Monthly water situation report

England

Summary – October 2016

October rainfall totals were well below average across England at 52% of the long term average (LTA). Soil moisture deficits decreased across north-east, east and south England but remained larger than average across much of the country at the end of October. River flows decreased at more than three quarters of indicator sites and were normal or below normal for the time of year at the majority of sites. Groundwater levels decreased at all indicator sites during October but remained within the normal range or higher for the time of year at the majority of sites. Reservoir stocks decreased at nearly all reported reservoirs and reservoir groups during October but remained normal for the time of year at nearly three quarters of sites. Overall stocks for England decreased to 76% of total capacity.

Rainfall

October has been moderately dry across much of England. Rainfall totals were above 60mm in parts of north-west, north-east, east and south-west England. For parts of Kent, Worcester, Gloucester and the Cotswolds, month totals were less than 20mm (Figure 1.1).

Monthly rainfall totals were above the long term average (LTA) for October in parts of Lincolnshire (143%) and north Norfolk (125%). For almost three-quarters of hydrological areas, rainfall was less than 50% of the October LTA, with the lowest being 23% (Cuckmere River, East Sussex). The rainfall across parts of the east coast of England was normal for the time of year, while parts of west and south-west England were exceptionally low for the time of year. For the rest of England, rainfall totals were below normal or notably low for the time of year. The 3-month accumulation to October was the second driest since 1910 in the North West Grain and South Essex hydrological catchments either side of the Thames Estuary (Figure 1.2).

At a regional scale, October was the fourth consecutive month of below average rainfall in central and south-east England. Month totals ranged from 32% of the LTA in north-west England to 79% in east England. Across England as a whole, monthly rainfall totals were just over half of the October LTA at 52% (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) decreased during October across north-east, east and south England and increased slightly elsewhere. At the end of October, SMDs were less than 10mm in parts of north-west, central and south-west England and between 70 and 100mm across much of the rest of England. In east and parts of south-east England, SMDs ranged from 100 to approximately 135mm. End of month SMDs were larger than the long term average (LTA) across much of England, although soils were slightly wetter than average in parts of north-east, north-west and south-west England (Figure 2.1).

At a regional scale, SMDs at the end of October were slightly smaller than at the end of September. End of month values ranged from almost 30mm in north-west England to almost 100mm in south-east England (Figure 2.2).

River flows

Monthly mean river flows for October decreased at more than three quarters of indicator sites across England compared with September. The majority of sites are classed as normal or below normal for the time of year. Six sites are notably low for October. The Lune at Caton in north-west England, and the Tone at Bishops Hull in south-west England, are classed as exceptionally low for the time of year, with the monthly mean flow for the Tone being the lowest October mean flow on record (since 1961) (Figure 3.1). Monthly mean river flows range from normal to exceptionally low for the time of year at the regional index sites (Figure 3.2).

Groundwater levels

At the end of October, groundwater levels had decreased at all of the indicator sites compared to the end of September. Groundwater levels were normal or higher for the time of year at just over three-quarters of the indicator sites. Six sites were below normal for the time of year, including Redlands Hall (Cam and Ely Ouse Chalk), Ashley Green (Chilterns East Chalk) and Chilgrove (Chichester Chalk), Jackaments Bottom (Burford Jurassic), Crossley Hill (Nottinghamshire and Doncaster Permo-Triassic sandstone) and Crow Lady Farm (Fylde and Preston Sandstone) (Figure 4.1). End of month groundwater levels at the major aquifer index sites ranged from below normal to above normal for the time of year (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at almost all reported reservoirs and reservoir groups during October, with the largest decrease occurring at Wimbleball reservoir in south-west England. Stocks at Stithians reservoir, also in south-west England, increased slightly. End of month stocks were classed as normal for the time of year at the majority of reservoirs and reservoir groups, with just over a quarter being below normal or lower (Figure 5.1).

At a regional, scale reservoir stocks decreased across England during October by between 4 and 8%. At the end of October stocks ranged from 58% of total capacity in south-west England to 80% in central England. Overall storage for England decreased by 5% to 76% of total capacity (Figure 5.2).

Forward look

Unsettled weather is expected to affect the north and west during November, with rain and snow at times. The rest of country will be more settled[1].

Projections for river flows at key sites[2]

By the end of March 2017, all but one of the modelled sites have a greater than expected chance of below normal or lower cumulative flows. By the end of September 2017, all modelled sites have a greater than expected chance of below normal or lower cumulative flows.

For scenario based projections of cumulative river flows at key sites by March 2017 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2017 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2017 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2017 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

At the end of March 2017 half of modelled sites have a greater than expected chance of normal or higher groundwater levels for the time of year. At the end of September 2017, three-quarters of modelled sites have a greater than expected chance of normal groundwater levels for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2017 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2017 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2017 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2017 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

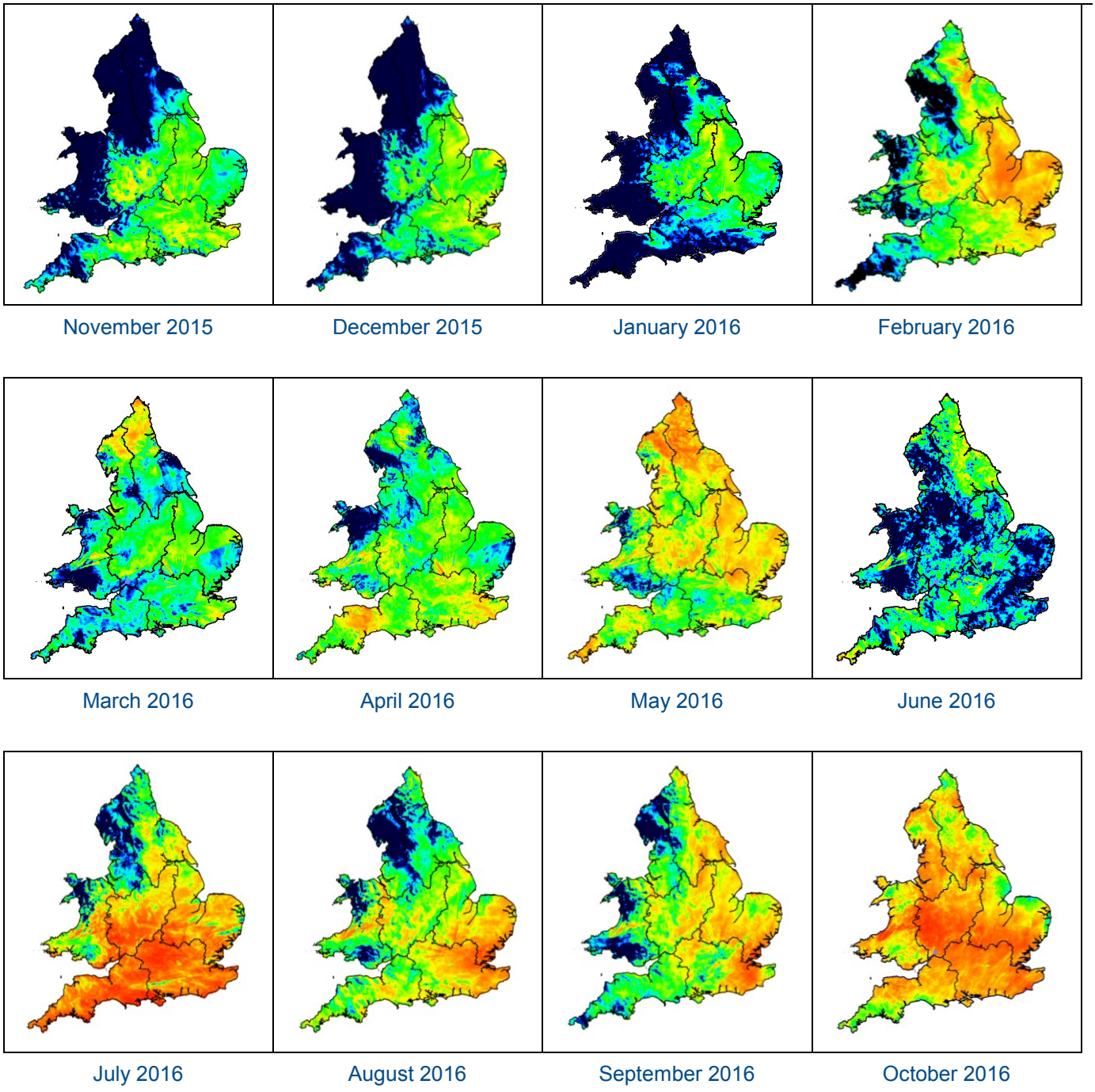


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2016). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

