Monthly water situation report

England

Summary – November 2018

The November rainfall total for England was just above average, but this follows six consecutive months of below average rainfall. It was wettest in the south west and south east while parts of north-west, central and eastern England received below average rainfall. Soils got wetter and in a few places groundwater levels started to rise. Despite this, groundwater levels at more than half of sites were classed as either below normal or notably low at the end of November. River flows increased at most indicator sites, but were still lower than normal for the time of year at over half of sites. Total reservoir stocks for England increased from 64% of total capacity to 70% during the month.

Rainfall

November rainfall totals were highest in the south-west of England, with 200 mm (215% of LTA) recorded across the Otter, Sid, Axe and Lim catchments. The lowest rainfall totals were in parts of East Anglia, around The Wash, and around Greater Manchester and Cheshire. The catchments forming the Cheshire rivers group received the least rainfall, with 37 mm, representing 48% of LTA (Figure 1.1).

November rainfall totals were classed as either below normal or notably low in just under a seventh of catchments. Across the rest of the country November rainfall totals were classed as normal or higher. The six-month cumulative rainfall totals were classed as exceptionally low in 27 catchments and as either notably low or below normal in most other catchments. In the River Tame and River Soar catchments, the six-month cumulative rainfall total was the lowest on record (records begin in 1910) (Figure 1.2).

The November rainfall total for England was 89 mm, representing 108% of the 1961-1990 LTA (101% of the 1981-2010 LTA). This was preceded by six consecutive months of below average rainfall. At a regional scale, the November rainfall totals for south-east and south-west England were classed as above normal with 139% and 152% of LTA respectively. In all other regions the rainfall totals were classed as normal for the time of year (Figure 1.3).

Soil moisture deficit

Soils got wetter during November. The smallest soil moisture deficits (SMDs) (wettest soils) were generally in western England and the driest soils were around the Ely-Ouse catchment in east England. Despite the reduction in SMD during November, SMD was still larger (i.e. drier) than the LTA for the time of year across much of England (Figure 2.1).

At a regional scale soil moisture deficit was equal to the LTA in south-west England by the end of November. The biggest remaining difference between the LTA SMD and the actual end of month SMD was in central England (Figure 2.2).

River flows

Monthly mean river flows increased at most indicator sites in November, compared to October. Despite this, flows were classed as below normal at a third of sites and notably low at just over a quarter of sites. Monthly mean flows for November in the River Wyre (38% of LTA) and River Mersey (40% of LTA) were classed as exceptionally low for the time of year (Figure 3.1).

Flows on the River Lune (in north-west England) were classed as normal in October, but were lower in November and classed as below normal with just over half of the monthly mean LTA (52%). At all other regional index sites monthly mean flows increased (Figure 3.2).

Groundwater levels

Groundwater levels have started rising in some aquifers, for example in parts of the Cotswolds and South Downs. Groundwater levels were still in recession during November at over three-quarters of indicator sites however. At

over half of the groundwater indicator sites levels were classed as either below normal or notably low at the end of the month.

At the main aquifer index sites, groundwater levels increased at Skirwith (Carlisle Basin and Eden Valley sandstone), Chilgrove (Chichester chalk) and Jackaments Bottom (Burford Jurassic limestone) (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks increased in almost three-quarters of the reservoirs and reservoir groups in England during November. The largest increases as a percentage of total capacity were at Stithians reservoir in the south-west (+20% of total capacity) and in the Elan Valley Group (+21% of total capacity) which supplies the Midlands.

The stocks in almost half of the reservoirs and reservoir groups were still classed as either below normal or notably low at the end of November. Stocks in the Dove reservoir group remained at 53% of capacity and in the Derwent Valley reservoir group stocks increased by 4% of capacity to 42%; both reservoir groups were classed as exceptionally low for the time of year at the end of November (Figure 5.1).

Regional reservoir stocks increased in all regions except for the east England. Here stocks reduced slightly to 69% of total storage capacity. Total reservoir stocks for England increased from 64% of total capacity to 70% during November (Figure 5.2).

Forward look

December is expected to be unsettled, with spells of rain and heavy showers affecting most parts of the country, particularly the north and west. The north and east of England may be drier at times. For the 3-month period December-January-February, the chances of above average or below average precipitation are roughly equal[1].

Projections for river flows at key sites[2]

Four-fifths 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 March 2019. By the end of September 2019, all but three of the modelled sites have a greater than expected chance of cumulative river flows being below normal or lower for the time of year.

For scenario based projections of cumulative river flows at key sites by March 2019 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2019 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2019 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2019 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Over half of the modelled sites have a greater than expected chance of groundwater levels being below normal for the time of year at the end of March 2019 and also by the end of September 2019.

For scenario based projections of groundwater levels in key aquifers in March 2019 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2019 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2019 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2019 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

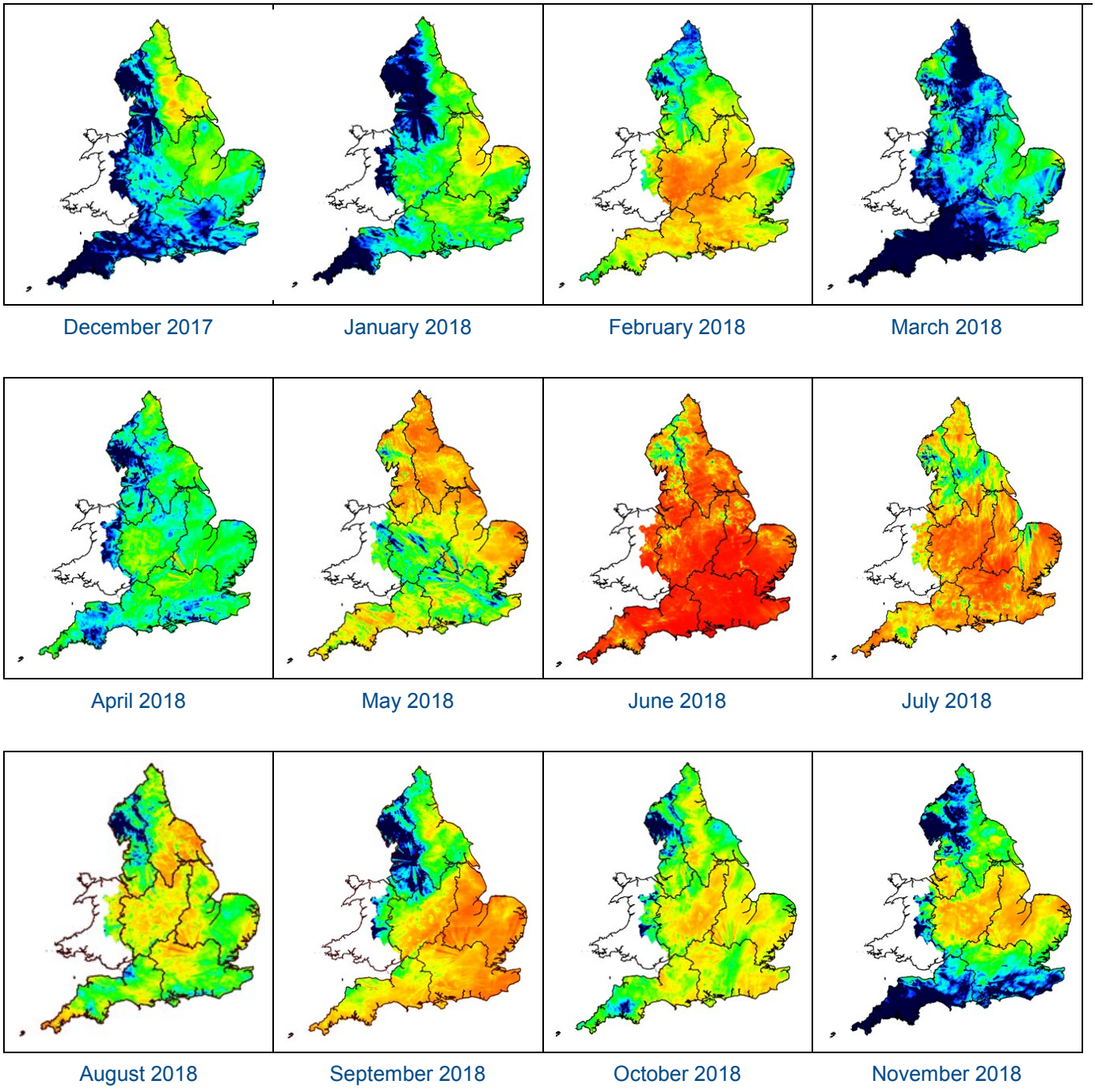


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2018). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

