Monthly water situation report

England

Summary – November 2017

The November rainfall total was below the monthly 1961-90 long term average (LTA) at 84% (78% of the 1981-2010 LTA). The lowest rainfall totals were in south-east England. Soil moisture deficits reduced, but soils remained drier than normal in east and south-east England. Monthly mean river flows increased at over two-thirds of indicator sites, compared to October. However, river flows were classed as below normal or lower at over half of indicator sites with four in east and south-east England being exceptionally low for the time of year. Groundwater levels continued to recede at just under two-thirds of indicator boreholes during November. Three boreholes were at exceptionally low levels for the time of year at the end of November. Reservoir stocks decreased or remained the same at half of the reported reservoirs or reservoir groups during November. Overall storage for England increased slightly to 81% of total capacity.

Rainfall

Rainfall totals were below the November LTA in most hydrological areas. Below normal rainfall totals were recorded in just over a third of hydrological areas, with notably low totals recorded in approximately an eighth of areas, across southern, eastern and central England. Rainfall totals in most other areas were normal for the time of year. The highest rainfall totals were generally in the north-west, with the River Esk catchment in Cumbria receiving 209 mm of rainfall (135% of LTA). By contrast, the lowest rainfall totals were seen in south-east England. South Essex received only 25 mm of rainfall, less than half (48 %) of the LTA for the month (Figure 1.1).

The 12 month cumulative rainfall totals highlight the rainfall deficit in much of south-east, south-west and central England. Here, the 12 month rainfall totals were either below normal or notably low in majority of hydrological areas and the rainfall was exceptionally low in parts of Somerset and Kent (Figure 1.2).

At a regional scale, November rainfall totals were below average across all regions, with the exception of north-west England. Rainfall totals ranged from 66% of the LTA in south-east England to 118% in north-west England. November rainfall was classed as below normal for the time of year in east and south-east England and normal across all other regions (Figure 1.3).

Soil moisture deficit

Rainfall in November has continued to wet the soils and reduce soil moisture deficits but geographical contrasts persisted from the end of October. Soil moisture deficits (SMDs) at the end of November in the far south-west and north-west remain at, or close to zero. In contrast, the east and south-east of England had the driest soils at the end of November, with a soil moisture deficit of up to 130 mm in parts so Norfolk and Cambridgeshire (Figure 2.1).

At a regional scale, end of month SMDs ranged from 2 mm in north-west England to 74 mm in east England. SMDs were higher than average (drier soils) in central, east and south-east England at the end of November (Figure 2.2).

River flows

Although the November rainfall total was below average, monthly mean river flows increased at over two-thirds of indicator sites, compared to October. Despite this, monthly mean flows at over half of the flow indicator sites were classified as either below normal, notably low or exceptionally low, for this time of year. The exceptionally low flows were all recorded in east and south-east England. Monthly mean naturalised flows for November on the River Lee were the lowest since November 1945, and the lowest on record on the Great Stour (records since 1964). Flows on the River Wyre in Lancashire were a notable contrast to the rest of the country; in response to high rainfall totals in the second half of the month, the monthly mean flow was exceptionally high for the time of year (Figure 3.1).

At the regional index sites, monthly mean river flows were below normal for the time of year on the Thames at Kingston, and exceptionally low on the Great Stour at Horton in south-east England but normal elsewhere (Figure 3.2).

Groundwater levels

Groundwater levels continued to recede at just under two-thirds of indicator boreholes during November. End of month groundwater levels were below normal or lower for the time of year at over half of indicator boreholes. Groundwater levels are particularly low for the time of year in southern England. Woodyates, in the Upper Dorset chalk, is the only borehole in southern England which recorded normal groundwater levels for the time of year. Little Bucket Farm borehole, in the East Kent Stour chalk, remains dry for the second consecutive month.

End of November groundwater levels at Little Bucket (east Kent Stour chalk aquifer), Ashley Green (Chilterns East chalk aquifer) and Woodleys No 1 (Otter Sandstone aquifer) were all exceptionally low for the time of year (Figures 4.1 and 4.2). The groundwater level at Ashley Green was the lowest on record for November (records since 1987).

Reservoir storage

Reservoir stocks decreased or remained the same at half of the reported reservoirs or reservoir groups during November. The Elan Valley Group (central Wales) was the only reported reservoir or reservoir group to increase in stocks by over 10% (an 11% increase). The largest decreases (6%) occurred in the Lower Lee reservoir group and Hanningfield reservoir (south-east and east England) (Figure 5.1). End of month stocks were classed as normal or higher for the time of year at most reported reservoirs and reservoir groups. However, almost a third of reported reservoirs and reservoir groups had stocks classed as below normal or lower for the time of year. Bewl reservoir stocks were classed as exceptionally low at 33% of total capacity.

End of November regional stocks ranged from 58% of total capacity in south-east England to 90% in north-east England. Overall storage for England increased slightly to 81% of total capacity (Figure 5.2).

Forward look

The weather during December and into early January is expected to be wintery, with spells of sleet and snow affecting most areas at times. The wintery conditions are likely to be interspersed with cold, dry spells and milder, wetter weather. For the 3-month period December-January-February, above-average rainfall is more likely than below-average rainfall[1].

Projections for river flows at key sites[2]

Nearly two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being notably low or lower for the time of year by both the end of March and the end of September 2018.

For scenario based projections of cumulative river flows at key sites by March 2018 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2018 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2018 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2018 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

More than two thirds of the modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year at the end of both March and September 2018.

For scenario based projections of groundwater levels in key aquifers in March 2018 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2018 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2018 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2018 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

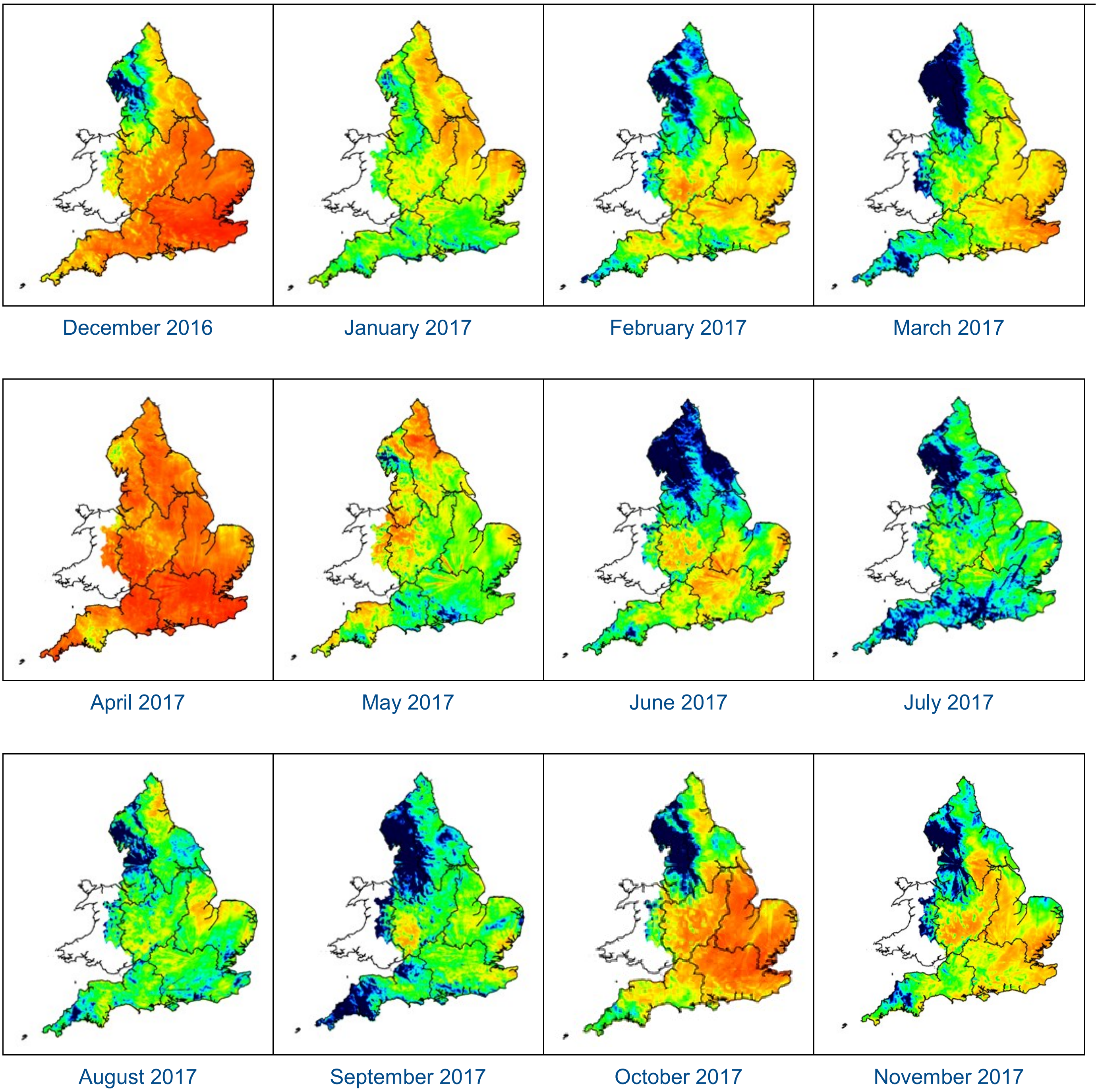
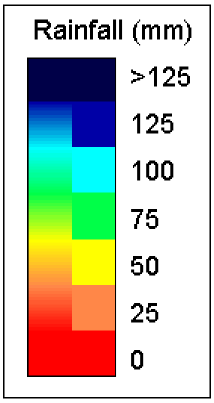


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2017). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2017.



