Monthly water situation report

England

Summary – February 2019

After a wet start, February was relatively dry, with rainfall below average for the month across England as a whole. The rainfall total for England was 49mm, which is 84% of the February long term average. Soils were drier at the end of February than at the start of the month. Monthly mean river flows increased compared with January, following the rainfall early in the month. River flows were classed as normal at just over half of the indicator sites, with the majority of remaining sites classed as below normal for the time of year. Groundwater levels were classed as below normal or lower at the end of February at the majority of sites, despite a rise in levels at almost two thirds of the indicator sites. Total reservoir stocks for England increased to 90% of total capacity at the end of February.

Rainfall

The majority of the total precipitation for February occurred within the first ten days of the month, falling as snow at the start of the month in some areas, followed by widespread rain across most of England. The latter part of the month was drier across most of England, with monthly rainfall totals for February below the long term average (LTA) for England as a whole. Rainfall totals were lowest in east England and highest in north-west England. The Little Ouse and Lark, Louth Grimsby and Ancholme, Cam, and North Essex hydrological areas in east England, and the Lower Trent hydrological area in central England received the lowest rainfall totals during February, with less than 25mm (Figure 1.1).

February rainfall totals were classed as normal in the majority of catchments across England. In north-east England, rainfall totals in half of the hydrological areas were classed as below normal for February. Cumulative rainfall totals for the last three months across approximately half of the north-east geographical region were classed as notably low or lower. In Northumberland and County Durham, the last 3 months have been the driest since 1973 in the Wear and Tees catchments and since 1964 in the Tyne catchment. Over the last 12 months, cumulative rainfall totals for the majority of catchments across England were below normal or lower (Figure 1.2).

The February rainfall total for England was 49mm, which is 84% of the 1961-1990 LTA (81% of the 1981-2010 LTA). This followed below average rainfall for England in January, and indeed below average rainfall across England in eight out of the last 10 months. At a regional scale, February rainfall totals ranged from 73% of the LTA in central and north-east England to 106% of LTA in south-east England (Figure 1.3)

Soil moisture deficit

Although soil moisture deficits (SMDs) decreased throughout the first half of February across much of England, by the end of the month, as a result of the dry and mild weather, soils were generally drier than at the start of the month. The driest soils at the end of February were seen across parts of east England, most notably around the River Great Ouse with a continued, large soil moisture deficit (Figure 2.1).

At a regional scale, SMDs remained at, or decreased to, close to the LTA by the middle of February, with the exception of SMDs in central England which remained slightly greater than average. However, by the end of February, SMDs across all geographical regions increased and soils were drier than average for the time of year (Figure 2.2).

River flows

Following the widespread rainfall across England during the early part of February, monthly mean flows increased at almost all indicator sites reported on, compared with monthly mean flows for January. River flows were classed as normal at just over half of the indicator sites, but were below normal or lower at more than a third of sites, most of which are located in central and east England and parts of south east and north east England. Two sites in east England, the Ely Ouse at Denver and Cam at Dernford were classed as notably low for the time of year (Figure 3.1). February monthly mean flows at all of the regional indicator sites were in the normal range for the time of year, with the exception of river flows in the South Tyne at Haydon Bridge, which were below normal for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels rose during February at almost two thirds of the indicator sites, but despite this, by the end of February, groundwater levels at more than two-thirds of sites were classed as below normal or lower for the time of year (Figures 4.1). The decrease in groundwater levels seen at a third of sites by the end of February mostly occurred in sandstone aquifer sites in central and north-west England.

Groundwater levels remained in the normal range at four of the regional indicator sites by the end of February, including two key chalk aquifer sites; Chilgrove (Chichester Chalk) and Little Bucket (East Kent Chalk) and two key sandstone sites; Heathlanes (Sherwood Sandstone) and Skirwith (Carlisle Basin and Eden Valley Sandstone). Groundwater levels at Stonor Park (South-west Chilterns Chalk) remained notably low for the time of year, and levels at Dalton Holme (Hull and East Riding Chalk) were below normal by the end of February, compared with an end of January class of normal (Figure 4.2).

Reservoir storage

Reservoir stocks increased or remained stable during February at almost all of the reservoirs or reservoir groups reported on in England. The largest increases, as a proportion of total storage, were at Ardingly Reservoir in south-east England (19% increase) and Wimbleball Reservoir and Chew Valley Lake in south-west England (13% and 12% increase respectively). The largest decrease in reservoir storage during February occurred in the Lower Lee Reservoir group in south-east England (17% decrease) as a result of planned maintenance on the Thames-Lee tunnel. The end of month stocks in just under half of the reservoirs and reservoir groups reported on were classed as either below normal or notably low for the time of year, with the remaining sites classed as normal or higher at the end of February (Figure 5.1).

At a regional scale, total reservoir storage increased across all geographical regions, with the exception of south-east England where there was a very slight decrease in reservoir storage. The largest increase occurred in north-west England, where reservoir stocks increased by 8% of total capacity. Total reservoir stocks for England were 90% of total capacity at the end of February (Figure 5.2).

Forward look

The unsettled conditions at the beginning of March are expected to continue throughout the month, with spells of wet and windy weather interspersed with some brighter, more showery conditions. Continued unsettled weather mid-month is likely to bring the heaviest rain to north and west England, with a possibility of more settled conditions developing in the south and east. Towards the end of the month, unsettled weather affecting most of England may give way to drier, more settled conditions predominating in the south, possibly spreading north by the start of April. For the 3 month period March-April-May, the chances of above and below average precipitation are similar[1].

Projections for river flows at key sites[2]

All but 3 of the modelled sites have a greater than expected chance of cumulative river flows being notably low or lower for the time of year by the end of March, increasing to all but one modelled site by the end of September 2019.

For scenario based projections of cumulative river flows at key sites by March 2019 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2019 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2019 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2019 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Approximately three-quarters of the modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year by the end of both March and September 2019.

For scenario based projections of groundwater levels in key aquifers in March 2019 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2019 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2019 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2019 see Figure 6.8

Authors: National Water Resources Hydrology Team

1 Source: Met Office
2 Information produced by the Water Situation Forward Look group led by Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office (www.hydoutuk.net).

Rainfall

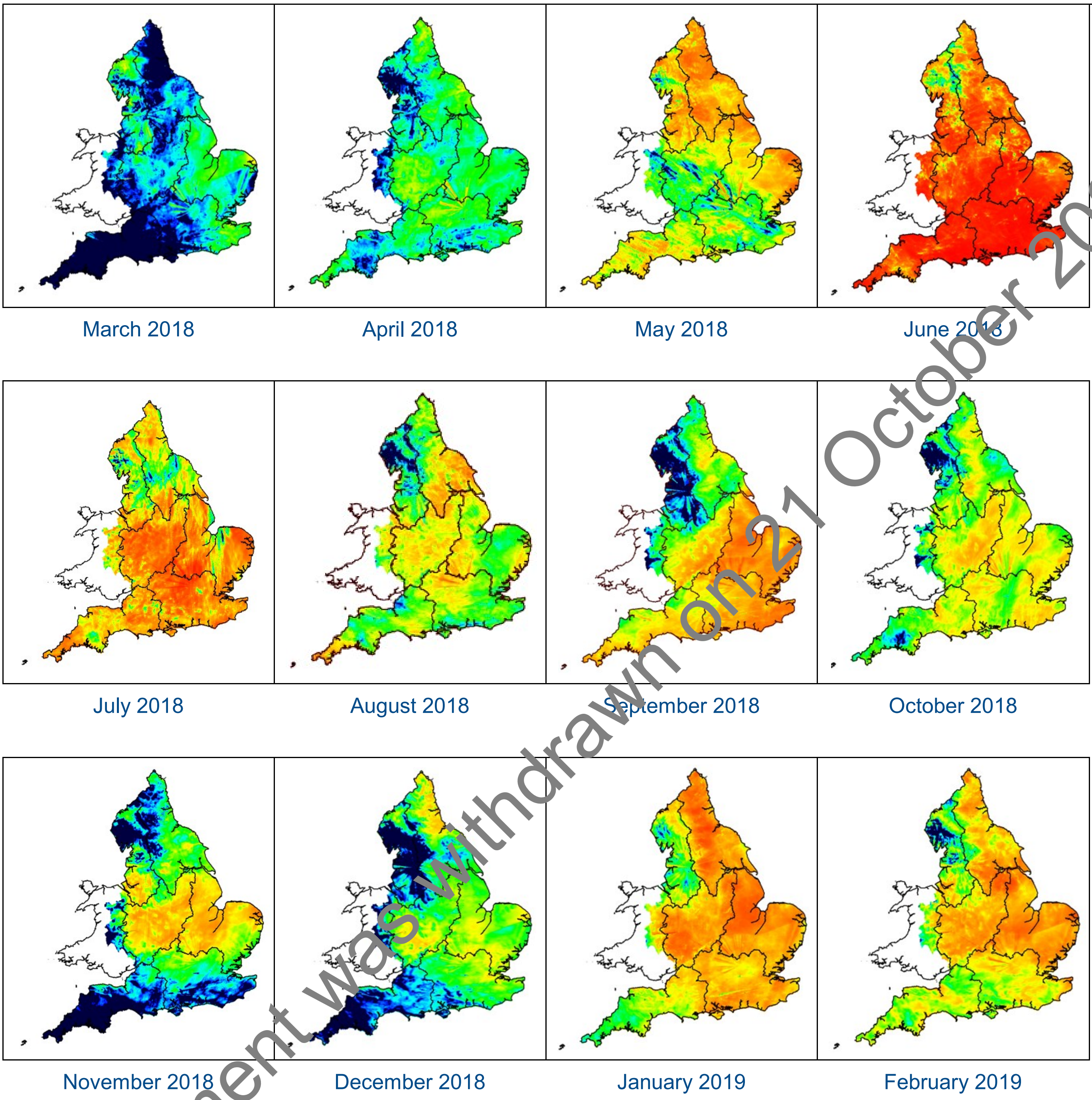
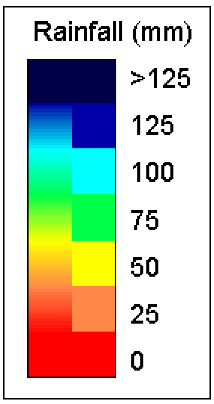


