Hydrological Summary

for the United Kingdom

November 2010

General

In meteorological terms, November was a month of remarkable contrasts. The first three weeks were mild and characterised by the passage frontal systems which brought strong winds and rainfall, which was occasionally very heavy and associated with localised flooding (notably so in Cornwall on the 16th/17th). In stark contrast, during the last ten days of the month winds from the northeasterly quadrant brought unusually early Arctic conditions to the UK, with exceptionally low temperatures and the earliest widespread snowfall in 17 years, with significant falls in eastern Britain. Substantial runoff in upland areas resulted in a small but welcome increase in reservoir stocks. Entering December, overall England & Wales stocks were healthy (5% above average), but with below average stocks in parts of the south (e.g. Clatworthy, 18% below average). On the evidence of the first three weeks, further seasonal recovery would have been anticipated, but the hydrological situation changed markedly due to the freezing conditions, with steep river flow recessions resulting in seasonally low flows by month end. A continuation of similar synoptic patterns could yield some notably low winter flows, and could significantly impact on the water resources outlook for 2011 if prolonged, particularly in parts of the south with below average reservoir stocks and seasonally depressed groundwater levels.

Rainfall

The month started wet, with a strong westerly airflow which brought heavy rain to the north and west, and cyclonic conditions persisted throughout the first few weeks. Heavy downpours were common, triggering some localised flash flooding (e.g. in Hampshire, West Sussex and the Isle of Wight on the 9th, with 80mm recorded in 24h at Duncton, West Sussex). A deep low pressure system brought intense rain to western areas on the 16/17th, leading to localised flooding in Cornwall; Cardinham registered 50mm in 12h, and there were reports of close to 40mm falling in an hour in some localities (e.g. Mevagissey). National rainfall totals were close to average, largely due to the comparatively dry polar episode late in the month. However, there were marked spatial contrasts: northeast England was notably wet, with Northumbria receiving >80% above average, whilst <60% of average was recorded in the western Highlands and islands of Scotland. Significant snowfalls were recorded – with widespread accumulations of over 25cm, and over 40cm in upland areas by month end; the systematic undercatch is likely to result in underestimation of precipitation in eastern districts. Below average rainfall has been a feature of the last three months in Thames and Wessex, and moderate rainfall deficiencies are apparent since March across most of England & Wales (most notably in Wessex).

River Flows

Successive pulses of frontal rainfall produced steep runoff increases early in the month in responsive catchments. Spates were common, and flood alerts widespread, although flooding was localised. The peak flow for the Wallington (Hants) on the 9th was the highest on record for November in a record from 1952. On the 16th, flood warnings were issued across the southwest, with the most severe flooding occurring in Lostwithiel and Mevagissey in south Cornwall, where river levels were exacerbated by high tides. Provisional data suggests the Warleggan registered its highest flow (for any month) in a record from 1969. Overall November runoff totals were fairly typical, but exhibited marked spatial and temporal variations. Across most of England & Wales, November runoff was in the normal range, whilst in Scotland above average runoff in the east contrasted with notably low totals in the northwest. Dry conditions in some areas and temporary snow storage in others contributed to steep flow recessions from mid-month, leading to notably low flows (end-of-November outflows for Great Britain were the lowest since 1993) with further flow decreases in early December. A thaw may result in runoff increases in areas with significant snow accumulations, and an elevated flood threat should a rapid thaw occur. Below average runoff was registered in many groundwater streams in the south (e.g. the Hampshire Avon and Lambourn) partly in response to longer-term rainfall deficiencies, with no evidence of the seasonal recovery normally seen in late autumn.

Groundwater

The frontal rainfall experienced in early November was welcome in the major aquifer outcrops of the English Lowlands, where above average soil moisture deficits were apparent at the start of the month. Whilst soils continued to wet-up, deficits persisted in across much of the English Lowlands, with above average deficits in isolated central areas. November groundwater levels were generally in the normal range, with the exception of Dalton Holme and some boreholes in Wessex and the North Downs. Whilst average levels predominate, limited recharge occurred in November, a time when the seasonal recovery is normally consolidated. A continued seasonal recovery was observed in limestone boreholes and in the responsive boreholes in the Permo-Triassic sandstone, but across the Chalk a combination of below average precipitation, residual soil moisture deficits and delayed infiltration due to storage in snow resulted in very patchy recharge. Whilst increases were observed in parts of the southern Chalk which experienced heavy rains early in the month (e.g. Chilgrove and Ashton Farm), recessions continued in a majority of Chalk boreholes. With levels in parts of the southern Chalk (e.g. Tilshead) approaching natural base levels, and the dry weather continuing into early December, a shortened recharge season is a very likely prospect.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

