Monthly water situation report

England

Summary – August 2014

It was the wettest August for 10 years across England with 157% of the long term average rainfall recorded. Rainfall totals were classed as **notably high** for the time of year in the east and southeast, and **above normal** elsewhere. With the wetter conditions, soil moisture deficits generally decreased through August. Monthly mean river flows for August were **normal** for the time of year at half of our indicator sites and **above normal** or higher at the other half. Groundwater levels decreased at all but two of our indicator sites, but remain **normal** or higher for the time of year at all sites. Reservoir stocks mostly decreased across the country during August, with overall storage in England at 81% of total capacity at the end of the month.

Rainfall

During August, the highest rainfall totals (more than 160 mm) fell across parts of Cornwall and Cumbria, whilst the lowest rainfall totals (less than 80 mm) fell across parts of Northumberland, Lincolnshire and Oxfordshire (Figure 1.1). August rainfall totals were above the August long term average (LTA) in all hydrological areas across England. The highest August rainfall totals as a percentage of LTA were in East Sussex where more than 220% of the LTA fell.

August rainfall totals were classed as **above normal** or **notably high** at more than four fifths of the hydrological areas across England. Cumulative rainfall totals for the 3 months ending in August were **normal** across most of England, with **above normal** totals in parts of eastern England. The exceptional winter rainfall is still influencing the cumulative 12 month rainfall totals, with much of England classed as **above normal** to **exceptionally high** (Figure 1.2).

Rainfall totals for August were **above normal** or **notably high** in all regions of England. Regional monthly totals as a percentage of the August LTA ranged from 137% in the northwest to 176% in southeast England. Overall, England received 157% of the August LTA rainfall, the wettest August since 2004 (Figure 1.3). It has been the wettest 12 month period on record (starting in 1910) ending in August in southwest England, and the second wettest in southeast England.

Soil moisture deficit

In response to the above average rainfall during August, soil moisture deficits (SMDs) decreased across England and by the end of the month ranged from approximately 5 mm in parts of Cumbria to almost 130 mm in parts of Norfolk. The pattern of SMDs across the country at the end of August was quite variable reflecting the spatial distribution of the month's rainfall. At the end of August, SMDs were broadly in the range 71 to 130 mm across much of central, southern and eastern England, whereas in northwest and south west England, deficits were generally in the range 4 to 70 mm (Figure 2.1).

End of August SMDs were generally near to the LTA or up to 50mm smaller in the majority of MORECS grid squares covering England. In a number of MORECS grid squares scattered across the country, SMDs were 6 to 25 mm larger than the LTA (Figure 2.1).

At the end of July, regional-scale SMDs ranged from 69 mm in northwest England to 100 mm in the east. By the end of August, SMDs ranged from 31 mm in northwest England to 86 mm in the east, with the largest decrease of 38 mm occurring in both northwest and southwest England (Figure 2.2).

River flows

Monthly mean river flows increased compared to July at four fifths of our indicator sites in response to the August rainfall. August river flows were **normal** at half of our indicator sites, and **above normal** or higher at the other half. Three sites; the Ely Ouse at Denver, the River Chelmer at Springfield and the River Darent at Hawley all had **exceptionally high** monthly mean flows in August (Figure 3.1)

River flows at the regional index sites in southwest, northwest and central England were **normal** for the time of year. At the regional index sites in southeast and northeast England, monthly mean flows were **above normal**, and in eastern England, flows were **notably high** for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels continued their seasonal decline at all but two indicator sites during August. The level at Watch Hill (Lower Trent Erewash sandstone aquifer) in central England remained constant during August, whilst the level at Priors Heyes (West Cheshire sandstone aquifer) in the northwest increased slightly compared to the end of July. At the end of August, groundwater levels were **normal** for the time of year at nearly two thirds of our indicator sites. The remaining sites were all **above normal** or higher, as the wet winter continues to exert an influence on groundwater levels (Figure 4.1).

Groundwater levels at the major aquifer index sites were **normal** at three sites, **above normal** at three sites, and **notably high** and **exceptionally high** for the time of year, at the remaining two (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at the majority of our reported reservoirs and reservoir groups during August. The largest decrease of in storage was 15% of total capacity reported for Hanningfield reservoir in east England. Grafham and Farmoor reservoirs by decreased by 6% and 9%, respectively. These three reservoirs are classed as being **below normal** for the time of year. Decreases of at least 10% were reported for 5 other reservoirs in southwest England, but reservoir stocks for the end of August for these, and the remaining reservoirs and reservoir groups, remain **normal** or higher for the time of year (Figure 5.1).

The broad-scale picture for August was that the reservoir stocks decreased across almost all English regions during the month. The exception was in the northwest, where reservoir storage increased very slightly (by less than 1%). Elsewhere, the decrease in reservoir storage ranged from 9% in southwest England to 1% in central England. At 64% of total capacity, the reservoir stocks for the end of August in northwest England remain lowest across England, with the stocks in southeast England remaining highest at 89% of total capacity. Overall reservoir storage for England decreased by 2% during August to 81% of total capacity (Figure 5.2)

Forward look

September is likely to have spells of fine weather interspersed with more unsettled, showery conditions for most of England. Night time temperatures under clear skies will be low throughout the month. Longer term, there is an increased likelihood of above average temperatures for the period September-October-November. There is also a slightly increased likelihood for below average rainfall from September to November[1].

Scenario based projections for river flows at key sites [2]

September 2014: With average (100% of the LTA) rainfall in September 2014, river flows are likely to be **normal** at nearly three quarters of our modelled sites, and higher at all of the others. With 120% of the LTA rainfall, river flows are likely to be **normal** at over half of the modelled sites, and **above normal** or higher at the other sites. With 80% of the LTA rainfall river flows are likely to be **normal** at three quarters of the modelled sites (see Figure 6.1).

March 2015: With average rainfall between September 2014 and the end of March 2015, cumulative river flows are likely to be **normal** at all except two of the modelled sites, where flows will be **above normal**. With above average rainfall (120% of the LTA), cumulative river flows are likely to be **above normal** at two thirds of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be **below normal** or lower at more than four fifths of our modelled sites (see Figure 6.2).

Probabilistic ensemble projections for river flows at key sites [2]

September 2014: More than half of our modelled sites have a greater than expected chance of **normal** flows in September 2014. More than half of our modelled sites also have a greater than expected chance of **above normal** or higher flows. A fifth of modelled sites have a greater than expected chance of **below normal** or lower flows in September 2014 (see Figure 6.3).

March 2015: Two thirds of our modelled sites have a greater than expected chance of **notably high** or higher cumulative flows from September 2014 to March 2015. Around a third of our modelled sites have a greater than expected chance of **below normal** or lower cumulative flows between September 2014 and March 2015 (see Figure 6.4).

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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.

Scenario based projections for groundwater levels in key aquifers [3]

September 2014: With average rainfall (100% of the LTA) or below average rainfall (80% of the LTA) during September 2014, groundwater levels are likely to be **normal** or higher at all except one of the modelled sites, and **above normal** or higher at more than half of the modelled sites. With above average rainfall (120% of the LTA) over two thirds of modelled sites will have **normal** or **above normal** levels for the time of year (see Figure 6.5).

March 2015: With average rainfall (100% of the LTA) from September 2014 to March 2015, groundwater levels are likely to be **normal** or **above normal** at more than two thirds of the modelled sites. With above average rainfall (120% of the LTA) groundwater levels are likely to be **exceptionally high** at a third of modelled sites. With below average rainfall (80% of the LTA) groundwater levels are likely to be **normal** for the time of year at two thirds of the modelled sites (see Figure 6.6).

Probabilistic ensemble projections for groundwater levels in key aquifers [3]

September 2014: Three quarters of modelled sites have a greater than expected chance of **above normal** or higher groundwater levels for the time of year (see Figure 6.7).

March 2015: Nearly four fifths of modelled sites have a greater than expected chance of **above normal** or higher groundwater levels in March 2015. More than a third of the sites have a greater than expected chance of **normal** levels for the time of year (see Figure 6.8).

Authors: E & B Hydrology Team

[3] Information produced by the Water Situation Forward Look group lead by Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office.

