Monthly water situation report

England

Summary – September 2019

The September rainfall total for England represented 151% of the long-term average, with the highest rainfall totals in parts of Lancashire, Cumbria and Devon. By the end of the month, soils were wetter than average across the majority of the country. Monthly mean river flows for September were classed as normal or above normal at over three-quarters of the sites we report on and lower than normal at approximately a quarter of our sites. End of month groundwater levels were classed as lower than normal at approximately two-thirds of the sites we report on. Total reservoir stocks were at 82% capacity at the end of September.

Rainfall

The September rainfall total for England was 107.5 mm, representing 151% of the 1961-90 long term average LTA (154% of the 1981-2010 LTA). The highest September rainfall totals were in parts of Lancashire, Cumbria and Devon, with lowest totals in parts of Kent (Figure 1.1).

September rainfall totals were the 4th highest on record (records from 1891) for the Ribble catchment in Lancashire and classed as exceptionally high for the time of year. Across most of England rainfall totals were above normal or higher for the time of year, with the exception of several catchments in east and south-east England which were classed as normal. Despite this, in parts of south-east and east England, the cumulative rainfall totals for the last 12 months remain below normal (Figure 1.2).

At a regional scale, September rainfall totals were above normal or higher in all regions. East England and south-east England were the driest regions, receiving 139% and 121% of LTA, respectively and were classed as above normal. Rainfall totals for all other regions were classed as notably high, ranging from 161% of the LTA in south-west and north-west England, to 166% of the LTA in north-east England (Figure 1.3). For north-west England, this was the 8th wettest September on record (records from 1891) and the past 6 months (April to September) were the 3rd wettest on record. For England it is the 4th consecutive month of above average rainfall (Figure 1.3).

Soil moisture deficit

Soils became wetter during September across the majority of the country in contrast with August (during which soils became drier across most of the country). By the end of September, soil moisture deficits (SMDs) were lower than average (soils were wetter than average) with the exception of the very east of the country. The SMD reflects the distribution of rainfall across the country, with SMDs still highest (soils driest) in the east (Figure 2.1).

At a regional scale SMDs increased in the middle of September across all regions before decreasing again in response to rainfall towards the end of the month. By the end of the September, soils were wetter than average in all regions (Figure 2.2).

River flows

Monthly mean river flows for September increased at most indicator sites in south-west England relative to August, but decreased at between one-half and two-thirds of indicator sites in the all other regions (Figure 3.1).

September monthly mean river flows were classed as normal at just under a third of indicator sites, with approximately a quarter of sites lower than normal. Of these, 3 were classed as exceptionally low, all within east England. For the 7th consecutive month monthly mean flows on the River Cam (Cambridgeshire) were classed as exceptionally low – for the last 13 months flows here have been classed as either exceptionally low or notably low. At nearly half of indicator sites monthly mean river flows were classed as above normal or higher. Of these, one site was classed as exceptionally high – the River Wyre (Lancashire) in north-west England (Figure 3.1).

At the regional index sites, monthly mean flows were classed as below normal for September at the Bedford Ouse at Offord in east England and notably low at the Great Stour at Horton in south-east England. Flows at the rest of the index sites in south- west, south-east, central, north-west and north-east were classed as normal or notably high (Figure 3.2).

Groundwater levels

Groundwater levels were in recession during September at over three-quarters of indicator sites – falling groundwater levels were mainly in chalk aquifers while rising levels were mainly in sandstone aquifers. End of month groundwater levels were classed as lower than normal at approximately two-thirds of indicator sites – a slightly higher proportion than at the end of August. 8 of these sites were classed as notably low or exceptionally low at the end of September, of which 6 were in chalk aquifers (Figure 4.1).

At the major aquifer index sites, the end of month groundwater levels were classed as lower than normal at 5 of the 8 index sites. 2 of these sites were classed as notably low – Redlands Hall (Cam and Ely Ouse Chalk) and Stonor Park (South West Chilterns) in east and south-east England, respectively. One of these sites was classed as exceptionally low – Chilgrove (Chichester Chalk) in south-east England. The remaining 3 sandstone and limestone aquifer index sites had groundwater levels classed as normal or higher for the time of year, with Skirwith (Carlisle Basin and Eden Valley Sandstone) in the north-west classed as notably high (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at over two-thirds of reported reservoirs and reservoir groups during September. The largest decreases in reservoir stocks, as a proportion of total storage capacity, were in south-east, south-west and east England, with a 15% decrease at Hanningfield reservoir (Essex), a 13% decrease at Clatworthy reservoir (Somerset), a 12% decrease at Ardingly reservoir (West Sussex) and an 11% decrease in the Lower Thames Group. Despite this, reservoir stocks at the end of September were classed as normal or higher at over three-quarters of reservoirs and reservoir groups (Figure 5.1).

Total reservoir stocks across England were at 82% of capacity at the end of September. At a regional scale, reservoir stocks ranged from 59% of capacity in south-west England to 92% of capacity in central England. Reservoir stocks at the end of September were below average in east, south-west and south-east England, and above average in the remaining regions (Figure 5.2).

Forward look

The weather throughout October is forecast to remain generally unsettled across England. There may be some drier, more settled interludes particularly in the south and east of England in the first half of the month. The latter part of the month is likely to see changeable conditions. For the three month period October to December, above average precipitation is more likely than below average precipitation[1].

Projections for river flows at key sites[2]

Three-quarters of the modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year by the end of March 2020. By the end of September 2020, half of the modelled sites have a greater than expected chance of flows being above normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by March 2020 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2020 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2020 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2020 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Half 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 March 2020. By the end of September 2020, two-fifths of the modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2020 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2020 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2020 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2020 see Figure 6.8

Authors: National Water Resources Hydrology Team

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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

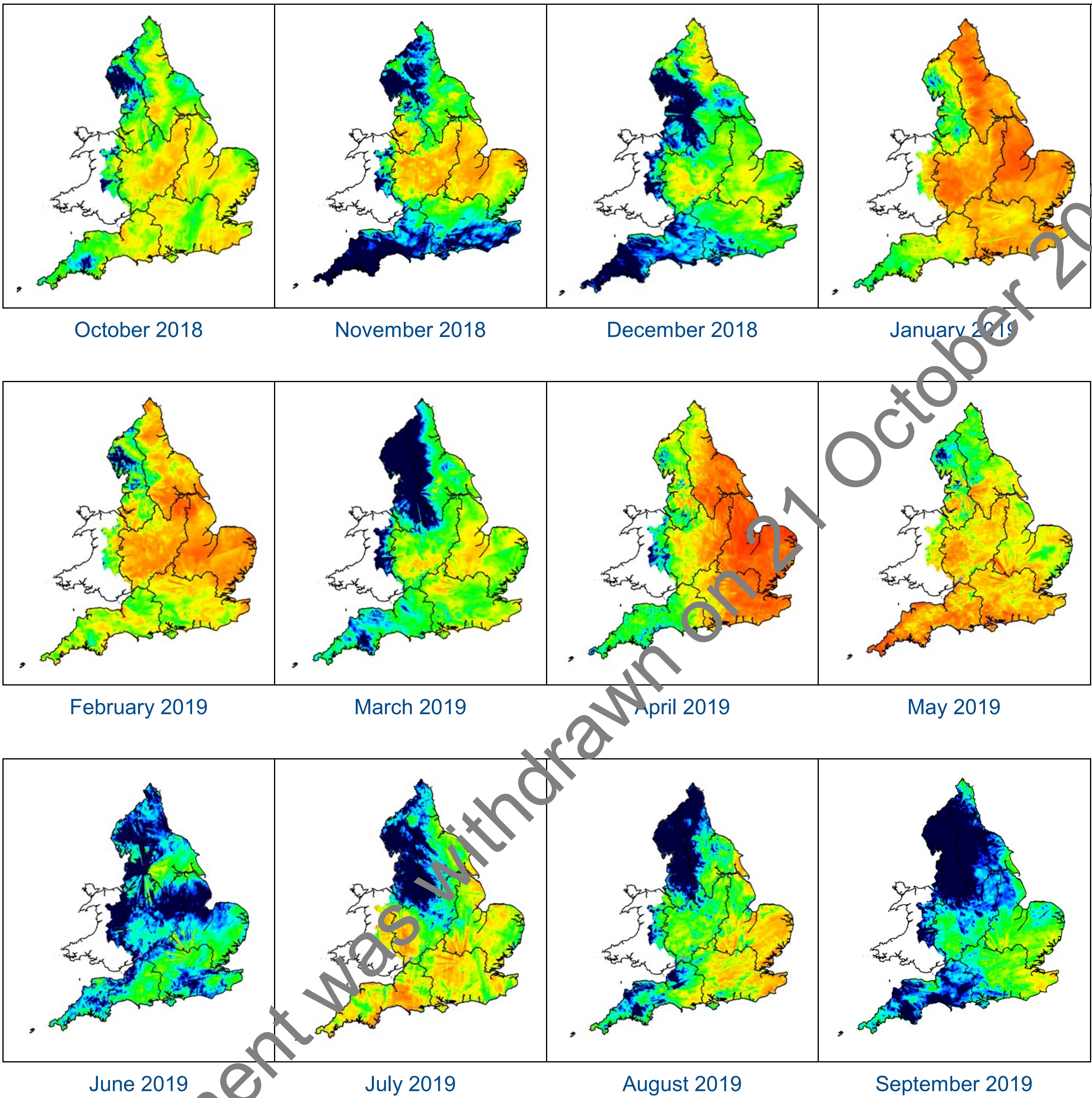
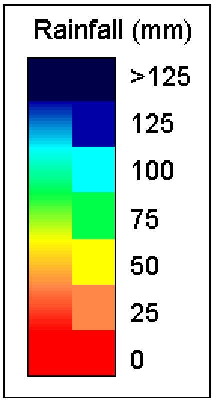