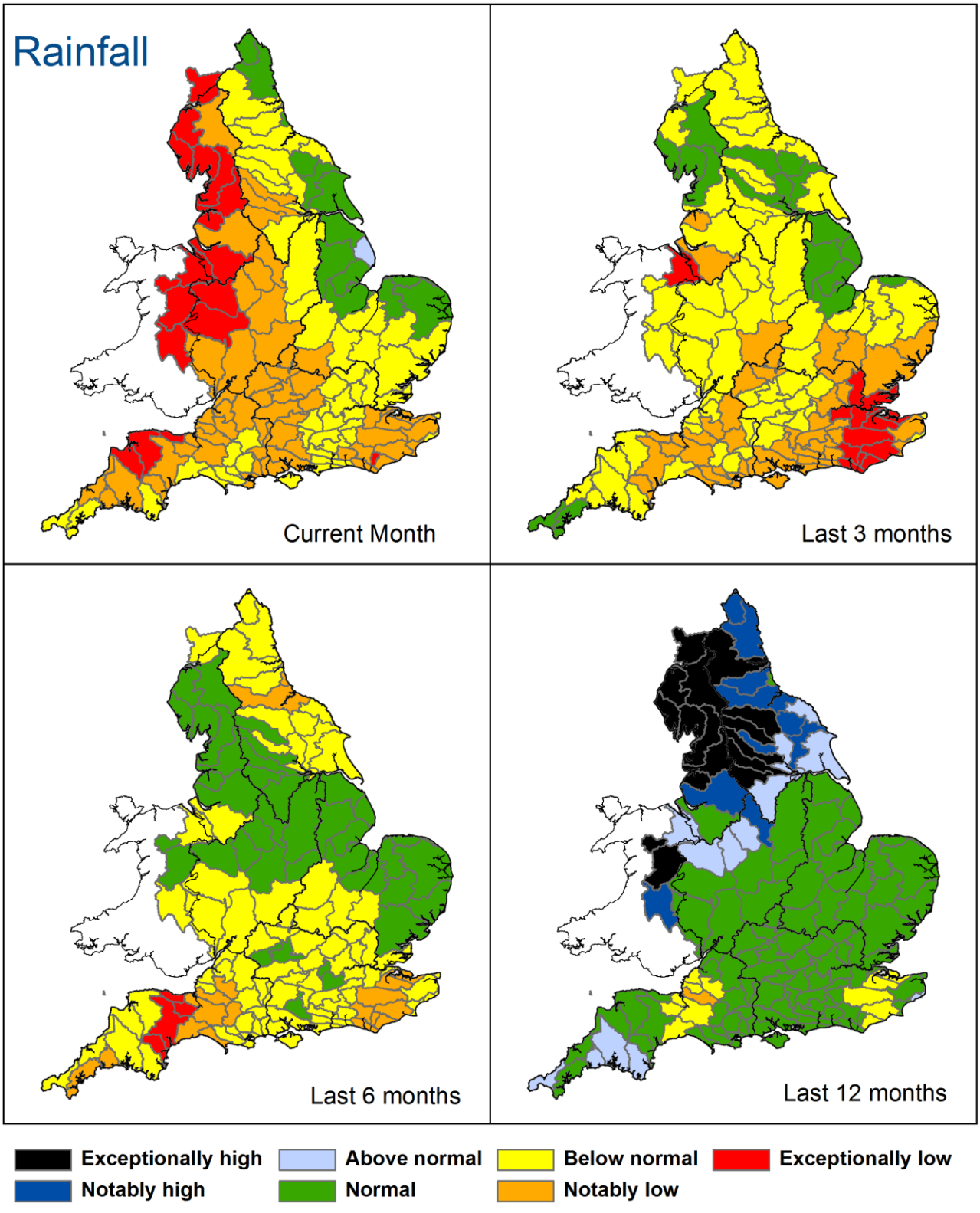


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 October), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2016)*. 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, 2016.

Rainfall charts

Above average rainfall

Below average rainfall

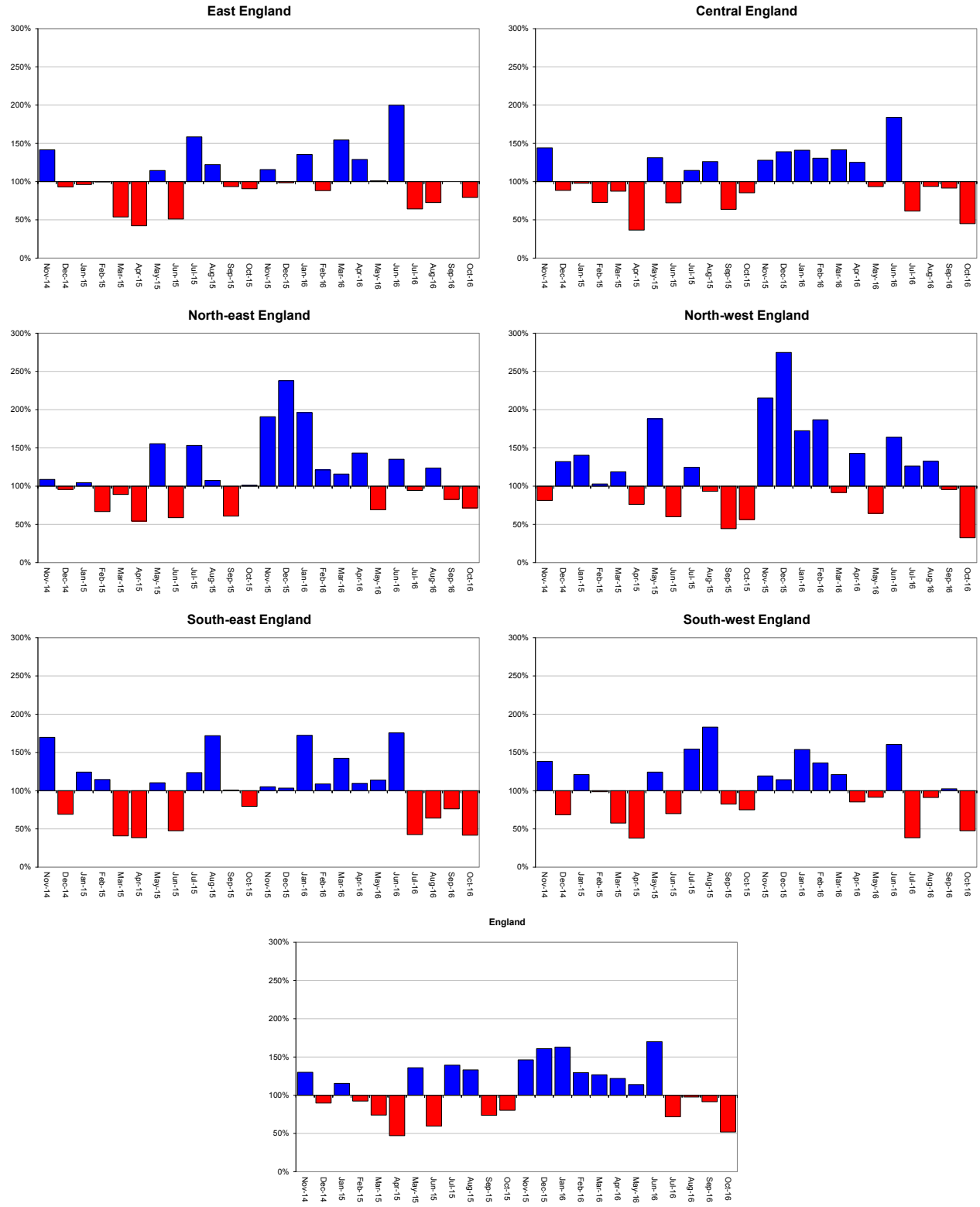


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2016).

Soil moisture deficit

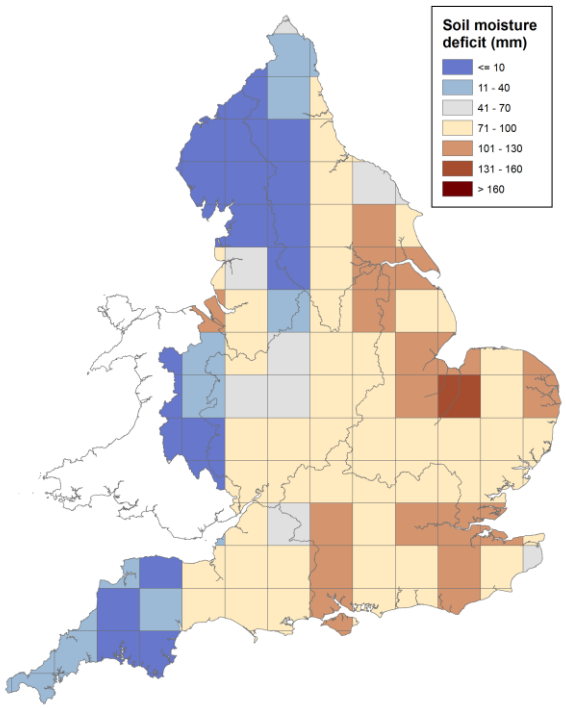
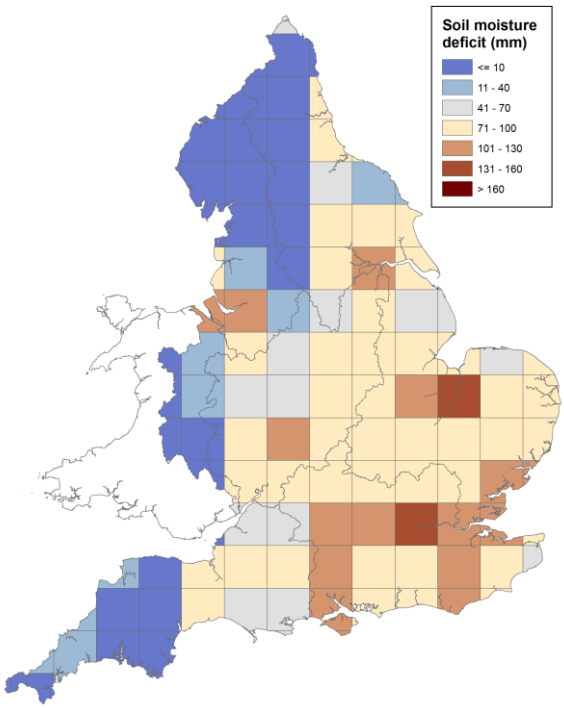
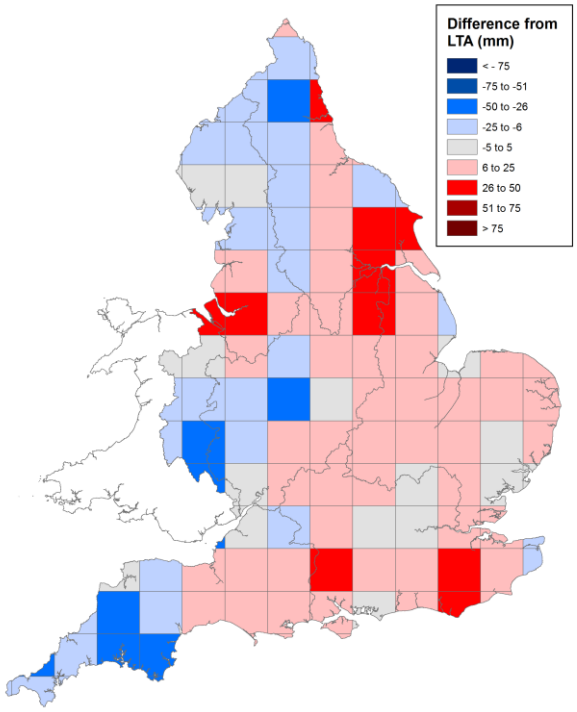
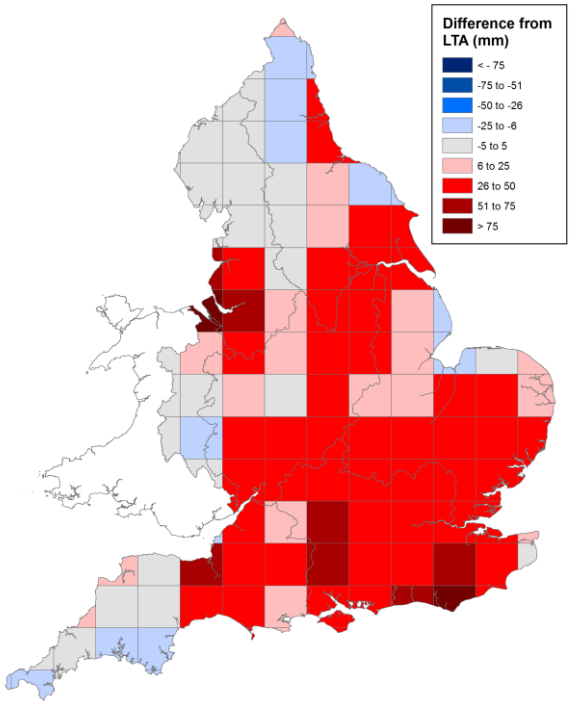
End of September 2016[1]	End of October 2016[2]
	
