# Monthly water situation report

## England

### Summary – November 2014

November rainfall was above average across England at 133% of the long term average. Soil moisture deficits decreased during the month and were generally close to or smaller than average by the end of the month. Monthly mean river flows increased at most of the indicator sites and were **above normal** or higher for the time of year at nearly half of the sites. Groundwater levels increased at more than half of the indicator sites and were **normal** or higher for the time of year at all reported boreholes. Reservoir stocks increased at four-fifths of sites and stocks were **normal** or higher for the time of year at all but four sites. Overall reservoir stocks for England were 80% of total capacity at the end of November.

### Rainfall

November rainfall totals were highest in parts of southern Cornwall at more than 200 mm and lowest across parts Lincolnshire, Cheshire and south Lancashire at less than 70 mm. Rainfall totals were above the November long term average (LTA) in most hydrological areas; parts of south-east England, including North London received more than 200% of the LTA (Figure 1.1).

November rainfall totals were **normal** or higher for the time of year across all hydrological areas except one. Across two thirds of the hydrological areas rainfall totals were **above normal** or **notably high** for the time of year. Over the 3 and 6 month periods ending in November, cumulative rainfall totals were generally **normal** to **above normal** across most of England, however some hydrological areas in northwest England had **below normal** to **exceptionally low** cumulative totals. The exceptional winter rainfall of 2013-14 remains evident in the 12 month cumulative rainfall totals, with the southern half of England and parts of the north classed as having received **above normal** to **exceptionally high** cumulative rainfall totals (Figure 1.2).

At a regional scale, November rainfall totals were **normal** to **above normal** for the time of year and ranged from 83% of the November LTA in north-west England to 175% in south-east England. Overall, England received 133% of the November LTA (Figure 1.3). The 12 month cumulative period ending in November was the wettest on record in south-east England and the fifth wettest on record in England as a whole.

### Soil moisture deficit

In November soil moisture deficits (SMDs) decreased across England. At the end of November SMDs were less than 10 mm across most of England, but up to approximately 55 mm in parts of Norfolk and Cambridgeshire. End of month SMDs were close to the LTA across much of south-west and north-west England, but in parts of central and south-east England SMDs were up to approximately 60 mm smaller than the LTA. In a few isolated parts of England, end of month SMDs were larger than the LTA, most notably in the far west of Cornwall and around Cheshire and Shropshire (Figure 2.1).

At a regional scale, SMDs decreased during November and by the end of the month ranged from 3 mm in south-west England to 13 mm in east England. The largest decrease of 40 mm occurred in south-east England (Figure 2.2).

### River flows

November monthly mean river flows increased compared to October at all except one indicator site across England in response to the above average monthly rainfall. Flows were **normal** or higher for the time of year at all indicator sites, with nearly half of all sites **above normal** or higher (Figure 3.1)

Monthly mean river flows were classed as **normal** at regional index sites in north and central England. The River Exe in south-west England, the River Bedford Ouse in east England and the Thames in south-east England were **above normal** for the time of year, and the River Great Stour in south-east England was **notably high** for the time of year (Figure 3.2).

## Groundwater levels

Groundwater levels rose at more than half of the indicator sites across England during November. At the end of the month levels were classed as **normal** or higher for the time of year at all sites.

Groundwater levels at the major aquifer index sites were **normal** at 2 sites (one in the Chichester chalk aquifer and one in the Burford Jurassic limestone aquifer), **above normal** at 5 sites (located in the Shropshire Middle Severn sandstone, Cam and Ely Ouse chalk, Hull and East Riding chalk, Carlisle Basin and Eden Valley sandstone, and South West Chilterns chalk aquifers) and **notably high** at 1 site (located in the East Kent Stour chalk aquifer) (Figures 4.1 and 4.2)

## Reservoir storage

During November reservoir stocks increased at four-fifths of the reported reservoirs and reservoir groups. The reservoirs and reservoir groups which experienced a decrease in stocks throughout November were all located in east and south-east England. Changes in reservoir stocks ranged from -9% at Grafham and Farmoor to +22% at Ardingly. At the end of November, stocks were classed as **normal** or **above normal** for the time of year at all but four reported reservoirs (Figure 5.1).

At a regional scale reservoir stocks increased during November by between 6 and 9% in central, north-east, north-west, and south-west England and decreased by up to 5% in east and south-east England. At the end of November regional stocks ranged from 74% of total capacity in north-west England to 88% in north-east England. Overall reservoir storage for England increased by 4% during November to 80% of total capacity (Figure 5.2).

Water quality issues have resulted in a pause to fill some reservoirs by abstraction in east and south-east England during October and November; while some of these have recently restarted, levels are still relatively low for the time of year as a result.

## Forward look

December's weather is likely to be unsettled with windy and sometimes wintery showers when weather systems arrive from the west or north-west. In between low pressure systems there is likely to be some clear spells when widespread ground frosts may develop overnight. Longer-term, the 3 month forecast for the winter period from December to February favours near to above average rainfall with above average temperatures more likely than below average[1].

**Projections for river flows at key sites** [2]

Nearly half of the sites have a greater than expected chance of **above normal** or higher cumulative flows from December 2014 to March 2015, and from December 2014 to September 2015. These sites are generally in the east and south of England.

For scenario based projections for river flows at key sites in March 2015 see Figure 6.1
For scenario based projections for river flows at key sites in September 2015 see Figure 6.2
For probabilistic ensemble projections for river flows at key sites in March 2015 see Figure 6.3
For probabilistic ensemble projections for river flows at key sites in September 2015 see Figure 6.4

**Projections for groundwater levels in key aquifers** [2]

With below average rainfall (80% of the LTA), all except three of the projection sites are expected to have **normal** or higher levels for the time of year in March 2015. The probabilistic projections indicate that at four-fifths of the sites there is a greater than expected chance of **above normal** or higher groundwater levels at the end of March 2015.

