Monthly water situation report

England

Summary – February 2020

It was the wettest February on record for England (Met Office records since 1862). This February, the weather was generally windy and extremely wet. Storms Ciara, Dennis and Jorge contributed to exceptionally high rainfall totals for the month, across much of the country and causing flooding in several areas. River flows were classed as exceptionally high or notably high at just under three-quarters of indicator sites, with record breaking flows recorded on some rivers for this month. Groundwater levels increased at almost all indicator sites during February and by the end of the month were classed as exceptionally high for the time of year at over a third of sites. Reservoir stocks increased at most of the reservoirs and reservoir groups during February. Total reservoir stocks across England at the end of February were at 97% capacity.

Rainfall

The February rainfall total for England was 155 mm, which represents 267% of the 1961-90 long-term average (258% of 1981-2010 LTA). High rainfall totals were widespread across the country (Figure 1.1).

February rainfall totals were classed as notably high or exceptionally high across all catchments in England. Rainfall as a percentage of LTA ranged from 191% of LTA (114 mm) in the Brue catchment (Somerset) to 417% of LTA (368 mm) in the Wyre and Lune catchments (Lancashire and Cumbria). The Wyre and Lune, Ribble, Eden catchments, along with 22 other catchments in England, all received the highest February rainfall total on record (using records from 1891). The catchment with the highest rainfall total was in the Upper Dee catchment (north Wales, which flows into England) with 528 mm representing (390% of LTA). Across almost all of central and northern England, the cumulative rainfall totals for the 12 months ending in February were classed as exceptionally high (Figure 1.2).

At a regional scale, February rainfall totals represented more than 200% of LTA in all regions. The north-west England rainfall total was highest (282 mm), representing 362% of LTA. The rainfall total for England has been above average in eight of the last nine months (Figure 1.3).

Soil moisture deficit

The high rainfall totals meant that soils were close to saturation (soil moisture deficits were <10mm) across England at the end of February (Figure 2.1). At a regional scale, soils were wetter than average in all regions at the end of the month (Figure 2.2).

River flows

In response to the rainfall, monthly mean river flows increased at almost all indicator sites, compared to January. River flows were classed as exceptionally high at just under a half of indicator sites, and notably high at a quarter of sites. Record high February monthly mean flows were recorded on the River Derwent, Eamont, Lune and Wyre in north-west England, the South Tyne, River Swale, Wharfe and Don in north-east England and the Upper River Severn in central England (Figure 3.1).

At the regional index sites, monthly mean flows on the Bedford Ouse at Offord (east England), were classed as above normal. On the River Exe at Thorverton (south-west England), the Great Stour at Horton (and the naturalised flows on the River Thames at Kingston (both south-east England) were classed as notably high for February. Flows at all other regional index sites were classed as exceptionally high, as highlighted above (Figure 3.2).

Groundwater levels

Groundwater levels increased at almost all of the sites we report on during February. By the end of the month, only 1 site was classed as below normal for the time of year; the Cam and Ely Ouse chalk aquifer at Redlands Hall, however groundwater levels have been rising at Redlands Hall since November 2019. End of month

groundwater levels were normal or higher for the time of year at all other sites we report on. At over a third of these sites, groundwater levels were classed as exceptionally high for the time of year (Figure 4.1).

At the major aquifer index sites, the end of month groundwater levels were classed as normal or above for all sites other than the Cam and Ely Ouse chalk aquifer at Redlands Hall in east England. Groundwater levels in 4 of the regional index sites in central, north east, north west and south east England were classed as exceptionally high for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks increased at most of the reservoirs and reservoir groups that we report on during February. The largest increases in reservoir stocks, as a proportion of total storage capacity, were seen at Clywedog reservoir (at the top of the Severn catchment in Wales) and Roadford reservoir (south-west England), both with a 12% increase in reservoir stocks. At the end of February, reservoir stocks were classed as normal or higher at all but 1 reservoir; Grafham Water in east England was classed as below normal at 82% capacity, as stocks were affected by an operational issue at the abstraction into the reservoir. Stocks were classed as normal or higher at all of the other reservoirs and reservoir groups we report on at the end of February (Figure 5.1).

Total reservoir stocks across England at the end of February were at 97% capacity. This is a slight increase compared to the end of January. At a regional scale, total reservoir stocks were above the long term average in all regions. Regional reservoir stocks ranged from 90% in east England to 99% in central and north-east England (Figure 5.2).

Forward look

During the beginning of March, rain in the south is expected to slowly clear and give way to sunshine and showers. It is likely to remain unsettled in the middle of the month, with some wet and windy weather, and temperatures likely to fluctuate around normal. Towards the end of March the weather may become less unsettled in the south, but further rain and strong winds are likely in the north.

For the 3 month period March to May, above average precipitation is slightly more likely than below average precipitation. Above average temperatures are more likely than below average temperatures[1].

Projections for river flows at key sites[2]

All modelled sites have a greater than expected chance of cumulative river flows being notably high or higher for the time of year by the end of March 2020. By the end of September 2020, all 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 March 2020 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2020 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2020 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2020see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Over three quarters of modelled sites have a greater than expected chance of groundwater levels being notably high or higher for the time of year by the end of March 2020. By the end of September 2020, nearly all 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 March 2020 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2020 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2020 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2020 see Figure 6.8

Authors: National Water Resources Hydrology Team

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

Rainfall

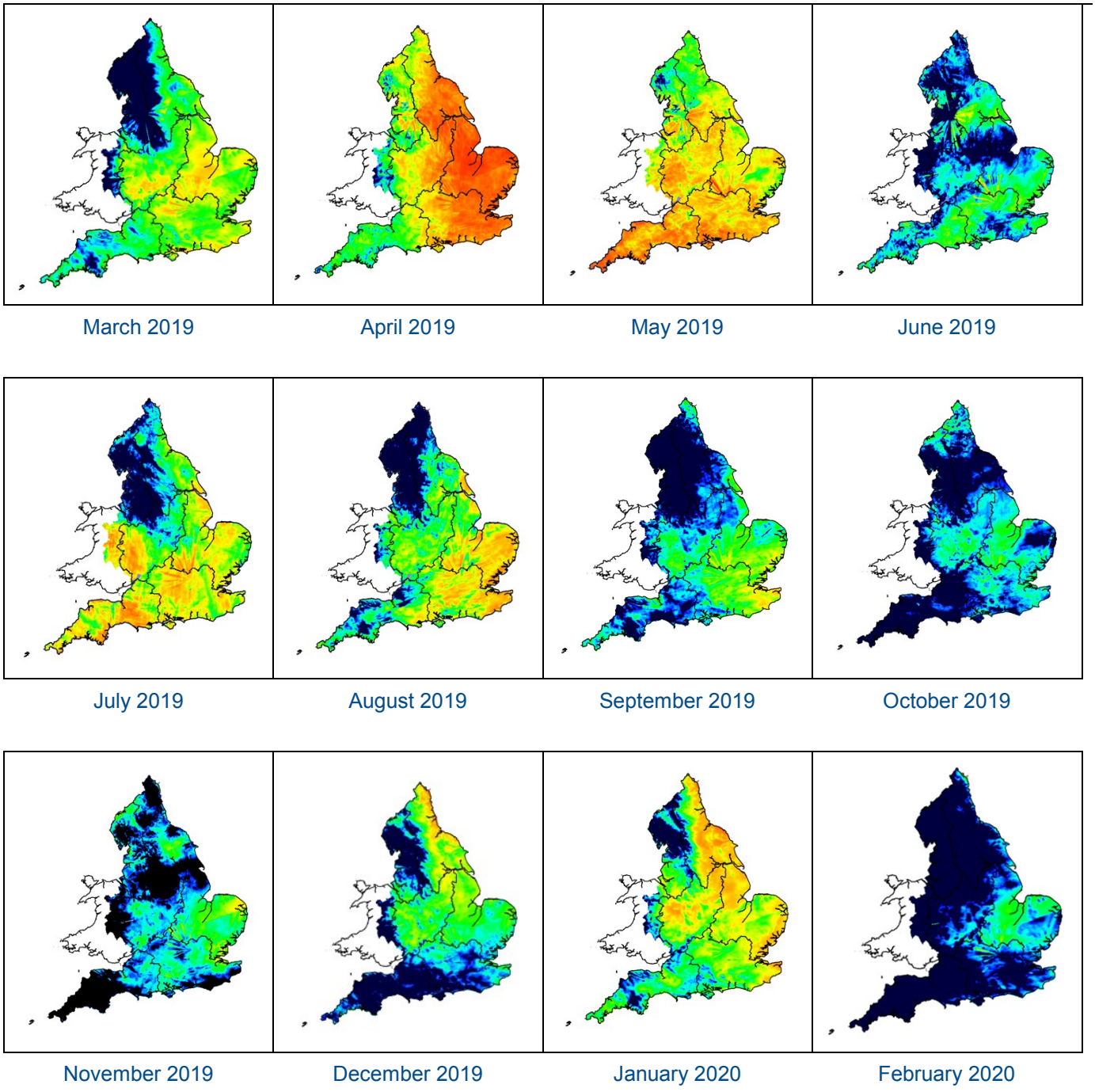


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2020). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2020.

