

# Monthly water situation report

## England

### Summary – July 2013

July has been a month of contrasts, both temporally and spatially. The first half of the month was hot and dry with almost all of the month's rainfall falling in the second half. Spatially, parts of Cumbria received fifteen times more rainfall than the Norfolk Broads. Over the whole month though, England received 92% of the July long term average (LTA). Consequently soil moisture deficits (SMDs) decreased in wetter areas but increased elsewhere. Monthly mean river flows for July were generally *normal* for the time of year in northern and central southern England but *below normal* or lower in the southwest and *above normal* in the East Midlands. Groundwater levels decreased at the majority of our indicator sites but ranged from *below normal* to *exceptionally high* across the principal aquifers of England. Overall reservoir stocks decreased during July with storage in England as a whole at 80% of total capacity at the end of the month.

### Rainfall

July rainfall totals were highest in our North West Region at 106mm. In our remaining regions totals ranged from 32mm (South East Region) to 65mm (Midlands and Yorkshire and North East Regions) ([Figure 1.1](#)). Locally, the highest rainfall totals (more than 140mm) fell in Cumbria, while the lowest rainfall totals (less than 20mm) fell in parts of East Anglia and south Devon.

Rainfall totals for the whole of July were classed as *normal* or lower for the time of year in the vast majority of hydrological areas across England. Rainfall totals in parts of north Cornwall/west Devon and the Norfolk Broads were classed as *exceptionally low* whereas rainfall totals in parts of the Midlands and northwest England were classed as *above normal*. Cumulative rainfall totals over the past three months showed a similar pattern ([Figure 1.2](#)). The four month period ending July 2013 was the fifth driest since records began in 1910 in our South West Region and the seventh driest in our Anglian Region.

Monthly rainfall totals as a percentage of the July LTA were above average in three of our six regions, ranging from 107% in our Yorkshire and North East Region to 128% in our North West Region ([Figure 1.3](#)). In our Anglian, South East and South West Regions, rainfall totals as a percentage of the July LTA were below average, ranging from 58% in our South West Region to 68% in our Anglian Region. England as a whole received 92% of the LTA rainfall ([Figure 1.3](#)).

### Soil moisture deficit

Soil moisture deficits (SMDs) increased in four of our regions during July 2013. At the end of July, SMDs ranged from less than 10mm in Cumbria, to more than 100mm in much of eastern and southeastern England and parts of southwestern England ([Figure 2.1](#)). The month end SMDs were 6-75mm greater than the LTA in 93 MORECS squares covering eastern, southern and parts of western England (which represents approximately 85% of the total number). SMDs were between 6-50mm less than the LTA in 16 MORECS grid squares (15% of the total number) covering large parts of the Midlands and north western England ([Figure 2.1](#)).

At the beginning of July, SMDs ranged from 44mm in our North West Region to 108mm in our Anglian Region. SMDs increased in all regions during the month in response to the hot, dry weather but had decreased in our Midlands, Yorkshire and North East and North West Regions by the end of the month following heavy rain. At the end of July, SMDs were between 6-29mm greater than the LTA in all our regions except Midlands and North West where SMDs were 5% less than the LTA ([Figure 2.2](#)).

### River flows

Compared with June, monthly mean river flows for July decreased at three quarters of our reported indicator sites across England. Monthly mean flows expressed as a percentage of the monthly LTA, were lower in July than in June at almost two-thirds of sites ([Figure 3.1](#)).

Monthly mean river flows for July were classed as *normal* or higher for the time of year at two thirds of our indicator sites across England. These included all sites in our Yorkshire and North East and North West Regions.

Monthly mean flows at the majority of indicator sites in our South West Region were *below normal* or lower for the time of year, and *exceptionally low* at the River Tone in Somerset ([Figure 3.1](#)).

River flows at the regional index sites in our Anglian, Yorkshire and North East, North West, and South East Regions were *normal* for the time of year. In our Midlands Region the regional index site was classed as *above normal* for the time of year, and in our South West Region the regional index site was classed as *notably low* ([Figure 3.2](#)).

## Groundwater levels

Groundwater levels decreased at the majority of indicator sites in England during July. At the end of July, groundwater levels were *normal* or higher for the time of year, at all but one of the sites reported on. The exception to this is Jackaments Bottom in the Burford Jurassic limestone, in our South East Region, where groundwater levels are *below normal* for the time of year ([Figures 4.1](#) and [4.2](#)). Nearly 70% of sites have *normal* groundwater levels for the time of year.

Priors Heyes and Skirwith in our North West Region, both sandstone, had *exceptionally high* groundwater levels for the end of July. Groundwater levels at Priors Heyes remain high compared with historic levels because the aquifer is recovering from the effects of historic abstraction.

## Reservoir storage

During July, reservoir stocks decreased at all of the reported reservoirs. Stocks decreased by more than 10% of full capacity at just over half of the reservoirs or reservoir groups reported on. Despite the decreases, reservoir stocks remain *normal* or higher for the time of year at more than 70% of the reported sites ([Figure 5.1](#)). At the end of July, reservoir stocks were classed as *below normal* for Hanningfield in our Anglian Region, Derwent Valley in our Midlands Region, Kielder in our Yorkshire and North East Region, the Pennines Group in our North West Region and Ardingly and Farmoor in our South East Region. Reservoir stocks at Abberton Reservoir in our Anglian Region are *notably low* for the time of year, but the level is affected due to ongoing engineering works.

At a regional scale, reservoir stocks decreased by between 5% and 10% in our Anglian, Midlands, Yorkshire and North East and South East Regions, and by more than 10% in our North West and South West Regions. At the end of July, regional reservoir stocks were lowest in our North West Region at 66% of total capacity, and highest in our South East Region at 90%. Overall reservoir storage for England decreased during July to 80% of total capacity ([Figure 5.2](#)).

## Forward look

August is likely to remain unsettled until the middle of the month, with some heavy showers in places. Later in the month, the south and east may become drier, but unsettled conditions could remain in the north and northwest. Further ahead, above average temperatures are most probable for the period August to October, with equal probabilities of high, low and average precipitation<sup>1</sup>.

## Scenario based projections for river flows at key sites<sup>2</sup>

**September 2013:** With average (100% of the LTA) rainfall between August and the end of September 2013, river flows are likely to be *normal* or higher at more than two thirds of our modelled sites. With 120% of the LTA rainfall, river flows are likely to be *above normal* or higher at nearly half of the modelled sites. With 80% of the LTA rainfall river flows are likely to be *below normal* or lower at nearly two thirds of the modelled sites (see [Figure 6.1](#)).

**March 2014:** With average rainfall between August and the end of March 2014, river flows are likely to be *normal* at over four fifths of modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *above normal* or higher at four fifths of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *notably low* or lower at over two thirds of the modelled sites (see [Figure 6.2](#)).

## Probabilistic ensemble projections for river flows at key sites<sup>2</sup>

**September 2013:** Two thirds of modelled sites have a greater than expected chance of *below normal* flows from August to September. More than a third of sites have a greater than expected chance of *normal* flows, whilst a third of the sites have a greater than expected chance of *above normal* flows (see [Figure 6.3](#)).

<sup>1</sup> Source: [Met Office](#)

<sup>2</sup> 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. Note that projections produced by the Centre for Ecology and Hydrology start from 22 July 2013 rather than the end of the month.

**March 2014:** More than a third of all modelled sites have a greater than expected chance of *normal* flows from August 2013 to March 2014. More than a third of modelled sites have a greater than expected chance of *notably low* flows, whilst more than a third of modelled sites have a greater than expected chance of *exceptionally high* flows between August 2013 and March 2014 (see [Figure 6.4](#)).

### **Scenario based projections for groundwater levels in key aquifers<sup>3</sup>**

**September 2013:** With average rainfall (100% of the LTA) from August 2013 to September 2013, groundwater levels are likely to be *normal* or higher for the time of year at all modelled sites, and *above normal* or higher at over a third of modelled sites. With above average rainfall (120% of the LTA) all sites will be *normal* or higher. With 80% of the LTA rainfall, all except one modelled sites are likely to have *normal* or higher groundwater levels for the time of year (see [Figure 6.5](#)).

**March 2014:** With average rainfall (100% of the LTA) from August 2013 to March 2014, groundwater levels are likely to be *normal* or higher for the time of year at all but one modelled site. With above average rainfall (120% of the LTA), levels are likely to be *above normal* or higher for the time of year at three quarters of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* or lower at over half of our modelled sites (see [Figure 6.6](#)).

### **Probabilistic ensemble projections for groundwater levels in key aquifers<sup>3</sup>**

**September 2013:** Nearly two thirds of modelled sites have a greater than expected chance of *normal* groundwater levels for the time of year. Nearly a third of the sites have a greater than expected chance of *above normal* levels. Only one site, Wetwang, in our North East region has a greater than expected chance of *below normal* levels for the time of year (see [Figure 6.7](#)).

