Monthly water situation report

England

Summary – March 2017

March rainfall totals were slightly above the long term average (LTA) across England as a whole, at 105%. However, at a hydrological area scale, rainfall totals varied widely, ranging from exceptionally high in parts of Cumbria (at almost twice the LTA) to below normal in parts of south-east England (at close to a third of the LTA). Soils remained close to saturation across much of England, although soil moisture deficits were starting to build in the east and south-east of England at the end of March. Monthly mean river flows for March decreased at just over half of indicator sites across England compared with February, although the majority of sites were classed as normal or higher for the time of year. Groundwater levels increased at nearly two-thirds of indicator sites during March and end of month levels were normal or higher at just over half of sites. Reservoir stocks increased or remained unchanged at all but four of the reported reservoirs or reservoir groups, with end of month stocks normal or higher for the time of year at nearly three quarters of sites. Overall reservoir storage for England increased to 95% of total capacity.

Rainfall

In a similar pattern to February, March rainfall totals were highest in the north-west and far south-west of England and lowest in the south and east. Totals exceeded 150mm across parts of Cumbria, Lancashire, Devon and in the head waters of some Welsh cross-border catchments, whilst parts of Kent and Essex received less than 20mm (Figure 1.1). It was the wettest March on record since 1910 in the Esk catchment in Cumbria and the third wettest March in the adjacent Derwent catchment.

Rainfall totals were below the long term average (LTA) for March across nearly two thirds of the hydrological areas in England, with those in the eastern part of Kent receiving less than 40% of the LTA. In contrast, rainfall totals across parts of Cumbria exceeded 175% of the LTA. Rainfall totals were classed as normal for the time of year across a central swathe of England, whilst much of north-east and north-west England and parts of Devon and Cornwall ranged from above normal to exceptionally high. Rainfall totals in the far south-east of England were classed as below normal for the time of year. The 3-month accumulations to March were largely normal across England, whilst the 6-month and 12-month accumulations were generally below normal or notably low across much of England. The 12-month accumulations remain the second driest on record since 1910 in the Teign and Torbay hydrological area (the driest since 1975/6) and the West Somerset Streams hydrological area (the driest since 1933/4) (Figure 1.2).

March rainfall totals ranged from 71% of the LTA in the south-east of England to 150% in the north-west. Across England as a whole, monthly rainfall totals were slightly above the 1961-90 LTA for March at 105% (110% of the 1981-2010 LTA) (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) increased slightly across England by the end of March, compared to the end of February. However, soils remained close to saturation across the north and west of England with SMDs less than 10mm. Soils were slightly drier across the east and south-east of England at the end of March, with SMDs ranging from 11 to just over 40mm. SMDs were close to the LTA for March across much of England, but up to 25mm drier than the LTA across parts of the east and south-east of the country (Figure 2.1).

At a regional scale, soils were slightly drier at the end of March than at the end of February, with end of month SMDs ranging from 4mm in north-west England to 15mm in east England. Soils were slightly drier than average across all regions except north-east and central England (Figure 2.2)

River flows

Compared to February, monthly mean flows for March decreased at just over half of indicator sites, which were mainly located in the south and east of England. Flows were classed as normal or higher for the time of year at the majority of sites, with four sites across northern England being notably high. In contrast, flows at five sites in south-east England and one in the south-west were below normal for the time of year, whilst the Great Stour in Kent and the naturalised flows on River Lee in Hertfordshire were notably low (Figure 3.1). At the regional index sites, monthly mean river flows were ranged from notably high for the time of year on the South Tyne in north-east England to notably low on the Great Stour in south-east England (Figure 3.2).

Groundwater levels

Groundwater levels increased at nearly two-thirds of indicator sites during March as recharge continued to reach the water table in many aquifers, however levels have started to recede in some of the faster responding limestone and chalk aquifers (Figures 4.1). End of month groundwater levels were normal or higher for the time of year just over half of indicator sites, whilst the remaining sites were below normal or notably low for the time of year.

End of month groundwater levels at the major aquifer index sites ranged from notably low at Little Bucket (East Kent Stour chalk aquifer) to normal for the time of year at Heathlanes (Shropshire Middle Severn sandstone aquifer), Skirwith (Carlisle Basin and Eden Valley sandstone aquifer), Dalton Holme (Hull and East Riding chalk aquifer) and Chilgrove (Chichester chalk aquifer) (Figure 4.2).

Reservoir storage

During March, reservoir stocks increased or remained unchanged at almost all reported reservoirs or reservoir groups. Notable increases of between 10 and 20% occurred at Hanningfield, Ardingly, Blagdon, Chew Valley and Wimbleball reservoirs and the NCZ Regional reservoir group. Decreases in storage were 2% or less. At the end of the month, 7 reservoirs were full and a further 9 were above 95% of total capacity. End of month stocks were classed as normal or higher for the time of year at nearly three quarters of reservoirs and reservoir groups, with the remaining sites being below normal or lower (Figure 5.1).

Reservoir stocks increased in all regions compared to the end of February. End of March stocks ranged from 87% of total capacity in south-west England to 97% in north-east England. Overall storage for England increased to 95% of total capacity (Figure 5.2).

Forward look

Weather conditions during April are likely to be a mix of more settled, drier periods as high pressure dominates, interspersed with periods of rain and showers as low pressure systems move across England. The dry weather early in the month is likely to give way to more unsettled weather mid-month, particularly in northern England. It is possible that this will be replaced by more settled and drier conditions again towards the end of the month. Across the UK ,over the 3 month period April to June, below average precipitation is slightly more probable than above average precipitation[1].

Projections for river flows at key sites[2]

There is a greater than expected chance of cumulative river flows being notably low or lower at around a third of the modelled sites by the end of September 2017, and a greater than expected chance of cumulative river flows being below normal or lower at more than half of the modelled sites by March 2018.
For scenario based projections of cumulative river flows at key sites by September 2017 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2018 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2017 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2018 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

More than half of the modelled sites have a greater than expected chance of below normal or lower groundwater levels for the time of year at the end of September 2017 and end of March 2018.
For scenario based projections of groundwater levels in key aquifers in September 2017 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2018 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2017 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2018 see Figure 6.8

Authors: E&B 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

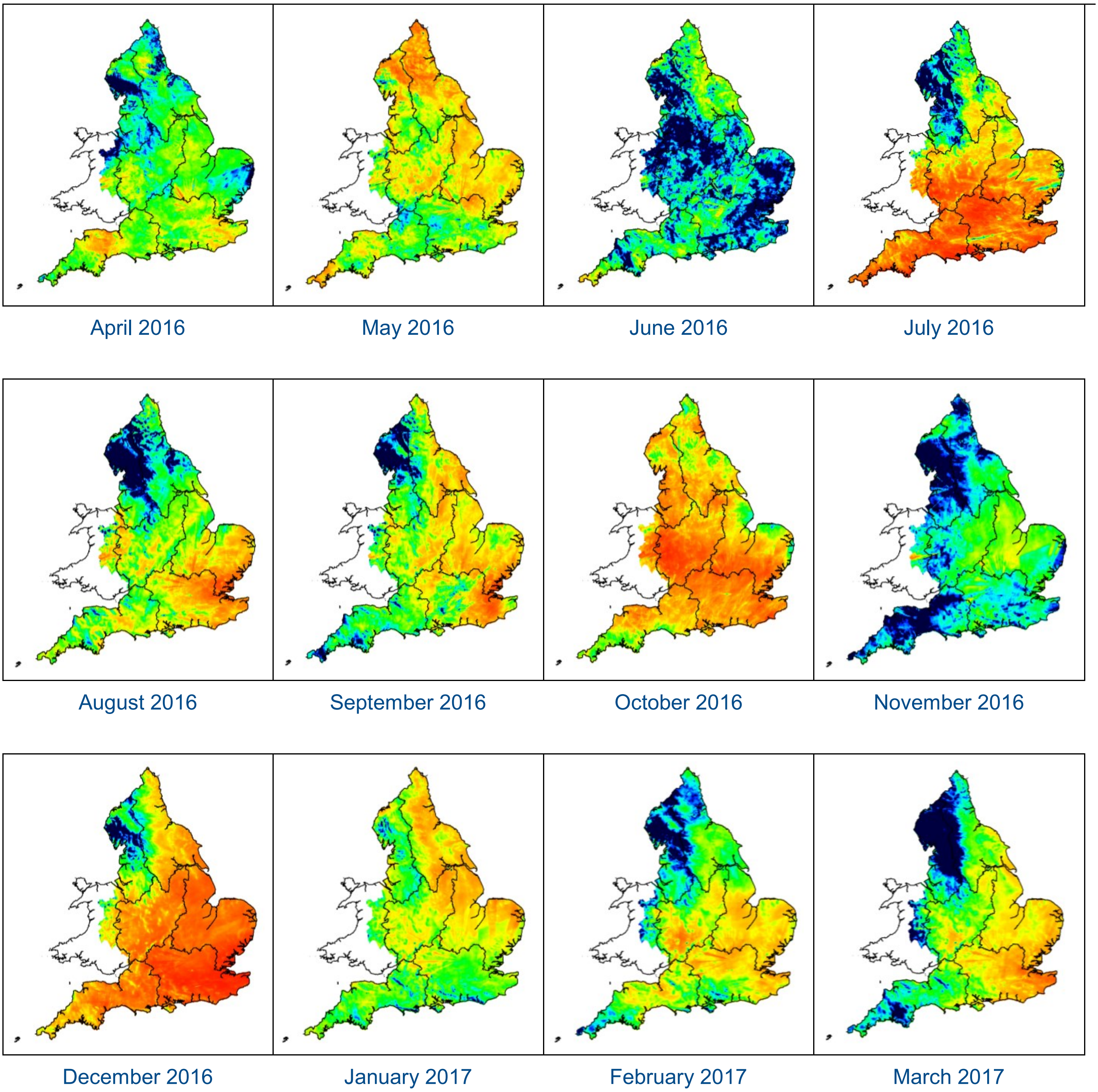
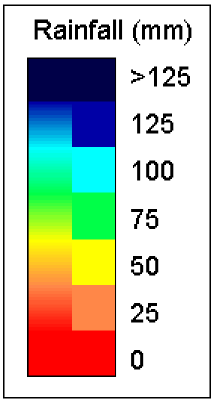


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2017). Note: Radar beam blockages in some regions may give anomalous totals in some areas.



