Hydrological Summary

for the United Kingdom

February 2012

General

February was a further month when synoptic patterns greatly restricted the passage of Atlantic frontal systems across most of southern and eastern Britain. Correspondingly, drought conditions intensified at a critical time in relation to the water resources outlook. Across Wales, northern Britain and Northern Ireland stocks in major reservoirs are generally within 10% of capacity; this is true also of the major pumped storage impoundments in the Thames basin. By contrast, stocks are below average in parts of the South West, East Anglia and, most notably the South East where Ardingly and Bewl Water reported their lowest early-March stocks in a series from 1988. Soils for the late winter were the driest on record in some central and eastern areas. This is a continuing problem for the farming community but after two successive dry winters the drought is also impacting severely on the environment and water resources. Some wetlands are highly stressed (e.g. Titchwell Marsh in Norfolk), movement restrictions apply on some canals (e.g. the Grand Union) and the failure of springs has contributed to an exceptional contraction in the river network. River flows in much of the drought-affected areas are below those normally expected in the late summer and in some rivers late-winter flows were below the corresponding flows during the extreme drought of 1975/76. The depressed flows are associated with low oxygen levels and limited dilution for sewage effluent, necessitating a number of fish rescues – a contingency normally associated with the late summer and early autumn. Groundwater recharge over the winter has been meagre across many of the major aquifer outcrop areas and February groundwater levels were close to the lowest on record over wide areas. Rainfall in early March was very welcome but in the absence of truly exceptional rainfall, in excess of 150% of average, over the next 6-8 weeks (by which time evaporation demands will be rising rapidly) no early termination to the drought can be expected.

Rainfall

The range of temperatures recorded in February was remarkable (>30°C in some areas). Very cold conditions prevailed during the early part of the month with significant snowfall extending down to south-east England on the 4th. Whilst a few significant storm events occurred in northern Britain (Alston in the Lake District reported 55mm on the 20th and Achnagart in the Scottish Highlands 60mm on the 21st) precipitation in the English lowlands was largely restricted to fog-drip over lengthy sequences of days. At Wallingford, rainfall in the three weeks from the 10th totalled <4mm and many eastern and central areas of England failed to register any significant rain events (>10mm) in the first two months of 2012. February rainfall totals exceeded the monthly average in parts of western Scotland, Northern Ireland and, more locally, the Pennines. By contrast, totals for the greater part of eastern, central and southern Britain fell below 50% of average with less than 10mm being recorded over a significant proportion of East Anglia. After a wet start to the winter, storm frequency declined markedly and the combined January-February rainfall total for 2012 was less than 50% across some southern, eastern and central parts of England. Longer term deficiencies are also exceptional: in parts of central and eastern England above average rainfall has been registered in only two or three months in the last two years and, for much of central England and East Anglia Mar-Feb rainfall has been the lowest on record (in a series from 1910). As significantly, 24-month rainfall totals for central England are similar to those recorded during the extended droughts of the mid-1990s, mid-1970s and early-1930s.

River Flow

Moderate spates occurred around the 22nd in some western catchments but February river flows were seasonally depressed in almost all index catchments. Above average February runoff was largely confined to a few catchments in north-west Britain. In most eastern, central and southern catchments flows were substantially below average, in many cases below those expected in an average August. The rivers Soar, Little Ouse and Great Stour were among a significant minority of index rivers registering new February runoff minima; naturalised flows for the Thames were the lowest since February 1976. Winter (Dec-Feb) runoff totals were also well below average across most of southern Britain particularly in impermeable catchments but in runoff terms the drought's impact is most starkly evident in accumulations over the last 12 months. The March-February runoff accumulations (see page 4) capture both the extreme accentuation in the north-west/south-east runoff gradient across the UK and, more pertinently, the exceptionally depressed nature of the river flows. For many catchments, runoff has been less than half the average over the last year and, crucially, estimated outflows for the English lowlands as a whole over the last 12 months are the lowest in a series beginning in 1961. With seasonal recoveries barely perceptible, in much of the drought-affected regions, and springs continuing to fail, the contraction in the river network has only a few modern late-winter parallels (early 1997 and early 1976 being examples). Low flow augmentation schemes are in operation both to support river flows and help maintain wetlands. They are expected to be required for extended periods; model analyses strongly suggest that spring rainfall is very unlikely to trigger a healthy recovery in runoff rates.

Groundwater

Groundwater levels are normally at their highest in late winter but this year a combination of sustained recessions in 2011, exceptionally high winter soil moisture deficits in the drought-affected regions, and very meagre late-winter rainfall has ensured an outstandingly weak seasonally recovery. Unusually, soil moisture deficits increased across much of the English lowlands during February and month-end deficits were the highest on record averaged across the Chalk outcrop. As a consequence infiltration was very moderate and in some areas (e.g. near Aldworth in the Berkshire Downs) no winter recharge is evident. Some appreciable groundwater level recoveries, mostly driven by the December rainfall, have occurred in northern and western aquifer outcrops (see, for example, the hydrographs for Ampney Crucis and West Woodyates) but recessions subsequently became re-established. In some index wells (including Stonor Park) there is little or no evidence of any sustained recovery, a situation paralleled, in the last 50 years, only by the winters of 96/97, 91/92, 75/76 and 64/65. Index boreholes registering new minimum mean February levels show a wide distribution and include wells in the Lincolnshire Limestone, Permo-Triassic sandstones and, of most concern, the Chalk – very depressed levels characterise the Chilterns and Berkshire Downs. Estimated overall groundwater stocks for February in the Chalk are lower than in 1976 but marginally higher than in 1997 and 1992. The window of opportunity for further significant recharge is now very narrow.

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.

