Hydrological Summary

for the United Kingdom

February 2016

General

February was a month of contrasting conditions, beginning wet and mild and ending cold and dry. The UK registered notably above average rainfall and most regions were wetter than average, some substantially so. The unsettled conditions early in the month (including the named storms 'Henry' and 'Imogen') contributed to the second wettest winter for the UK (in a series from 1910) and the second warmest winter in the Central England Temperature series (from 1659). Soils remained saturated, and average river flows were above normal in most of northern and western Britain and in the normal range elsewhere. Average river flows for the winter were the highest on record for a large number of northern and western catchments, as were the outflows from Great Britain (in a series from 1961). Groundwater levels generally remained in the normal range or above, notably so in parts of northern England and along the south coast. The majority of reservoirs remained close to capacity and overall stocks for England & Wales were above average. The dry weather over the latter part of the month has moderated the risk of surface water and groundwater flooding, although with soils saturated and river flows and groundwater levels generally in the normal range or above, many regions of the UK remain sensitive to additional rainfall.

Rainfall

February began mild and unsettled with a west to south-westerly airflow bringing stormy conditions and frontal rainfall. On the 1st/2nd, 'Henry' brought rainfall (95mm fell at Kinlochewe, Highlands) and gale-force winds to the north of the UK. Unsettled conditions persisted during the first week, 58mm of rainfall was recorded in Okehampton on the 6th. 'Imogen' brought heavy rainfall and gale-force winds to the UK on the 8th, causing transport disruption and the loss of power to around 19,000 properties across southern England and Wales. A change in synoptic patterns mid-month to a north-easterly airflow brought colder temperatures and substantial snowfall to Scotland and northern England (e.g. on the 15th). After a frontal system traversed the UK on the 17th (51mm of rainfall was recorded at St Bees Head, Cumbria), high pressure dominated bringing drier conditions and colder temperatures to the majority of the UK. For the UK, February registered 136% of the long-term average rainfall, but there were notable spatial variations. In the North West region, February was the fourth consecutive month in which rainfall exceeded 160% of average. In contrast, below average rainfall was confined to parts of eastern Britain; parts of East Anglia received less than half the average. Winter (December-February) rainfall was above average for almost all of the UK, substantially so for a large swathe of the north and west which received more than twice the average. In the North West and Northumbrian regions, previous records for winter rainfall were exceeded by more than 20%. UK rainfall in winter 2015/2016 ranked second behind 2013/2014, both eclipsing the third wettest winter by a wide margin.

River flows

Following substantial rainfall in late January, flows were high in many rivers entering February. Flood alerts and warnings were issued across Scotland following 'Henry' on the 1st/2nd – a new February peak flow maximum was registered on the Naver (in a series from 1978). Further south, flows increased sharply on the 6th in Wales and south-west England; over 100 flood alerts and warnings were issued, there were reports of flooding in a few properties and a new February peak flow maximum was registered on the Tone (in a series from 1961). Flood warnings were issued again on the 8th/9th during the passage of 'Imogen', causing high flows on some rivers in central and southern England (e.g. the Trent, Blackwater and Stour). The drier conditions across the UK from mid-month heralded steep recessions. Overall, February average river flows were above normal across most of western Britain and a number of rivers registered more than 150% of the average February flow. Flows on the Colne were approximately half the average, although still within the normal range along with much of eastern England. Average flows for the winter (December-February) were the highest on record for many catchments in northern and western Britain, exceeding those set in the winter of 2013/2014 by wide margins in some catchments (e.g. the Scottish Dee, Tweed, Wharfe and Tywi; all in records since 1961). The persistence of high flows can also be traced back to November in some catchments; November-February average flows exceeded previous maxima on the Conwy, Ribble, Eden and Tyne (all in records since 1967).

Groundwater

Groundwater levels remained in the normal range or above except for three of the slower responding sites (Aylesby, Dial Farm and Stonor Park) in the central and eastern Chalk where levels increased. At the four Chalk boreholes where levels were exceptionally high at the end of January, there were substantial decreases. At Compton House, Chilgrove House and Houndean levels fell but remained above normal, whilst at Wetwang levels fell into the normal range. The levels in the Chalk in Dorset also fell, but rose at Tilshead, across most of the North Downs and northwards into Yorkshire (with the exception of Wetwang). Levels also fell in the Carboniferous Limestone of south Wales and the Peak District, the fast responding Magnesian Limestone site at Brick House Farm (where a record high level had been reached at the end of January) and also slightly in the Jurassic limestones. In the Permo-Triassic sandstones, responses were mixed with decreasing levels at Newbridge, Skirwith and Nuttalls Farm. Conversely, levels increased at Llanfair DC and Heathlanes, where levels remained in the normal range, and at Bussells No.7a where they were above normal for February.

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

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

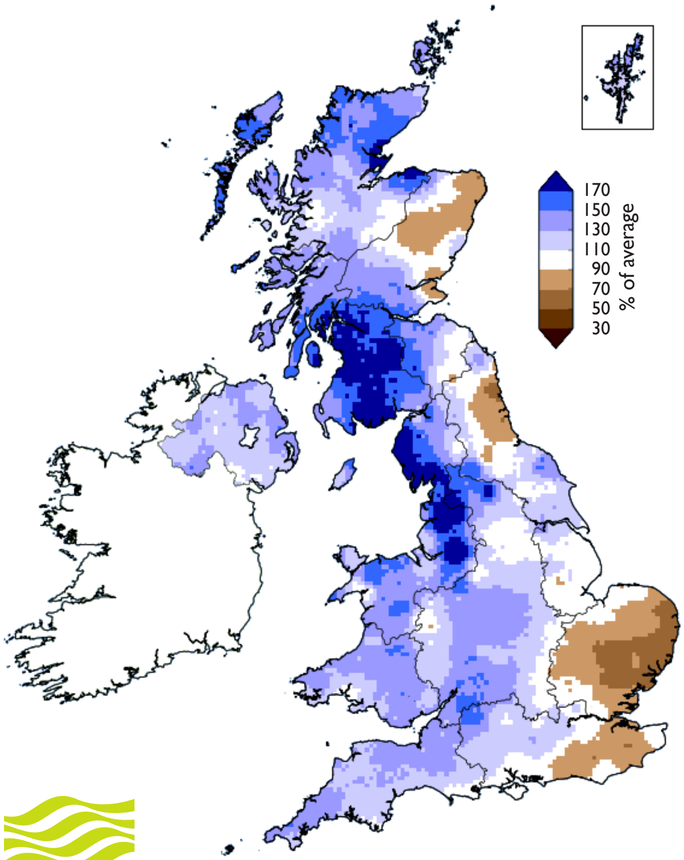
Area	Rainfall	Feb 2016	Dec15 – Feb16	RP	Aug15 – Feb16	RP	May15 – Feb16	RP	Jan15 – Feb16	RP
United	mm	**114**	529		832		1104		1355	
Kingdom	%	**136**	166	>>100	130	80-120	129	80-120	126	>100
England	mm	**74**	340		574		788		942	
	%	**125**	149	20-30	126	5-10	124	5-10	116	5-10
Scotland	mm	**171**	780		1164		1523		1926	
	%	**145**	177	>>100	131	>100	132	>100	134	>>100
Wales	mm	**155**	778		1197		1503		1770	
	%	**142**	185	>>100	144	>100	138	70-100	130	70-100
Northern	mm	**109**	508		810		1087		1373	
Ireland	%	**126**	159	>>100	127	>100	124	50-80	124	>>100
England &	mm	**85**	401		660		887		1056	
Wales	%	**129**	157	40-60	130	10-20	127	10-20	119	8-12
North West	mm	**142**	692		1078		1350		1652	
	%	**165**	206	>>100	158	>>100	144	>100	142	>>100
Northumbrian	mm	**62**	472		747		976		1166	
	%	**106**	209	>>100	167	>>100	153	>100	142	>100
Severn-Trent	mm	**73**	287		484		665		821	
	%	**134**	139	10-15	118	5-10	114	2-5	109	2-5
Yorkshire	mm	**75**	389		679		896		1076	
	%	**130**	172	80-120	153	40-60	143	30-50	134	50-80
Anglian	mm	**33**	159		322		491		590	
	%	**89**	109	2-5	104	2-5	106	2-5	99	2-5
Thames	mm	**55**	231		414		588		693	
	%	**118**	125	2-5	109	2-5	110	2-5	100	2-5
Southern	mm	**51**	289		508		720		823	
	%	**95**	131	5-10	111	2-5	118	2-5	107	2-5
Wessex	mm	**89**	327		545		782		908	
	%	**132**	127	5-10	108	2-5	116	2-5	106	2-5
South West	mm	**137**	497		797		1132		1312	
	%	**131**	127	5-10	108	2-5	118	5-10	110	2-5
Welsh	mm	**147**	740		1136		1435		1690	
	%	**141**	184	>100	143	80-120	137	60-90	129	50-80
Highland	mm	**208**	846		1243		1624		2140	
	%	**141**	156	50-80	114	5-10	117	8-12	124	30-50
North East	mm	**73**	523		757		1047		1265	
	%	**110**	207	>>100	141	40-60	141	40-60	134	40-60
Tay	mm	**134**	802		1133		1485		1807	
	%	**126**	200	>>100	146	>>100	148	>>100	143	>>100
Forth	mm	**138**	672		1022		1331		1631	
	%	**152**	198	>>100	151	>>100	148	>>100	145	>>100
Tweed	mm	**102**	639		943		1197		1435	
	%	**144**	234	>>100	175	>>100	162	>>100	152	>>100
Solway	mm	**188**	901		1360		1710		2079	
	%	**167**	213	>>100	161	>>100	153	>>100	149	>>100
Clyde	mm	**228**	935		1455		1895		2393	
	%	**160**	175	>>100	135	>100	135	>100	138	>>100

