Monthly water situation report

England

Summary – July 2019

The July rainfall total for England represented 115% of long-term average, with highest rainfall totals in parts of north-west and central England. There was an exceptionally hot spell from 22 to 26 July in which new temperature records for July were set in many parts of the country[1]. The highest temperature officially recorded in the UK (38.7 °C) was recorded at Cambridge Botanic Garden on 25 July[1]. By the end of the month, soils were drier than average across much of south-west and south-east England, but generally wetter than average elsewhere. Monthly mean river flows for July decreased at almost all indicator stations, compared to June. End of month groundwater levels were classed as below normal or lower at over half of the sites we report on. Total reservoir stocks across England were at 82% of capacity at the end of July.

Rainfall

The July rainfall total for England was 68 mm, representing 115% of the 1961-90 long-term average (LTA) (109% of 1981-2010 LTA). The highest July rainfall totals were in parts of north-west and central England, with the lowest totals in parts of east and south-west England (Figure 1.1). Thunderstorms were widespread and periods of intense localised rainfall were experienced in many catchments.

July rainfall totals in the Mersey, Irwell and Cheshire Rivers Group catchments were the 6th highest on record (records assessed from 1891) and were classed as exceptionally high for the time of year. Across most of the country rainfall totals were normal or lower for the time of year. In North Norfolk the rainfall total was only half of the July LTA and was classed as notably low (Figure 1.2). The three month and six month cumulative rainfall totals were classed as above normal or higher across much of north-east and north-west England. The cumulative rainfall totals for the last 12 months were below normal across many of the areas in southern and eastern England.

At a regional scale, July rainfall totals were below average for the month in south-west, south-east and east England (72%, 88% and 95% of LTA respectively). Higher than average rainfall totals were recorded in all other regions, ranging from 143% of LTA in north-east England to 160% of LTA in north-west England (Figure 1.3).

Soil moisture deficit

Soils became wetter during July in north-west England and became drier in parts of southern and eastern England, reflecting the spatial distribution of rainfall. By the end of July, soil moisture deficits (SMDs) were lower than average (soils were wetter than average) for the time of year across much of north-west, north-east and central England. By contrast, soil moisture deficits across much of south-east and south-west England remained below average for July (soils were drier than average) (Figure 2.1;).

At a regional scale, SMD decreased in the second half of the month, in all regions. By the end of July, soils were significantly wetter than average in north-west England and close to average for the time of year in east England (Figure 2.2).

River flows

Monthly mean river flows for July decreased at almost all indicator stations, compared to June. This reflects the widespread high rainfall totals, across England, during June. The only two indicator sites where flows increased in July were in north-west England, on the River Mersey at Ashton Weir and the River Wyre at St. Michaels. The flow on the River Mersey was classed as notably high for the time of year, representing 233% of LTA (Figure 3.1).

July monthly mean river flows were classed as below normal or lower at over a third of indicator sites. Exceptionally low monthly mean flows were recorded on the Hampshire Avon, River Chelmer (Essex) and Ely Ouse (Norfolk).

[1] Source: Met Office

The exceptionally low monthly mean flow on the River Cam (Cambridgeshire) was the lowest July flow on record, representing 33% of LTA (records since 1949). It was the fifth consecutive month that flows on the River Cam have been classed as exceptionally low (Figure 3.1).

At most of the regional index sites monthly mean flows were classed as normal for July. The exceptions to this were in east England, at Offord on the Bedford Ouse, where flows were classed as below normal and in central England, at Marston-on-Dove on the River Dove, where flows were classed as above normal for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels were in recession during July at the majority of indicator sites. End of month groundwater levels were classed as normal at just over a third of indicator sites and as below normal or lower at over half of indicator sites. Notably low groundwater levels were recorded at 6 sites, including the East Chilterns Chalk aquifer at Ashley Green, the North West Norfolk Chalk aquifer at Washpit Farm, the Hull & East Riding Chalk at Wetwang and the Staffordshire Trent Valley Sandstone at Four Crosses.

At the major aquifer index sites, the end of month groundwater levels were classed as below normal at Clanville Gate (Test Chalk aquifer) and notably low at Redlands Hall (Cam and Ely Ouse Chalk) and at Stonor Park (South West Chilterns). At all other major aquifer index sites, groundwater levels were classed as normal for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at most reported reservoirs and reservoir groups during July. The largest decreases in reservoir stocks, as a proportion of total storage capacity, were in south-west and south-east England, with a 15% decrease at Wimbleball reservoir (Somerset) and 14% decreases at Ardingly reservoir (West Sussex) and in the Lower Thames Group (west London). Despite this, reservoir stocks at the end of July 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 July. At a regional scale, total reservoir stocks ranged from 71% of capacity in south-west England to 86% of capacity in central England (Figure 5.2).

Forward look

August's weather is expected to be unsettled across England, with some prolonged spells of rain and periods of scattered heavy showers affecting all areas. Towards the end of the month, there is a chance that more settled conditions will become established in the south, with rain and showers continuing in the north and west. For the three month period August to October, the chances of above or below average precipitation are similar[2].

Projections for river flows at key sites[3]

Nearly two-thirds 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 September 2019. By the end of March 2020, just over half of the modelled sites have a greater than expected chance of flows being below normal or lower for the time of year.

For scenario based projections of cumulative river flows at key sites by September 2019 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2020 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2019 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2020 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Just over two-thirds 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 September 2019 and March 2020.

For scenario based projections of groundwater levels in key aquifers in September 2019 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2020 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2019 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2020 see Figure 6.8

Authors: National Water Resources Hydrology Team

[2] Source: Met Office
[3] 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

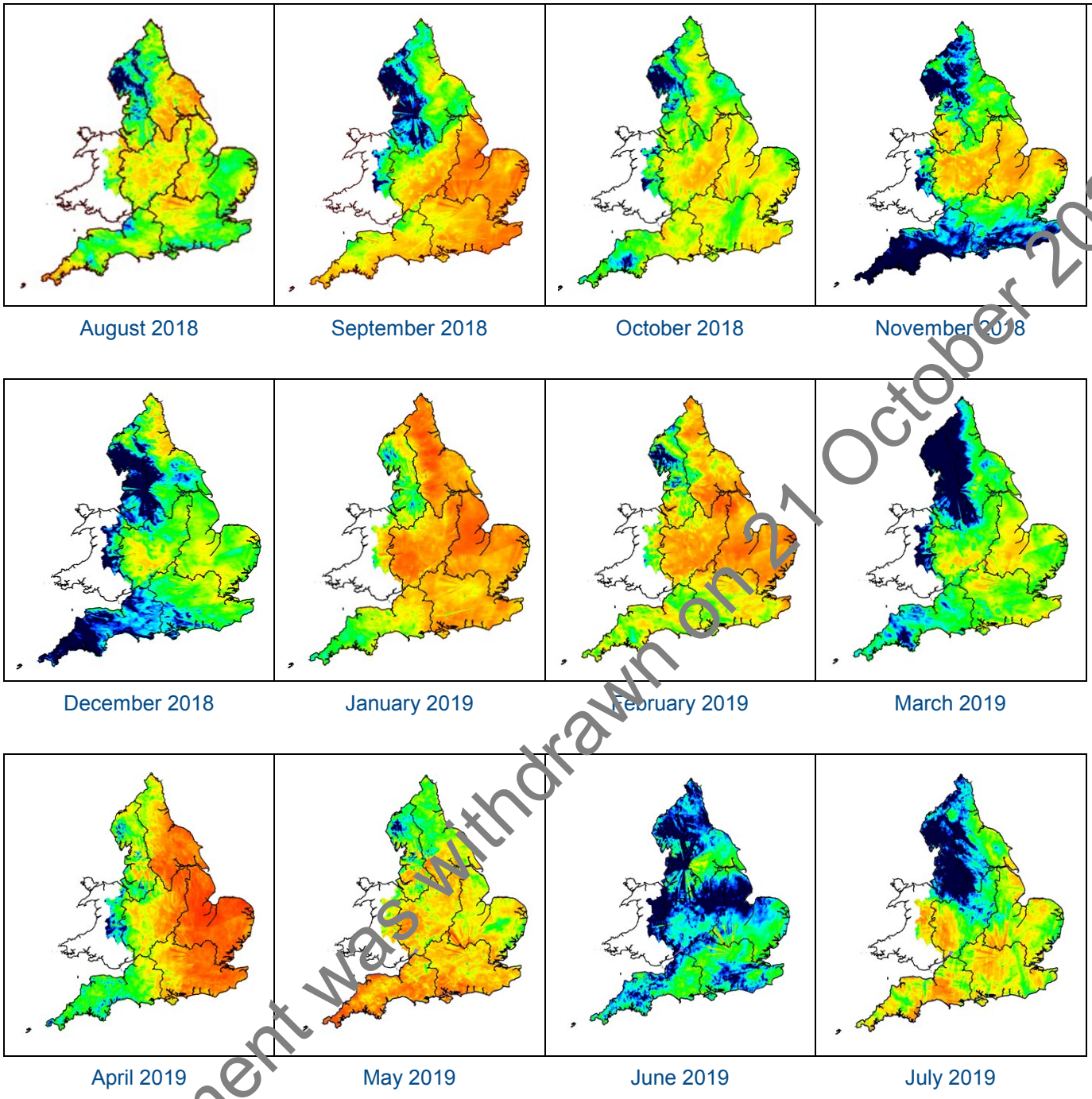
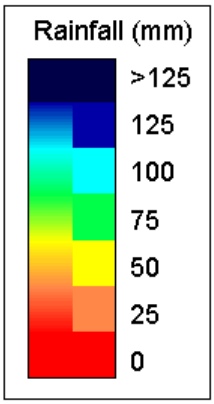