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



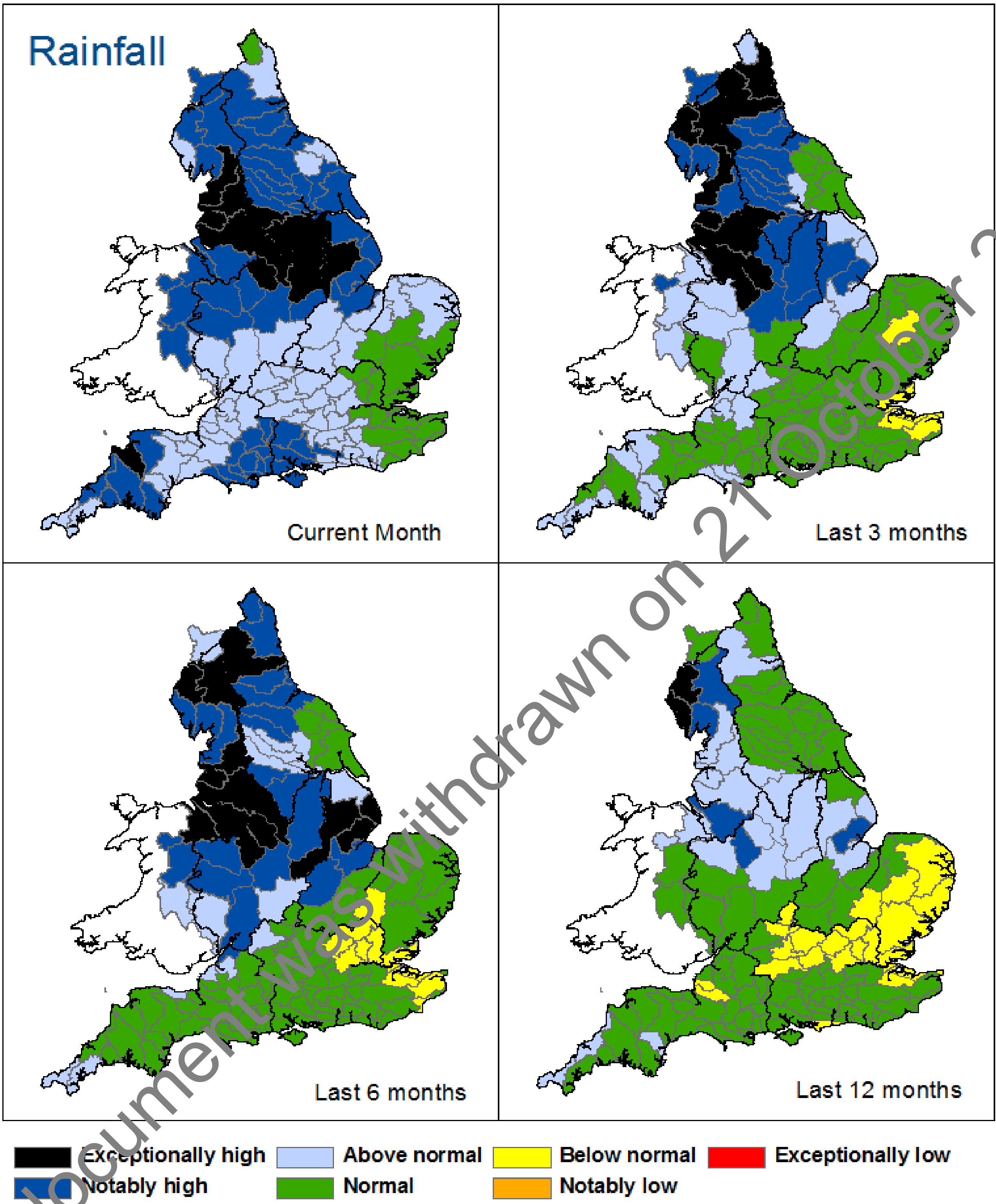


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 September), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived 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

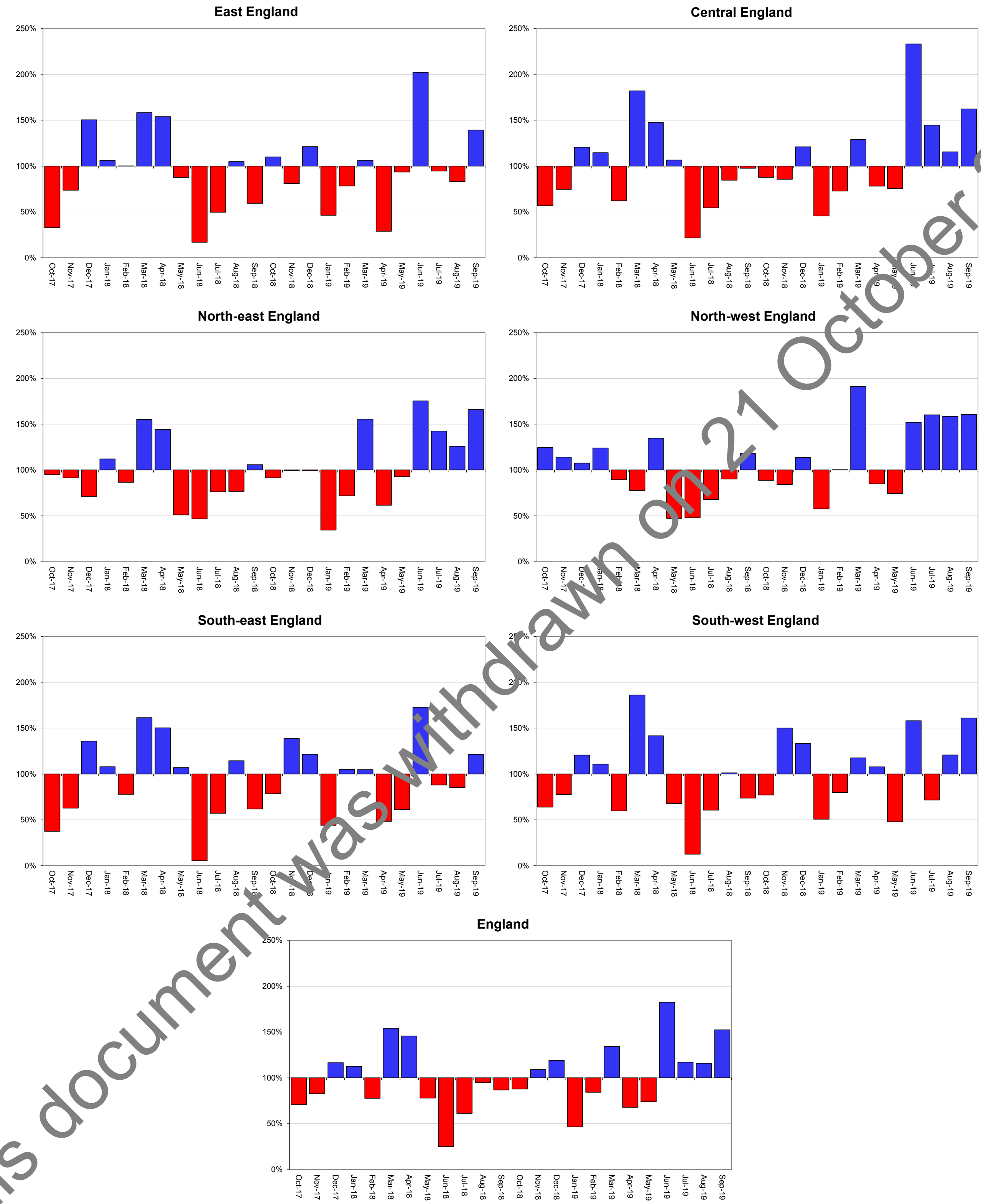


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of August 2019[1]	End of September 2019[2]

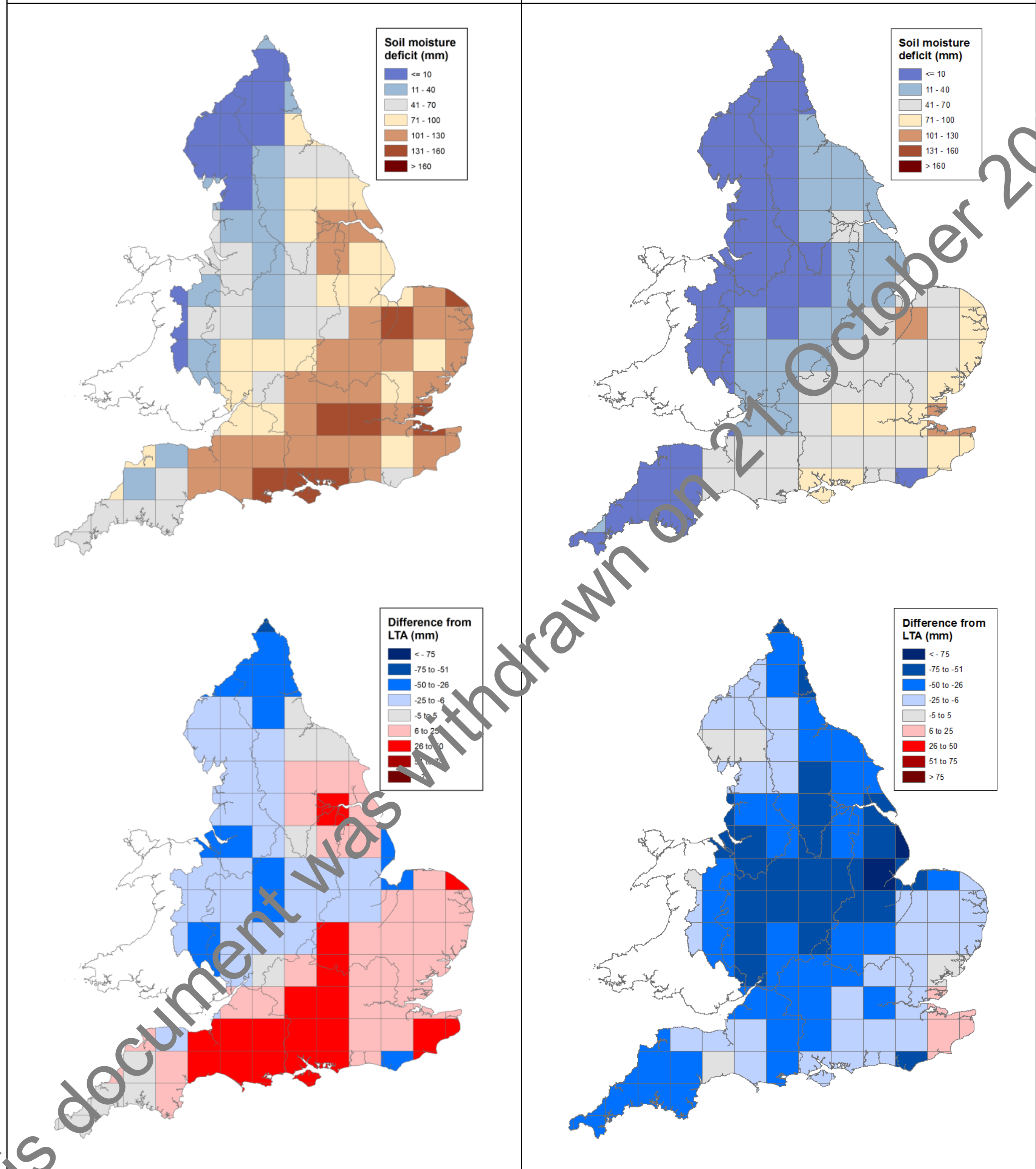


Figure 2.1: Soil moisture deficits for weeks ending 3 September 2019 [1] (left panel) and 1 October 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

