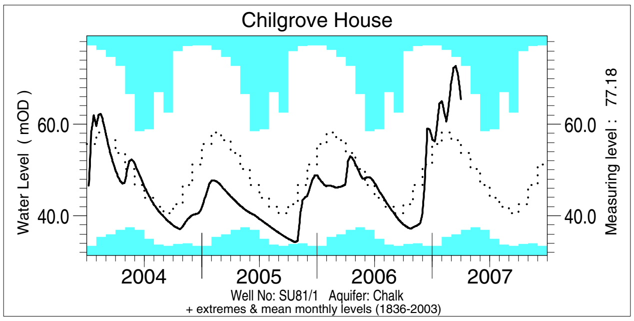


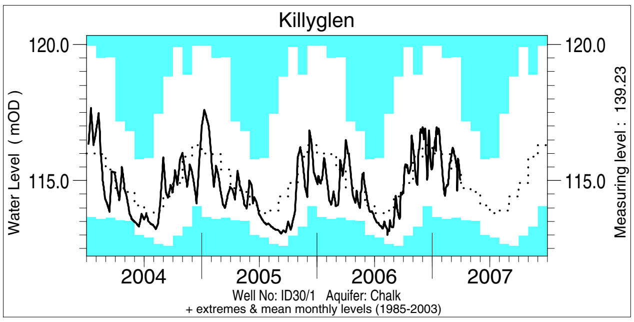


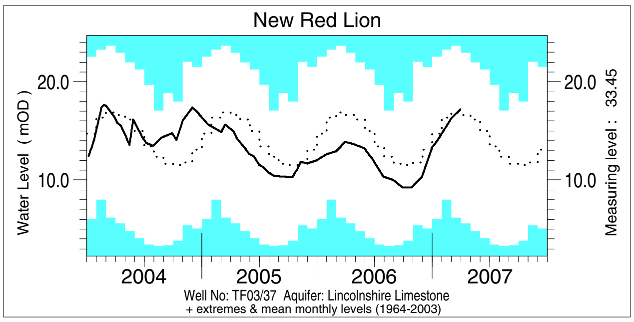






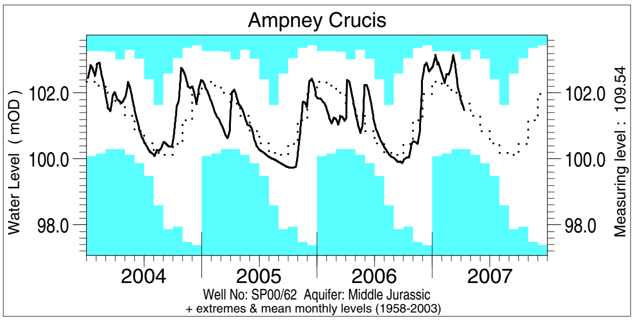


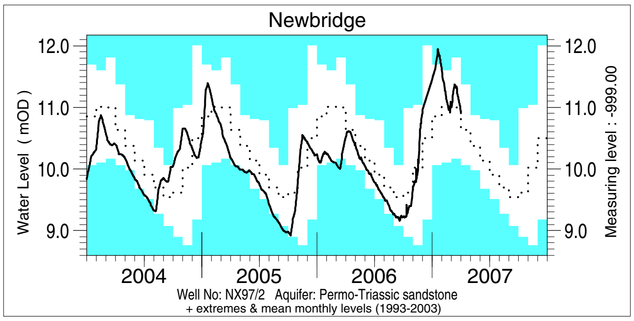


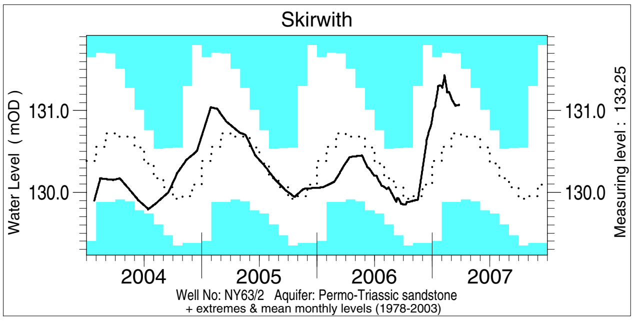


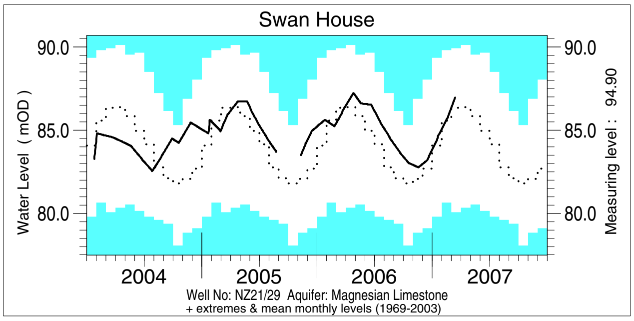
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