% = 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. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals from June 2015 (inclusive) are provisional.

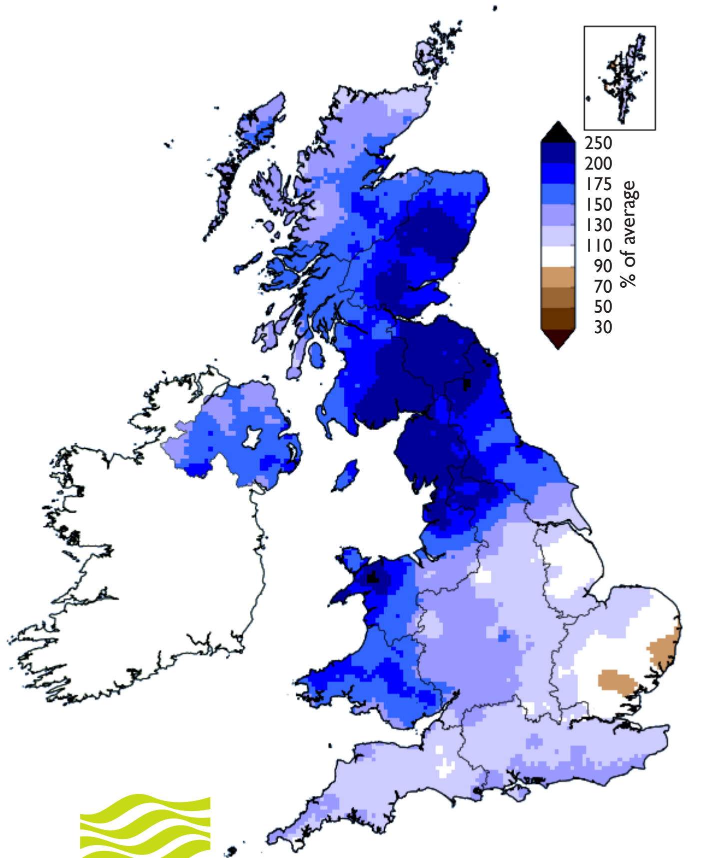
Rainfall . . . Rainfall . . .