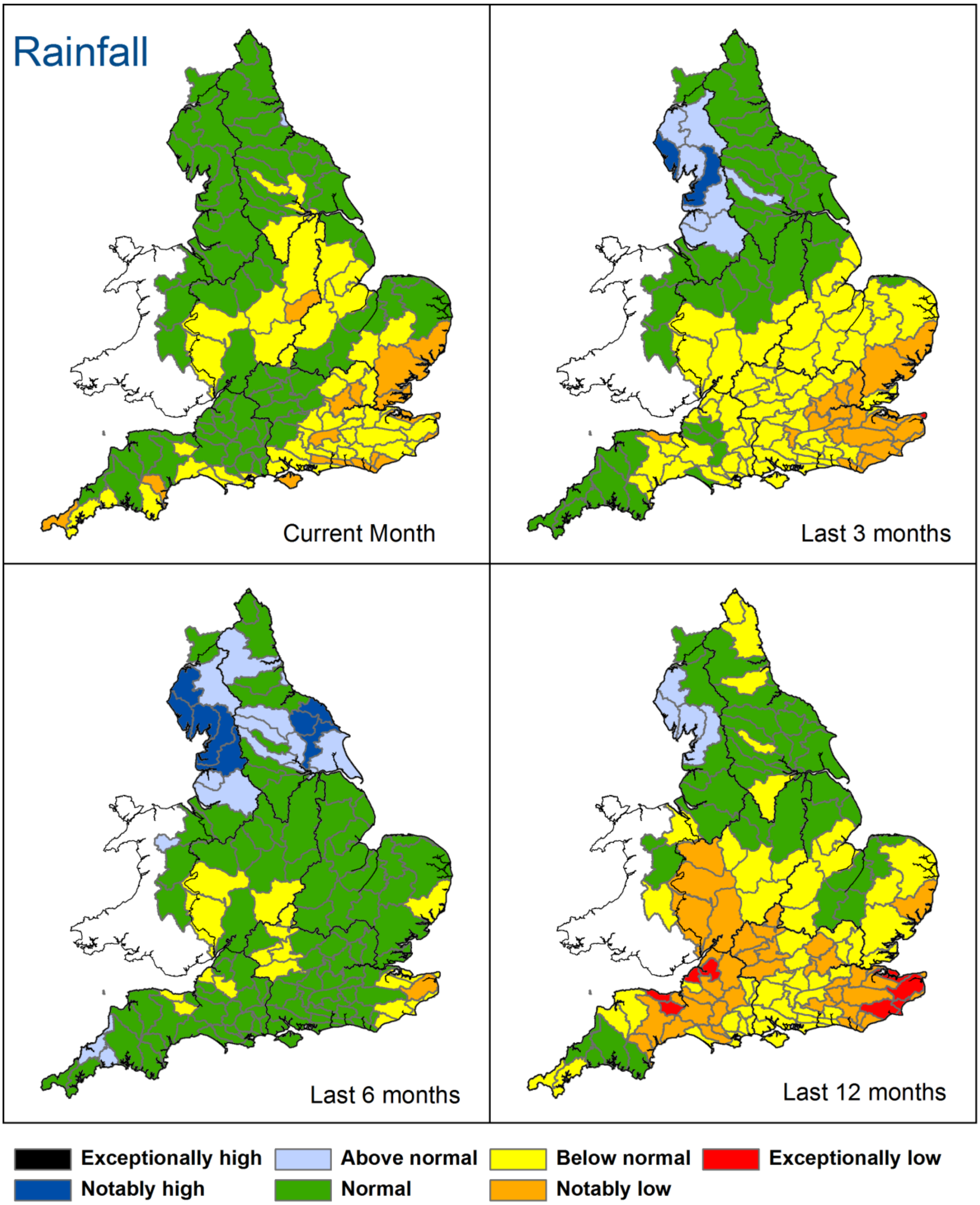


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 November), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met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

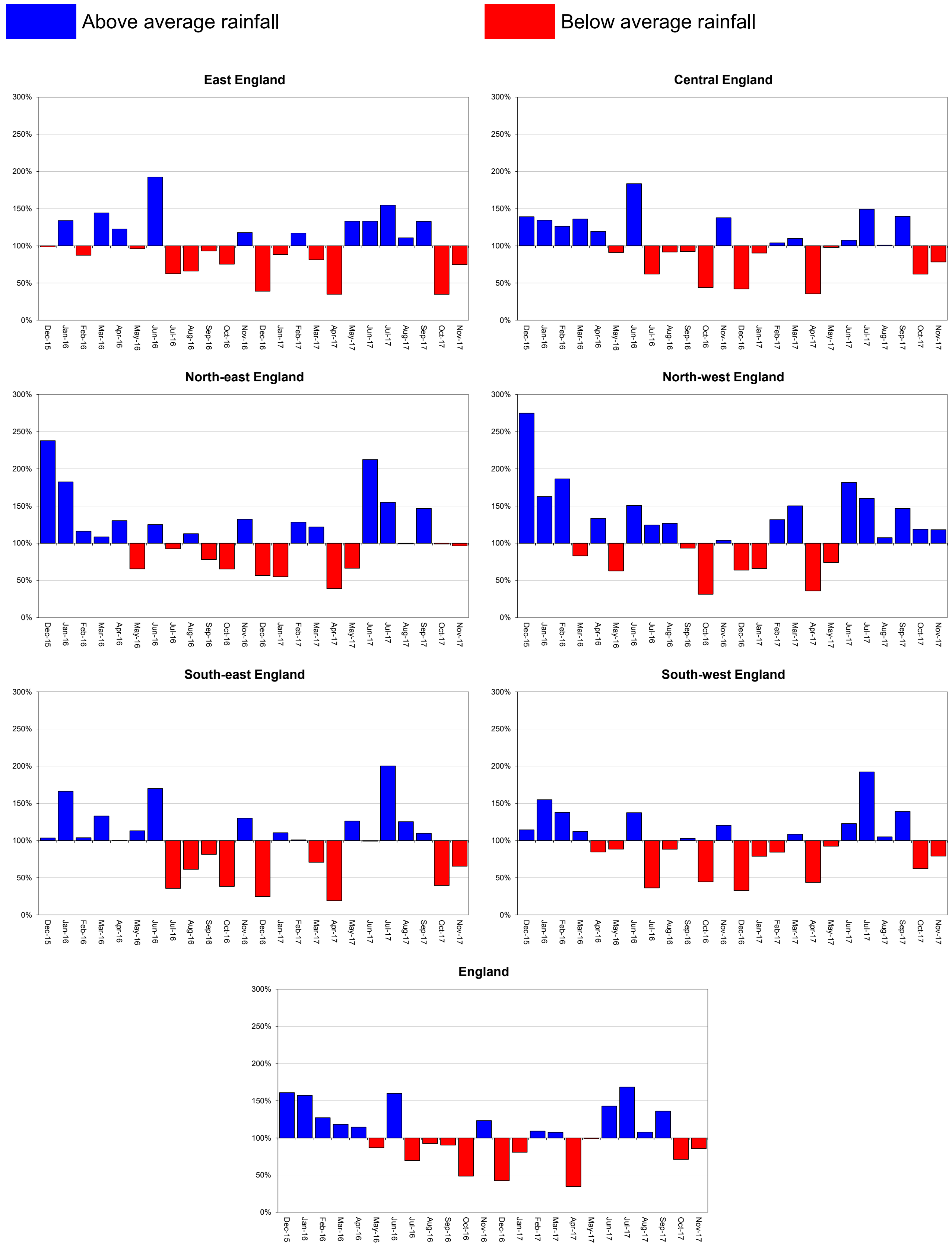


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2017).

Soil moisture deficit

End of October 2017[1]	End of November 2017[2]