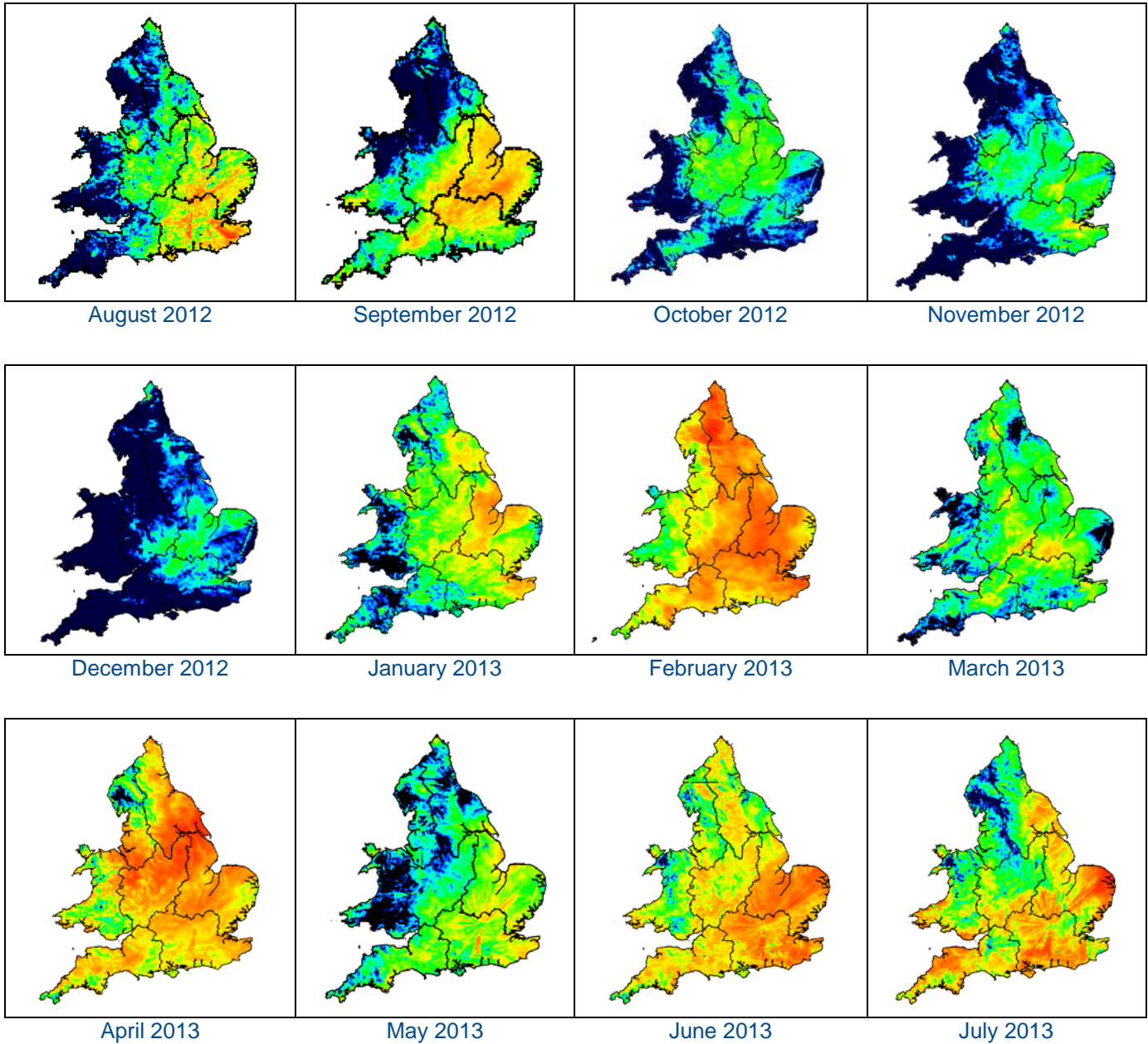
**March 2014:** Nearly half of the modelled sites have a greater than expected chance of levels being *normal* for the time of year. Over two thirds of the modelled sites have a greater than expected chance of *exceptionally high* groundwater levels for the time of year. Nearly a third of all modelled sites have a greater than expected chance of *exceptionally low* groundwater levels by the end of March 2014 (see [Figure 6.8](#)).

Authors: [Natalie Armitage](#), [Caroline Wallis](#) and [Tom Schnetler](#) (Hydrology – Water Resources Technical Services)

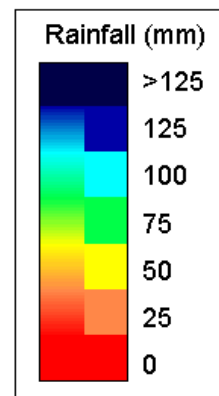
---

<sup>3</sup> 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.

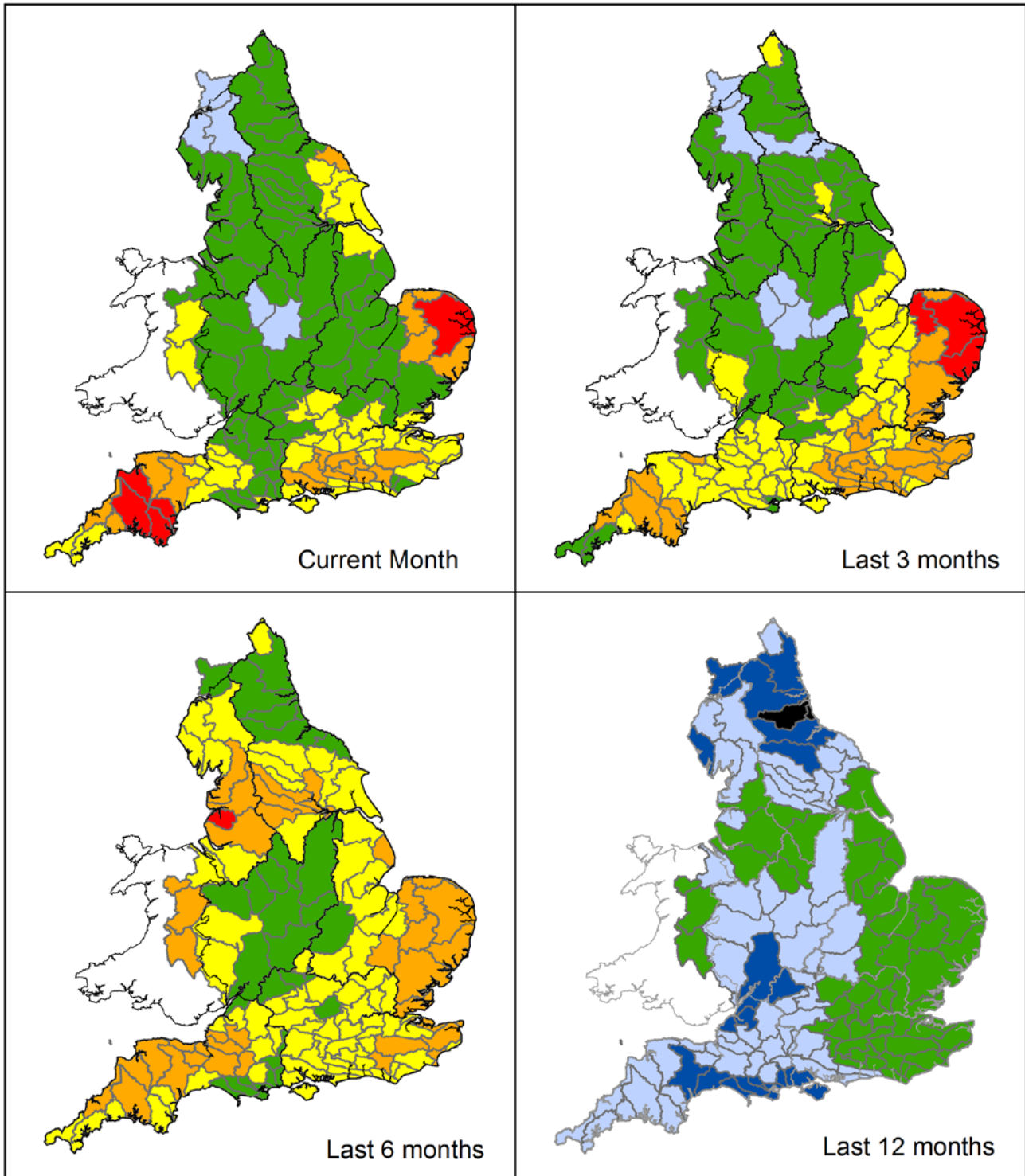
# Rainfall



**Figure 1.1:** Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2013). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

