Monthly water situation report

England

Summary – May 2019

May's rainfall was below average across England at 73% of the long term average. Soils have continued to dry and were drier than average across the whole country by the end of May. River flows decreased during May and monthly mean flows were lower than normal at the majority of sites that we report on. Groundwater levels continued to decline and by the end of May, were lower than normal for the time of year at the majority of sites that we report on. Total reservoir stocks for England were at 86% of capacity at the end of May, 4% lower than at the end of April.

Rainfall

The May rainfall total for England was 44mm, which makes it the second consecutive month of below average rainfall, at 73% of the 1961-90 long term average (75% of the 1981-2010 long term average (LTA)). However, there were marked differences at a regional scale, with rainfall totals being close to average in east and north-east England, but well below average in south-east and south-west England. The highest rainfall totals relative to the May LTA were in parts of Lincolnshire at between110-120%, whilst parts of Devon and Cornwall only received 35% of the LTA (Figure 1.1).

May rainfall totals were classed as normal for the time of year in all catchments across north-east England and the majority across north-west and east England. Elsewhere, rainfall totals were below normal or notably low, with all catchments in Cornwall being notably low. Cumulative rainfall totals for the past 6 month were below normal or notably low across most of east and south-east England whilst 12-month cumulative totals were notably low or exceptionally low across most of England.

The 3, 6 and 12 month cumulative rainfall totals for east England are the sixth driest on record (records started in 1910) and the driest since 1996. The 12 month cumulative totals were in the top 5 driest on record in 20 catchments covering parts of all regions except north-west. It was the second driest 12 month cumulative period on record in the Cotswold East and Upper Cherwell catchments in south-east England, the Soar catchment in central England and the Upper Welland and Nene catchment in east England (Figure 1.2).

At a regional scale, May rainfall totals were well below average in south-east and south-west England at 62% and 49% of the LTA respectively. Elsewhere, totals ranged from 76% in central and north-west England to 94% and 95% in east and north-east England respectively (Figure 1.3).

Soil moisture deficit

Soils continued to become drier across the whole of England during May, with soil moisture deficits increasing by up to approximately 60mm by the end of the month. The largest SMDs of greater than 100mm developed across areas covered by The Fens, the Thames Estuary and the South Downs. Soils were drier than average across the whole of England, particularly across much of the south-east (Figure 2.1).

At a regional scale, SMDs increased during May in all regions and soils were drier than average for the time of year in all regions (Figure 2.2).

River flows

Monthly mean river flows for May were lower than April flows at all but two indicator sites across England. May flows were slightly higher than April's flows on rivers Swale and Wharfe in north-east England (Figure 3.1).

Monthly mean flows were classed as lower than normal for the time of year at all but 7 sites across England. Flows were particularly low in the eastern half of England, with flows on the Ely Ouse and the River Cam in east England classed as exceptionally low for the time of year. Monthly mean flows on the River Cam have been exceptionally low for 3 consecutive months and for 5 out of the last 7 months (Figure 3.1).

At the regional index sites, May flows were normal for the time at year on the River Exe (south-west England), the River Lune (north-west England) and the South Tyne (north-east England). At all other regional indicator sites monthly mean flows were below normal or lower for May (Figure 3.2).

Groundwater levels

Groundwater levels continued to recede during May and at the end of the month, levels were lower than at the end of April at all but 3 indicator sites. At nearly three-quarters of the indicator sites, end of month groundwater levels were classed as below normal or lower (Figures 4.1).

At the major aquifer index sites, the end of month groundwater levels were classed as notably low at Redlands Hall (Cam and Ely Ouse chalk aquifer), Stonor Park (South West Chilterns chalk aquifer) and Jackaments Bottom (Burford Jurassic Limestone aquifer). Dalton Estate Well (Hull and East Riding chalk aquifer) was below normal, whilst the remaining sites were classed as normal (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased during May at the majority of the reported reservoirs and reservoir groups in England. The biggest reductions as a proportion of total storage capacity were seen in north-west, central and south-west England, with storage at Wimbleball being 19% lower than the previous month. Reservoir stocks at the end of May were classed as below normal or lower at the majority of reported reservoirs and reservoir groups. Maintenance of the Thames Lee Tunnel between January and March and subsequent water quality issues has resulted in the Lower Lee Group of reservoirs being drawn down (Figure 5.1)

At a regional scale, total reservoir stocks remained the same in east England during May, but decreased elsewhere. Total reservoir stocks for England were at 86% of capacity at the end of May, which is below average for the time of year (Figure 5.2).

Forward look

The first part of June is expected to be unsettled, with showers and longer spells of rain for most parts. Thereafter, showery weather is expected to continue in the south whilst drier, more settled conditions return to the north. For both June, and the three month period June to August, the chances of above or below average precipitation are similar. However wetter than average conditions are marginally more likely[1].

Projections for river flows at key sites[2]

Approximately three-quarters 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 both September 2019 and March 2020.

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]

Nearly 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 September 2019, increasing to nearly three-quarters of sites by the end of 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

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

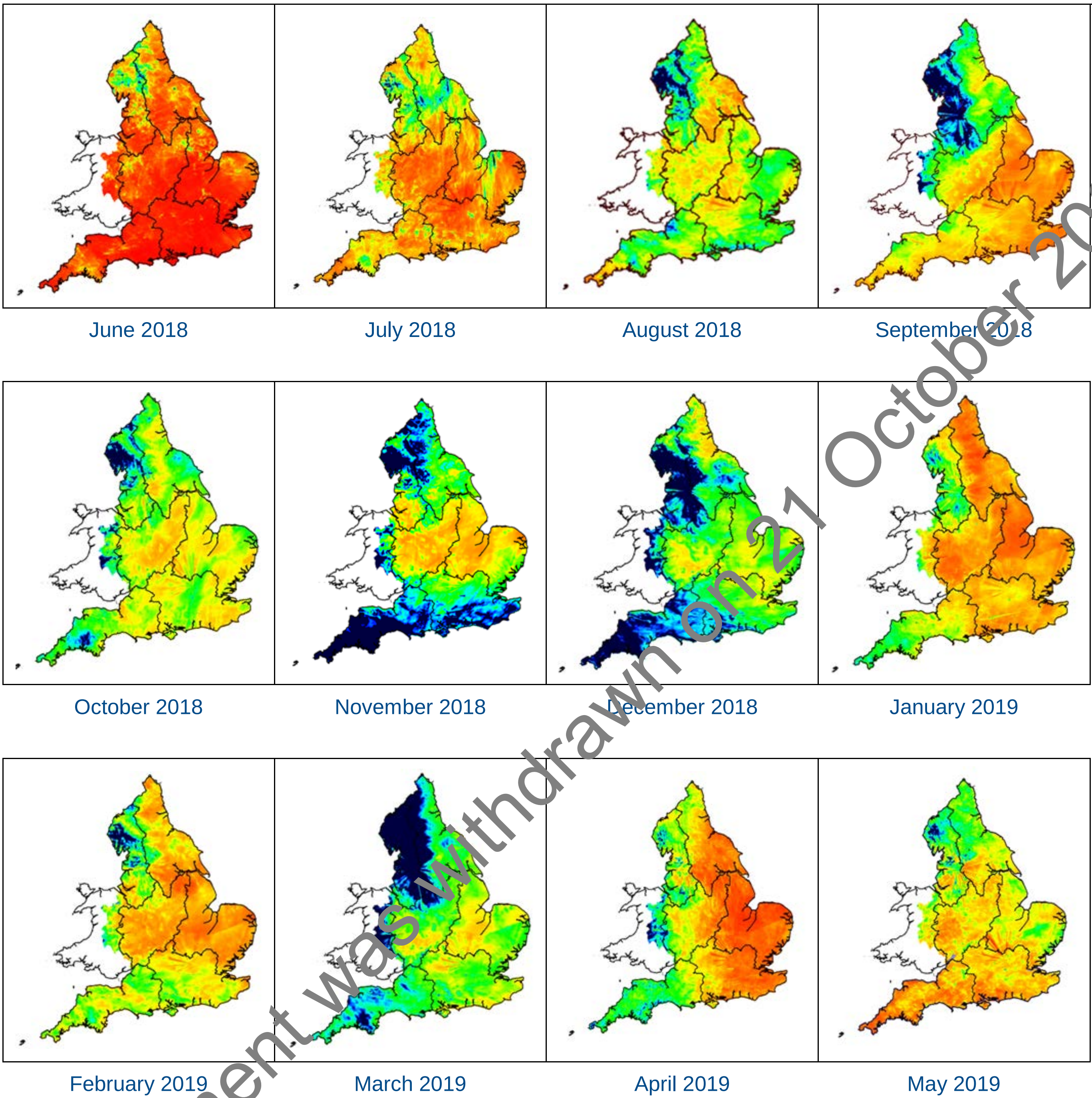
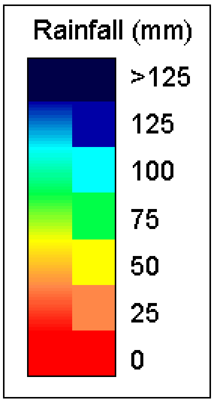


