Monthly water situation report

England

Summary – April 2021

April was a very dry month across the whole of England, with all parts of the country receiving below average rainfall totals, and some catchments experiencing the driest April on record. Rainfall totals in nearly all catchments were notably low or exceptionally low for the time of year. Soil moisture deficits increased across England. Mean monthly river flows decreased at all of the sites reported on, compared with March, and more than two-thirds of sites recorded river flows that were below normal or lower for the time of year. Groundwater levels decreased at all except two of the sites reported on during April, but levels remain normal or higher for the time of year at the majority of sites. Five groundwater sites recorded the highest end of April levels on record. Reservoir stocks generally decreased compared with last month, with total stocks for England slightly below average for this time of year.

Rainfall

The April rainfall total for England was 11mm, which represents 20% of the 1961 to 1990 long term average (LTA) (19% of the 1981 to 2010 LTA). Below average rainfall for April was recorded across the whole of England. The lowest monthly catchment rainfall totals were recorded in south-east England (Figure 1.1).

Monthly rainfall totals were classed as below normal or lower across all catchments in England. Just over half of all catchments had monthly rainfall totals that were classed as exceptionally low for the time of year. The lowest rainfall total as a proportion of the LTA was in the Roding catchment in Essex, where the rainfall was less than 1mm (2% of the April LTA). A number of catchments across Essex, Sussex, Hertfordshire and Kent recorded rainfall totals of less than 5mm during April. The highest catchment rainfall total for April, of 25mm (49% of the April LTA) was recorded in the Berkshire Downs and classed as below normal for the time of year (Figure 1.2). Many catchment rainfall totals for April ranked in the top 10 driest April periods on record (records start 1891). Notably, the Roding and South London catchments were the driest April on record.

Cumulative rainfall totals for the last 3 months ending in April, were classed as below normal or lower for the majority of catchments across south-west, south-east, central and east England, with most catchments in north-east and north-west England classed as normal or higher. The 6 and 12 month cumulative rainfall totals ending in April were classed as normal or higher in all catchments across England (Figure 1.2).

At a regional scale, April rainfall totals ranged from 12% of the LTA in east England, to 24% of the LTA in central England (Figure 1.3). April was the second consecutive month of below average rainfall for all regions except north-west England (where March rainfall totals were above average) and south-east England, where April was the third consecutive month of below average rainfall. All regions recorded monthly rainfall totals that ranked in the top ten driest April periods on record (records start 1891). For north-west England this was the third driest April on record, and for east England, this was the fifth driest April on record.

Soil moisture deficit

Compared to the end of March, soils at the end of April were drier in all reported grid squares across England. Soil moisture deficits (SMD) were greater than 40mm across the majority of England, and greater than 70mm in parts of Cornwall. Across large parts of England, end of April SMD were more than 25mm greater (ie drier) than the LTA for this time of year (Figure 2.1).

At a regional scale, the end of April SMD values were greater than the end of April LTA in all regions and soils were notably drier than at the end of March (Figure 2.2).

River flows

In response to the low rainfall totals across England during April, river flows decreased at all of the sites reported on, compared with last month. Monthly mean river flows for April were classed as below normal or lower for the time of year at more than two-thirds of the reported gauging stations, with one site (River Kenwyn at Truro)

classed as exceptionally low for the time of year. One quarter of the reported sites were classed as normal, the majority of these being located on chalk aquifers in south-east and east England. Two sites (River Burn at Burnham and River Ver at Hansteads) were classed as notably high (Figure 3.1).

At the regional index sites monthly mean flows ranged from being classed as notably low on the South Tyne at Haydon Bridge (north-east England), Lune at Caton (north-west England) and Exe at Thorverton (south-west England) to normal on the Great Stour at Horton and the Thames at Kingston (south-east England) (Figure 3.2).

Groundwater levels

Groundwater levels decreased at all except two of the sites reported on during April, but remain normal or higher for the time of year at the majority of sites. A quarter of the indicator sites were classed as exceptionally high for the time of year, and around one-third of sites were classed as normal (Figure 4.1).

Skirwith (Carlisle Basin and Eden Valley sandstone), Aycliffe (Wear Magnesian Limestone), Priors Heyes (West Cheshire sandstone), Coxmoor (Idle and Torne Permotriassic sandstone) and Weir Farm (Bridgnorth sandstone) all recorded the highest end of April levels on record (records go back to 1978, 1979, 1972, 1969 and 1983 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction. For Weir Farm, it was the fourth consecutive month with the highest levels on record for the time of year, and the second consecutive month for Aycliffe.

End of month groundwater levels at the major aquifer index sites ranged from notably low at Jackaments Bottom (Jurassic limestone) to exceptionally high at Weir Farm (Bridgnorth sandstone) and Skirwith (Carlisle Basin and Eden Valley sandstone) (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at three-quarters of the reservoirs and reservoir groups we report on during April. The biggest decrease, as a proportion of total capacity, was at the Derwent Valley reservoir (Derbyshire), where stocks decreased from 97% of capacity at the end of March to 83% at the end of April. Stocks increased at only 4 of the reservoirs and reservoir groups we report on.

Reservoir stocks in nearly three-quarters of the reservoirs and reservoir groups we report on were classed as normal; six were classed as below normal and three were classed as notably low for the time of year (Figure 5.1).

At a regional scale, total reservoir stocks ranged from 86% in north-east England to 96% in south-east England. Total reservoir stocks for England were at 90% of total capacity at the end of April (a decrease from 95% at the end of March), this is 3% below the LTA for the time of year. (Figure 5.2).

Forward look

After a wet start to the month over the bank holiday weekend, particularly in northern England, much of May is expected to be characterised by unsettled conditions. Sunny spells, interspersed with showers and some bands of heavier and more persistent rain are expected. Towards the end of the month it is possible that drier and more settled conditions will become established in southern England, with an increased chance of rain and strong winds in the north and north-west. Confidence in the forecast for this period remains low however[1].

For the 3 month period May to July, there is half the normal chance of dry conditions and a slightly higher chance of wet conditions than normal[2].

Projections for river flows at key sites[3]

Over half of the modelled sites have a greater than expected chance of cumulative river flows being below normal or lower for the time of year by the end of September 2021. By the end of March 2022, a third of the 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 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

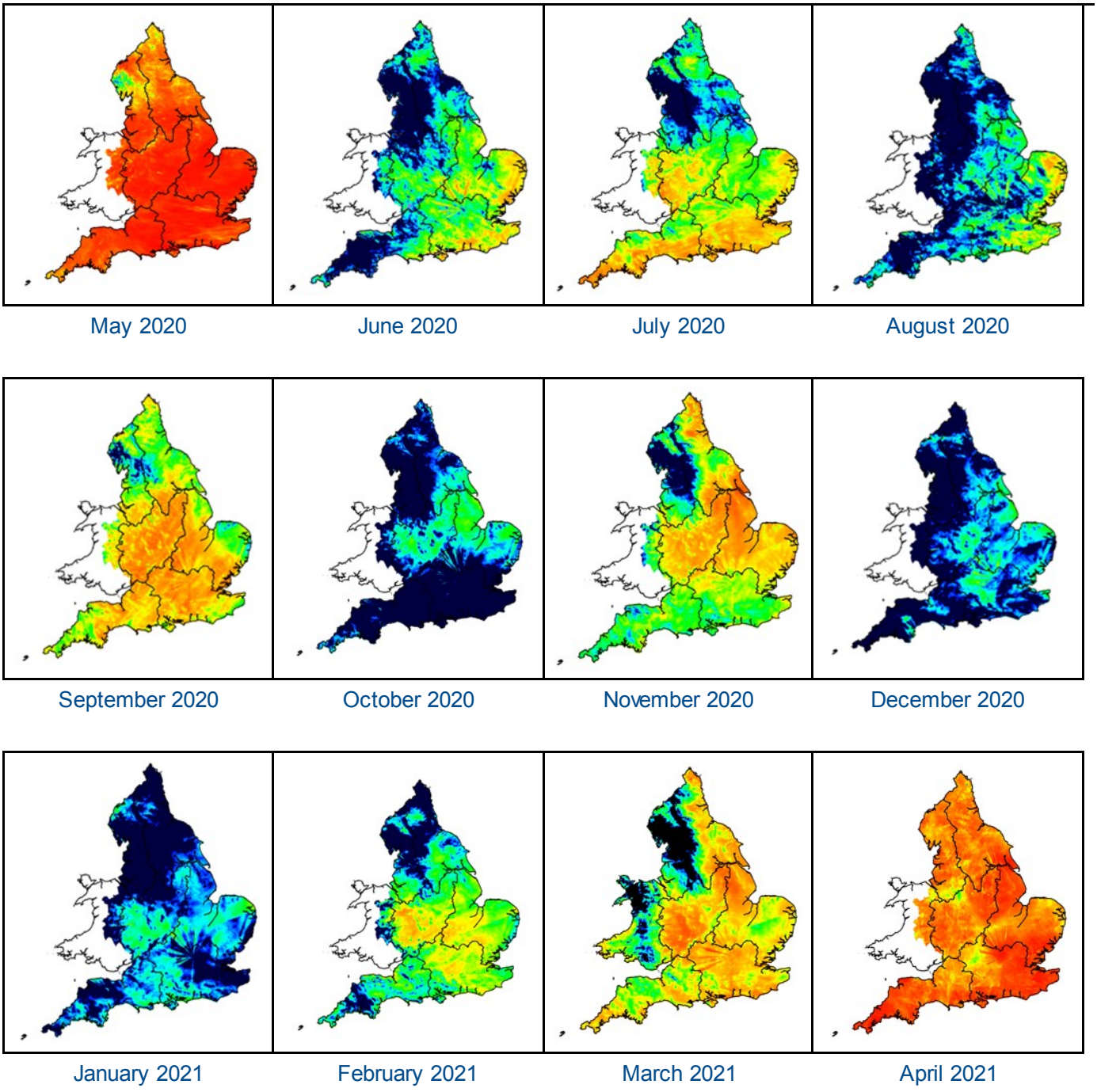
1 Source: Met Office
2 Source: Met Office
3 Information produced by the Water Situation Forward Look group led by Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office (www.hydoutuk.net).