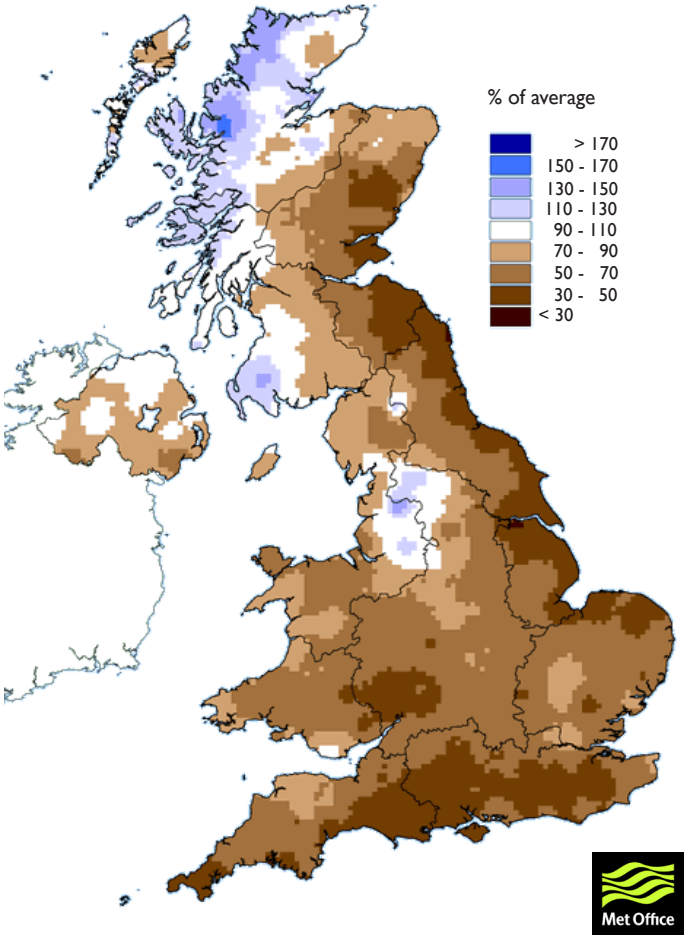
Area	Rainfall	Feb 2012	Jan12 - Feb12	RP	Sep11 - Feb12	RP	Mar11 - Feb12	RP	Dec09 - Feb12	RP
United Kingdom	mm	**56**	165		664		1120		2388	
	%	**67**	82	2-5	103	2-5	103	2-5	96	2-5
England	mm	**27**	90		359		646		1624	
	%	**46**	64	8-12	77	8-12	79	20-35	87	15-25
Scotland	mm	**104**	282		1125		1865		3527	
	%	**88**	100	2-5	126	60-90	130	>100	106	5-10
Wales	mm	**57**	180		745		1189		2750	
	%	**52**	69	5-10	88	2-5	87	5-10	87	15-20
Northern Ireland	mm	**63**	178		795		1239		2567	
	%	**73**	86	2-5	124	>100	112	8-12	101	2-5
England & Wales	mm	**31**	102		413		721		1779	
	%	**47**	65	5-10	80	5-10	81	15-25	87	15-25
North West	mm	**62**	184		749		1257		2635	
	%	**72**	89	2-5	108	2-5	107	2-5	98	2-5
Northumbria	mm	**29**	85		376		784		1928	
	%	**50**	60	10-20	83	5-10	94	2-5	102	2-5
Midlands	mm	**24**	82		300		521		1347	
	%	**44**	64	5-10	72	15-20	69	>100	78	>100
Yorkshire	mm	**27**	101		377		669		1657	
	%	**47**	73	5-10	83	5-10	82	10-20	89	10-15
Anglian	mm	**13**	51		187		389		1150	
	%	**35**	56	10-20	59	60-90	65	>100	85	15-20
Thames	mm	**21**	66		248		490		1320	
	%	**44**	57	8-12	64	15-25	70	35-50	83	20-30
Southern	mm	**18**	68		296		543		1570	
	%	**34**	50	10-15	63	15-25	70	50-80	88	8-12
Wessex	mm	**24**	82		358		654		1606	
	%	**36**	51	10-15	70	10-15	75	20-35	81	60-90
South West	mm	**41**	144		602		938		2296	
	%	**39**	58	5-10	80	5-10	78	15-25	82	40-70
Welsh	mm	**54**	169		708		1134		2640	
	%	**52**	67	5-10	87	2-5	86	8-12	86	15-25
Highland	mm	**158**	414		1466		2322		4111	
	%	**107**	119	2-5	135	70-100	135	>100	103	2-5
North East	mm	**37**	126		508		1080		2483	
	%	**56**	77	5-10	93	2-5	114	2-5	115	5-10
Tay	mm	**50**	175		861		1587		3160	
	%	**47**	66	5-10	110	2-5	125	40-60	107	2-5
Forth	mm	**46**	154		739		1385		2829	
	%	**50**	71	2-5	109	5-10	122	25-40	109	5-10
Tweed	mm	**34**	101		548		1112		2435	
	%	**49**	59	10-15	101	2-5	117	5-10	112	5-10
Solway	mm	**96**	260		1090		1793		3524	
	%	**85**	97	2-5	127	40-60	127	>100	109	8-12
Clyde	mm	**133**	353		1520		2355		4268	
	%	**93**	103	2-5	141	>>100	136	>>100	107	5-10

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

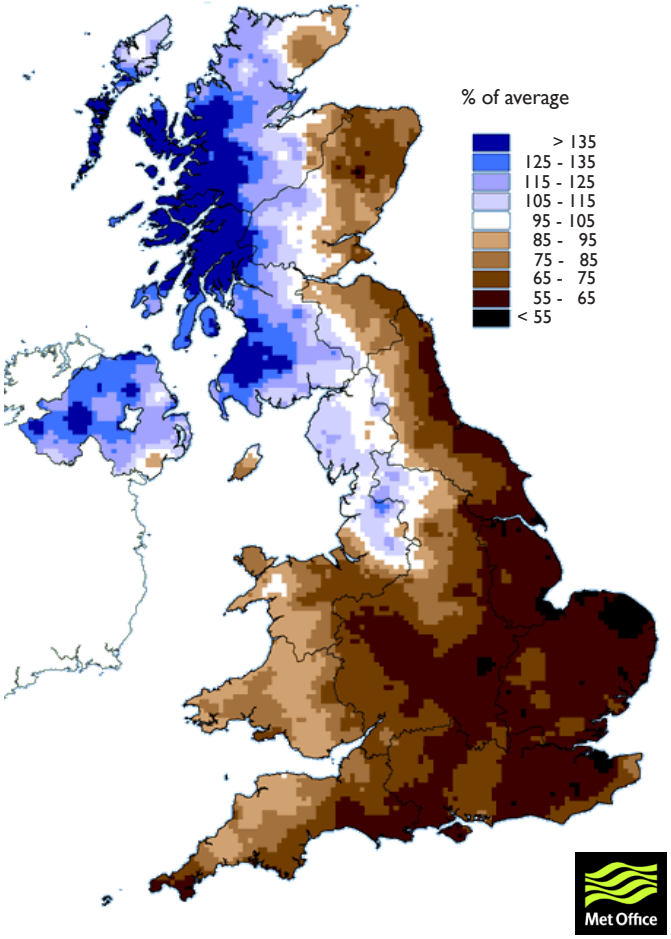
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; 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 September 2011 are provisional.

Rainfall . . . Rainfall . . .

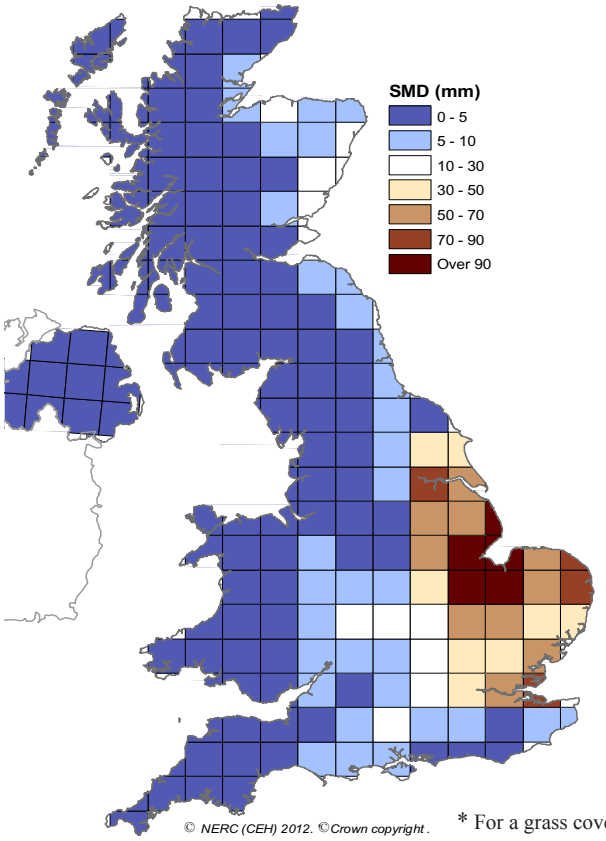
January - February 2012 rainfall as % of 1971-2000 average



