Monthly water situation report

England

Summary – August 2017

The August rainfall total for England was just over the monthly long term average (LTA) at 105%. Monthly rainfall totals were normal or higher for the time of year across the majority of hydrological areas. Soil moisture deficit increased during August across much of England and at the end of the month, soils were drier than average across east and central England. Monthly mean river flows increased compared to July at more than two-thirds of indicator sites and were classed as normal or higher or the time of year at all but 3 sites. Groundwater levels decreased at all but 3 indicator sites during August but end of month levels were normal or higher for the time of year at half of the indicator sites. Reservoir stocks decreased at just over half of reported reservoirs or reservoir groups, but stocks remain normal or higher for the time of year at nearly three-quarters of sites. Overall reservoir storage for England decreased slightly during August to 79% of total capacity.

Rainfall

August rainfall was highest in north-west England and lowest across parts of east and north-east England, with totals ranging from 170mm in parts of Cumbria to approximately 40mm across parts of Lincolnshire, Norfolk and Northumbria. Rainfall totals were above the long term average (LTA) for August across two-thirds of hydrological areas, with parts of Kent and West Sussex receiving just over 150% of the August LTA. (Figure 1.1).

August rainfall totals were classed as normal or higher for the time of year across almost all of the hydrological areas. Cumulative rainfall totals for the past 3 months range from normal to notably high for the time of year across the whole of England. In contrast, cumulative rainfall totals for the past 12 months still show a rainfall deficit with most of England being below normal or notably low for the time of year (Figure 1.2).

At a regional scale, August rainfall totals ranged from 99% of the LTA in north-east England to 126% in south-east England and were normal for the time of year across all regions. The monthly rainfall total for England was 105% of the 1961-90 LTA for August (108% of the 1981-2010 LTA) (Figure 1.3).

Soil moisture deficit

Despite the above average August rainfall across much of England, soil moisture deficits (SMDs) generally increased during August. At the end of August, soils were drier than at the end of July across nearly two-thirds of England, with SMDs ranging from approximately 1mm in parts of north-west England to nearly 160mm across parts of Norfolk and Cambridgeshire. Soils were drier than the August LTA across much of central and east England in particular, but wetter than average elsewhere, particularly across parts of Devon and Cornwall (Figure 2.1).

At a regional scale, soils were drier at the end of August compared to the end of July across all regions, with end of month SMDs ranging from 29mm in north-west England to 99mm in east England. Soils were drier than the LTA in east and central England but wetter elsewhere (Figure 2.2).

River flows

Compared with July, monthly mean river flows for August increased at just over two-thirds of indicator sites across England. River flows were classed as normal or higher for the time of year at all but 3 indicator sites; flows in the rivers Itchen and Eastern Rother were below normal for the time of year whilst the River Coln remained exceptionally low for the second consecutive month. Flows at all indicator sites in north-west England were above normal for the time of year, with the River Derwent being notably high (Figure 3.1).

At the regional index sites, monthly mean river flows were normal for the time of year at 4 of the 6 sites, whilst the River Lune in north-west England and the Bedford Ouse in east England were above normal (Figure 3.2).

Groundwater levels

Groundwater levels decreased during August at all but 3 of the indicator sites – levels at Wetwang (Hull and East Riding chalk aquifer), Crow Lady Farm (Fylde and Preston sandstone aquifer) and Woodyates (Upper Dorset Stour chalk aquifer) all increased slightly compared to the end of July. End of month groundwater levels were below normal or lower for the time of year at half of the indicator sites, with Ashley Green (Chilterns East chalk aquifer) and Little Bucket (East Kent Stour chalk aquifer) both remaining exceptionally low for the third consecutive month.

End of month groundwater levels at the major aquifer index sites ranged from exceptionally low for the time of year at Little Bucket (East Kent Stour chalk aquifer) to normal for the time of year at Heathlanes (Shropshire sandstone aquifer), Dalton Holme (Hull and East Riding chalk aquifer) and Skirwith (Carlisle Basin and Eden Valley sandstone aquifer) (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at just over half of the reported reservoirs or reservoir groups during August. Notable decreases occurred at Carsington and Ogston (9%), Bough Beech (9%) and Chew Valley (12%) reservoirs, whilst Clywedog reservoir increased by 11%. End of month stocks were classed as normal or higher for the time of year at nearly three-quarters of all reported reservoirs and reservoir groups. The remaining sites were classed as below normal or notably low for the time of year (Figure 5.1).

Compared with the end of July, regional reservoir stocks increased in north-west and central England by 4% and 2% respectively and decreased elsewhere by up to 3%. End of August stocks ranged from 67% of total capacity in south-west England to 87% in east England. Overall storage for England decreased slightly to 79% of total capacity (Figure 5.2).

Forward look

The first half of September is likely to see a mix of clear spells and heavy showers across most of the country. The second half of September is likely to see more settled spells – especially in the south, south-east and west of the country. For the 3-month period September to November above-average rainfall is considered slightly more probable than below-average rainfall but the forecast is uncertain[1].

Projections for river flows at key sites[2]

Two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being below normal or lower by both the end of September 2017 and the end of 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]

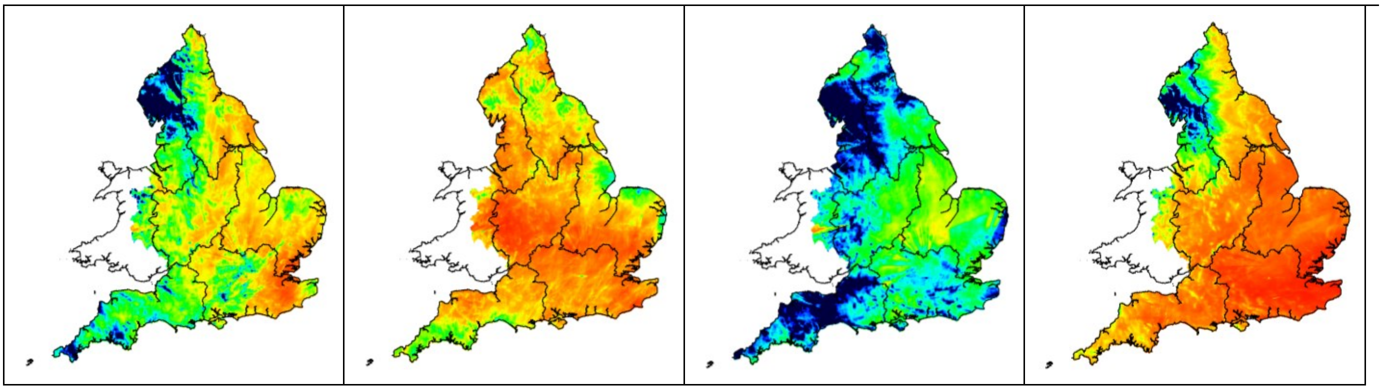
Half of the modelled sites have a greater than expected chance of below normal or lower groundwater levels for the time of year at the end of September 2017. By March 2018, just over a third of all modelled sites have a greater than expected chance of notably low or lower groundwater levels for the time of year.

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

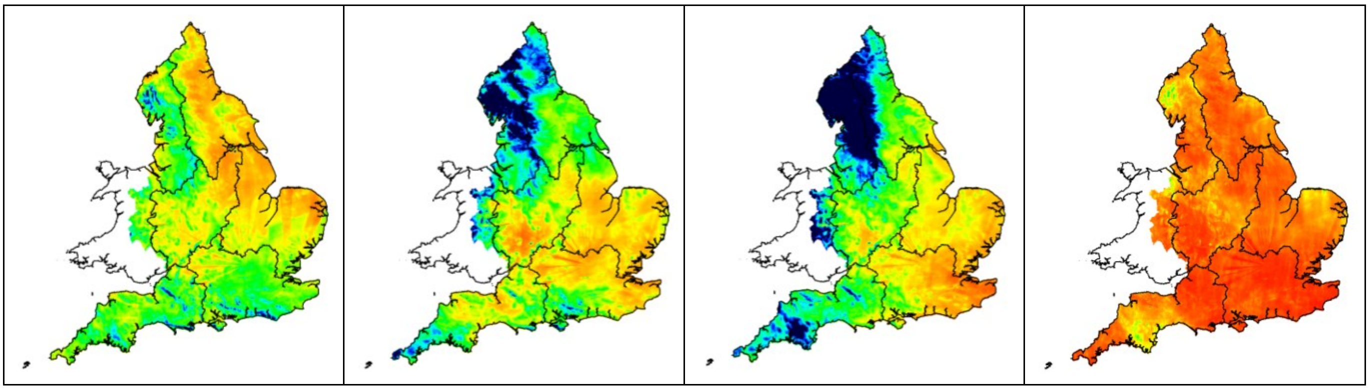
Authors: National Water Resources Hydrology Team

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).

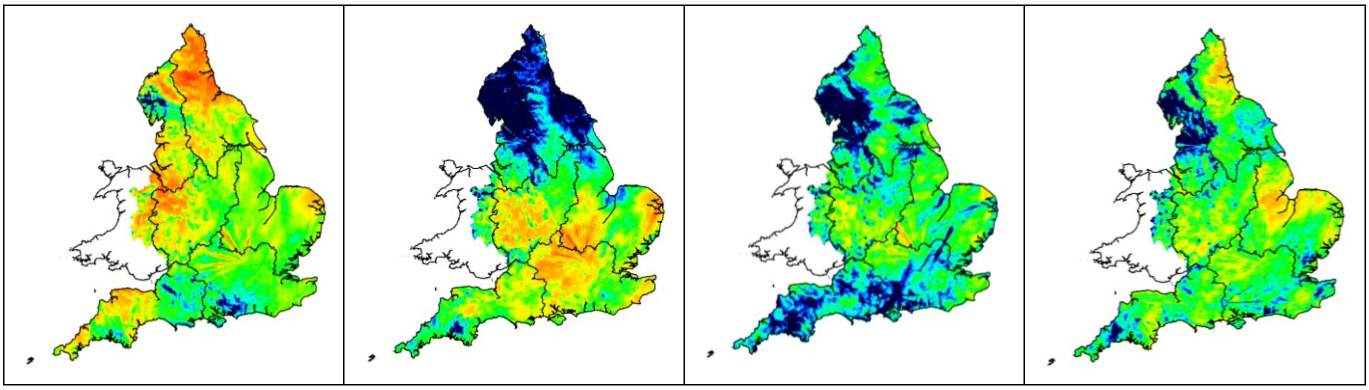
Rainfall



September 2016 | October 2016 | November 2016 | December 2016

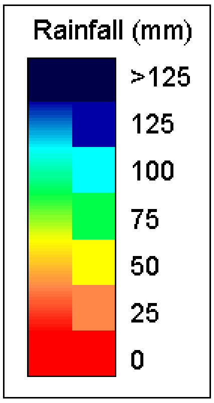


January 2017 | February 2017 | March 2017 | April 2017



May 2017 | June 2017 | July 2017 | August 2017

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.



