Hydrological Summary *for the United Kingdom*

December 2008

General

Weather conditions varied markedly through December but, generally, it was a cold and sunny month featuring a notably dry end to an exceptionally wet year – provisionally, 2008 registered the 3rd highest annual rainfall for the UK in a series from 1914. Flood warnings were very widespread in mid-month, significant but generally localised flooding was widely reported. The ensuing river flow recessions were steep and sustained – resulting in depressed flows over wide areas in early 2009. Nonetheless, December runoff totals were typical of the early winter across most of the UK but appreciably below average nationally. Despite the dry spell late in December, overall reservoir stocks fell only marginally. For England & Wales as a whole, stocks were around 5% above the early January average and were within 5% of capacity in the majority of index reservoirs. Recharge to the major aquifers during December was relatively modest and, in some areas, was broadly balanced by the outflows from springs and seepages. Consequently, the 2008/09 winter recovery in groundwater levels has stalled in many outcrop areas. Nonetheless, December levels were generally well within the normal range – groundwater flooding, which might have occurred if winter rainfall was well above average, now looks increasingly unlikely.

Rainfall

The wintry conditions which characterised late November continued into December – bringing damaging blizzards on the 4th (20cm of snow was reported for Wensleydale) with widespread snow cover on high ground. Towards the end of the 2nd week, a series of Atlantic frontal systems generated substantial rainfall (e.g. 53mm at Shap, Cumbria on the 13th) and further substantial rain in Scotland (Inveruglas: 48mm on the 17th & 44mm on the 19th). Subsequently the western extension of a continental high pressure cell blocked further Atlantic influence and airflows from the north-easterly quadrant brought a return to exceptionally cold conditions (certainly compared to the recent past) from Boxing Day. From mid-month, in southern Britain particularly, precipitation was largely confined to fog-drip, light drizzle and snow flurries. Many areas registered <5mm over three weeks or more with totals of <2mm in parts of central southern England (e.g. Wallingford, Chalfont St Giles); a relatively rare occurrence for early winter. Parts of eastern and south-western Scotland aside, December precipitation totals were below average across the UK with a significant proportion of southern England registering less than half the 1961-90 average. By contrast, long-term regional rainfall accumulations are generally very high (the annual total for Northumbria is the highest on record) but, significantly, rainfall in the 3-month timeframe is appreciably below average in parts of southern Britain.

River flows

December was a month of contrasts in relation to runoff patterns. Modest flows early in the month were succeeded by notable spates in mid-month. Provisionally, the Mole registered its 3rd highest December flow on the 13th and the South Tyne established a new December maximum on 19th. Over this period, flood warnings were common and showed a wide spatial distribution. The peak flows were generally notable rather than extreme but moderate floodplain inundations were widely reported and, locally, some flood events were severe (e.g. in Crawley where a nursing home was evacuated on the 13th). Flood risk generally moderated rapidly during late December when sustained recessions produced notably low flows in many responsive catchments at year-end. Rivers approaching, or eclipsing, previous year-end minima showed a wide spatial distribution (from the Aberdeenshire Dee to the Gt Stour in Kent). December runoff totals were mostly within the normal range but notably low in a few responsive catchments; the 3rd lowest in a 36-yr series for the Yscir. By contrast, flows in spring-fed rivers streams remained healthy, reflecting the substantial autumn groundwater recharge. Across most of the UK accumulated runoff totals, over a wide range of durations, remain very healthy. Considering index rivers, the Naver, Tweed, Lune and Wharfe each established new maximum annual runoff totals and only in the extreme south-east of England did annual runoff totals fall (marginally) below average.

Groundwater

Across most outcrop areas of the major aquifers, December rainfall was considerably below average, declining to less than 40% in a few parts of the south eastern Chalk. Low evaporation demands and near-saturated soil conditions were helpful but over much of the English Lowlands recharge was only around half of the December average. In most parts of the country, the groundwater level hydrographs reflect the healthy groundwater replenishment during the autumn rather than the impact of the recent very dry spell (a significant proportion of index wells reported levels for early December). Its impact can however be seen in the levels for the responsive Ampney Crucis borehole. Aquifer recharge during 2008 (as in 2007) has shown significant departures from the normal seasonal pattern but the net effect has been to leave late-2008 groundwater levels within the normal range across most of the UK, and modestly above average throughout most of the major aquifer outcrop areas. This situation could change if anticyclonic weather patterns dominate throughout the late-winter. The very modest recent recharge implies that the risk of groundwater flooding (in vulnerable areas) has receded. Late-2008 groundwater levels are appreciably below those recorded in December 2000 (which heralded extensive and protracted groundwater flooding in early 2001).

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Dec 08	Oct 08- Dec 08	RP	Jul 08- Dec 08	RP	Apr 08- Dec 08	RP	Jan 08- Dec 08	RP
England & Wales	**mm**	**63**	**264**		**596**		**790**		**1078**	
	%	**66**	**97**	**2-5**	**122**	**5-10**	**117**	**5-10**	**119**	**15-25**
North West	mm	**102**	420		871		1088		1506	
	%	**81**	111	2-5	126	10-20	118	5-15	124	40-60
Northumbrian	mm	**65**	236		645		852		1124	
	%	**79**	96	2-5	137	40-60	131	30-45	130	>100
Severn Trent	mm	**55**	218		513		681		921	
	%	**70**	101	2-5	127	5-10	117	5-10	120	10-20
Yorkshire	mm	**71**	215		564		744		1050	
	%	**85**	90	2-5	126	5-10	118	5-10	126	40-60
Anglian	mm	**31**	170		377		530		709	
	%	**56**	103	2-5	117	2-5	113	2-5	117	5-10
Thames	mm	**43**	181		418		608		813	
	%	**60**	90	2-5	113	2-5	114	2-5	116	5-10
Southern	mm	**41**	217		423		615		840	
	%	**49**	87	2-5	100	<2	105	2-5	107	2-5
Wessex	mm	**63**	232		537		742		1011	
	%	**66**	89	2-5	118	2-5	118	2-5	118	5-10
South West	mm	**88**	317		748		973		1312	
	%	**62**	82	2-5	117	2-5	114	2-5	110	2-5
Welsh	mm	**92**	429		917		1157		1605	
	%	**59**	98	2-5	123	5-10	117	5-10	119	5-15
Scotland	**mm**	**135**	**522**		**898**		**1132**		**1734**	
	%	**87**	**110**	**2-5**	**108**	**5-10**	**105**	**2-5**	**118**	**30-40**
Highland	mm	**169**	705		1039		1293		2046	
	%	**87**	121	5-15	105	2-5	101	2-5	118	20-30
North East	mm	**93**	310		588		815		1166	
	%	**95**	102	2-5	104	2-5	105	2-5	113	10-20
Tay	mm	**111**	373		744		958		1519	
	%	**83**	94	2-5	106	2-5	103	2-5	118	10-20
Forth	mm	**81**	317		716		920		1419	
	%	**71**	91	2-5	112	2-5	109	2-5	124	25-40
Tweed	mm	**81**	286		717		946		1326	
	%	**83**	98	2-5	131	25-40	126	20-30	132	>100
Solway	mm	**138**	515		1005		1218		1756	
	%	**92**	114	2-5	124	10-20	115	5-10	122	35-50
Clyde	mm	**163**	602		1083		1334		2058	
	%	**88**	106	2-5	108	2-5	104	2-5	118	10-20
Northern Ireland	**mm**	**82**	**308**		**756**		**894**		**1273**	
	%	**75**	**93**	**2-5**	**126**	**10-20**	**110**	**2-5**	**116**	**10-20**