Rainfall

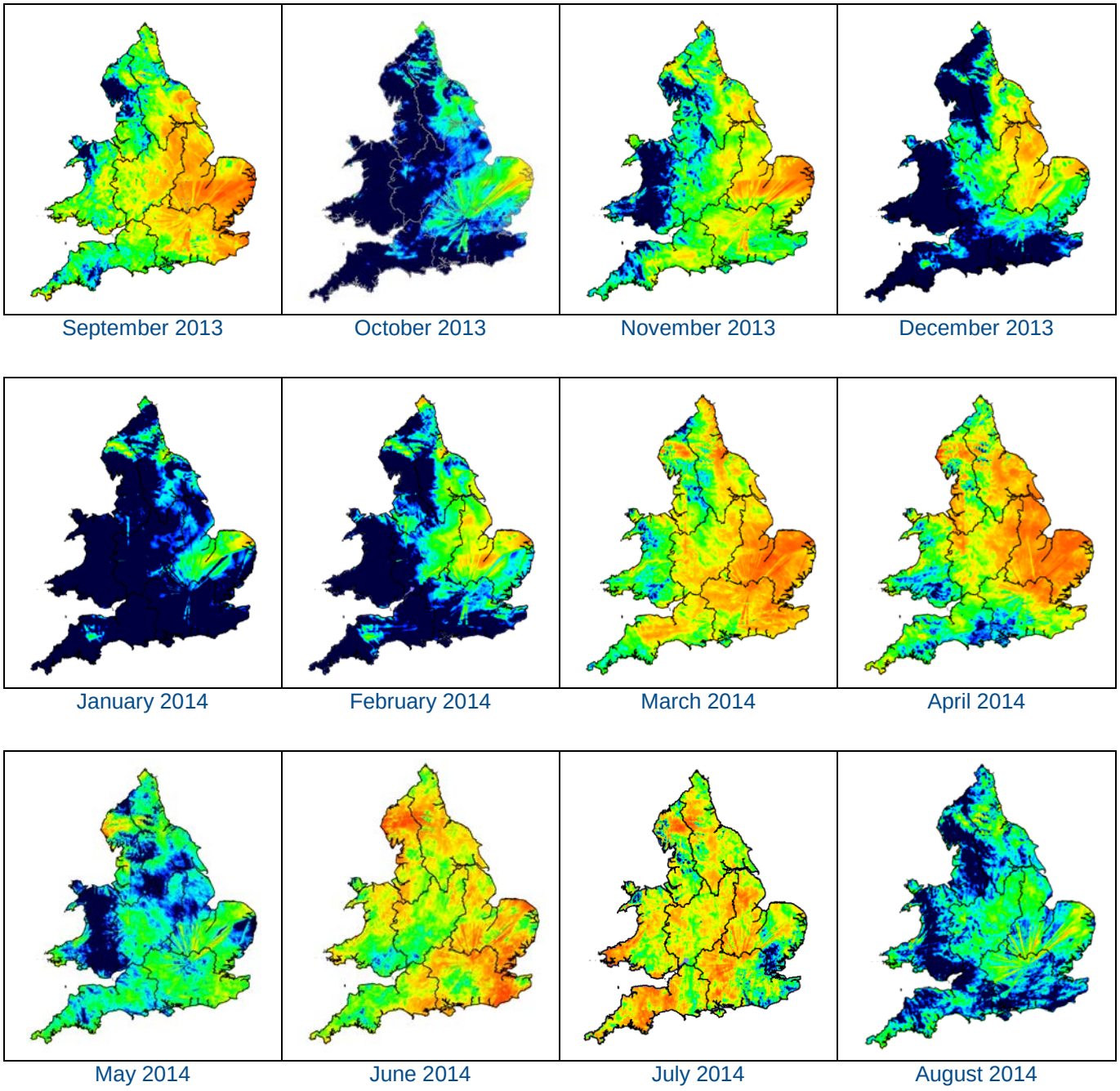


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

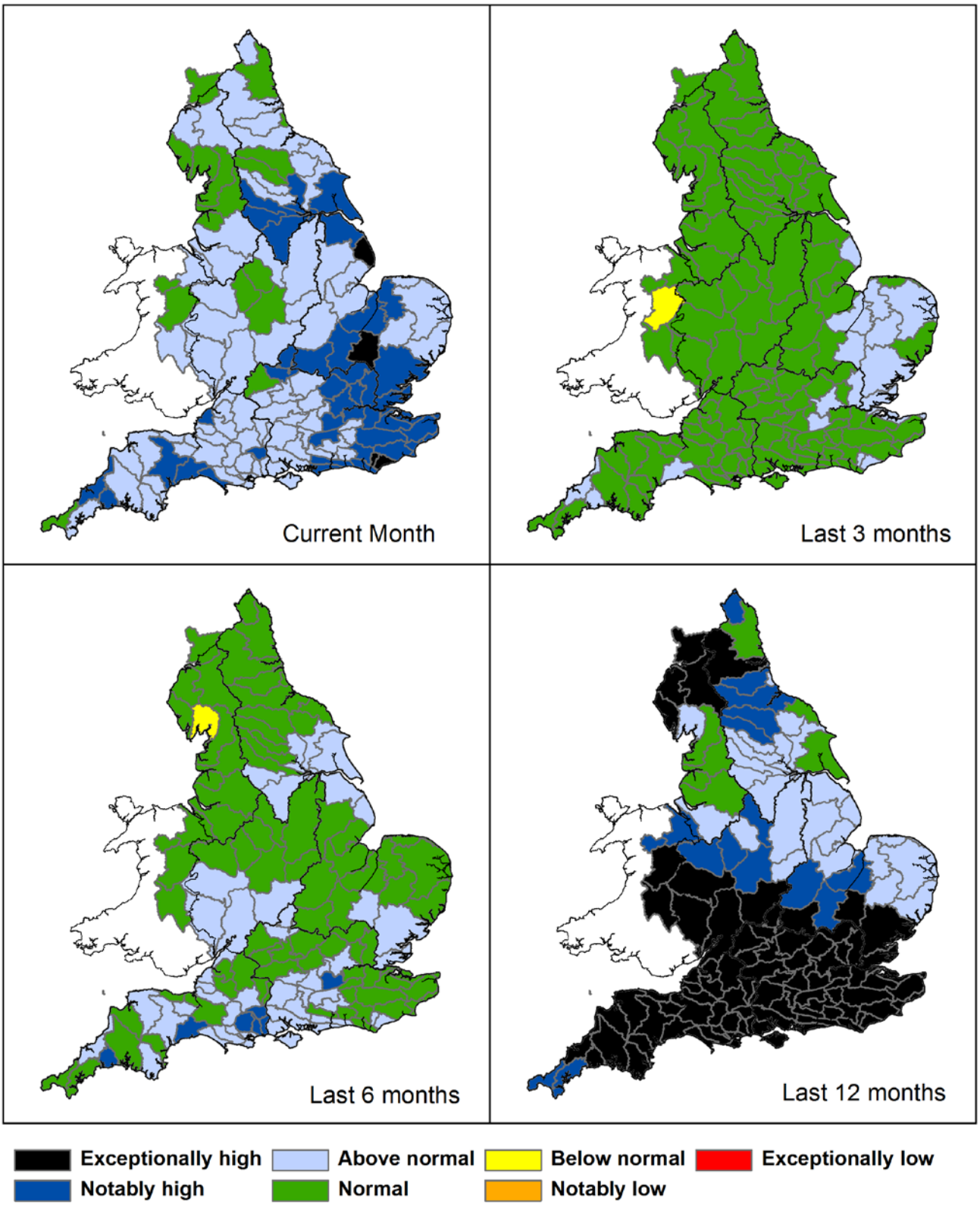


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31st August), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2014).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