	

Figure 2.1: Soil moisture deficits for weeks ending 27 September 2016 [1] (left panel) and 1 November 2016 [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, 2016). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016

Soil moisture deficit charts

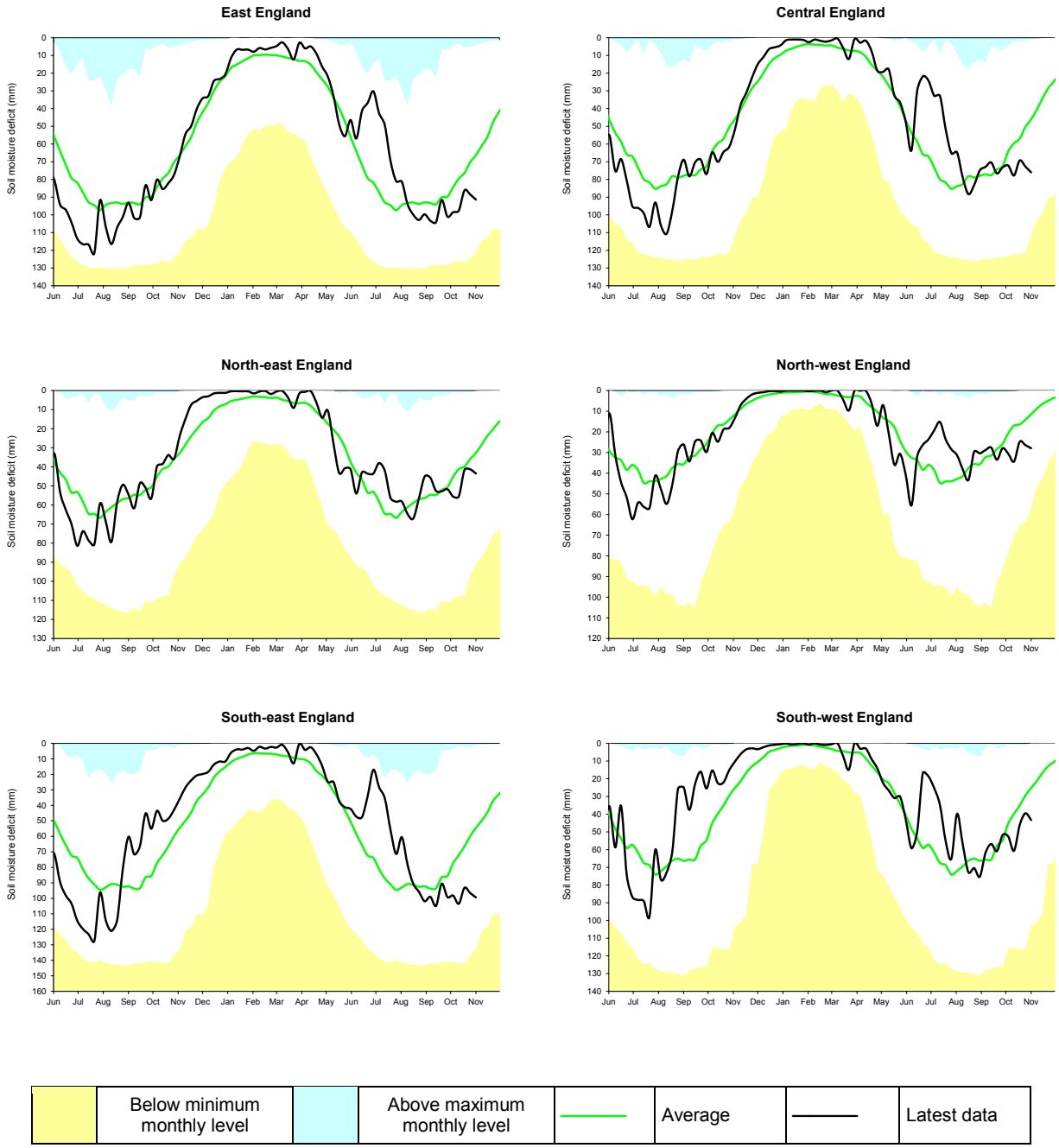
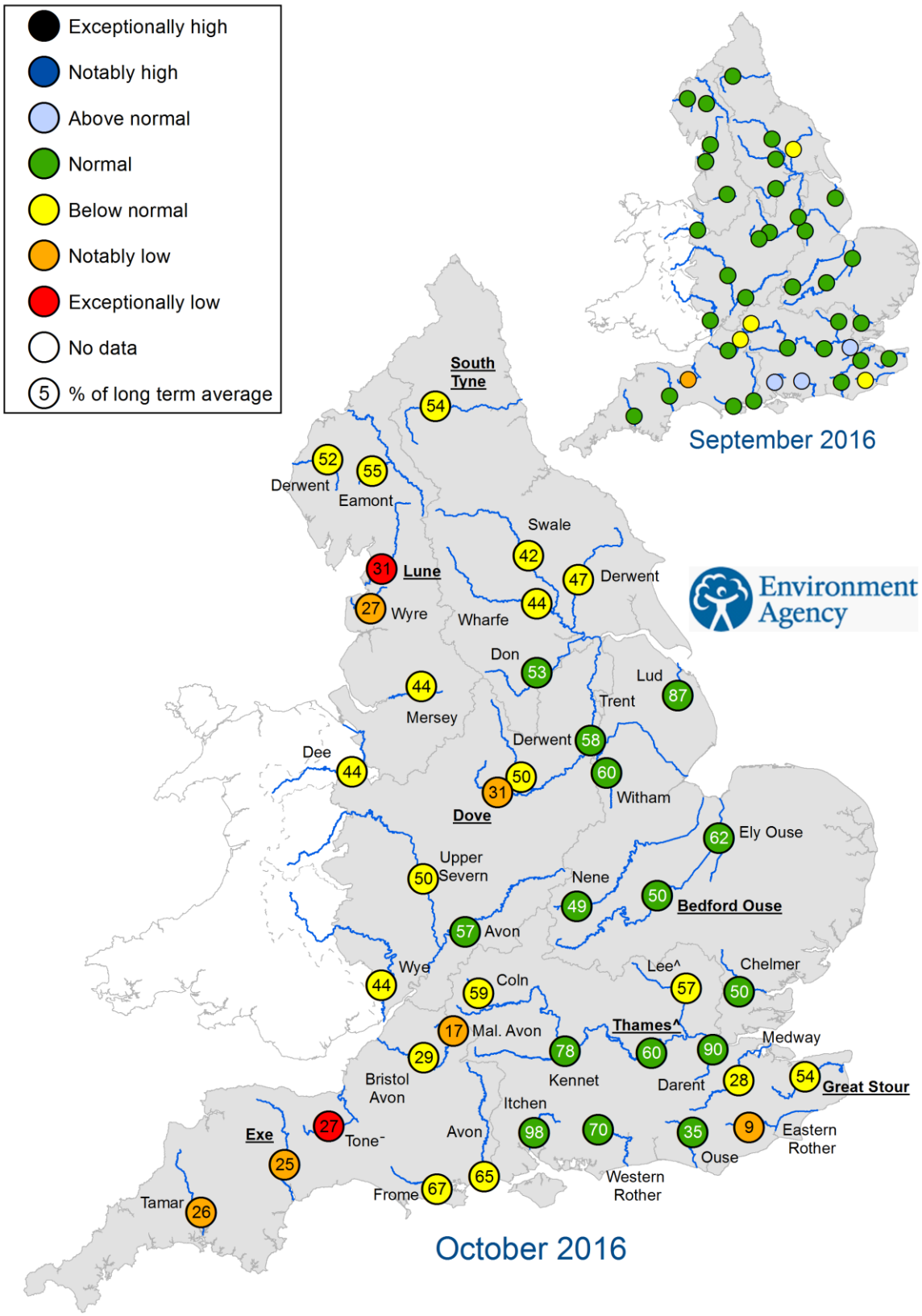


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2016).