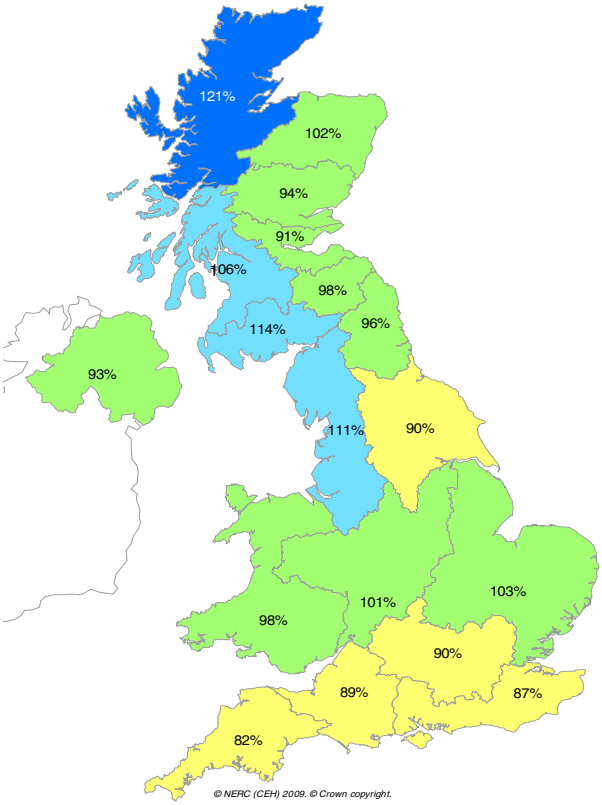
% = percentage of 1961-90 average

RP = Return period

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and derived following the method described in: Tabony, R. C. 1977, *The variability of long duration rainfall over Great Britain*. Met Office Scientific Paper no. 37. The estimates reflect climatic variability since 1913 and assume a stable climate. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals.
All monthly rainfall totals since May 2008 are provisional.

Rainfall . . . Rainfall . . .

October - December 2008



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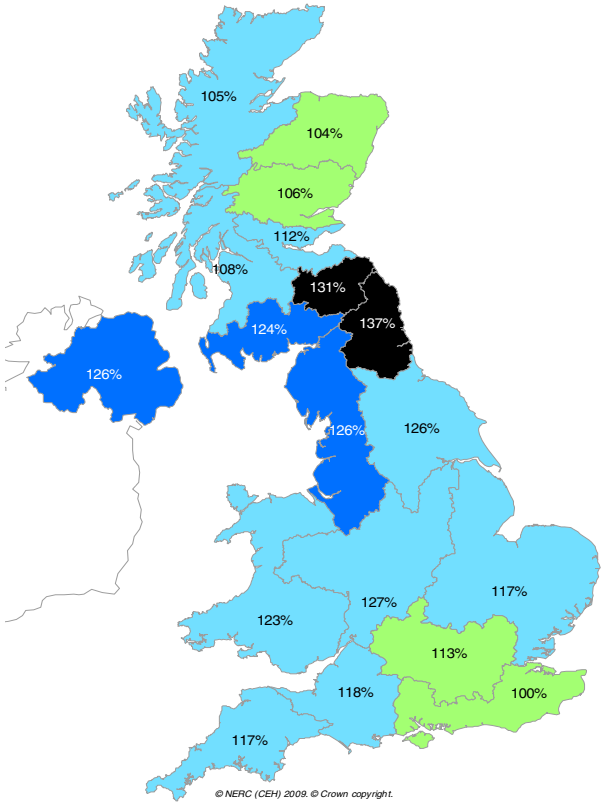

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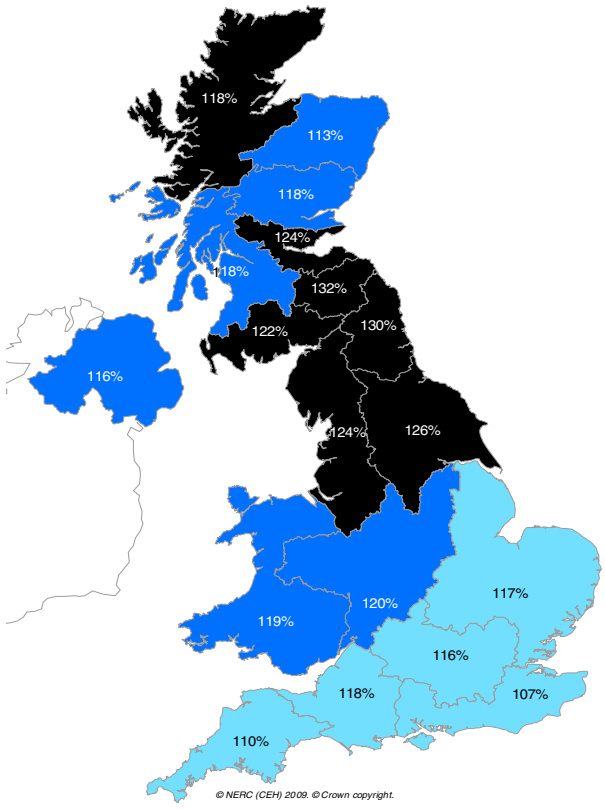


