Monthly water situation report

England

Summary – July 2015

Following on from a dry June, July was wetter than average, with rainfall totals across England at 144% of the long term average (LTA). Soil moisture deficits decreased by up to 50mm across most areas during the month, with the greatest decreases in parts of Cumbria. Monthly mean river flows decreased compared to June at most indicator sites, but remained **normal** or higher for the time of year at more than two-thirds of sites. Groundwater levels decreased during the month at all but one indicator site. End of month groundwater levels remain **normal** or higher at half of the indicator sites. Reservoir stocks decreased at all reported reservoirs and reservoir groups during July, and at the end of the month were **normal** for the time of year at most sites. Overall stocks for England decreased to 82% of total capacity.

Rainfall

July rainfall totals were highest across parts of Cumbria and North Devon at between 130 and 180mm. The lowest rainfall totals of between 35 and 45 mm occurred across parts of Hampshire, Sussex and Kent. July rainfall totals were above the LTA in almost all hydrological areas, with the Lee Chalk, and Chilterns East Colne catchments receiving over 210% of the LTA (Figure 1.1)

July rainfall totals were classed as **normal** or **above normal** for the time of year across the majority of hydrological areas. Those hydrological areas covering parts of Cambridgeshire, Bedfordshire and Northumberland were classed as **notably high** or **exceptionally high**. Over the 3 month period ending in July, cumulative rainfall totals were broadly **above normal** for the time of year in northern England, and **normal** elsewhere. The 6 month cumulative rainfall totals were broadly **normal** or higher in East Anglia, and northern England, and **below normal** in most southern and central areas. The 12 month cumulative rainfall totals were generally **normal**, except in the far north, where totals were higher than **normal** (Figure 1.2)

At regional scale, July rainfall totals ranged from 114% of the July LTA in central England to 165% in south-west England. Totals were **normal** for the time of year in central, south-east and north-east England and **above normal** elsewhere. Across England as a whole, rainfall was **normal** for the time of year at 144% of the July LTA (Figure 1.3)

Soil moisture deficit

Soil moisture deficits (SMDs) decreased by up to 50 mm across all areas during July, with the largest decreases in parts of Cumbria. At the end of July, SMDs ranged between 40 and 130mm across most of central, east and south-east England. End of month SMDs were smallest in the far north-west of England at 0 to 10mm. In contrast to the end of June, end of month SMDs in July were much closer to or even smaller than the LTA across much of East Anglia, central, southern, south-west and northern England (Figure 2.1)

At a regional scale, SMDs decreased during July by between approximately 2 and 30mm across all regions. The largest decrease of just less than 27mm occurred in south-west England. End of month SMDs ranged from 44mm in north-west England to 95mm in east England (Figure 2.2)

River flows

Monthly mean river flows decreased compared to June at the majority of sites across England. Monthly mean flows were classed as **normal** or **above normal** for the time of year at over two-thirds of indicator sites. The remaining sites were classed as **below normal** for the time of year, with the exception of the river Coln in south-east England, and the Hampshire Avon in south-west England, where flows were **notably low** for the time of year (Figure 3.1)

Monthly mean river flows were classed as **normal** for the time of year at 6 of the 7 regional index sites; the river Dove in central England was classed as **below normal** for the time of year (Figure 3.2).

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Groundwater levels

Groundwater levels continued to decline in July at all but one indicator site. At the end of the month, levels were classed as **normal** or higher for the time of year at half of the sites. Levels at 10 sites across north-east, east, south-east and south-west England were **below normal** for the time of year, whilst the levels at Jackaments Bottom (in the Burford Jurassic limestone aquifer) and Tilshead (in the upper Hampshire Avon chalk aquifer) remained **notably low** for the time of year.

End of month groundwater levels at the major aquifer index sites remained **normal** for the time of year at 4 of the 8 sites. Stonor Park (in the south west Chilterns chalk) changed to **below normal** for the time of year, whilst Chilgrove (in the Chichester chalk aquifer) and Dalton Holme (in the Hull and East Riding chalk aquifer) remained **below normal**. Jackaments Bottom remained **notably low** for the time of year (Figures 4.1 and 4.2)

Reservoir storage

Reservoir stocks decreased at all reported reservoirs and reservoir groups during July, with the exceptions of Kielder and Farmoor reservoirs, where storage increased by 4% at each. The largest decreases occurred at Ardingly reservoir in south-east England (16%), and at the Pennines group in north east England (13%). End of month stocks were classed as **normal** or higher for the time of year at most reservoirs and reservoir groups. Only three reservoirs and reservoir groups; Ardingly, Hanningfield and the Lower Thames group, are now classed as **below normal** (Figure 5.1)

Regional-scale reservoir stocks decreased by between 2 and 9% across all regions. At the end of July, regional stocks ranged from 74% of total capacity in north-west England to 88% in central England. Overall reservoir storage for England decreased by 5% to 82% of total capacity (Figure 5.2)

Forward look

Throughout August the driest, warmest and most settled weather is expected in south-east England, although there remains a chance of thundery outbreaks of rain here. Further north the weather is likely to be cooler and more unsettled with a mix of sunshine and showery outbreaks. Total rainfall for England during August is likely to be above average – particularly in the south. For the three months to October it is currently most likely that total rainfall across England will be below average – particularly in south-west and northern England[1].

Projections for river flows at key sites[2]

Over two-thirds of modelled sites have a greater than expected chance of lower than **normal** cumulative flows by the end of September 2015. By the end of March 2016, the picture is similar, with more than two-thirds of sites having a greater than expected chance of lower than **normal** cumulative flows.

For scenario based projections of cumulative river flows at key sites by September 2015 see Figure 6.1.
For scenario based projections of cumulative river flows at key sites by March 2016 see Figure 6.2.
For probabilistic ensemble projections of cumulative river flows at key sites by September 2015 see Figure 6.3.
For probabilistic ensemble projections of cumulative river flows at key sites by March 2016 see Figure 6.4.

Projections for groundwater levels in key aquifers[2]

By the end of March 2016, two-thirds of modelled sites have a greater than expected chance of **normal** or higher groundwater levels.

For scenario based projections of groundwater levels in key aquifers in September 2015 see Figure 6.5.
For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.6.
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2015 see Figure 6.7.
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 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.

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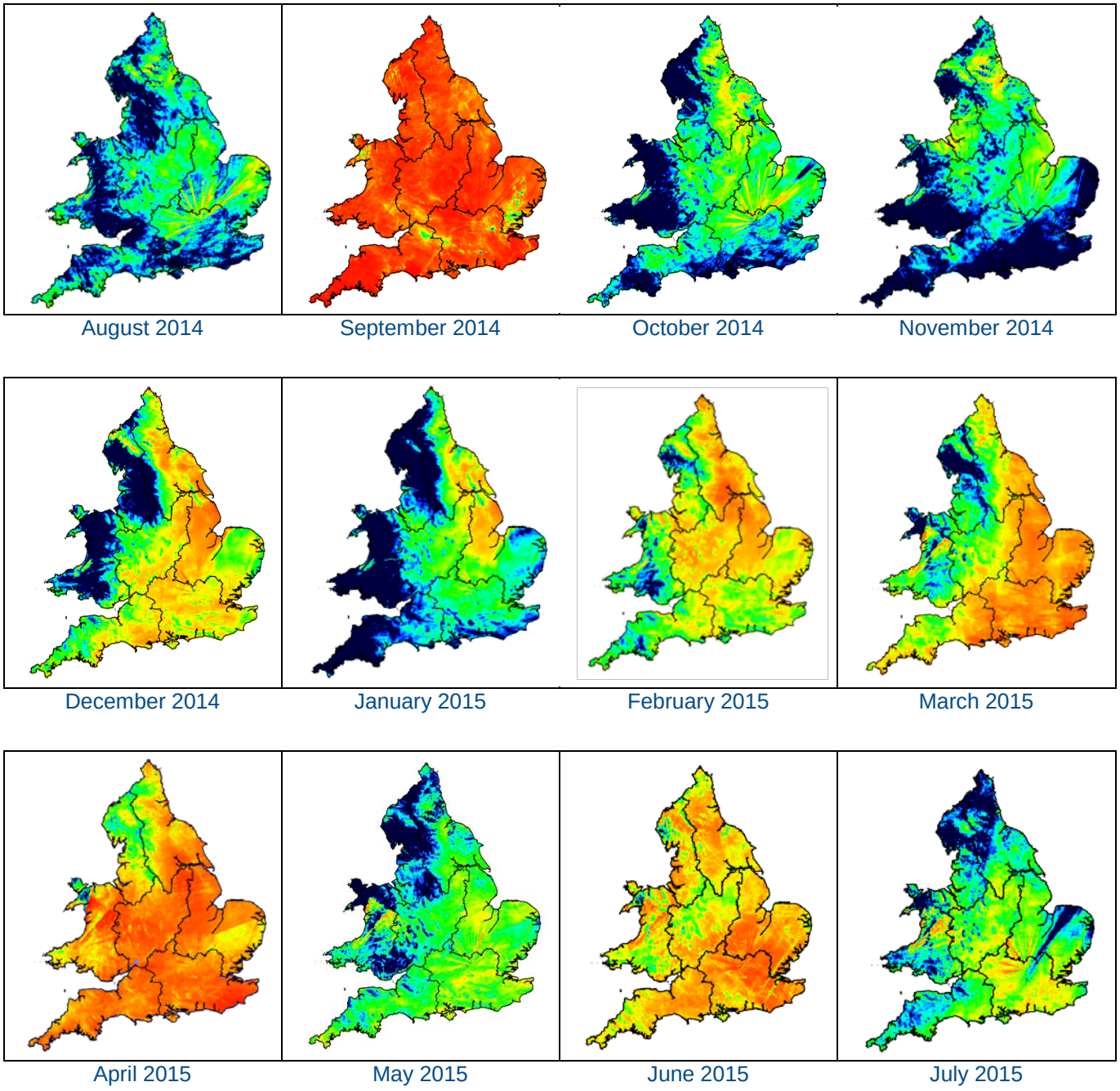
Rainfall



