Monthly water situation report

England

Summary – March 2020

March rainfall totals were lower than average across all regions of England. The lowest rainfall totals for this month were recorded in eastern England. As a result, by the end of the month, soils were drier across most of the country compared to the average for the time of year. Following the exceptionally high rainfall totals and flooding in February, monthly mean river flows for March were classed as exceptionally high or notably high at over a half of indicator sites. End of month groundwater levels were classed as normal or higher at almost all indicator sites. Total reservoir stocks across England were at 95% capacity at the end of March.

Rainfall

The March rainfall total for England was 49 mm, which represents 74% of the 1961-90 long-term average (77% of 1981-2010 LTA) and just over a quarter of the record breaking February 2020 rainfall total for England (175 mm). Generally showery and unsettled weather at the beginning of the month gave way to very dry conditions across the country in the last two weeks of March. The lowest March rainfall totals were in eastern England (Figure 1.1).

Across most of England, March rainfall totals were classed as normal for the time of year. Rainfall totals, as a percentage of LTA, ranged from a notably low 30% of LTA in the Steeping, Great Eau and Long Eau catchment and in the South Forty Foot and Hobhole catchment (Lincolnshire) to an above normal 126% of LTA in the Dover chalk catchment (Kent). The 6 month and 12 month cumulative rainfall totals were classed as either exceptionally high or notably high in over three-quarters of catchments and were classed as normal or higher in all catchments across England (Figure 1.2).

At a regional scale, March rainfall totals were lower than the long-term average in all regions. Totals ranged from 22 mm (48% of LTA) in east England to 85 mm (90% of LTA) in north-west England (Figure 1.3).

Soil moisture deficit

Soils across England were close to saturation at the start of March (soil moisture deficits were <10mm). By the end of the month, soils were drier than average for the time of year across most of the country, with soil moisture deficits ranging from 13-32 mm (Figure 2.1). This was reflected at a regional scale, with higher than average soil moisture deficits in all regions at the end of the March (Figure 2.2).

River flows

Monthly mean river flows decreased at almost all indicator sites, compared to February. Despite this, March river flows were classed as exceptionally high or notably high at over half of the indicator sites. Of these, on five rivers the monthly mean flows represented more than twice the LTA; these were the River Ouse, Darent, Medway and Rother (in south-east England) and the River Severn (at Bewdley, in central England) (Figure 3.1).

River flows on the Bedford Ouse (east England) were classed as normal for the time of year. At all of the other regional indicator sites, monthly mean flows were classed as either above normal or notably high (Figure 3.2).

Groundwater levels

Groundwater levels fell during March at just under two-thirds of indicator sites. End of month groundwater levels were classed as normal or higher at almost all sites and groundwater levels were classed as exceptionally high or notably high for the time of year at over half of indicator sites. Record high end of March groundwater levels were recorded at five indicator sites (Figures 4.1 and 4.2).

In the Cam and Ely Ouse chalk aquifer at Redlands Hall (south-east England), groundwater levels continued to rise, but the end of the month groundwater level was still classed as below normal. At the other major aquifer index sites, exceptionally high groundwater levels were recorded in the sandstone aquifers measured at Weir

Farm (central England) and at Skirwith (north-west England) and the chalk aquifers measured at Little Bucket and Chilgrove (both in south-east England) (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at just under half of the reservoirs and reservoir groups that we report on during March. The biggest decrease in reservoir stocks, as a proportion of total storage capacity, was seen in the Teesdale Group of reservoirs (north-east England); a 12% reduction in reservoir stocks meant it was classified as a below normal 88% of capacity at the end of the month. The largest increases in reservoir stocks were in east-England with an 8% increase in reservoir stocks at both Abberton and Hanningfield reservoirs. Stocks were classed as normal or higher at over three-quarters of the other reservoirs and reservoir groups we report on at the end of March (Figure 5.1).

Total reservoir stocks across England were at 95% capacity at the end of March. Although this is a small decrease compared to the end of February it is still above the LTA. At a regional scale, total reservoir stocks were equal to or above the LTA in all regions. Regional reservoir stocks ranged from 92% in north-east England to 98% in south-west England (Figure 5.2).

Forward look

The beginning of April is expected to remain largely fine and dry for the majority of England, with some rain likely across north-west England. The fine and dry weather is expected to continue through the middle of the month, with long spells of sunshine and warm conditions in the south and south-east of England, but possibly with some showery rain in west and north-west England during this period. The latter part of April may be dominated by continuing dry weather, with interludes of more unsettled conditions at times, perhaps wetter in the south.

For the 3 month period April to June, across the UK, below average precipitation is moderately more likely than above average precipitation[1].

Projections for river flows at key sites[2]

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 2020. By the end of March 2021, half of all modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by September 2020 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2021 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2020 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2021 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Half of all of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year by the end of September 2020. By the end of March 2021, two-thirds of modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2020 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2021 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2020 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2021 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

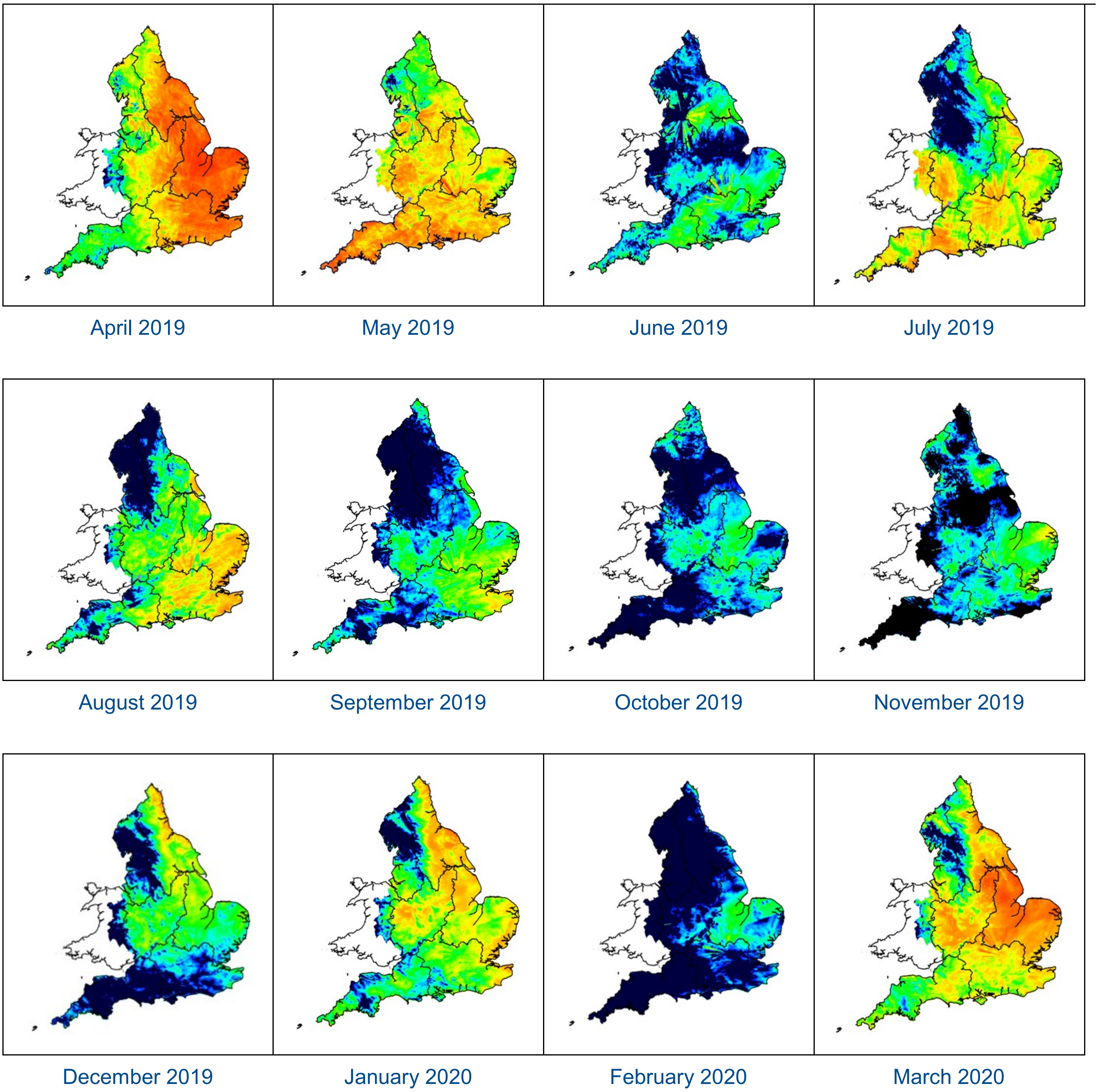
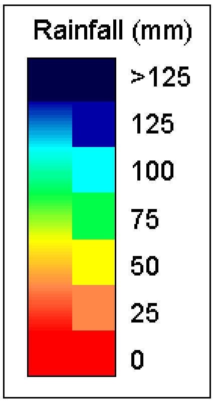


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2020). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2020.