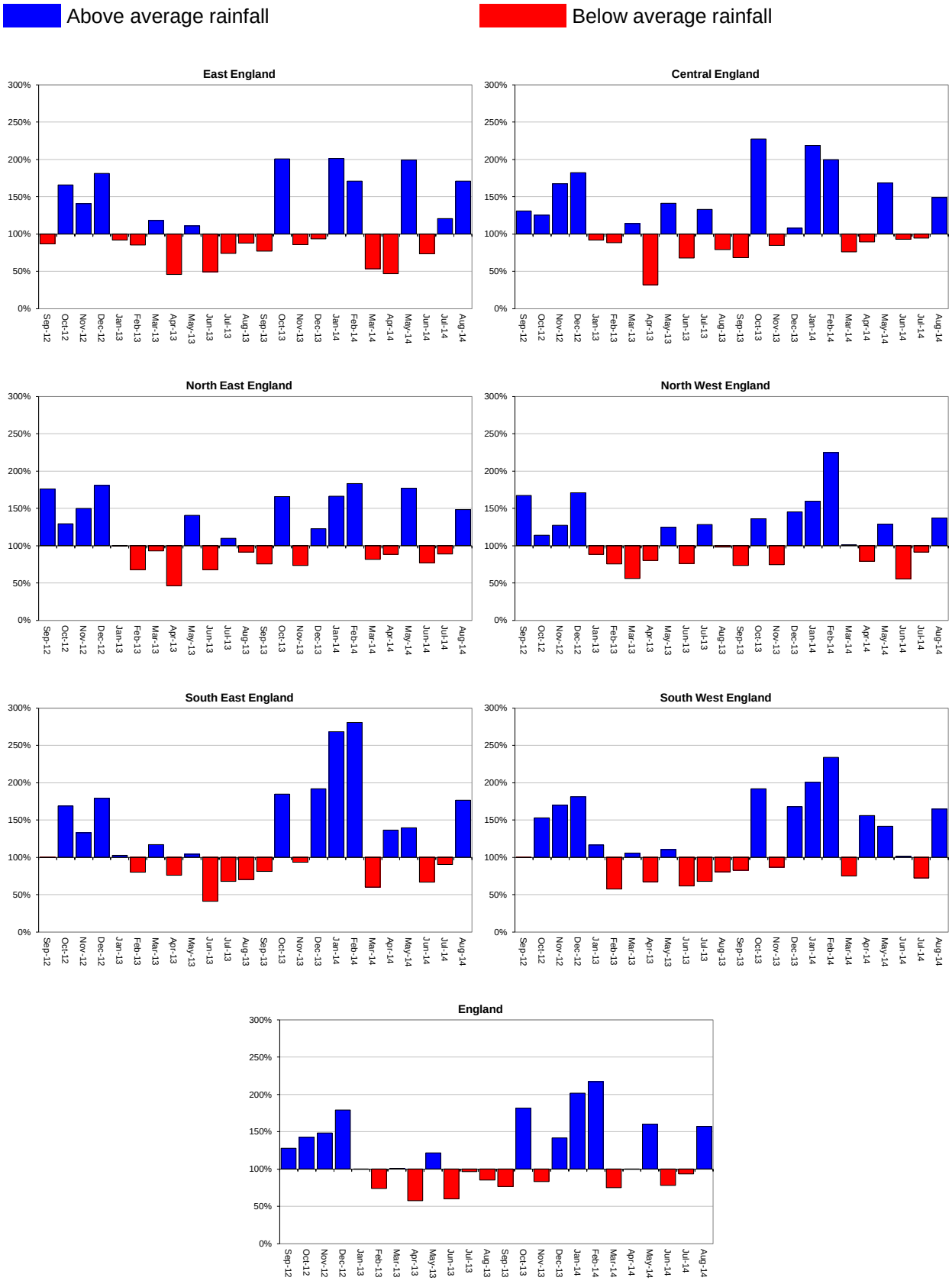


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

Soil moisture deficit

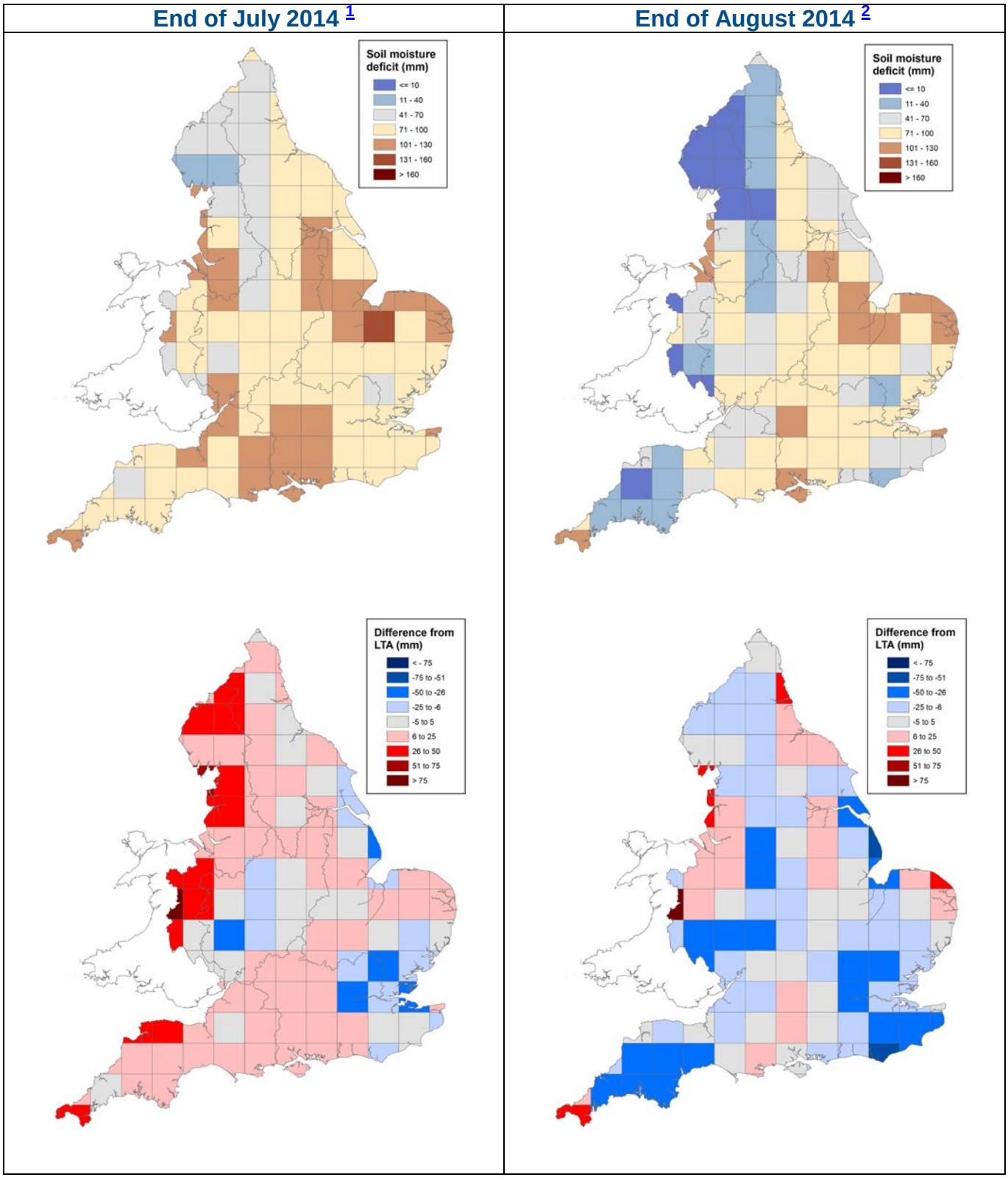


Figure 2.1: Soil moisture deficits for weeks ending 30 July 2014 [1] (left panel) and 03 September 2014 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014

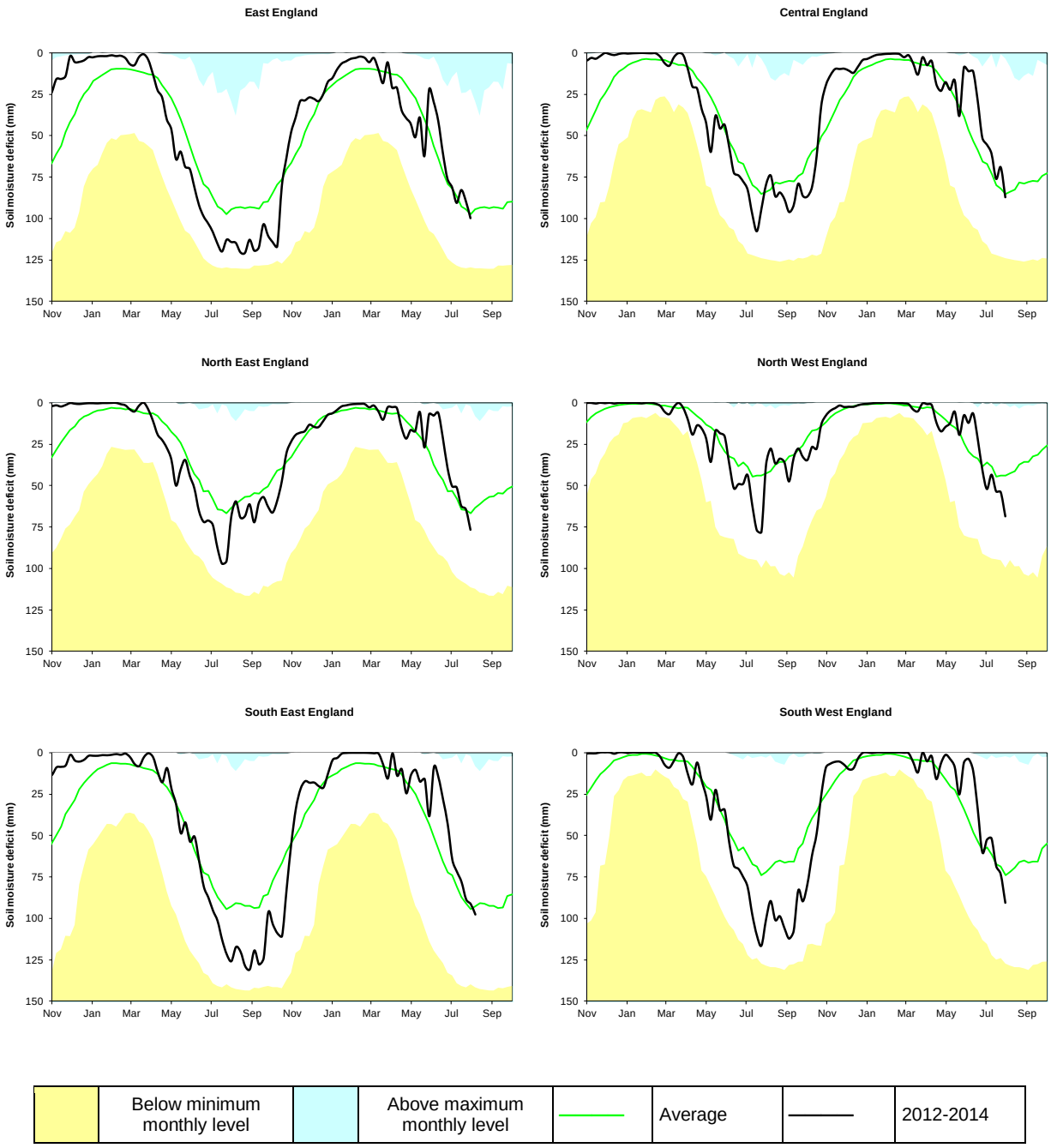
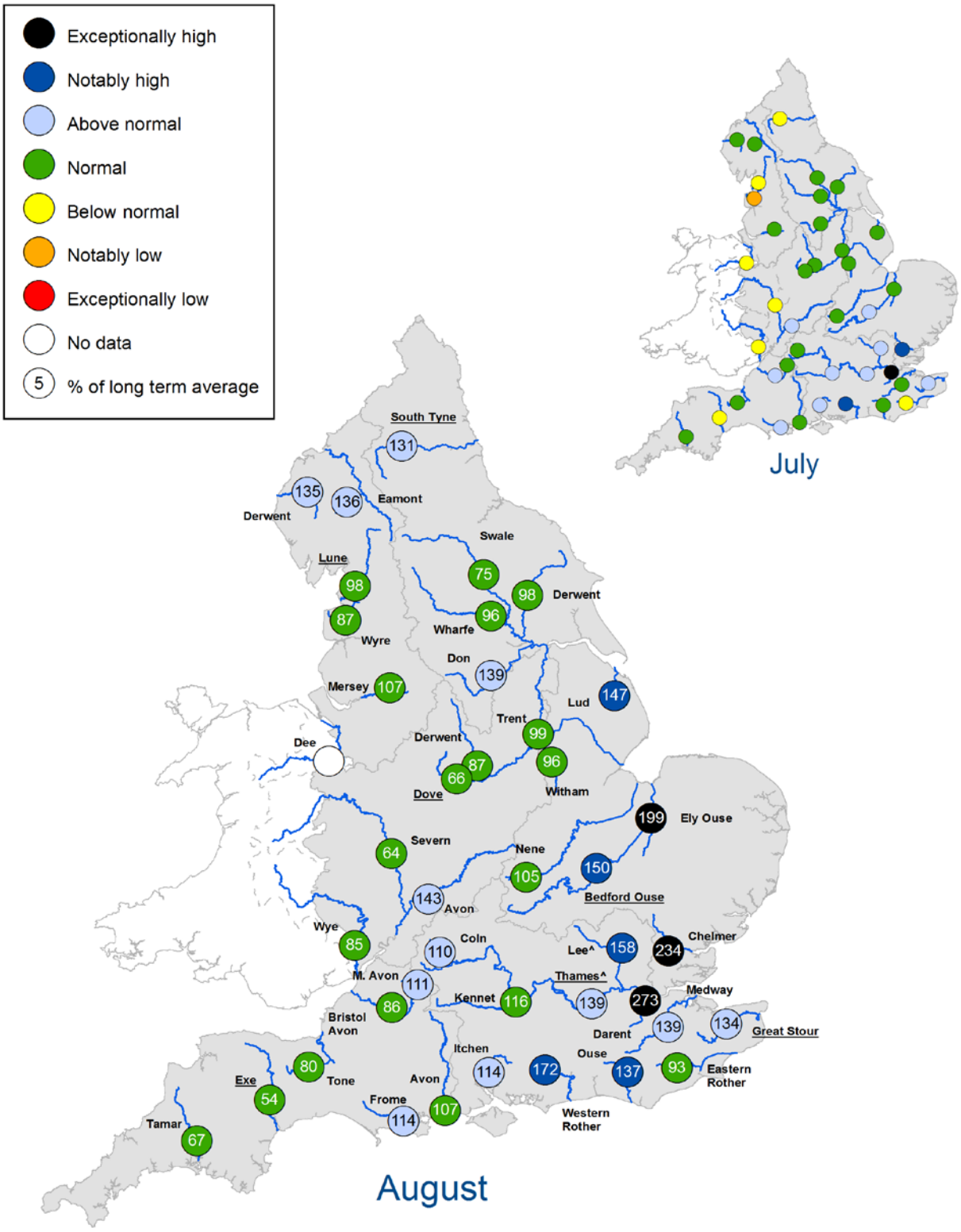


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2014).