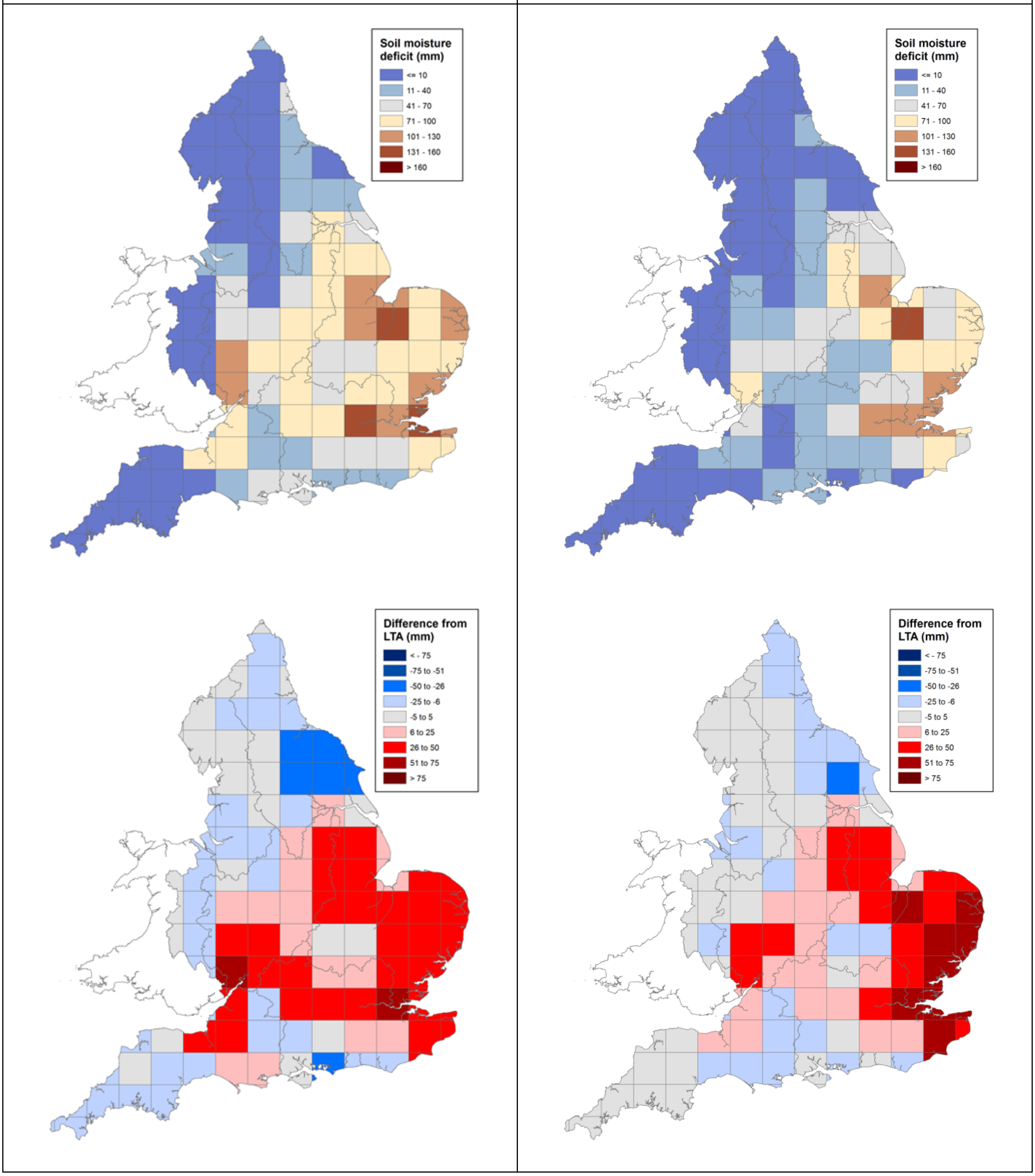


Figure 2.1: Soil moisture deficits for weeks ending 31 October 2017 [1] (left panel) and 28 November 2017 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2017). Crown copyright. All rights reserved. Environment Agency, 100026380, 2017

Soil moisture deficit charts

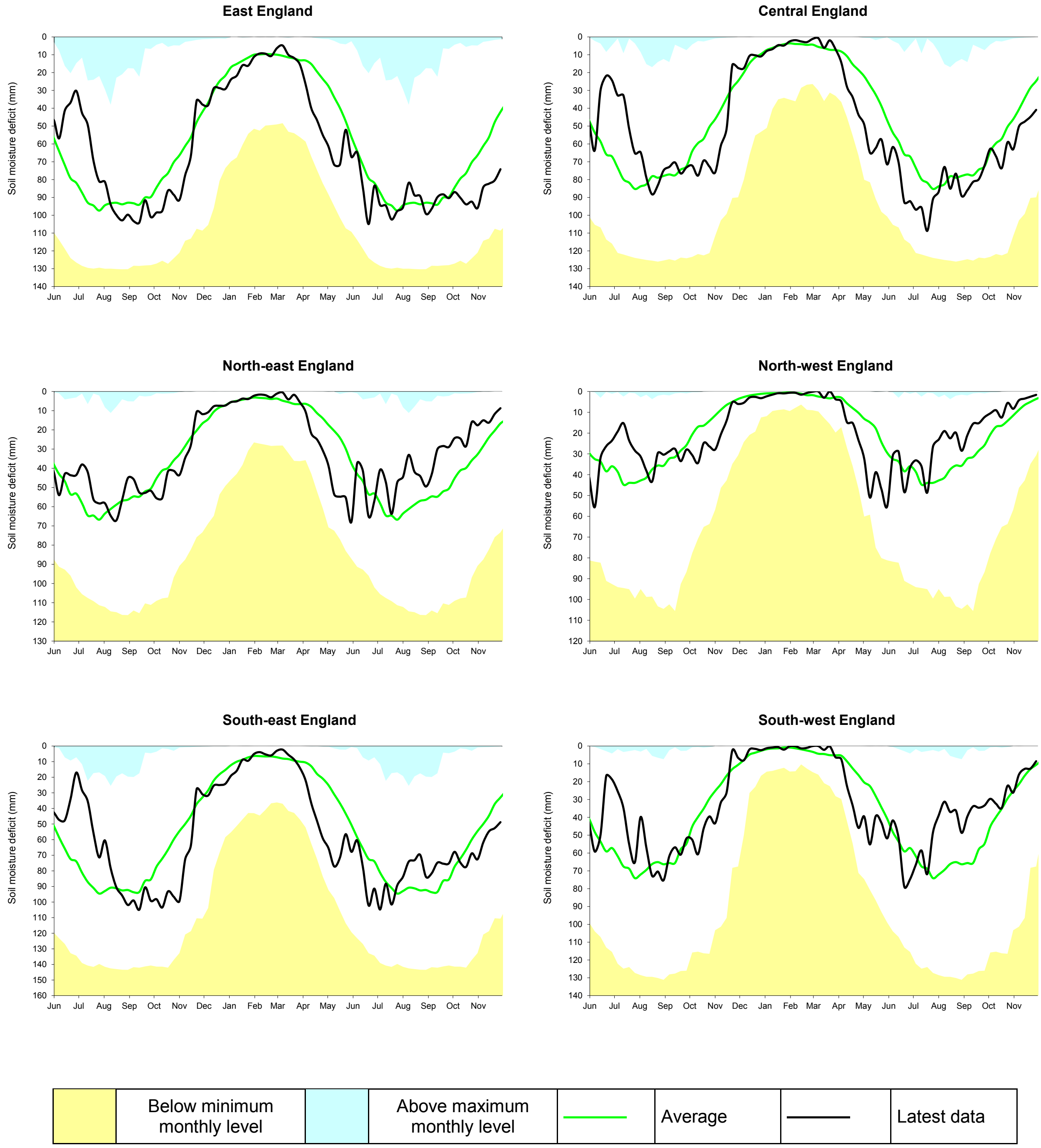
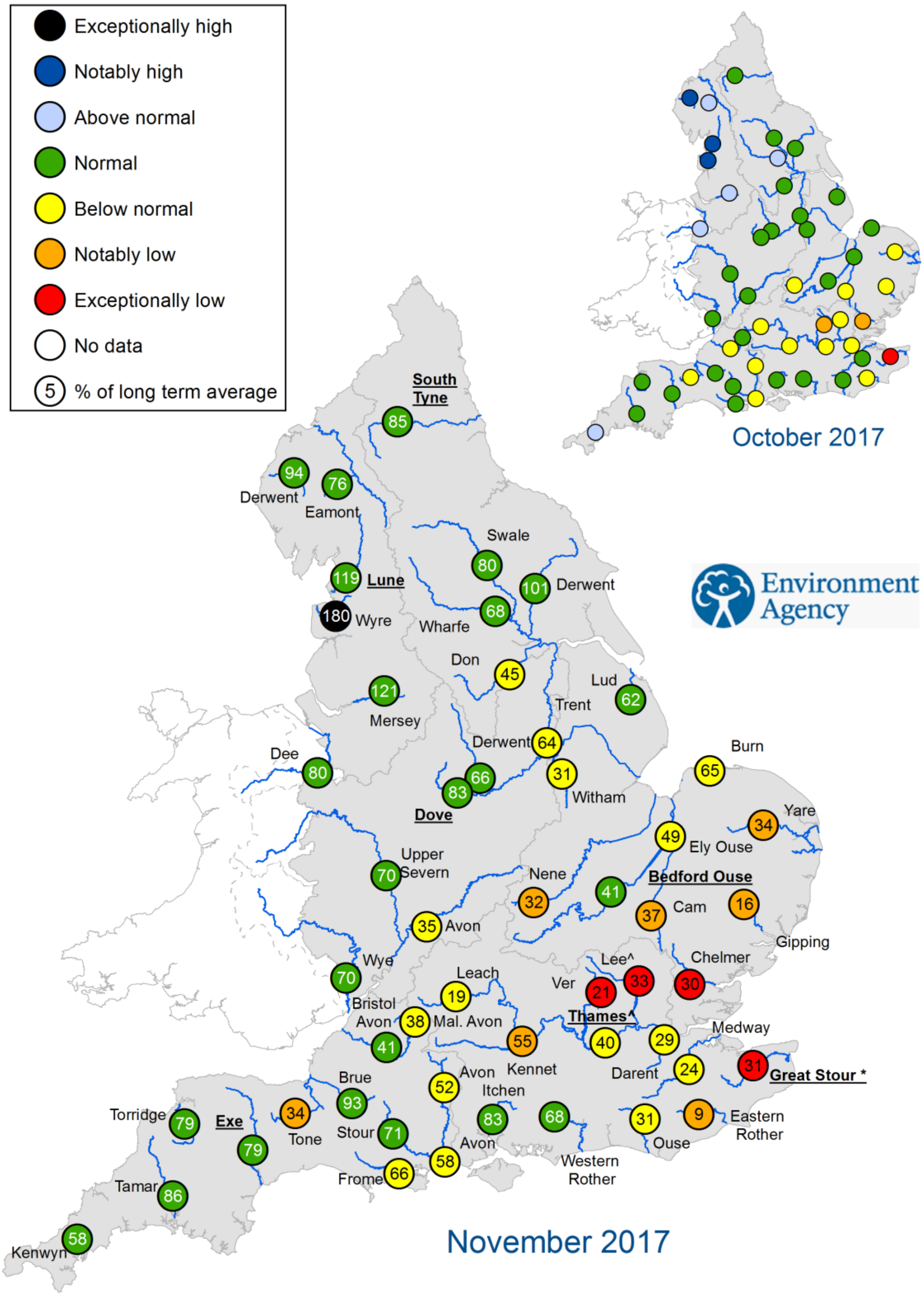


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2017).

River flows



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

* Monthly mean flow is the lowest on record for the current month (note that record length varies between sites)

Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for October 2017 and November 2017, 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, 2017.