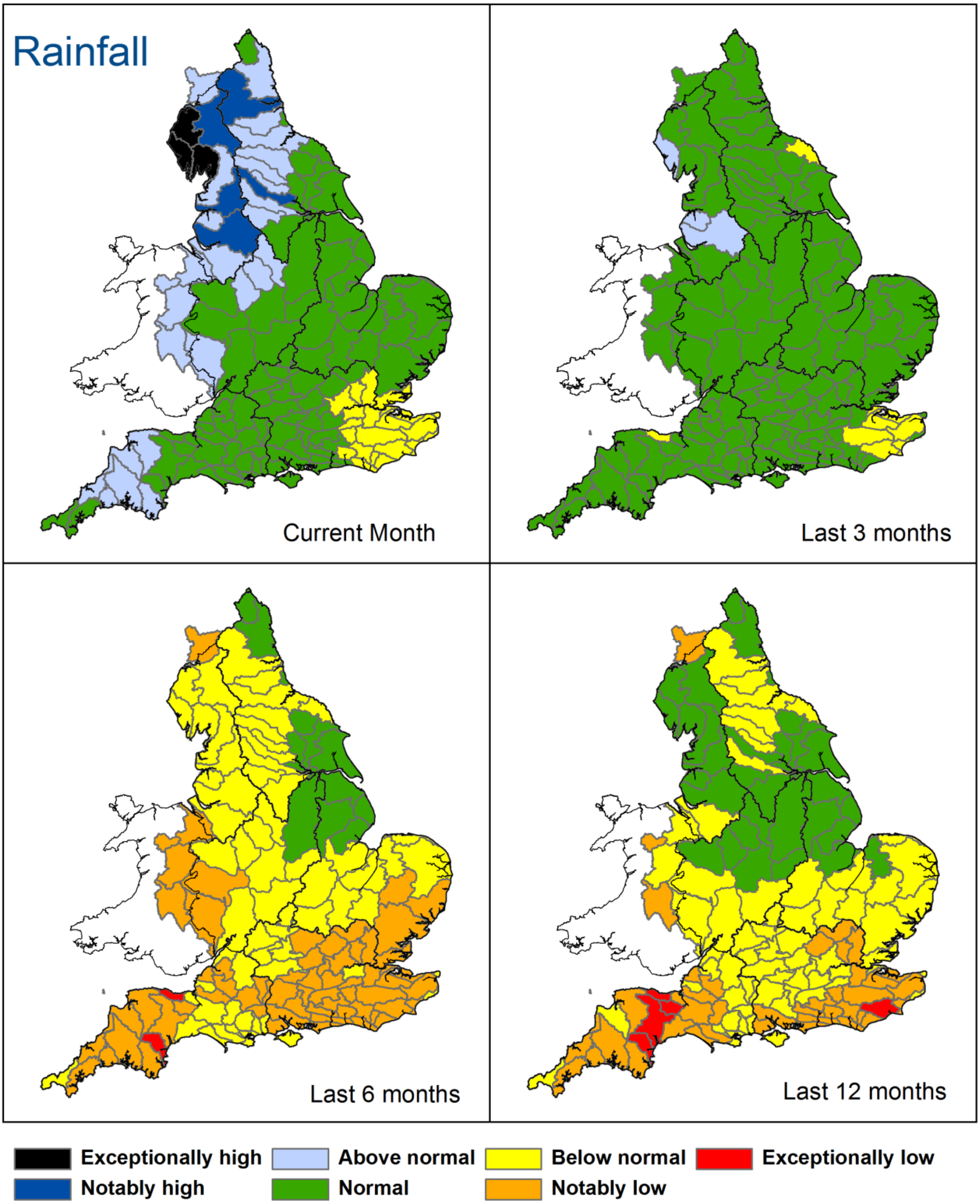


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 March), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2017).* 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, 2017.

Rainfall charts

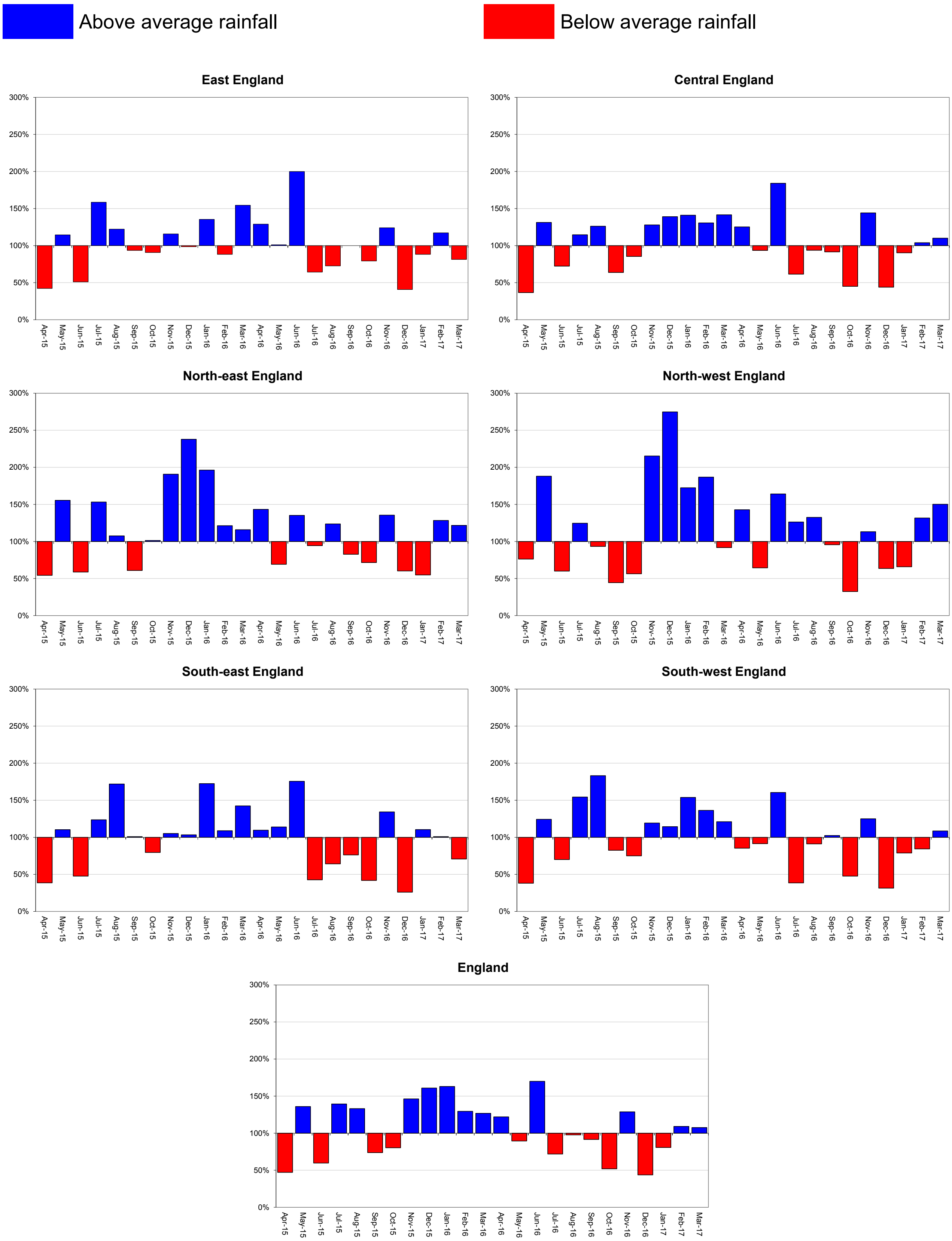


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2017).

Soil moisture deficit maps

End of February 2017[1]	End of March 2017[2]