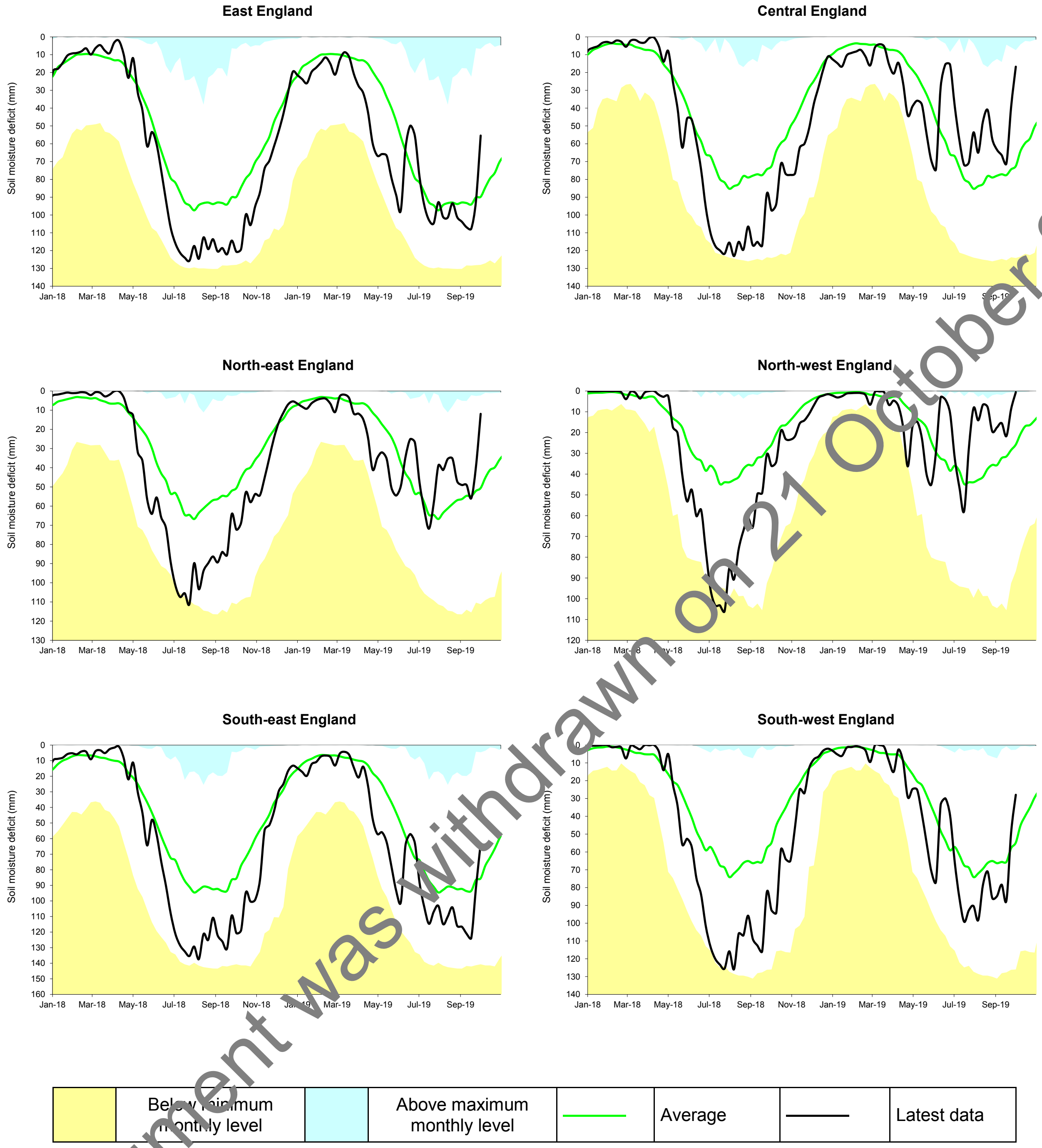
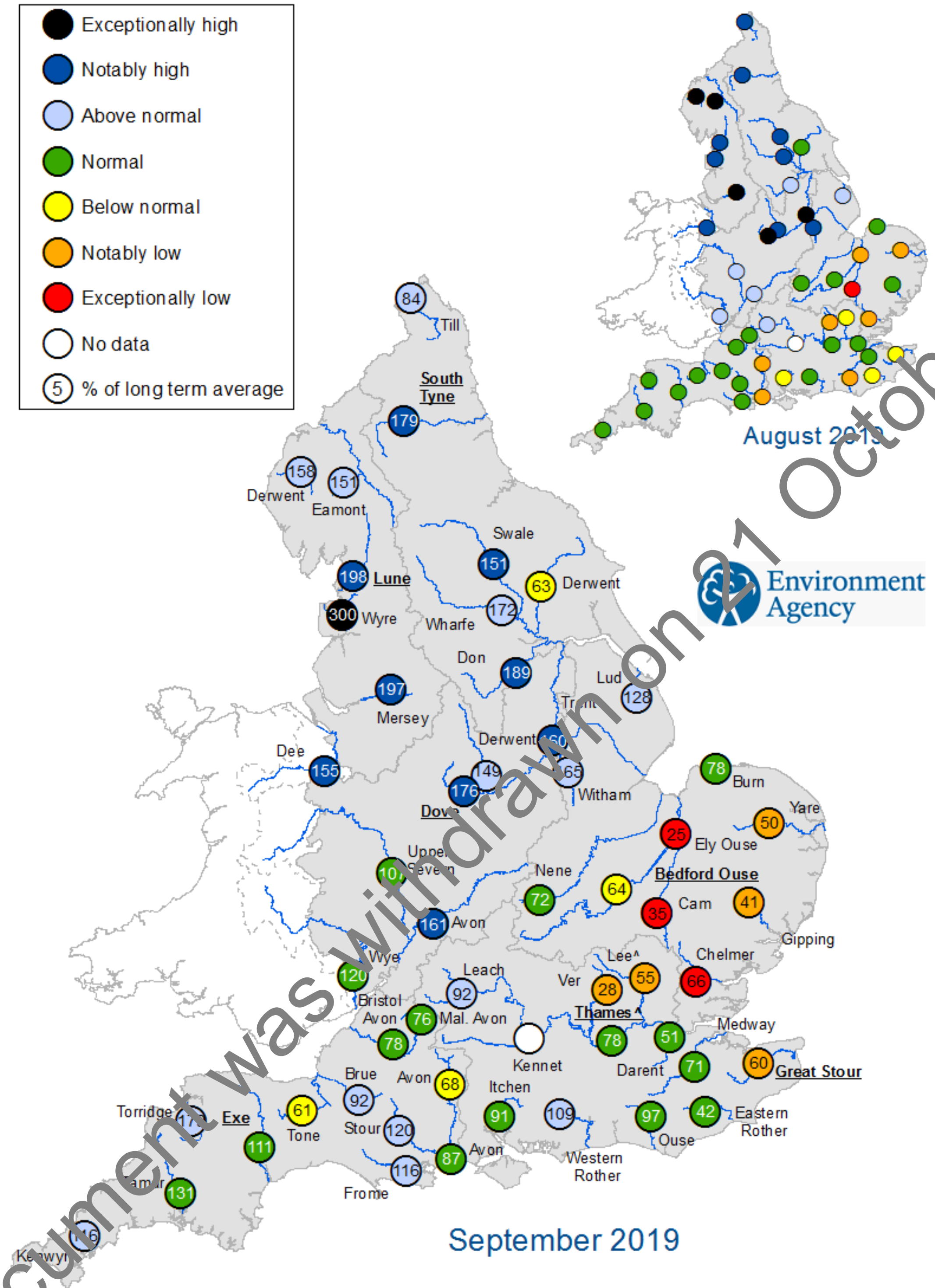


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

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 August and September 2019, expressed as a percentage of the respective long term average and classed relative to an analysis of historic August and September monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