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



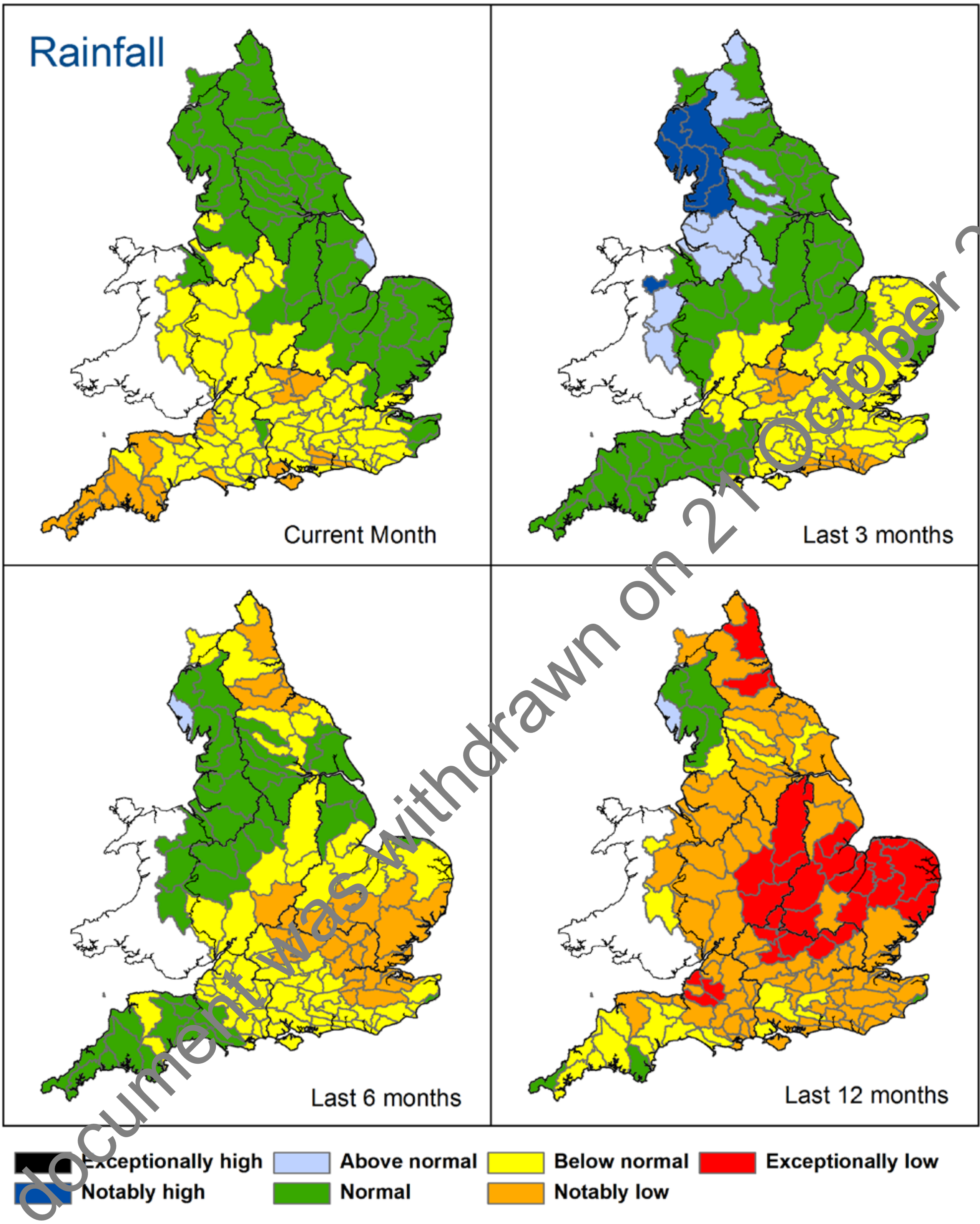


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 May 2019), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met 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

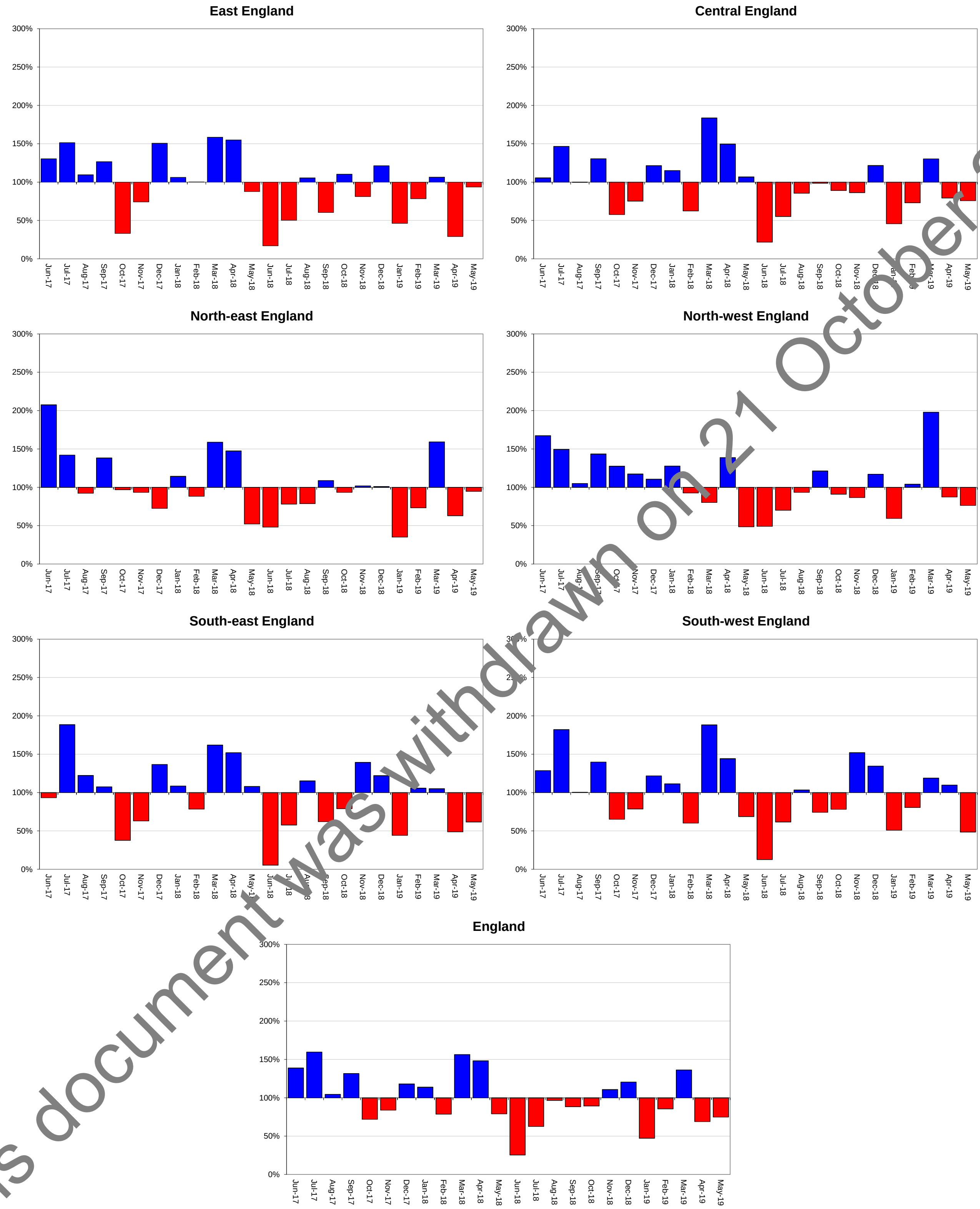


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of April 2019[1]	End of May 2019[2]