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

## Rainfall

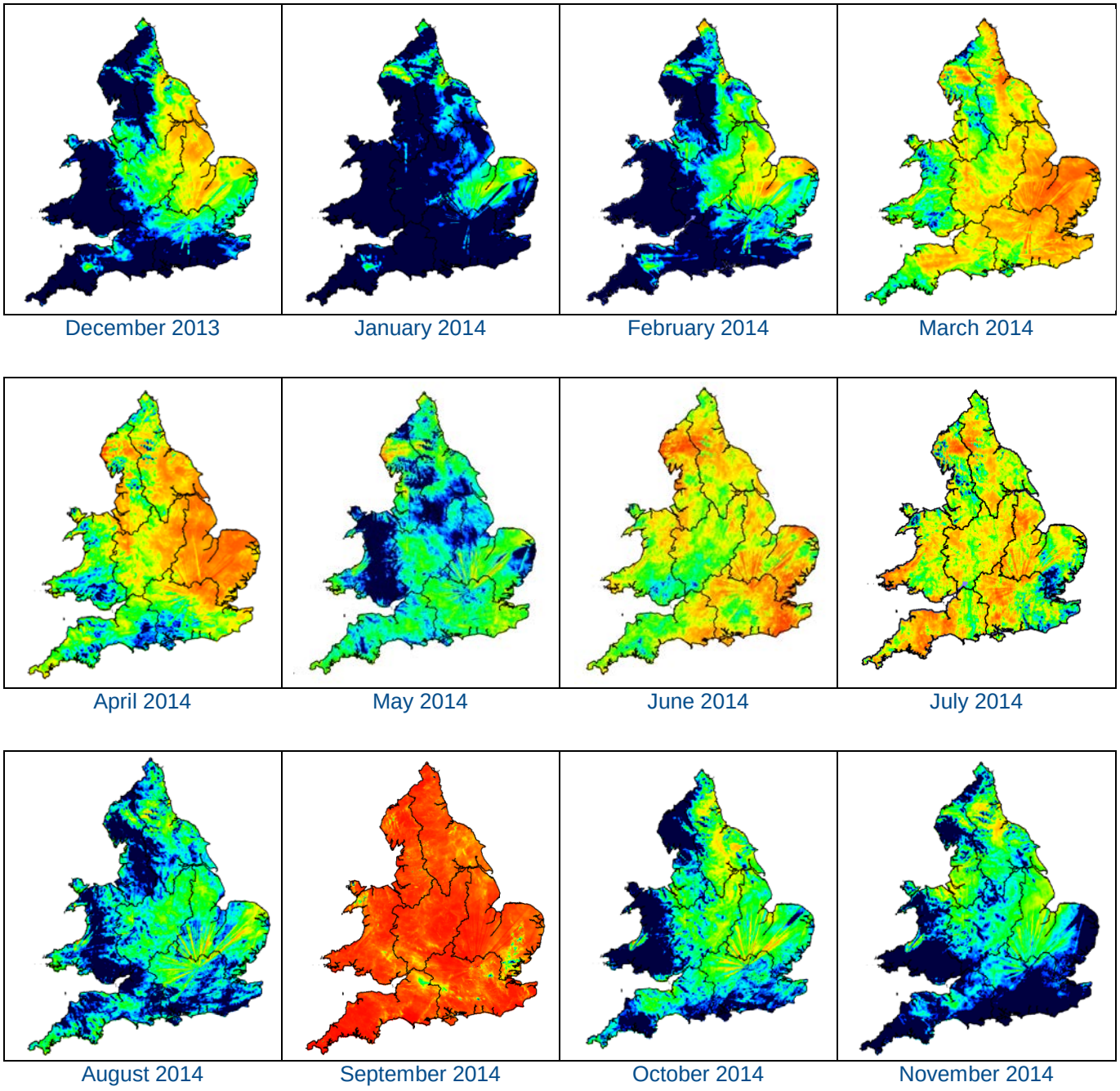



**Figure 1.1**: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

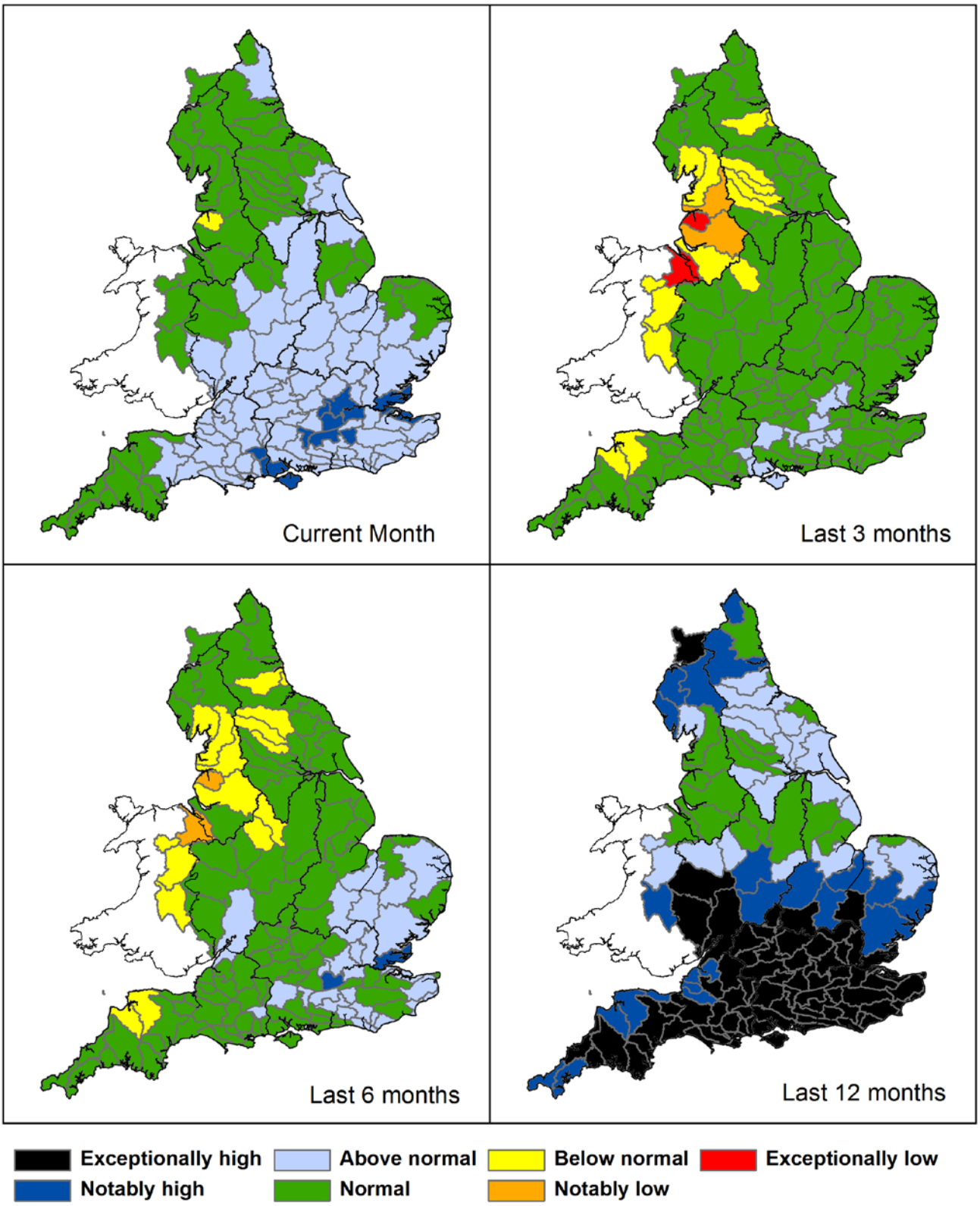



**Figure 1.2**: Total rainfall for hydrological areas across England for the current month (up to 30 November), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre)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

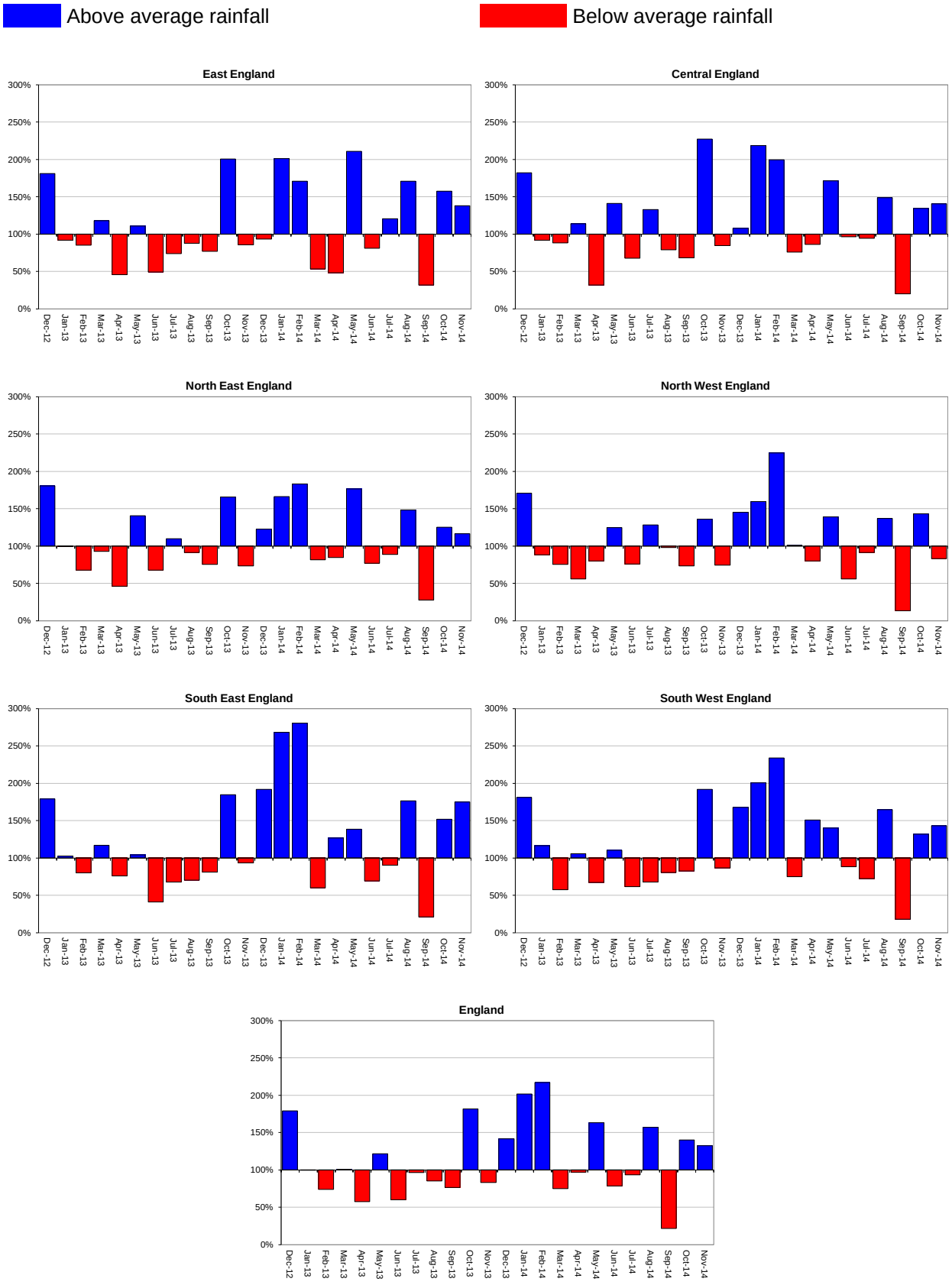



**Figure 1.3**: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each geographic region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