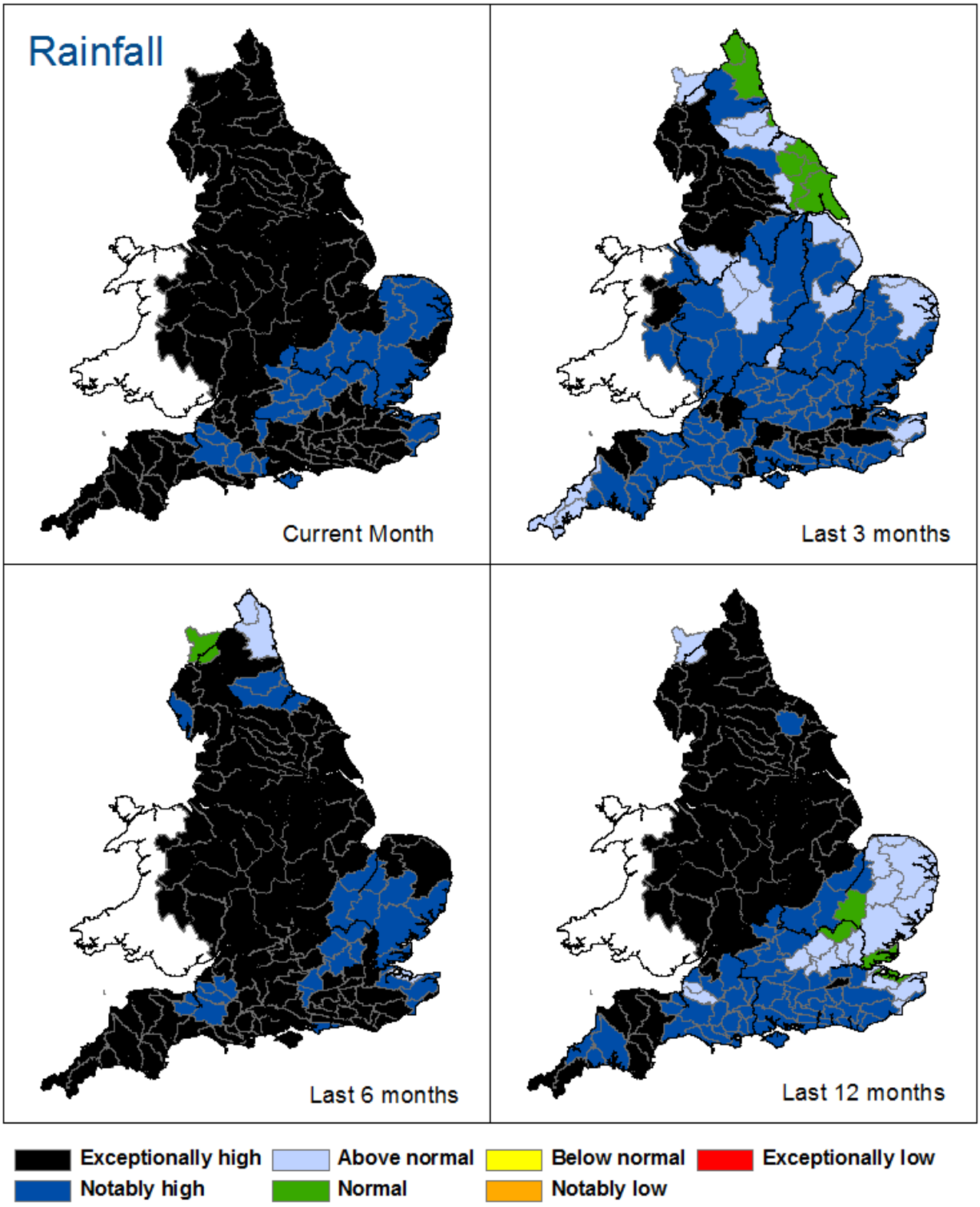


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 29 February 2020), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset 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

Above average rainfall

Below average rainfall

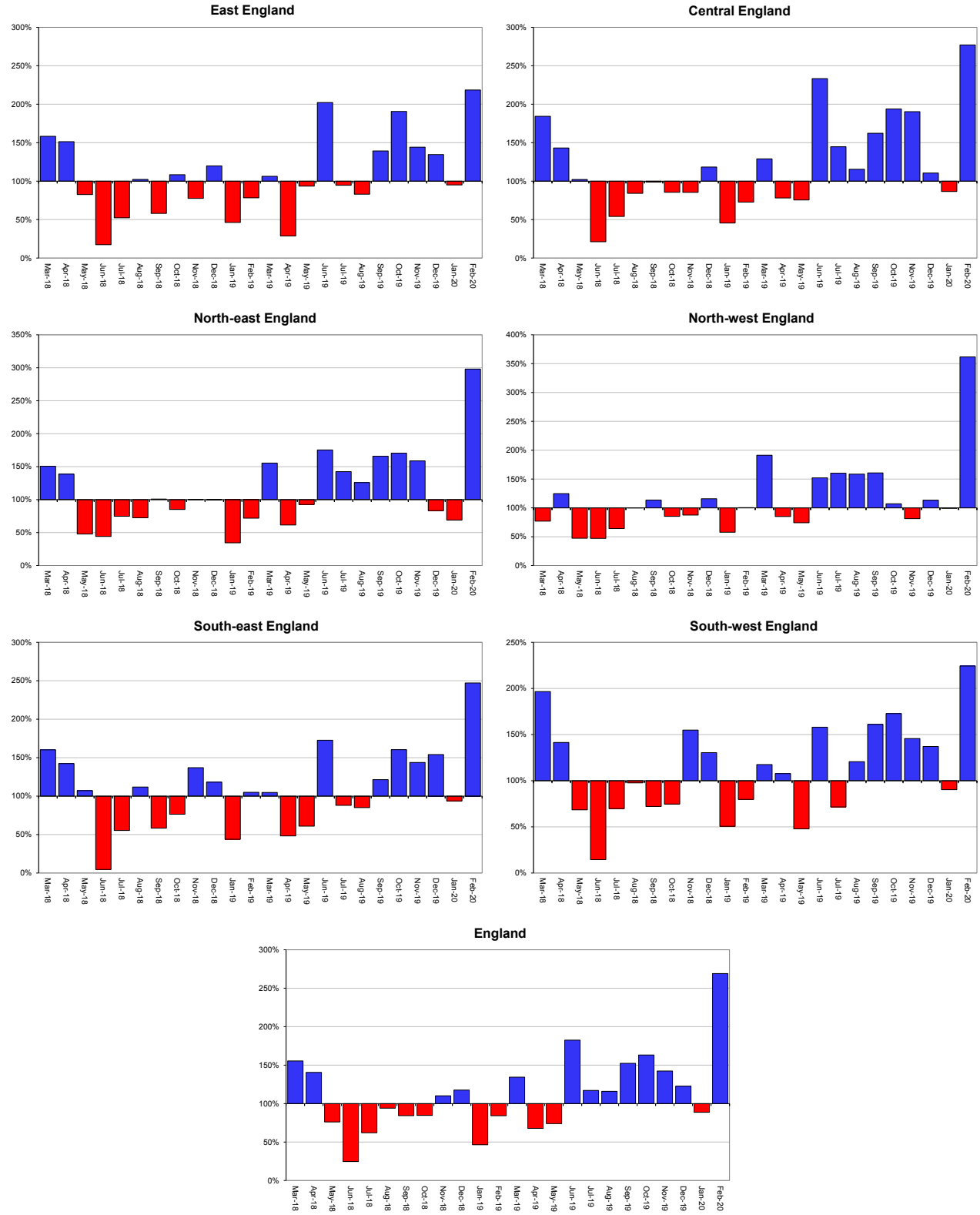


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2020).

Soil moisture deficit

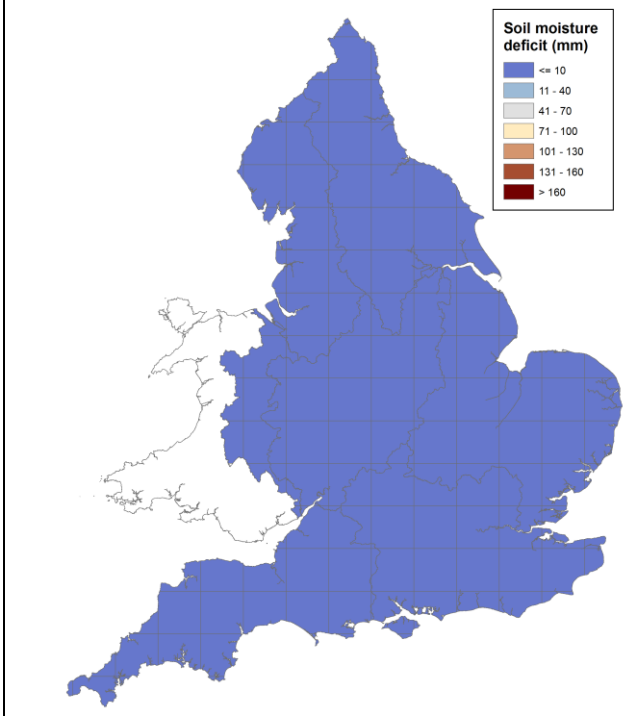
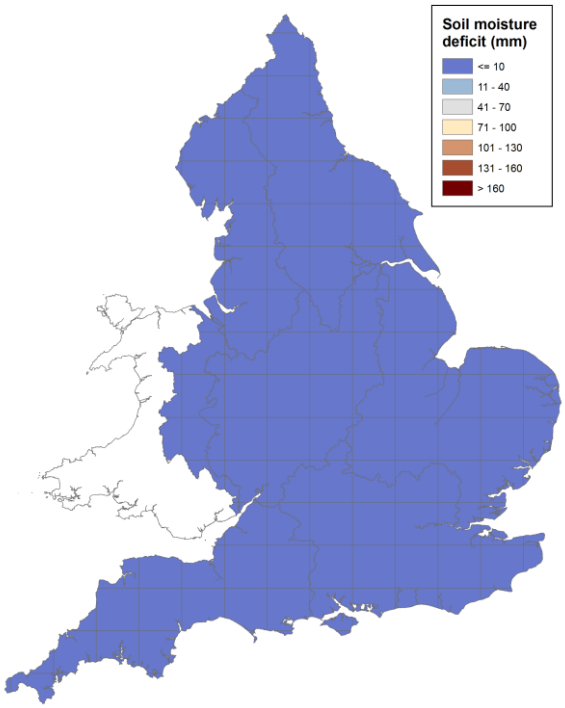
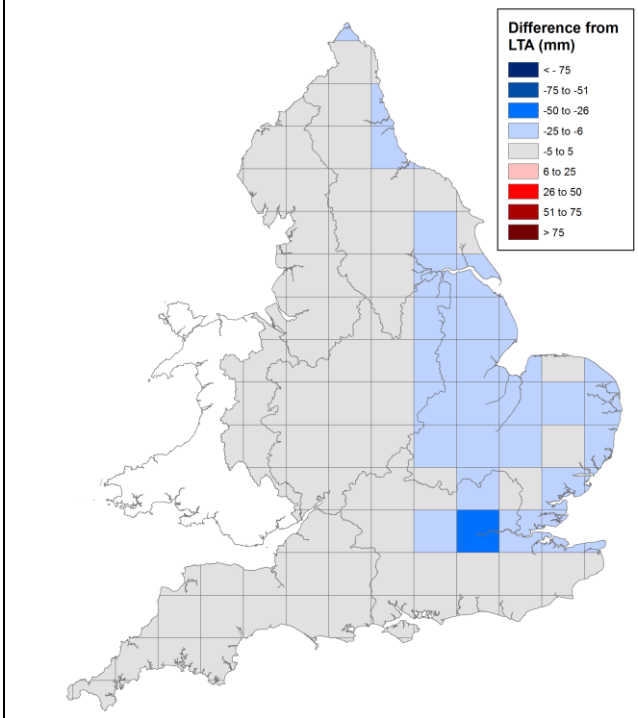
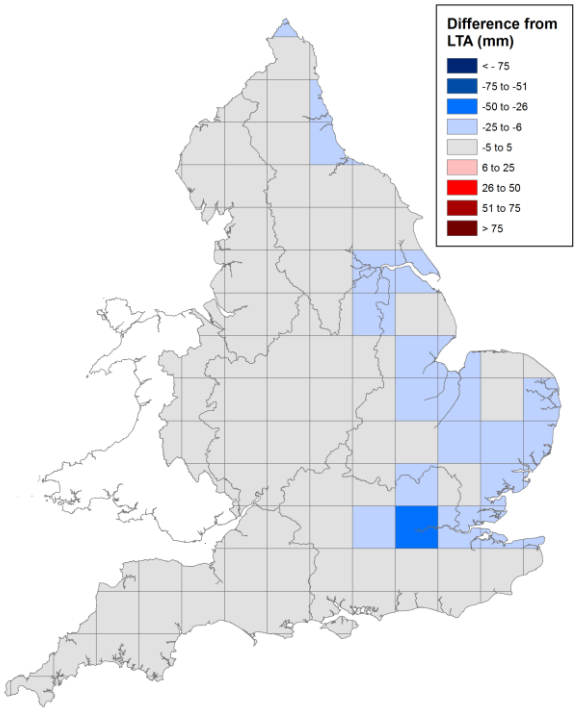
End of January 2020[1]	End of February 2020[2]
	
