Monthly water situation report

England

Summary – September 2021

Monthly rainfall totals were within the normal range for the time of year in most of the catchments across England. Soils got wetter during September across much of England. The six month period ending in September was the driest since 1995 and 1984 in the Derwent and Esk catchments (Cumbria/Scottish borders) respectively. The September monthly mean river flow at Heaton Mill on the River Till (Northumbria) was classed as exceptionally low for the time of year. Flows at all other reported sites in north-east and north-west were classed as either below normal or notably low for September. The end of September groundwater levels were classed as normal or higher for the time of year at nine-tenths of the indicator sites. Reservoir stocks decreased during September at almost all of the reservoirs and reservoir groups we report upon. End of the month reservoir stocks were classed as below normal or lower for the time of year at a third of reported reservoirs and reservoir groups.

Rainfall

The September rainfall total for England was 57mm, which represents 80% of the 1961-1990 long term average LTA (81% of the 1981-2010 LTA). The highest monthly rainfall totals were generally in western areas, with lower totals in eastern and central England (Figure 1.1).

Monthly rainfall totals were classed as normal for the time of year in most of the catchments across England. Below normal rainfall totals were recorded in parts of northern England and in some coastal catchments in Norfolk, Suffolk, Kent and East Sussex. The lowest rainfall total as a proportion of the LTA was over Romney Marsh in Kent, with 21mm of rainfall representing only 35% of the September LTA. The highest rainfall total as a proportion of the LTA was over the River Cam catchment in Cambridgeshire, with 72mm of rainfall representing 150% of the LTA. The 6 month cumulative rainfall totals were classed as normal for the majority of the country but as exceptionally low in 3 catchments in north Cumbria. The Derwent and Esk catchments (Cumbria/Scottish border) were the 3rd and 2nd driest on record (records since 1891) and the driest since 1995 and 1984 respectively. The 12 month cumulative rainfall totals were classed as normal or higher in all catchments across England, except for the River Esk catchment on the Scottish border. Here the cumulative rainfall totals were classed as notably low (Figure 1.2).

At a regional scale, September rainfall totals ranged from 68% of the LTA in north-east England to 94% of the LTA in central England. All regional rainfall totals for September were within the normal range for the time of year (Figure 1.3).

Soil moisture deficit

Across much of England soils got wetter during September (soil moisture deficit decreased). End of September soil moisture deficit (SMD) values were close to or smaller than the LTA for the time of year (soils were wetter than average) across south-east England, south-west England and parts of central England. Soil moisture deficit values were greater than the LTA across parts of the rest of the country (soils were drier than average for the time of year) at the end of the month (Figure 2.1).

At a regional scale, the end of September SMD values meant that soils were wetter than average for the time of year in south-west and south-east England, and close to average or drier than average in all other regions (Figure 2.2).

River flows

September monthly mean river flows decreased at over four-fifths of the indicator sites we report on, compared to August. Flows at all of the reported sites in north-east and north-west England were classed as either below normal or notably low for the time of year. The only exception was at Heaton Mill on the River Till (Northumbria) where the monthly mean flow was classed as exceptionally low at 36% of the LTA. By contrast, monthly mean flows at almost all of the indicator sites we report on in south-east, south-west and east England were classed as

above normal or higher. At Allbrook and Highbridge on the River Itchen (Hampshire) the flow was classed as exceptionally high at 137% of the LTA (Figure 3.1).

At the regional index sites monthly mean flows ranged from being classed as notably low on the River Lune at Caton (north-west England), and below normal on the South Tyne at Haydon Bridge (north-east England), to normal at all other regional indicator sites (Figure 3.2).

Groundwater levels

Groundwater levels were in recession at nine-tenths of the reported indicator sites during September. At most indicator sites, the end of September groundwater levels were classed as normal or higher for the time of year. The exceptions were in the Burford Jurassic limestone aquifer at Jackaments Bottom and in the Fylde and Preston sandstone at Crow Lady Farm, where groundwater levels were classed as below normal at the end of the month (Figure 4.1).

At Priors Heyes (West Cheshire sandstone) and Weir Farm (Bridgnorth sandstone) the highest end of September levels on record were recorded (records go back to 1972 and 1983 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction (Figure 4.1).

End of September groundwater levels at the major aquifer index sites ranged from being classed as exceptionally high at Weir Farm (central England) to below normal in the Jurassic limestone at Jackaments Bottom (south-east England) (Figure 4.2).

Reservoir storage

End of September reservoir stocks decreased compared with the end of August at almost all of the reservoirs and reservoir groups we report upon. Reductions of over 10% of total capacity were recorded at over a third of these, with the biggest reduction seen at Ardingly Reservoir in south-east England (-21% of capacity). End of month reservoir stocks were classed as notably low at 4 reservoirs or reservoirs groups. Stocks in the Teesdale group of reservoirs (north-east England) fell from 53% of capacity at the end of August to 41% of capacity at the end of September, which was classed as exceptionally low for the time of year, stocks here have been drawn down for planned maintenance and safety inspections (Figure 5.1).

At a regional scale, total reservoir stocks ranged from 54% in north-west England to 79% in south-east England. Total reservoir stocks for north-east, north-west, central and south-west England were below the LTA for the time of year. Total reservoir stocks for England were at 67% of total capacity at the end of September (Figure 5.2)

Forward look

It was a wet start to October, with most parts of England seeing large rainfall totals in the first few days of the month. The wet conditions are set to continue for north-west England into the second week of October, with cloudy conditions elsewhere and a chance of light rain. Southern and central England are likely to see some drier, brighter weather once early morning fog and patchy rain clears. The middle of the month is expected to be largely unsettled in northern England to begin with, whereas southern England will remain largely dry with sunny spells. A spell of high pressure and dry conditions for most of England is then expected to dominate for a while, before a change back to unsettled weather during the latter part of October, with the wettest weather expected in the north and north-west of England.

For the 3 month period October to December, there is a slightly higher than normal chance that the period will be wet, and it is significantly more likely than normal to be mild[1].

Projections for river flows at key sites[2]

By the end of March 2022, 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, and around half of 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 2022, half 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 March 2022 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2022 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2022 see Figure 6.3

1 Source: Met Office
2 Information produced by the Hydrological Outlook a partnership between UK Centre for Ecology and Hydrology, British Geological Survey, Met Office, Environment Agency and other devolved agencies.

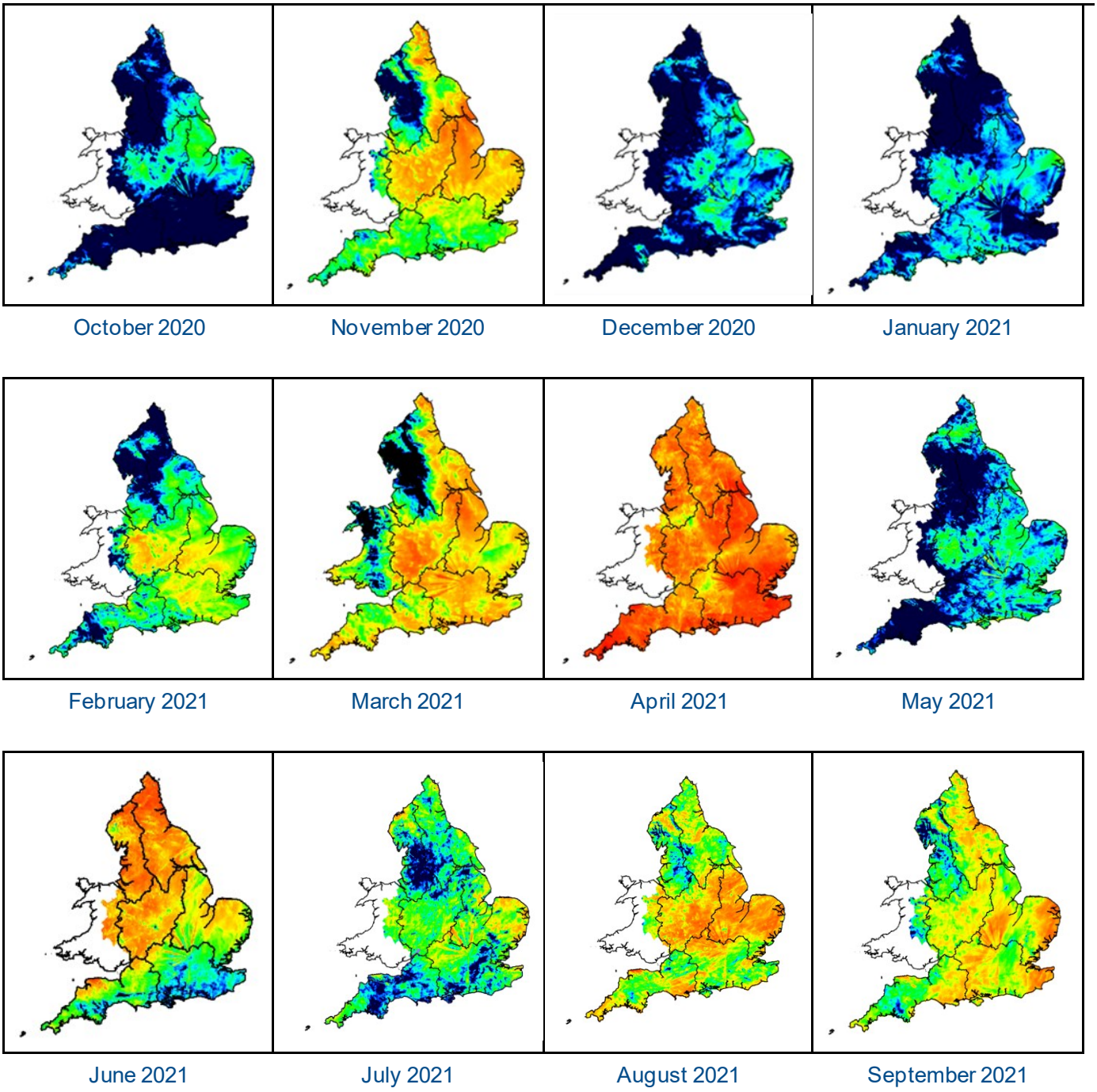
For probabilistic ensemble projections of cumulative river flows at key sites by September 2022 see Figure 6.4