# Soil moisture deficit

| End of October 2014 [1] | End of November 2014 [2] |
|---|---|

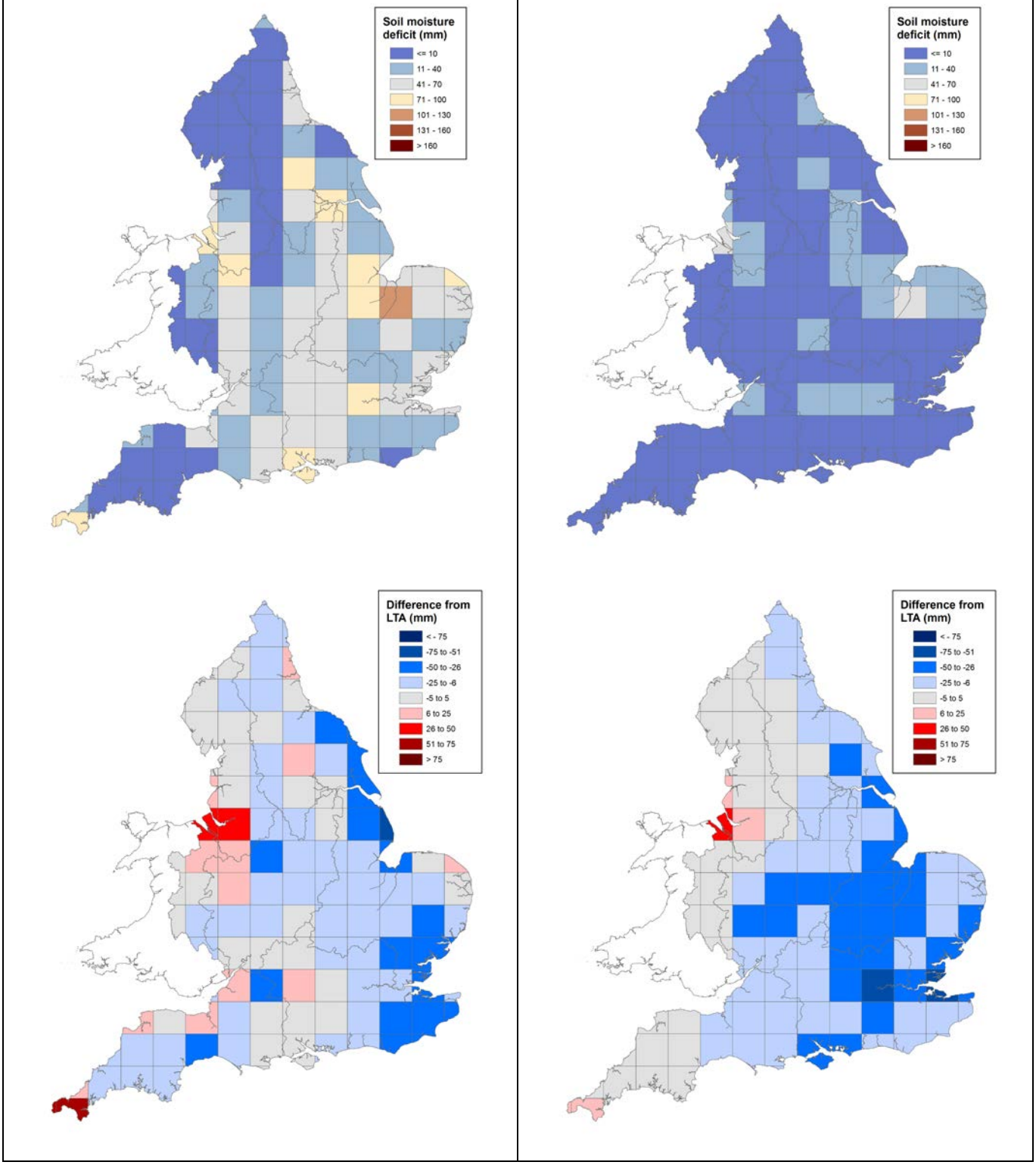



**Figure 2.1**: Soil moisture deficits for weeks ending 28 October 2014 [1] (left panel) and 2 December 2014 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014