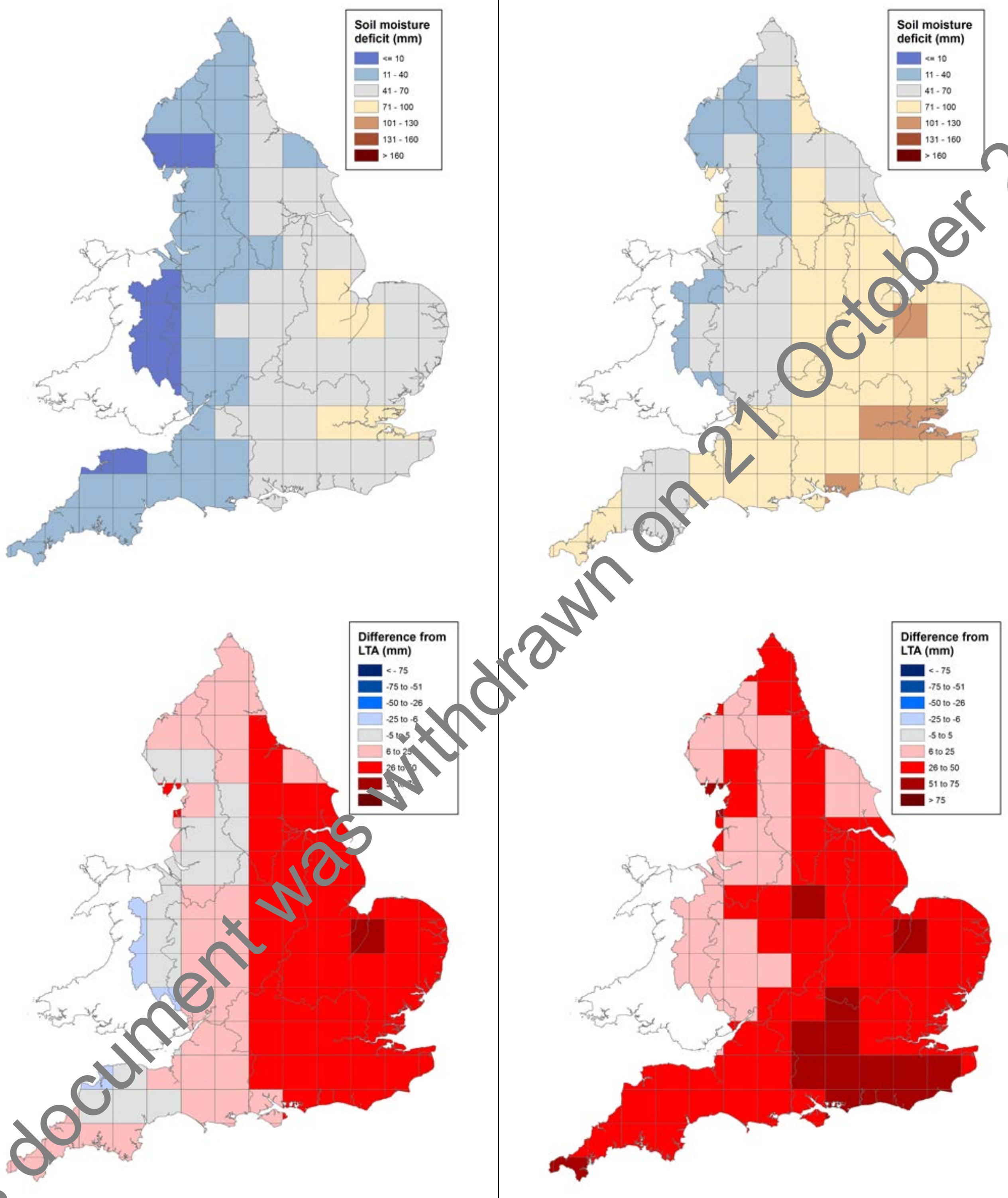


Figure 2.1: Soil moisture deficits for weeks ending 30 April 2019 [1] (left panel) and 28 May 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

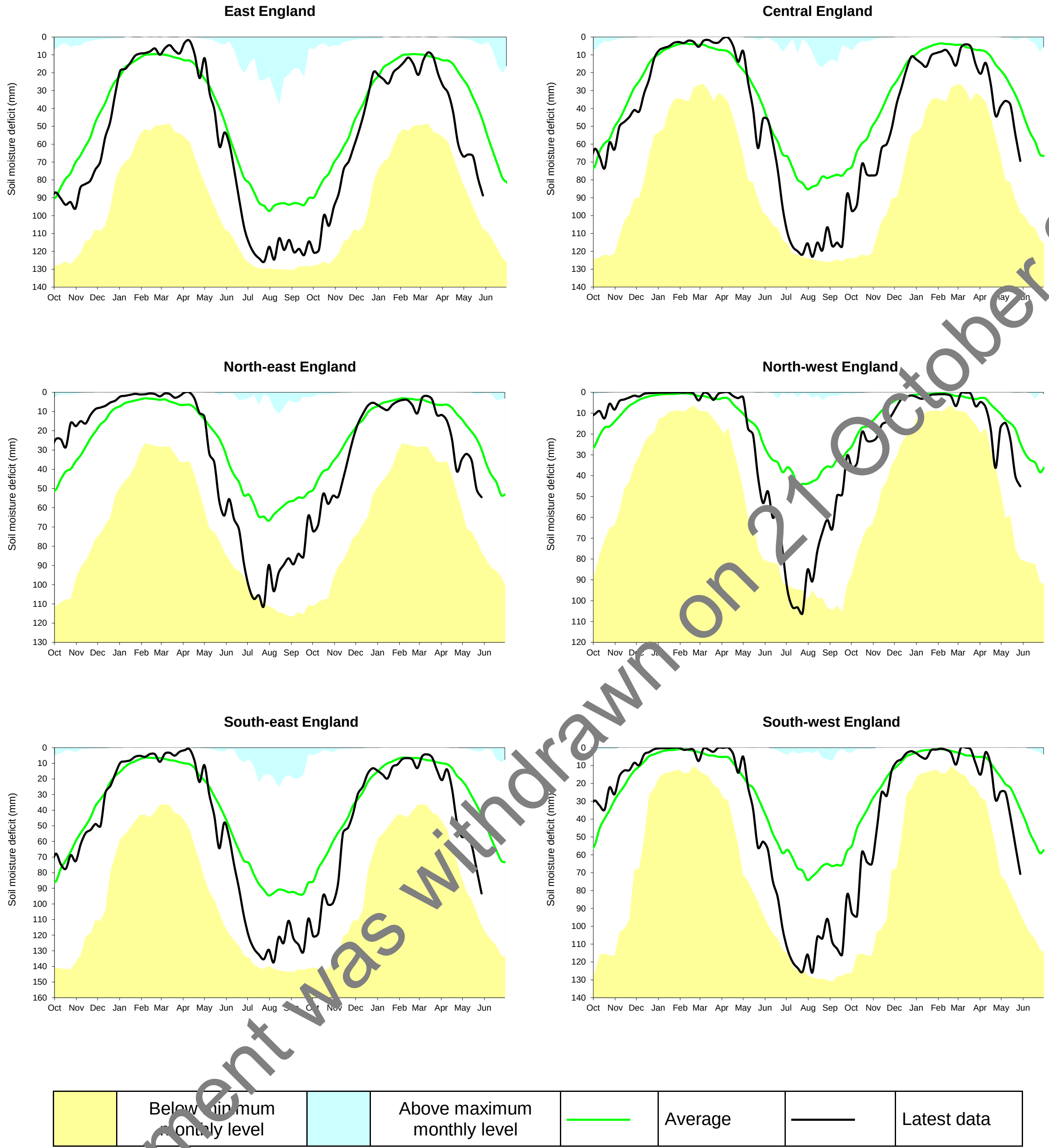
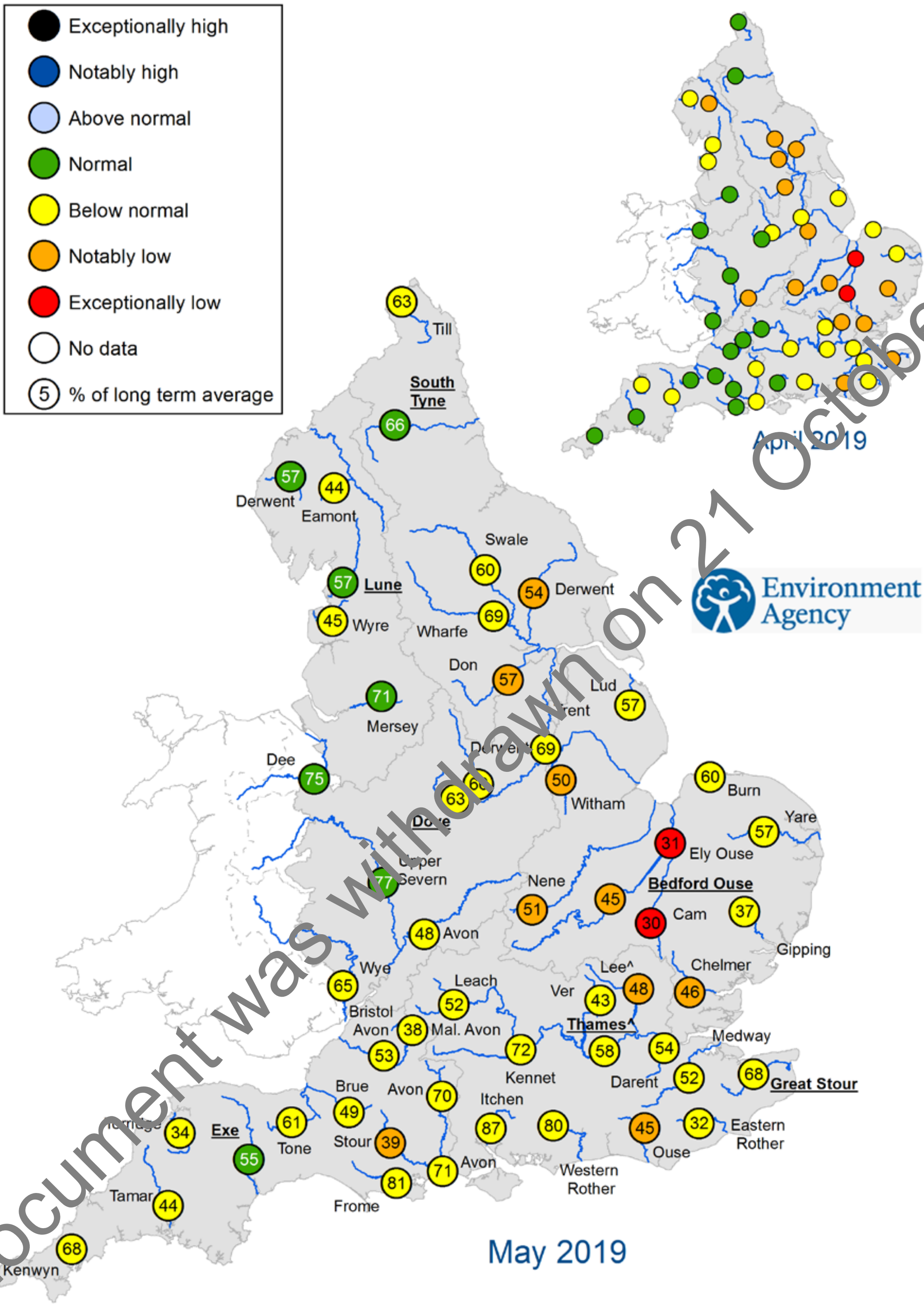