February 2016 rainfall as % of 1971-2000 average



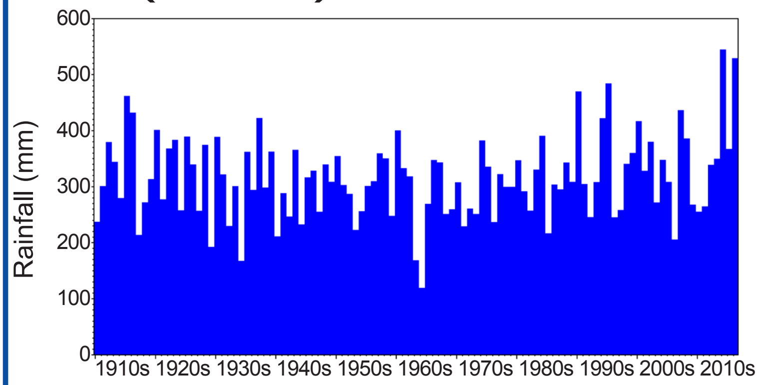
Met Office

December 2015 - February 2016 rainfall as % of 1971-2000 average

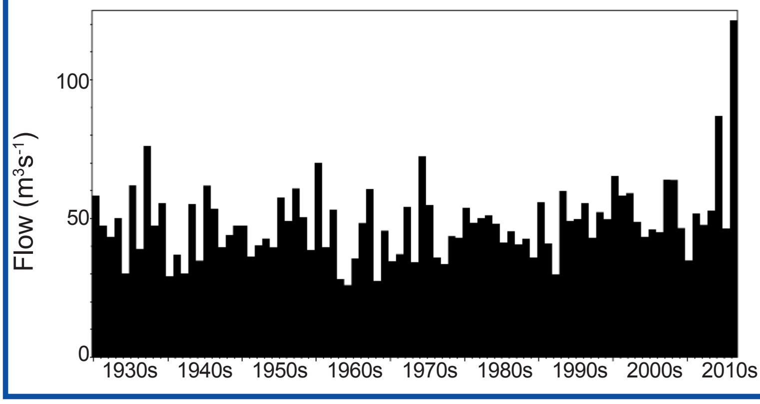


Met Office

Winter (Dec - Feb) rainfall for the UK



Winter (Dec - Feb) average flows for the Scottish Dee



Met Office

Met Office 3-month outlook Updated: February 2016

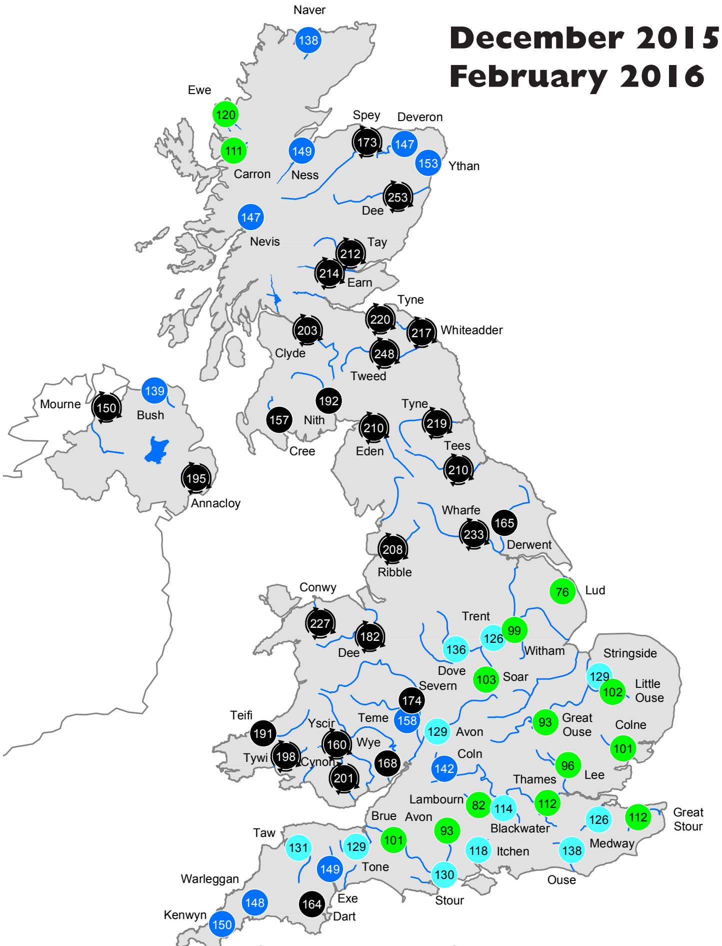
Predictions for UK-mean precipitation for the 3-month period (March-April-May) are that above-average precipitation is slightly more probable than below-average. Overall, the probability that the UK-average precipitation for March-April-May will fall into the driest of our five categories is 20% and the probability that it will fall into the wettest of our five categories is around 25% (the 1981-2010 probability for each of these categories is 20%).

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 ...

December 2015 - February 2016



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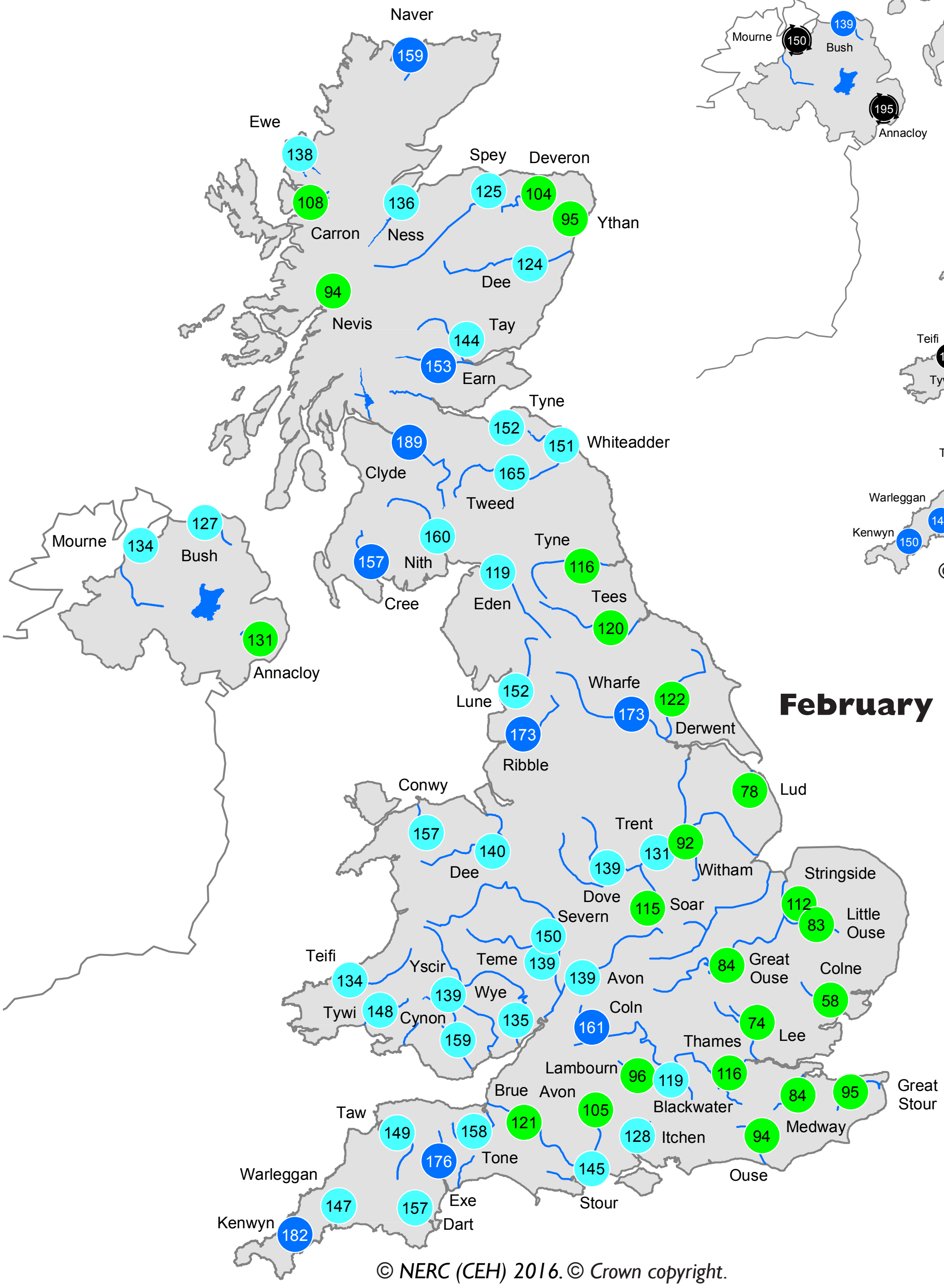
February 2016



