Monthly water situation report

England

Summary – March 2021

March was the first month with below average rainfall for most of England since November 2020, apart from the north-west where it was another wet month. However rainfall totals for the 6 month period from October to March were exceptionally or notably high compared to the historic record for many parts of England. After a very wet winter the low rainfall in March meant soils were drier than the previous month by the end of March. Monthly mean river flows were lower than in February but remain normal or higher for the time of year at nearly all reported sites. Groundwater levels at many reported sites peaked and started to decrease although some slower responding aquifers maintained historically high levels. Some reservoir stocks increased while some decreased, however total stocks for England remain above average for the time of year.

Rainfall

The March rainfall total for England was 50mm, which represents 75% of the 1961 to 1990 long term average (LTA) (78% of the 1981 to 2010 LTA). For most of England this is the first month with below average rainfall since November 2020. Only north-west England recorded widespread above LTA March rainfall totals (Figure 1.1 and Figure 1.3).

Monthly rainfall totals were classed as normal across two thirds of all catchments in England and below normal across just under a quarter of catchments. The lowest rainfall total as a proportion of the LTA was over the Sussex coast where the rainfall total was less than 25mm, representing 39% of the March LTA. Exceptionally high rainfall totals for the time of year were recorded over just one catchment: the Wyre and Lune in Lancashire (180mm and 165% of the LTA), this was the eighth wettest March on record for the catchment (records since 1891) (Figure 1.2).

The 3, 6 and 12 month cumulative rainfall totals ending in March were classed as normal or higher in every catchment across England. Rainfall totals for the January to March 3 month period were the wettest on record for the River Tees catchment in north-east England (records since 1891). The 6 month cumulative rainfall totals were higher than normal for nearly all of the catchments across England and exceptionally high or notably high at over half of them (Figure 1.2). A third of catchments have recorded rainfall totals ranked within the top ten wettest on record for the October to March 6 month period, these were mainly across northern and eastern England. Rainfall totals for the April to March 12 month period were the wettest on record for the Esk catchment in Cumbria.

At a regional scale, March rainfall totals ranged from 54% of the LTA in south-west England, to 134% of the LTA in north-west England (Figure 1.3). North-east and north-west England have recorded rainfall totals for the October to March 6 month period that rank within the top ten wettest on record (records since 1891). For England as a whole it has been the 11th wettest October to March 6 month period on record. This is now the fourth October to March period within the last 8 years to fall within the top 11 wettest periods in 130 years of record.

Soil moisture deficit

Compared to the end of February, soils at the end of March were drier in almost all reported grid-squares across England. However soil moisture deficits (SMD) remain smaller than 30mm and the difference compared to the March LTA was in the range +/-15mm. (Figure 2.1)

At a regional scale, the end of month SMD values were slightly larger (drier) than the end of March LTA in all regions and larger than at the end of February (Figure 2.2)

River flows

Monthly mean flows for March were classed as normal for the time of year at over two-thirds of the reported gauging stations; flows were classed as higher than normal at a quarter of the indicator sites – mainly in north-west England.

River flows decreased at almost all reported flow indicator sites compared to February which was a much wetter month. The only site where reported river flows increased compared to February was the River Lune at Caton in Lancashire where flows were 172% of the March LTA. In north-east England the River Derwent in North Yorkshire and the River Till in Northumberland changed from having flows classed as exceptionally high in February to normal in March; a similar change was also seen on the River Yare in Norfolk. Rivers with a high groundwater contribution to flow were better able to maintain sustained high flows despite the relatively low March rainfall; for example the River Burn in north Norfolk and the River Ver in Hertfordshire had flows that were classed as exceptionally high in both February and March. (Figure 3.1)

At the regional index sites monthly mean flows were classed as normal at all sites apart from the River Lune (north-west England) where flows were notably high and the River Great Stour (south-east England) where flows were above normal. (Figure 3.2)

Groundwater levels

Groundwater levels decreased at slightly more of the indicator sites we report on than the number of sites where levels increased during March. The end of month groundwater levels were classed as normal or higher for the time of year at nearly all sites, with exceptionally high groundwater levels recorded at 6 out of 26 sites (down from 10 sites at the end of February).

Aycliffe (Wear Magnesian Limestone), Washpit Farm (north-west Norfolk chalk), Weir Farm (Bridgnorth sandstone) and Priors Heyes (West Cheshire sandstone) recorded the highest end of March levels on record (records go back to 1979, 1950, 1983 and 1972 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction. For all these indicator sites apart from Aycliffe this is the third consecutive month with the highest levels on record for the time of year.

End of month groundwater levels at the major aquifer index sites ranged from below normal at Jackaments Bottom (Jurassic limestone) to exceptionally high at Weir Farm (Bridgnorth sandstone) and Skirwith (Carlisle Basin and Eden Valley sandstone). End of March levels changed to a lower class compared to the end of February at half of the major aquifer index sites; these were the faster responding chalk and limestone aquifers rather than slower responding sandstone (Figures 4.1 and 4.2)

Reservoir storage

Reservoir stocks increased at the same number of the reservoirs and reservoir groups we report on as saw decreases during March. The biggest decreases between the end of February and the end of March as a proportion of total capacity were in central England at Blithfield (99% to 94%), north-east England at Kielder (99% to 94%) and north-west England at the Haweswater/Thirlmere group (100% to 95%). The biggest increases in stocks were in east England at Abberton (83% to 93%) and Grafham (82% to 92%).

Reservoir stocks in only three of the reservoirs and reservoir groups we report on were classed as below normal, the rest were classed as normal or higher for the time of year. (Figure 5.1)

Total reservoir stocks for England were at 95% of total capacity at the end of March (a decrease from 96% at the end of February), this is 4% above the LTA for the time of year. At a regional scale, total reservoir stocks were all greater than the LTA and ranged from 93% in north-east England to 97% in central, south-east and south-west England. (Figure 5.2)

Forward look

After a warm and bright start for much of England during the first few days of April, conditions will turn colder and more unsettled, with wintry showers of snow and sleet affecting most areas. Towards the middle of April most places will be mainly dry with settled conditions as high pressure dominates, particularly in the south-east. Temperatures will likely remain at or slightly below average at first, before recovering to potentially slightly above average at times, although temperatures could be suppressed in wetter areas. Confidence is low for the end of April, however mixed and slowly evolving weather patterns, typical of spring, are most likely. Fine and dry weather is likely to be more prevalent overall, although all areas are likely to see some showers or longer spells of rain at times. Temperatures probably close to average with some warmer spells possible at times.

For the 3 month period April to June, there is a higher than typical chance of near average precipitation across the UK, and half the normal chance of dry conditions[1].

[1] Source: Met Office

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 2021. By the end of March 2022, half of the modelled sites have a greater than expected chance of cumulative river flows being above normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by September 2021 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2022 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2021 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2022 see Figure 6.4

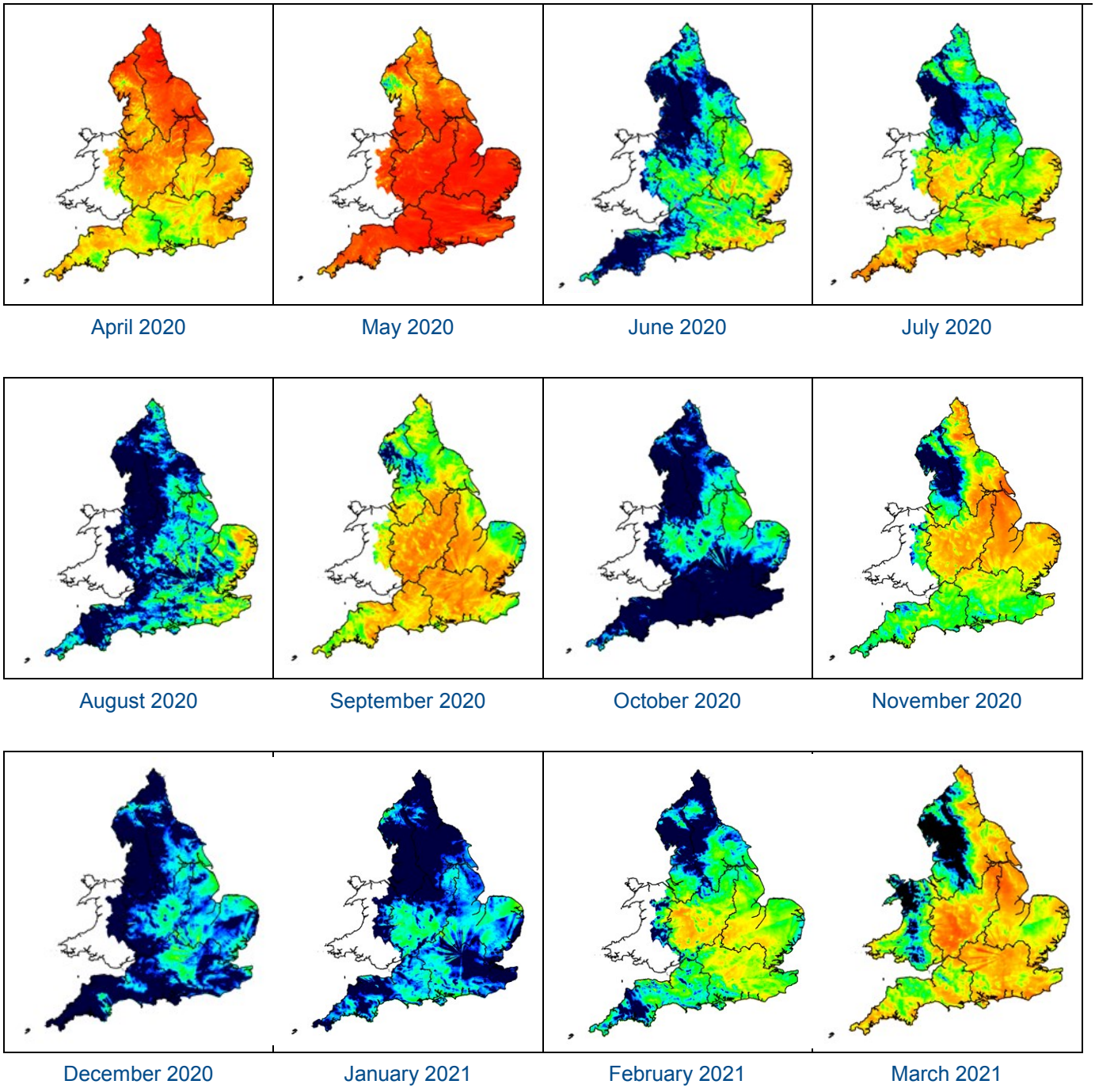
Projections for groundwater levels in key aquifers[2]
By the end of September 2021, more than 90% of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year. By the end of March 2022, two-thirds of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2021 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2022 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2021 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2022 see Figure 6.8