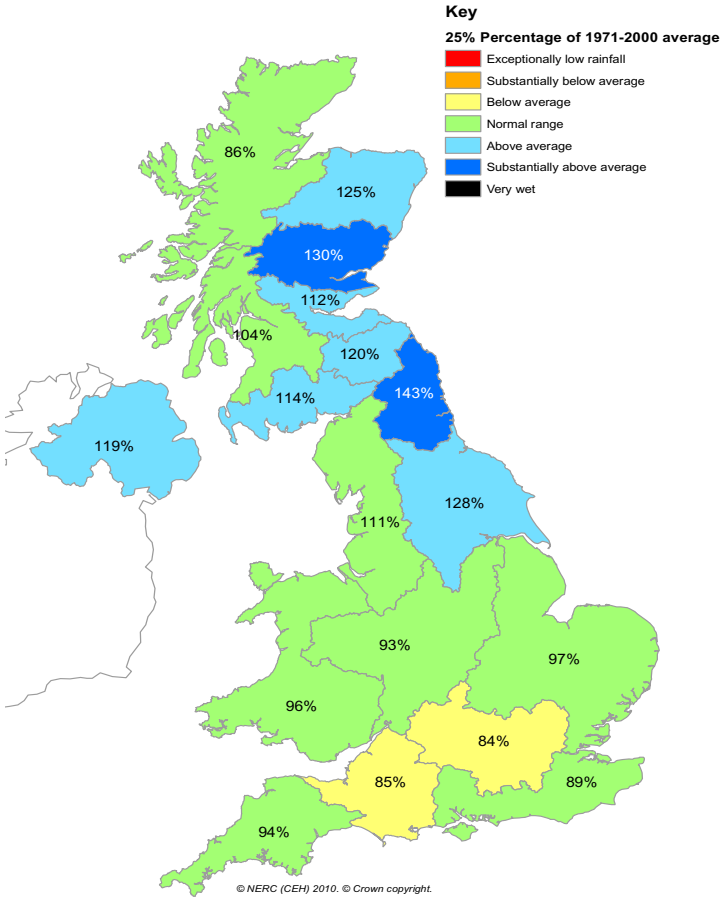
Area	Rainfall	Nov 2010	Sep10 - Nov10	RP	Jul10 - Nov10	RP	Mar10 - Nov10	RP	Dec09 - Nov10	RP
England & Wales	**mm**	**94**	**262**		**434**		**596**		**841**	
	%	**103**	**101**	**2-5**	**113**	**2-5**	**93**	**2-5**	**94**	**2-5**
North West	mm	**131**	394		642		820		1057	
	%	**105**	111	2-5	122	2-5	98	2-5	90	5-10
Northumbrian	mm	**156**	327		499		682		932	
	%	**187**	143	5-15	140	5-10	113	2-5	112	2-5
Severn Trent	mm	**63**	194		338		489		672	
	%	**89**	93	2-5	105	2-5	89	5-10	89	5-10
Yorkshire	mm	**110**	288		415		564		793	
	%	**140**	128	5-10	121	2-5	96	2-5	97	2-5
Anglian	mm	**49**	164		314		426		628	
	%	**86**	97	2-5	118	2-5	93	2-5	104	2-5
Thames	mm	**52**	168		305		432		667	
	%	**78**	84	2-5	102	2-5	84	5-10	95	2-5
Southern	mm	**81**	216		343		496		807	
	%	**97**	89	2-5	101	2-5	89	2-5	103	2-5
Wessex	mm	**89**	213		350		500		749	
	%	**103**	85	2-5	96	2-5	83	5-15	87	5-10
South West	mm	**145**	337		536		737		1067	
	%	**110**	94	2-5	107	2-5	91	2-5	88	2-5
Welsh	mm	**129**	385		637		870		1178	
	%	**88**	96	2-5	111	2-5	95	2-5	89	5-10
Scotland	**mm**	**154**	**455**		**726**		**1006**		**1284**	
	%	**97**	**102**	**2-5**	**115**	**2-5**	**101**	**2-5**	**89**	**2-5**
Highland	mm	**130**	467		779		1103		1373	
	%	**64**	86	2-5	104	2-5	94	2-5	80	5-15
North East	mm	**134**	362		596		834		1152	
	%	**134**	125	5-10	140	10-20	120	5-10	121	5-10
Tay	mm	**200**	492		745		981		1252	
	%	**152**	130	5-10	139	10-20	114	2-5	99	2-5
Forth	mm	**137**	378		603		837		1080	
	%	**119**	112	2-5	123	2-5	106	2-5	95	2-5
Tweed	mm	**137**	322		521		736		1008	
	%	**146**	120	2-5	128	2-5	108	2-5	106	2-5
Solway	mm	**195**	486		729		1023		1306	
	%	**131**	114	2-5	117	2-5	105	2-5	93	2-5
Clyde	mm	**187**	563		874		1172		1452	
	%	**100**	104	2-5	113	2-5	98	2-5	84	5-10
Northern Ireland	**mm**	**151**	**381**		**576**		**830**		**1057**	
	%	**136**	**119**	**5-10**	**119**	**5-10**	**105**	**2-5**	**95**	**2-5**

% = percentage of 1971-2000 average *RP = Return period*

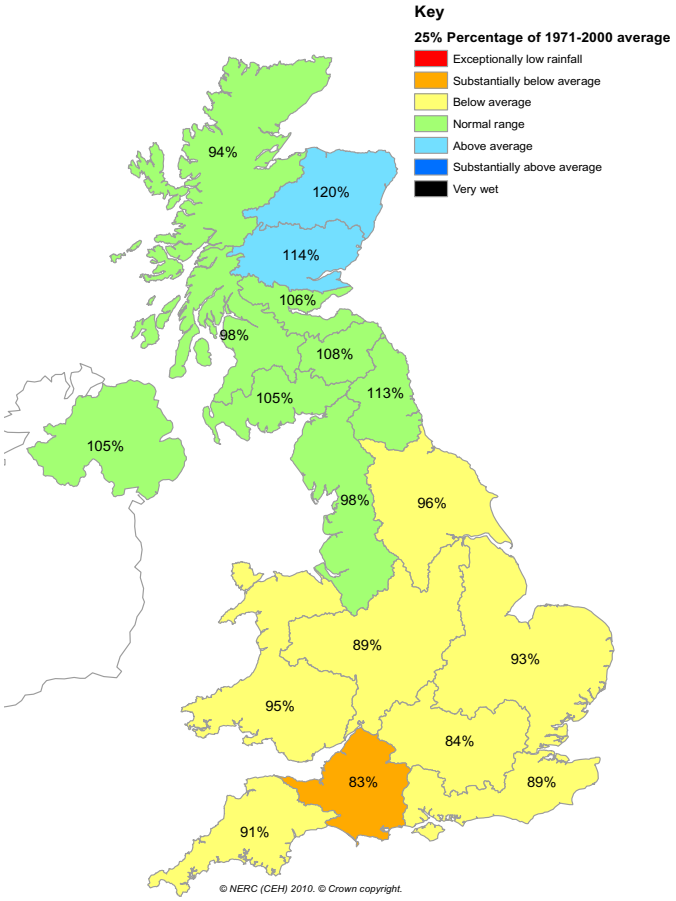
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1913; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. 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 June 2010 are provisional.

Rainfall . . . Rainfall . . .