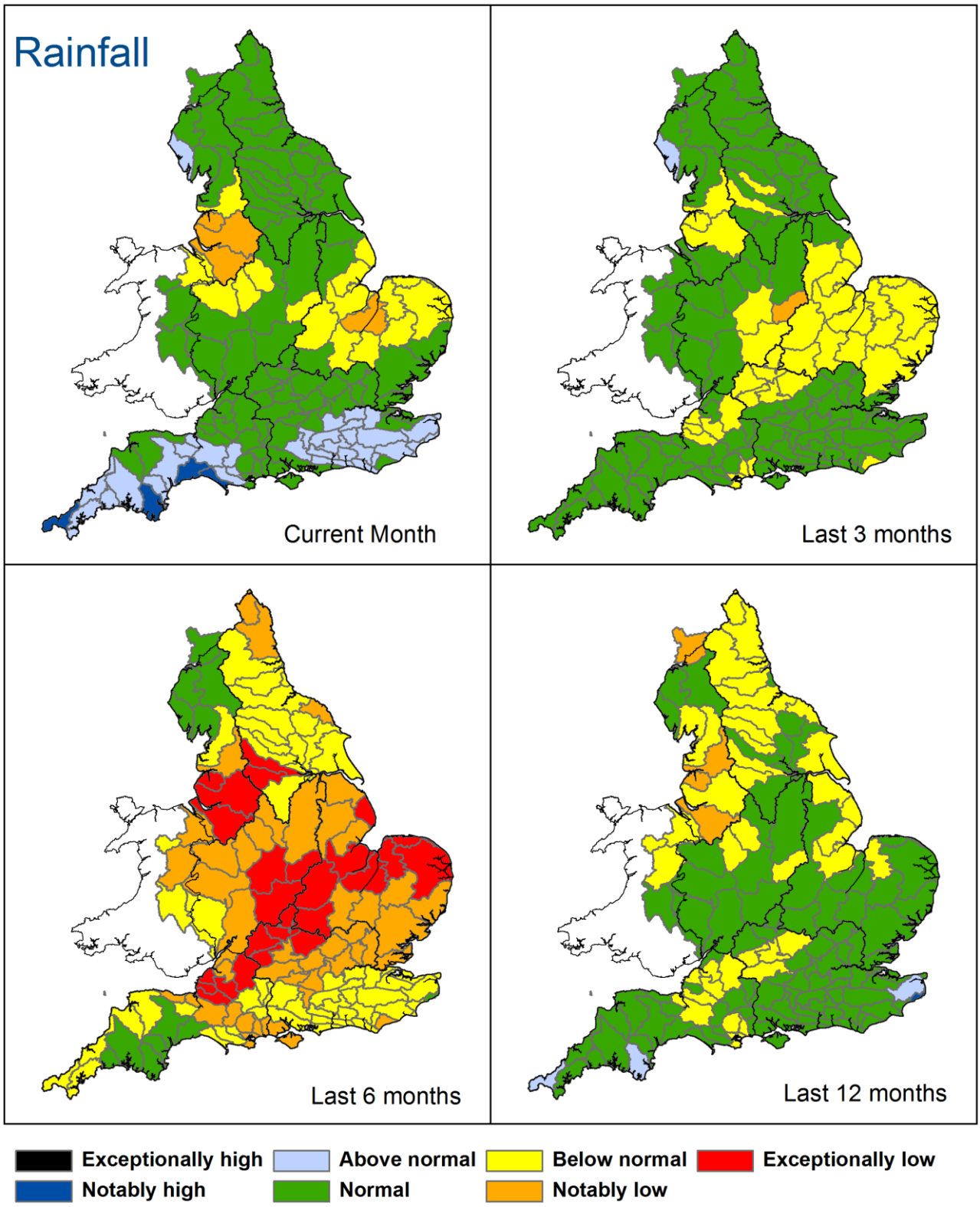


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 November), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2018).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

Rainfall charts

Above average rainfall

Below average rainfall

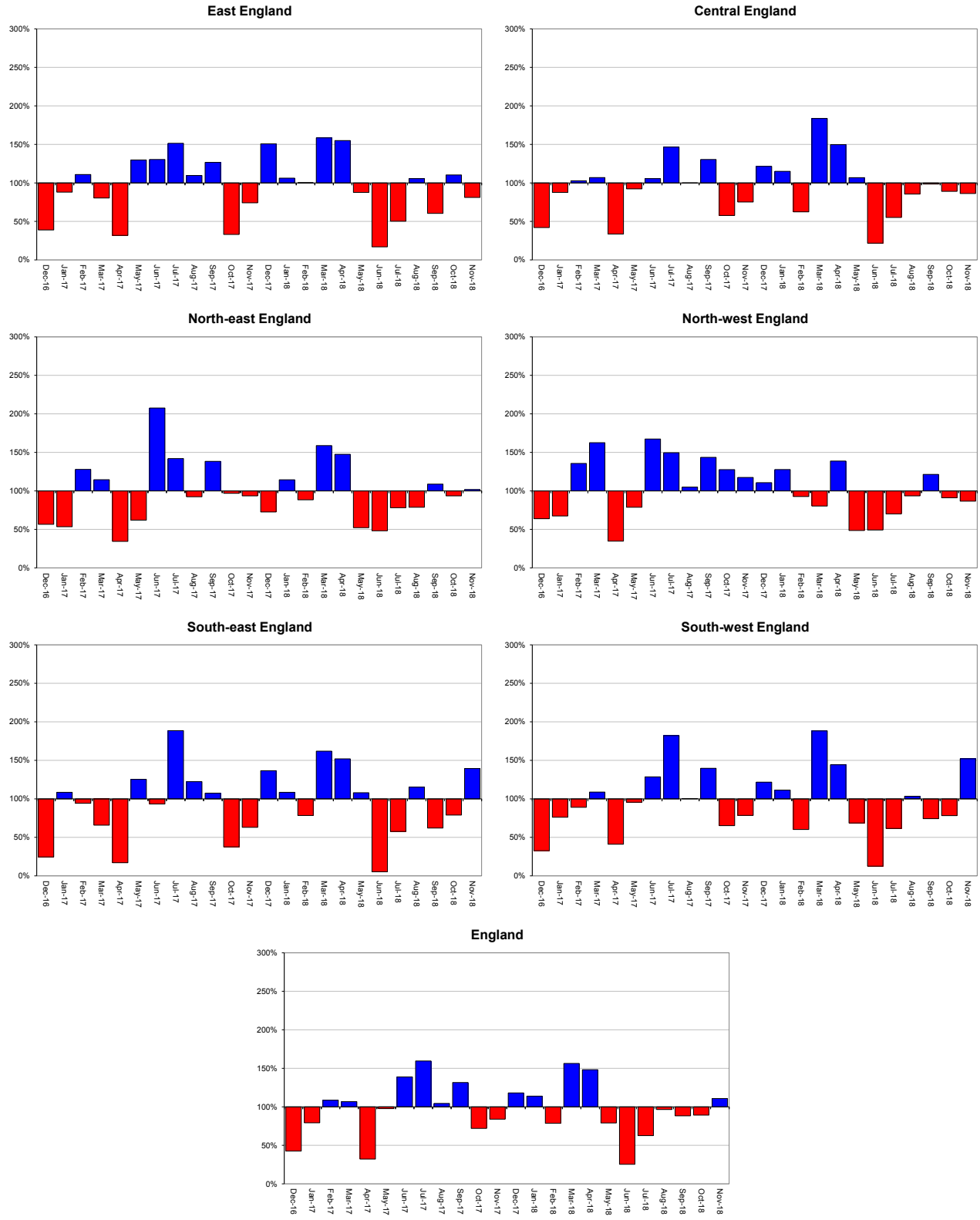


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2018).

Soil moisture deficit

End of October 2018[1]	End of November 2018[2]

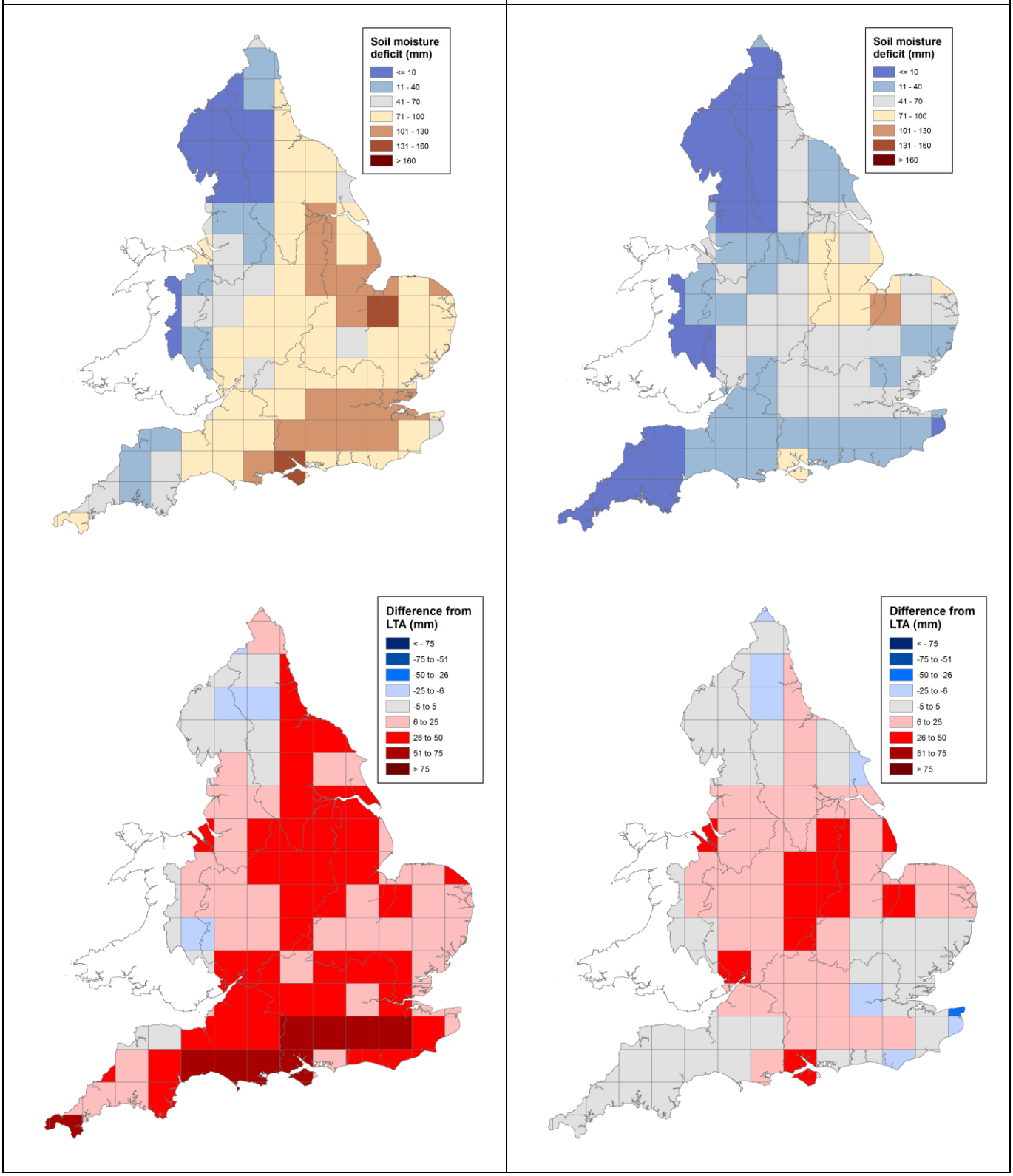


Figure 2.1: Soil moisture deficits for weeks ending 30 October 2018 [1] (left panel) and 28 November 2018 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2018). Crown copyright. All rights reserved. Environment Agency, 100026380, 2018