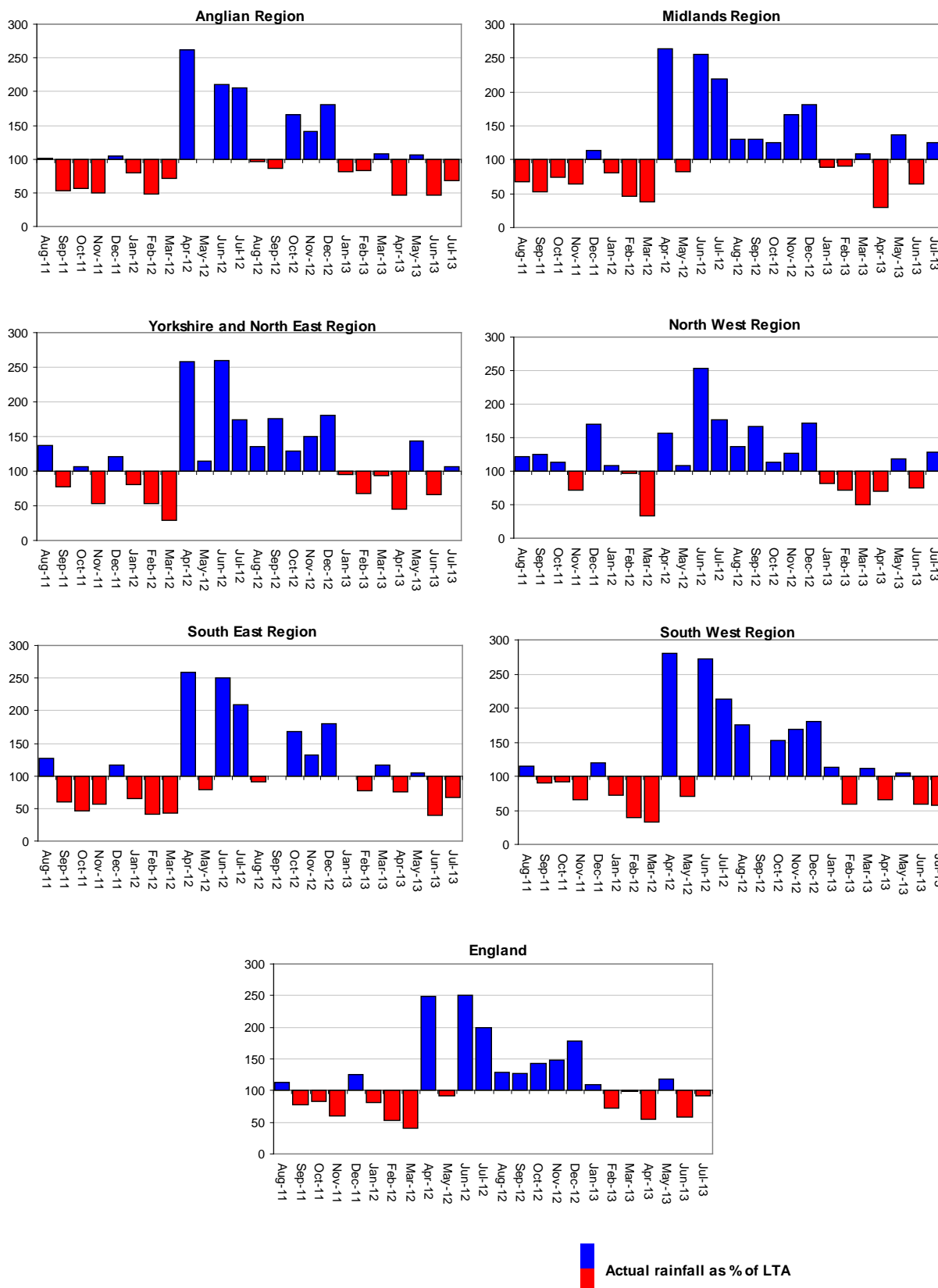






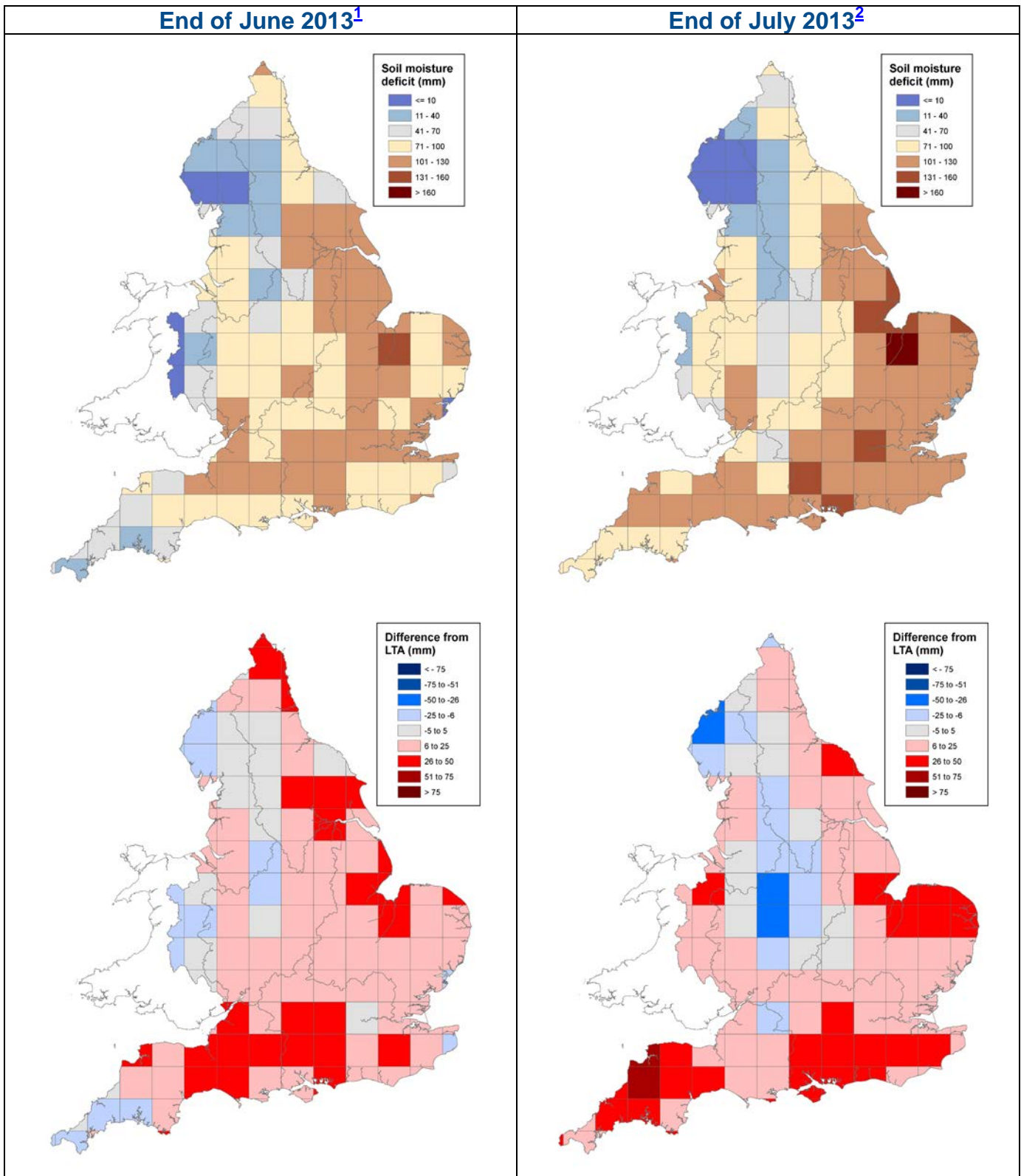
Exceptionally high  
  Above normal  
  Below normal  
  Exceptionally low  
 Notably high  
  Normal  
  Notably low

**Figure 1.2:** Total rainfall for hydrological areas across England for the current month (up to 31st July), 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, 2013). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