River flow charts

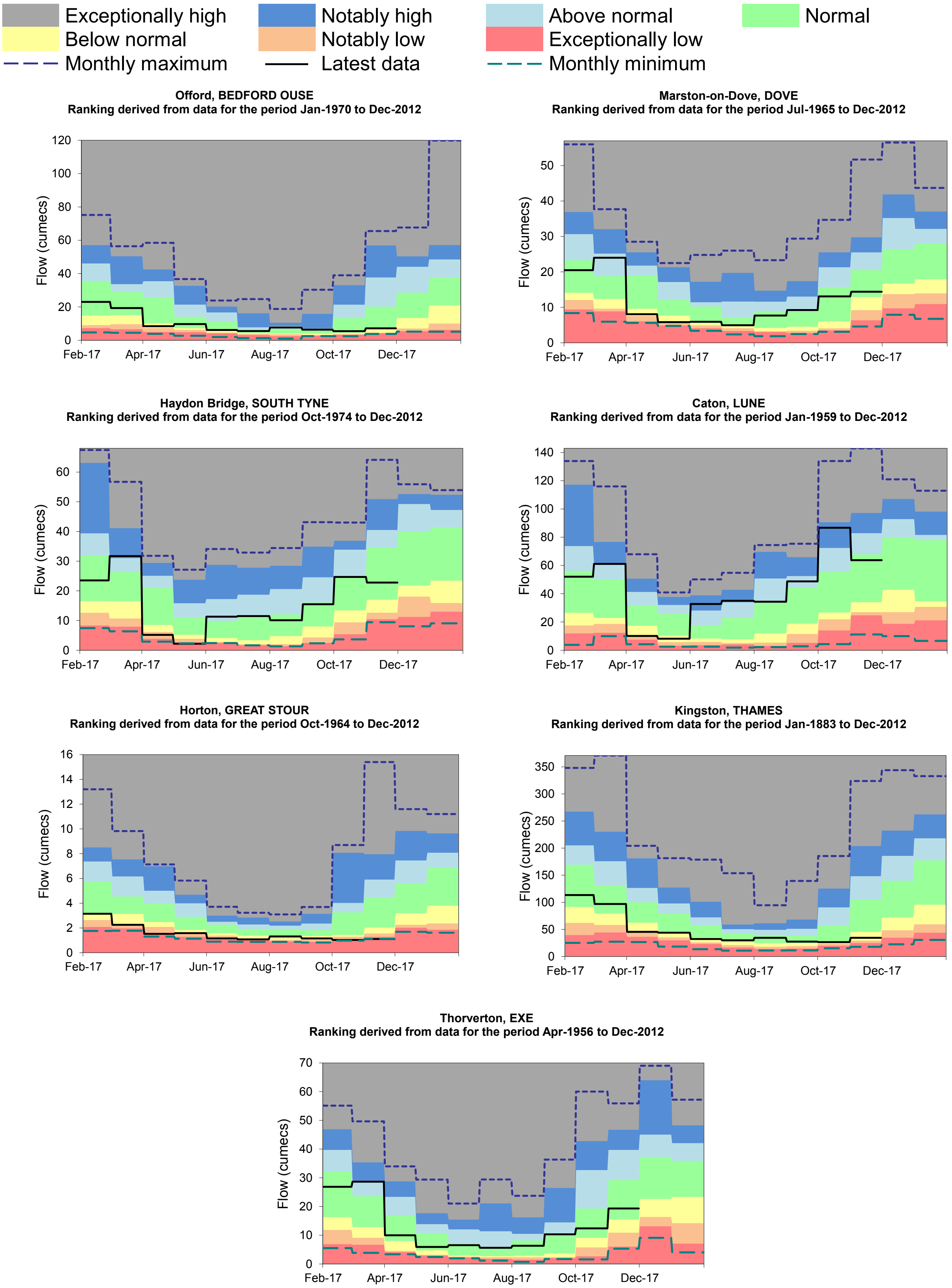
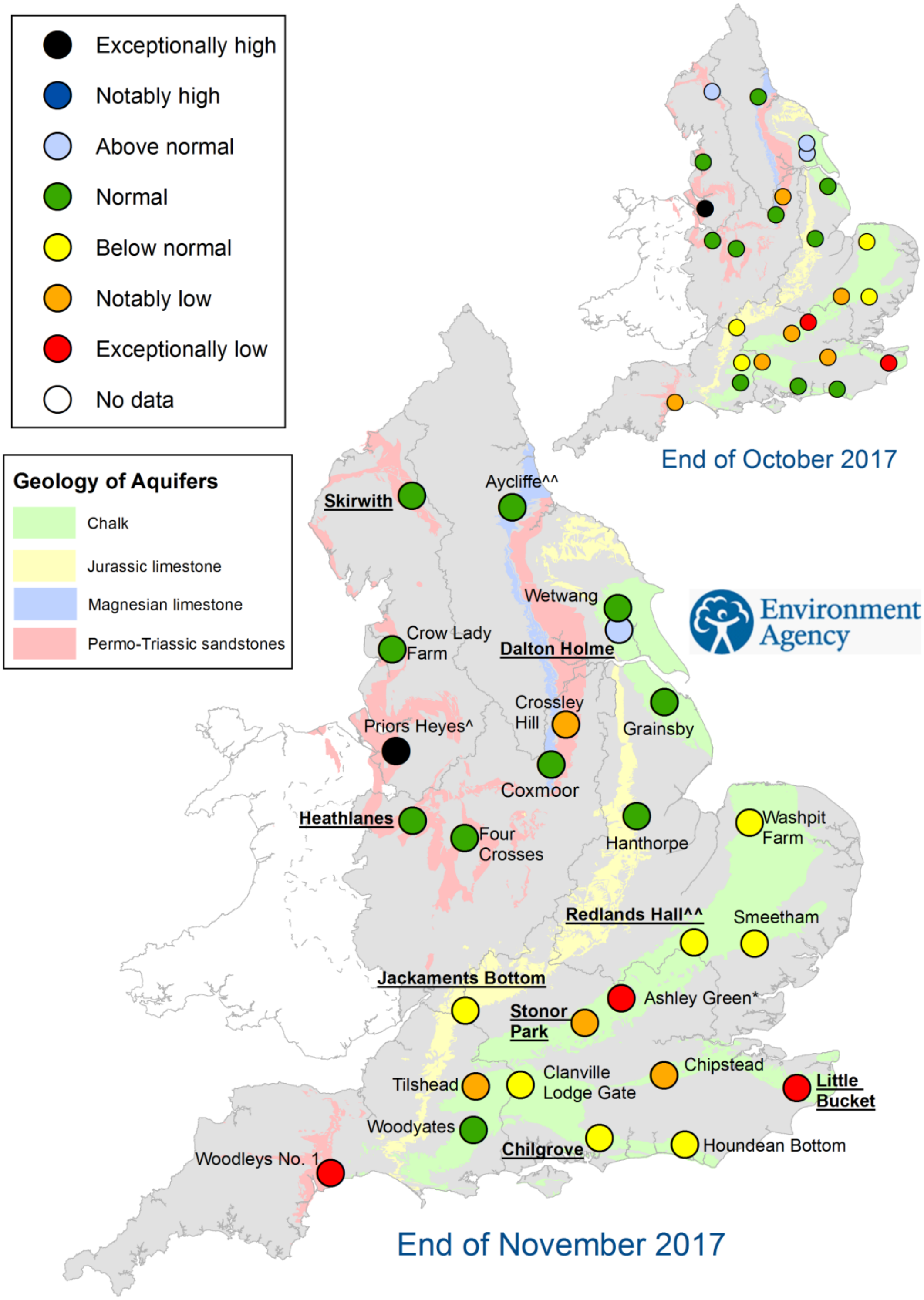


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 lowest on record for the current month (note that record length varies between sites).
Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of October 2017 and November 2017, 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, 2017.