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 July 2014 and August 2014, 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). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

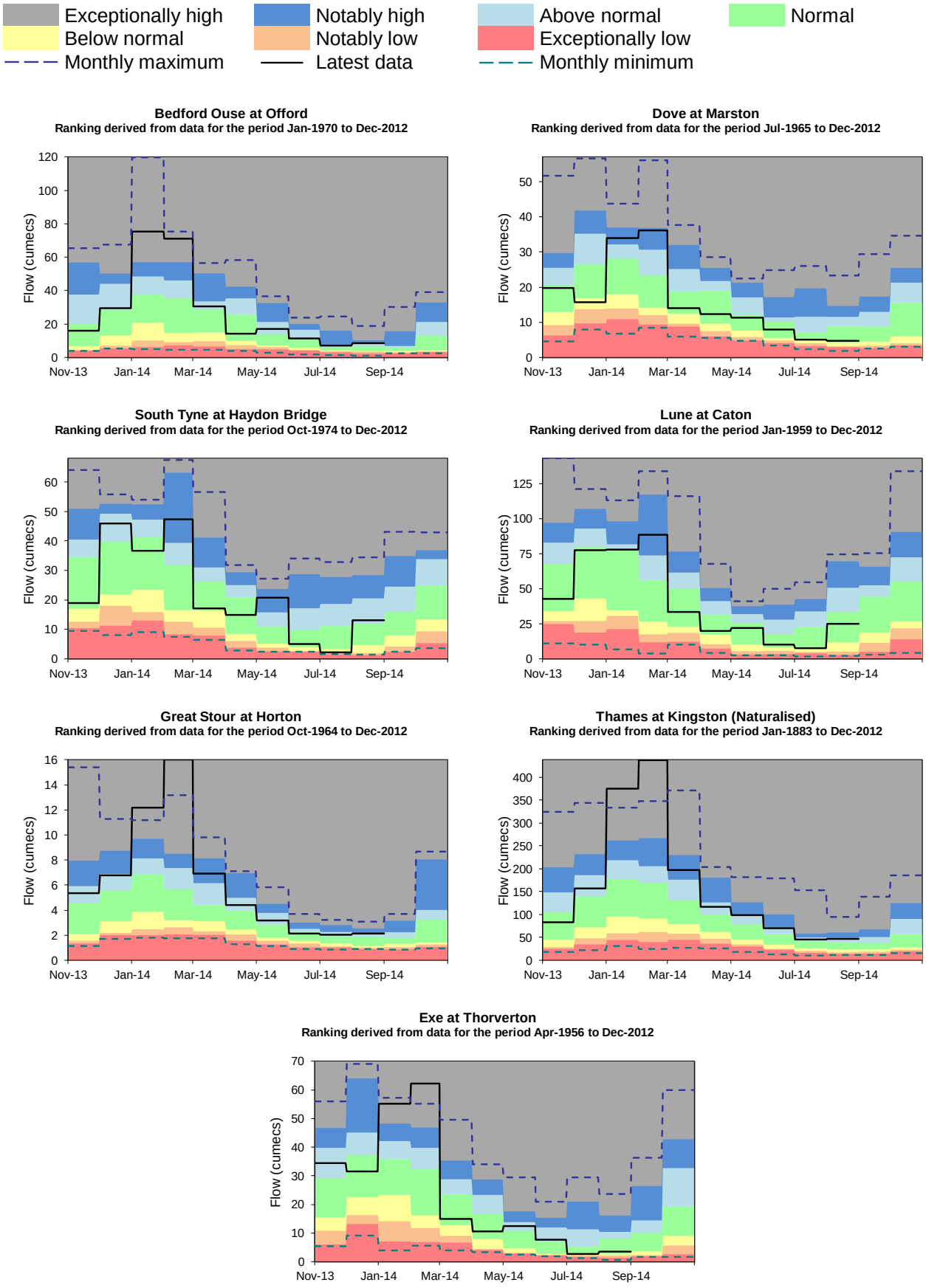
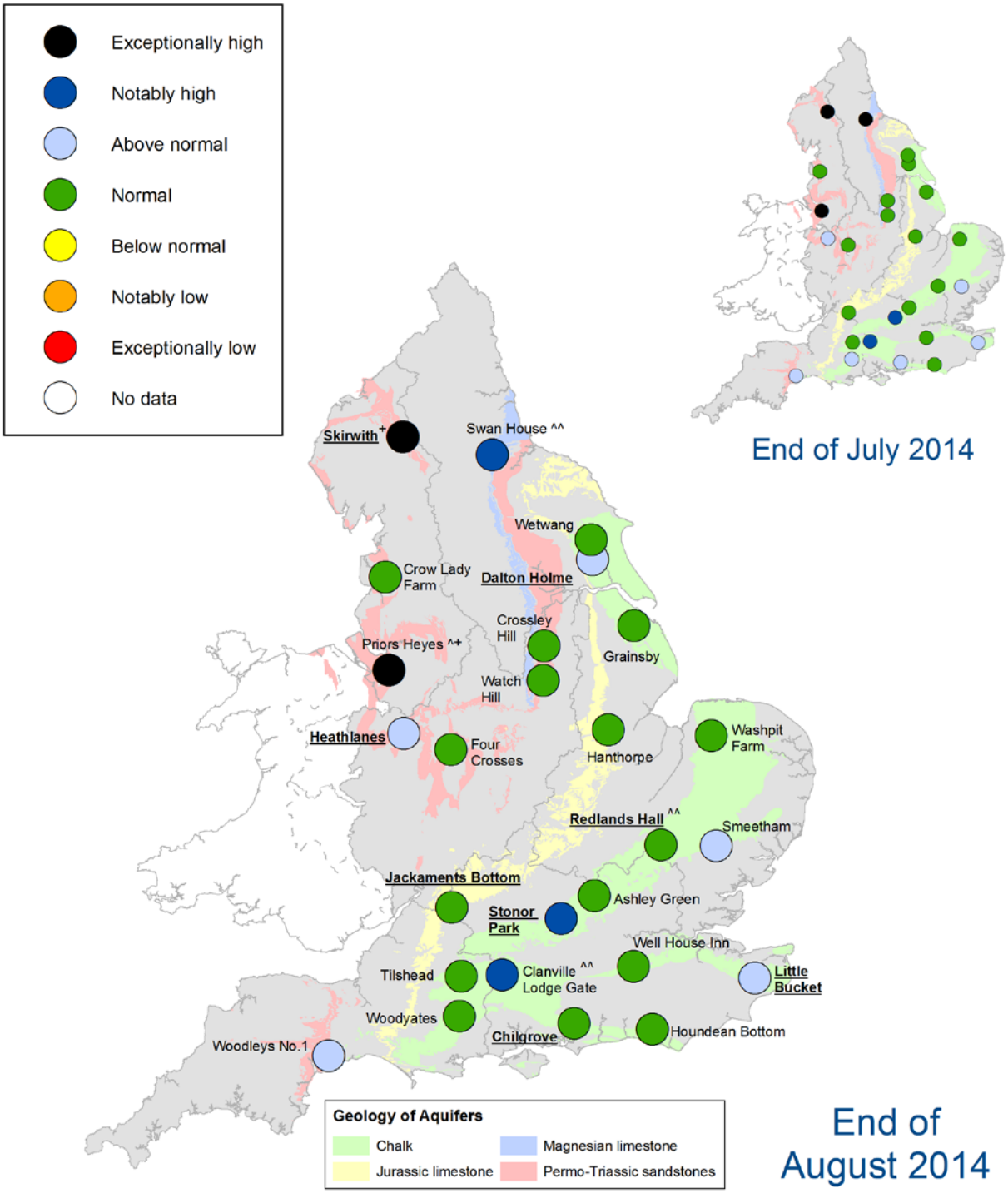


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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/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 July 2014 and August 2014, 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, 2014.