River flows



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

+/- Monthly mean flow is the highest/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 September 2016 and October 2016, expressed as a percentage of the respective long term average and classed relative to an analysis of historic September and October monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

River flow charts

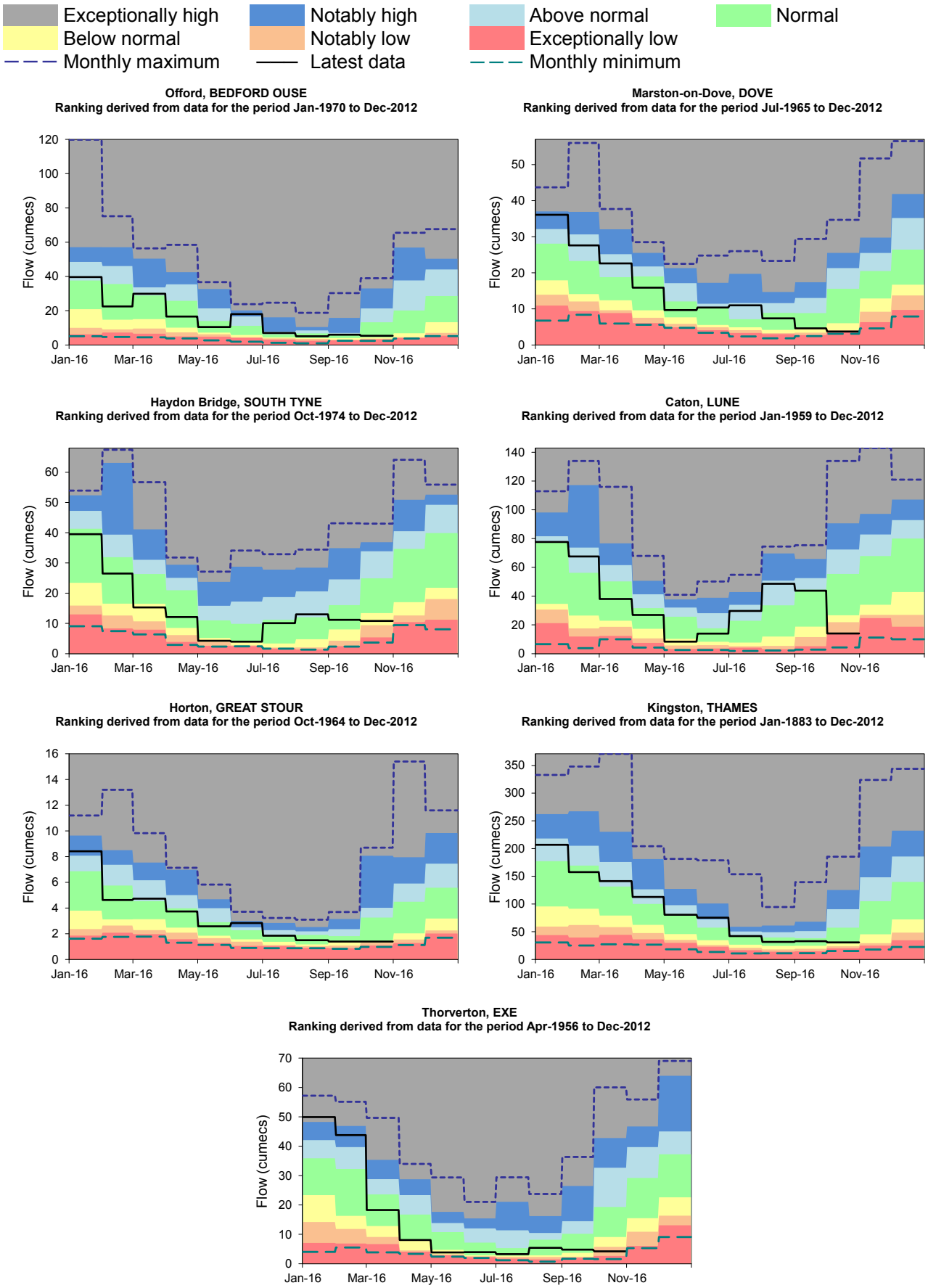
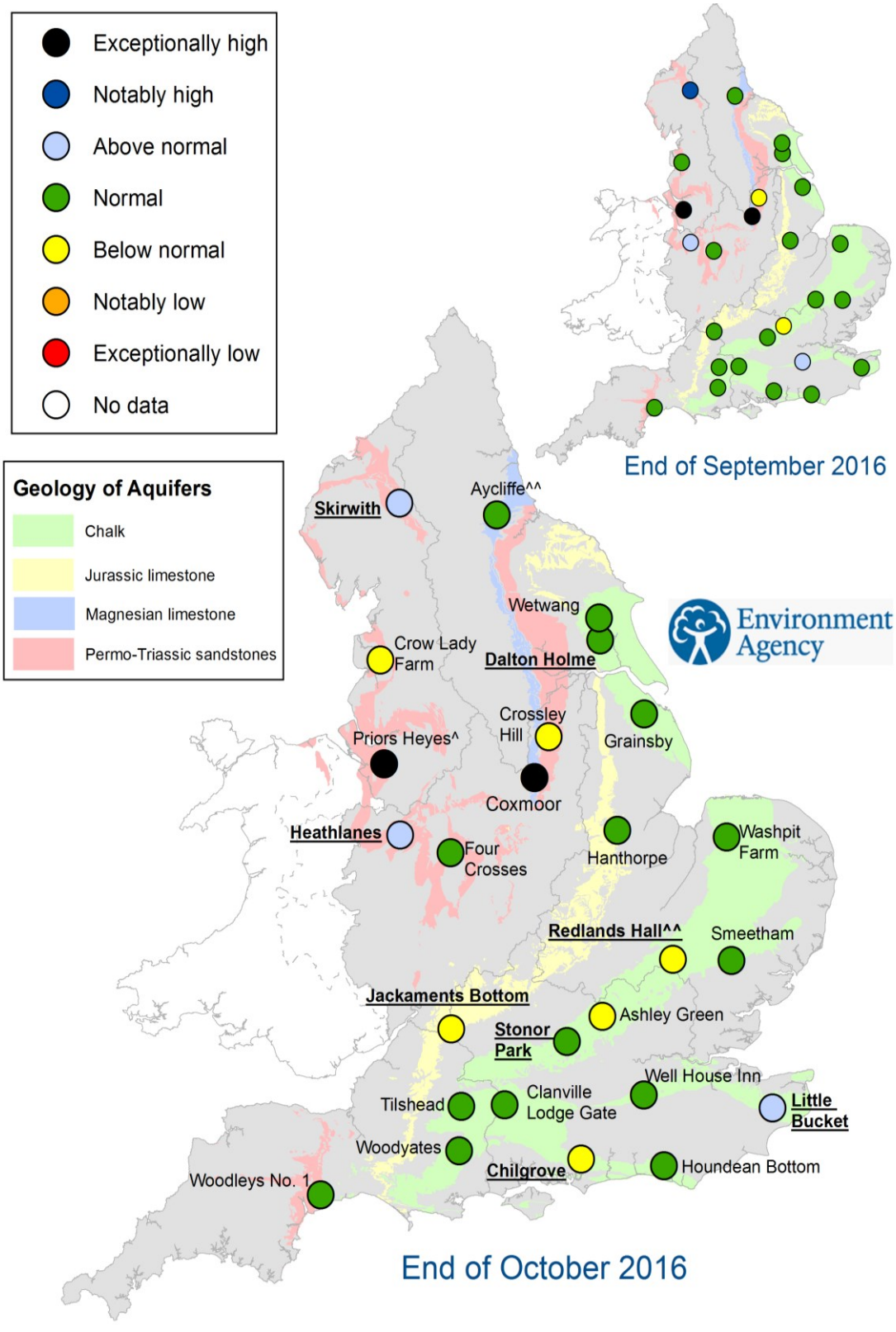


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
Highlighted 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 September and October 2016, classed relative to an analysis of respective historic September and October levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