River flow charts

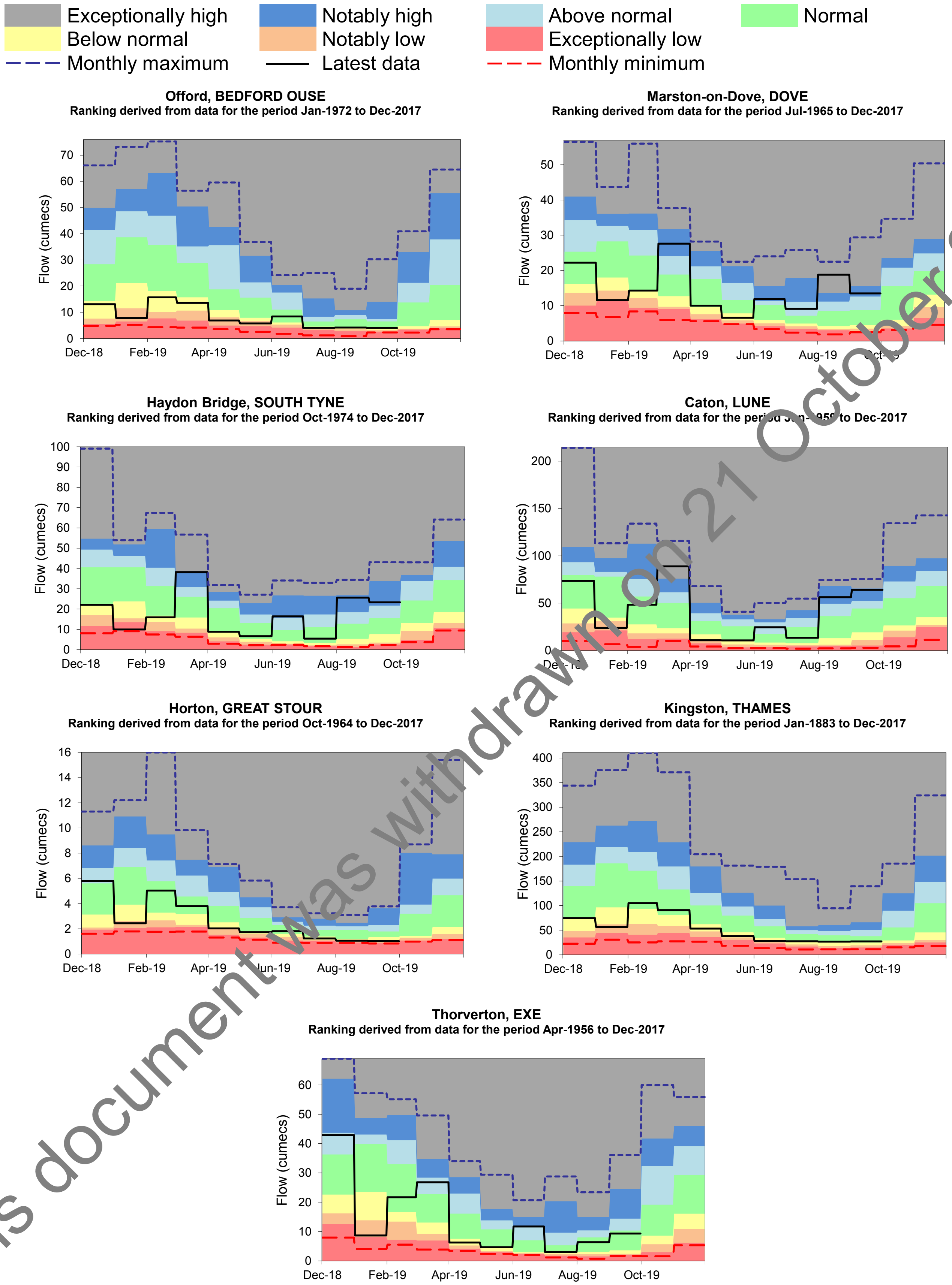
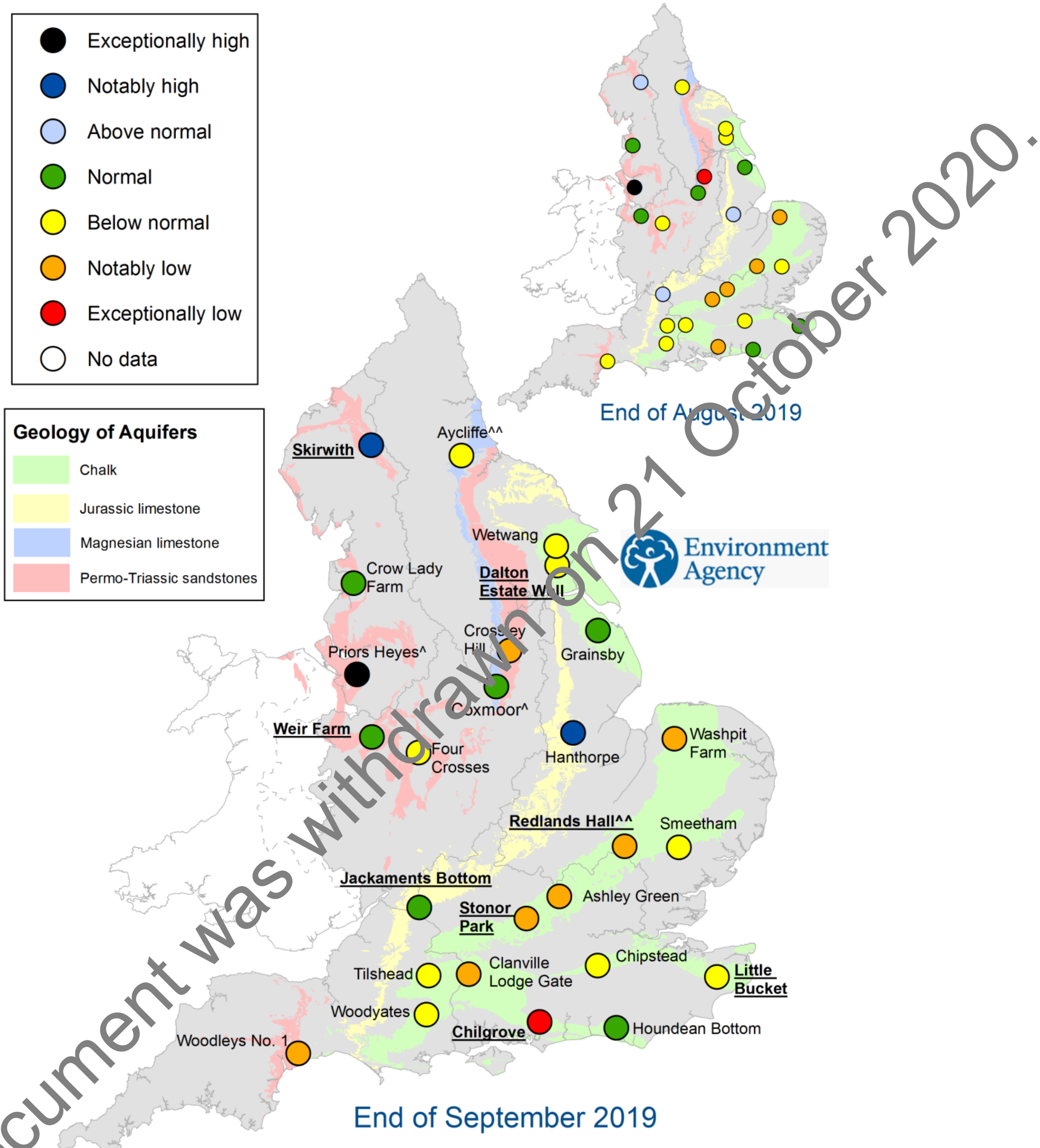


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

Groundwater levels



^ The level at Priors Heyes remains 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 August 2019 and September 2019, classed relative to an analysis of respective historic August and September 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

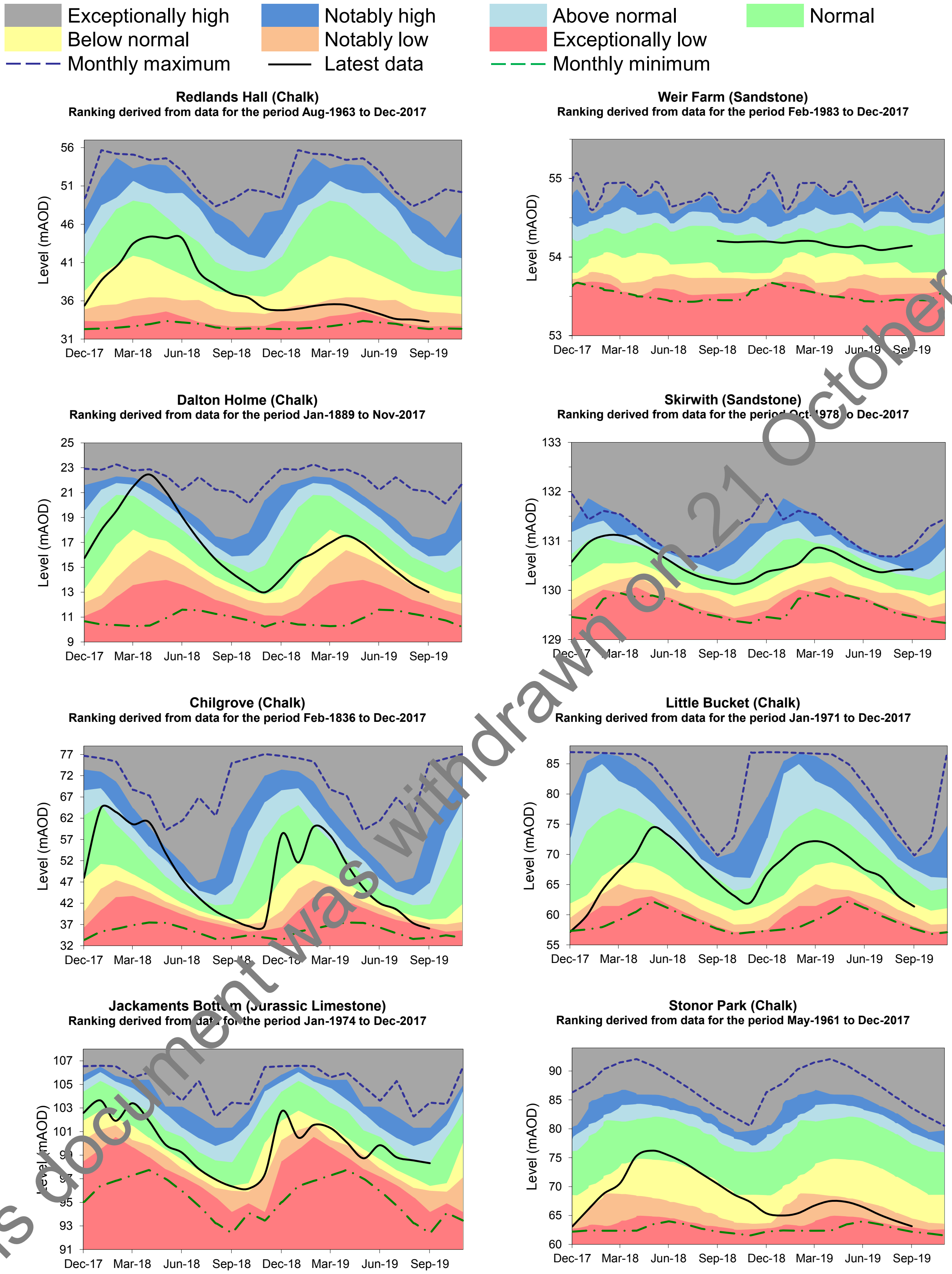
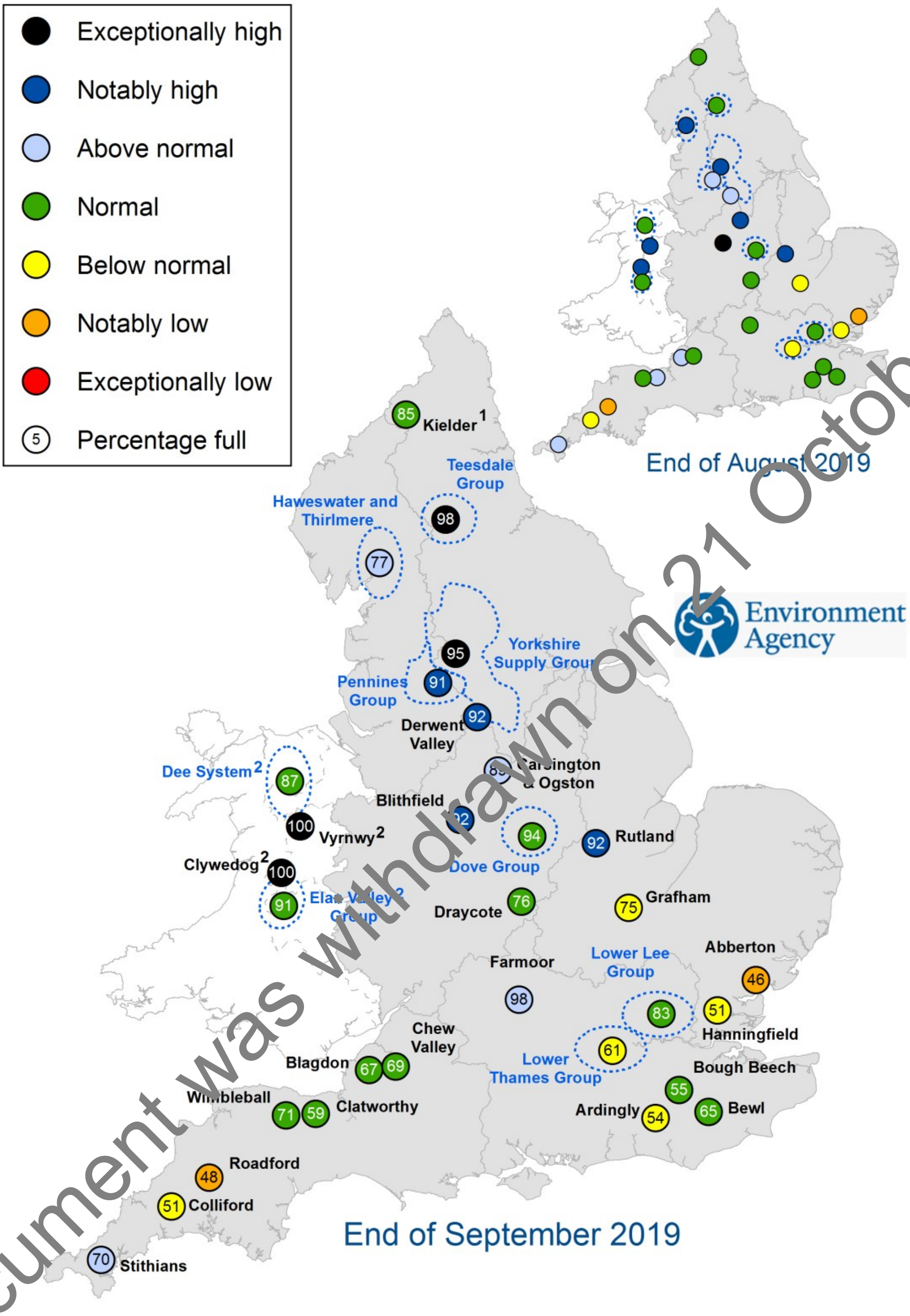