Authors: National Water Resources Hydrology Team

[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



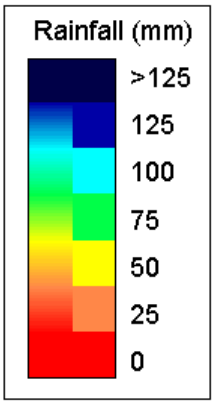


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

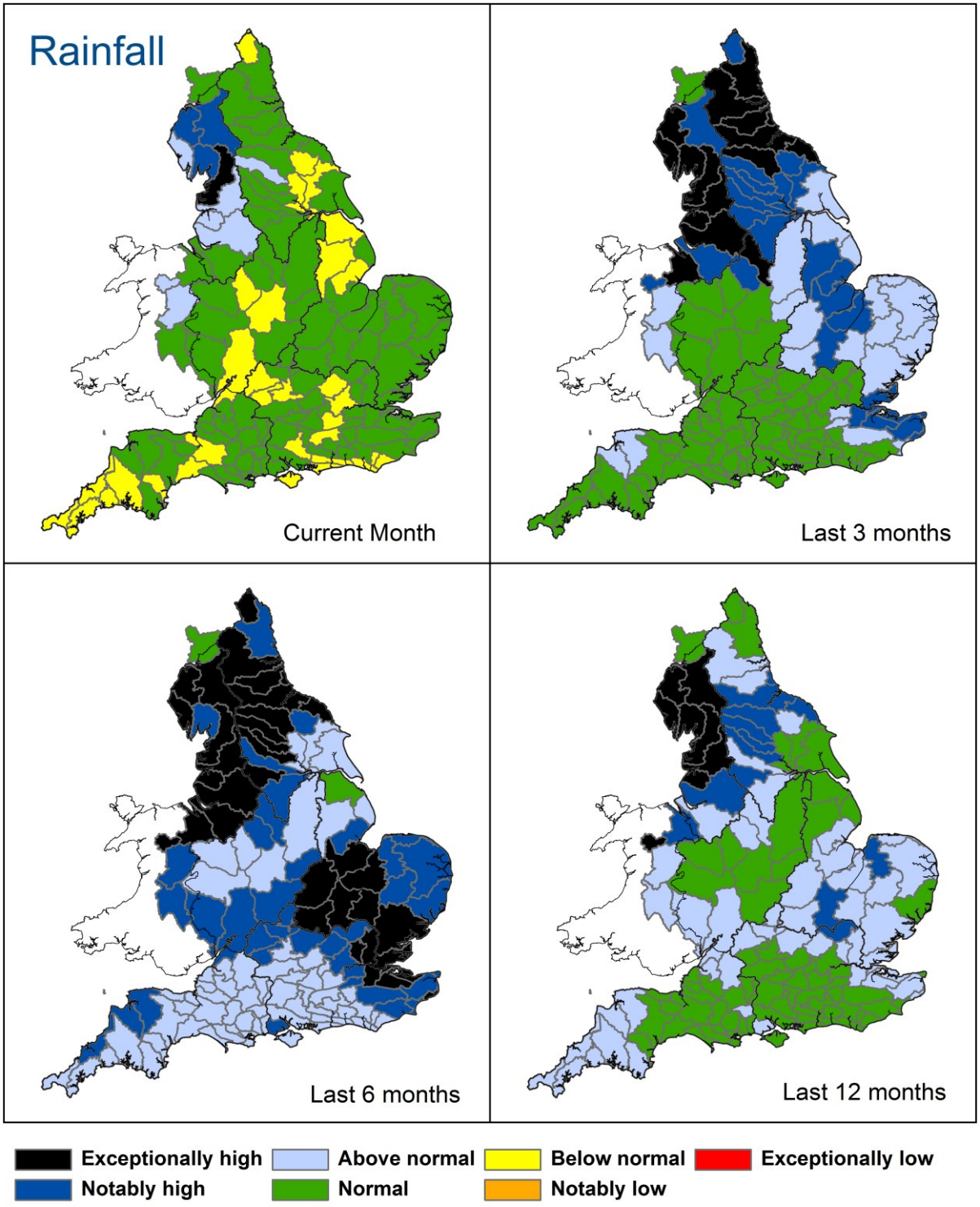


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 March), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2021).* 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, 2021.