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



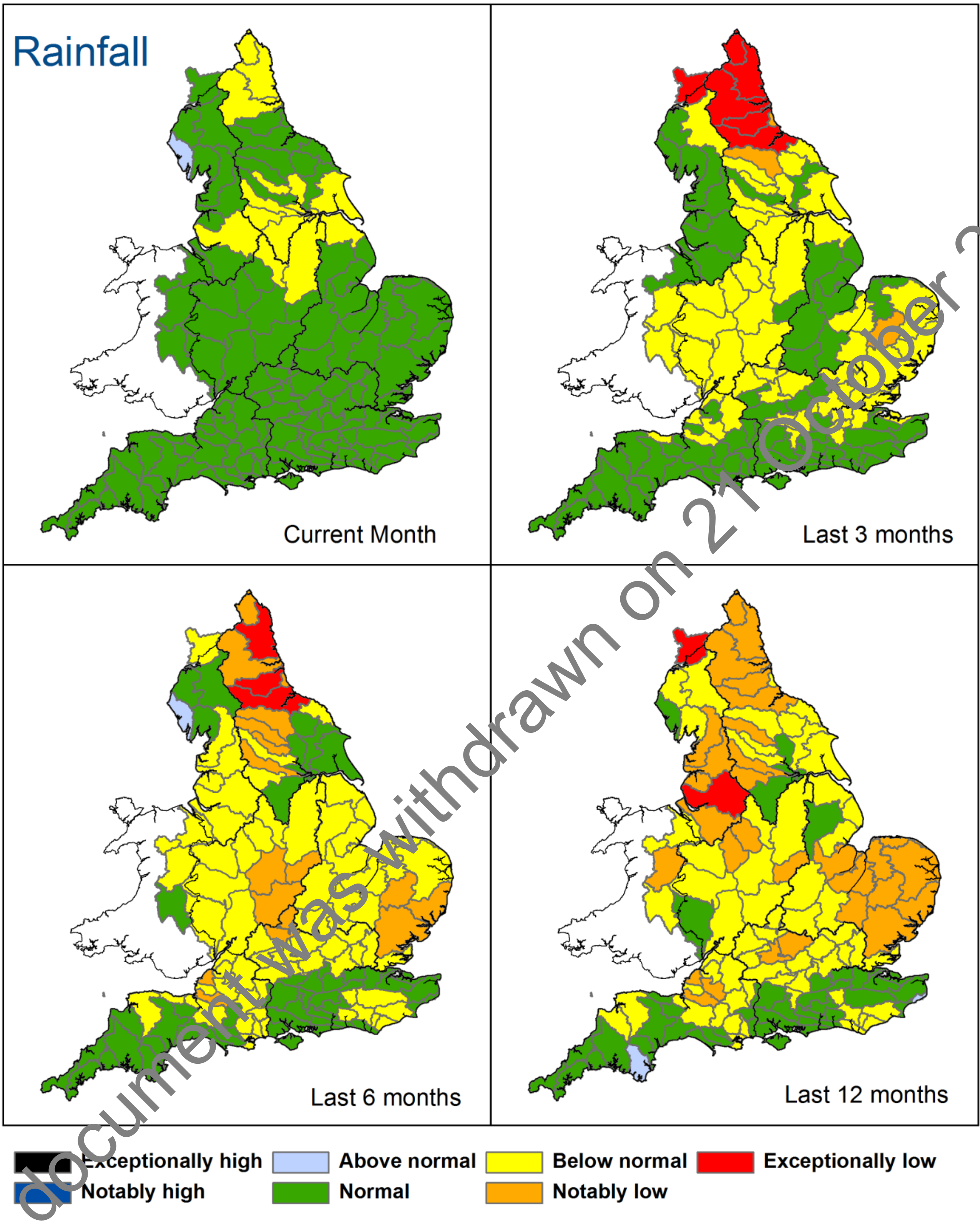


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 28 February), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2019).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

Rainfall charts

Above average rainfall

Below average rainfall

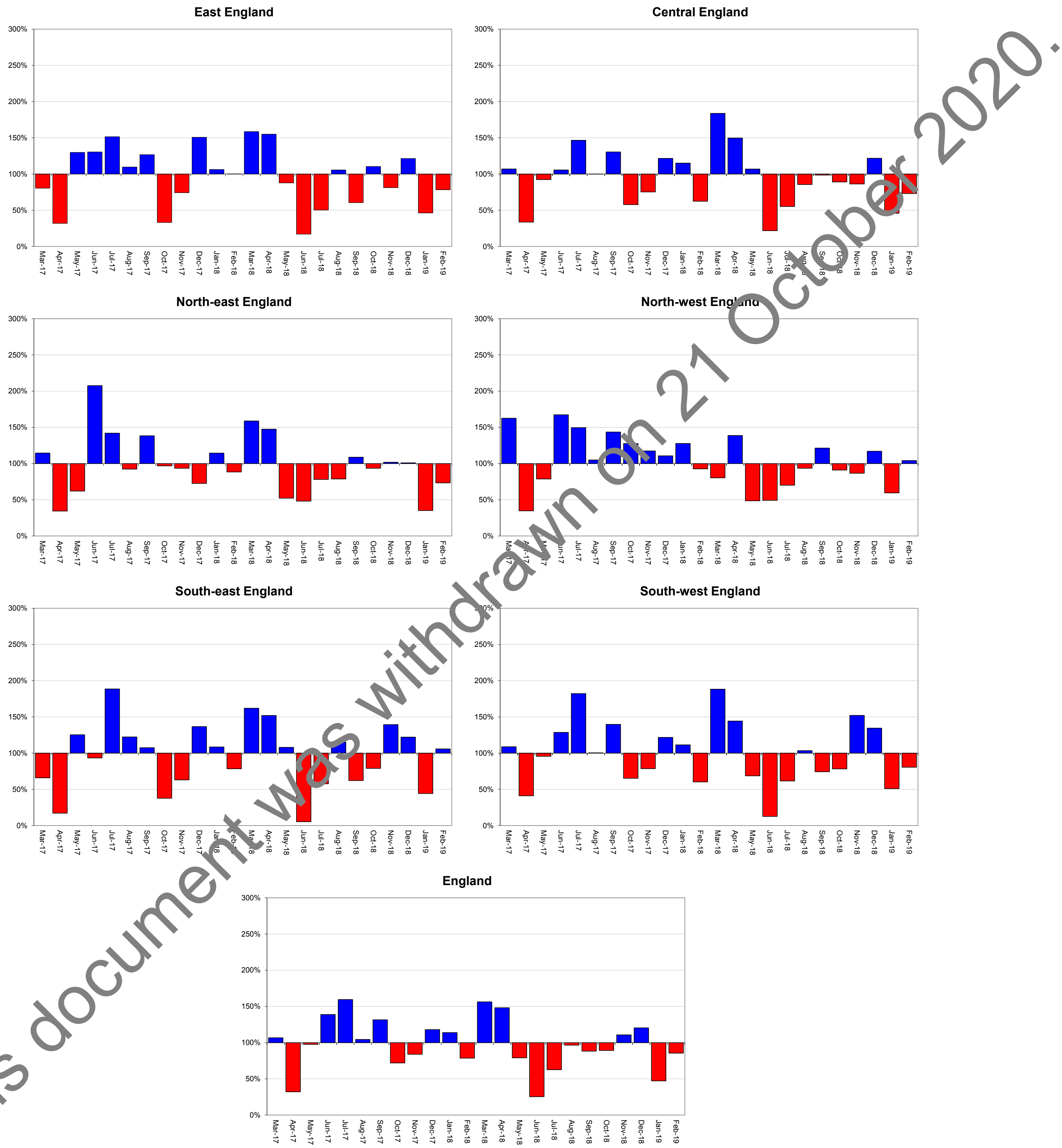


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of January 2019[1]	End of February 2019[2]