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

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

River flow charts

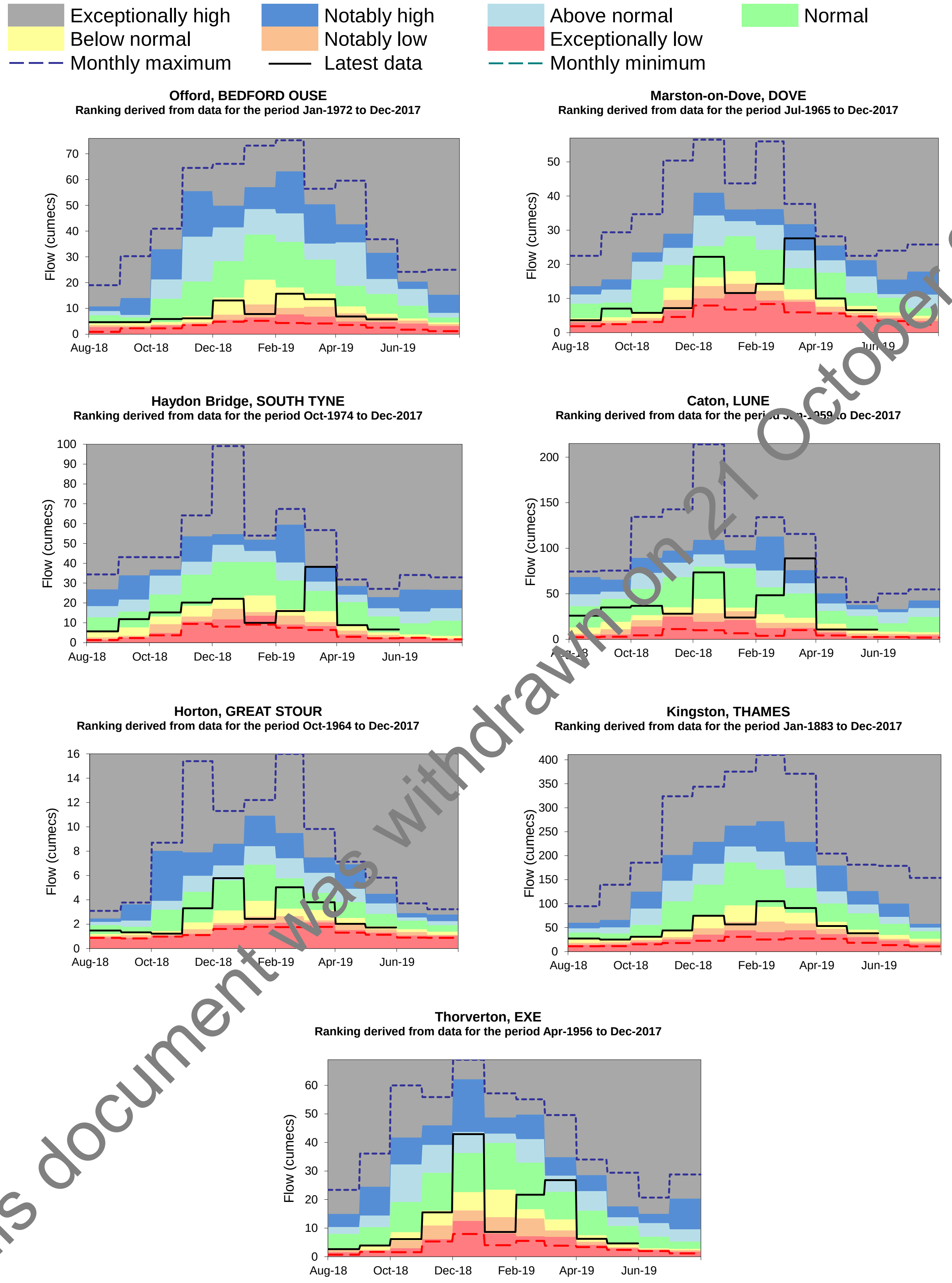
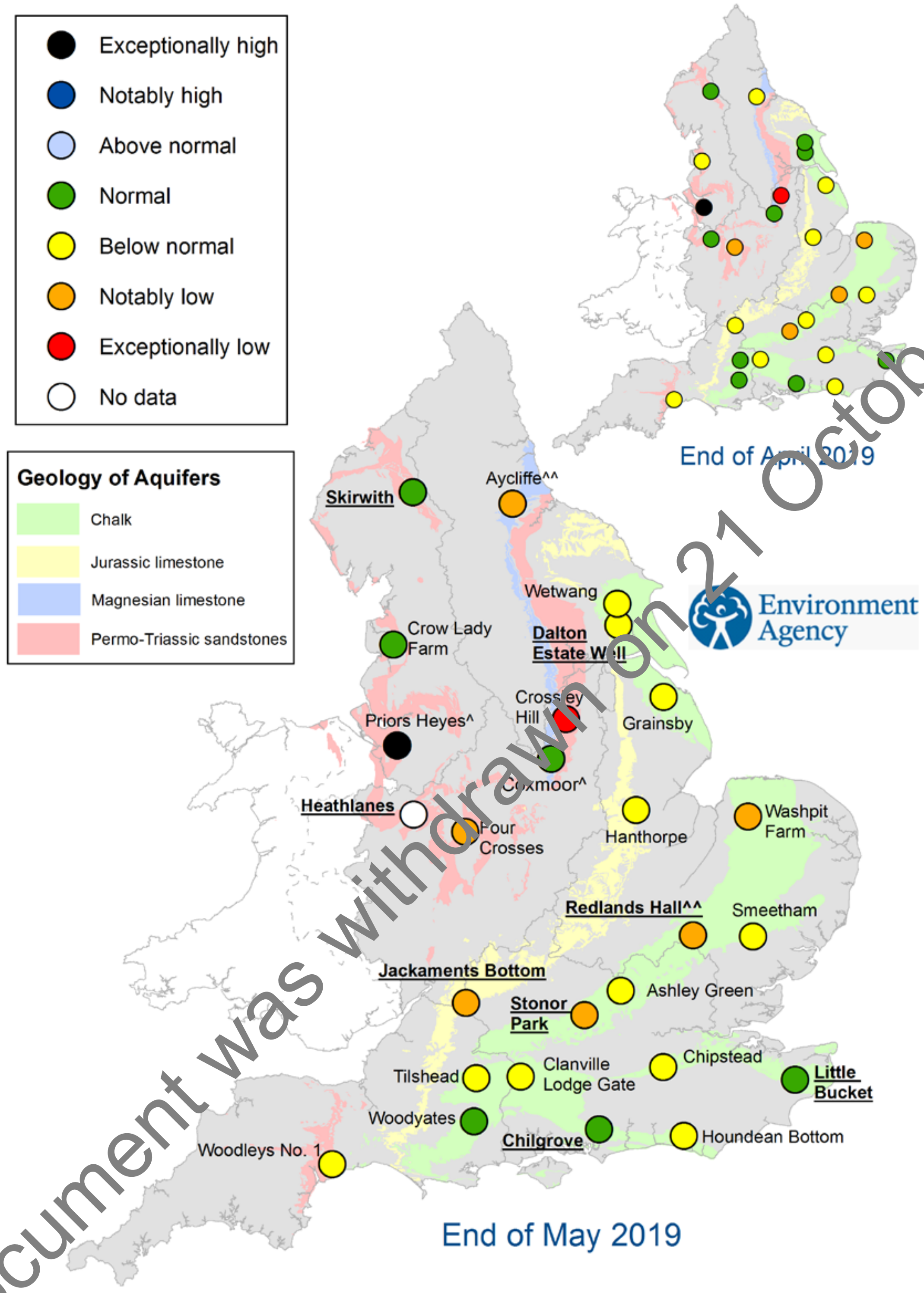


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 April and May 2019, classed relative to an analysis of respective historic April and May 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