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



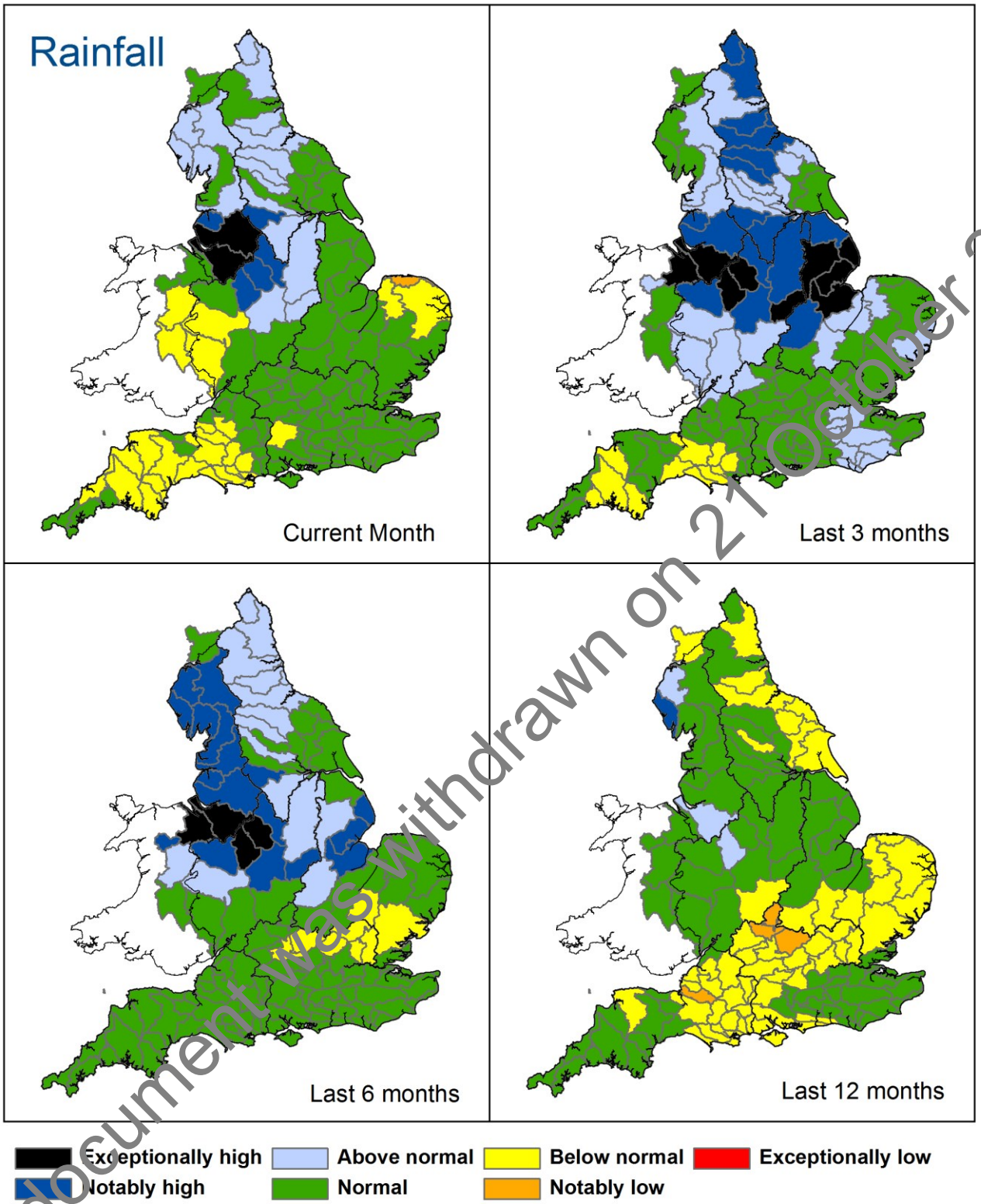


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 July), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived 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

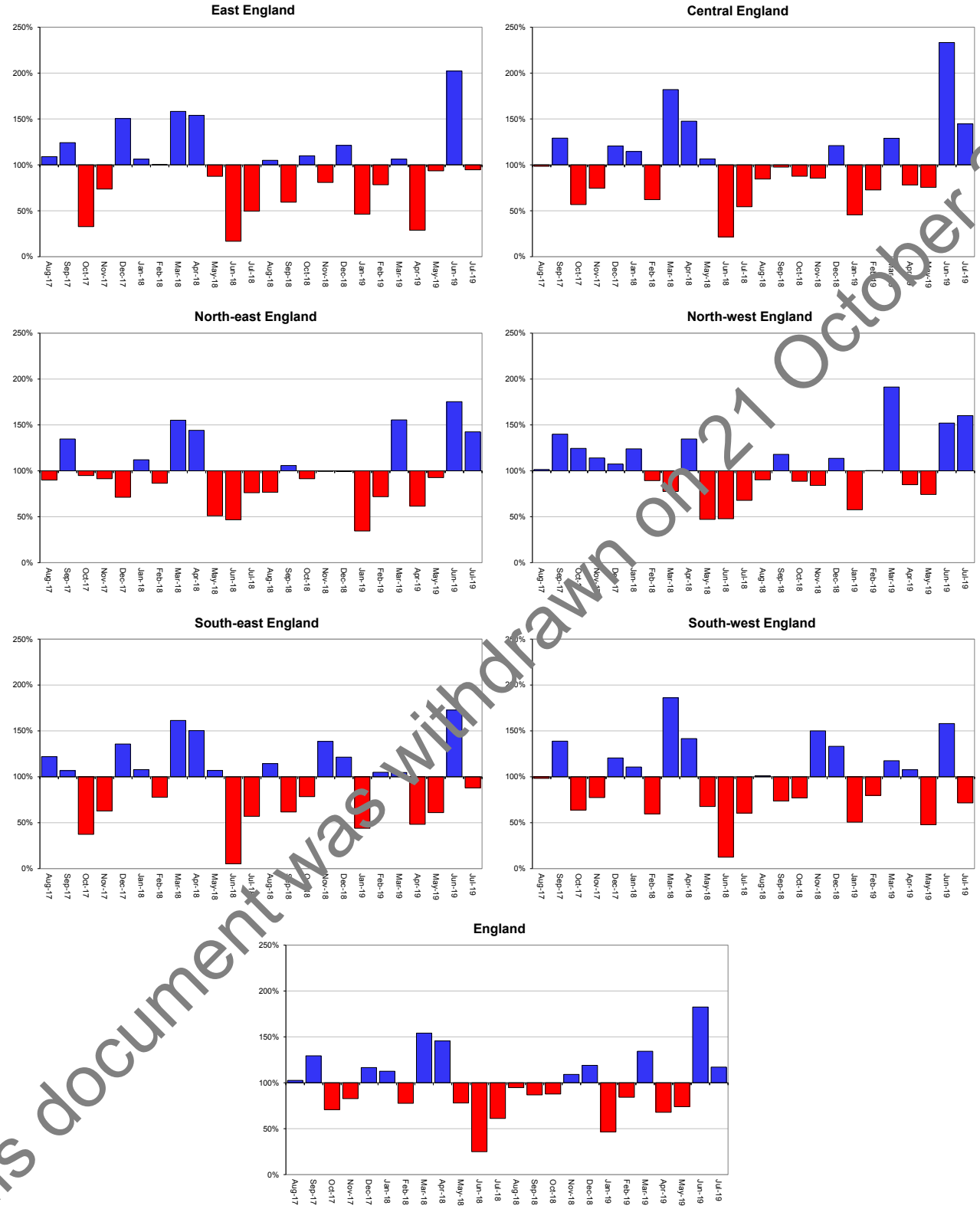


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. HadUK/NCIC rainfall data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of June 2019[1]	End of July 2019[2]

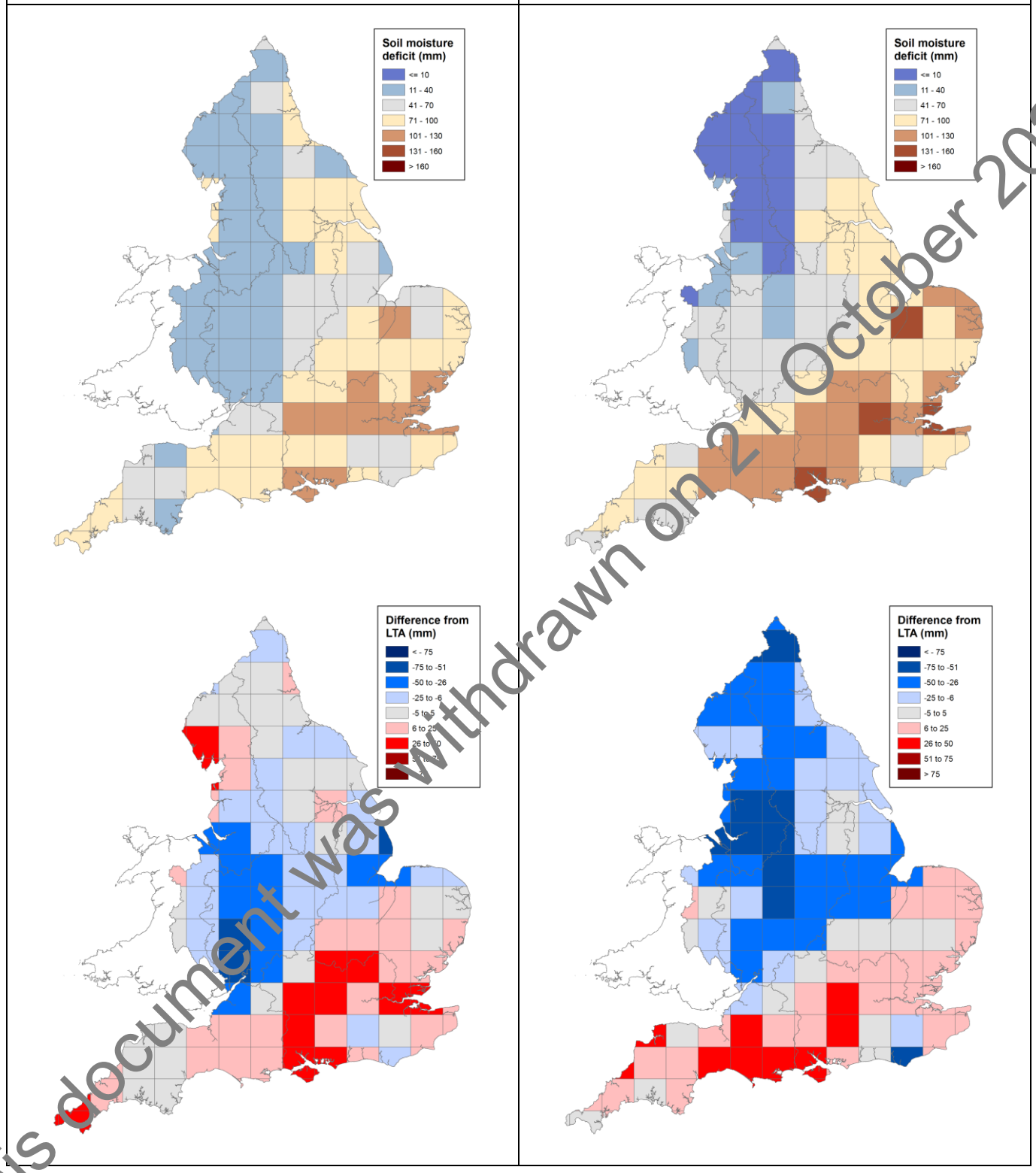


Figure 2.1: Soil moisture deficits for weeks ending 2 July 2019 [1] (left panel) and 30 July 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