Projections for groundwater levels in key aquifers[2]
By the end of March 2022, three-quarters of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year, and a quarter have a greater than expected chance of groundwater levels being below normal or lower. By the end of September 2022, a third 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 March 2022 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2022 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2022 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2022 see Figure 6.8

Authors: National Water Resources Hydrology Team

Rainfall



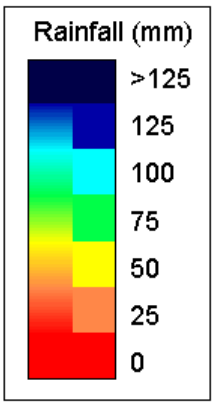


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

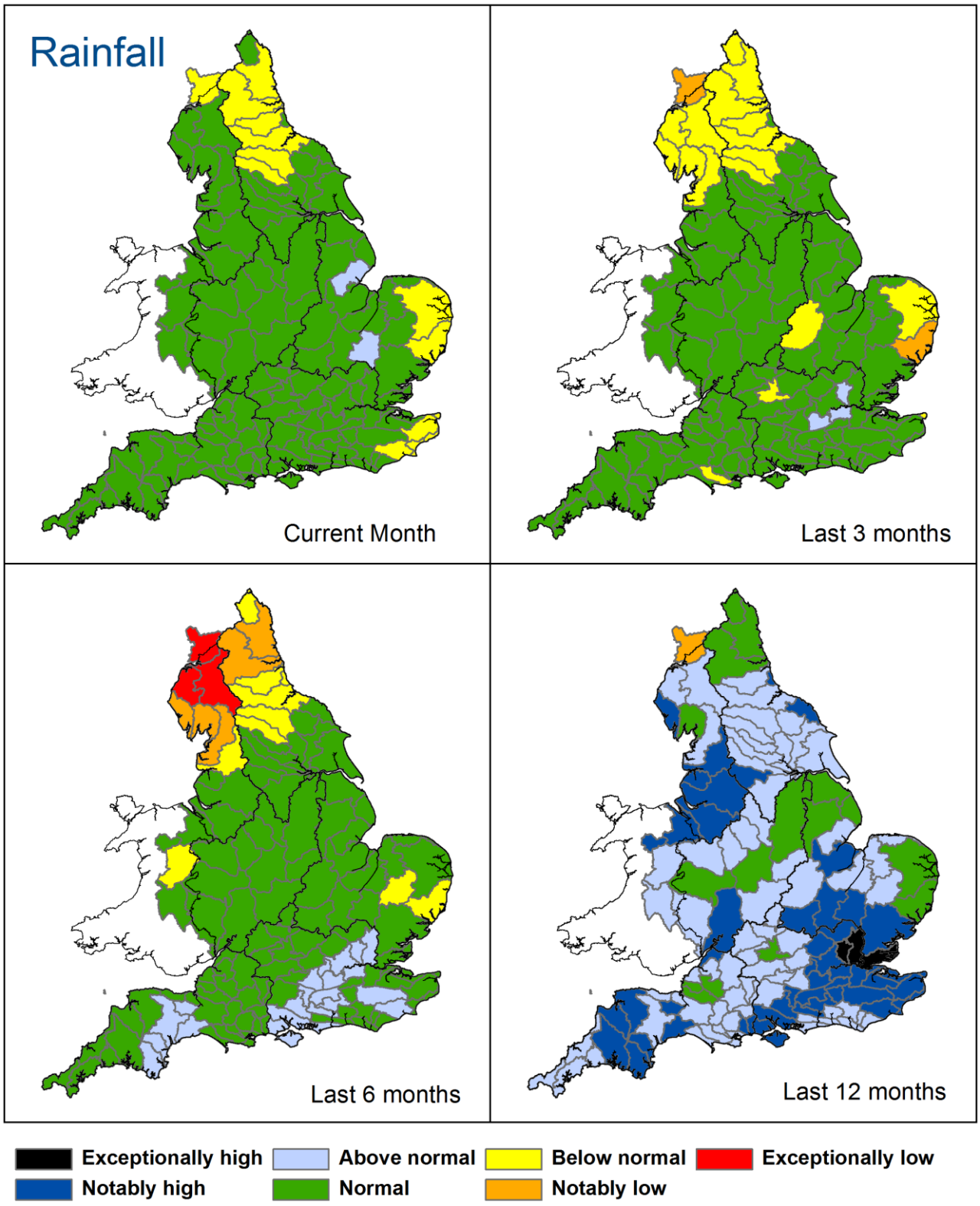


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 September), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived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