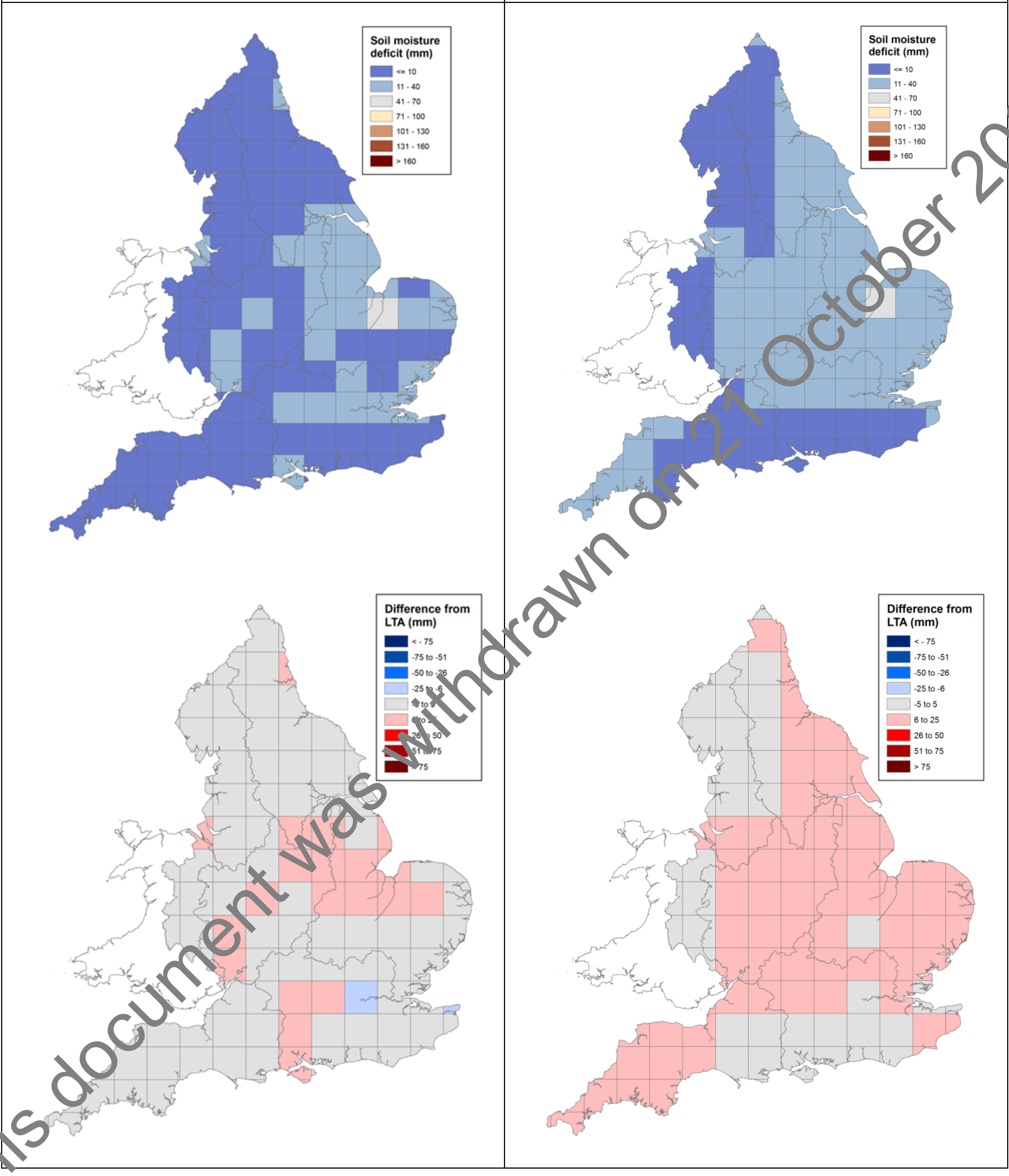
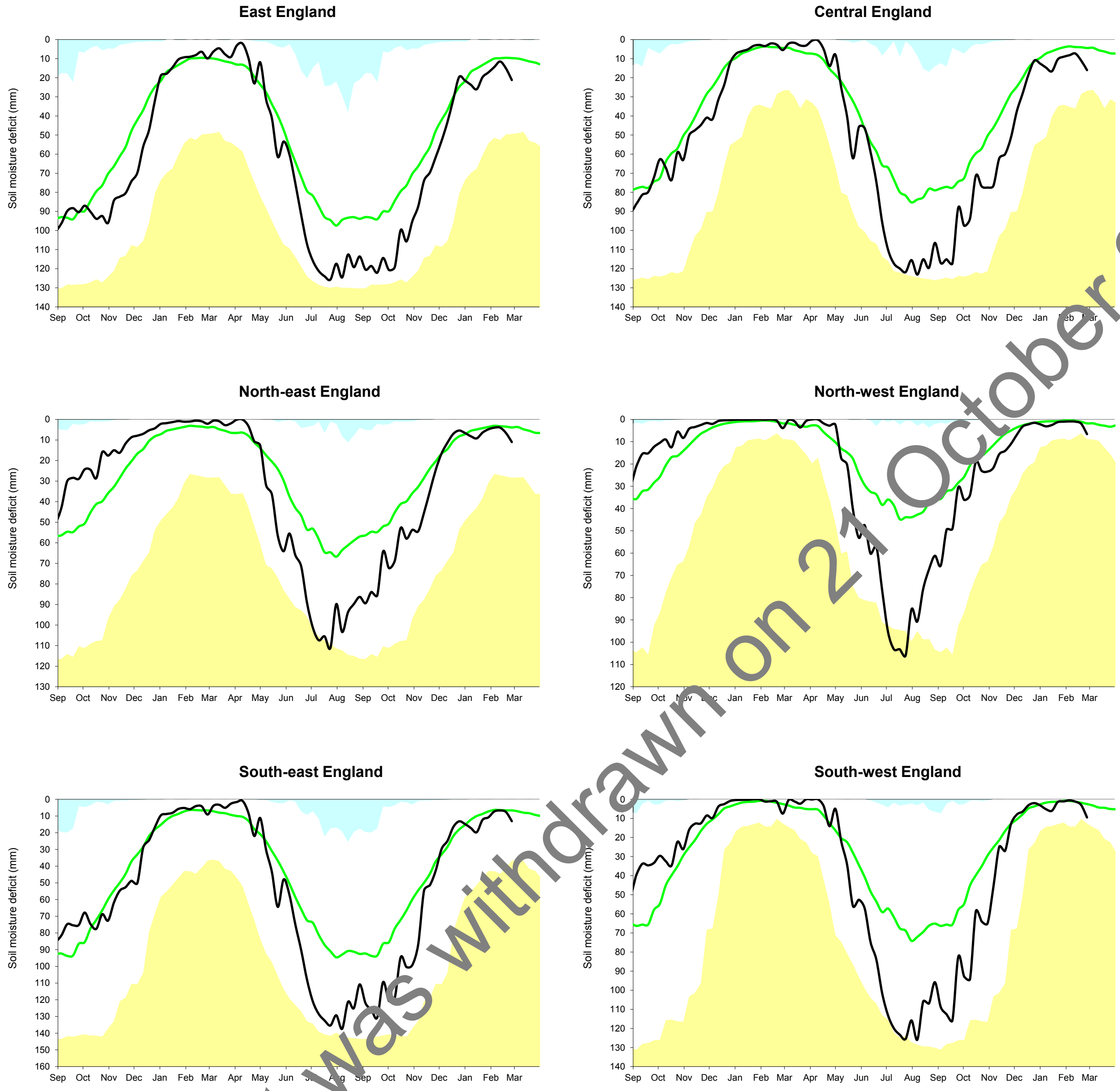


Figure 2.1: Soil moisture deficits for weeks ending 29 January 2019 [1] (left panel) and 26 February 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

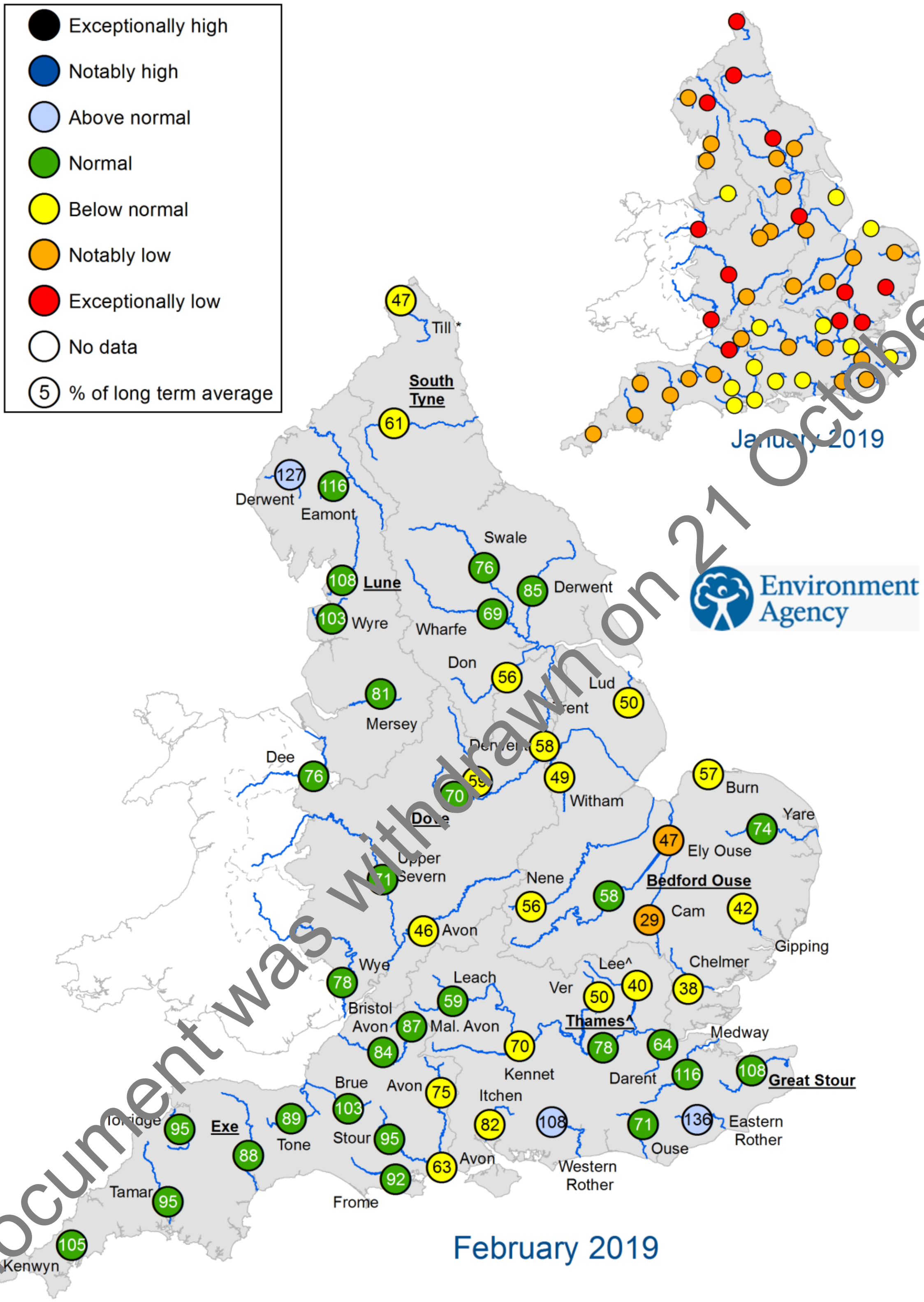
Soil moisture deficit charts



	Below minimum monthly level		Above maximum monthly level		Average		Latest data

Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

River flows



^ "Naturalised" flows are provided for the River Thames at Kingston and the River Lee at Feildes Weir

Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for January 2019 and February 2019, expressed as a percentage of the respective long term average and classed relative to an analysis of historic January and February monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