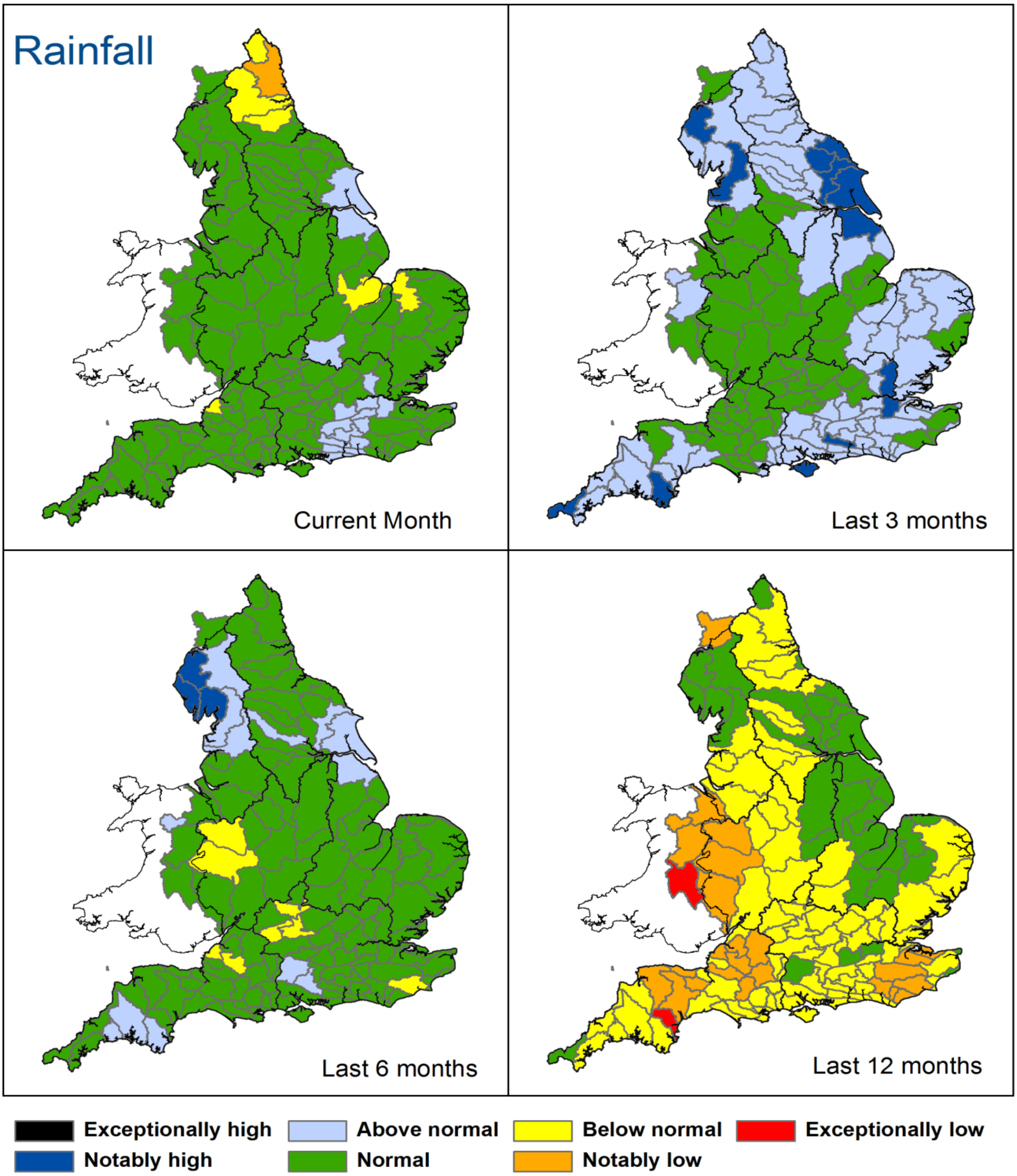


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 August), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met 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

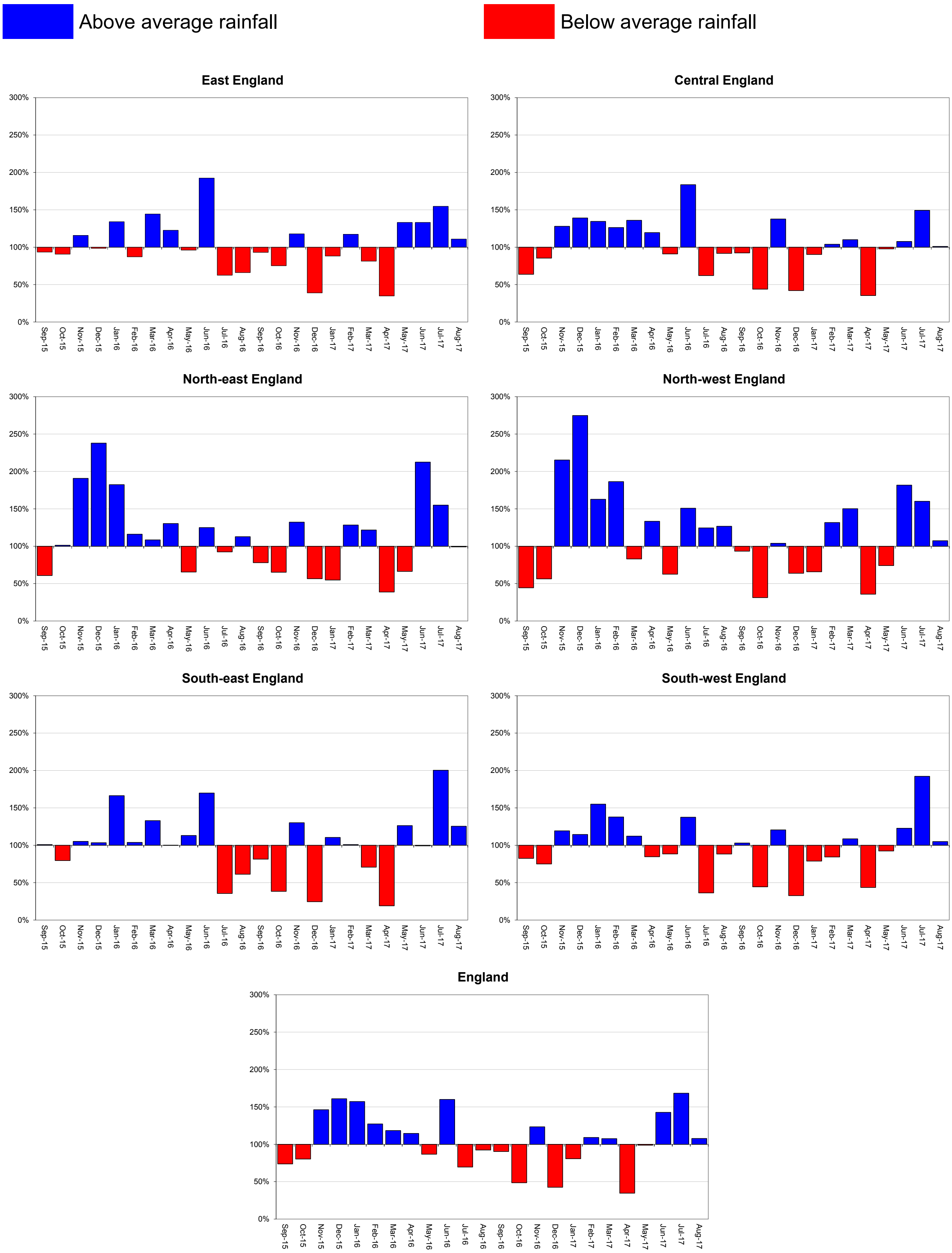


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2017).