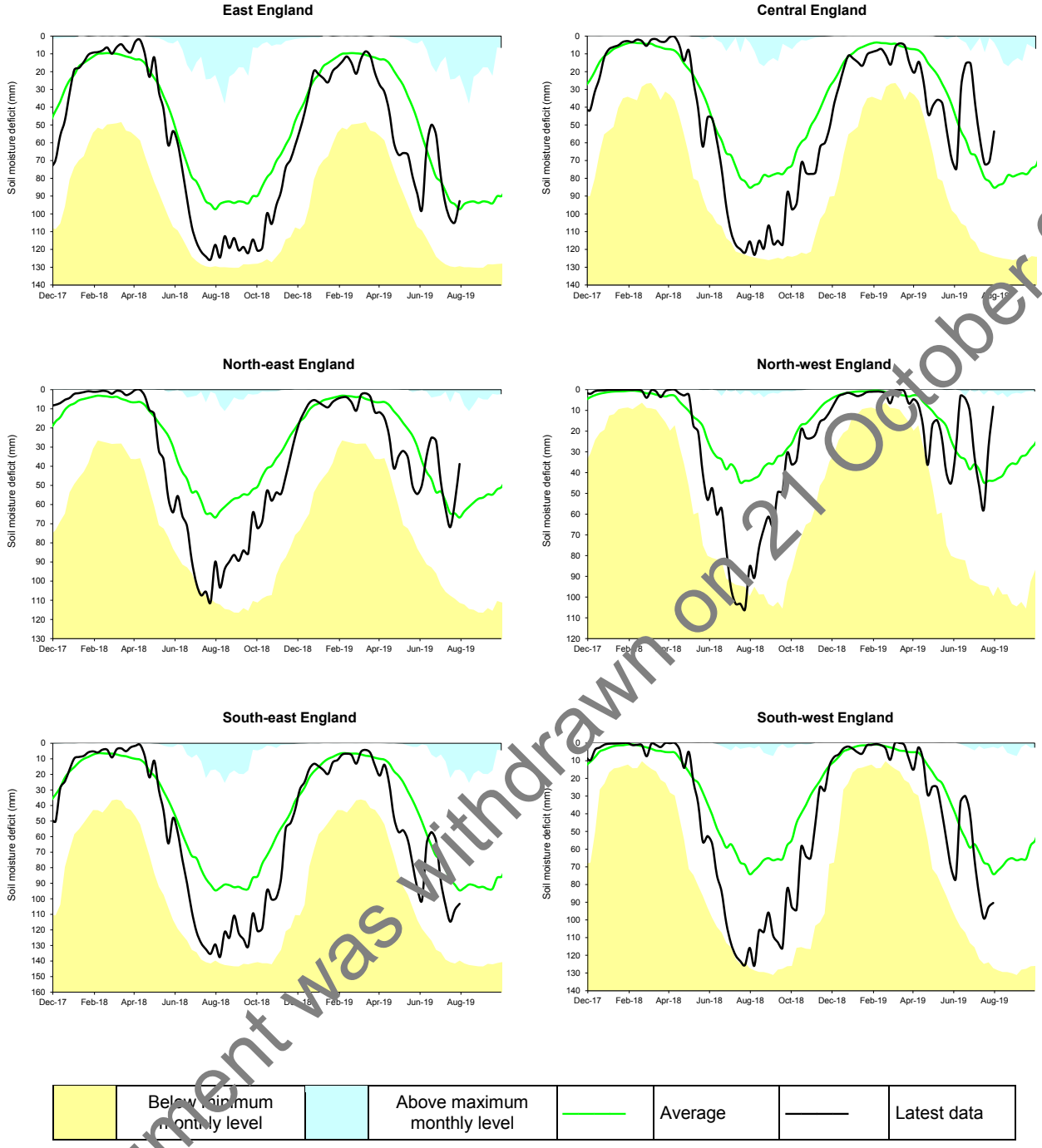
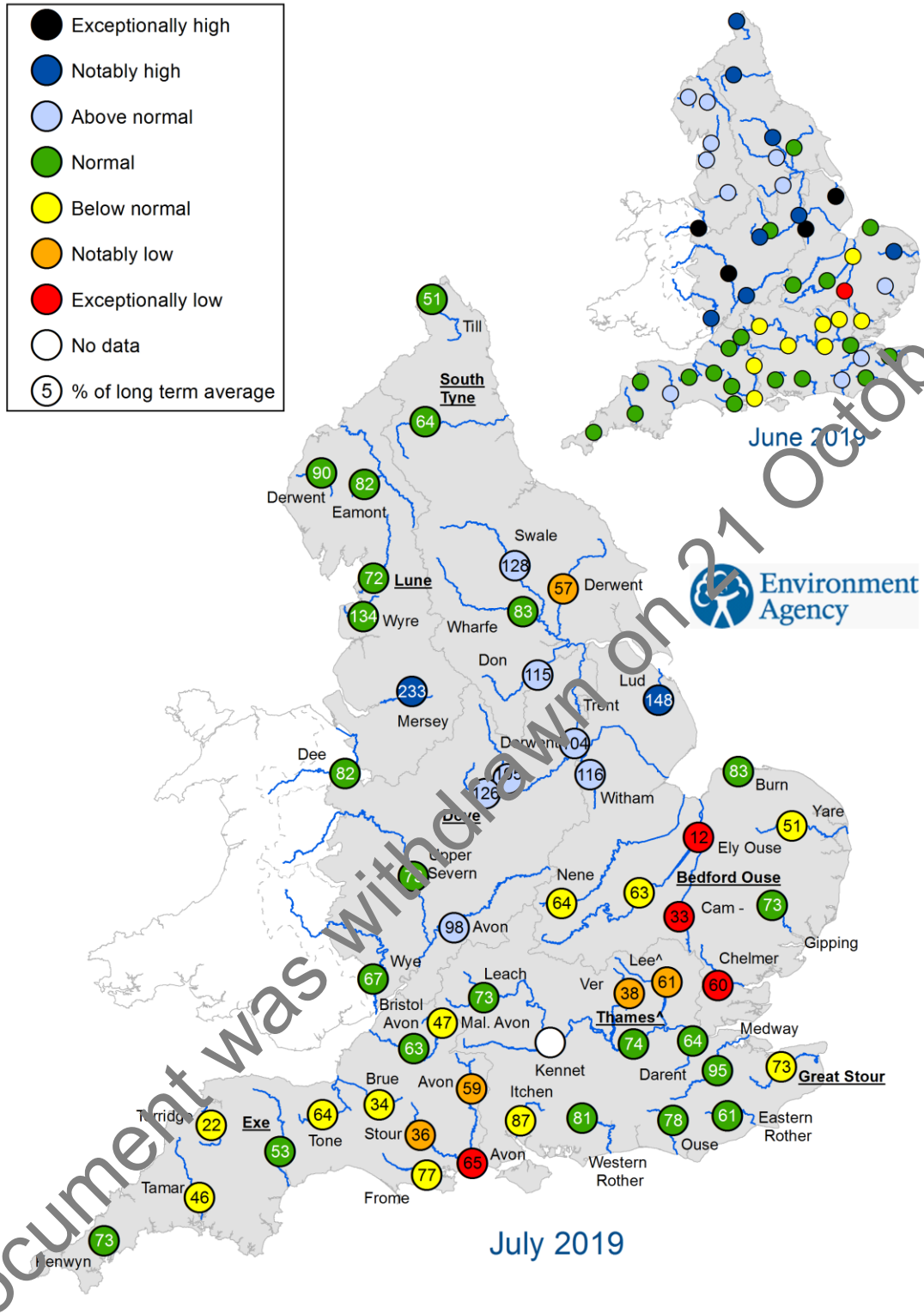


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

River flows



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

- Monthly mean flow is the lowest on record for the current month (note that record length varies between sites)
  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 June and July 2019, expressed as a percentage of the respective long term average and classed relative to an analysis of historic June and July monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

