Hydrological Summary

for the United Kingdom

May 2019

General

May was a mixed month, with below average rainfall in the south and west of the UK, whilst substantially above average rainfall was registered in north-eastern Scotland; at the national scale, this resulted in a near average May total for the UK. River flows were generally below normal to notably low, with many catchments registering less than 60% of average; with below normal flows in accumulations extending back to at least the summer of 2017 in the south-east of England. Soil moisture deficits (SMDs) increased and remained drier than average for Great Britain, particularly in southern England. Average outflows for England for May were the third lowest in a series from 1961. Groundwater levels commenced or continued their seasonal recession and the majority of levels were below normal at the end of May. Despite low rainfall in England and Wales, reservoir stocks remained near average. In Northern Command Zone, Bradford Supply and Derwent Valley groups and at Roadford, stocks were less than 80% of capacity and more than 10% below average; stocks in the south-east of England however, remained near average. On the basis of the hydrological situation at the end of May, further environmental and agricultural stress appears likely for the summer of 2019. However, an exceptionally wet start to June has ameliorated these pressures in some areas (with some localised flooding reported) but the impact of much longer-term rainfall deficits is still likely to be felt, especially in groundwater-dominated catchments.

Rainfall

May began with changeable conditions across the country with showers dominating the first 10 days; although high pressure brought drier weather on the 5th/6th and thunderstorms brought localised heavy rain to south-east England on the 9th. High pressure established from the 10th to the 17th, bringing more settled conditions to the UK, with particularly dry weather in the south and east. In Wallingford (Oxfordshire), 0.2mm of rainfall was registered between the 10th and 26th. Reasonably settled conditions, although with some showers, remained in most southern and eastern parts of the UK – with the exception of the heavy rain resulting in travel disruption in the West Country on the 19th/20th. It was wet to month-end across northern England, Northern Ireland and northern Scotland with totals including 36mm at Dunstaffnage (Argyll and Bute) on the 31st. The UK received 96% of average rainfall for May, however this masked some stark regional differences. England & Wales received less than three-quarters of average with less than 30% of average rainfall in localised parts of south Wales and the south-west of England. The South West region received 45% of average, and it was the driest May since 1992 for Wessex region and since 1998 for the Welsh region (in series from 1910). In contrast, Scotland as a whole registered 133% of average, with parts in the north-east receiving over 170% of average. The North East region in Scotland registered almost twice the average for May, the wettest since 1968. Over the last two months (April-May) substantial rainfall deficits occurred across southern and eastern England with 56% and 53% of average recorded in Thames and Southern regions. Although at the national scale spring (Mar-May) rainfall was near average, regions in south-east England received around 75% of average. Across southern and eastern England and eastern Scotland rainfall deficits can be seen in accumulations over the last 12-18 months.

River flows

May started with below average flows in almost all catchments recessing from late April peaks. Recessions were then interrupted by flow responses in the first week when flows in some north-eastern catchments increased to near or above average. Recessions then continued, in some cases recording new daily flow minima for multiple days (e.g. the Soar for six consecutive days ending on the 26th), to month-end in groundwater dominated catchments and those along the south coast. In the last week, flow responses in more responsive catchments were modest in the south and east, whilst in the north and west many catchments ended May with above average flows. New daily flow maxima were established across Scotland in the last week and the Oykel recorded its second highest May peak flow on the 26th (in a series from 1978). Across the UK, May monthly mean flows were generally below normal or notably low, with many around half the average or less. Exceptionally low flows were registered on the Soar with 41% of average, the second lowest May flows in a record from 1972; and on the Twyi, mean flows were just over a quarter of average, the fourth lowest for May in a series from 1959. Only a handful of catchments in north-east Scotland and northern England recorded above average flows in May, with the 125% of average on the Deveron. Over the two month period from April to May, a similar pattern can be seen with most flows registering as below normal to exceptionally low. A new April-May minimum was established on the Nevis (in a record from 1983), whilst exceptionally low flows were registered on the Tay, Luss, North Yorkshire Derwent, Soar and East Sussex Ouse all ranking as the second or third lowest April-May flows (in records exceeding 42 years). Over the longer-term, flow deficits are present in accumulations extending back to summer 2017 in the south-east of England and north-east of Scotland.

Groundwater

SMDs increased and remained drier than average in many regions, except in Scotland where soils were wetter than average. Groundwater levels fell in almost all Chalk boreholes during May. Levels in six boreholes dropped to a lower category, with Westdean No.3 falling from notably high in April to below normal. Levels in the majority of boreholes in the Chalk ended the month below normal or notably low. Three of the four boreholes where levels remained in the normal range were in the south-western part of the Chalk; the other was Little Bucket Farm in Kent. Recessions occurred at all Permo-Triassic sandstone boreholes, but levels remained above normal at Newbridge; two boreholes had levels in the normal range, while two were below normal, including Nuttalls Farm which changed from normal to below normal. Levels declined in the Jurassic, Carboniferous and Magnesian limestone boreholes, and were below normal. At Ampney Crucis and the three Carboniferous Limestone boreholes, levels dropped from normal at the end of April to below normal. Levels fell but remained in the normal range at Lime Kiln Way in the Upper Greensand and Royalty Observatory in the Fell Sandstone.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1981-2010 average.

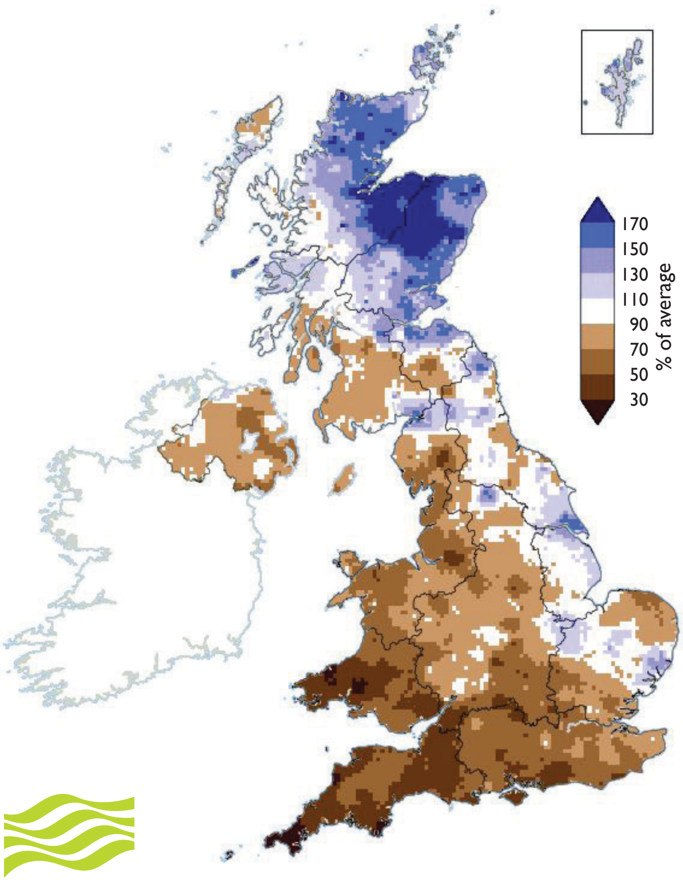
Region	Rainfall	May 2019	Apr19 – May19	RP	Mar19 – May19	RP	Dec18 – May19	RP	Jun18 – May19	RP
United Kingdom	mm	**65**	116		249		505		1012	
	%	**96**	84	2-5	108	2-5	91	2-5	90	2-5
England	mm	**44**	82		171		357		692	
	%	**76**	71	5-10	96	2-5	88	2-5	82	5-10
Scotland	mm	**106**	161		346		687		1445	
	%	**133**	97	2-5	115	5-10	90	2-5	95	2-5
Wales	mm	**47**	148		340		723		1357	
	%	**56**	87	2-5	120	5-10	102	2-5	96	2-5
Northern Ireland	mm	**59**	137		296		533		1037	
	%	**81**	93	2-5	122	10-15	95	2-5	91	2-5
England & Wales	mm	**44**	91		194		408		784	
	%	**72**	74	2-5	101	2-5	91	2-5	85	5-10
North West	mm	**56**	116		300		589		1141	
	%	**78**	81	2-5	125	8-12	100	2-5	93	2-5
Northumbria	mm	**59**	106		219		347		755	
	%	**107**	91	2-5	120	5-10	83	2-5	87	5-10
Severn-Trent	mm	**45**	88		171		337		617	
	%	**78**	76	2-5	99	2-5	90	2-5	79	8-12
Yorkshire	mm	**55**	83		187		354		685	
	%	**103**	72	2-5	105	2-5	87	2-5	81	5-10
Anglian	mm	**45**	59		108		228		452	
	%	**92**	62	5-10	78	2-5	80	5-10	72	15-25
Thames	mm	**35**	61		120		274		537	
	%	**62**	56	8-12	75	2-5	79	5-10	75	10-15
Southern	mm	**32**	56		121		322		653	
	%	**60**	53	10-15	74	2-5	83	2-5	82	5-10
Wessex	mm	**30**	87		166		395		726	
	%	**50**	73	2-5	89	2-5	90	2-5	82	5-10
South West	mm	**34**	110		230		563		1066	
	%	**45**	72	2-5	93	2-5	90	2-5	87	2-5
Welsh	mm	**46**	144		325		691		1302	
	%	**56**	87	2-5	119	5-10	102	2-5	95	2-5
Highland	mm	**125**	180		399		843		1724	
	%	**142**	96	2-5	111	5-10	89	2-5	95	2-5
North East	mm	**129**	194		294		474		960	
	%	**197**	149	10-15	140	20-30	99	2-5	95	2-5
Tay	mm	**116**	168		323		562		1242	
	%	**148**	109	2-5	119	5-10	82	2-5	93	2-5
Forth	mm	**95**	144		287		475		1042	
	%	**135**	105	2-5	119	5-10	80	2-5	86	2-5
Tweed	mm	**68**	123		278		433		959	
	%	**104**	96	2-5	133	10-15	87	2-5	93	2-5
Solway	mm	**78**	148		370		727		1513	
	%	**95**	87	2-5	125	10-20	99	2-5	101	2-5
Clyde	mm	**91**	142		368		773		1717	
	%	**102**	75	2-5	104	2-5	85	2-5	94	2-5