	

Figure 2.1: Soil moisture deficits for weeks ending 28 January 2020 [1] (left panel) and 3 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

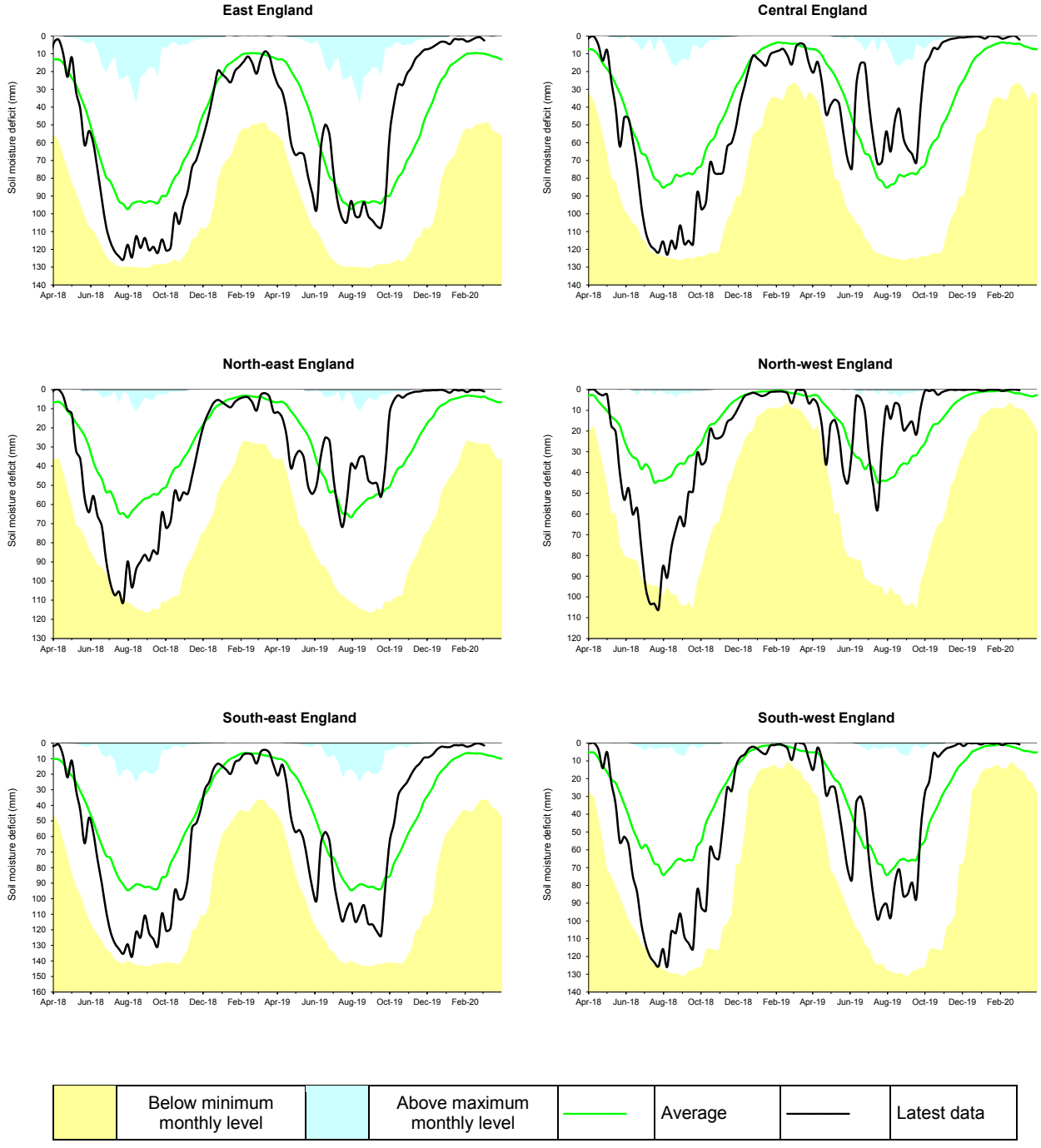
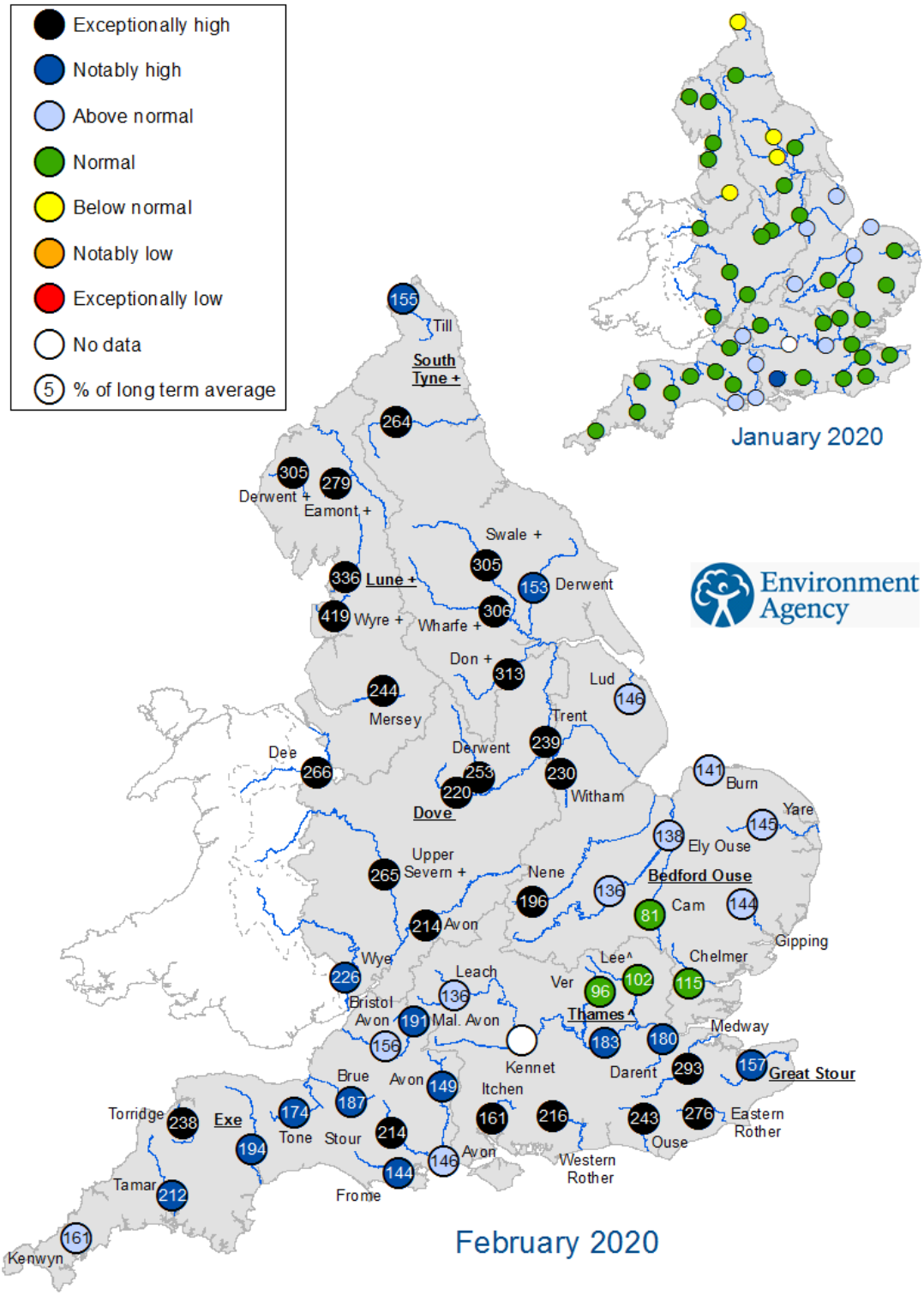


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2020).