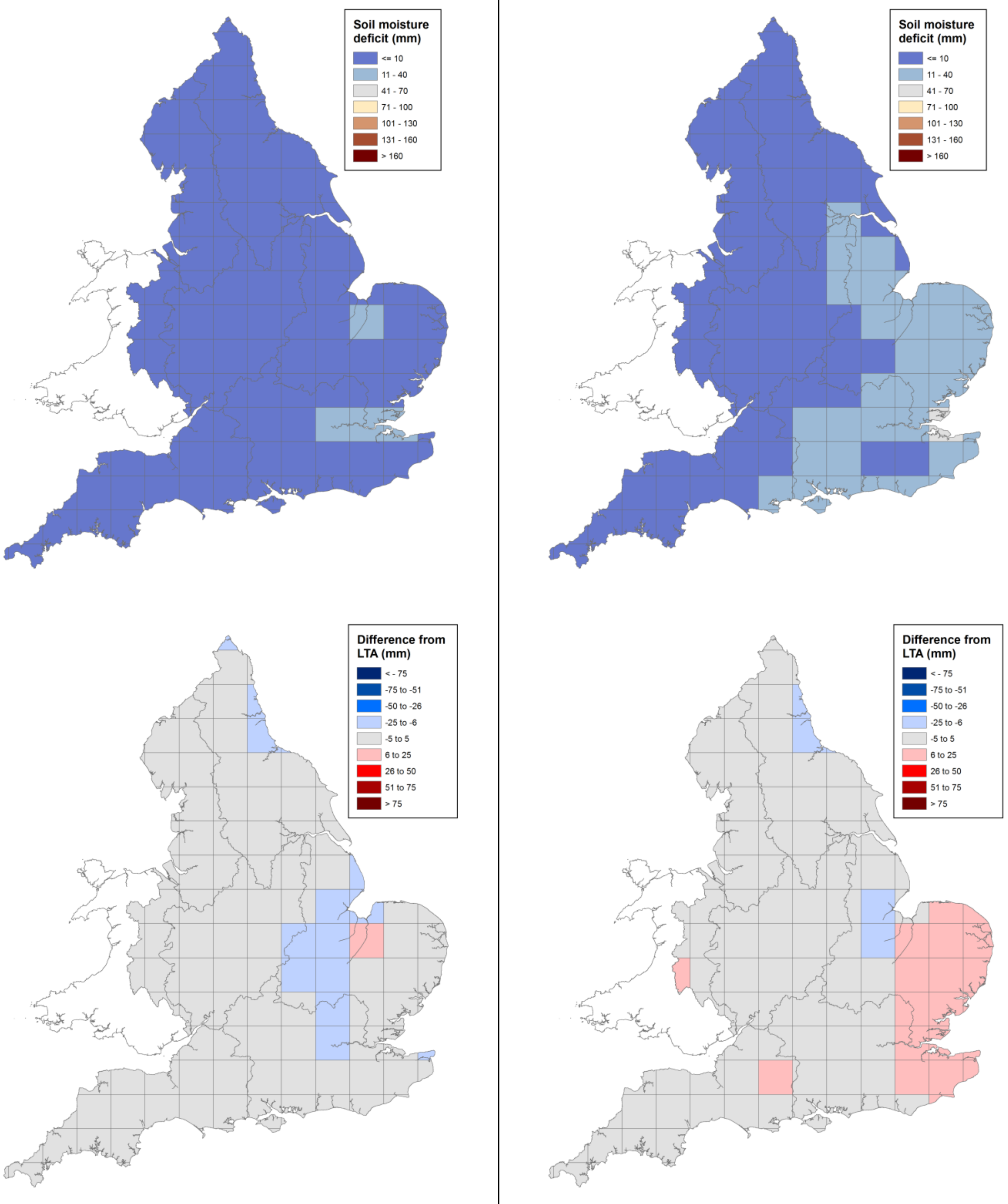


Figure 2.1: Soil moisture deficits for weeks ending 28 February 2017 [1] (left panel) and 28 March 2017 2017 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2017). Crown copyright. All rights reserved. Environment Agency, 100026380, 2017

Soil moisture deficit charts

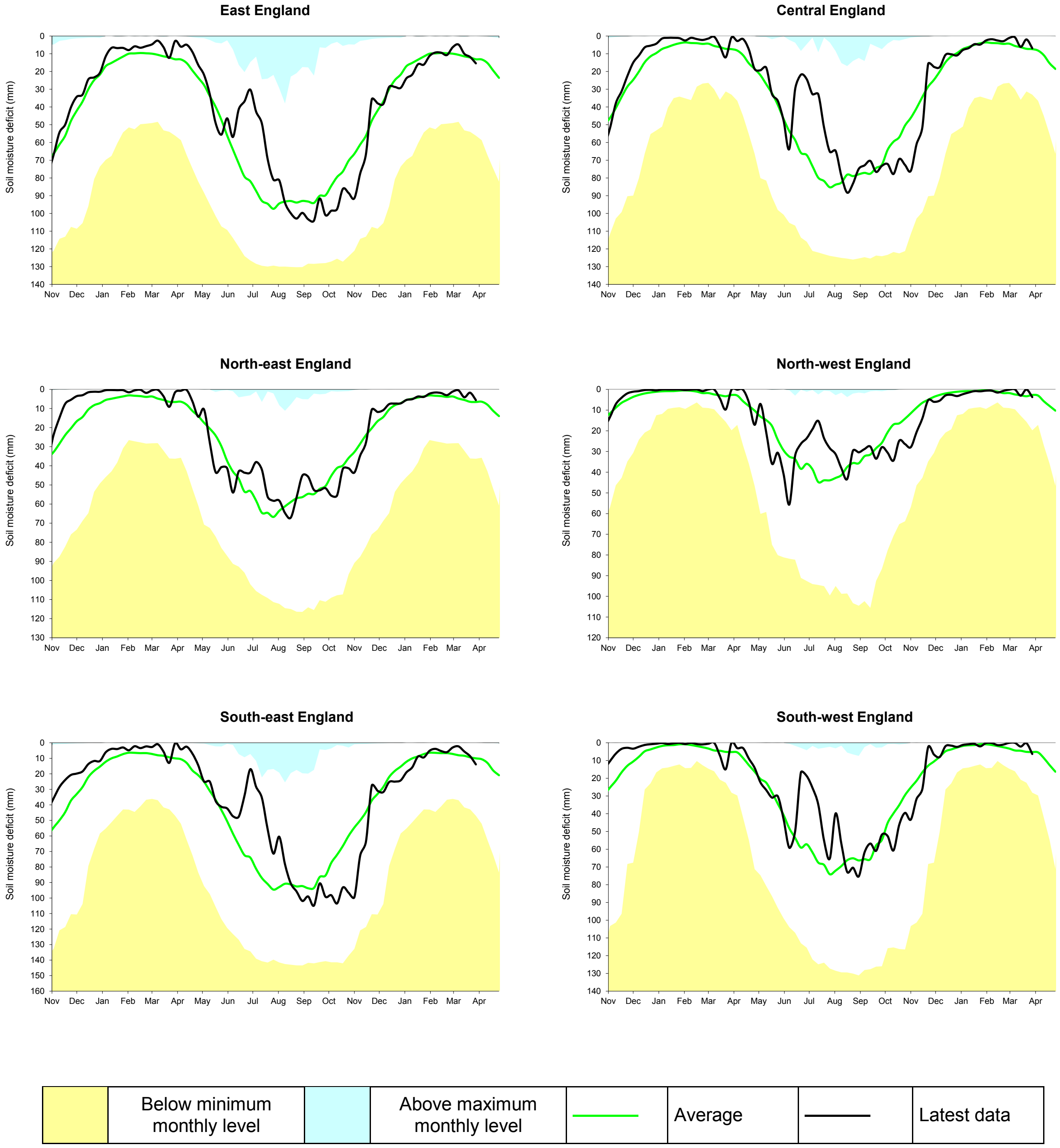
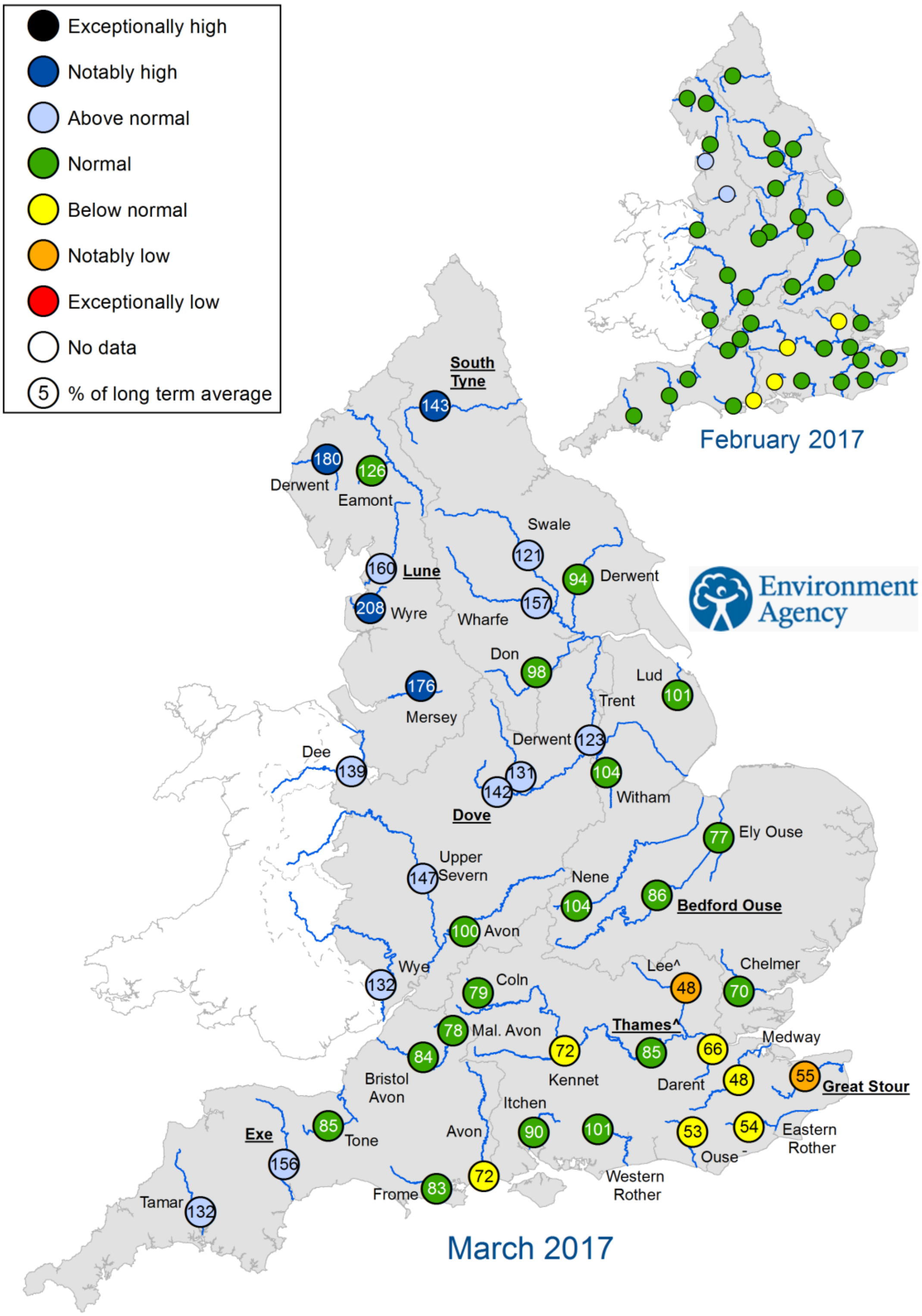


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2017).

River flows



^ “Naturalised” flows are provided for the ‘Thames at Kingston’ and the ‘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 February 2017 and March 2017, expressed as a percentage of the respective long term average and classed relative to an analysis of historic February and March monthly means (Source: Environment Agency).