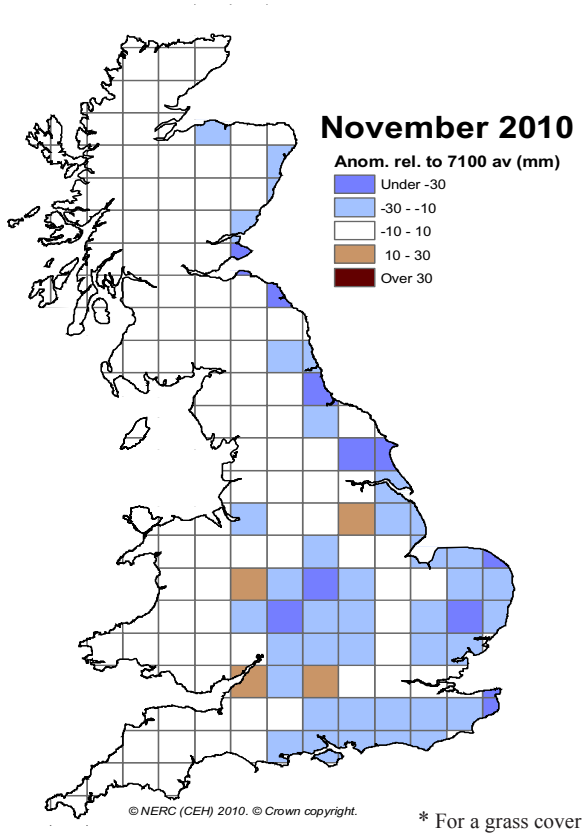
September - November 2010



March - November 2010



MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Weather forecast

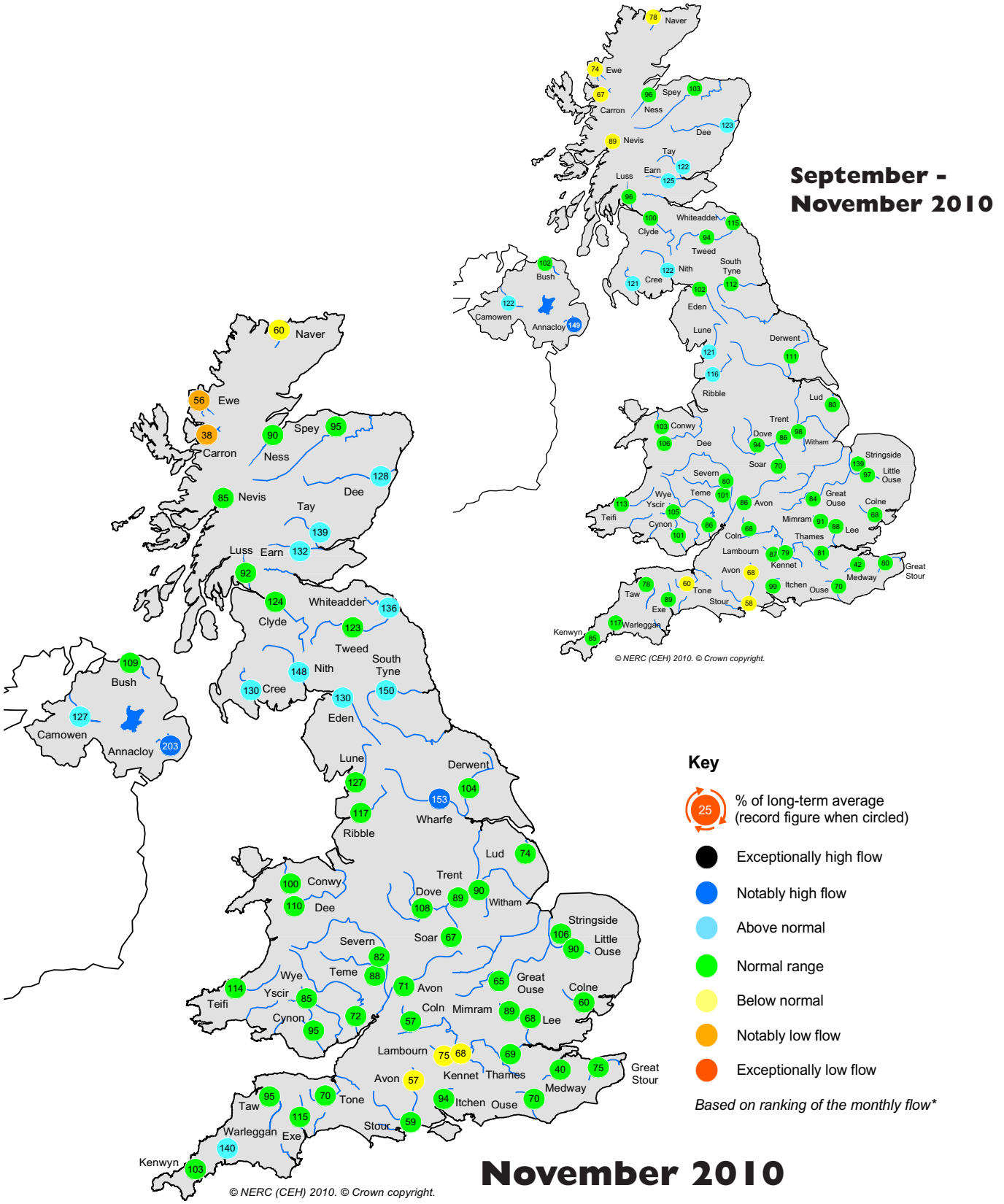
Updated: 12:29 on Tues 14 December

UK Outlook for Sunday 19 Dec to Tuesday 28 Dec 2010: Further snow, widespread ice and severe overnight frosts are likely in most parts of the UK, especially England and Wales. Locally significant accumulations of snow can be expected as showers merge to become more persistent in places. Windward coasts of southern England and Wales may see showers of rain or sleet at times, presenting an ice risk during overnight periods. Sheltered parts of western Scotland and Wales may become drier during the week. The unsettled and wintry weather is expected to continue across the UK towards the Christmas weekend, remaining cold for most with a risk of further snowfall in places, but perhaps becoming less-cold in the south for a time with a chance of some rain or sleet, with temperatures perhaps returning to near-normal here.

UK Outlook for Weds 29 Dec 2010 to Weds 12 Jan 2011: Continuing unsettled and often windy with further wintry showers and perhaps some longer outbreaks of snow in places, especially in the north of the UK. Temperatures look set to be generally below average for much of the country, with a risk of overnight frost and ice continuing in places. However, some less-cold conditions can be expected at times, with rain rather than snow, especially in the south and west of the UK.

For further details please visit:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_alltext.html

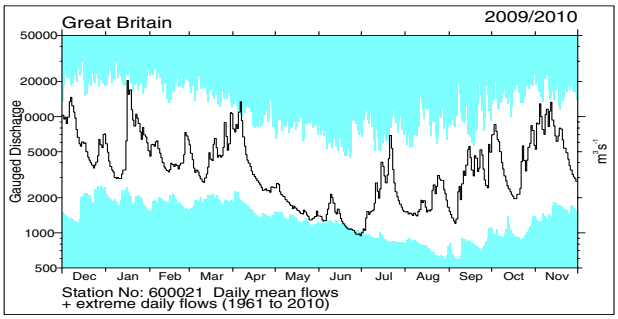
River flow . . . River flow . . .

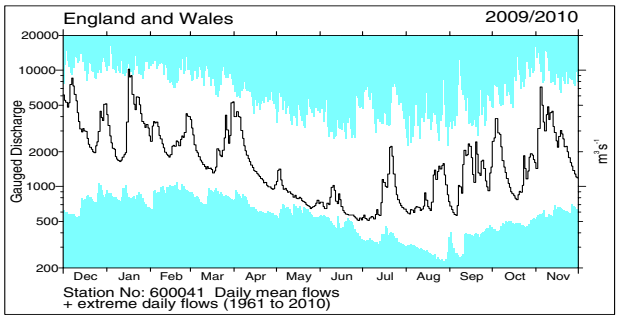


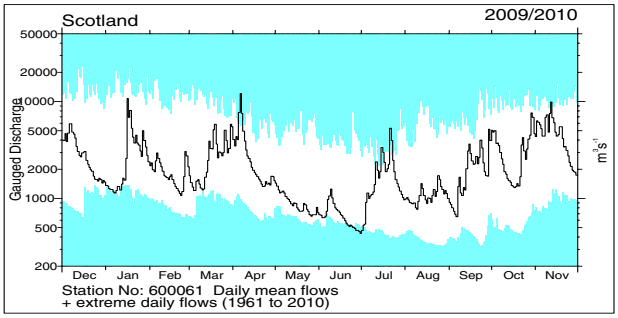
River flows

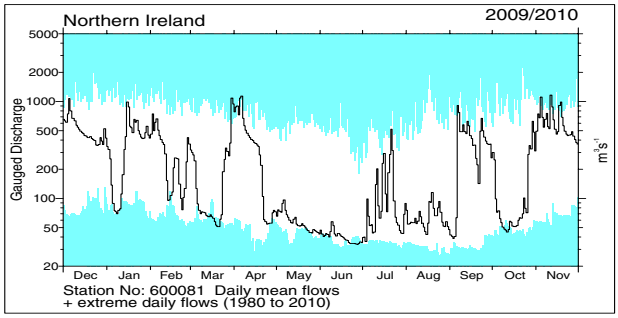
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

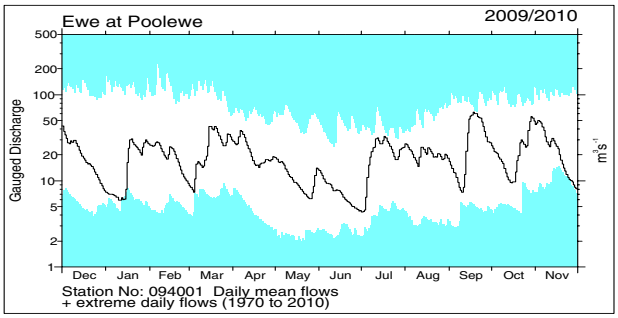
River flow . . . River flow . . .