September 2011 - February 2012 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits* February 2012



* For a grass cover

Met Office 3-month outlook

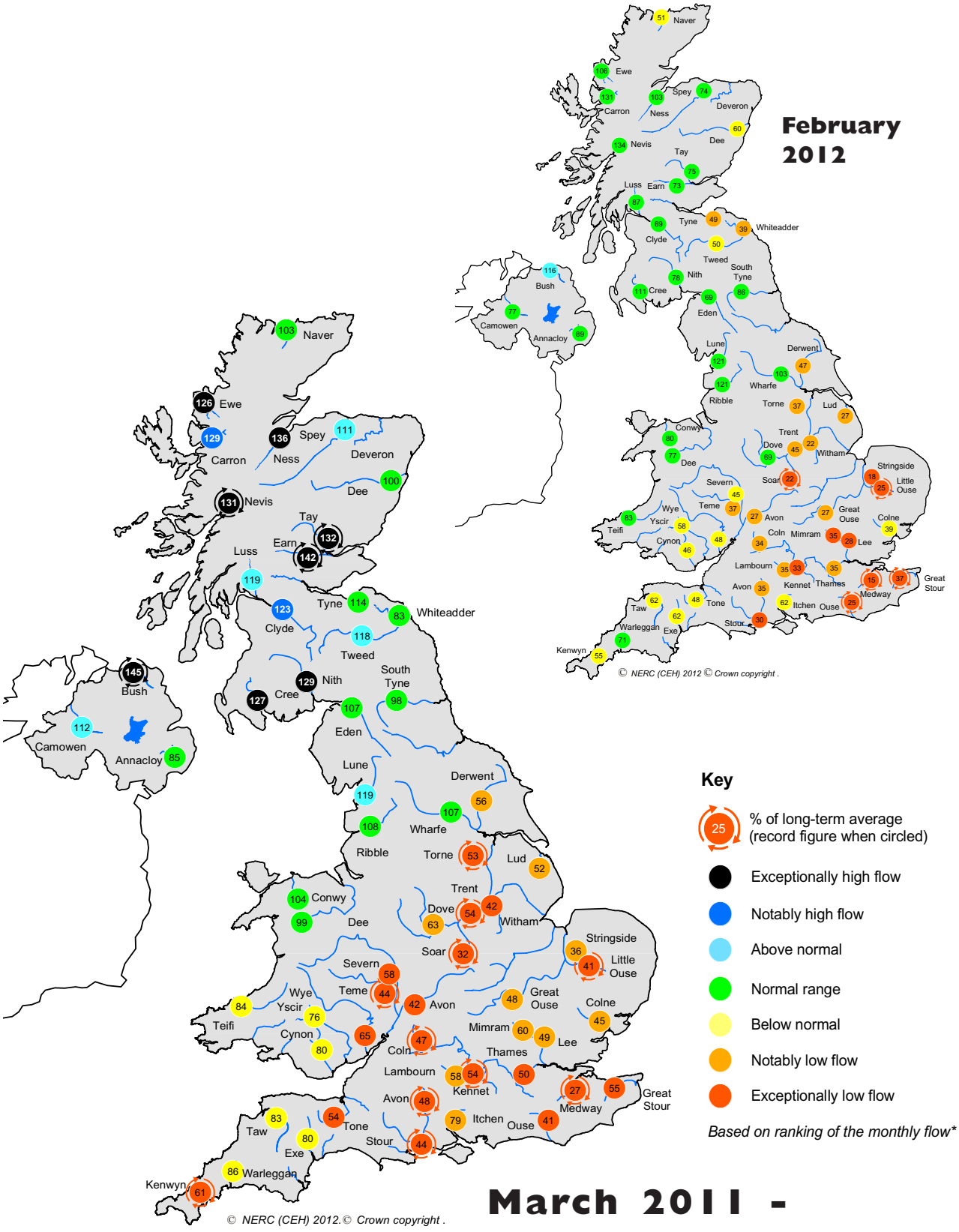
While wet weather is predicted for the shorter term - with the potential for persistent rain in parts of England and Wales - the total rainfall amounts over the remainder of March are likely to be below average.

The probability that UK precipitation for March-April-May will fall into the driest of our five categories is 20-25% whilst the probability that it will fall into the wettest of our five categories is 10-15%.

The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

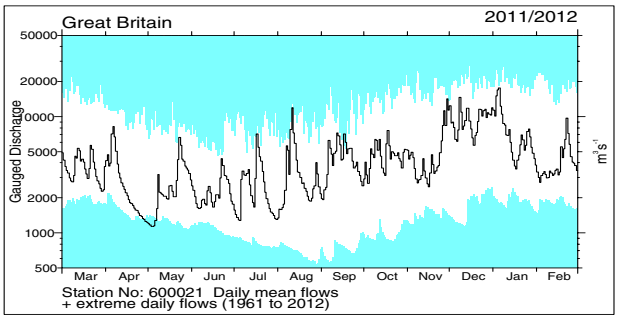
River flow . . . River flow . . .

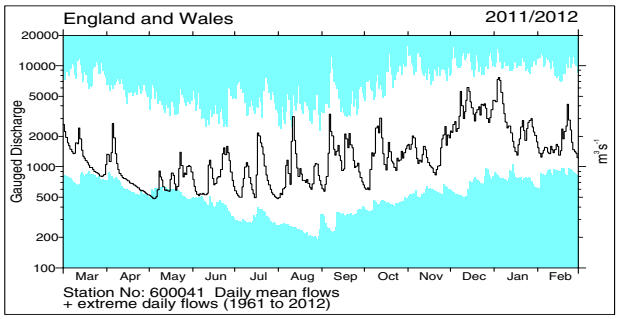


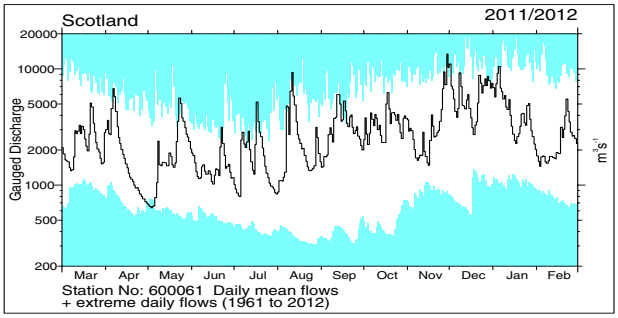
River flows

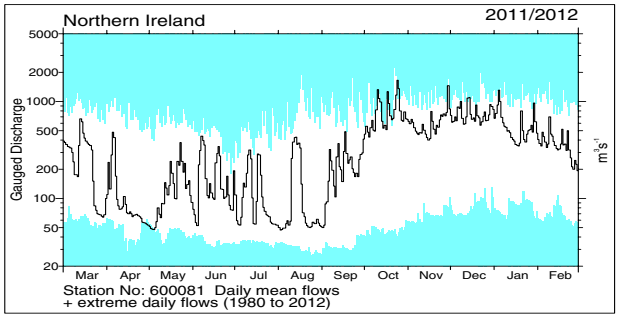
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

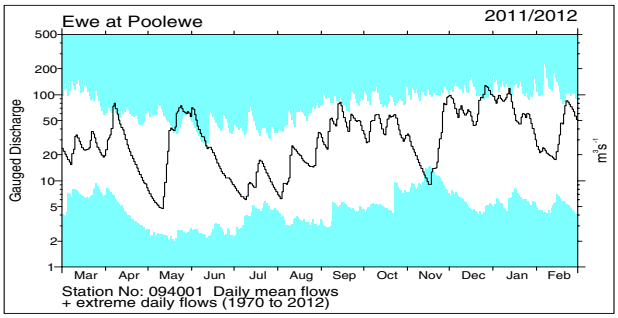
River flow . . . River flow . . .

