Monthly water situation report

England

Summary – September 2015

September rainfall totals were below average across England at 77% of the long term average (LTA). Soil moisture deficits increased by up to 18mm across most areas during the month, with the greatest increases occurring across central England. Monthly mean river flows decreased compared to August at just over half of the indicator sites, but remained **normal** or higher for the time of year at 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 most reported reservoirs and reservoir groups during September, but remained **normal** or higher for the time of year at most sites. Overall stocks for England decreased to 75% of total capacity.

Rainfall

September rainfall totals ranged from around 100mm across parts of Devon and east Kent, to around 30mm across parts of Lincolnshire and Leicestershire. September rainfall totals were below the long term average (LTA) in nearly three quarters of hydrological areas, with those covering Cumbria and parts of Lancashire receiving less than 40% of the LTA. In contrast, parts of the English Channel/Thames Estuary coast from East Sussex up to Suffolk received approximately 125 to 150% of the LTA (Figure 1.1).

September rainfall totals were **normal** for the time of year across most of central, eastern and southern England; by contrast, totals across much of north-west and the far north-east of England were **notably low** and **below normal** respectively. Over the 3 month period ending in September, cumulative rainfall totals were **above normal** or **notably high** for the time of year across south and east England, but generally **normal** elsewhere. Over the 6 and 12 month periods ending in September, rainfall totals were generally **normal** across England (Figure 1.2).

At regional scale, September rainfall totals ranged from 44% of the LTA in north-west England to 103% in south-east England. Totals were **notably low** for the time of year in north-west England, **below normal** in north-east England and **normal** elsewhere. Across England as a whole, rainfall was **normal** for the time of year at 77% of the September LTA (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) increased by up to 18mm across much of England during September, in response to below average rainfall. The largest increases occurred across parts of central England. SMDs decreased by up to 30mm across much of south-east England and parts of east and north-east England, with the largest decreases occurring across east Kent. At the end of September, soils were generally wettest in north-west and south-west England and driest in the east, particularly in parts of Norfolk and Lincolnshire (Figure 2.1).

End of month SMDs were up to 64mm smaller than the LTA predominately across the whole of southern England. Across central, east and north-east England SMDs were up to 55mm larger than the LTA (Figure 2.1).

At a regional scale, SMDs decreased slightly during September in east and south-east England and increased slightly elsewhere. End of month SMDs ranged from 26mm in south-west England to 92mm in east England (Figure 2.2).

River flows

Monthly mean river flows decreased compared to August at just over half of the indicator sites across England, including all those in central England and all but one in north-west England. Monthly mean flows were classed as **normal** or higher for the time of year at two-thirds of indicator sites, mainly located in the southern half of England. Flows at the remaining sites were classed as **below normal** or **notably low** (Figure 3.1).

Monthly mean river flows were classed as **normal** for the time of year at 4 of the 7 regional index sites. The River Exe in south-west England and the Great Stour in south-east England were classed as **above normal** and **notably high** respectively. The River Dove in central England was classed as **below normal** for the time of year, for the third consecutive month (Figure 3.2).

Groundwater levels

Groundwater levels continued their seasonal decline during September at all but one site. At the end of September, the groundwater level class at each site remained unchanged from the previous month at all but 3 sites, with just over half classed as **normal** or higher for the time of year. Levels at 11 sites across north-east, east, south-east and south-west England were **below normal** for the time of year, whilst the level at 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, with Stonor Park (in the south-west Chilterns chalk), Chilgrove (in the Chichester chalk aquifer), Dalton Holme (in the Hull and East Riding chalk aquifer) and Jackaments Bottom (in the Burford Jurassic limestone aquifer) being **below normal** for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at two thirds of reported reservoirs and reservoir groups during September, with the largest decreases of 10% occurring at the Teesdale and NCZ Regional reservoir groups in north-east and north-west England respectively. The largest increase in stocks of 8% occurred at Clatworthy reservoir in south-west England. End of month stocks were classed as **normal** or higher for the time of year at all but 5 reported reservoirs and reservoir groups. Draycote and Carsington & Ogston reservoirs and the Derwent Valley and Dove reservoir groups in central England, together with the Pennines group in north-west England were classed as **below normal** or lower for the time of year (Figure 5.1).

Regional-scale reservoir stocks decreased during September by between 5 and 8% across 5 of the 7 regions; stocks in east England remained unchanged whilst stocks in south-east England increased slightly. At the end of September, regional stocks ranged from 65% of total capacity in south-west England to 83% in east England. Overall reservoir storage for England decreased by 5% to 75% of total capacity (Figure 5.2).

Forward look

October is likely to see some periods of settled weather through the middle part of the month, beyond this the forecast is uncertain, but with some unsettled conditions probable. Further ahead, for the period from October to December, above average precipitation is more likely than below average precipitation[1].

Projections for river flows at key sites[2]

More than half of modelled sites have a greater than expected chance of **below normal** or lower cumulative flows between October 2015 and March 2016. A similar proportion of modelled sites have a greater than expected chance of **below normal** or lower cumulative flows between October 2015 and September 2016.

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

Projections for groundwater levels in key aquifers[2]

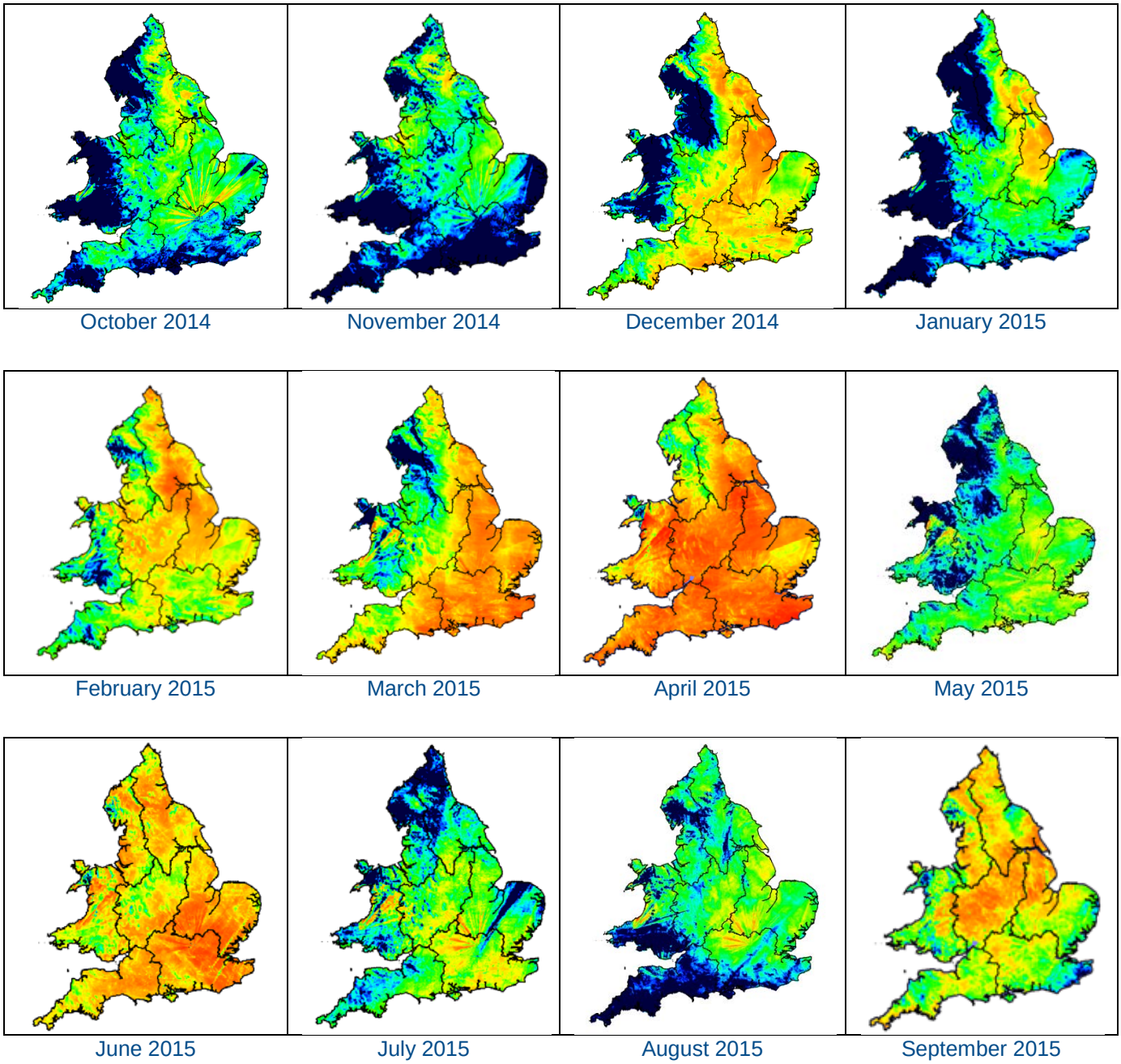
Half of modelled sites have a greater than expected chance of **normal** groundwater levels by March 2016. By September 2016, more than three quarters of sites have a greater than expected chance of **normal** groundwater levels.

For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2016 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 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 (www.hydoutuk.net).