Groundwater level charts

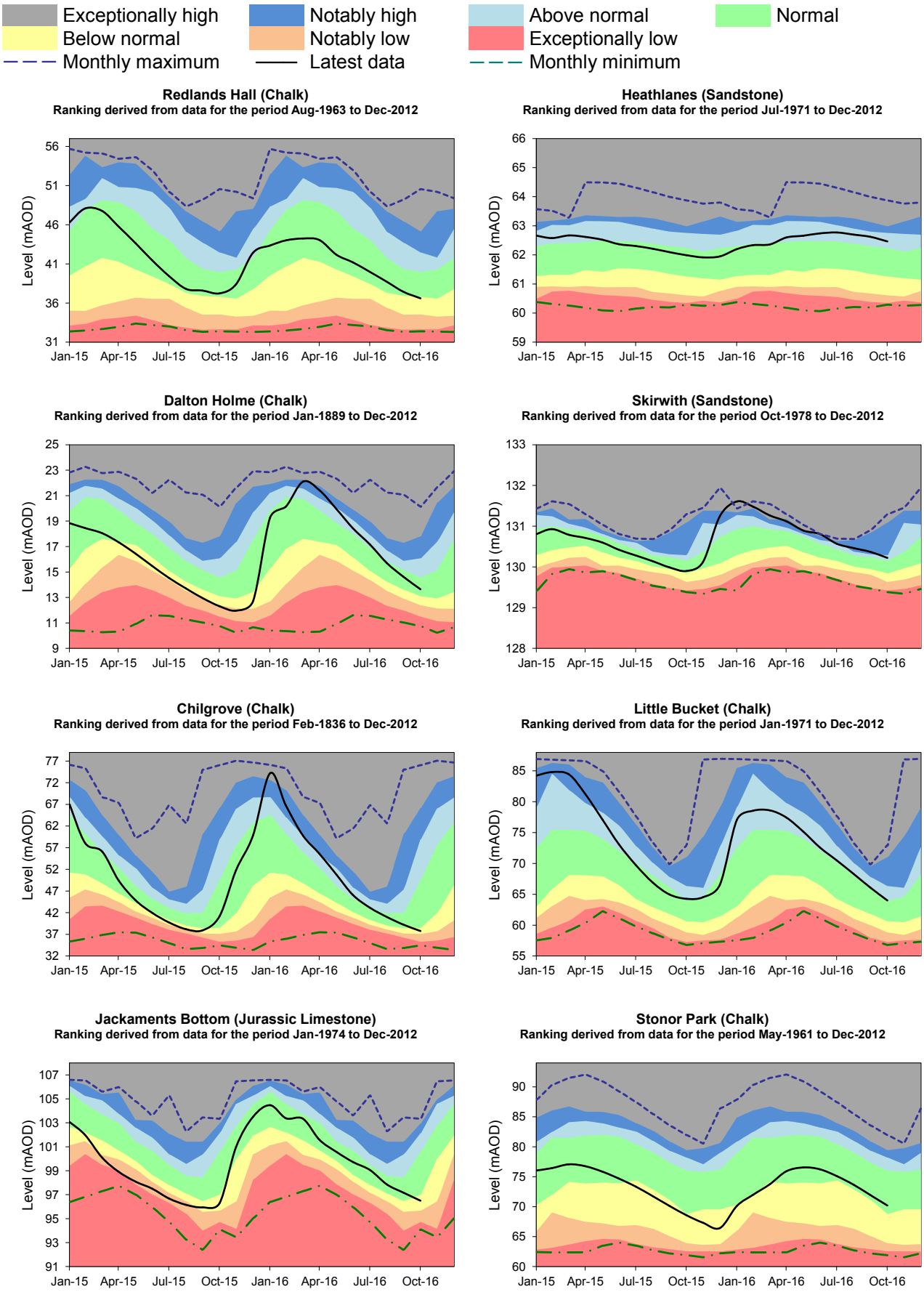
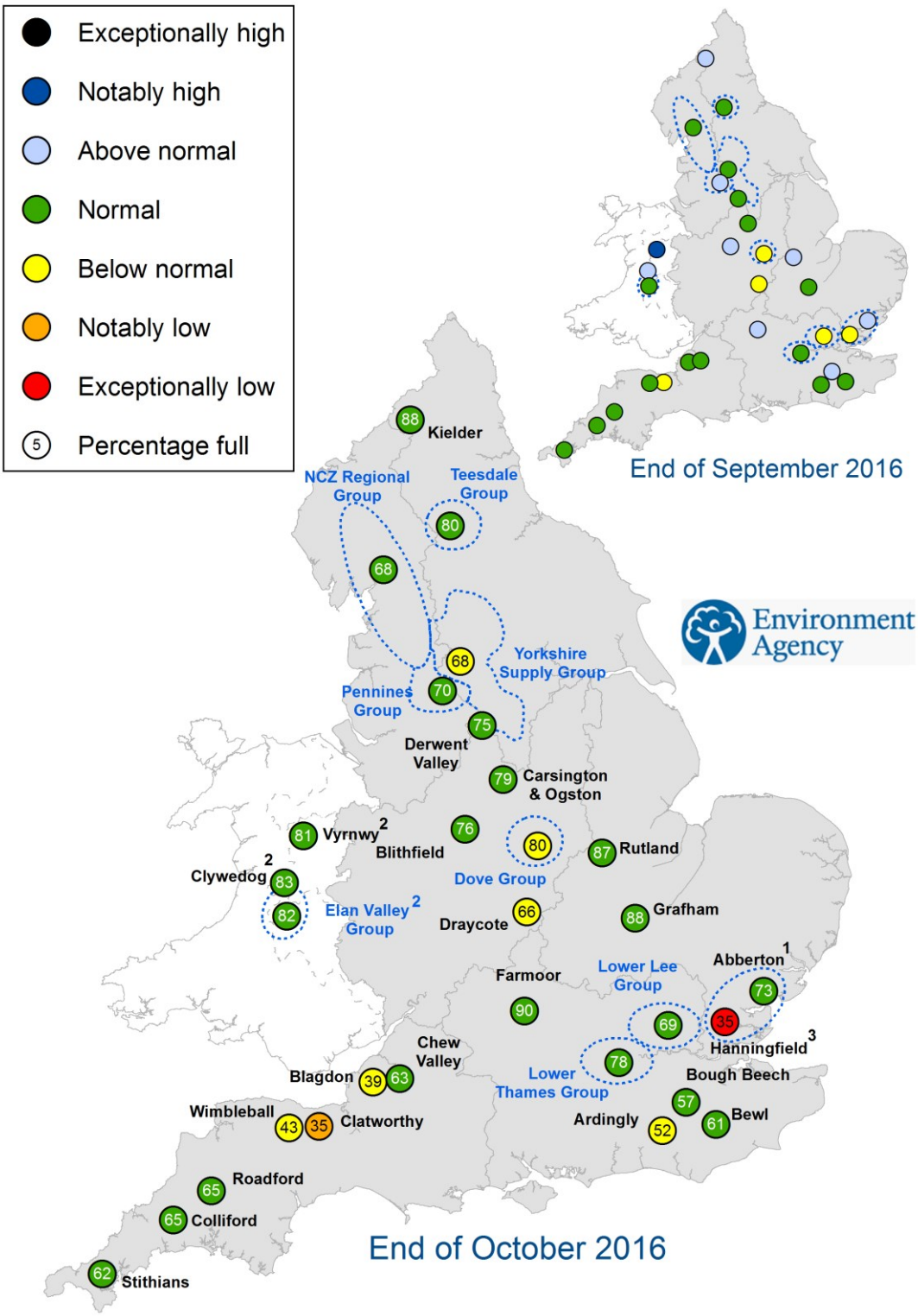


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2016).

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. Stocks at Hanningfield Reservoir are affected by recent exceptionally dry weather but are now increasing.

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of September and October 2016 as a percentage of total capacity and classed relative to an analysis of historic September and October 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