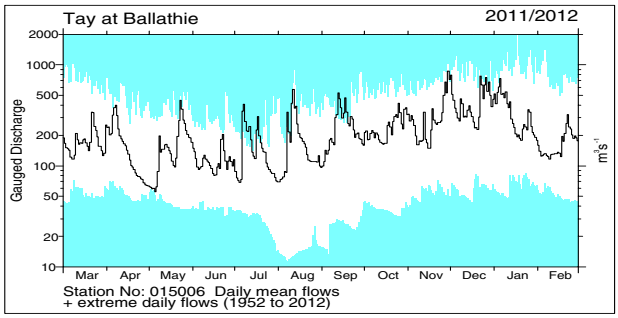


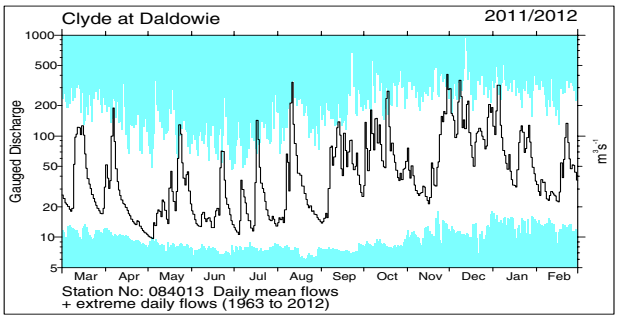


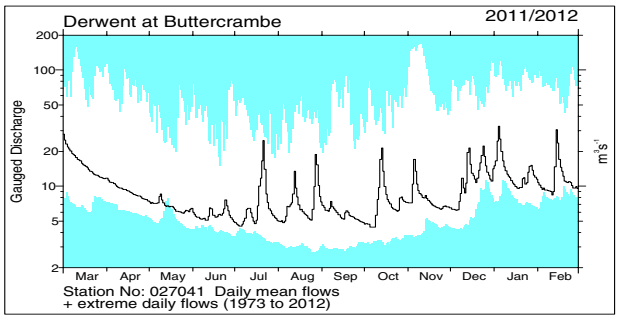


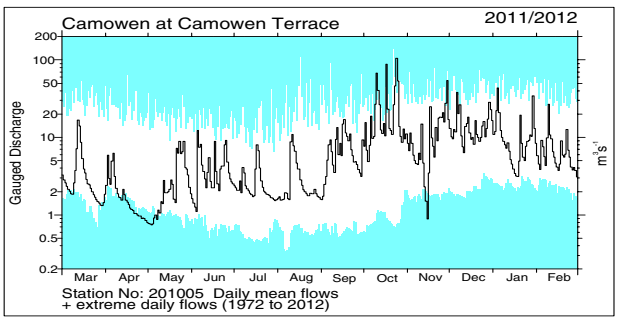


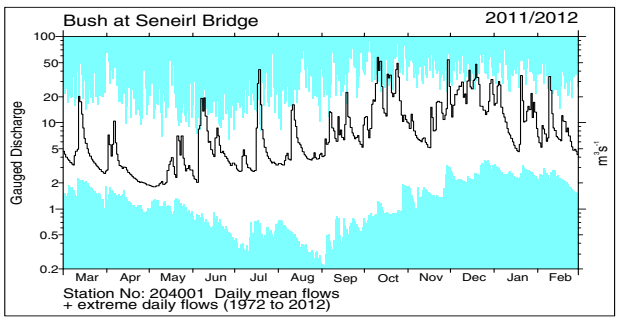








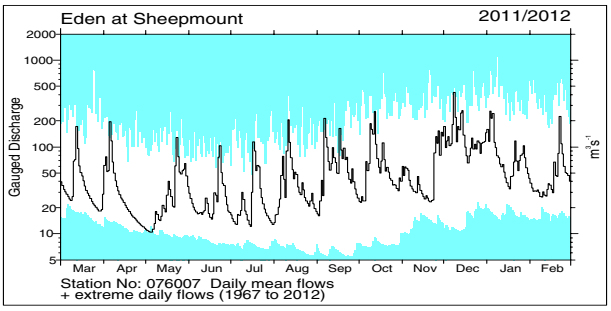


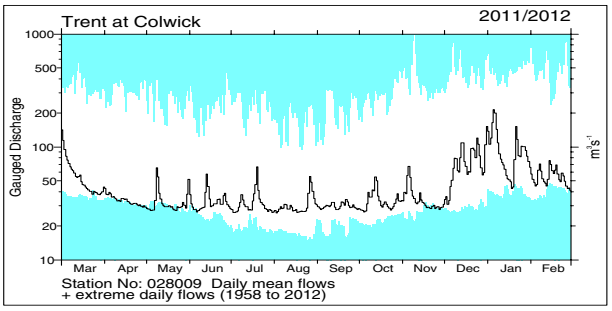


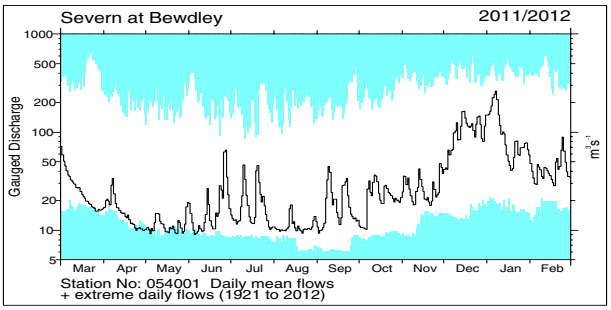
River flow hydrographs

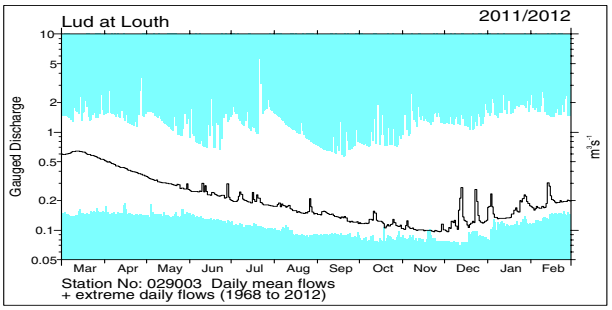
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to March 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

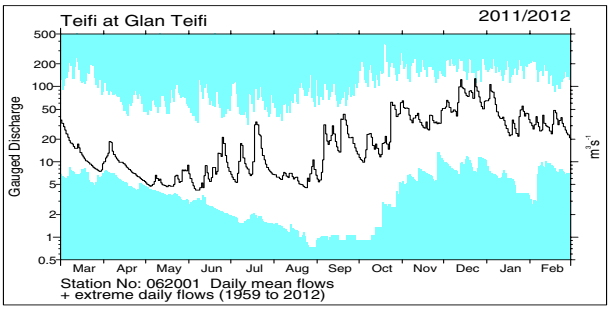
River flow . . . River flow . . .