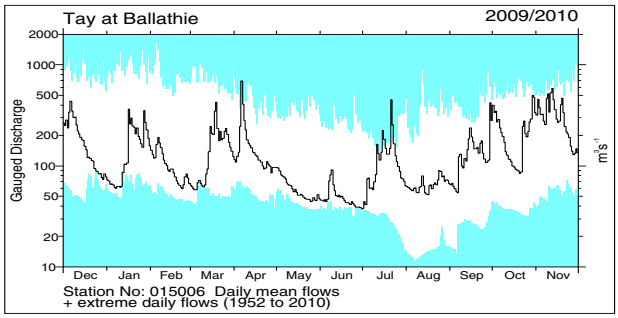


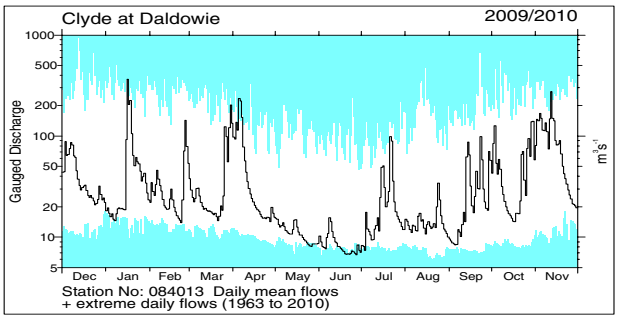


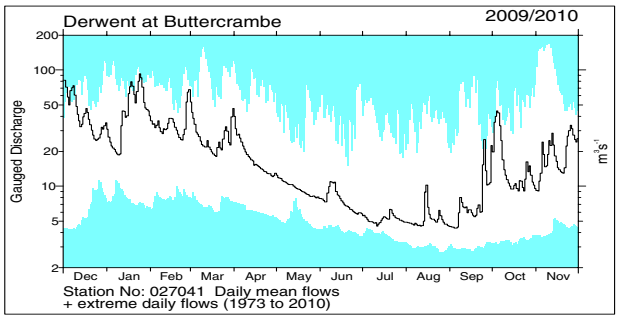


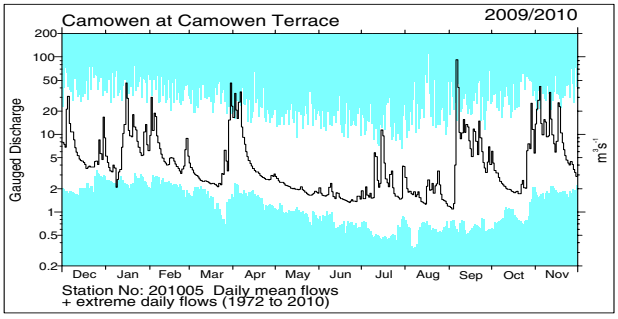


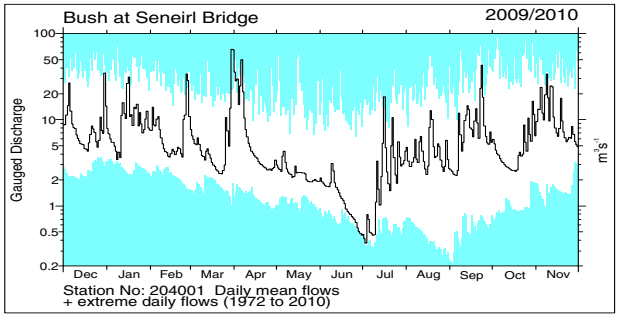








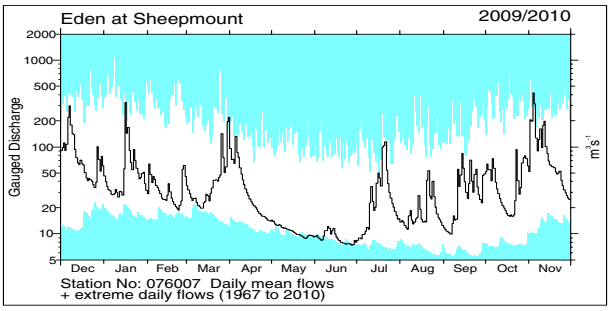


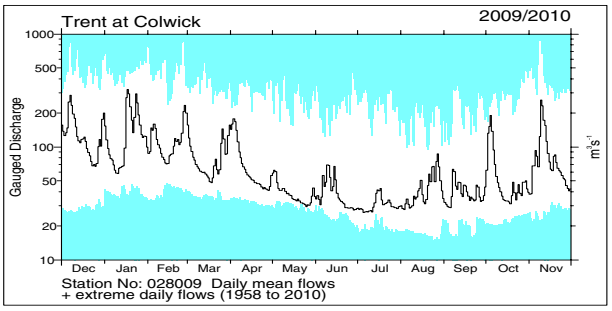


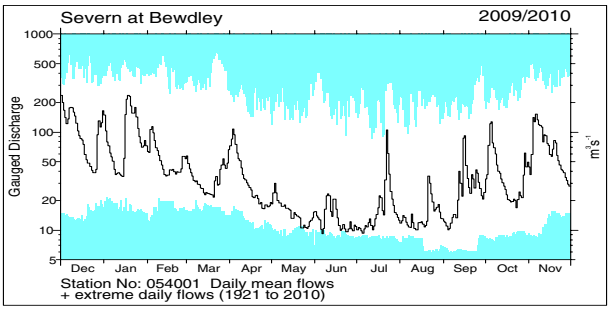
River flow hydrographs

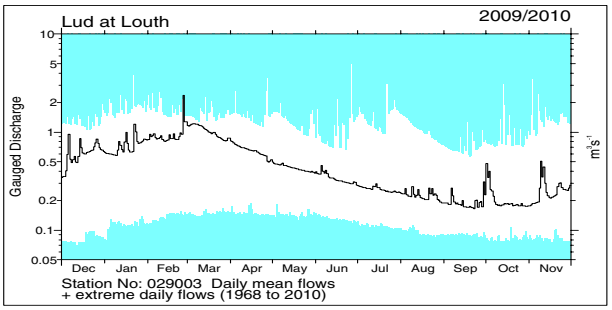
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to December 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

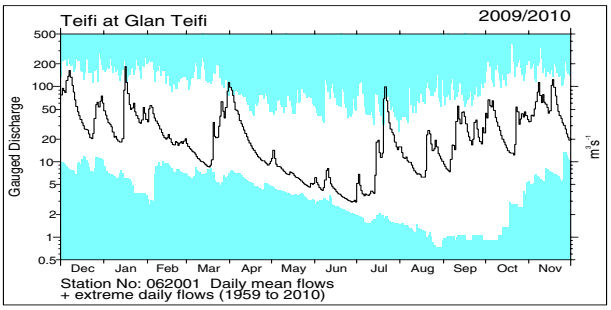
River flow . . . River flow . . .