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

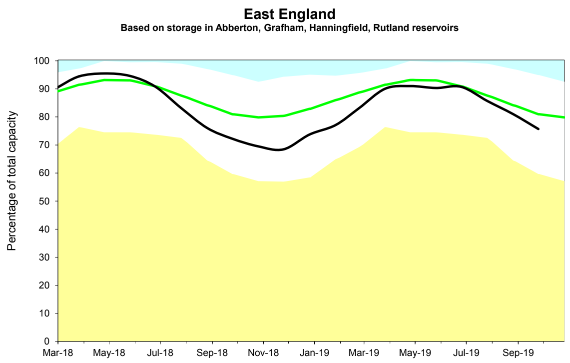
Reservoir storage

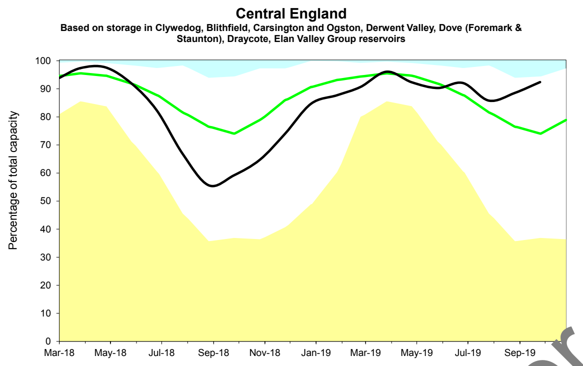


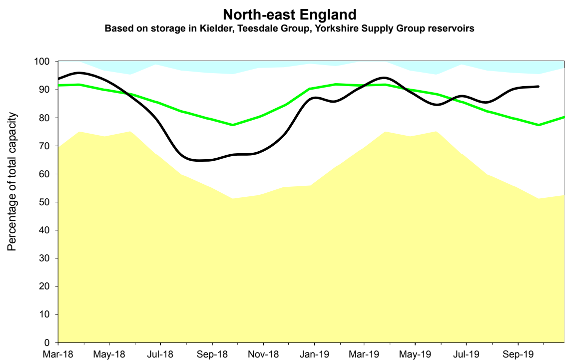
1. Current levels at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England

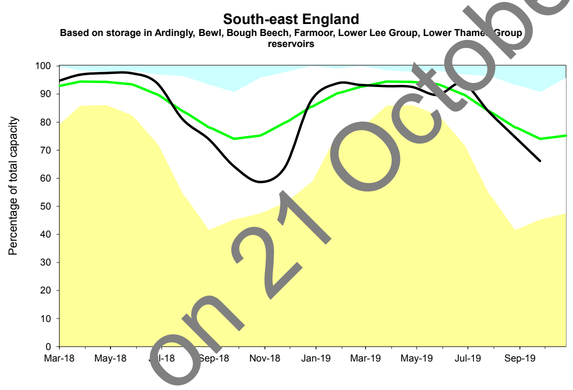
Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of August and September 2019 as a percentage of total capacity and classed relative to an analysis of historic August and September values respectively (Source: Water Companies). Note: Classes shown may not necessarily 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.