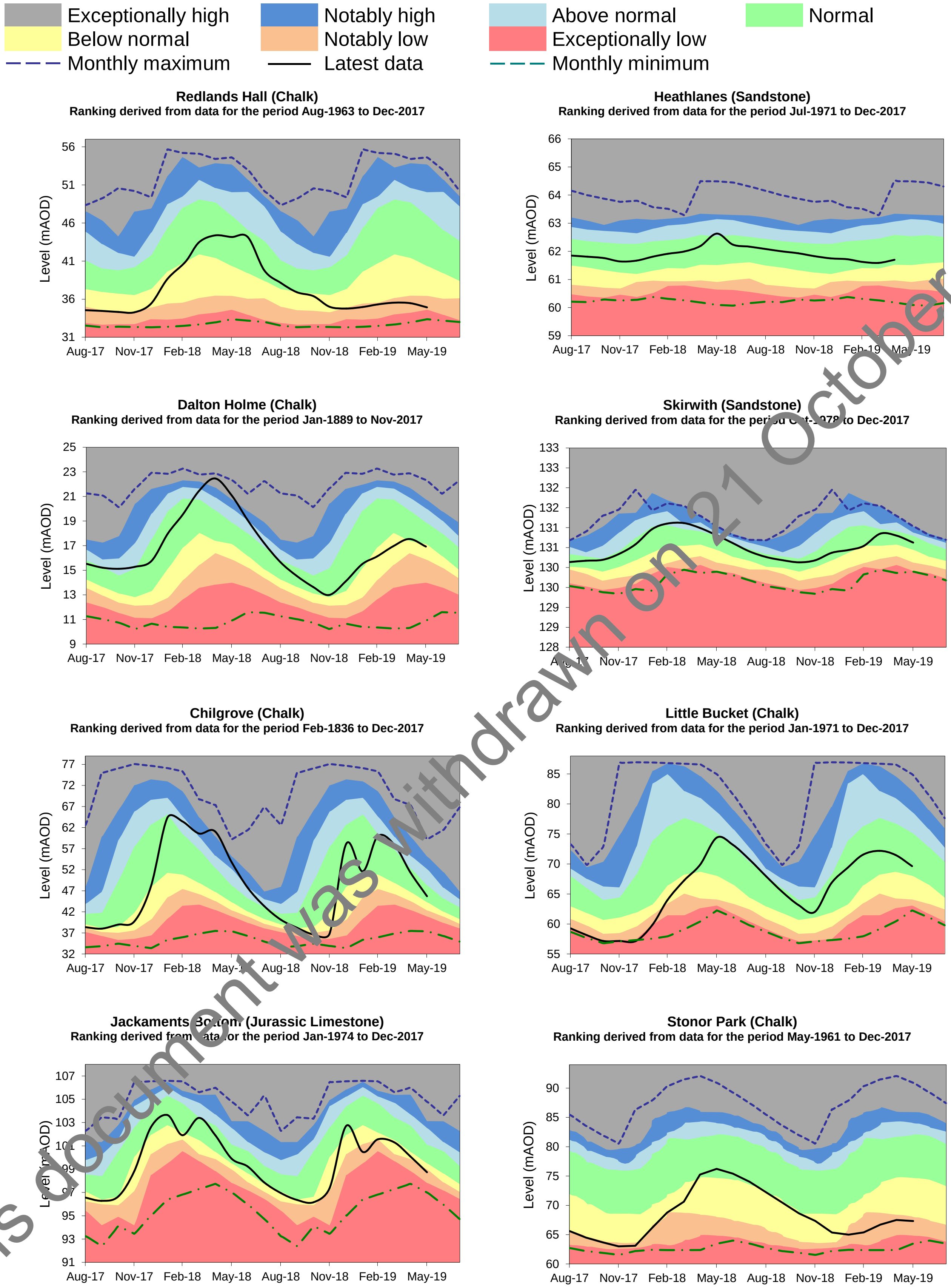
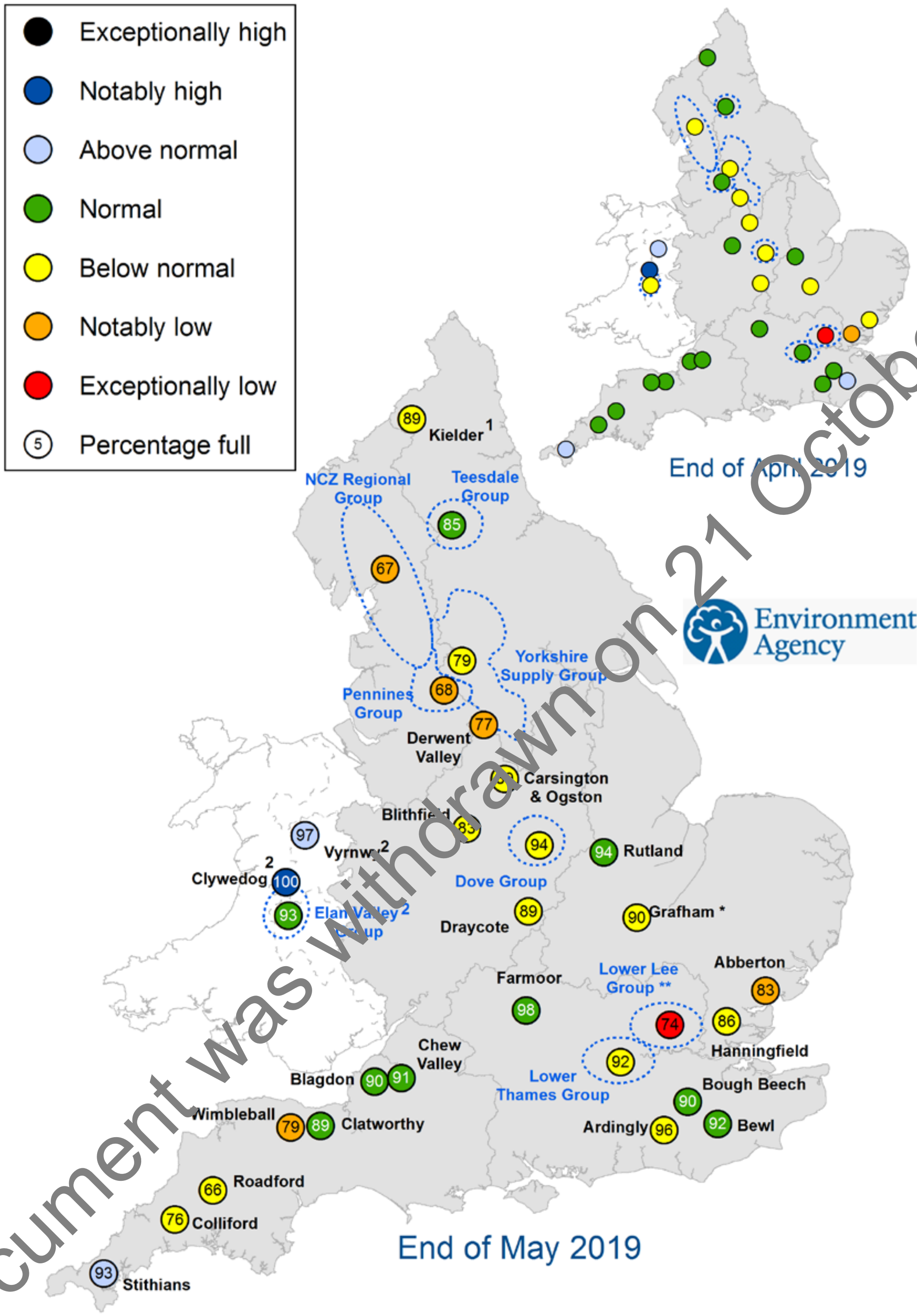


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

Reservoir storage



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

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of April and May 2019 as a percentage of total capacity and classed relative to an analysis of historic April and May 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