River flow charts

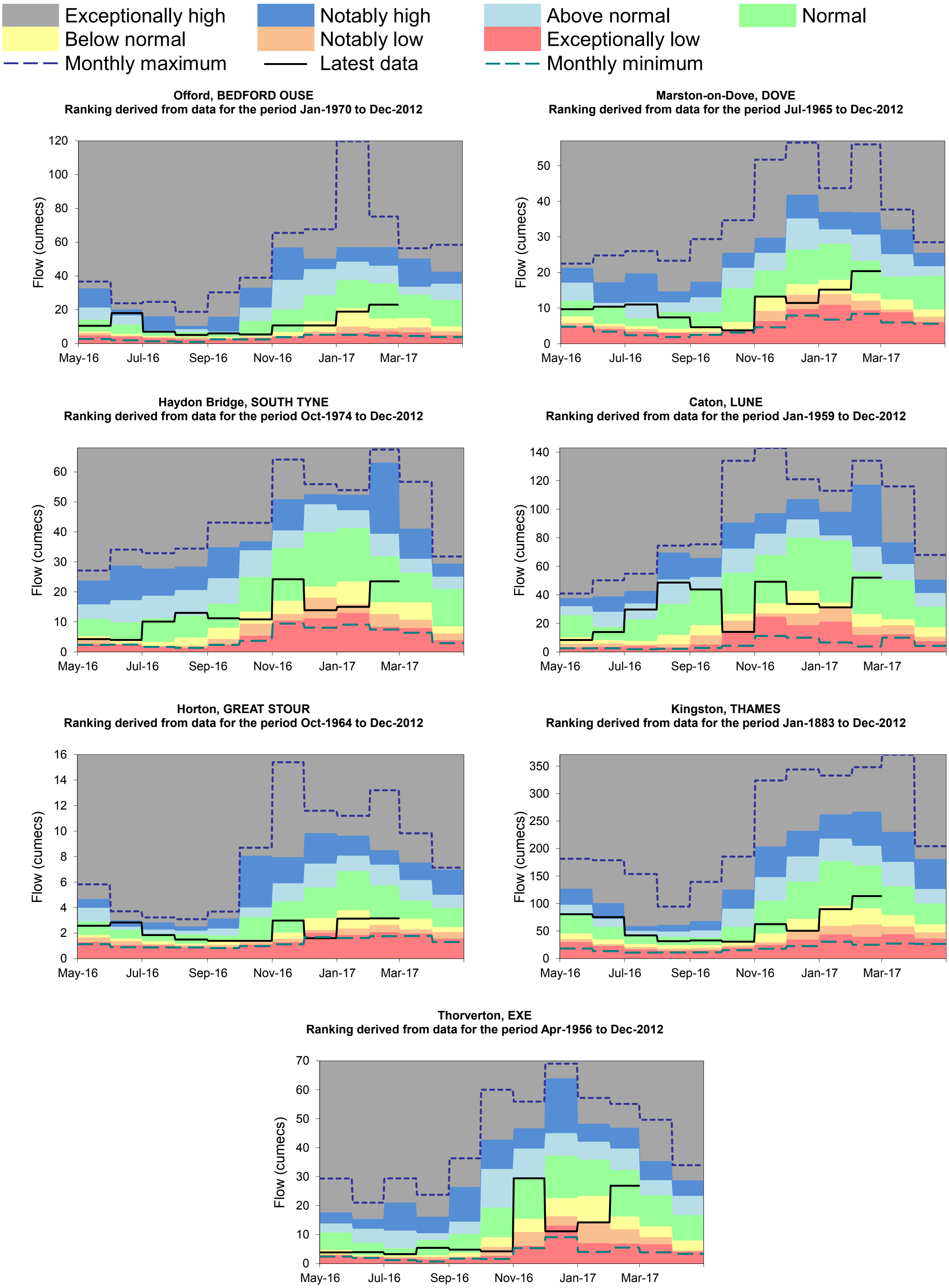
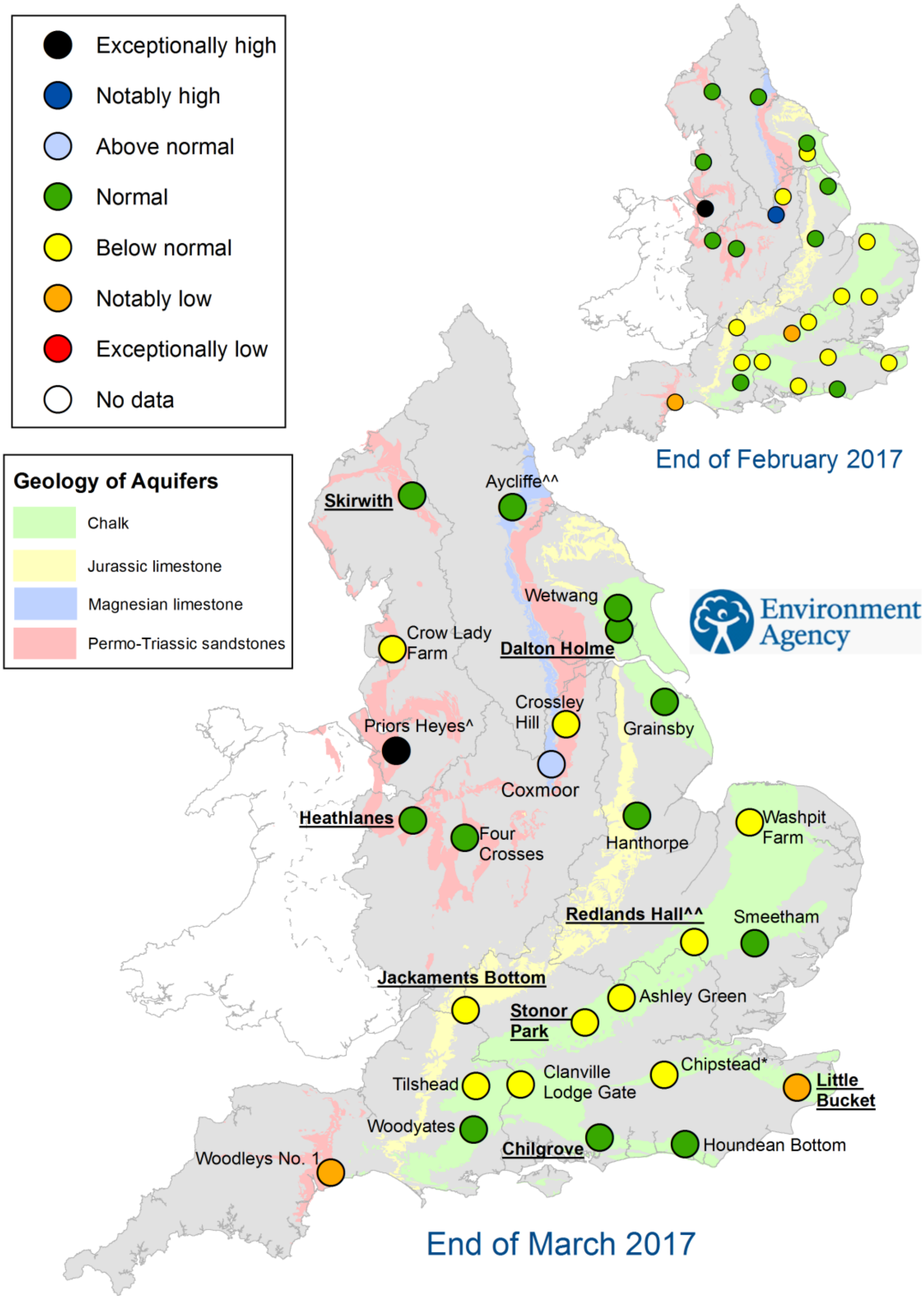


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
* Chipstead has replaced Well House Inn
Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of February 2017 and March 2017 and, classed relative to an analysis of respective historic February and March levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2017.