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, over a third of the modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year.

For scenario based projections of groundwater levels in key aquifers in 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

Rainfall



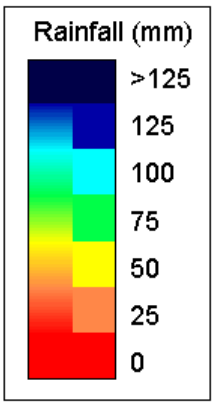


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

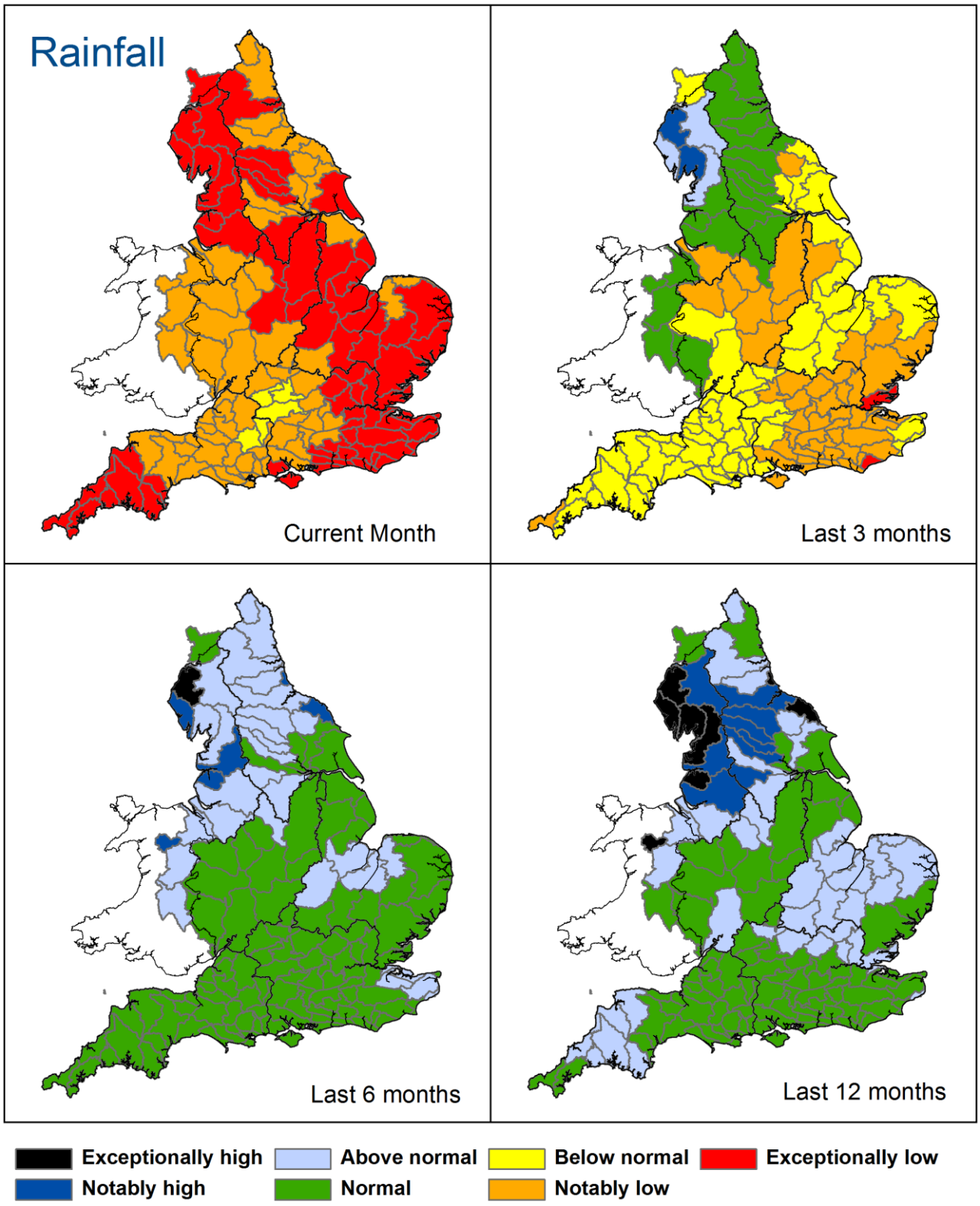


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 April), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived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