Rainfall



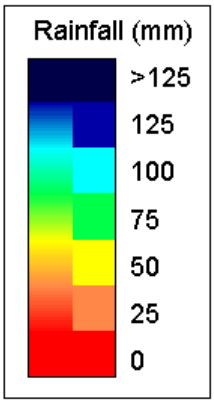


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

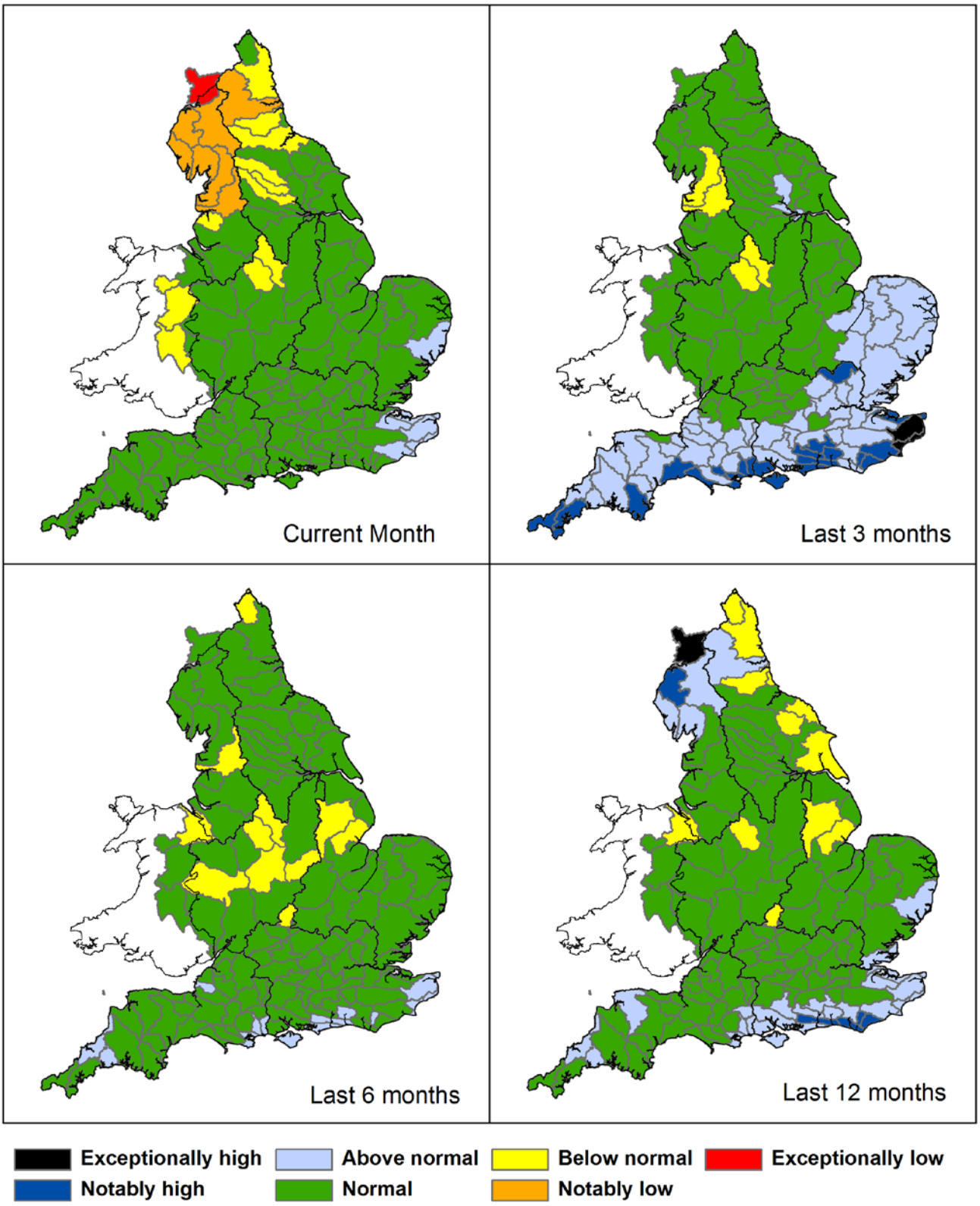


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 September), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data 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.