River flow charts

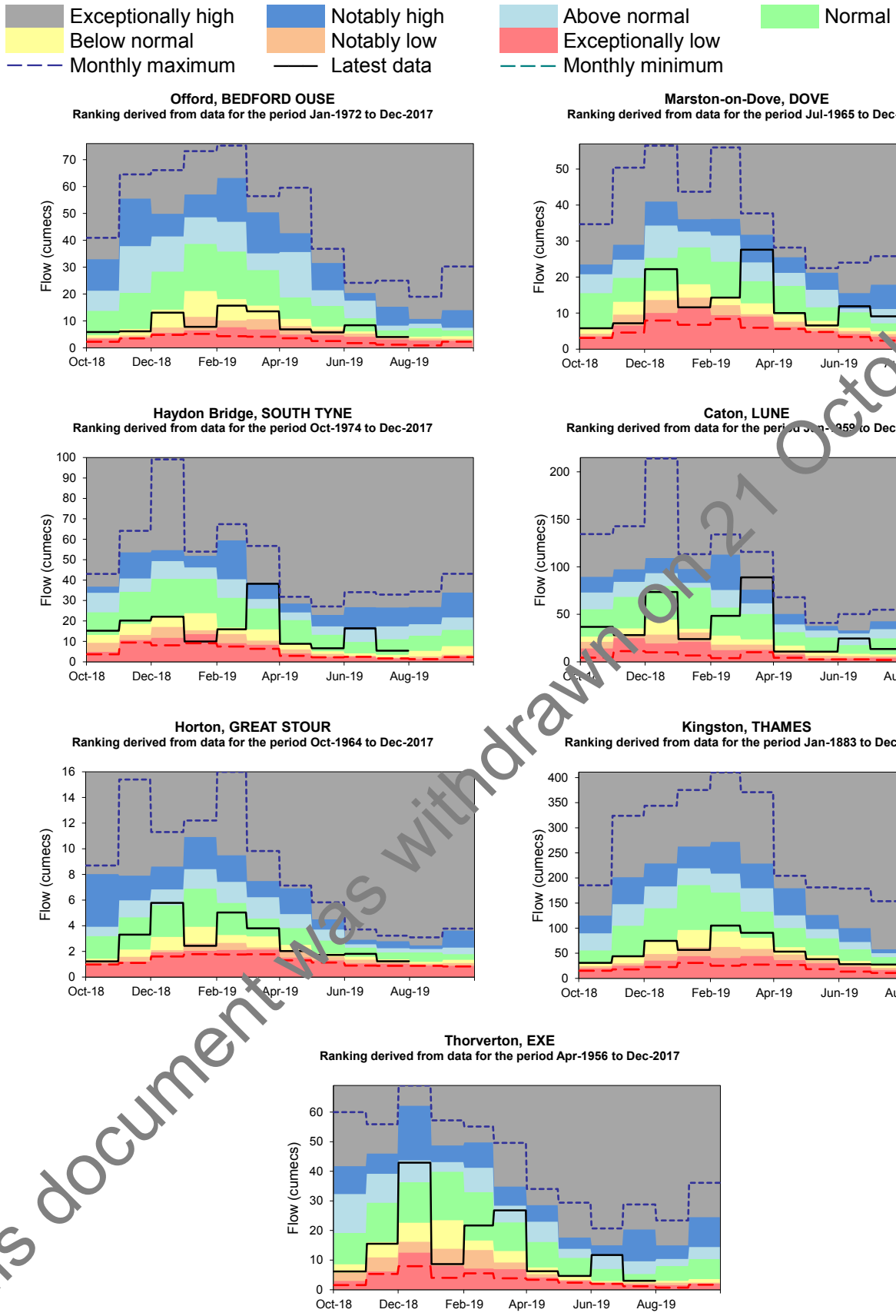
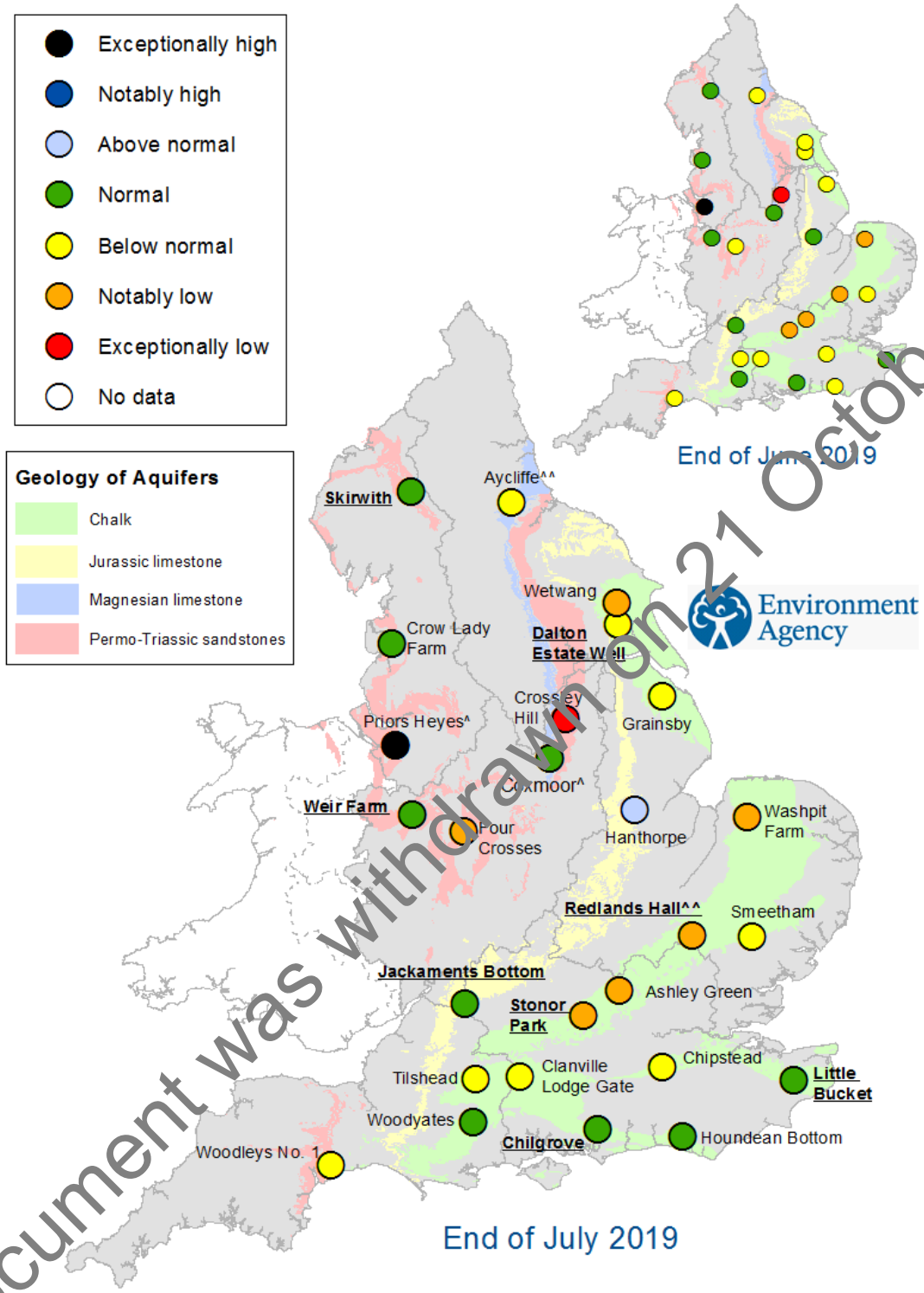


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
Weir Farm is a new site to replace Heathlanes.

Figure 4.1: Groundwater levels for indicator sites at the end of June 2019 and July 2019, classed relative to an analysis of respective historic June and July 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

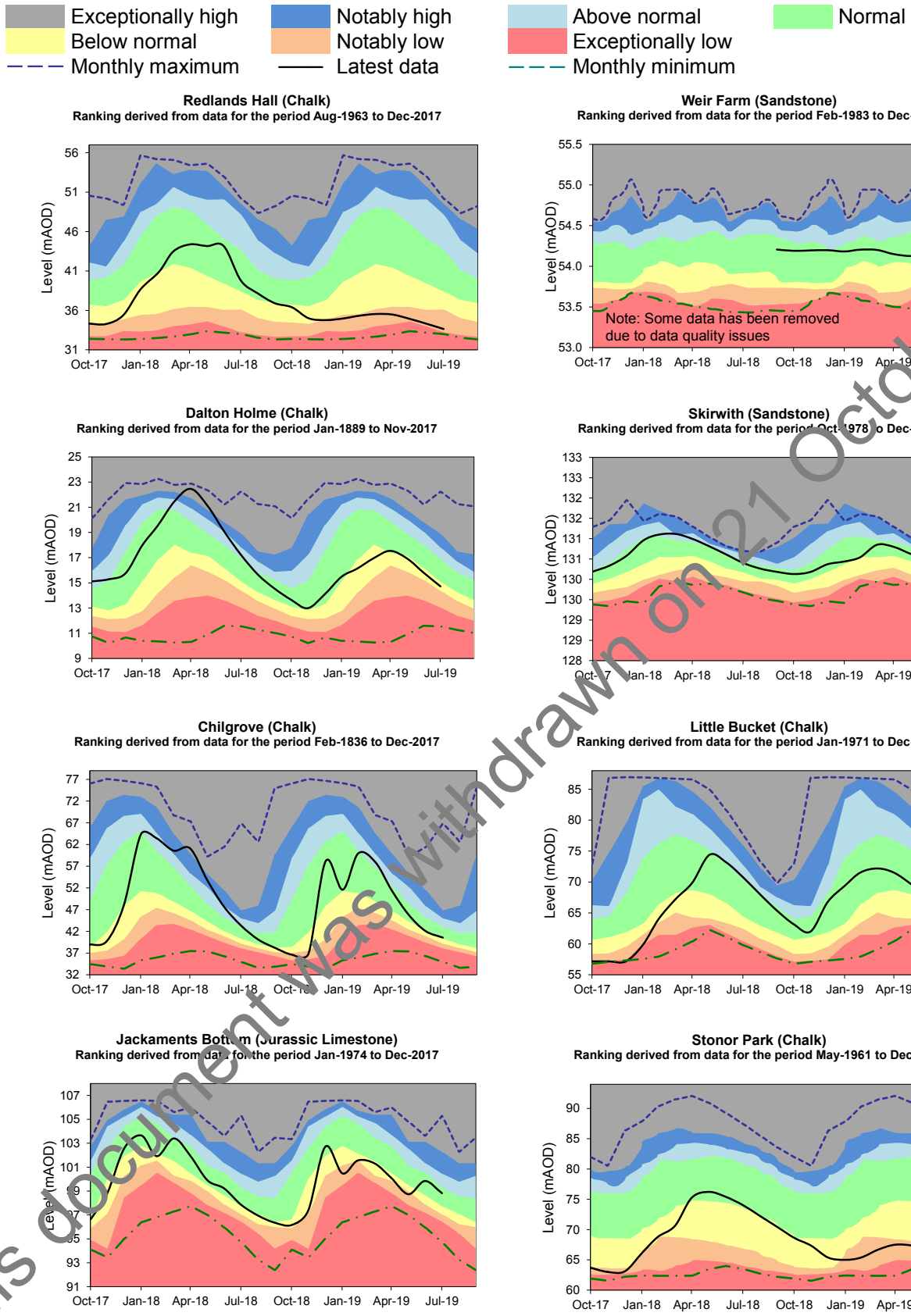
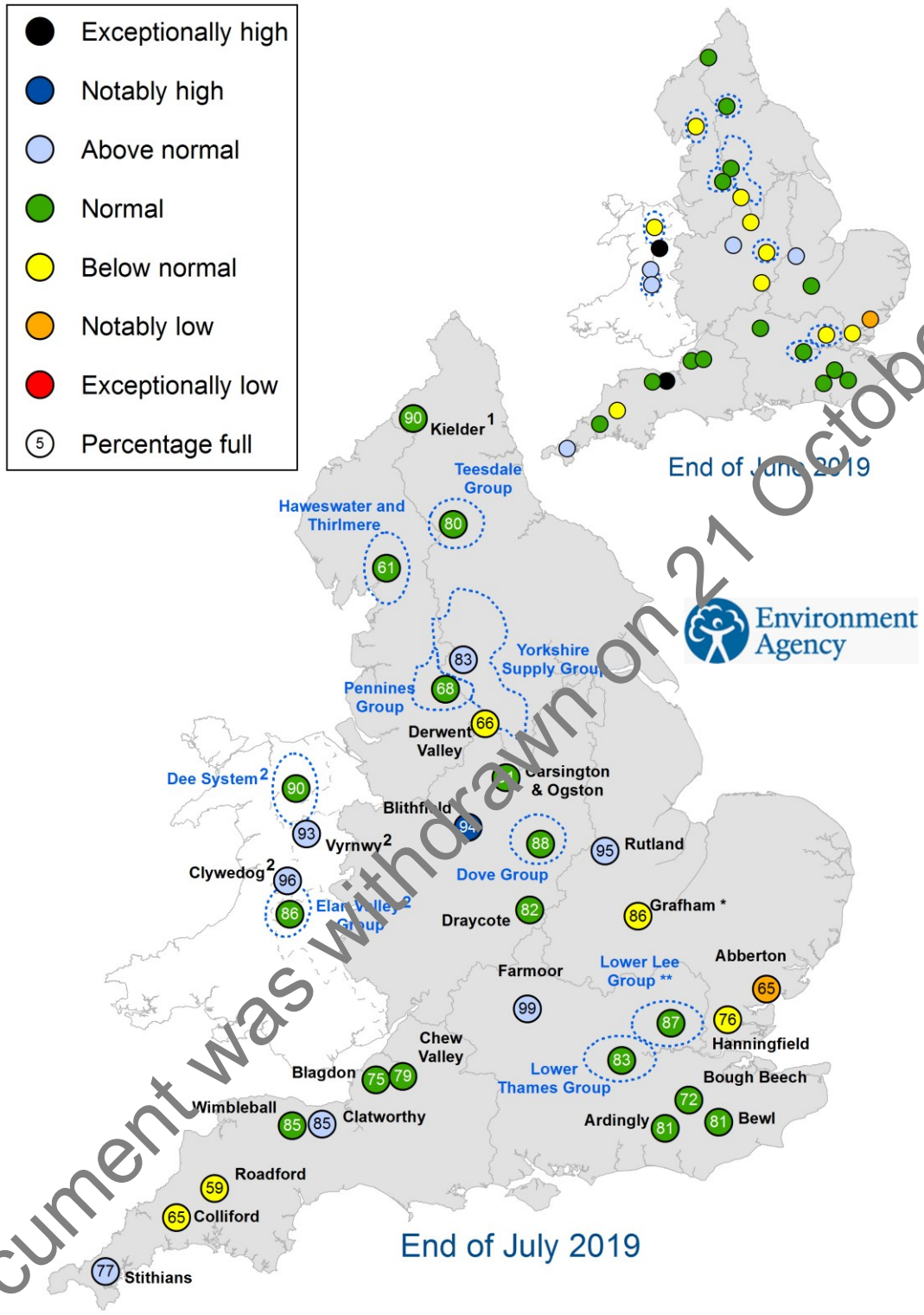