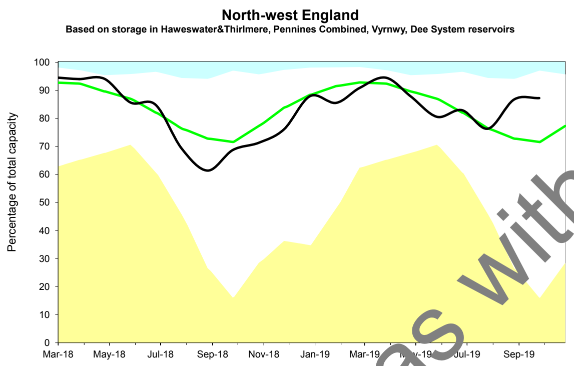
Reservoir storage charts

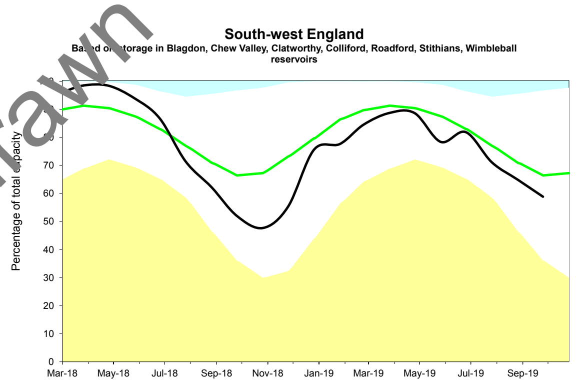


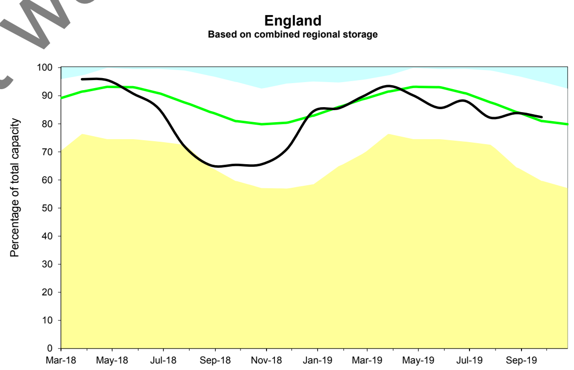












	Below minimum monthly level		Above maximum monthly level		Average		Latest data

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

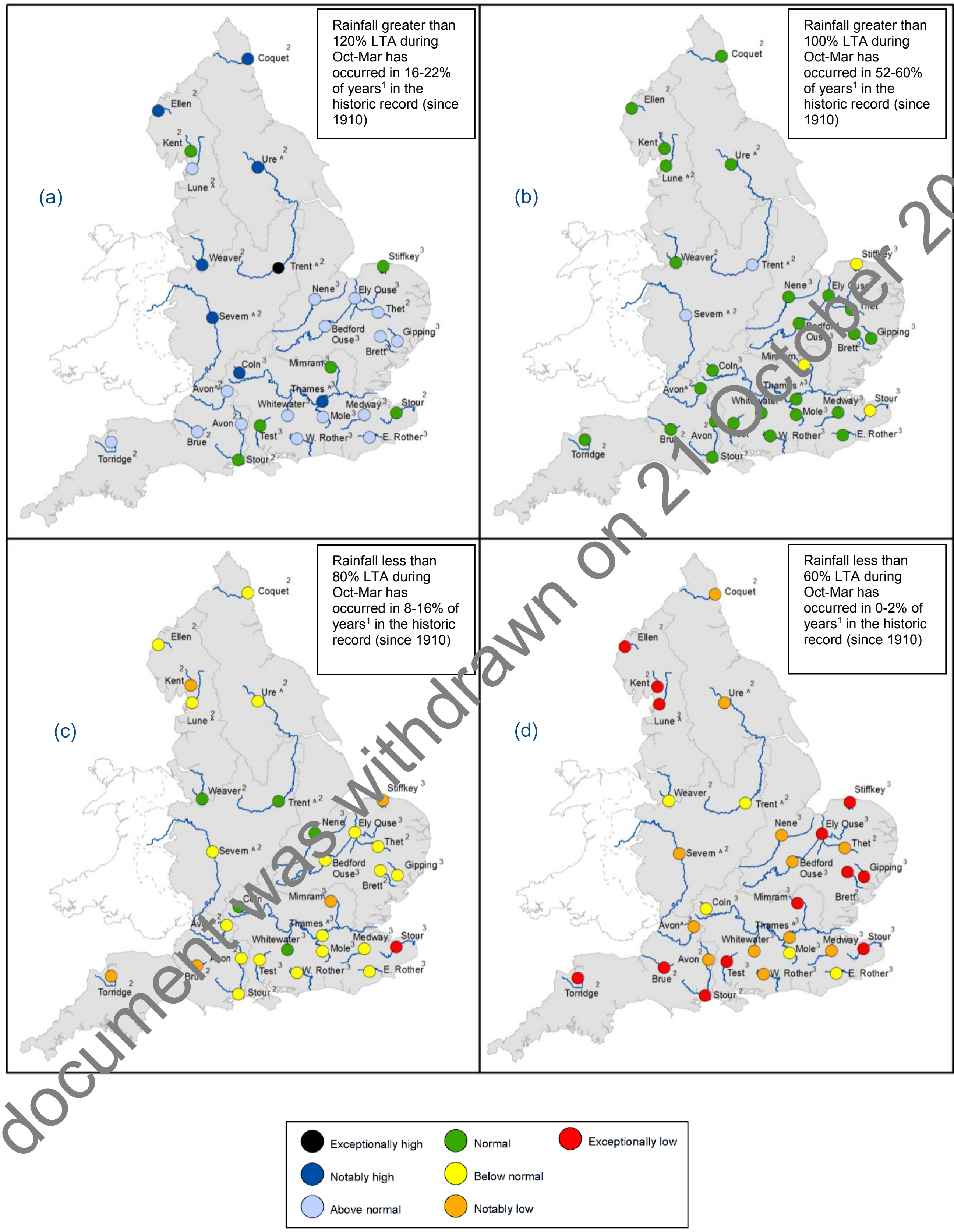
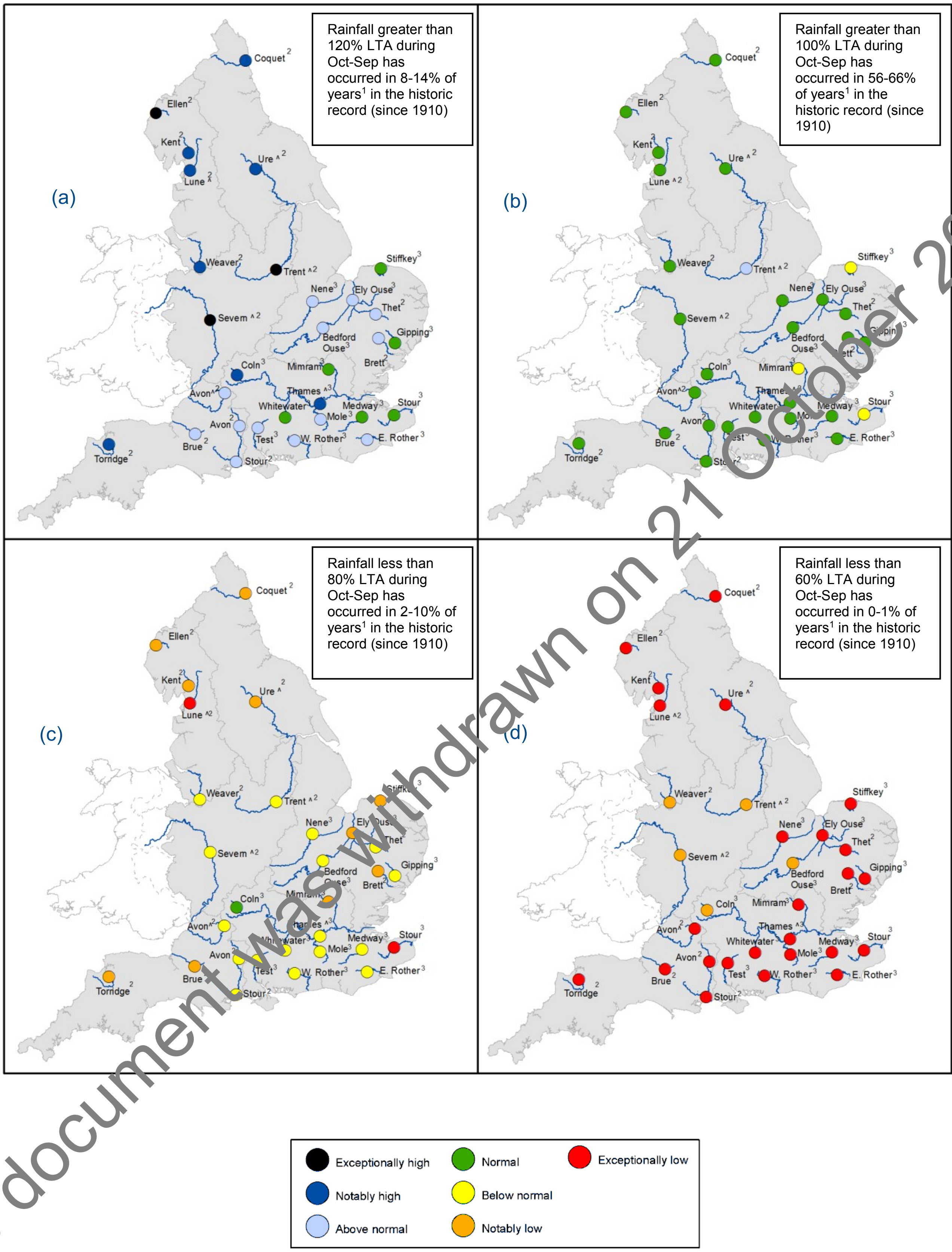


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2019 and March 2020 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*



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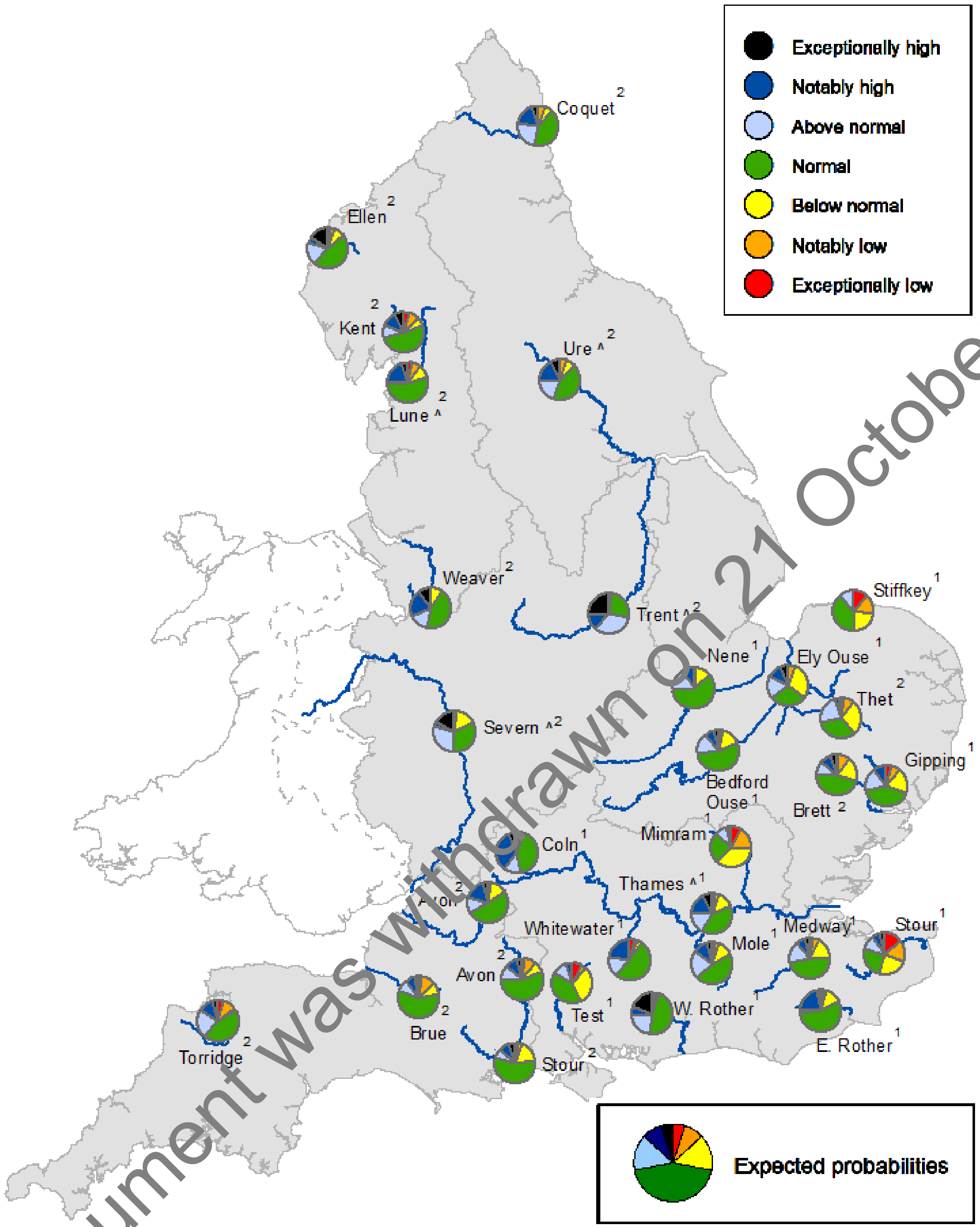