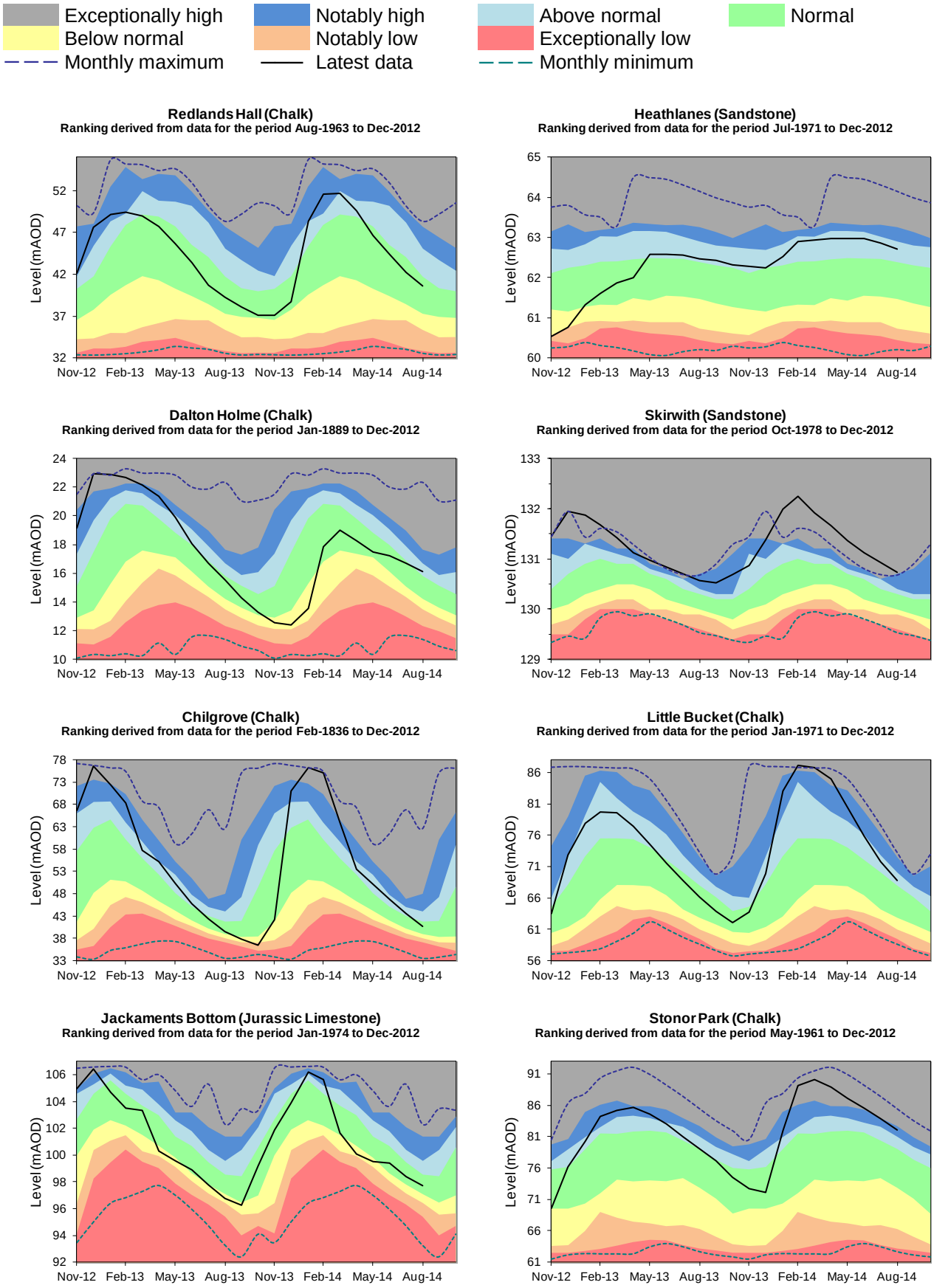
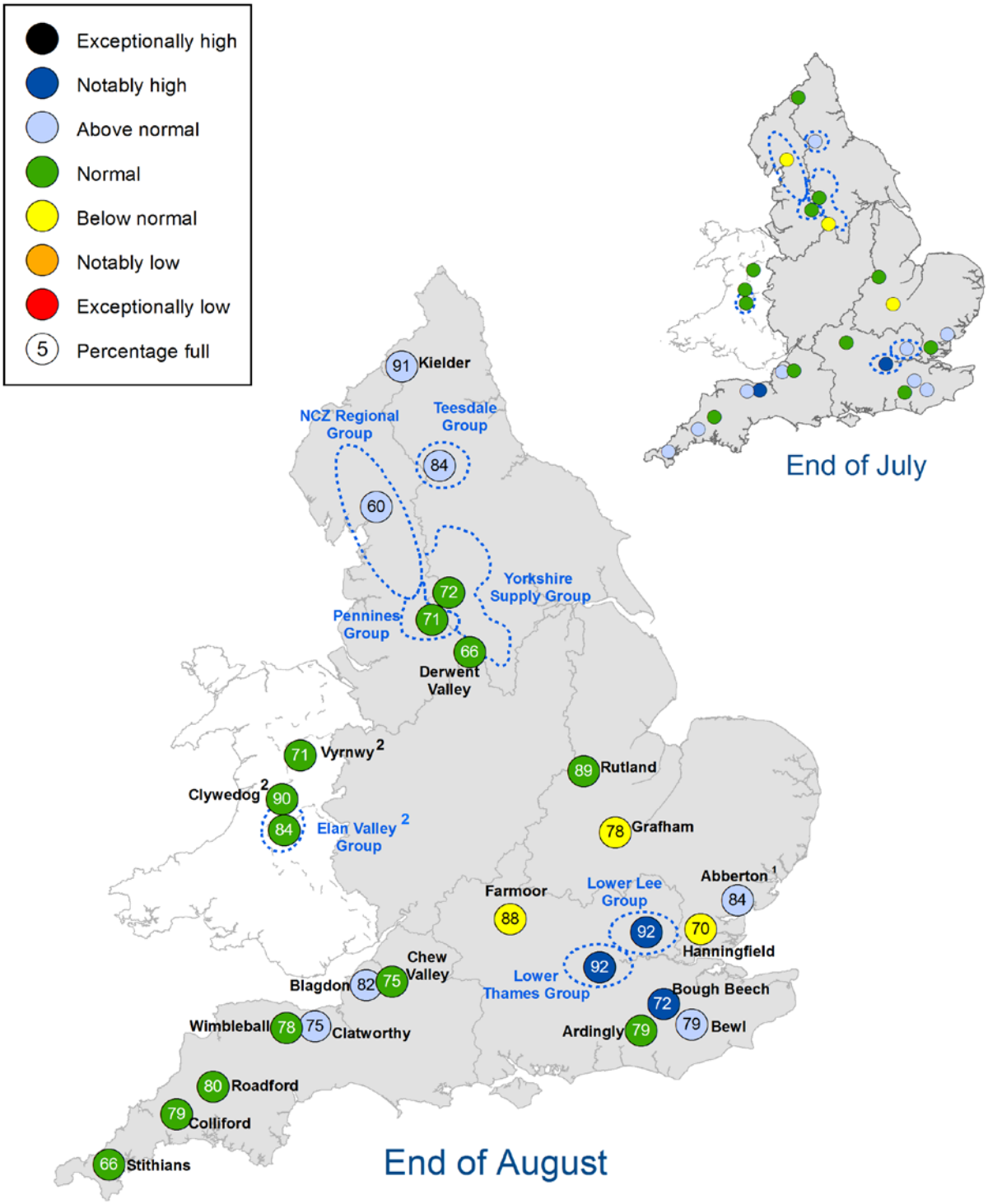


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

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

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of July 2014 and August 2014 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. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