Groundwater level charts

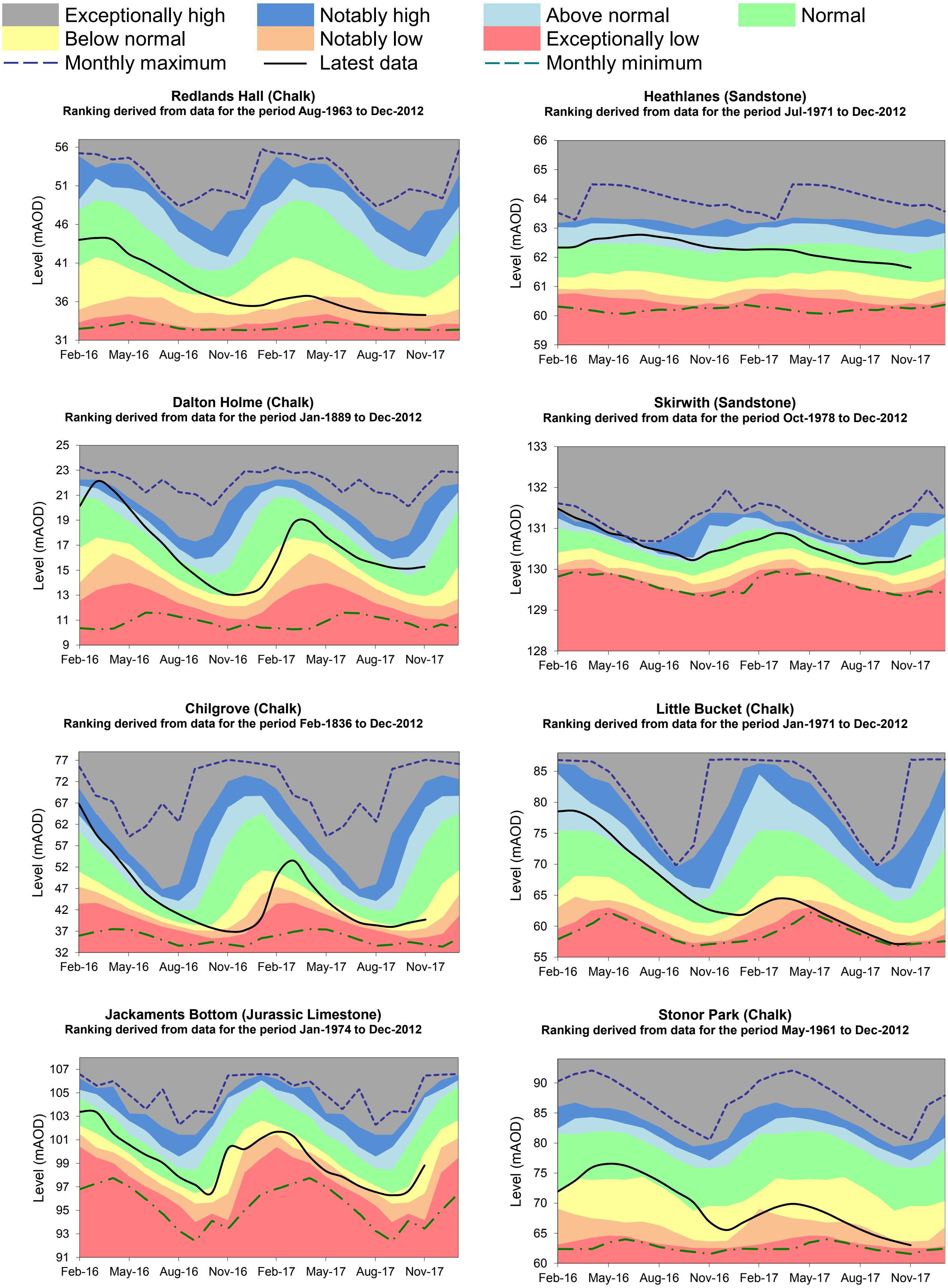
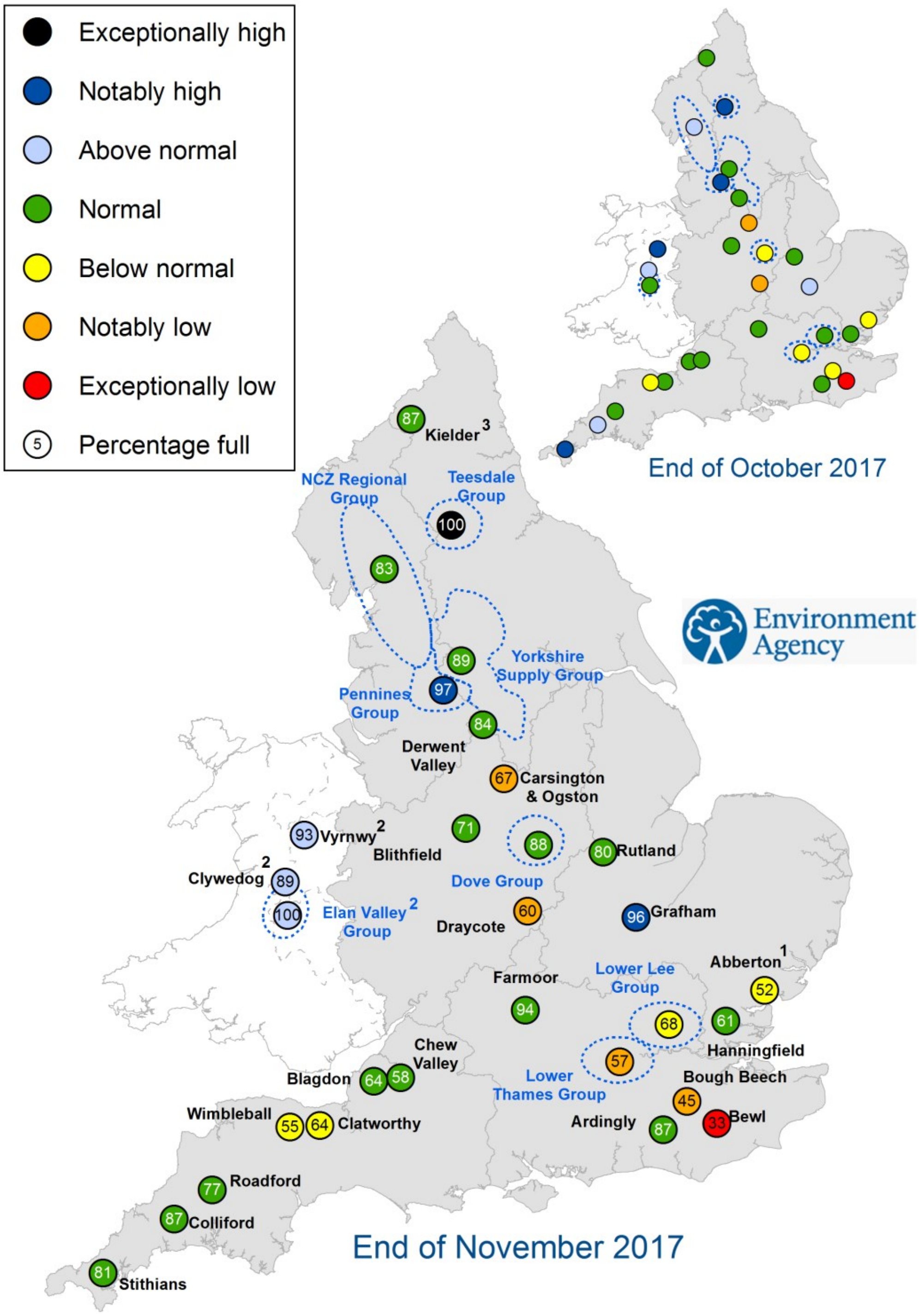


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2017).

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 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 2017 and November 2017 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. Crown copyright. All rights reserved. Environment Agency, 100026380, 2017.