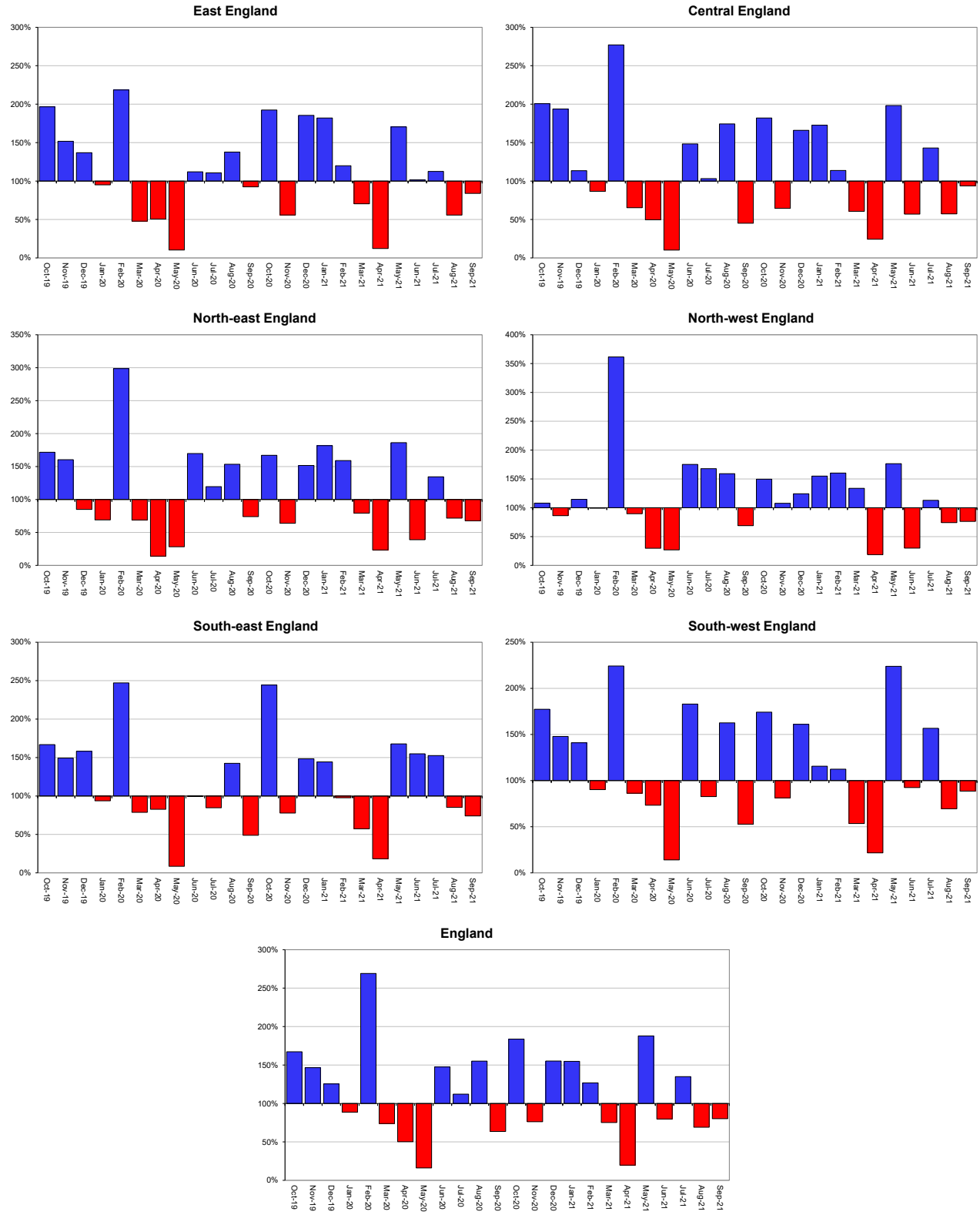


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

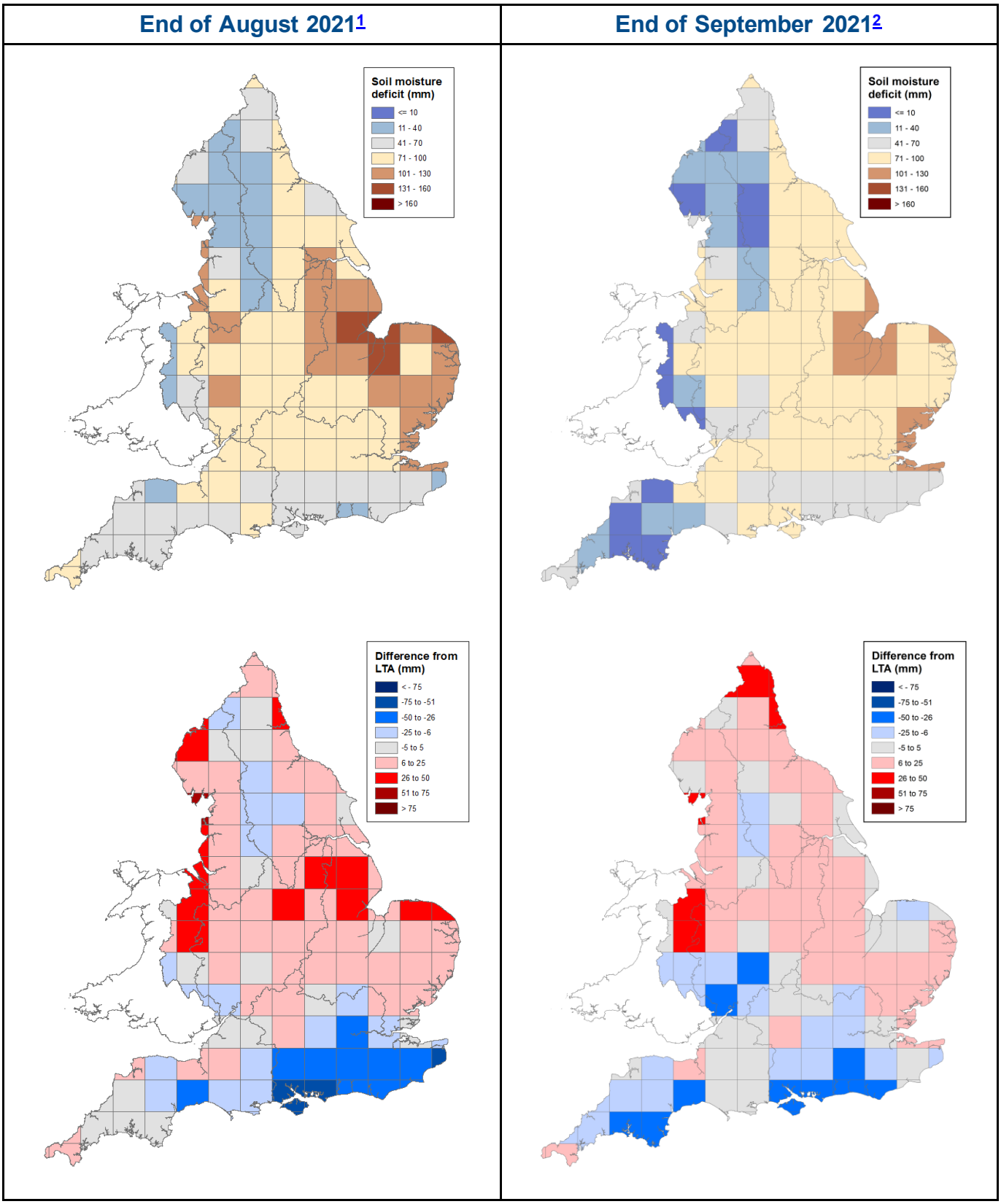


Figure 2.1: Soil moisture deficits for weeks ending 31 August 2021[1] (left panel) and 28 September 2021[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2021). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021

Soil moisture deficit charts

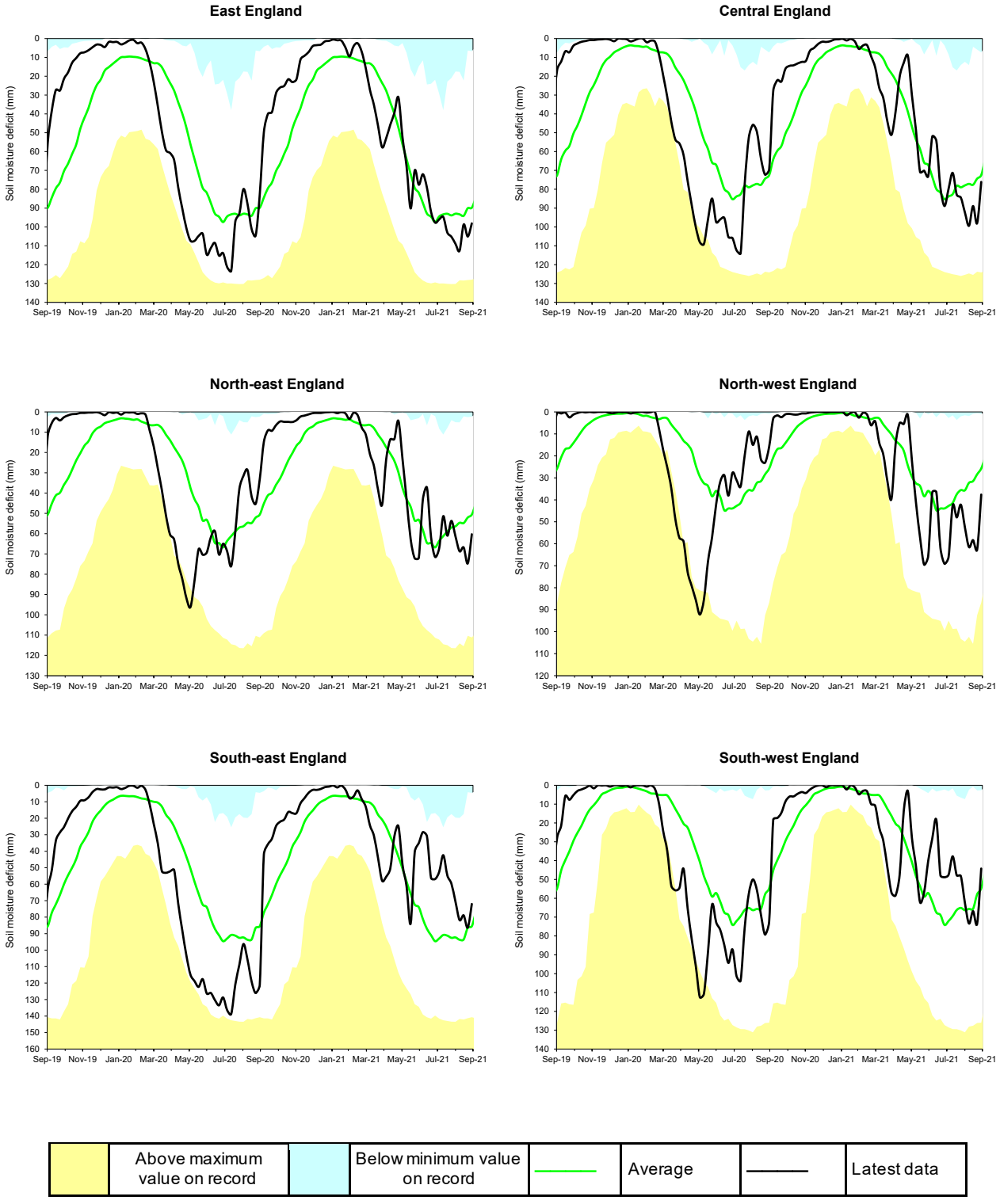
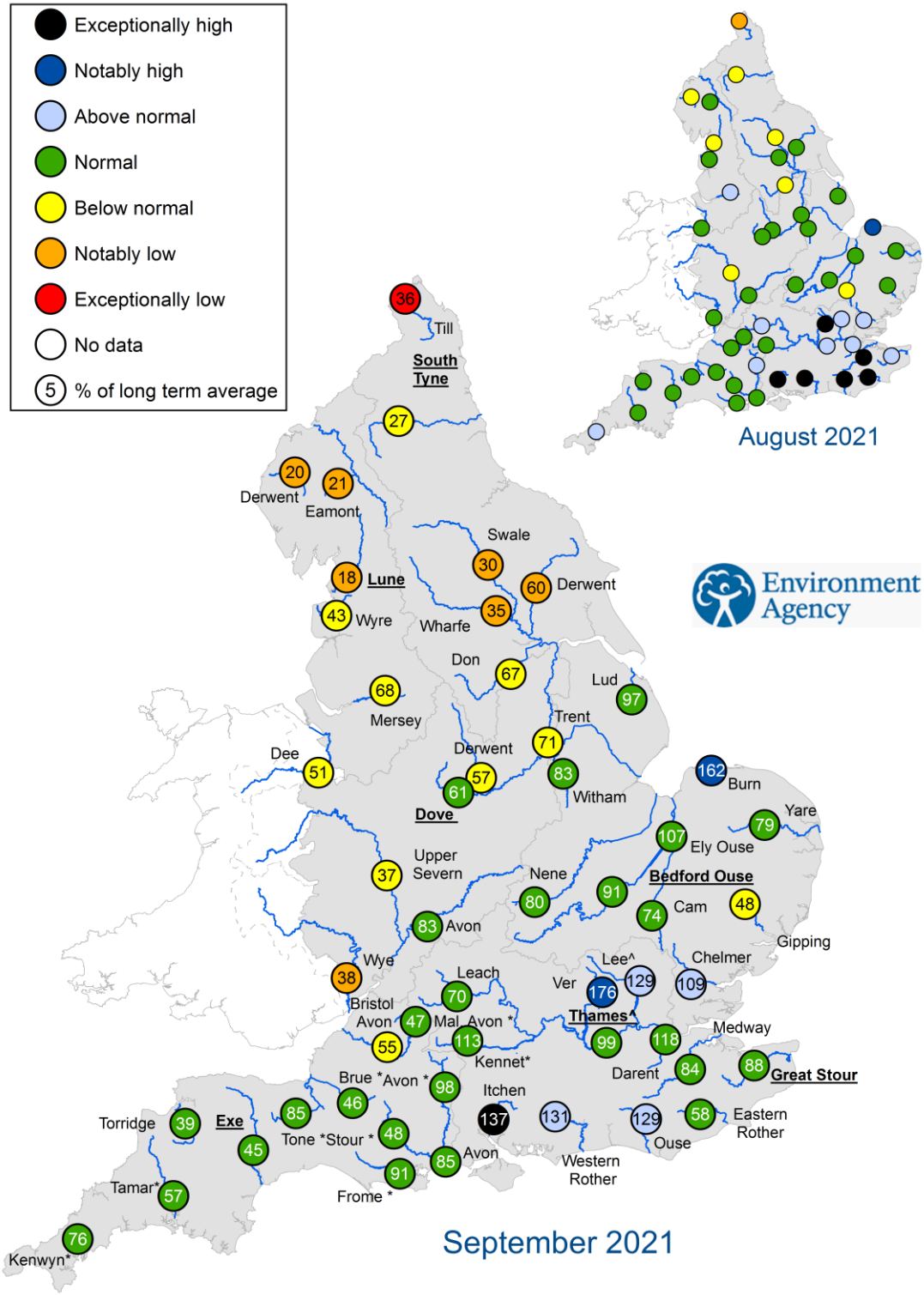


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

River flows



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

* Flows may be overestimated at these sites the data should be treated with caution