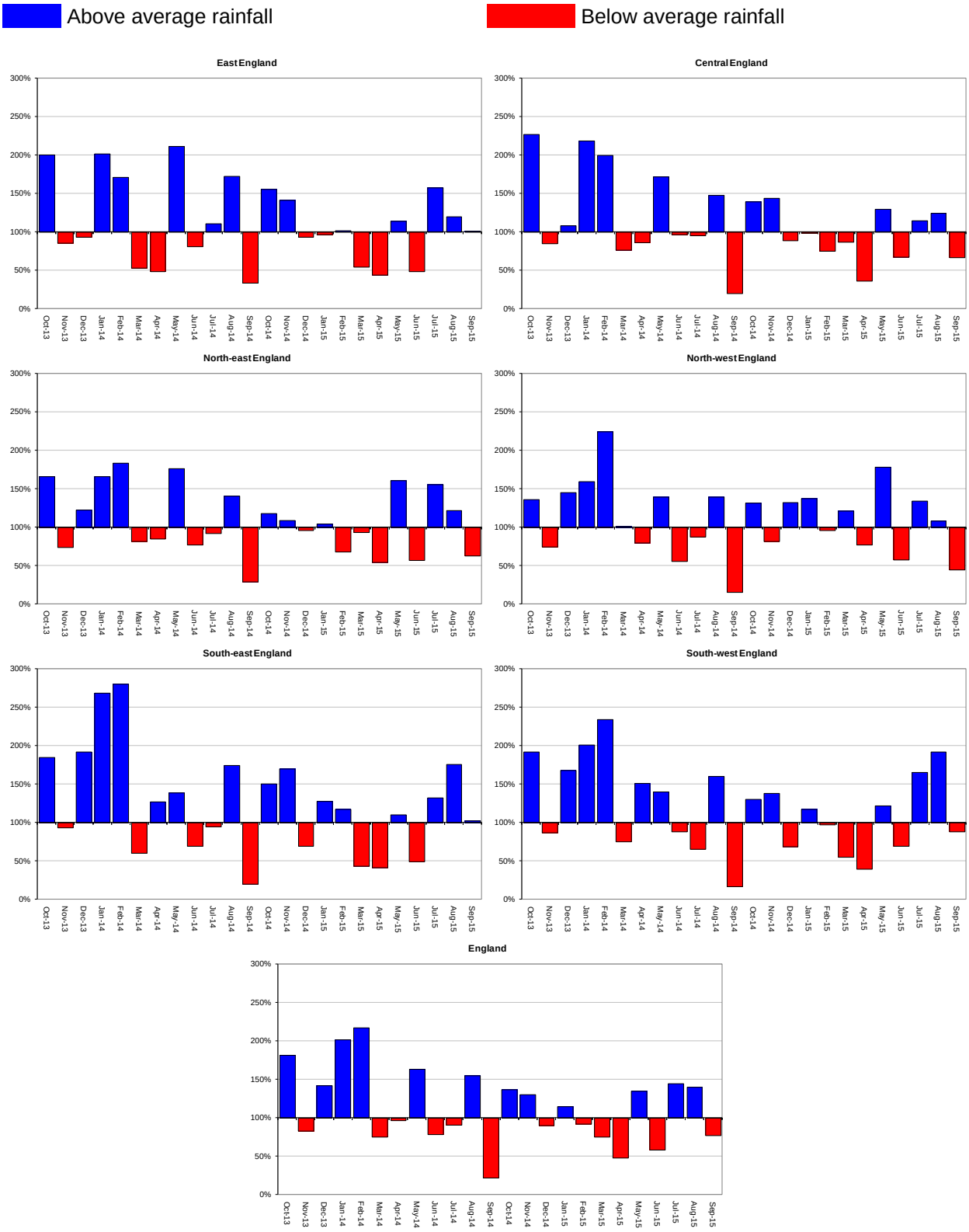


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

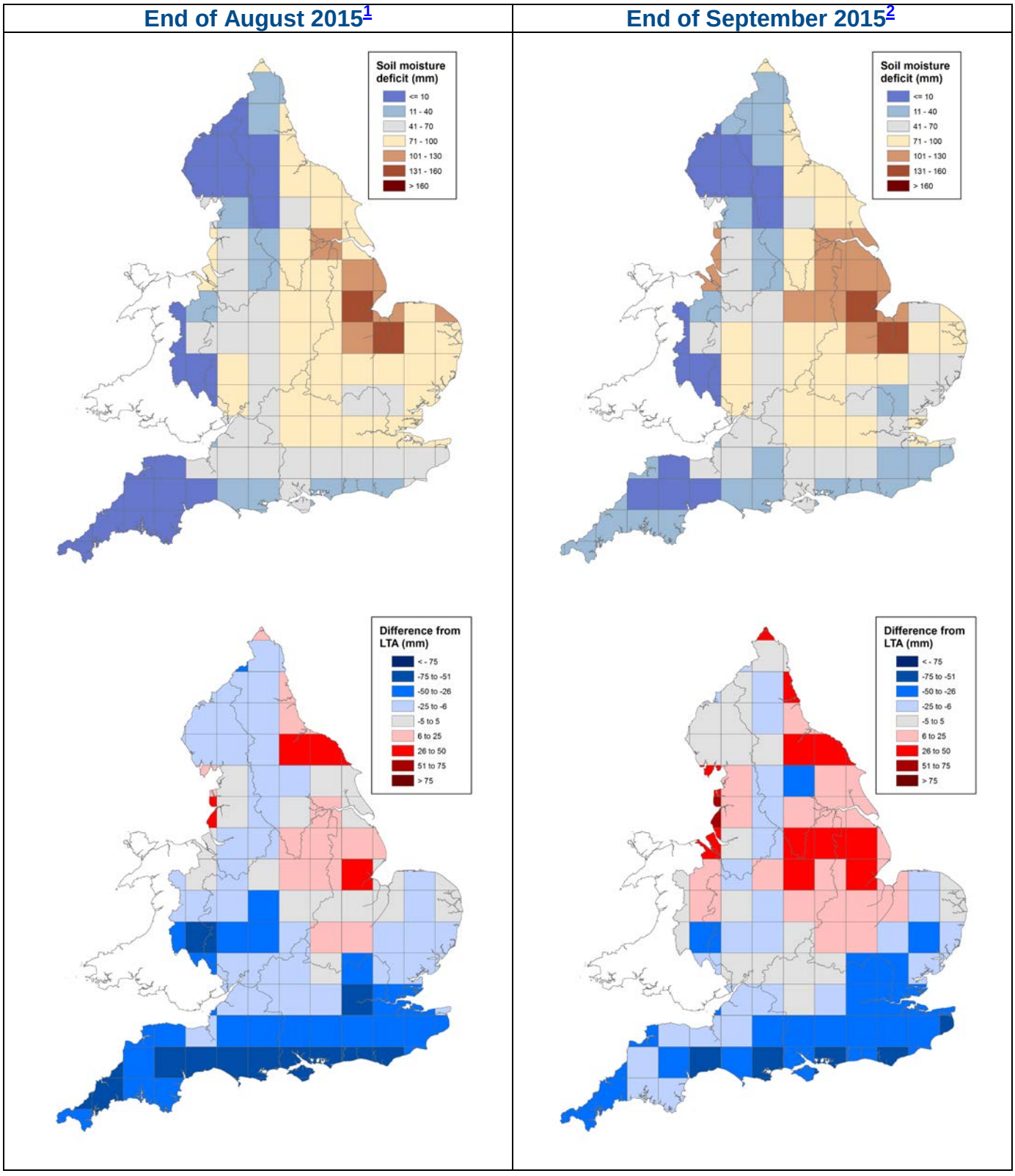


Figure 2.1: Soil moisture deficits for weeks ending 01 September 2015[1] (left panel) and 29 September 2015[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

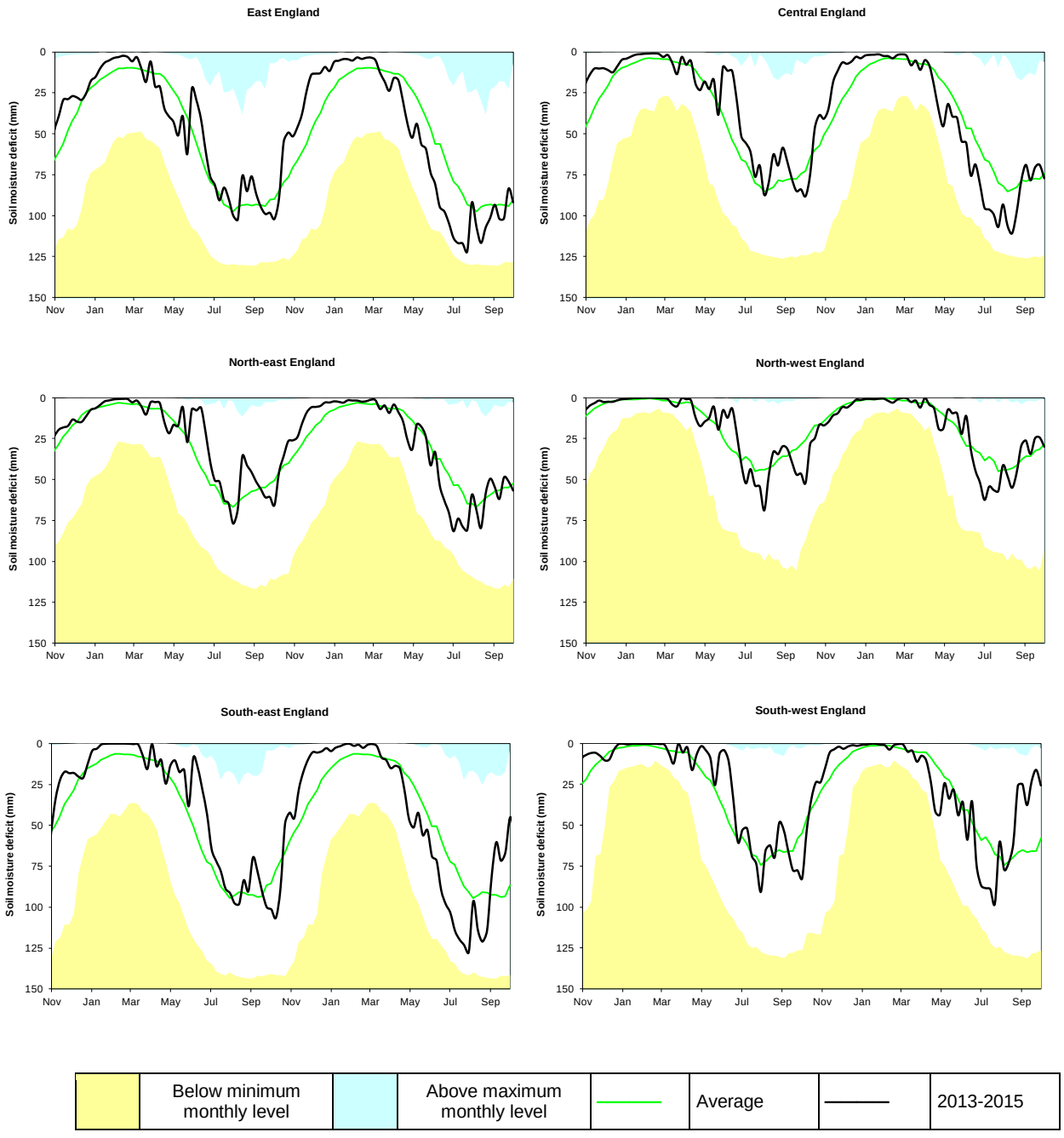
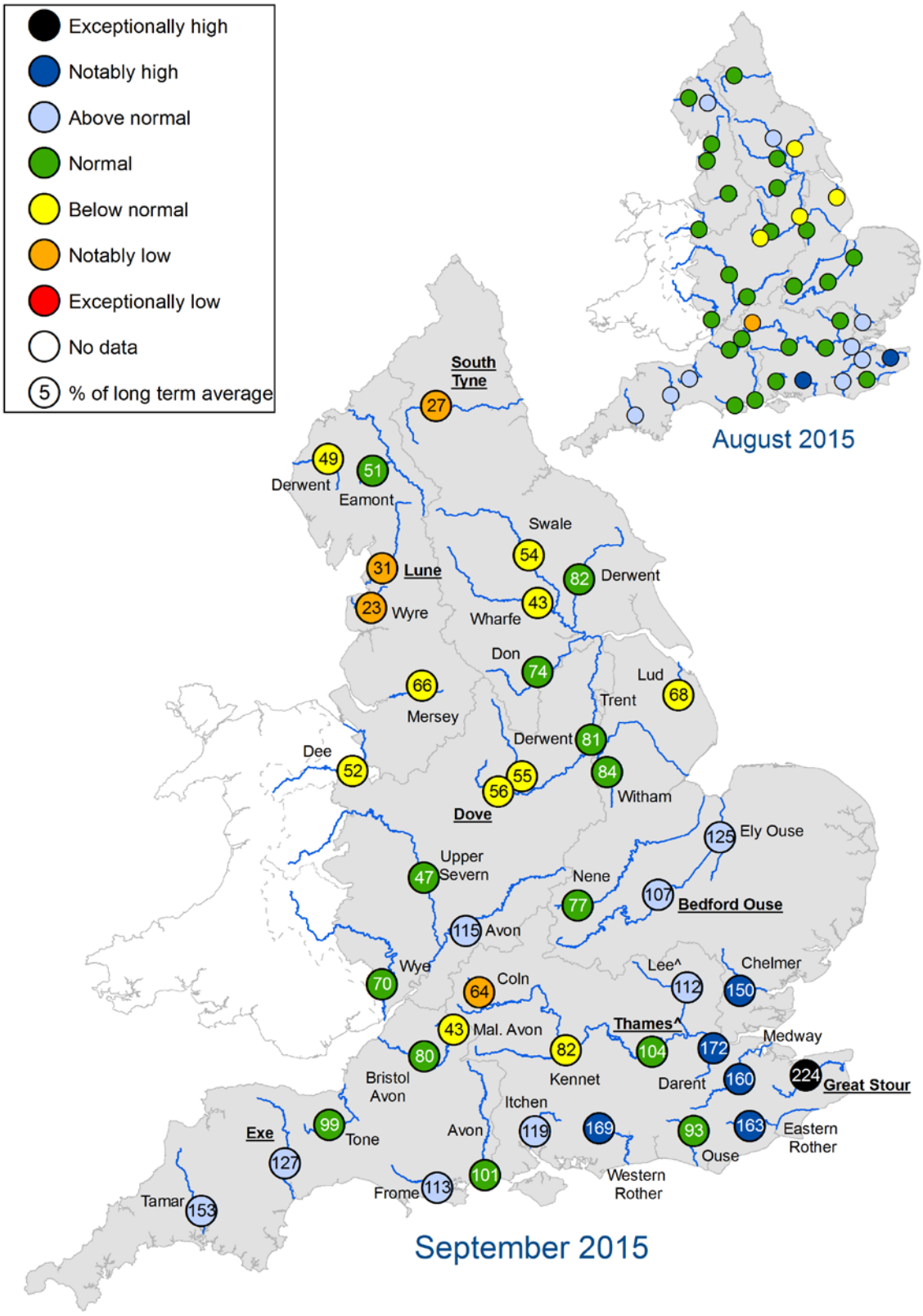