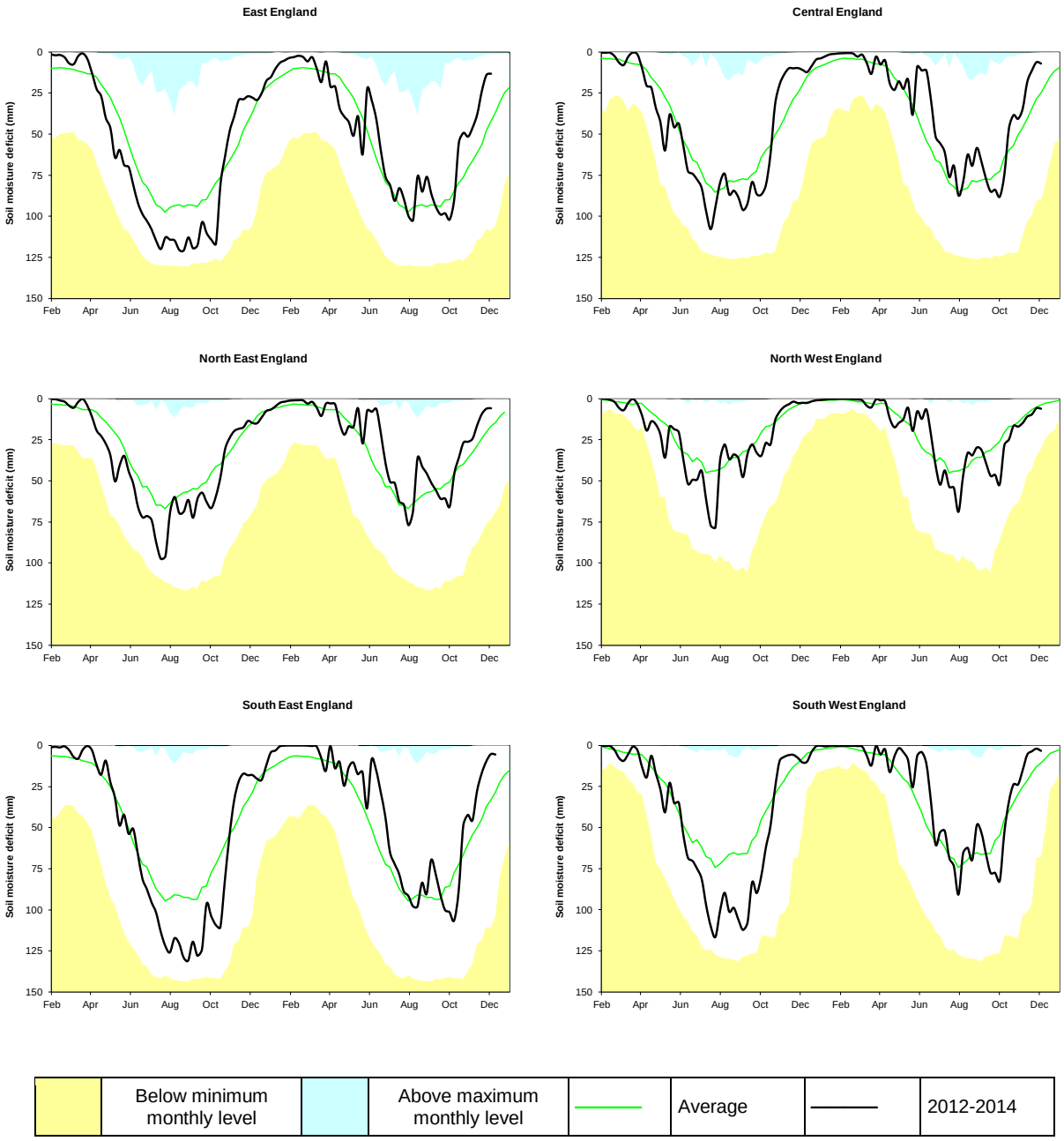
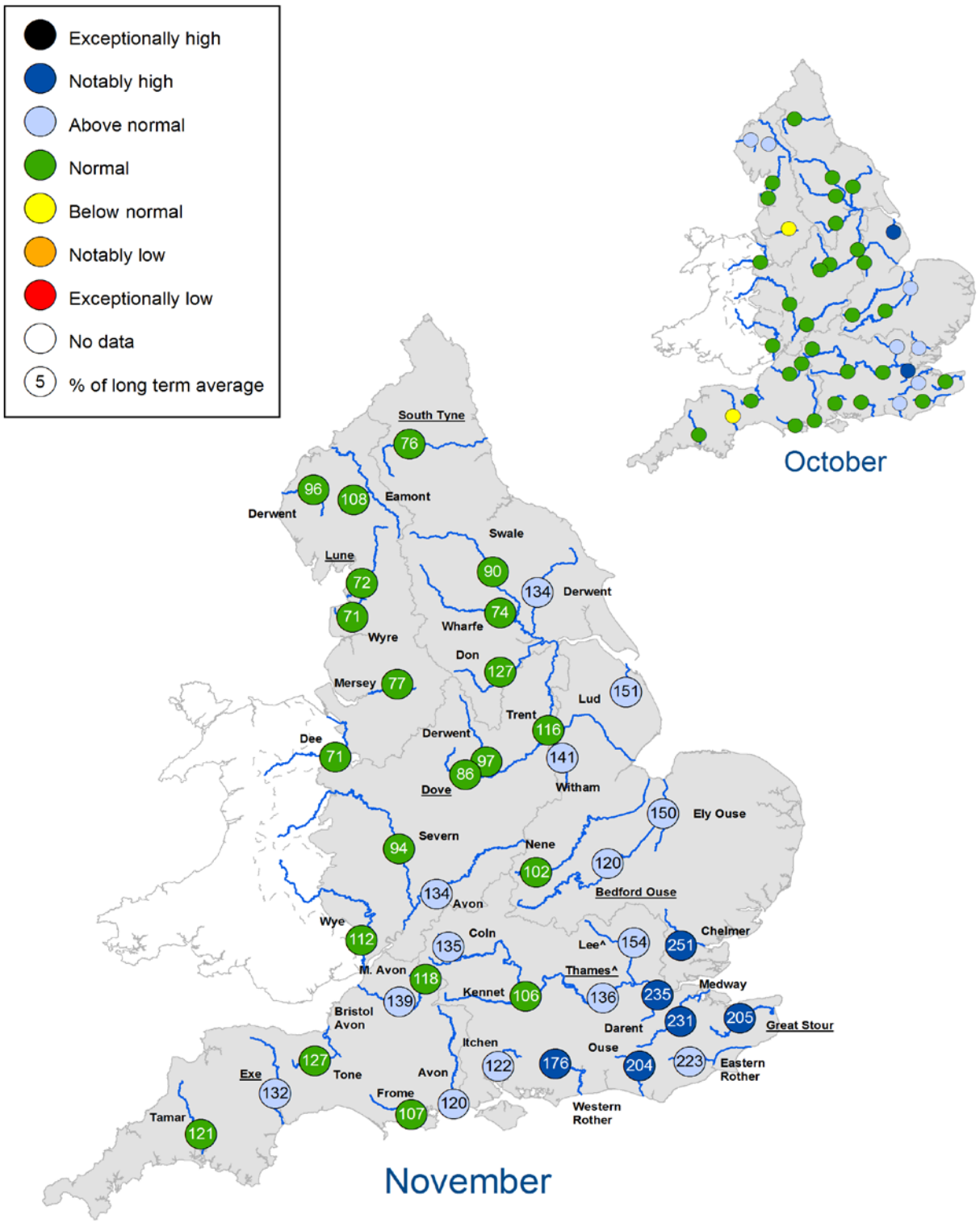