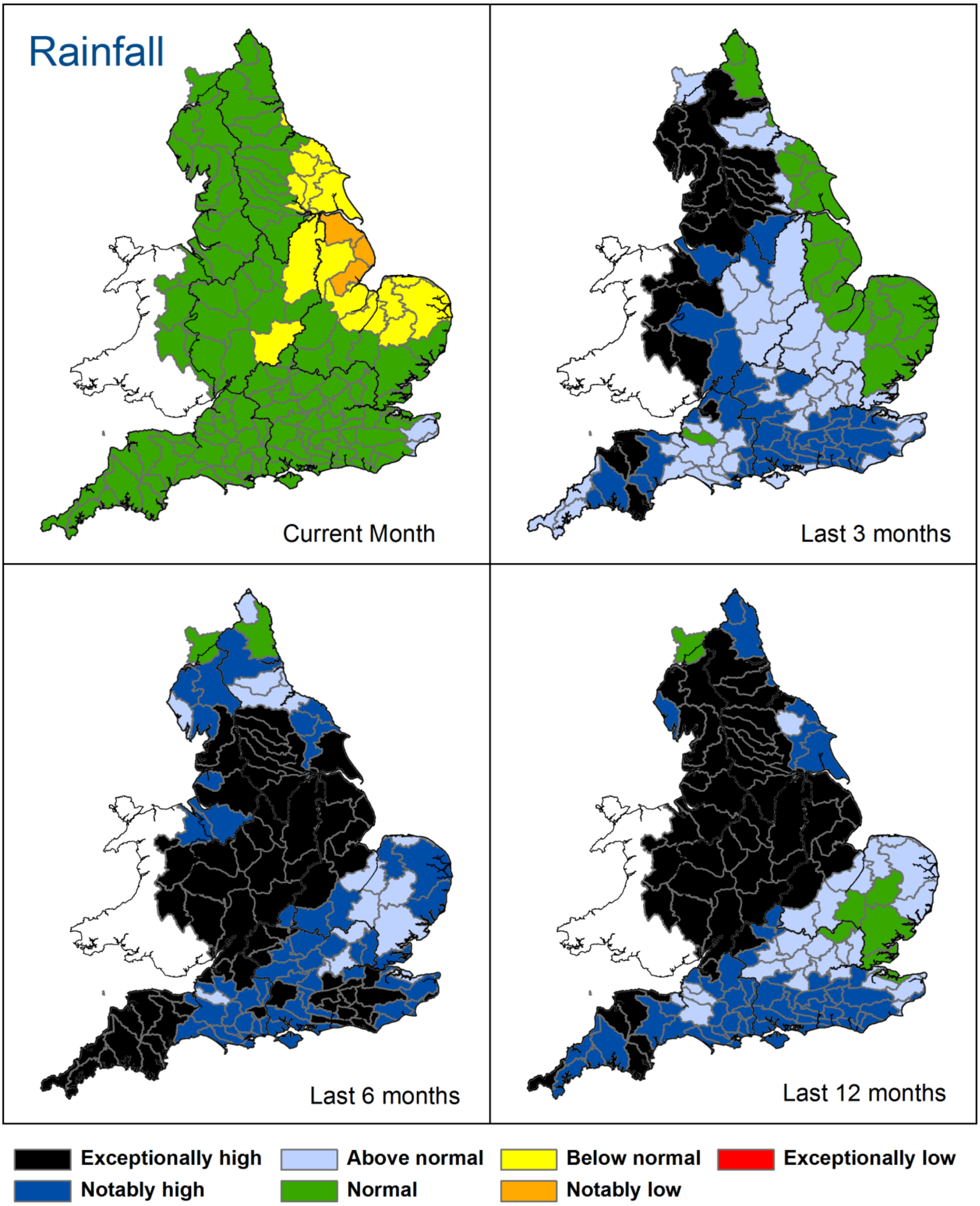


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 March 2020), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2020).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100024198, 2020.

Rainfall charts

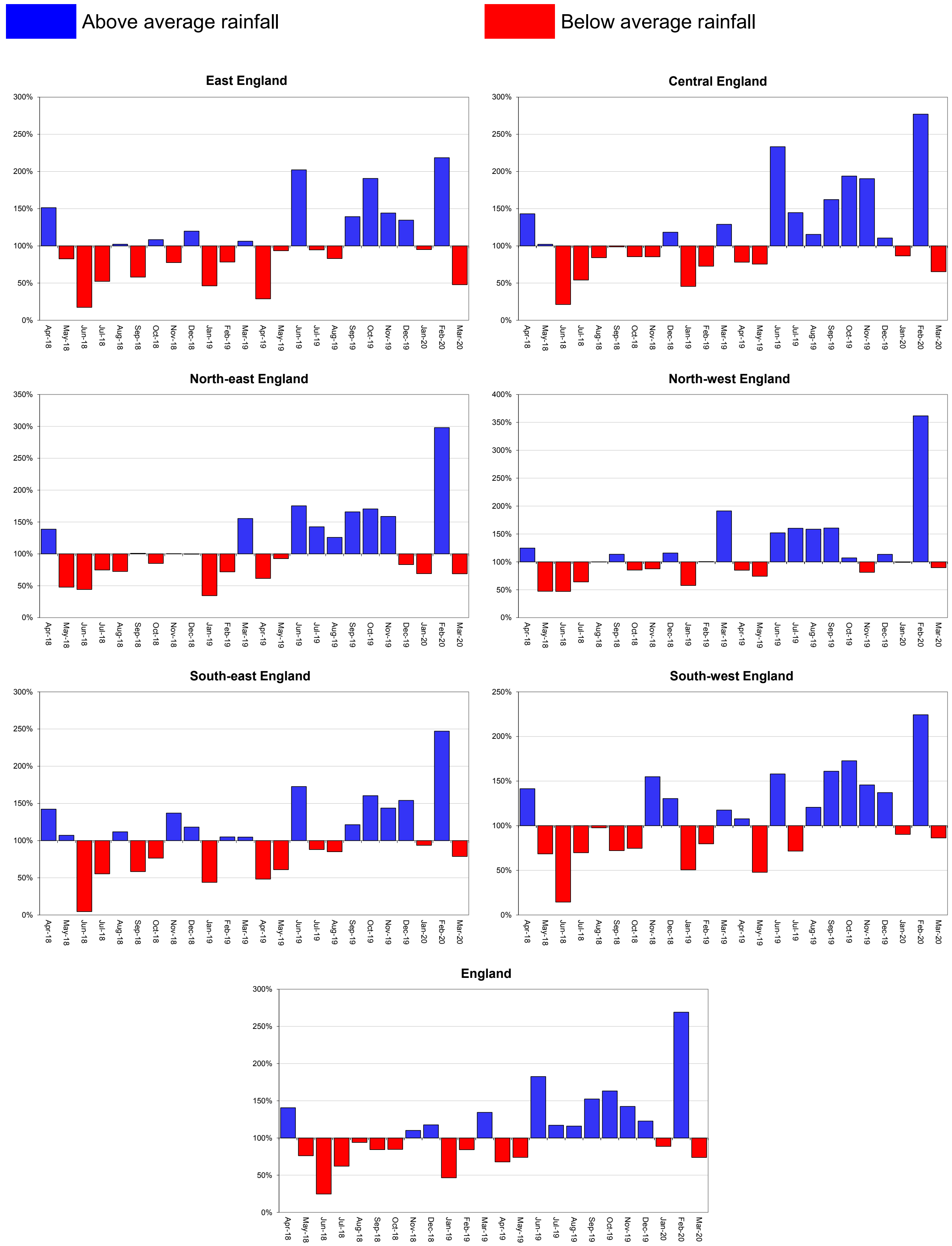


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2020).

Soil moisture deficit

End of February 2020[1]	End of March 2020[2]

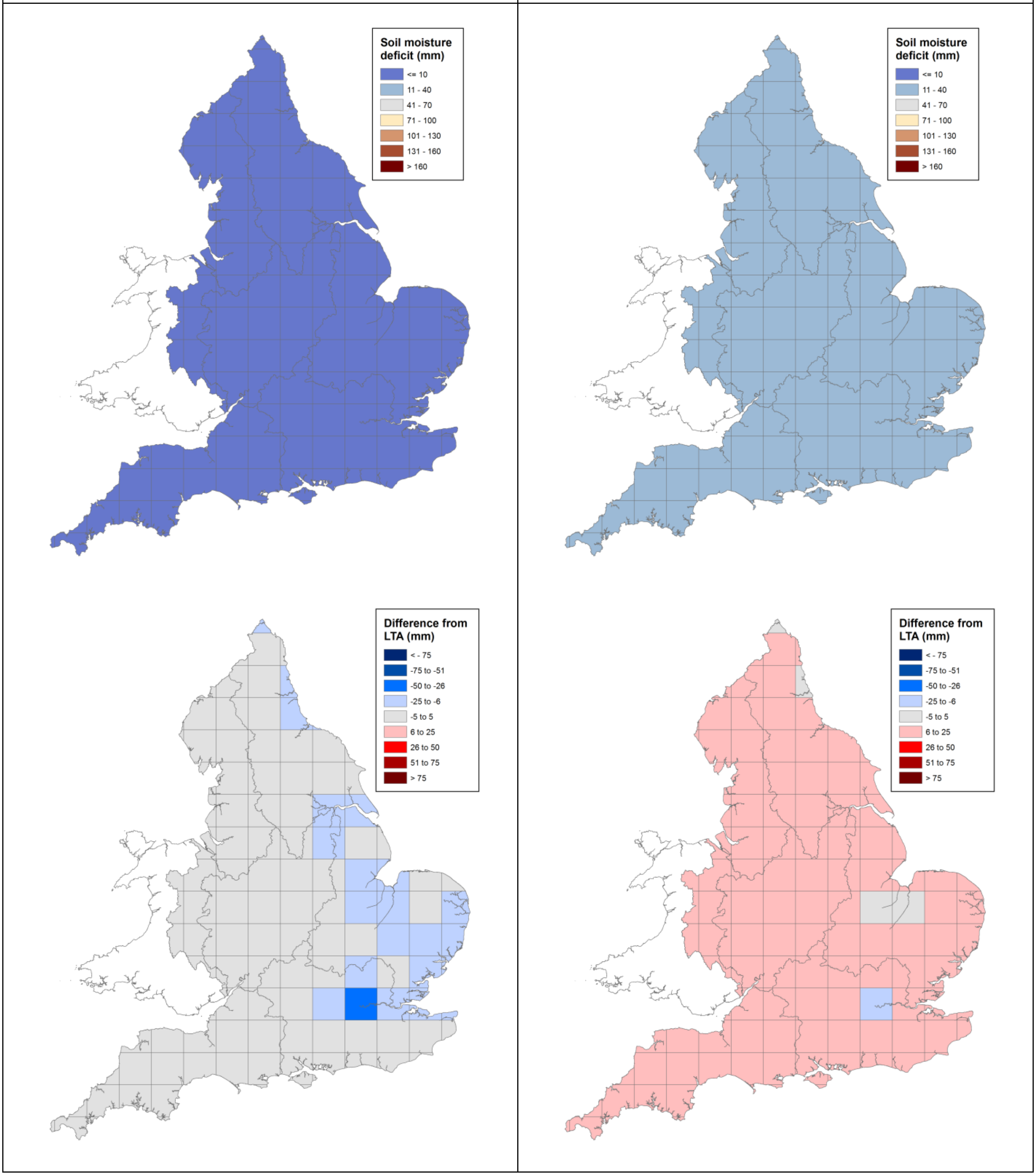


Figure 2.1: Soil moisture deficits for weeks ending 3 March 2020 [1] (left panel) and 31 March 2020 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2020). Crown copyright. All rights reserved. Environment Agency, 100024198, 2020