Soil moisture deficit charts

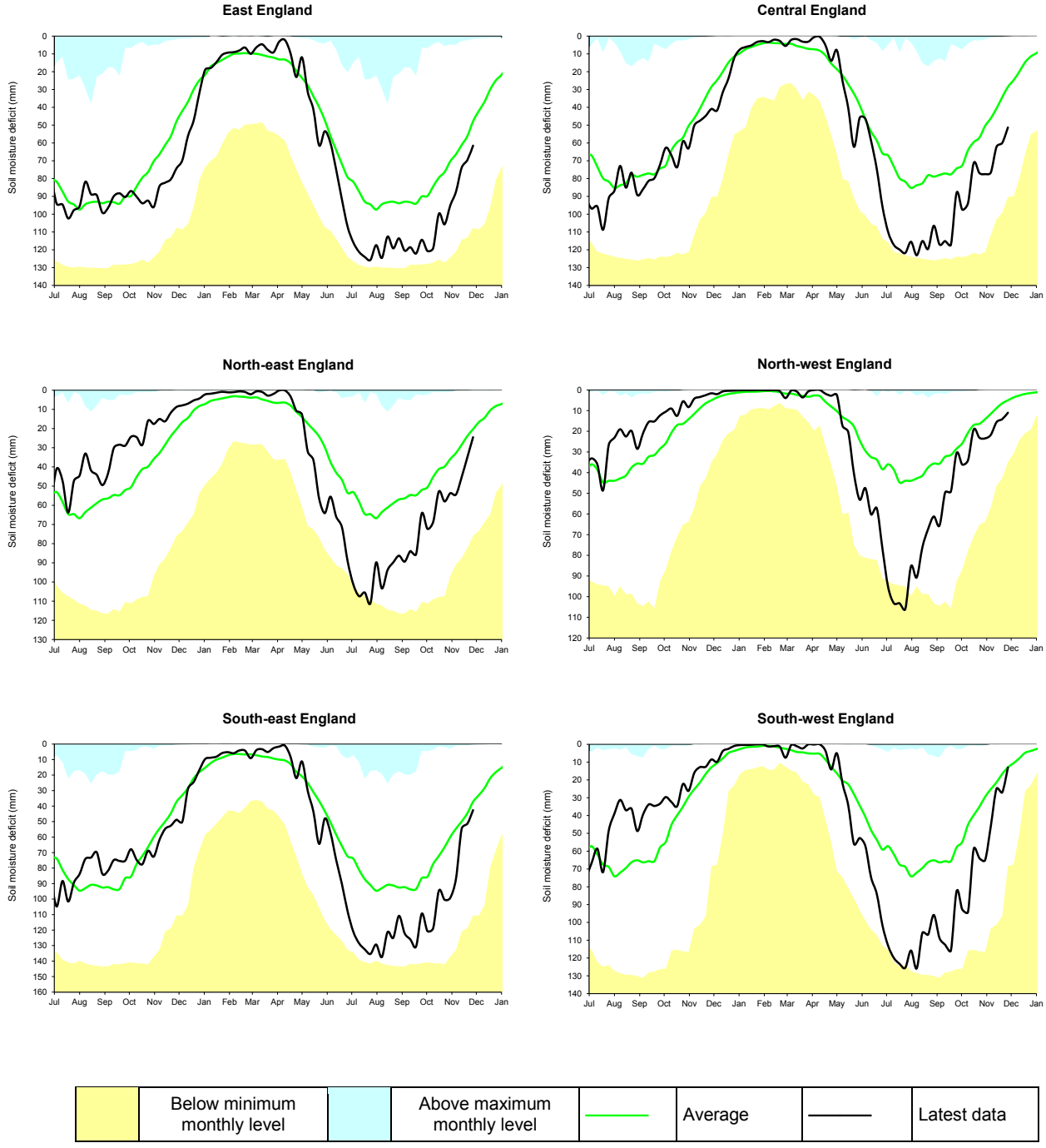
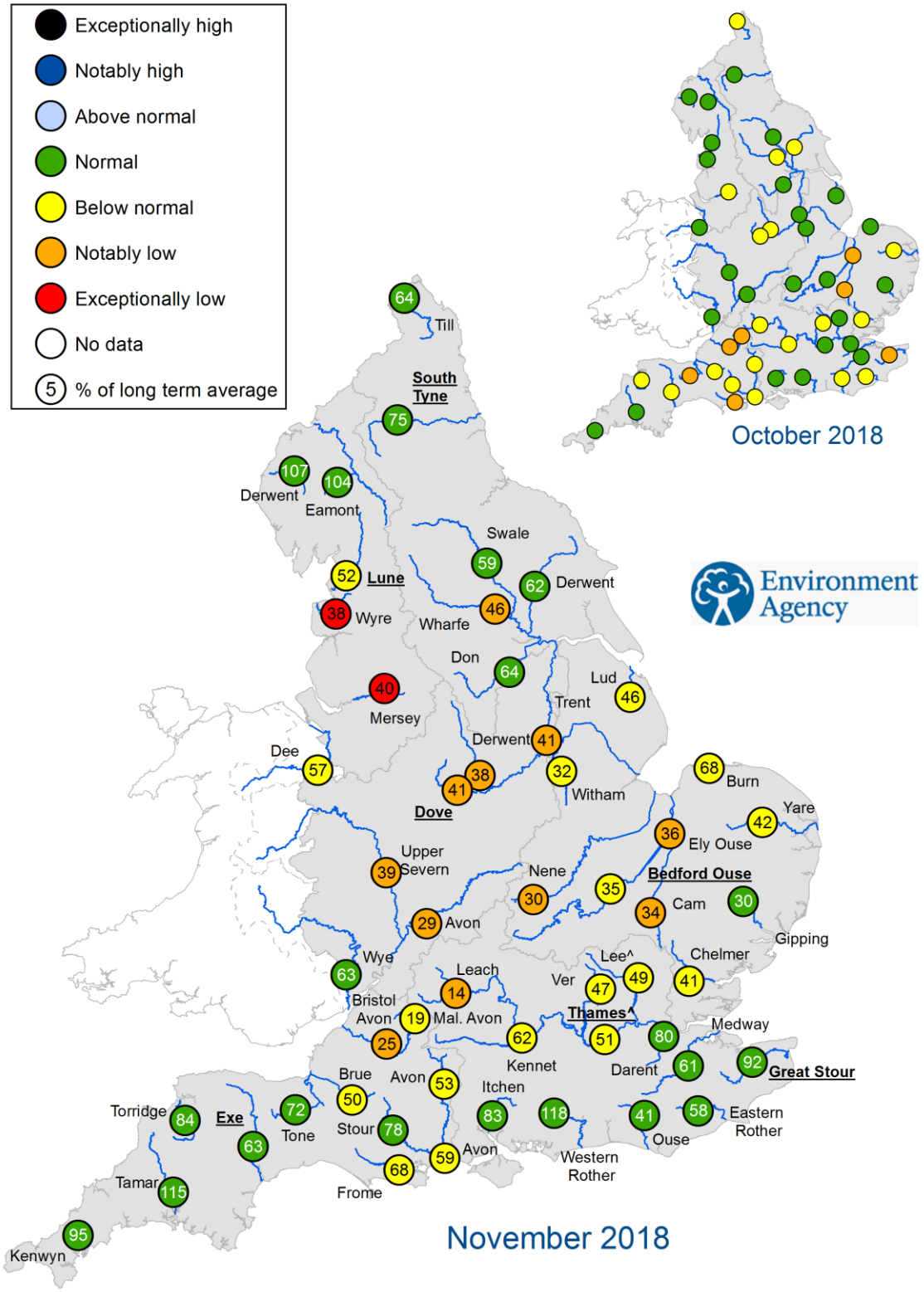


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2018).