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

River flows



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

\+ Monthly mean flow is the highest 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 August and September 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic August and September monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

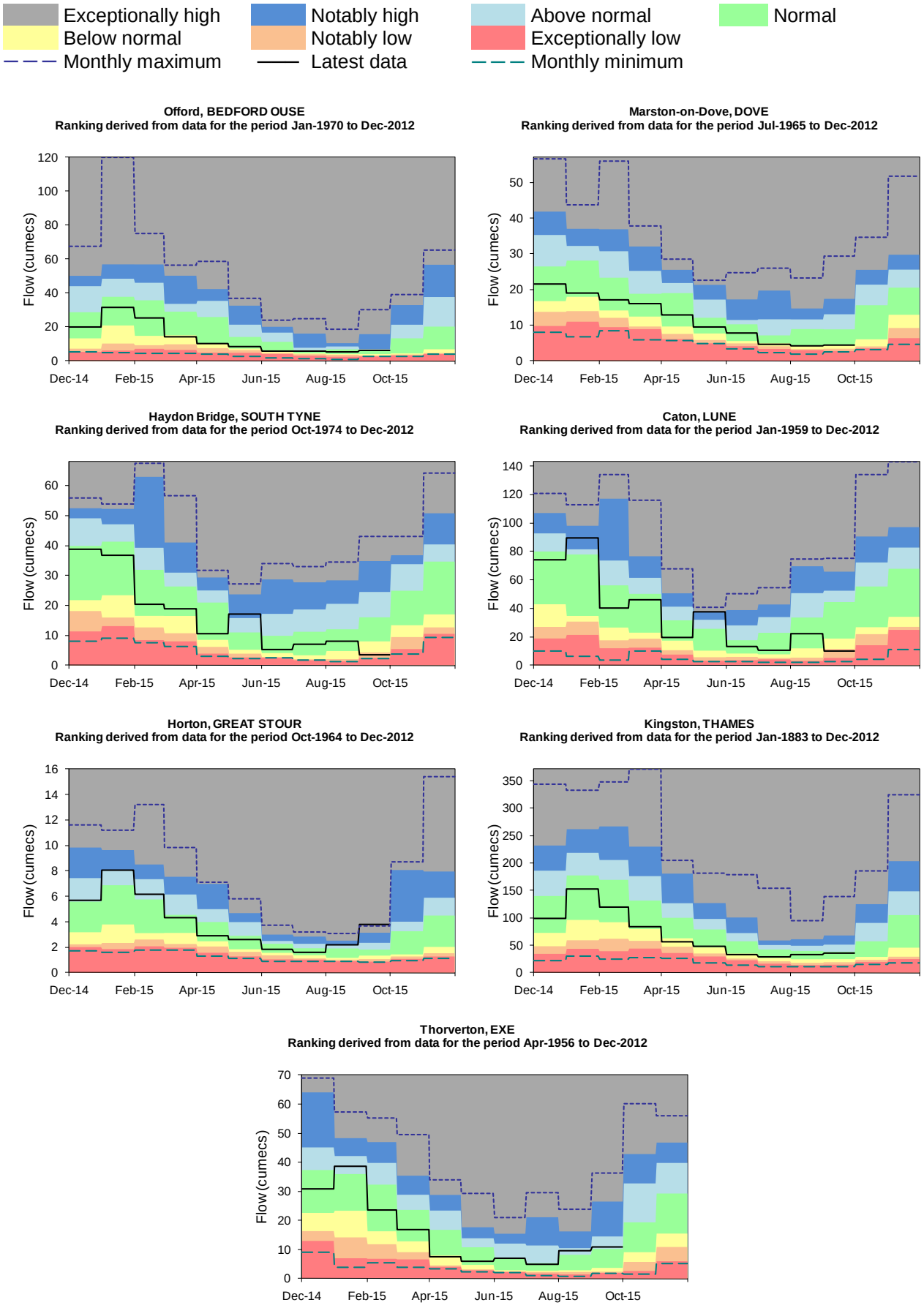
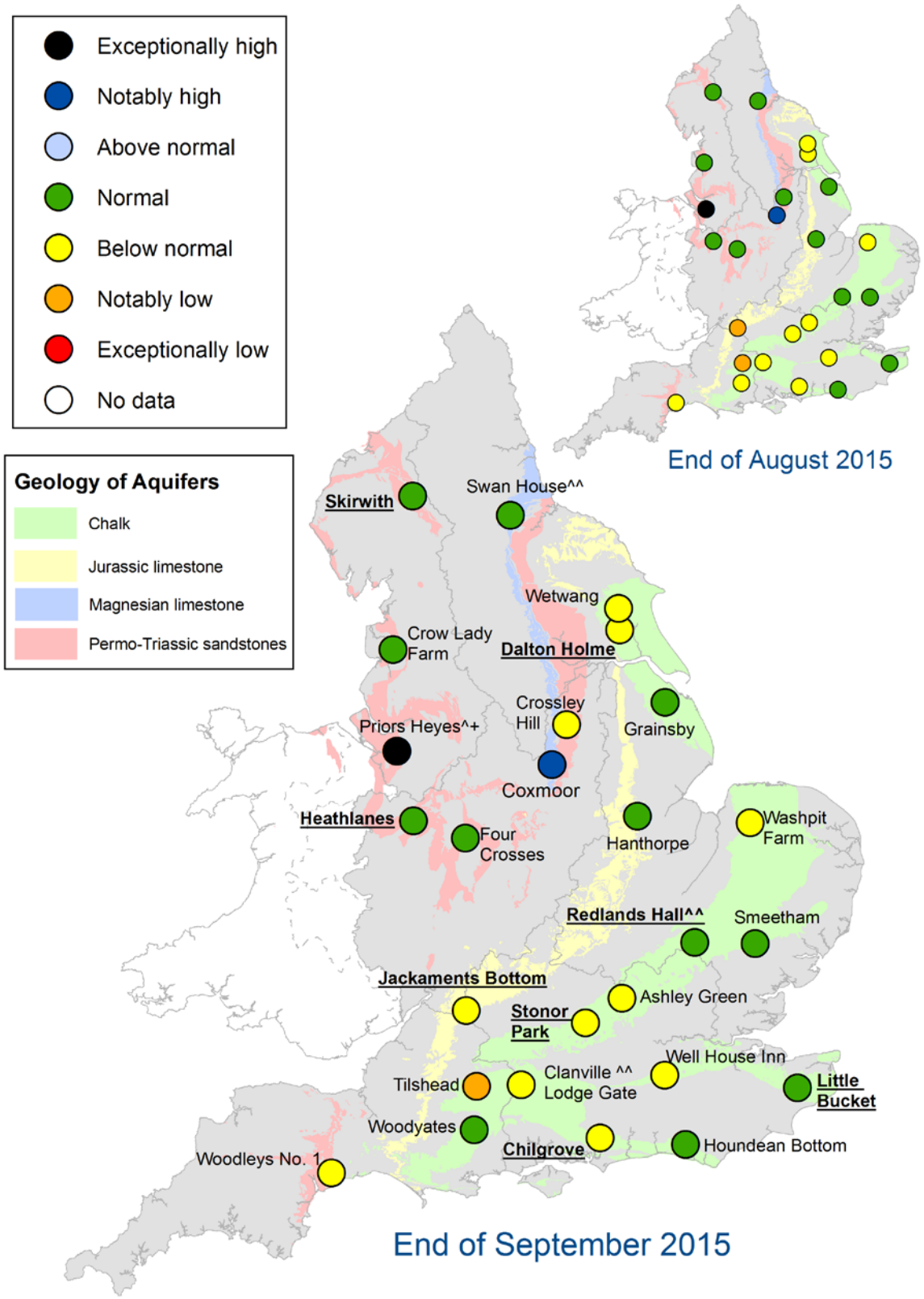


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 highest 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 August and September 2015, classed relative to an analysis of respective historic August and September 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.