Soil moisture deficit charts

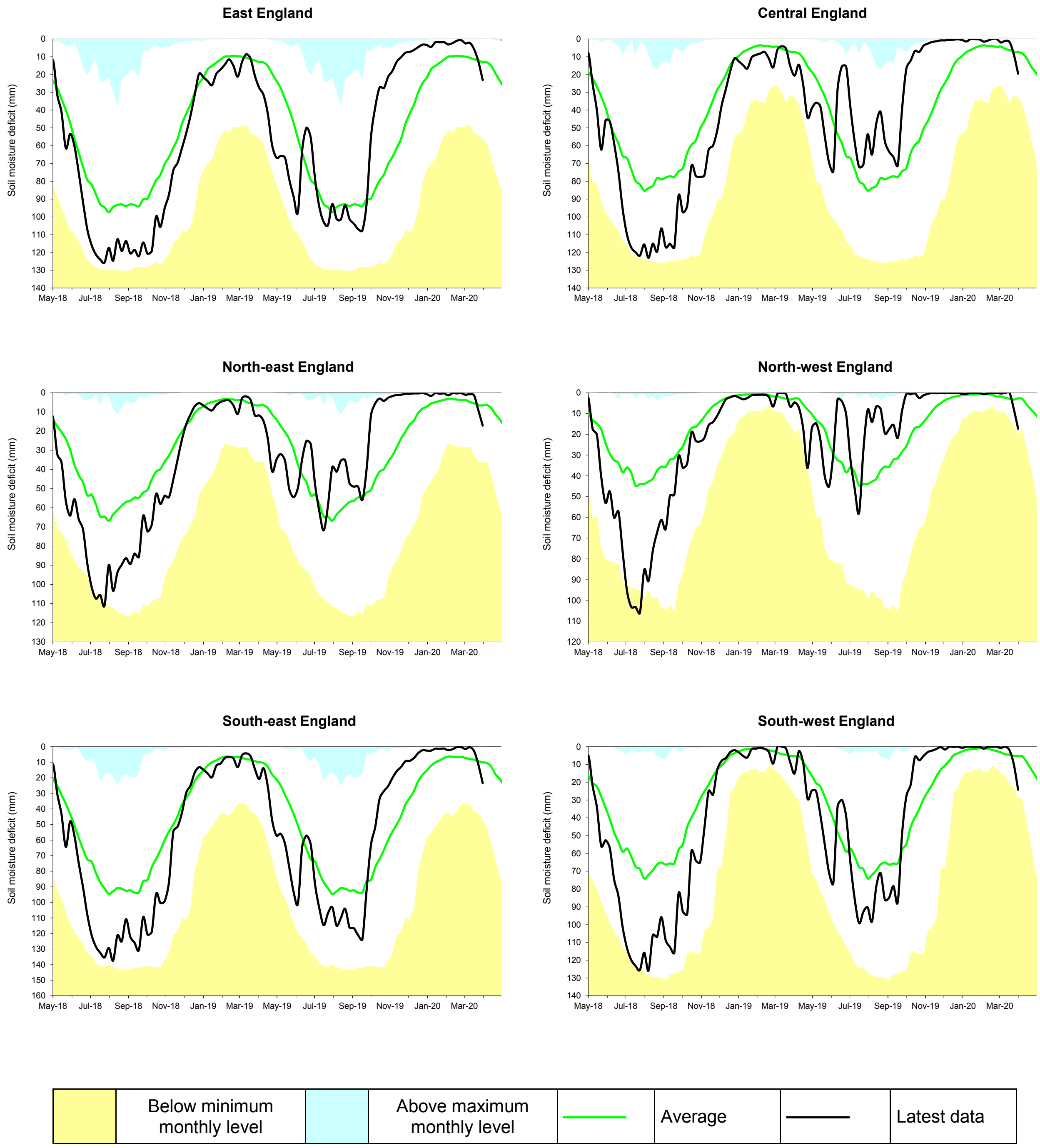
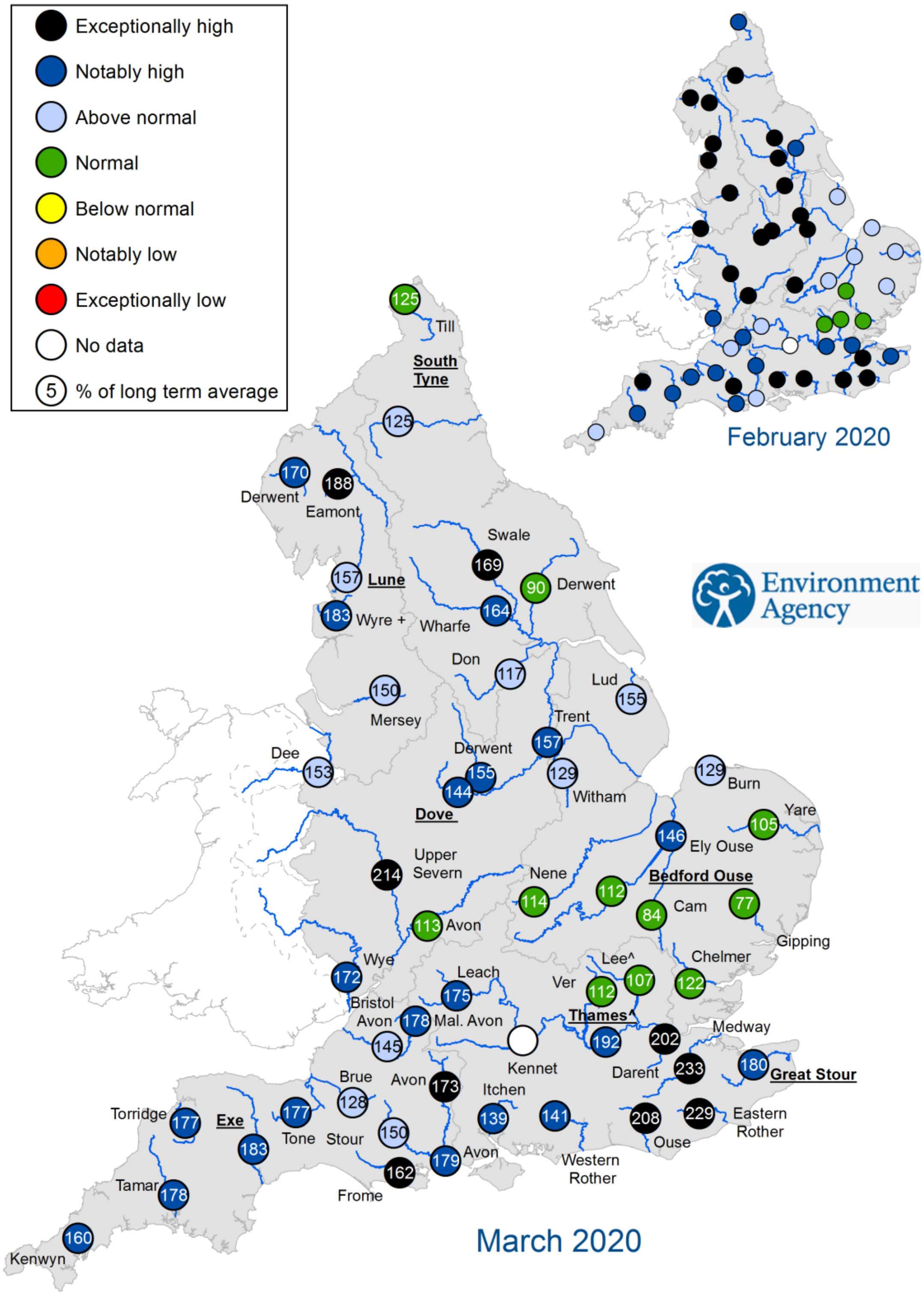


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2020).

River flows



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

+/- Monthly mean flow is the highest/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 February and March 2020, expressed as a percentage of the respective long term average and classed relative to an analysis of historic February and March monthly means (Source: Environment Agency).