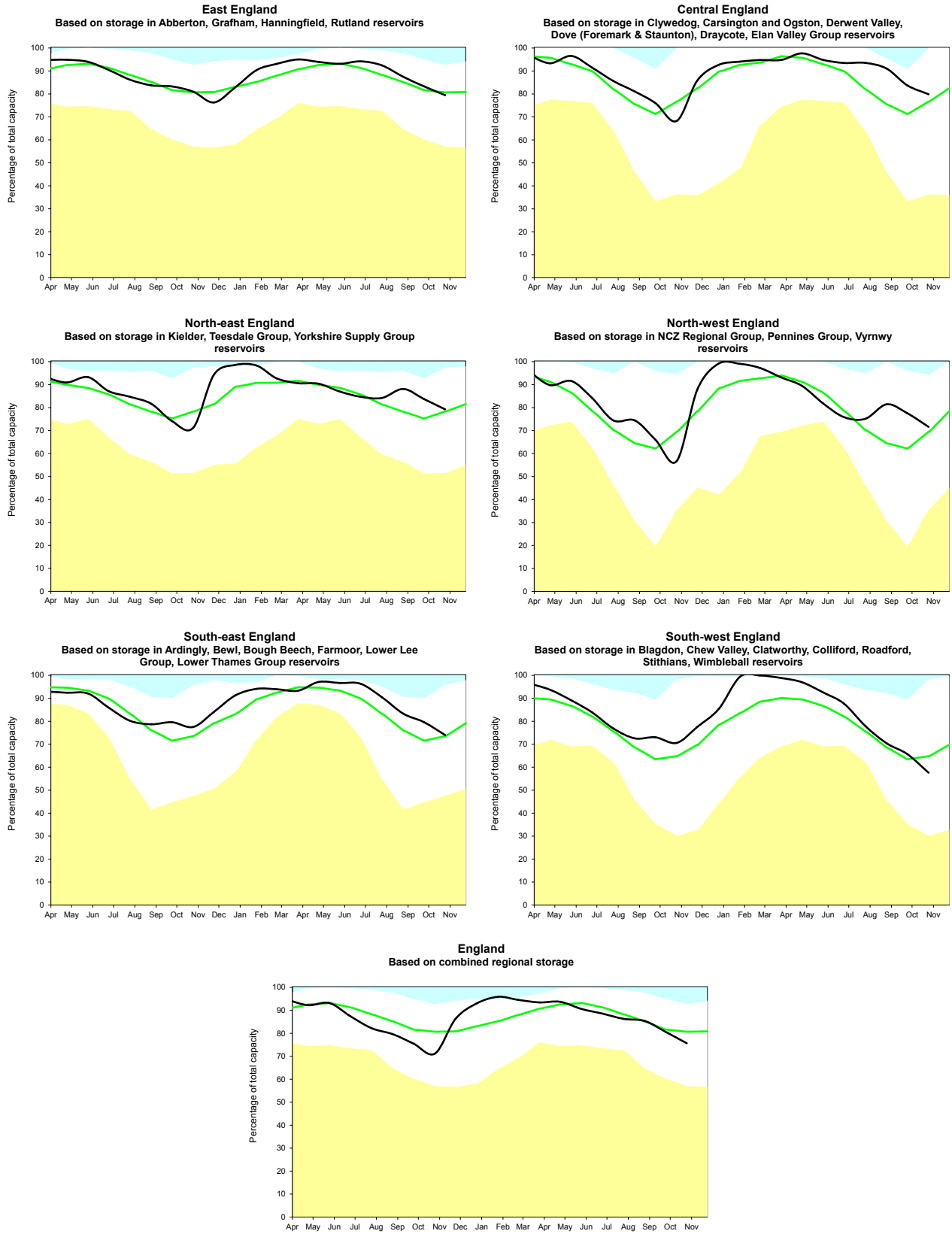


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

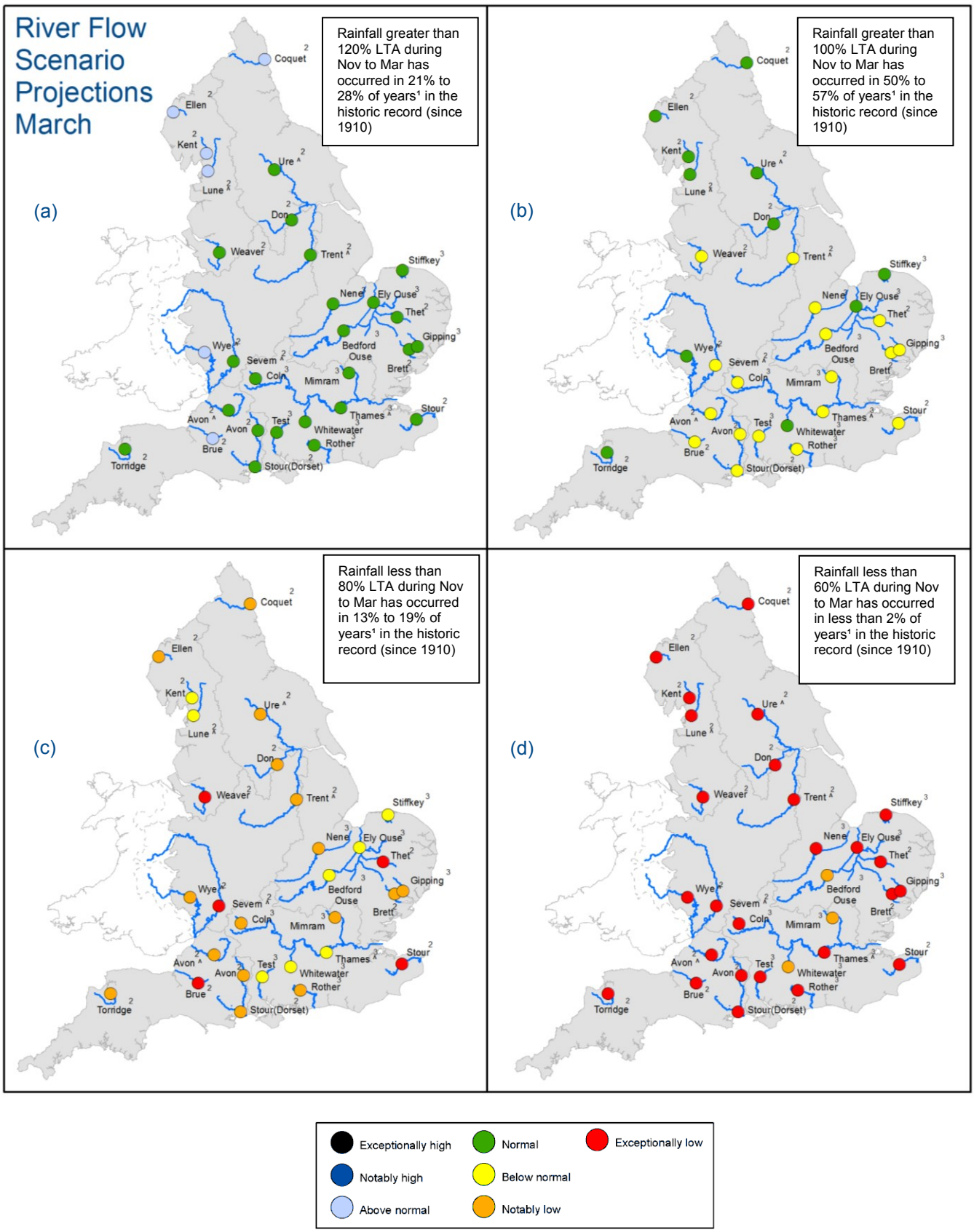
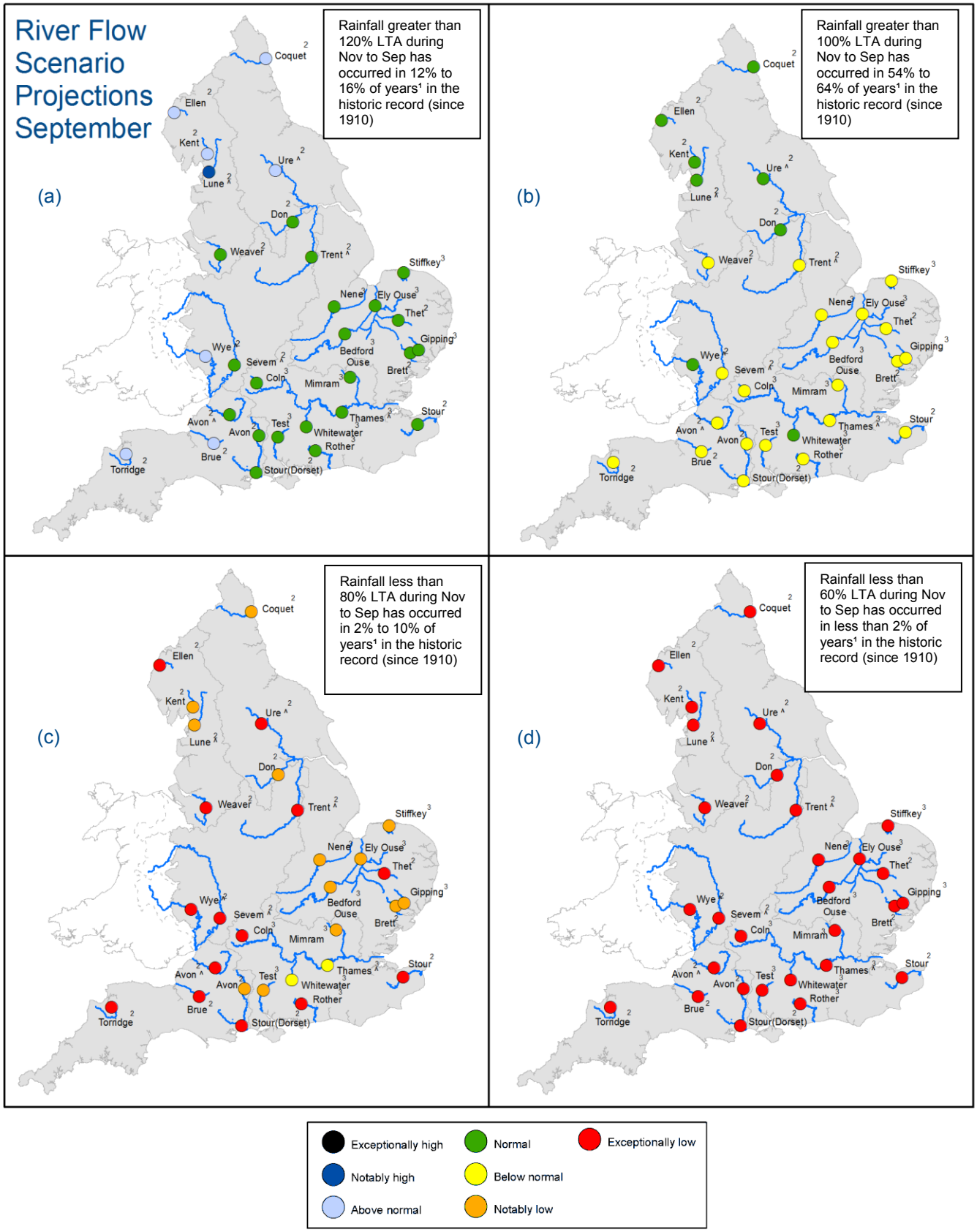


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2016 and March 2017 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*



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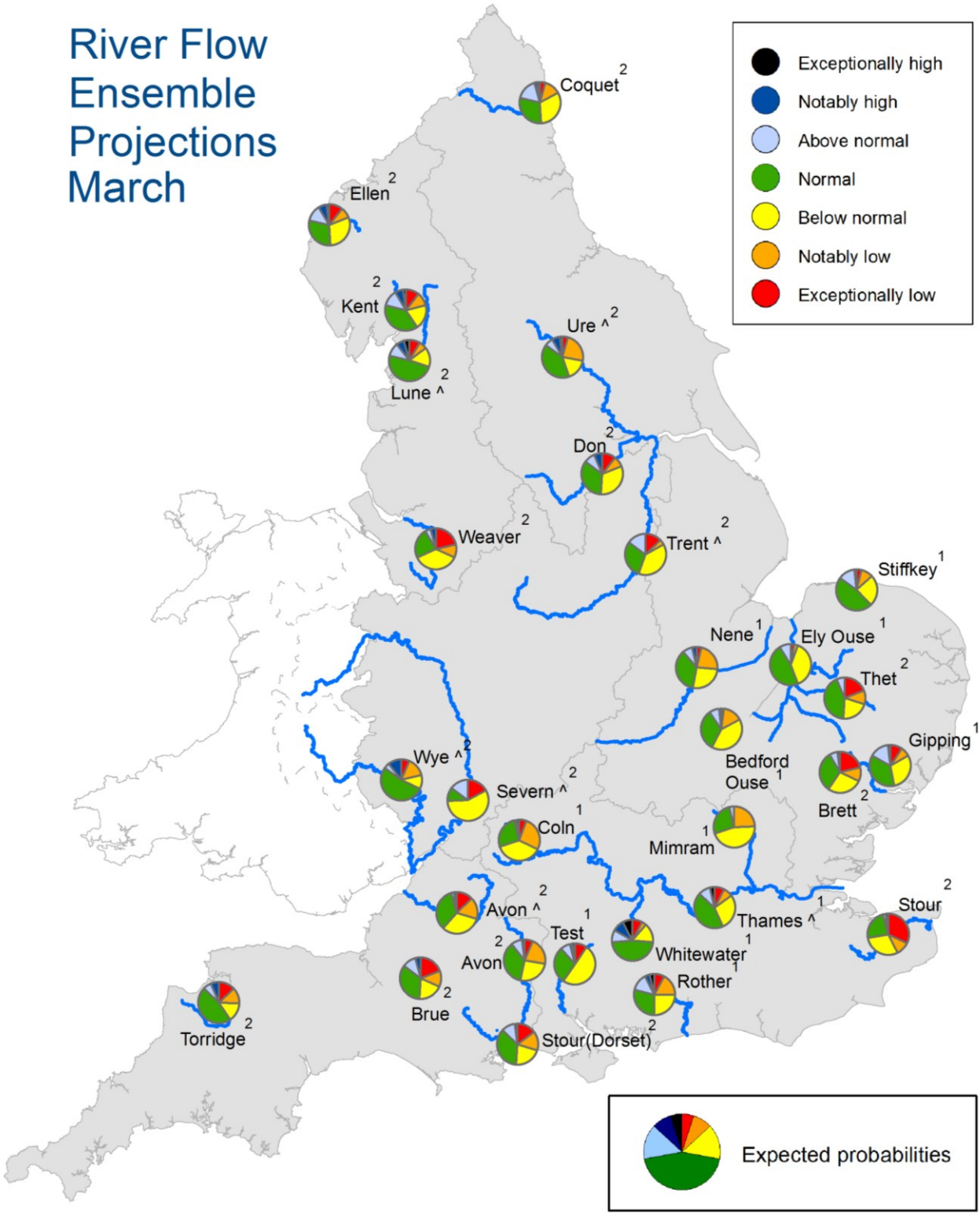