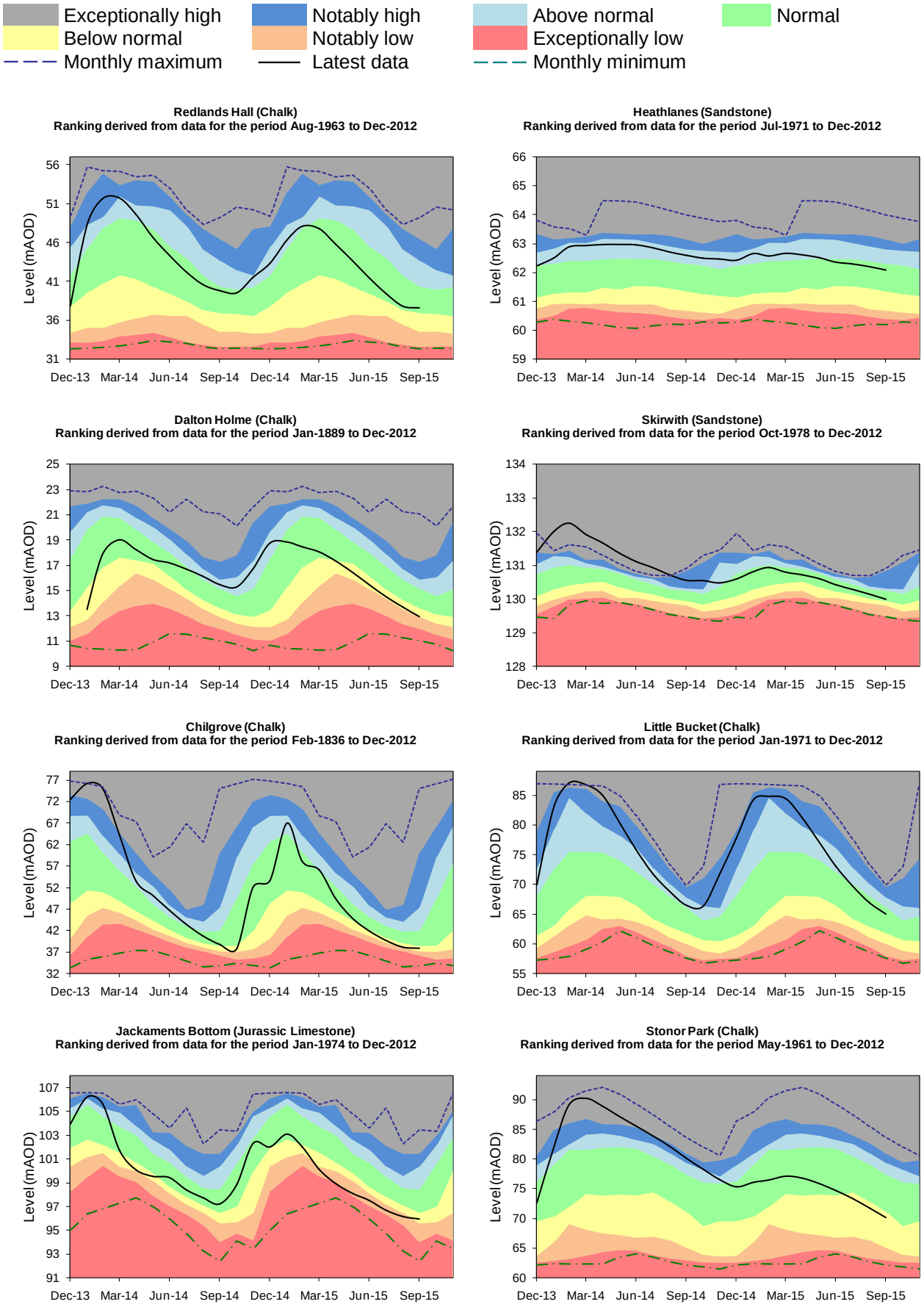
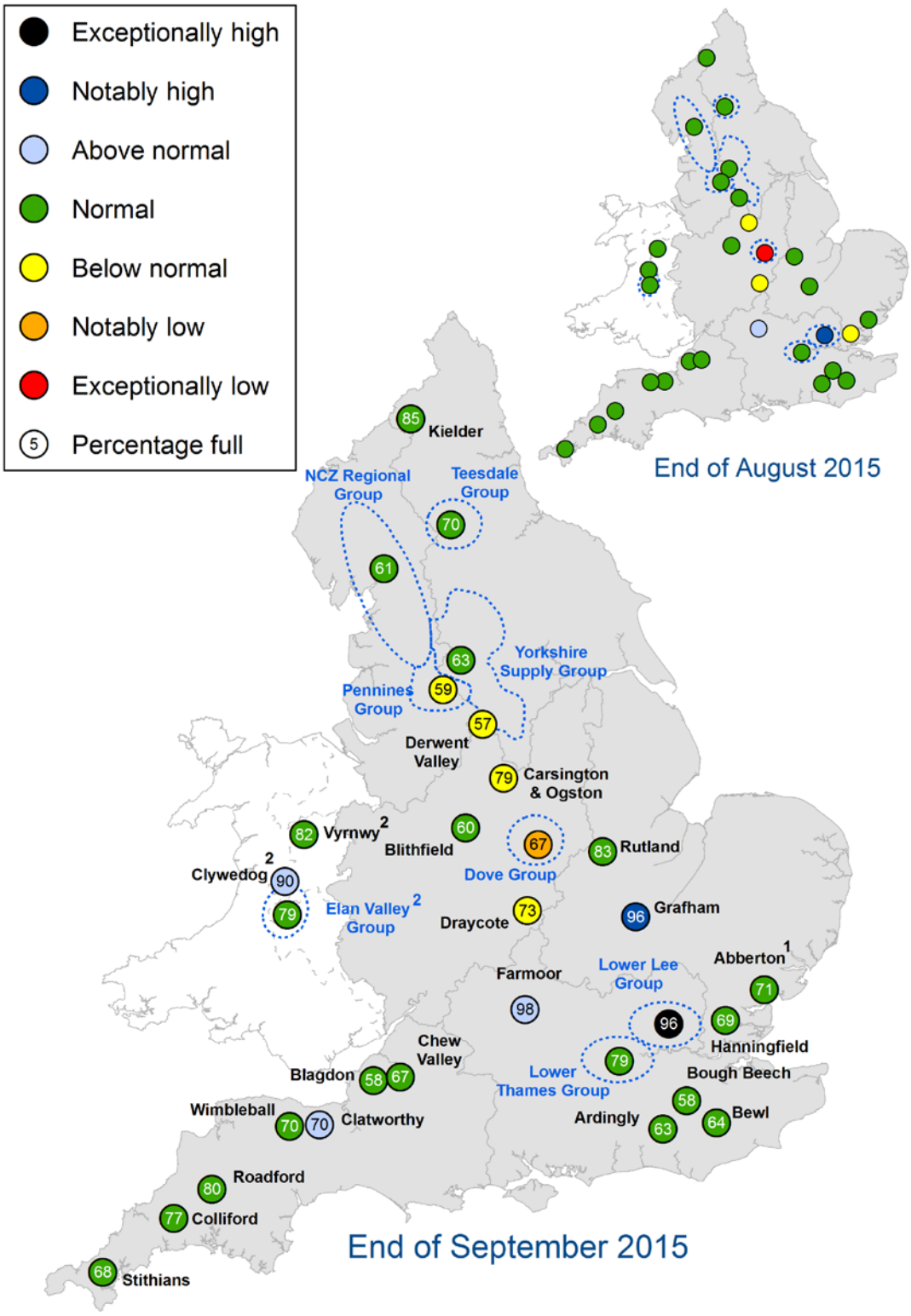


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

Reservoir storage



1. Engineering work at Abberton Reservoir in Anglian Region to increase capacity has been completed
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to our Midlands and North West regions