Groundwater level charts

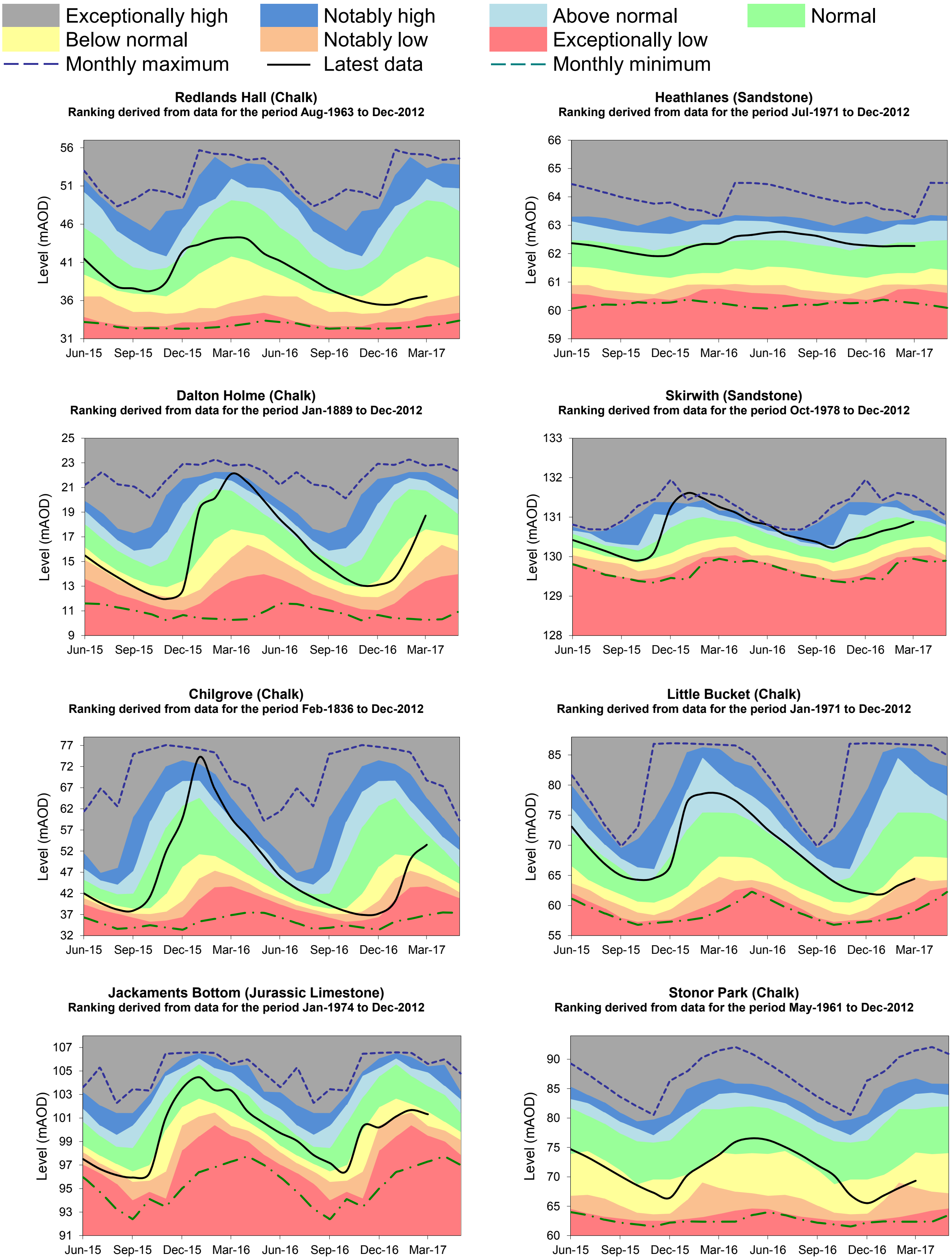
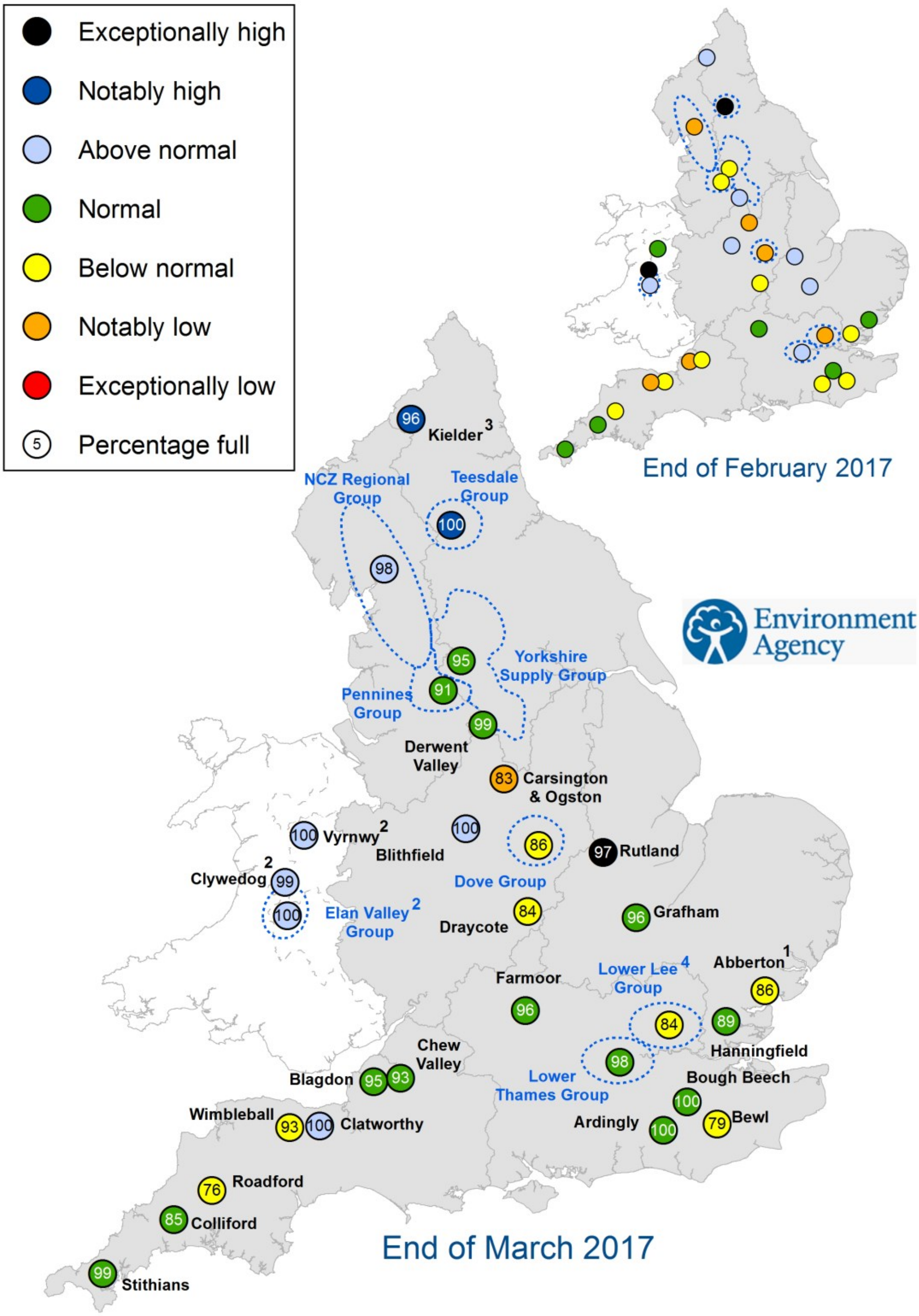


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2017).

Reservoir storage



1. Engineering work at Abberton Reservoir in east England to increase capacity has been completed
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 will be deliberately lower than historical levels during a trial of a new flood alleviation control curve

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of February 2017 and March 2017 as a percentage of total capacity and classed relative to an analysis of historic February and March values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones.