% = percentage of 1981-2010 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 since January 2018 are provisional.

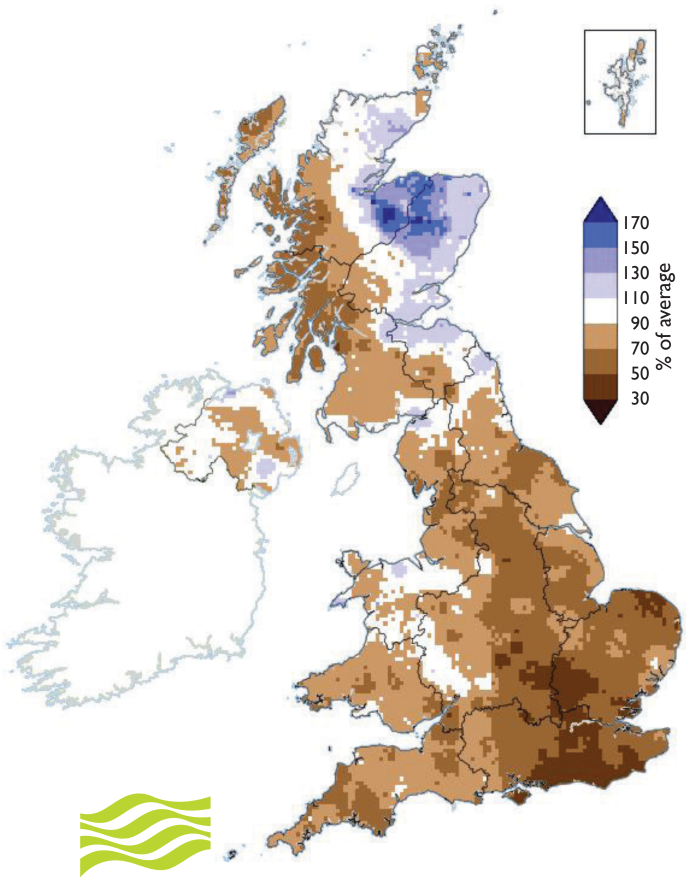
Rainfall . . . Rainfall . . .

May 2019 rainfall
as % of 1981-2010 average



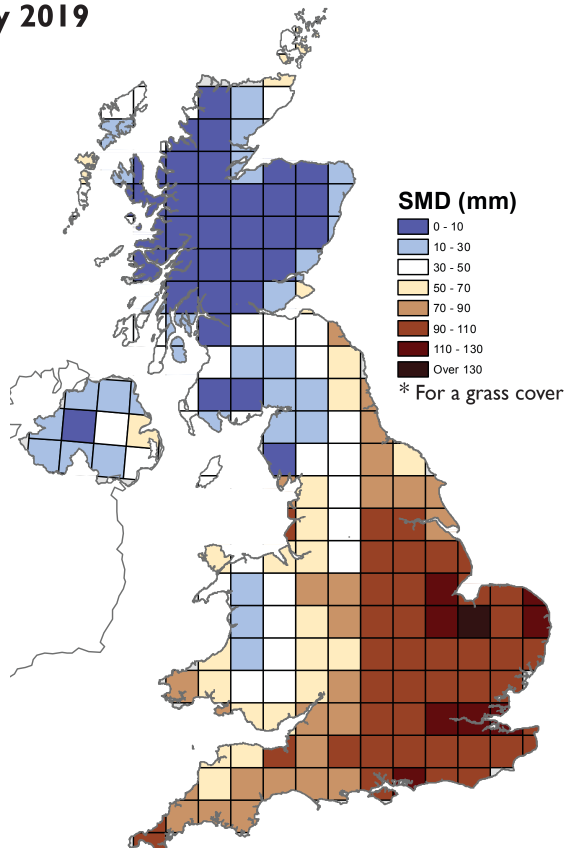
Met Office

April 2019 - May 2019 rainfall
as % of 1981-2010 average



Met Office

MORECS Soil Moisture Deficits*
May 2019



* For a grass cover

Hydrological Outlook UK

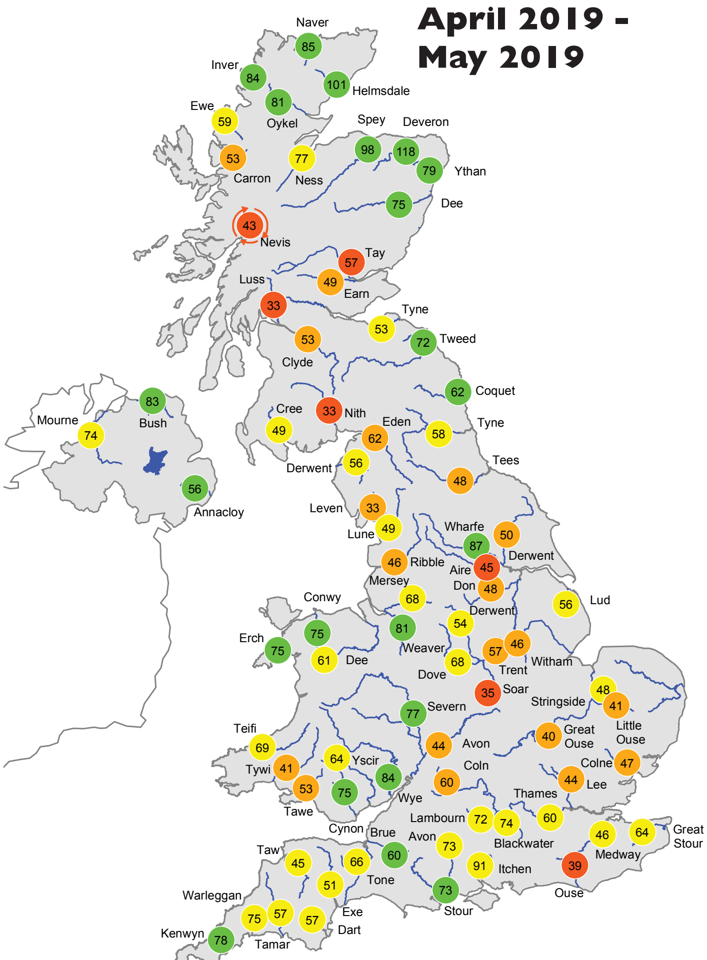
The Hydrological Outlook provides an insight into future hydrological conditions across the UK. Specifically it describes likely trajectories for river flows and groundwater levels on a monthly basis, with particular focus on the next three months.