River flow charts

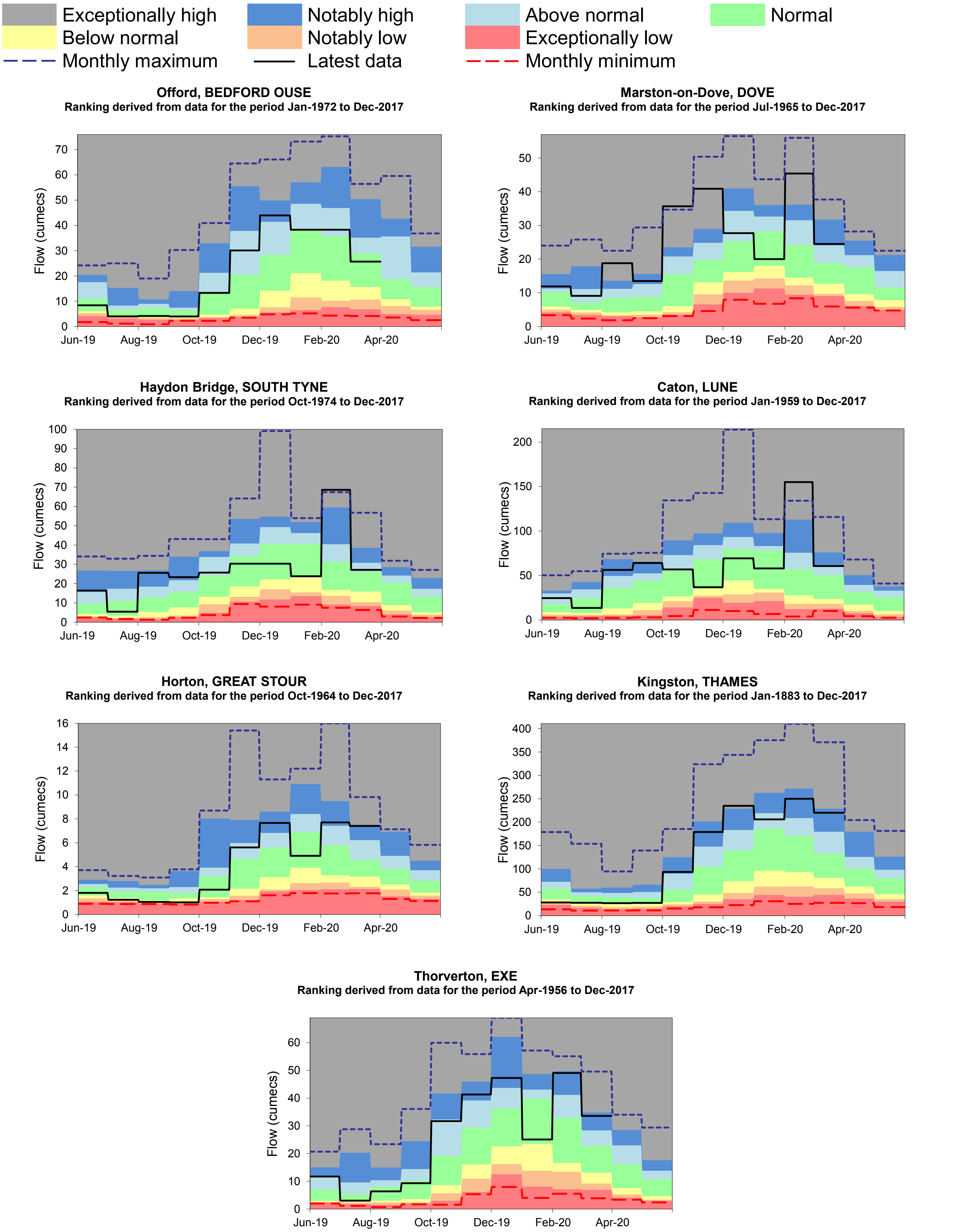
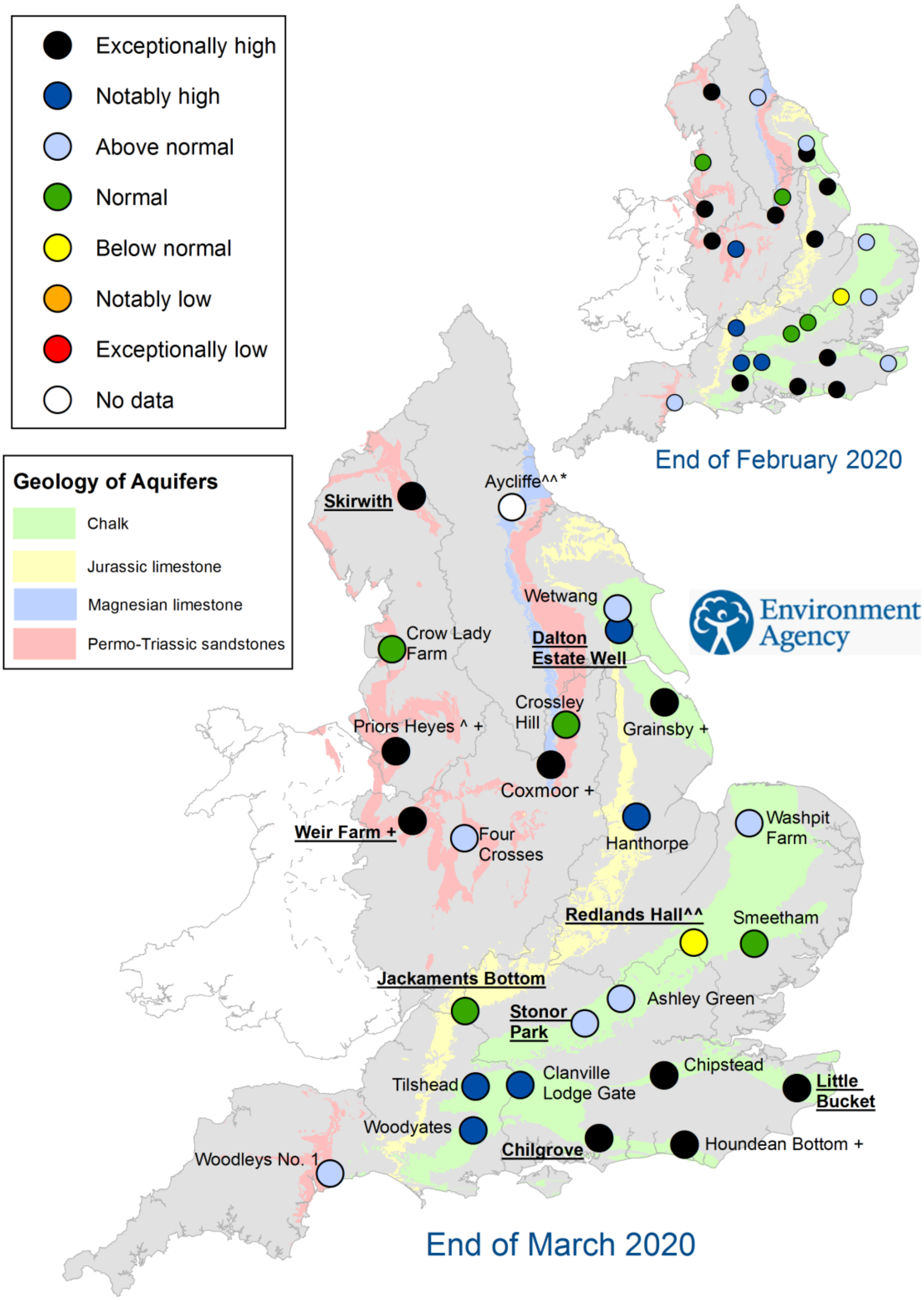


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
+/- End of month groundwater level is the highest/lowest on record for the current month (note that record length varies between sites).
Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2
* Observation well not dipped owing to current COVID-19 restrictions.

Figure 4.1: Groundwater levels for indicator sites at the end of February 2020 and March 2020, classed relative to an analysis of respective historic February and March levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2020.