Reservoir storage charts

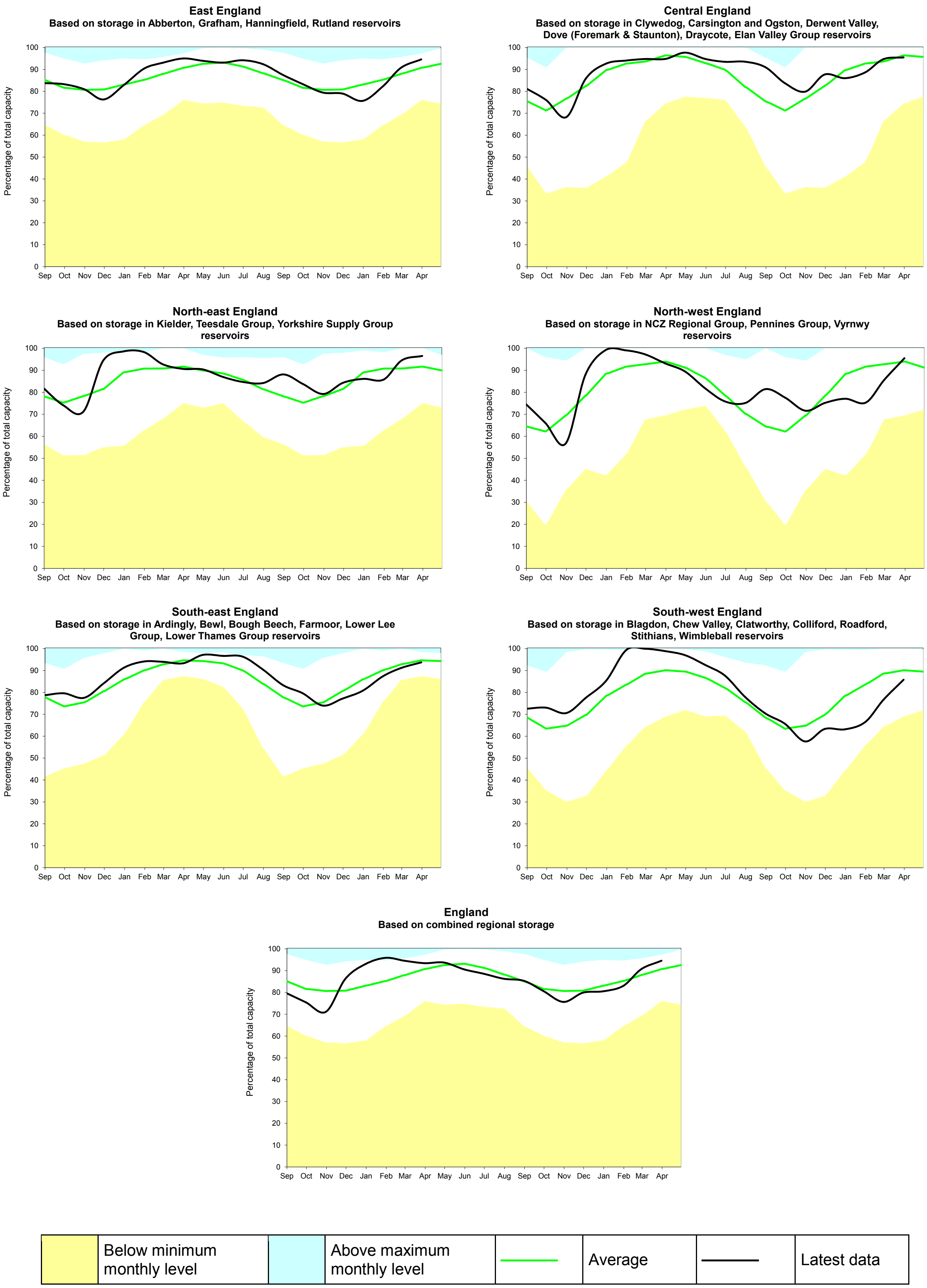


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

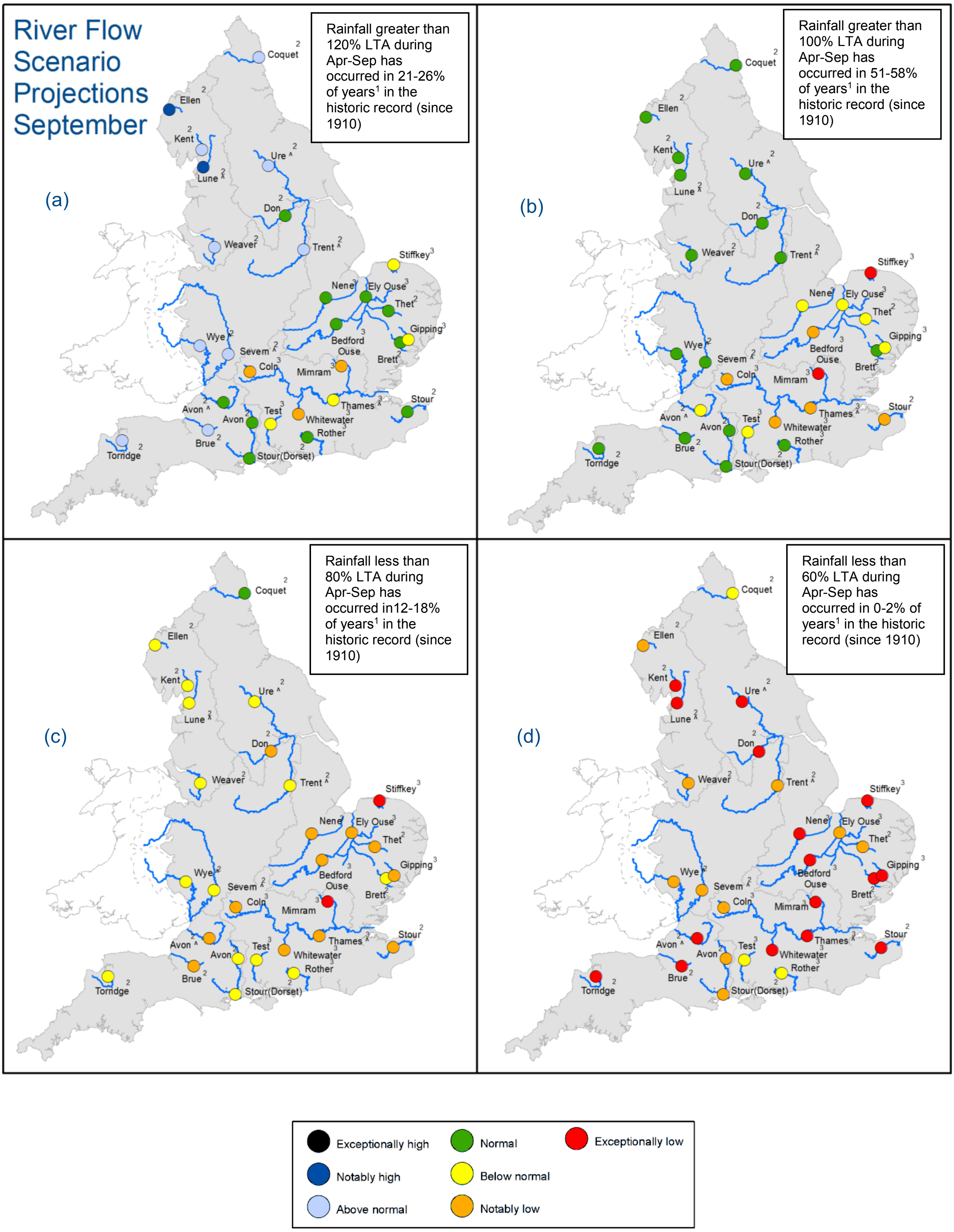


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2017 and September 2017 (Source: Centre for Ecology and Hydrology, Environment Agency)

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

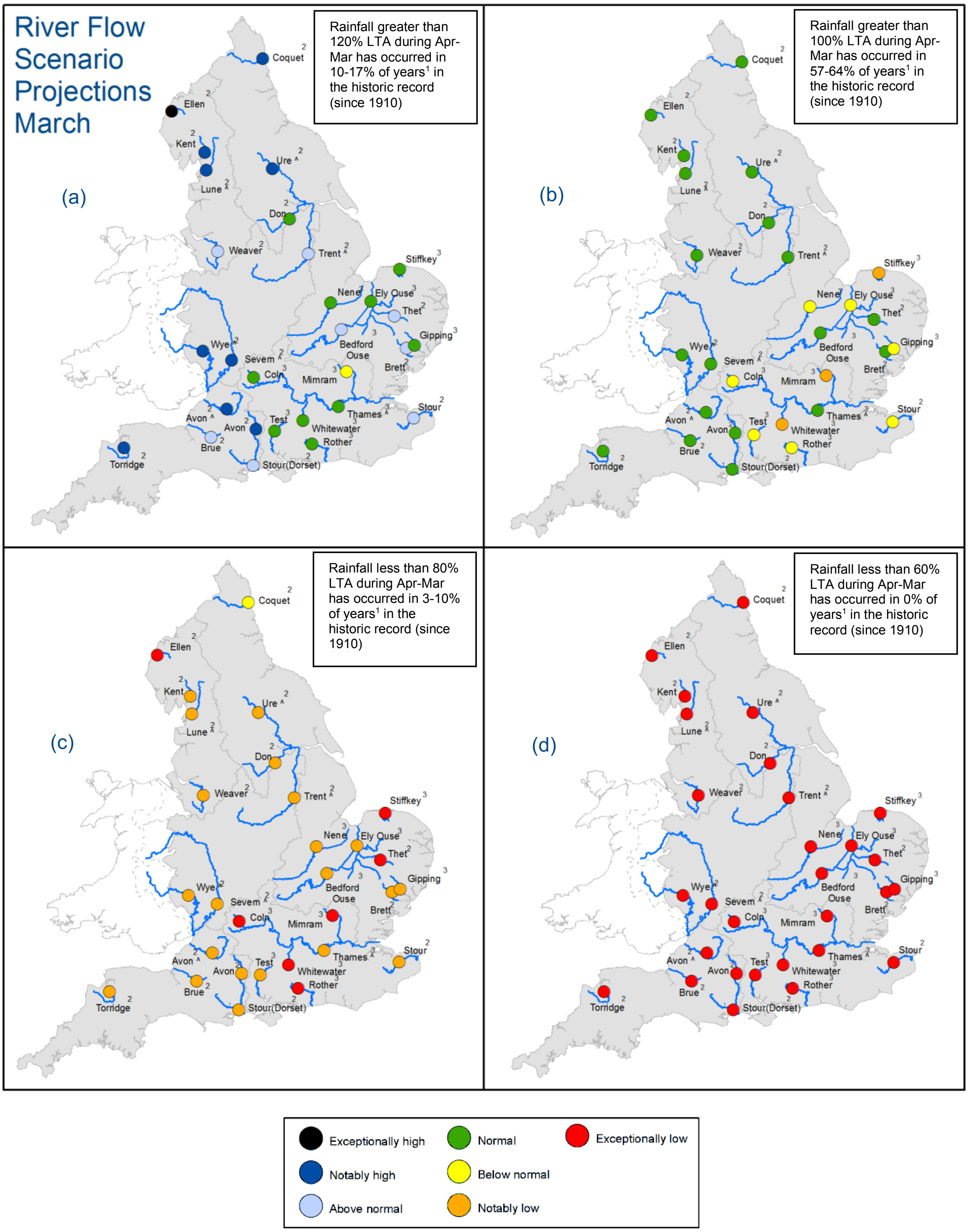


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2017 and March 2018 (Source: Centre for Ecology and Hydrology, Environment Agency)

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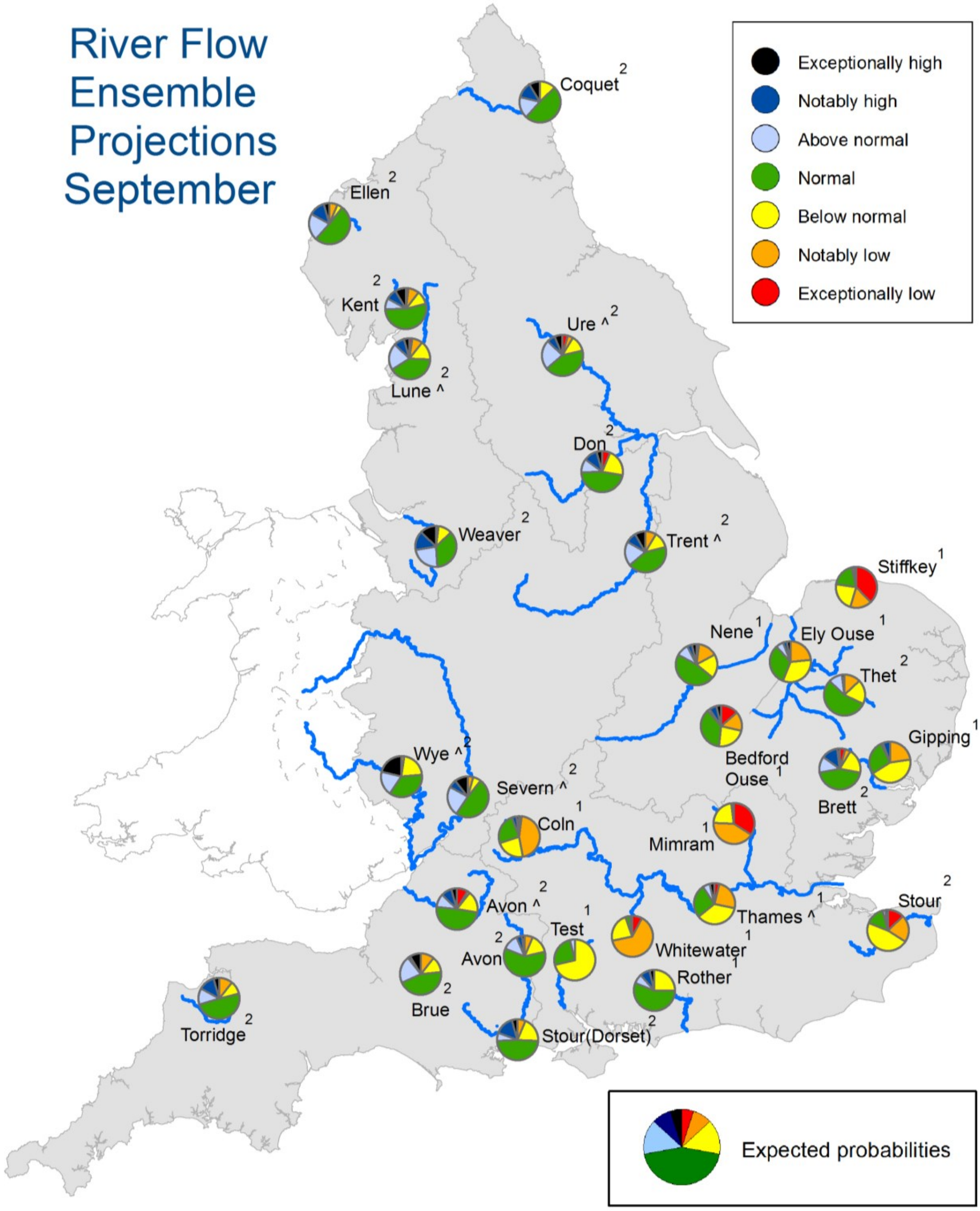