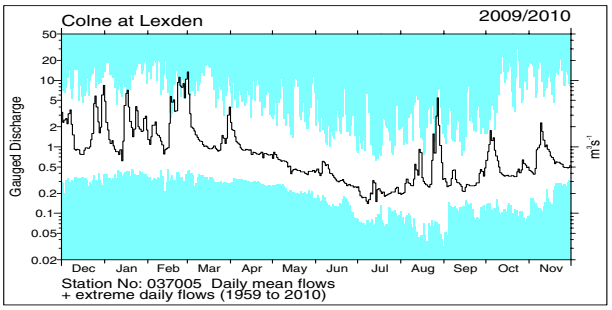


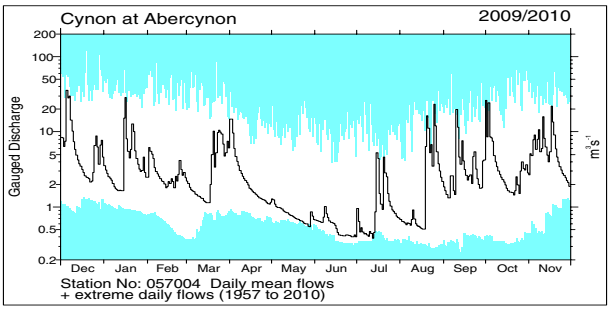


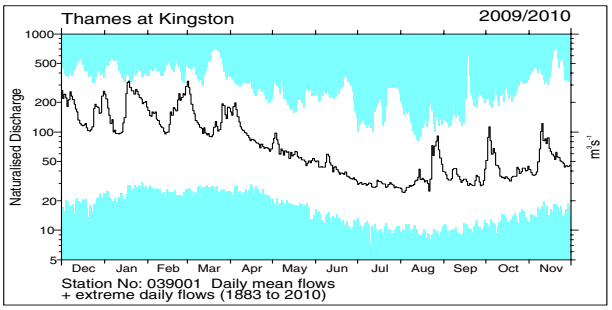


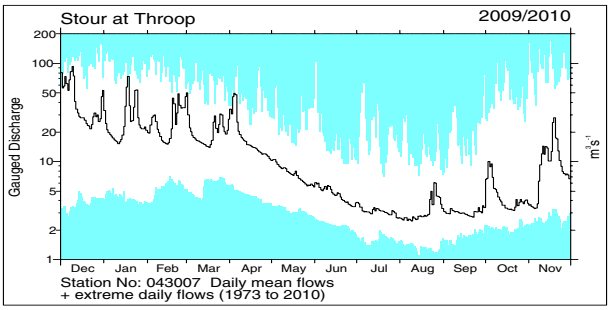


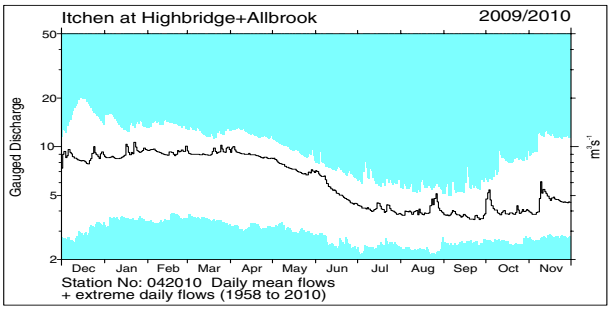












Notable runoff accumulations (a) March - November 2010 (b) December 2009 - November 2010

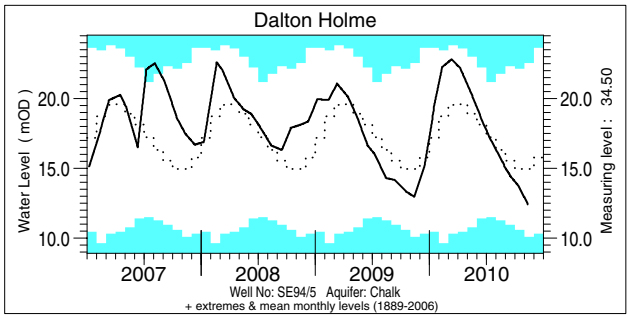
	River	%lta	Rank
a)	Dee (Woodend)	126	75/81
	Taw	66	8/52
	Tone	69	6/50
	Brue	61	5/45
	Severn	66	8/89

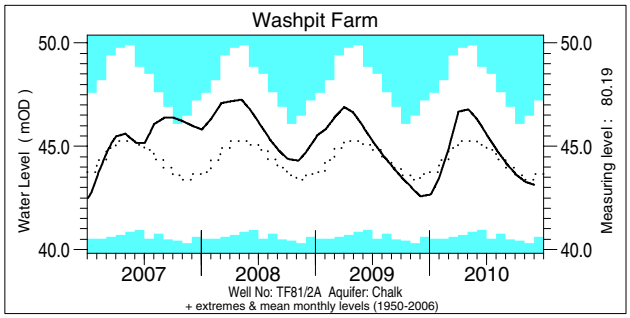
	River	%lta	Rank
b)	Ness	75	3/37
	Forth	70	2/29
	Tyne (Spilmersford)	151	42/44
	Whiteadder	150	39/41
	Dover Beck	139	30/33
	Blackwater	130	55/58
	Mole	127	33/35
	Itchen	120	48/52

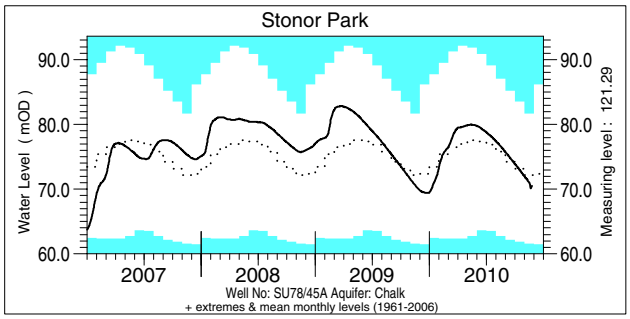
	River	%lta	Rank
b)	Luss	70	1/30
	Nevis	64	1/28
	Carron	58	1/31
	Ewe	69	3/40
	Mourne	84	5/28
	Faughan	79	5/34
	Annacloy	116	29/31

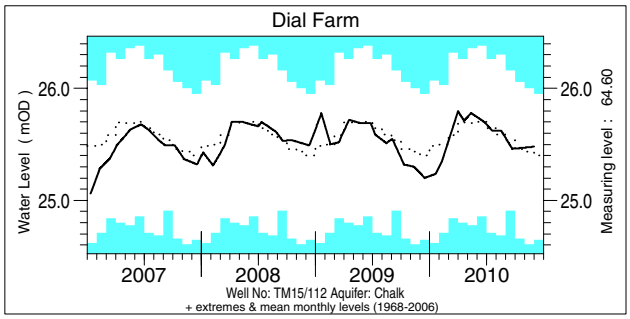
lta = long term average
Rank 1 = lowest on record