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

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 June and July 2019 as a percentage of total capacity and classed relative to an analysis of historic June and July 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

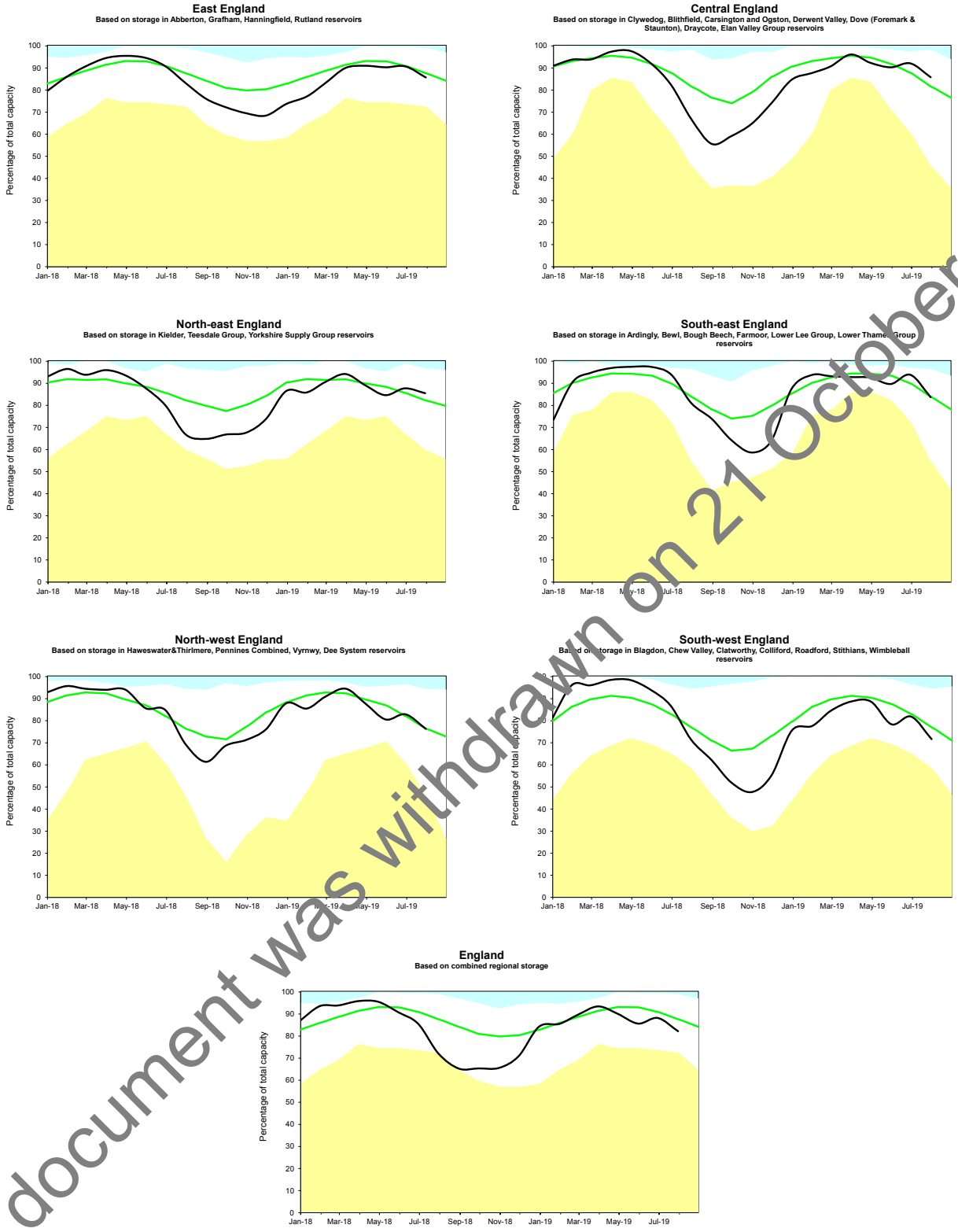


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

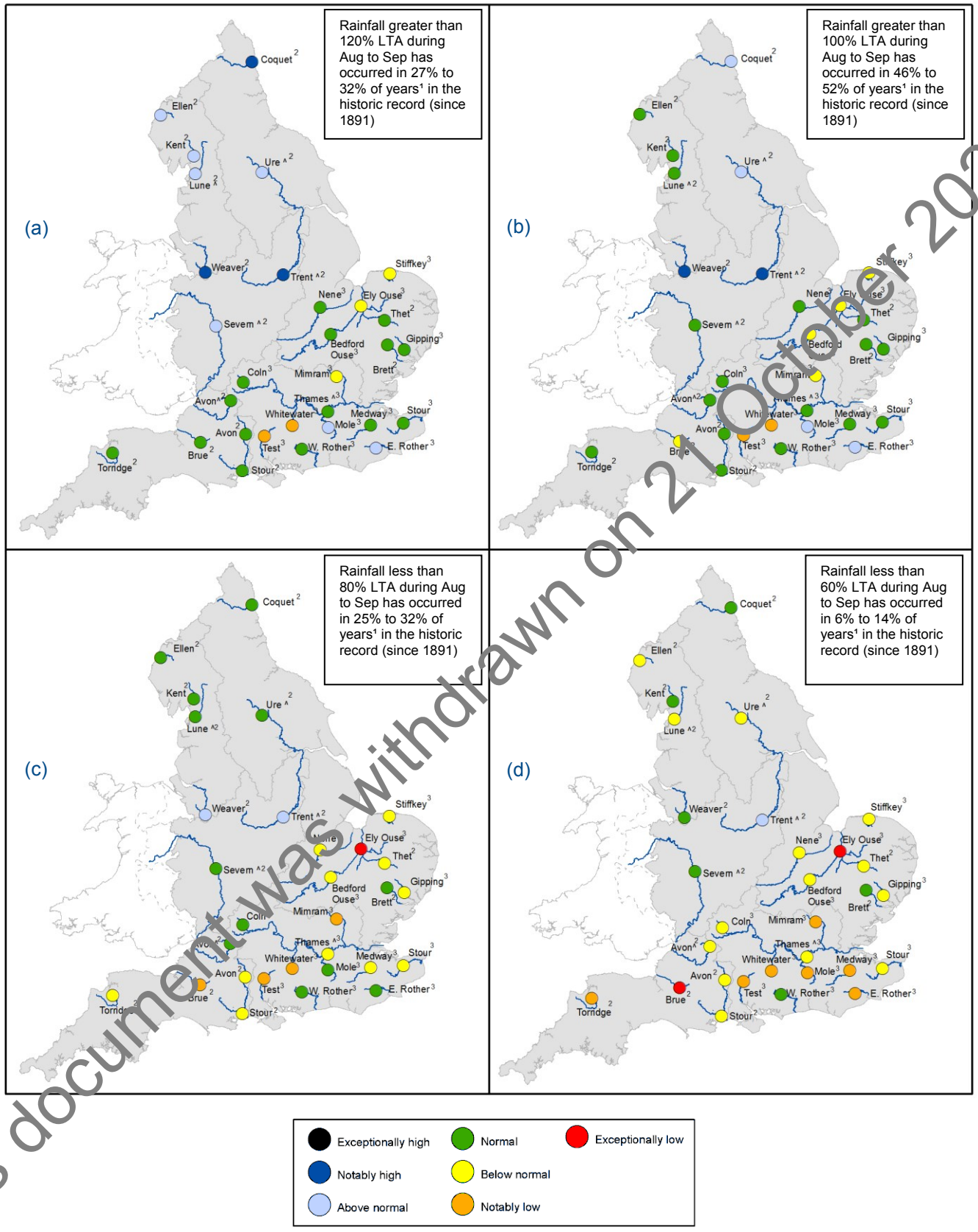
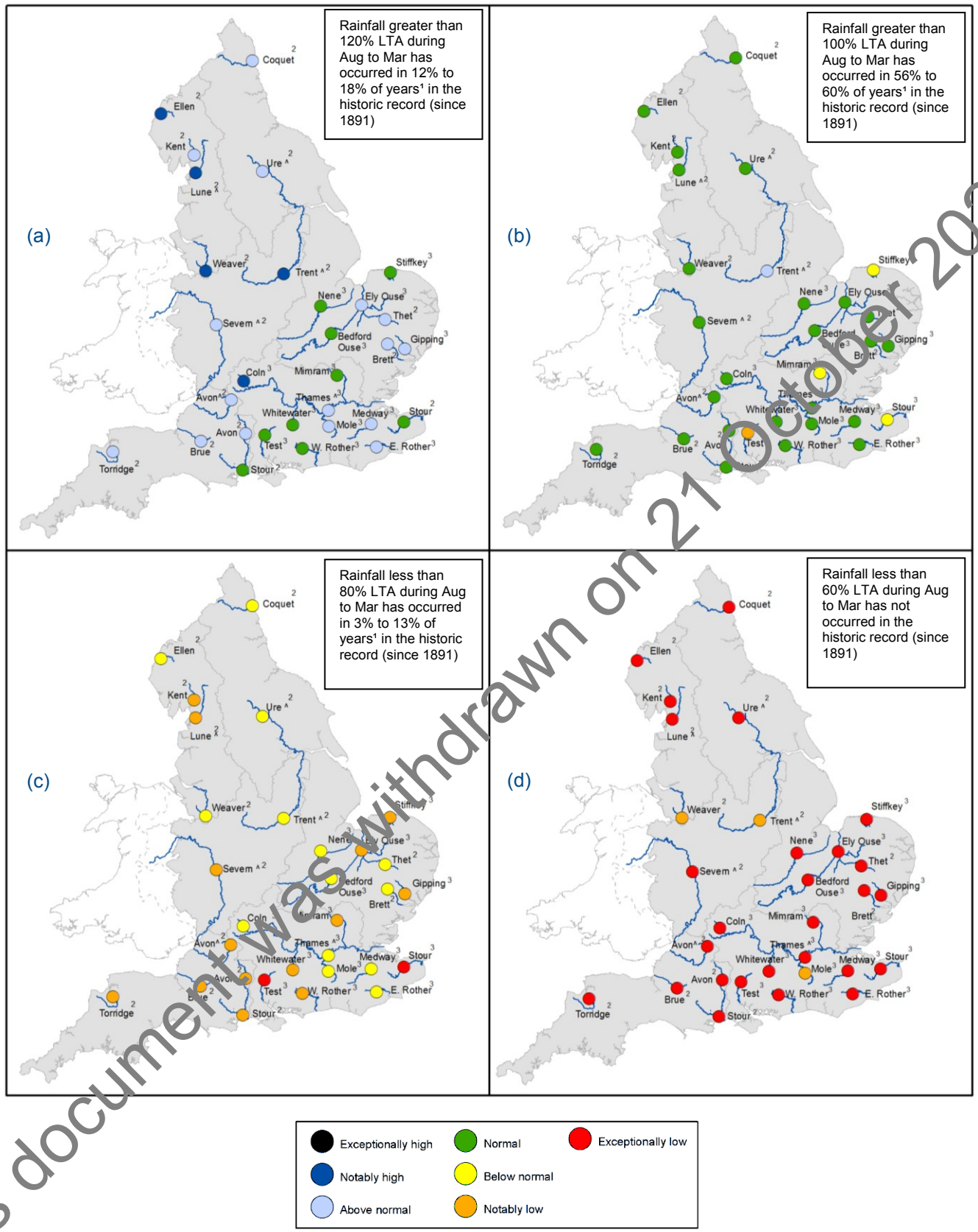