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

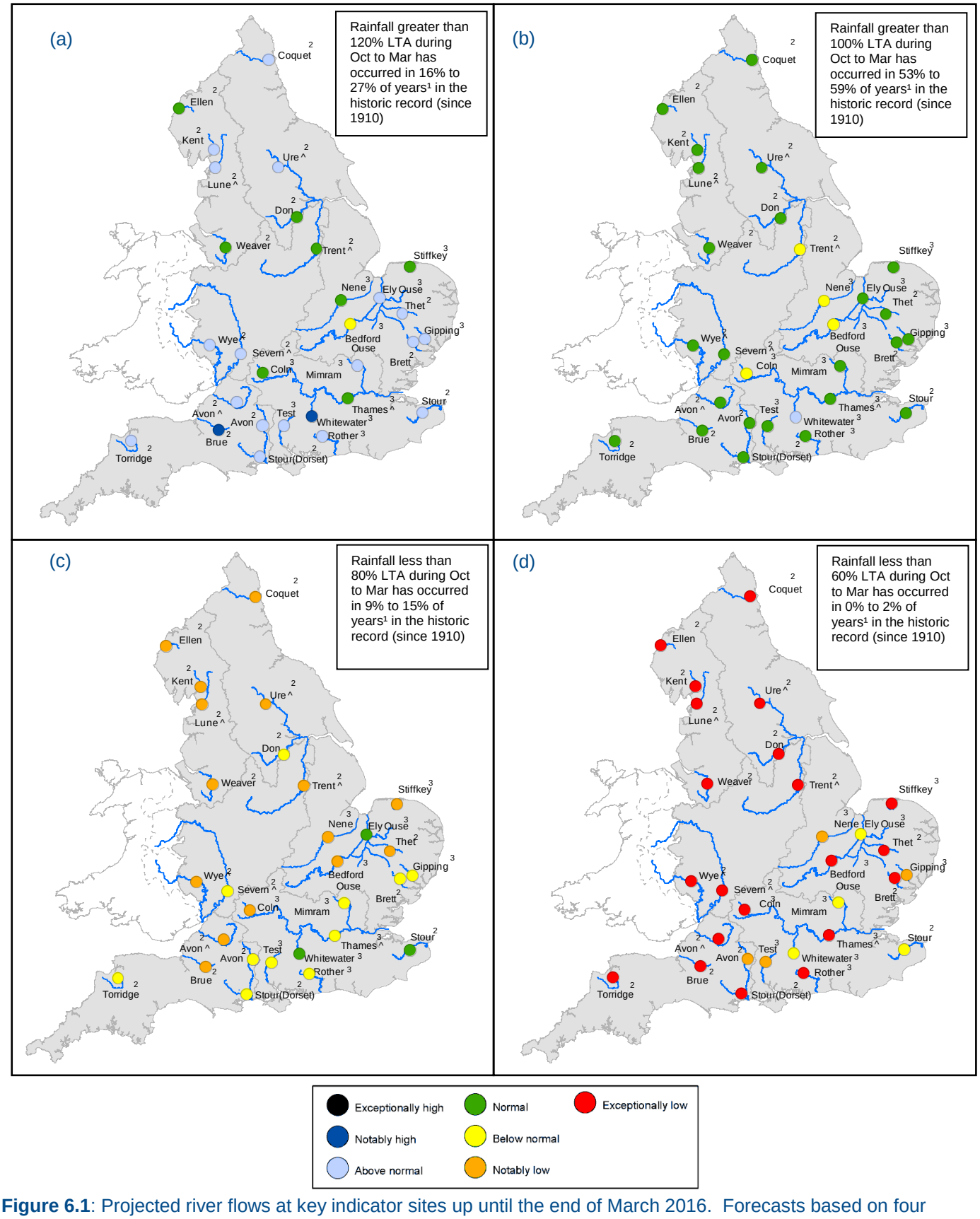
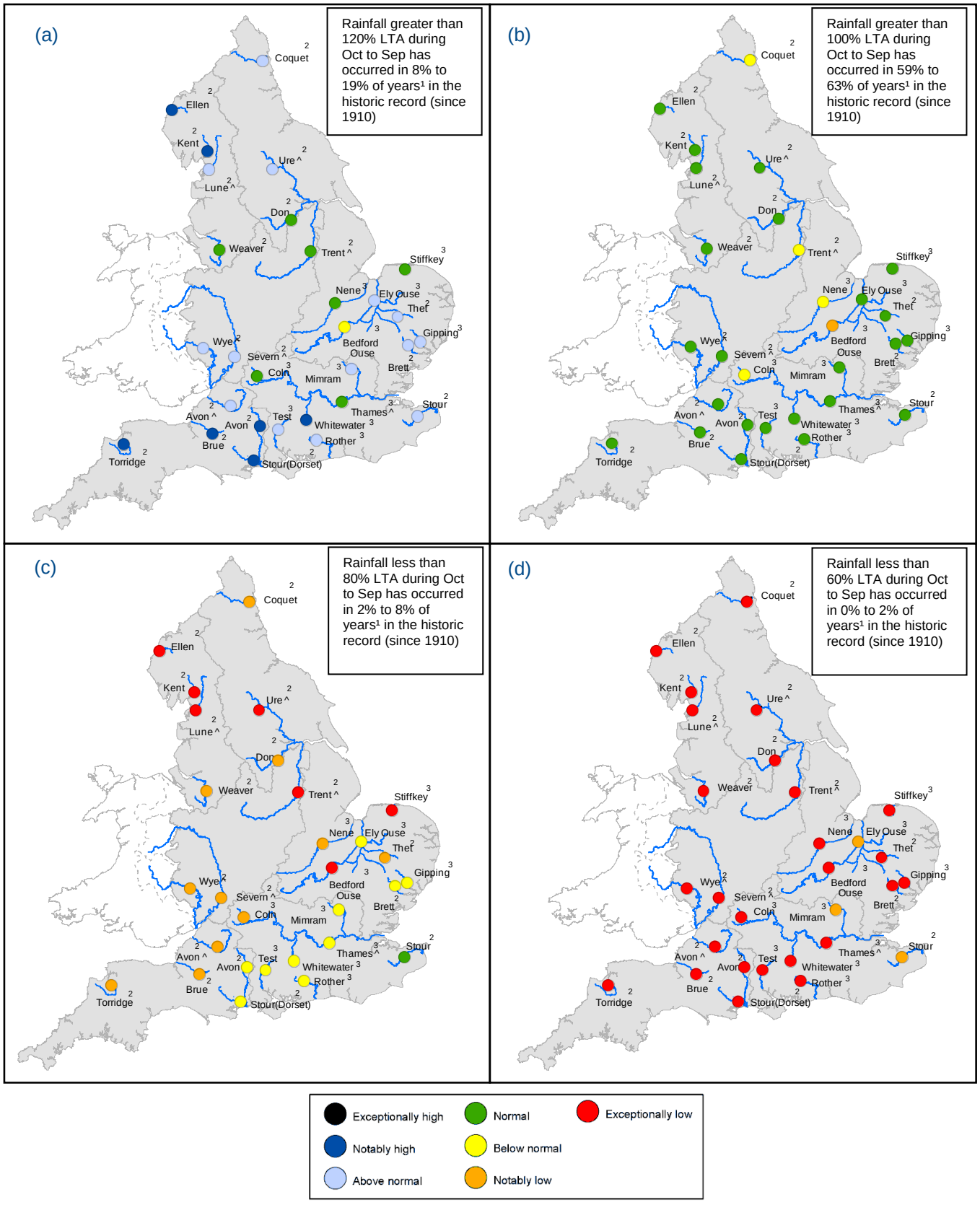


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency).

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



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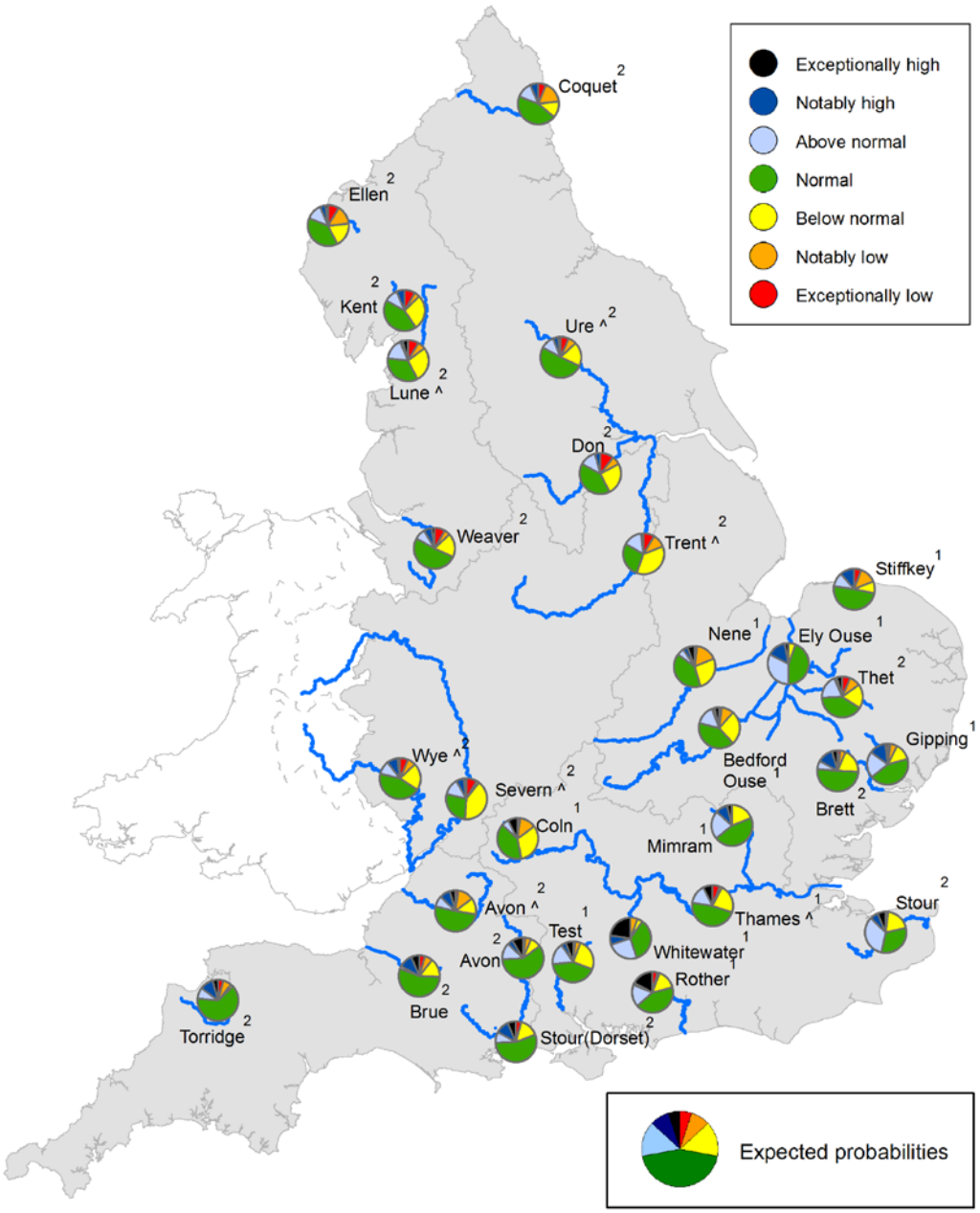