Met Office Winter 2008/9 forecast

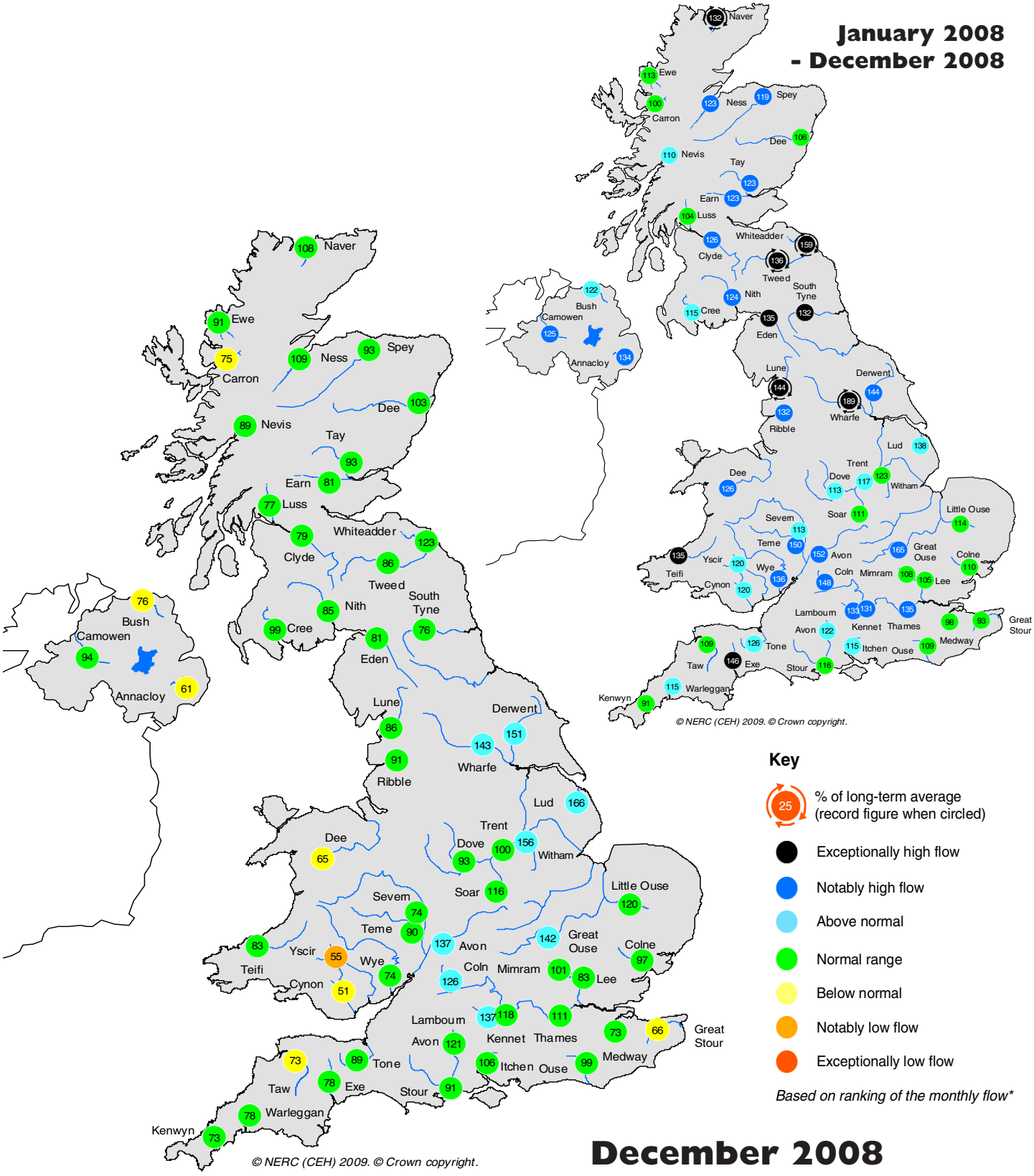
Forecast for the remainder of Winter 2008/9:
updated 22 December 2008

Temperature
UK mean temperatures are likely to be below average in January and nearer average in February. Mean temperatures for other parts of Europe during the rest of winter are more likely to be near average, but near or above average in south-east Europe.

Rainfall
Precipitation for the remainder of winter is more likely to be average, or below average over much of Europe, including the UK. However, above-average precipitation is favoured over parts of south-eastern Europe.

Updates and reviews of the forecast
The winter forecast will next be updated at 10 a.m. on 22 January 2009. For further details please visit: http://www.metoffice.gov.uk/weather/seasonal/winter2008_9

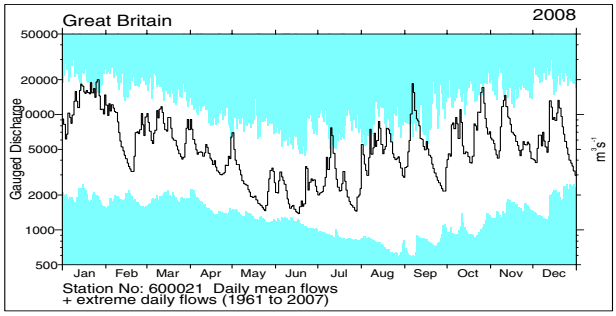
River flow . . . River flow . . .

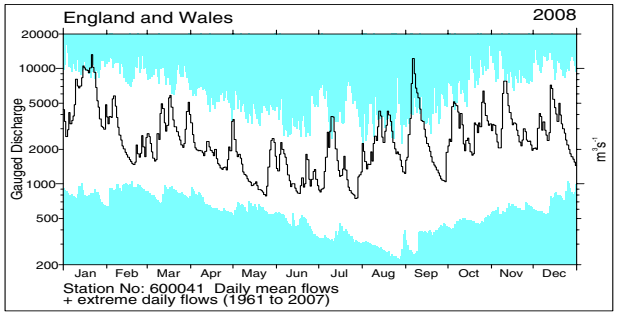


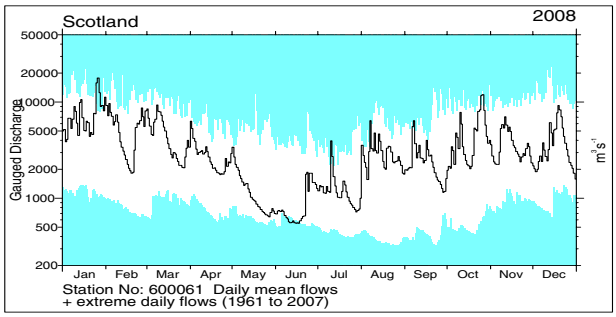
River flows

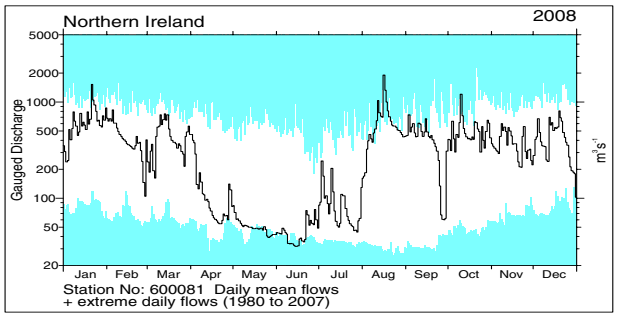
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

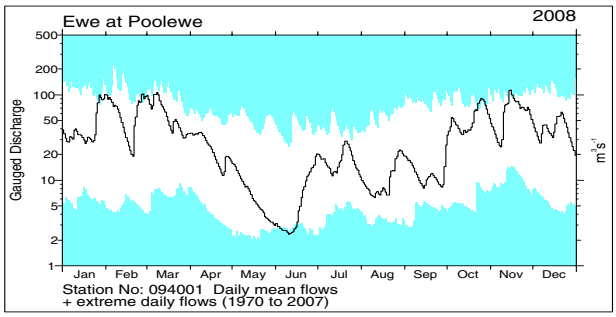
River flow . . . River flow . . .