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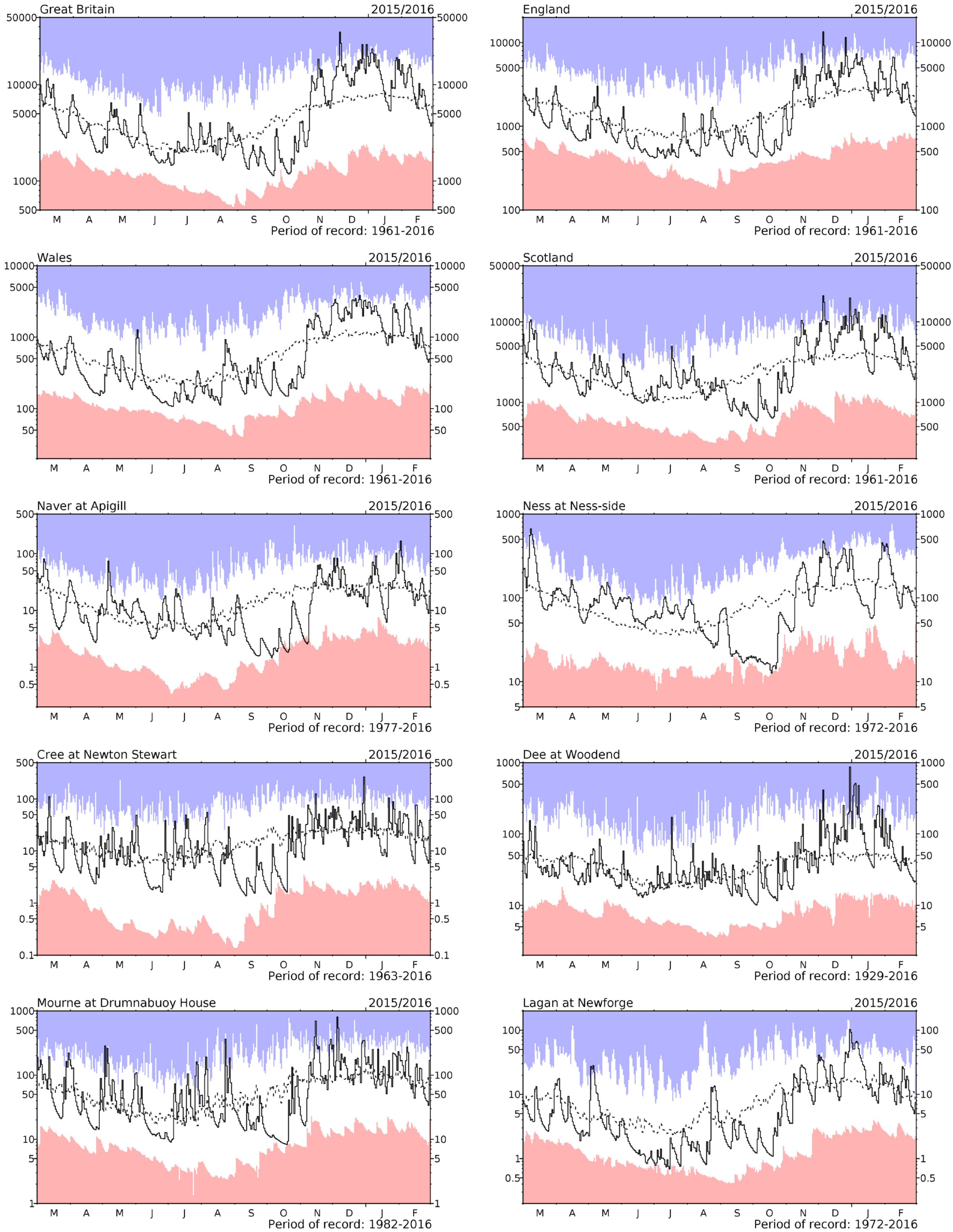
Key

- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on ranking of the monthly flow**

River flows

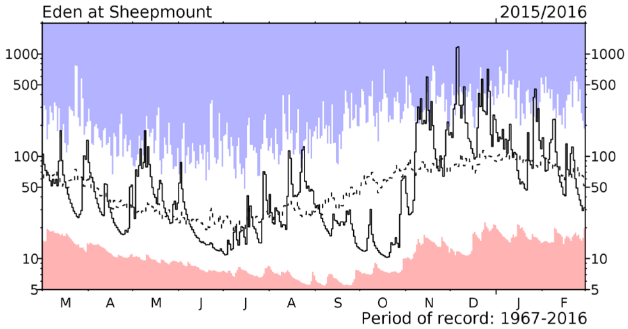
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

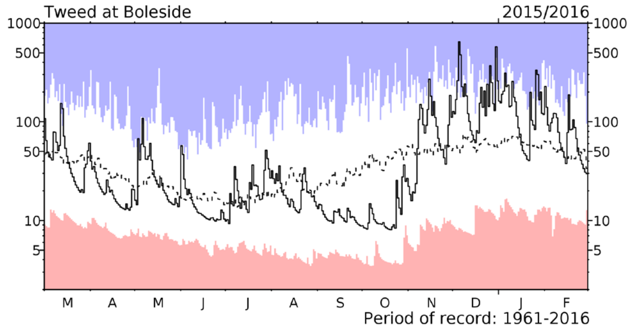


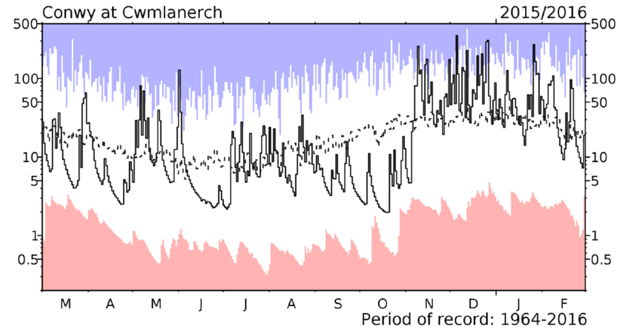
River flow hydrographs

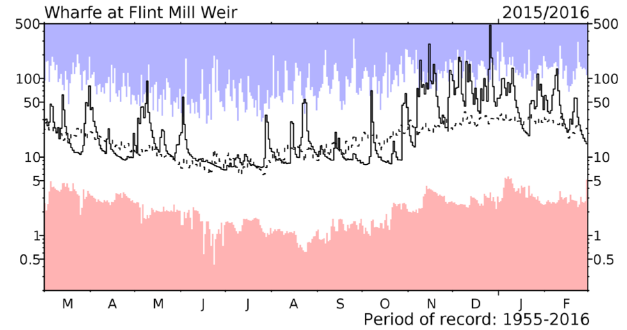
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to March 2015 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

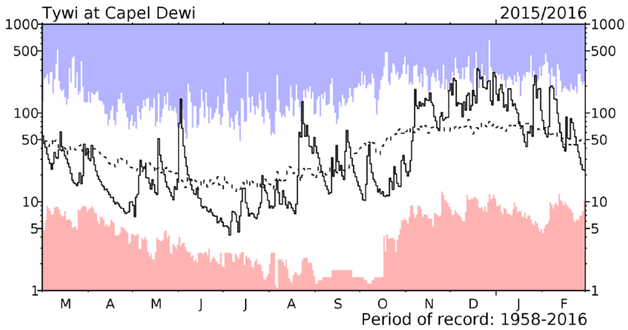
River flow . . . River flow . . .