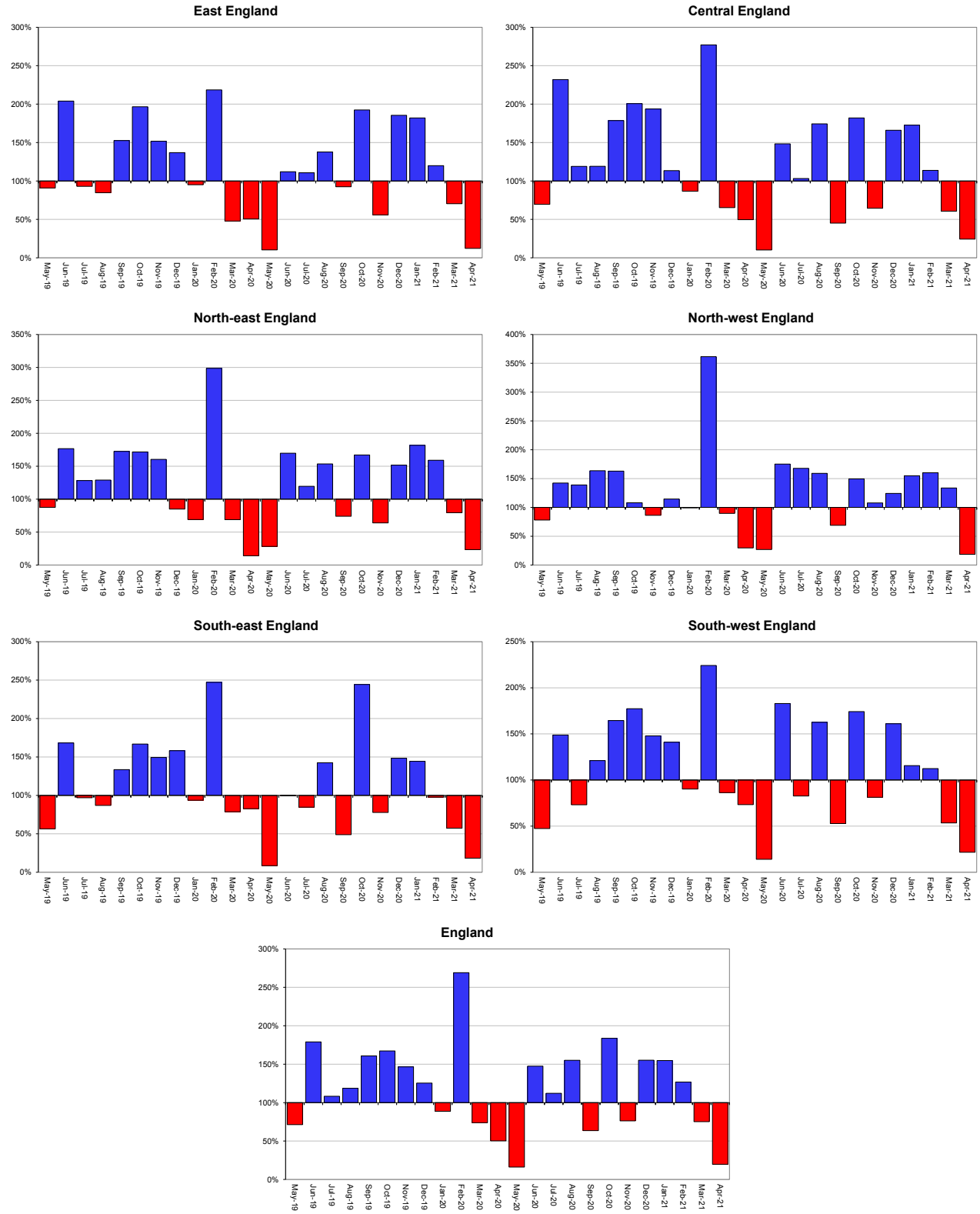


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

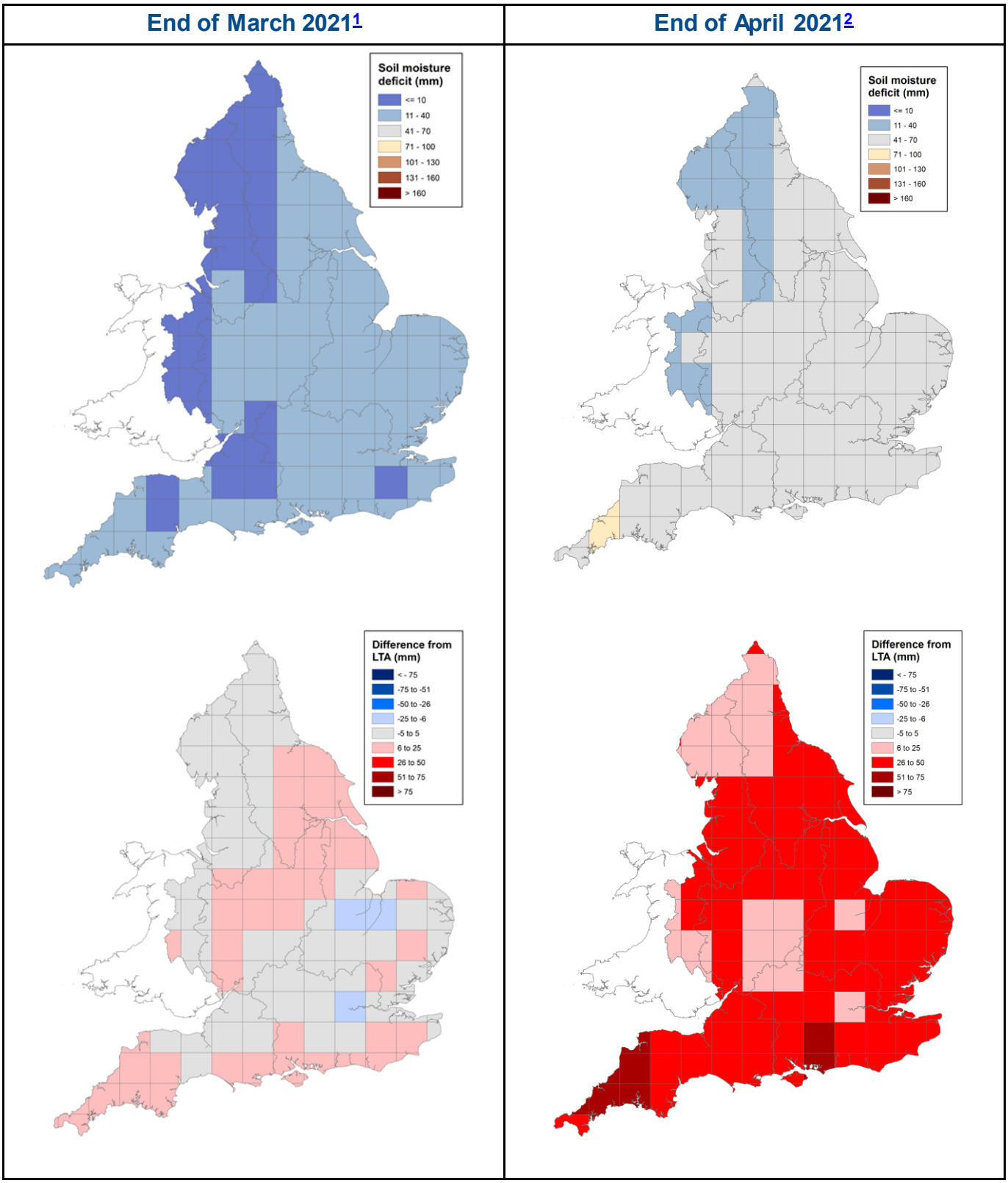


Figure 2.1: Soil moisture deficits for weeks ending 30 March 2021[1] (left panel) and 28 April 2021[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2021). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021

Soil moisture deficit charts

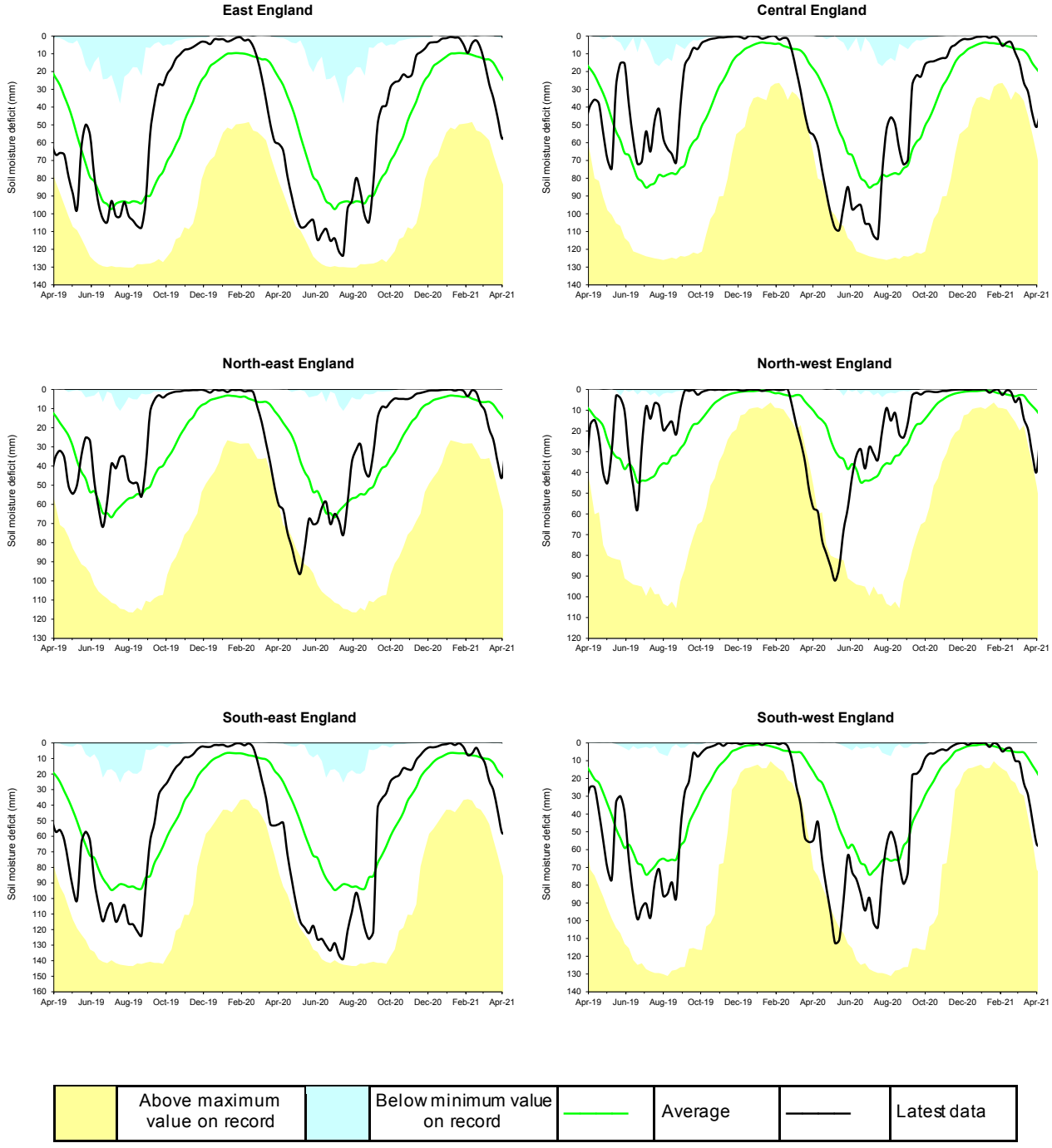
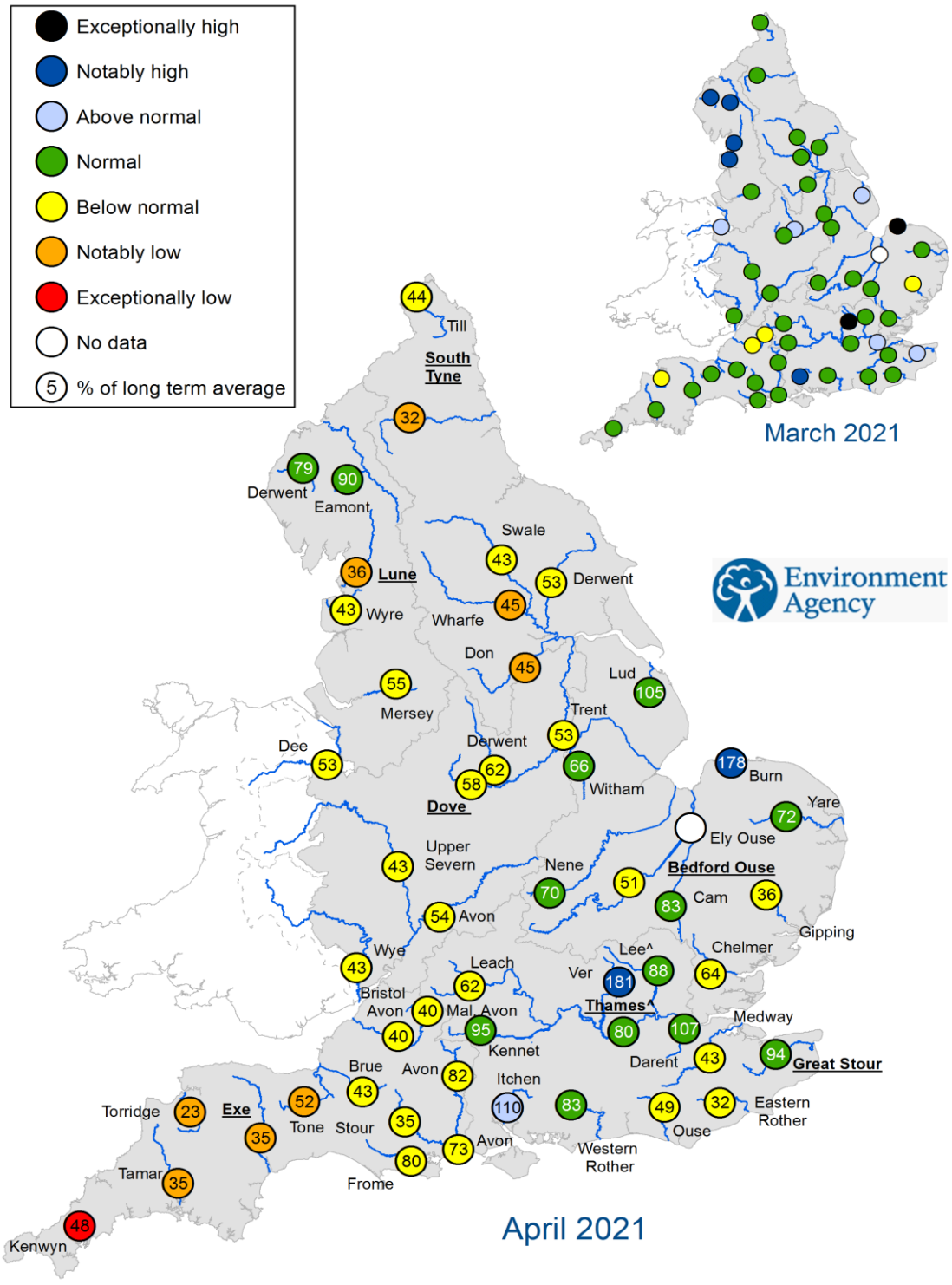


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

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 March 2021 and April 2021, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March and April monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