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

River flow charts

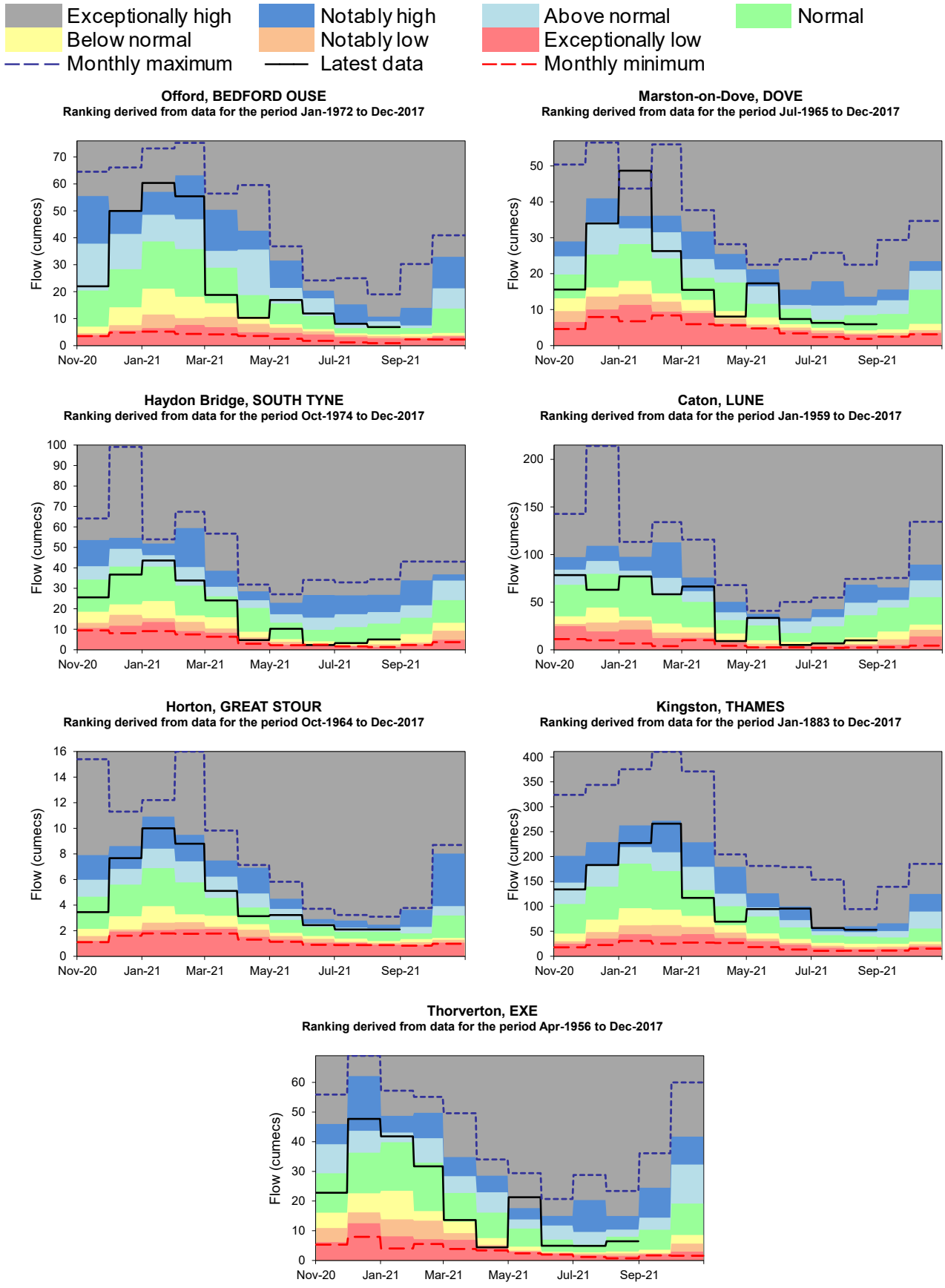
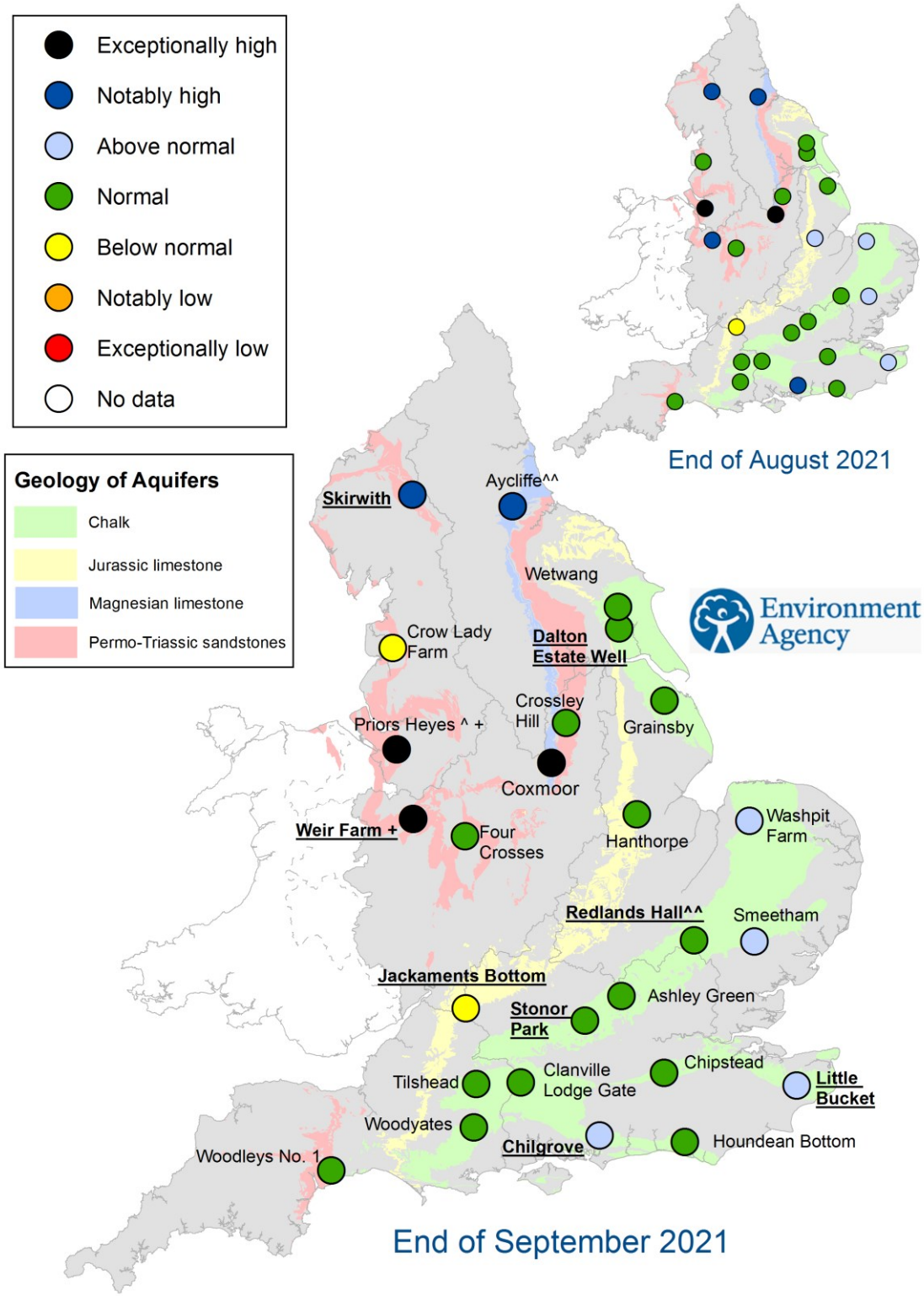


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 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 August 2021 and September 2021, classed relative to an analysis of respective historic August and September 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