Groundwater level charts

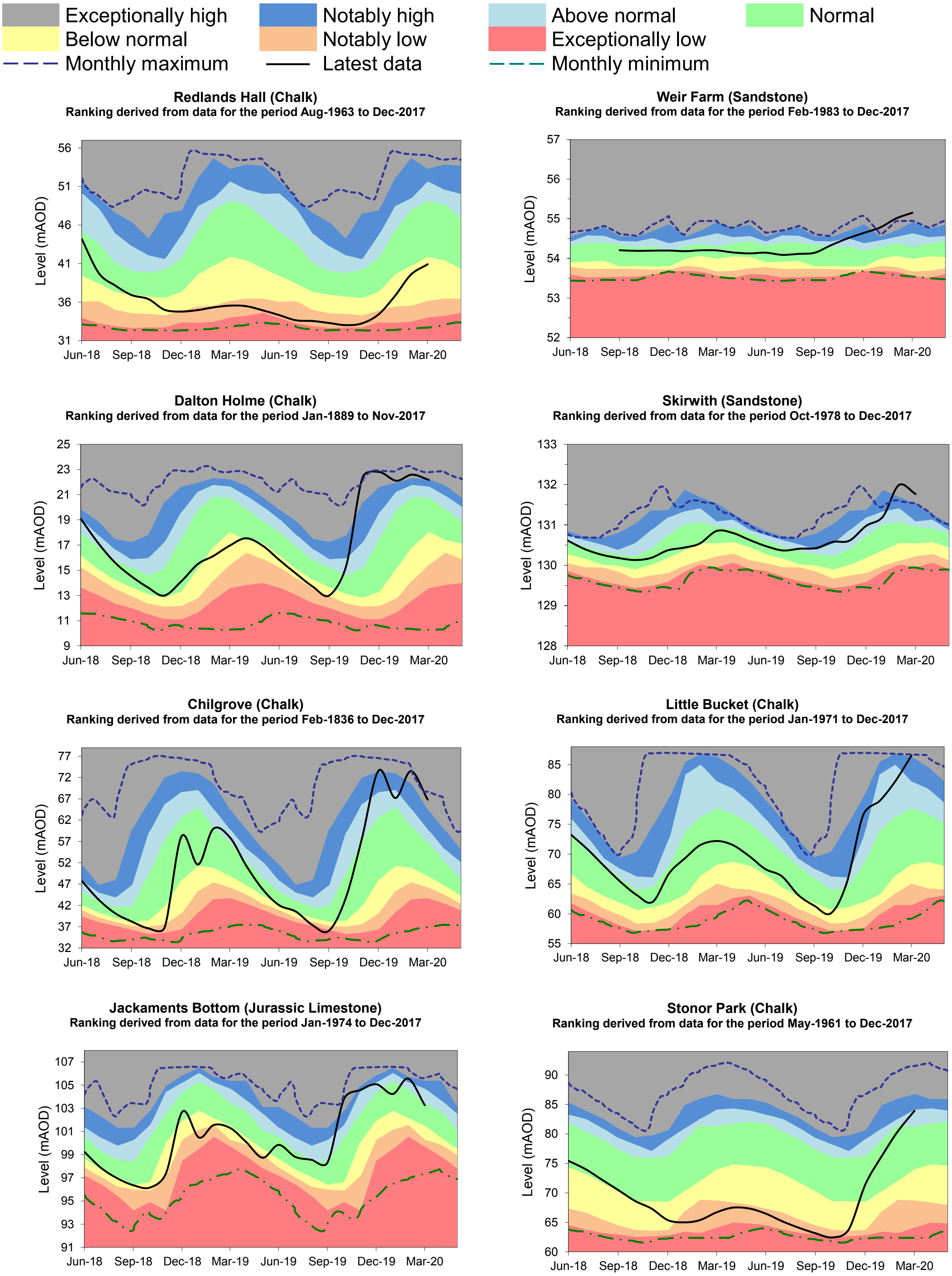
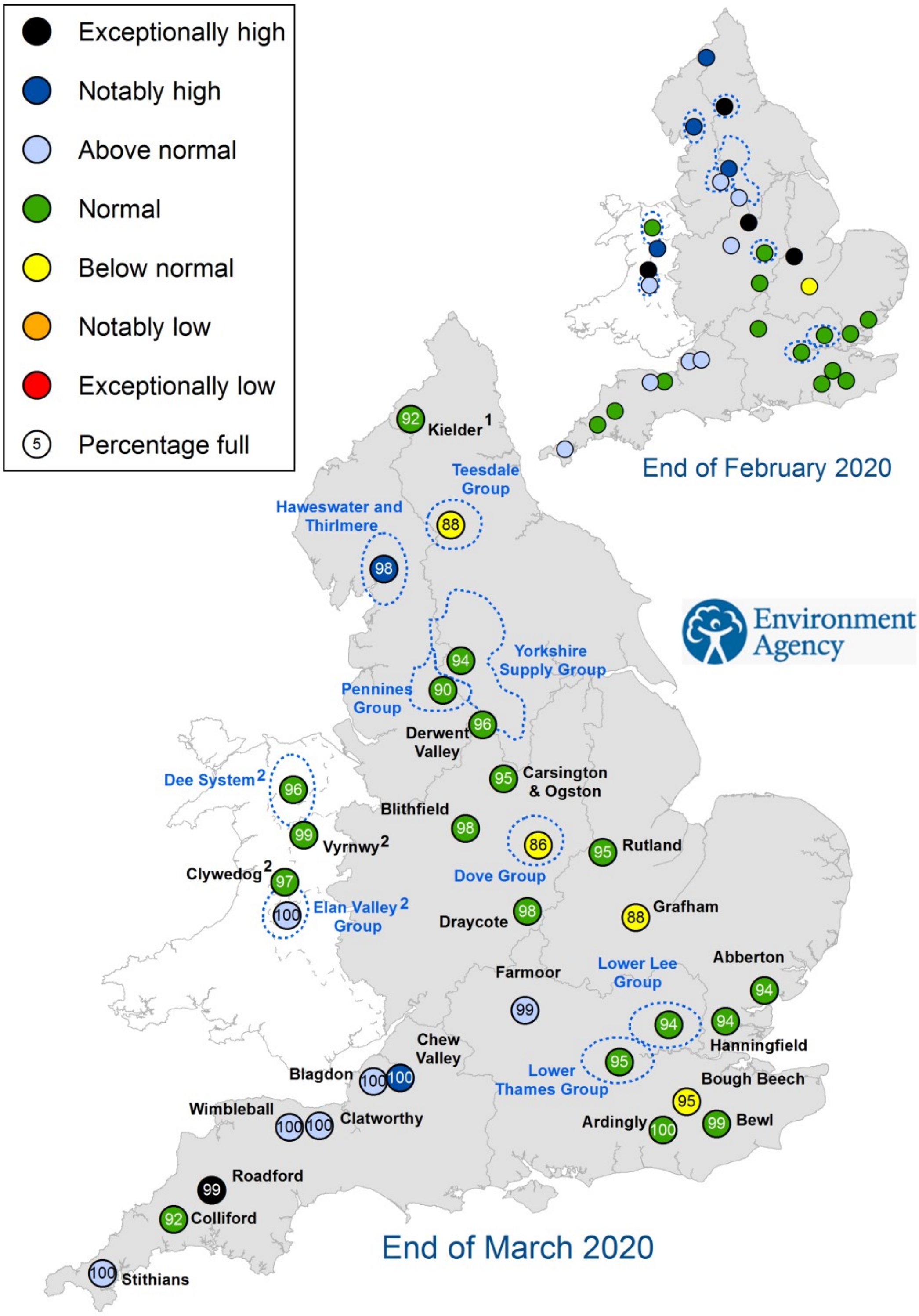


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2020).

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 February 2020 and March 2020 as a percentage of total capacity and classed relative to an analysis of historic February and March 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.