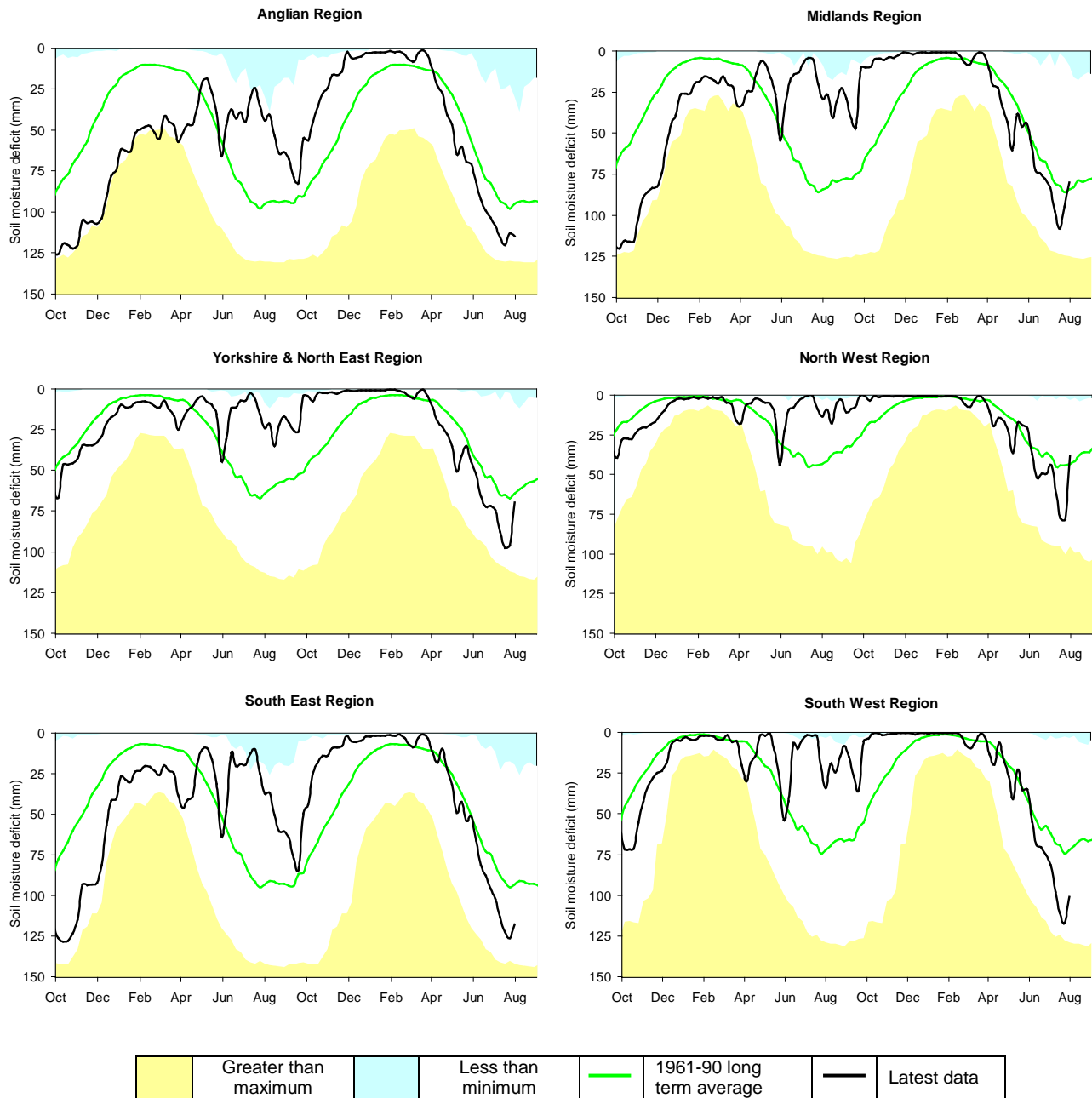


**Figure 1.3:** Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2013).

# Soil moisture deficit



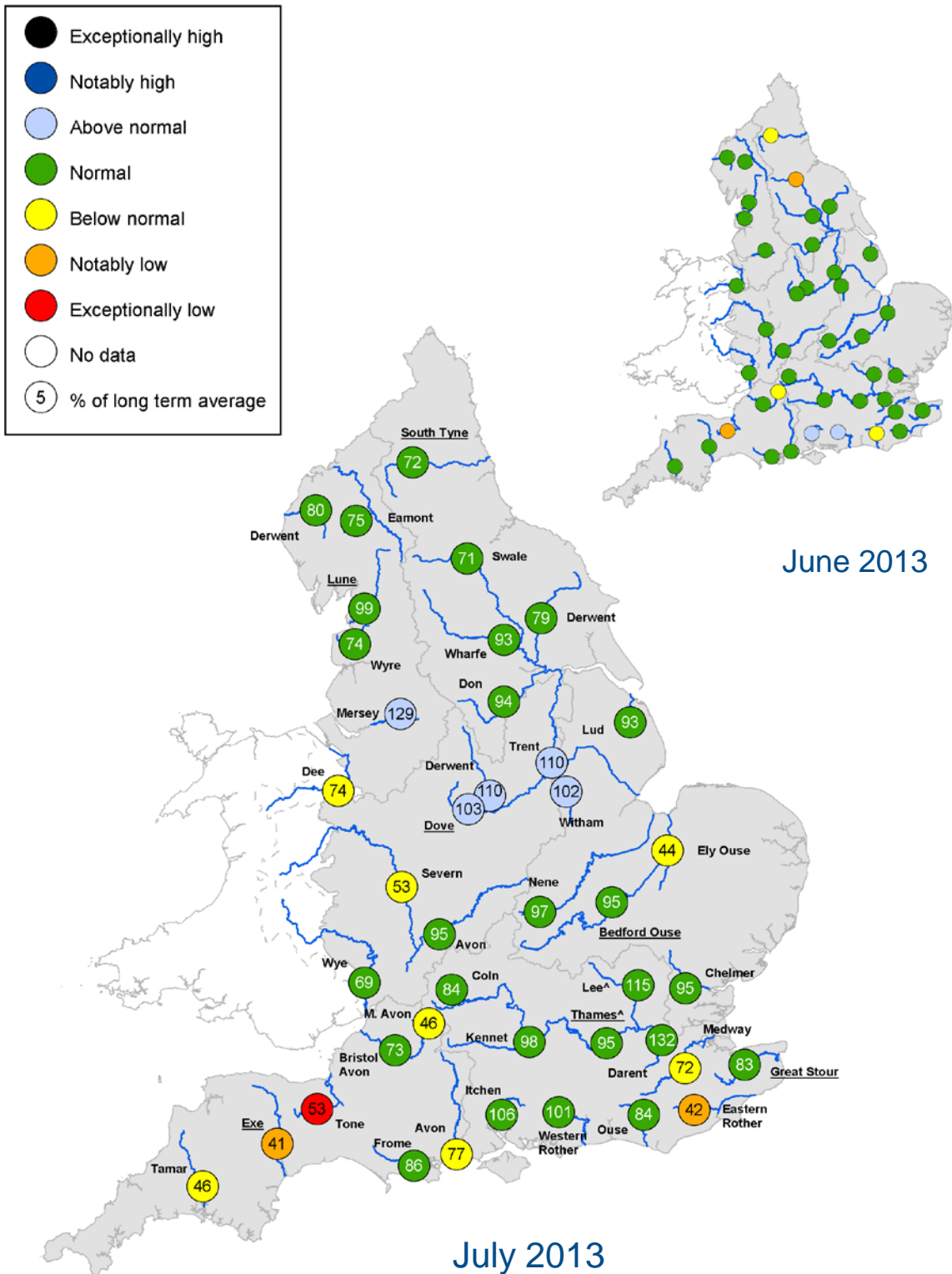
**Figure 2.1:** Soil moisture deficits for weeks ending 03 July 2013<sup>1</sup> (left panel) and 30 July 2013<sup>2</sup> (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2013). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013



**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, 2013).

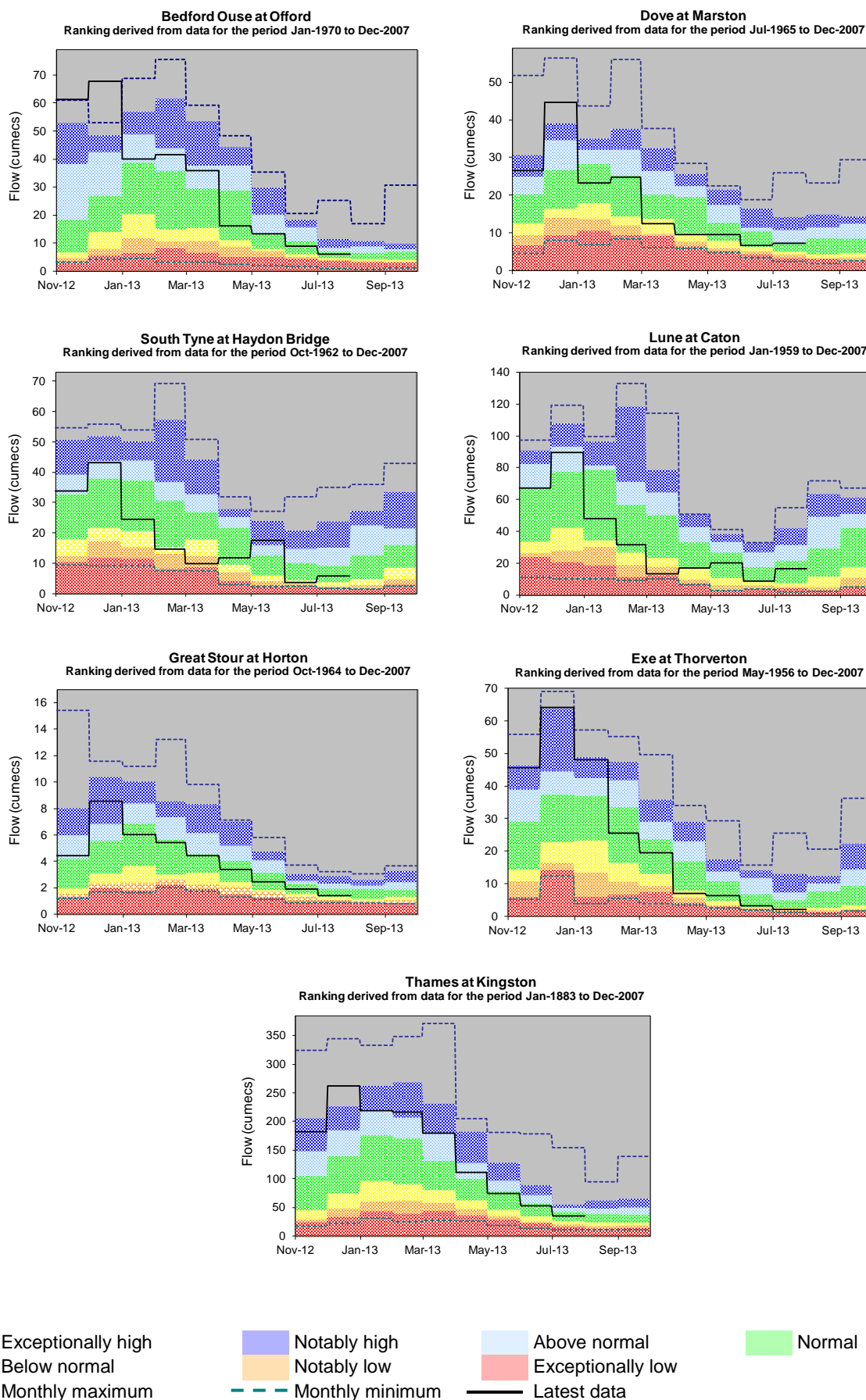


# River flows



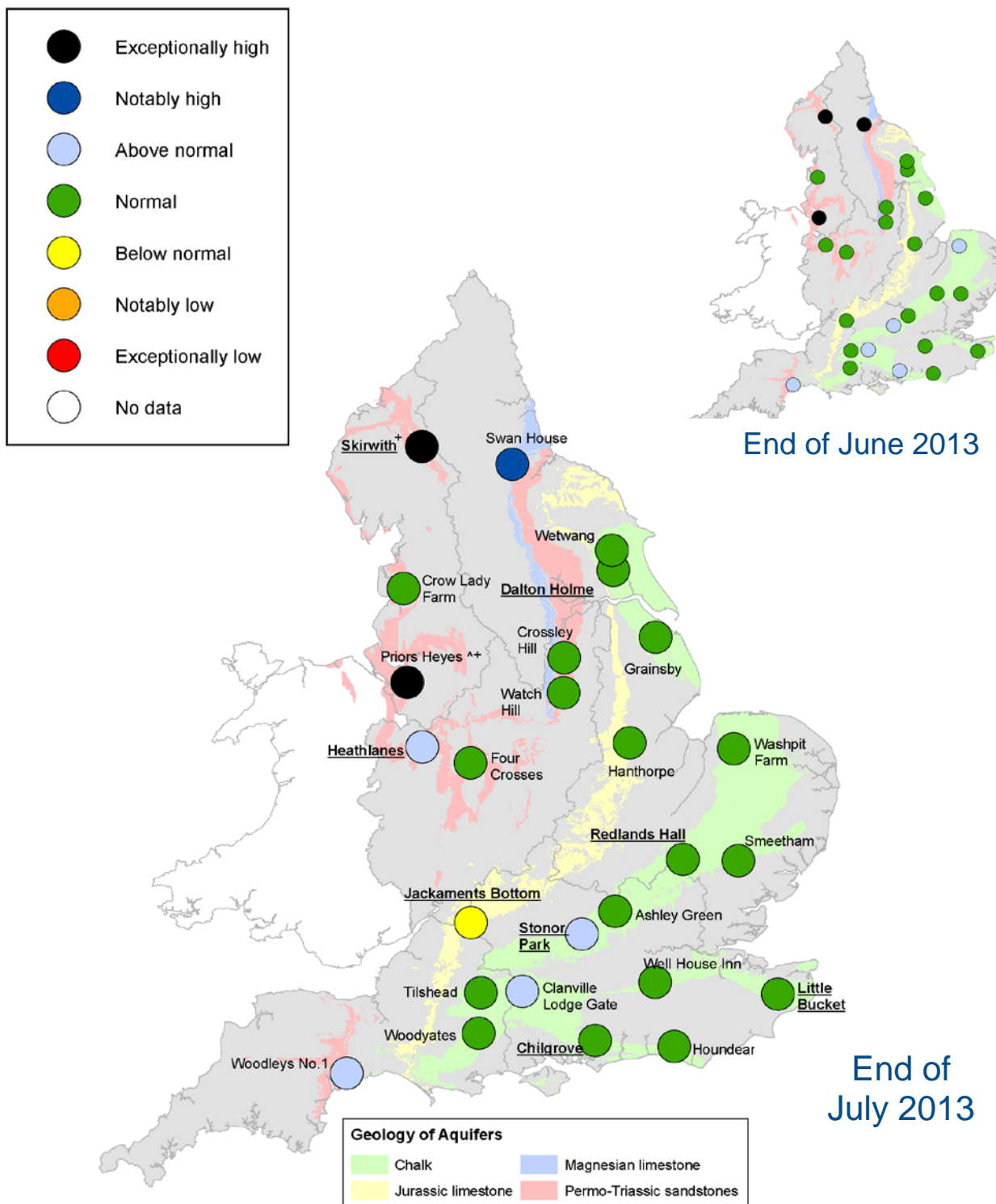
^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'  
 \* Monthly mean flow is the highest/lowest on record for the current month (note that record length varies between sites)  
 Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

**Figure 3.1:** Monthly mean river flow for indicator sites for June 2013 and July 2013, expressed as a percentage of the respective long term average and classed relative to an analysis of historic May and June monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.