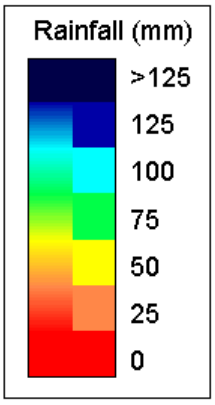


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

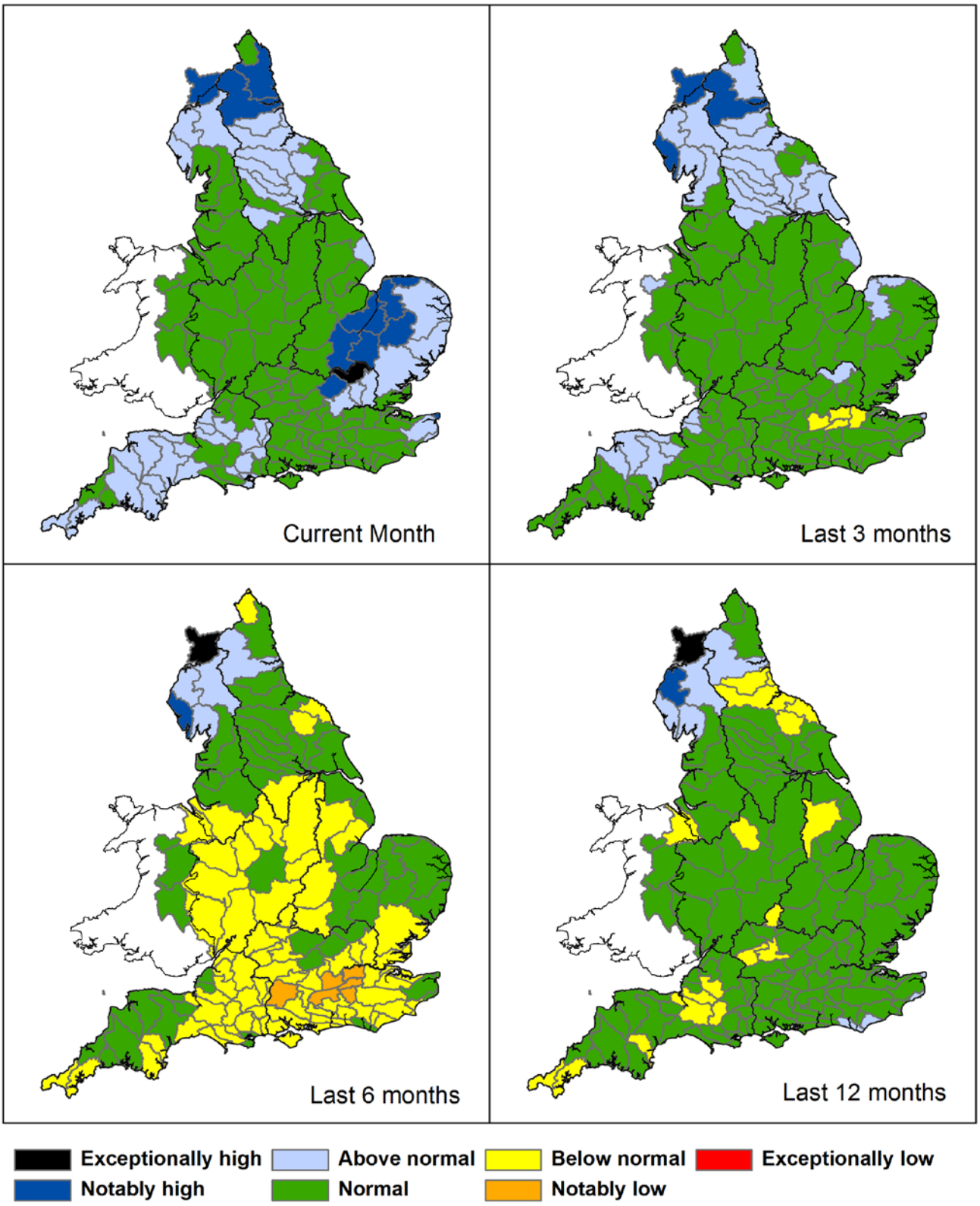


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 July), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2015).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