River flow charts

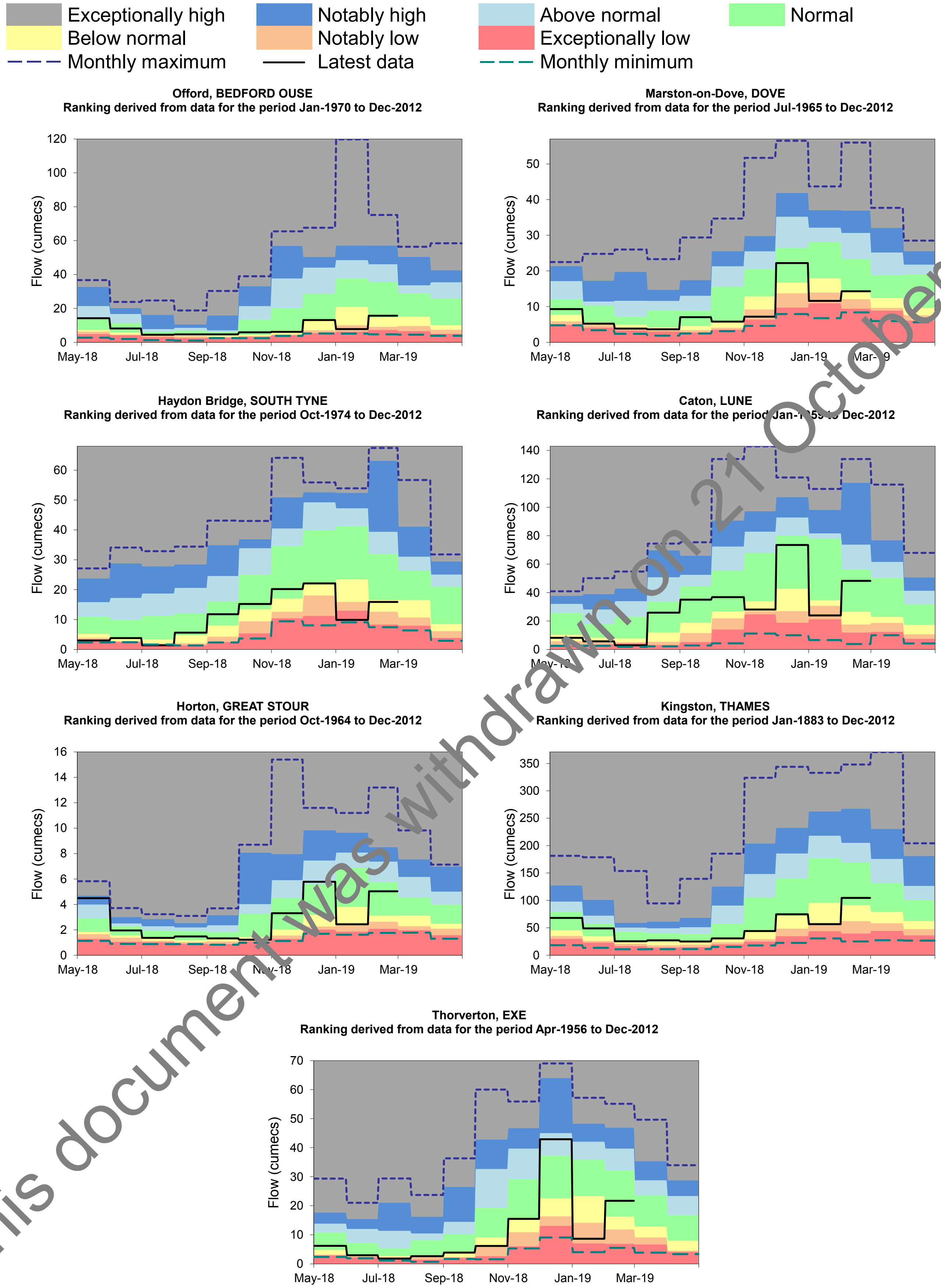
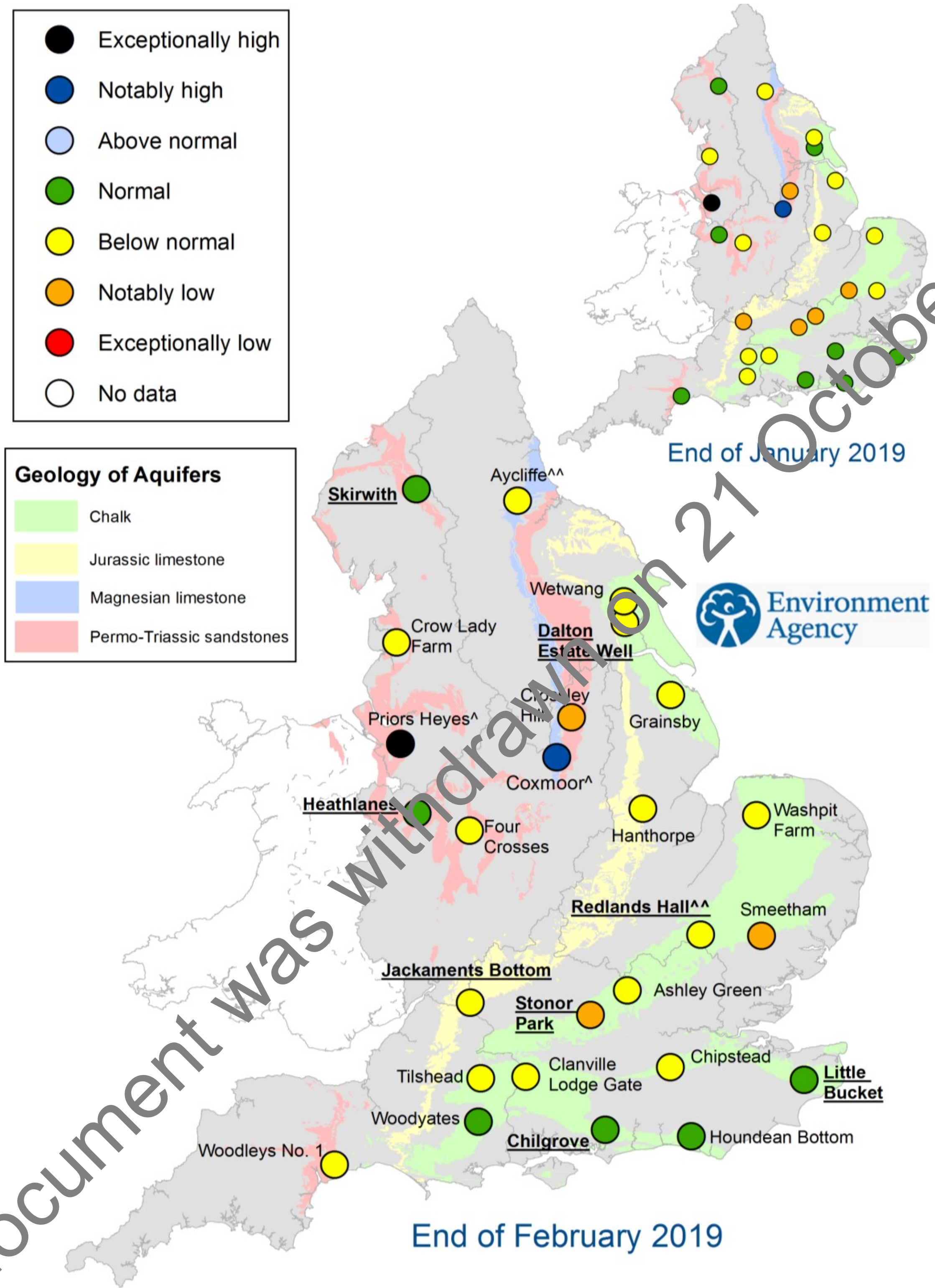


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

Groundwater levels



^ The levels at Priors Heyes and Coxmoor remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction

^^ Sites are manually dipped at different times during the month. They may not be fully representative of levels at the month end

Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of January 2019 and February 2019, classed relative to an analysis of respective historic January and February levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

Groundwater level charts

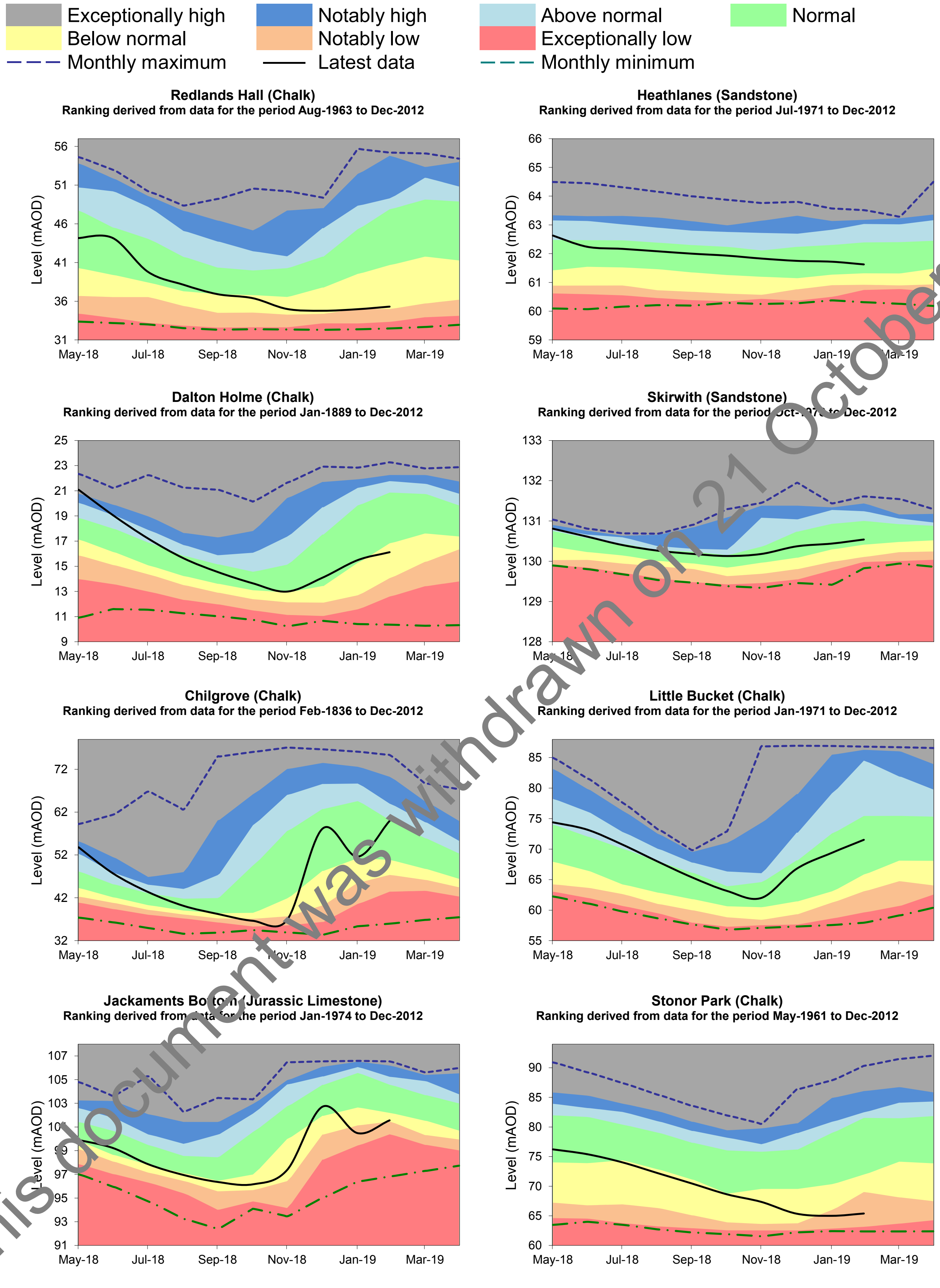
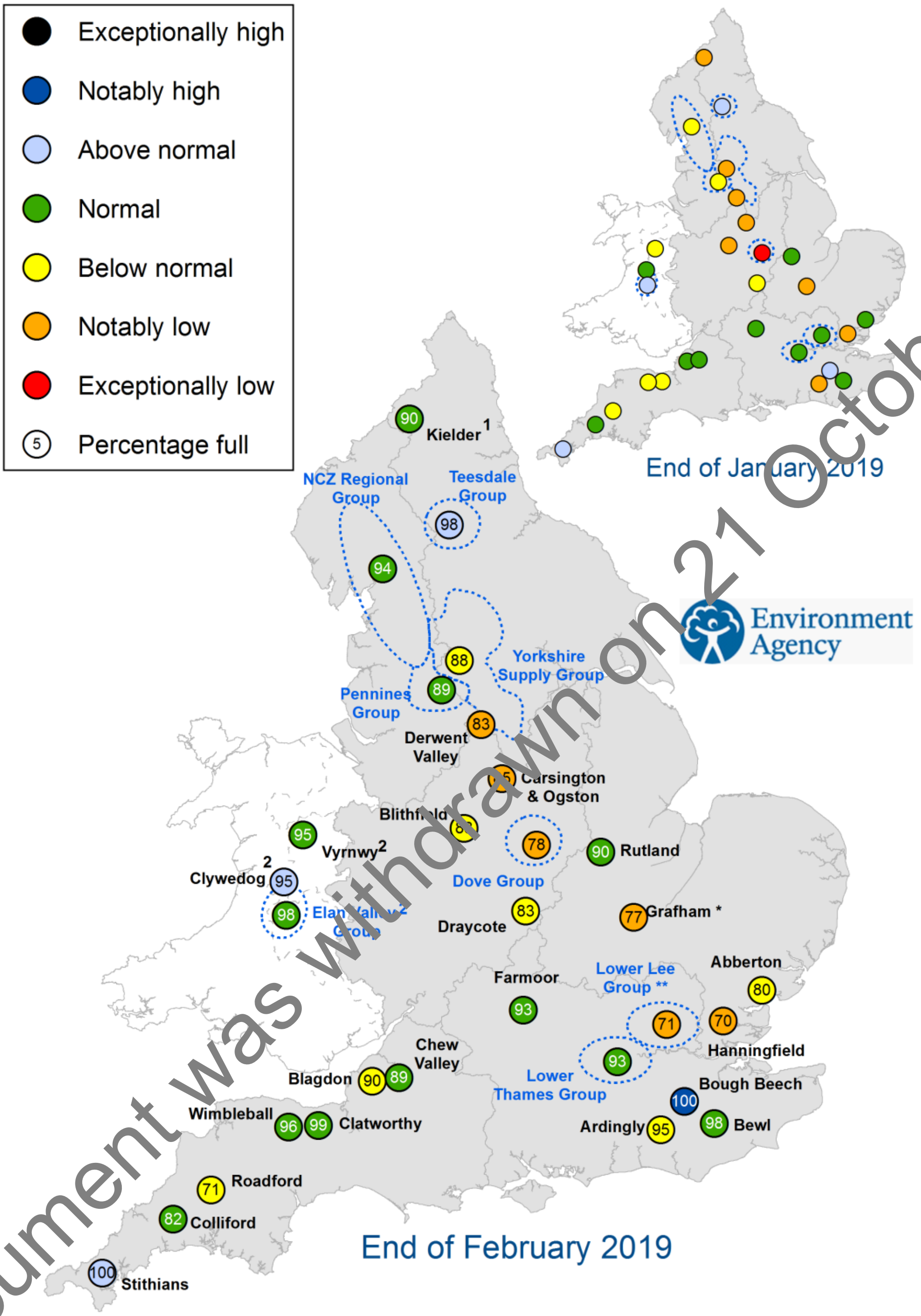