Reservoir storage charts

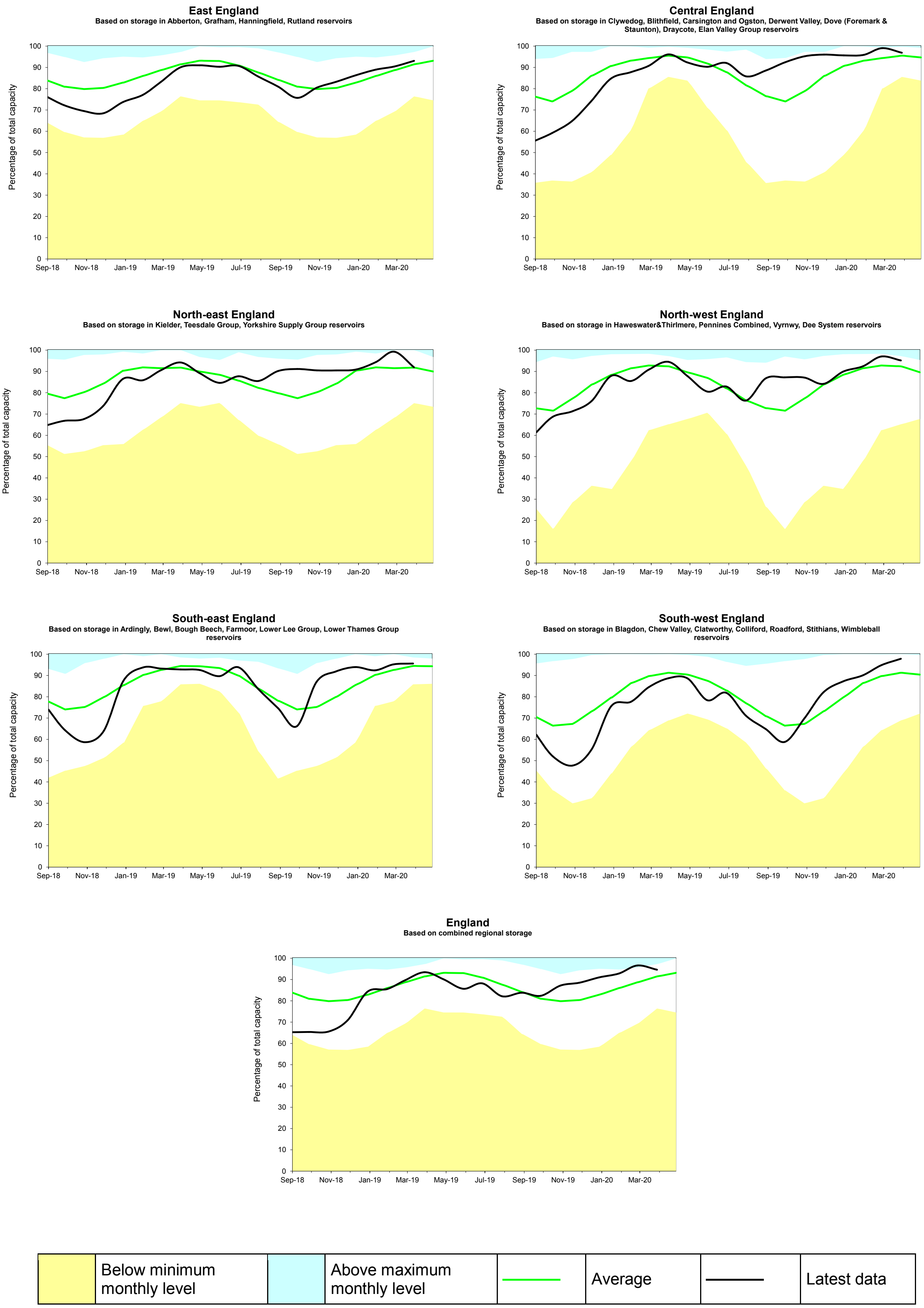


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

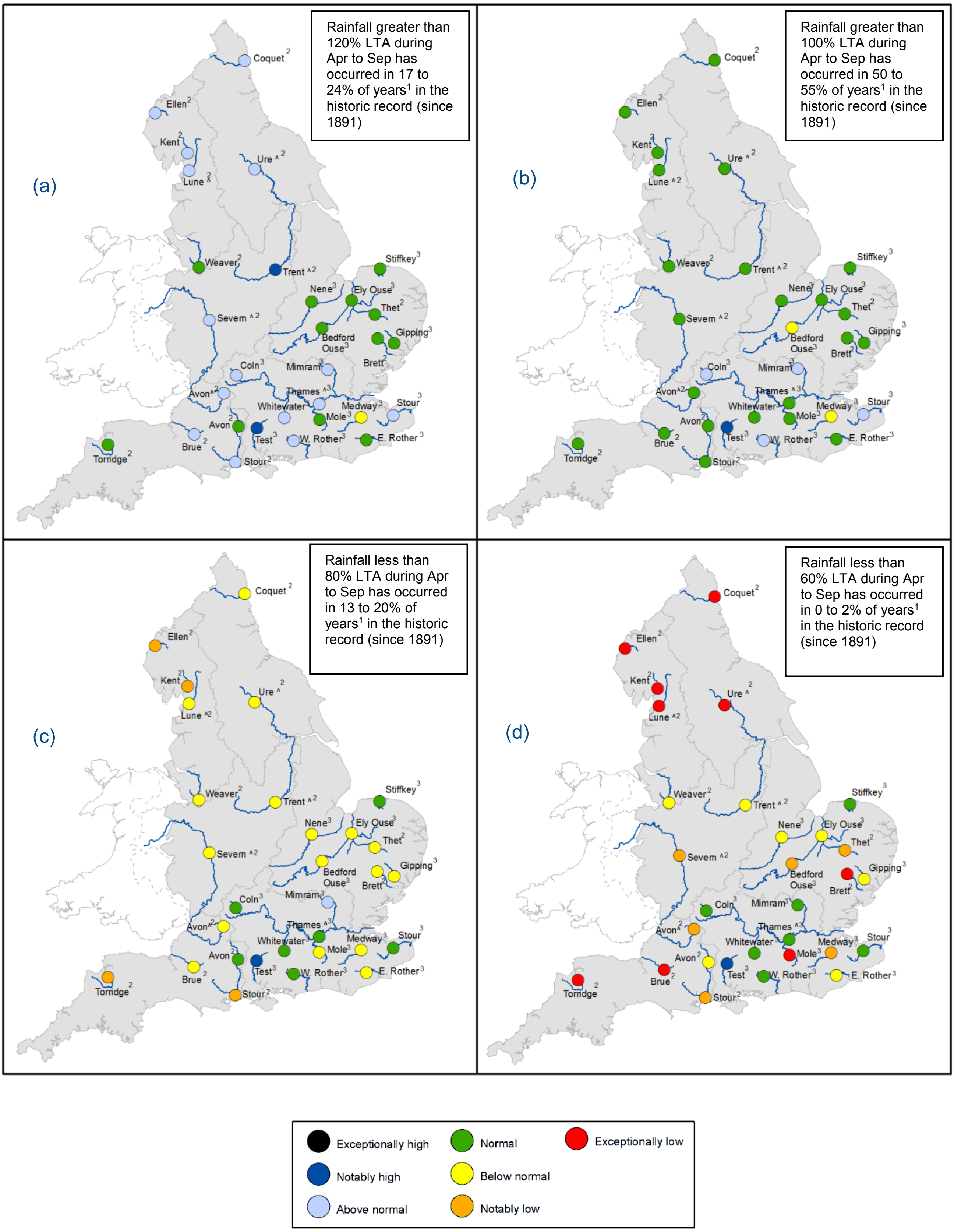


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2020 and September 2020 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

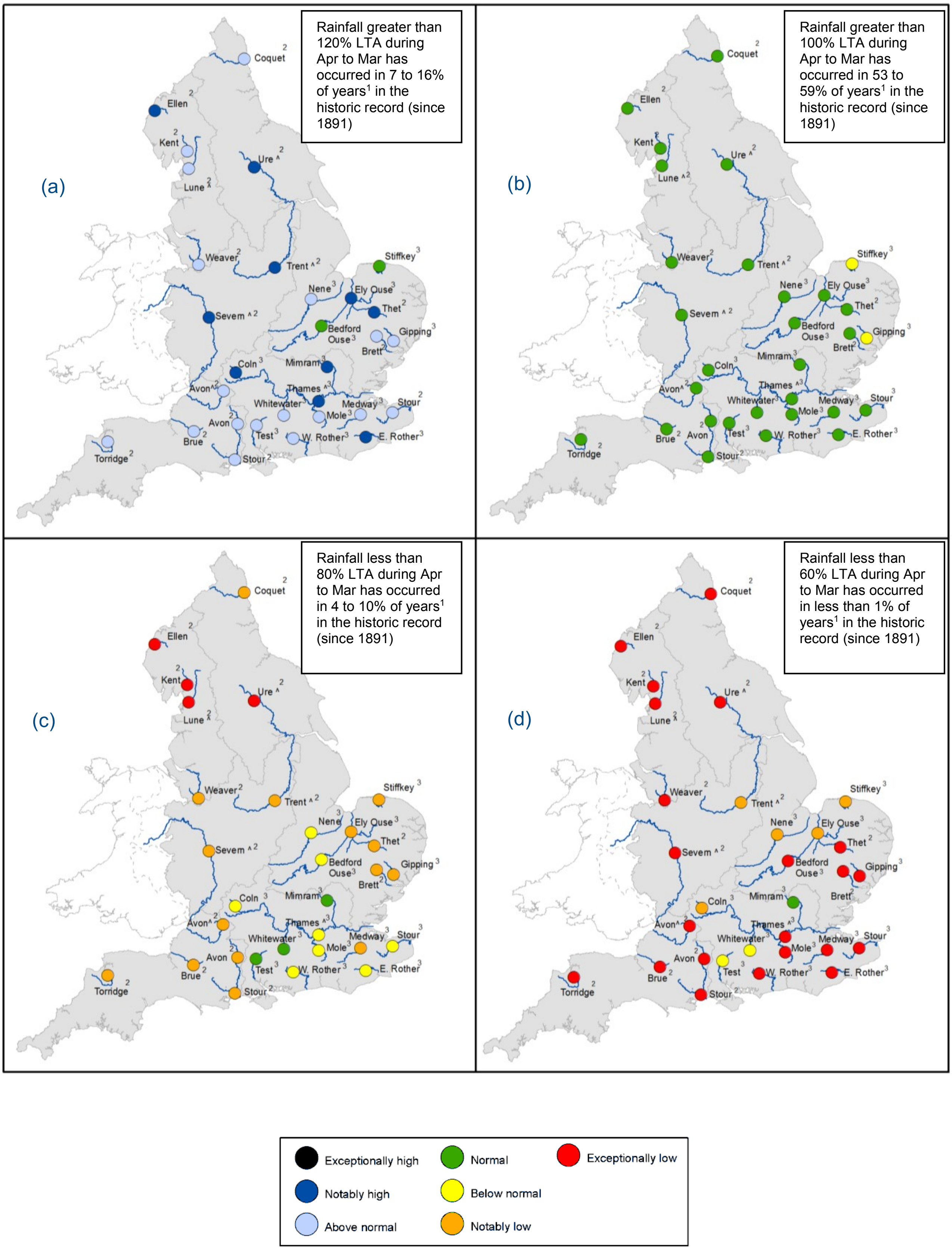


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2020 and March 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

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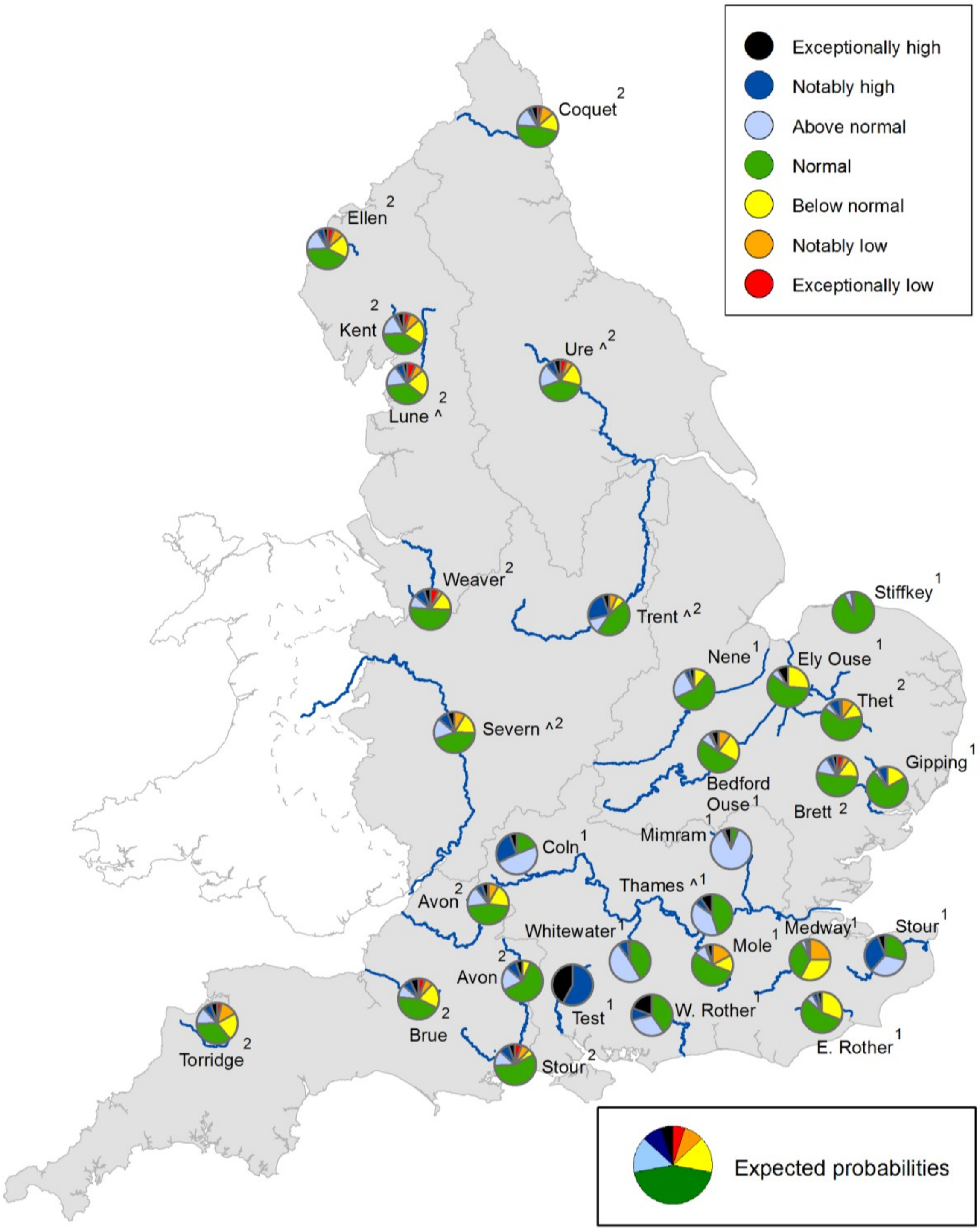