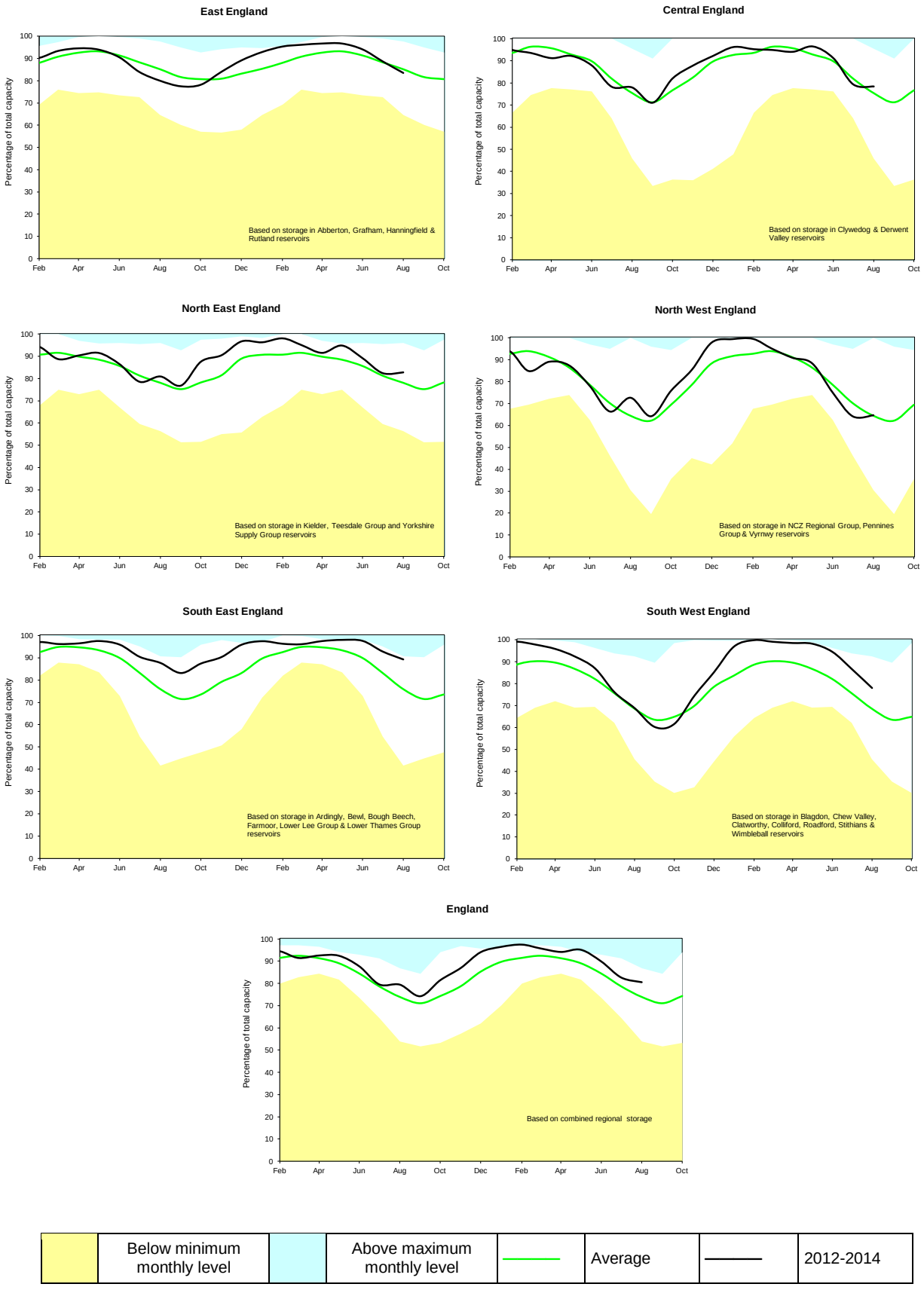


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

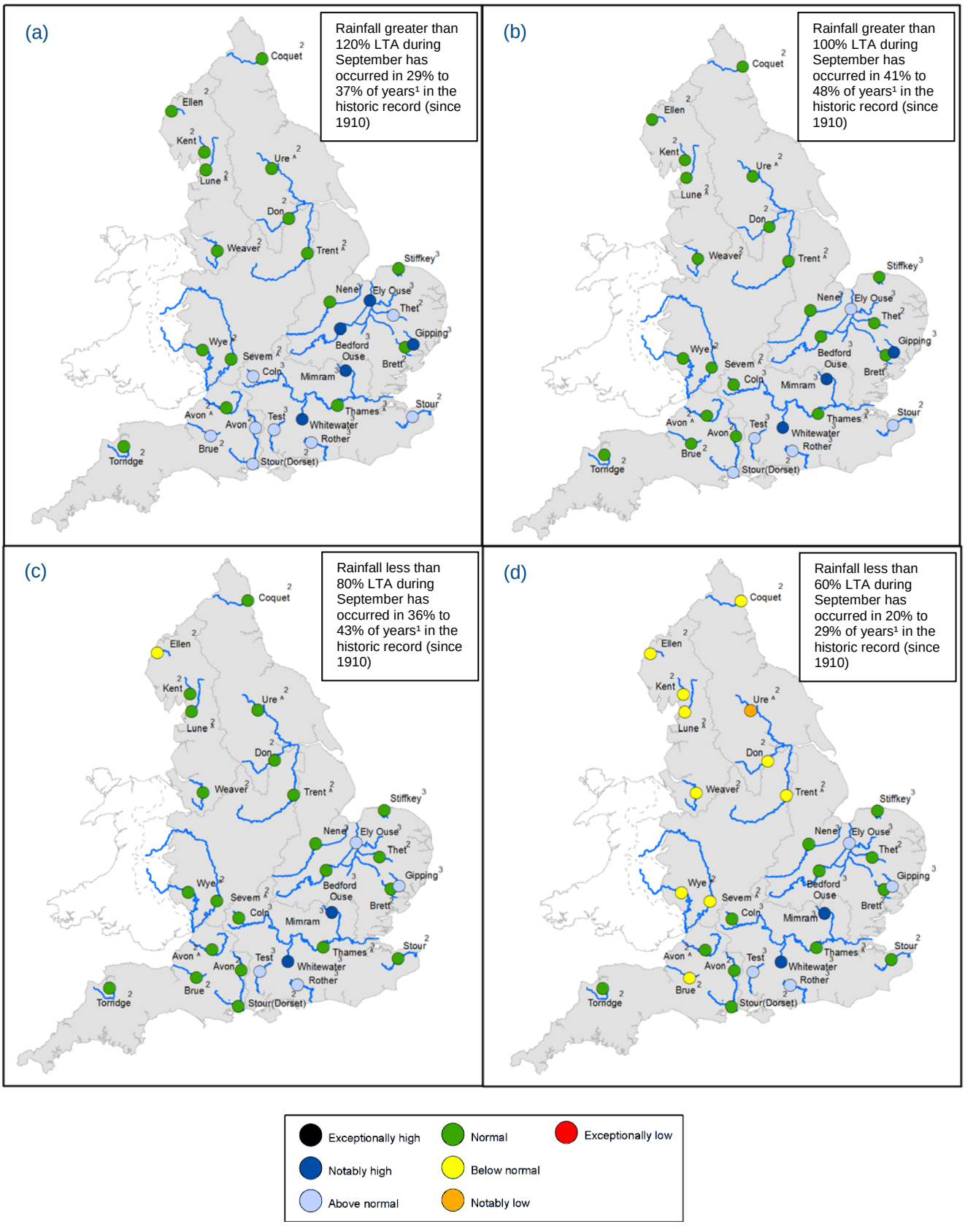


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall in September (Source: Centre for Ecology and Hydrology, Environment Agency)

[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

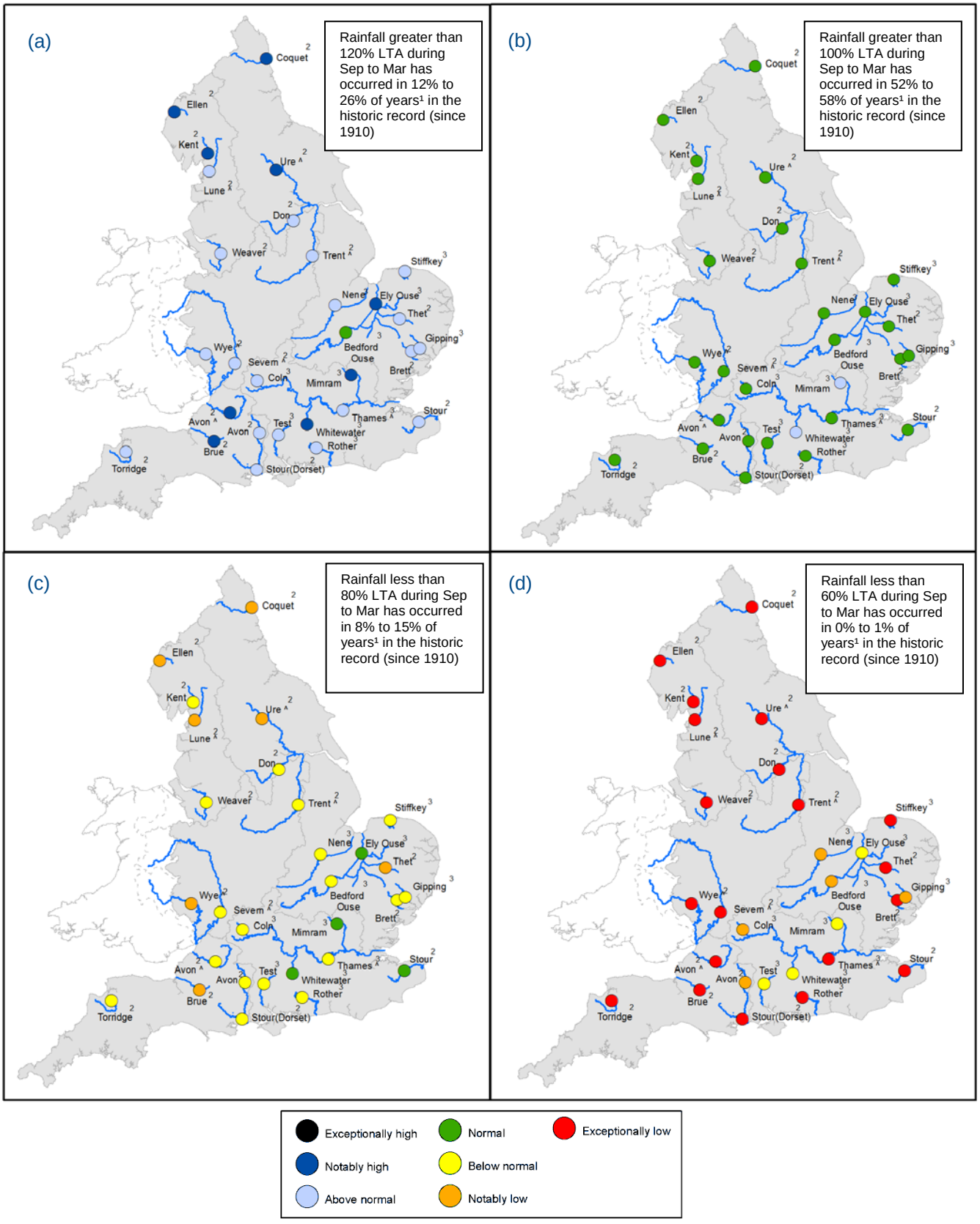


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2014 and March 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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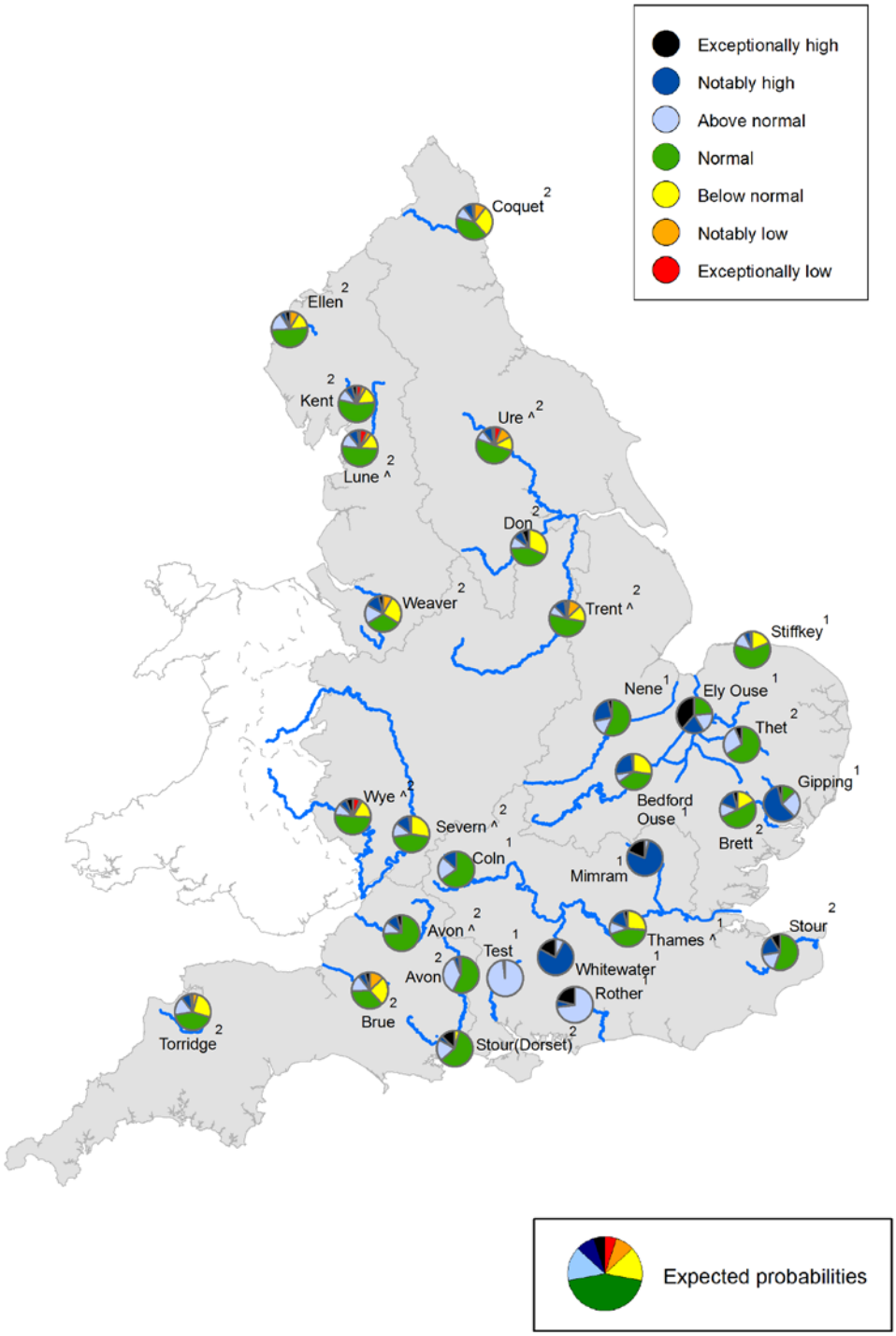