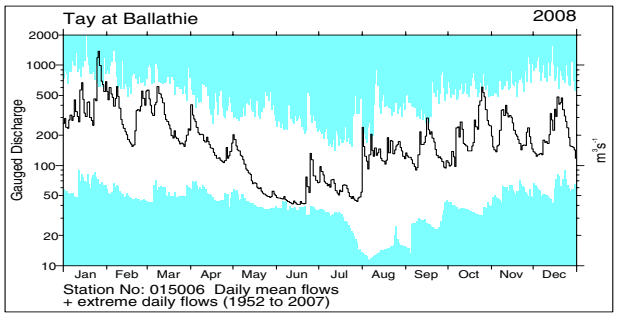


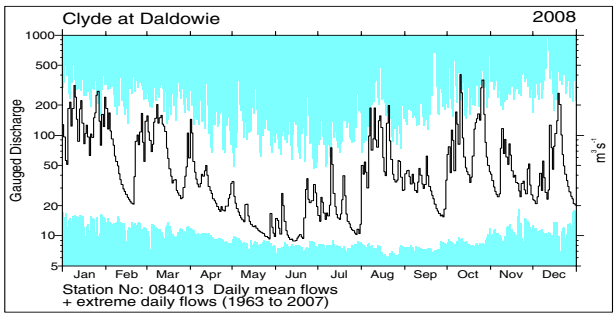


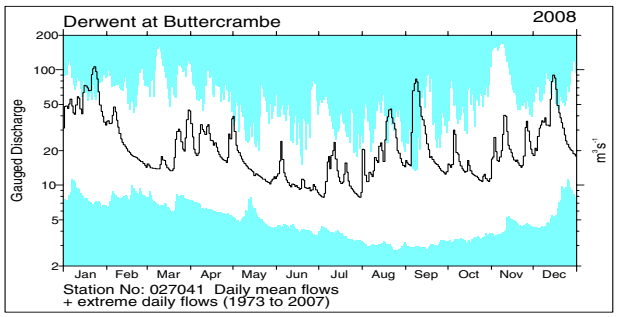


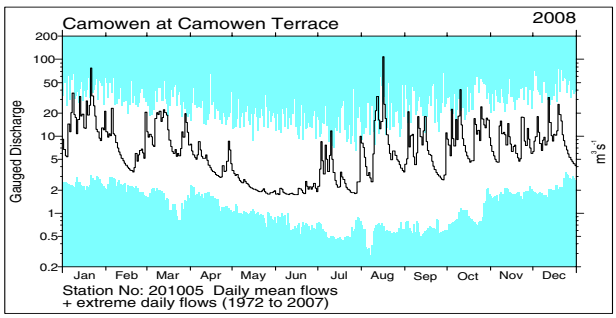


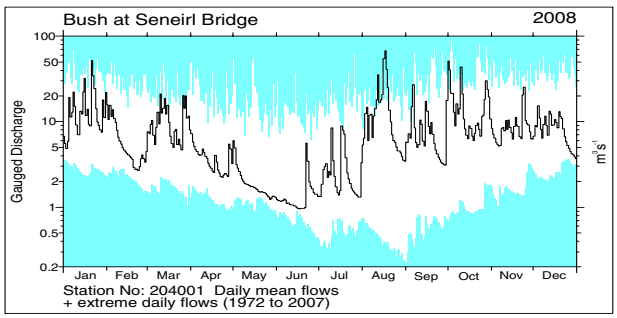








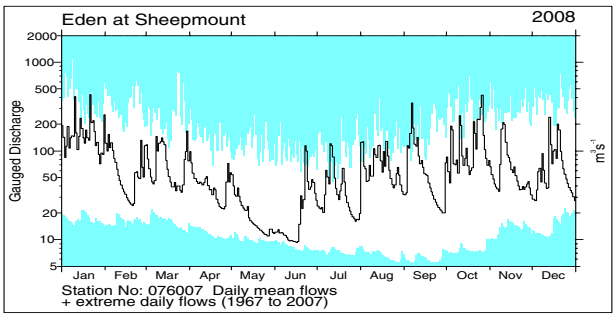


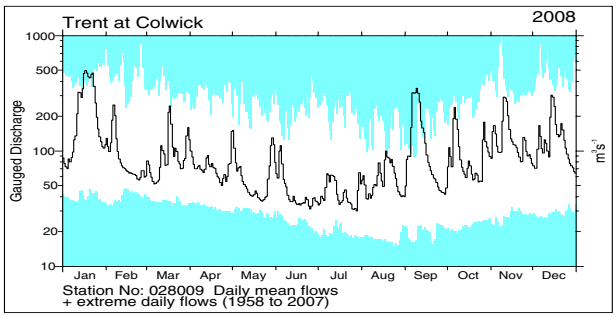


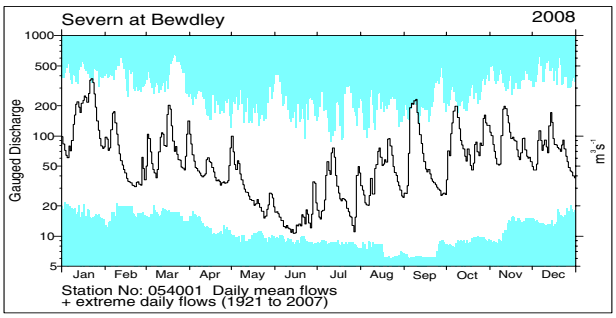
River flow hydrographs

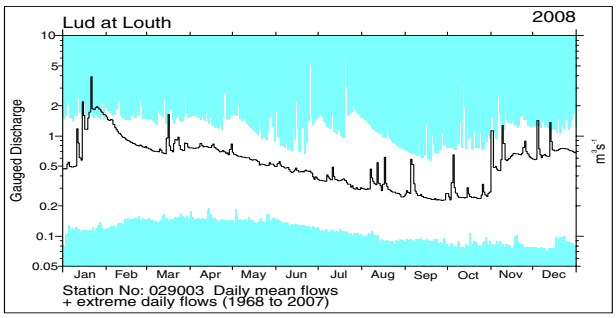
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to January 2008 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

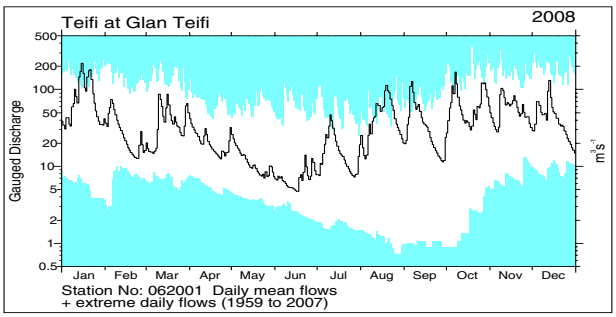
River flow . . . River flow . . .