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August and September (Source: Centre for Ecology and Hydrology, Environment Agency).

[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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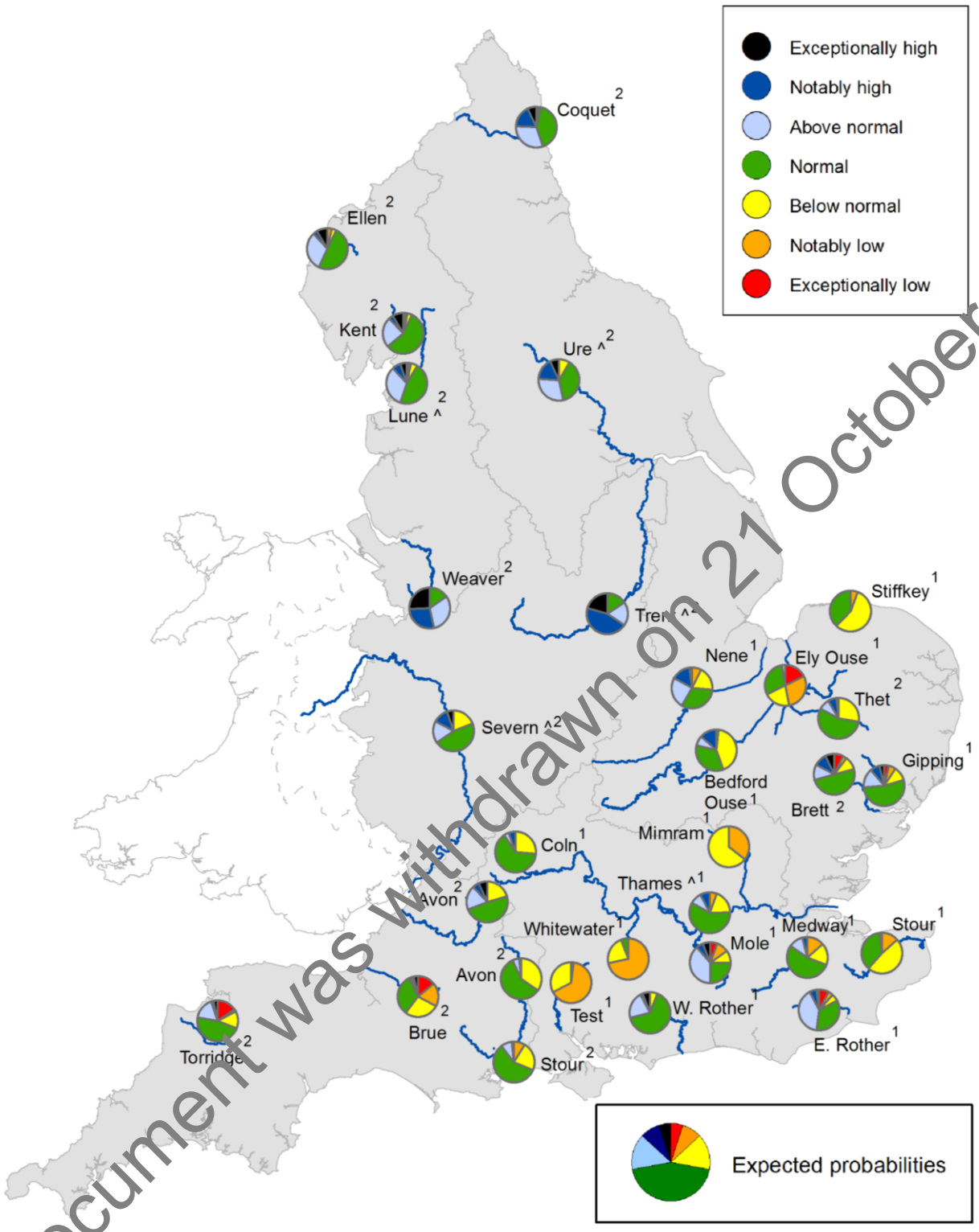

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

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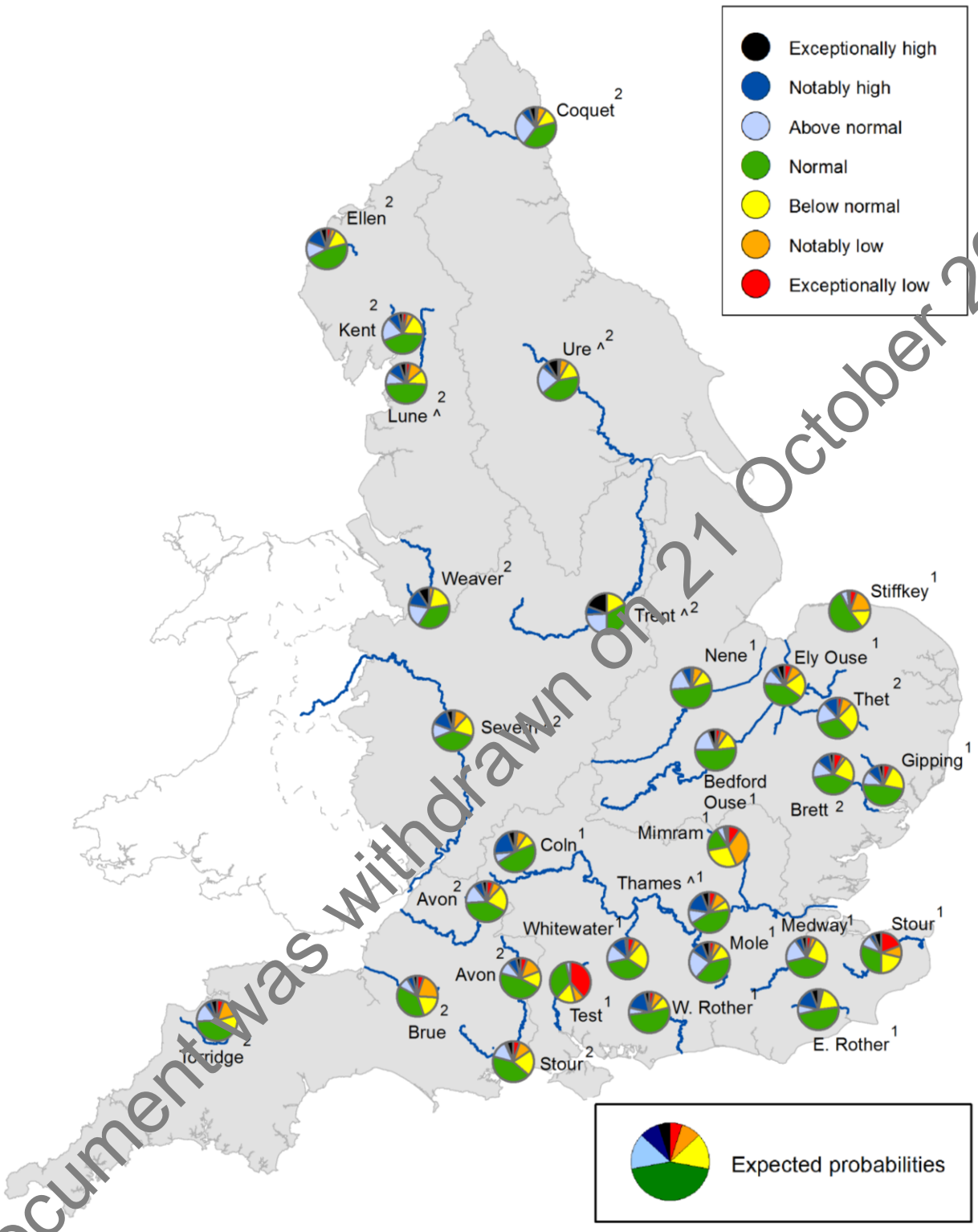