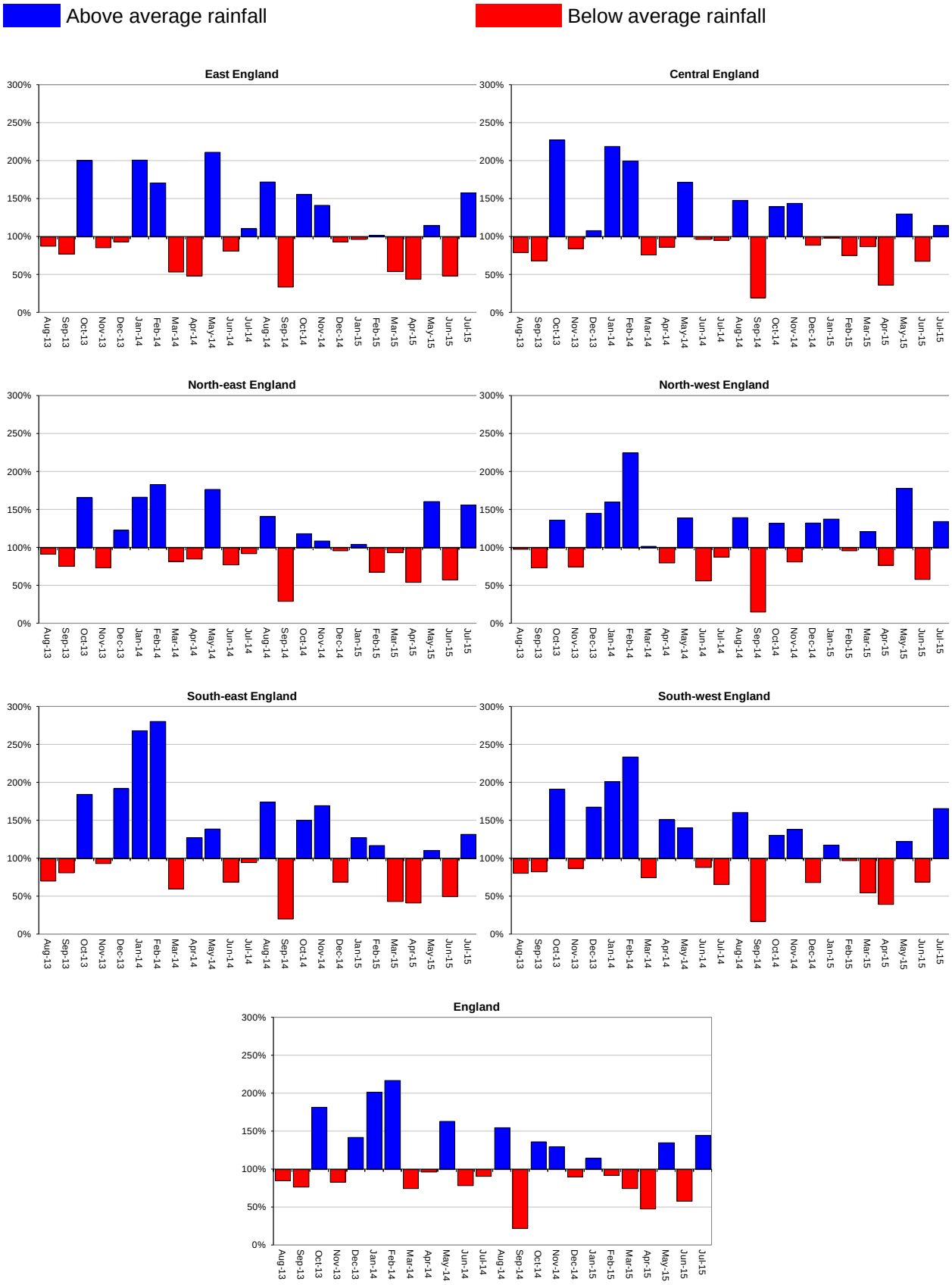


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

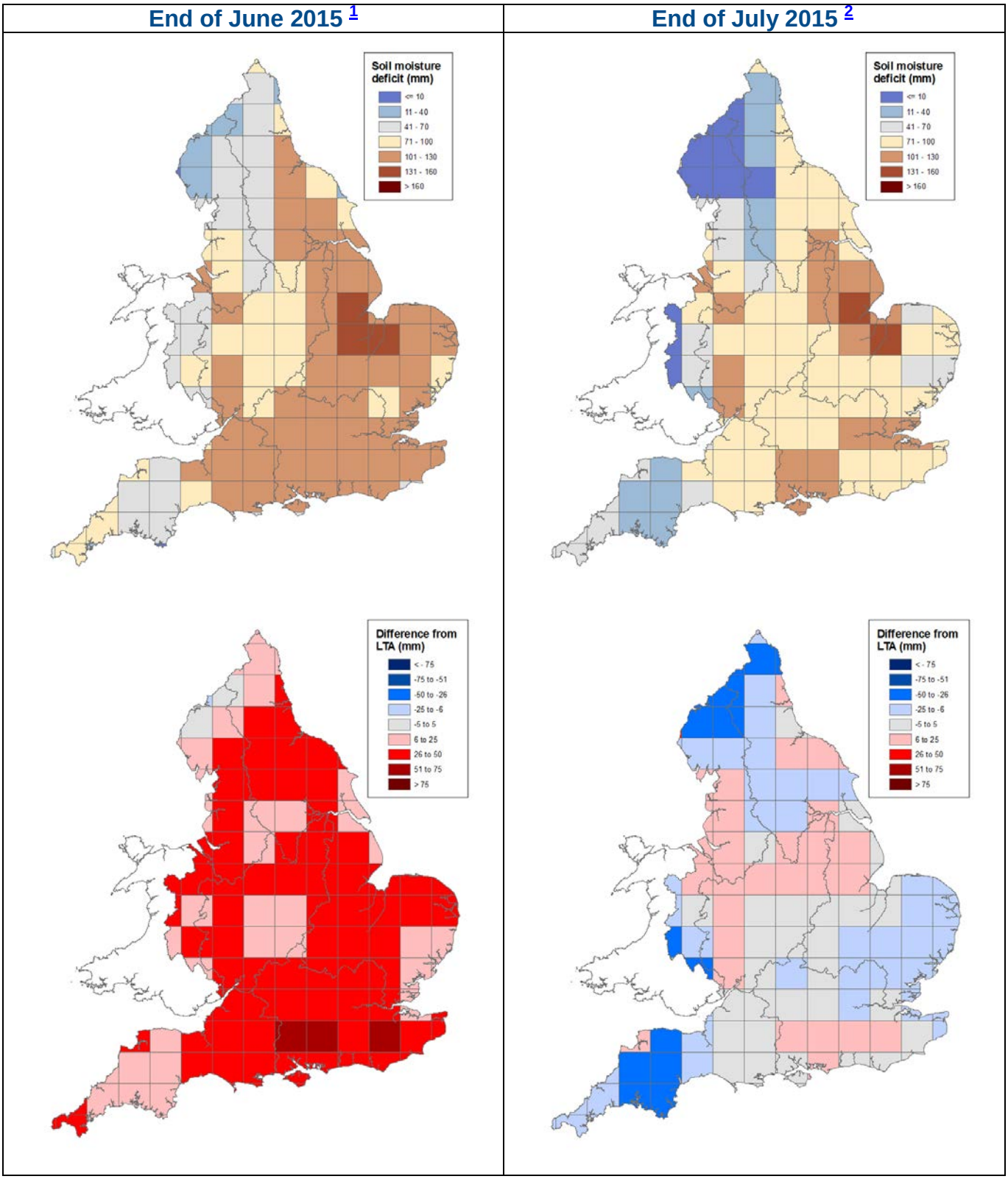


Figure 2.1: Soil moisture deficits for weeks ending 30 June[1] (left panel) and 29 July 2015[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

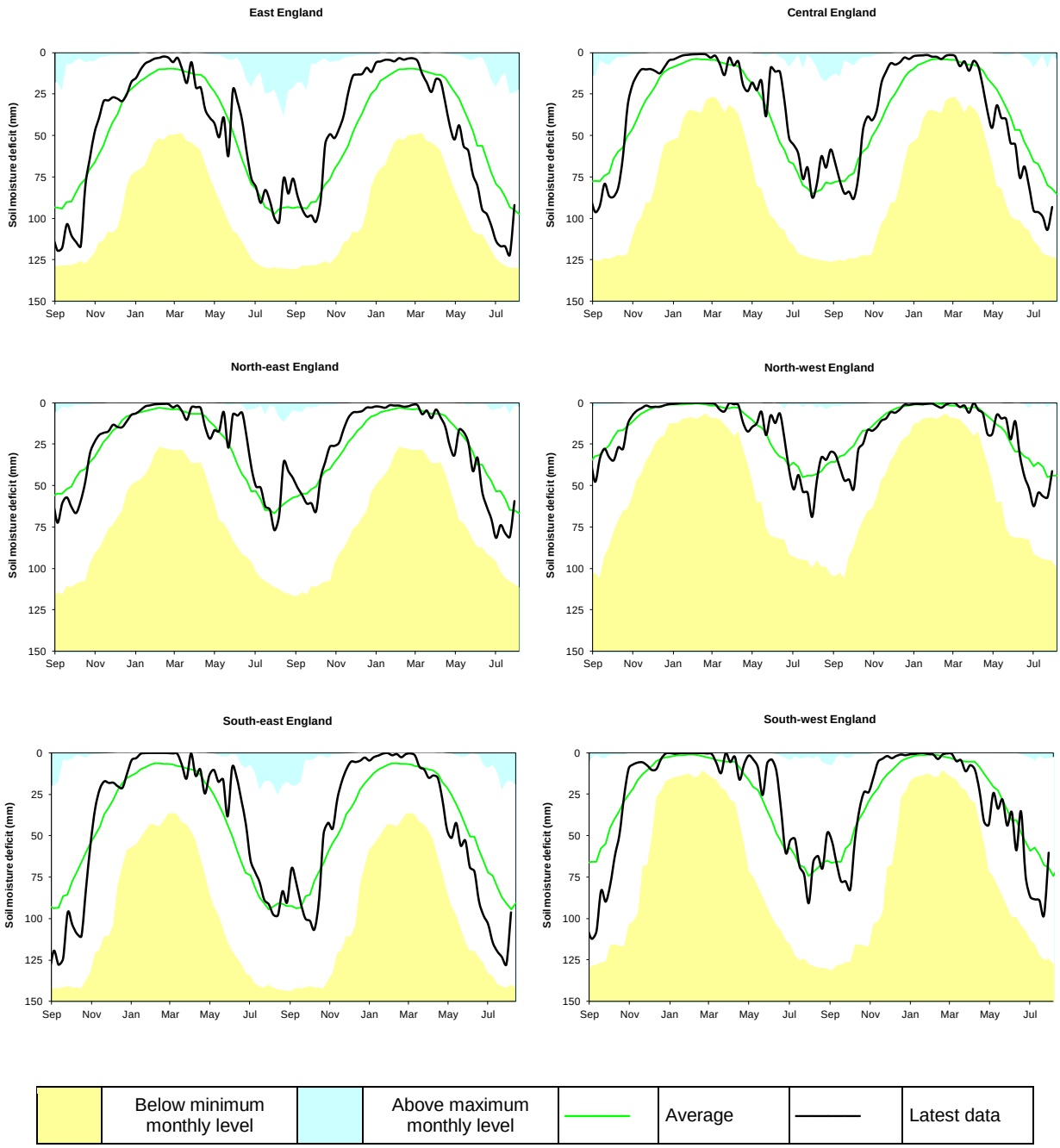
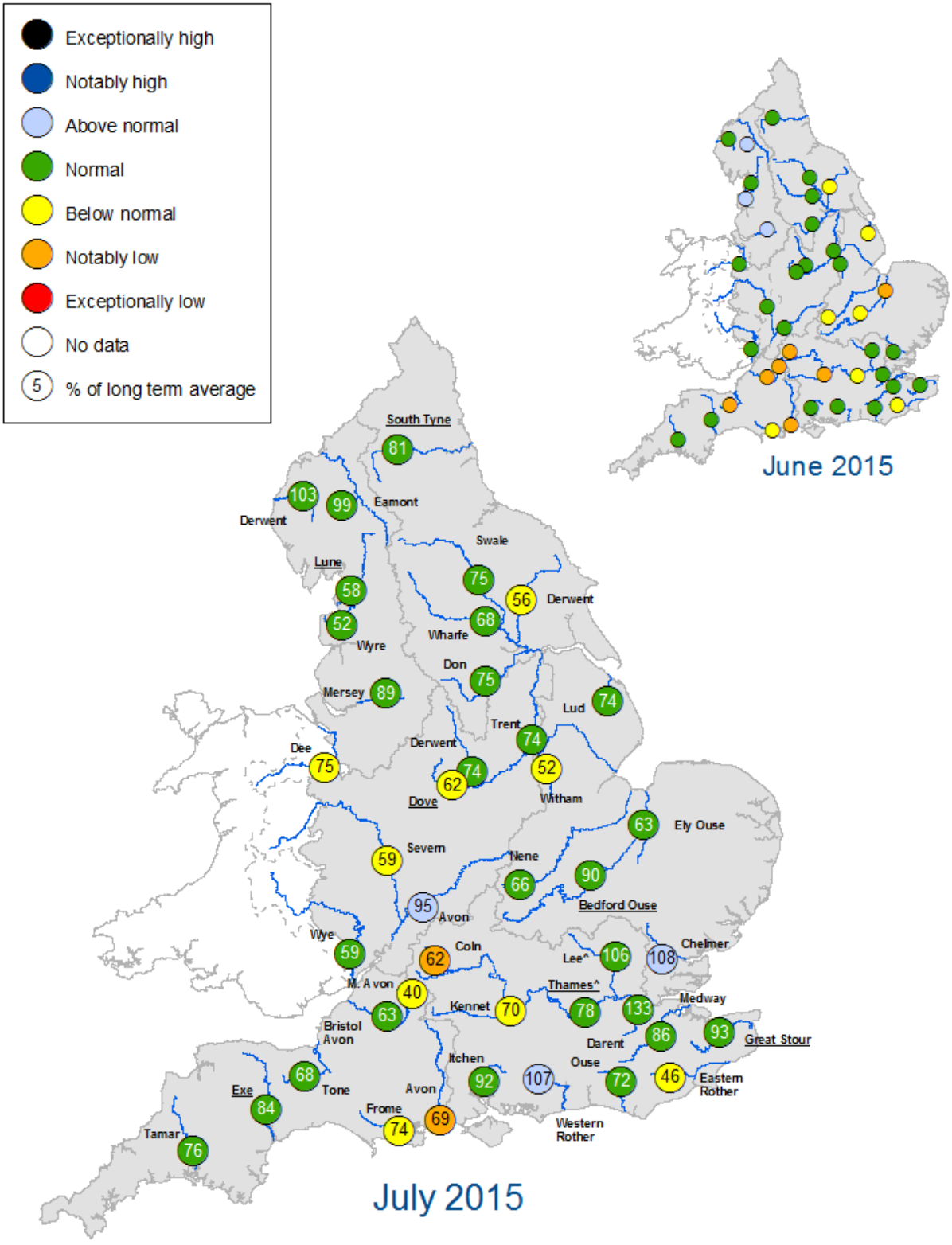


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 June 2015 and July 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic June and July monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