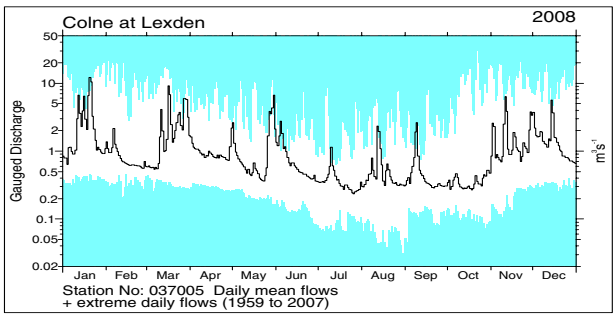


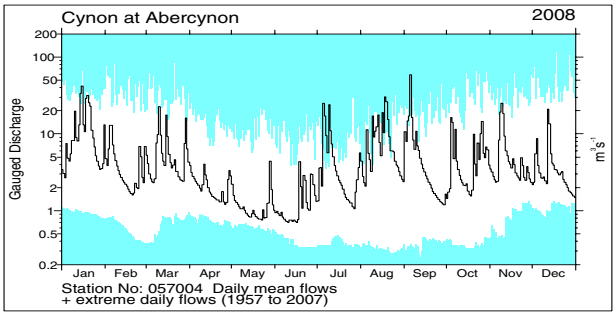


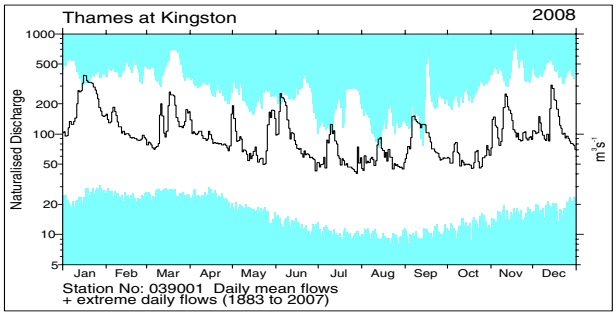


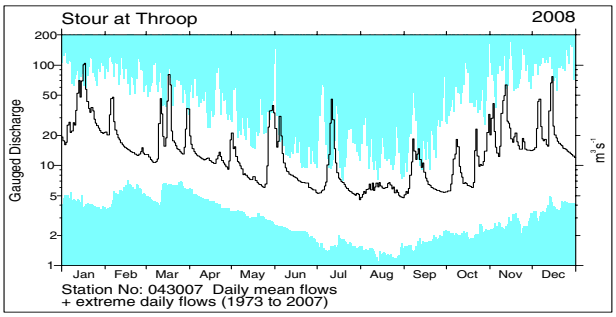


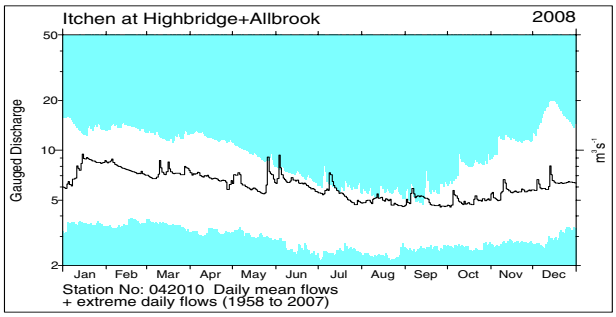












Notable runoff accumulations (a) July - December 2008, (b) January - December 2008

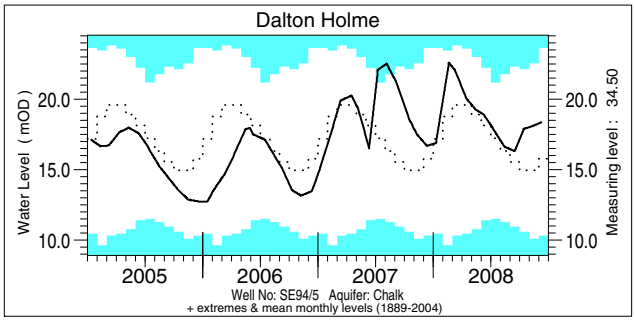
	River	%lta	Rank
a)	Tweed (Norham)	173	49/49
	Whiteadder	211	39/39
	Tyne (Bywell)	173	50/50
	Dart	161	48/50
	Warleggan	156	38/39
	Tawe	144	48/50
	Teifi	155	48/49
	L Bann	153	28/29

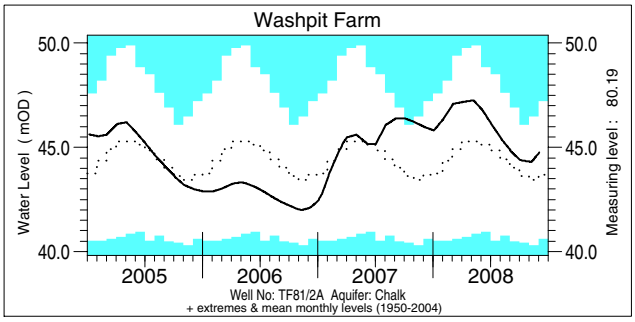
	River	%lta	Rank
b)	Tyne (Spilmersford)	168	43/43
	Tweed (Boleside)	136	48/48
	S Tyne	132	44/45
	Wharfe	189	53/53
	Derwent	144	44/47
	Coln	148	43/45
	Exe	146	51/52
	Brue	140	41/43

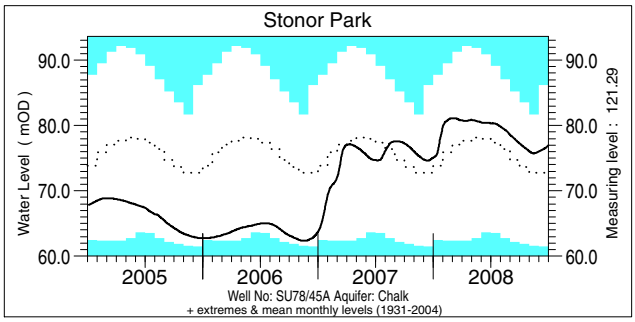
	River	%lta	Rank
b)	Teme	150	36/38
	Lune	144	48/48
	Eden	135	40/41
	Clyde (Blairston)	139	48/48
	Naver	132	31/31
	Camowen	125	32/34
	Annacloy	134	28/29

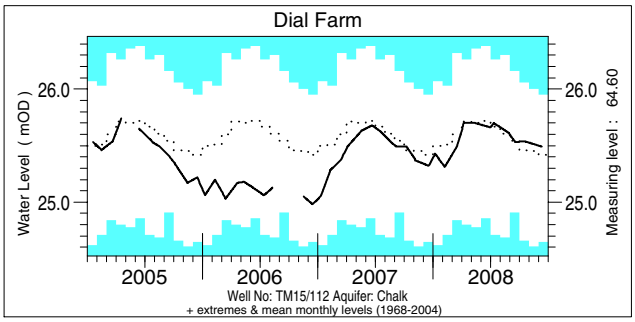
lta = long term average
Rank 1 = lowest on record