**Figure 2.2**: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2014).

# 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 October and November 2014, expressed as a percentage of the respective long term average and classed relative to an analysis of historic October and November monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

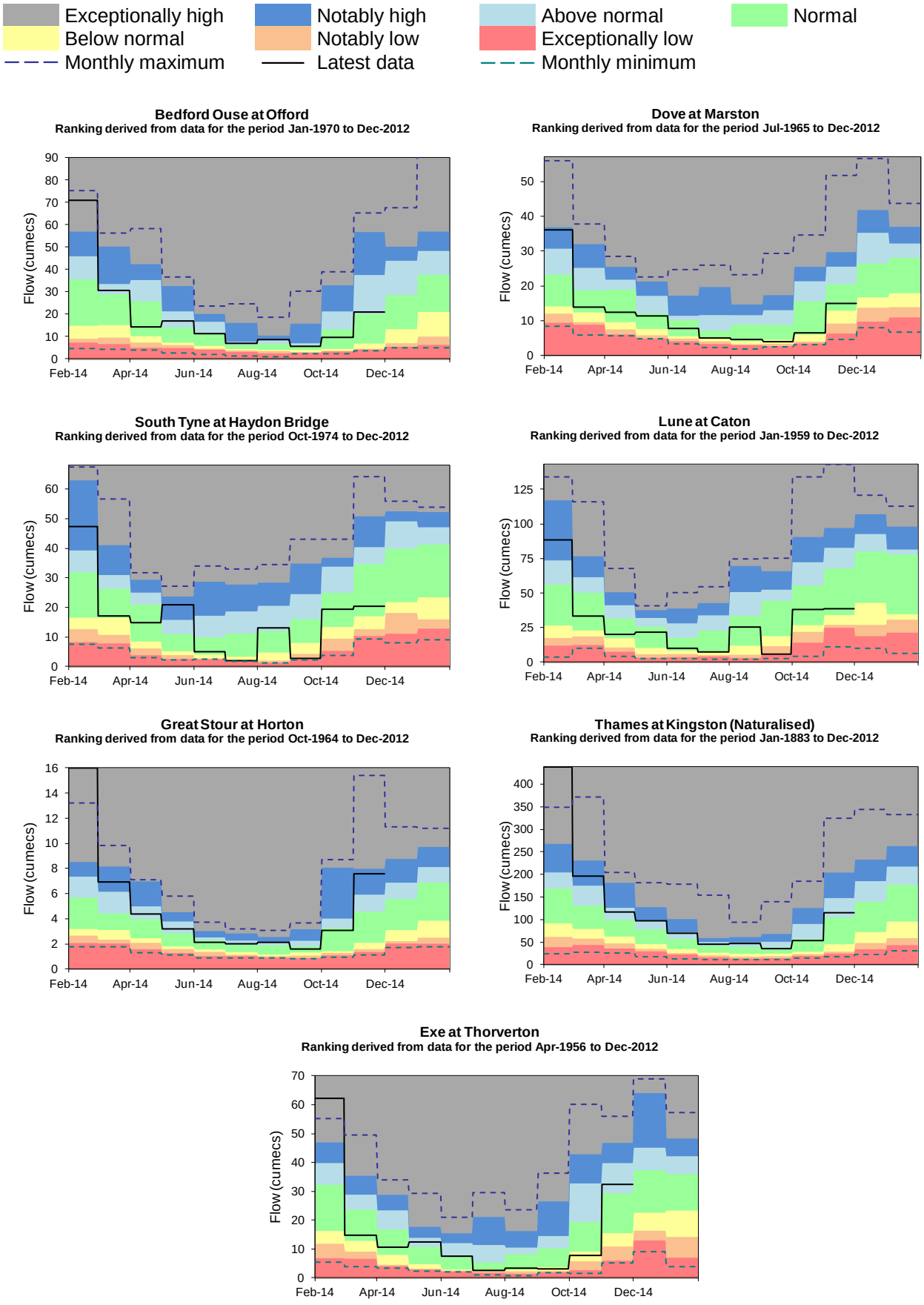
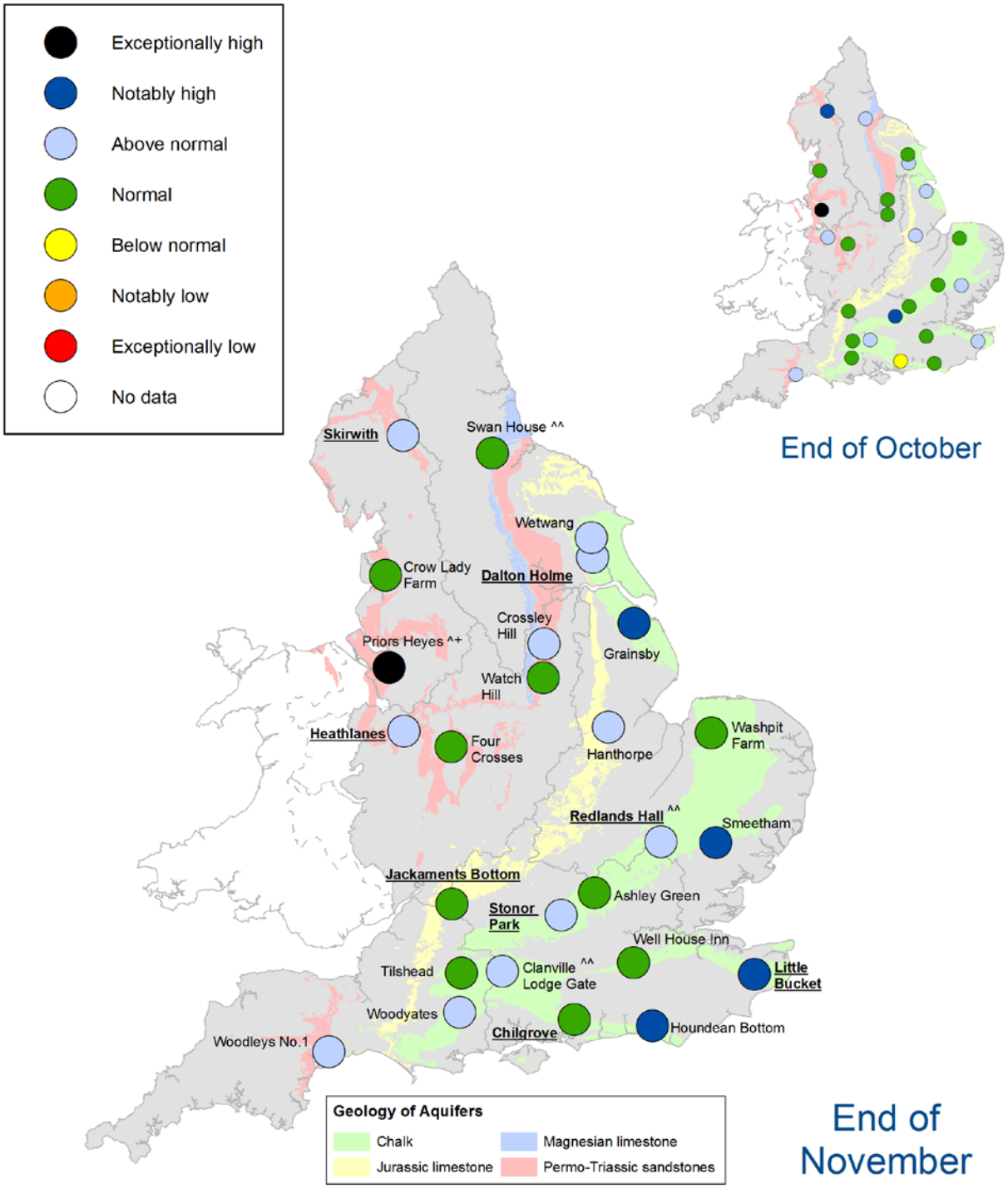