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2020. 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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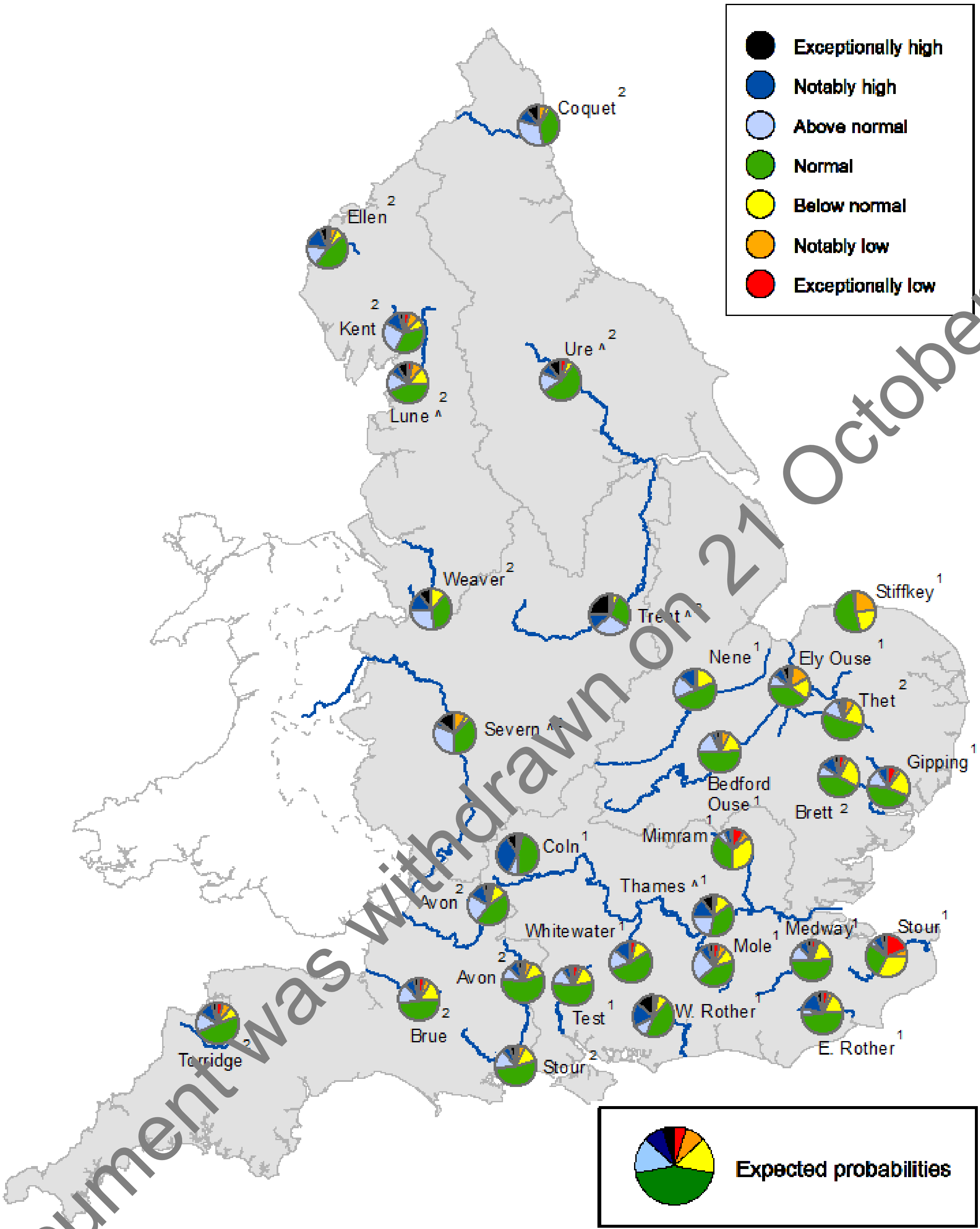

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2020. 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

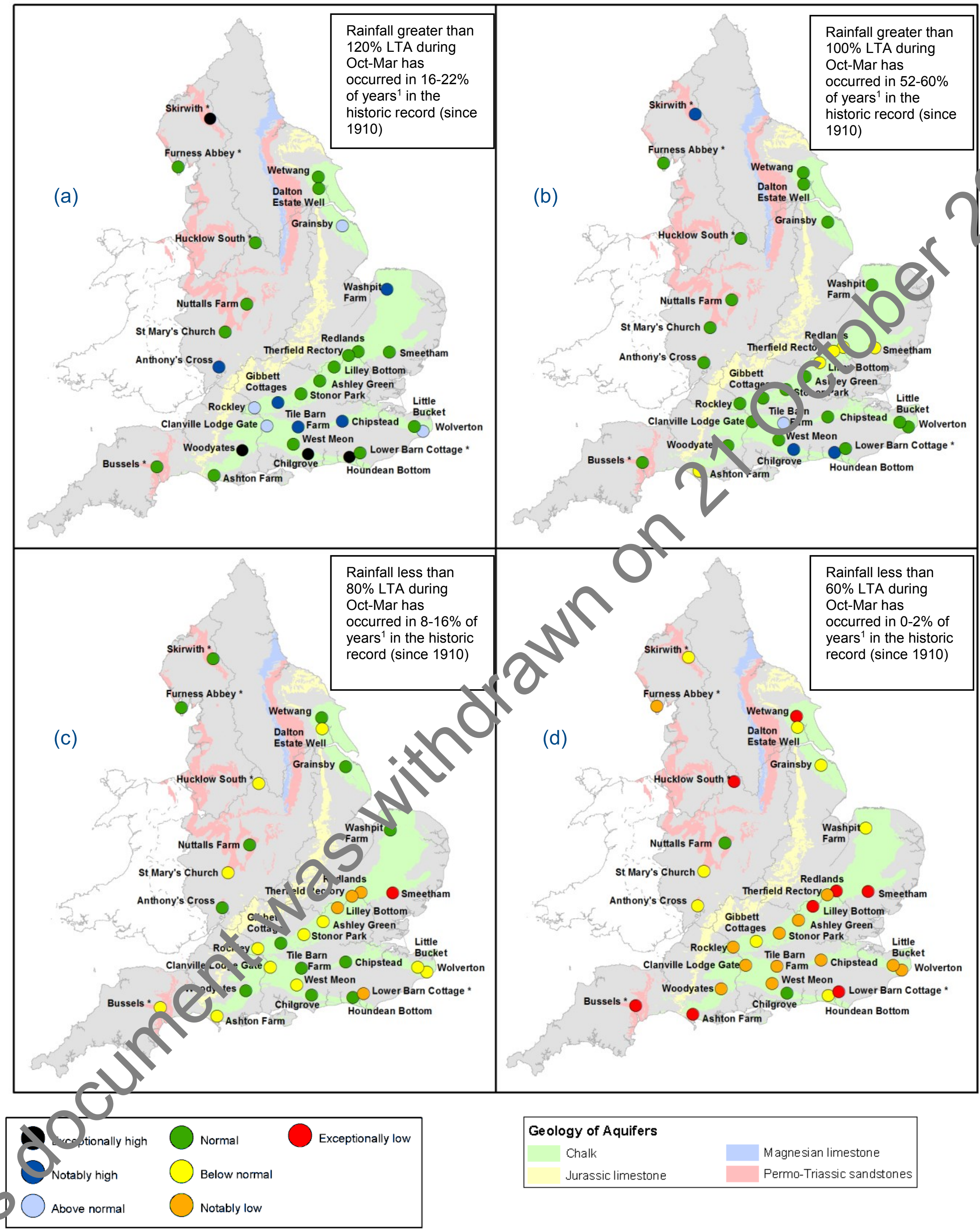

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2019 and March 2020 (Source: Environment Agency) Geological map reproduced with kind permission 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

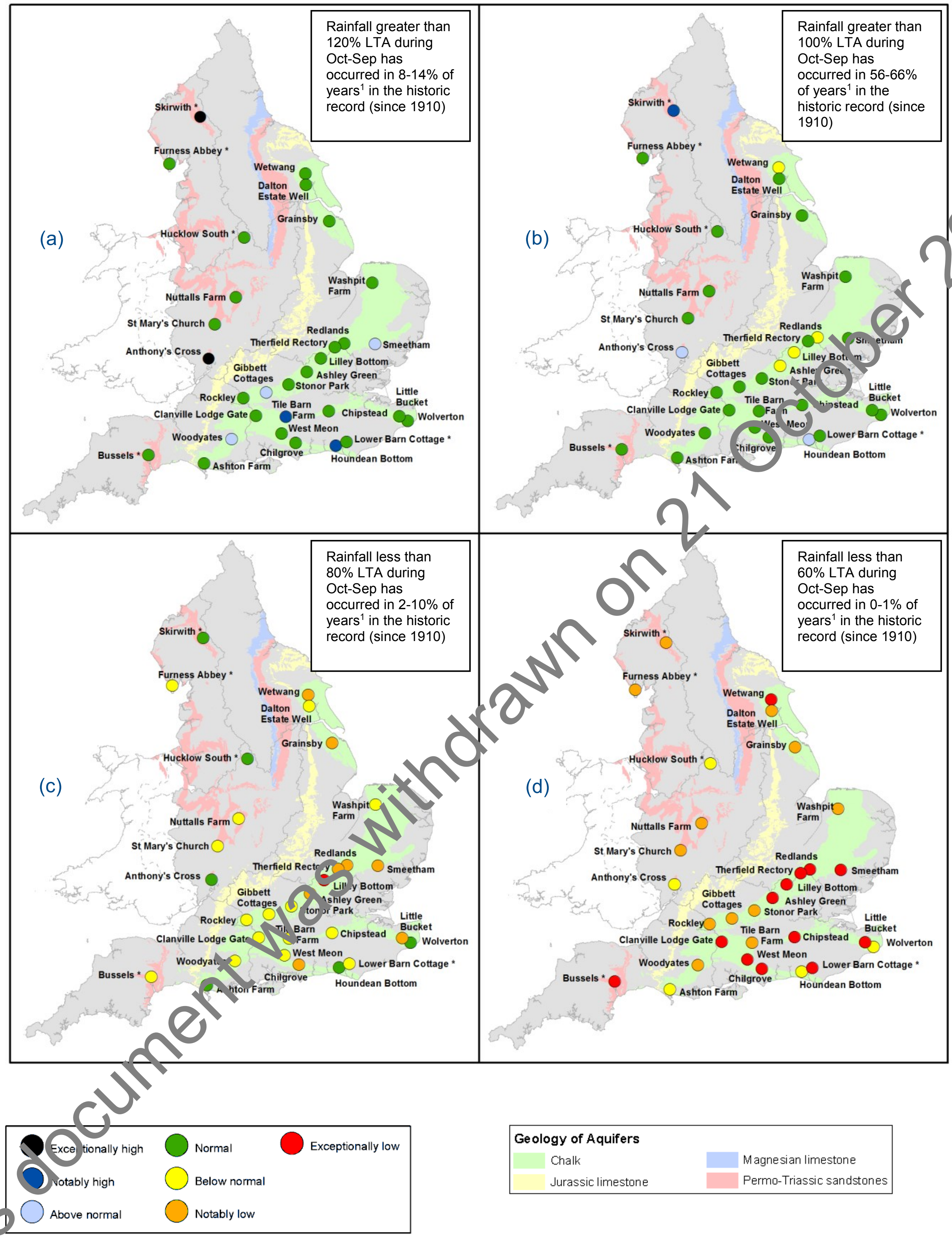

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2019 and September 2020 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2019.