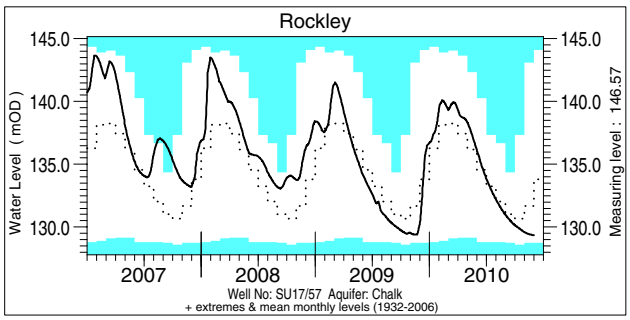
Groundwater . . . Groundwater

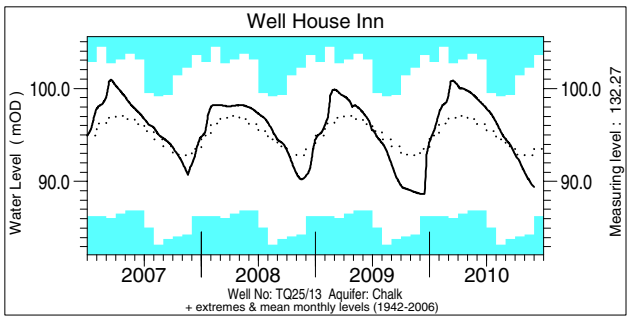


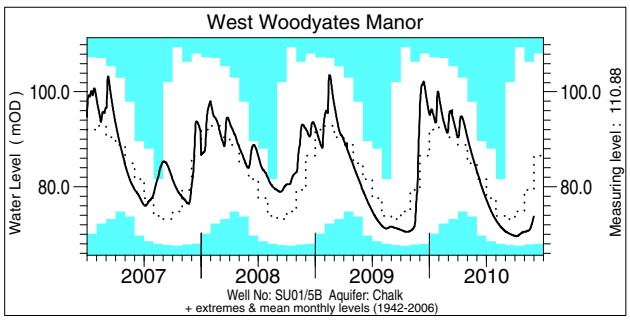


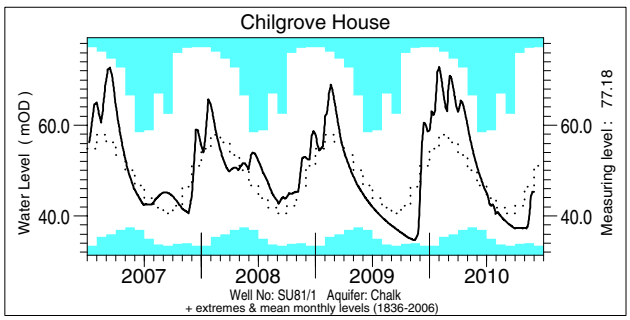


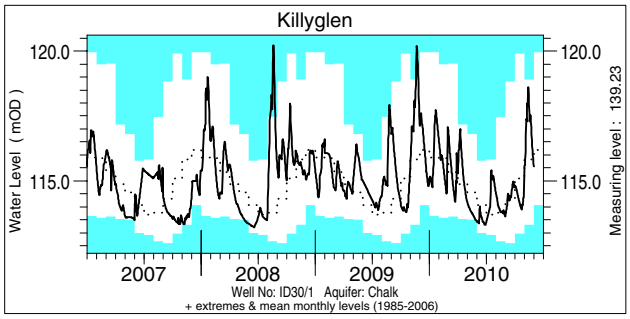


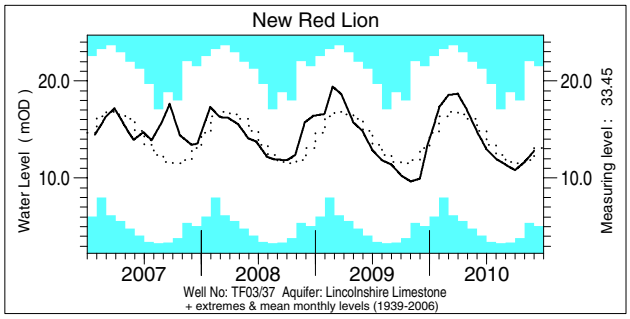






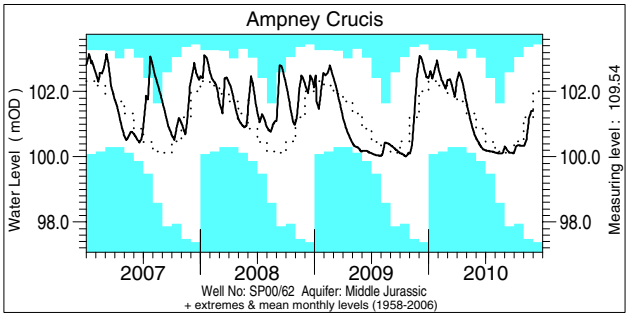


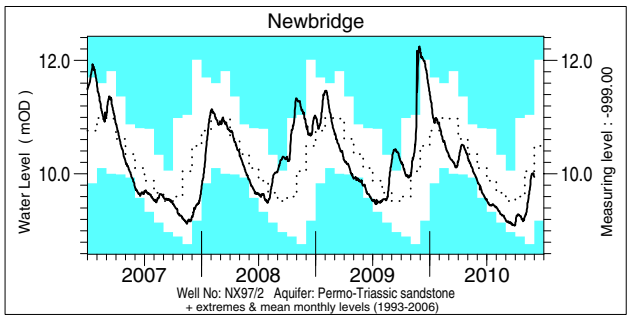


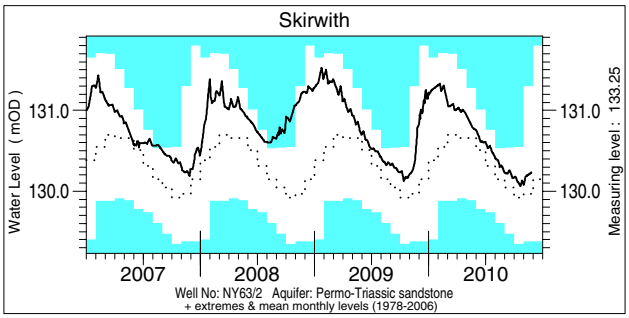


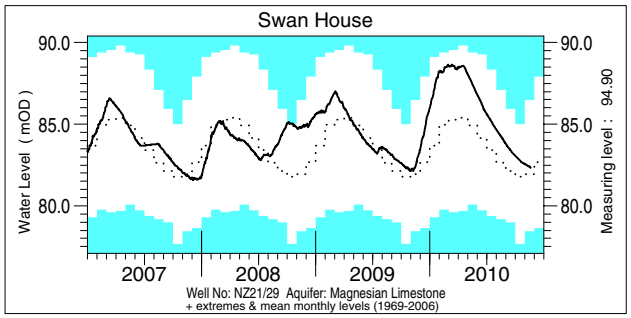
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