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

Reservoir storage



1. Current levels at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England
* Levels at Grafham affected by engineering works in late 2018.
** Maintenance of the Thames Lee Tunnel since mid-January has resulted in the reservoirs being drawn down.

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of January 2019 and February 2019 as a percentage of total capacity and classed relative to an analysis of historic January and February values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

Reservoir storage charts

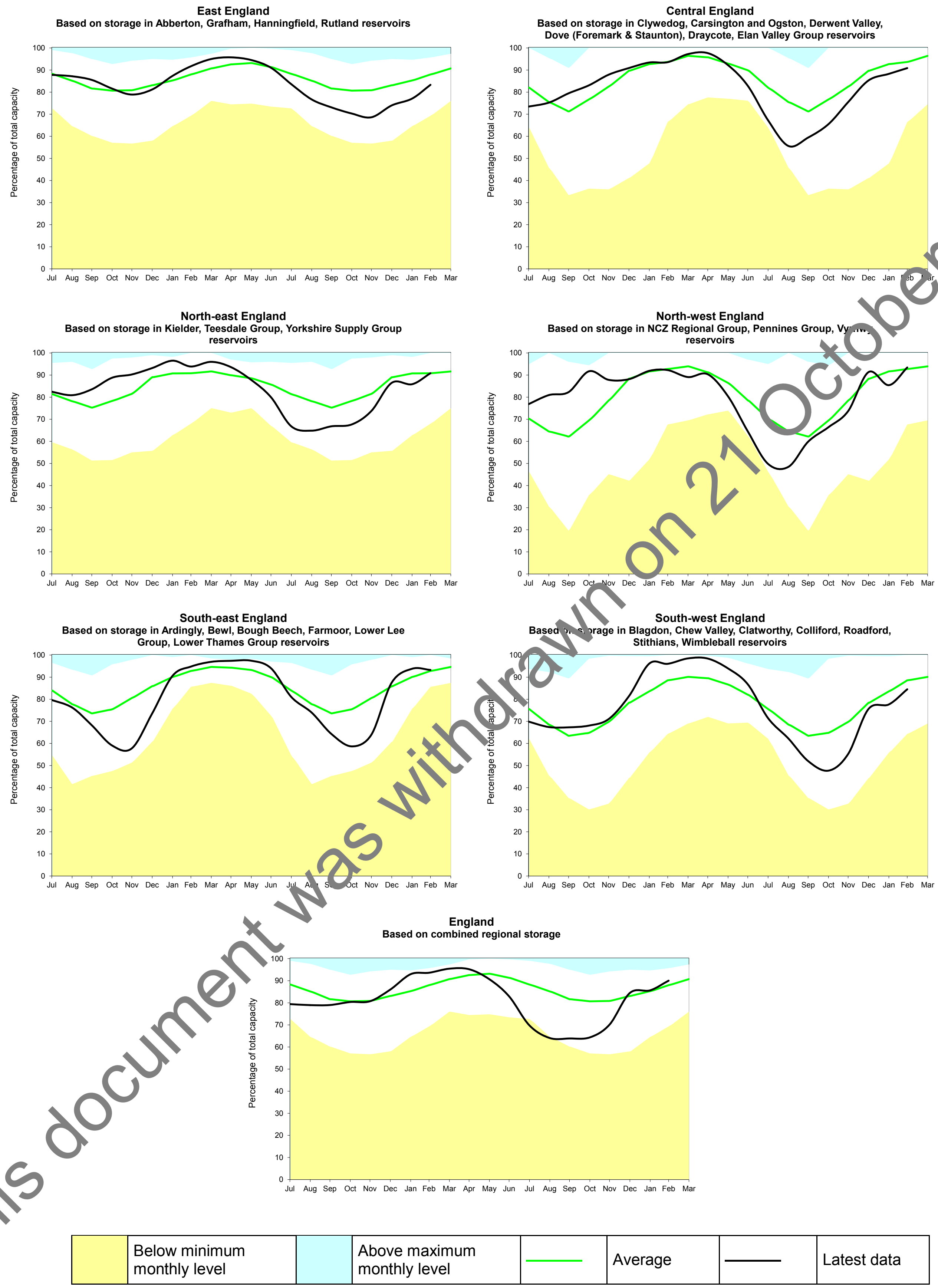


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

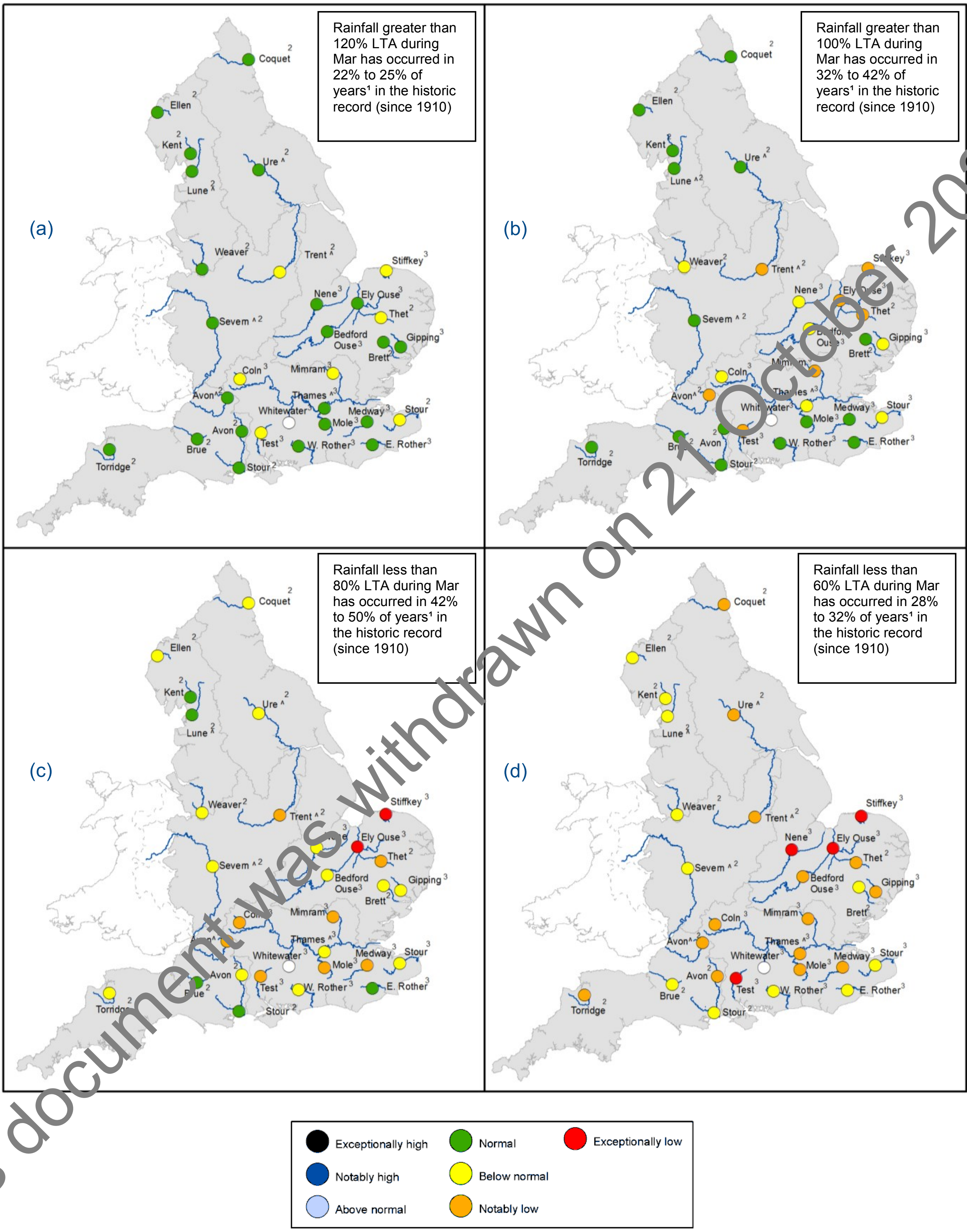


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during March 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by CEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*