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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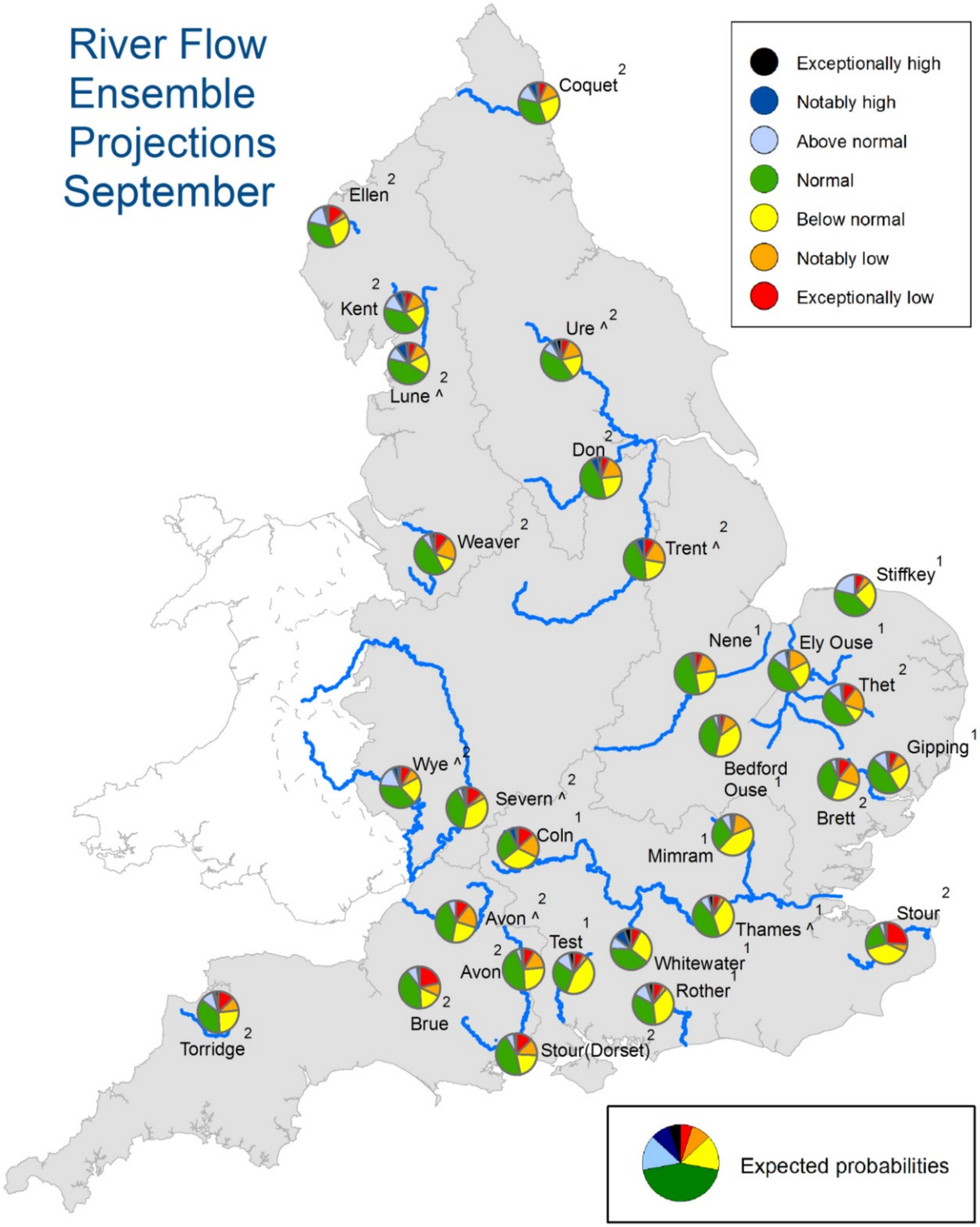

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2017. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[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

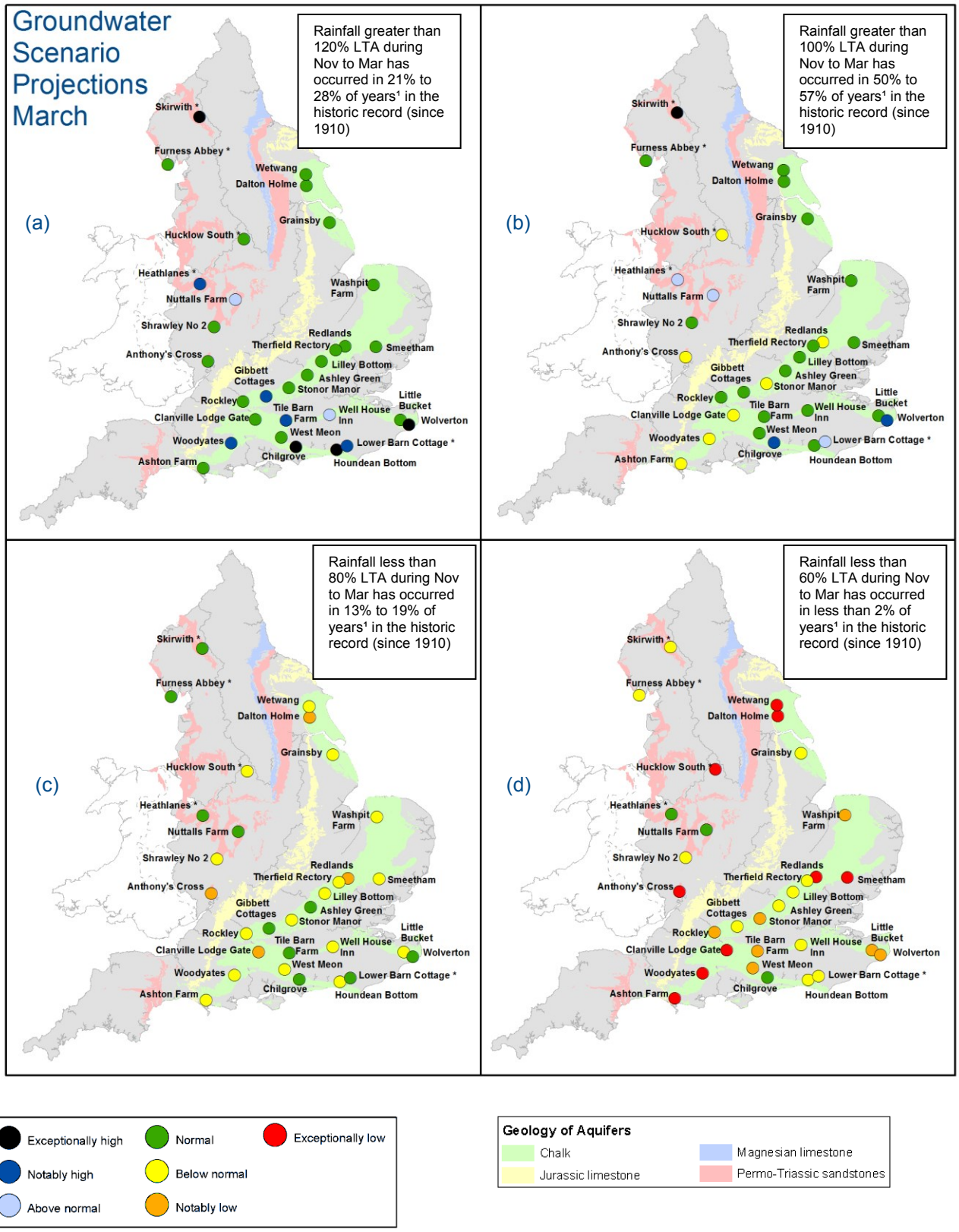

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2016 and March 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2016.