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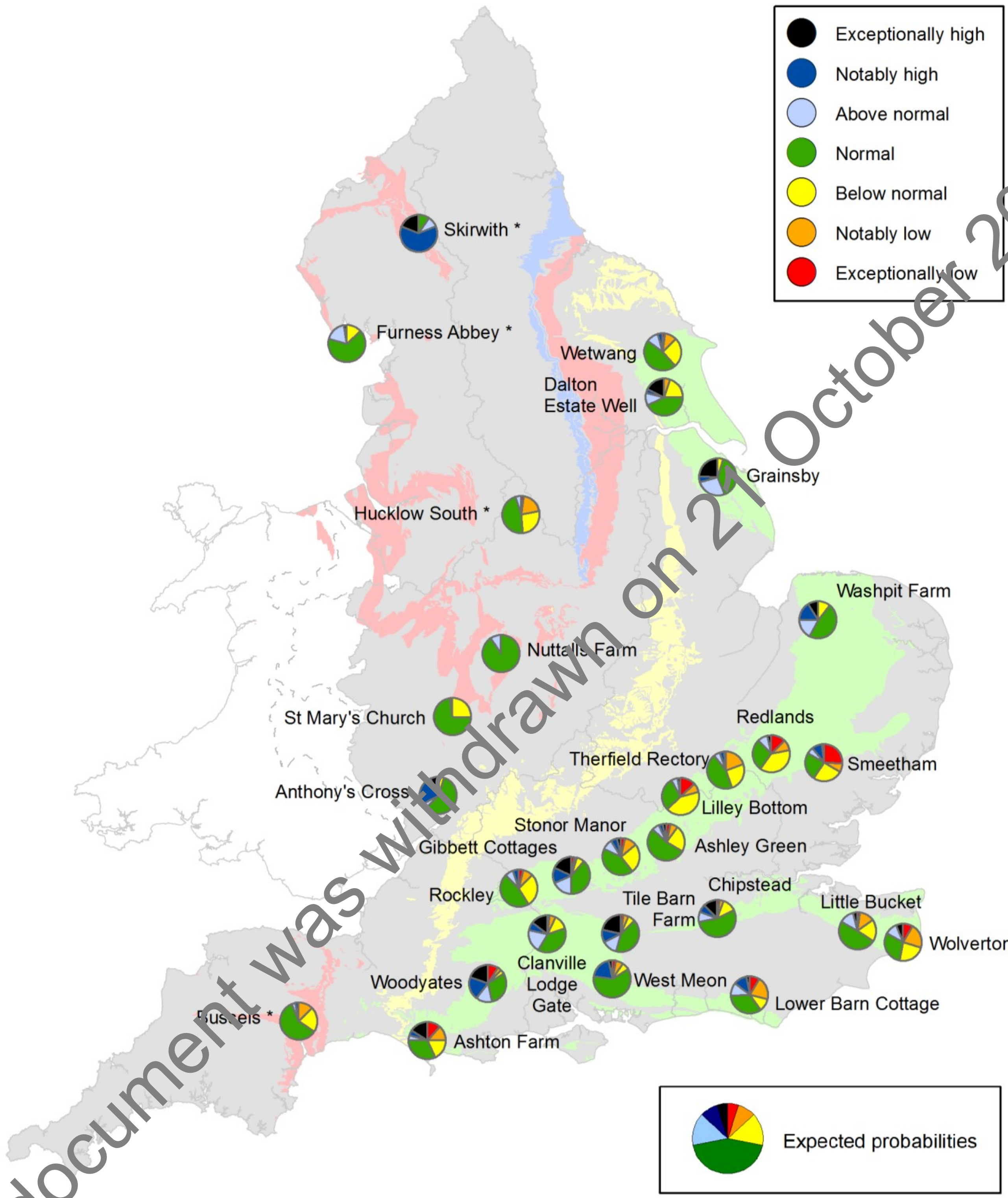
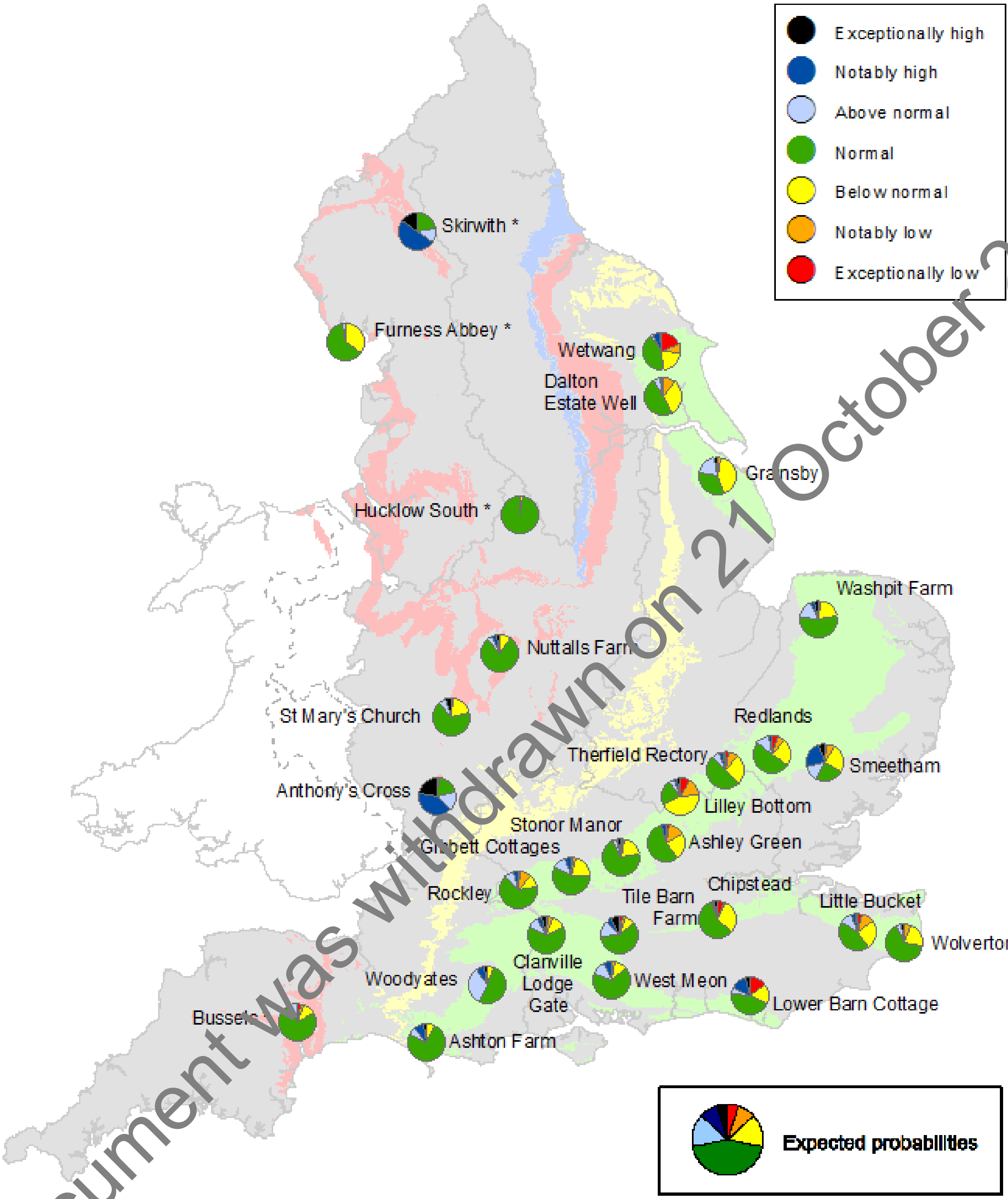


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2020. 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.

** 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 2020. 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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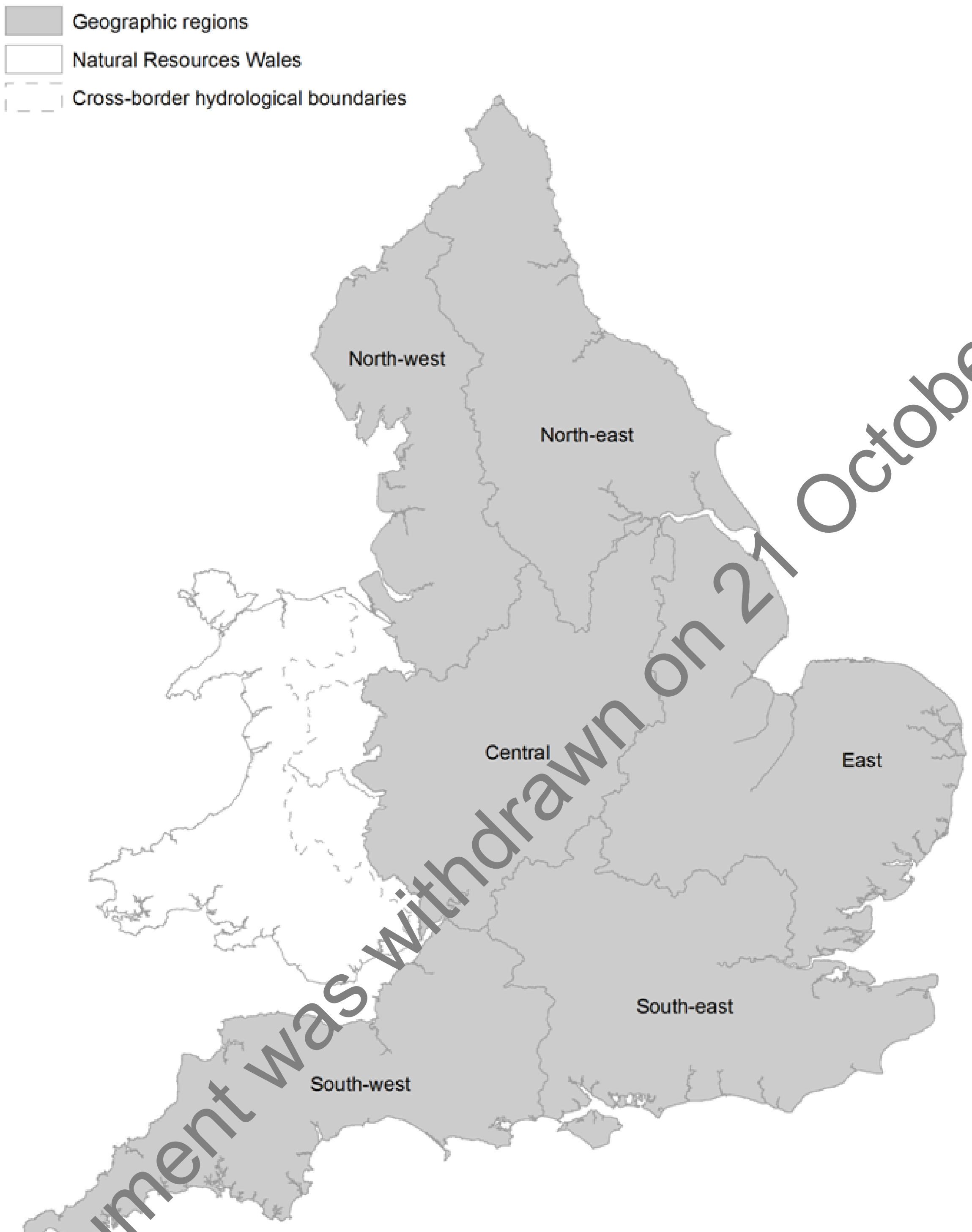

Figure 7.1: Geographic regions

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