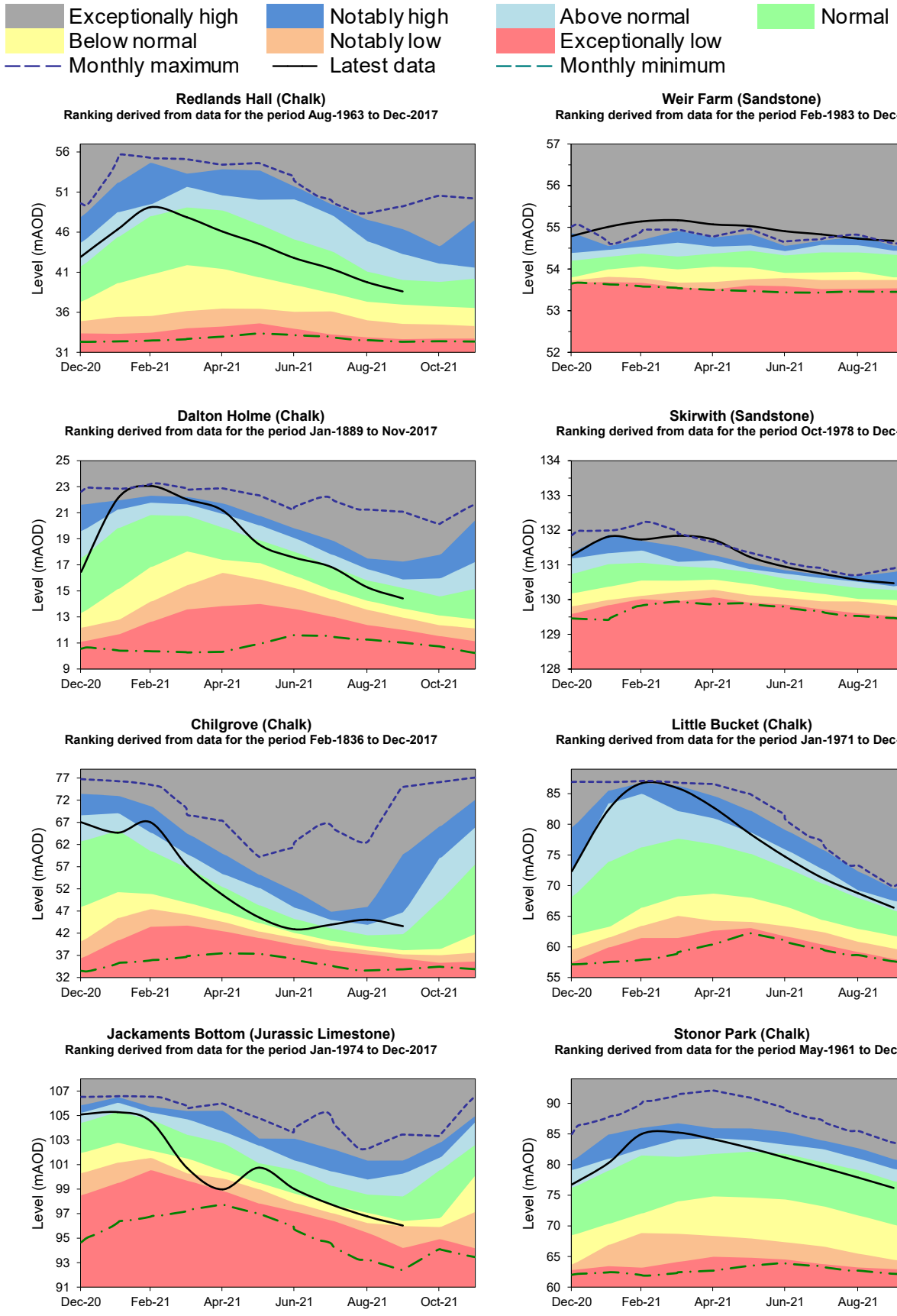
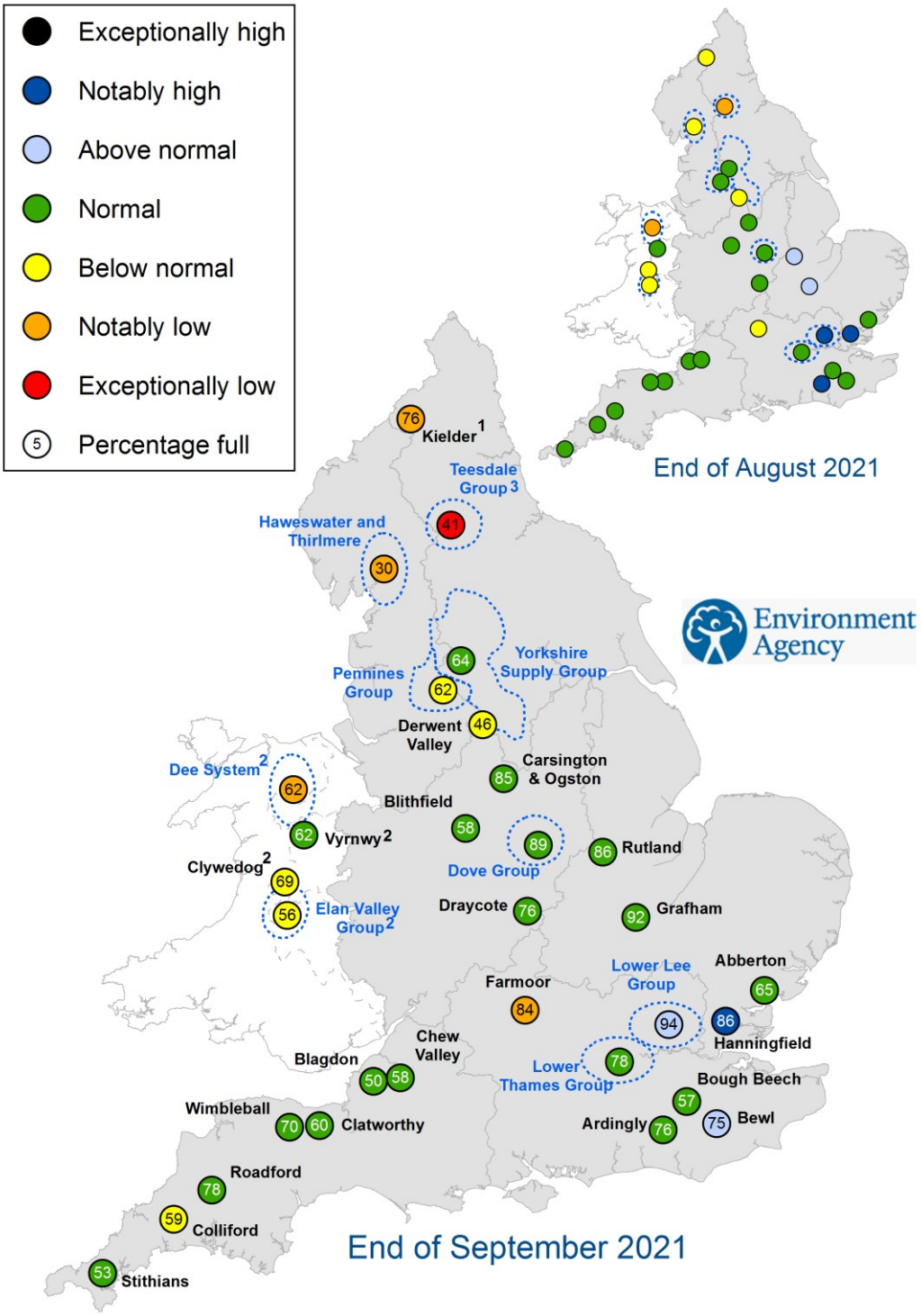


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

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
3. Current levels in the Teesdale group have been drawn down for maintenance and safety inspections

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of August 2021 and September 2021 as a percentage of total capacity and classed relative to an analysis of historic August and September 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