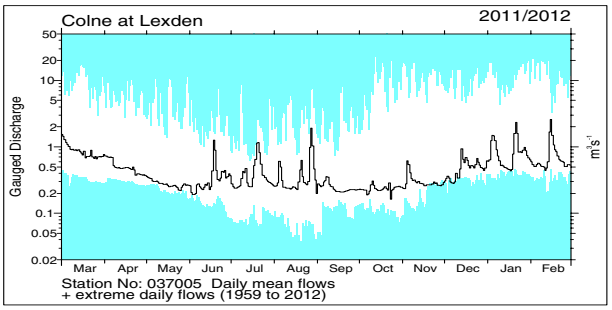


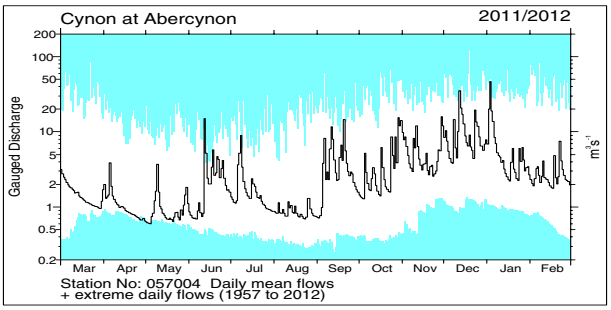


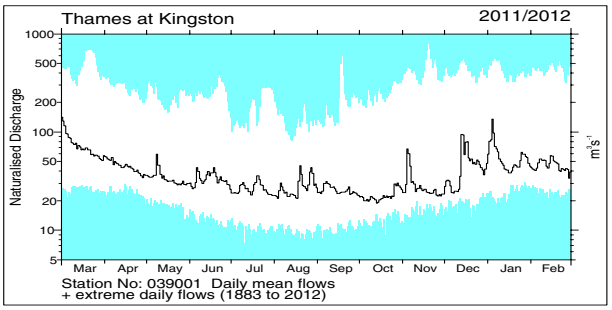


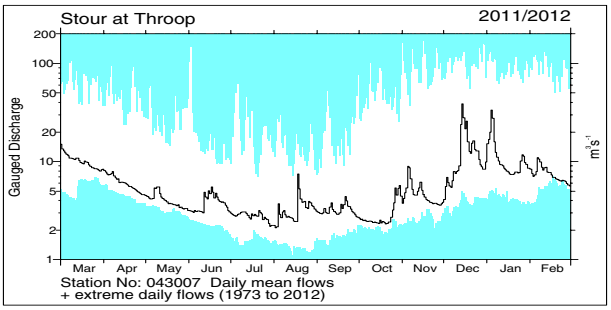


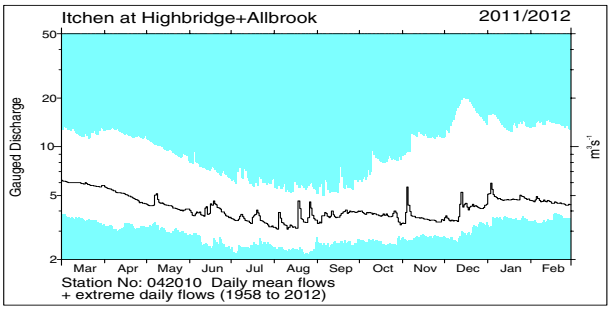












Notable runoff accumulations (a) September 2011 - February 2012, (b) December 2009 - February 2012

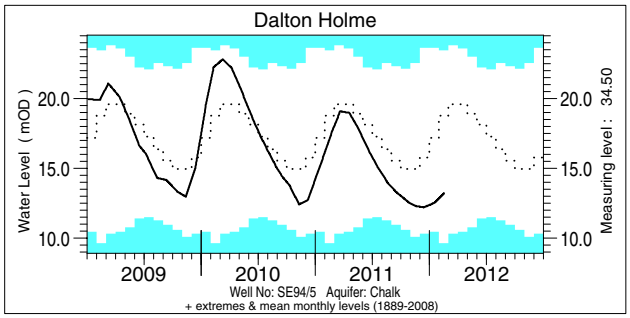
	River	%lta	Rank
a)	Soar	25	1/41
	Little Ouse	27	1/42
	Kennet	45	2/50
	Lambourn	50	1/49
	Coln	33	2/48
	Medway	20	1/50
	Great Stour	43	1/47
	Ouse	31	2/52
	Wallington	29	1/57

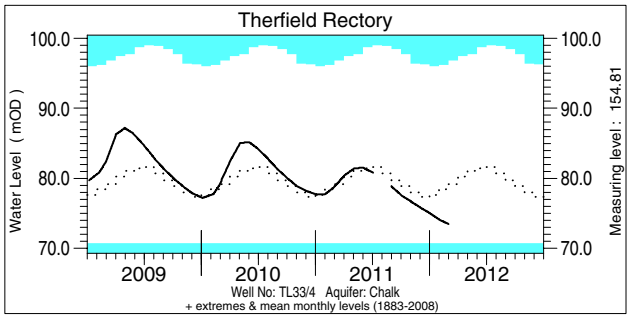
	River	%lta	Rank
a)	Avon (Amesbury)	39	2/47
	Nith	140	54/54
	Cree	138	48/48
	Clyde (Blairston)	145	51/51
	Nevis	145	29/29
	Mourne	151	30/30
	Faughan	145	36/36
	Bush	162	38/38

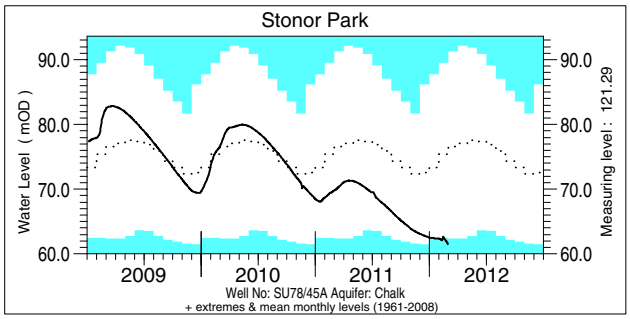
	River	%lta	Rank
b)	Tyne (Spilmersford)	142	43/43
	Kenwyn	75	1/42
	Tone	66	1/49
	Brue	69	1/44
	Severn (Montford)	73	1/57
	Teme	69	1/40
	Usk (Chain Bridge)	70	1/53
	Yscir	73	1/37