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2017. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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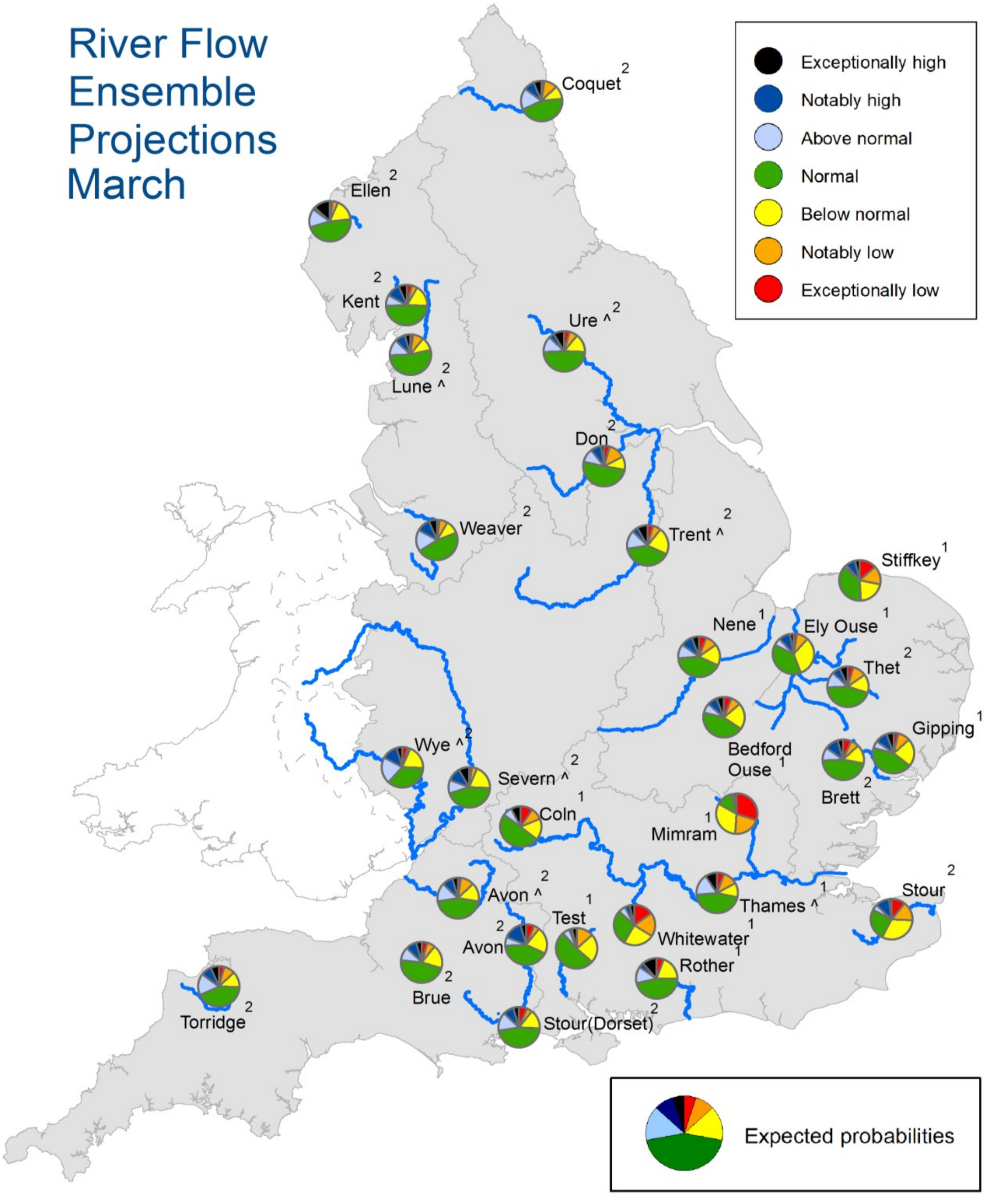

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2018. 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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Forward look - groundwater

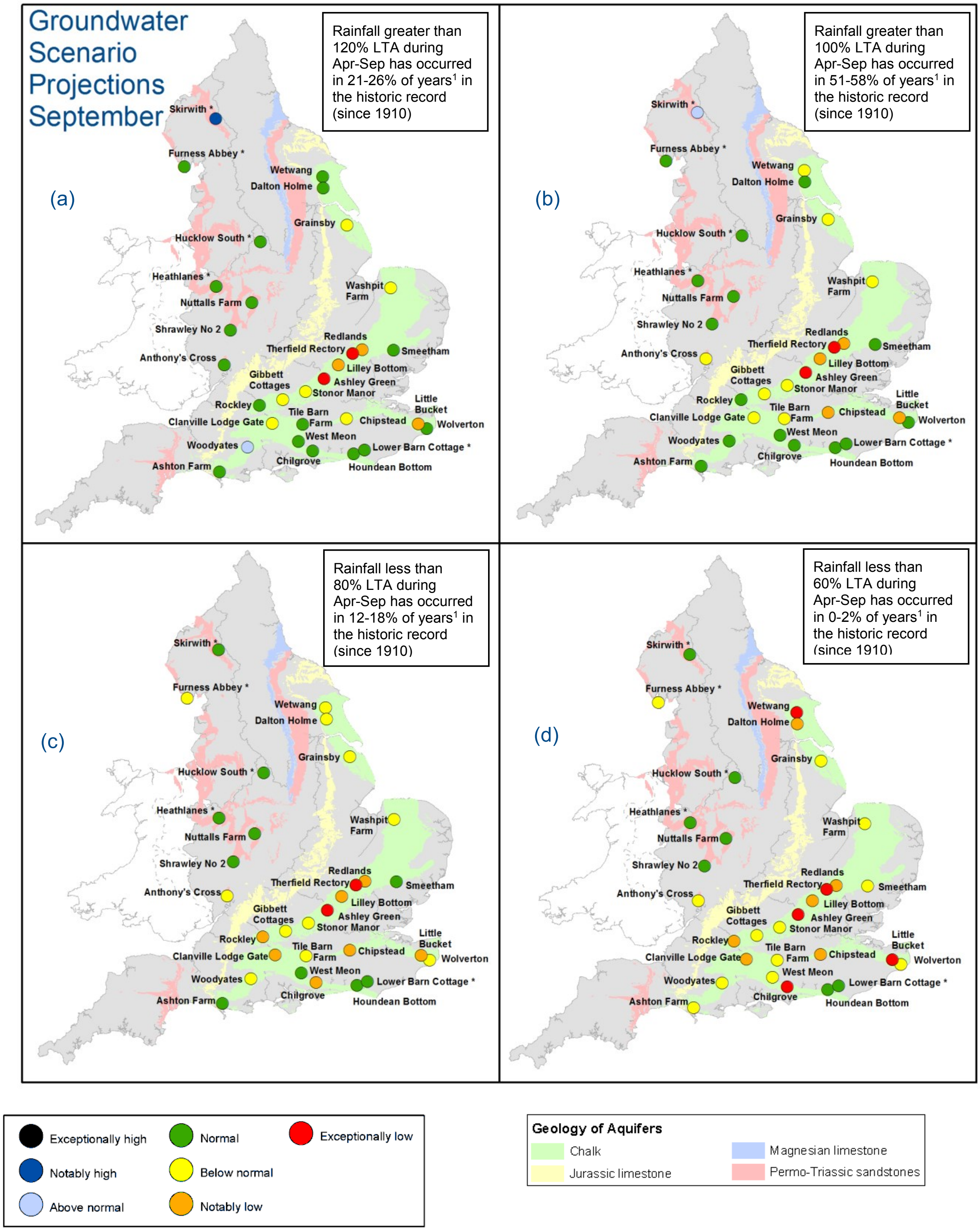

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2017 and September 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2017.

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[1] This range of probabilities is a regional analysis