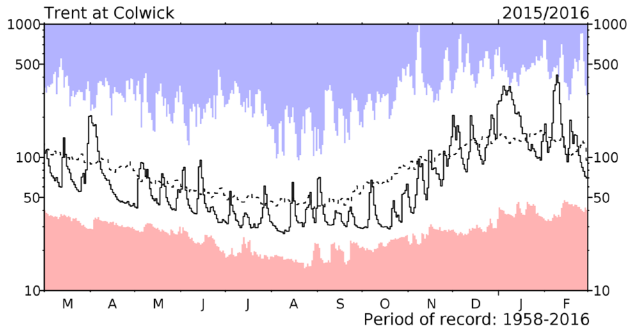


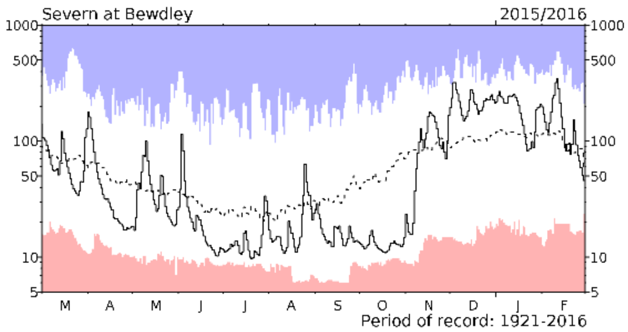


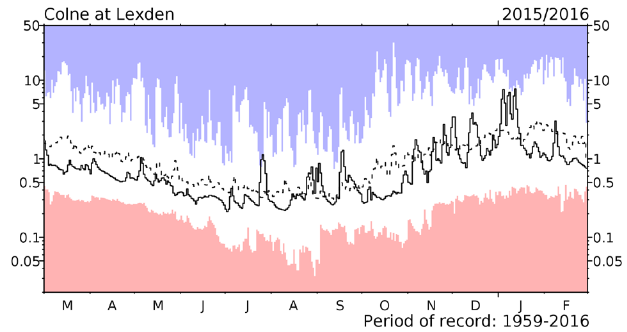


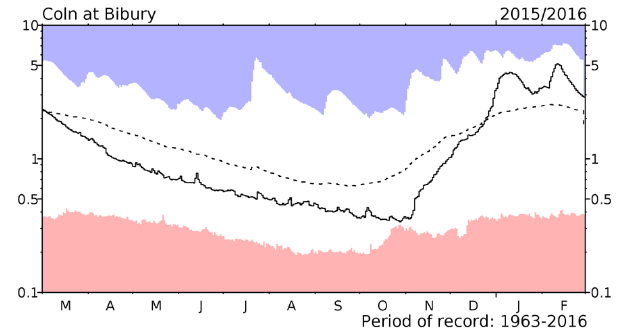


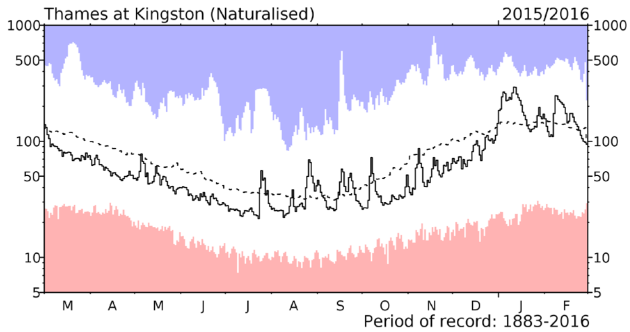


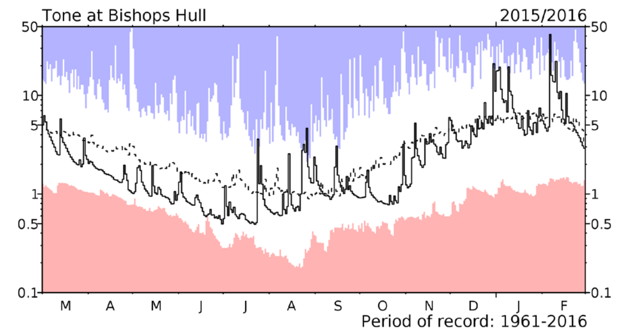


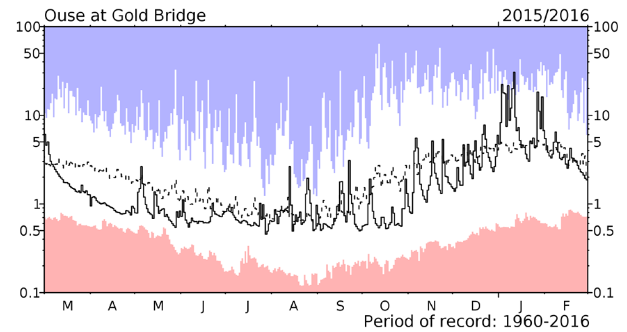




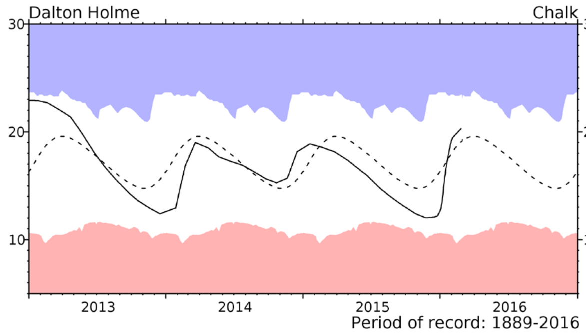


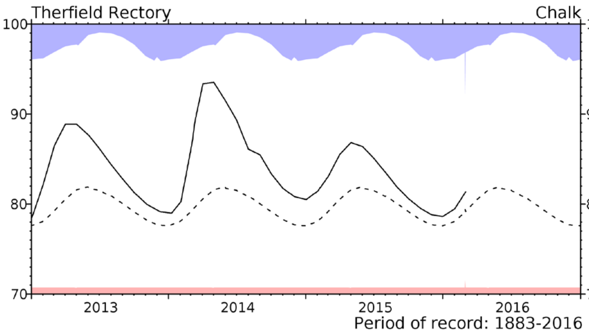


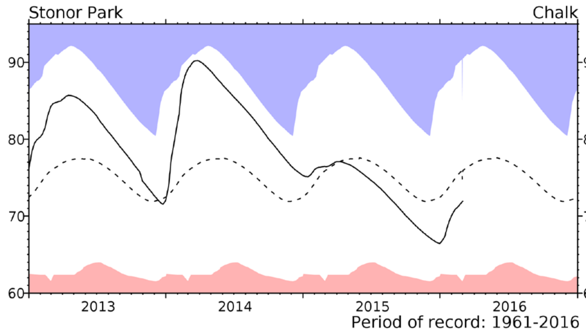


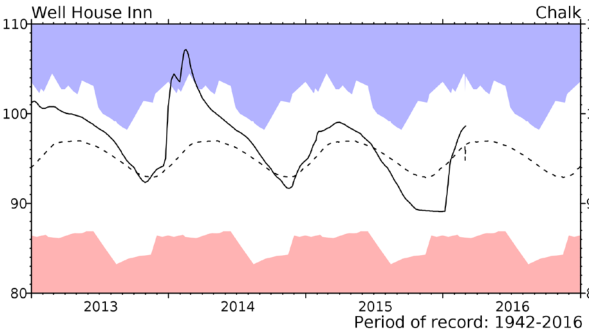