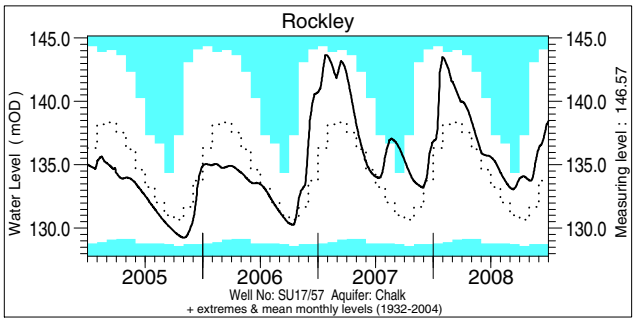
Groundwater . . . Groundwater

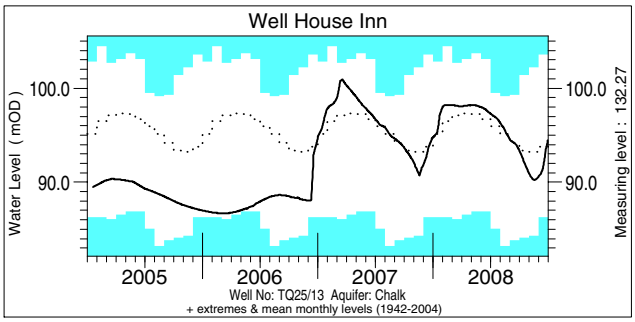


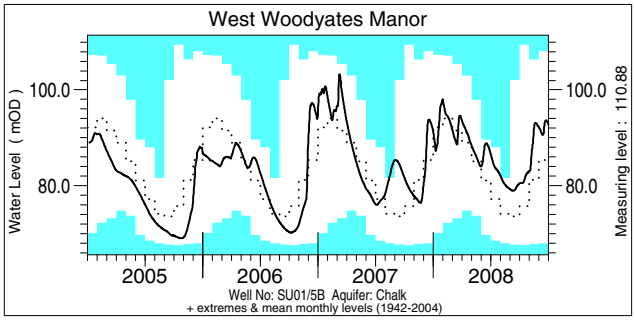


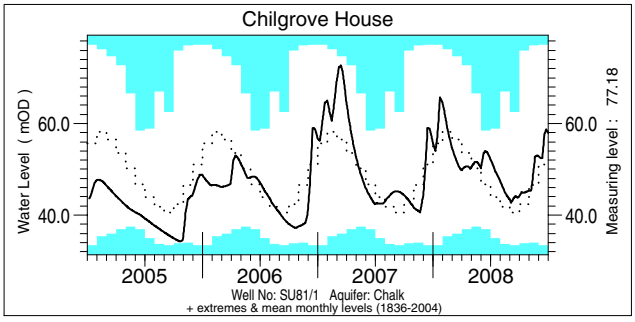


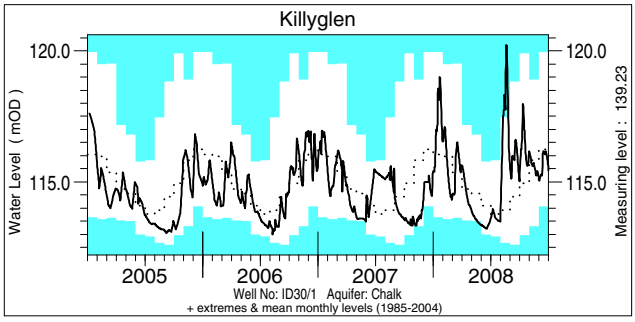


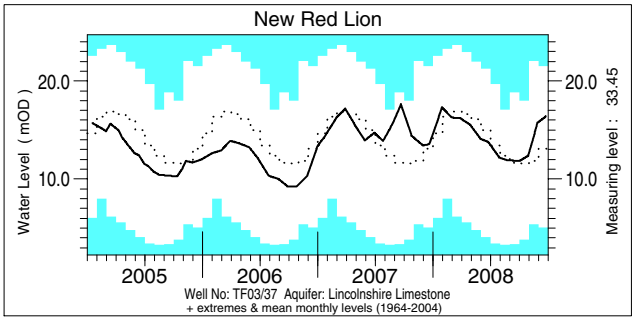






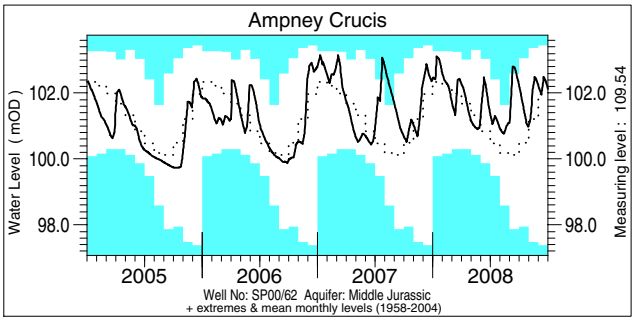


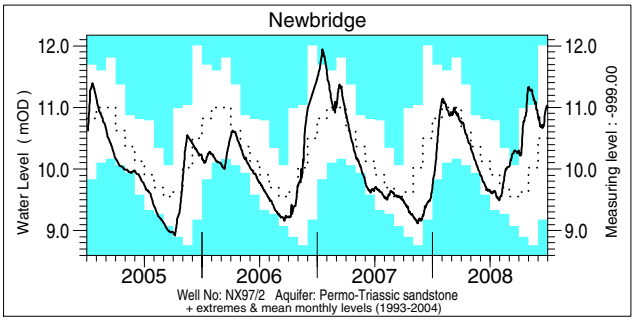


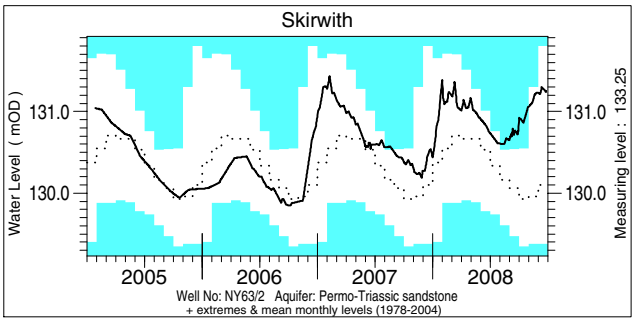


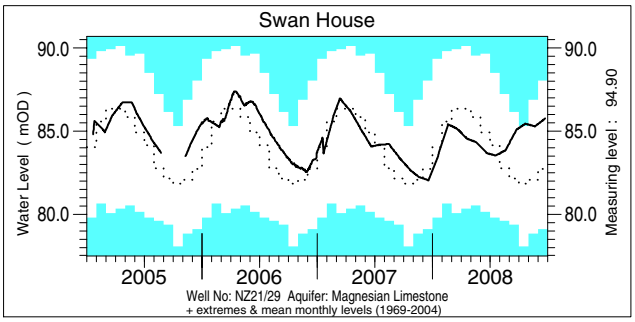
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