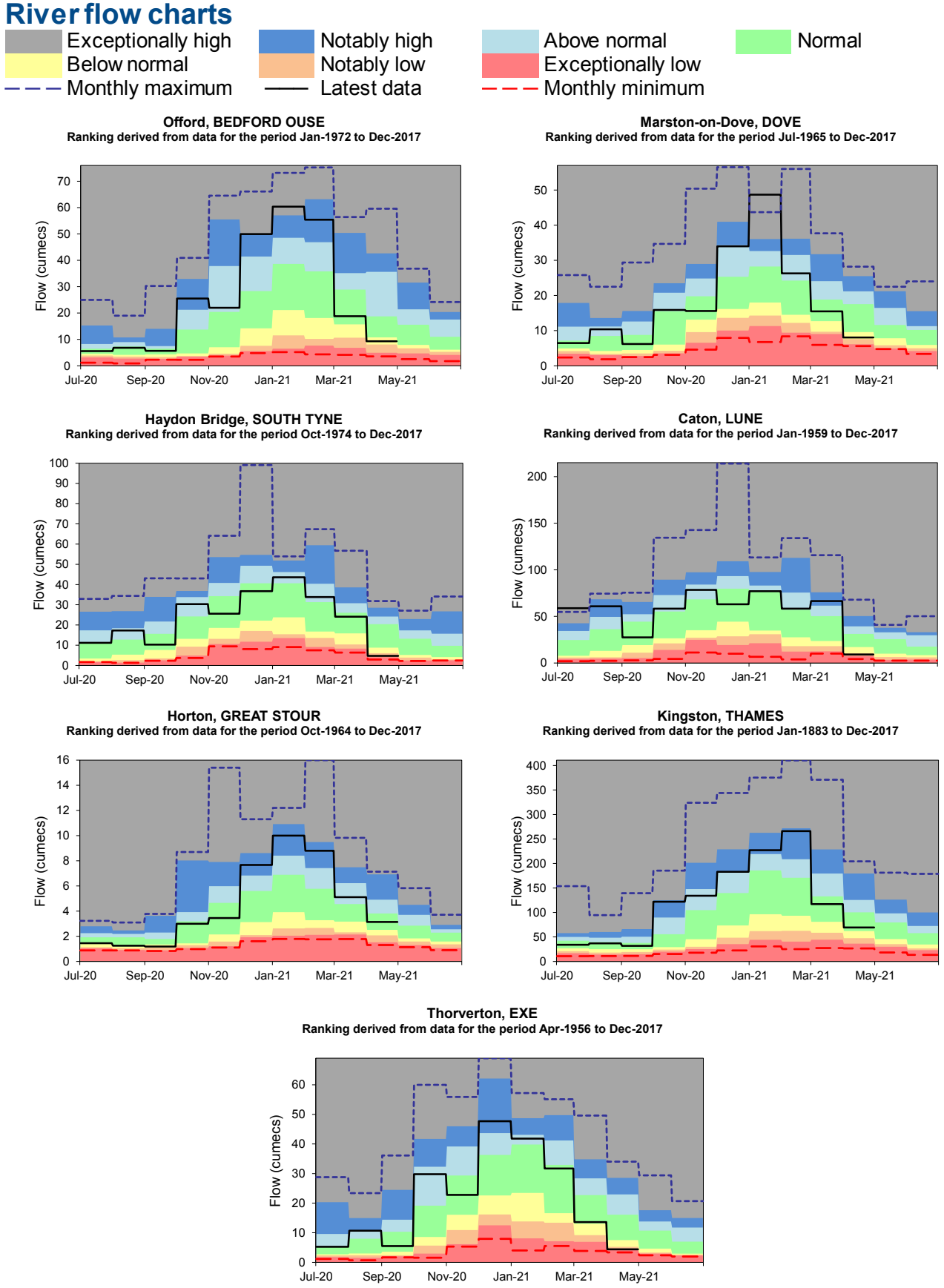
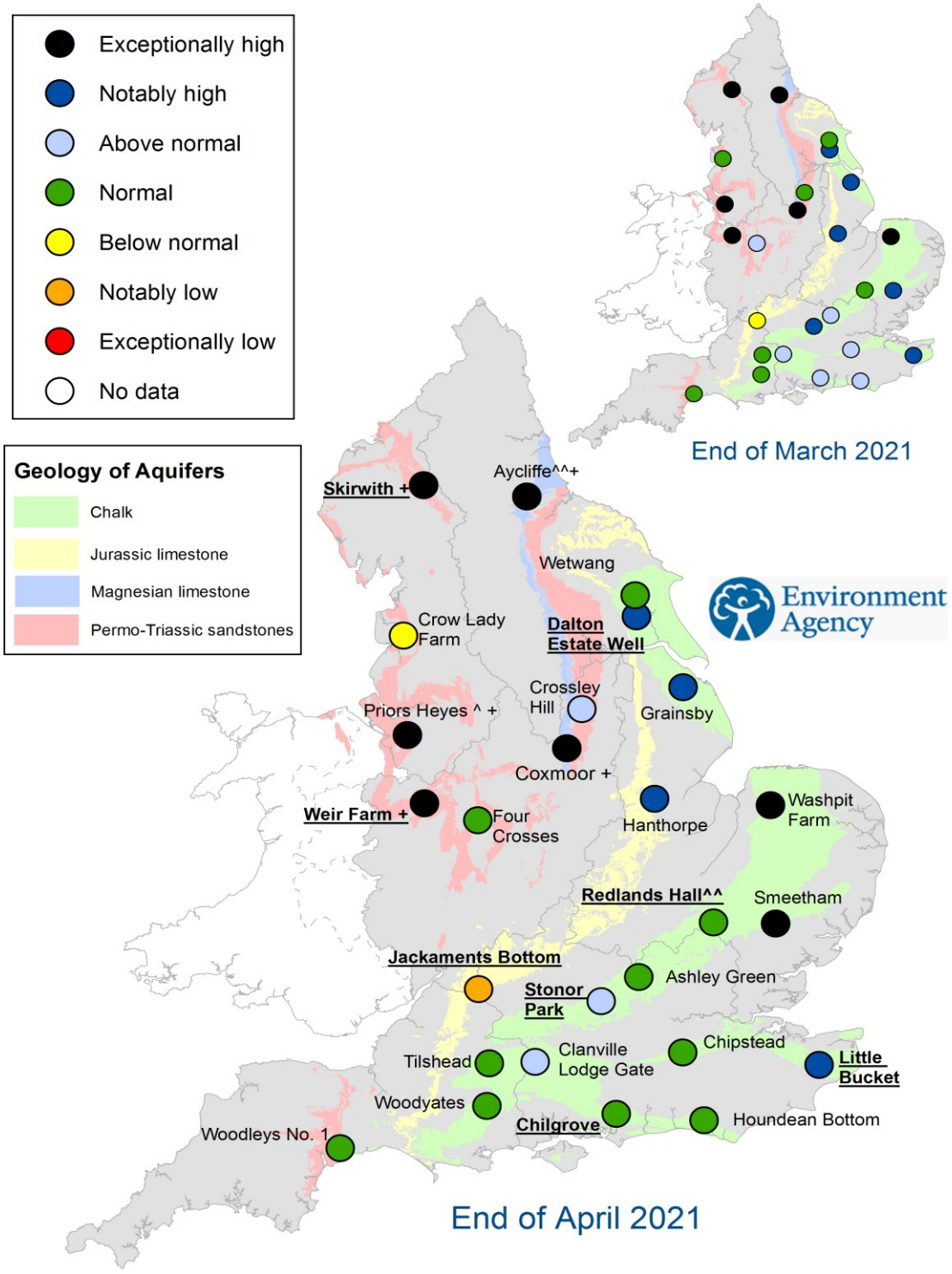


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 March 2021 and April 2021, classed relative to an analysis of respective historic March and April 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