River flows



^ "Naturalised" flows are provided for the River Thames at Kingston and the River Lee at Feildes Weir
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 October 2018 and November 2018, expressed as a percentage of the respective long term average and classed relative to an analysis of historic October and November monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

River flow charts

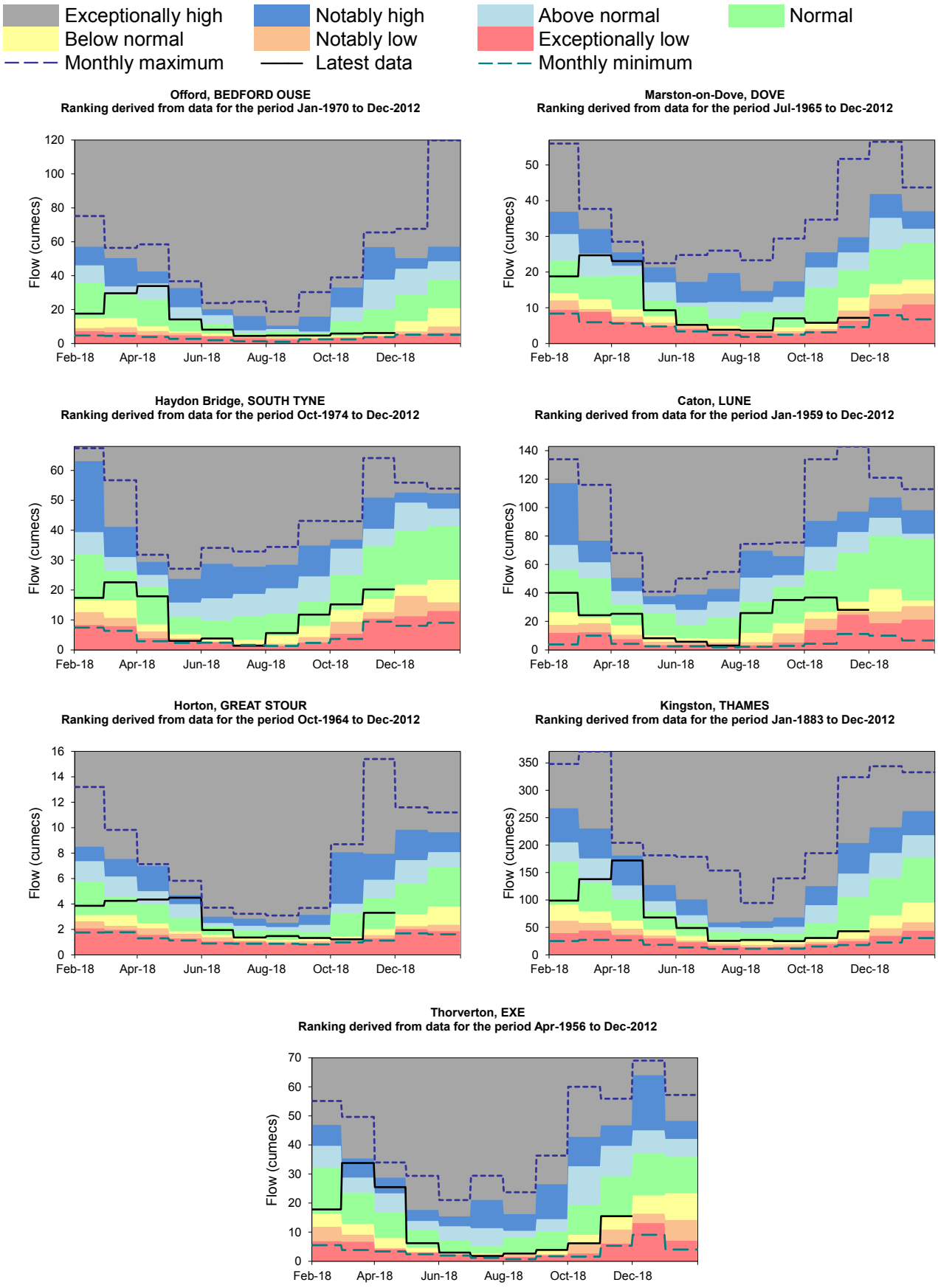
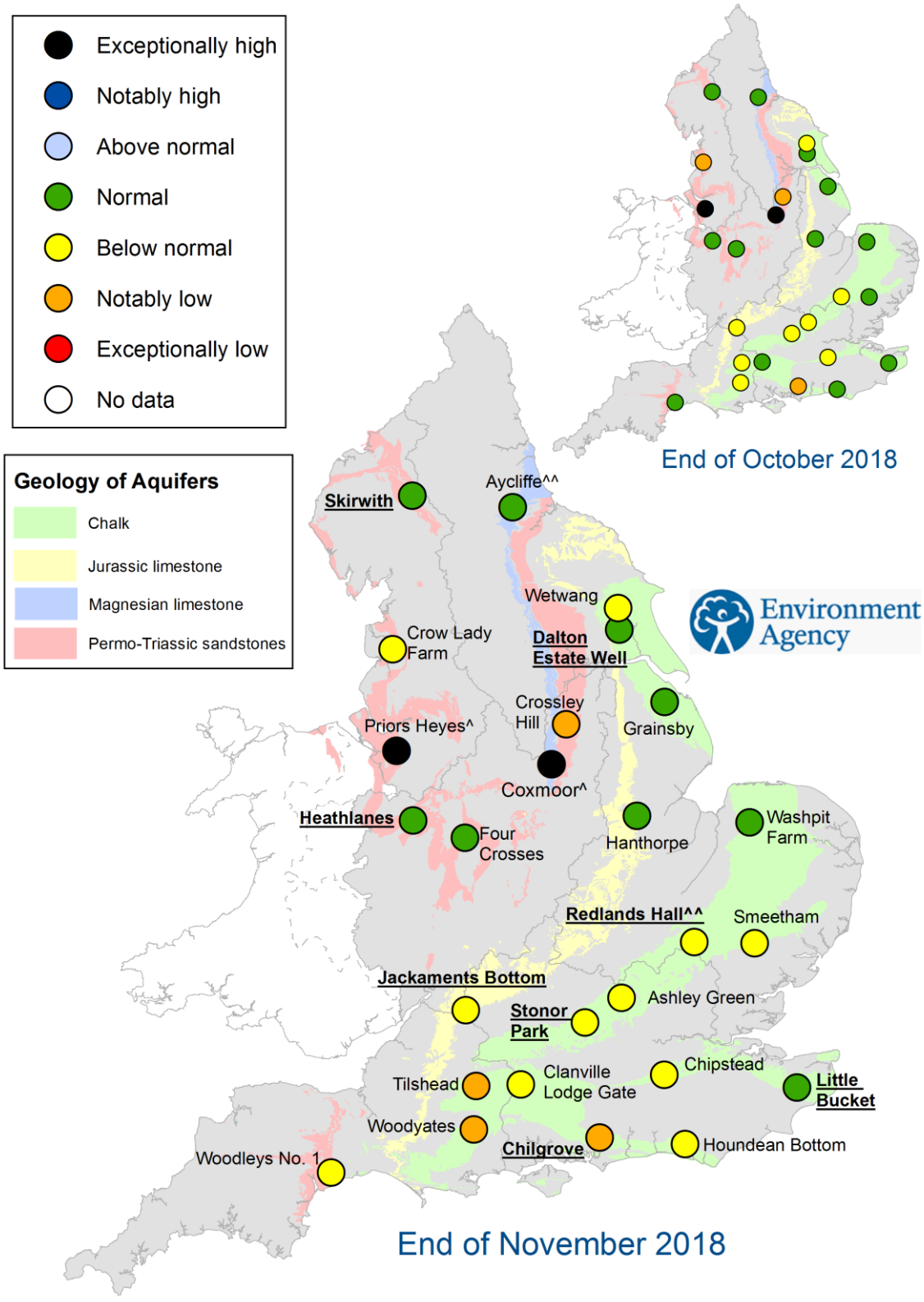


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
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 October 2018 and November 2018, classed relative to an analysis of respective historic October and November levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