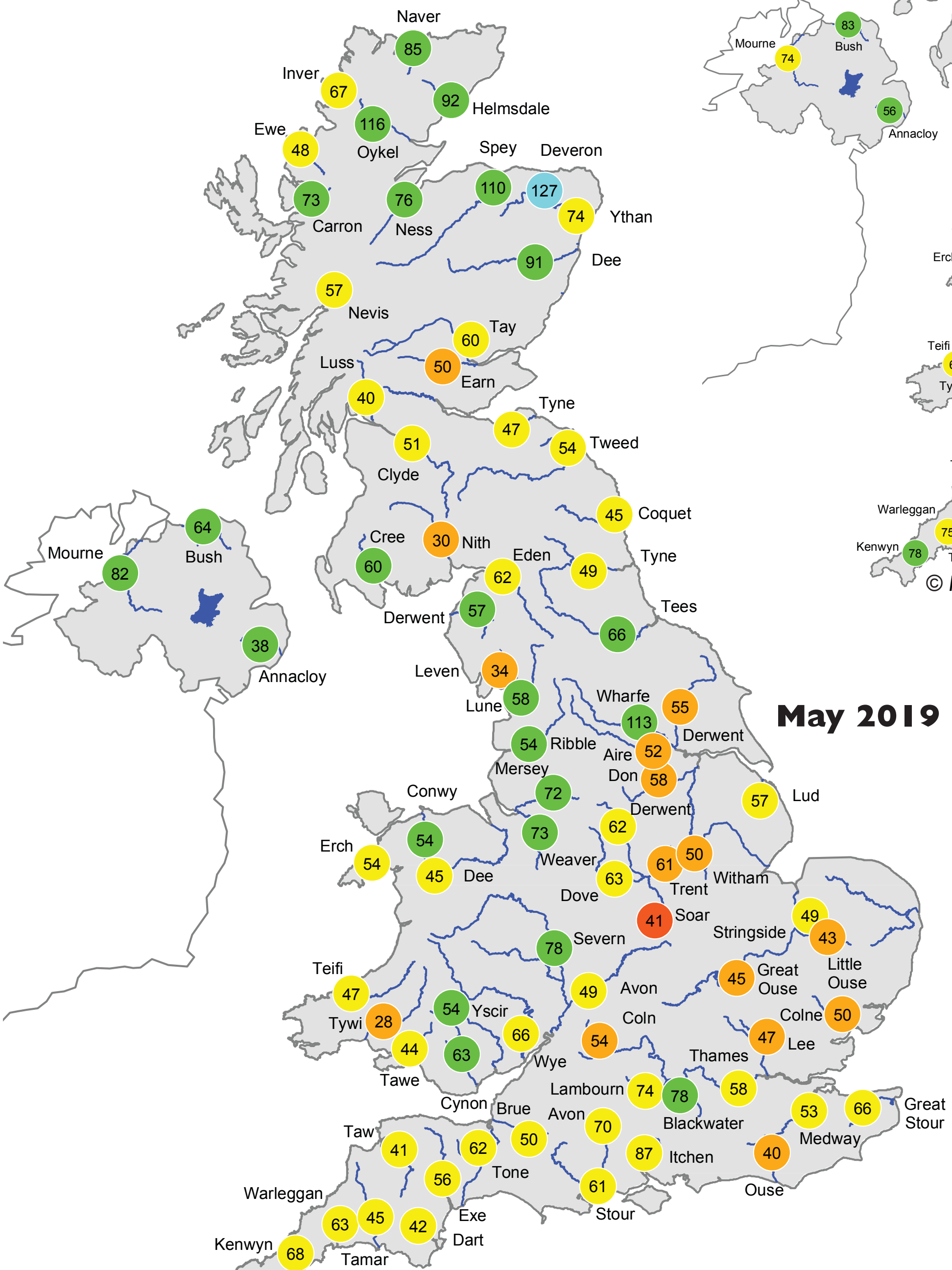
The complete version of the Hydrological Outlook UK can be found at: www.hydoutuk.net/latest-outlook/

Period: **from June 2019**
Issued: **10.06.2019**
using data to the end of May 2019

The outlook is for below normal river flows in central, southern and eastern England both in June and for the summer overall (June-August). Elsewhere, river flows are most likely to be within the normal range. Groundwater levels in the eastern Chalk are likely to be notably low over the next one- and three-month timeframes. Elsewhere in England and Wales, groundwater levels are generally likely to be below normal in June and normal to below normal for June-August.

River flow . . . River flow . . .





Key

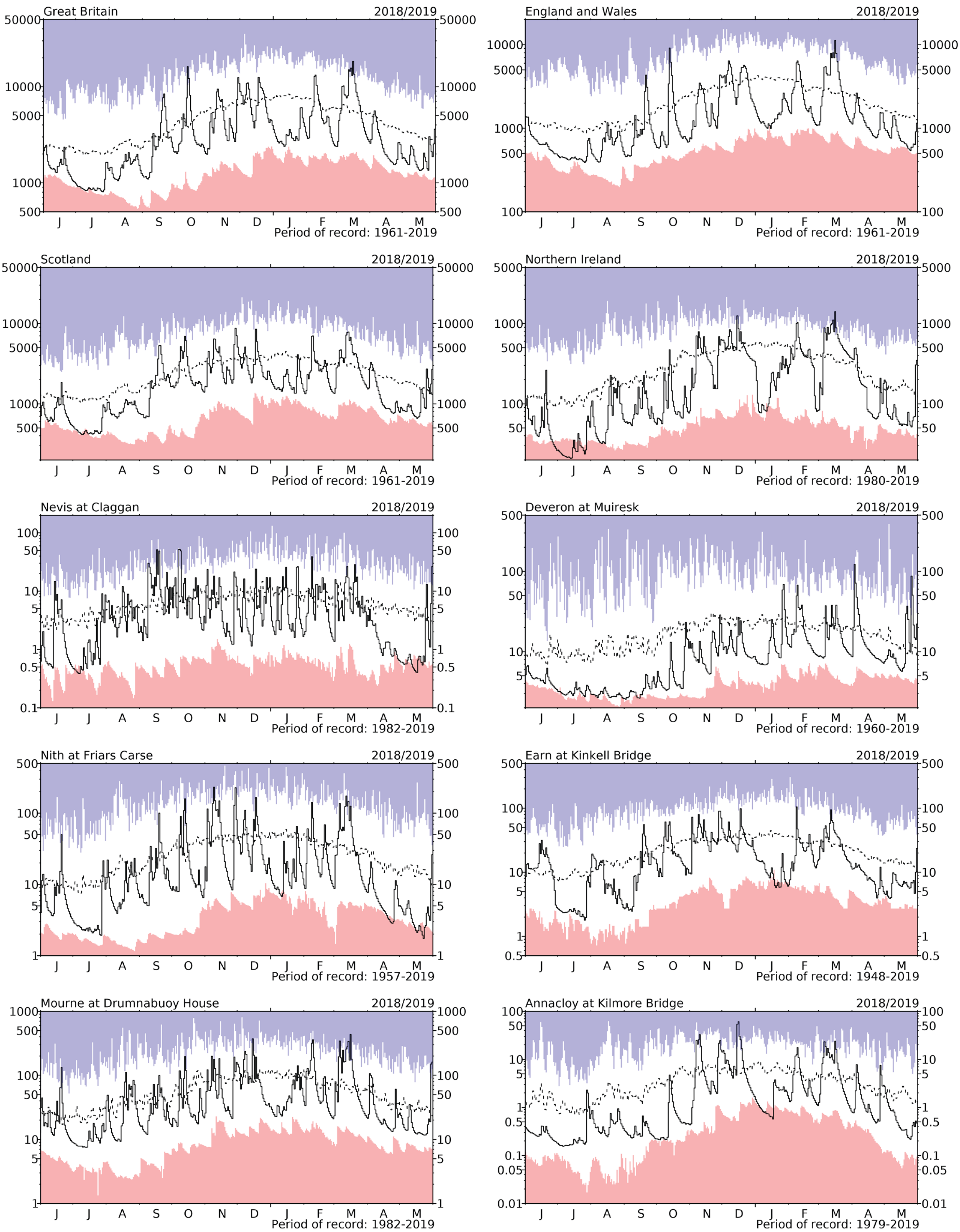
- (25, circled) % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on ranking of the monthly flow**