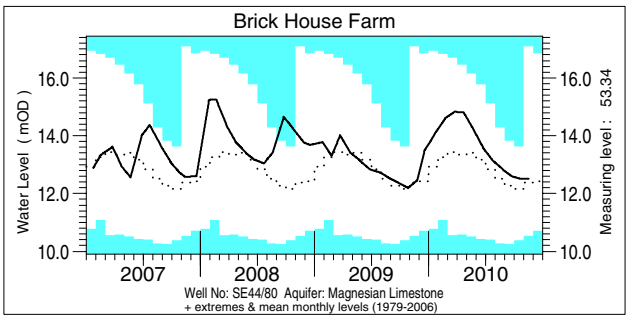
Groundwater . . . Groundwater

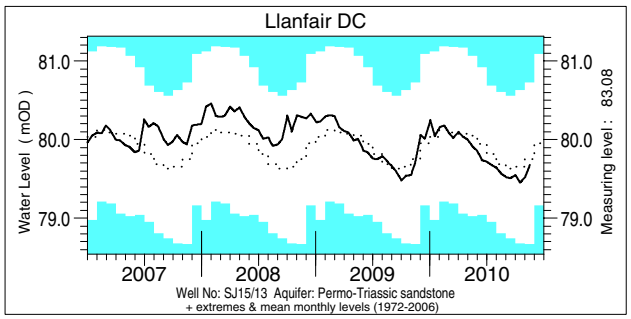


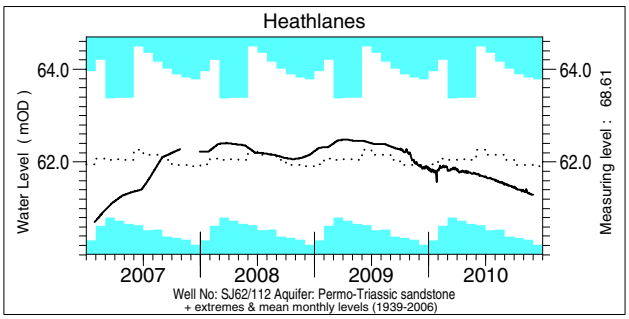


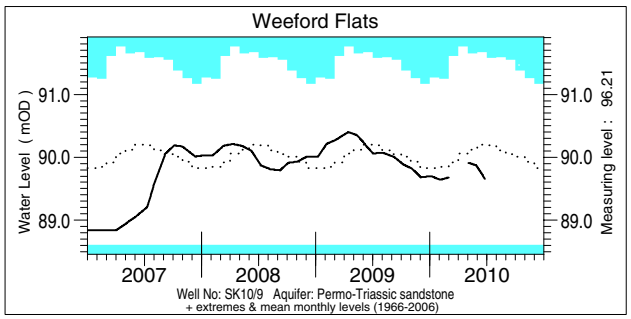


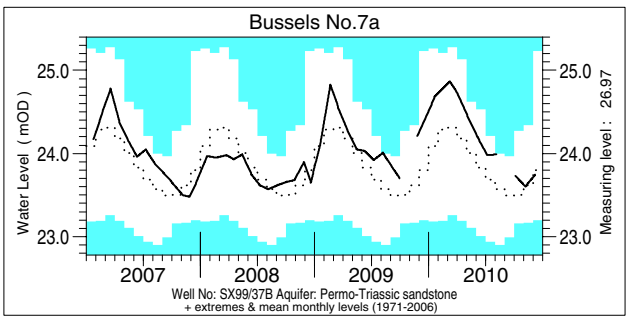


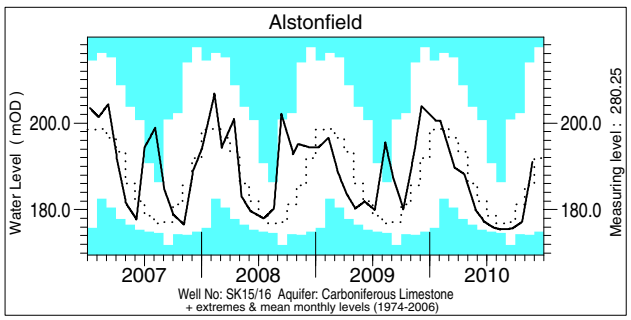






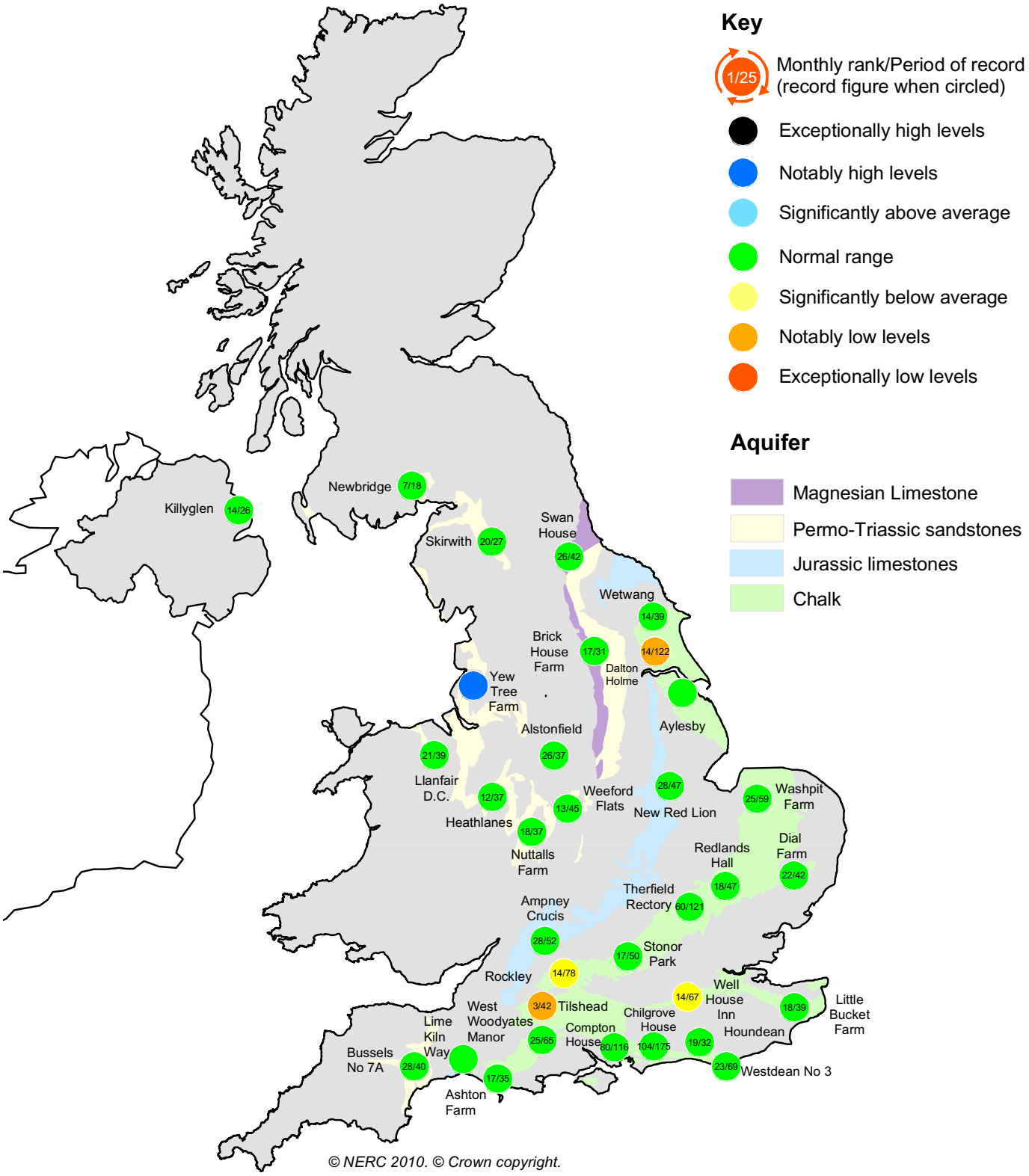






Groundwater levels November / December 2010

Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.
Dalton Holme	12.42	10/11	14.81	Chilgrove House	45.30	30/11	46.46	Brick House Farm	12.52	16/11	12.33
Washpit Farm	43.13	01/12	43.34	Killyglen (NI)	115.56	30/11	115.93	Llanfair DC	79.68	15/11	79.69
Stonor Park	70.48	24/11	72.28	New Red Lion	12.80	30/11	12.26	Heathlanes	61.29	30/11	61.90
Dial Farm	25.48	30/11	25.43	Ampney Crucis	101.41	30/11	101.22	Weeford Flats	89.25	30/11	89.70
Rockley	129.37	30/11	131.65	Newbridge	9.95	01/12	10.15	Bussels No.7a	23.75	07/12	23.65
Well House Inn	89.39	30/11	92.93	Skirwith	130.23	25/11	130.07	Alstonfield	191.05	24/11	186.97
West Woodyates	73.74	30/11	80.80	Swan House	82.34	18/11	82.06	*Levels in metres above Ordnance Datum*			



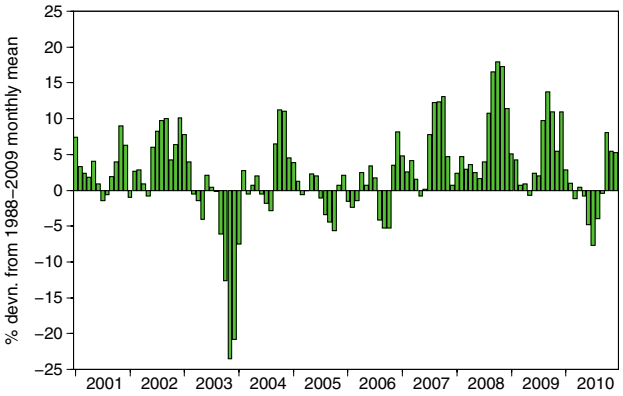
Groundwater levels - November 2010

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.

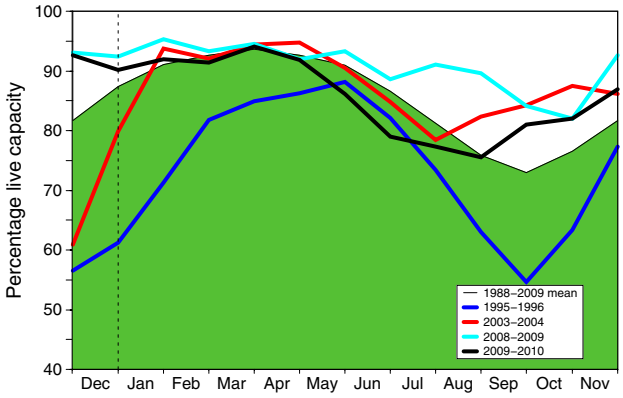
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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)	2010 Oct	Nov	Dec	Dec Anom.	Min Dec	Year* of min	2009 Dec	Diff 10-09
North West	N Command Zone	•	124929	69	70	**83**	6	44	1993	99	-16
	Vyrnwy		55146	81	79	**96**	14	33	1995	99	-3
Northumbrian	Teesdale	•	87936	80	86	**90**	10	39	1995	98	-8
	Kielder		(199175)	(89)	(89)	**(88)**	4	(55)	2007	(97)	-9
Severn Trent	Clywedog		44922	90	85	**86**	6	43	1995	98	-12
	Derwent Valley	•	39525	63	70	**85**	6	9	1995	100	-15
Yorkshire	Washburn	•	22035	81	75	**89**	16	16	1995	93	-4
	Bradford supply	•	41407	72	70	**92**	11	20	1995	100	-8
Anglian	Grafham		(55490)	(92)	(95)	**(95)**	13	(47)	1997	(84)	11
	Rutland		(116580)	(75)	(75)	**(75)**	-4	(57)	1995	(70)	5
Thames	London	•	202828	87	89	**89**	7	52	1990	94	-5