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 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 January and February 2020, expressed as a percentage of the respective long term average and classed relative to an analysis of historic January and February monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2020.

River flow charts

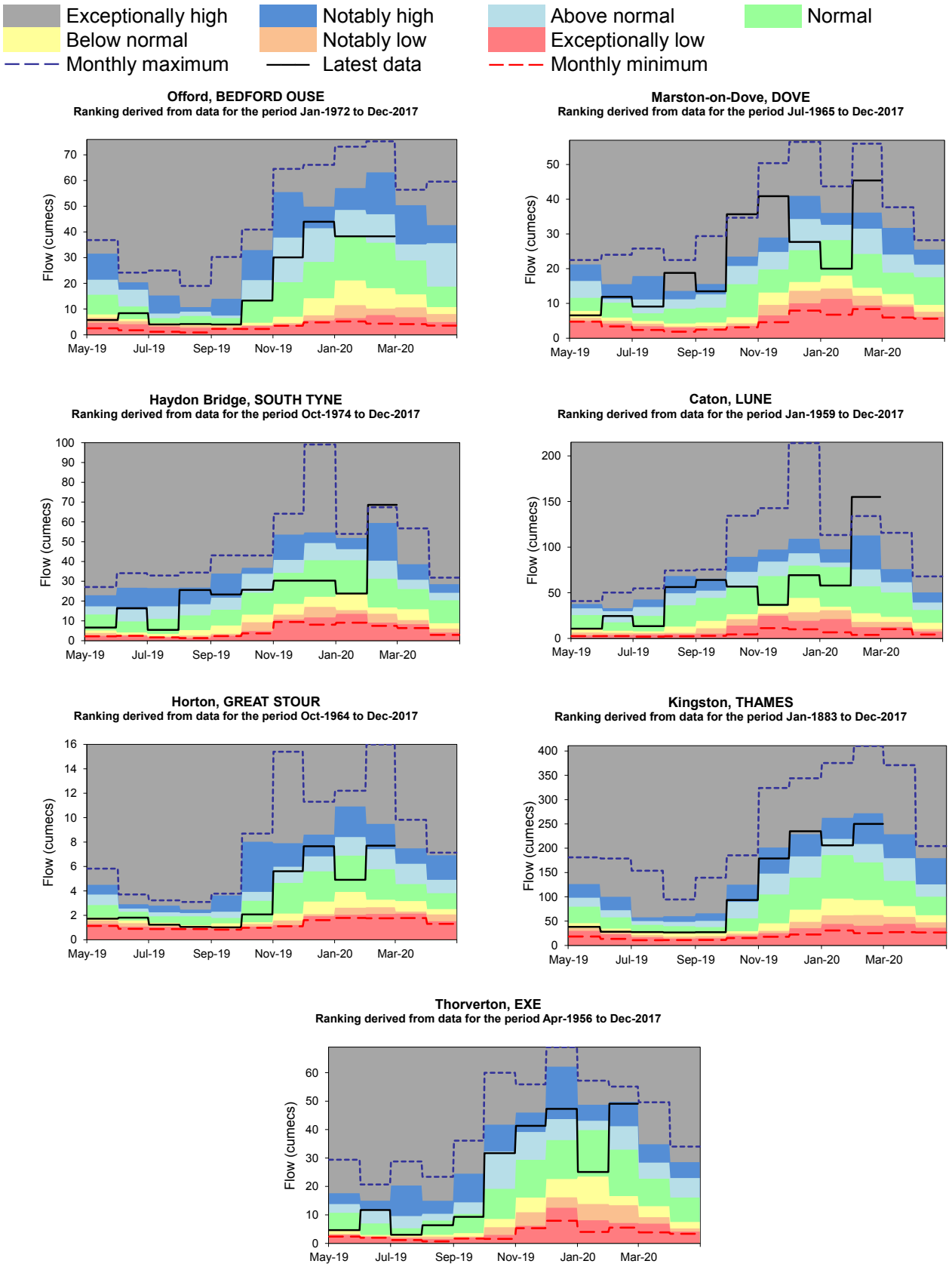
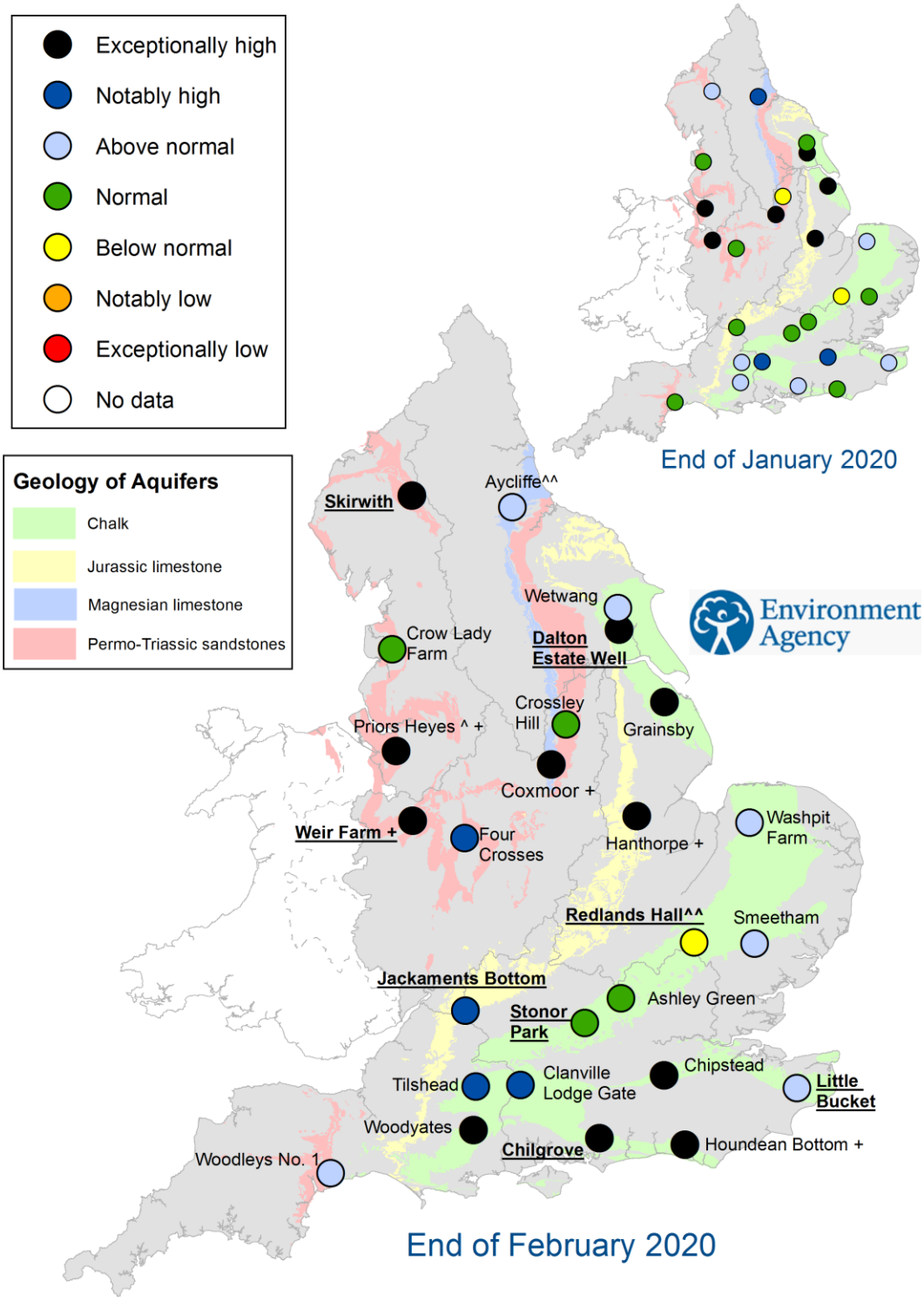


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 January and February 2020, classed relative to an analysis of respective historic January and February 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