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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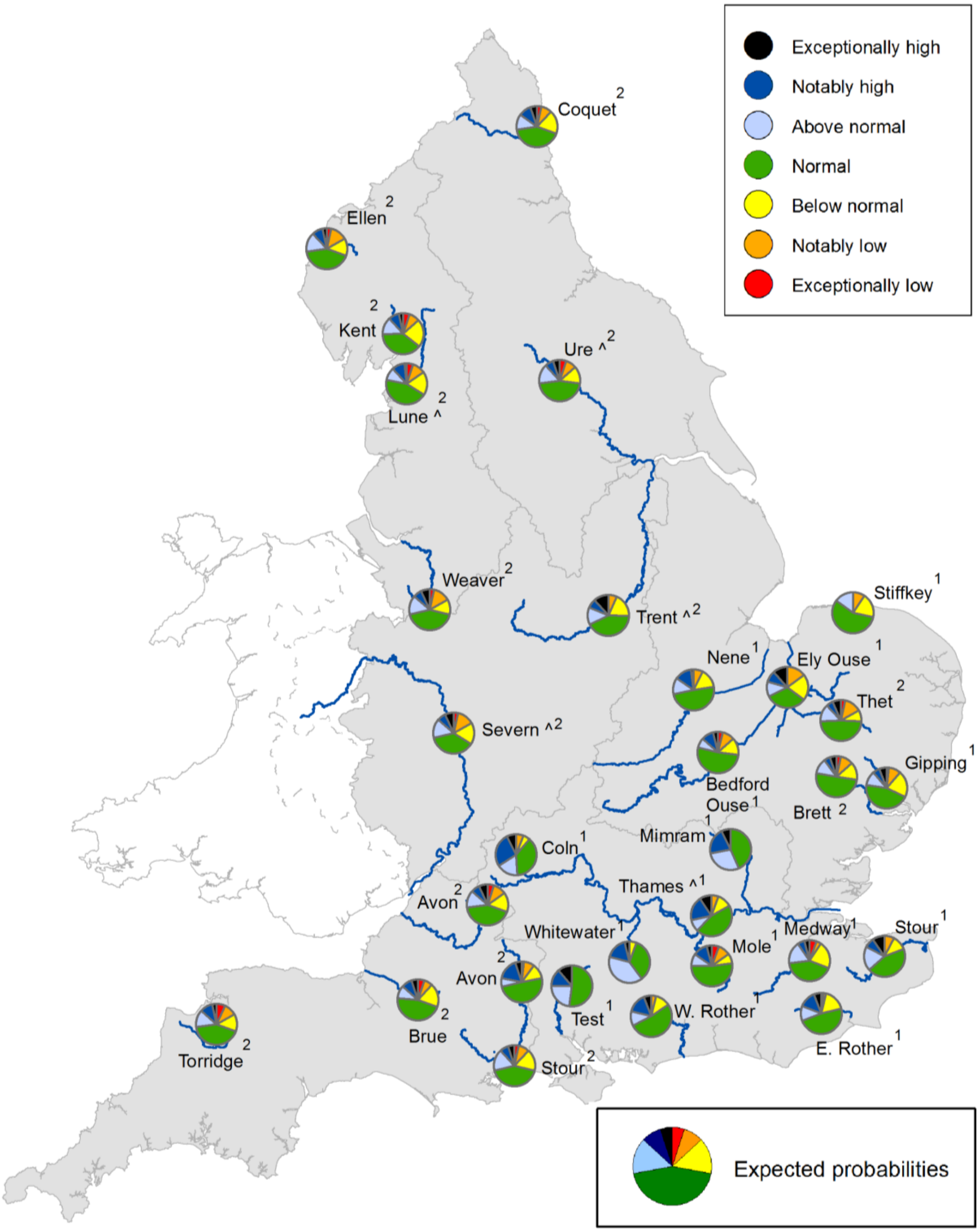

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2021. 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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Forward look: groundwater

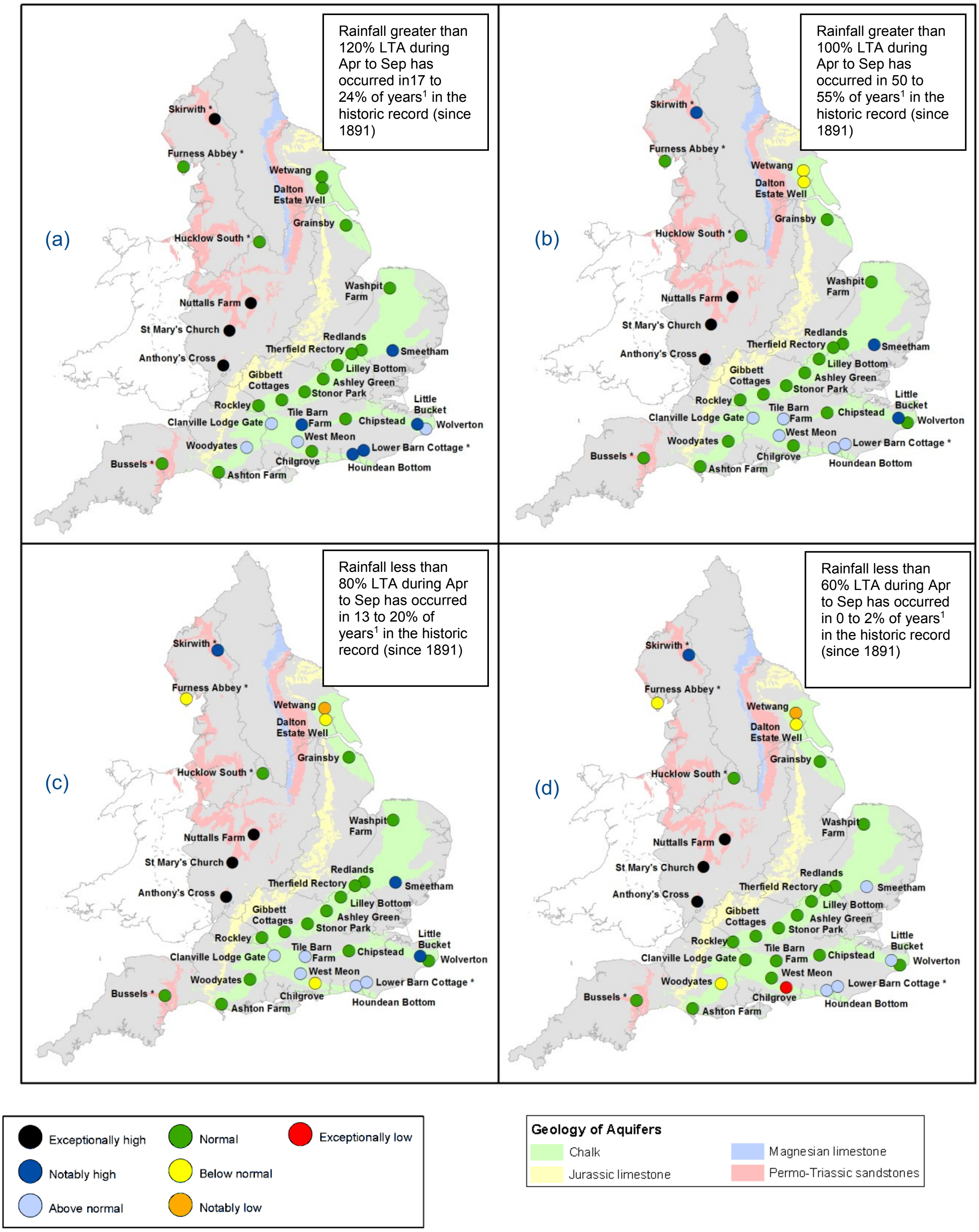

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2020 and September 2020 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2020.