Groundwater level charts

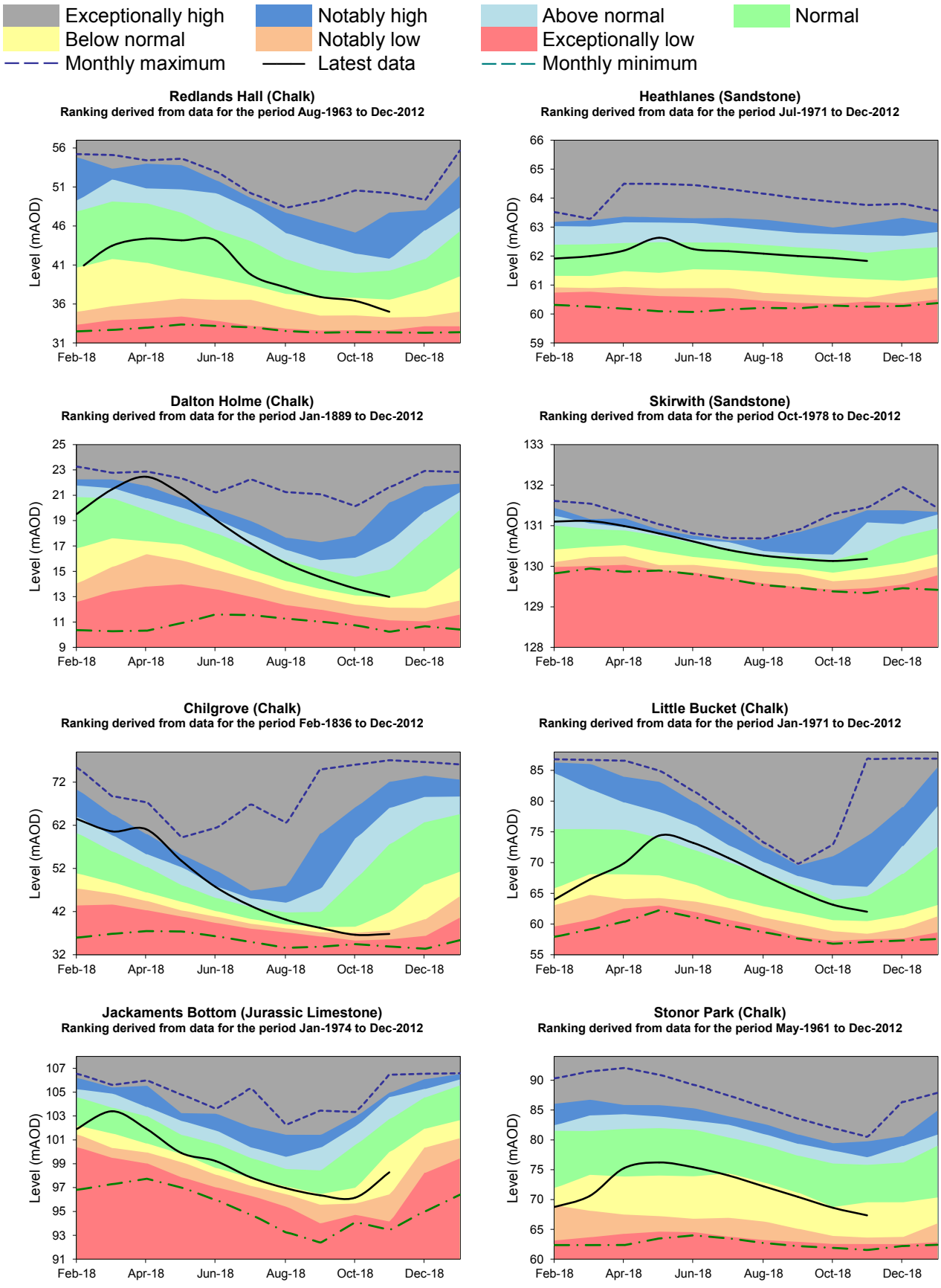
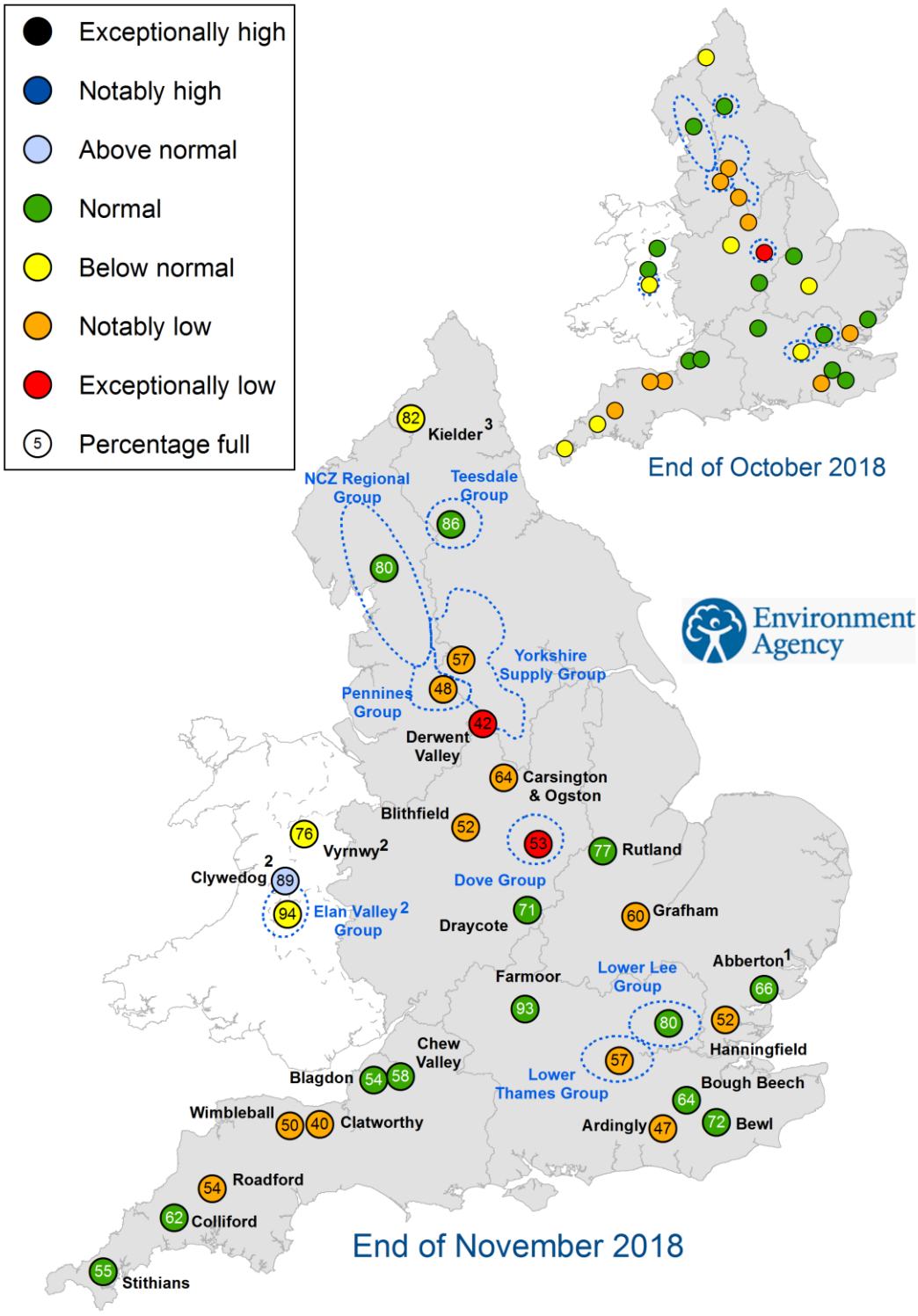


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2018).

Reservoir storage



1. Current levels at Abberton Reservoir in east England are relative to increased capacity
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 at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of October 2018 and November 2018 as a percentage of total capacity and classed relative to an analysis of historic October and November 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