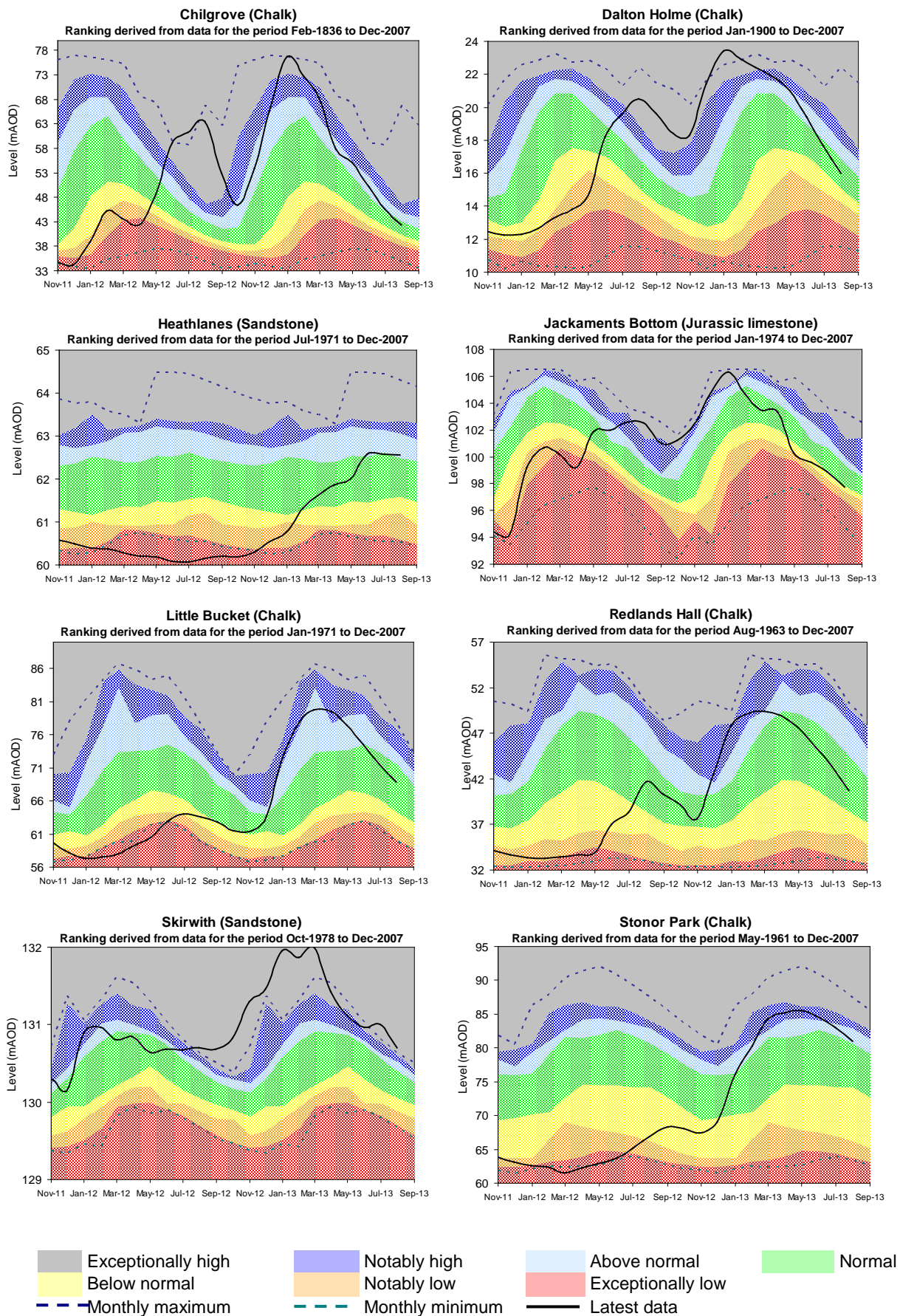
**Figure 3.2:** Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

# Groundwater levels



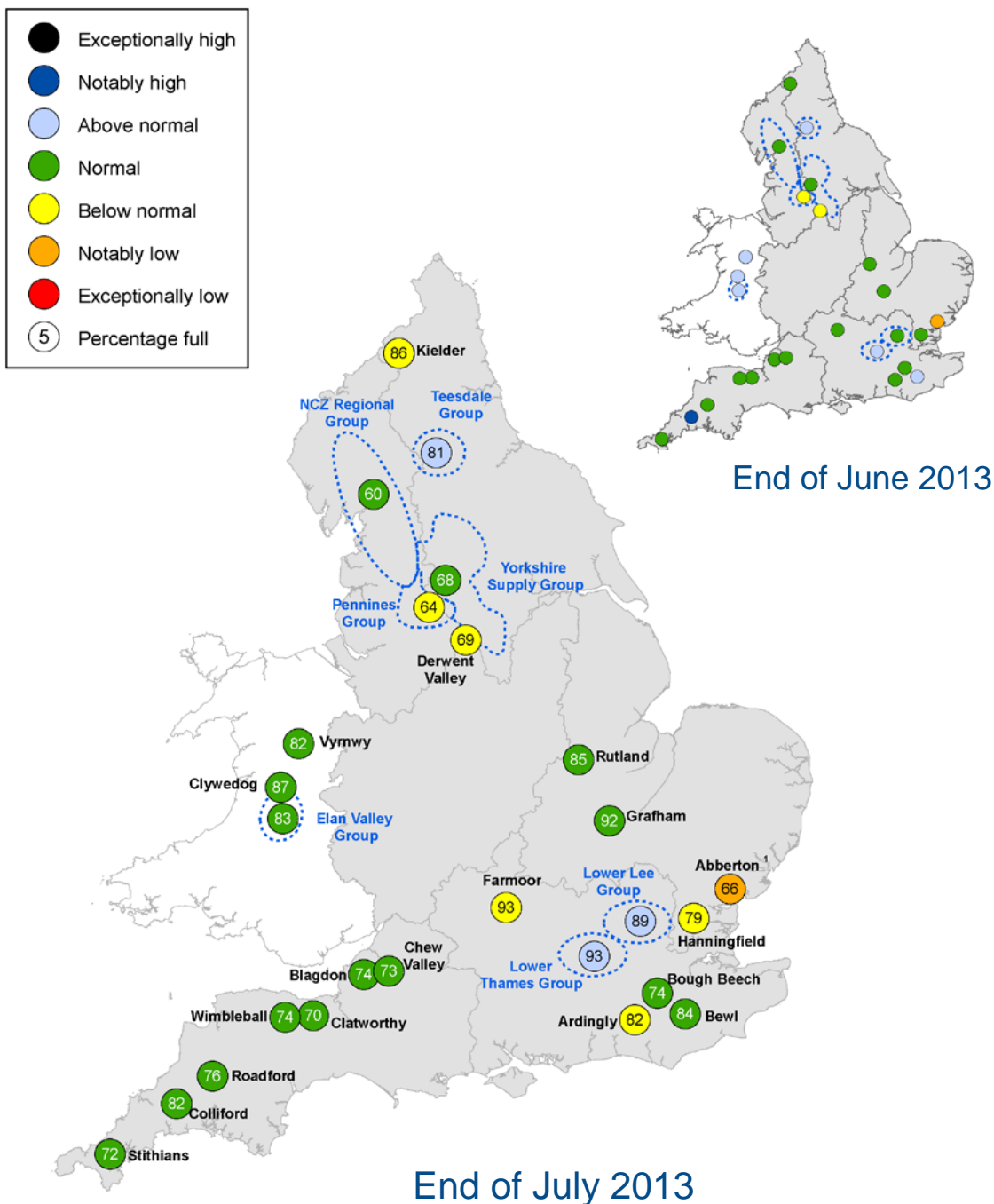
<sup>^</sup> The level at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction. End of month groundwater level is the highest (+) and lowest (-) on record (note that record length varies between sites). Highlighted sites are 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 2013 and July 2013, classed relative to an analysis of respective historic May and June levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Note: groundwater levels are reported at different times during the month and therefore may not be fully representative of levels at the month end. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.



**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, 2013).

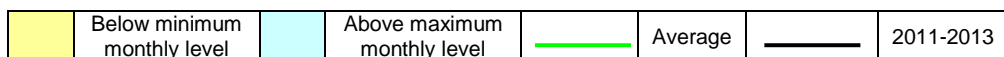
# Reservoir storage



1. The level at Abberton Reservoir in Anglian Region is affected by ongoing engineering works to increase capacity by 60% - works are expected to be complete by the end of 2013.
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to our Midlands and North West regions