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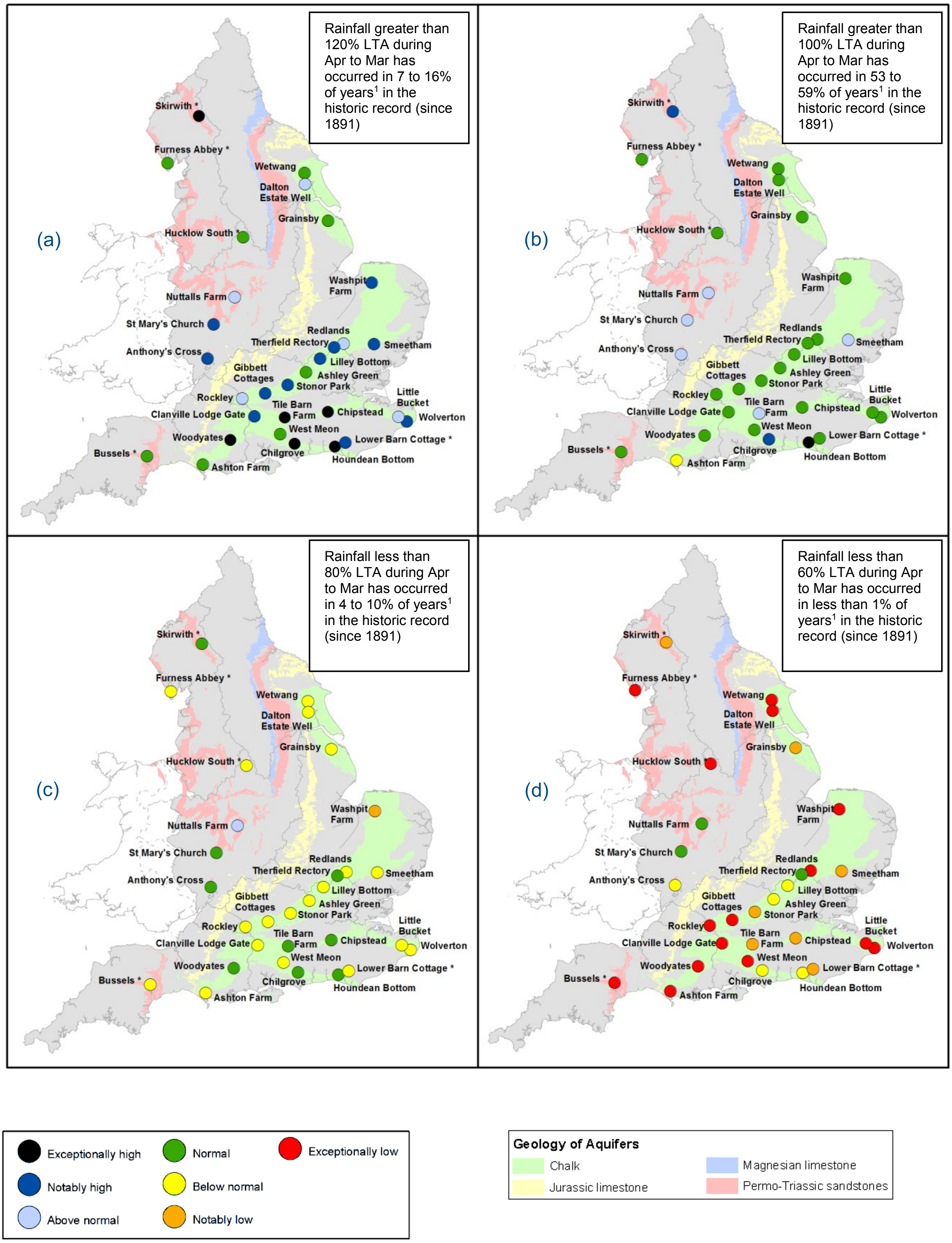

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2020 and March 2021 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2020.

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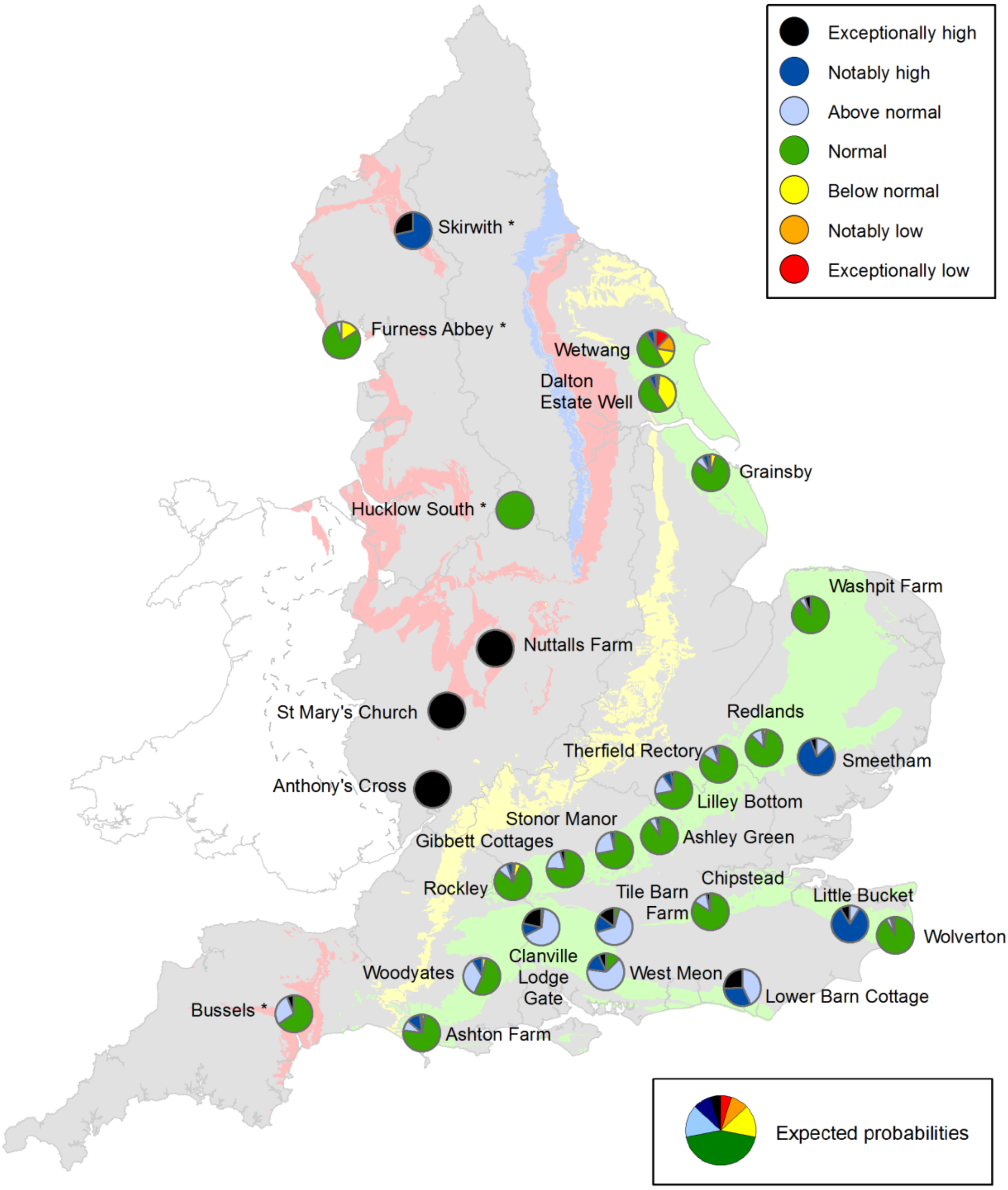
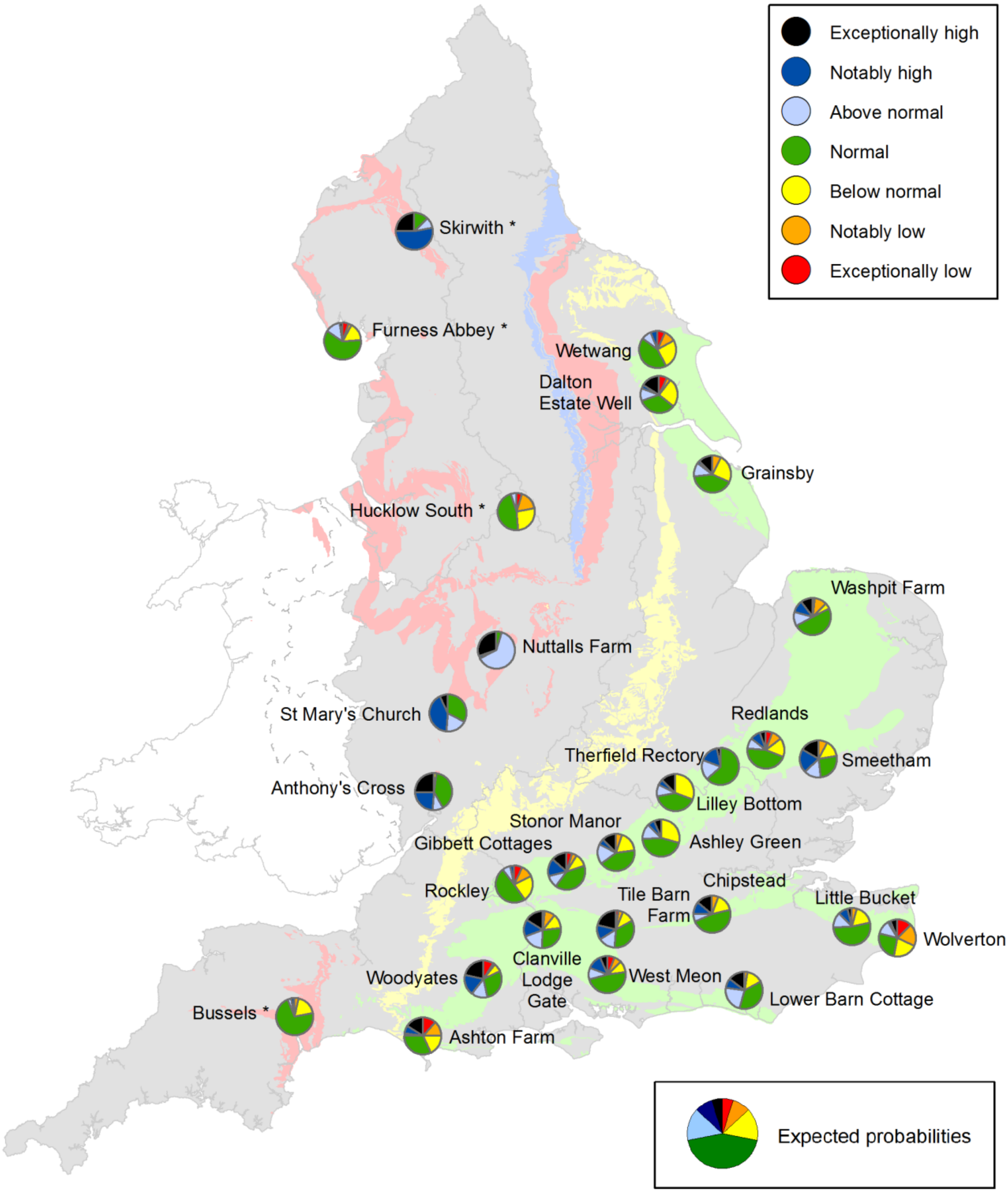


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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, 100024198, 2020.

** 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 March 2021. 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, 100024198, 2020.

* 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 to 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