River flows

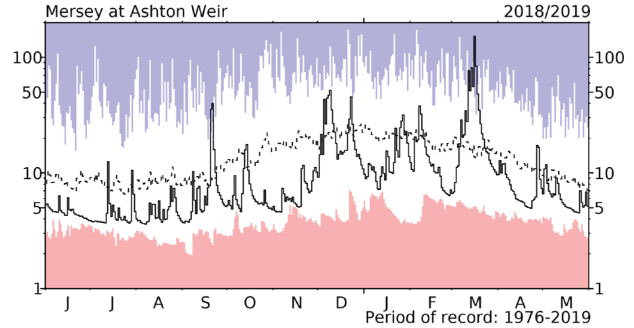
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the averaging period on which these percentages are based is 1981-2010. Percentages may be omitted where flows are under review.

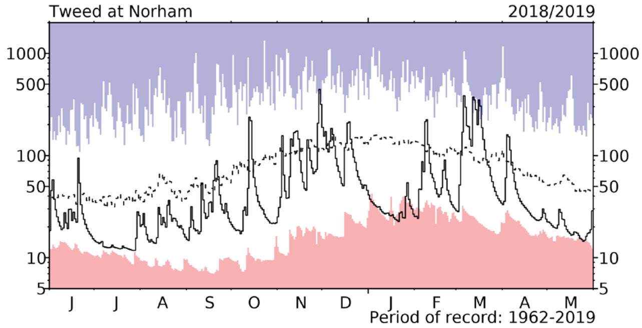
River flow . . . River flow . . .

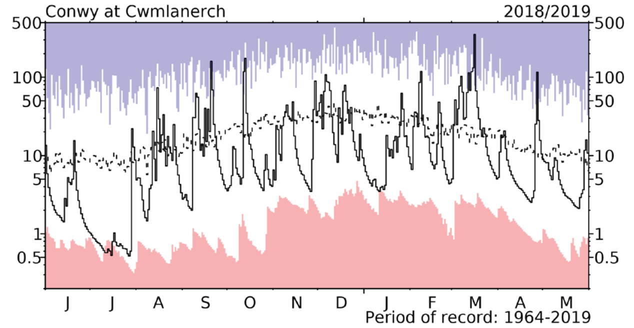


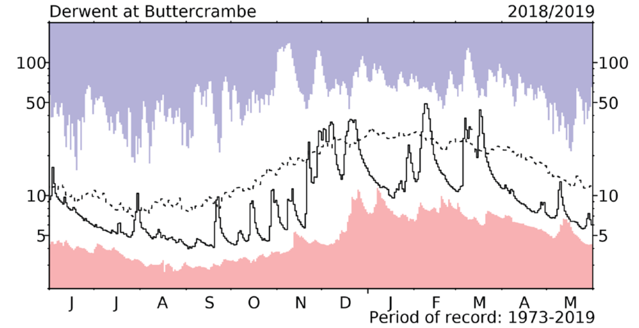
River flow hydrographs

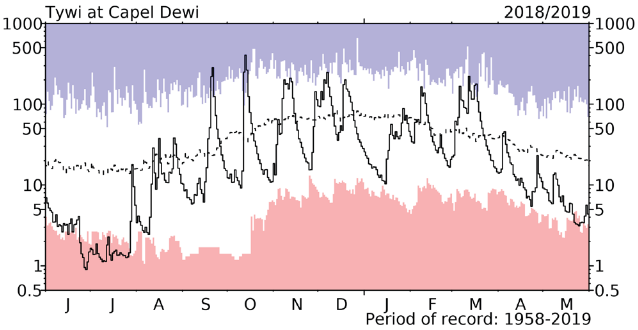
*The river flow hydrographs show the daily mean flows (measured in m^3s^{-1}) together with the maximum and minimum daily flows prior to June 2018 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. The dashed line represents the period-of-record average daily flow.

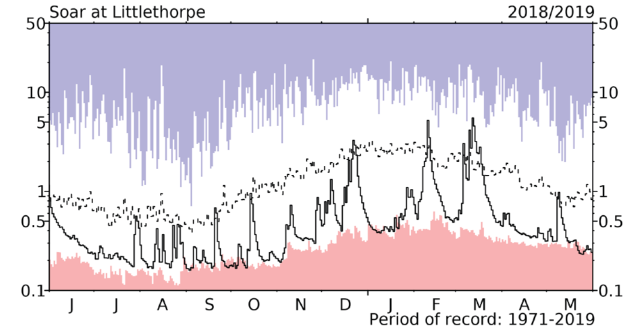

Mersey at Ashton Weir
2018/2019
J J A S O N D J F M A M
Period of record: 1976-2019

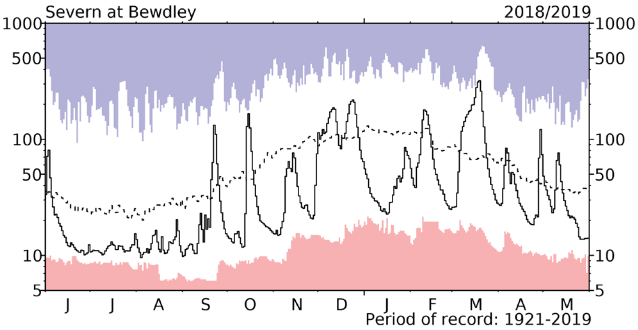

Tweed at Norham
2018/2019
J J A S O N D J F M A M
Period of record: 1962-2019

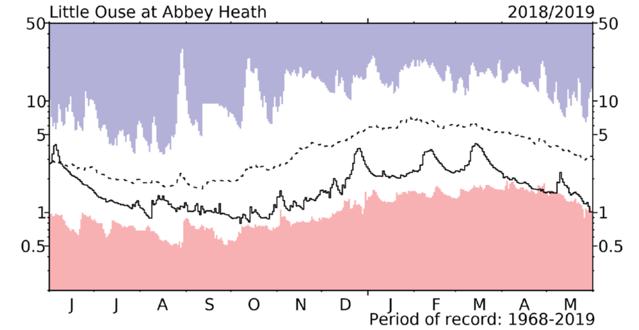

Conwy at Cwmlanerch
2018/2019
J J A S O N D J F M A M
Period of record: 1964-2019