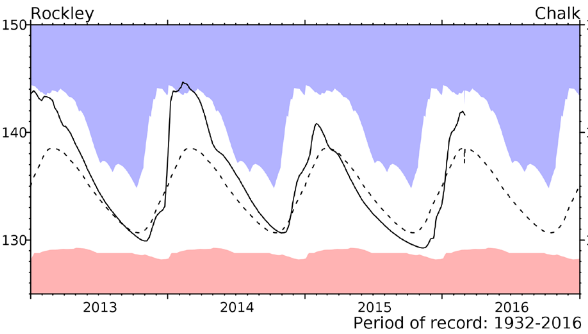
Groundwater . . . Groundwater

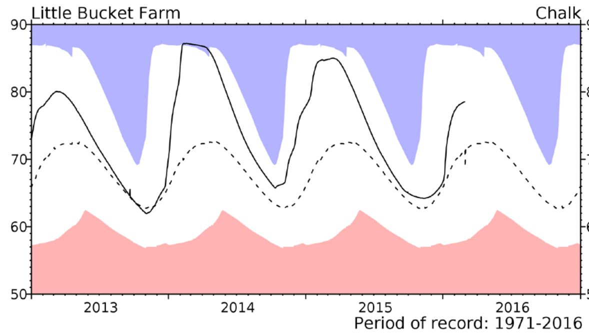


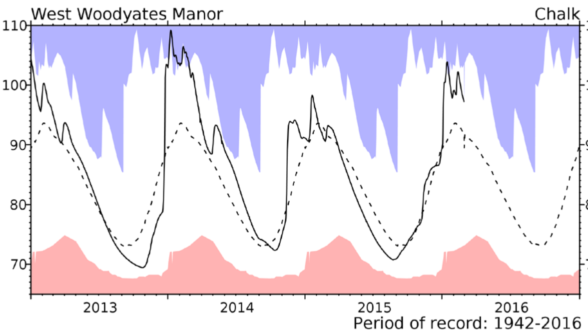


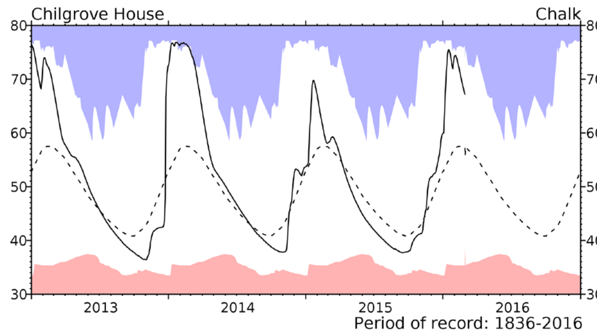


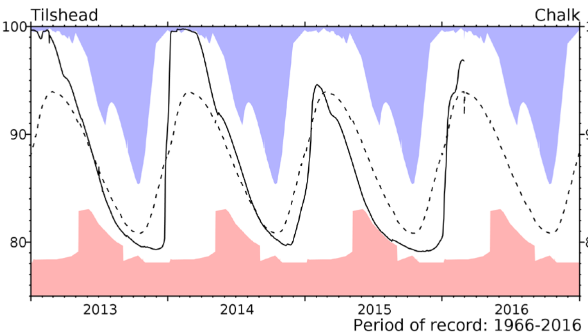


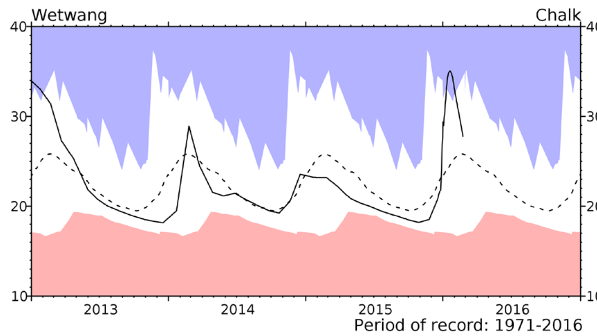






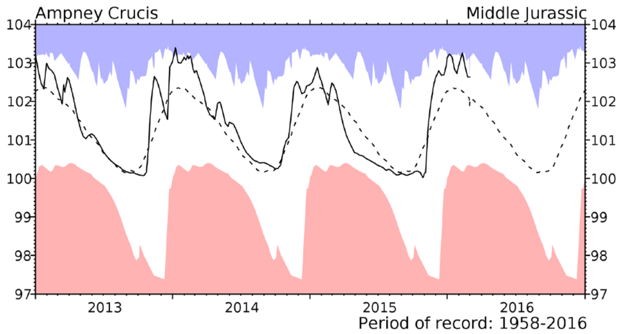


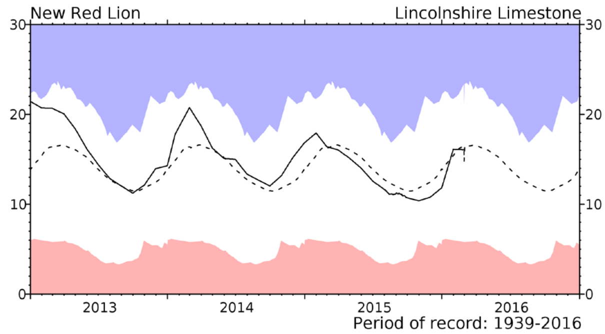


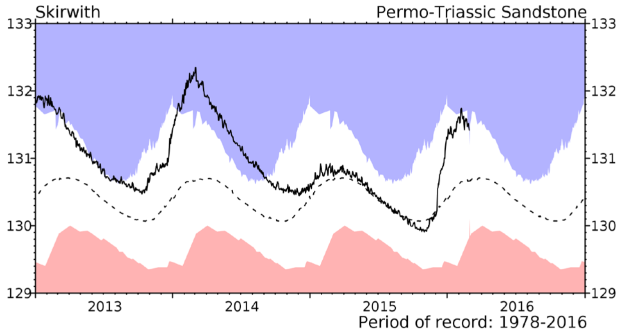


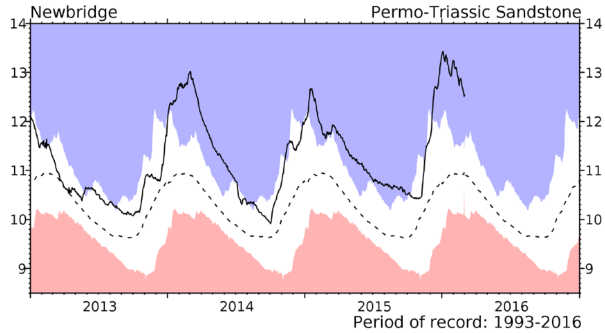
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