Rainfall charts

Above average rainfall

Below average rainfall

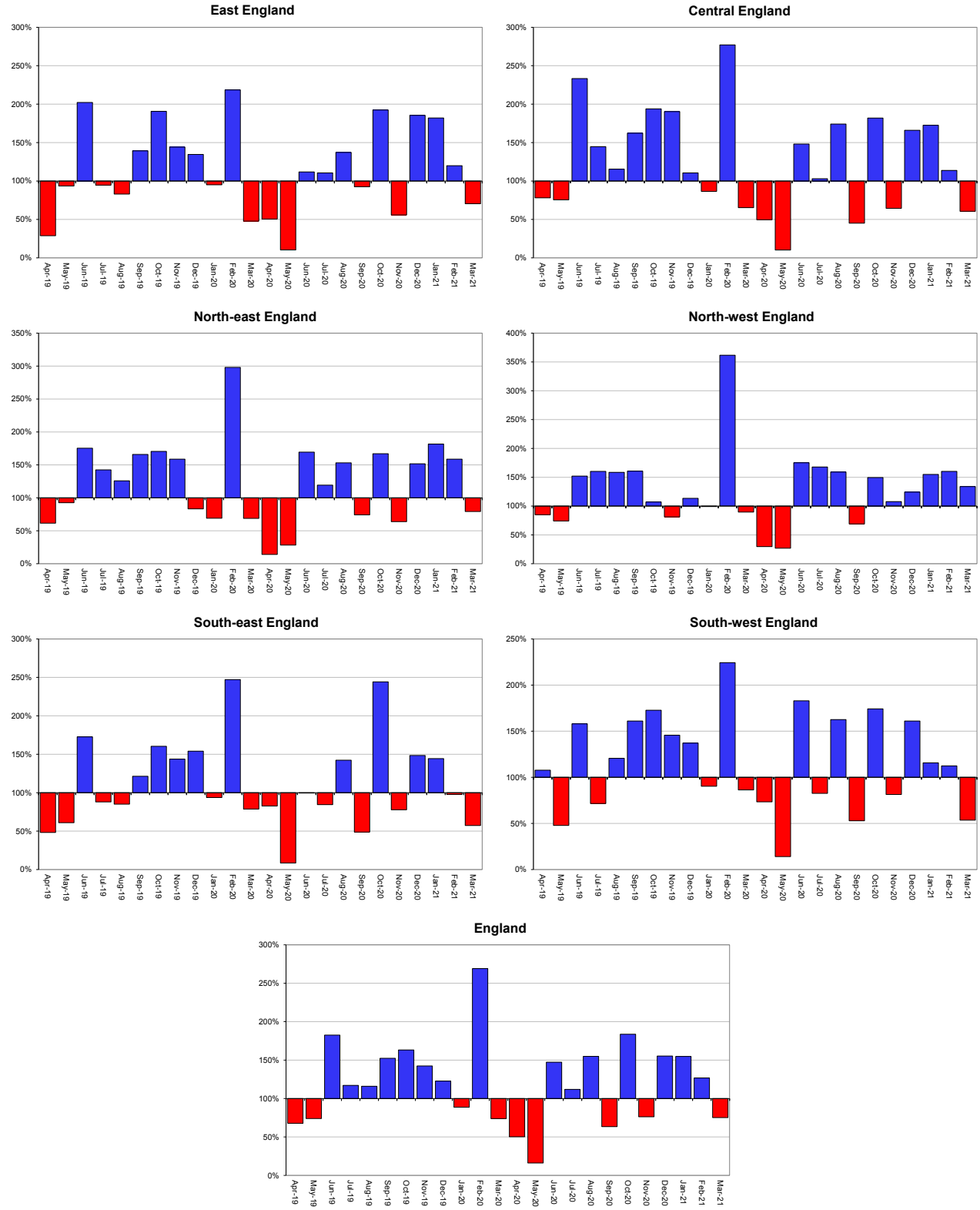


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

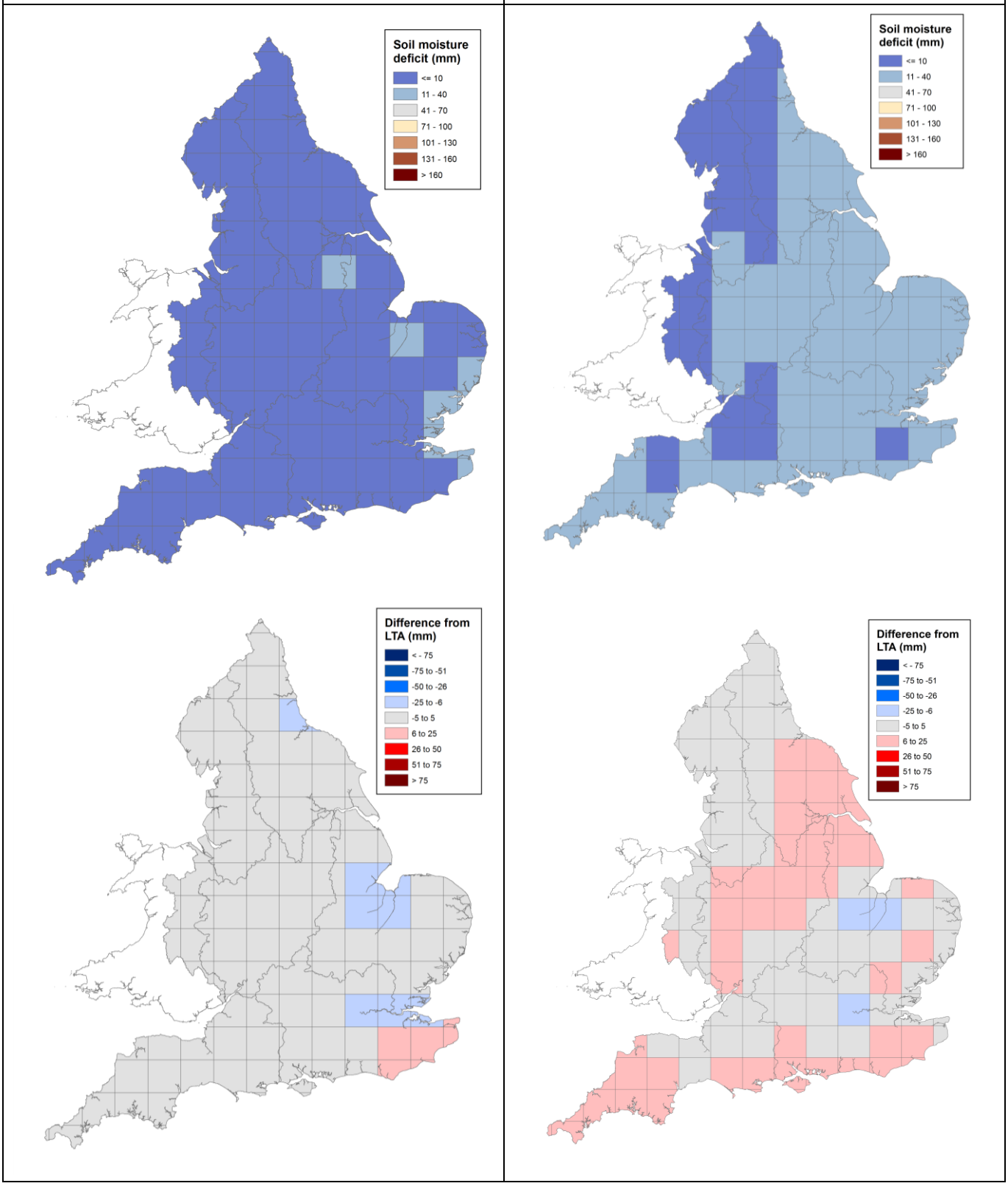
End of February 2021[1]	End of March 2021[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 02 March 2021 [1] (left panel) and 30 March 2021 [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, 2021). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021

Soil moisture deficit charts

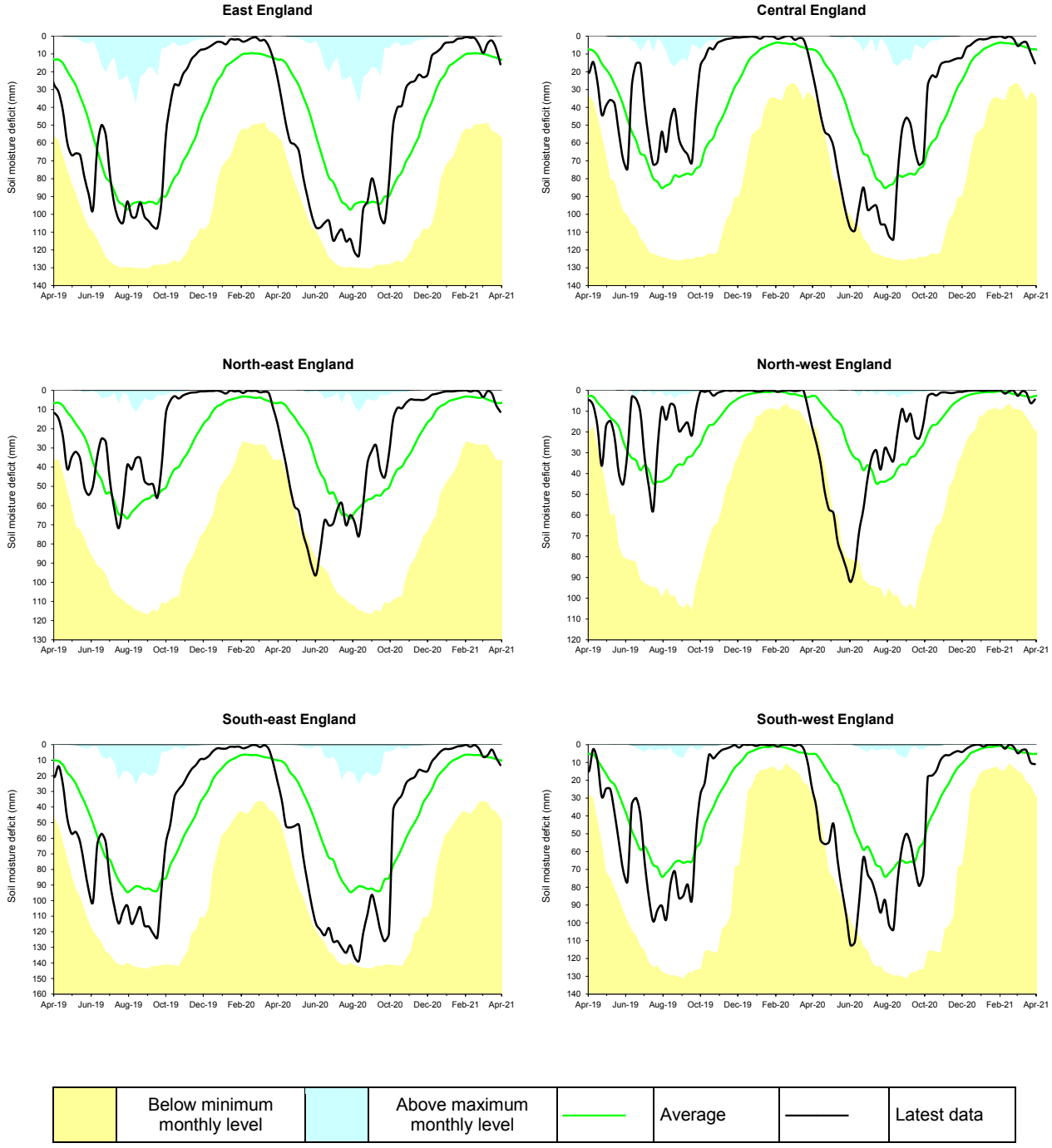
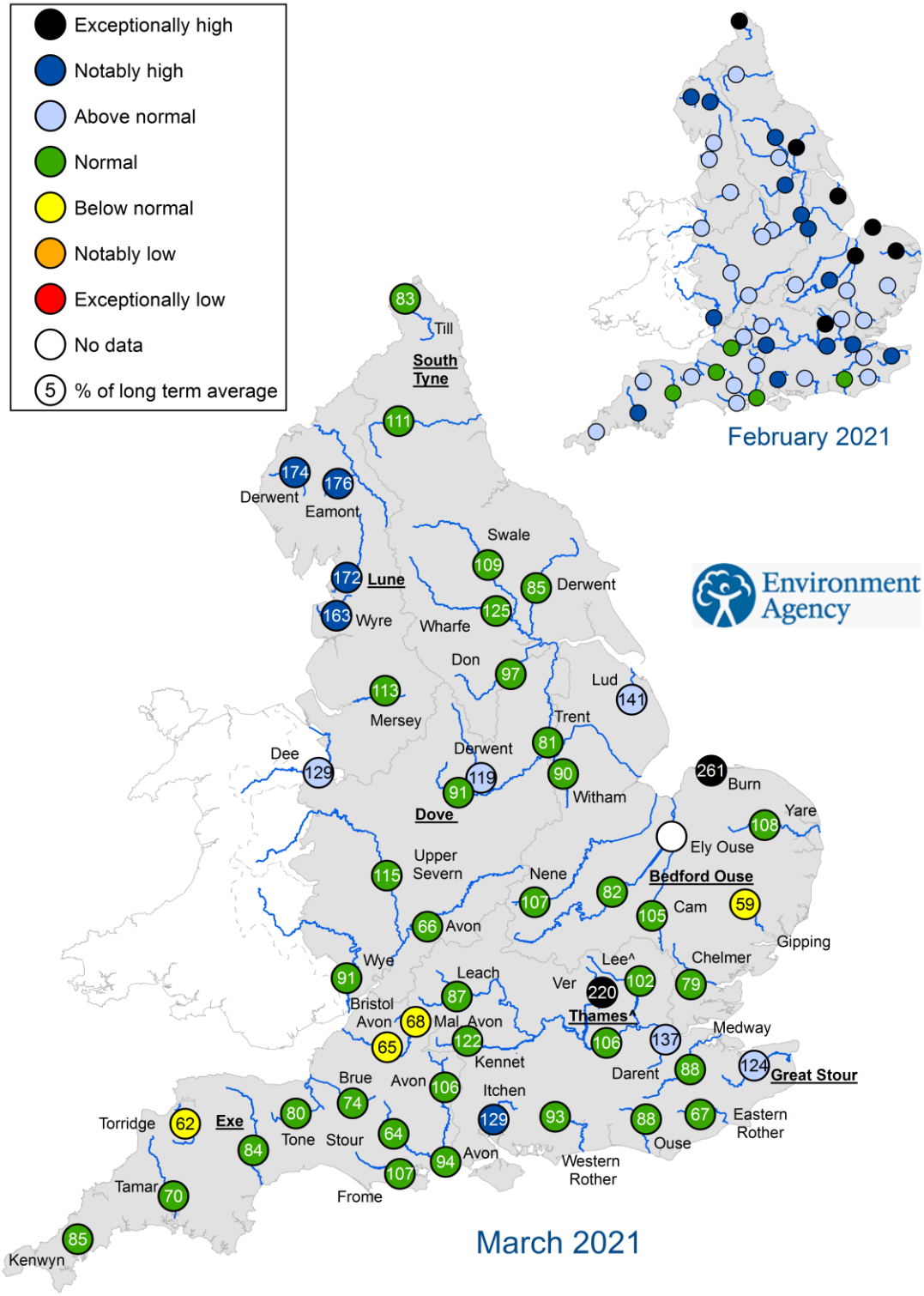