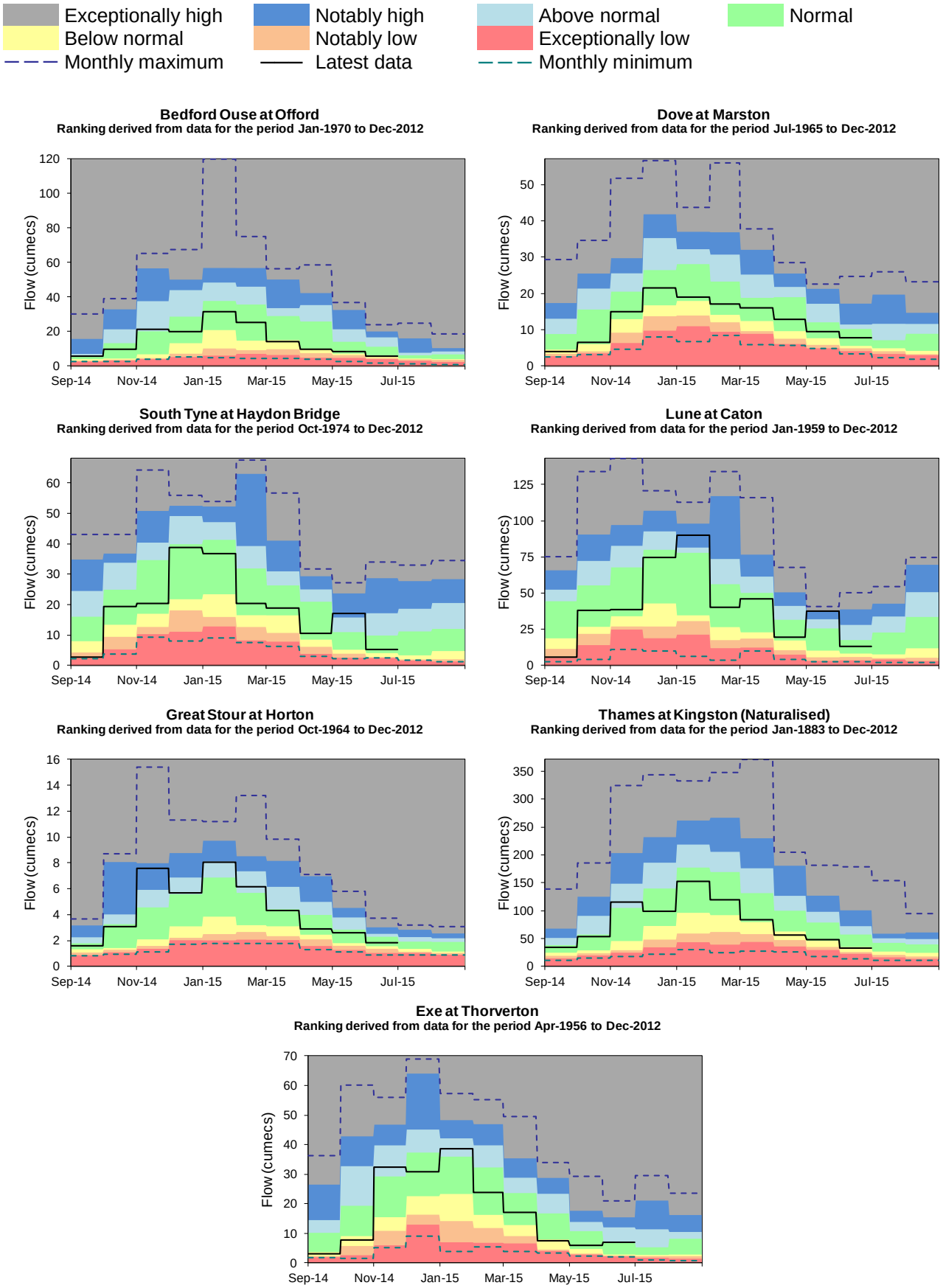


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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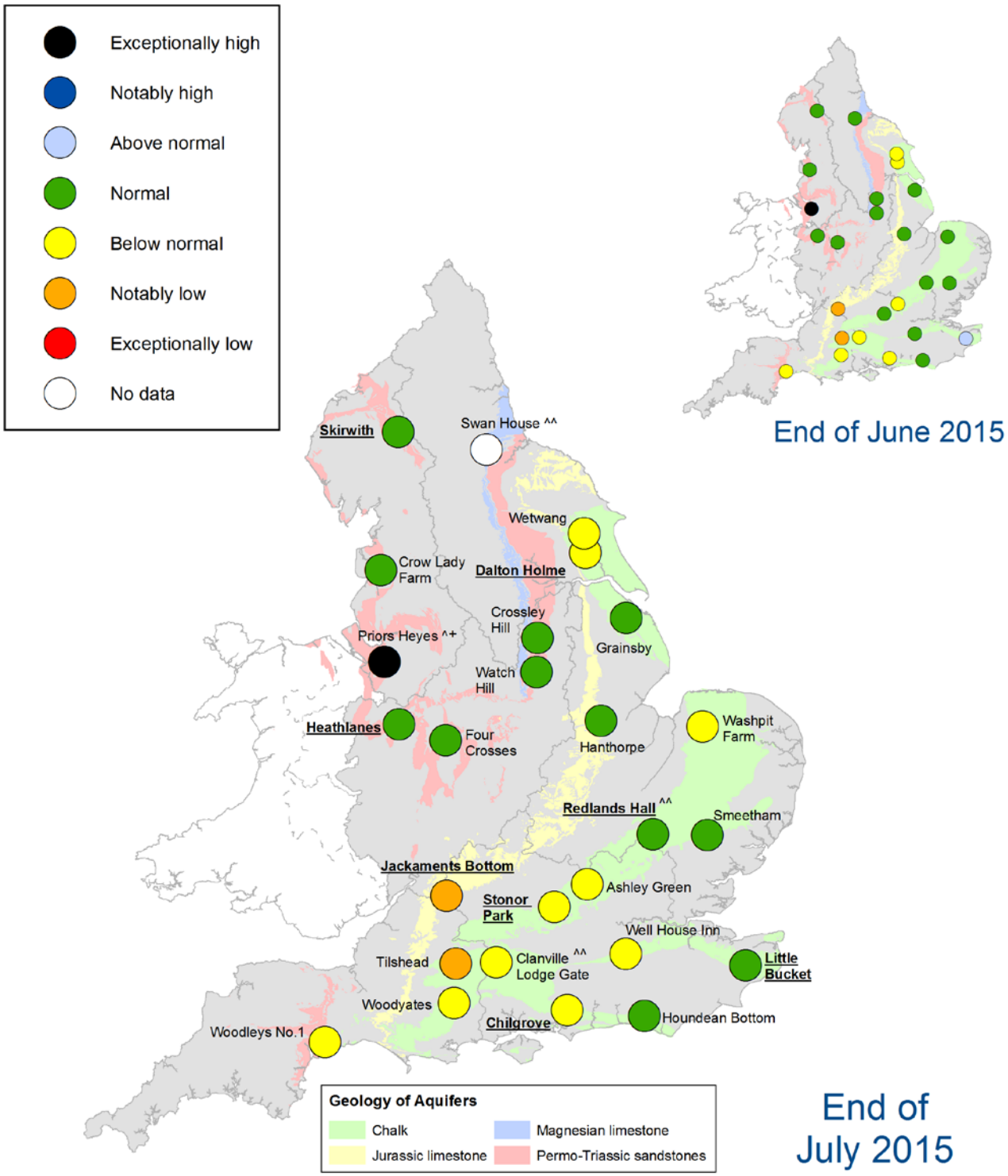
Groundwater levels



^ 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. No data was available at Swan House this month due to site access issues.
+/- End of month groundwater level is the highest/lowest on record for the current month (note that record length varies between sites). 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 June 2015 and July 2015, classed relative to an analysis of respective historic June and July levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