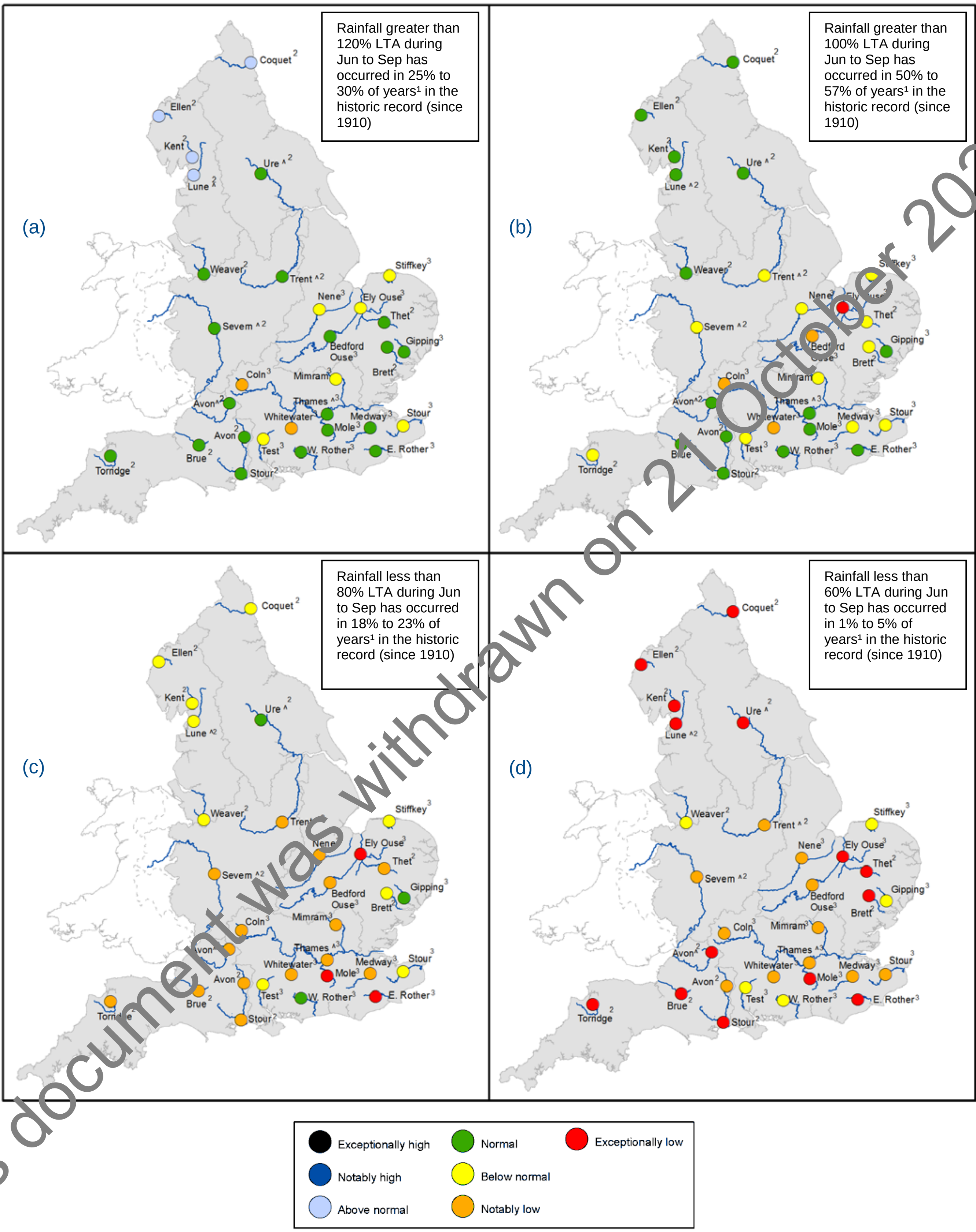


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*

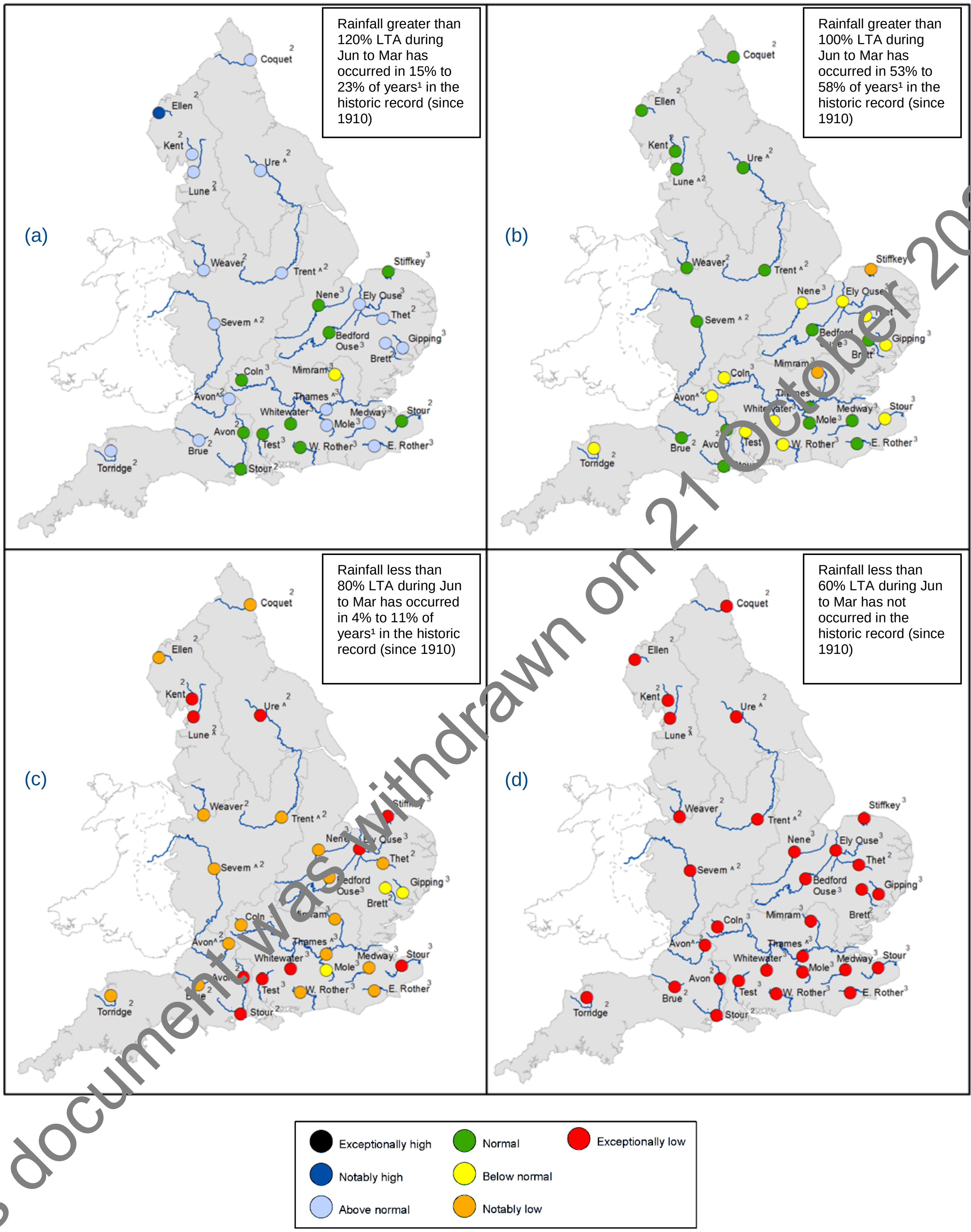


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and March (Source: Centre for Ecology and Hydrology, Environment Agency).

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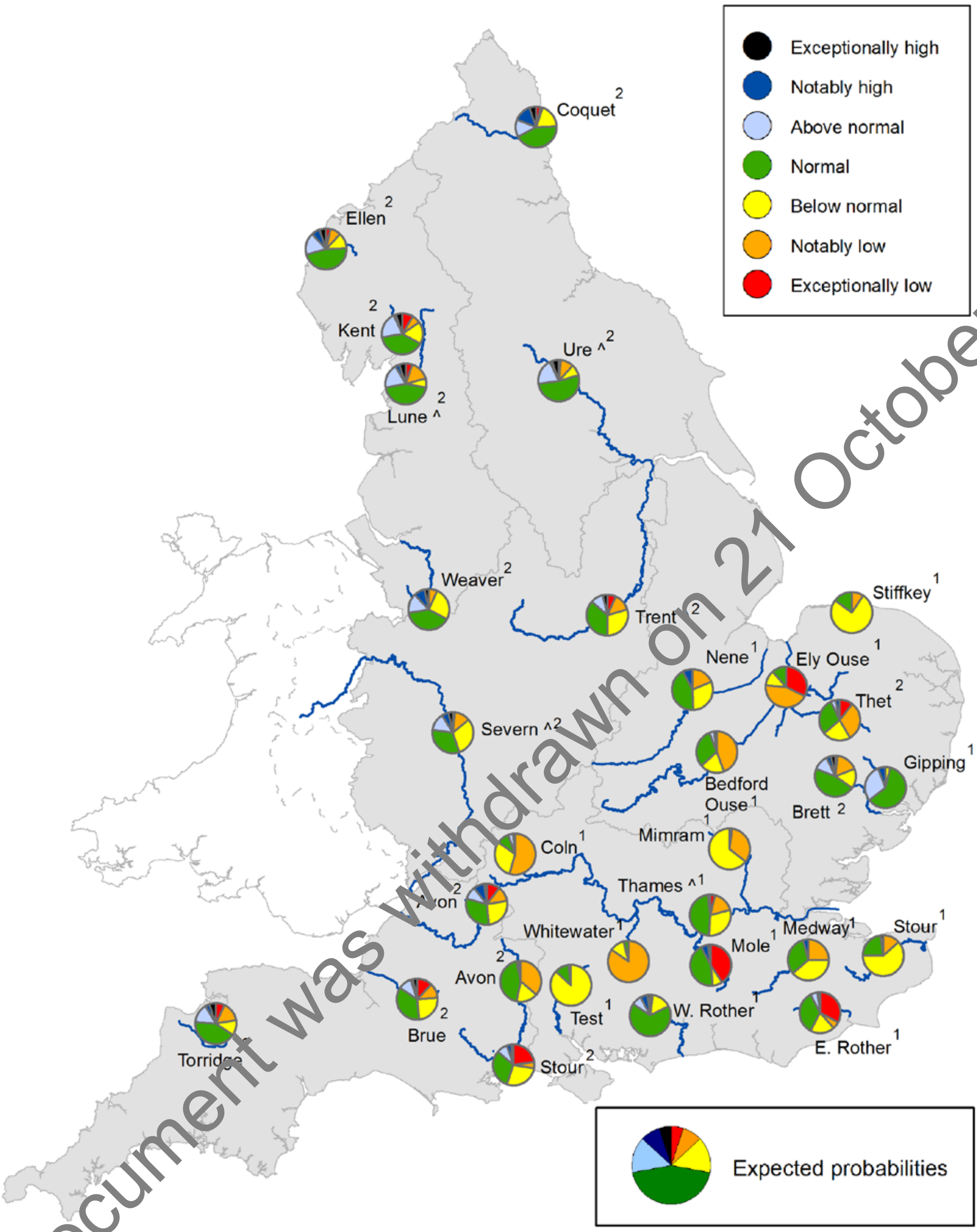