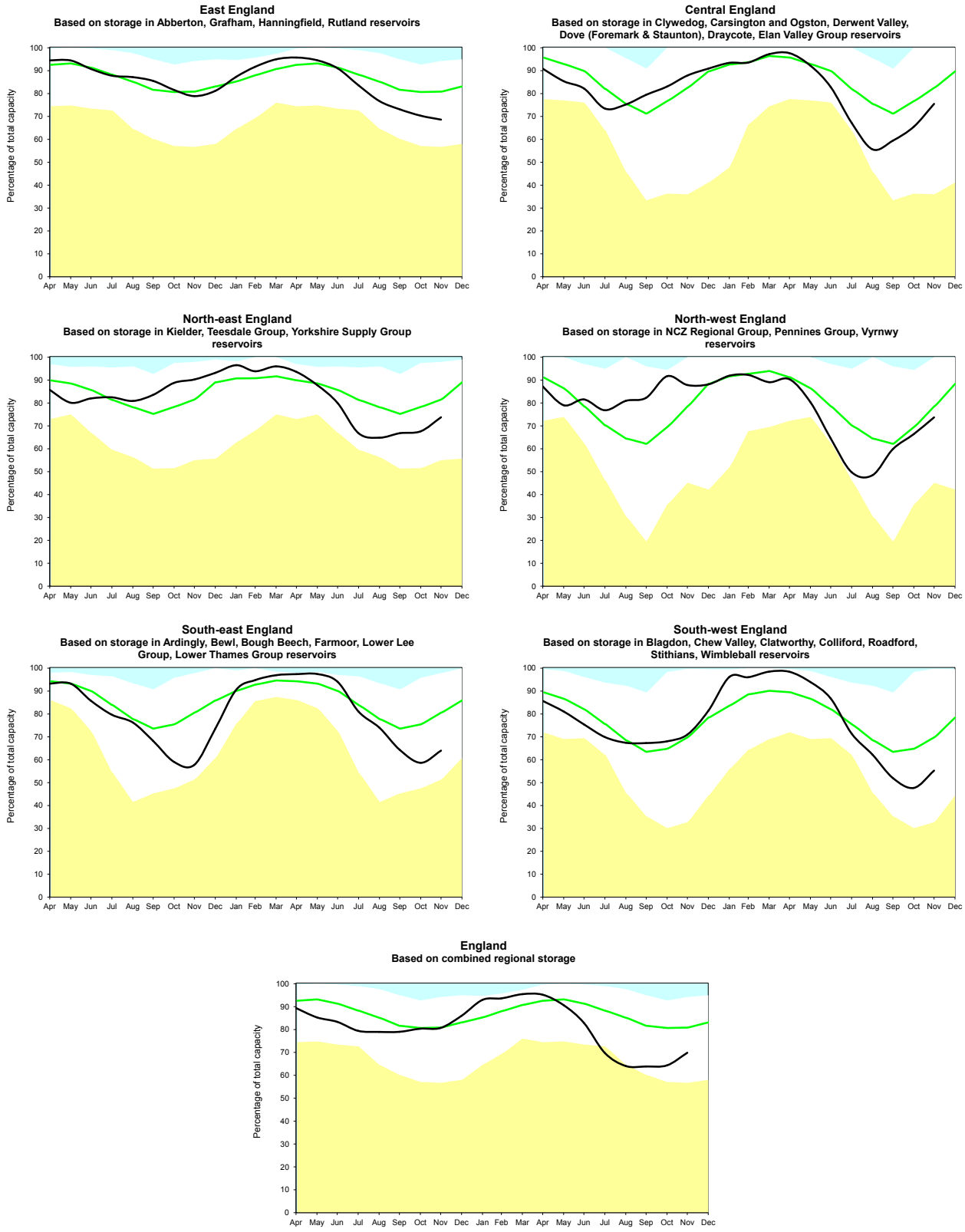


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

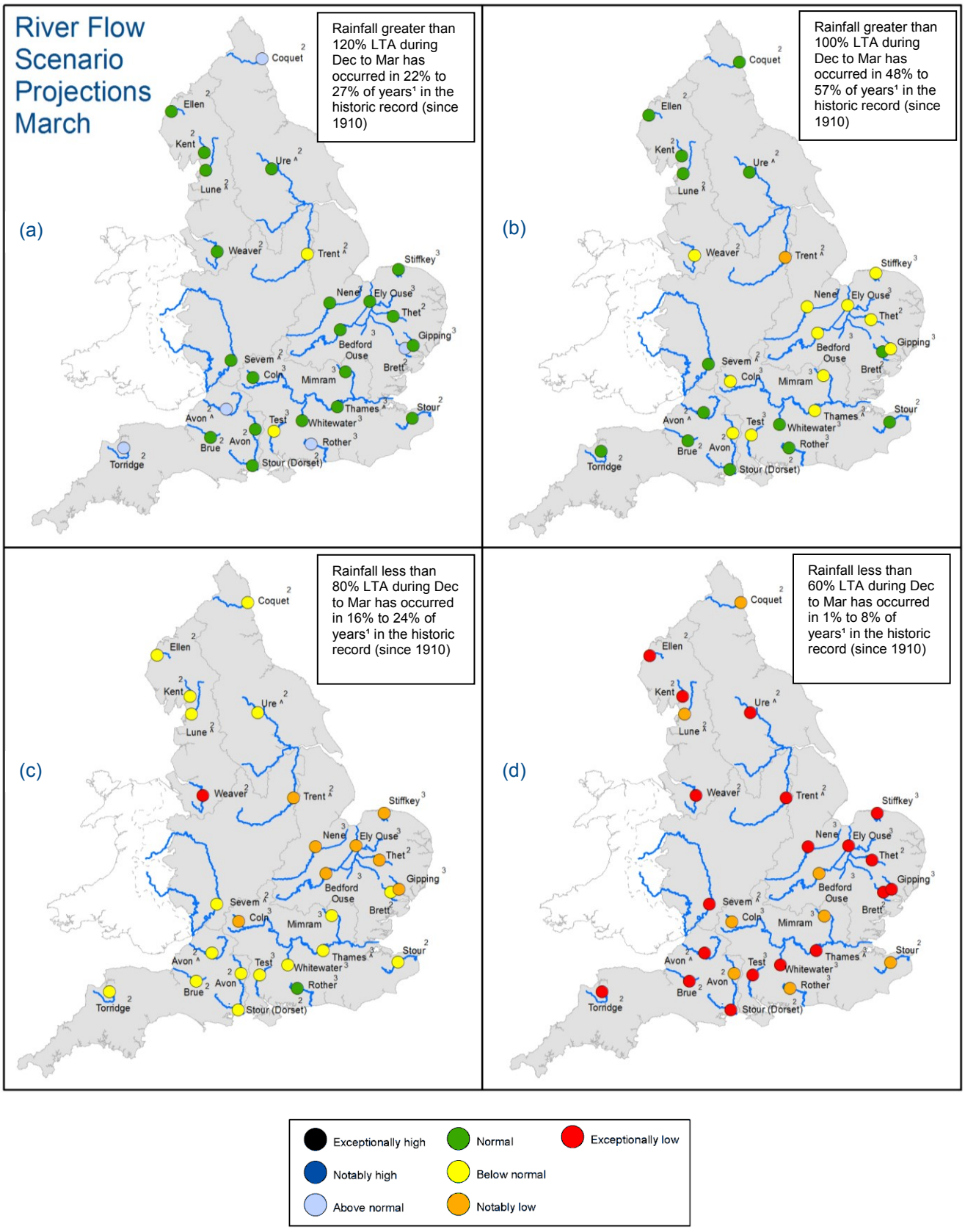
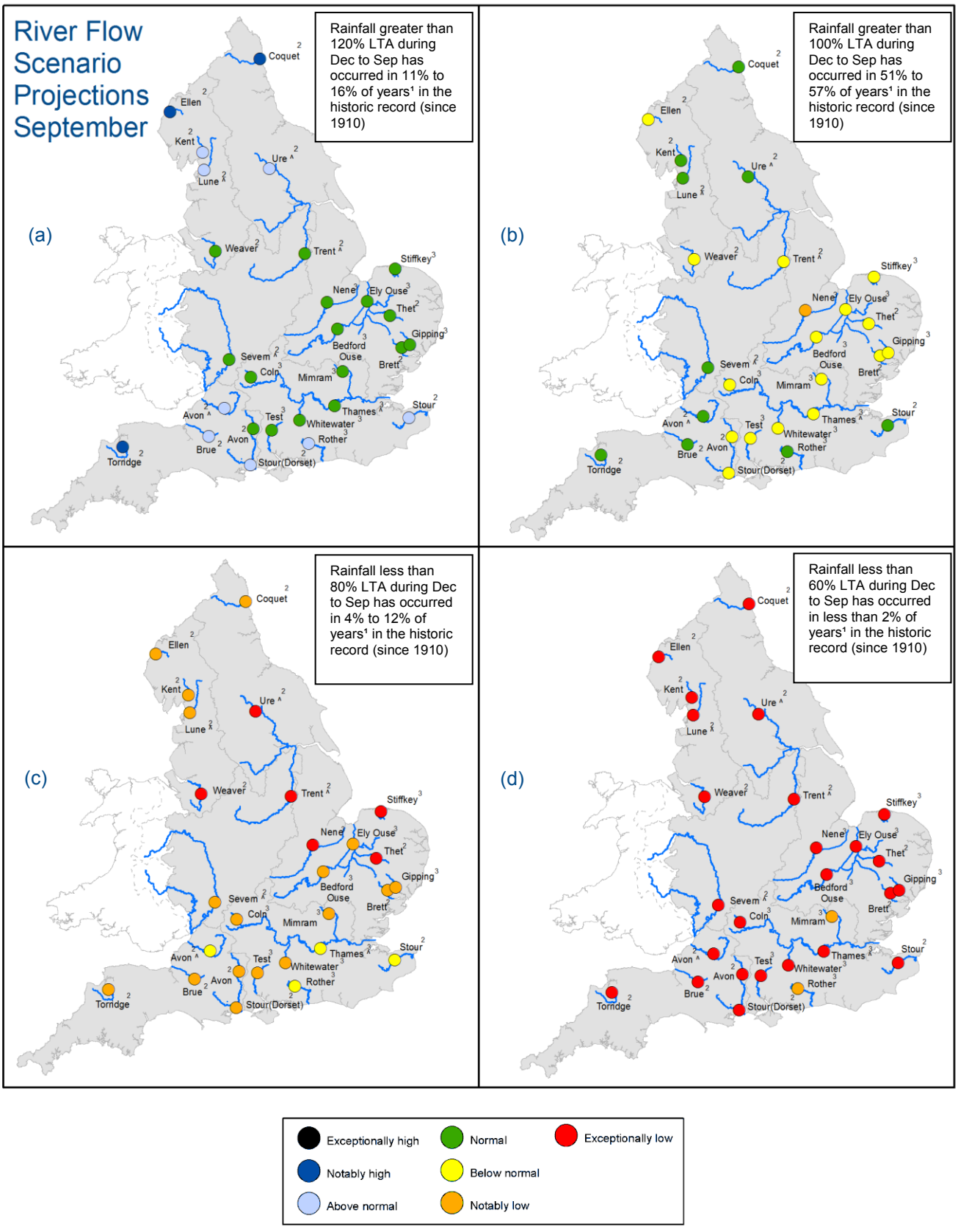


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2018 and March 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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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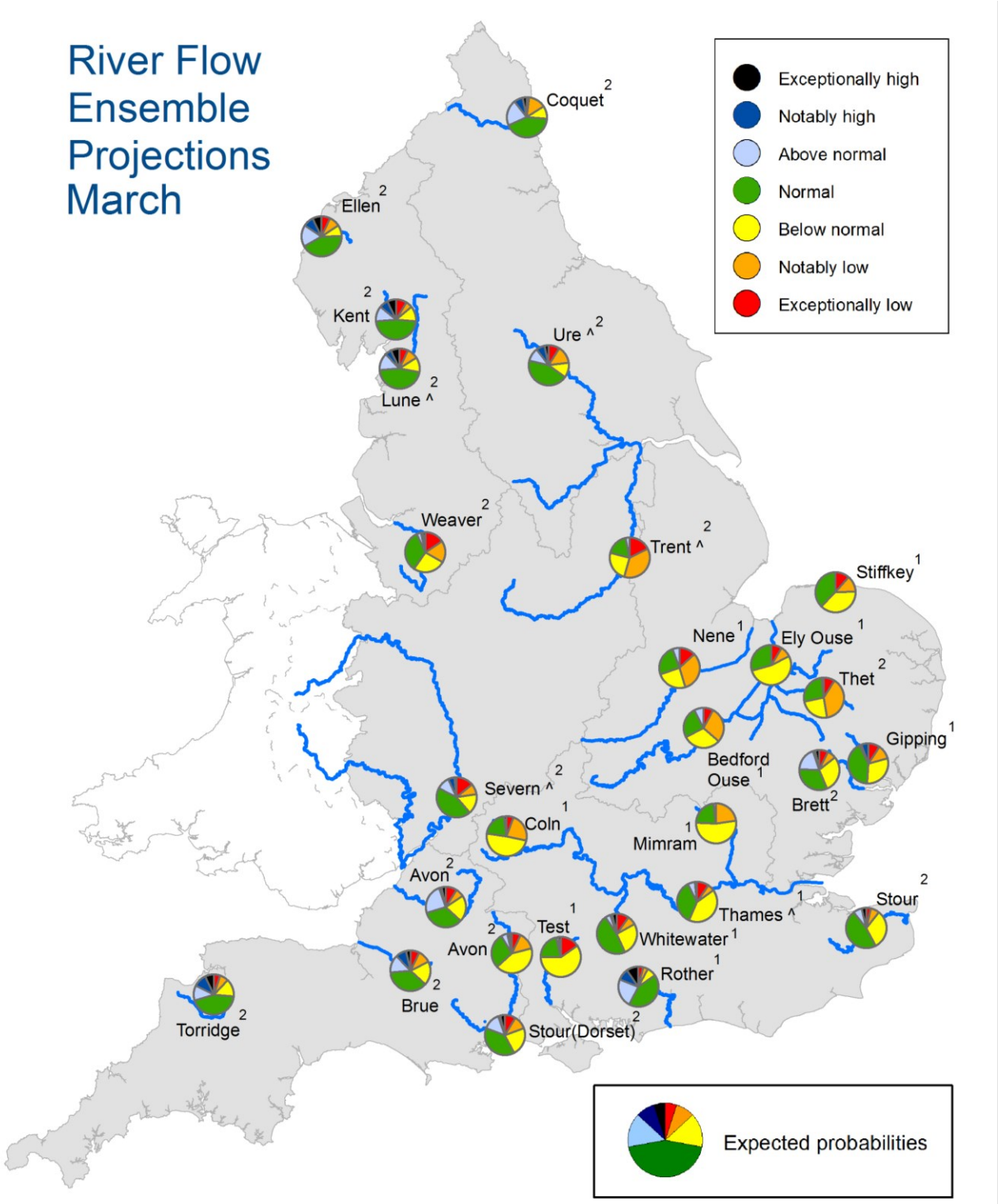