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

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 2021, 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). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

River flow charts

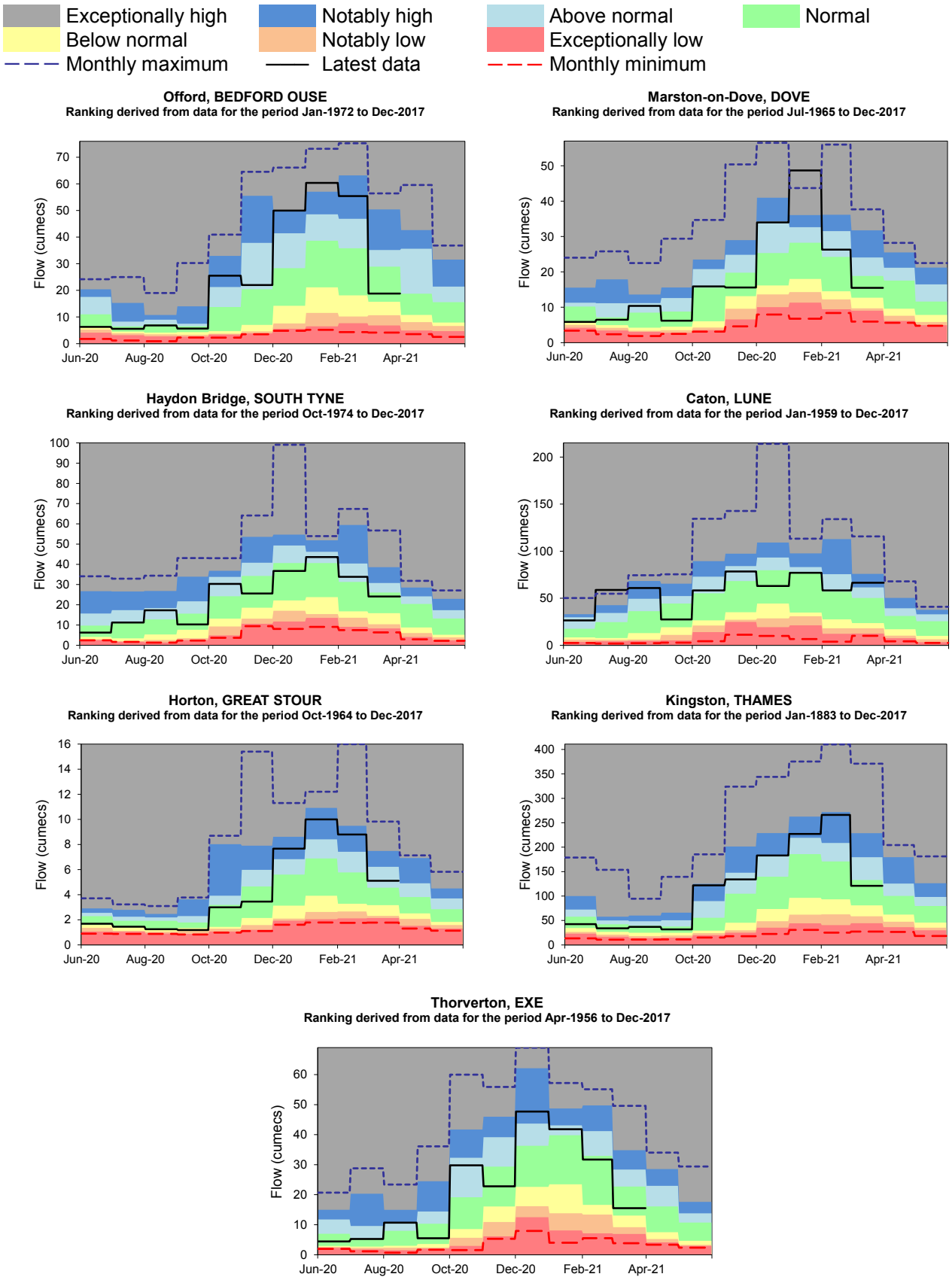
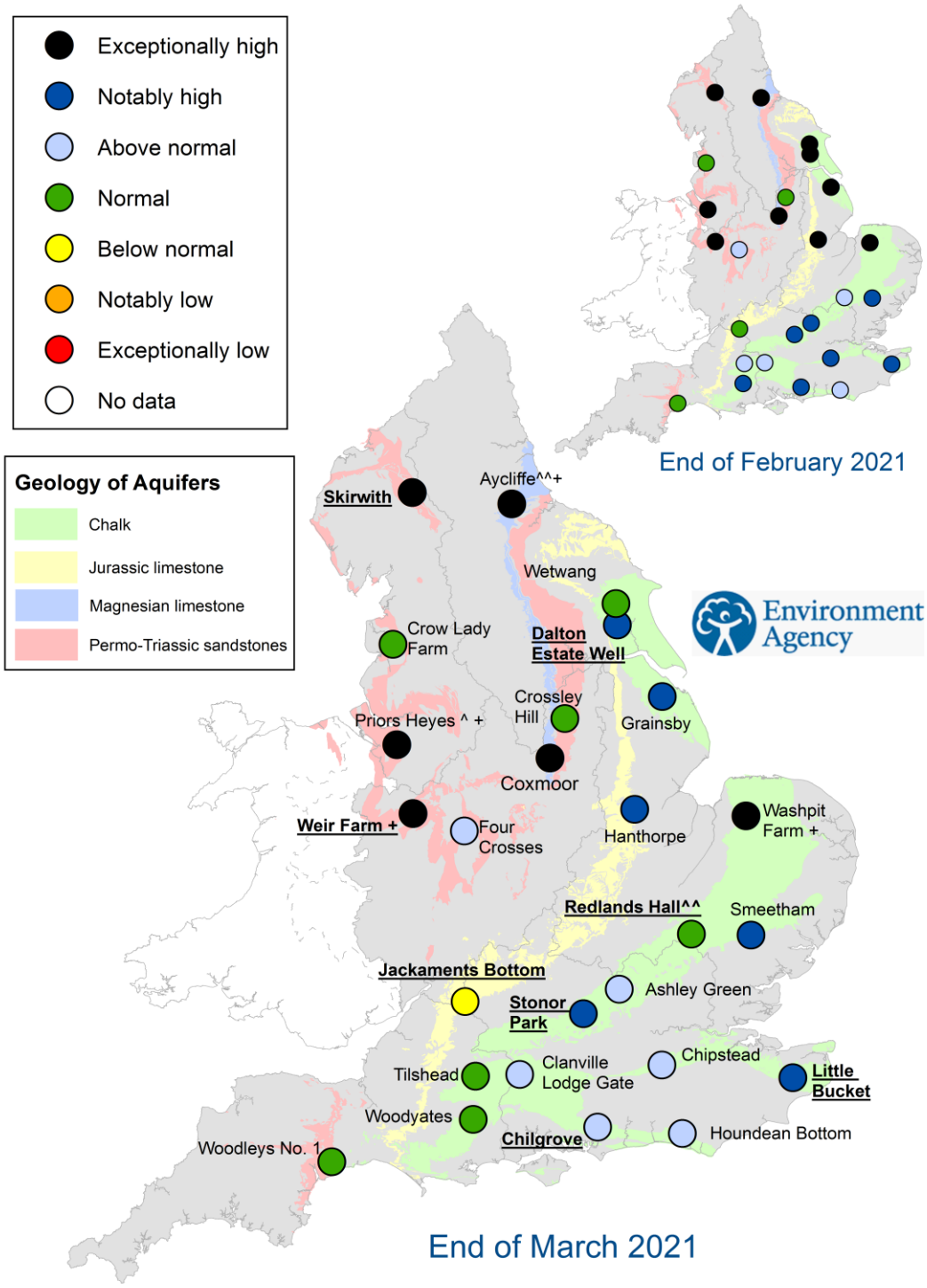


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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

Figure 4.1: Groundwater levels for indicator sites at the end of February and March 2021, 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, 2021.