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2020. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[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

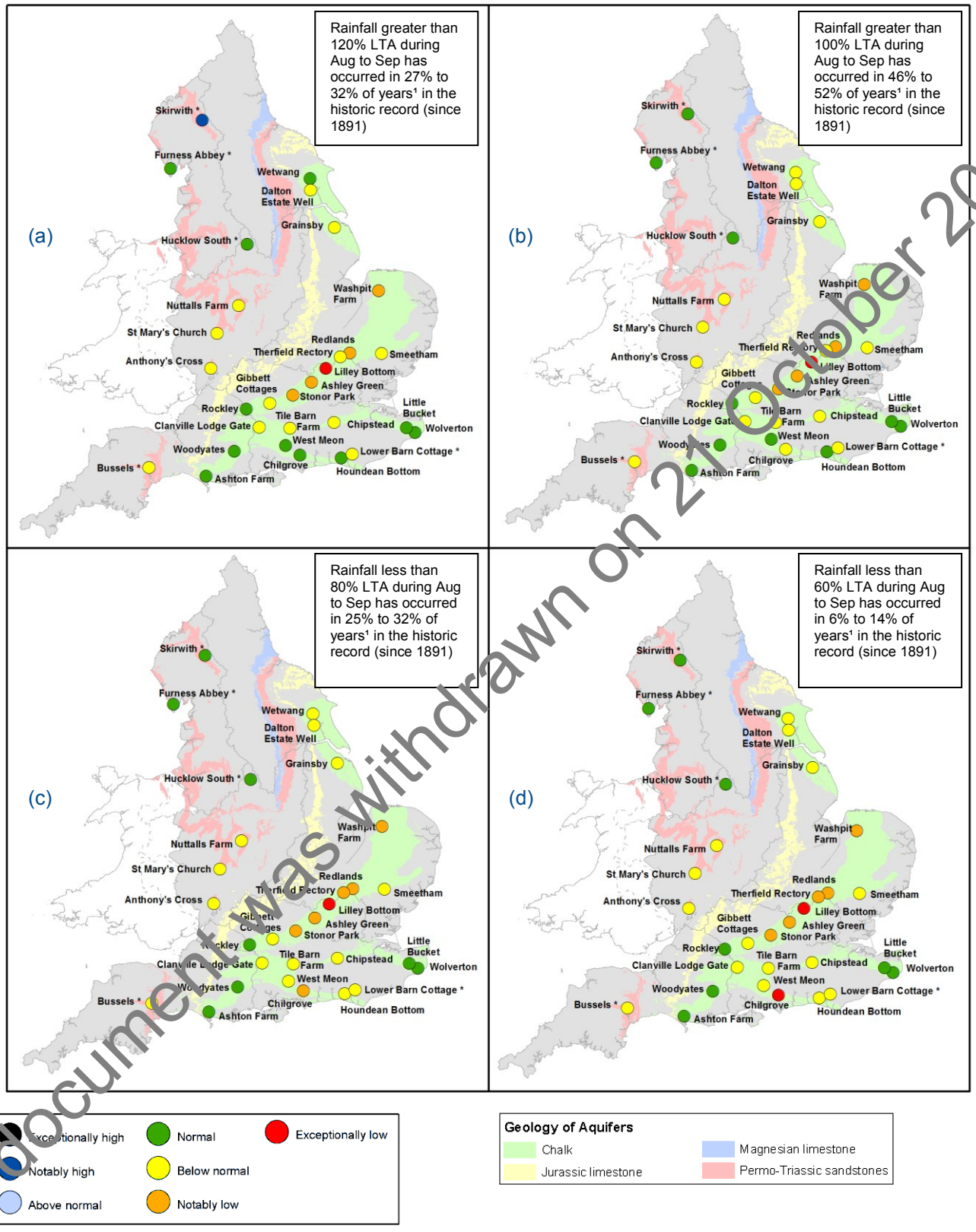

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August and September (Source: Environment Agency). Geological map reproduced with kind permission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

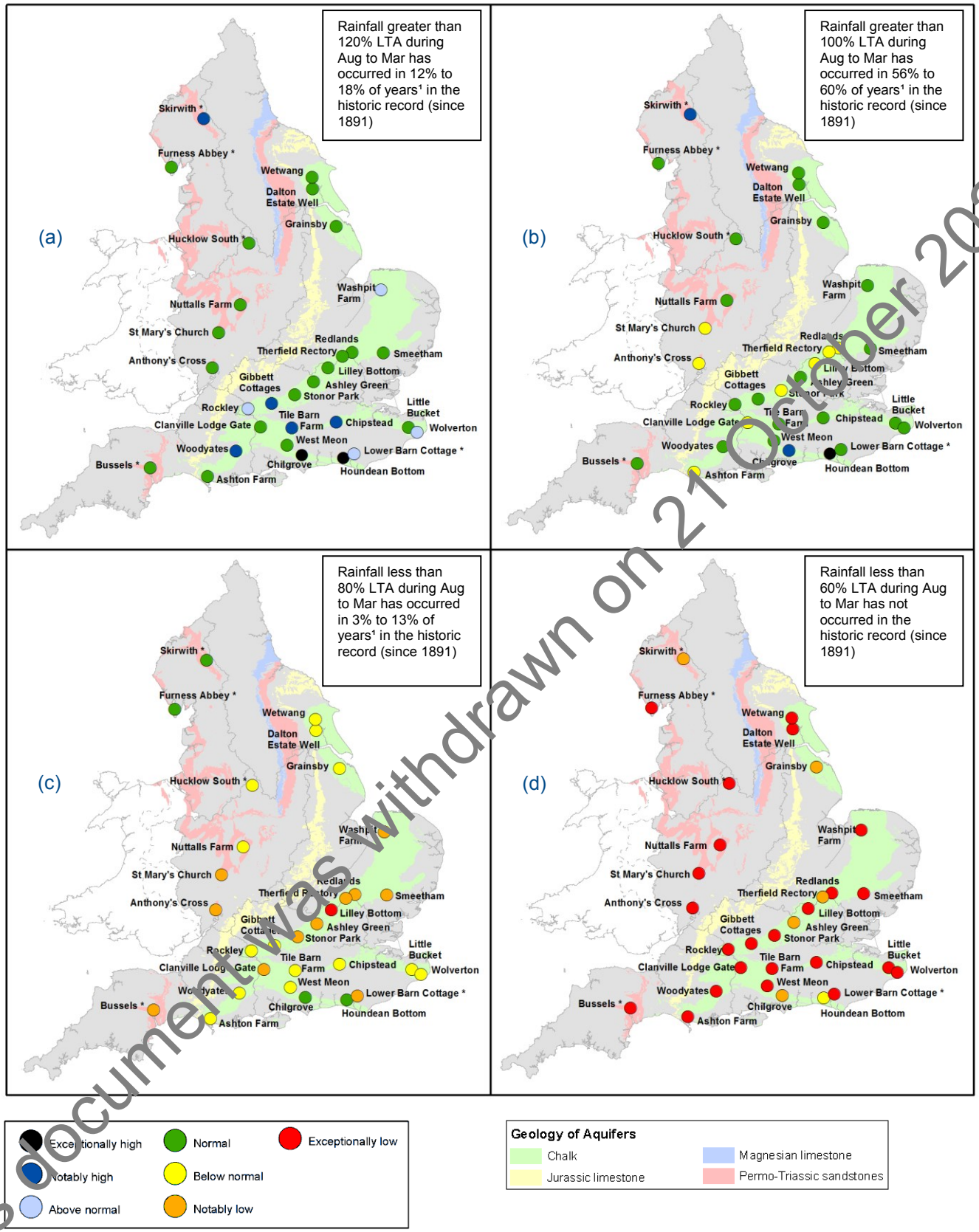

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August and March (Source: Environment Agency). Geological map reproduced with kind permission from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