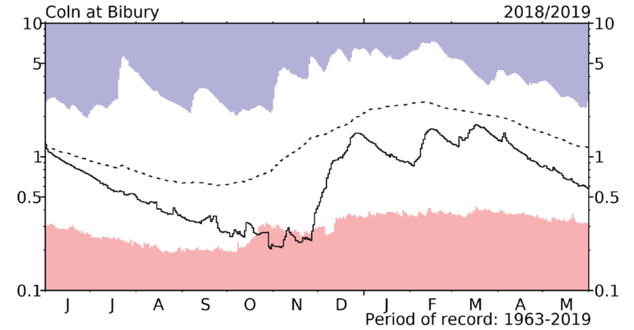

Derwent at Buttercrambe
2018/2019
J J A S O N D J F M A M
Period of record: 1973-2019

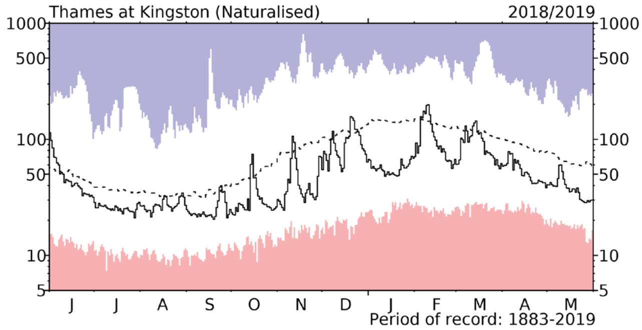

Tywi at Capel Dewi
2018/2019
J J A S O N D J F M A M
Period of record: 1958-2019

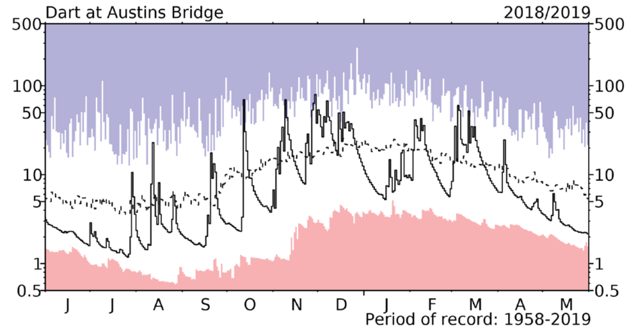

Soar at Littlethorpe
2018/2019
J J A S O N D J F M A M
Period of record: 1971-2019

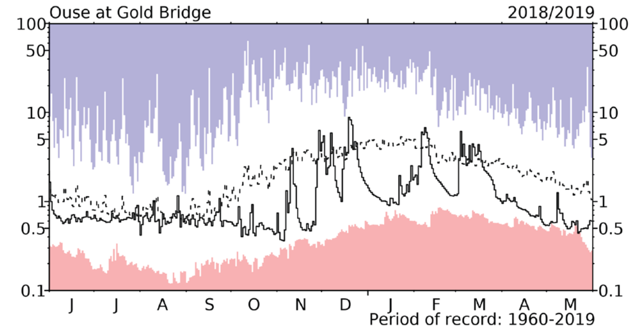

Severn at Bewdley
2018/2019
J J A S O N D J F M A M
Period of record: 1921-2019


Little Ouse at Abbey Heath
2018/2019
J J A S O N D J F M A M
Period of record: 1968-2019

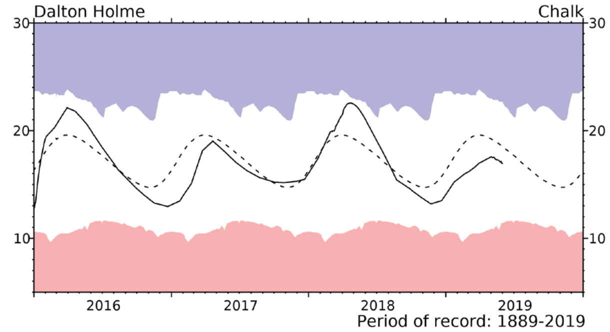

Coln at Bibury
2018/2019
J J A S O N D J F M A M
Period of record: 1963-2019

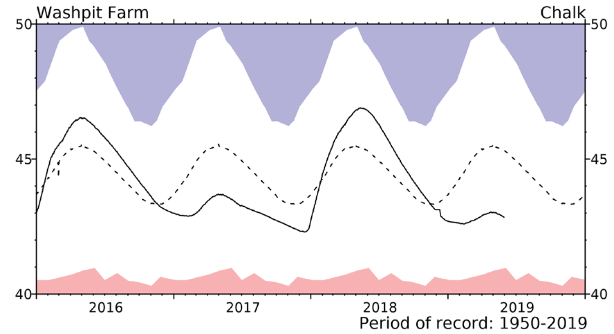

Thames at Kingston (Naturalised)
2018/2019
J J A S O N D J F M A M
Period of record: 1883-2019

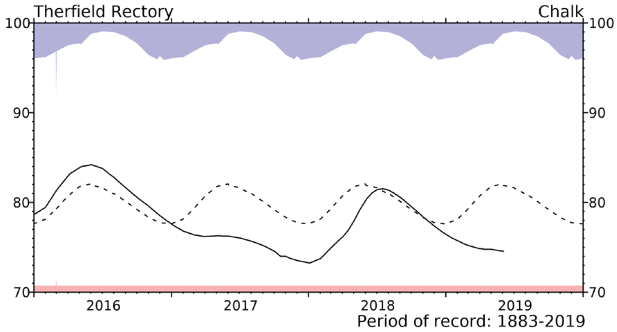

Dart at Austins Bridge
2018/2019
J J A S O N D J F M A M
Period of record: 1958-2019

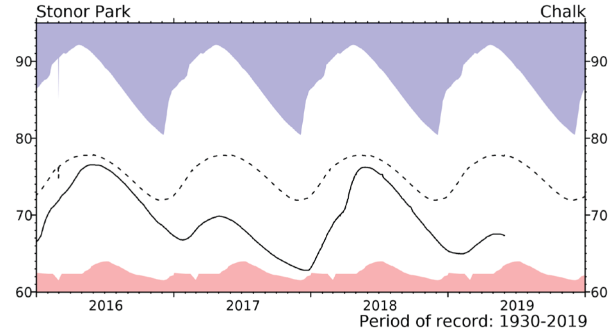

Ouse at Gold Bridge
2018/2019
J J A S O N D J F M A M
Period of record: 1960-2019