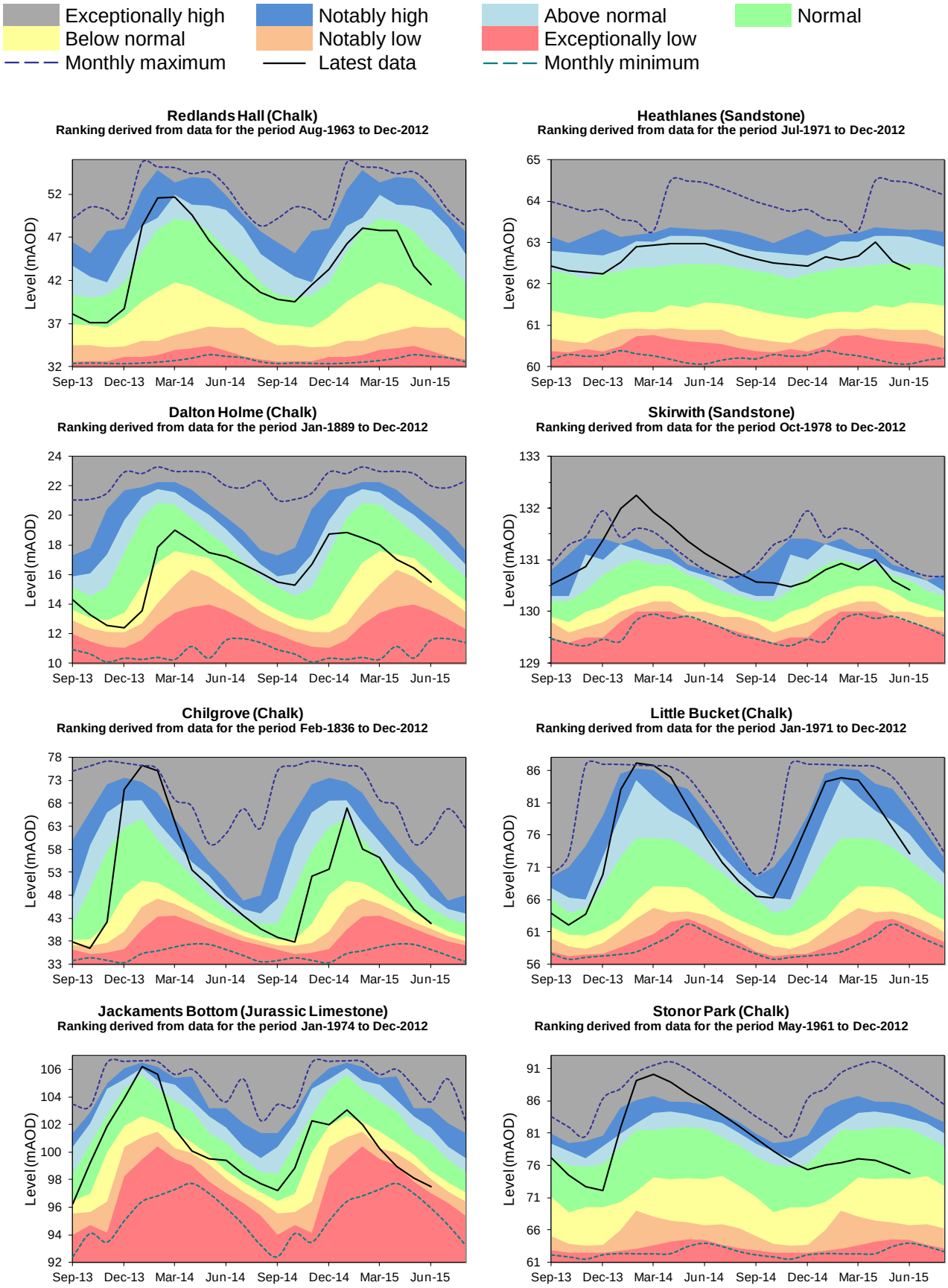


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

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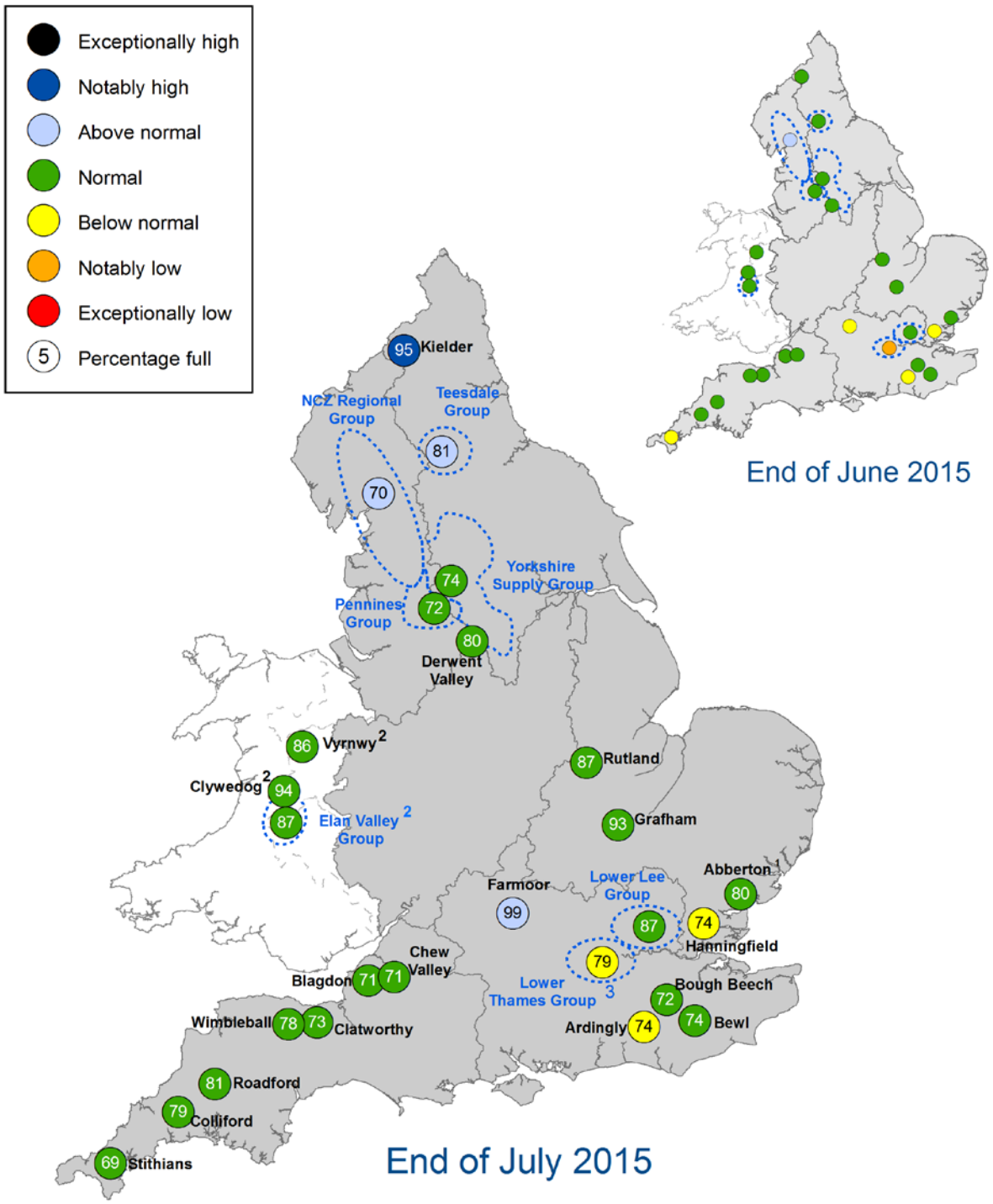
Reservoir storage



1. Water levels have been affected by engineering work at Abberton Reservoir in Essex to increase capacity
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to central and northwest England
3. Stocks in the Lower Thames Group have been affected by maintenance work

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of June 2015 and July 2015 as a percentage of total capacity and classed relative to an analysis of historic June and July 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, 2015.