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2019. 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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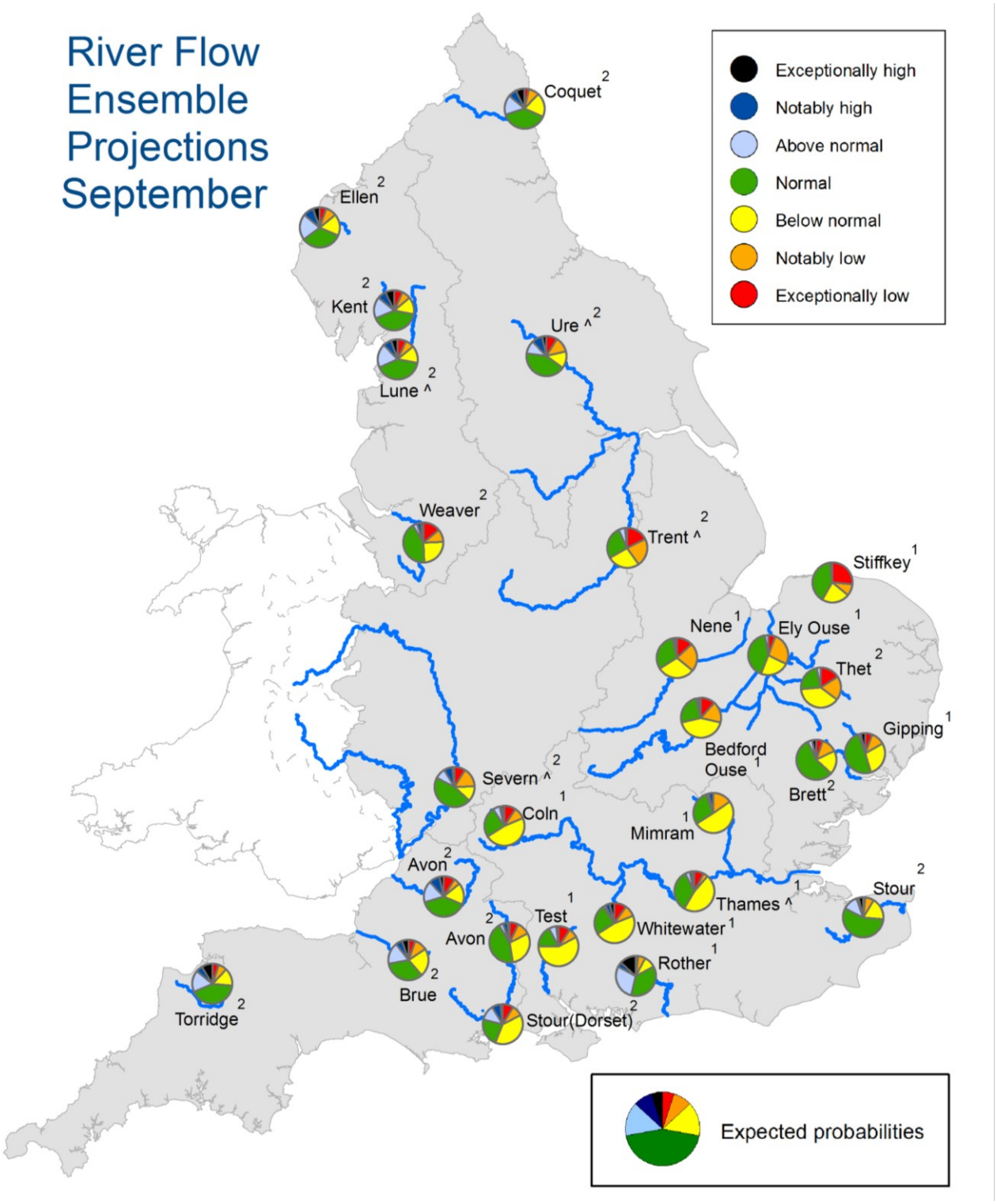

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2019. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for 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

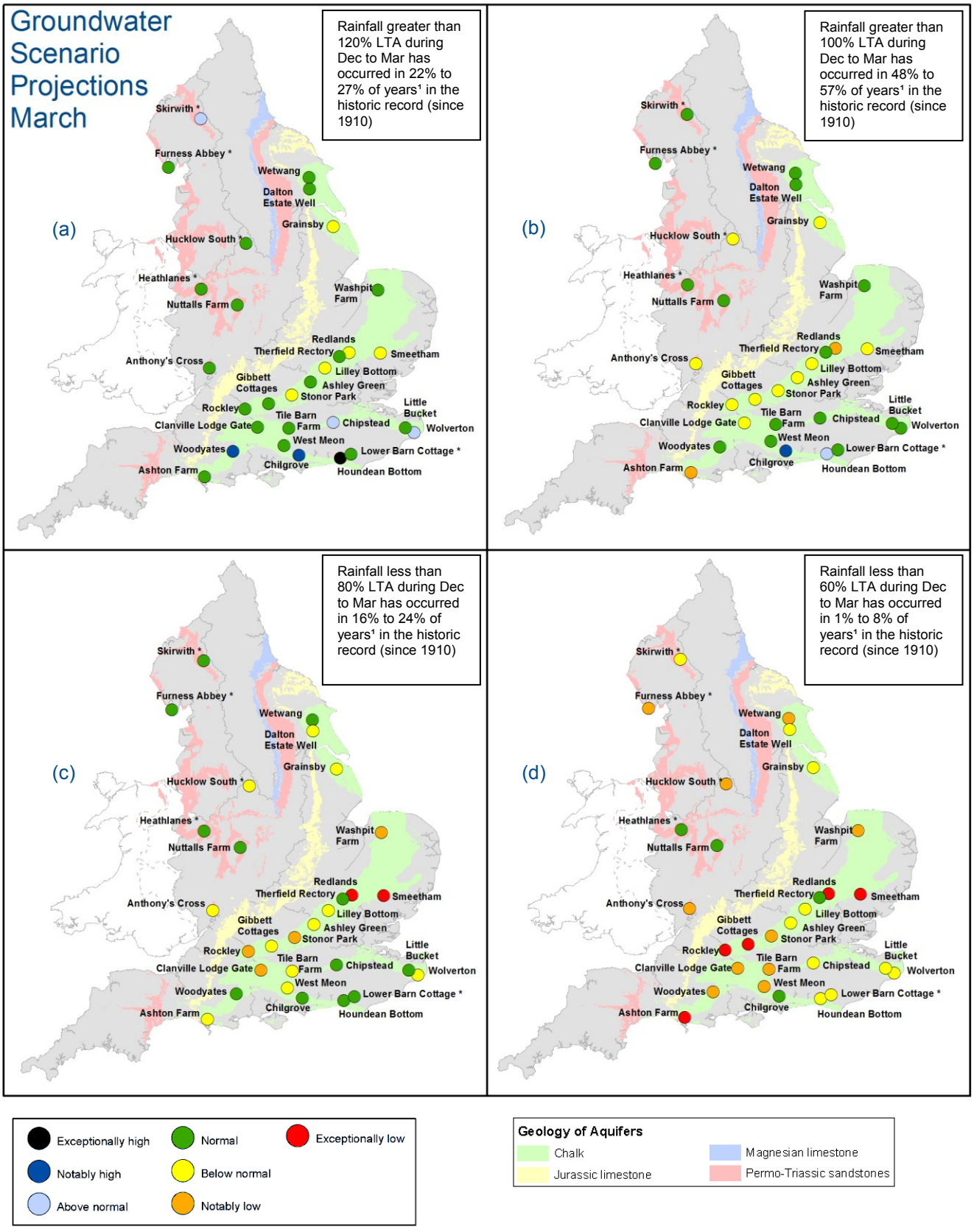

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2018 and March 2019 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2018.

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[1] This range of probabilities is a regional analysis