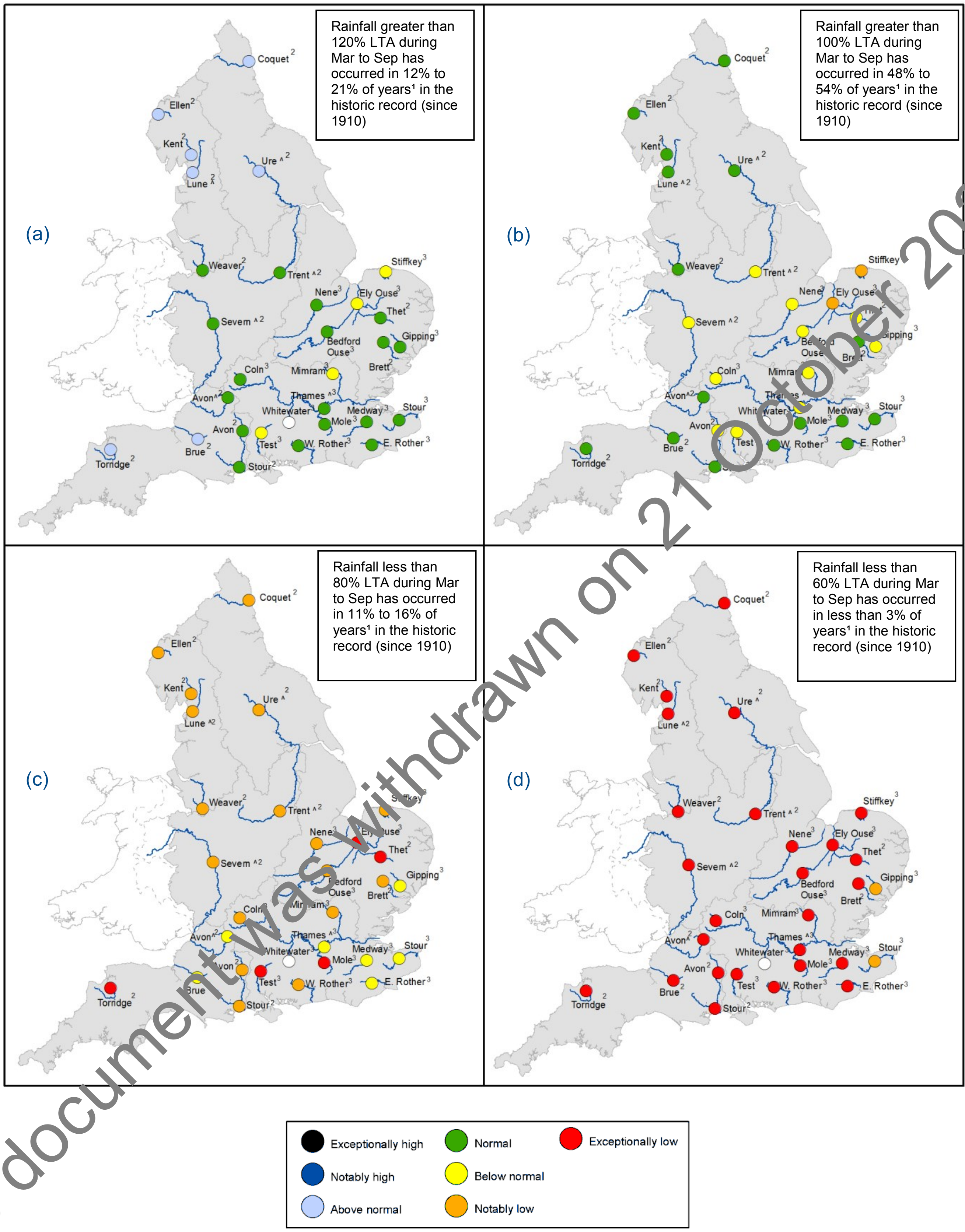


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between March and September 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

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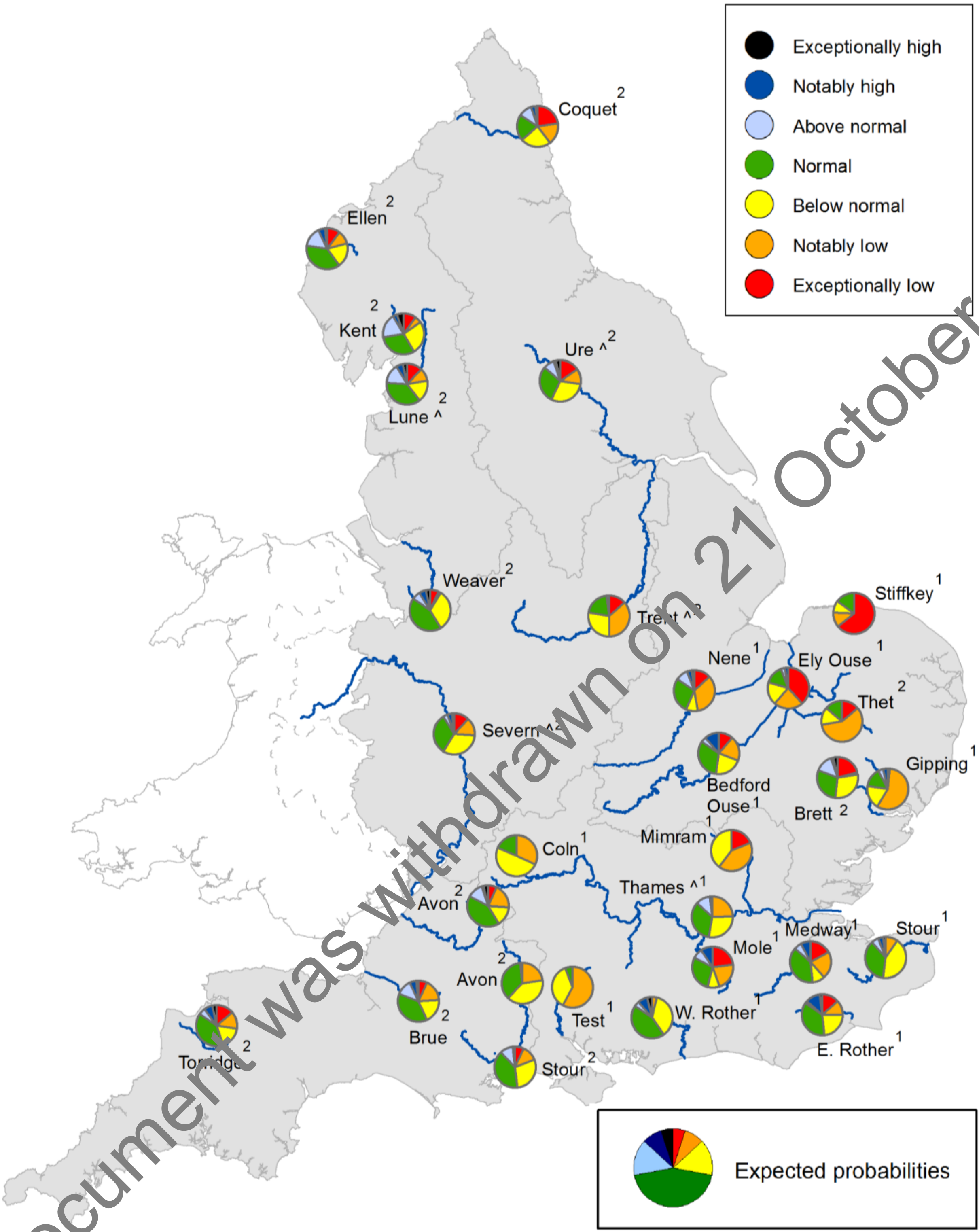

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2019. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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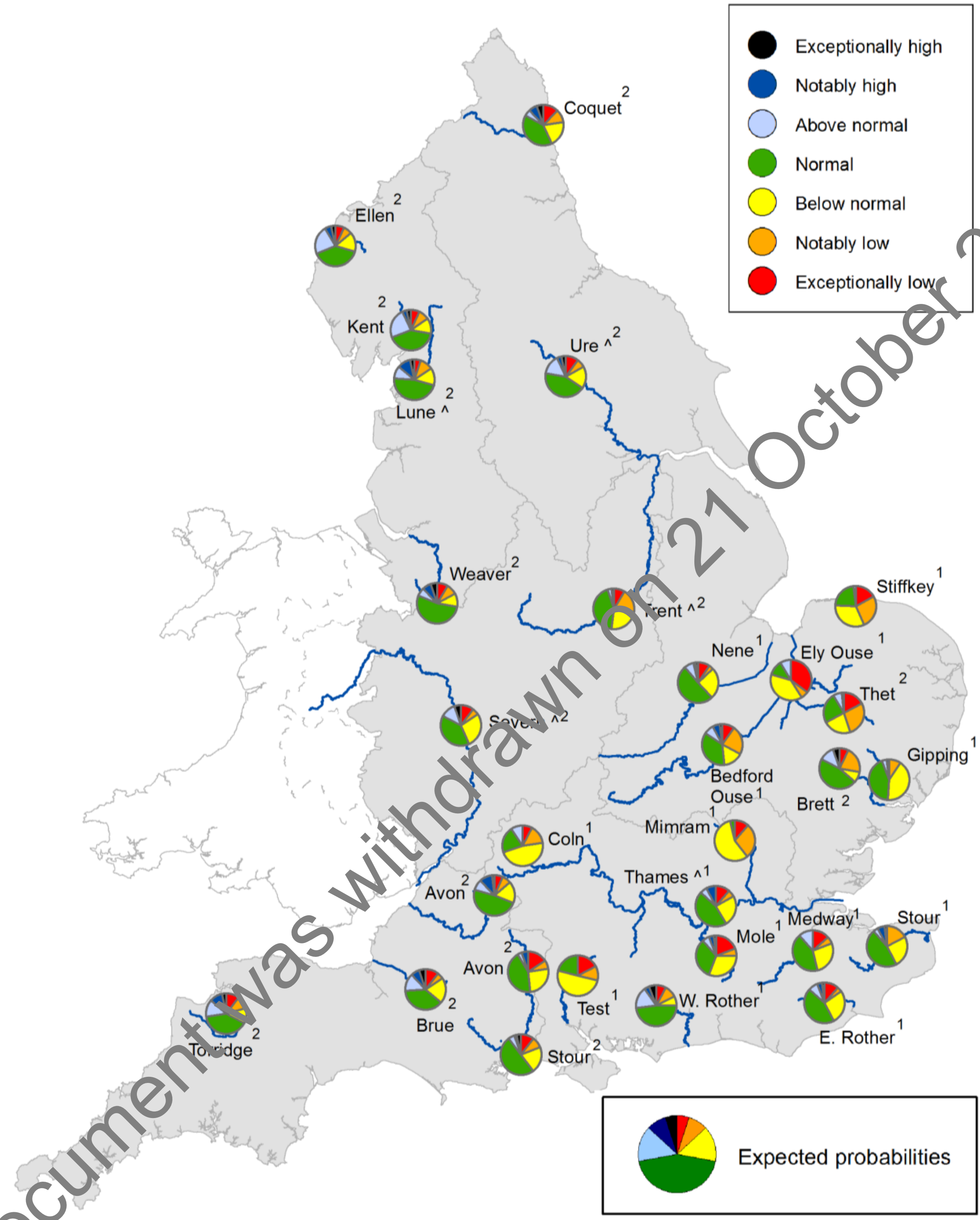


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2019. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[1] Projections for these sites are produced by the Environment Agency
[2] Projections for these sites are produced by CEH
^"Naturalised" flows are projected for these sites