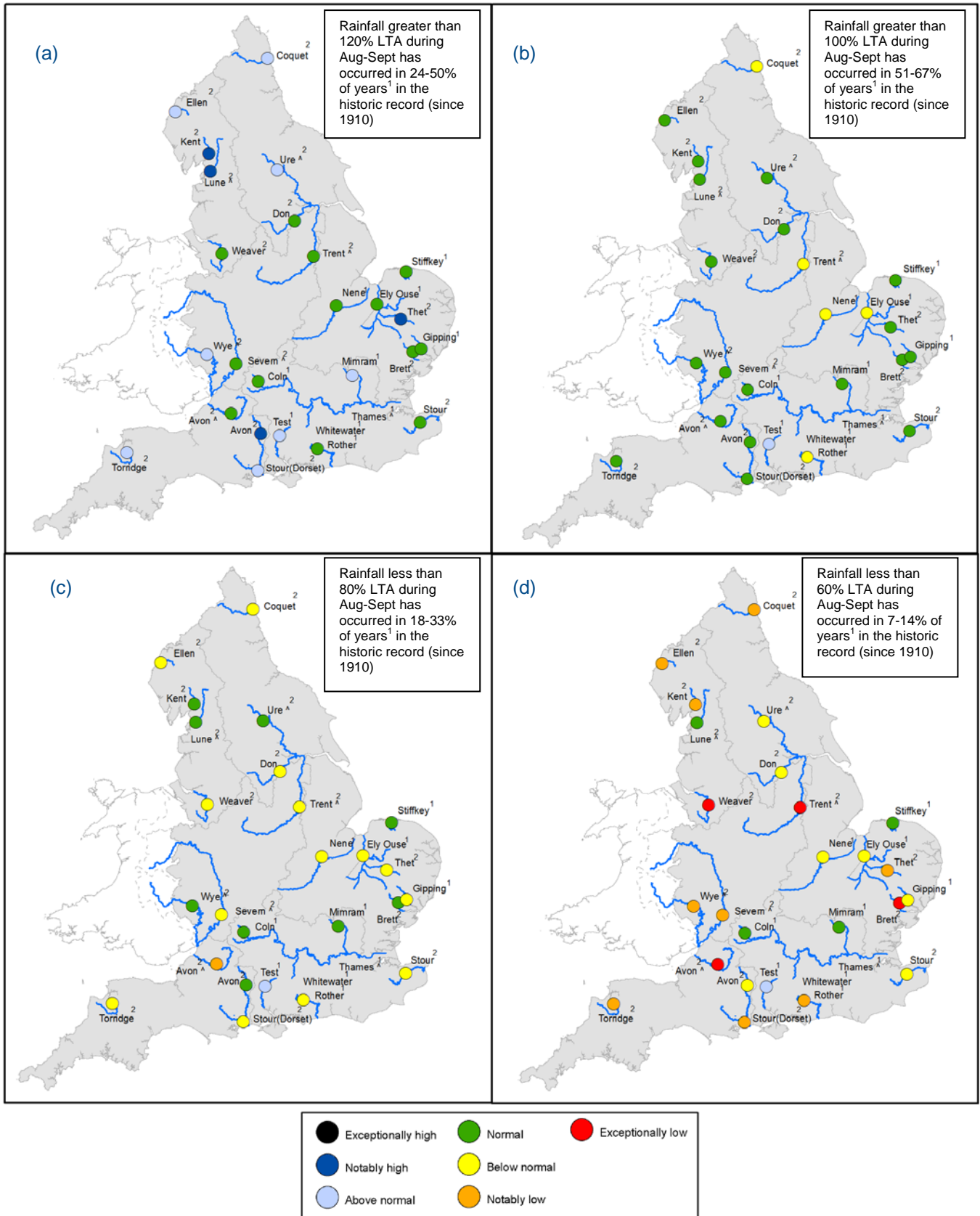
**Figure 5.1:** Reservoir stocks at key individual and groups of reservoirs at the end of June 2013 and July 2013 as a percentage of total capacity and classed relative to an analysis of historic June and July values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate 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, 2013.





**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

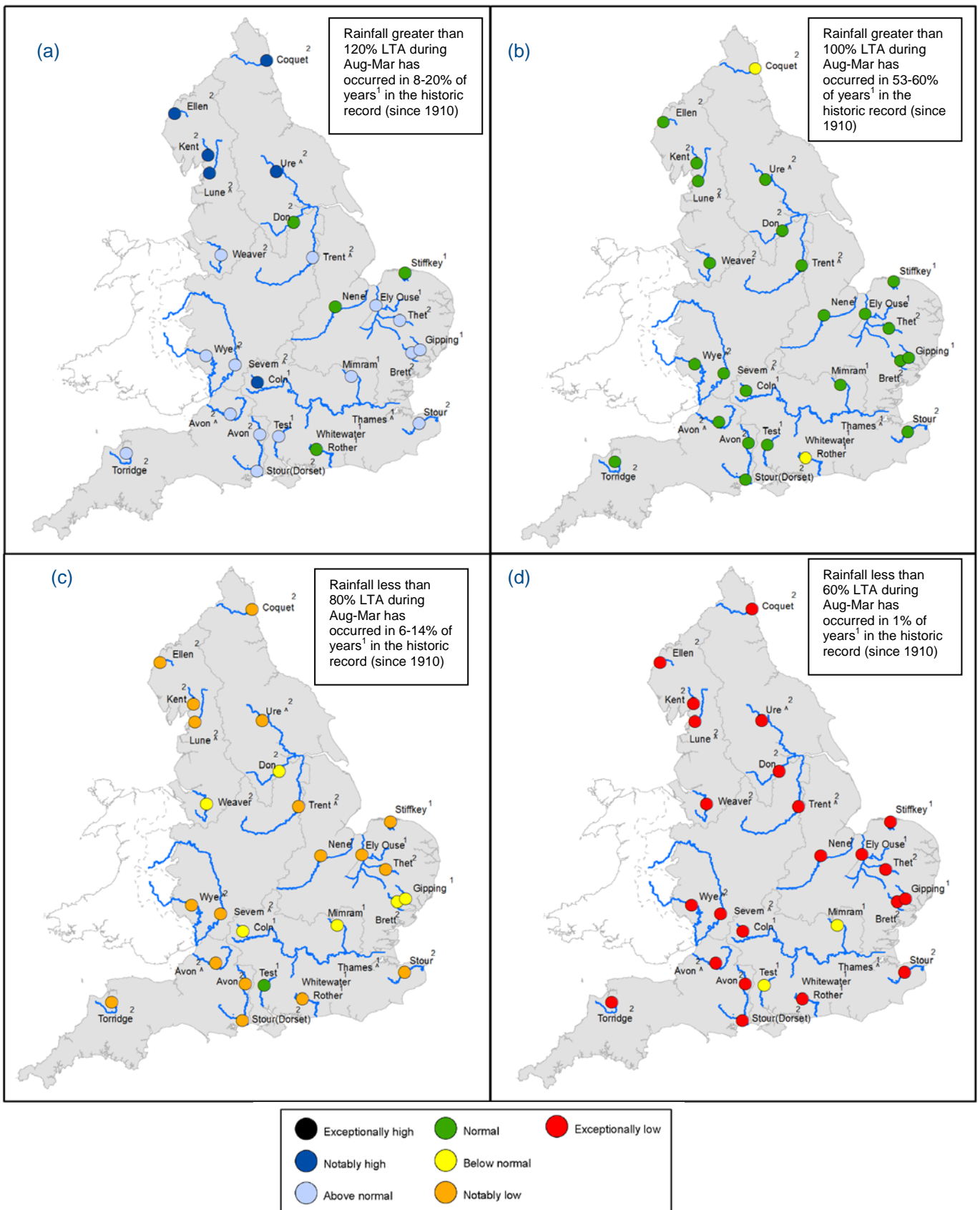


**Figure 6.1:** Projected river flows at key indicator sites up until the end of September 2013. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2013 and September 2013 (Source: Centre for Ecology and Hydrology, Environment Agency)

<sup>1</sup> Projections for these sites are produced by the Environment Agency

<sup>2</sup> Projections for these sites are produced by CEH, <sup>3</sup> This range of probabilities is a regional analysis

<sup>^</sup> "Naturalised" flows are projected for these sites



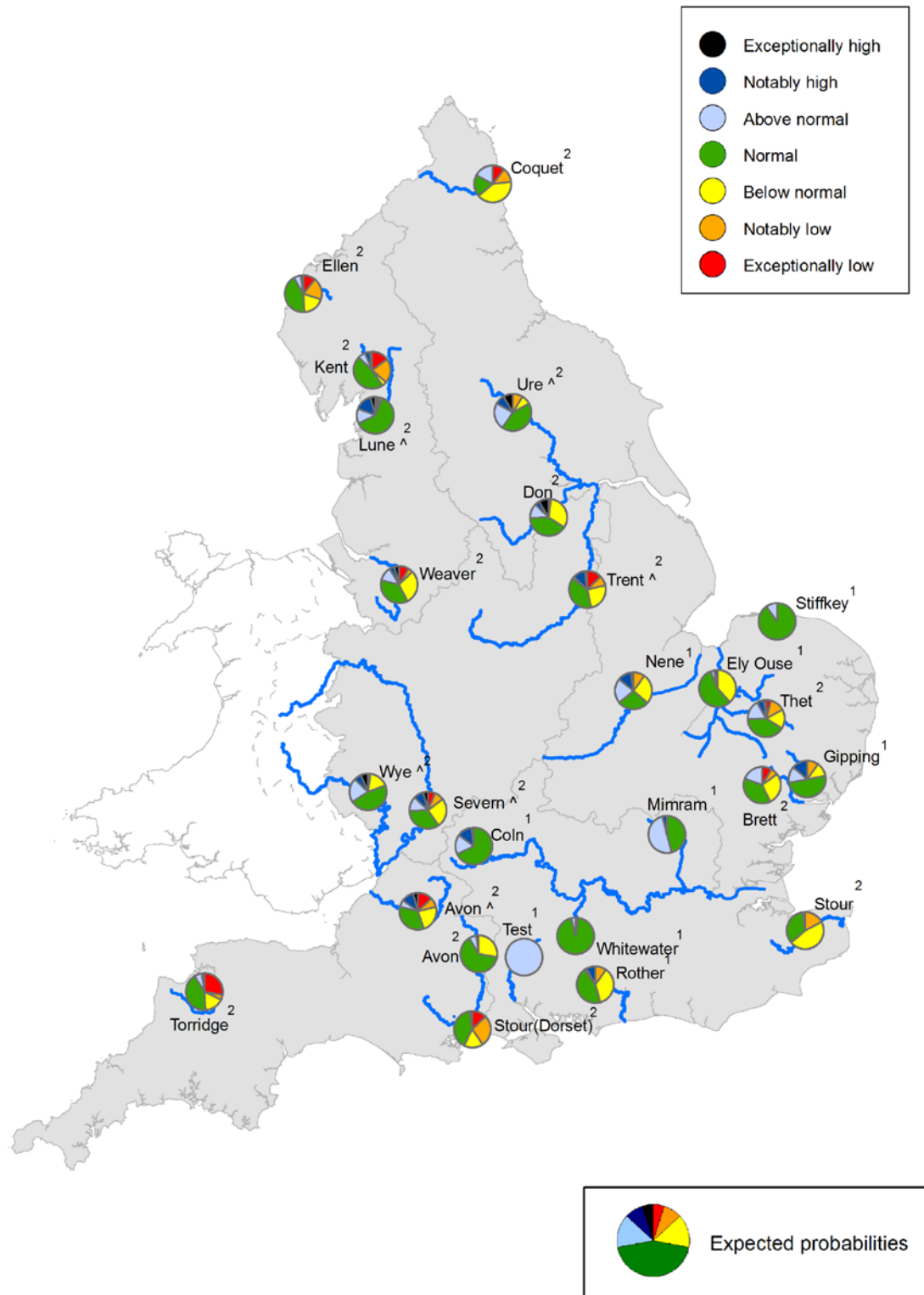
**Figure 6.2:** Projected river flows at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2013 and March 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