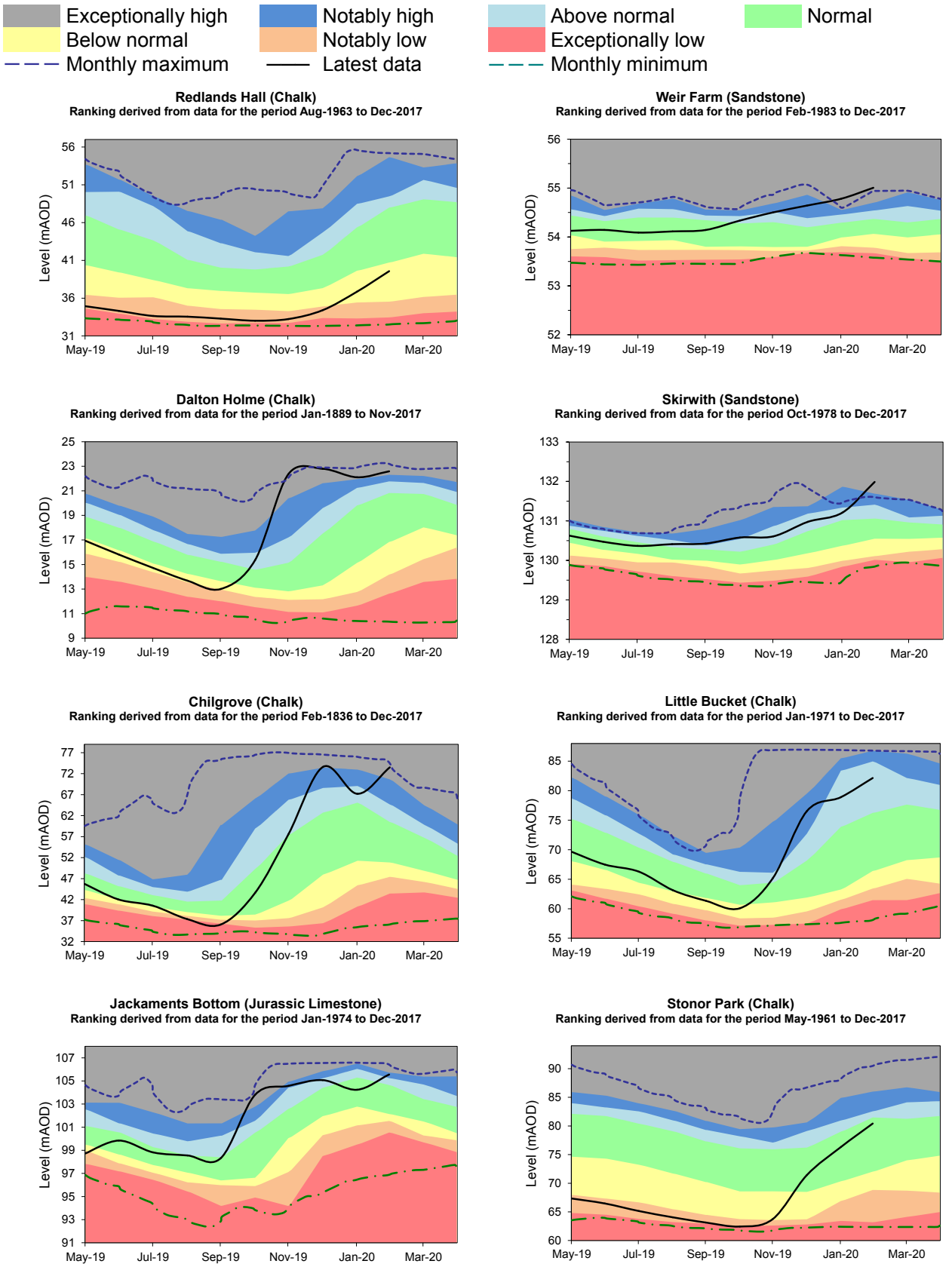
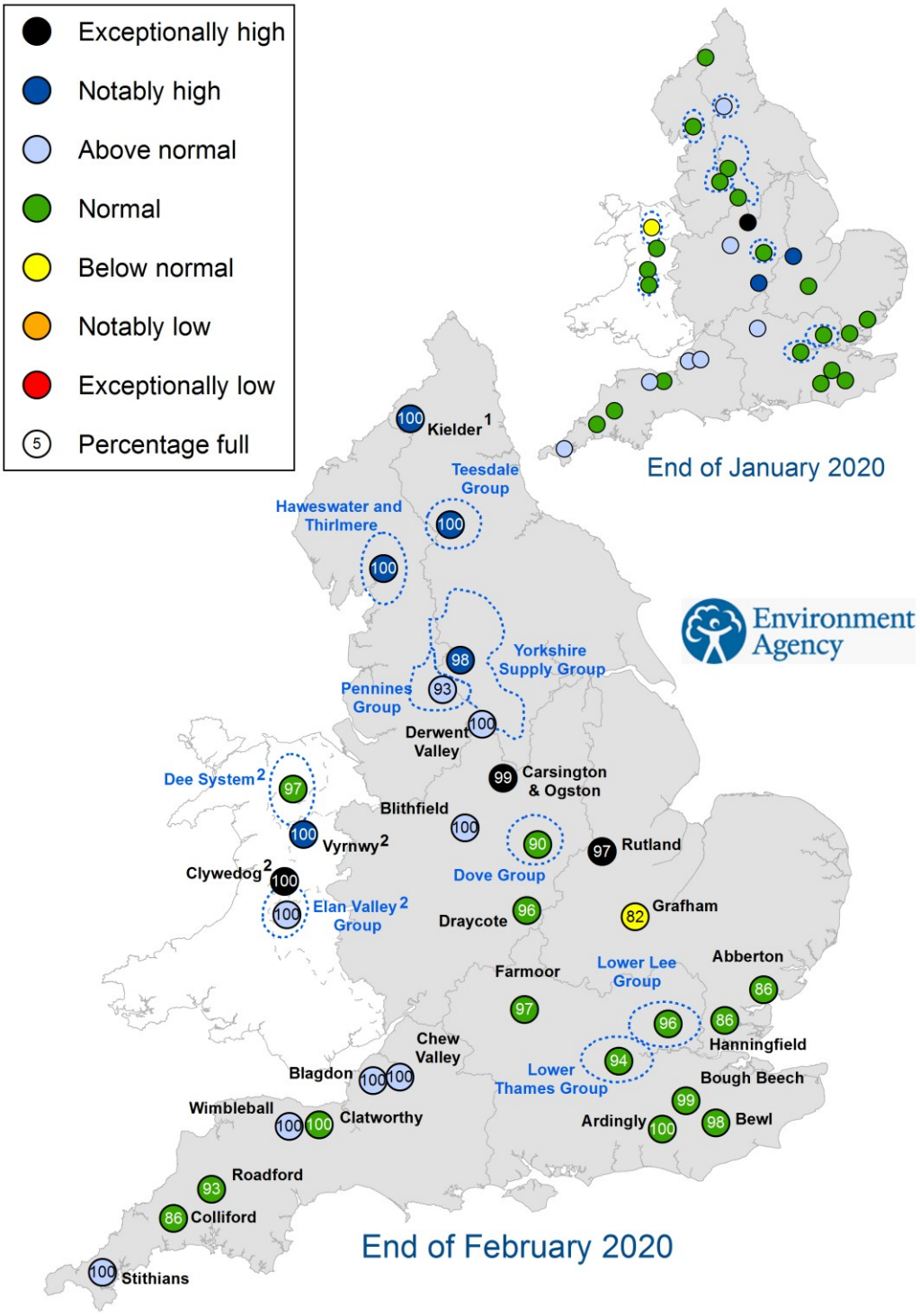


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2020).