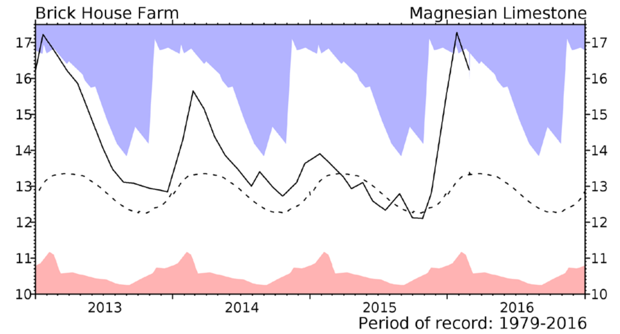
Groundwater ... Groundwater

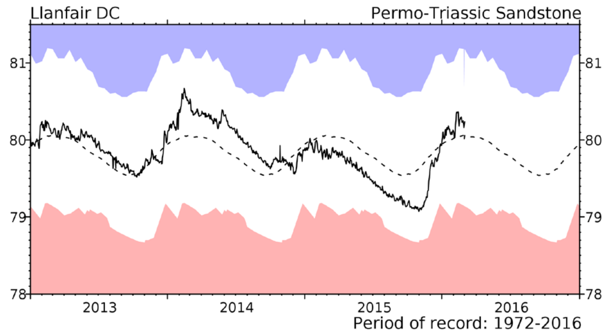


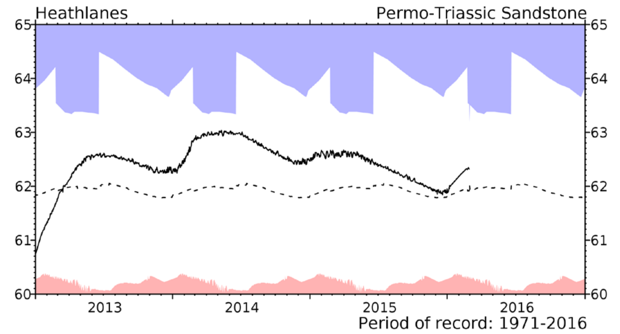


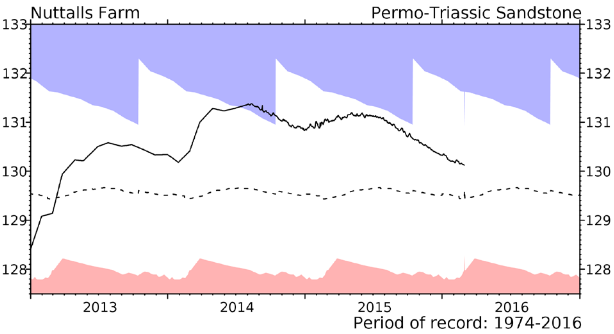


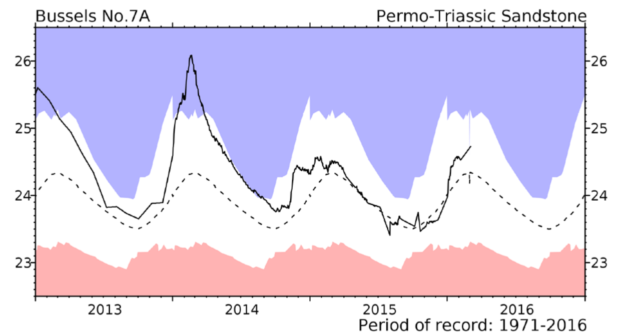


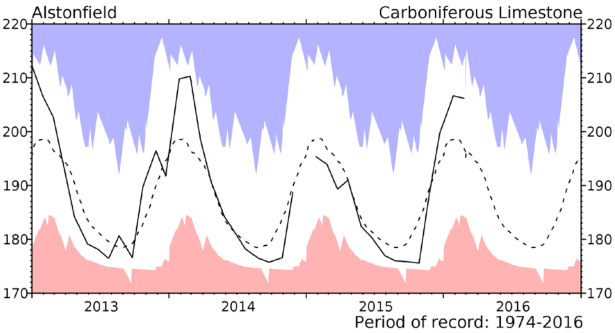










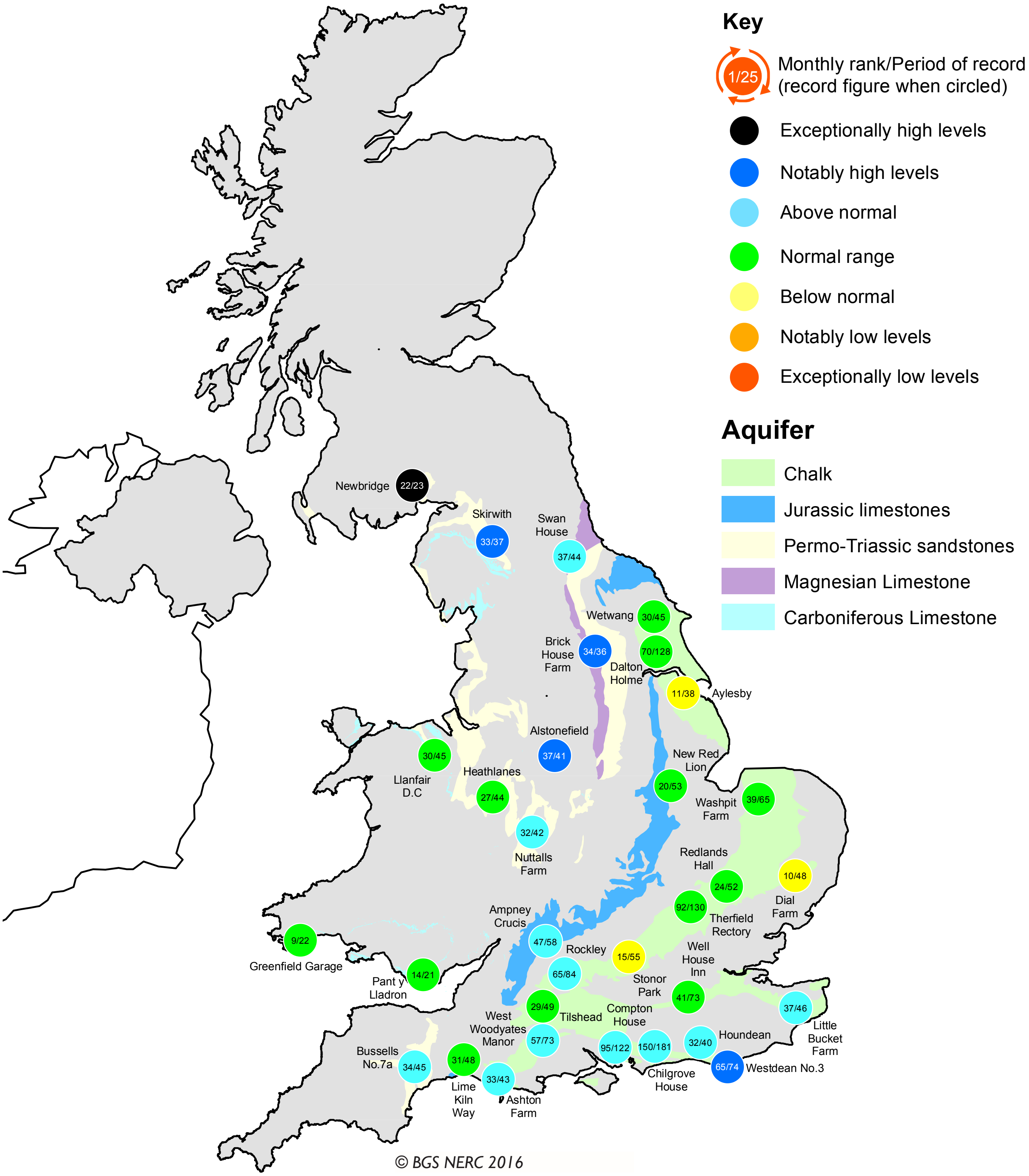


Groundwater levels February / March 2016

Borehole	Level	Date	Feb av.	Borehole	Level	Date	Feb av.	Borehole	Level	Date	Feb av.
Dalton Holme	20.28	25/02	18.69	Chilgrove House	66.64	29/02	57.81	Brick House Farm	16.23	29/02	13.42
Therfield Rectory	81.34	01/03	78.27	Little Bucket Farm	78.53	29/02	71.20	Llanfair DC	80.24	01/03	80.05
Stonor Park	71.95	01/03	75.60	Wetwang	27.77	23/02	25.63	Heathlanes	62.34	29/02	61.96
Tilshead	96.75	29/02	94.09	Ampney Crucis	102.63	01/03	102.24	Nuttalls Farm	130.11	29/02	129.53
Rockley	141.61	01/03	138.40	New Red Lion	16.06	29/02	16.45	Bussells No.7a	24.73	03/03	24.36
Well House Inn	98.62	01/03	96.43	Skirwith	131.47	29/02	130.79	Alstonefield	206.15	24/02	198.85
West Woodyates	96.94	29/02	93.31	Newbridge	12.54	01/03	11.09				

Levels in metres above Ordnance Datum

Groundwater...Groundwater

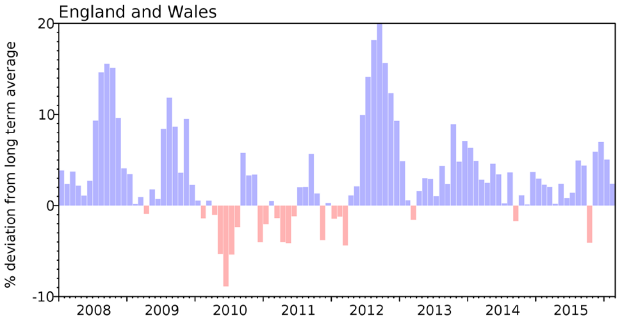


Groundwater levels - February 2016

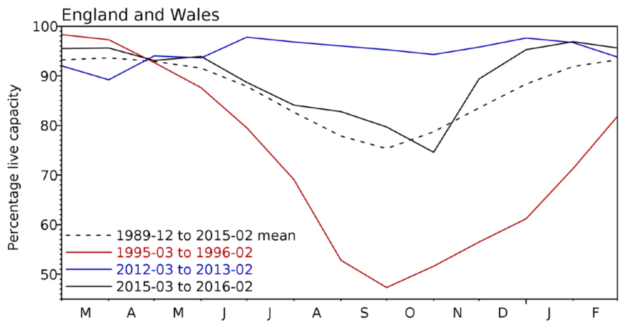
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