Forward look - groundwater

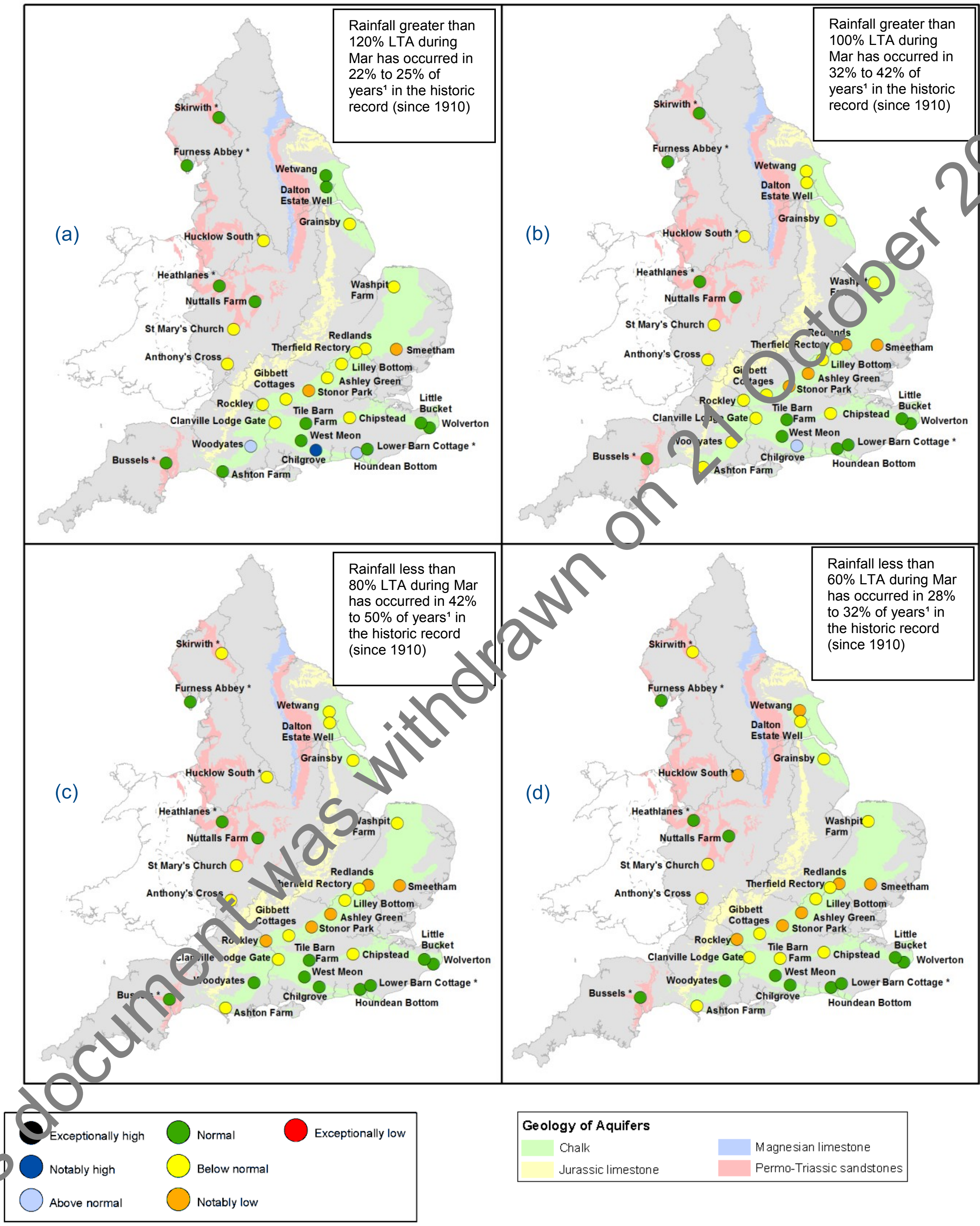


Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during March 2019 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2019.

* Projections for these sites are produced by BGS
¹ This range of probabilities is a regional analysis

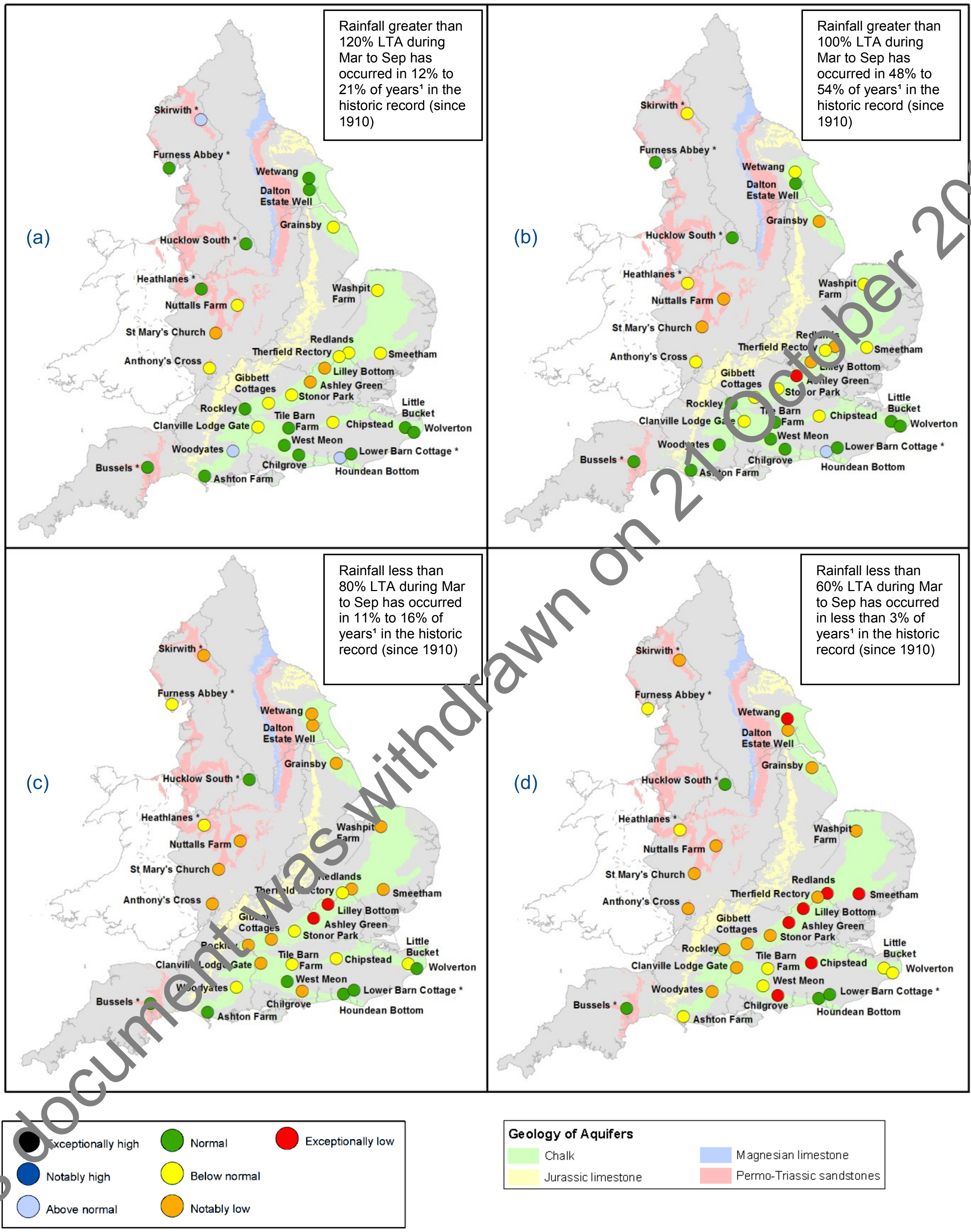
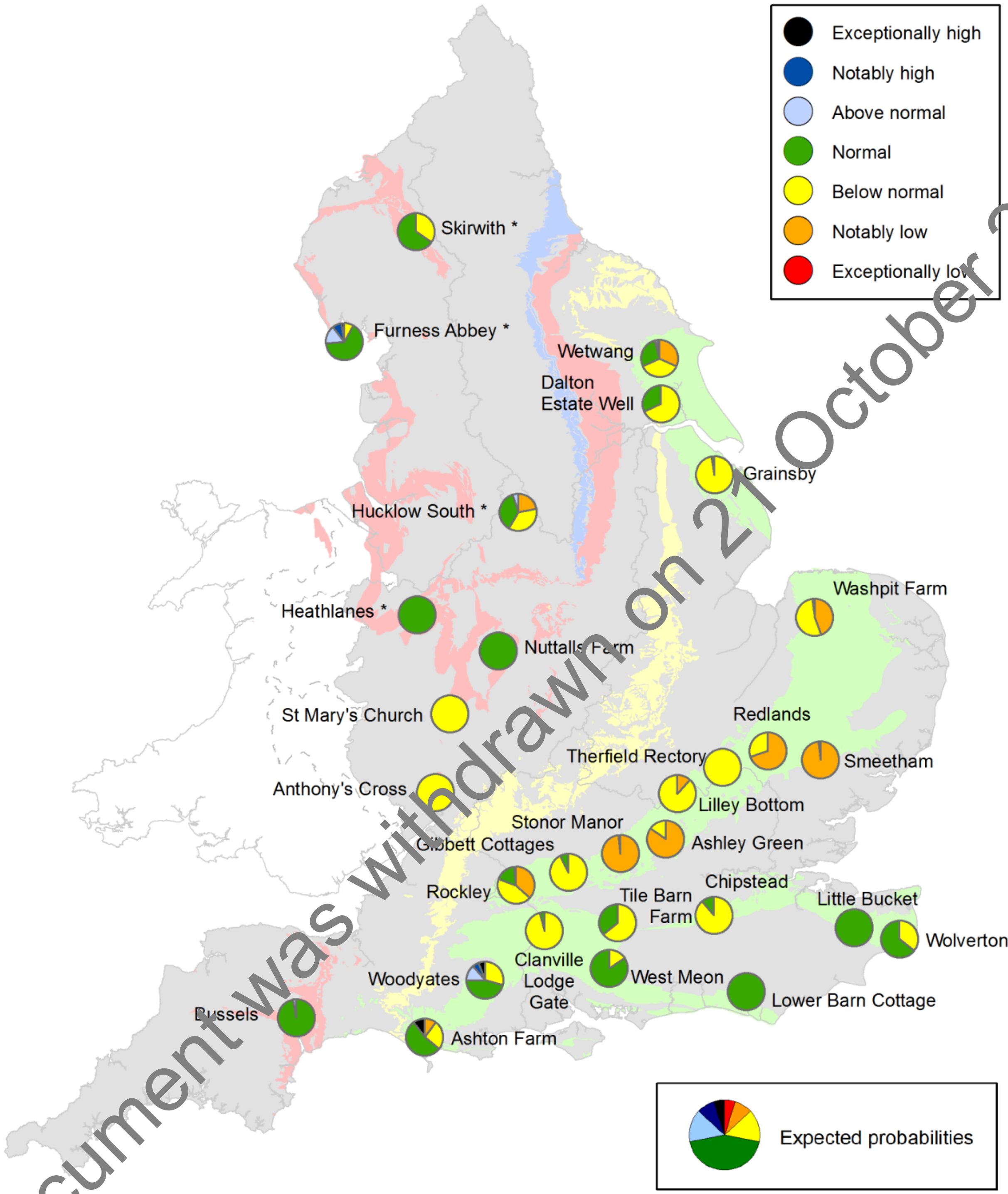


Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between March and September 2019 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2019.