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

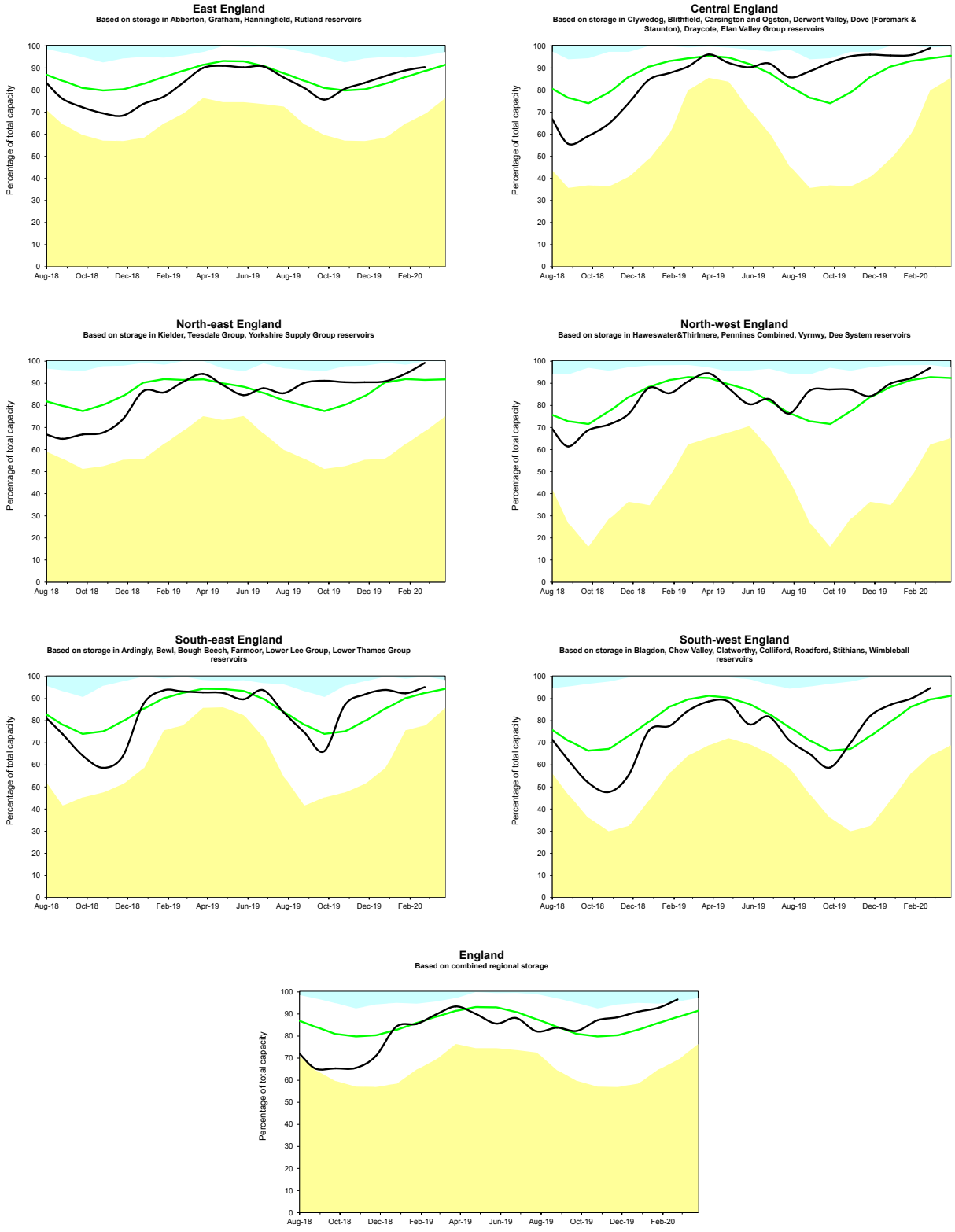


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

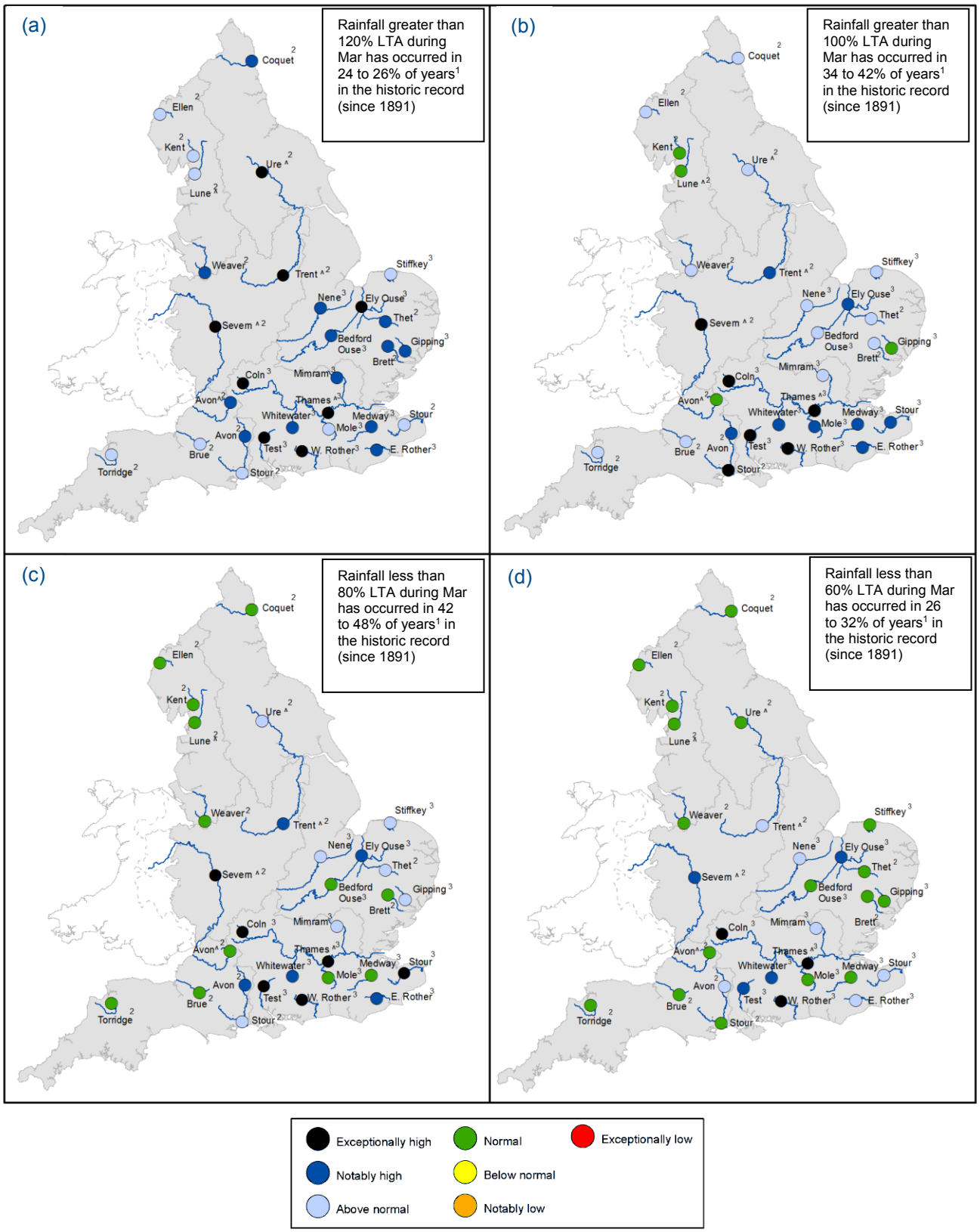


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during March 2020 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

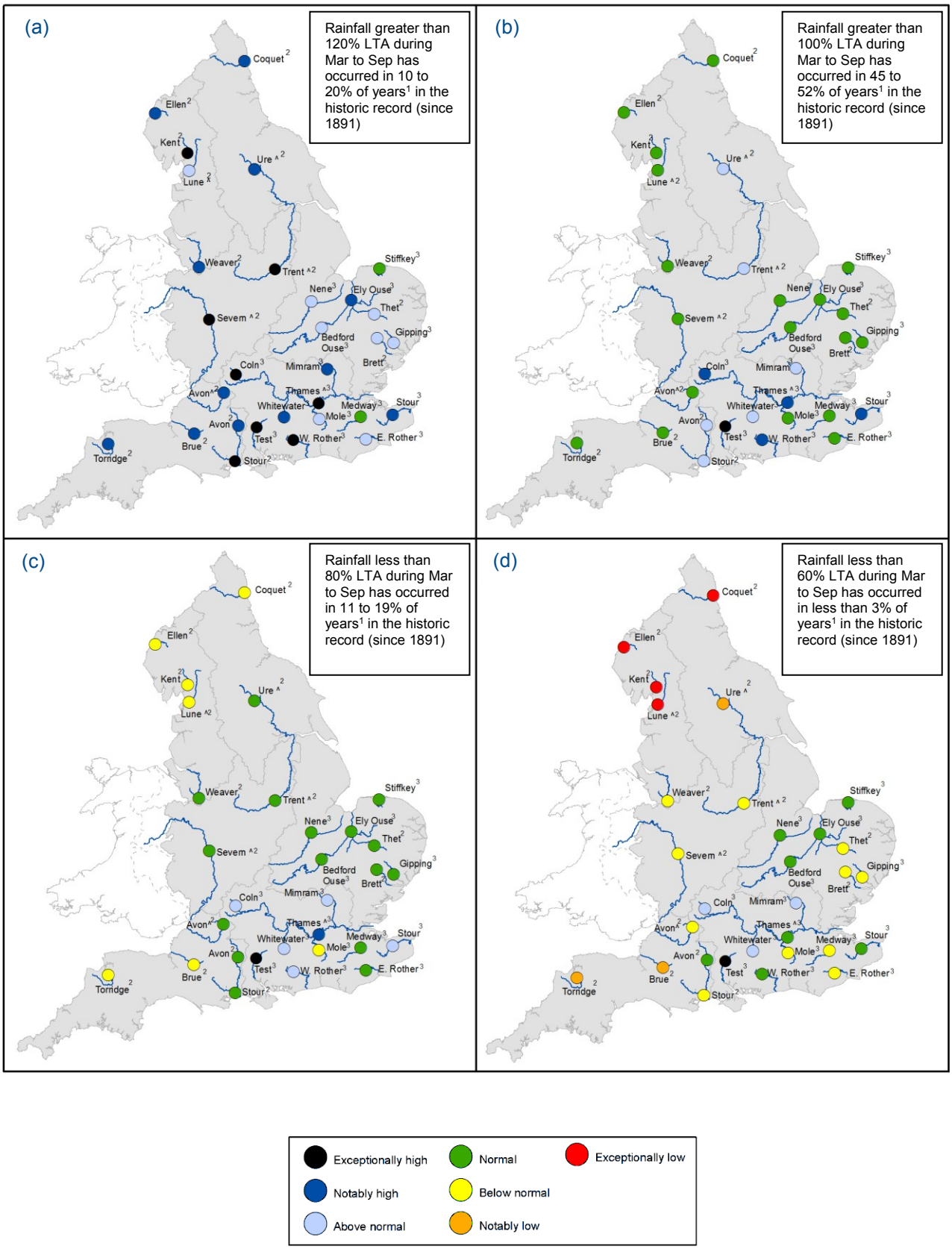


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between March 2020 and September 2020 (Source: Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
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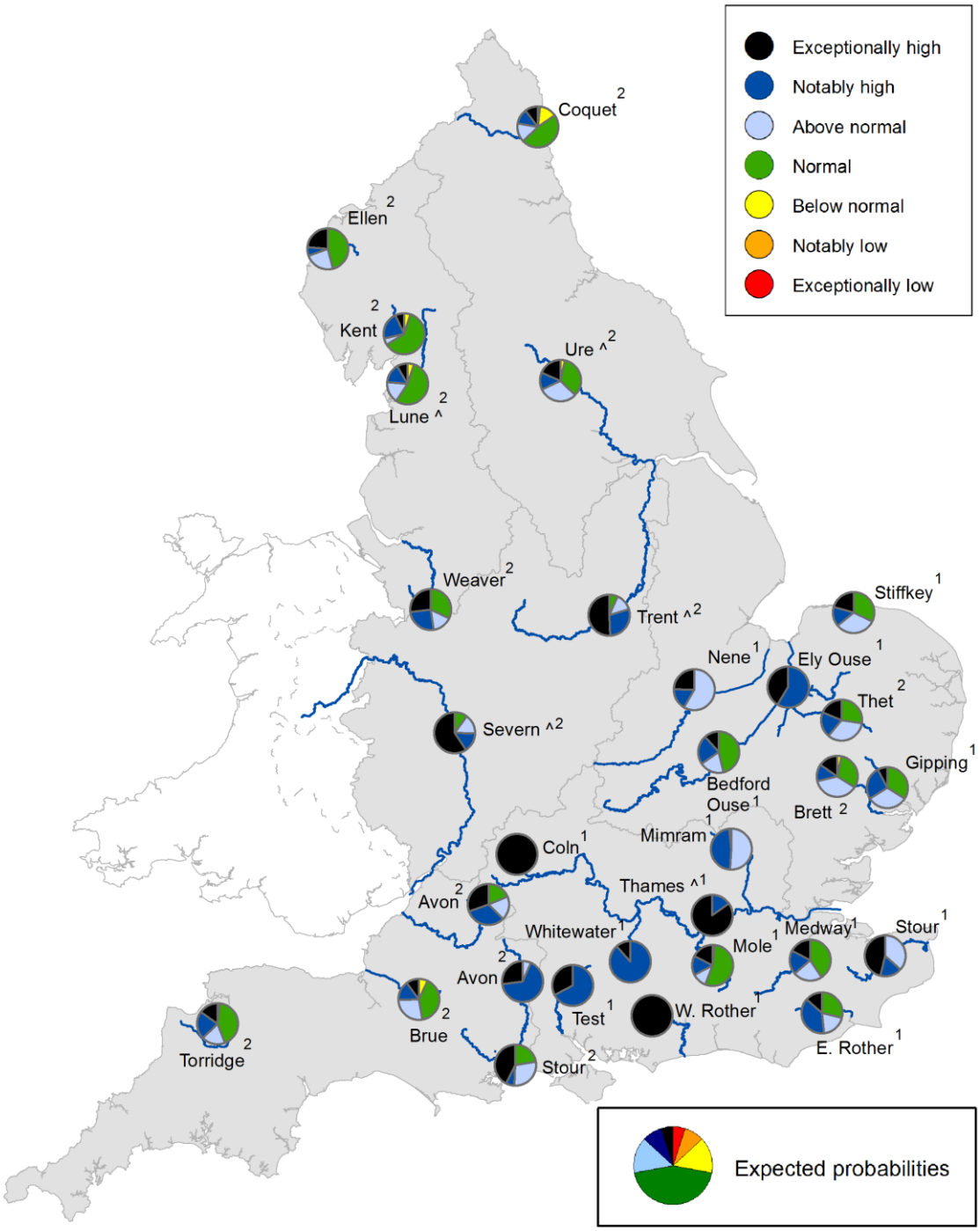