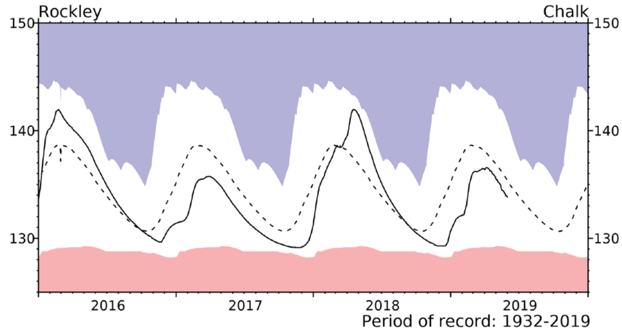
Groundwater . . . Groundwater

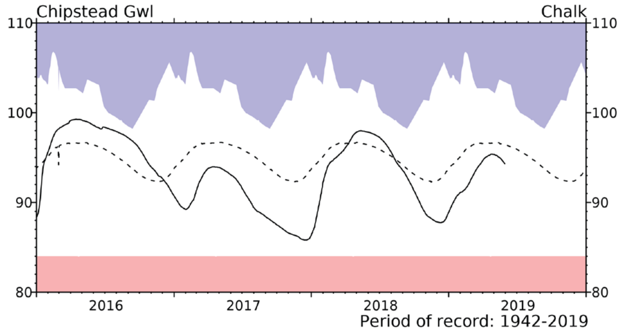


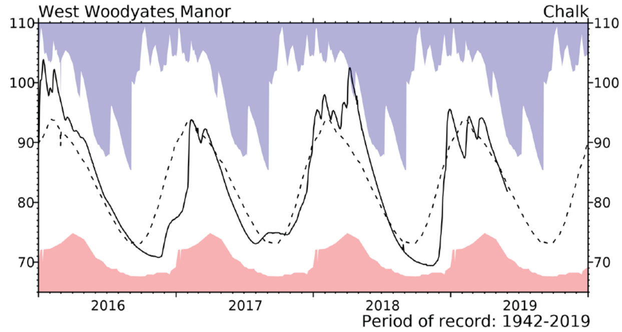


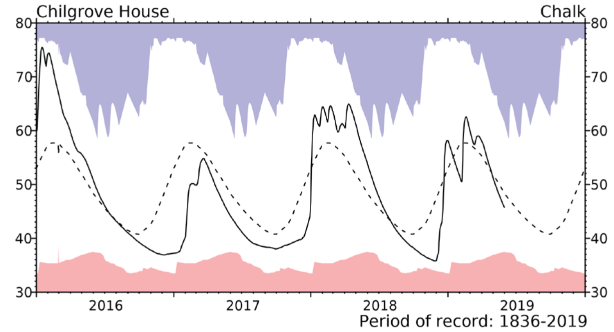


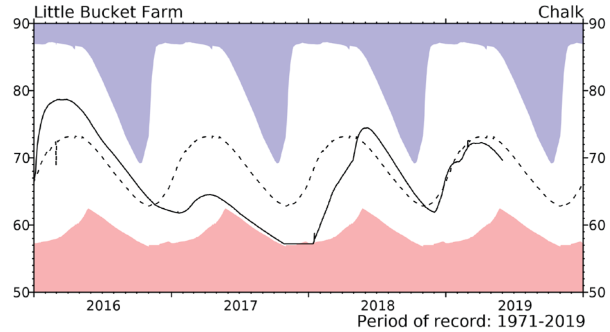


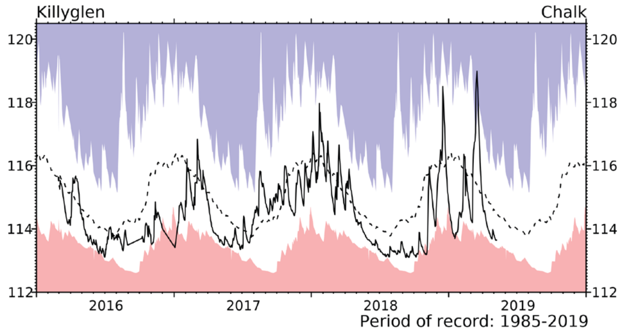




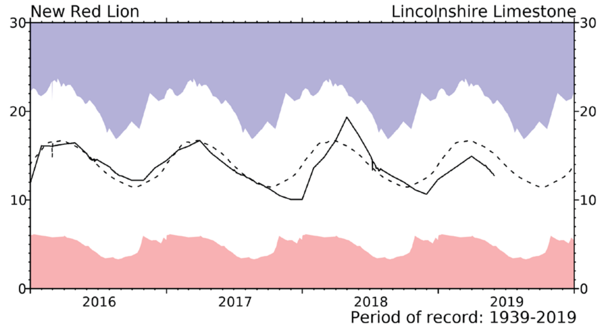


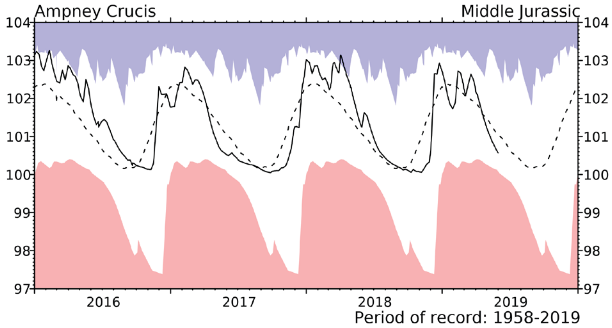


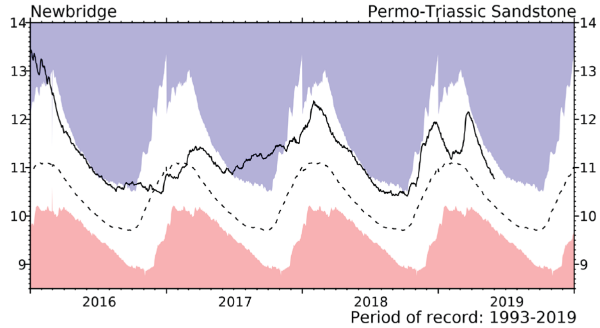


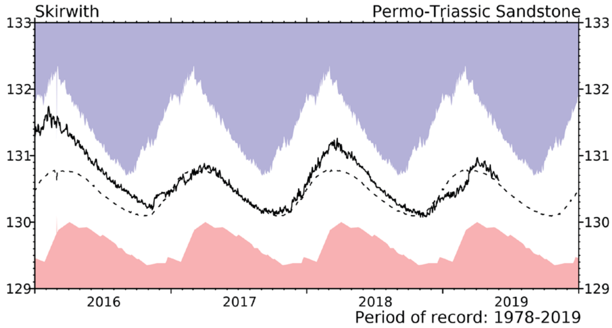


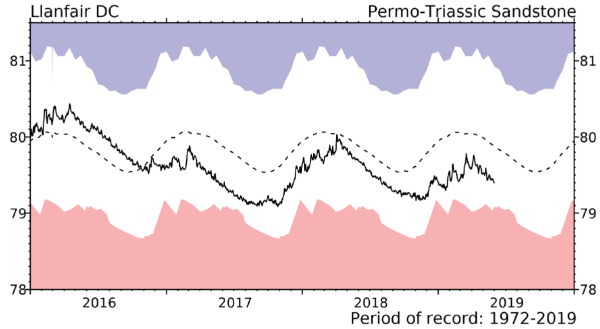
Groundwater levels (measured in metres above ordnance datum) normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is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

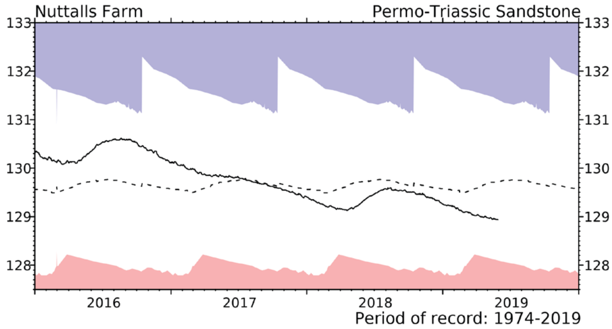

New Red Lion
Lincolnshire Limestone
2016
2017
2018
2019
Period of record: 1939-2019

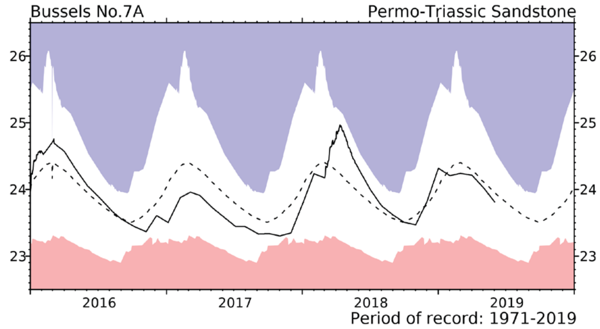

Ampney Crucis
Middle Jurassic
2016
2017
2018
2019
Period of record: 1958-2019

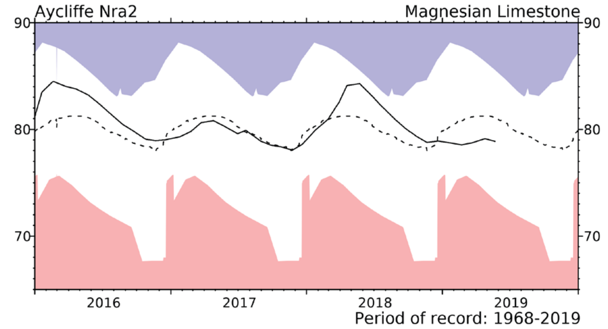

Newbridge
Permo-Triassic Sandstone
2016
2017
2018
2019
Period of record: 1993-2019