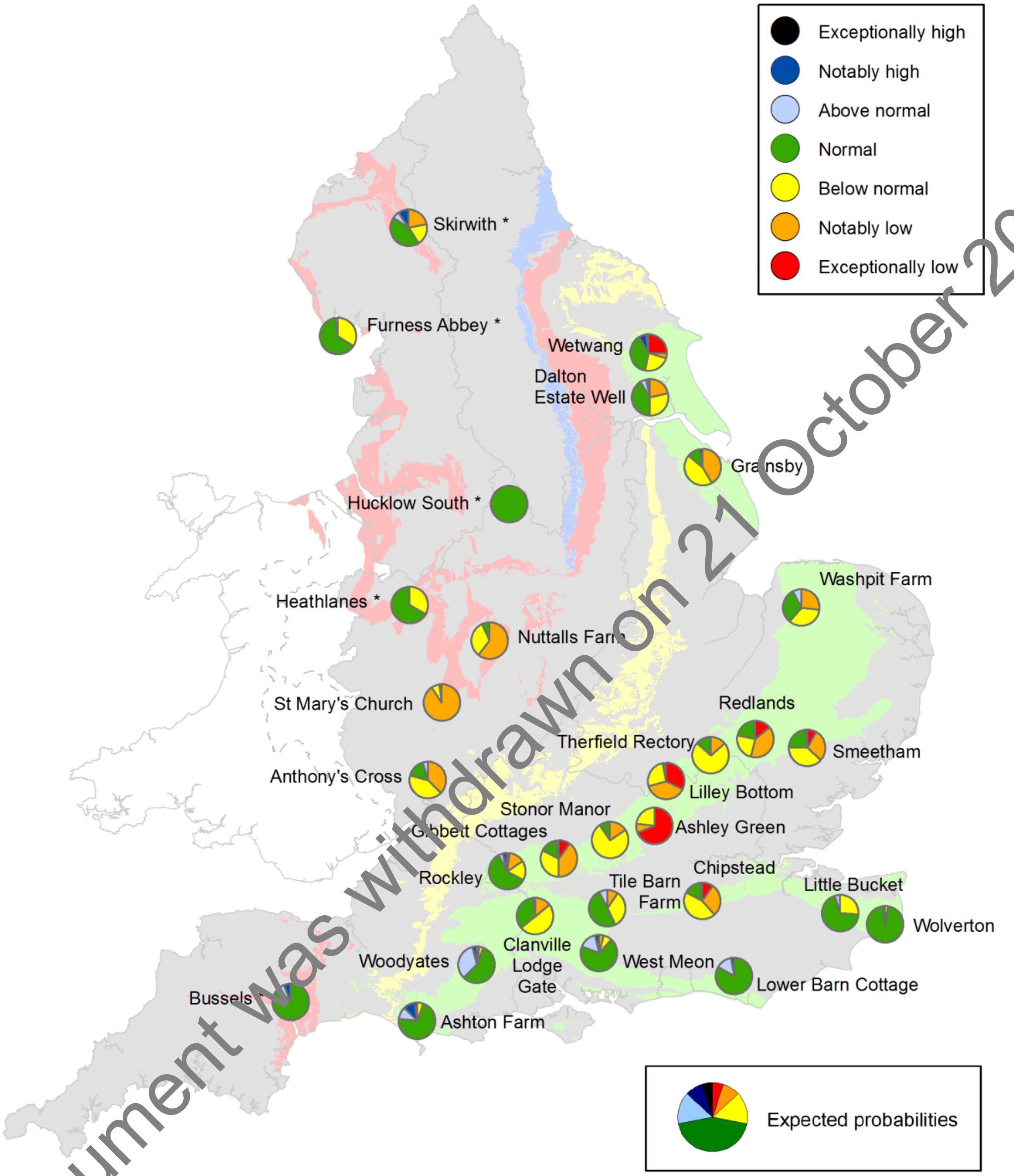
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2019. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

* Projections for these sites are produced by BGS



Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2019. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

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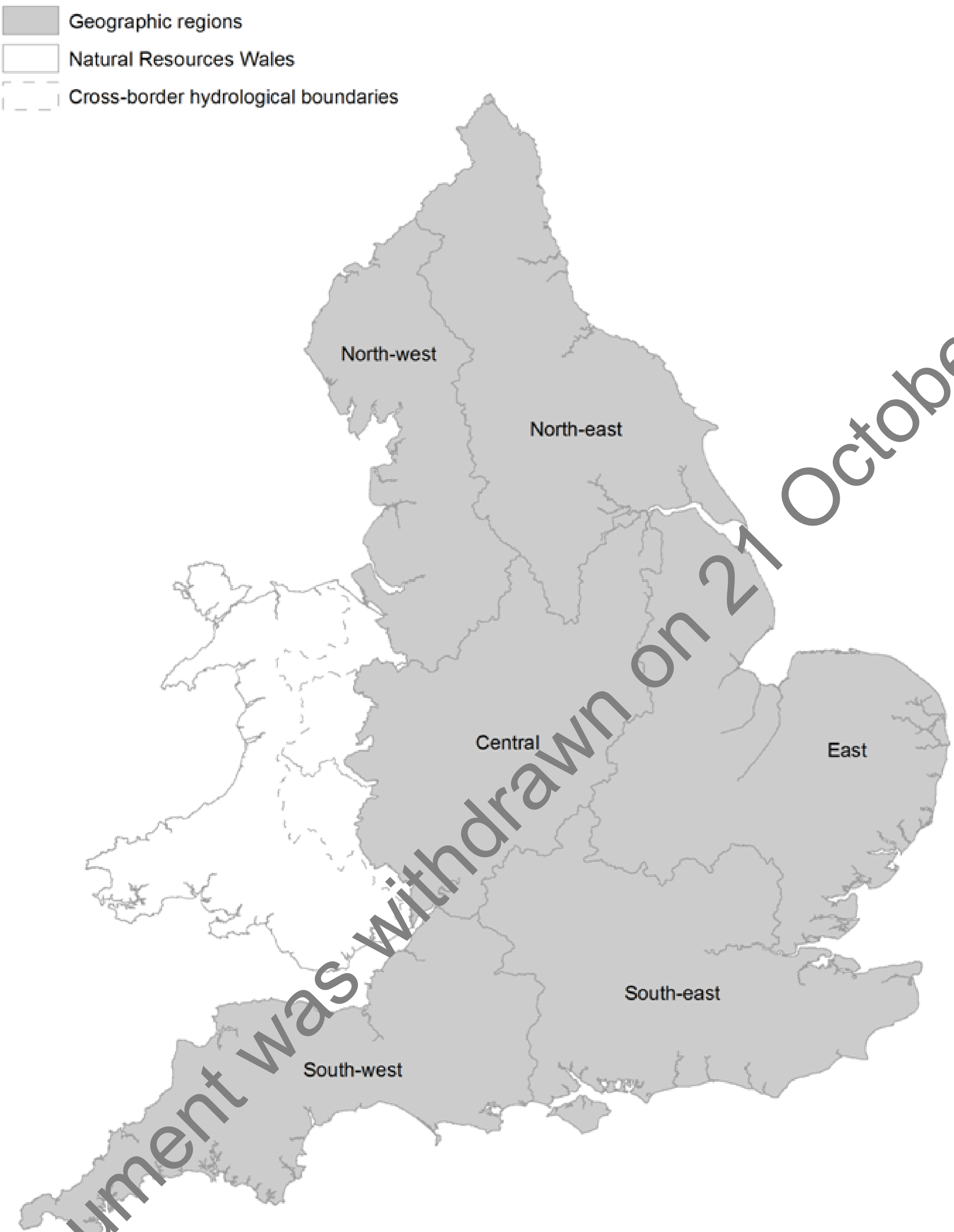

Figure 7.1: Geographic regions

Glossary

Term	Definition
Aquifer	A geological formation able to store and transmit water.
Areal average rainfall	The estimated average depth of rainfall over a defined area. Expressed in depth of water (mm).
Artesian	The condition where the groundwater level is above ground surface but is prevented from rising to this level by an overlying continuous low permeability layer, such as clay.
Artesian borehole	Borehole where the level of groundwater is above the top of the borehole and groundwater flows out of the borehole when unsealed.
Cumecs	Cubic metres per second (m^3s^{-1})
Effective rainfall	The rainfall available to percolate into the soil or produce river flow. Expressed in depth of water (mm).
Flood Alert/Flood Warning	Three levels of warnings may be issued by the Environment Agency. Flood Alerts indicate flooding is possible. Flood Warnings indicate flooding is expected. Severe Flood Warnings indicate severe flooding.
Groundwater	The water found in an aquifer.
Long term average (LTA)	The arithmetic mean, calculated from the historic record. For rainfall and soil moisture deficit, the period refers to 1961-1990, unless otherwise stated. For other parameters, the period may vary according to data availability
mAOD	Metres Above Ordnance Datum (mean sea level at Newlyn Cornwall).
MORECS	Met Office Rainfall and Evaporation Calculation System. Met Office service providing real time calculation of evapotranspiration, soil moisture deficit and effective rainfall on a 40 x 40 km grid.
Naturalised flow	River flow with the impacts of artificial influences removed. Artificial influences may include abstractions, discharges, transfers, augmentation and impoundments.
NCIC	National Climate Information Centre. NCIC area monthly rainfall totals are derived using the Met Office 5 km gridded dataset, which uses rain gauge observations.
Recharge	The process of increasing the water stored in the saturated zone of an aquifer. Expressed in depth of water (mm).
Reservoir gross capacity	The total capacity of a reservoir.
Reservoir live capacity	The capacity of the reservoir that is normally usable for storage to meet established reservoir operating requirements. This excludes any capacity not available for use (e.g. storage held back for emergency services, operating agreements or physical restrictions). May also be referred to as 'net' or 'deployable' capacity.
Soil moisture deficit (SMD)	The difference between the amount of water actually in the soil and the amount of water the soil can hold. Expressed in depth of water (mm).

Categories

Exceptionally high	Value likely to fall within this band 5% of the time
Notably high	Value likely to fall within this band 8% of the time
Above normal	Value likely to fall within this band 15% of the time
Normal	Value likely to fall within this band 44% of the time
Below normal	Value likely to fall within this band 15% of the time
Notably low	Value likely to fall within this band 8% of the time
Exceptionally low	Value likely to fall within this band 5% of the time