Reservoir storage charts

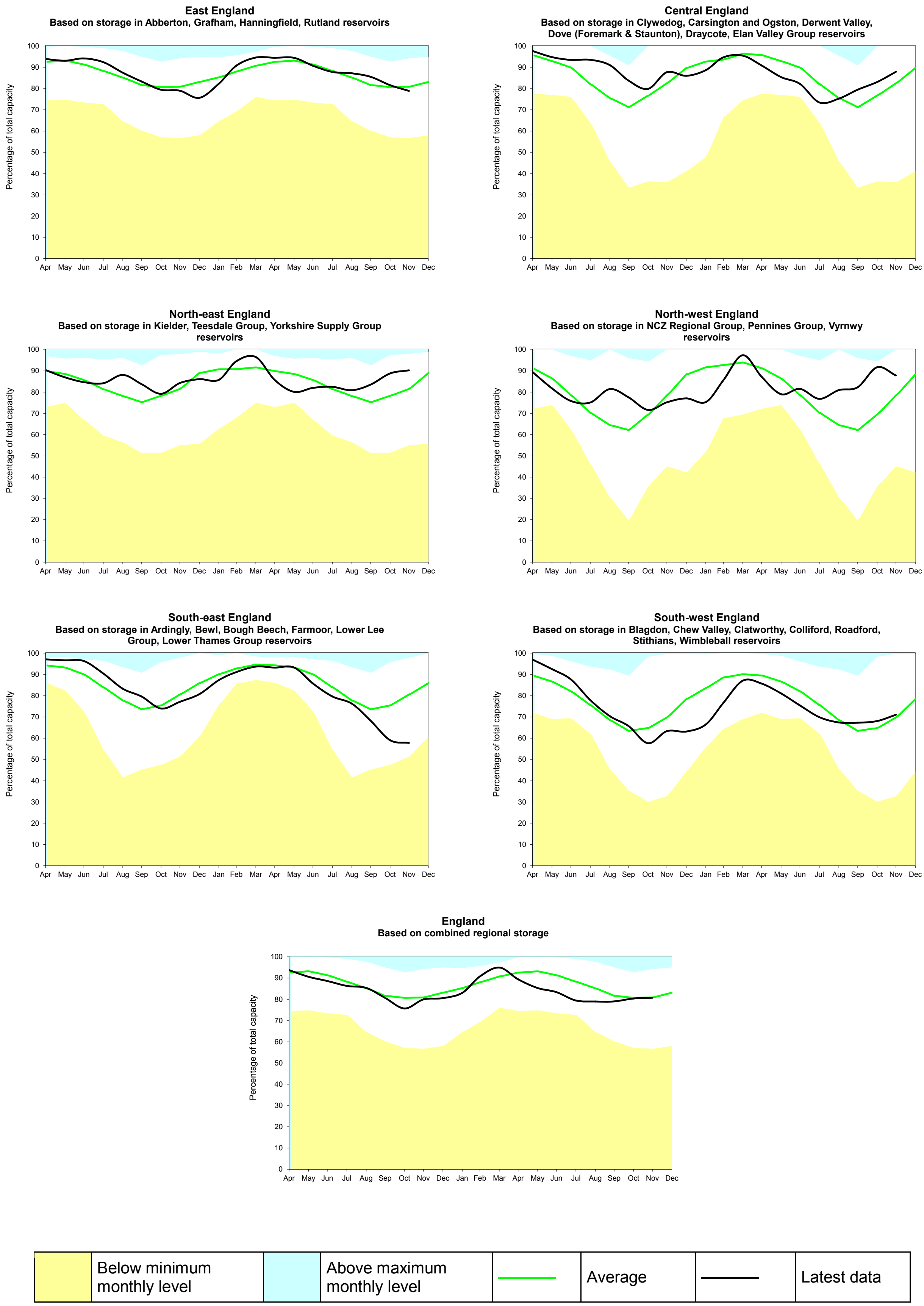


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

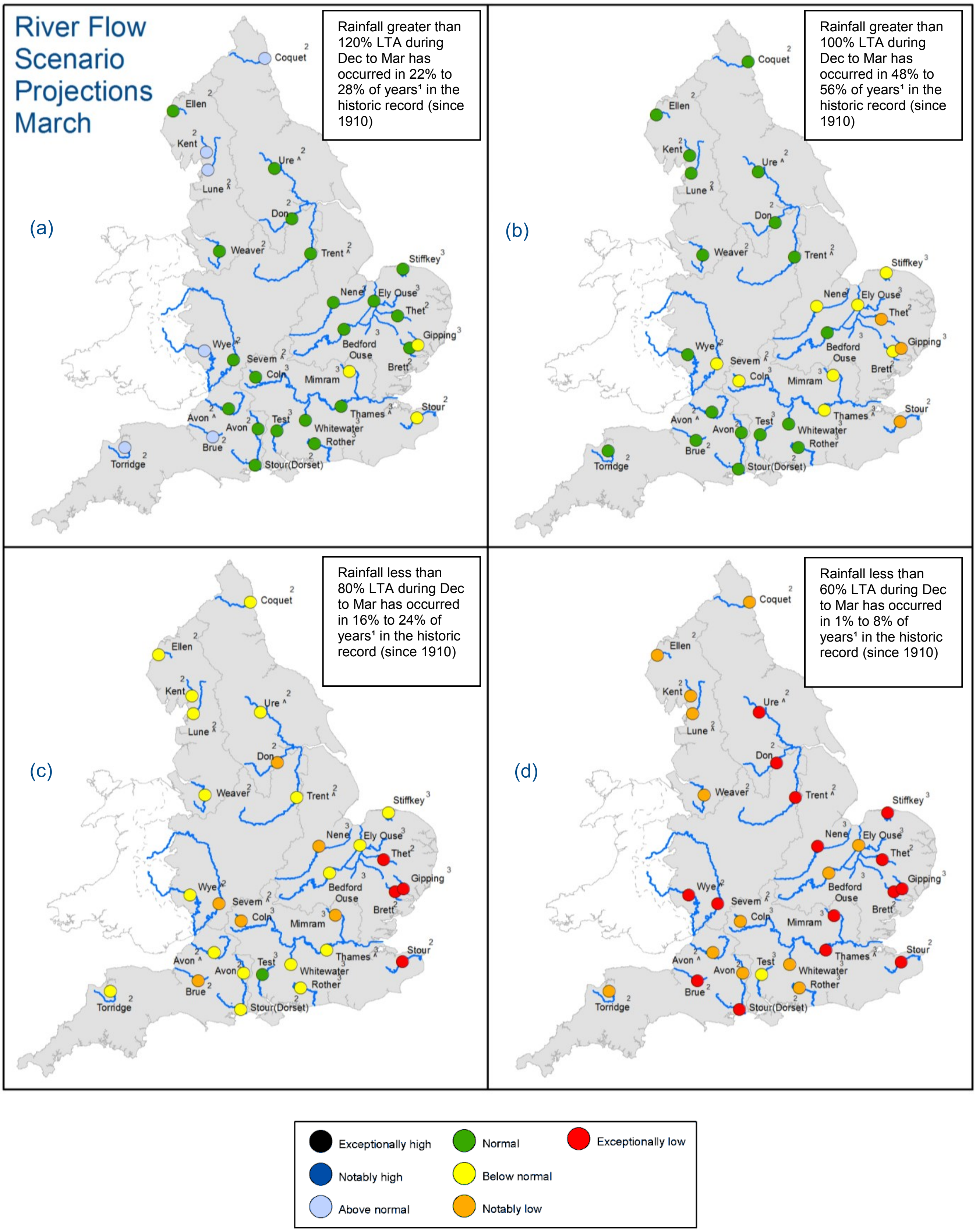


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2017 and March 2018 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*

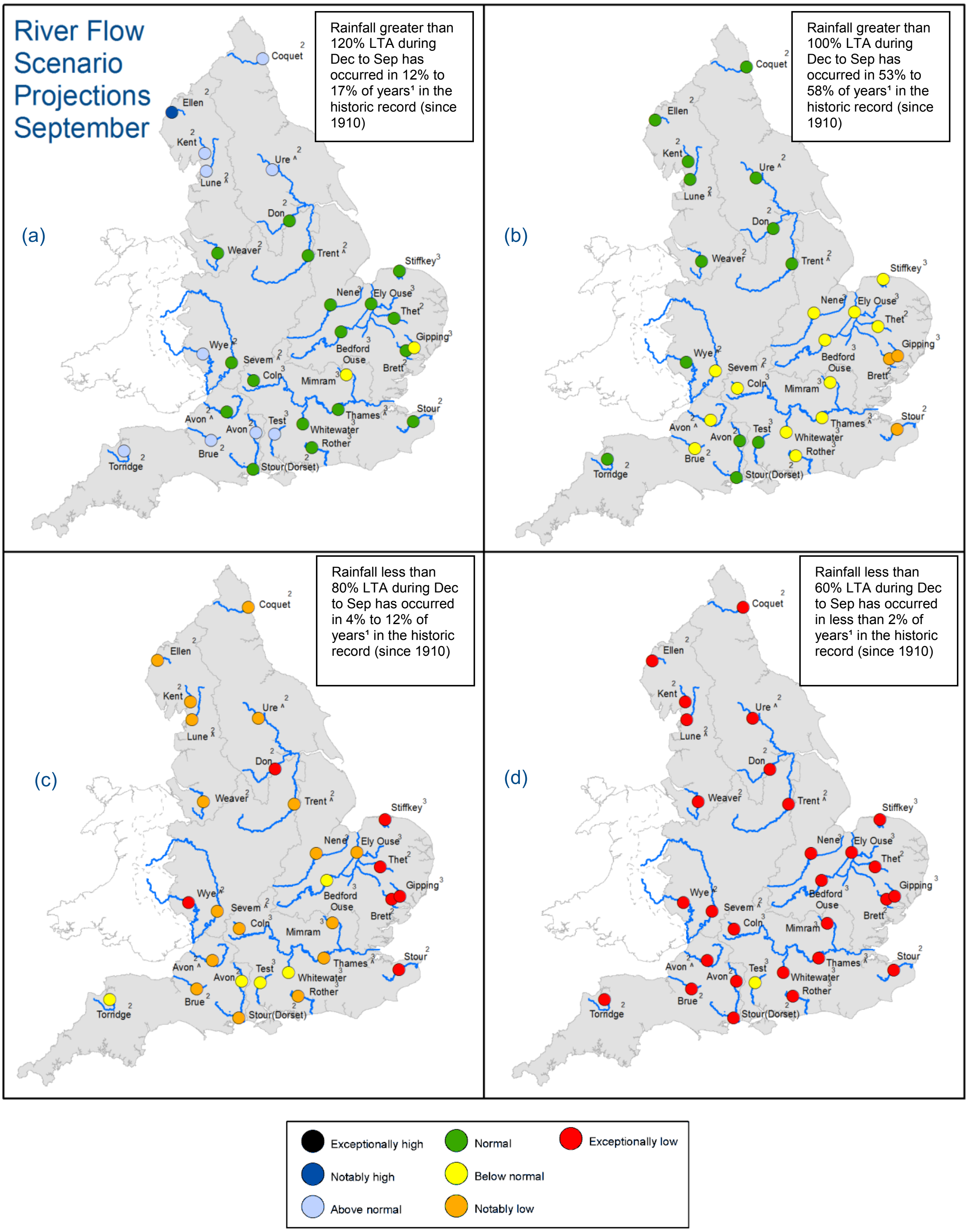


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2017 and September 2018 (Source: Centre for Ecology and Hydrology, Environment Agency).

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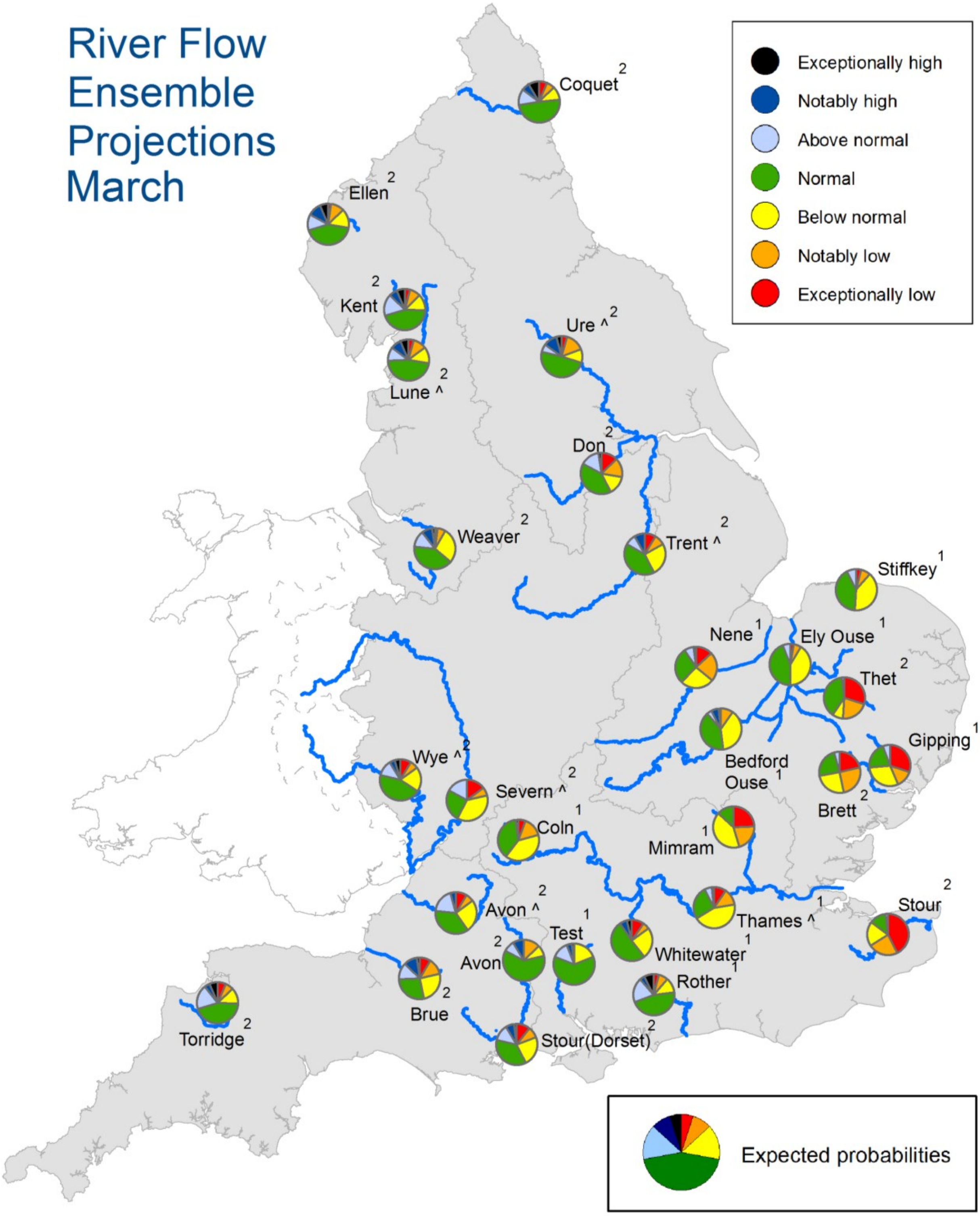