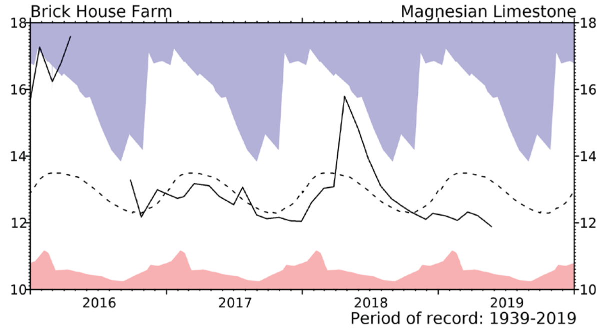

Skirwith
Permo-Triassic Sandstone
2016
2017
2018
2019
Period of record: 1978-2019

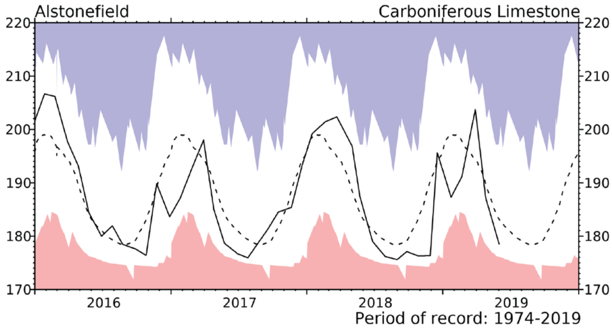

Llanfair DC
Permo-Triassic Sandstone
2016
2017
2018
2019
Period of record: 1972-2019

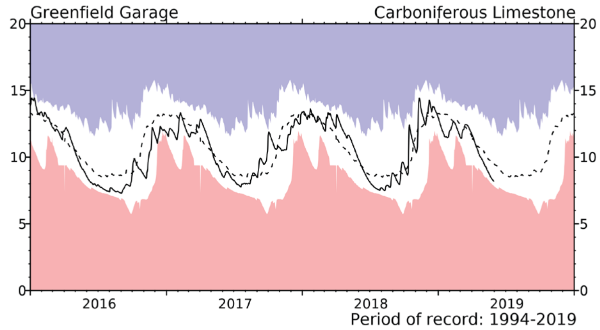

Nuttalls Farm
Permo-Triassic Sandstone
2016
2017
2018
2019
Period of record: 1974-2019

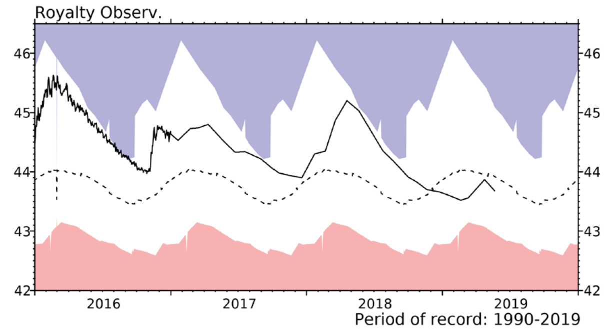

Bussels No.7A
Permo-Triassic Sandstone
2016
2017
2018
2019
Period of record: 1971-2019


Aycliffe Nra2
Magnesian Limestone
2016
2017
2018
2019
Period of record: 1968-2019

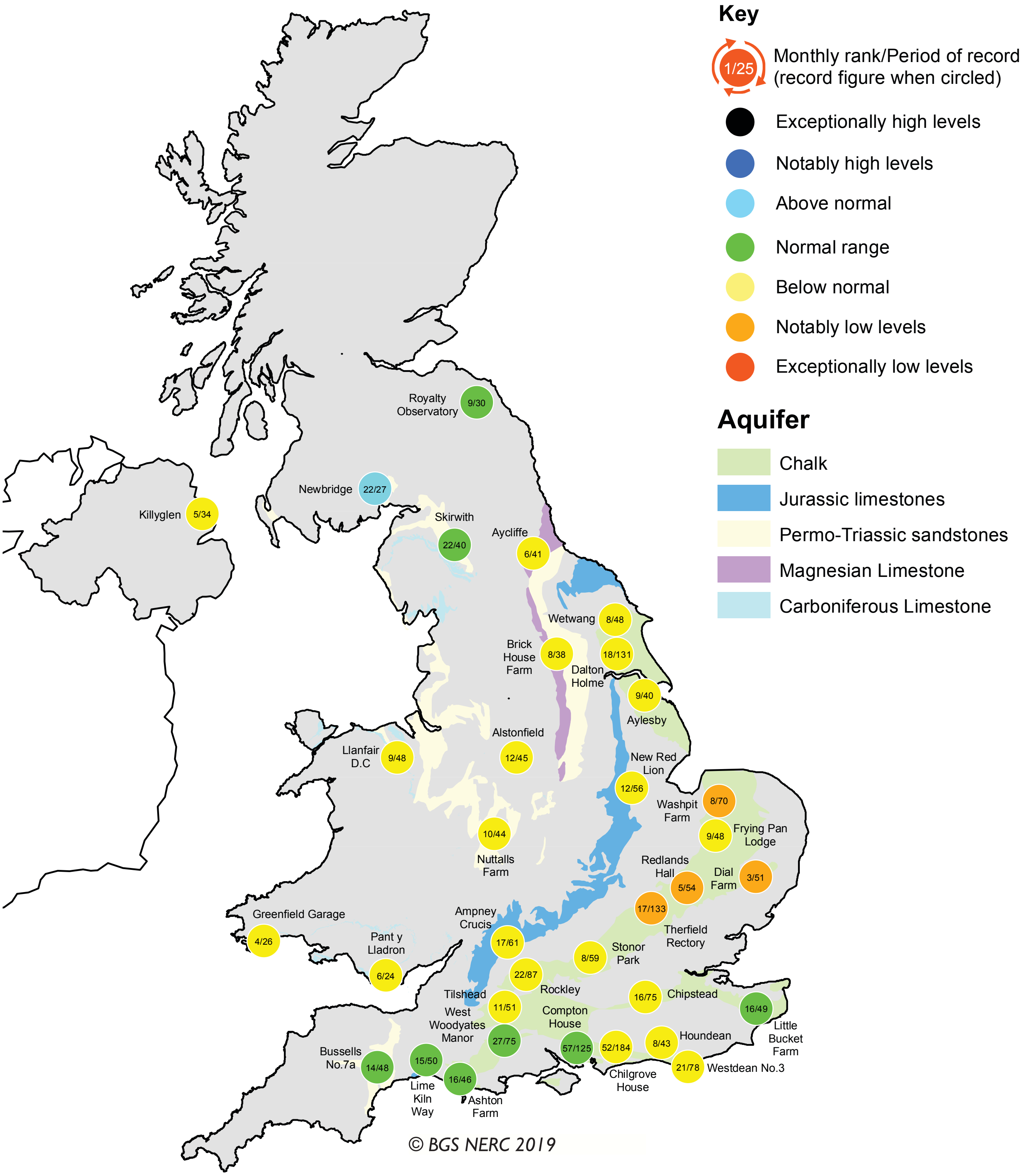

Brick House Farm
Magnesian Limestone
2016
2017
2018
2019
Period of record: 1939-2019


Alstonefield
Carboniferous Limestone
2016
2017
2018
2019
Period of record: 1974-2019


Greenfield Garage
Carboniferous Limestone
2016
2017
2018
2019
Period of record: 1994-2019