Groundwater level charts

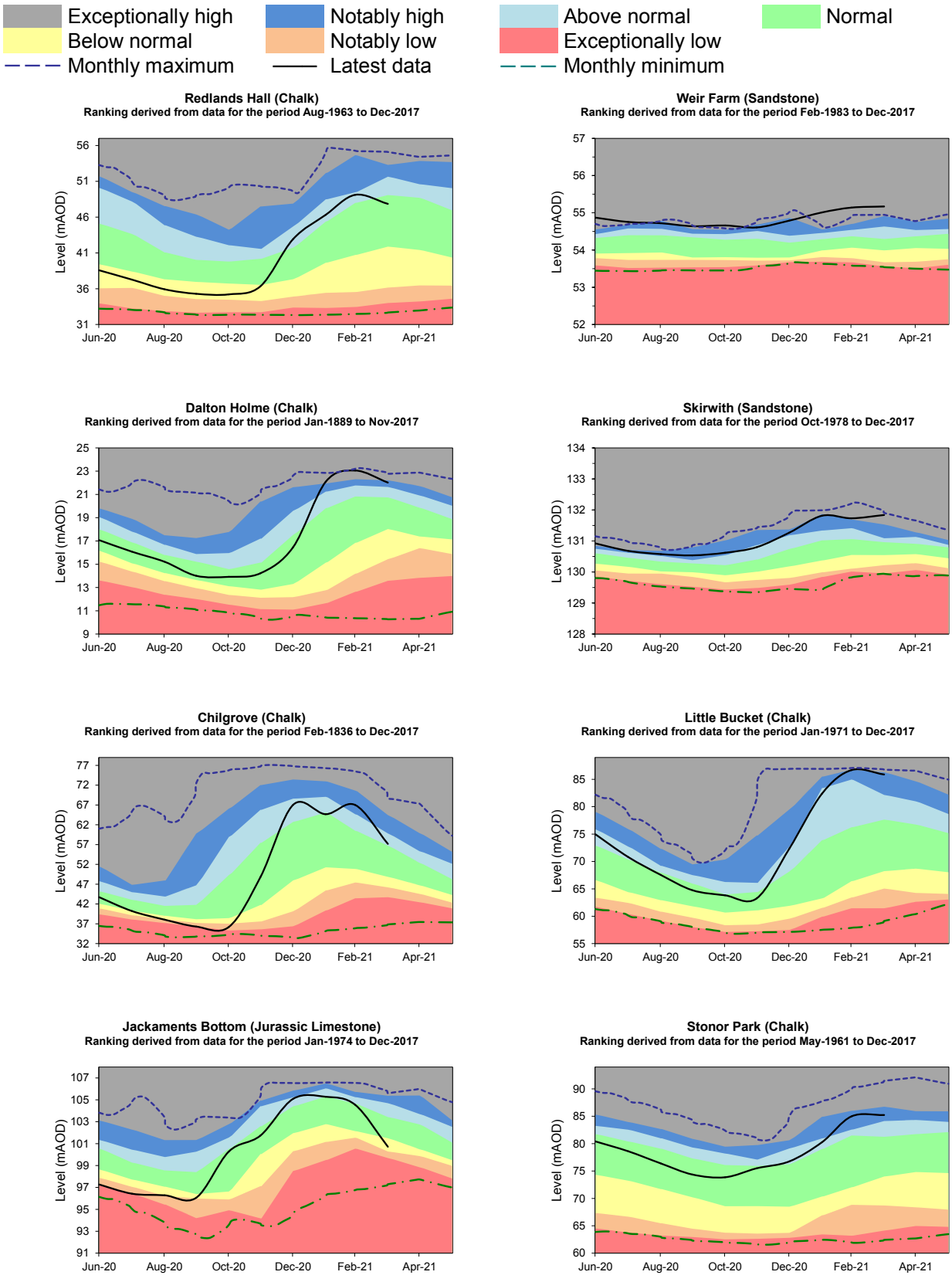
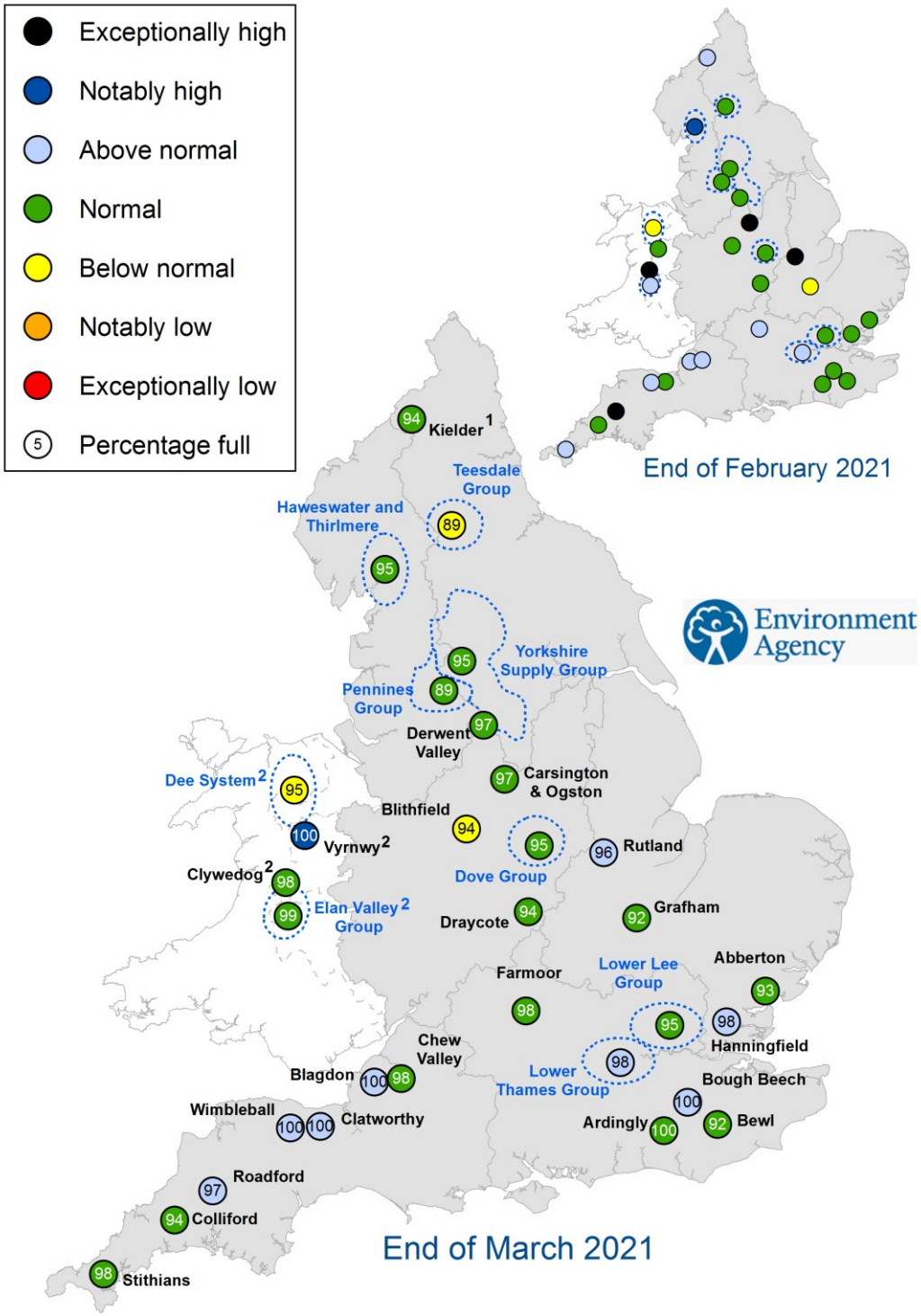


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

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 and March 2021 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