Soil moisture deficit

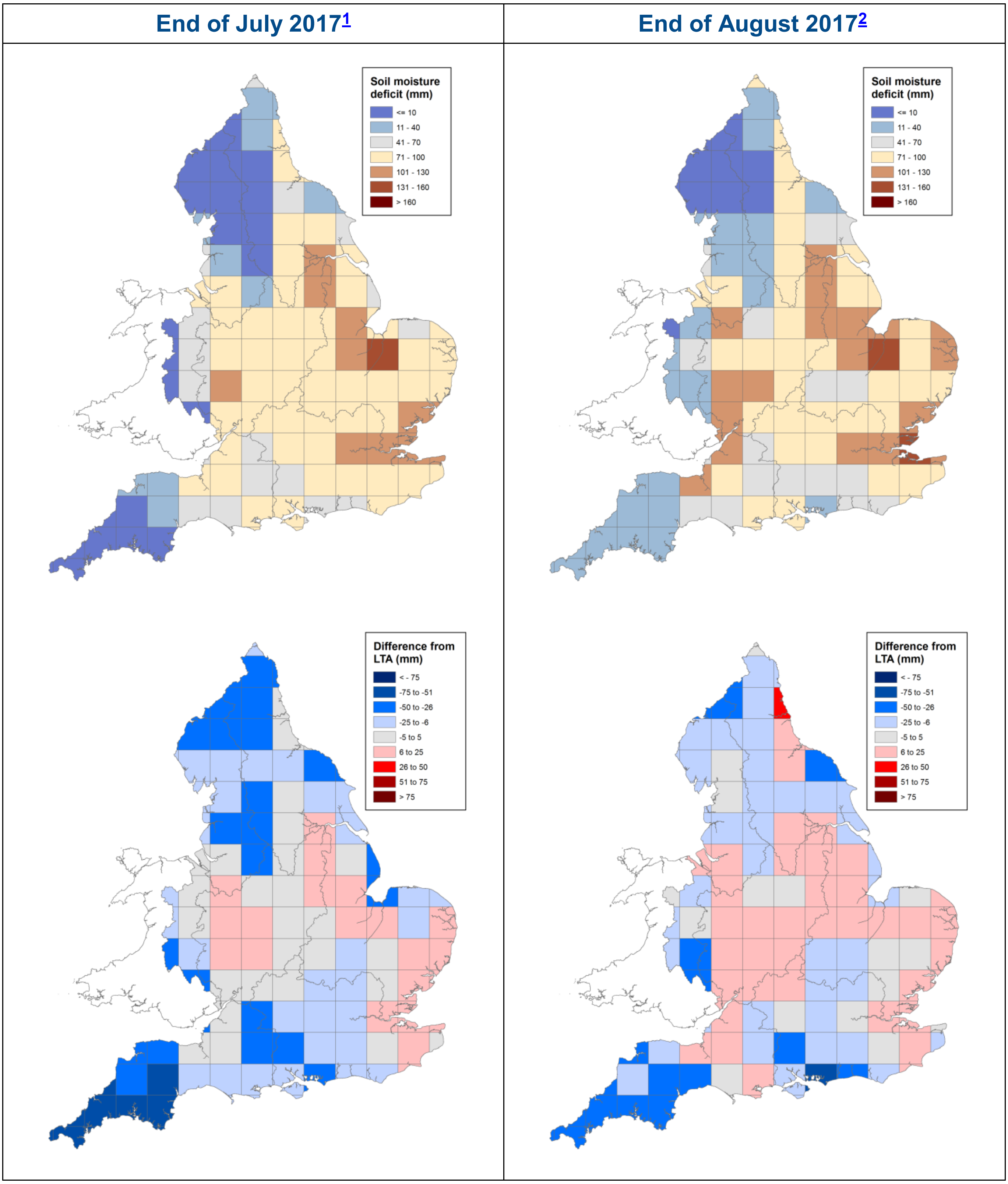


Figure 2.1: Soil moisture deficits for weeks ending 1 August 2017 [1] (left panel) and 29 August 2017 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2017). Crown copyright. All rights reserved. Environment Agency, 100026380, 2017

Soil moisture deficit charts

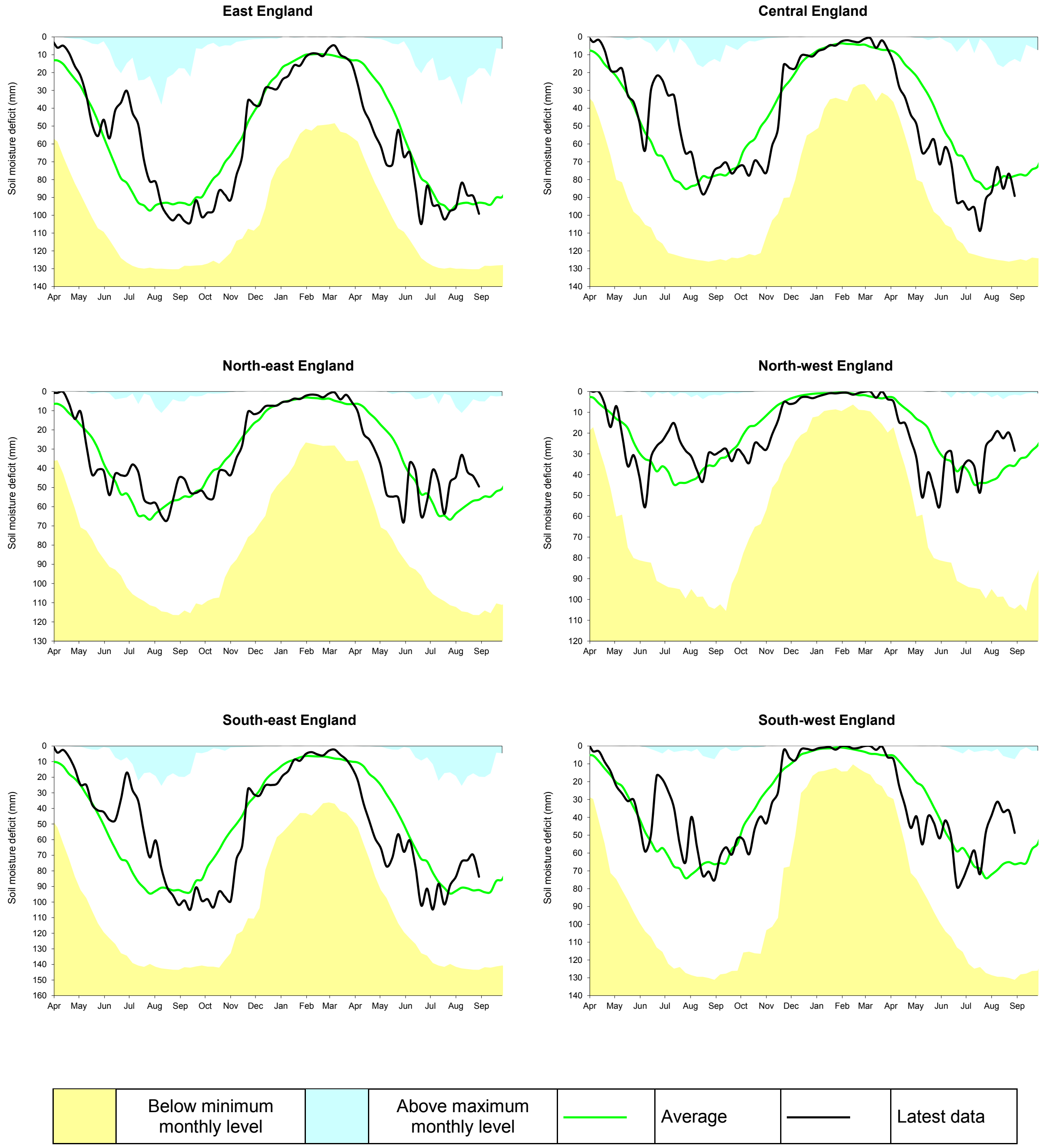
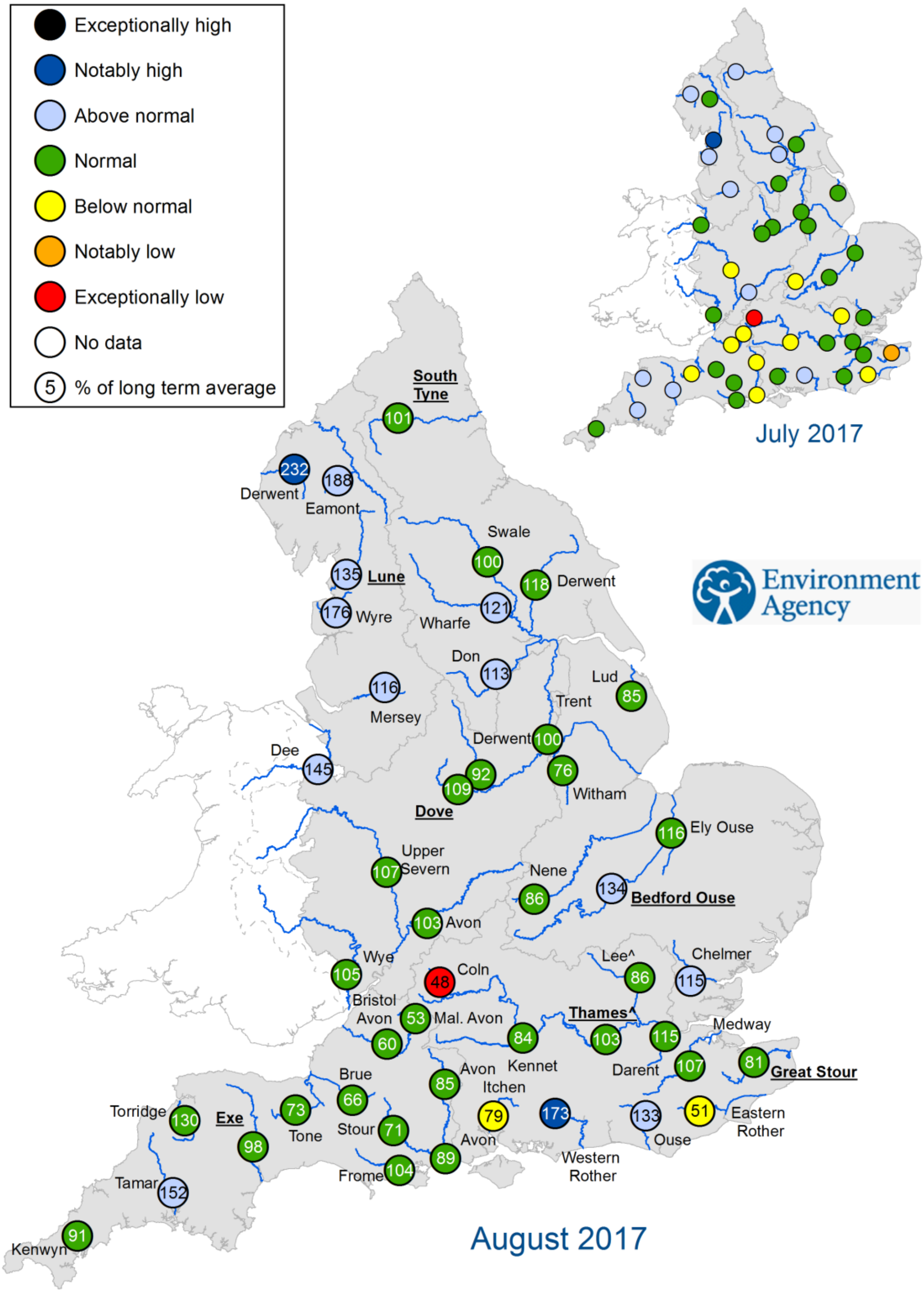


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2017).

River flows



^ "Naturalised" flows are provided for the River Thames at Kingston and the River Lee at Feildes Weir
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 July and August 2017, expressed as a percentage of the respective long term average and classed relative to an analysis of historic July and August monthly means (Source: Environment Agency).