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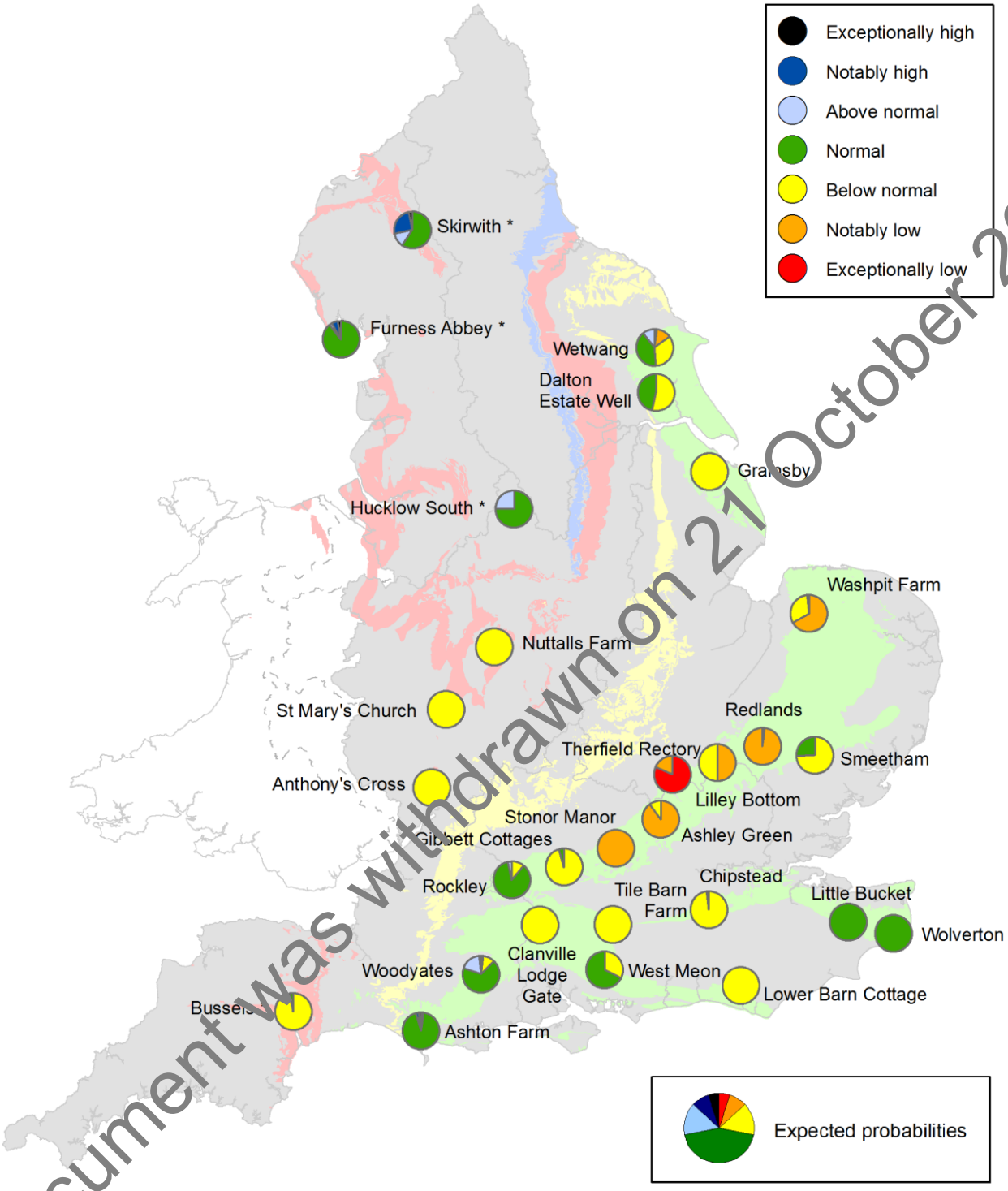

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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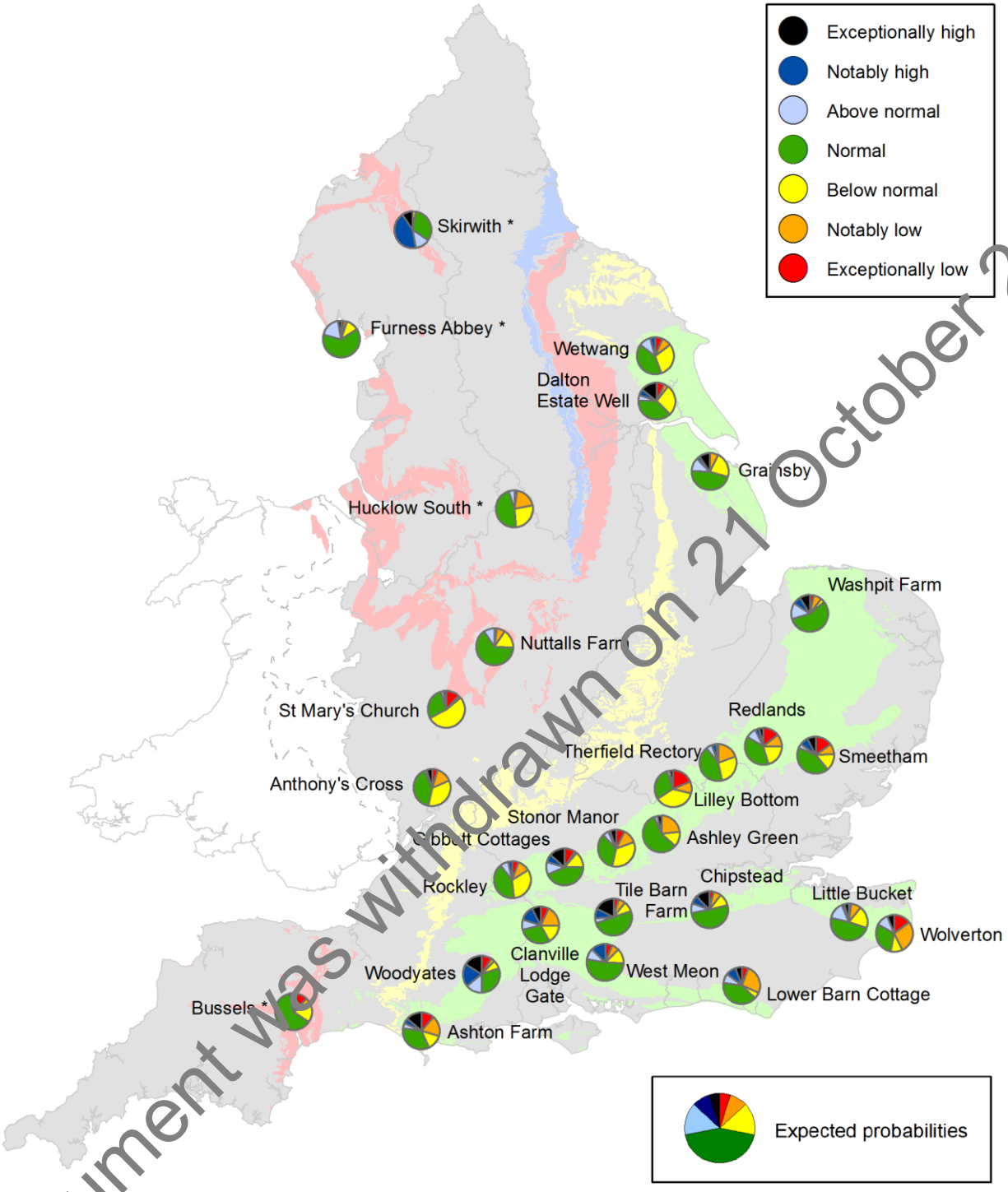

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

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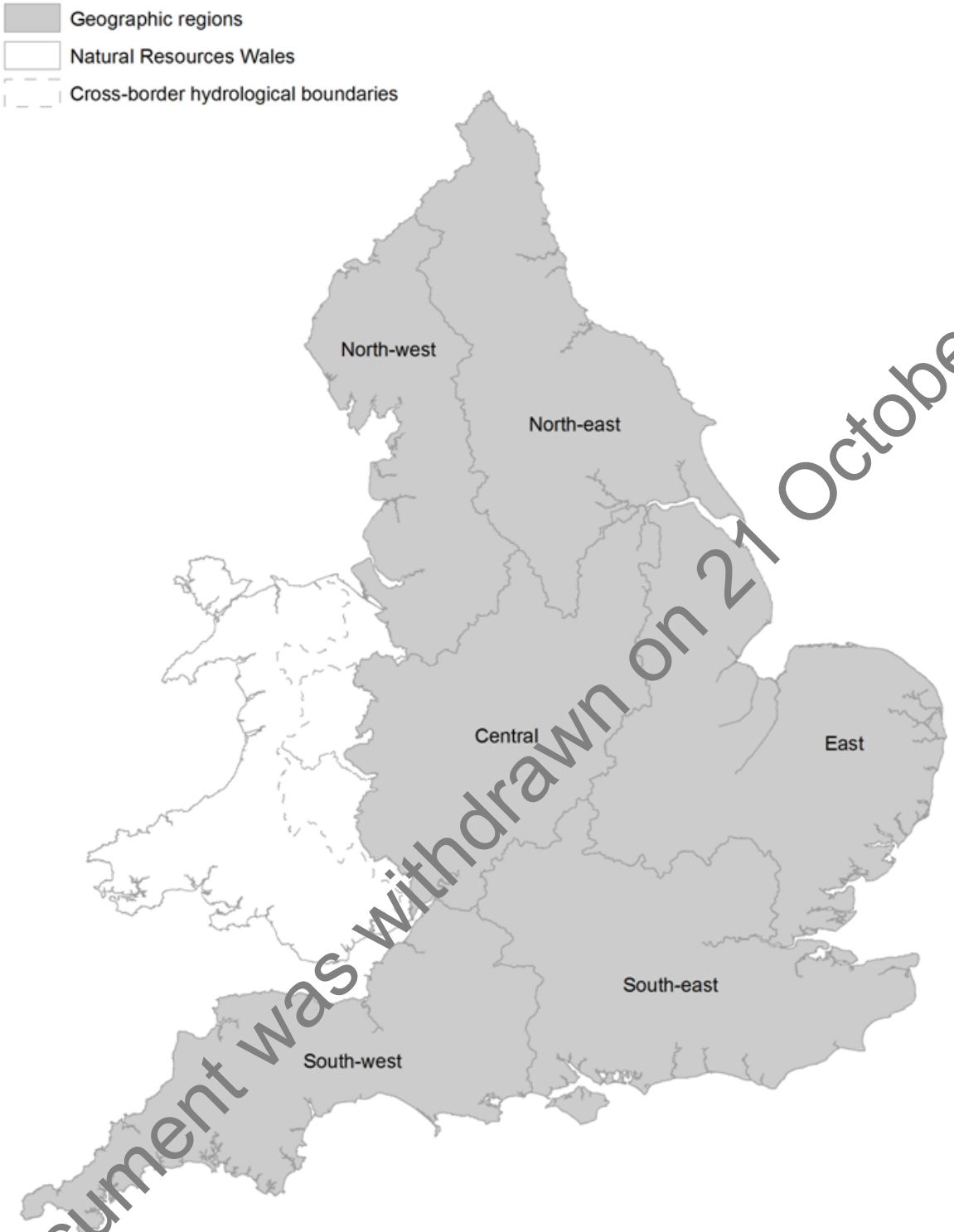

Figure 7.1: Geographic regions

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.
HadUK	A new 1km gridded dataset from the Met Office which uses rain gauge observations to derive monthly areal rainfall totals.
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