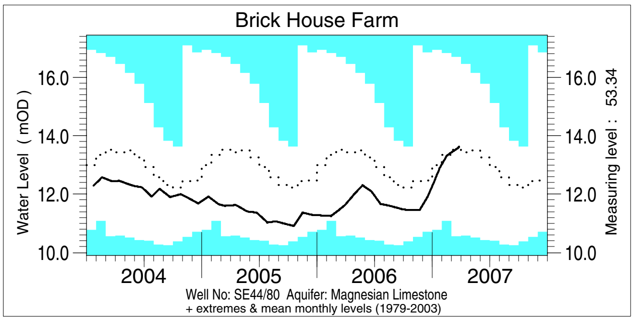
Groundwater . . . Groundwater

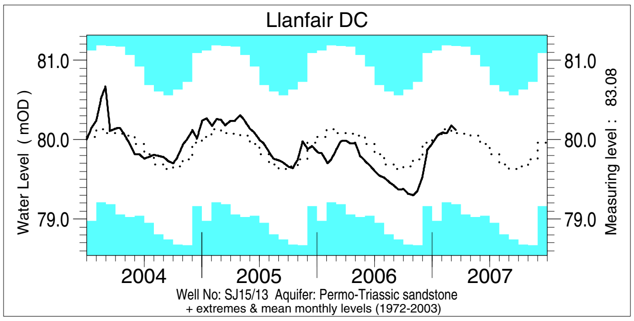


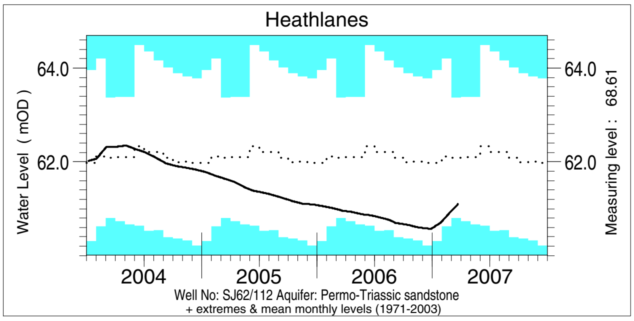


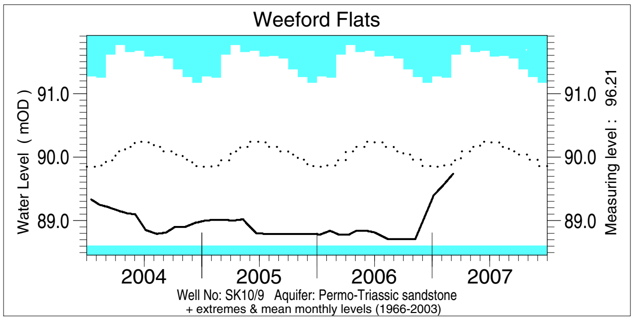


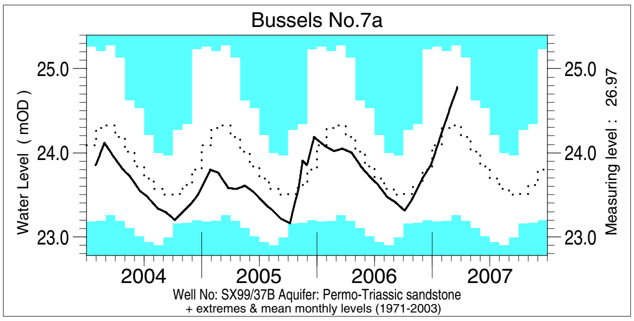


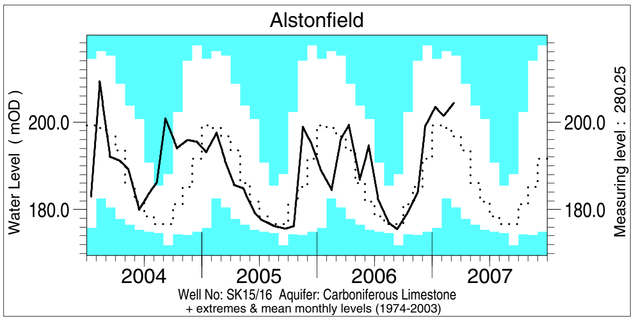










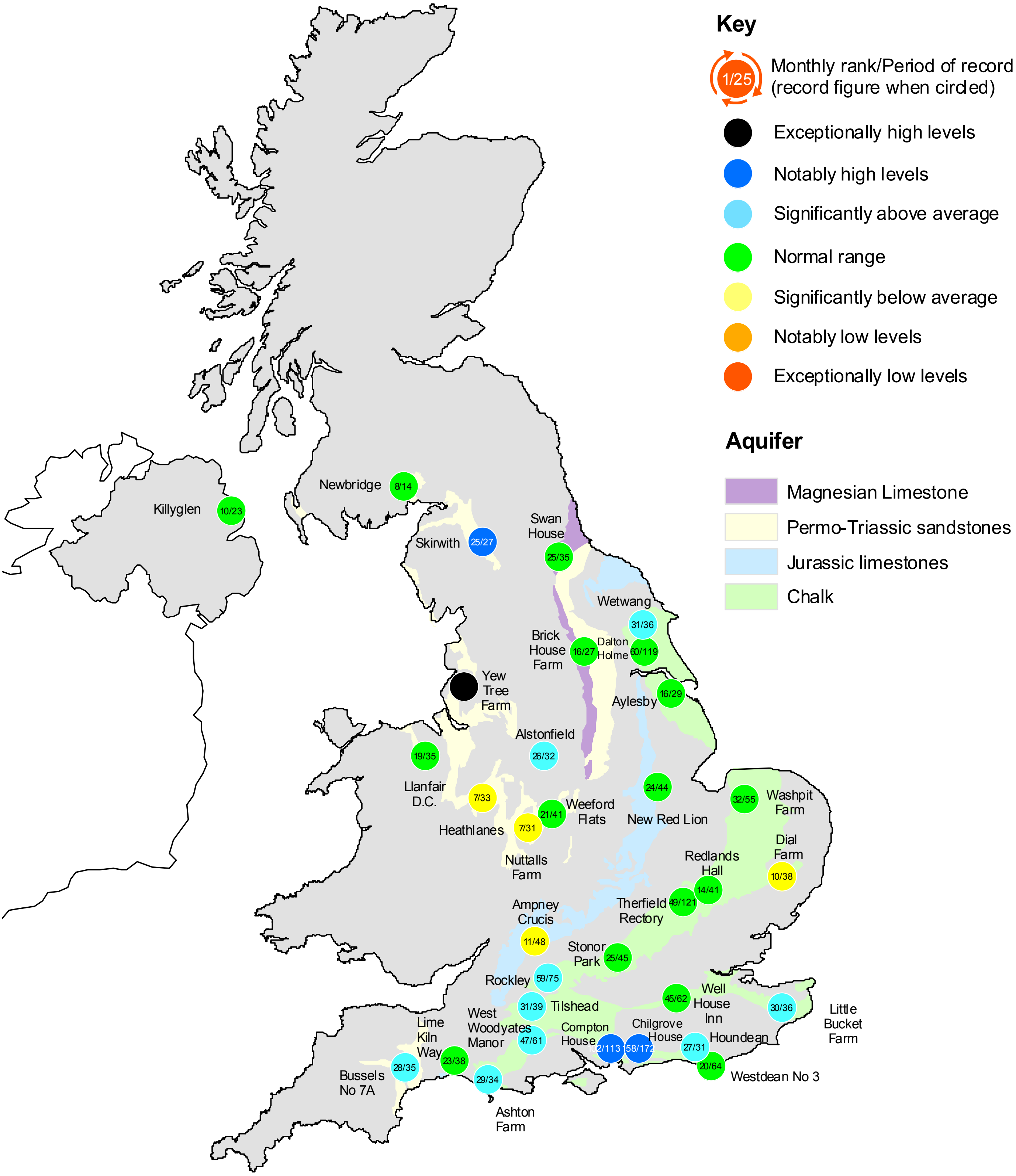


Groundwater levels March/ April 2007

Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.
Dalton Holme	19.88	12/03	19.45	Chilgrove House	65.53	31/03	55.44	Brick House Farm	13.62	26/03	13.29
Washpit Farm	45.48	03/04	44.98	Killyglen	115.02	30/03	115.50	Llanfair DC	80.12	15/03	80.06
Stonor Park	77.14	11/04	76.61	New Red Lion	17.19	29/03	16.62	Heathlanes	61.10	22/03	62.01
Dial Farm	25.38	16/03	25.58	Ampney Crucis	101.48	11/04	101.99	Weeford Flats	89.74	07/03	89.77
Rockley	141.04	11/04	138.35	Newbridge	10.91	01/04	10.85	Bussels No.7a	24.78	20/03	24.30
Well House Inn	99.98	10/04	96.81	Skirwith	131.07	26/03	130.65	Alstonfield	204.39	09/03	196.23
West Woodyates	94.21	31/03	90.58	Swan House	86.97	13/03	85.72				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