River flow charts

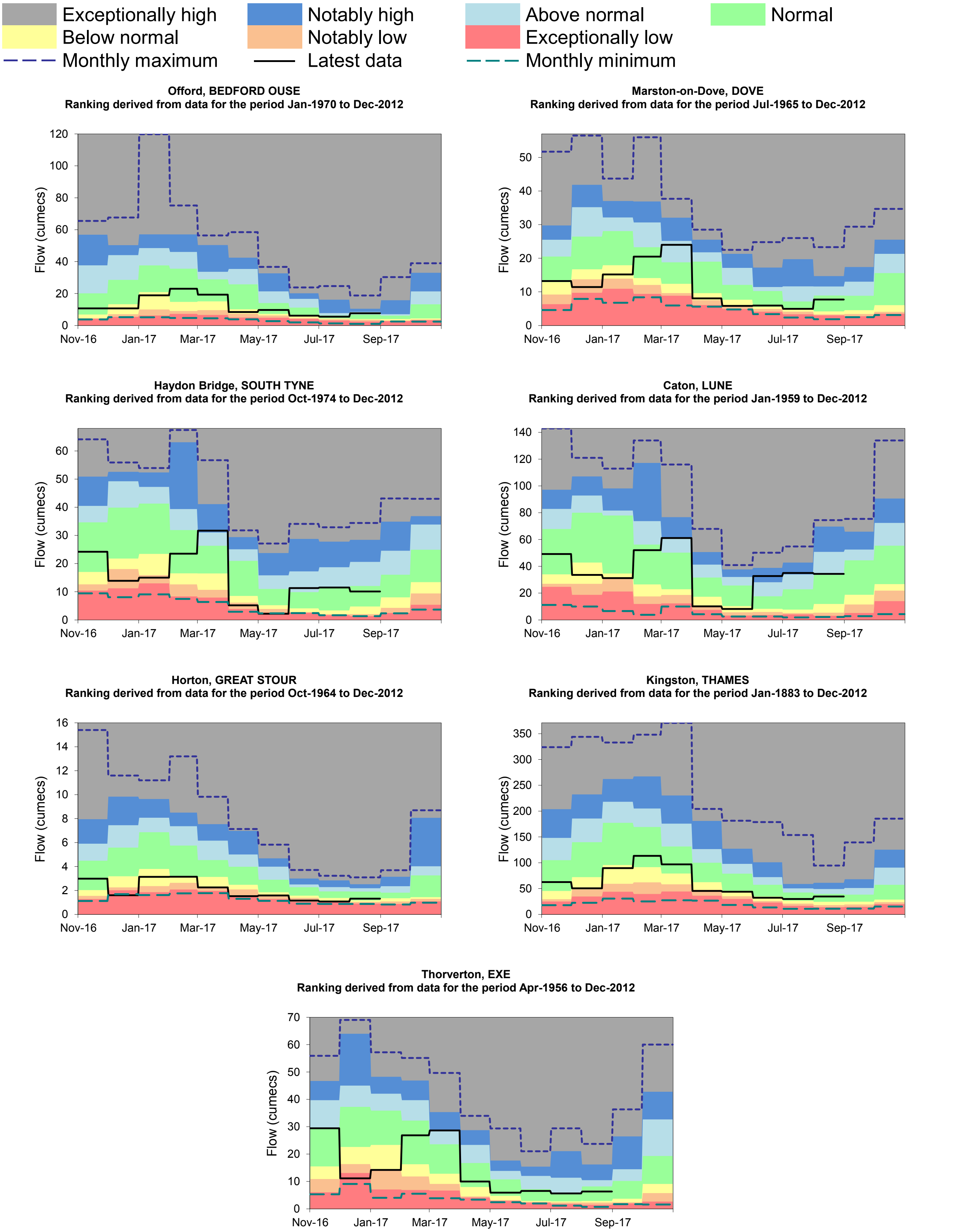
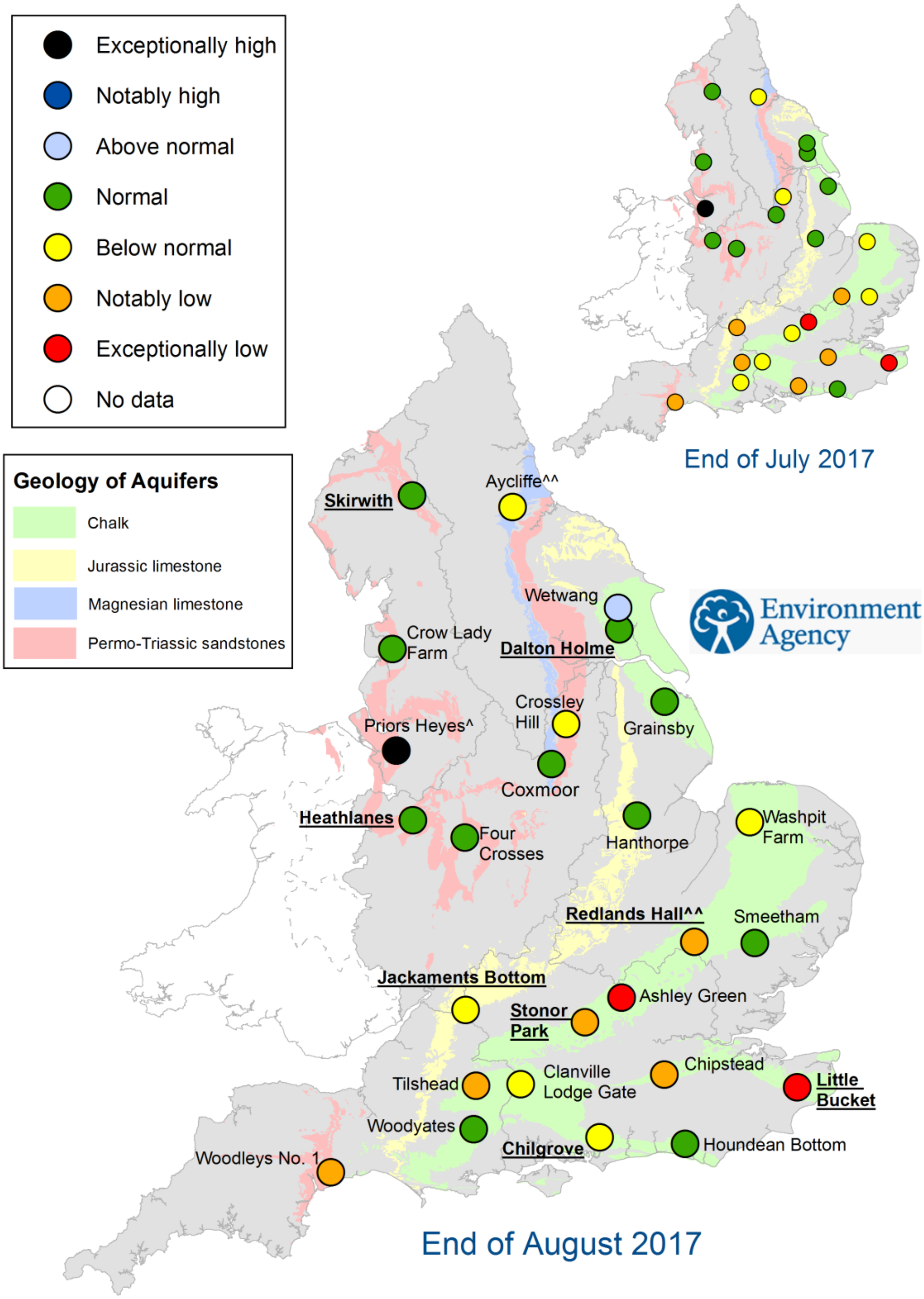


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
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 July and August 2017, classed relative to an analysis of respective historic July and August 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