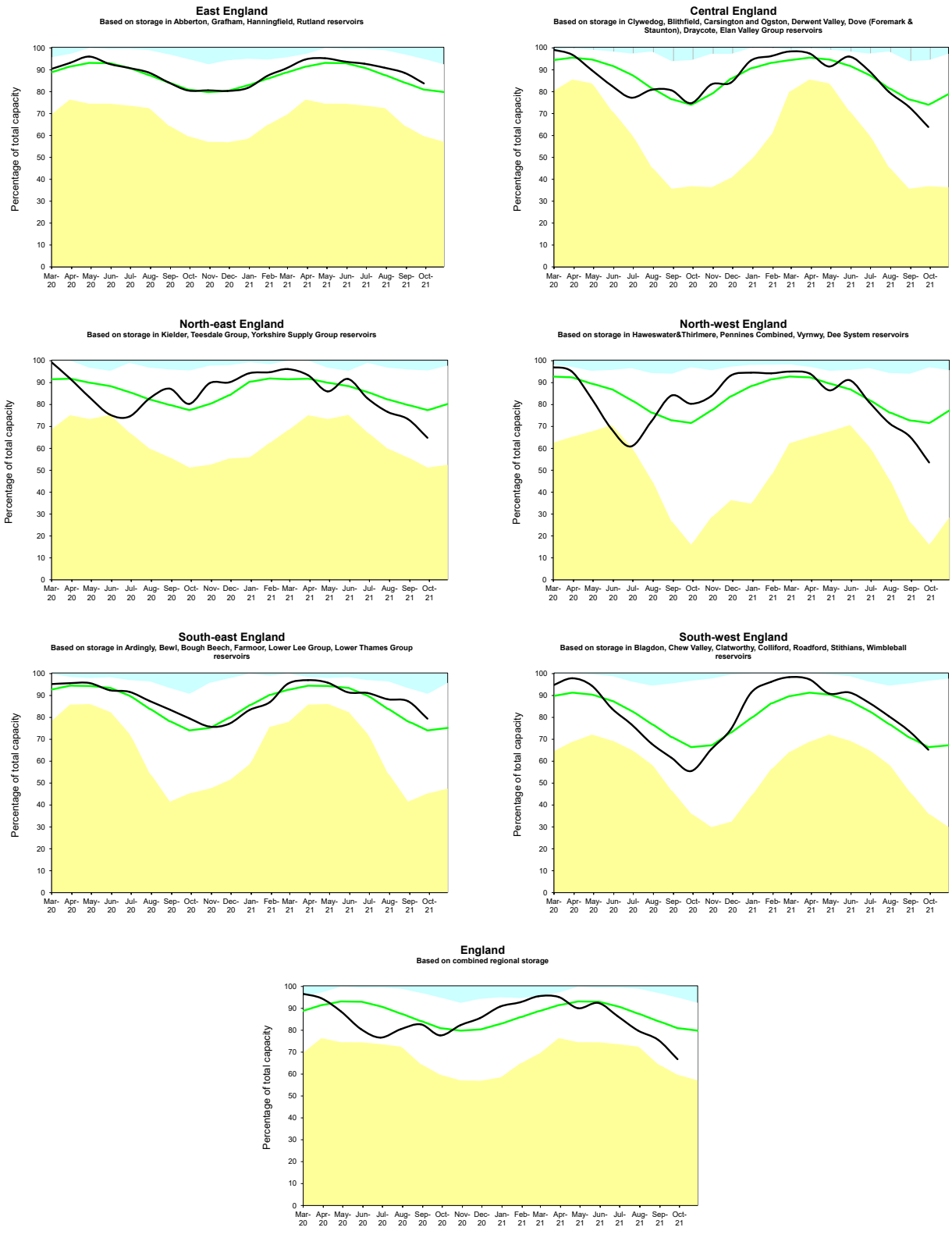


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

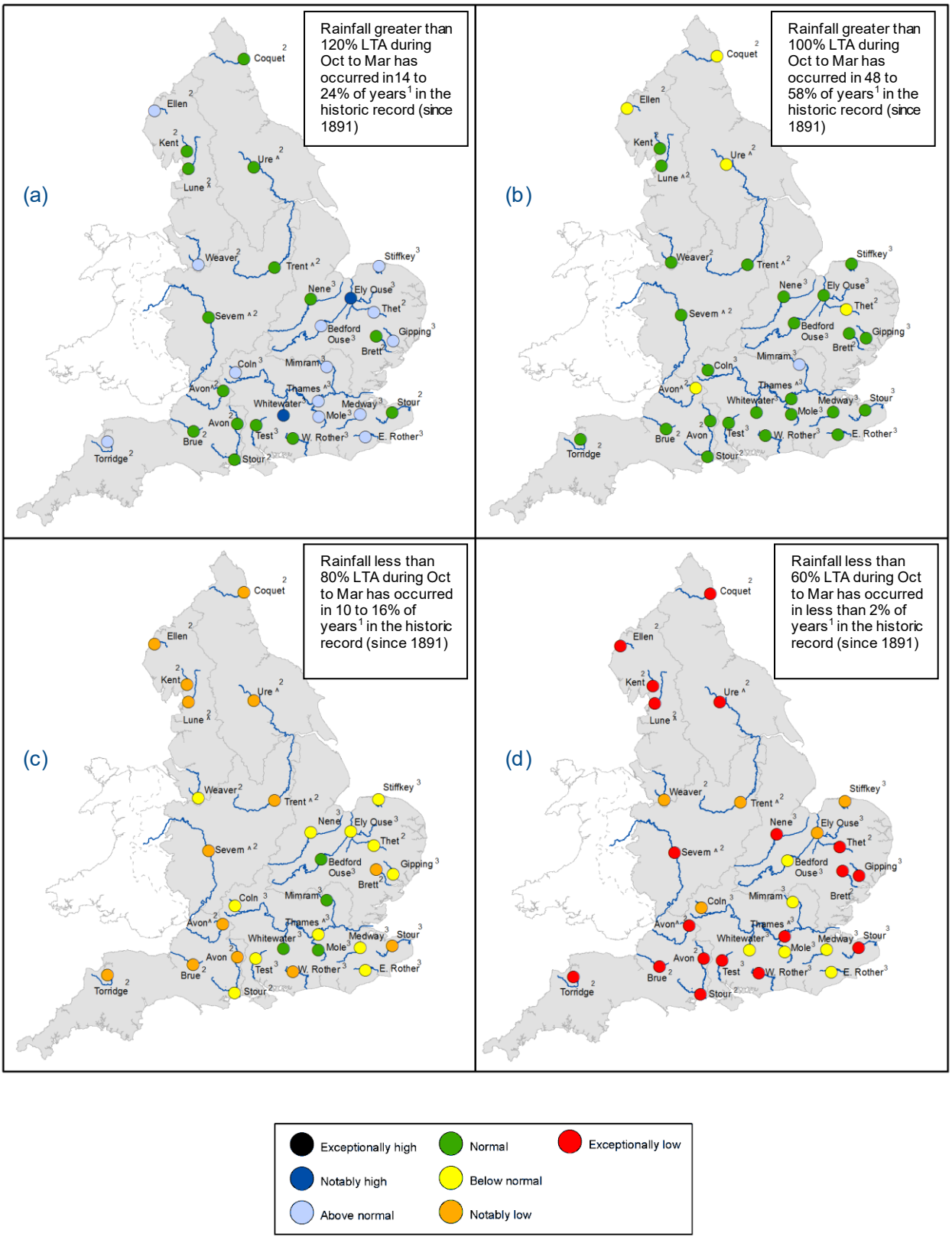
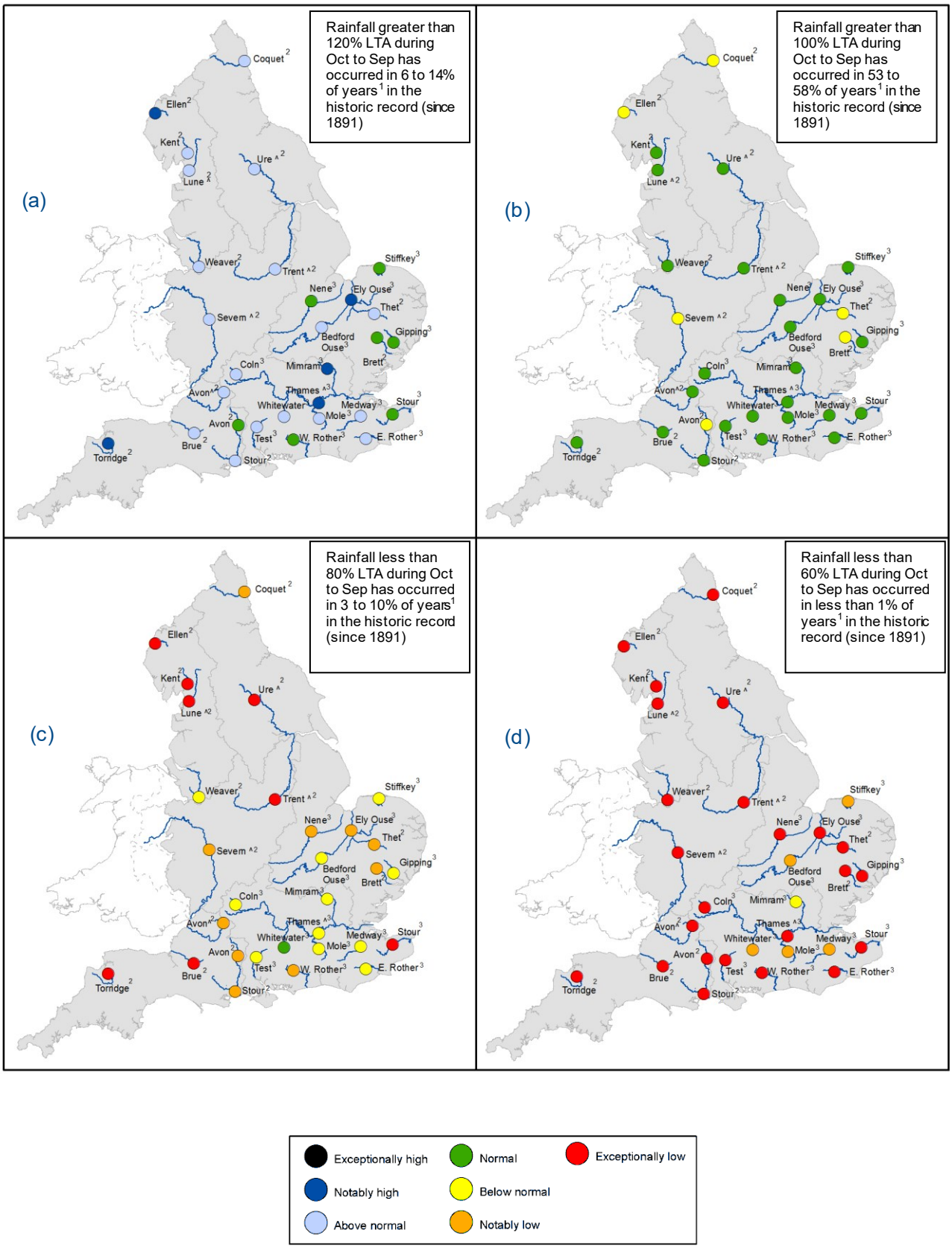


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2021 and March 2022 (Source: UK Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by UKCEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*



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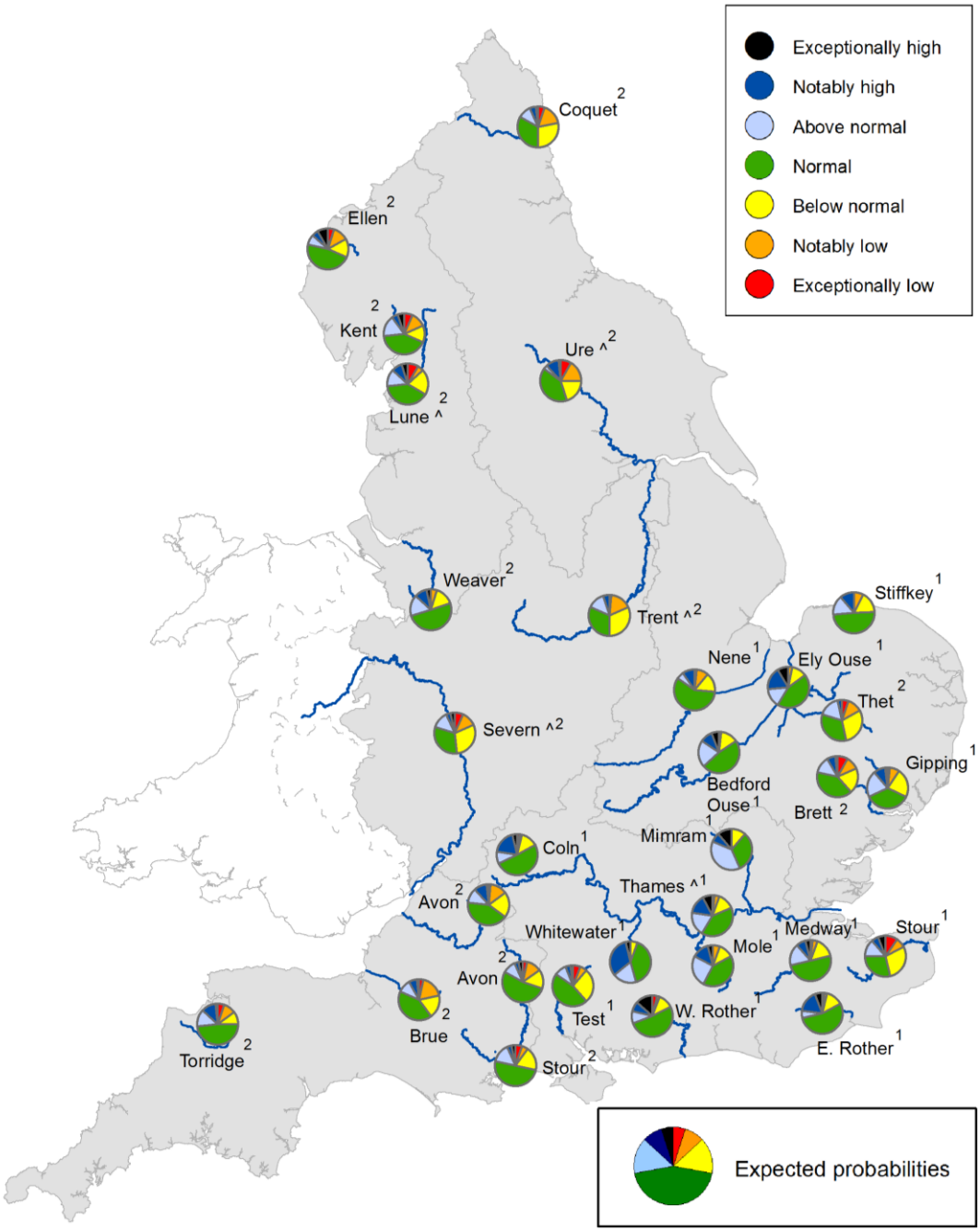

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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: UK Centre for Ecology and Hydrology, Environment Agency).