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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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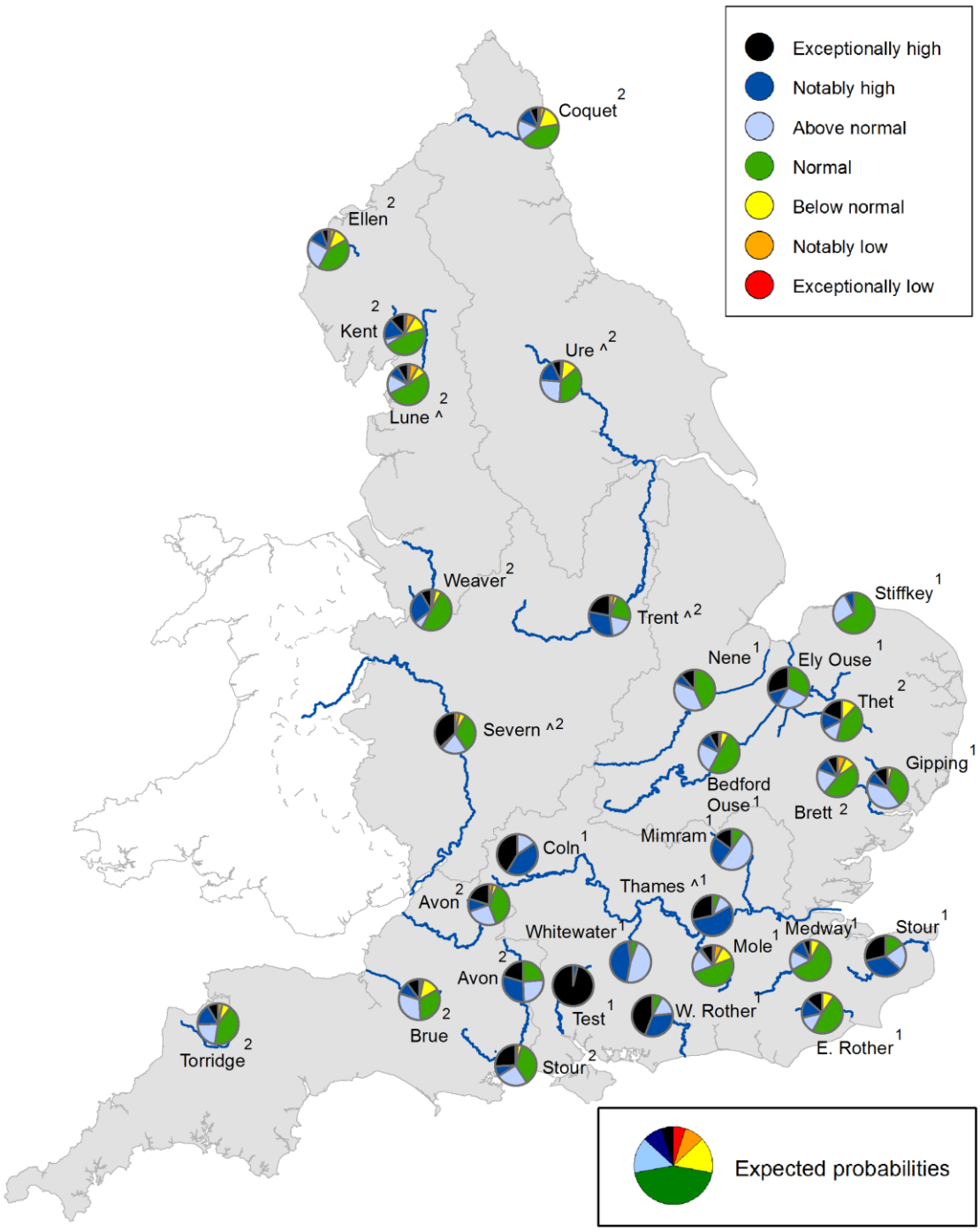
^"Naturalised" flows are projected for these sites



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 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).

[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

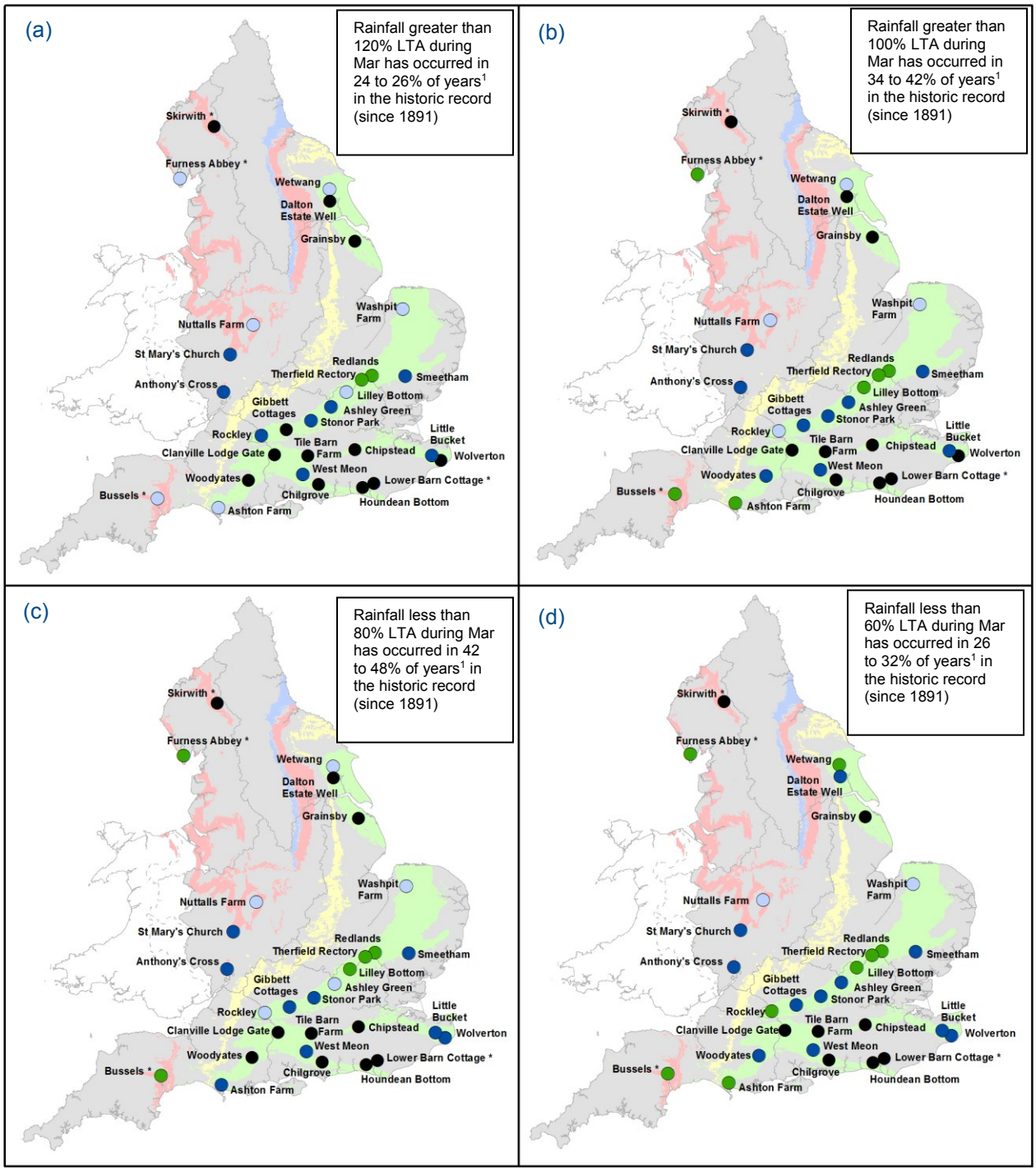


Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during March 2020 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater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

* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis
Note: No data available for Hucklow South this month