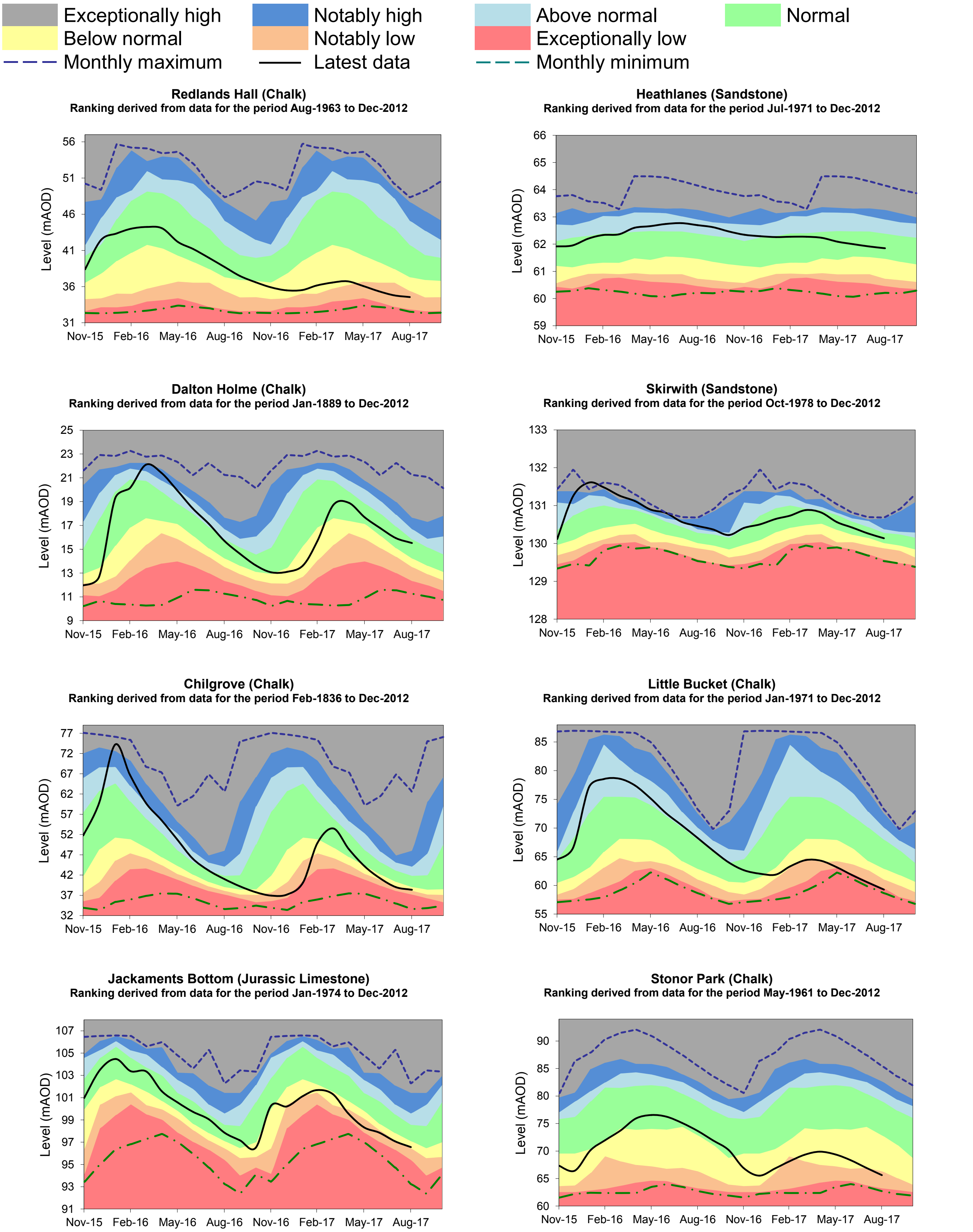
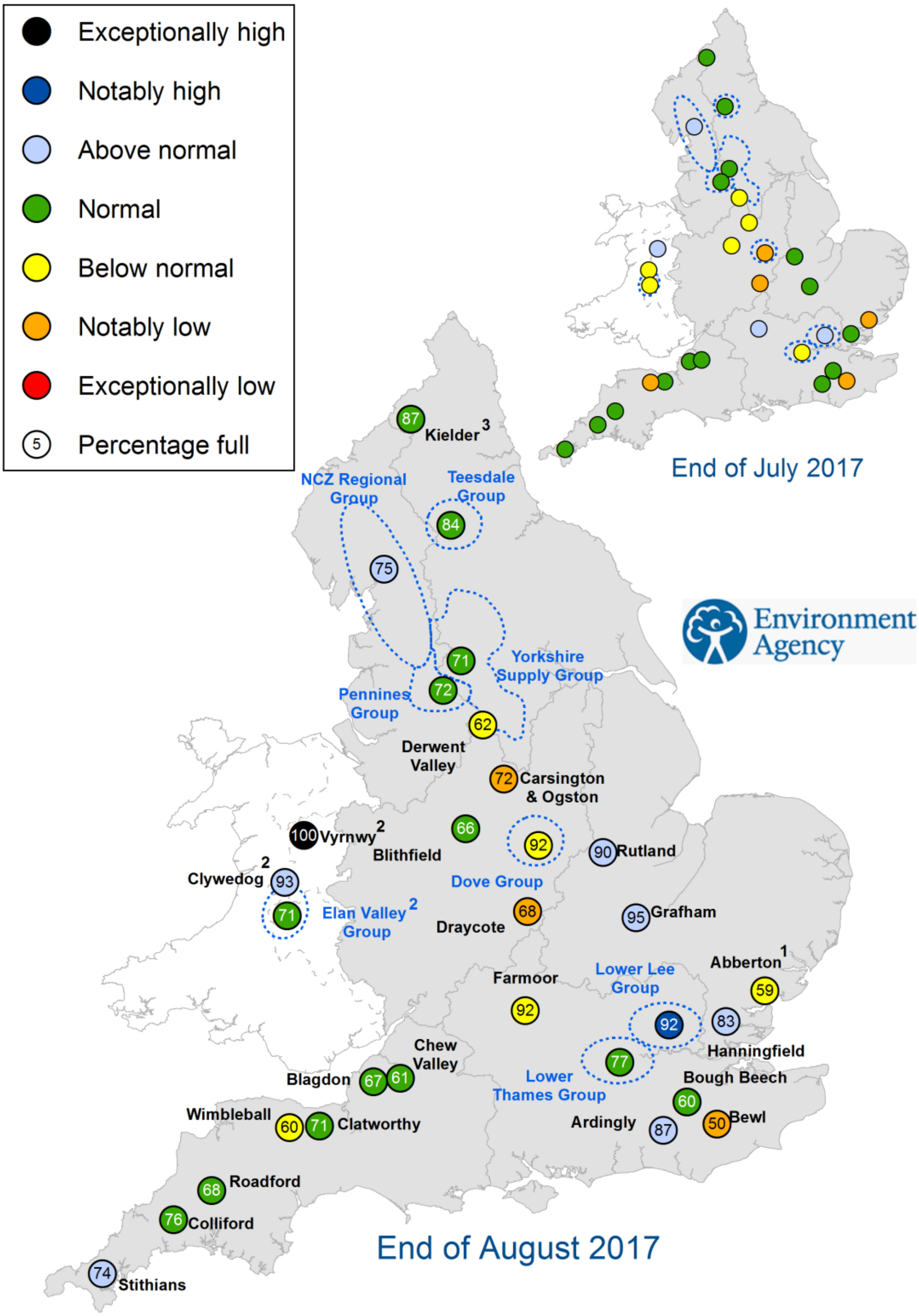


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2017).

Reservoir storage

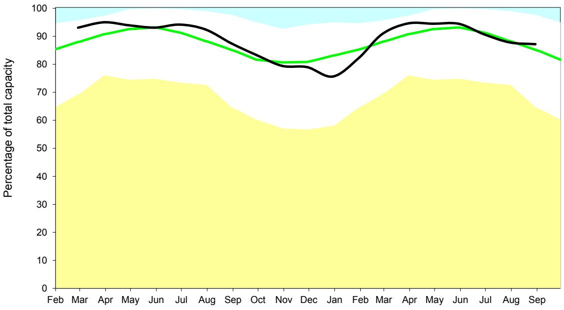


1. Engineering work at Abberton Reservoir in east England to increase capacity has been completed
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England
3. Current levels at Kielder will be deliberately lower than historical levels during a trial of a new flood alleviation control curve

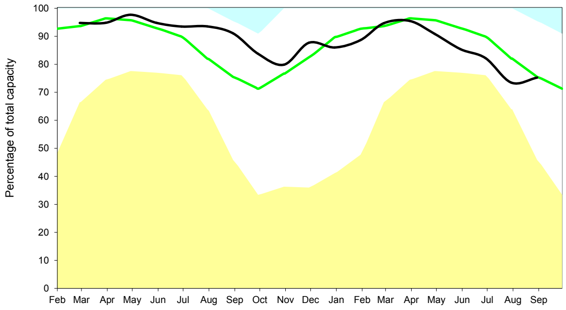
Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of July and August 2017 as a percentage of total capacity and classed relative to an analysis of historic July and August values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to 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

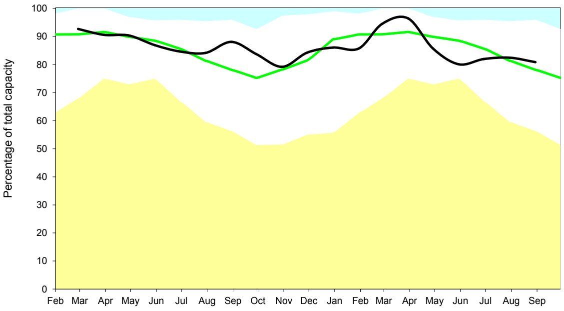
East England
Based on storage in Abberton, Grafham, Hanningfield, Rutland reservoirs



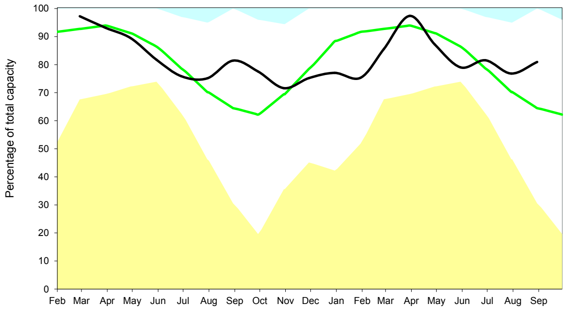
Central England
Based on storage in Clywedog, Carsington and Ogston, Derwent Valley, Dove (Foremark & Staunton), Draycote, Elan Valley Group reservoirs



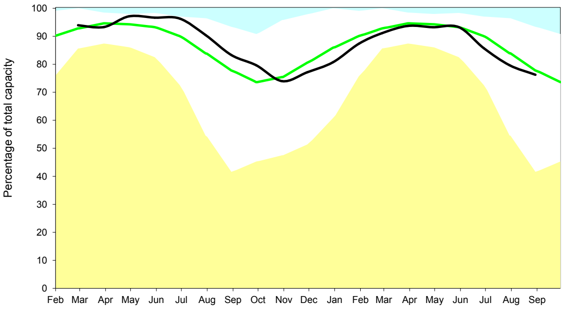
North-east England
Based on storage in Kielder, Teesdale Group, Yorkshire Supply Group reservoirs



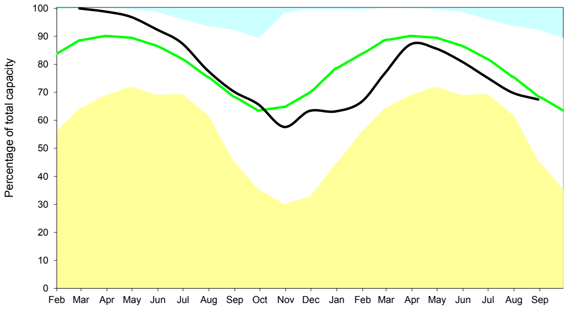
North-west England
Based on storage in NCZ Regional Group, Pennines Group, Vyrnwy reservoirs



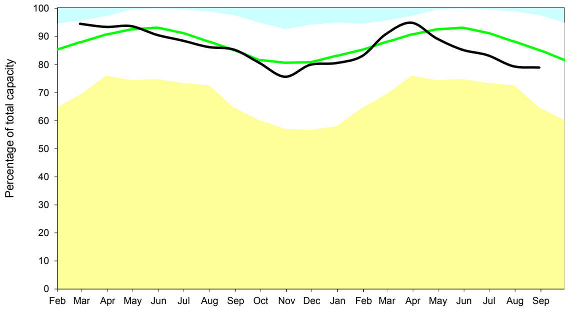
South-east England
Based on storage in Ardingly, Bewl, Bough Beech, Farmoor, Lower Lee Group, Lower Thames Group reservoirs



South-west England
Based on storage in Blagdon, Chew Valley, Clatworthy, Colliford, Roadford, Stithians, Wimbleball reservoirs