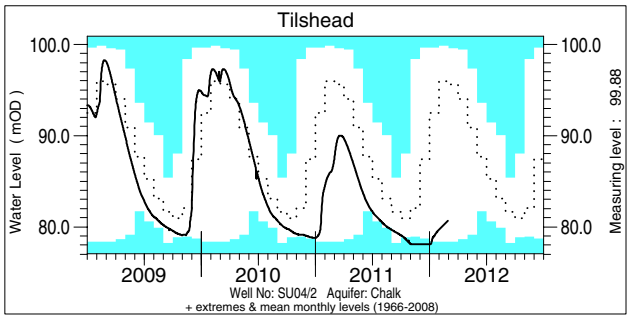
lta = long term average
Rank 1 = lowest on record

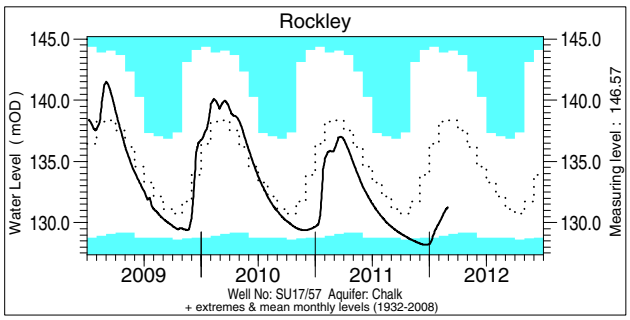
Groundwater . . . Groundwater

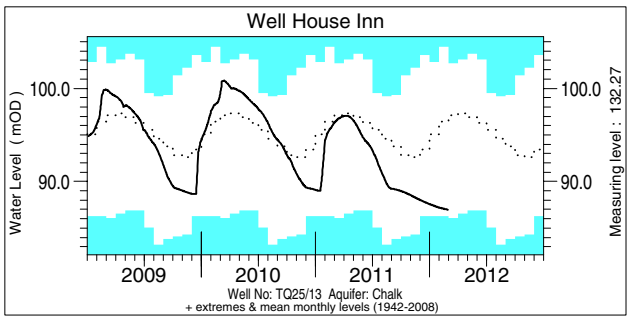


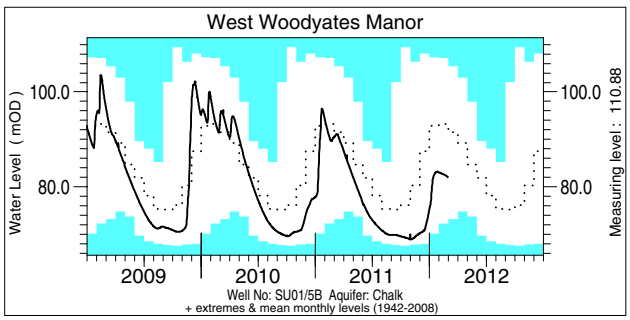


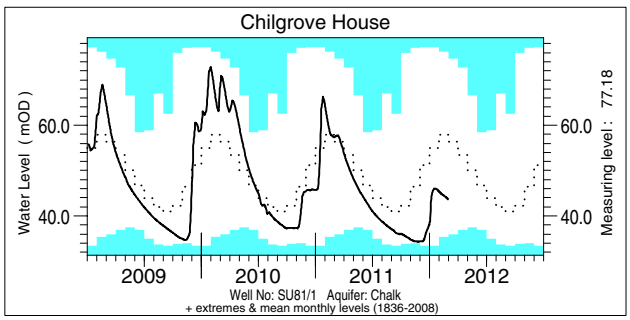


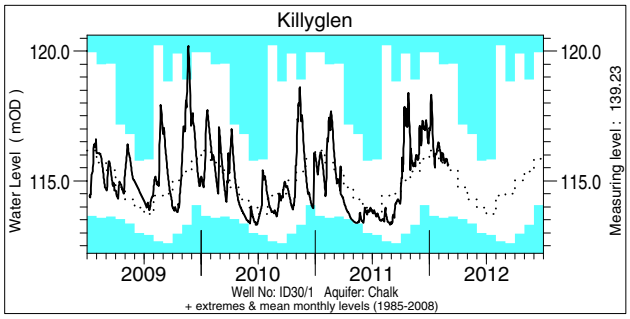


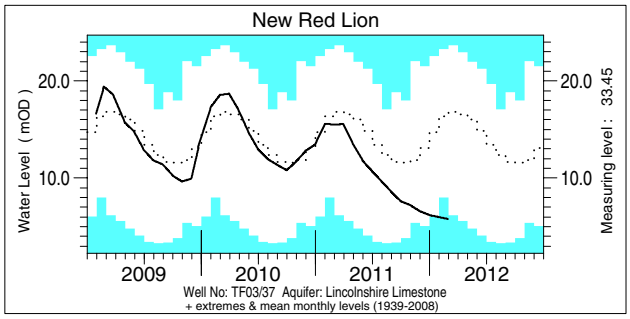






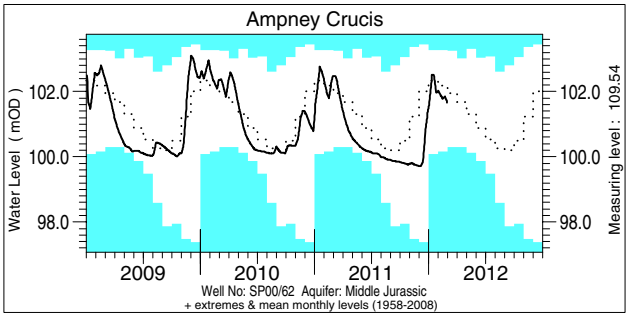


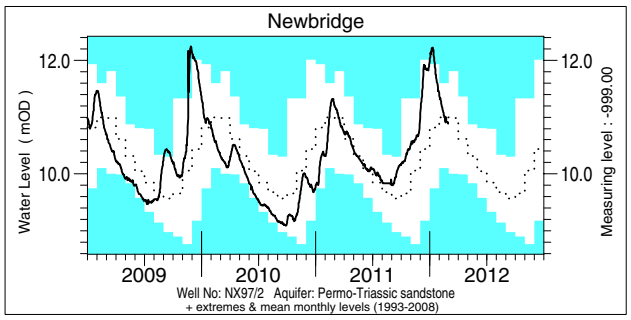


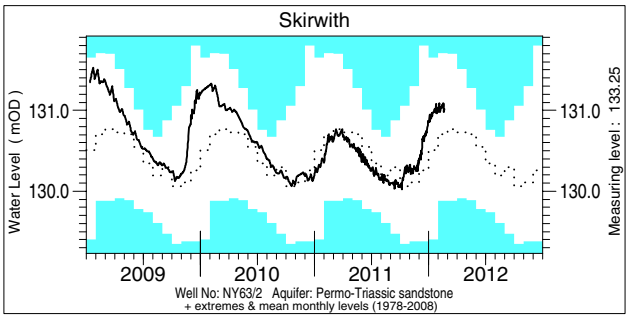


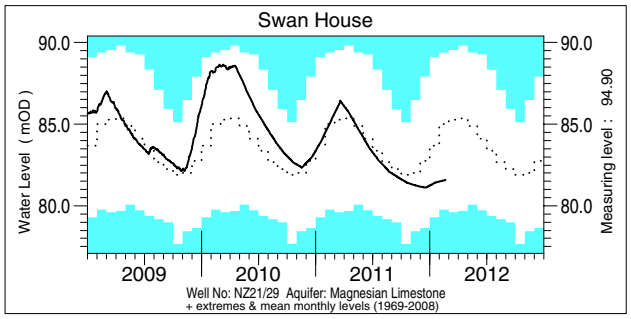
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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 and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation. The latest recorded levels are listed overleaf.