	Farmoor	•	13822	97	99	**87**	-3	52	1990	81	6
Southern	Bewl		28170	55	48	**51**	-13	34	1990	54	-3
	Ardingly		4685	71	68	**75**	0	23	2003	72	3
Wessex	Clatworthy		5364	39	36	**60**	-18	16	2003	100	-40
	Bristol WW	•	(38666)	(54)	(50)	**(54)**	-14	(27)	1990	(80)	-26
South West	Colliford		28540	74	75	**79**	6	42	1995	100	-21
	Roadford		34500	68	67	**72**	-2	19	1995	98	-26
	Wimbleball		21320	52	51	**62**	-13	34	1995	100	-38
	Stithians		4967	52	51	**64**	-1	29	2001	91	-27
Welsh	Celyn and Brenig	•	131155	91	94	**97**	10	50	1995	95	2
	Brianne		62140	95	97	**92**	-4	72	1995	100	-8
	Big Five	•	69762	91	92	**100**	19	49	1990	91	9
	Elan Valley	•	99106	81	84	**99**	5	47	1995	100	-1
Scotland(E)	Edinburgh/Mid Lothian	•	97639	77	79	**90**	5	45	2003	100	-10
	East Lothian	•	10206	69	98	**100**	13	38	2003	99	1
Scotland(W)	Loch Katrine	•	111363	63	93	**90**	0	65	2007	100	-10
	Daer		22412	88	99	**99**	2	73	2003	98	1
	Loch Thom	•	11840	79	95	**96**	3	72	2003	96	0
Northern Ireland	Total+	•	56920	91	87	**92**	8	59	2003	99	-7
	Silent Valley	•	20634	93	89	**93**	16	43	2001	99	-6

() 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 1988-2009 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)[#] is undertaken jointly by the Centre for Ecology & Hydrology (CEH) 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) 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 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.
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.

[#] Instigated in 1988

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The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged; the November Summary, in particular, stands as a testament to the assistance provided by many hydrometric personnel working in exceptionally challenging circumstances.

Enquiries

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Selected text and maps are available on the WWW at
http://www.ceh.ac.uk/data/nrfa/index.html
Navigate via National Hydrological Monitoring Programme.

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