England
Based on combined regional storage



(yellow)	Below minimum monthly level	(light blue)	Above maximum monthly level	(green line)	Average	(black line)	Latest data

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

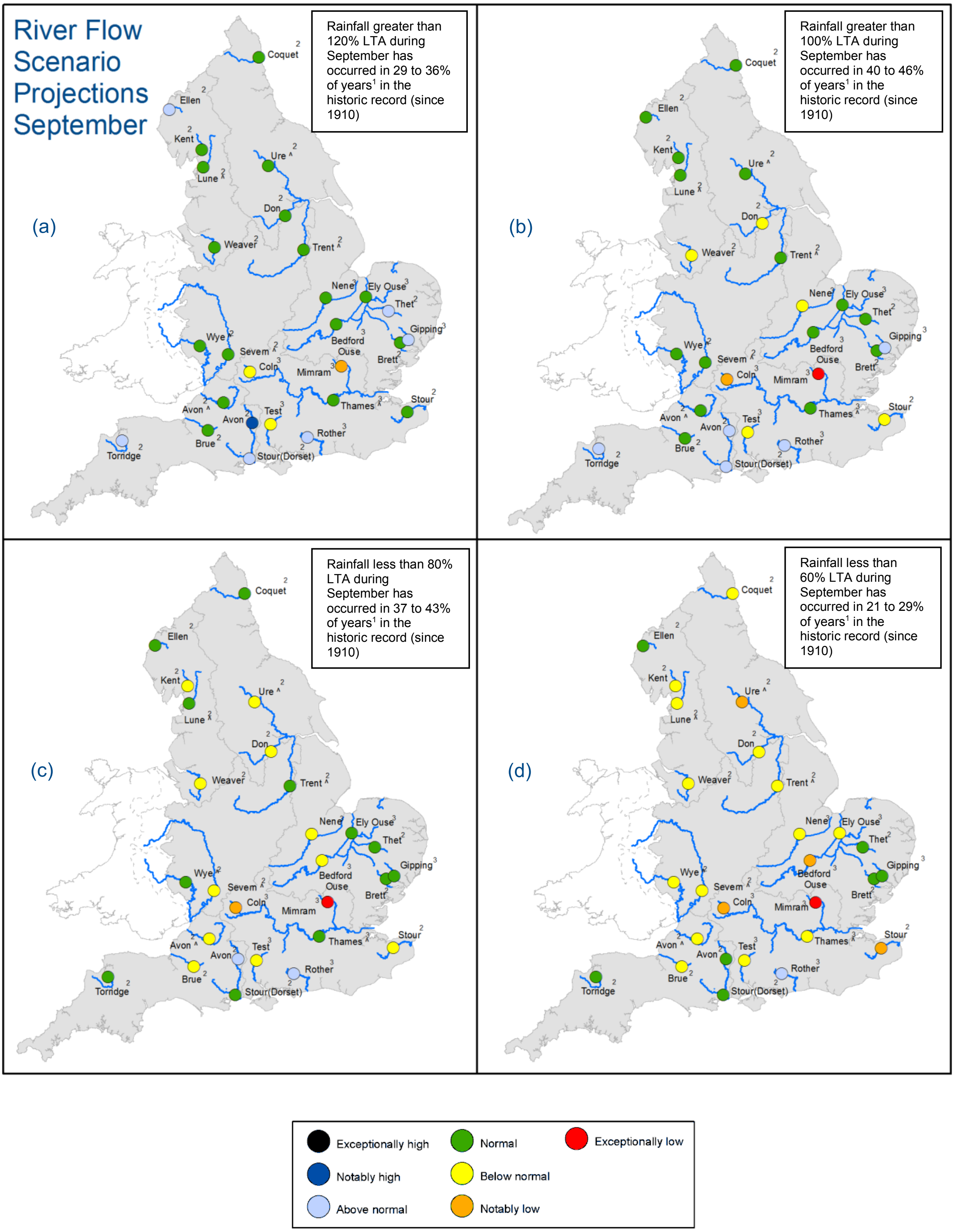


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during September 2017 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

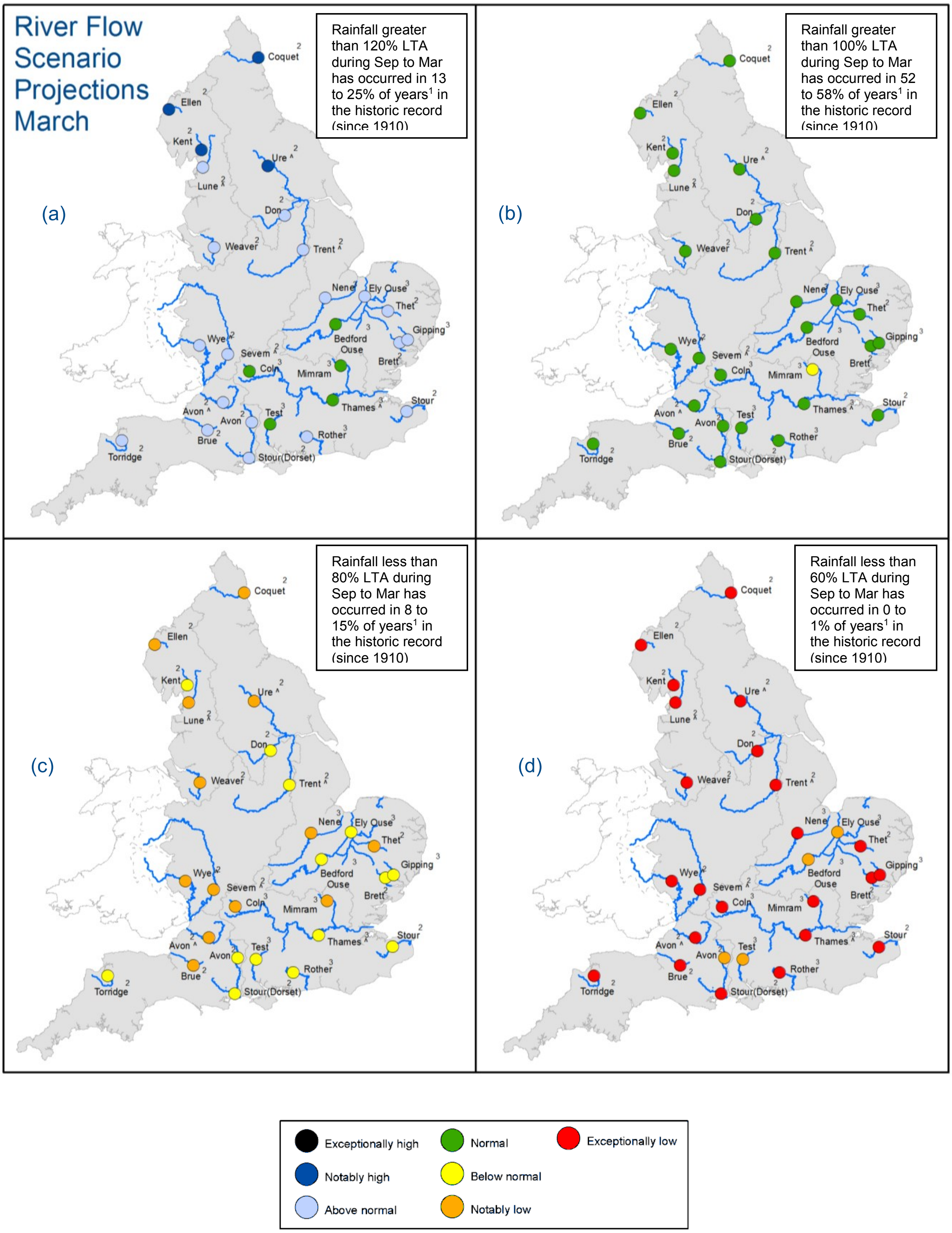
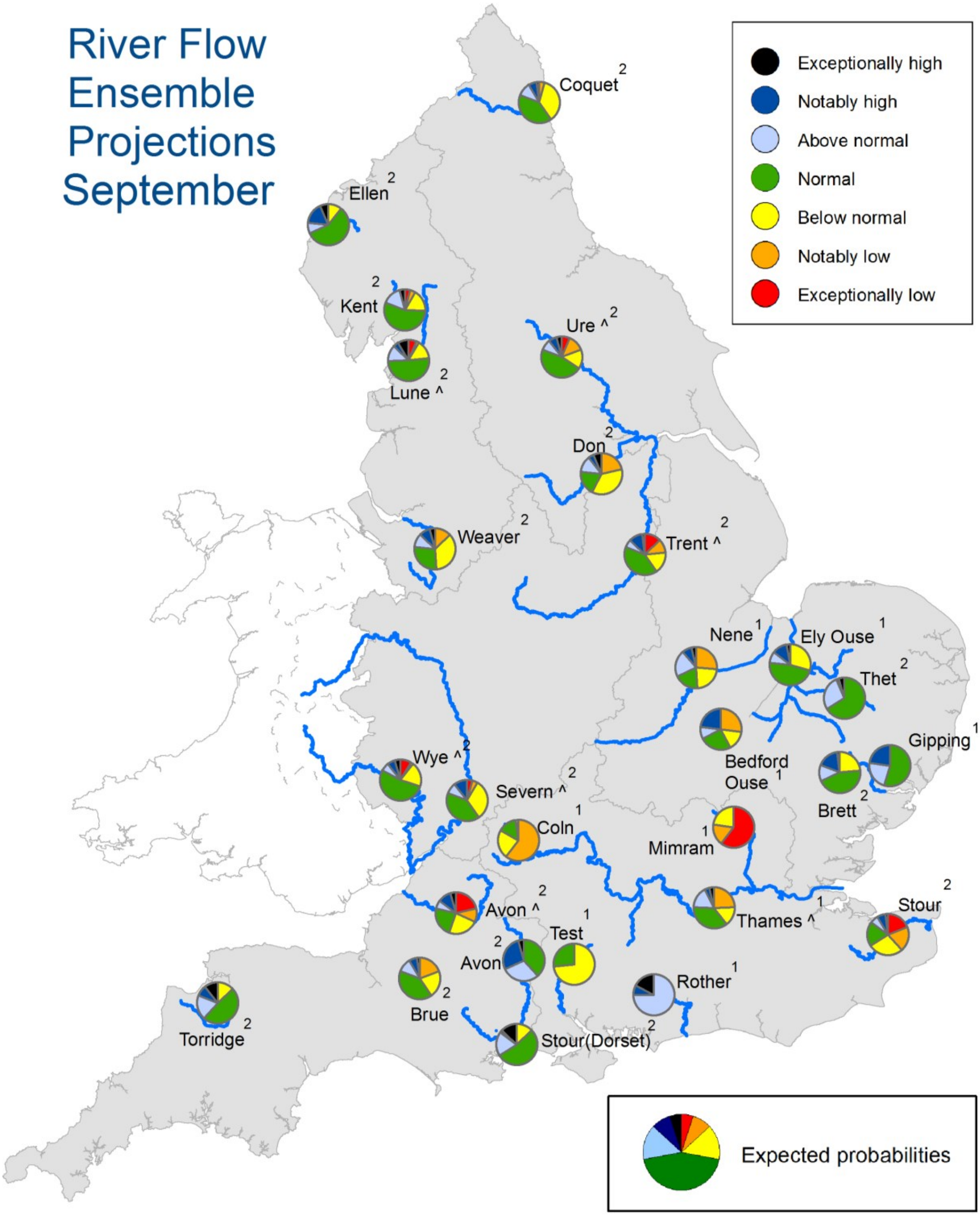