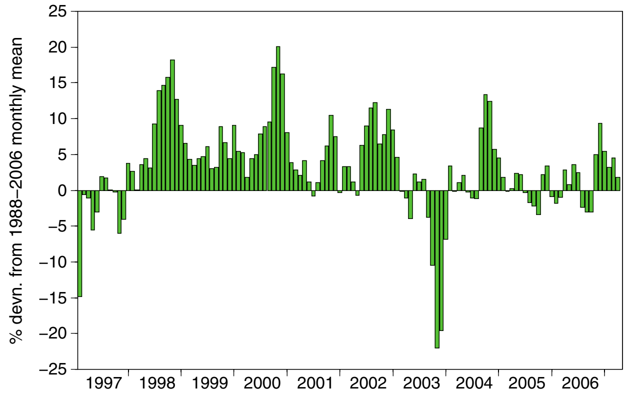
Groundwater levels - March 2007

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.

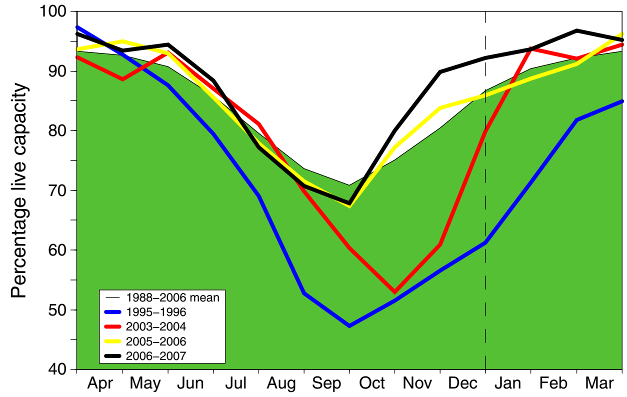
Notes:
i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.
iii. Data for Nuttalls Farm are currently under review.

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.