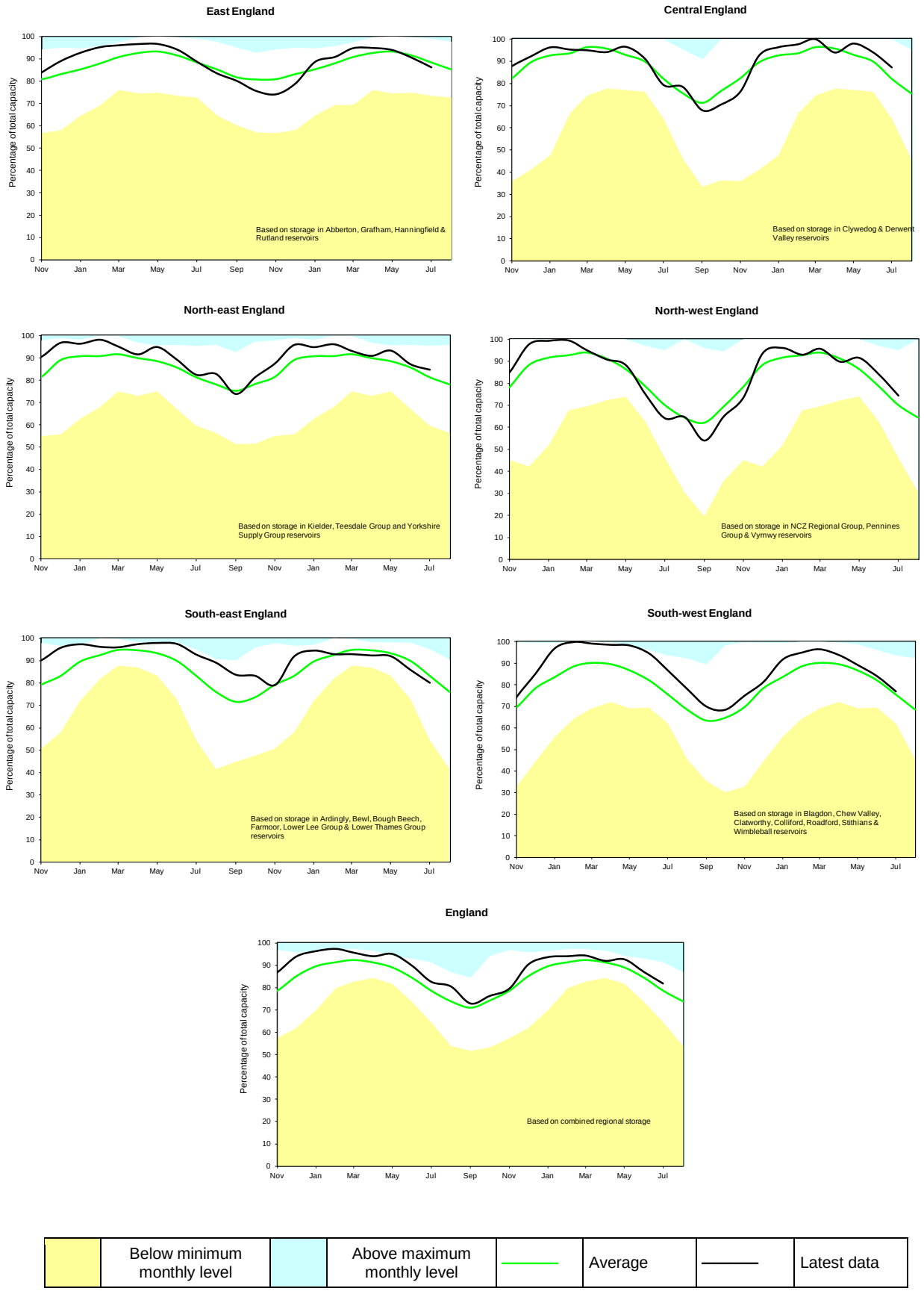


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

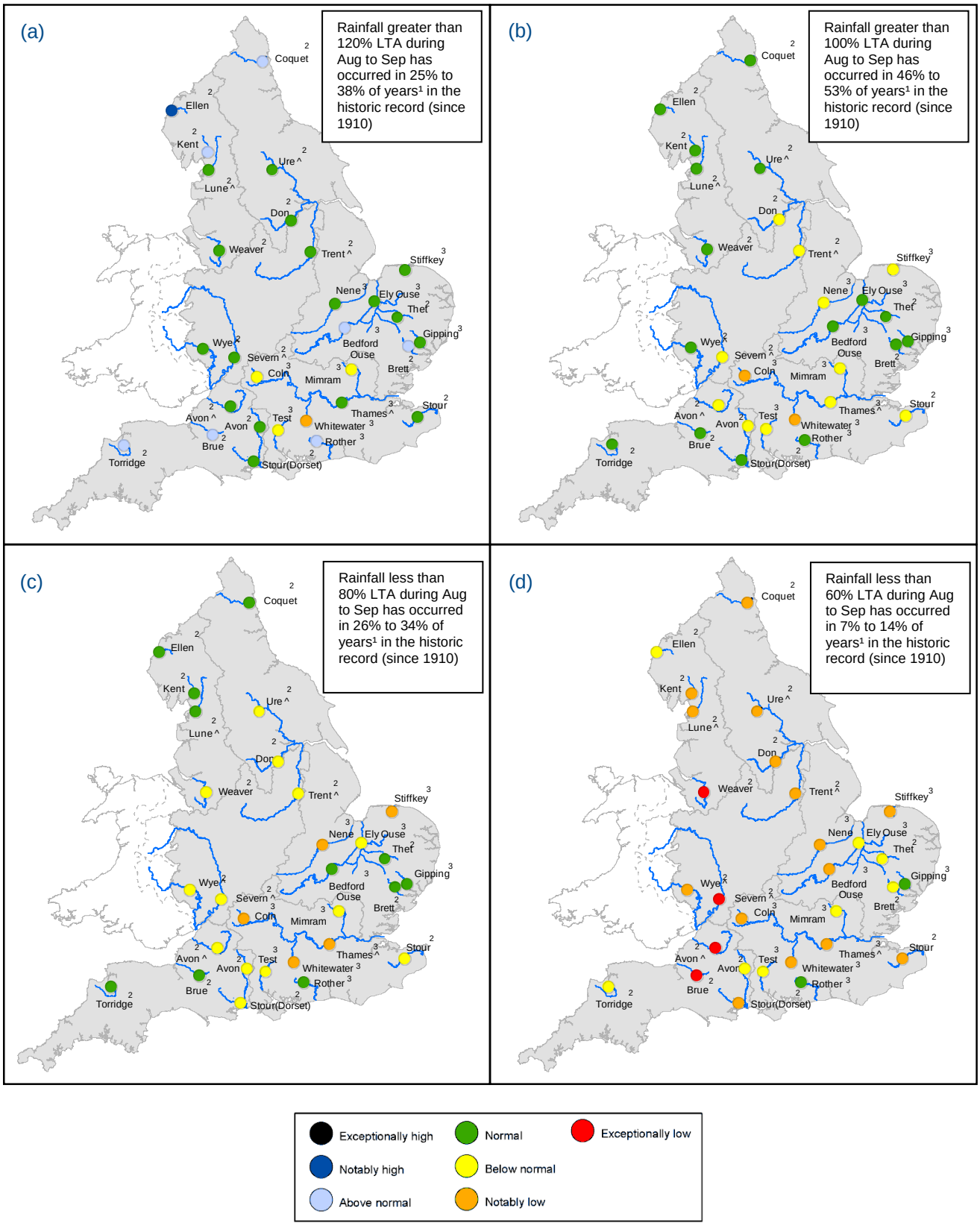


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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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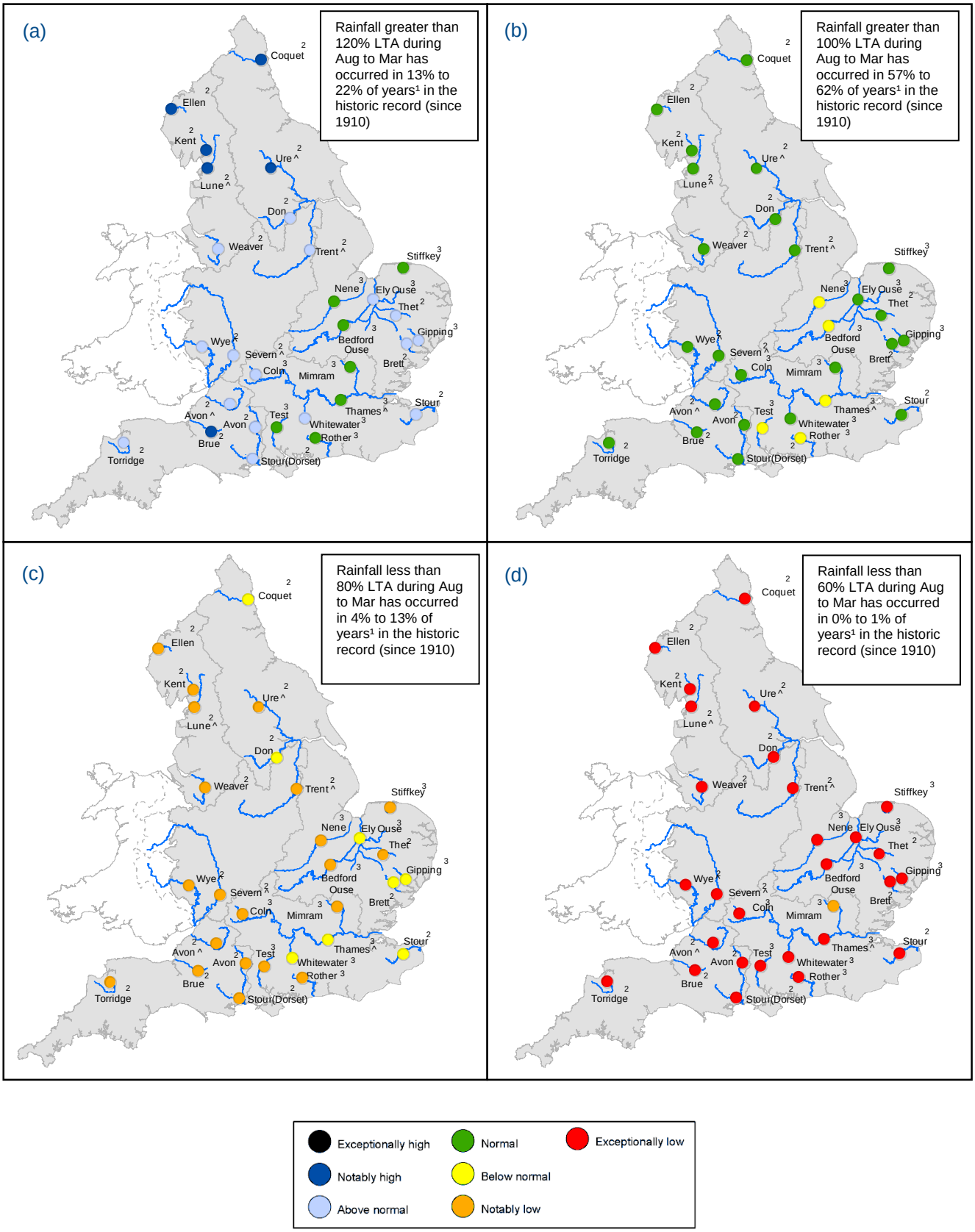

Figure 6.2: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

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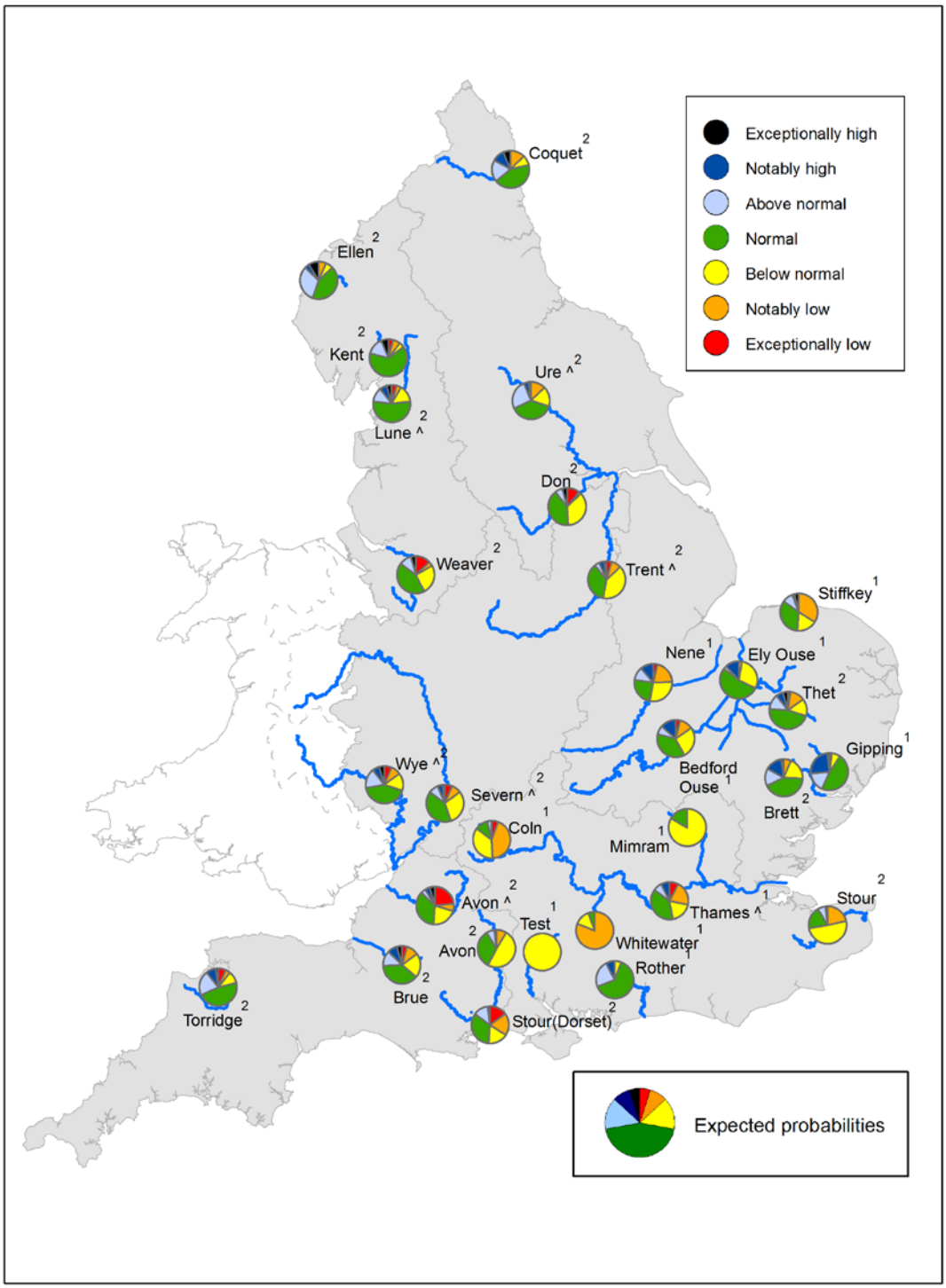