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

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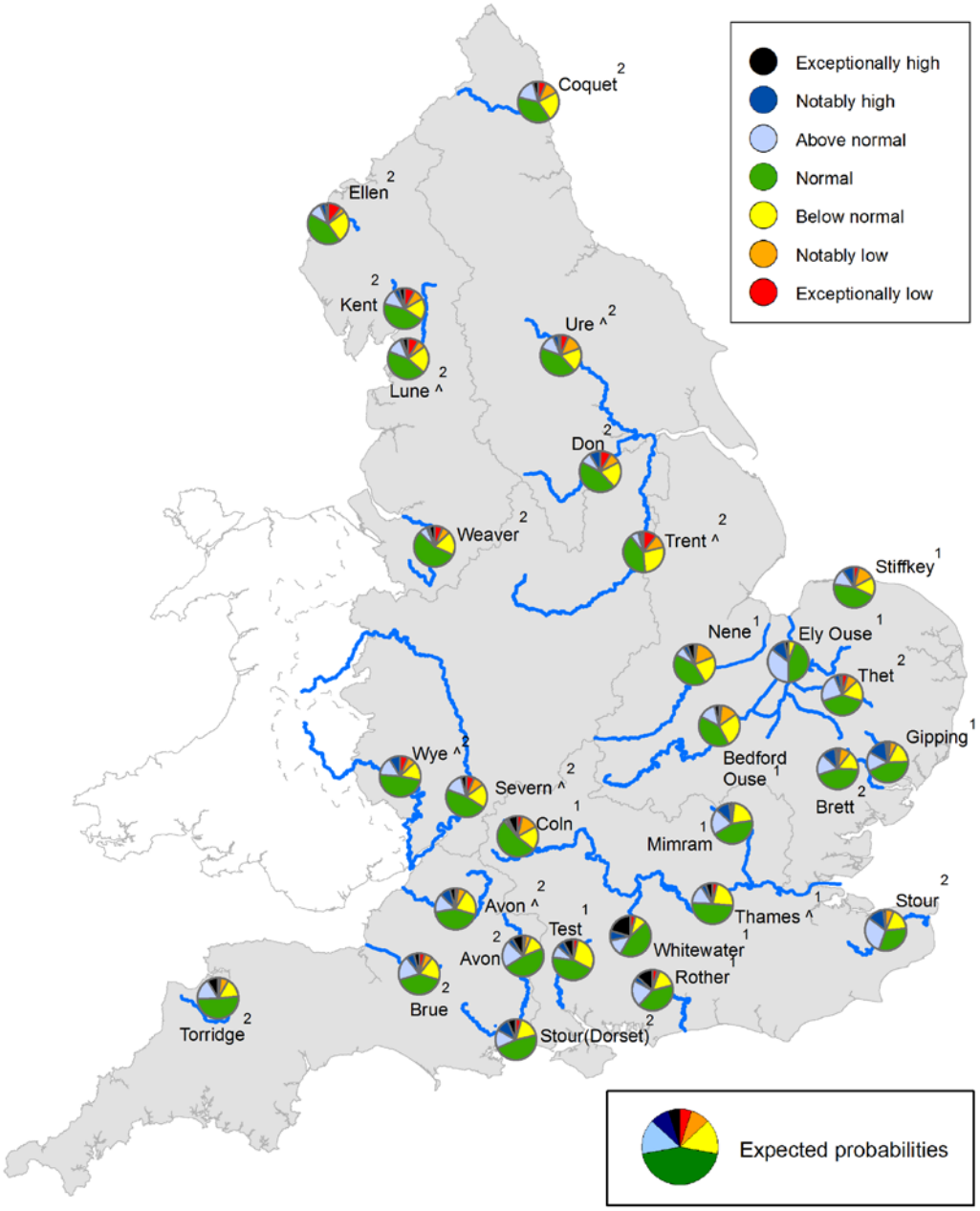

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Forward look - groundwater

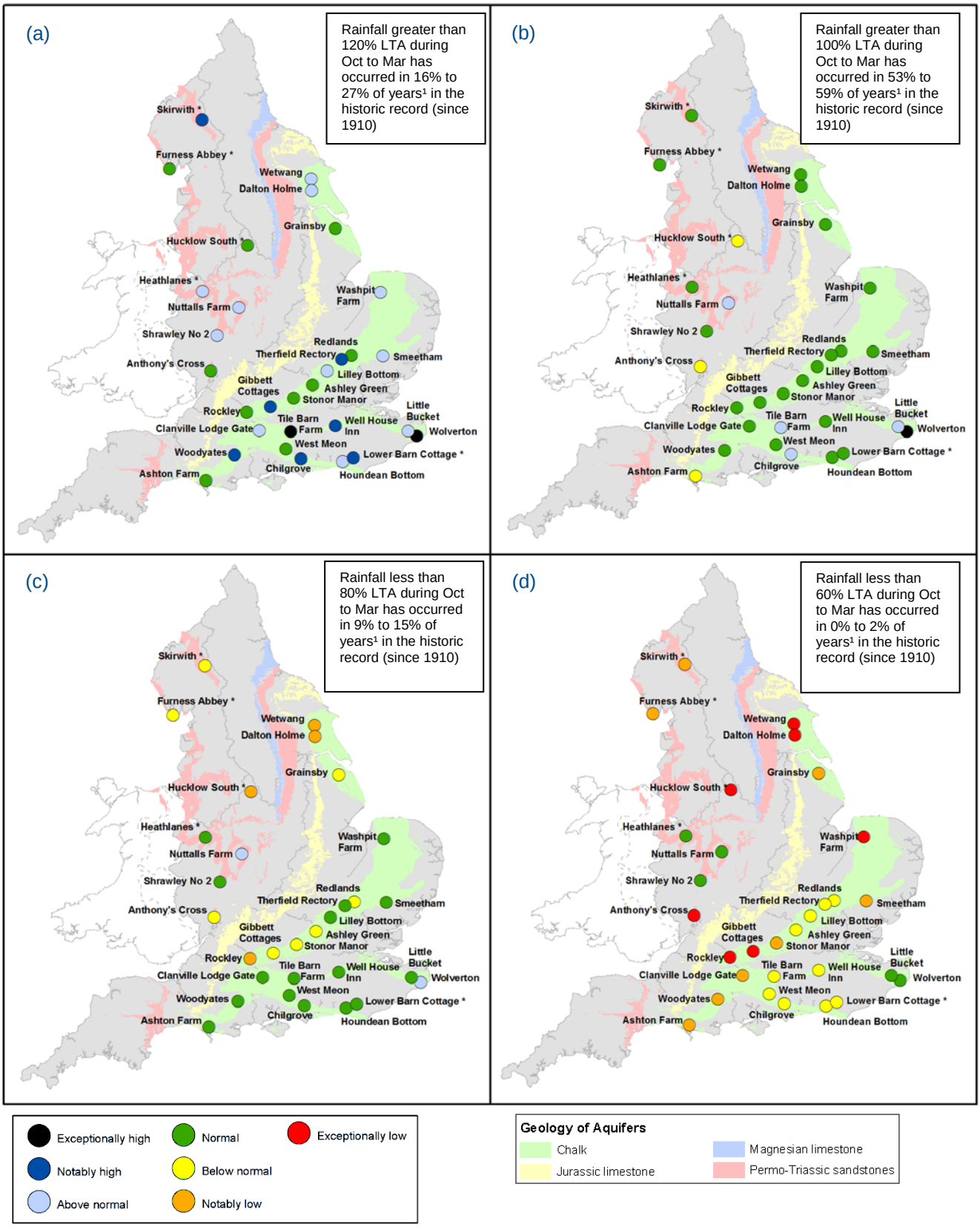

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2015.