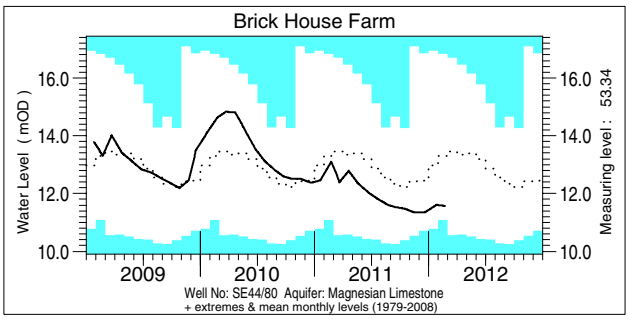
Groundwater . . . Groundwater

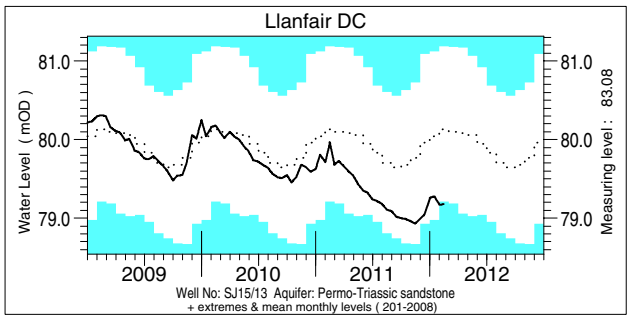


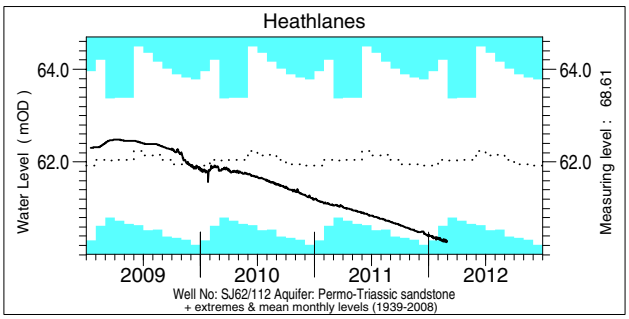


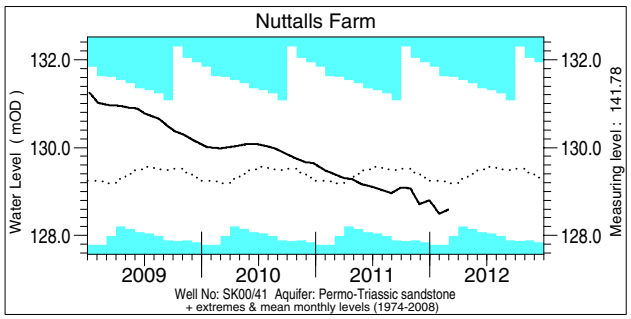


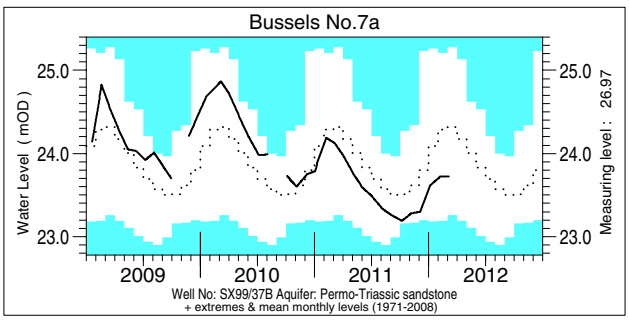


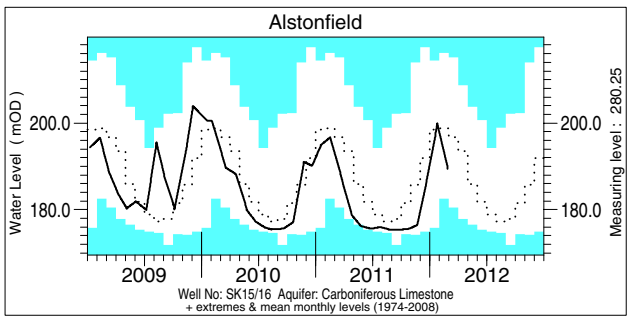










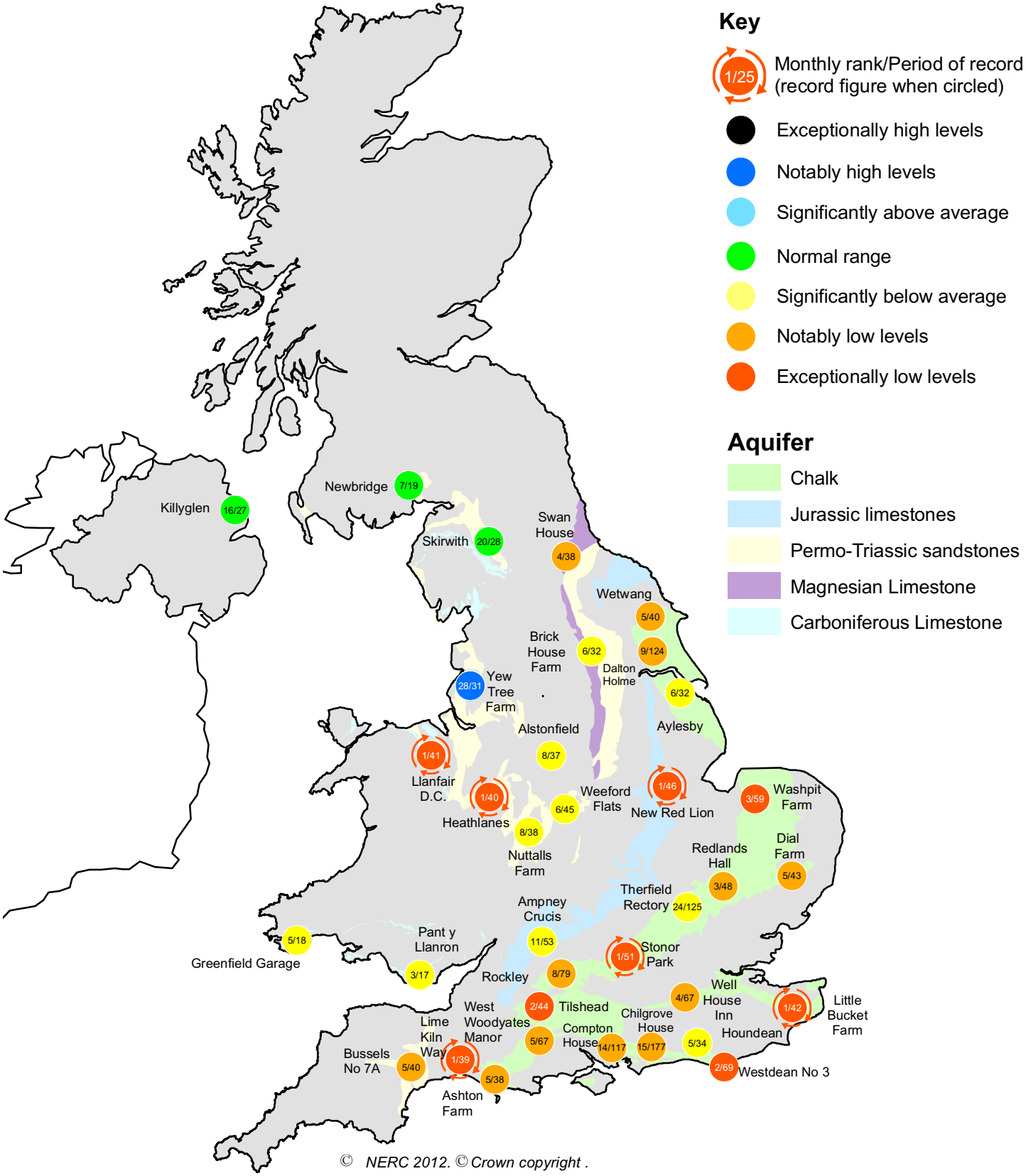


Groundwater levels February / March 2012

Borehole	Level	Date	Feb av.	Borehole	Level	Date	Feb av.	Borehole	Level	Date	Feb av.
Dalton Holme	13.25	17/02	18.72	Chilgrove House	43.69	29/02	57.68	Brick House Farm	11.57	23/02	13.29
Therfield Rectory	73.45	01/03	78.23	Killyglen (NI)	115.58	29/02	115.64	Llanfair DC	79.17	01/02	80.06
Stonor Park	61.52	29/02	75.48	New Red Lion	5.78	29/02	16.50	Heathlanes	60.27	27/02	61.97
Tilshead	80.68	29/02	94.16	Ampney Crucis	101.66	29/02	102.22	Nuttalls Farm	128.59	29/02	129.51
Rockley	131.28	29/02	138.35	Newbridge	10.88	29/02	10.93	Bussels No.7a	23.72	05/03	24.31
Well House Inn	86.97	29/02	96.33	Skirwith	131.02	21/02	130.70	Alstonfield	189.48	27/02	198.82
West Woodyates	82.07	29/02	93.25	Swan House	81.59	21/02	85.00				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - February 2012

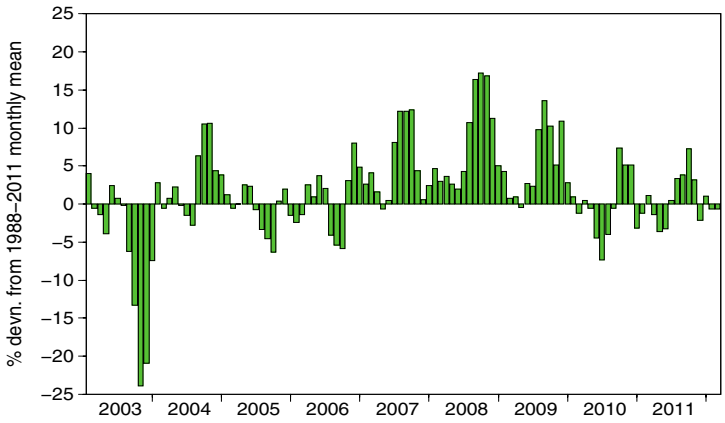
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

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

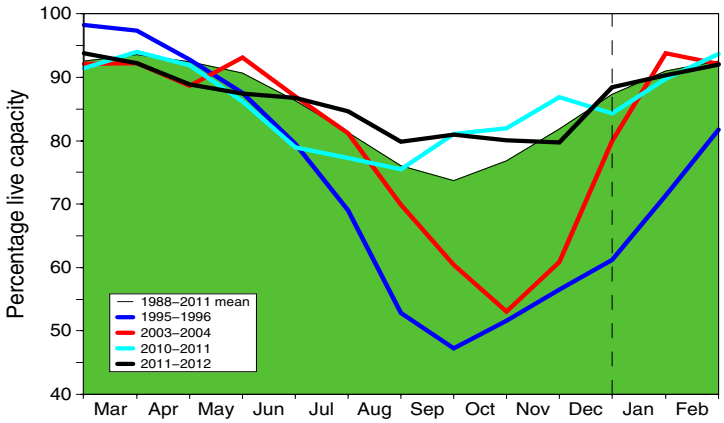
ii. Yew Tree Farm levels are now received quarterly.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2012 Jan	Feb	Mar	Mar Anom.	Min Mar	Year* of min	2011 Mar	Diff 12-11
North West	N Command Zone	•	124929	100	96	**93**	0	78	1996	97	-4
	Vyrnwy		55146	100	92	**96**	2	59	1996	100	-4
Northumbrian	Teesdale	•	87936	100	96	**98**	7	72	1996	93	5
	Kielder		(199175)	95	91	**92**	-1	81	1993	91	1
Severn Trent	Clywedog		44922	86	93	**96**	6	77	1996	94	2
	Derwent Valley	•	39525	100	100	**99**	4	46	1996	100	-1