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



Percentage live capacity of selected reservoirs at end of month

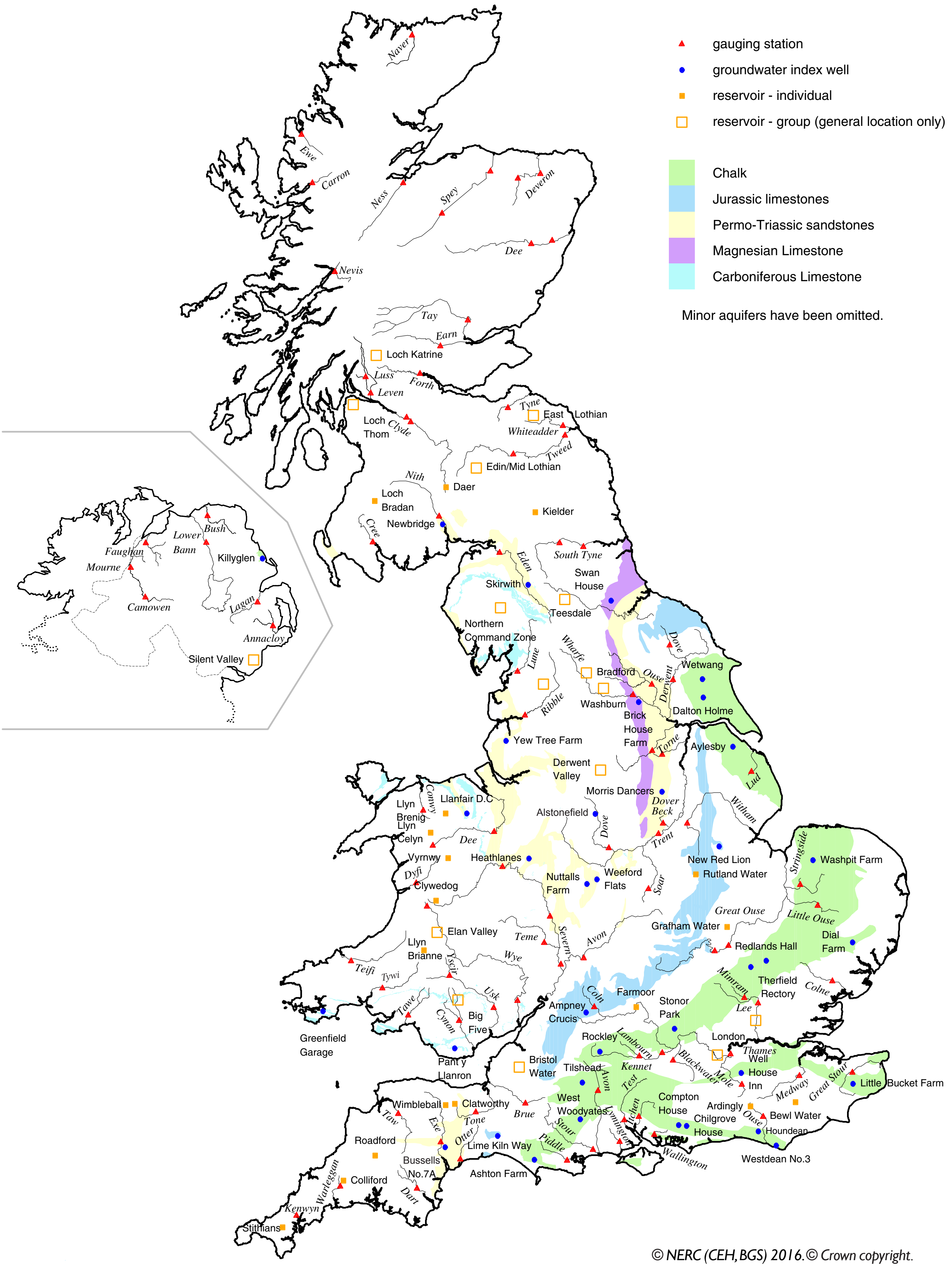
Area	Reservoir		Capacity (Ml)	2015 Dec	2016 Jan	2016 Feb	Feb Anom.	Min Feb	Year* of min	2015 Feb	Diff 16-15
North West	N Command Zone	•	124929	100	100	98	5	78	1996	94	4
	Vyrnwy		55146	100	99	97	2	59	1996	92	5
Northumbrian	Teesdale	•	87936	100	100	97	6	72	1996	100	-3
	Kielder		(199175)	97	99	89	-4	81	1993	96	-7
Severn-Trent	Clywedog		44922	97	97	96	5	77	1996	96	0
	Derwent Valley	•	39525	101	100	100	4	46	1996	100	0
Yorkshire	Washburn	•	22035	96	96	95	2	53	1996	86	8
	Bradford Supply	•	41407	100	97	98	3	53	1996	100	-2
Anglian	Grafham		(55490)	86	91	96	8	72	1997	83	13
	Rutland		(116580)	87	94	95	6	71	2012	95	-1
Thames	London	•	202828	96	97	96	3	83	1988	93	3
	Farmoor	•	13822	78	79	88	-5	64	1991	93	-5
Southern	Bewl		28170	70	83	89	3	40	2012	90	-1
	Ardingly		4685	91	100	100	4	46	2012	100	0
Wessex	Clatworthy		5364	100	100	100	2	82	1992	100	0
	Bristol	•	(38666)	92	99	99	7	65	1992	99	0
South West	Colliford		28540	92	100	100	14	57	1997	91	9
	Roadford		34500	96	98	98	14	35	1996	95	3
	Wimbleball		21320	92	100	100	5	72	1996	100	0
	Stithians		4967	98	100	100	7	45	1992	84	16
Welsh	Celyn & Brenig	•	131155	100	100	99	1	69	1996	97	2
	Brianne		62140	100	100	96	-2	92	2004	100	-4
	Big Five	•	69762	82	84	92	-4	85	1988	98	-6
	Elan Valley	•	99106	100	99	98	0	88	1993	100	-2
Scotland(E)	Edinburgh/Mid-Lothian	•	96518	100	100	100	5	73	1999	92	8
	East Lothian	•	9374	100	100	100	1	91	1990	99	1
Scotland(W)	Loch Katrine	•	110326	99	98	95	1	76	2010	98	-3
	Daer		22412	100	100	99	0	94	2004	100	-1
	Loch Thom	•	10798	100	100	100	2	90	2004	100	0
Northern	Total+	•	56800	99	100	99	8	81	2004	93	6
Ireland	Silent Valley	•	20634	100	100	98	10	57	2002	97	1

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

+ excludes Lough Neagh

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 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

Location map…Location map



NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow data in particular may be subject to significant revision).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at http://www.metoffice.gov.uk/climate/uk/about/methods

Long-term averages are based on the period 1971-2000 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

The monthly rainfall figures are provided by the Met Office NCIC and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0870 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

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