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

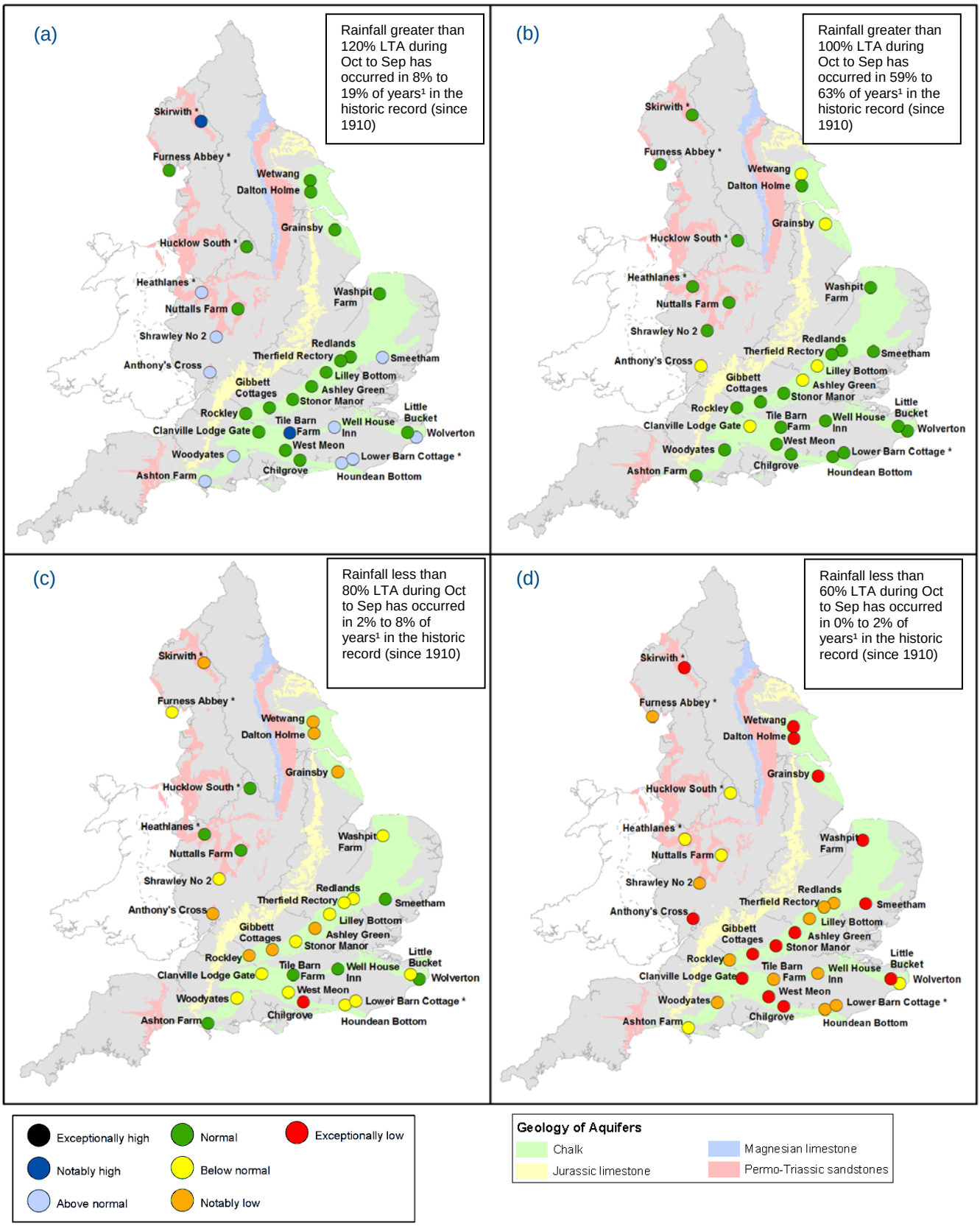

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2015 and September 2016 (Source: Environment Agency) Geological map reproduced with kind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

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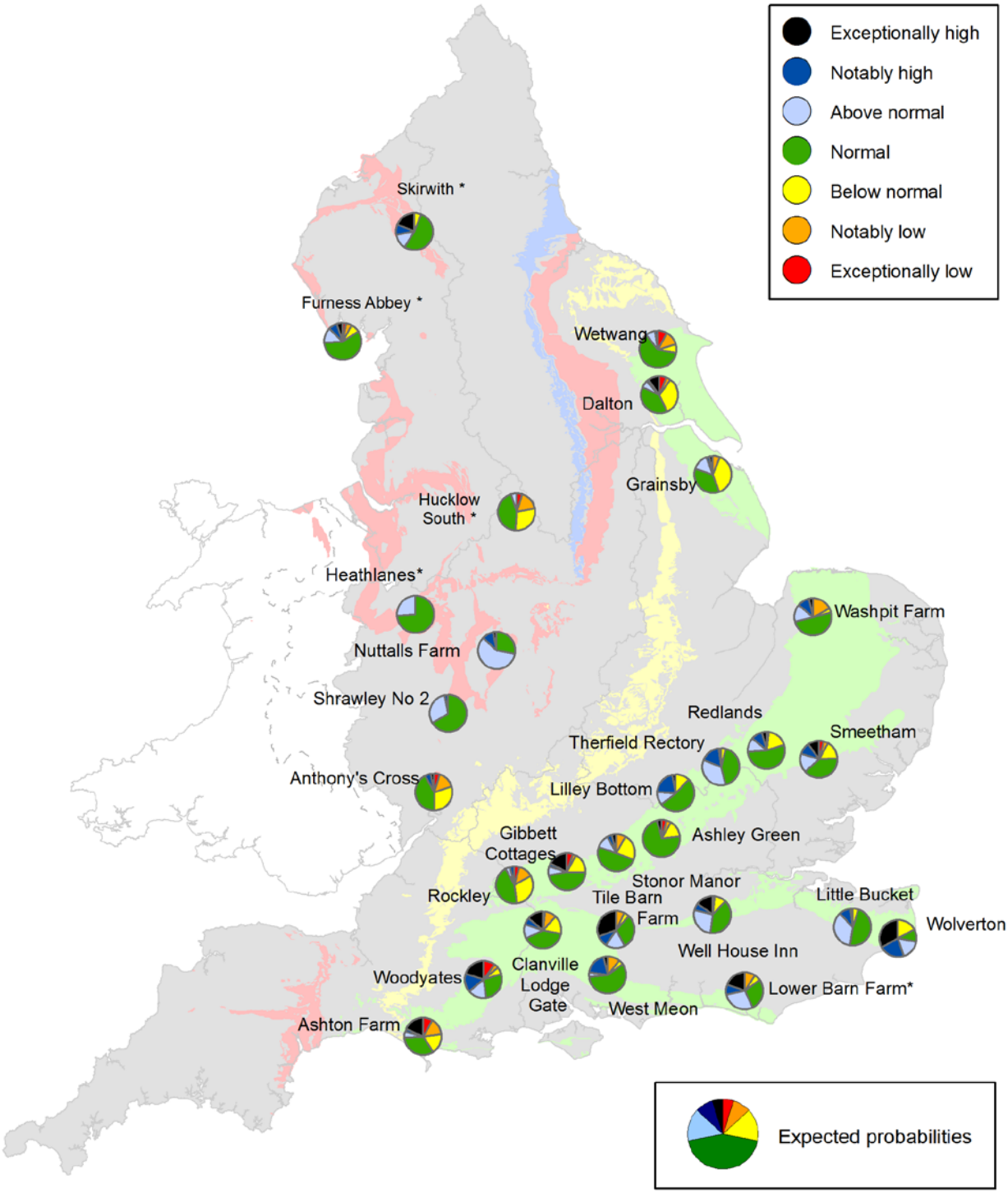
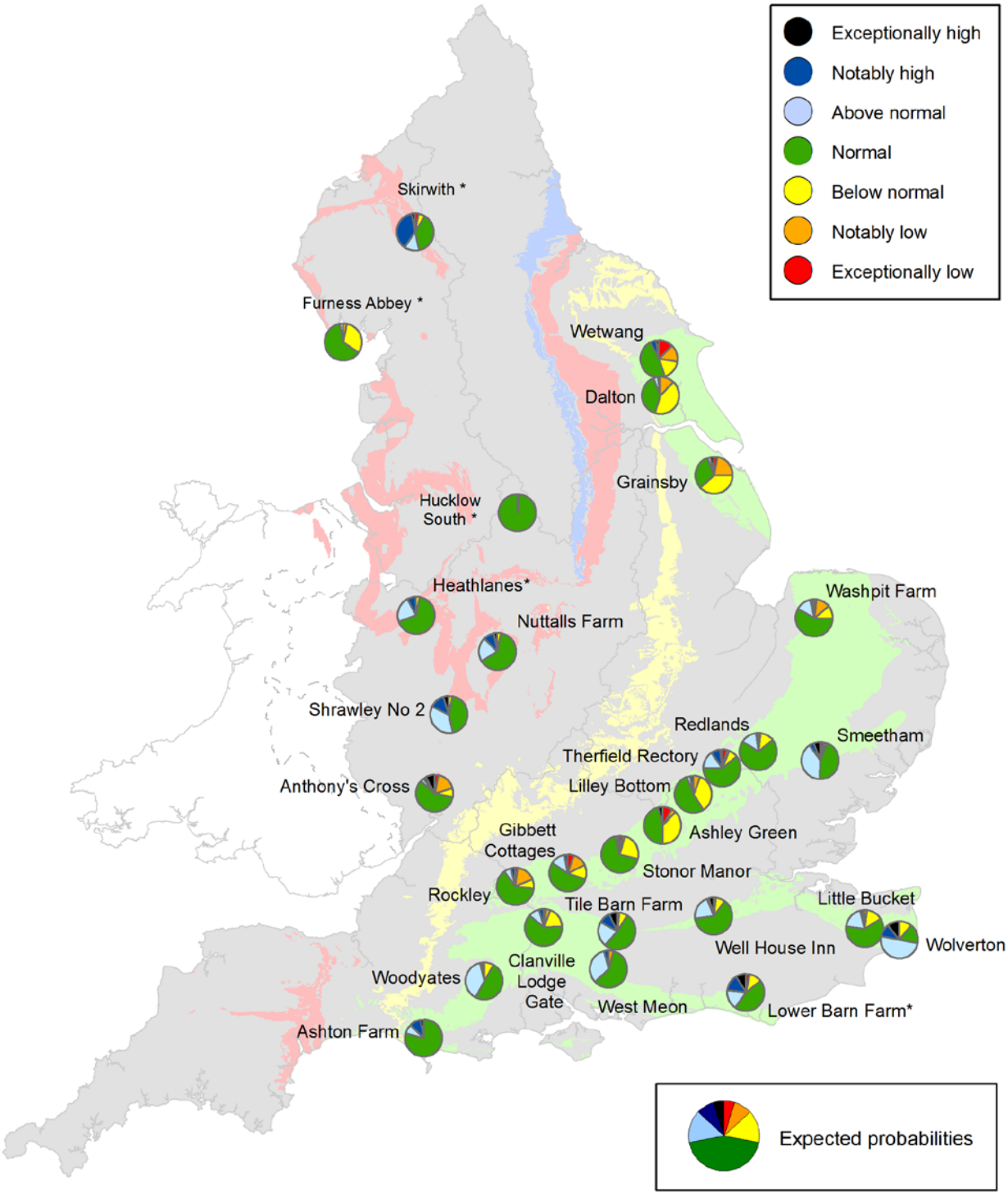


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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



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 September 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

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