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2017 and March 2018 (Source: Centre for Ecology and Hydrology, Environment Agency)

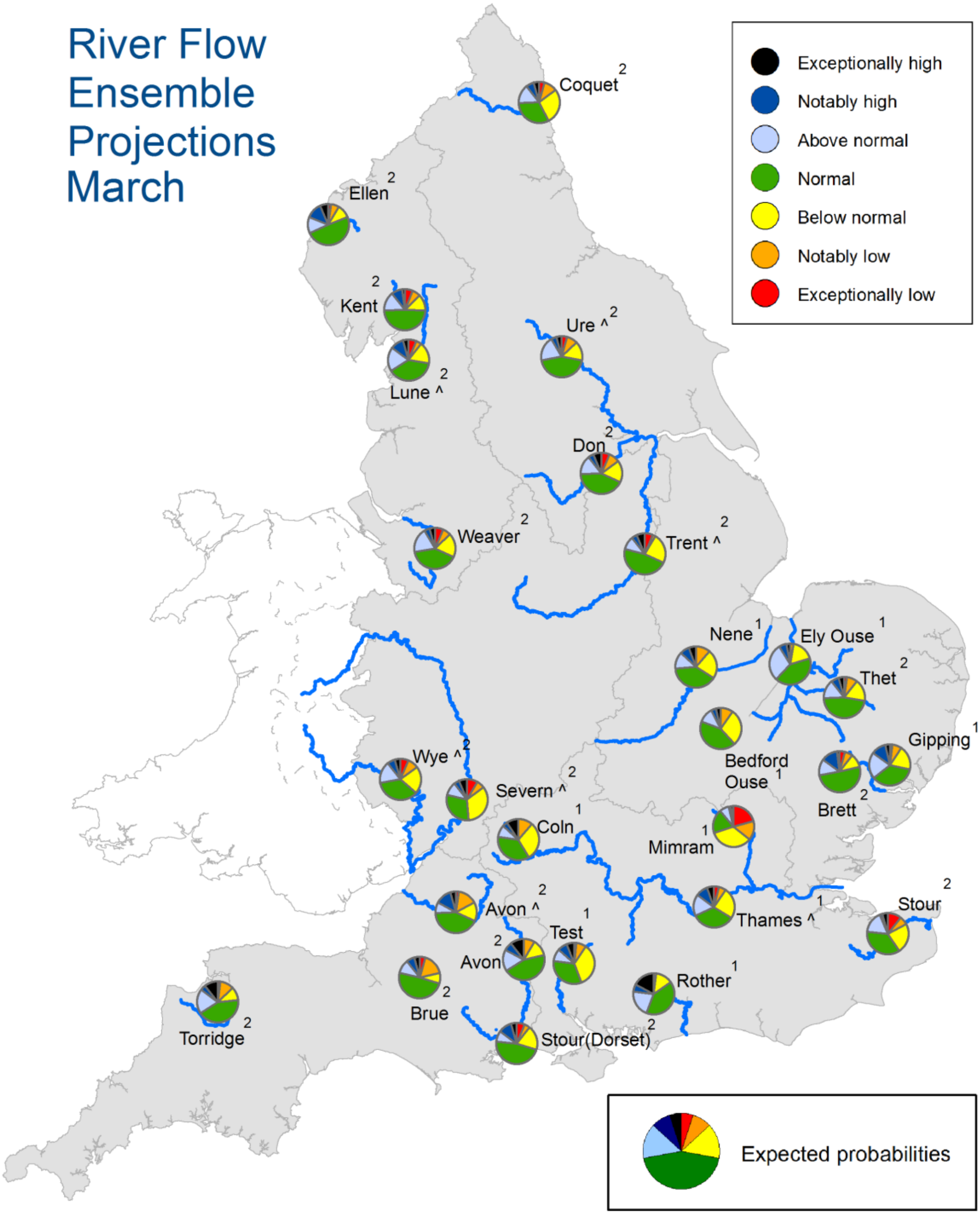
[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by CEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*



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).

[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



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).

[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

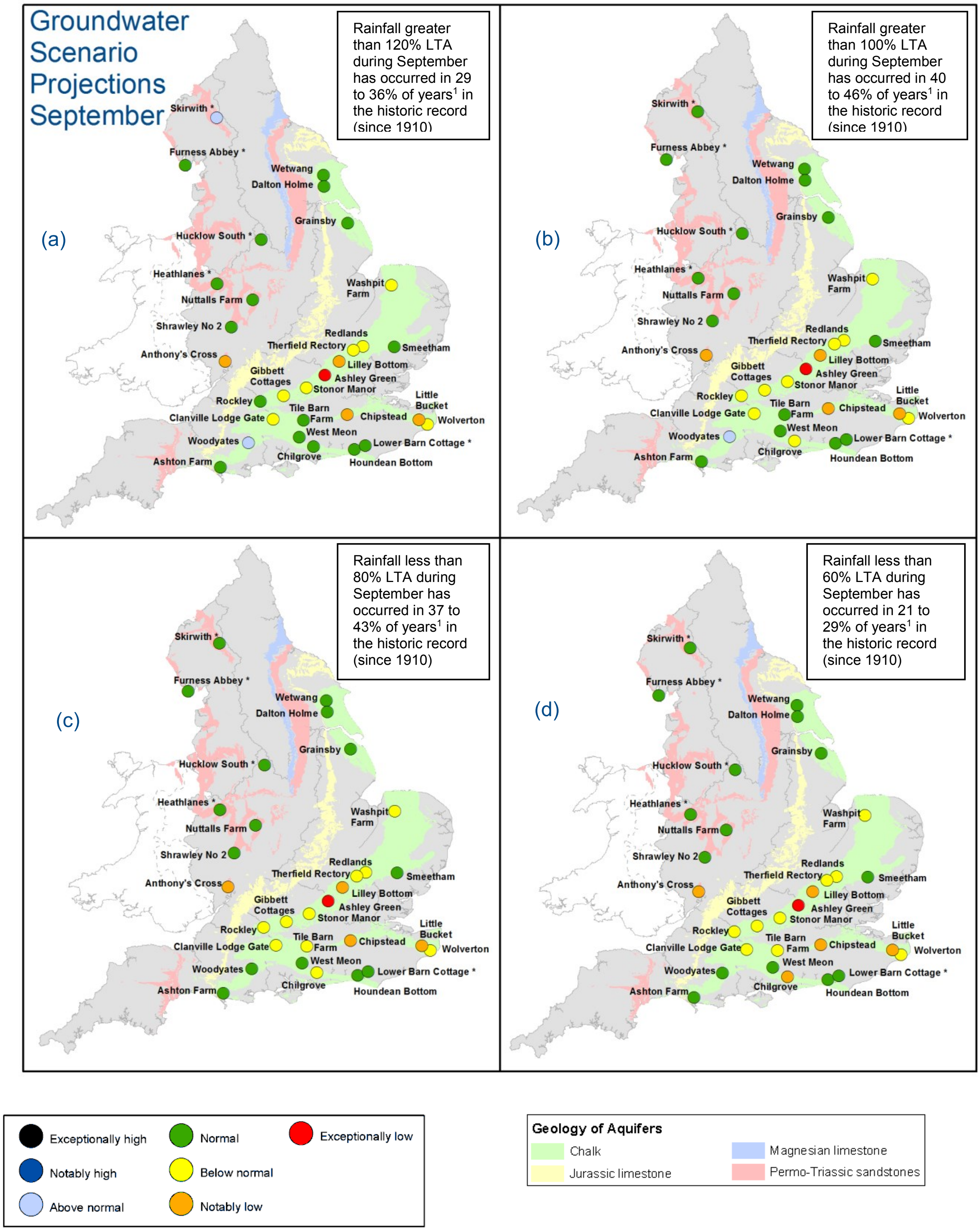


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during September 2017 (Source: Environment Agency) Geological map reproduced with kind permission from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