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2014. 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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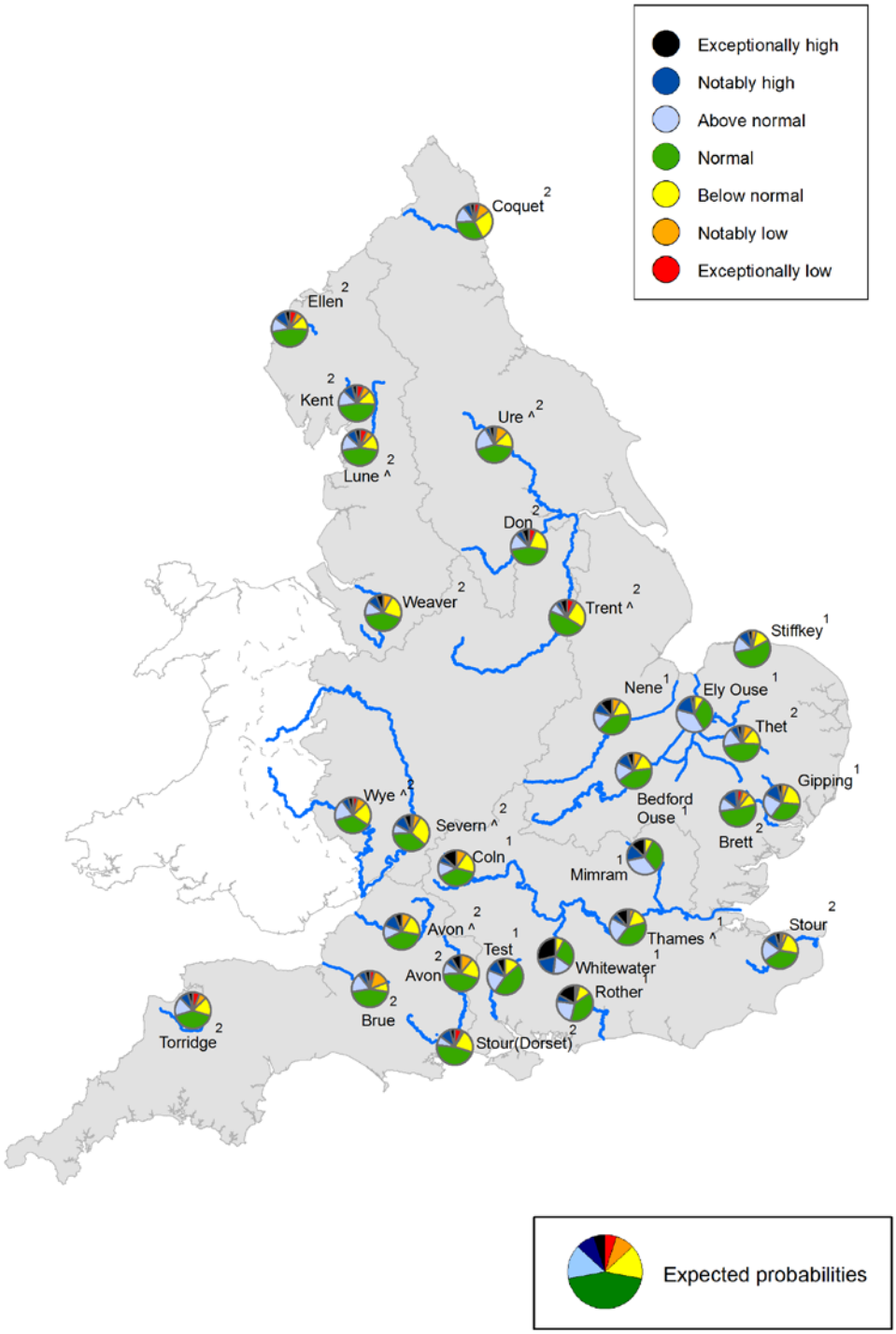


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[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

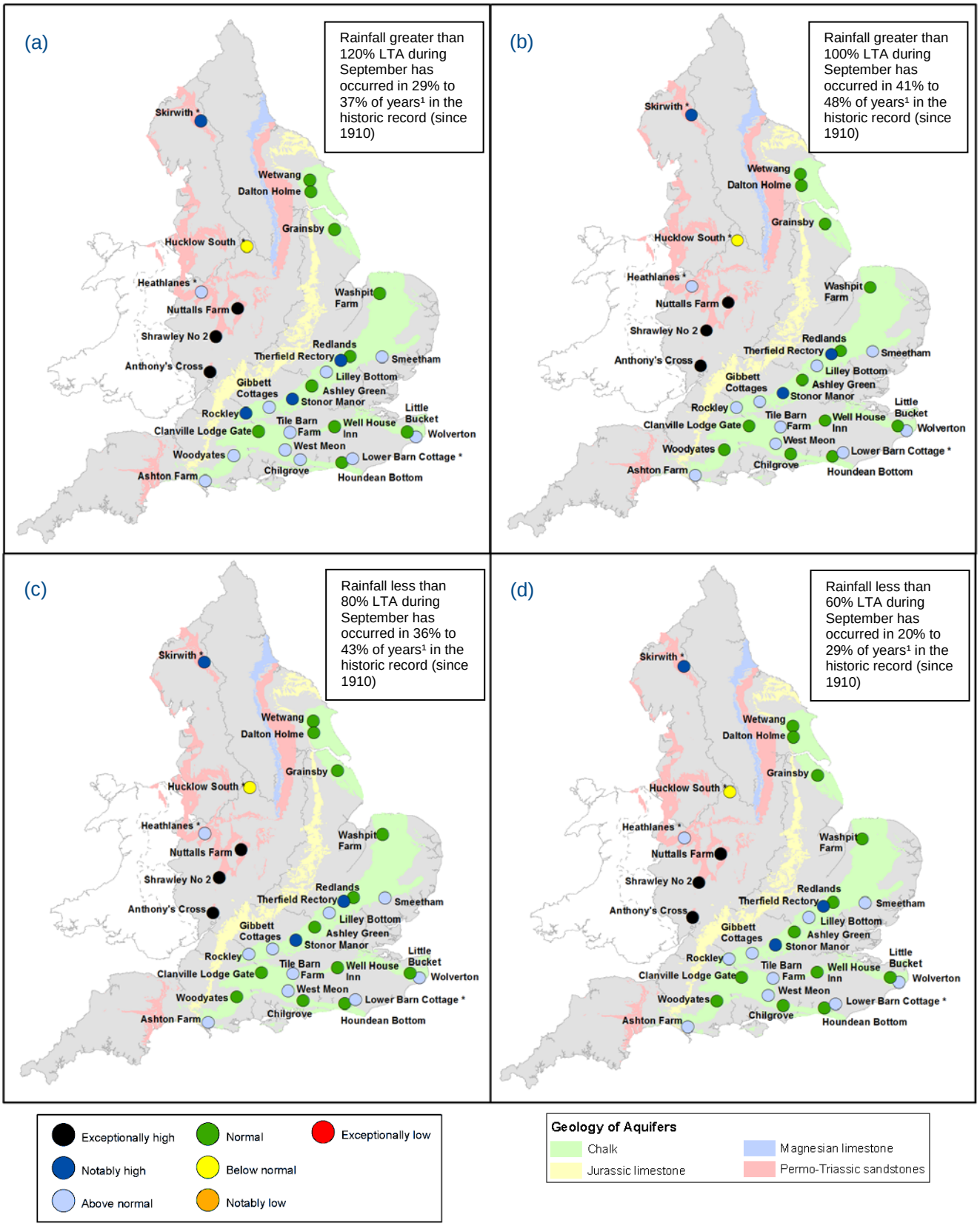


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall in September 2014. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2014.