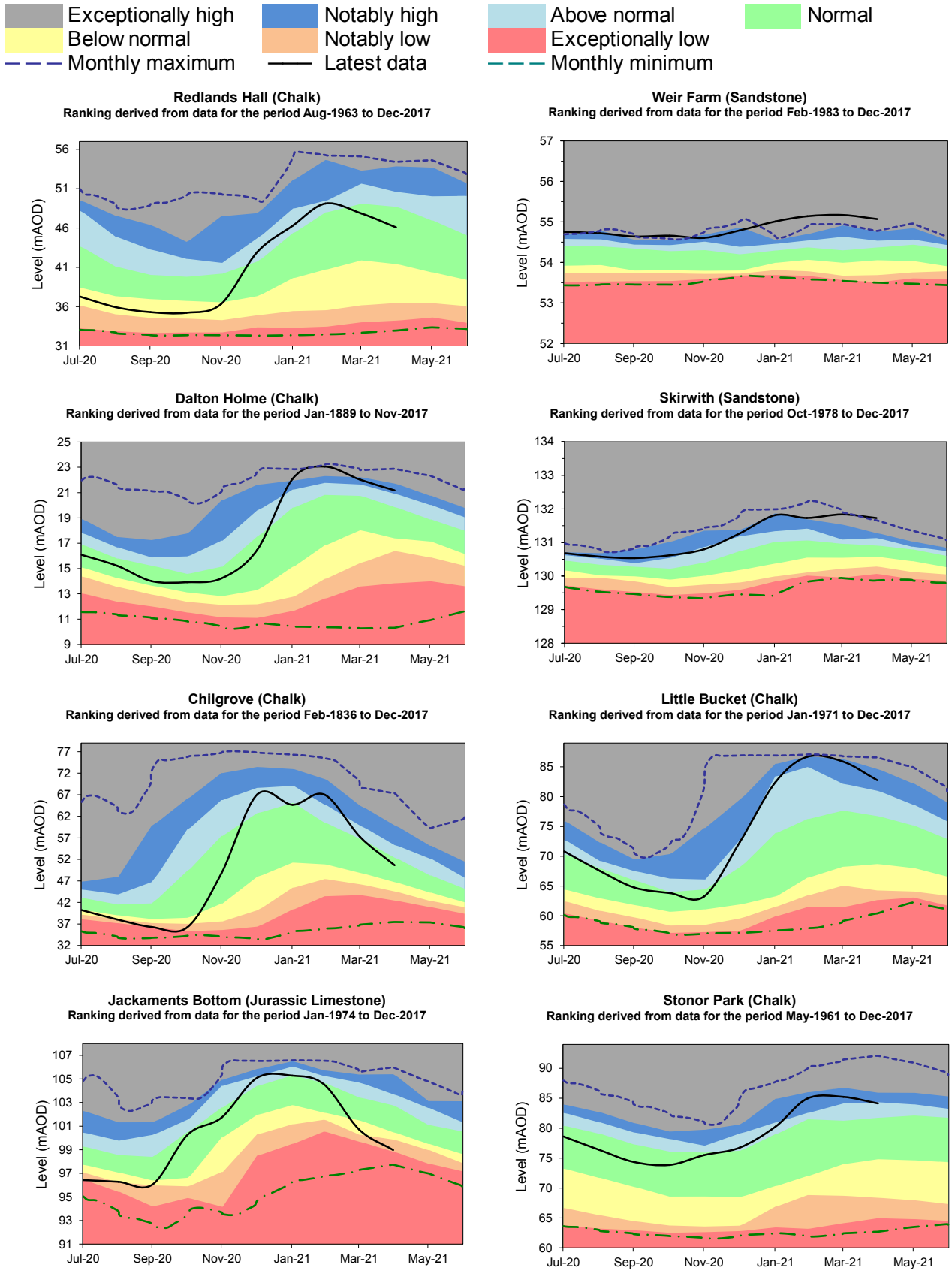
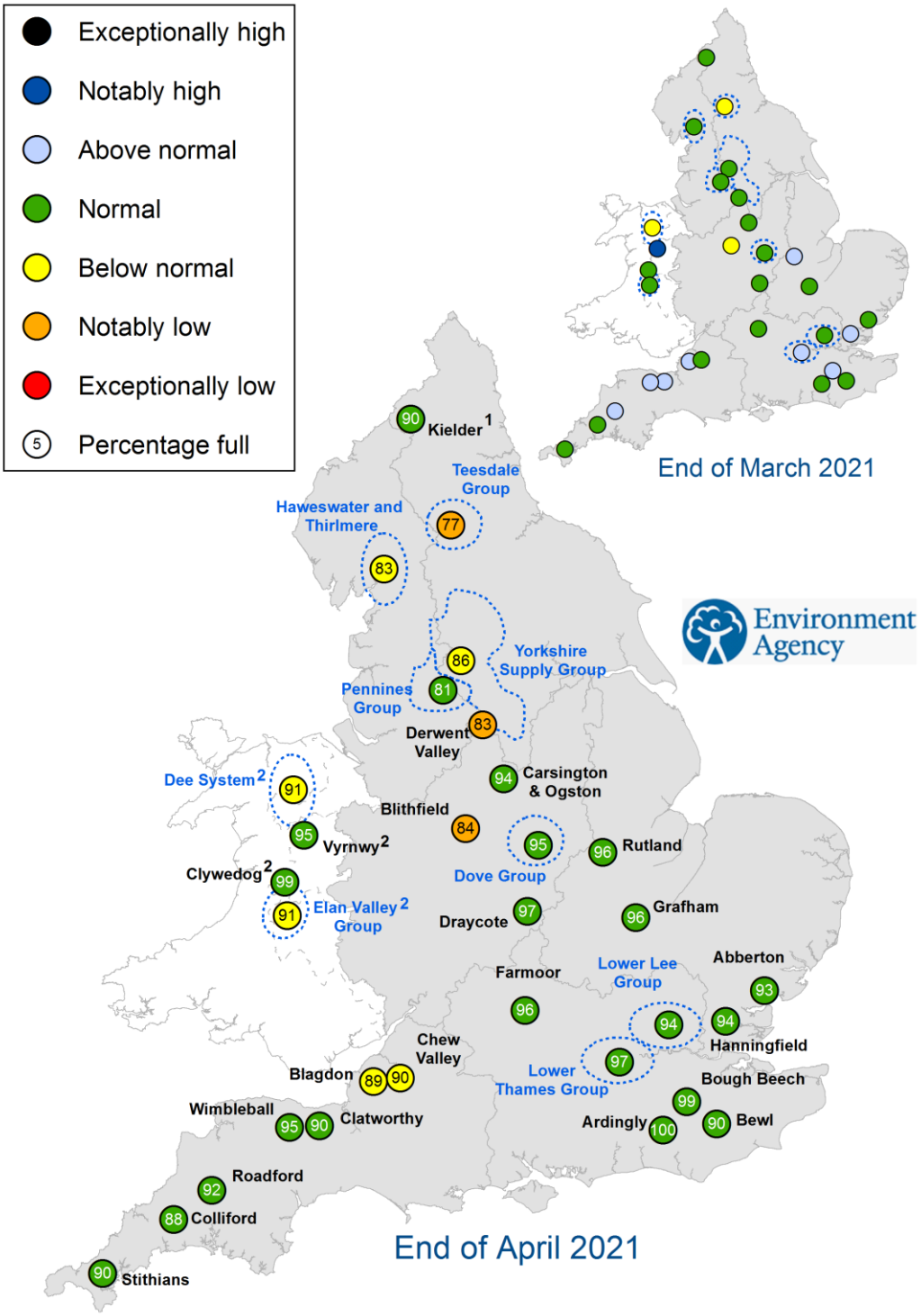


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

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 March 2021 and April 2021 as a percentage of total capacity and classed relative to an analysis of historic March and April 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, 100024198, 2021.