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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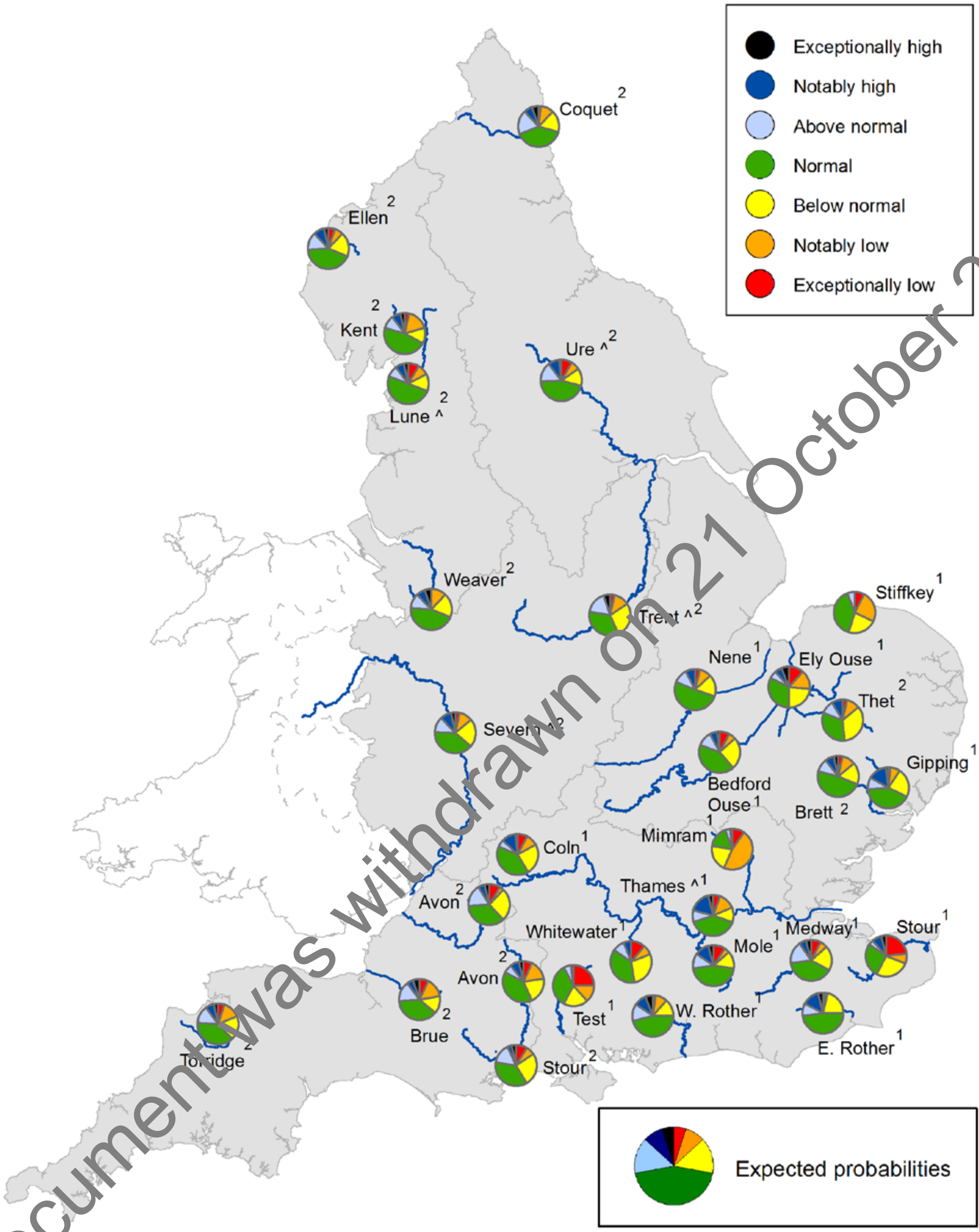

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2020. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the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

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

Forward look - groundwater

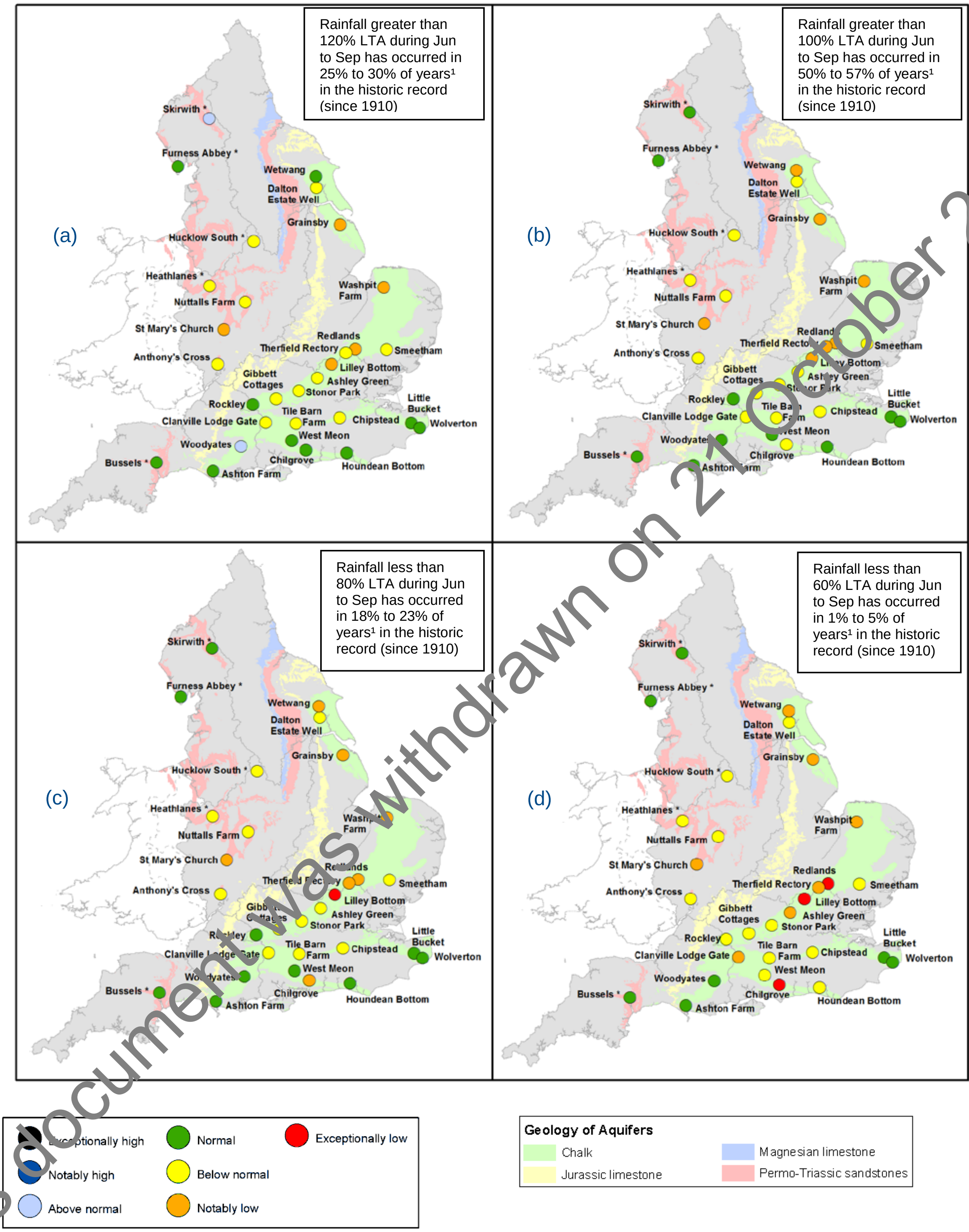

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September (Source: Environment Agency). Geological map reproduced with kind permission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

* Projections for these sites are produced by BGS
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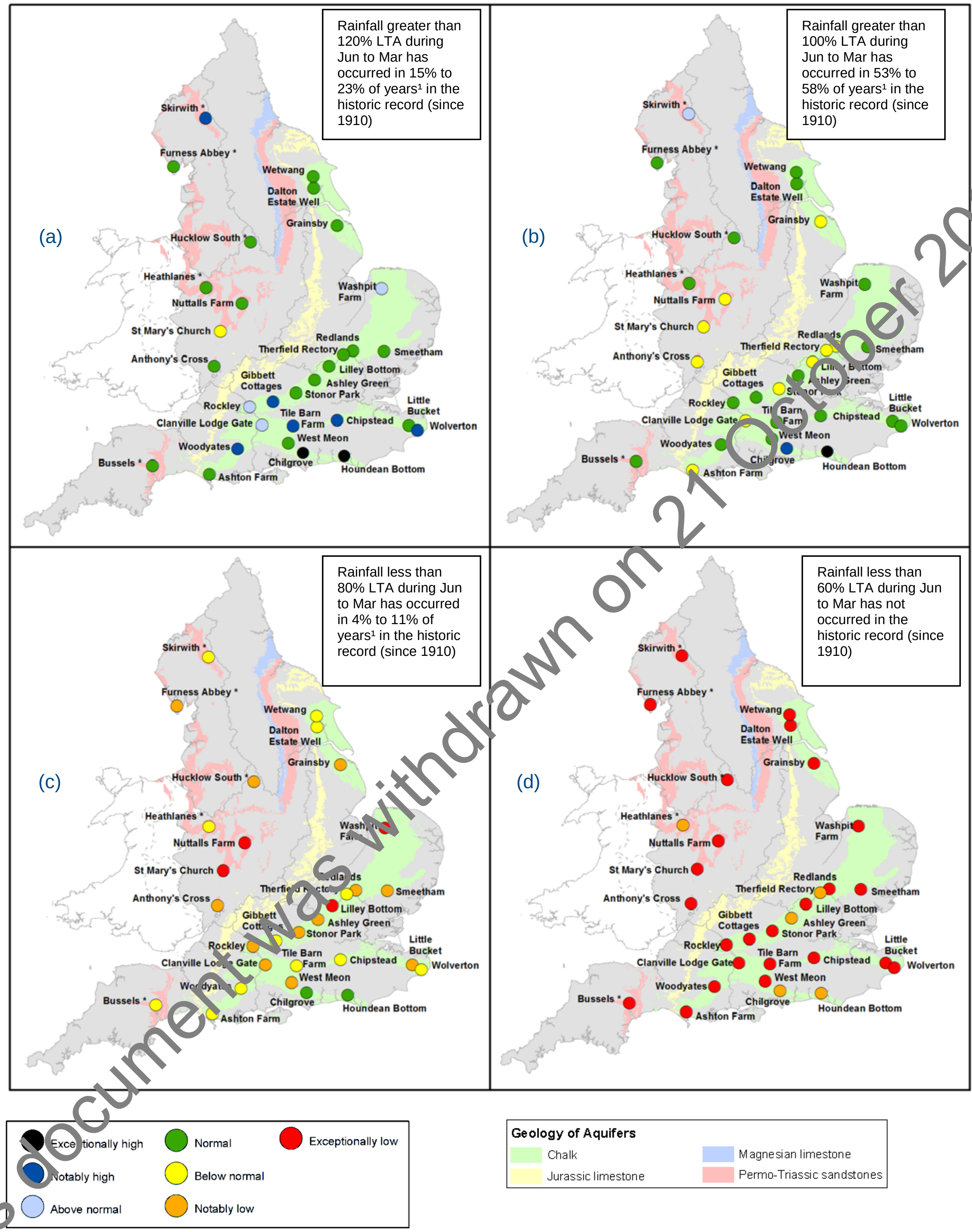