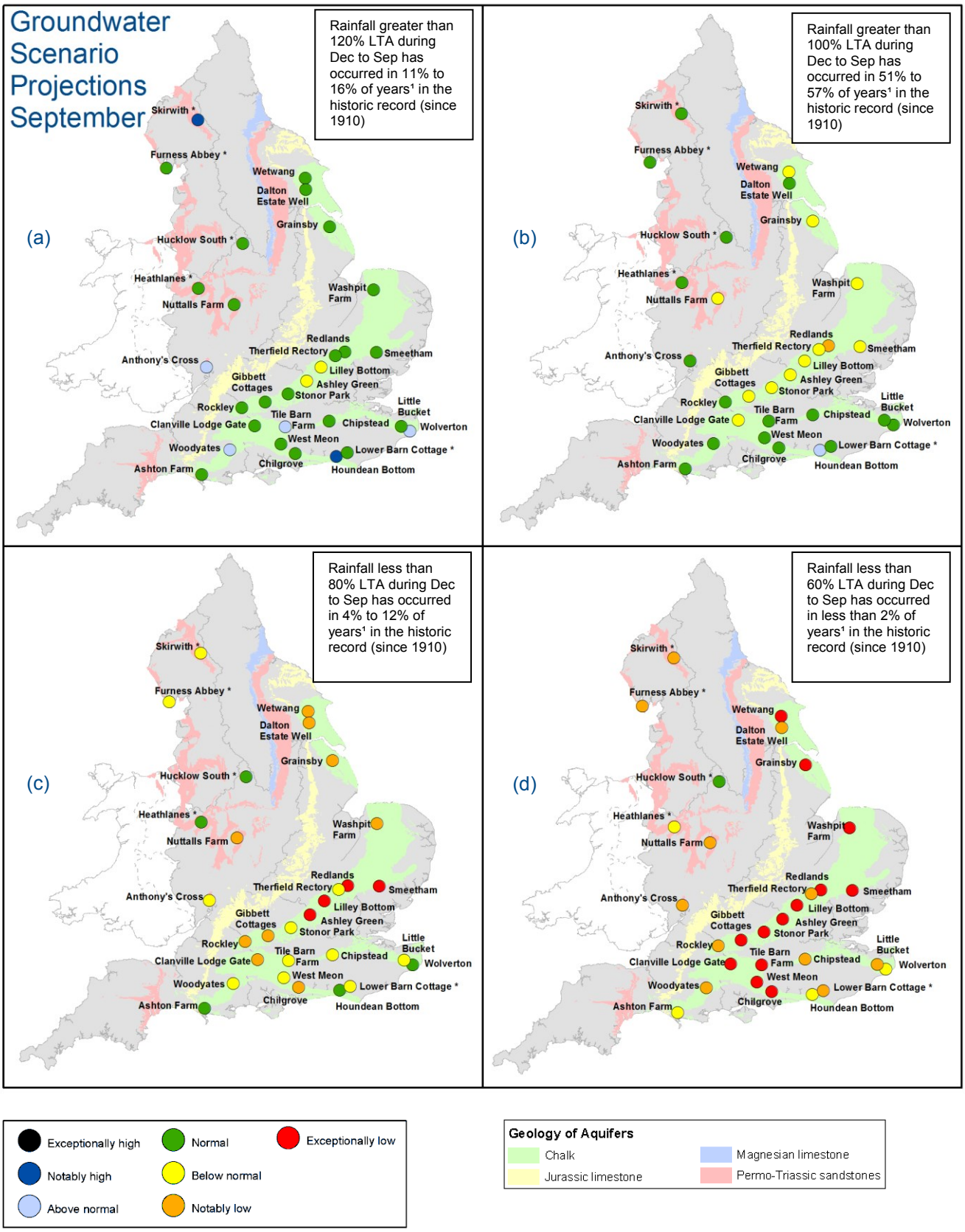

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2018 and September 2019 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2018.

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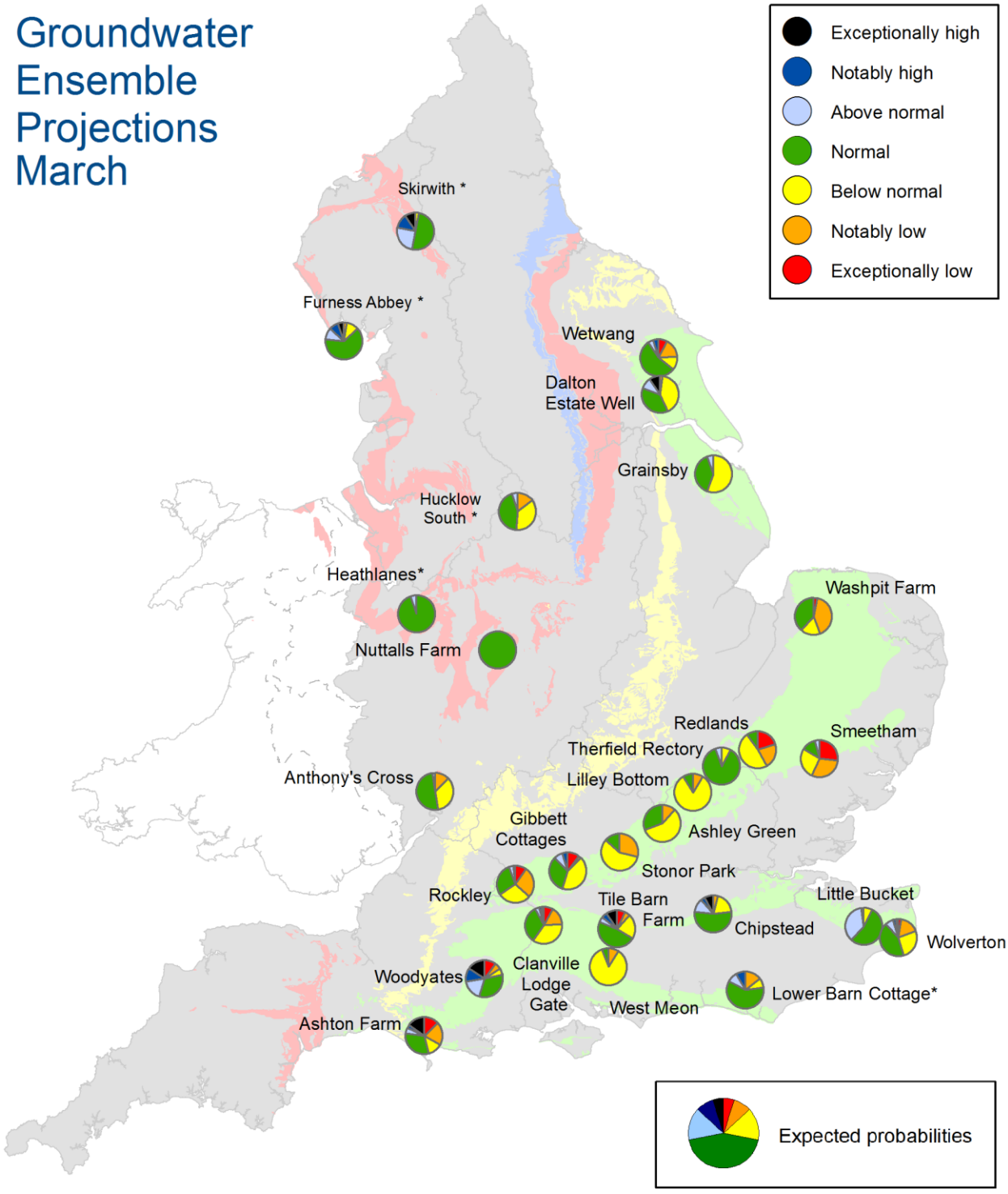

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2019. 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, 100026380, 2018.

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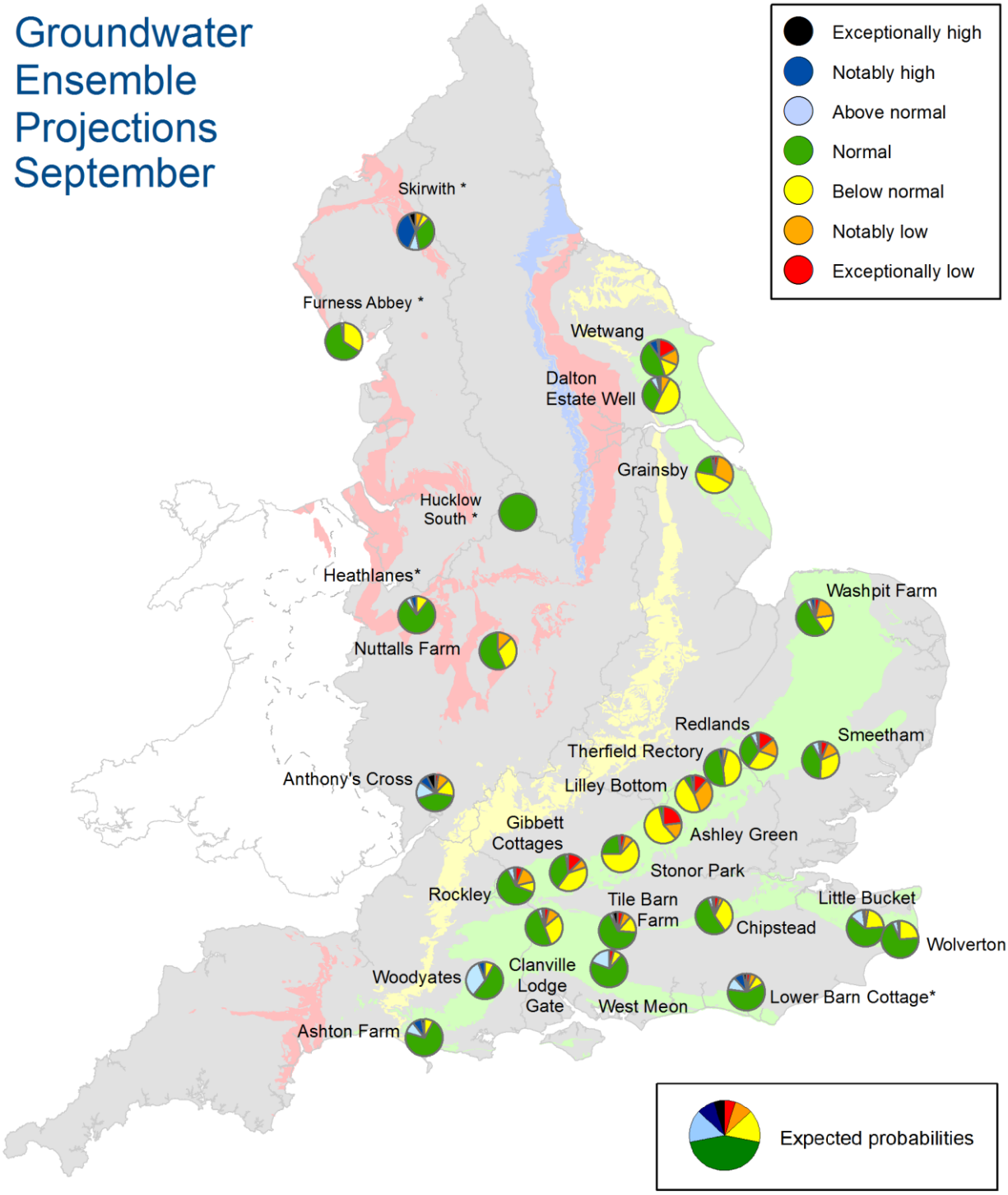

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2019. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for 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, 100026380, 2018.

* 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 1961-1990, 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