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2015. 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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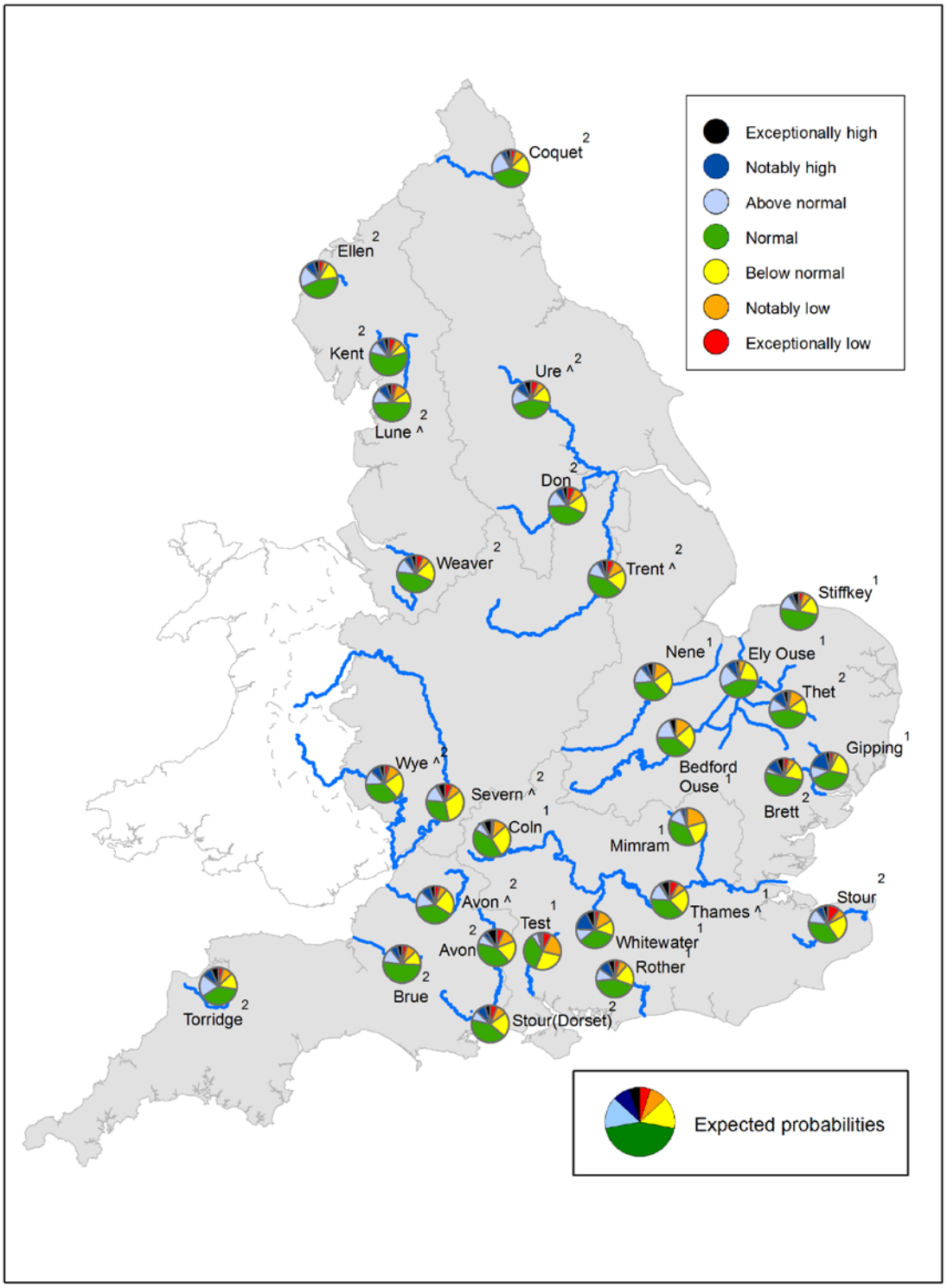

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2016. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the 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

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Forward look - groundwater

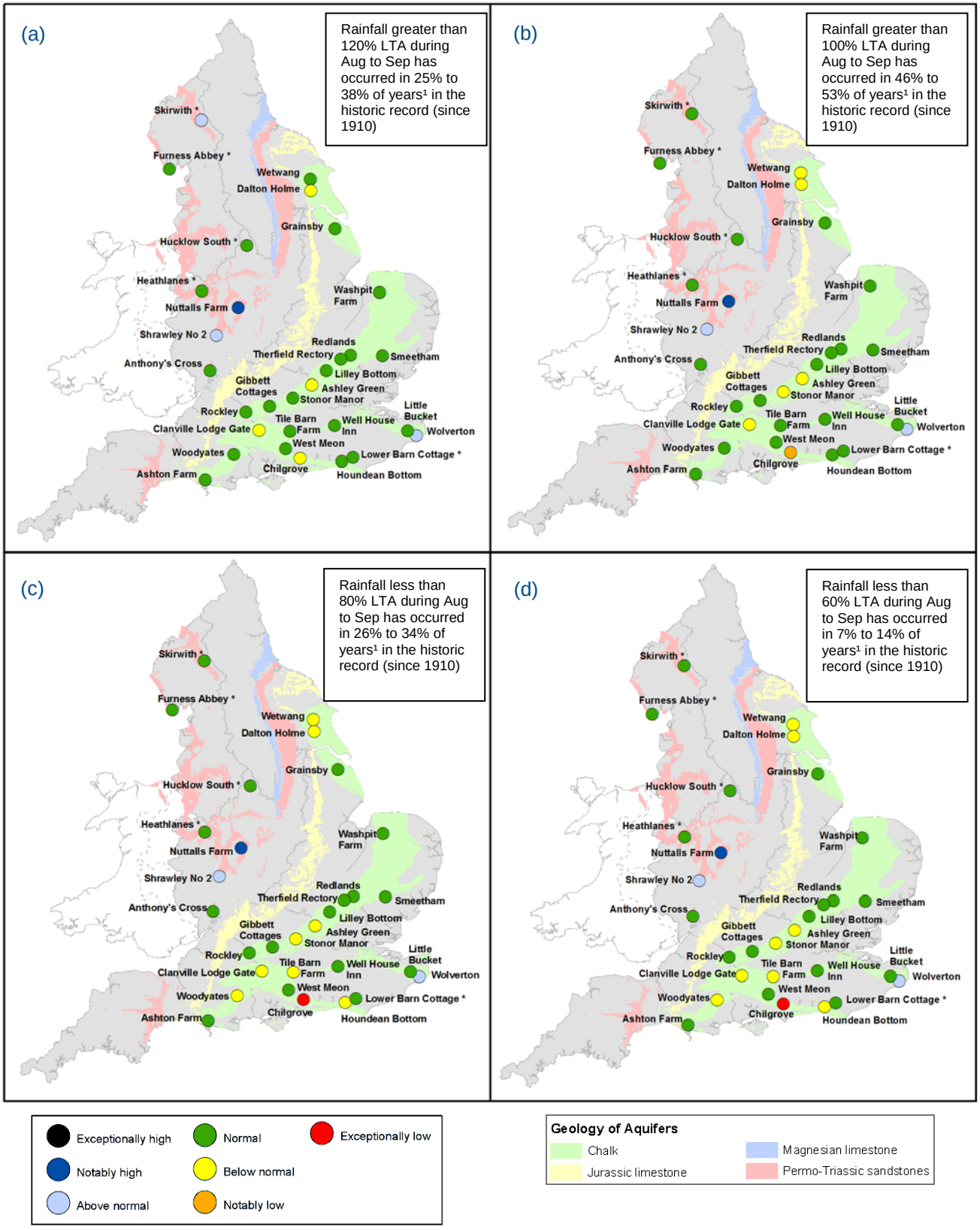

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August and September 2015 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2015.