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and March (Source: Environment Agency). Geological map reproduced with kind permission from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

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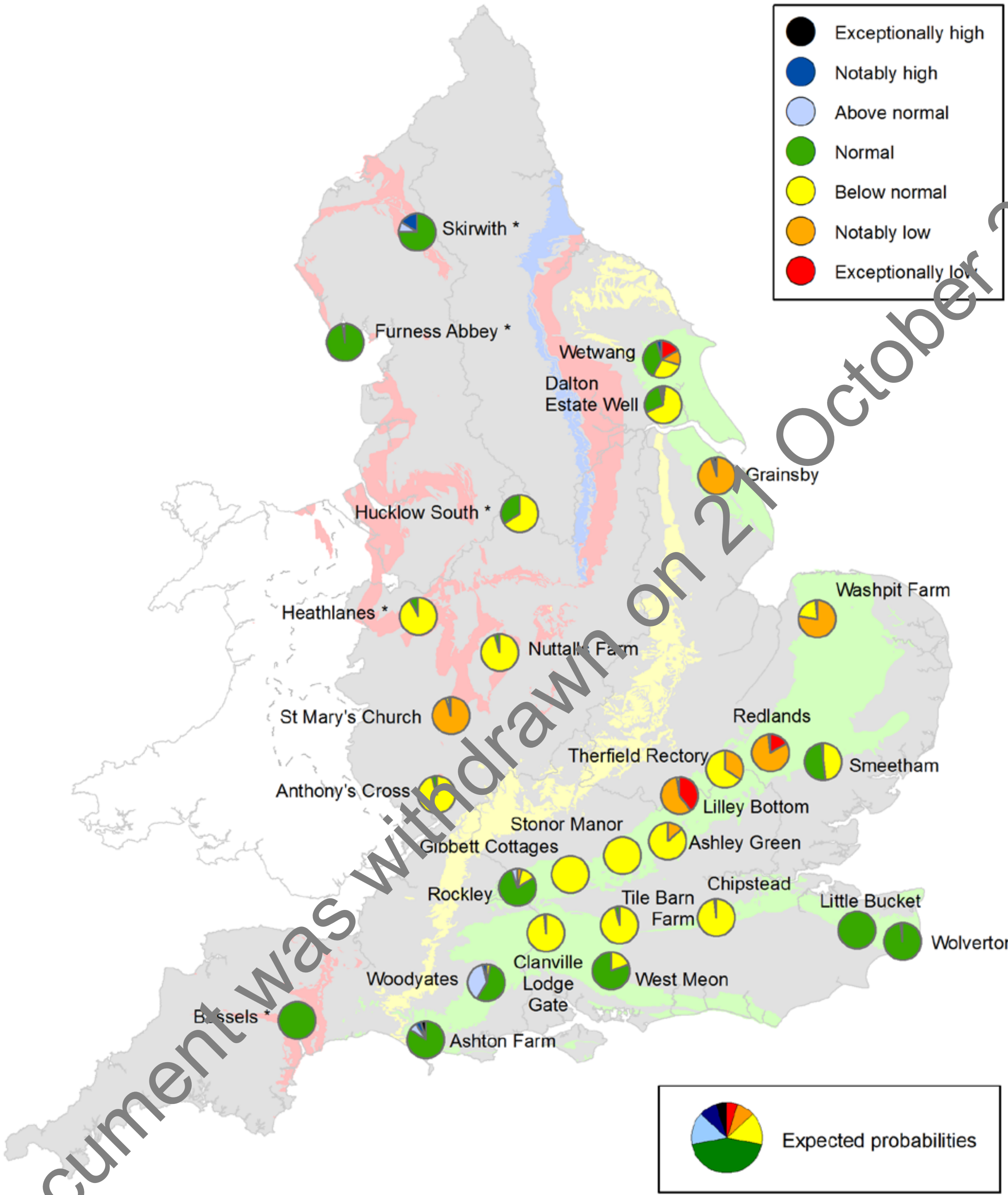

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

* Projections for these sites are produced by BGS

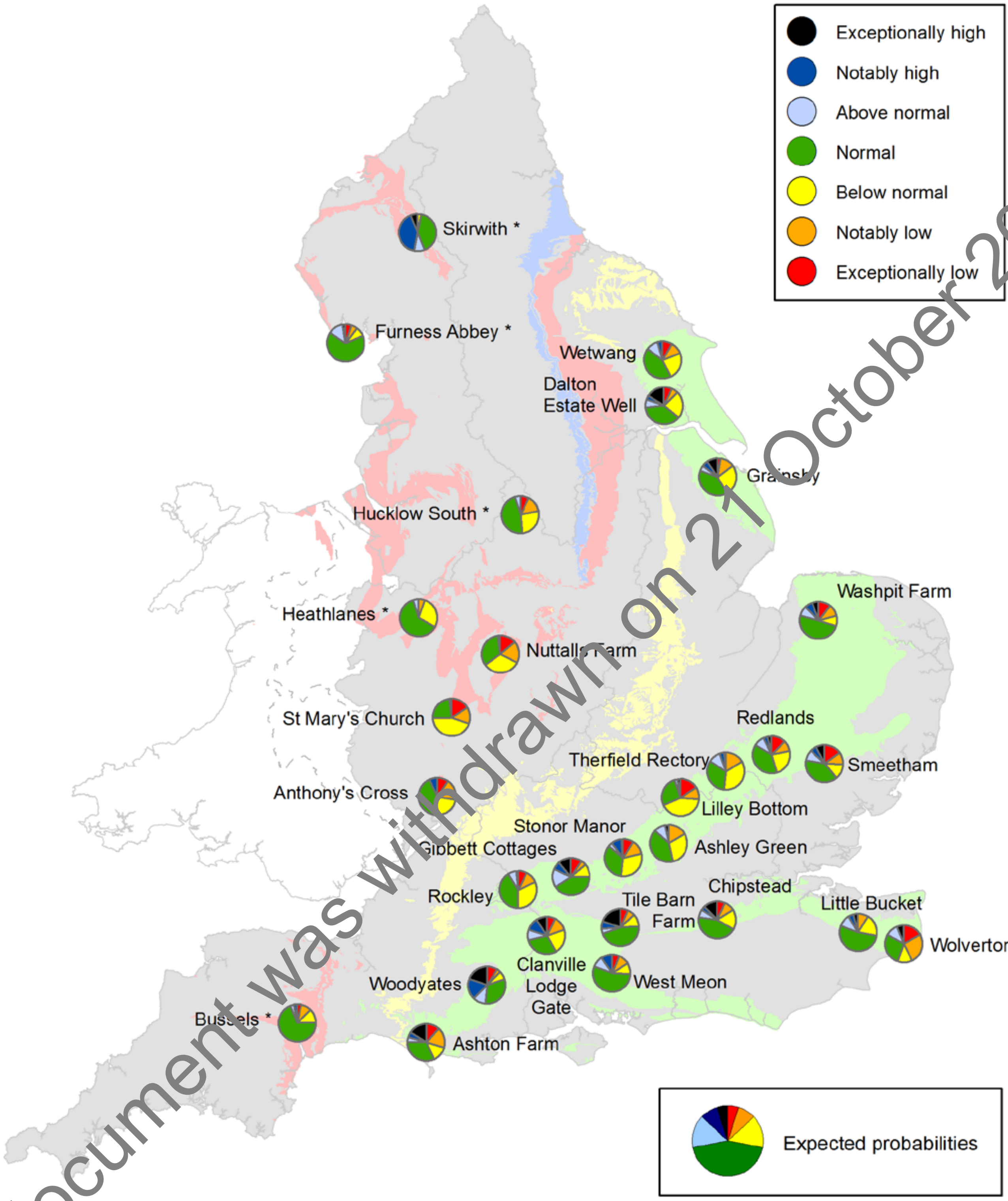

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2020. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the 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.

* Projections for these sites are produced by BGS

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