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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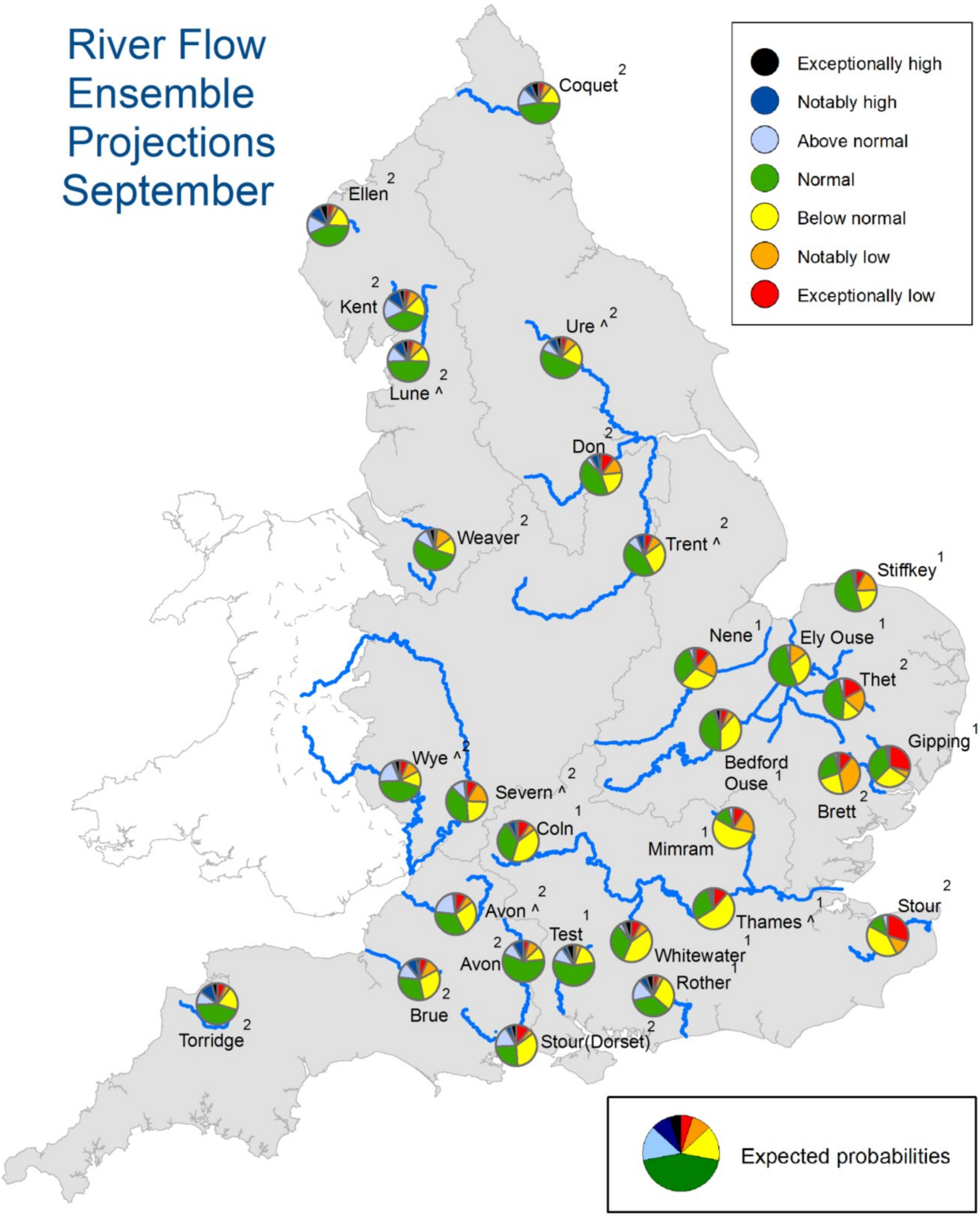


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[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

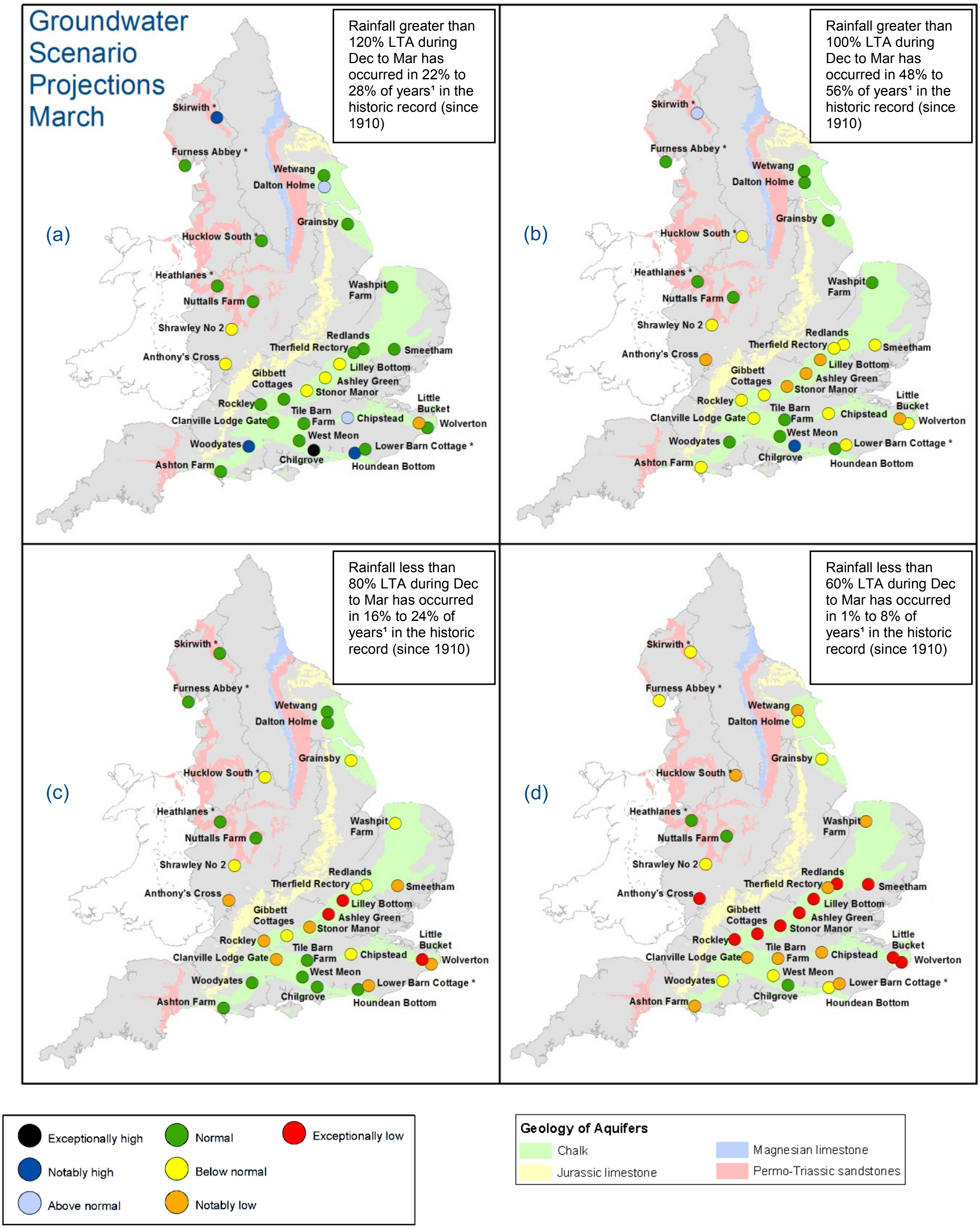


Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2017 and March 2018 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2017.