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

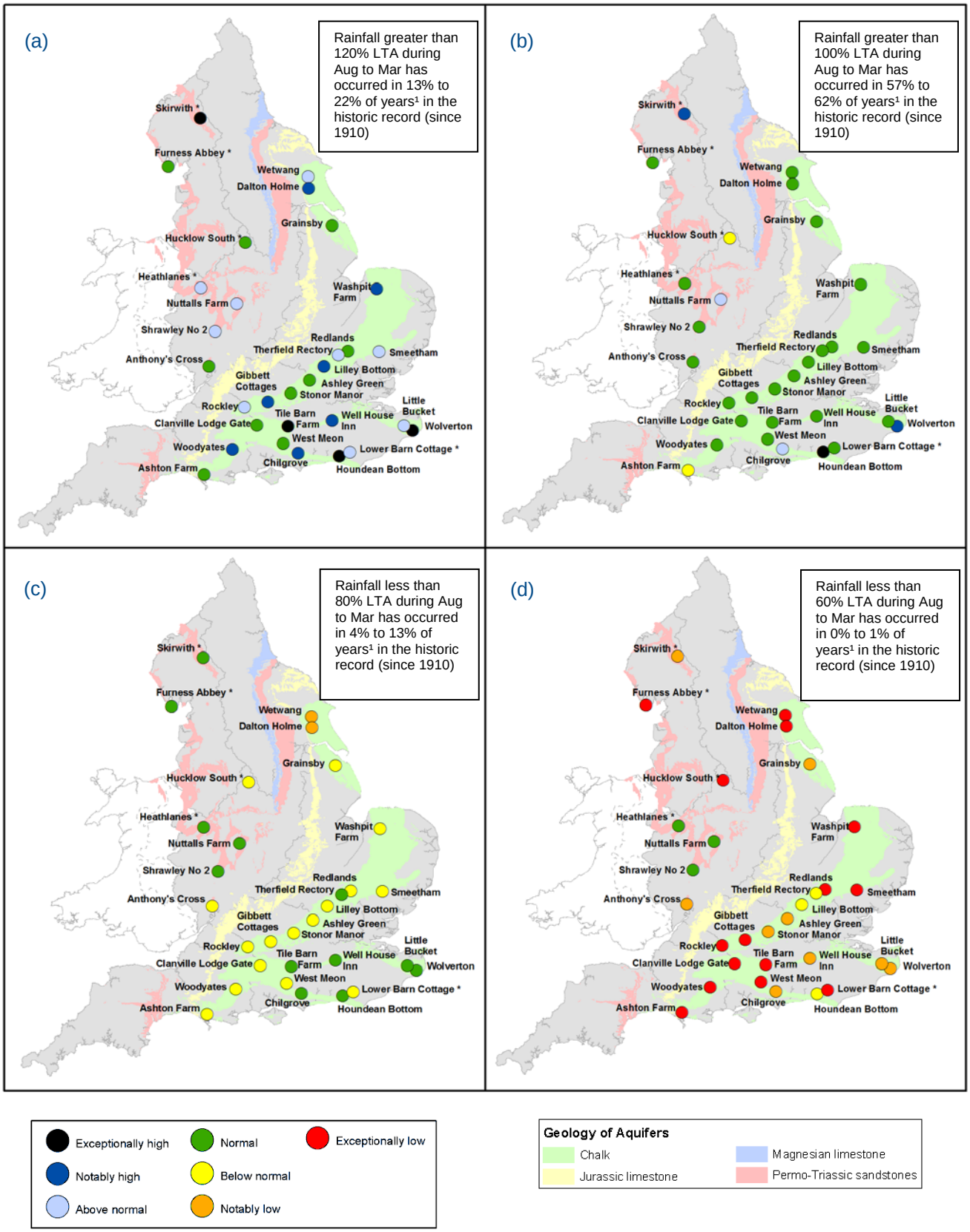

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016 Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2015.

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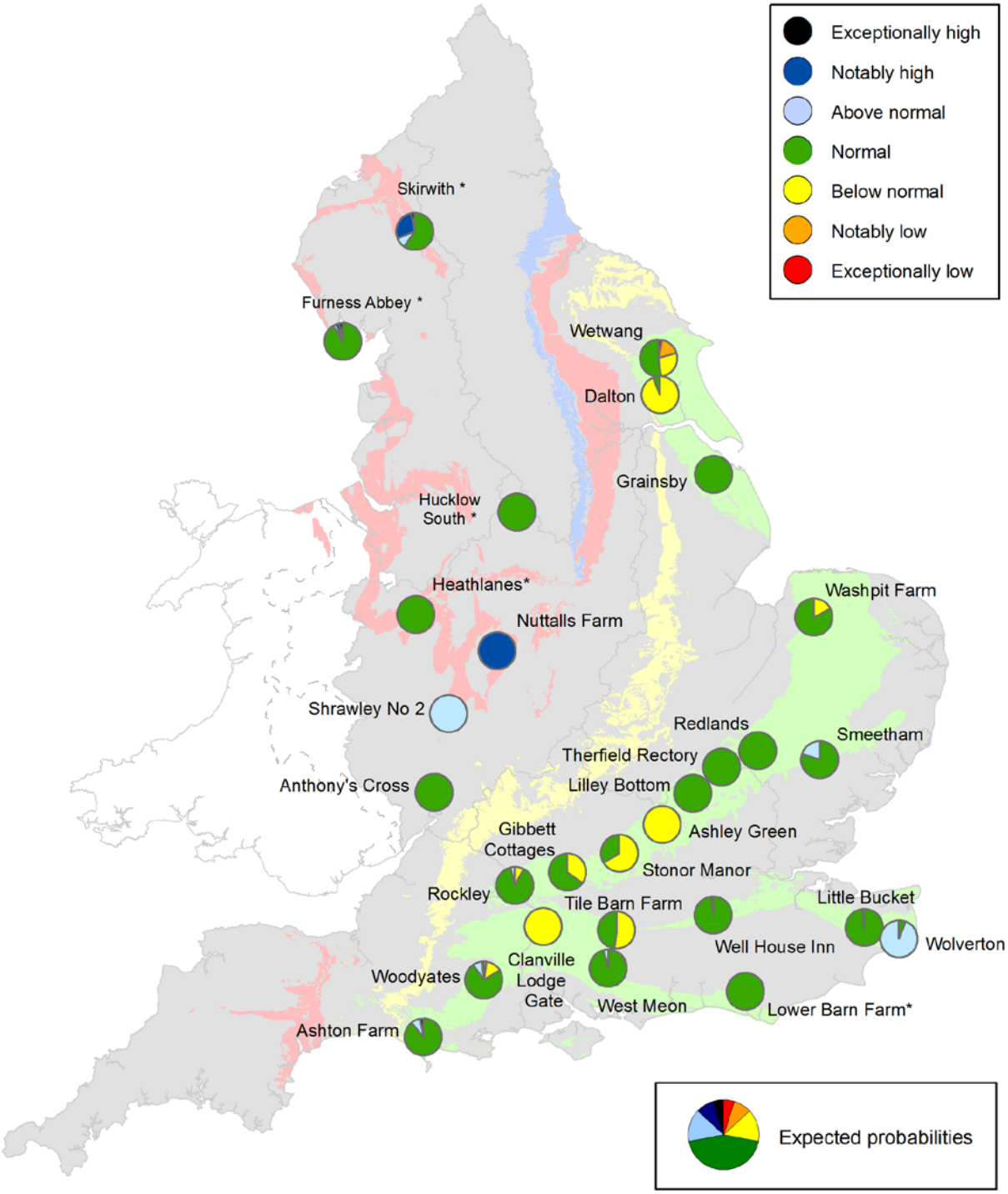
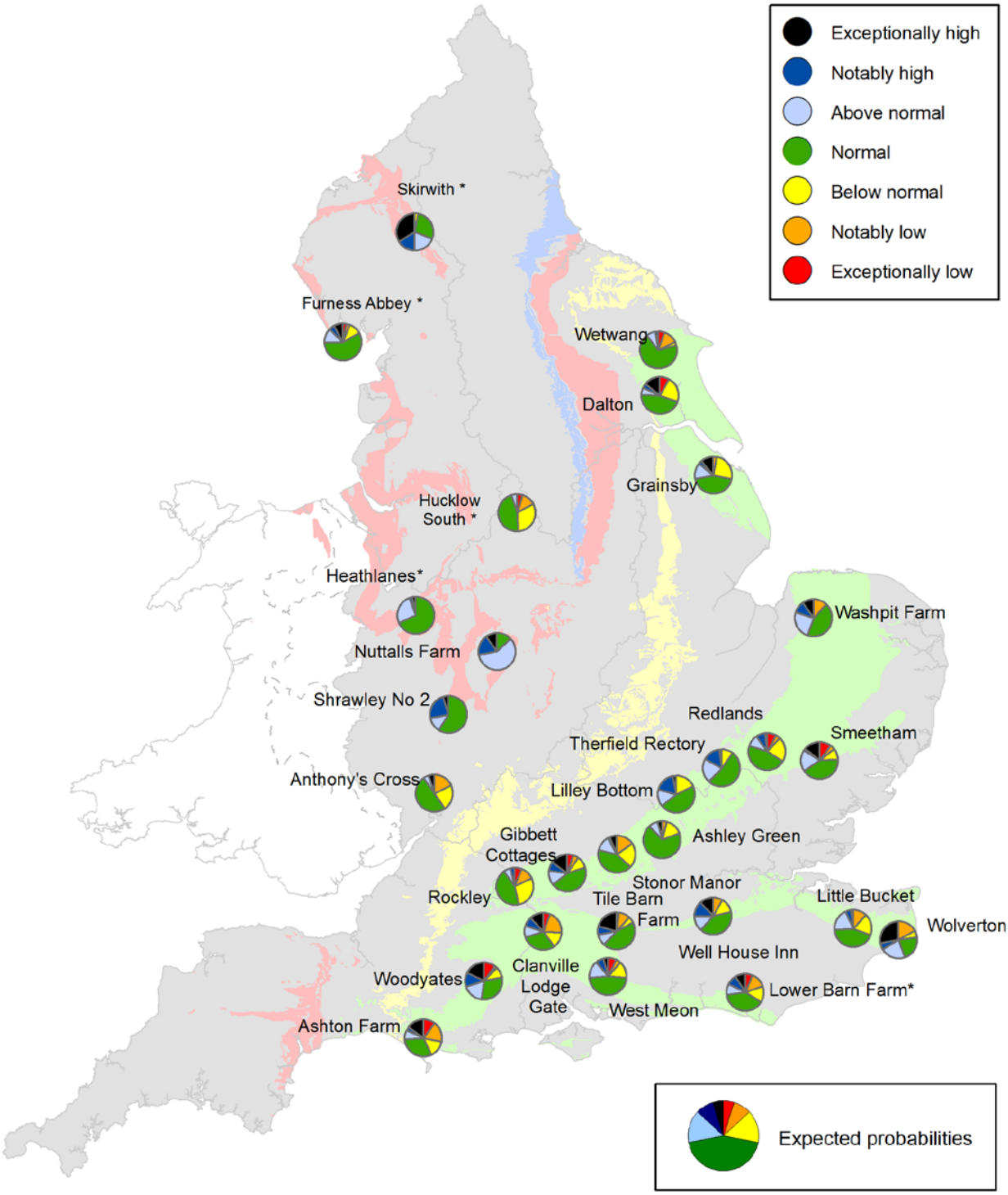


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2015. 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, 2015.

* 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 2016. 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, 2015.

* Projections for these sites are produced by BGS

Figure 7.1: Geographic regions

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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