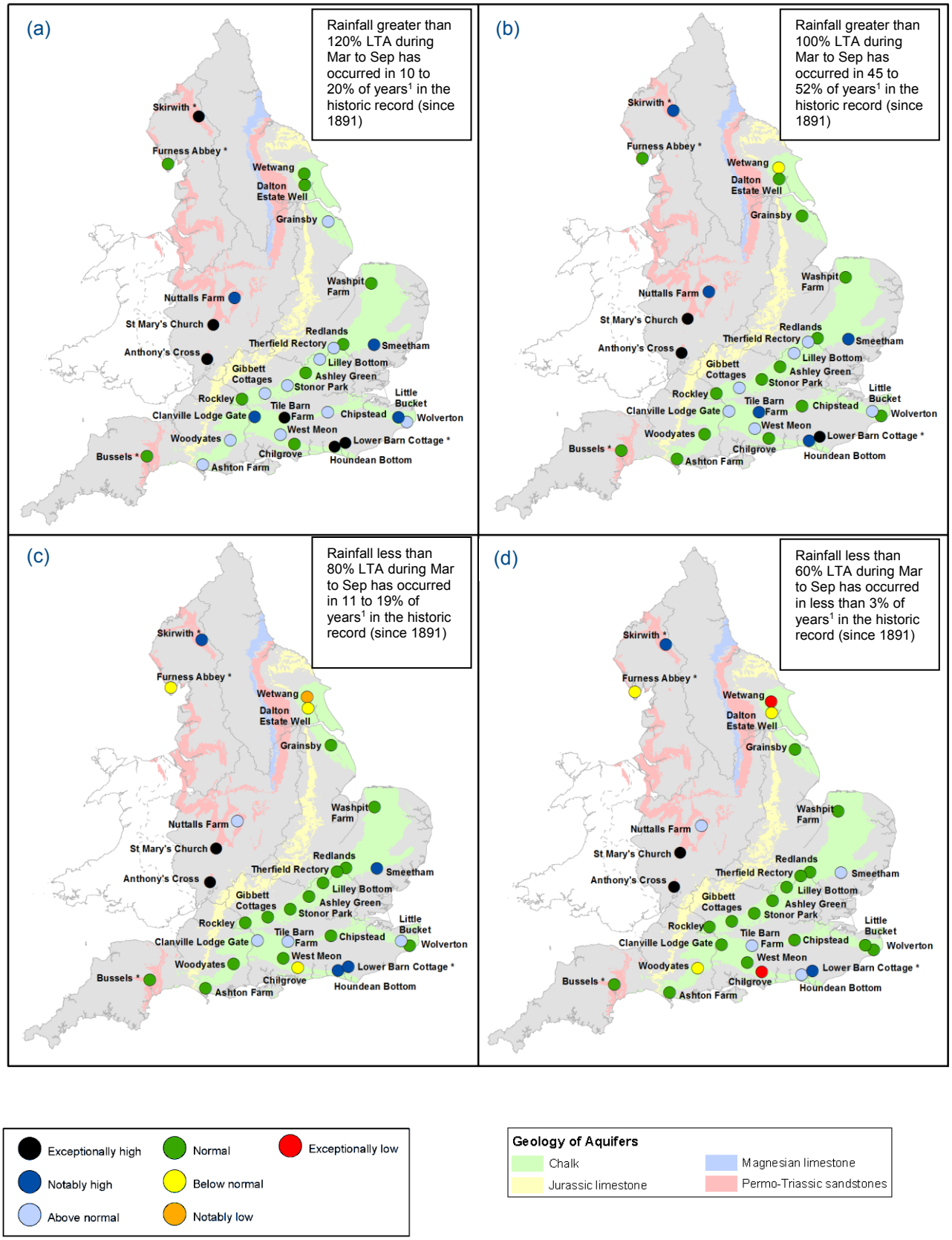


Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between March 2020 and September 2020 (Source: Environment Agency) Geological map reproduced with kind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

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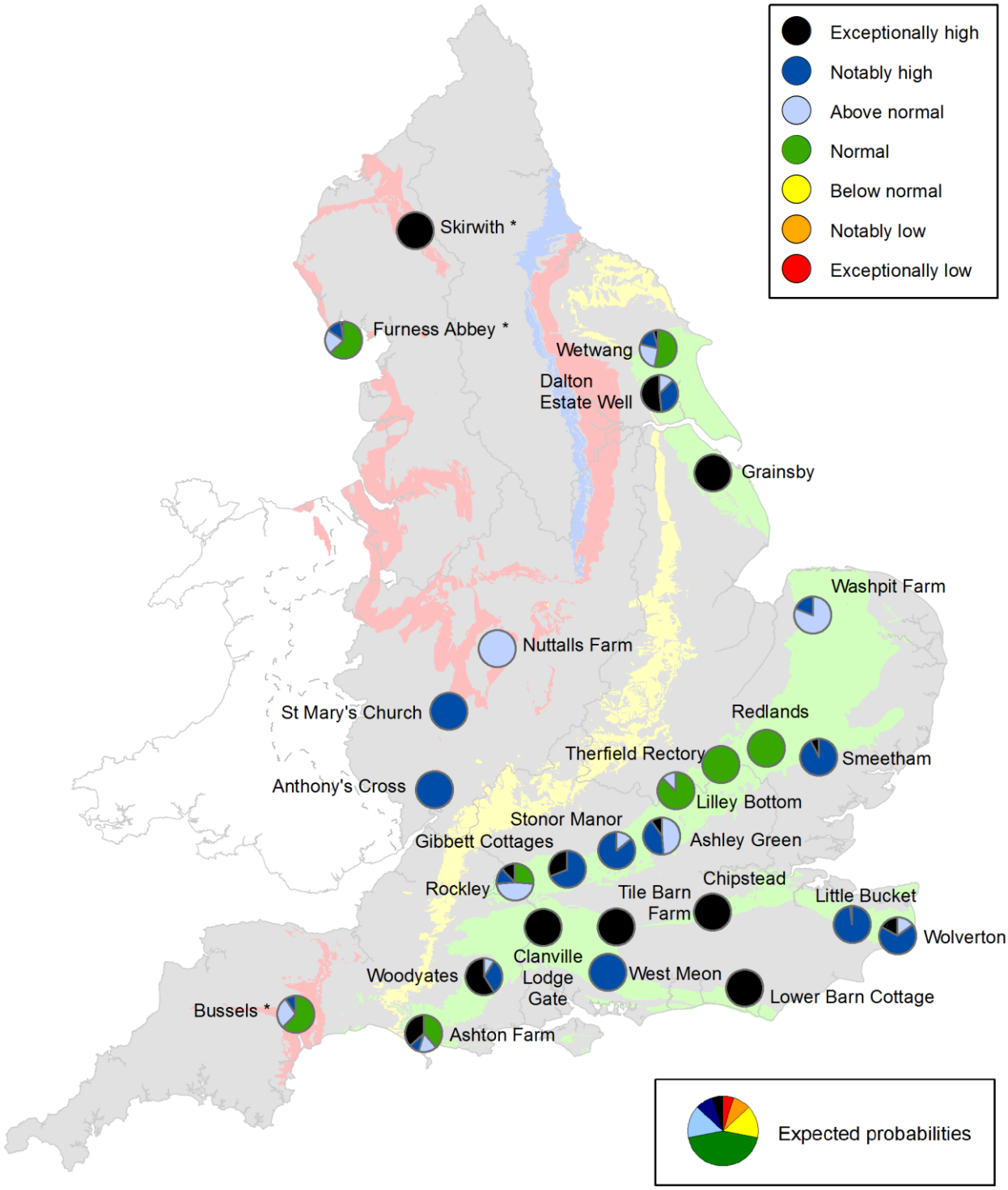
Note: No data available for Hucklow South this month

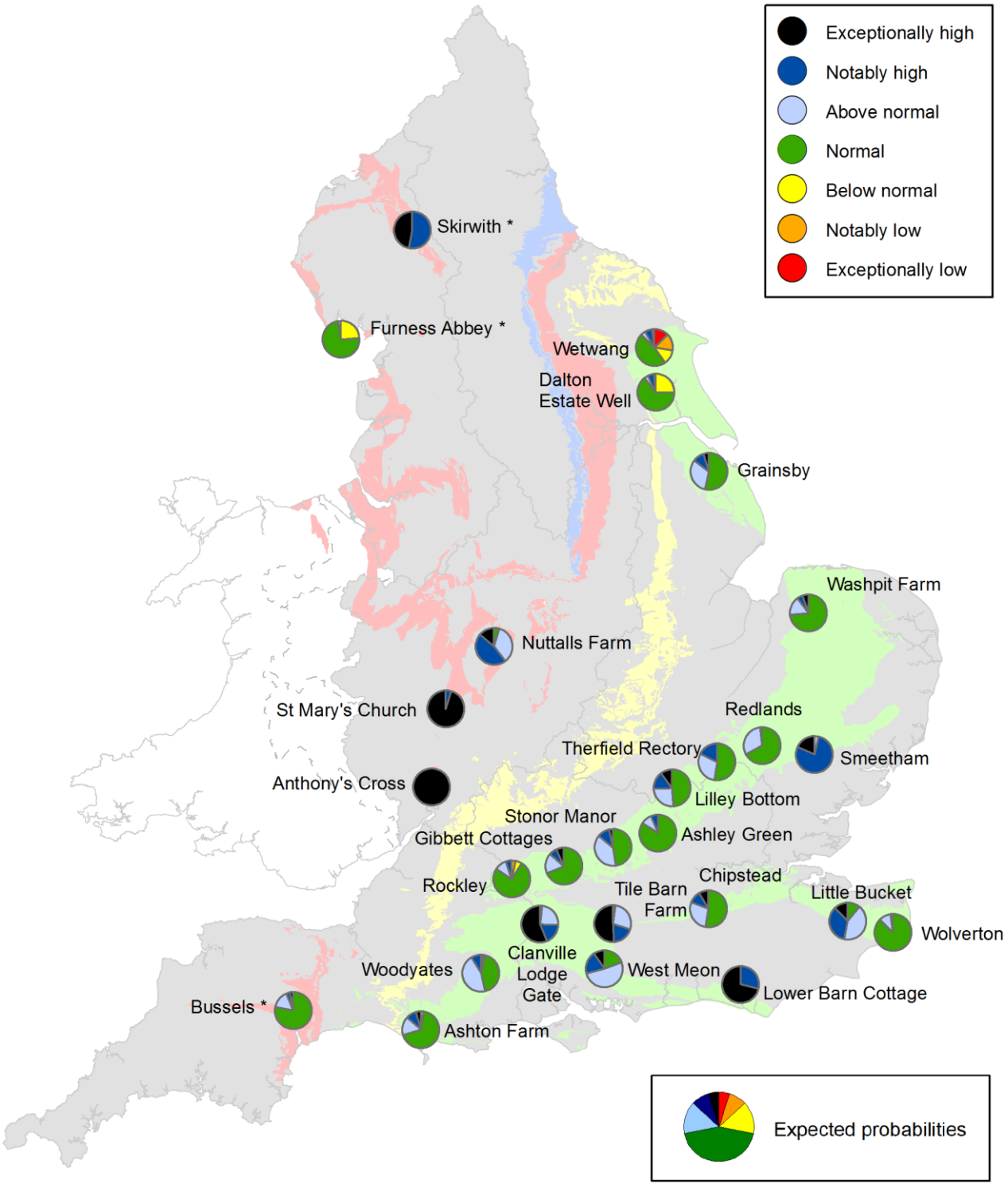


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Note: No data available for Hucklow South this month



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 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

Note: No data available for Hucklow South this month

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