* Projections for these sites are produced by BGS

[1] This range of probabilities is a regional analysis

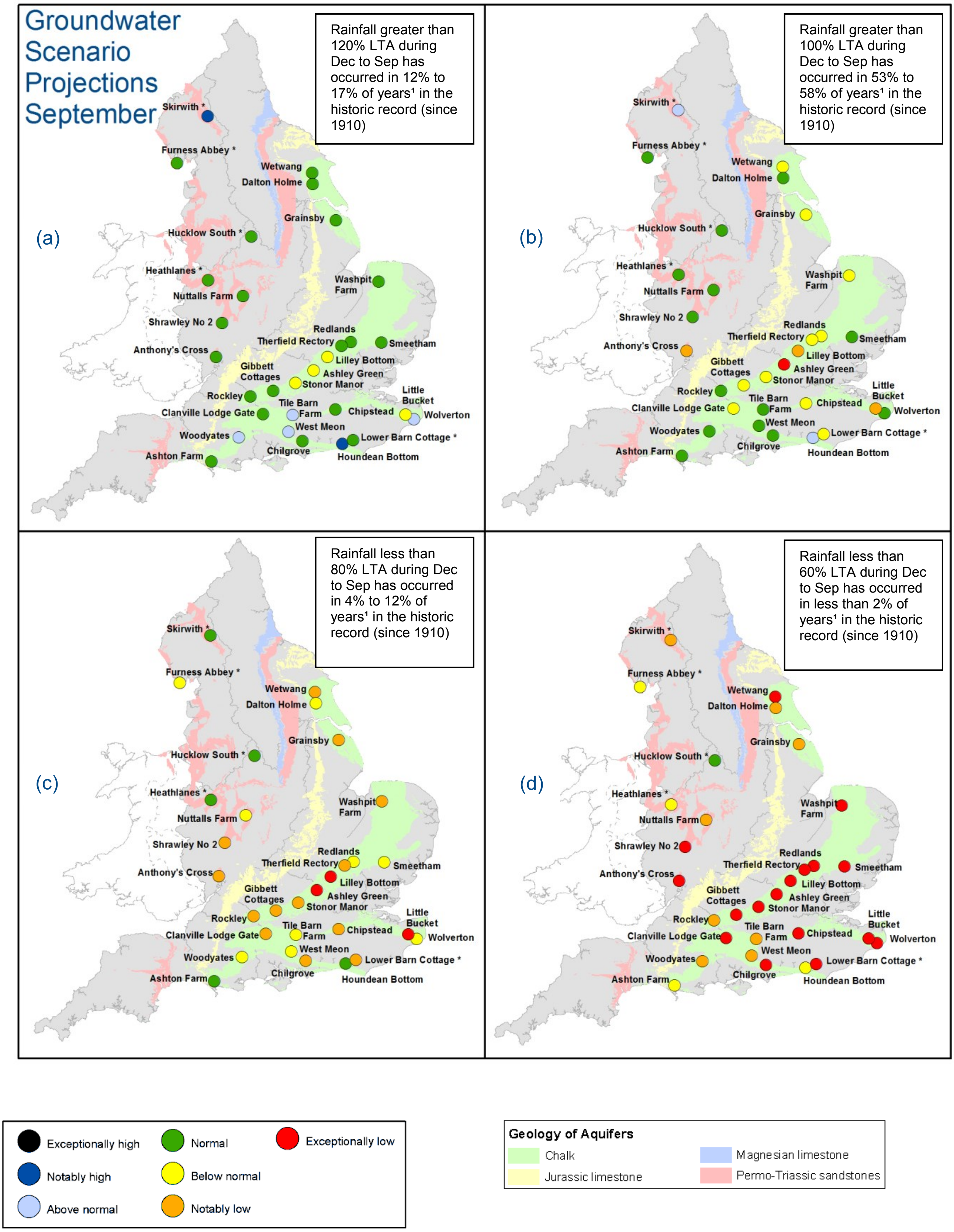
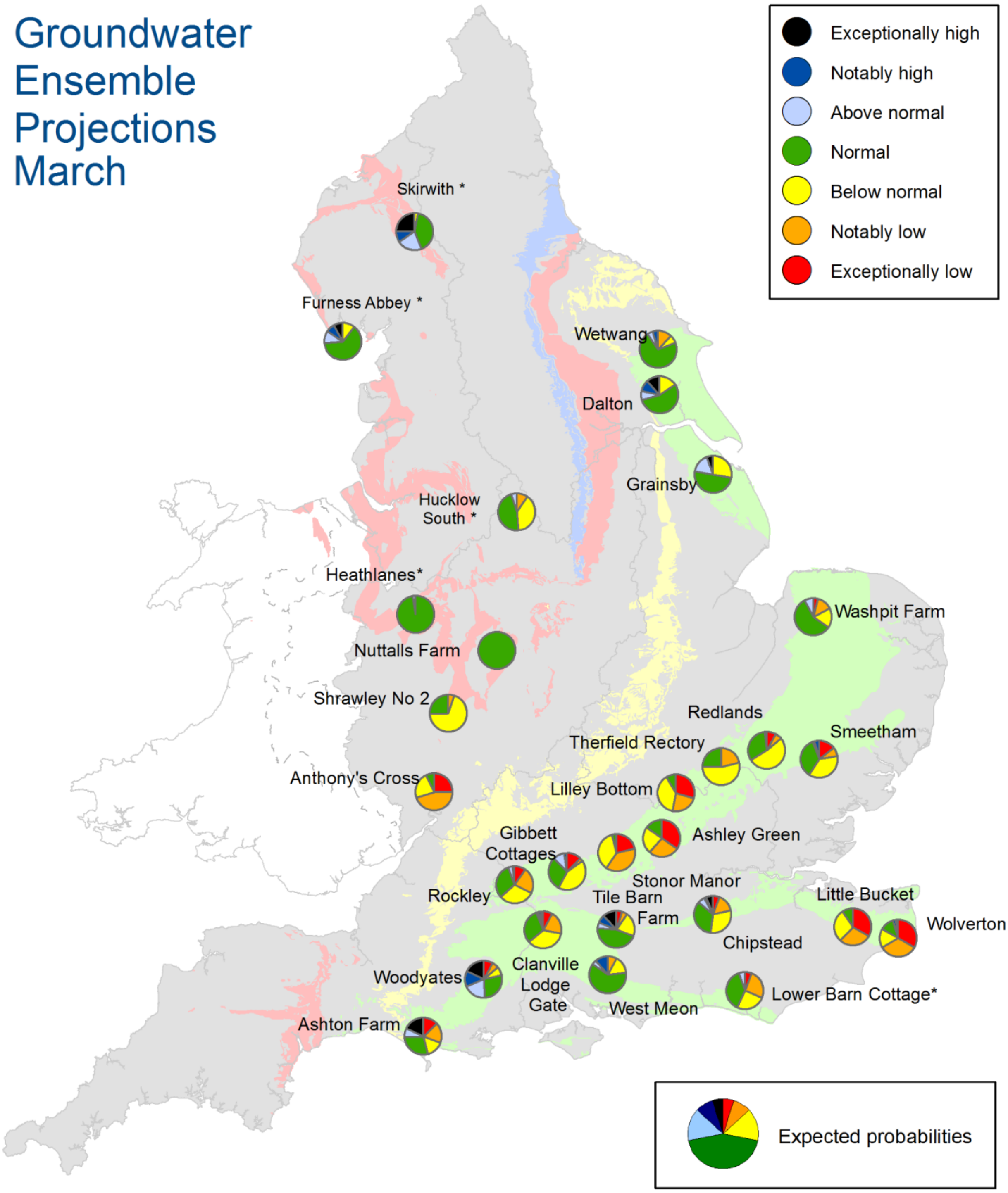


Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2017 and September 2018 (Source: Environment Agency). Geological map reproduced with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

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



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 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*

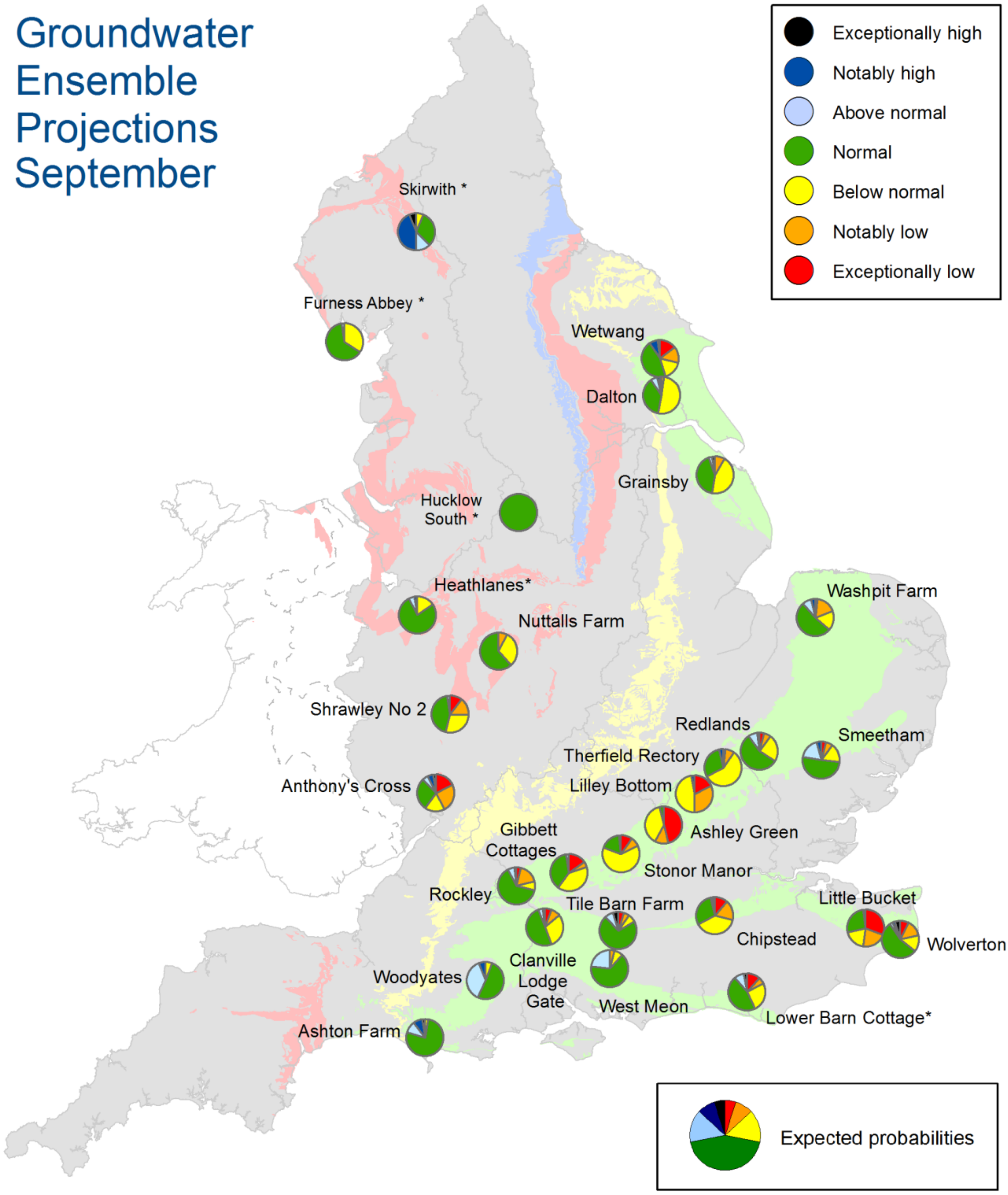


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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2018. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for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