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

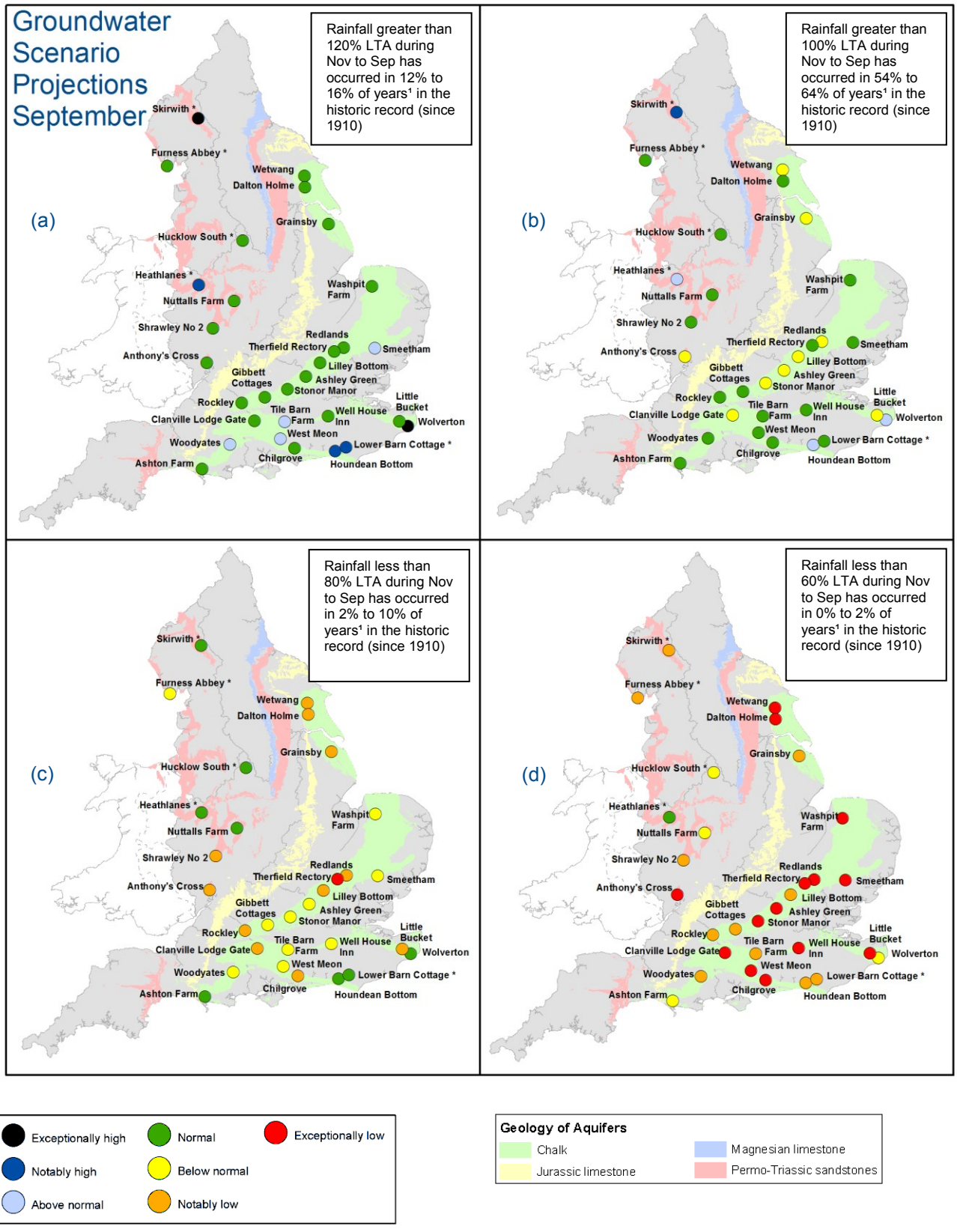

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2016 and September 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2016.

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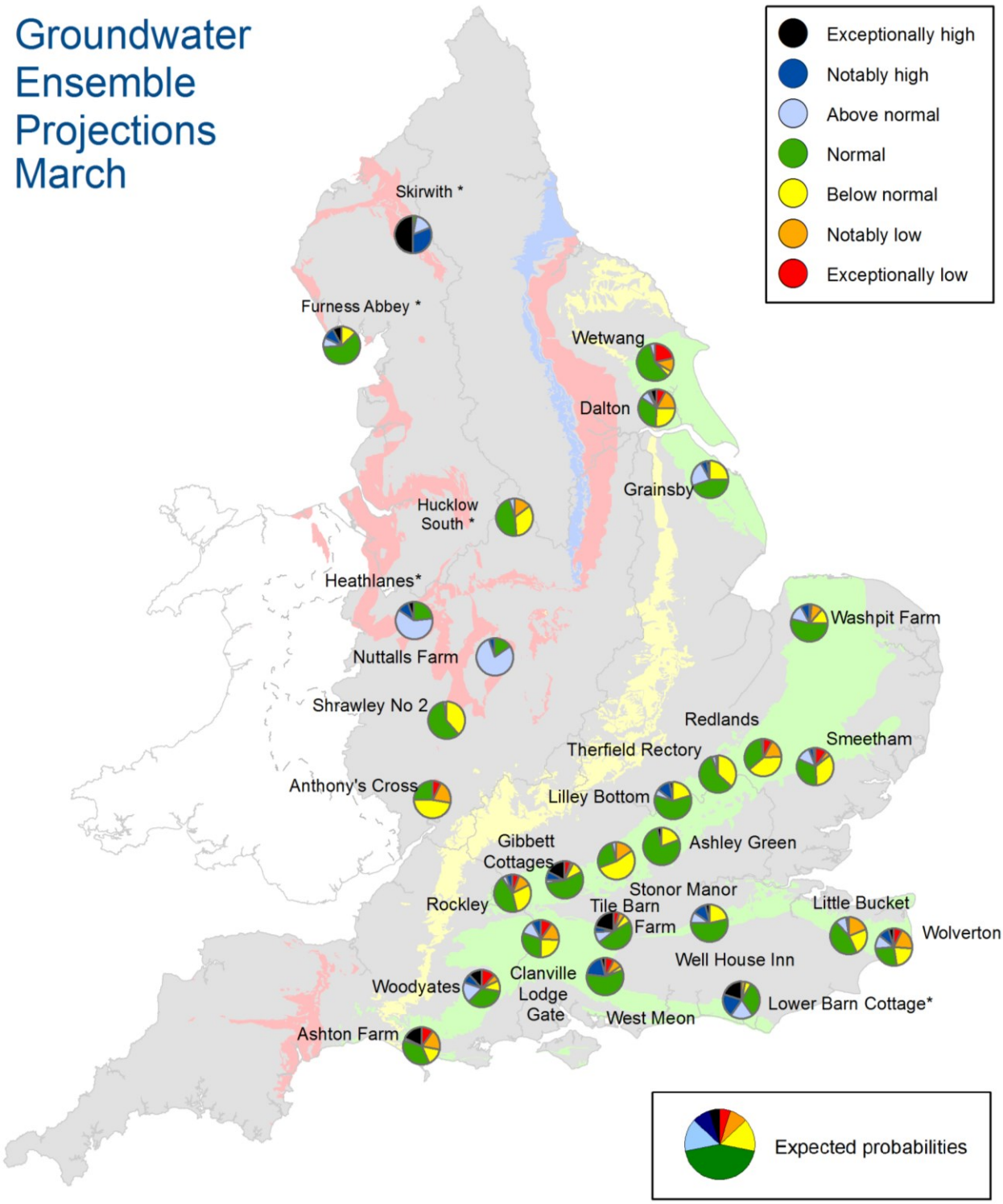

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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, 2016.

** Projections for these sites are produced by BGS*

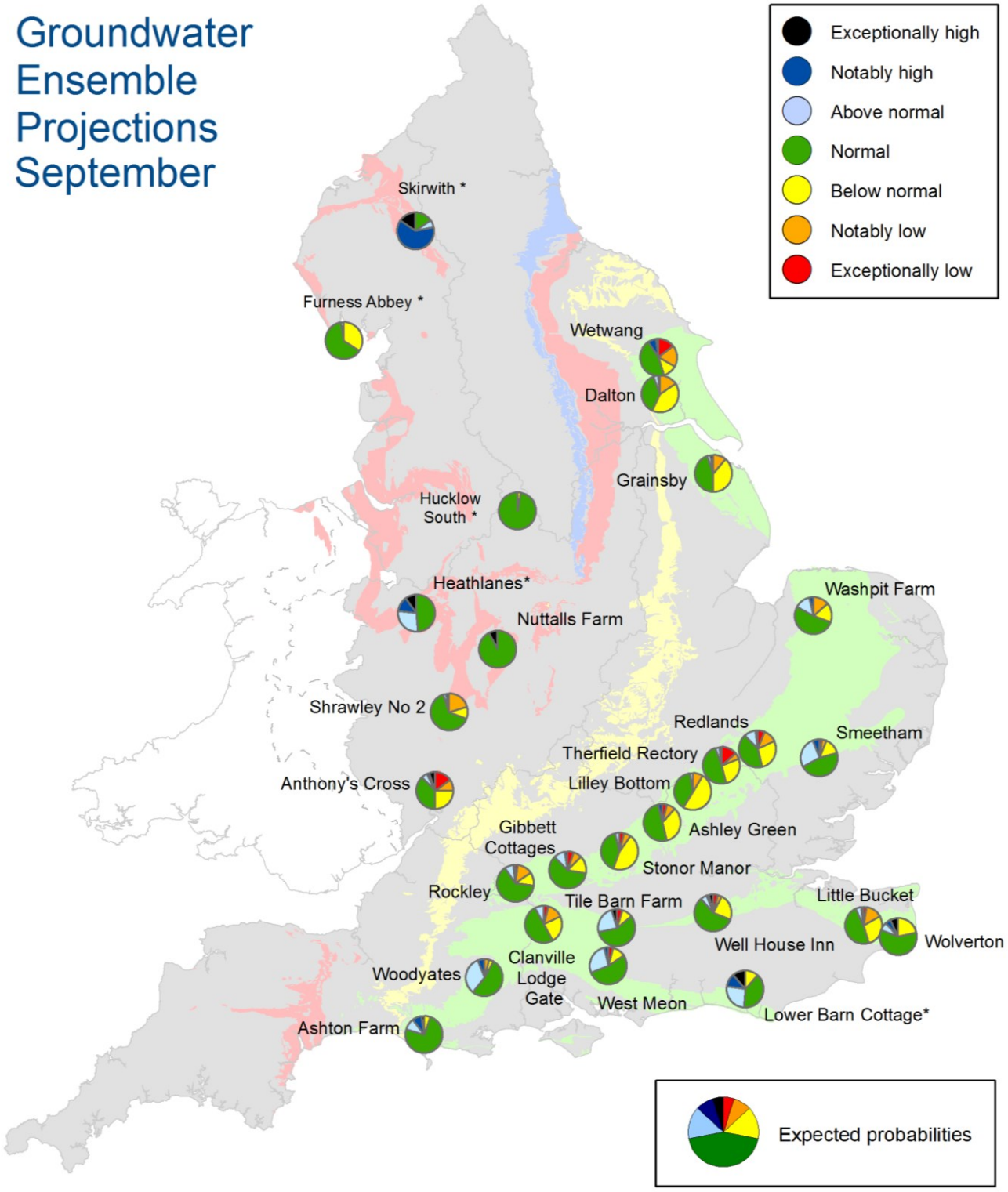

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2017. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for 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, 2016.

* 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, usually based on the period 1961-1990. However, the period used may vary by parameter being reported on (see figure captions for details).
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