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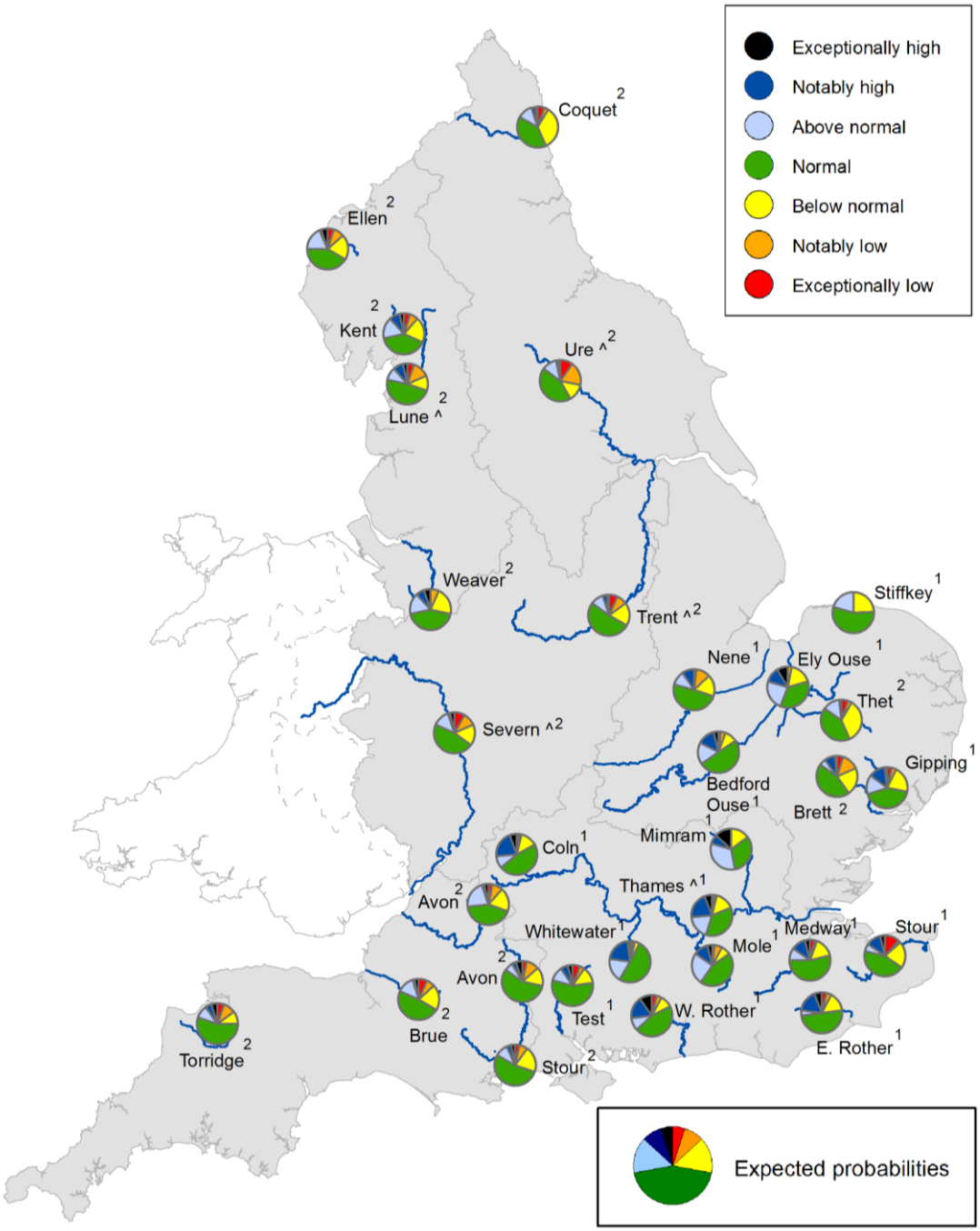

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2022. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: UK Centre for Ecology and Hydrology, Environment Agency).

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[2] Projections for these sites are produced by UKCEH
^"Naturalised" flows are projected for these sites

Forward look: groundwater

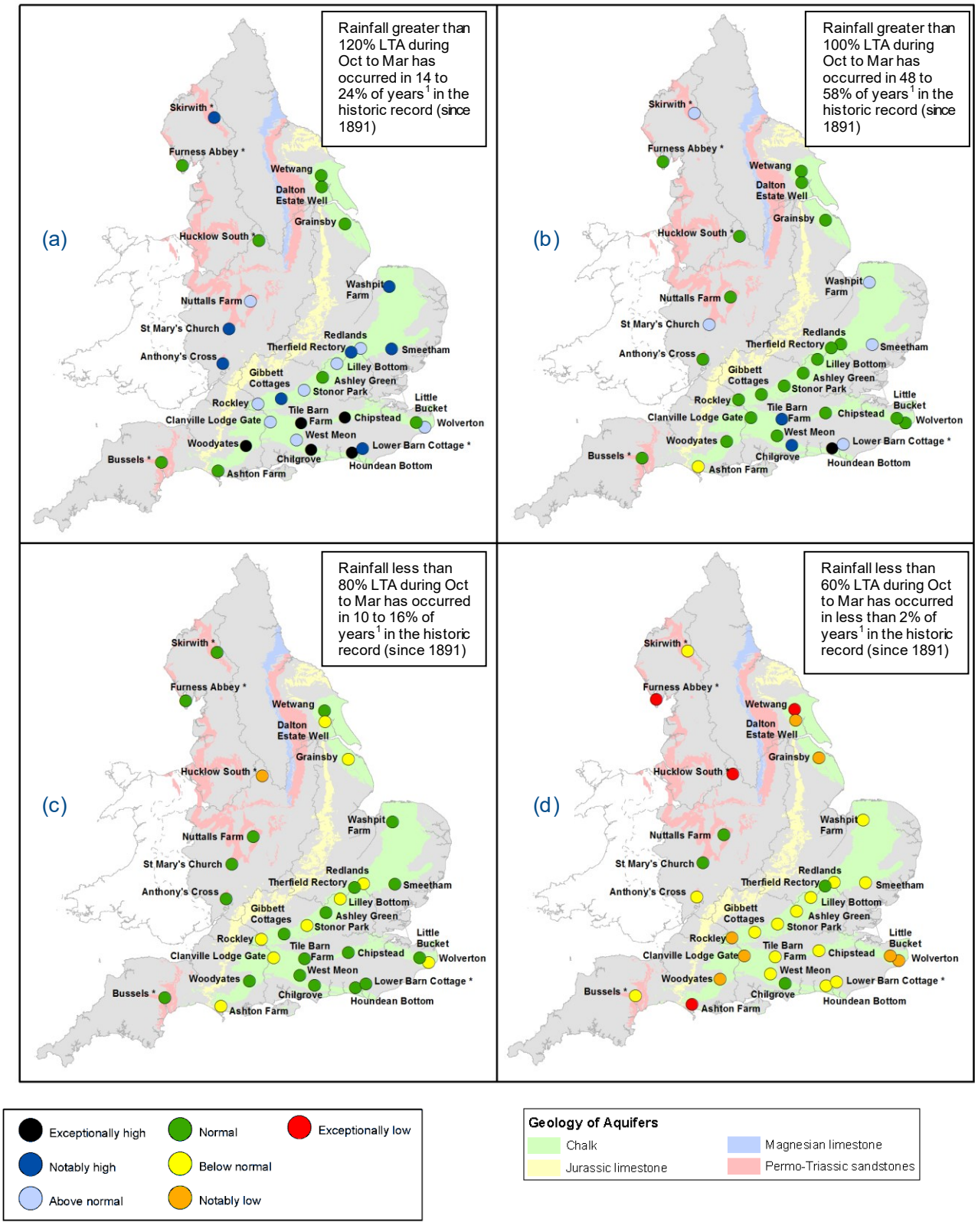

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2021.