Yorkshire	Washburn	•	22035	98	93	**97**	5	53	1996	98	-1
	Bradford supply	•	41407	100	100	**99**	4	53	1996	100	-1
Anglian	Grafham		(55490)	84	90	**95**	7	72	1997	84	11
	Rutland		(116580)	65	69	**71**	-18	71	2012	87	-16
Thames	London	•	202828	78	92	**96**	4	83	1988	92	4
	Farmoor	•	13822	99	99	**100**	8	64	1991	76	24
Southern	Bewl		28170	37	43	**40**	-46	40	2012	99	-59
	Ardingly*		4685	30	41	**46**	-52	46	2012	100	-54
Wessex	Clatworthy		5364	82	100	**100**	2	82	1992	97	3
	Bristol WW	•	(38666)	69	76	**79**	-13	65	1992	82	-3
South West	Colliford		28540	63	70	**76**	-9	57	1997	87	-11
	Roadford		34500	72	79	**81**	-3	35	1996	79	2
	Wimbleball		21320	71	88	**94**	-1	72	1996	93	1
	Stithians		4967	70	82	**90**	-3	45	1992	100	-10
Welsh	Celyn and Brenig	•	131155	98	98	**100**	2	69	1996	100	0
	Brianne		62140	100	96	**98**	0	92	2004	98	0
	Big Five	•	69762	99	98	**98**	2	85	1988	100	-2
	Elan Valley	•	99106	100	100	**100**	2	88	1993	100	0
Scotland(E)	Edinburgh/Mid Lothian	•	97639	100	99	**99**	4	73	1999	97	2
	East Lothian	•	10206	100	100	**99**	0	91	1990	100	-1
Scotland(W)	Loch Katrine	•	111363	96	94	**95**	1	76	2010	93	2
	Daer		22412	100	100	**100**	1	94	2004	99	1
	Loch Thom	•	11840	100	100	**99**	1	90	2004	95	4
Northern Ireland	Total+	•	56920	98	96	**98**	8	81	2004	96	2
	Silent Valley	•	20634	96	96	**98**	12	57	2002	99	-1

() 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 1988-2011 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.

*** The monthly record of Ardingly reservoir stocks is under review.**

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.

[#] Instigated in 1988
[*]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.

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Selected text and maps are available on the WWW at
http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html
Navigate via Hydrological Summary for the UK.

03/12