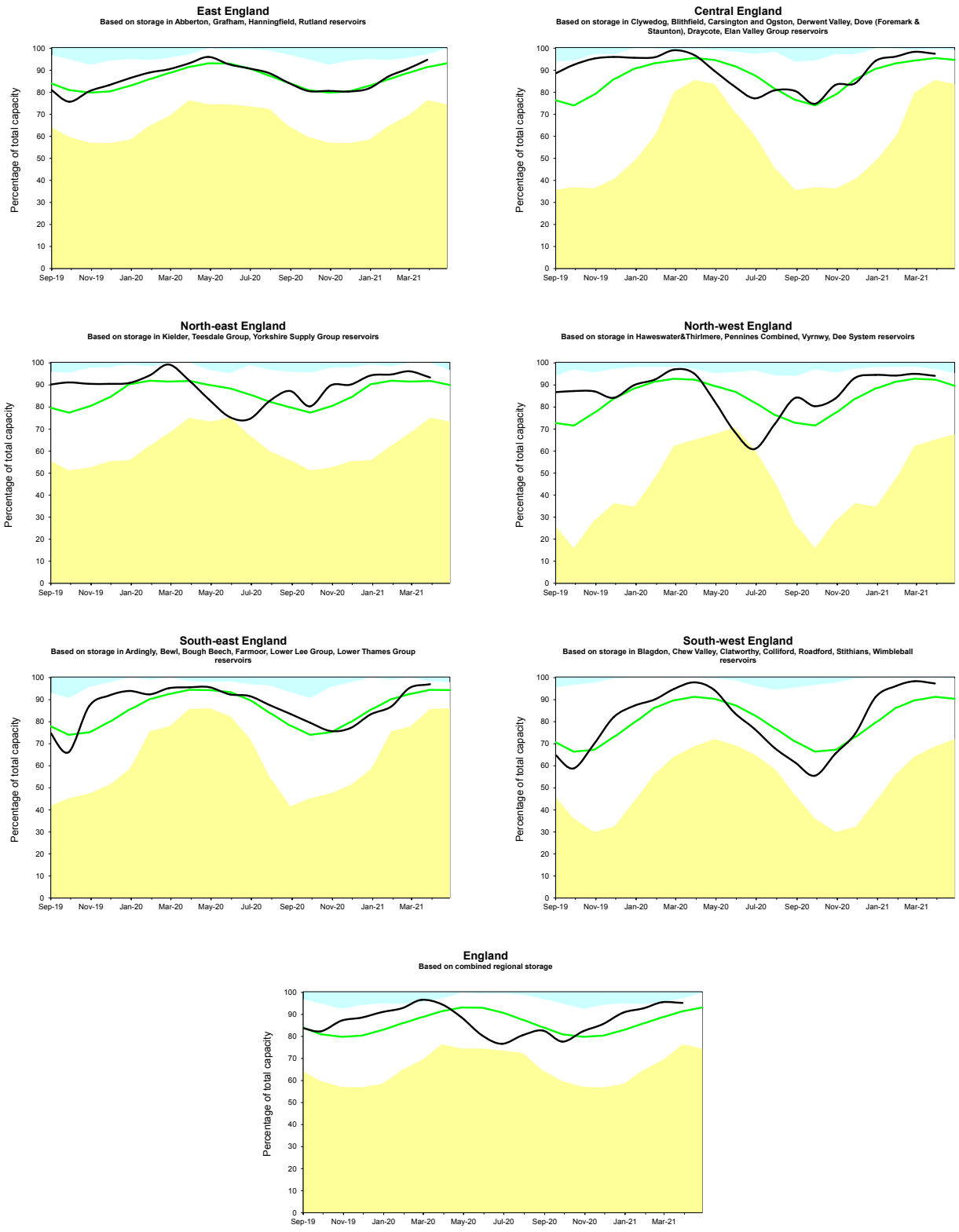


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

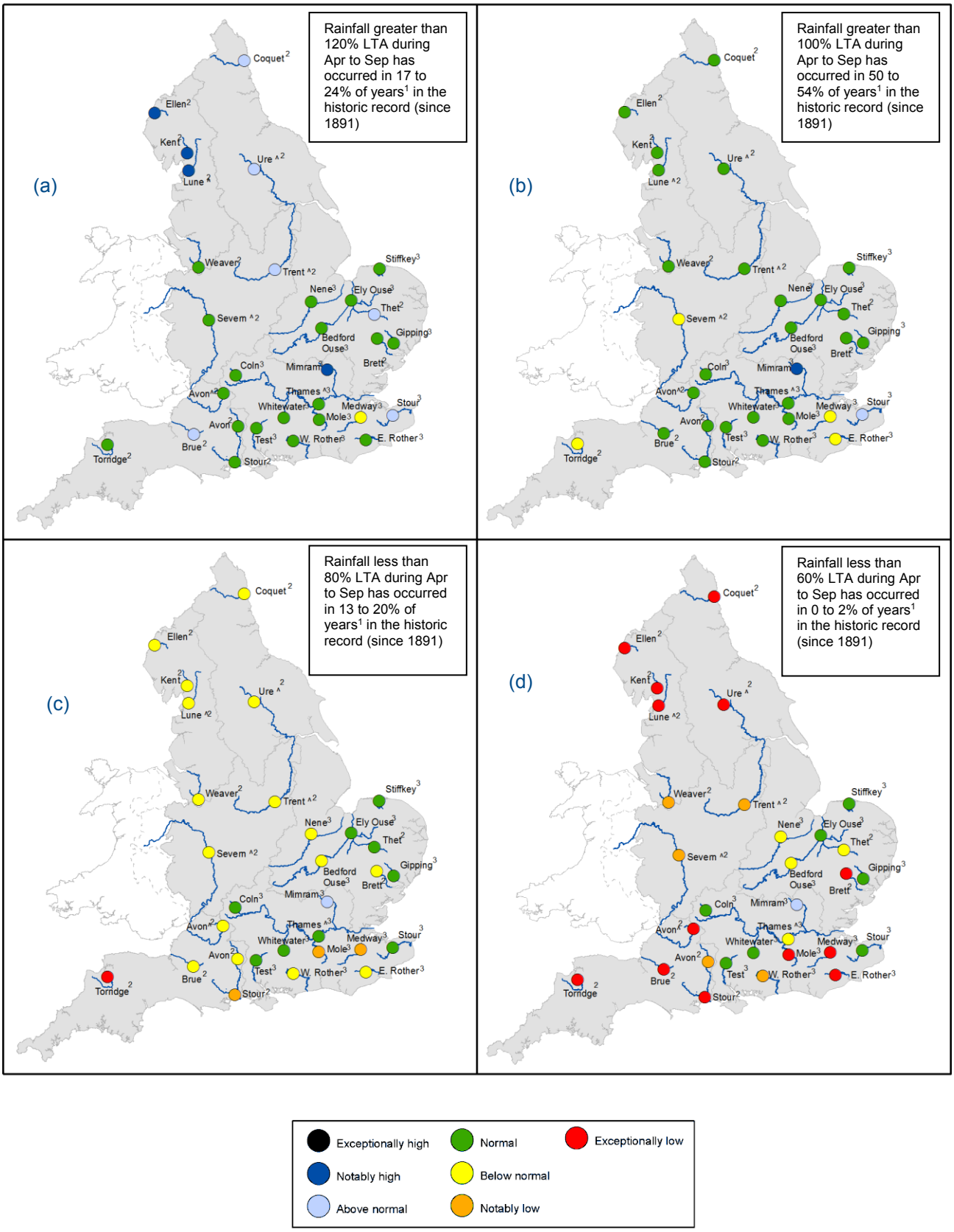


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2021 and September 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

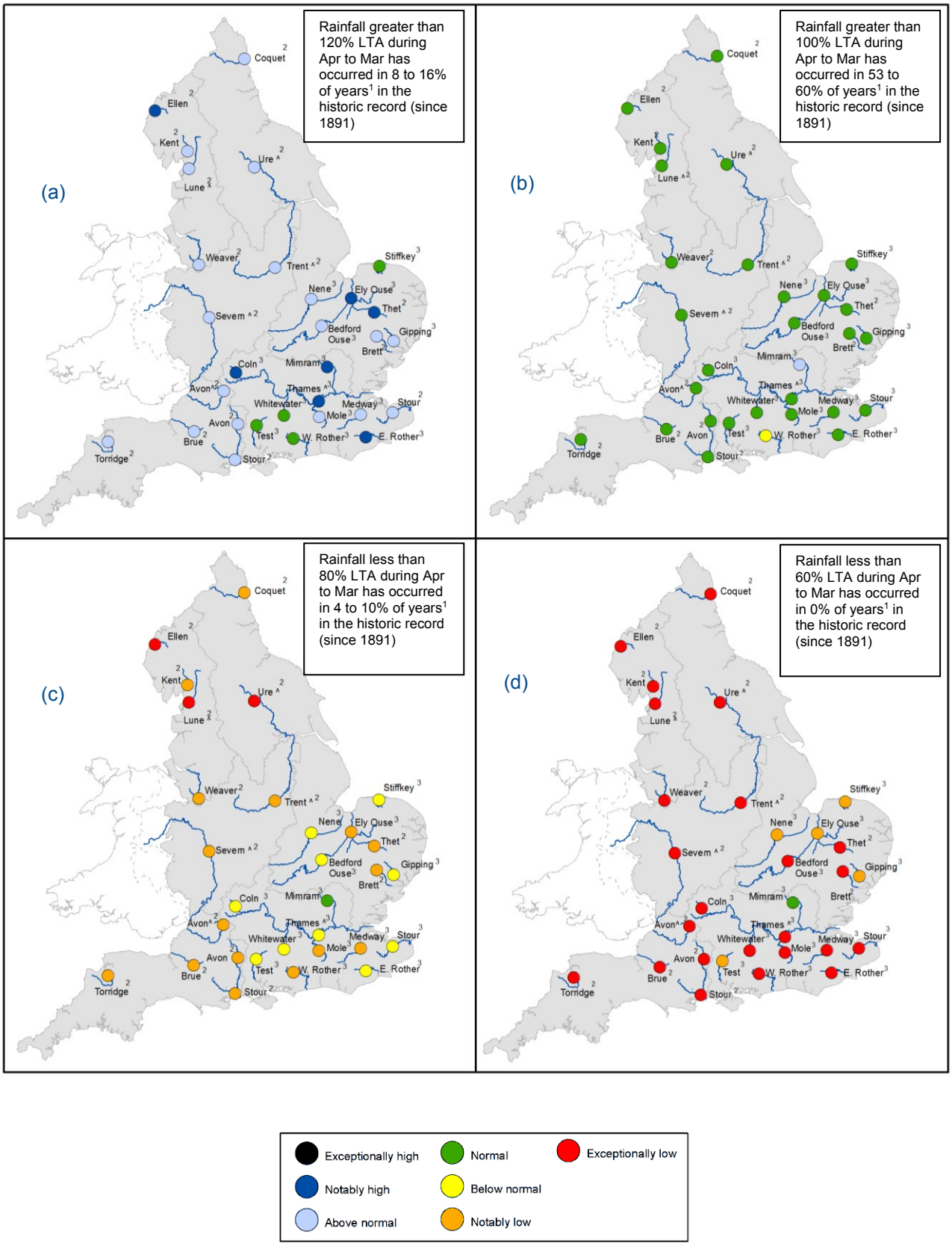


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2021 and March 2022 (Source: Centre for Ecology and Hydrology, Environment Agency)

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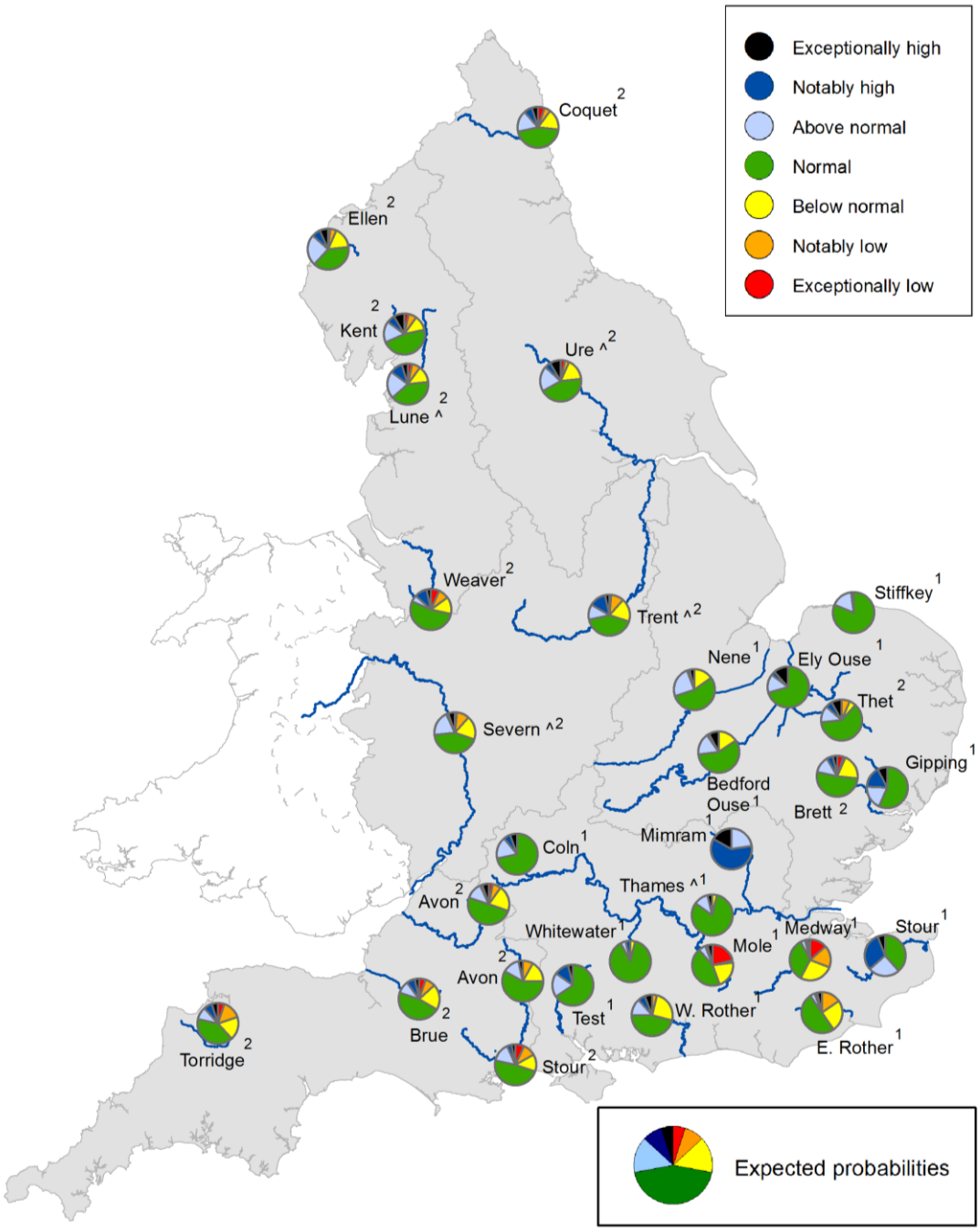