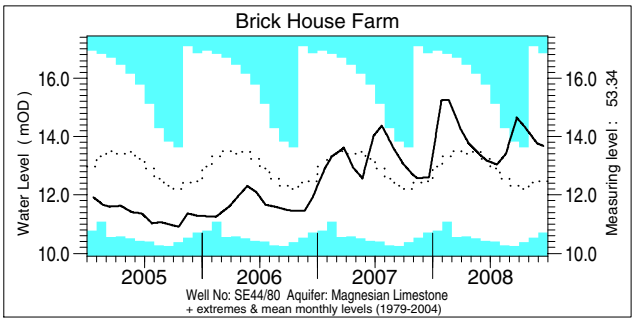
Groundwater . . . Groundwater

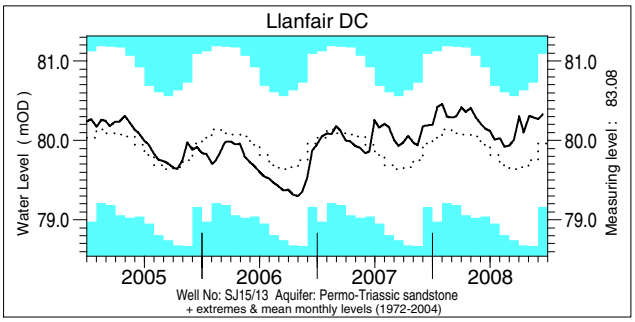


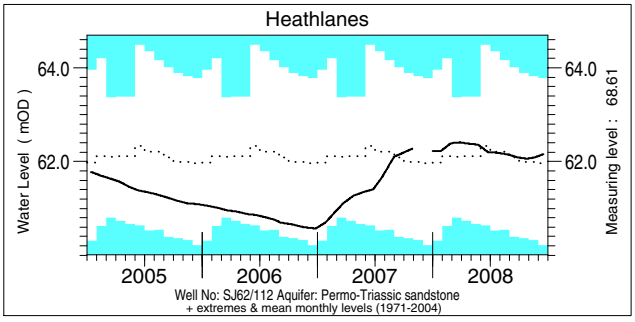


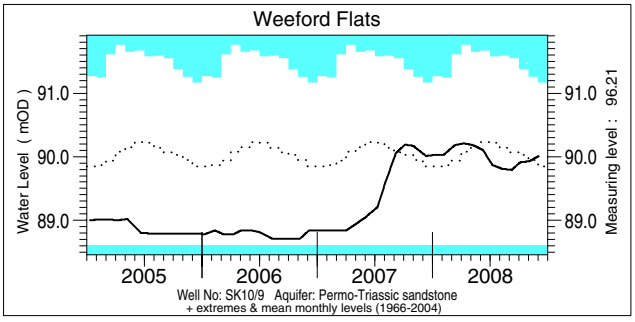


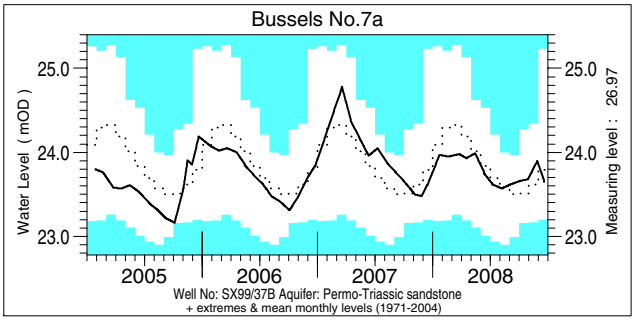


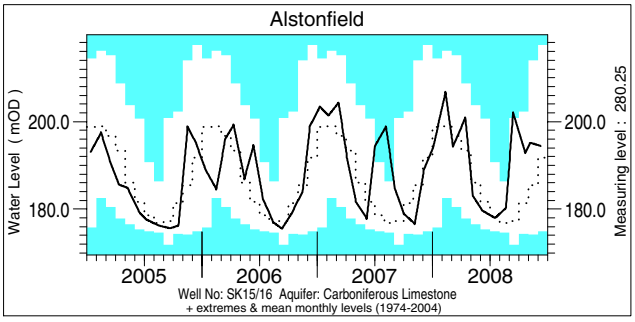










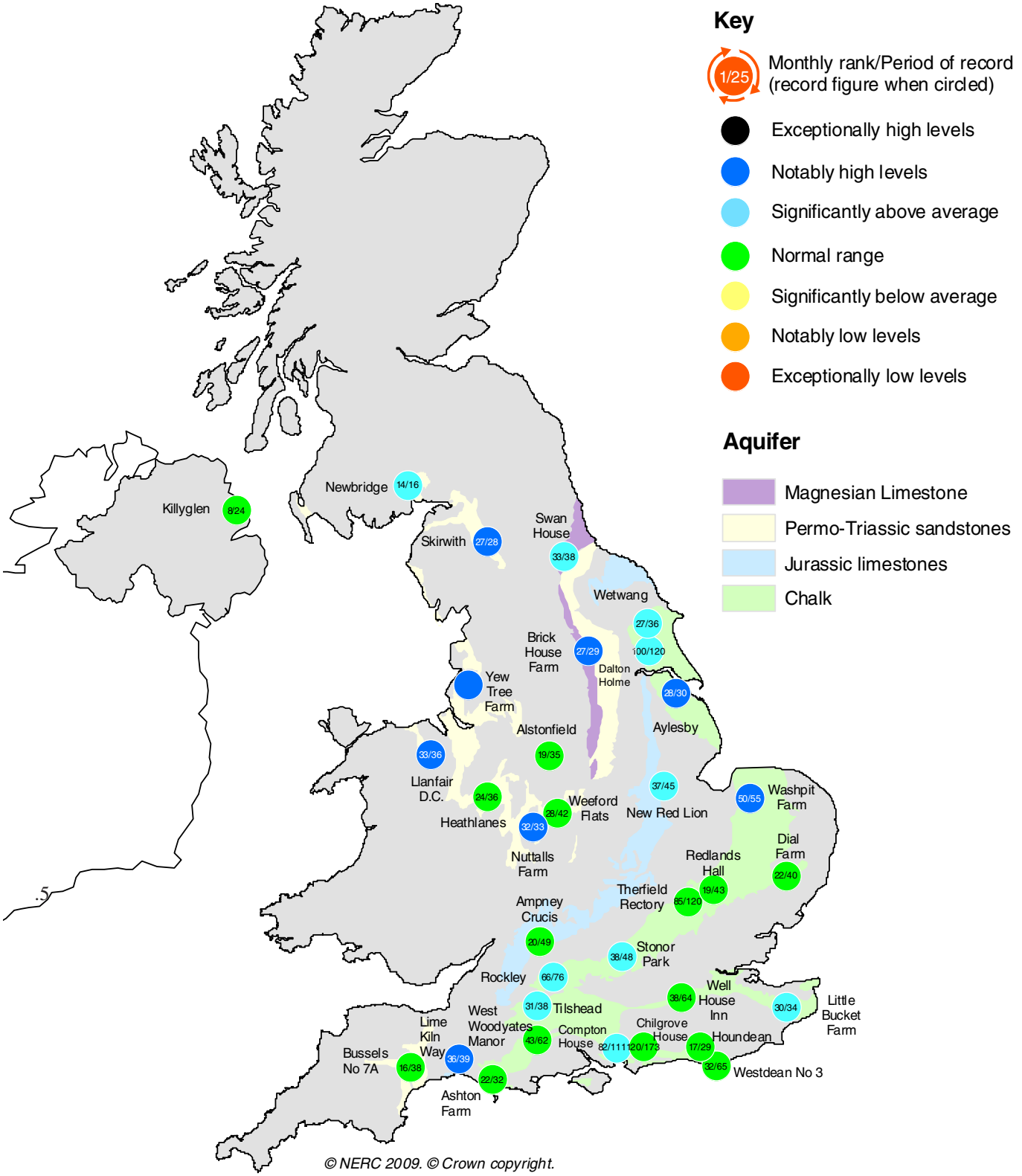


Groundwater levels December 2008 / January 2009

Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.
Dalton Holme	18.36	08/12	15.57	Chilgrove House	57.91	31/12	51.89	Brick House Farm	13.68	16/12	12.40
Washpit Farm	45.52	05/01	43.41	Killyglen (NI)	115.44	31/12	116.14	Llanfair DC	80.33	15/12	79.88
Stonor Park	77.00	30/12	72.37	New Red Lion	16.40	23/12	12.96	Heathlanes	62.16	16/12	61.89
Dial Farm	25.49	11/12	25.40	Ampney Crucis	102.13	30/12	101.95	Weeford Flats	90.01	02/12	89.65
Rockley	138.43	30/12	133.86	Newbridge	11.00	31/12	10.45	Bussels No.7a	23.65	19/12	23.84
Well House Inn	94.45	29/12	93.62	Skirwith	131.25	25/12	130.25	Alstonfield	194.44	08/12	192.69
West Woodyates	92.69	31/12	86.95	Swan House	85.75	22/12	83.02				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



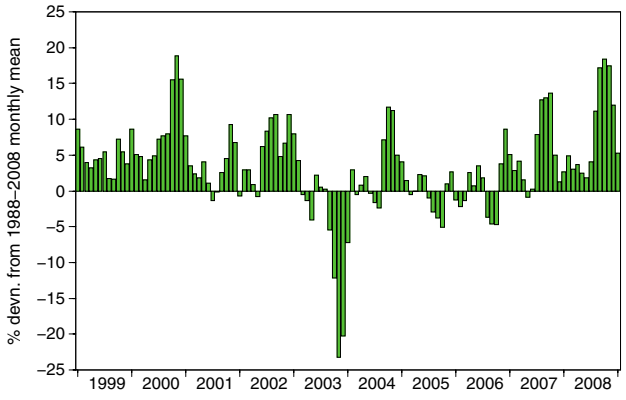
Groundwater levels - December 2008

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.

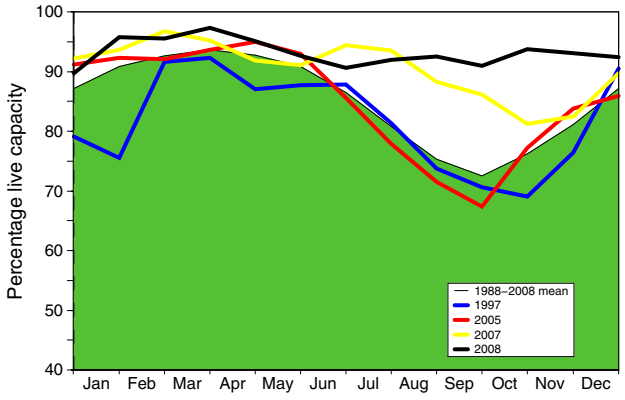
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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)	2008 Nov	2008 Dec	2009 Jan	Jan Anom.	Min. Jan	Year* of min.	2008 Jan	Diff 09-08
North West	N Command Zone	• 124929	98	95	**92**	6	51	1996	87	5
	Vyrnwy	55146	100	93	**90**	-1	35	1996	99	-9
Northumbrian	Teesdale	• 87936	93	91	**83**	-5	41	1996	100	-17
	Kielder	(199175)	(94)	(88)	**(90)**	-1	(70)	1990	(73)	17