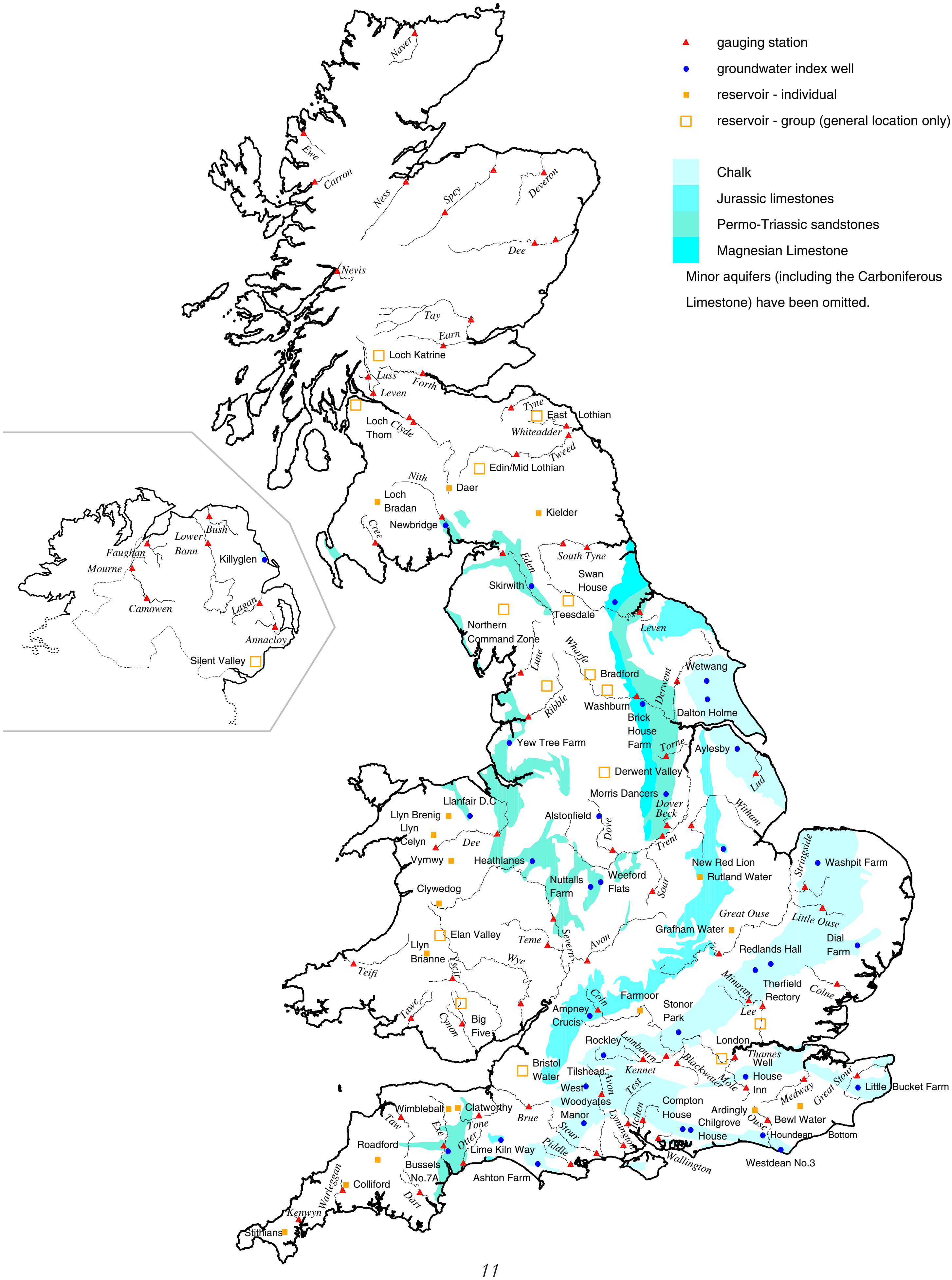
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2007 Feb	Mar	Apr	Apr Anom.	Min. Apr	Year* of min.	2006 Apr	Diff 07-06
North West	N Command Zone	• 124929	96	98	**94**	1	77	1993	100	-6
	Vyrnwy	55146	93	100	**97**	2	64	1996	100	-3
Northumbrian	Teesdale	• 87936	86	97	**94**	1	77	2003	100	-6
	Kielder	(199175)	(91)	(94)	**(89)**	-4	(81)	1993	(98)	-9
Severn Trent	Clywedog	44922	90	96	**98**	4	86	1996	99	-1
	Derwent Valley	• 39525	100	100	**98**	3	54	1996	100	-2
Yorkshire	Washburn	• 22035	96	98	**91**	-2	70	1996	99	-8
	Bradford supply	• 41407	98	100	**96**	2	59	1996	97	-1
Anglian	Grafham	(55490)	(93)	(95)	**(97)**	6	(77)	1997	(96)	1
	Rutland	(116580)	(94)	(96)	**(95)**	5	(74)	1992	(88)	7
Thames	London	• 202406	95	96	**97**	3	88	1990	99	-2
	Farmoor	• 13822	95	97	**99**	4	84	1992	97	2
Southern	Bewl	28170	100	100	**100**	12	58	1989	65	35
	Ardingly	4685	100	100	**100**	1	88	2006	88	12
Wessex	Clatworthy	5364	100	100	**100**	3	82	1992	100	0
	Bristol WW	• (38666)	(97)	(98)	**(95)**	2	(71)	1992	(87)	8
South West	Colliford	28540	61	75	**79**	-6	58	1997	68	11
	Roadford	34500	78	88	**91**	7	37	1996	76	15
	Wimbleball	21320	100	100	**99**	4	78	1996	100	-1
	Stithians	5205	85	100	**97**	4	52	1992	96	1
Welsh	Celyn and Brenig	• 131155	98	100	**100**	2	72	1996	100	0
	Brianne	62140	97	97	**96**	-2	90	1993	100	-4
	Big Five	• 69762	97	99	**97**	1	78	1993	99	-2
	Elan Valley	• 99106	97	100	**98**	0	89	1993	100	-2
Scotland(E)	Edinburgh/Mid Lothian	• 97639	100	100	**98**	4	71	1998	96	2
	East Lothian	• 10206	100	100	**100**	1	95	1990	100	0
Scotland(W)	Loch Katrine	• 111363	94	100	**83**	-12	88	2001	99	-16
	Daer	22412	98	98	**98**	0	93	2001	100	-2
	Loch Thom	• 11840	94	98	**98**	0	93	2001	100	-2
Northern Ireland	Total+	• 67270	89	90	**87**	-2	83	2002	93	-6
	Silent Valley	• 20634	91	97	**93**	11	57	2000	98	-5

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2006 period 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

*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

04/07