Reservoir storage charts

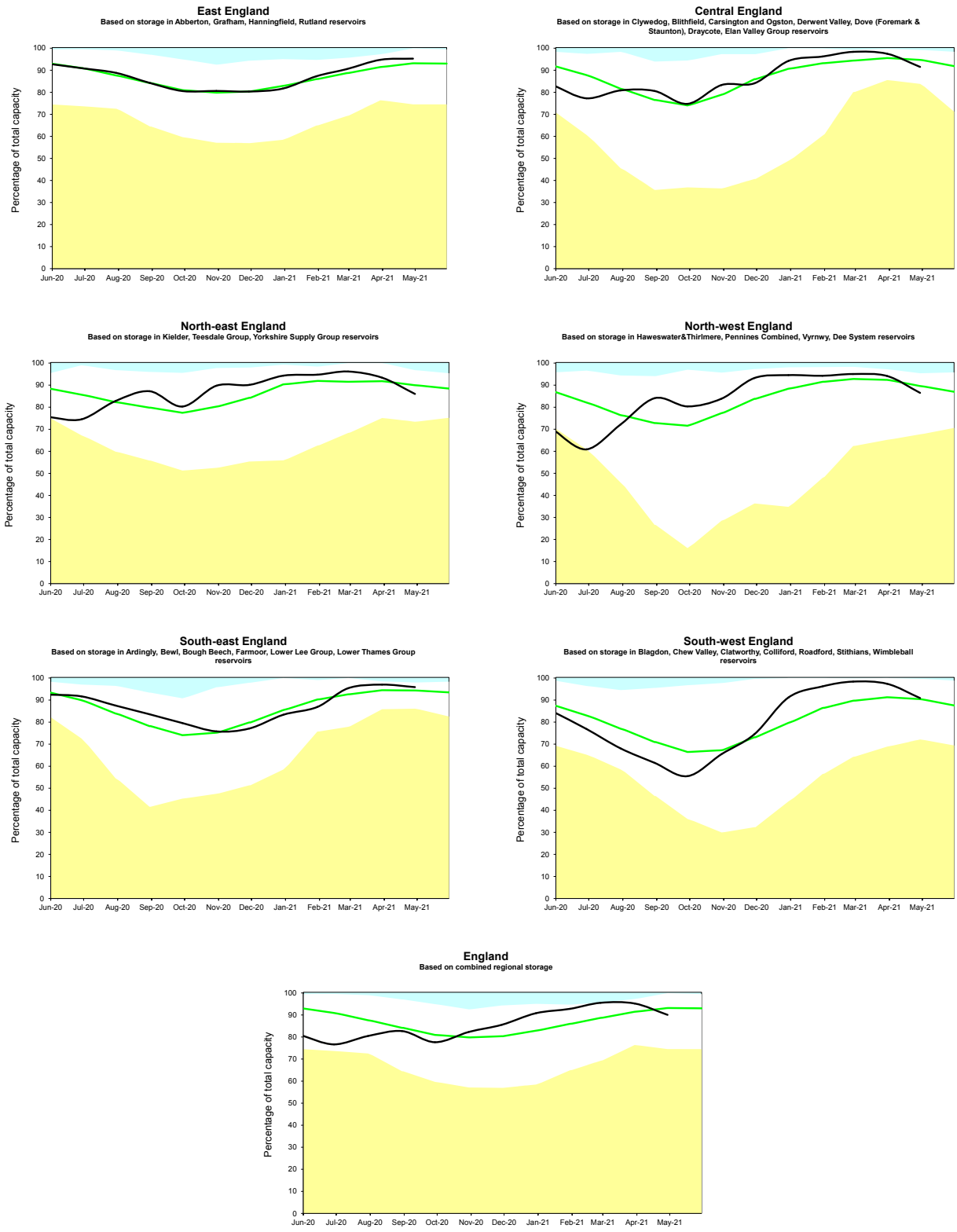


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

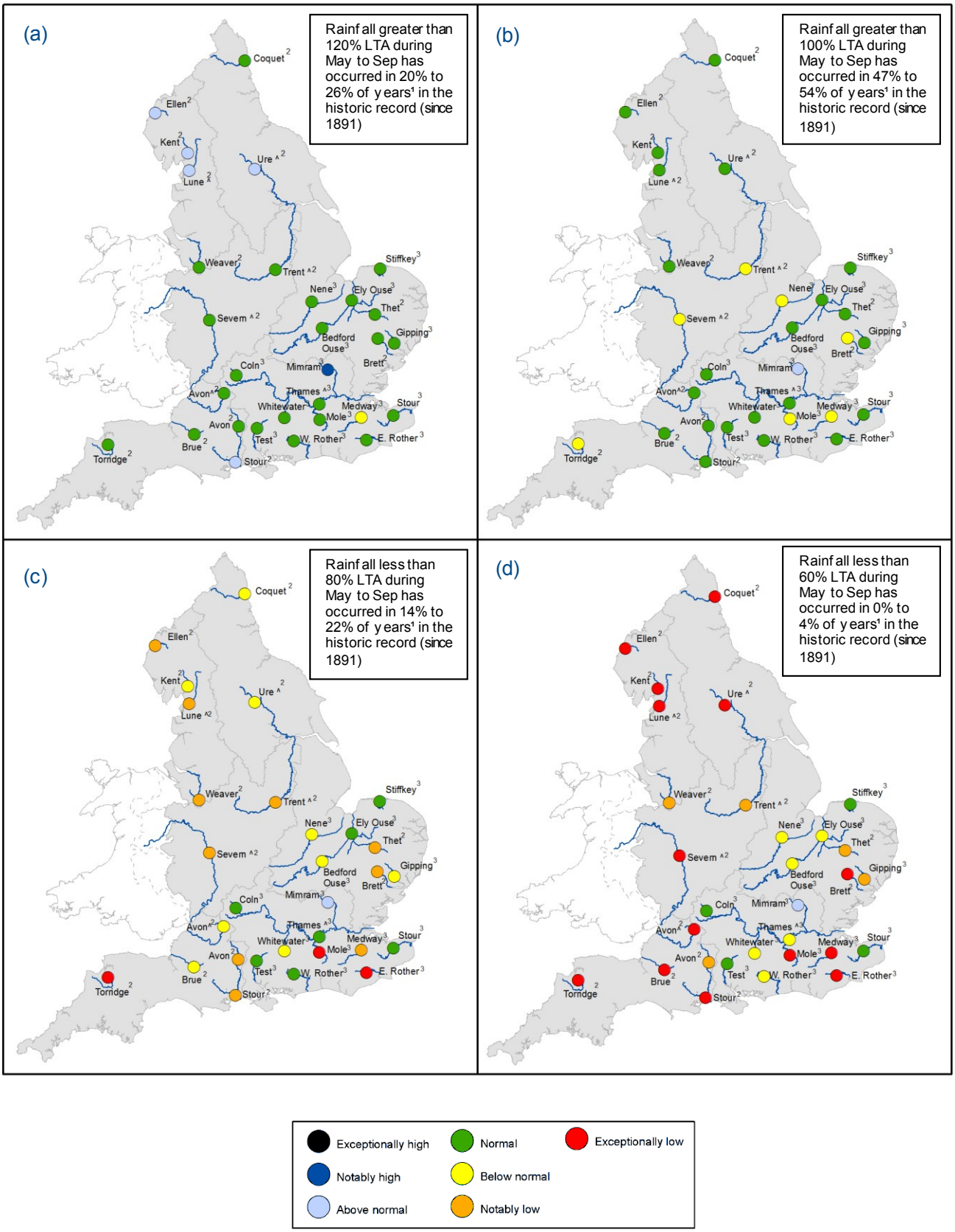
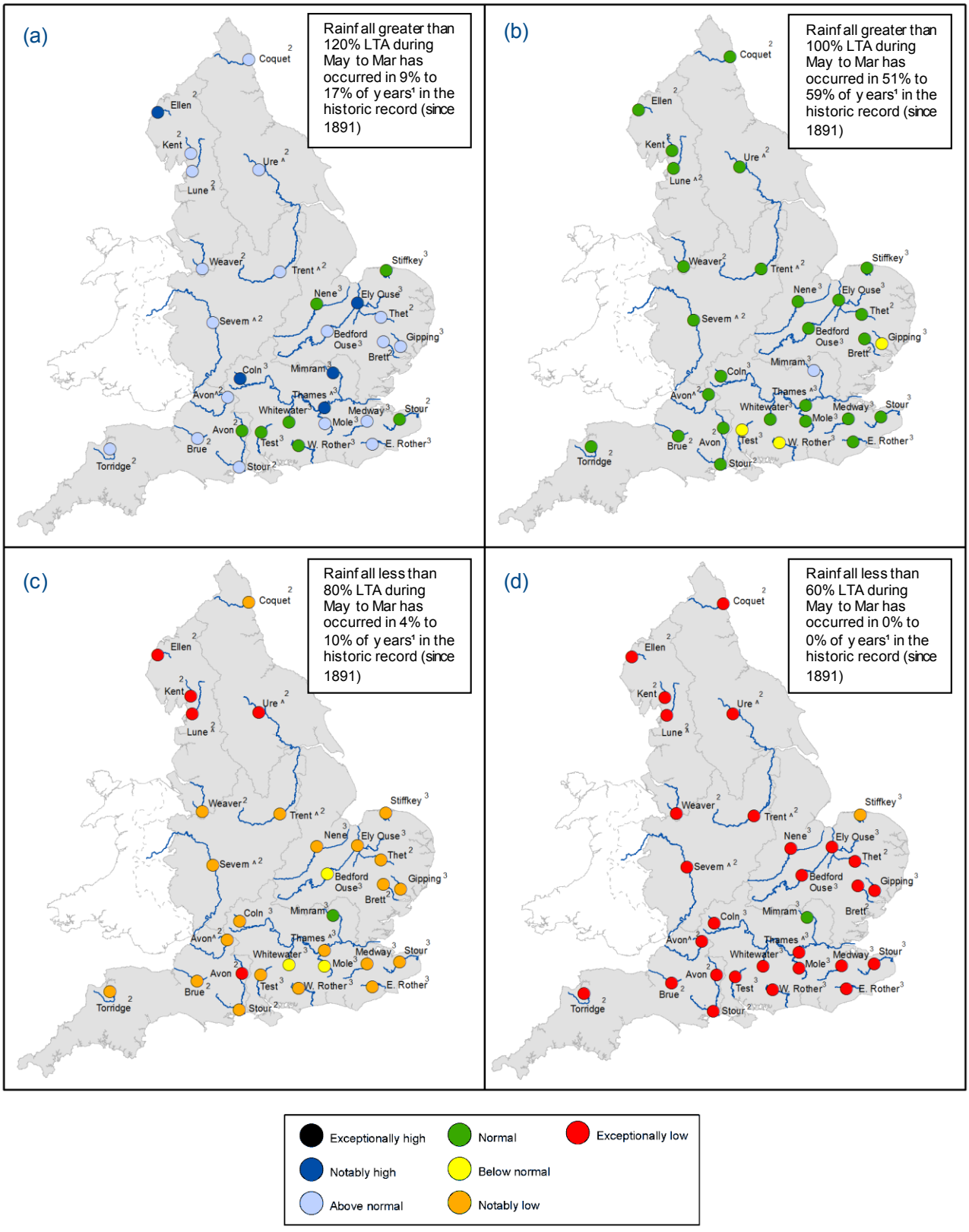


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2021 and September 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*



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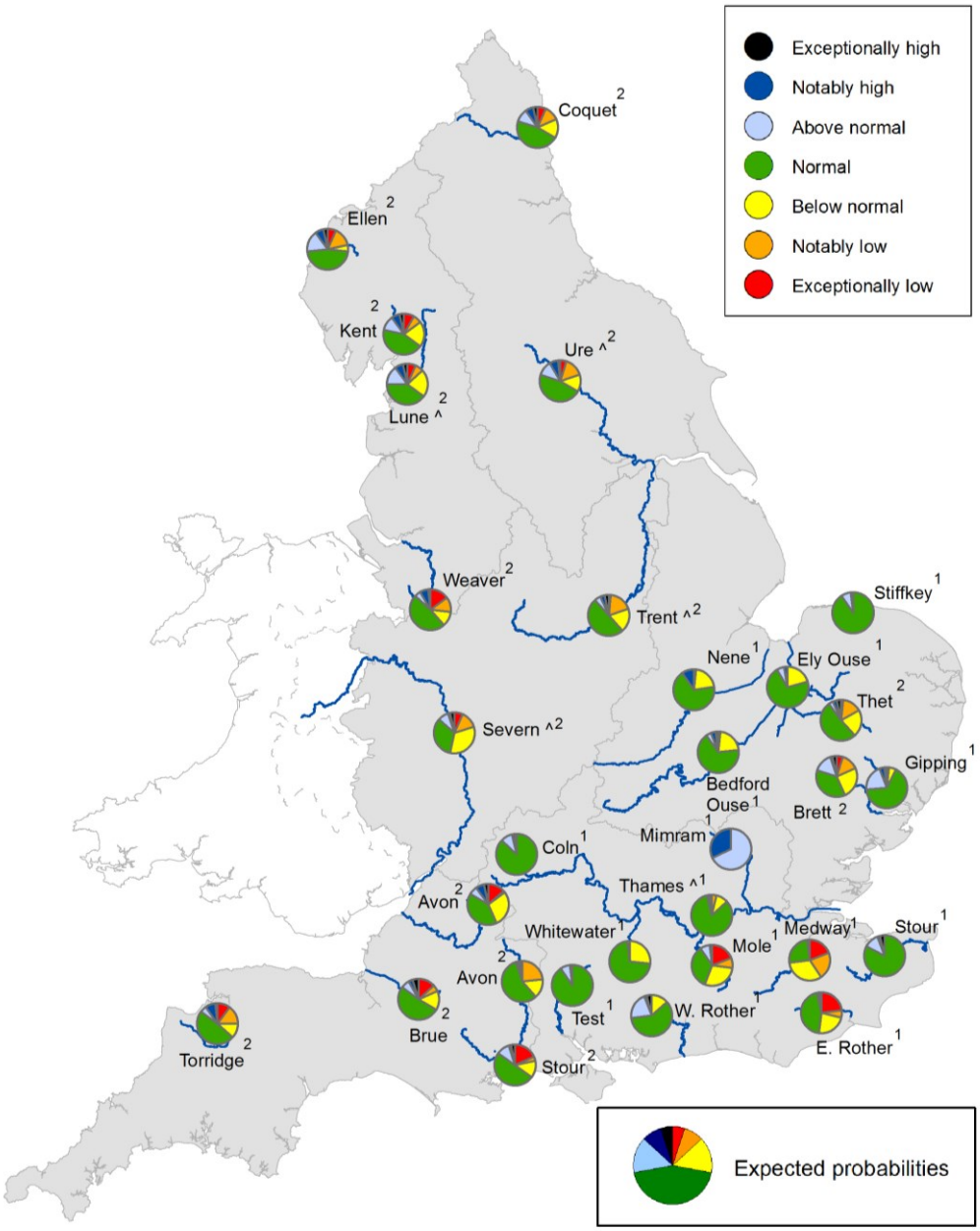