<sup>1</sup> Projections for these sites are produced by the Environment Agency

<sup>2</sup> Projections for these sites are produced by CEH

<sup>3</sup> This range of probabilities is a regional analysis

<sup>^</sup> "Naturalised" flows are projected for these sites

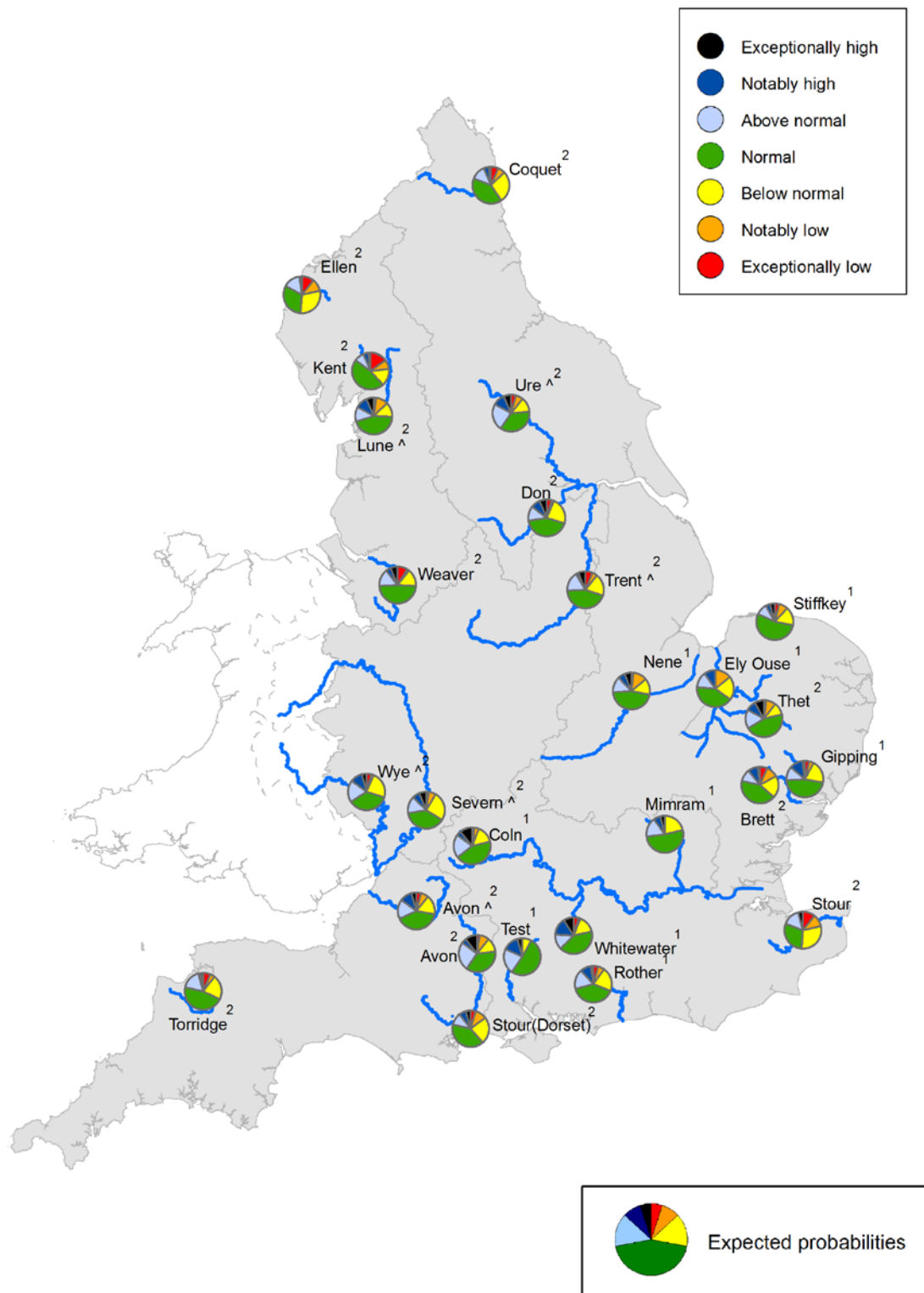


**Figure 6.3:** Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2013. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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.

<sup>^</sup> "Naturalised" flows are projected for these sites'

<sup>1</sup>Projections for these sites are produced by the Environment Agency,<sup>2</sup> Projections for these sites are produced by CEH



**Figure 6.4:** Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 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).

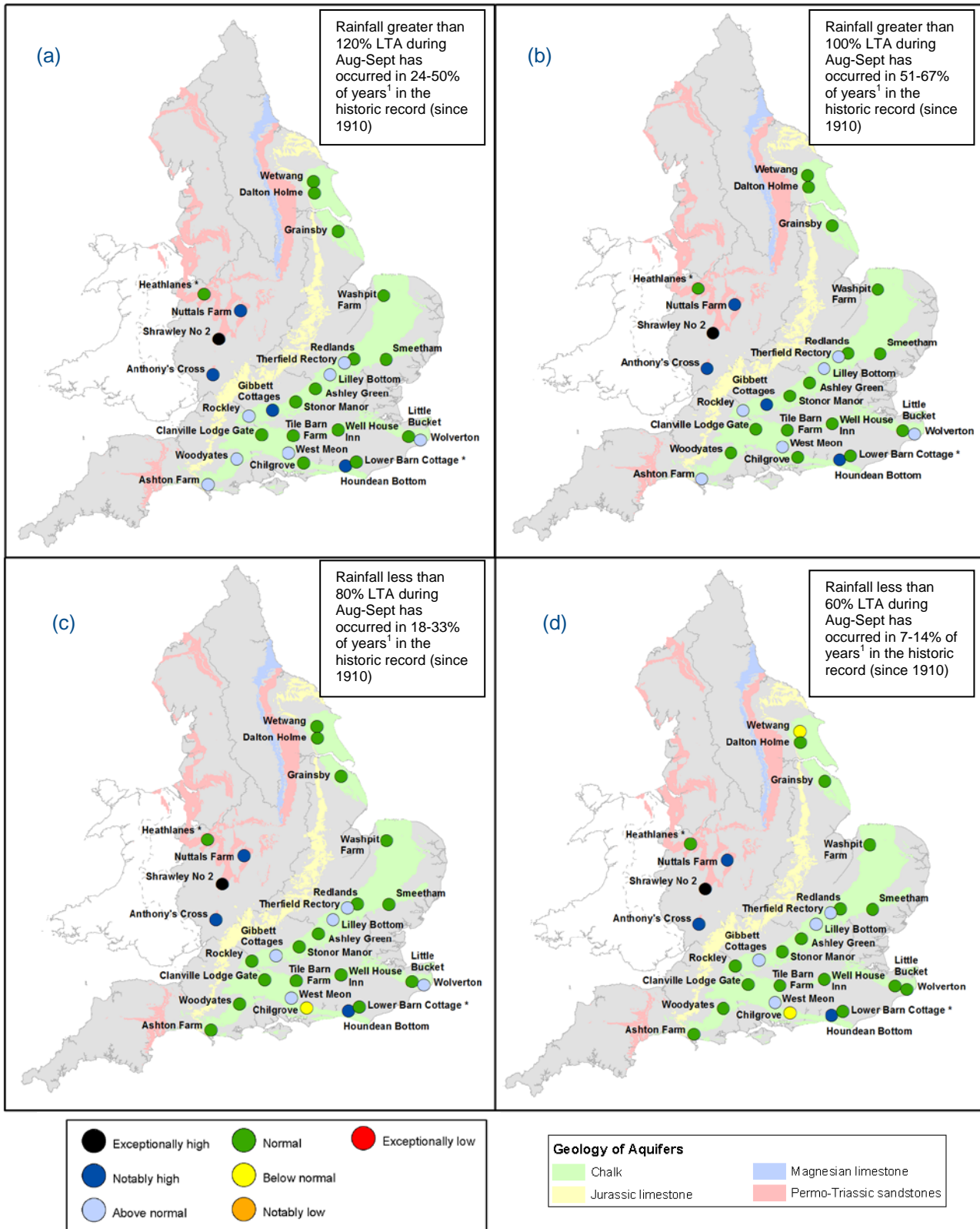
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

^ "Naturalised" flows are projected for these sites

<sup>1</sup>Projections for these sites are produced by the Environment Agency, <sup>2</sup> Projections for these sites are produced by CEH