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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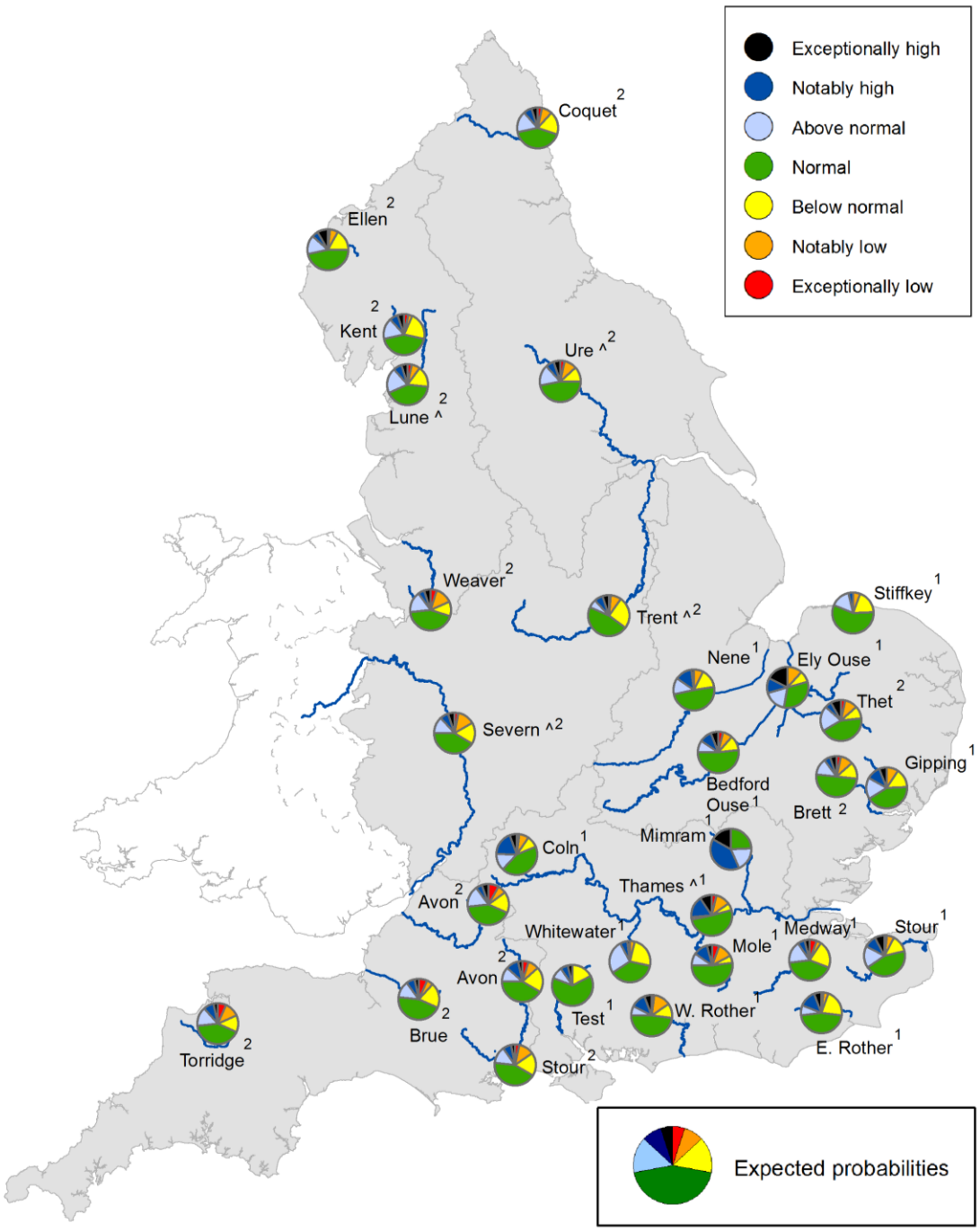

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2022. 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

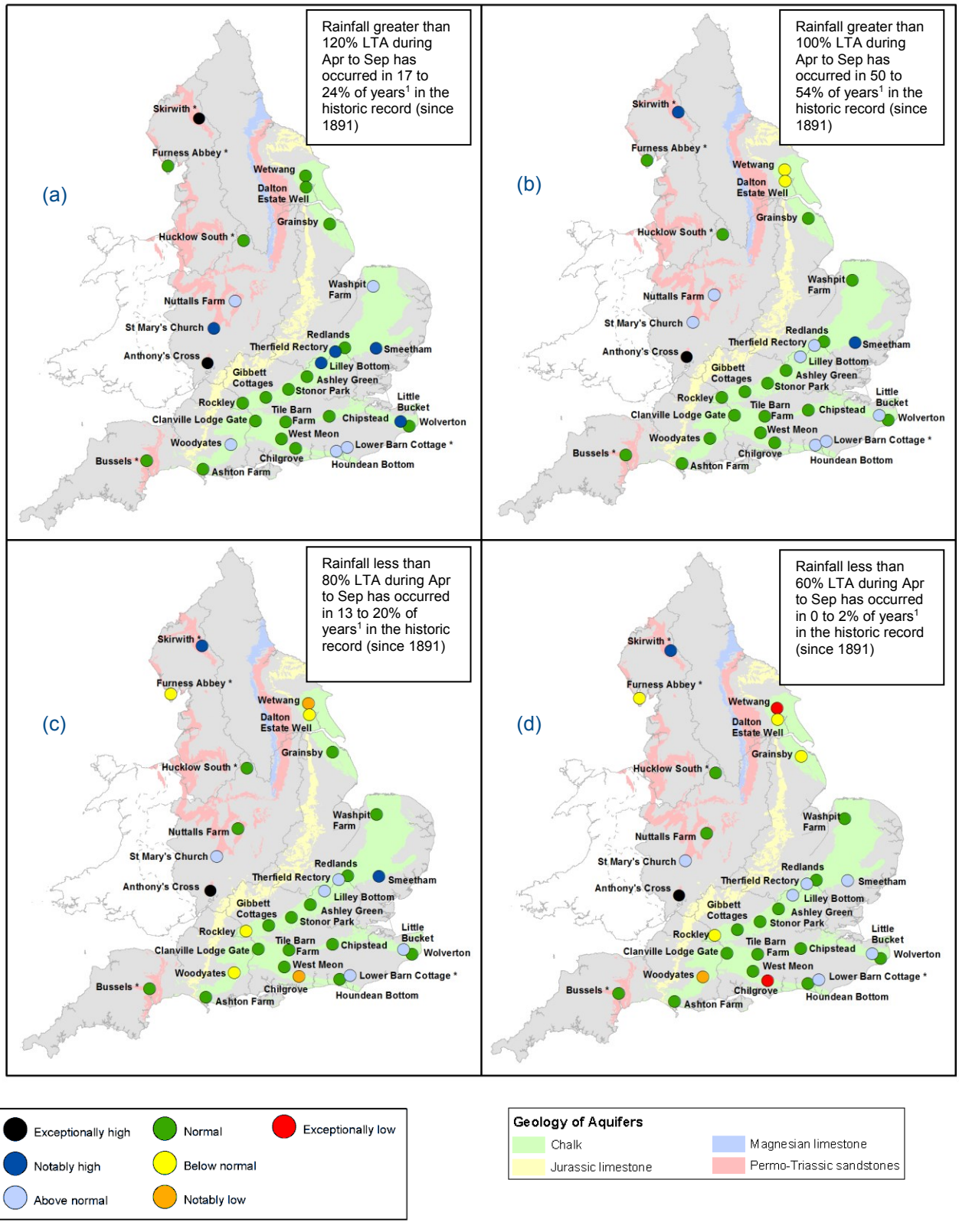

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2021 and September 2021 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2021.