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

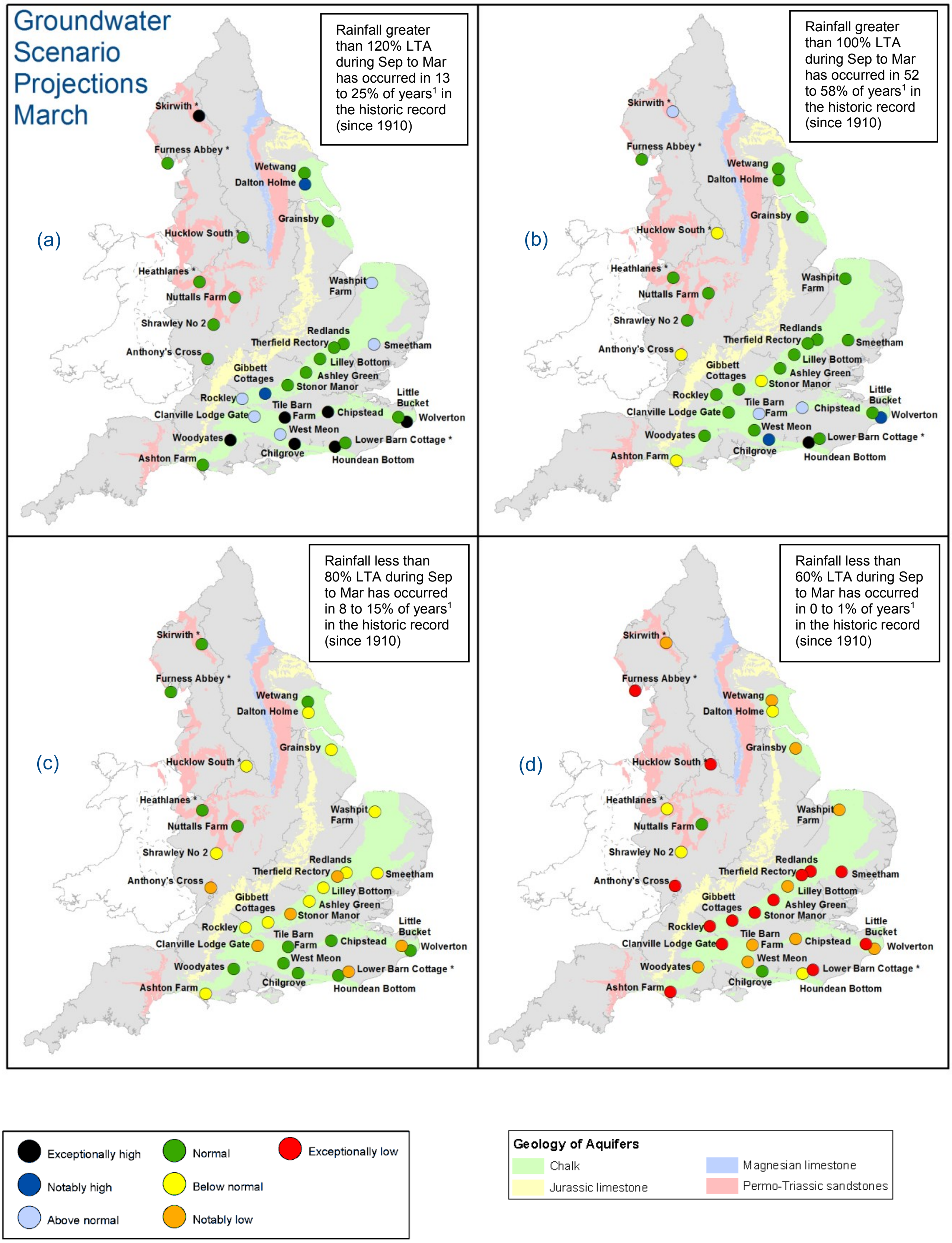
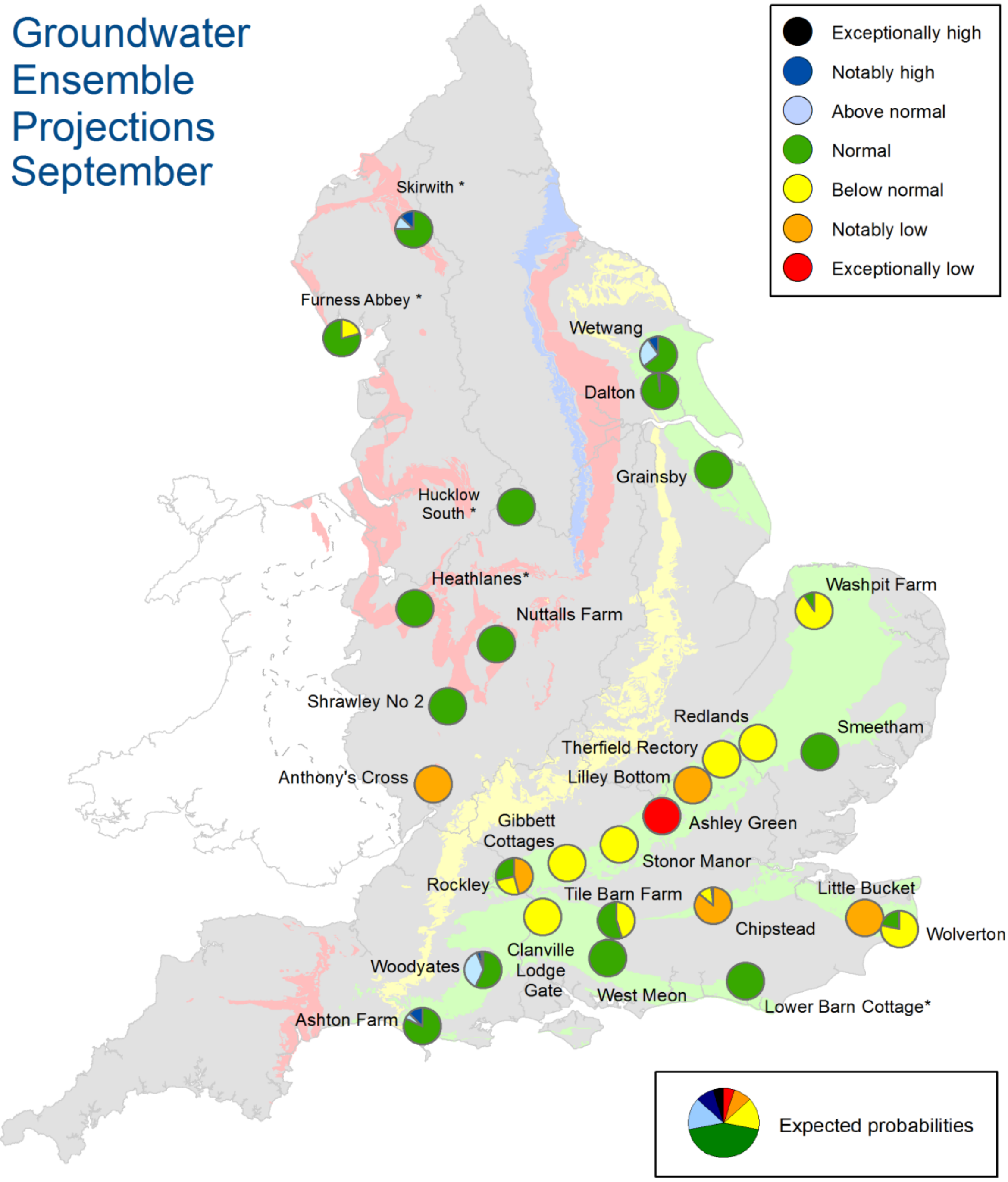


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2017 and March 2018 (Source: Environment Agency) Geological map reproduced with kind permission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

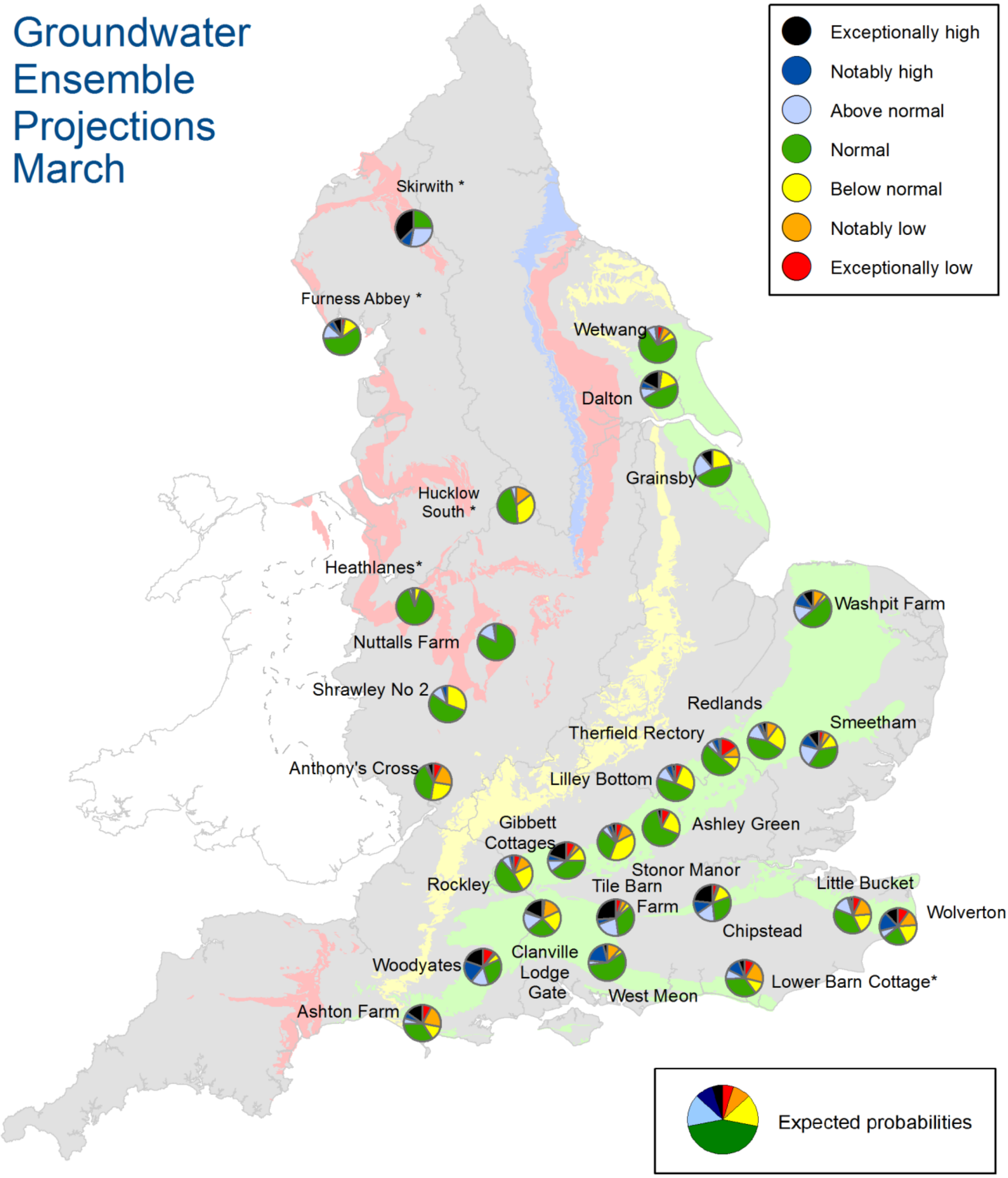
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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*



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

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of 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