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

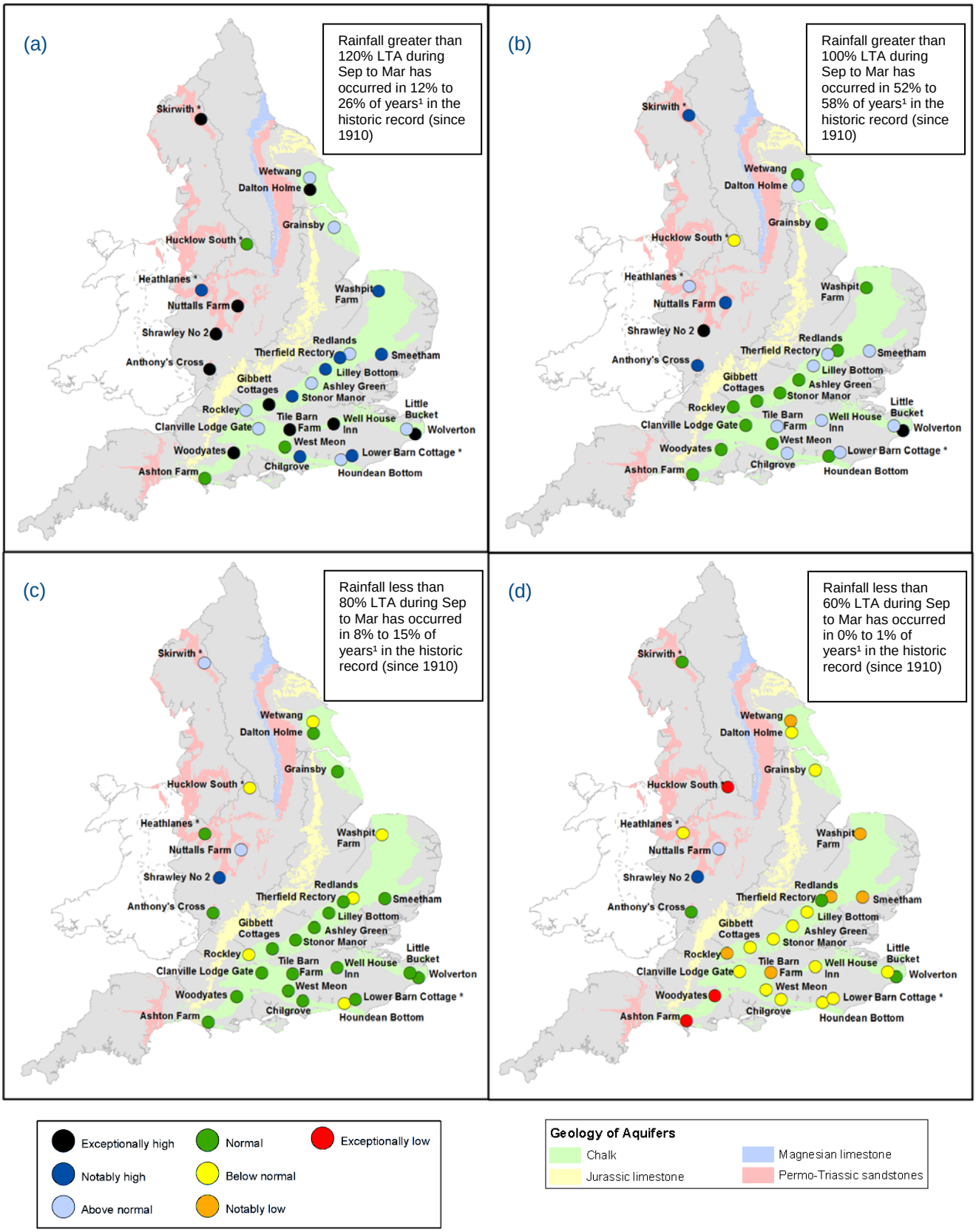
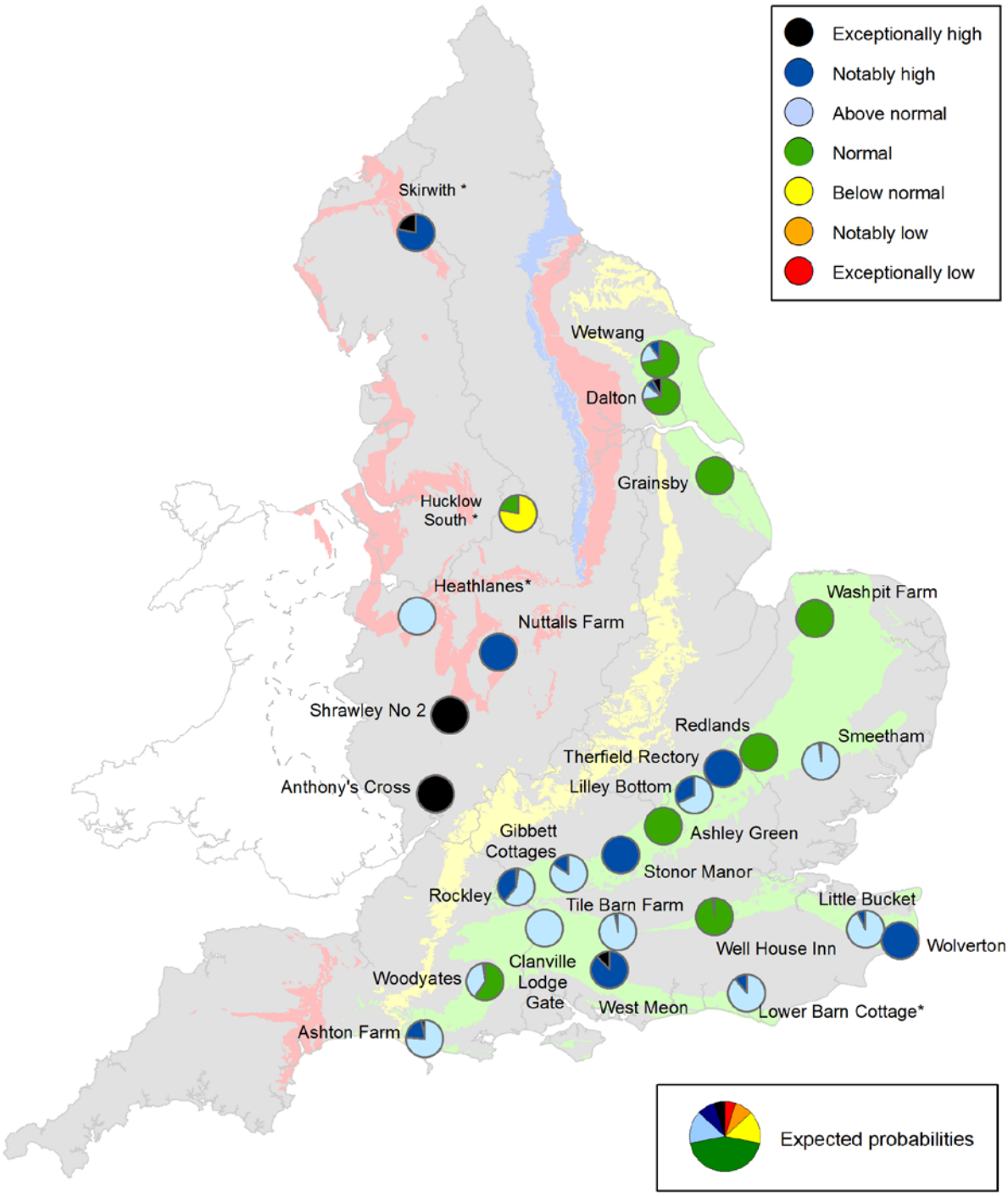


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2014 and March 2015 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2014.

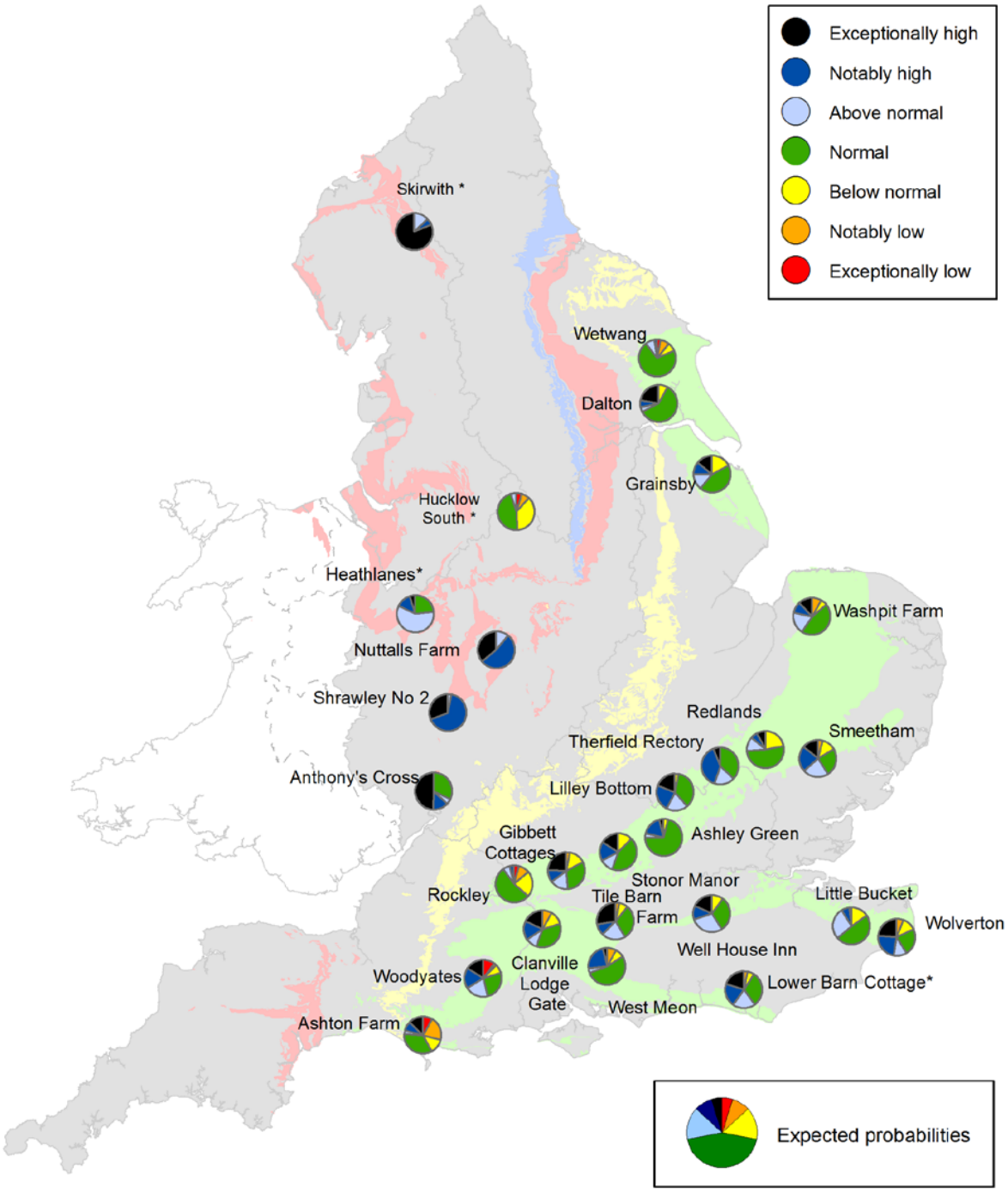
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 2014. 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, 2014.

* 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 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, 2014.

* 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