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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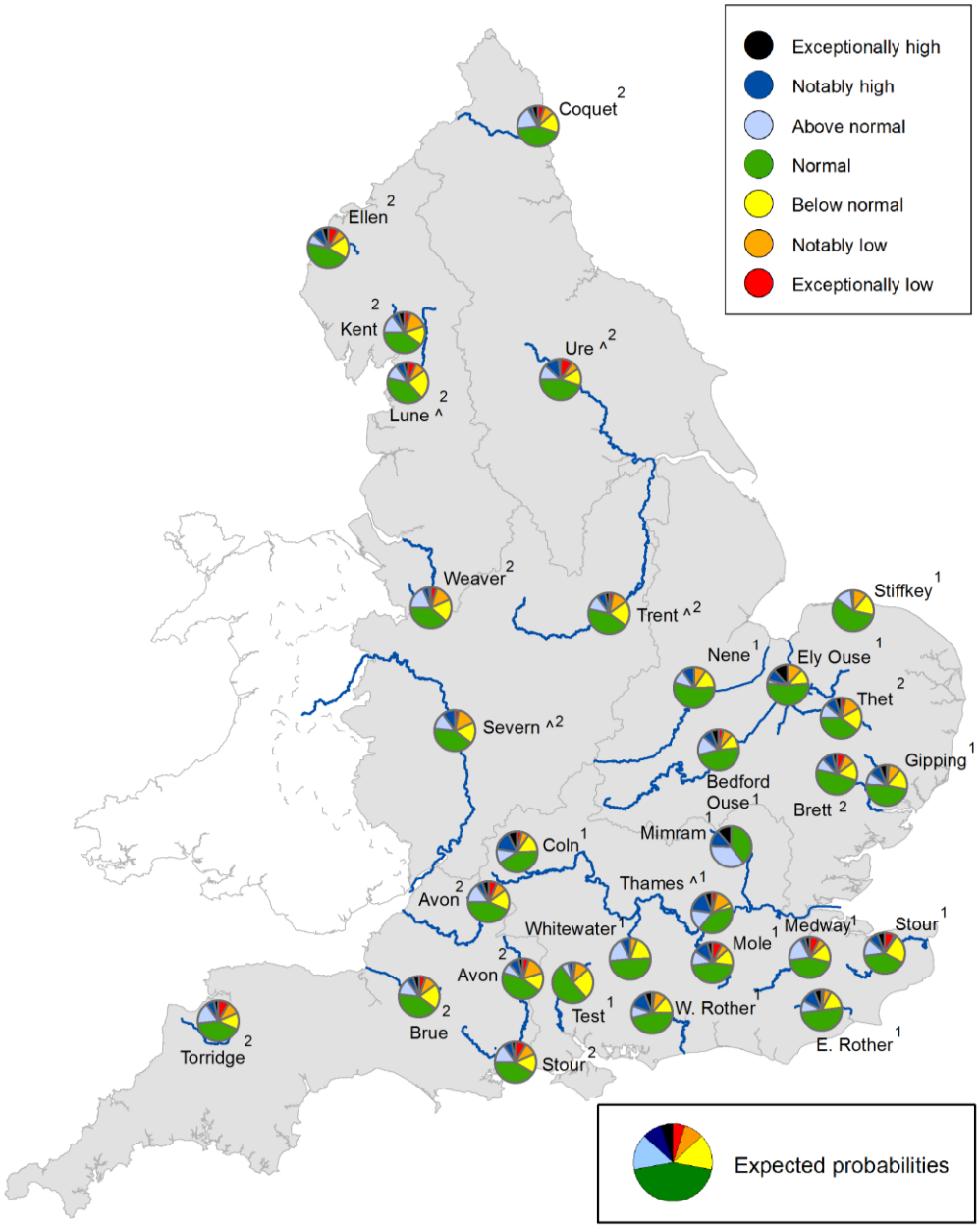

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2022. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the 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

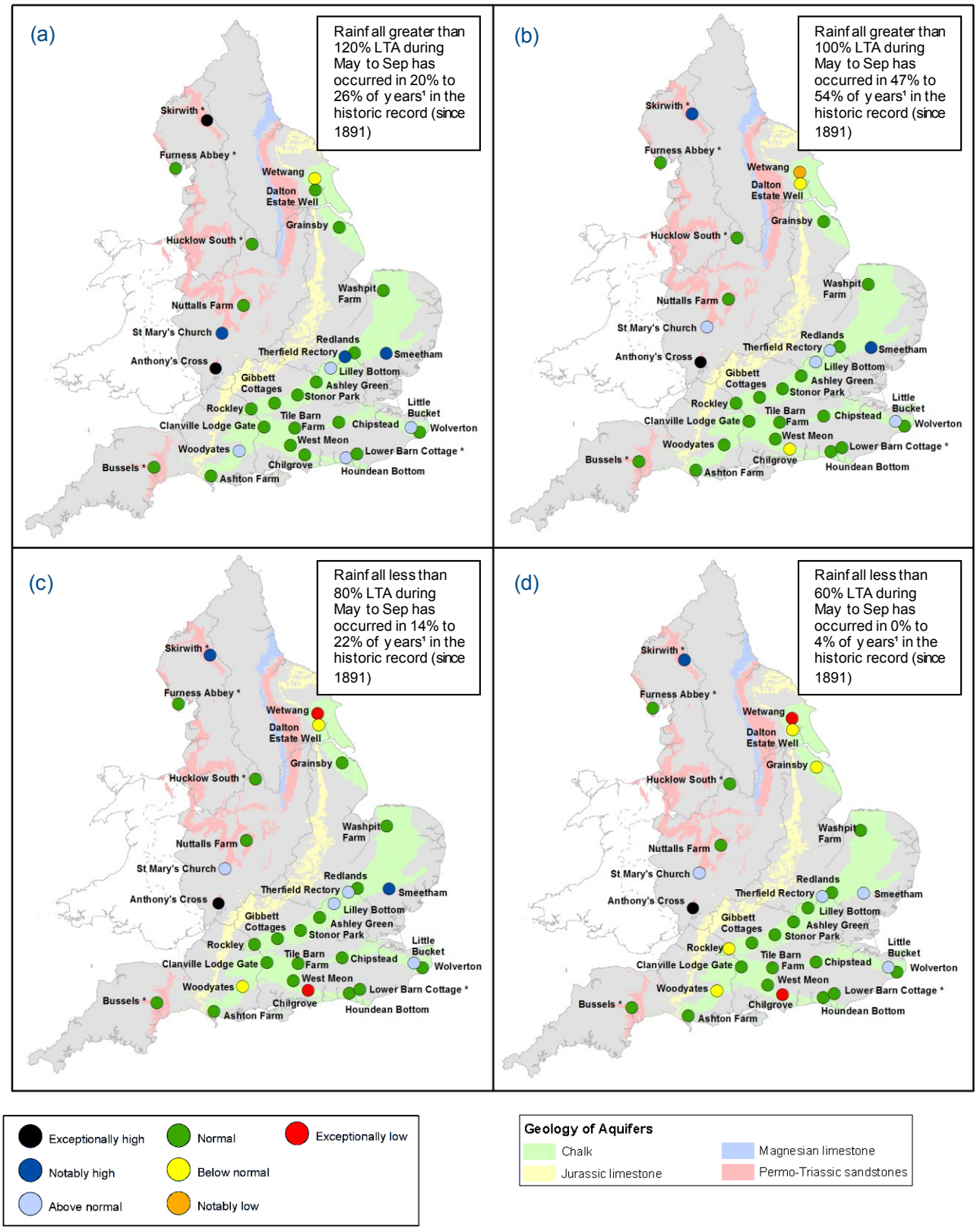

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2021 and September 2021 (Source: Environment Agency) Geological map reproduced with kind 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