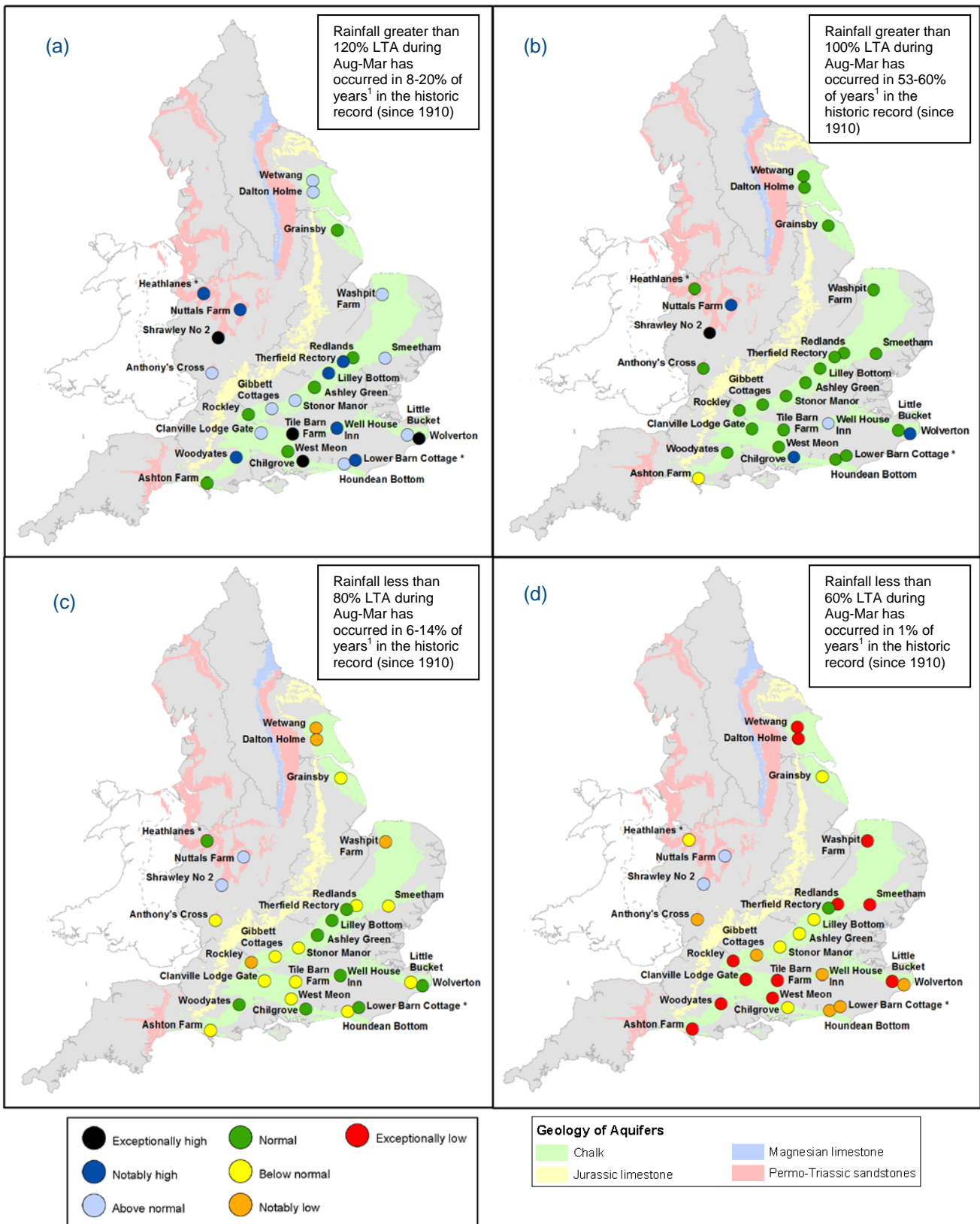


# Forward look - groundwater



**Figure 6.5:** Projected groundwater levels at key indicator sites up until the end of September 2013. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2013 and September 2013 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2013.

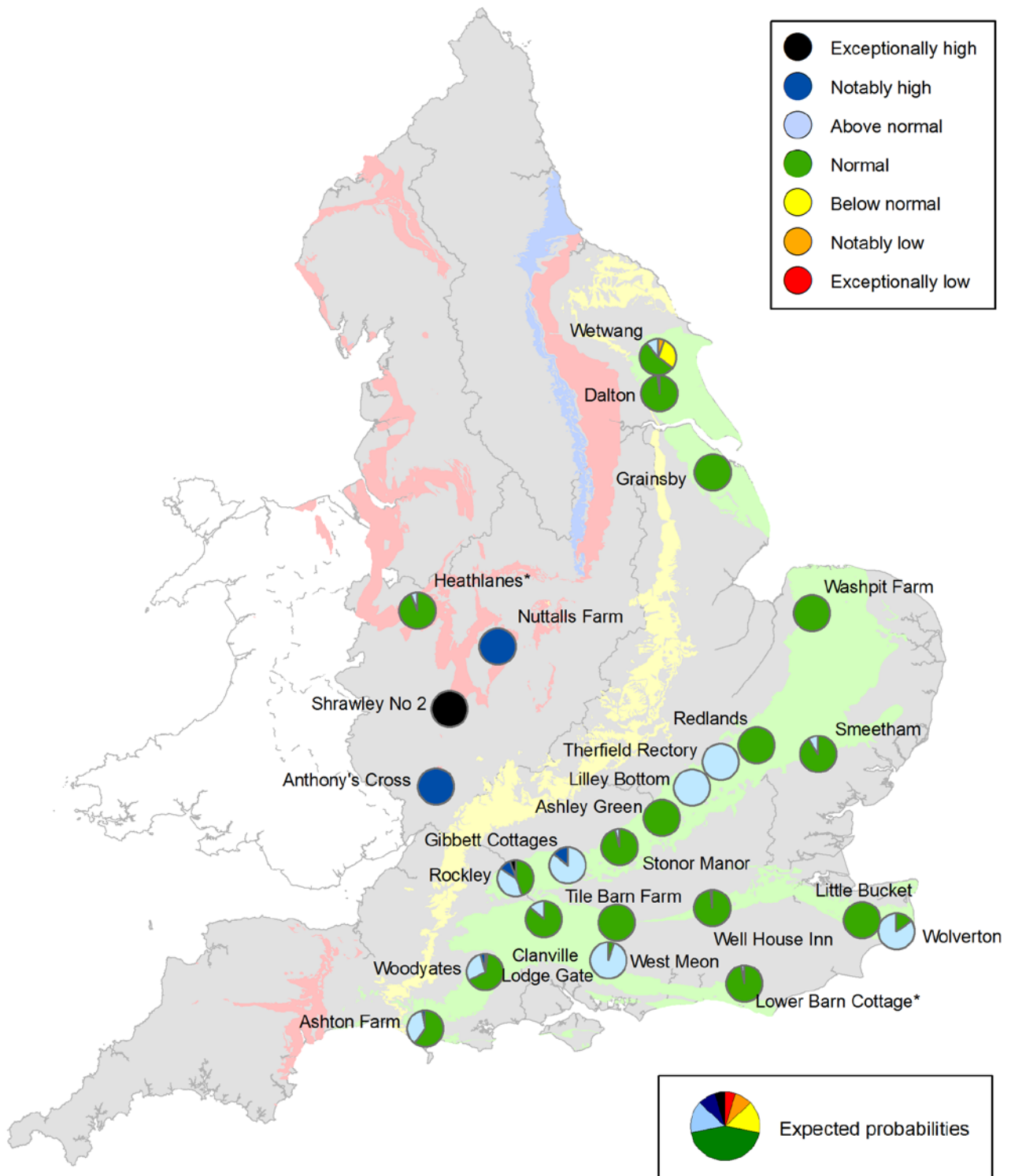
\* Projections for these sites are produced by BGS  
<sup>1</sup> This range of probabilities is a regional analysis



**Figure 6.6:** Projected groundwater levels at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2013 and March 2014 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2013.

\* Projections for these sites are produced by BGS

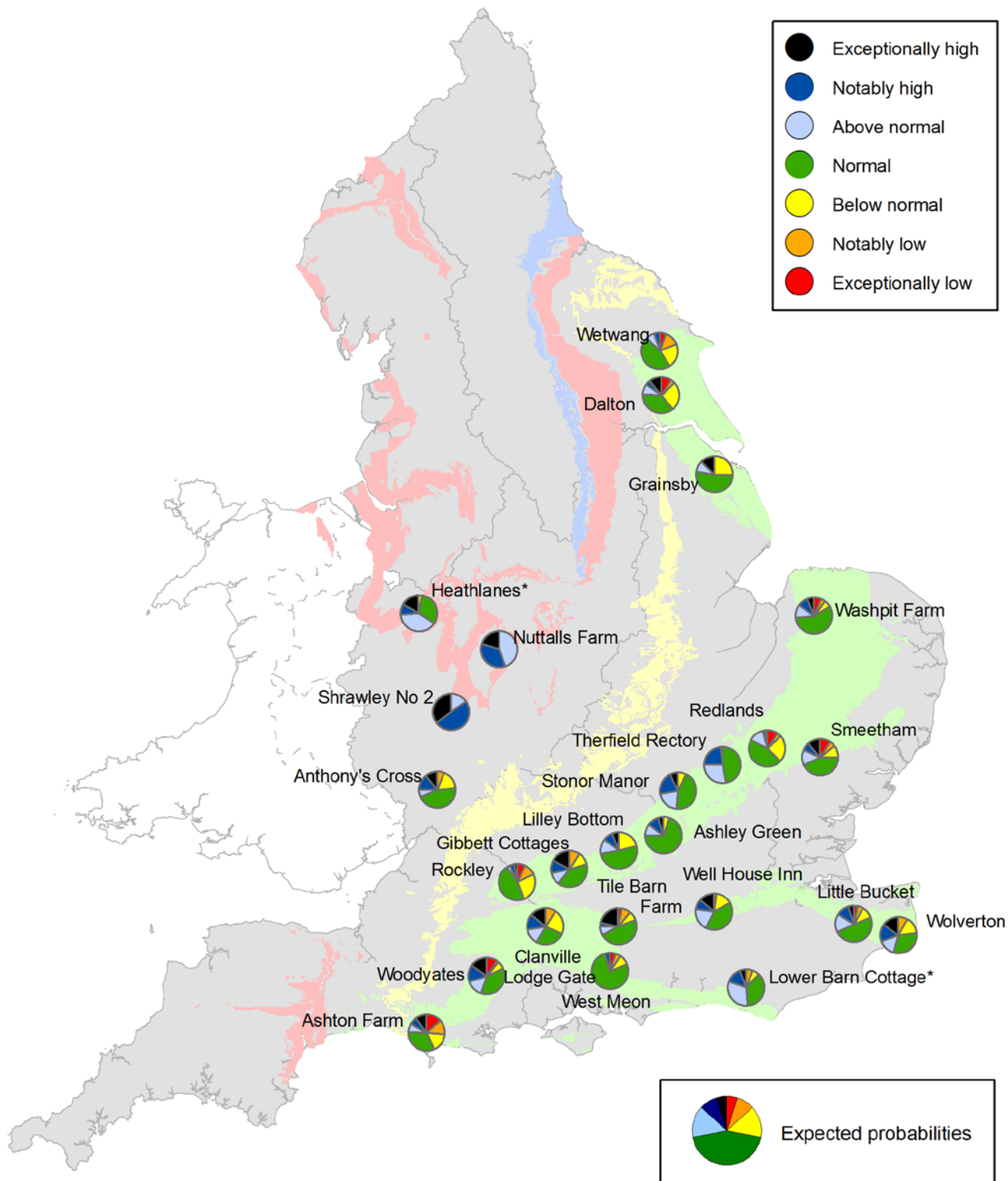
<sup>1</sup> This range of probabilities is a regional analysis



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 up until the end of September 2013. 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, 2013.

\* 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 up until the end of March 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, 2013.

\* Projections for these sites are produced by BGS



- Environment Agency regions
- Natural Resources Wales
- Cross-border hydrological boundaries



**Figure 7.1:** Environment Agency Region Location Map

Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.