Royalty Observ.
2016
2017
2018
2019
Period of record: 1990-2019

Groundwater...Groundwater

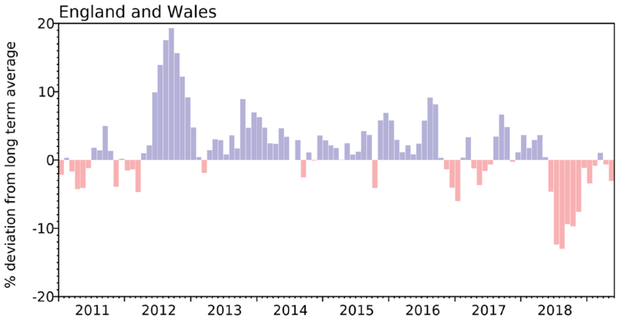


Groundwater levels - May 2019

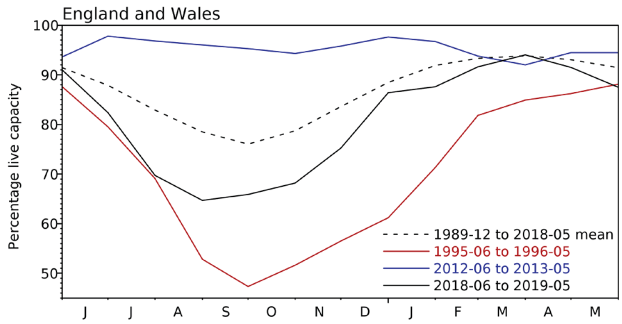
The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. 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

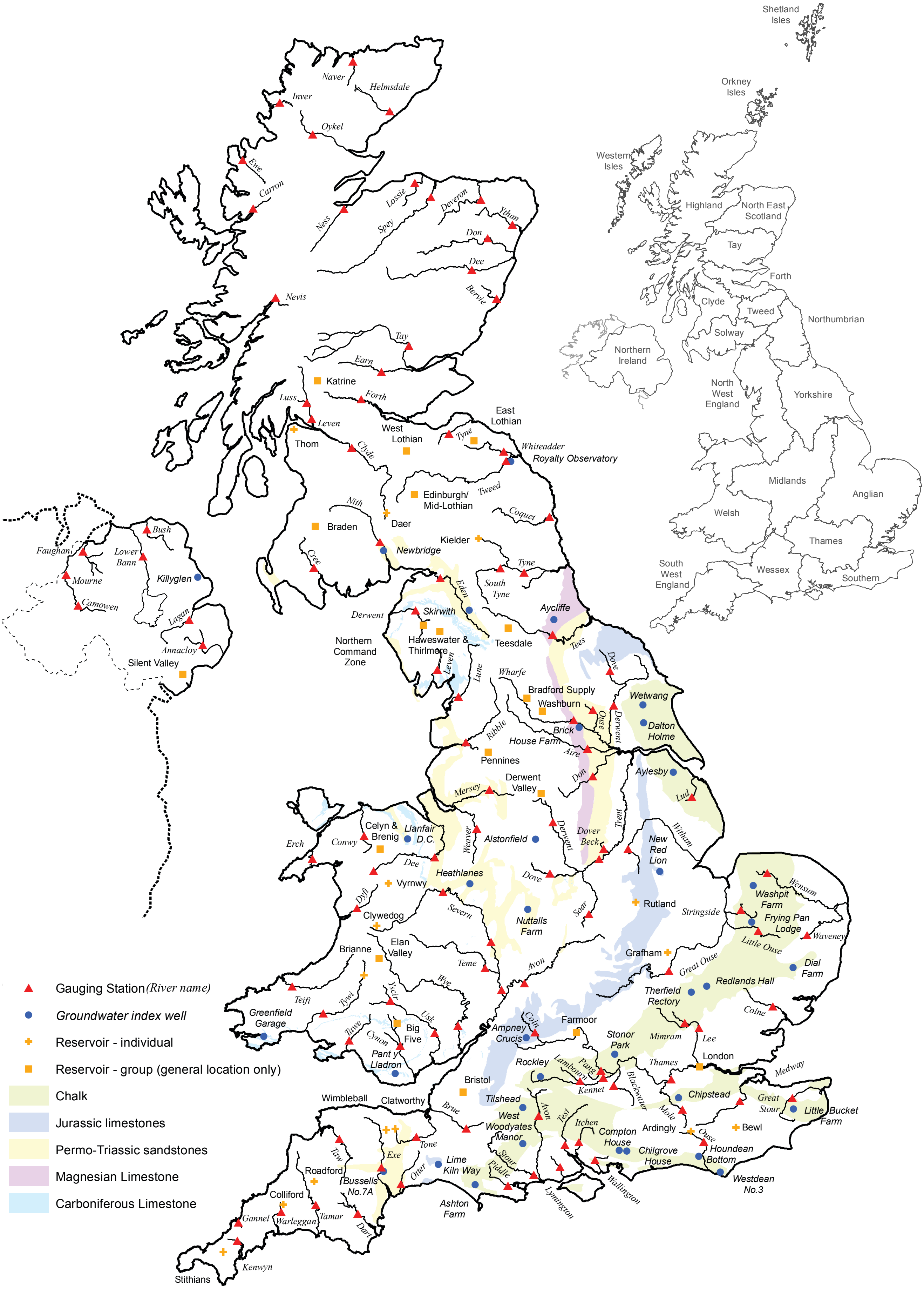
Area	Reservoir		Capacity (Ml)	2019 Mar	2019 Apr	2019 May	May Anom.	Min May	Year* of min	2018 May	Diff 19-18
North West	N Command Zone	•	124929	95	80	67	-14	50	1984	69	-2
	Vyrnwy		55146	99	100	97	8	69	1984	93	4
Northumbrian	Teesdale	•	87936	97	93	85	-1	64	1991	82	3
	Kielder		(199175)	94	91	91	-1	85	1989	91	0
Severn-Trent	Clywedog		49936	99	100	100	3	83	1989	100	0
	Derwent Valley	•	46692	97	86	77	-11	56	1996	86	-9
Yorkshire	Washburn	•	23373	95	86	84	-3	72	1990	85	-1
	Bradford Supply	•	40942	88	77	73	-13	70	1996	84	-11
Anglian	Grafham		(55490)	86	91	90	-4	72	1997	92	-3
	Rutland		(116580)	89	95	94	2	75	1997	96	-2
Thames	London	•	202828	91	90	88	-6	83	1990	97	-9
	Farmoor	•	13822	98	98	98	0	90	2002	98	-1
Southern	Bewl		31000	100	97	92	4	57	1990	98	-6
	Ardingly		4685	99	100	95	-3	89	2012	100	-4
Wessex	Clatworthy		5364	100	91	89	3	67	1990	93	-4
	Bristol	•	(38666)	97	95	90	0	70	1990	93	-4
South West	Colliford		28540	88	88	83	-3	52	1997	98	-15
	Roadford		34500	77	76	73	-11	48	1996	92	-19
	Wimbleball		21320	100	98	94	3	74	2011	98	-4
	Stithians		4967	99	97	93	6	66	1990	96	-3
Welsh	Celyn & Brenig	•	131155	95	95	93	-4	82	1996	96	-3
	Brianne		62140	97	96	90	-6	84	2011	94	-4
	Big Five	•	69762	97	95	85	-5	70	1990	88	-3
	Elan Valley	•	99106	98	95	93	-1	81	2011	93	-1
Scotland(E)	Edinburgh/Mid-Lothian	•	97223	99	95	88	-3	52	1998	93	-5
	East Lothian	•	9317	99	100	100	2	84	1990	99	0
Scotland(W)	Loch Katrine	•	110326	100	91	88	1	66	2001	88	0
	Daer		22494	98	89	85	-5	69	2017	79	6
	Loch Thom		10798	99	93	88	-4	72	2017	95	-7
Northern Ireland	Total+	•	56800	95	93	93	7	69	2008	88	5
	Silent Valley	•	20634	99	93	96	15	56	2000	86	11

( ) 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.

The Hydrological Summary is supported by the Natural Environment Research Council award number NE/R016429/1 as part of the UK-SCAPE programme delivering National Capability.

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 Department for Infrastructure - Rivers 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 1981-2010 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.

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

06/2019

UK-SCAPE
UK Status, Change and Projections of the Environment

NERC SCIENCE OF THE ENVIRONMENT