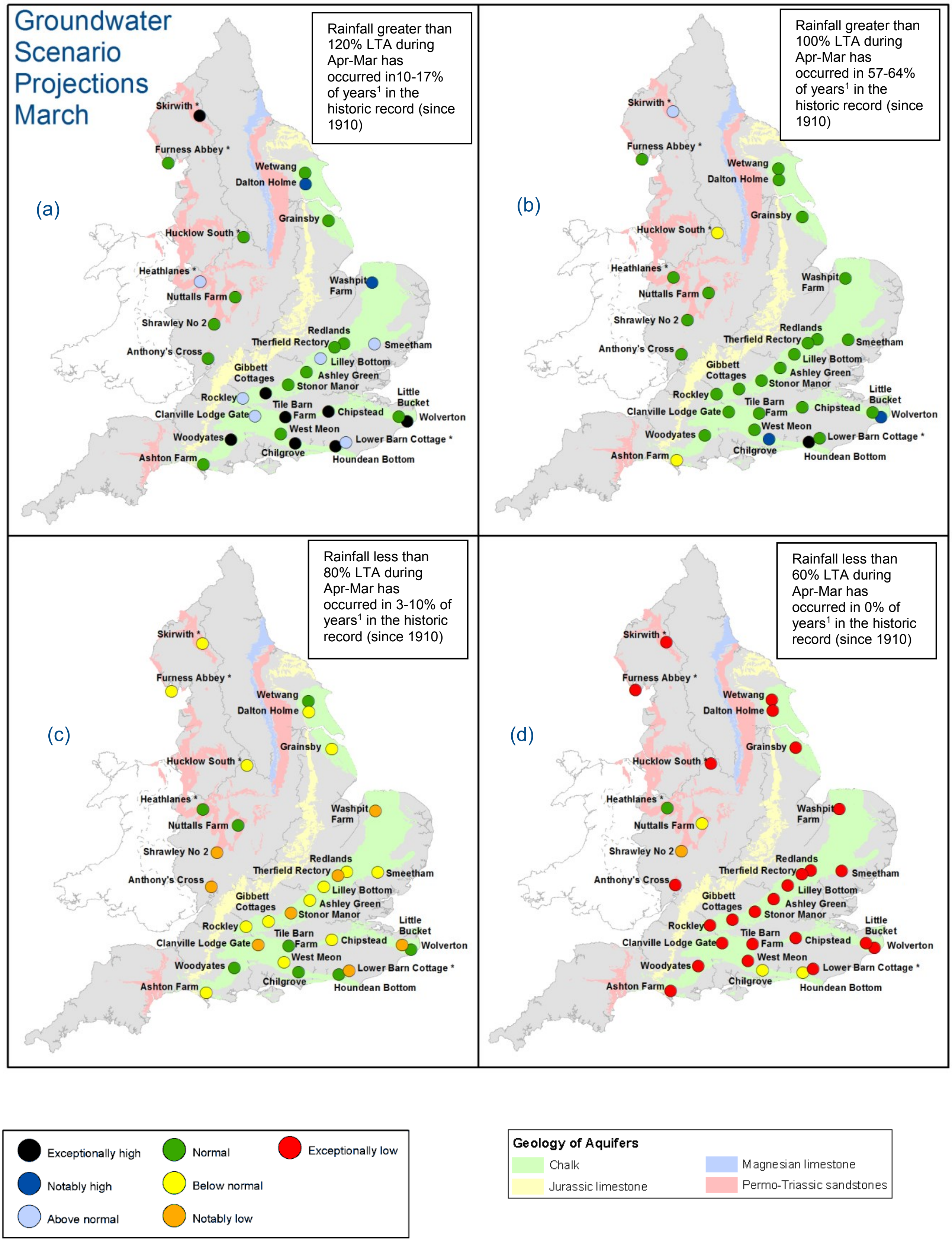

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2017 and March 2018 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2017.

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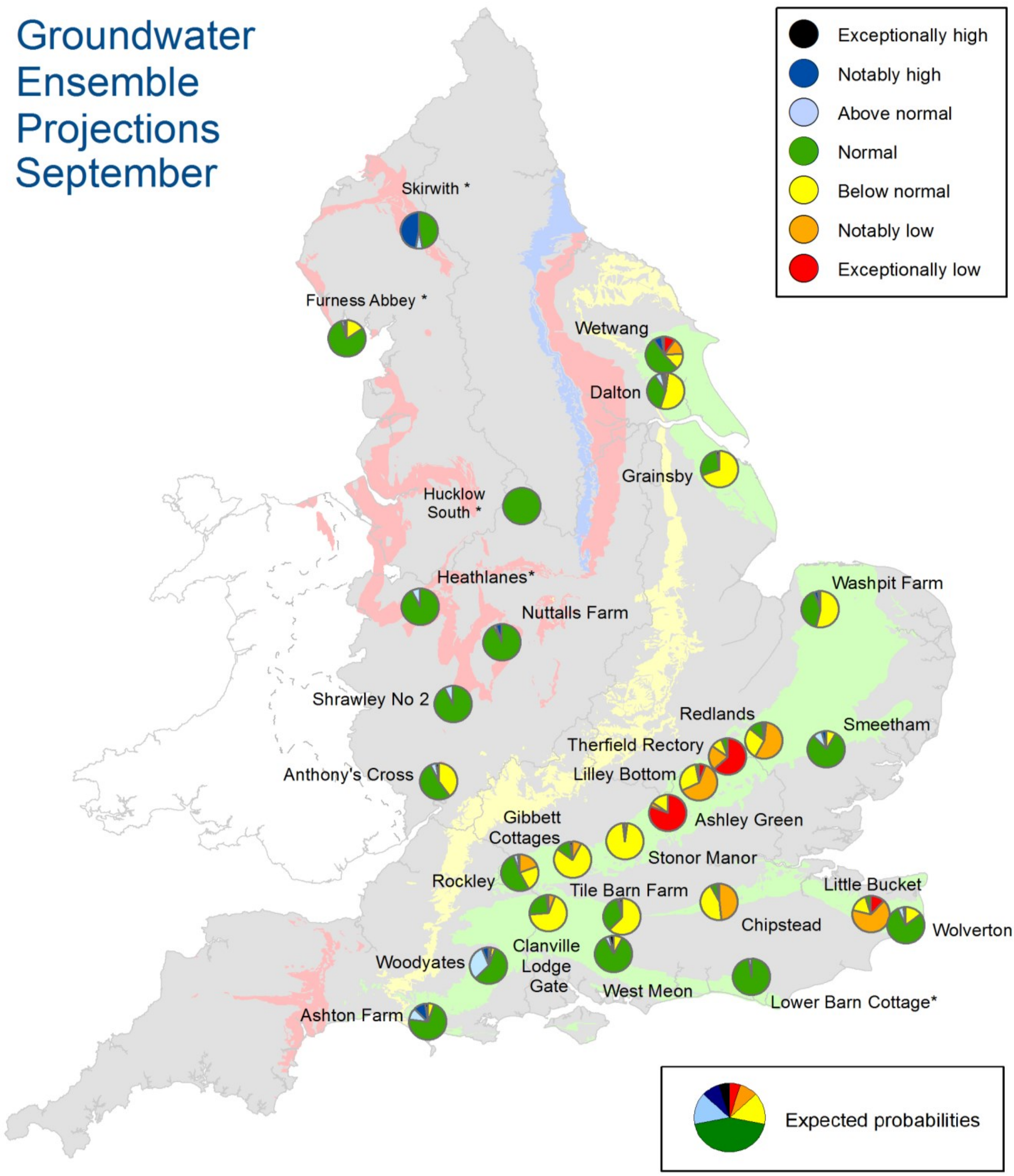

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2017. 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, 2017.

** Projections for these sites are produced by BGS*

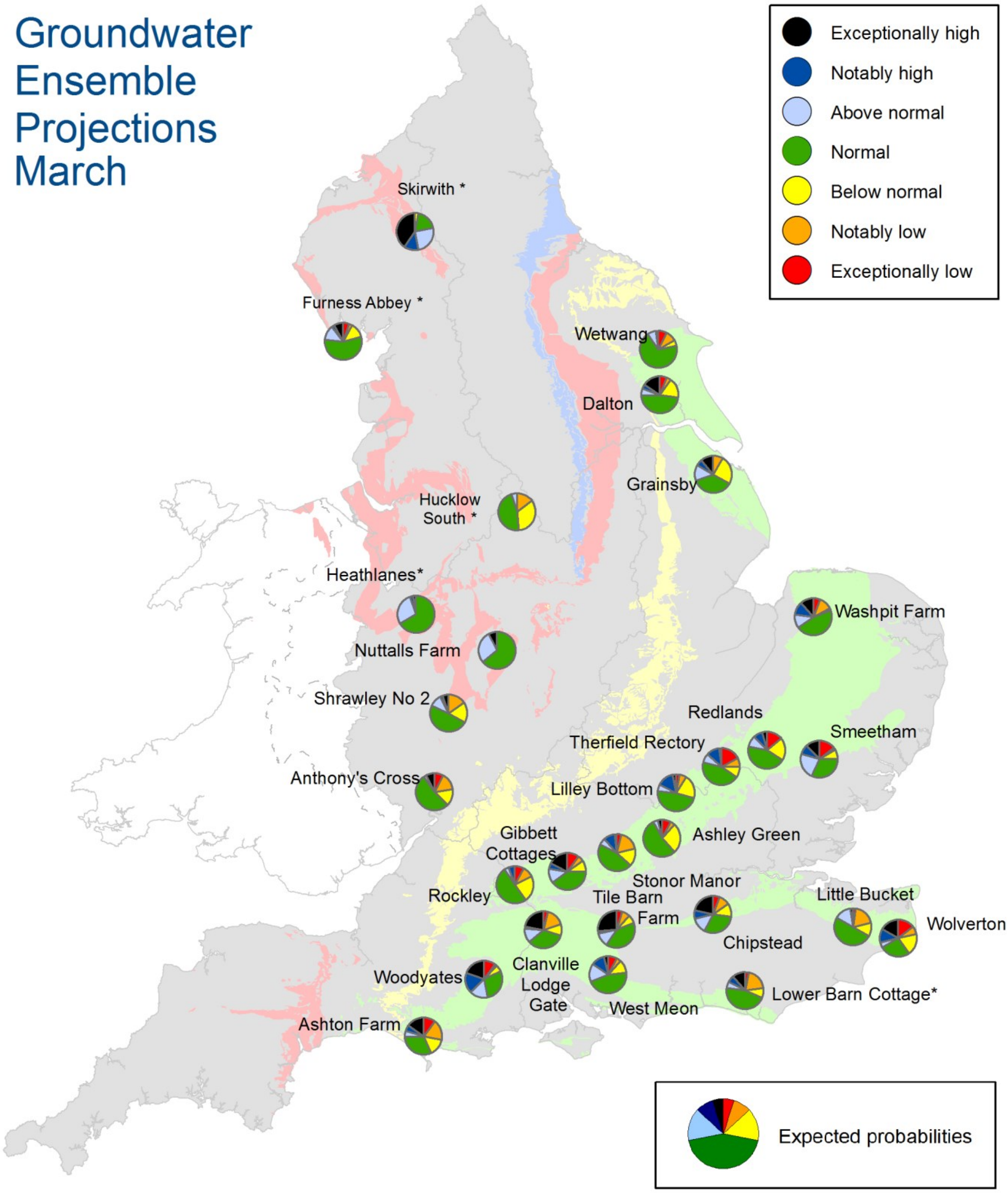

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2018. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the 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, 2017.

* 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

Return to Summary