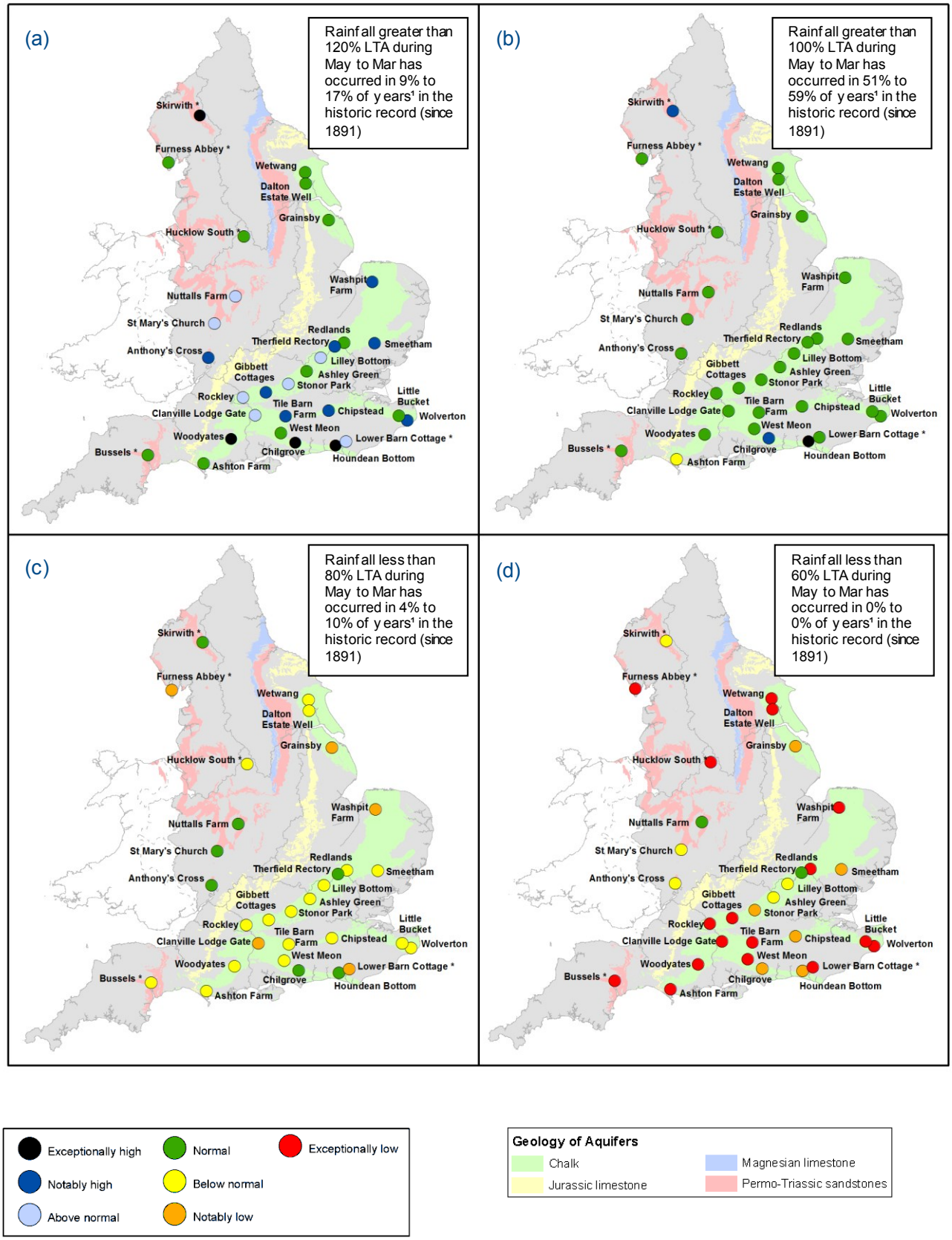

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission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

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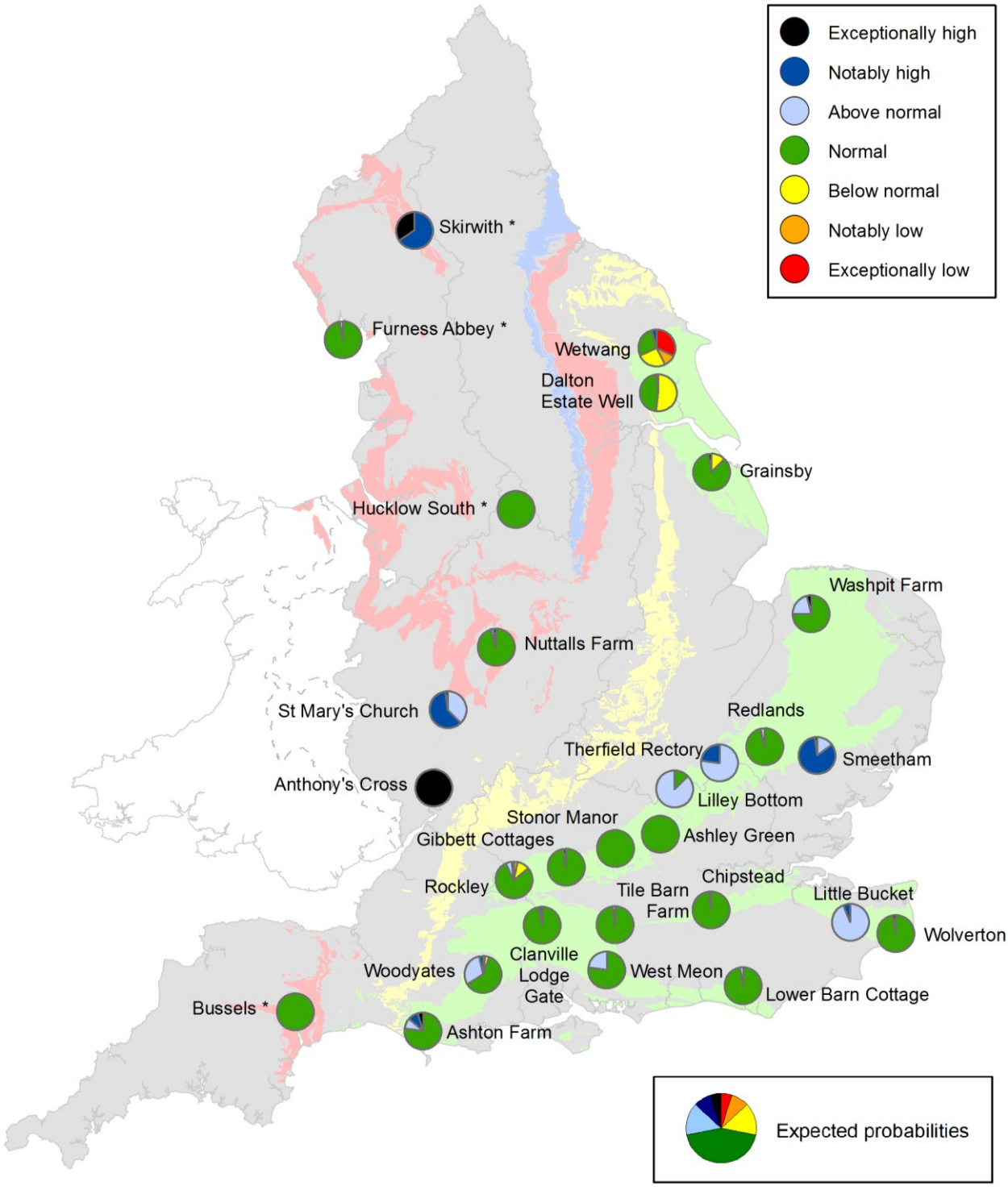

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

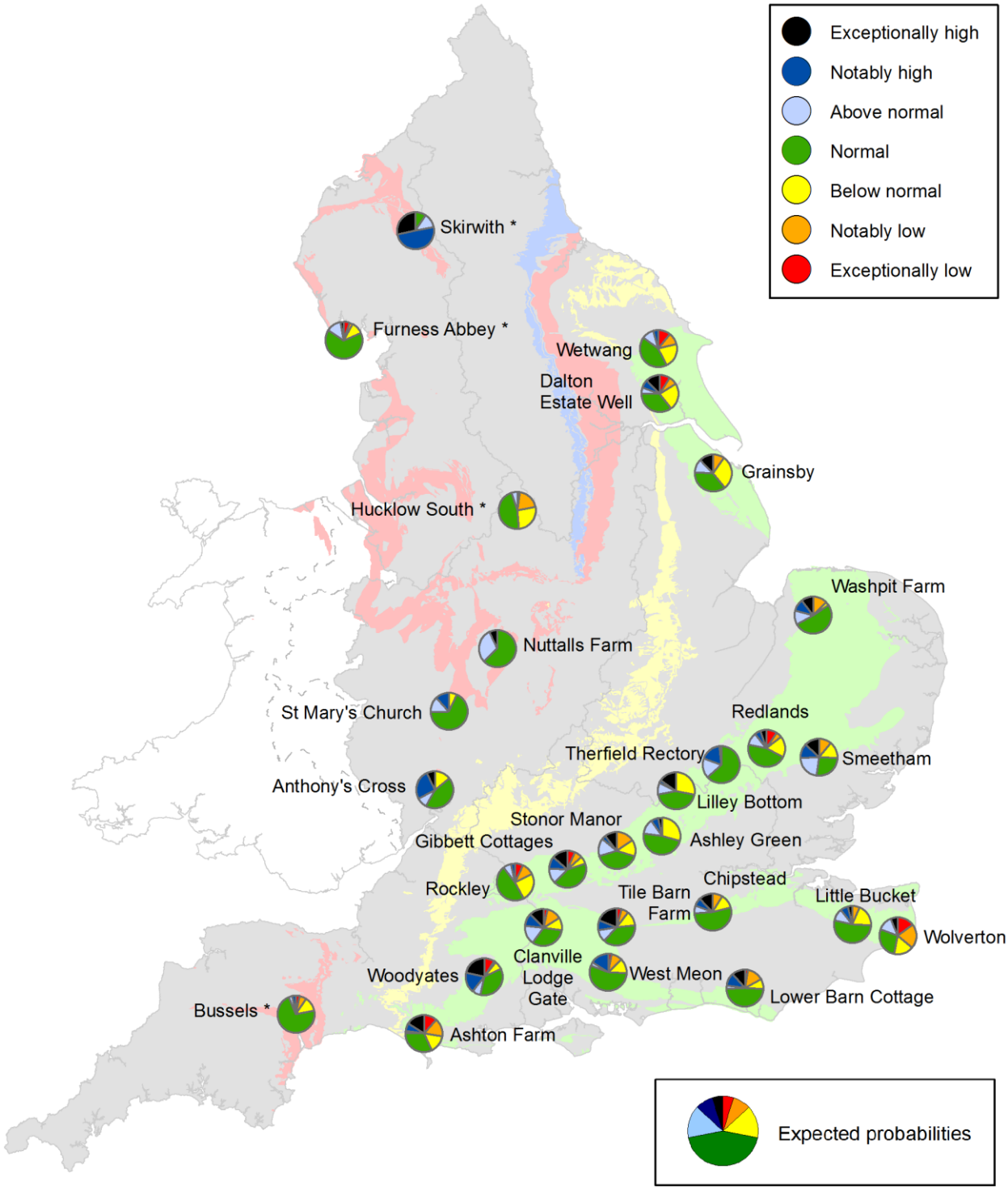

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2022. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the 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