Severn Trent	Clywedog	44922	80	79	**83**	-1	54	1996	85	-2
	Derwent Valley	• 39525	100	95	**99**	10	10	1996	94	5
Yorkshire	Washburn	• 22035	98	94	**94**	11	23	1996	89	5
	Bradford supply	• 41407	99	97	**99**	10	22	1996	99	0
Anglian	Grafham	(55490)	(95)	(93)	**(92)**	8	(57)	1998	(95)	-3
	Rutland	(116580)	(80)	(88)	**(90)**	8	(60)	1991	(89)	1
Thames	London	• 202828	92	95	**96**	11	60	1991	89	7
	Farmoor	• 13822	95	93	**96**	5	71	1991	81	15
Southern	Bewl	28170	61	75	**80**	8	34	2006	74	6
	Ardingly	4685	75	93	**100**	16	41	2004	92	8
Wessex	Clatworthy	5364	100	100	**100**	9	54	2004	100	0
	Bristol WW	• (38666)	(90)	(94)	**(96)**	19	(40)	1991	(94)	2
South West	Colliford	28540	100	100	**98**	22	46	1996	78	20
	Roadford	34500	97	97	**96**	19	23	1996	88	8
	Wimbleball	21320	100	100	**100**	17	46	1996	98	2
	Stithians	5205	84	88	**95**	20	33	2002	56	39
Welsh	Celyn and Brenig	• 131155	98	96	**94**	2	54	1996	97	-3
	Brianne	62140	100	98	**92**	-5	76	1996	100	-8
	Big Five	• 69762	99	96	**92**	3	67	1996	92	0
	Elan Valley	• 99106	99	100	**97**	1	56	1996	99	-2
Scotland(E)	Edinburgh/Mid Lothian	• 97639	97	97	**97**	8	60	1999	85	12
	East Lothian	• 10206	99	99	**99**	4	48	1990	100	-1
Scotland(W)	Loch Katrine	• 111363	91	95	**98**	9	75	2008	75	23
	Daer	22412	99	99	**99**	2	83	1996	100	-1
	Loch Thom	• 11840	96	96	**96**	0	80	2008	80	16
Northern Ireland	Total+	• 67270	91	90	**90**	6	61	2002	82	8
	Silent Valley	• 20634	95	89	**91**	10	39	2002	83	8

() 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 1988-2008 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 Northern Ireland Environment Agency. 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 Northern Ireland Water.

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

01/09