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

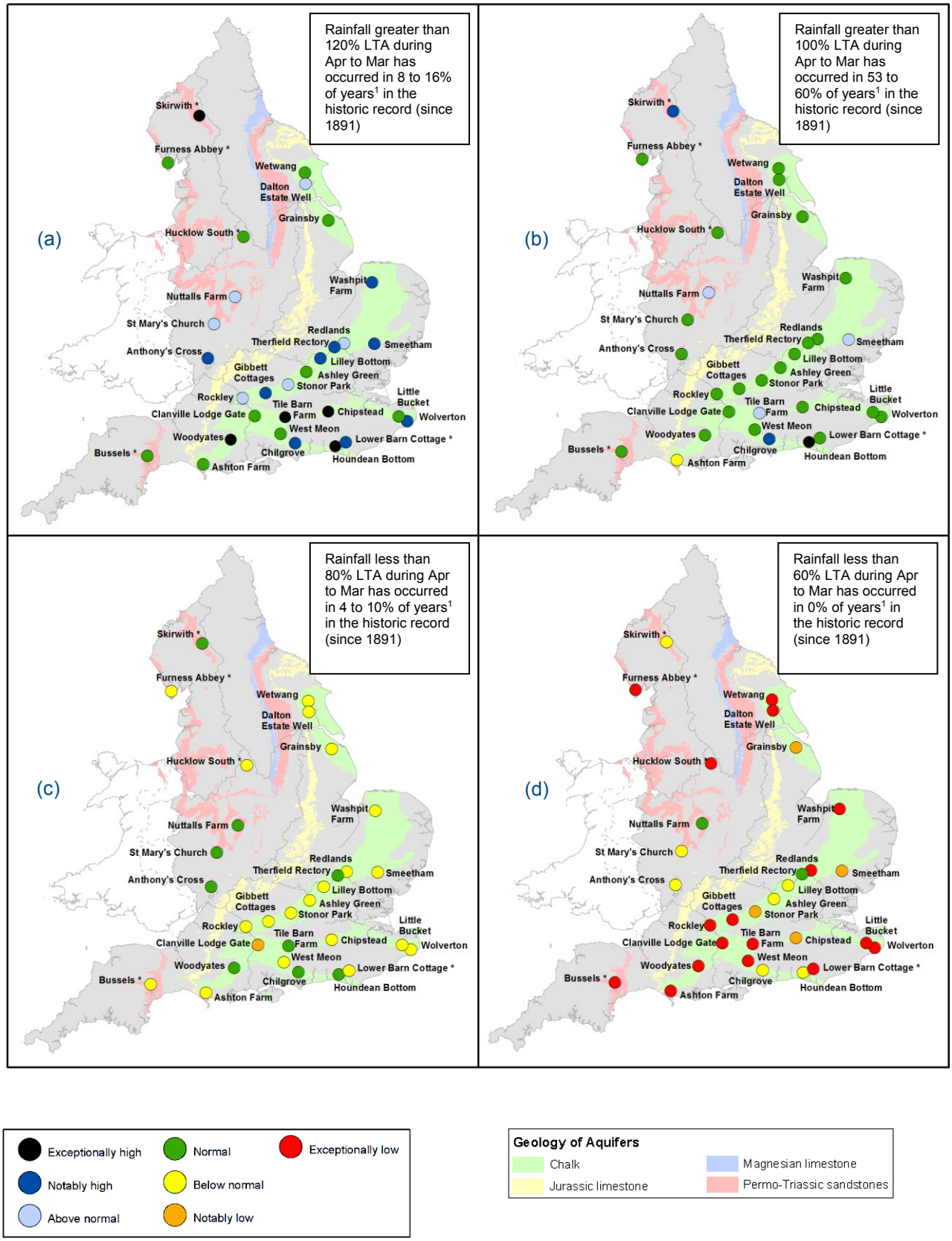

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2021.

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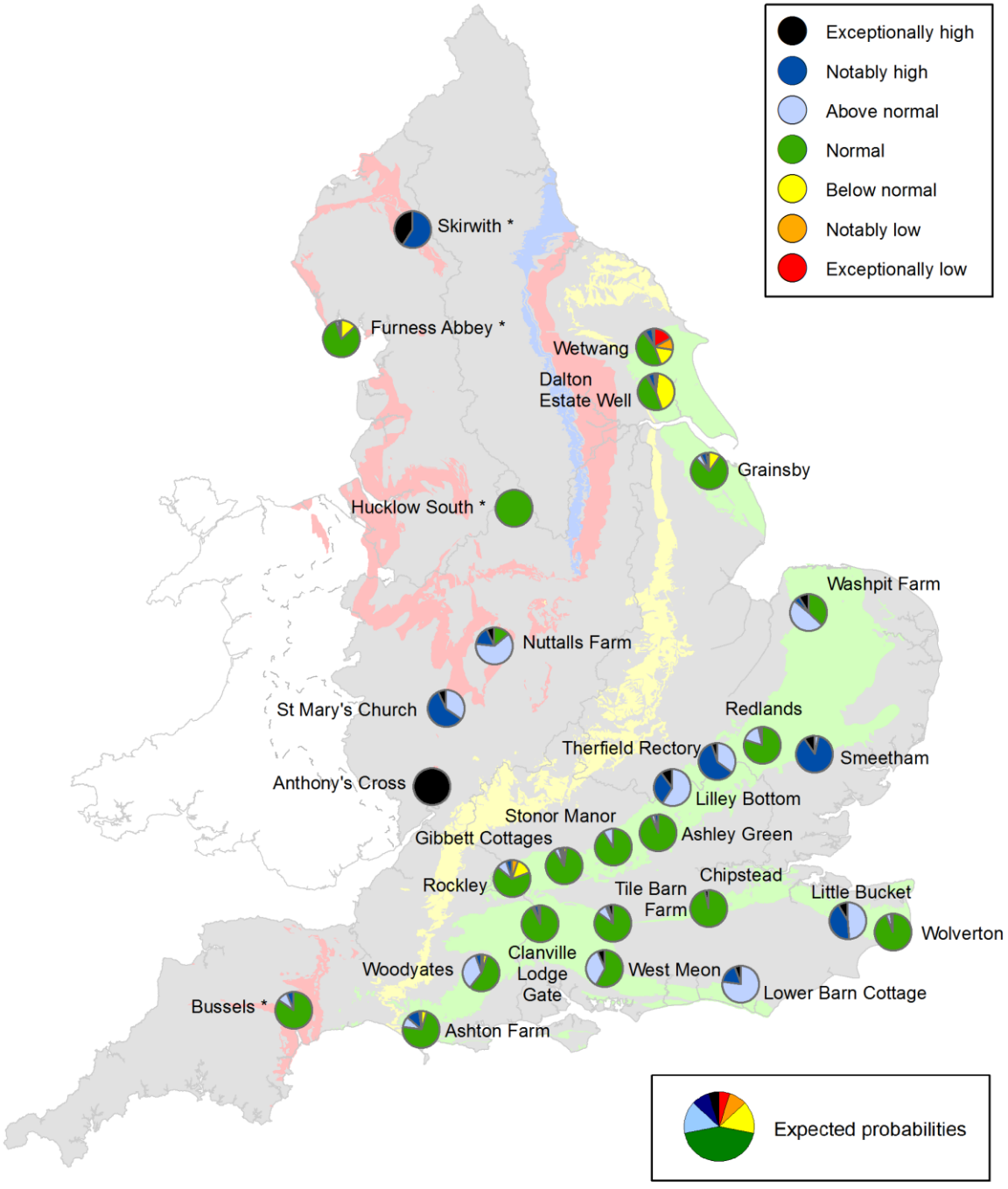
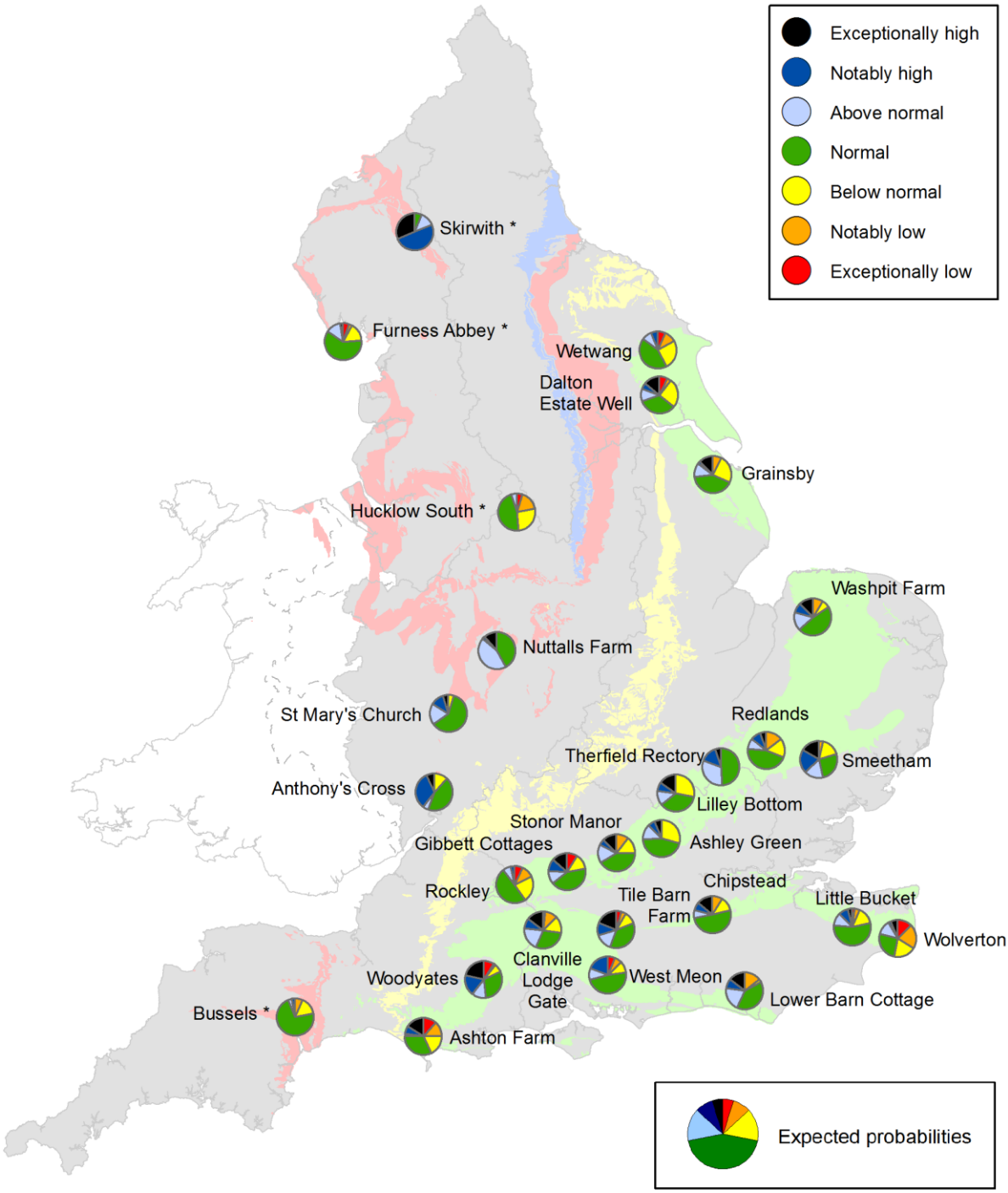


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

** 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 2022. 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, 2021.

* 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