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

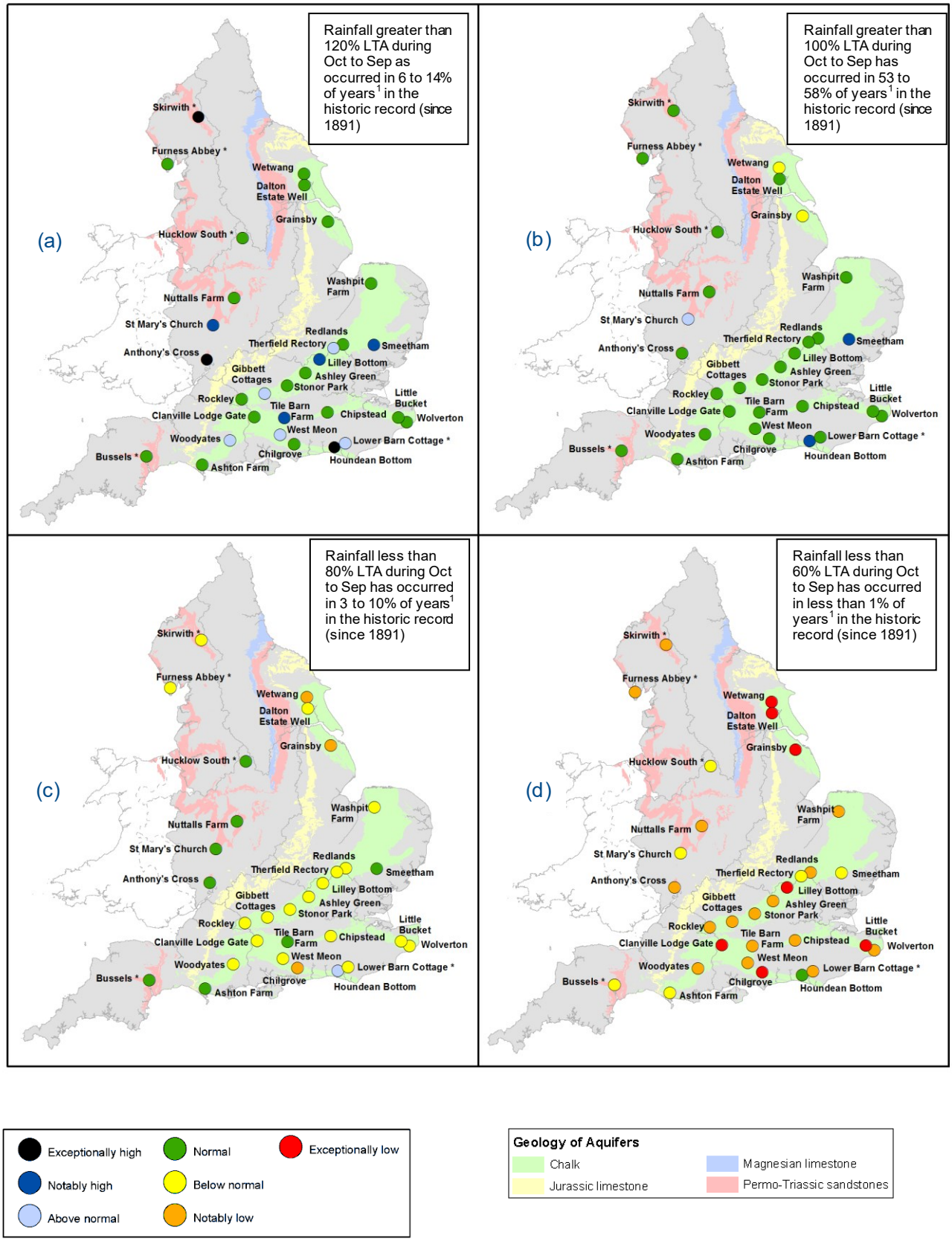

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2021 and September 2022 (Source: Environment Agency) Geological map reproduced with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

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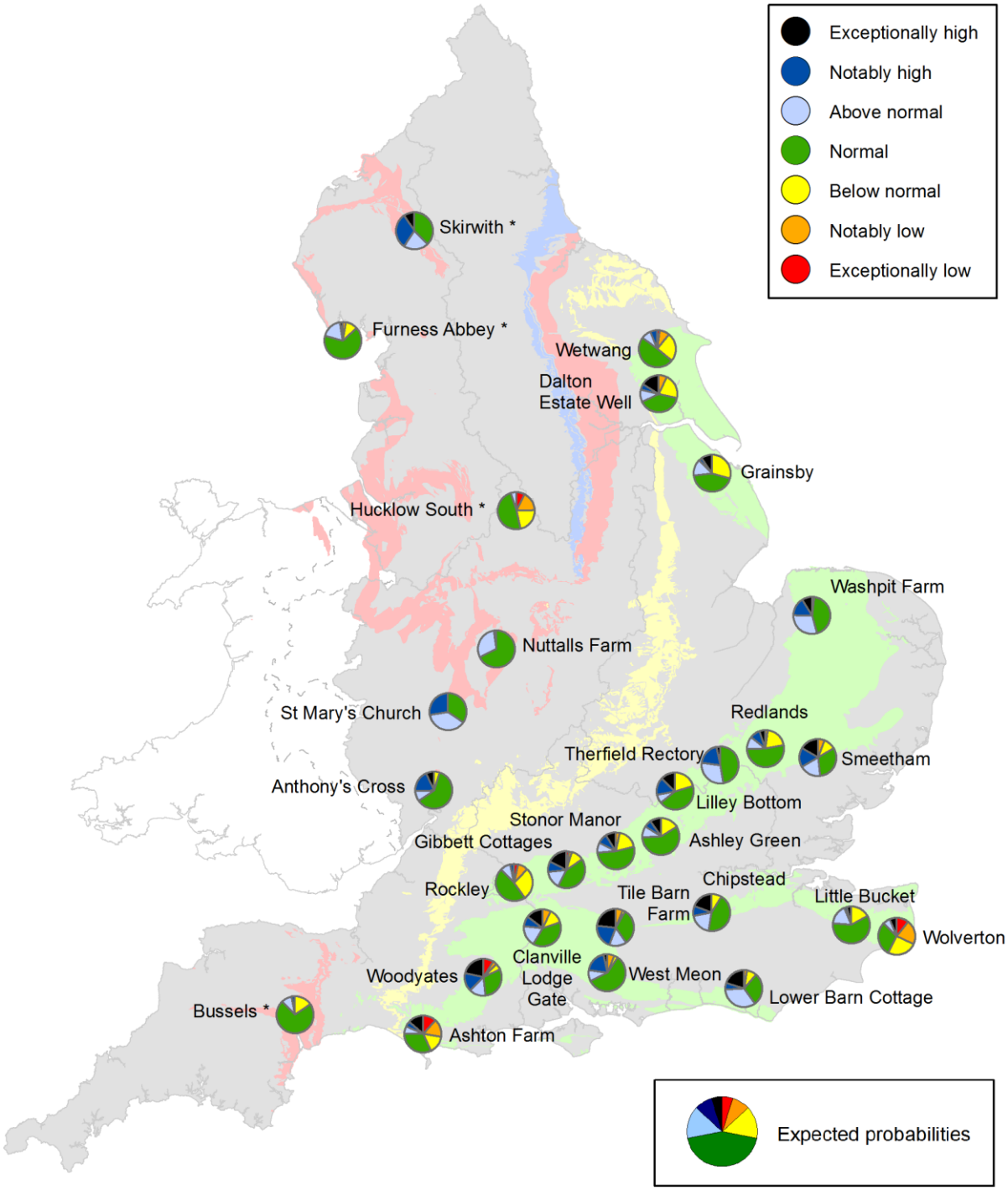

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

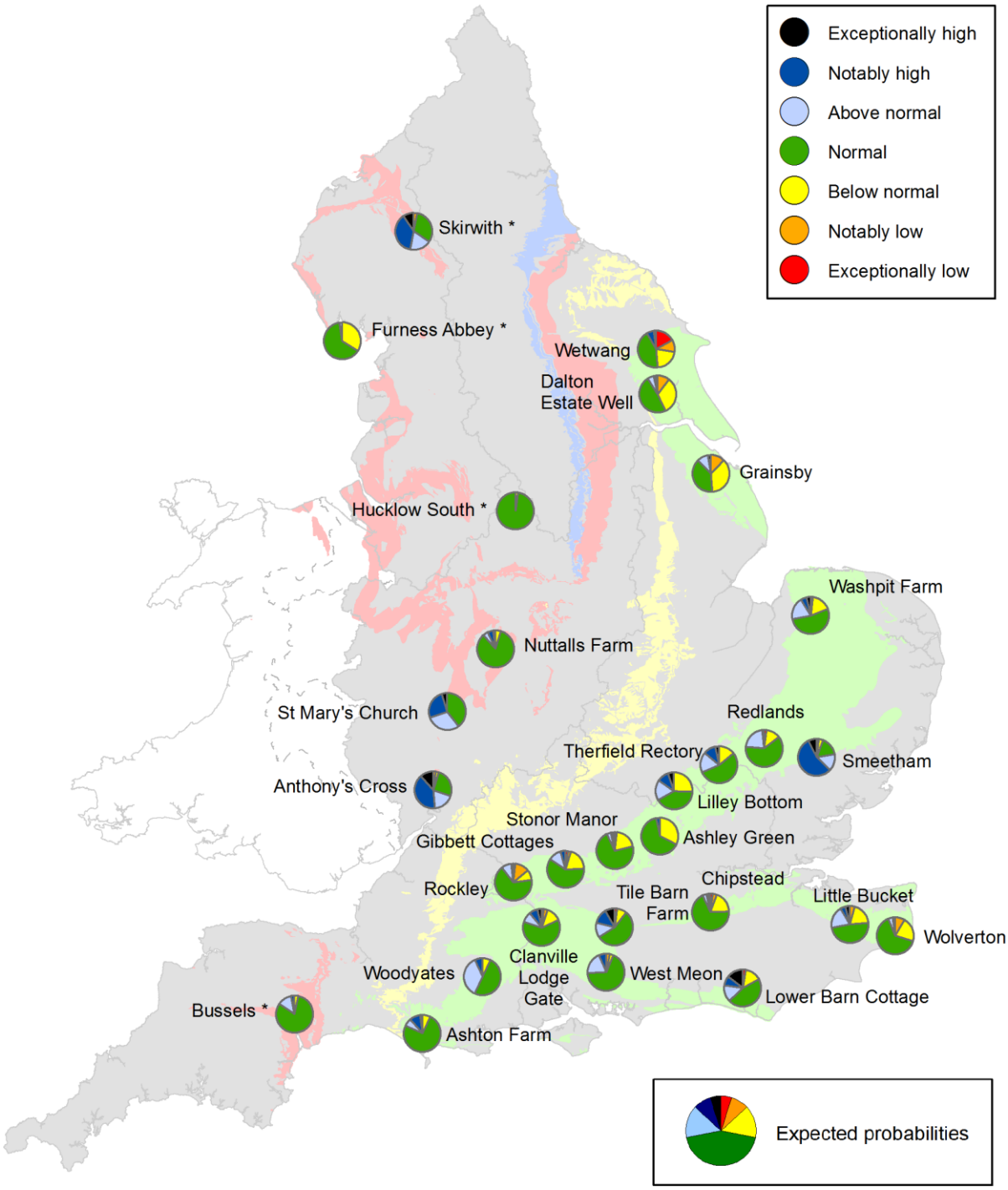

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2022. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for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