**Figure 3.2**: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

# Groundwater levels




^ The level at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction.
^^ Sites are manually dipped at different times during the month. They may not be fully representative of levels at the month end
+/- 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 October and November 2014, classed relative to an analysis of respective historic October and November 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.

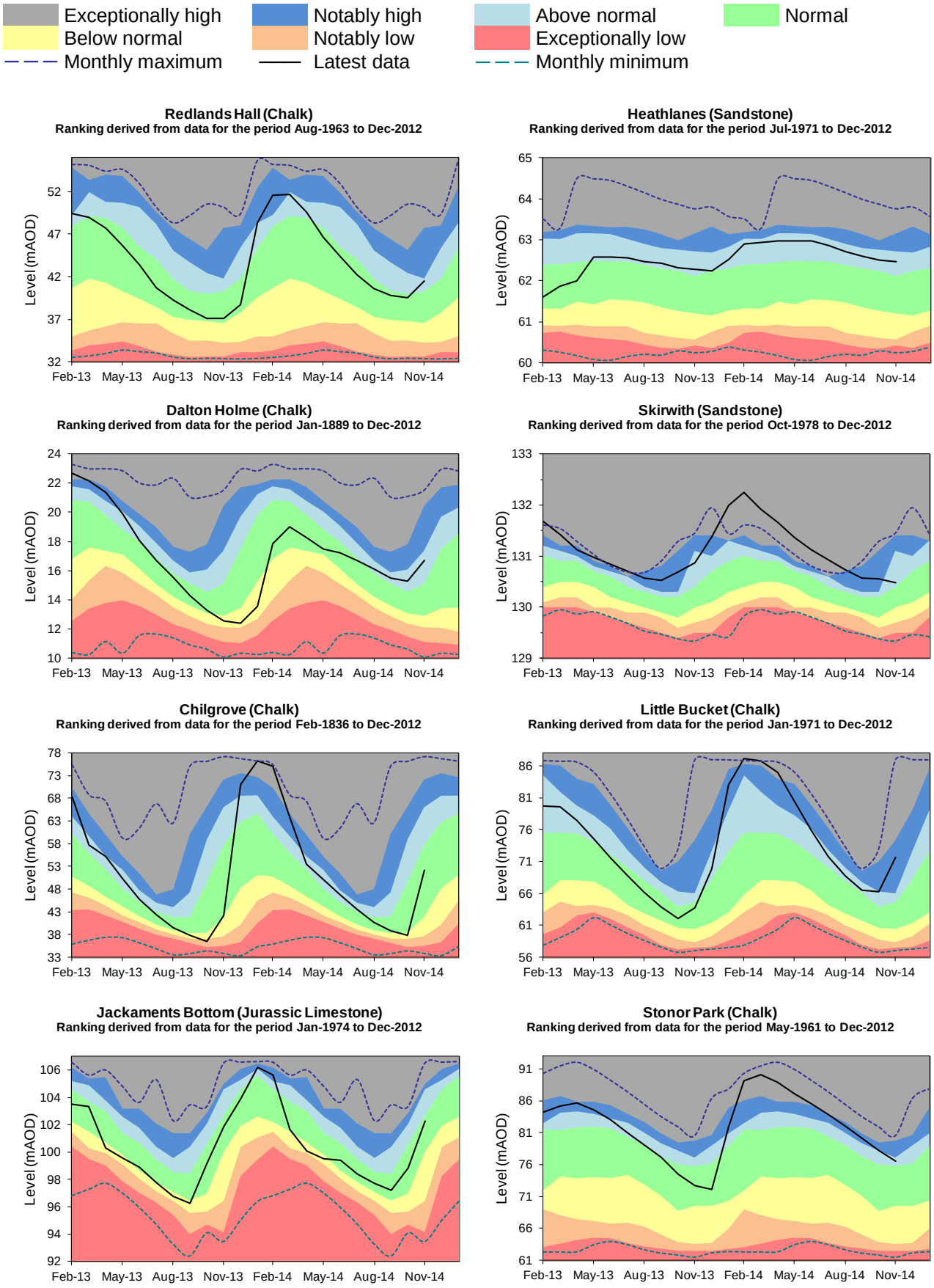
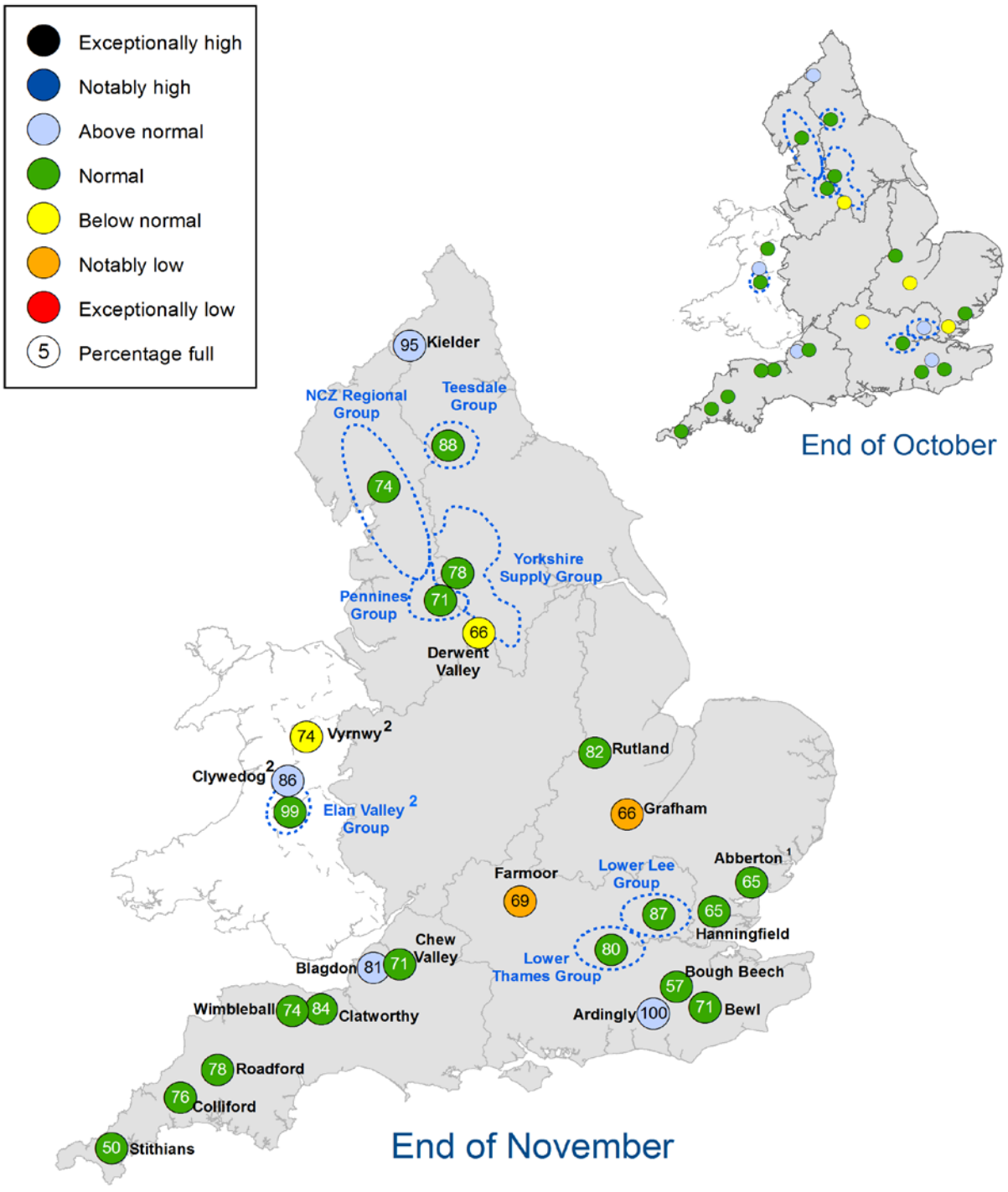



**Figure 4.2**: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

# 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 north-west England

**Figure 5.1**: Reservoir stocks at key individual and groups of reservoirs at the end of October and November 2014 as a percentage of total capacity and classed relative to an analysis of historic October and November 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.

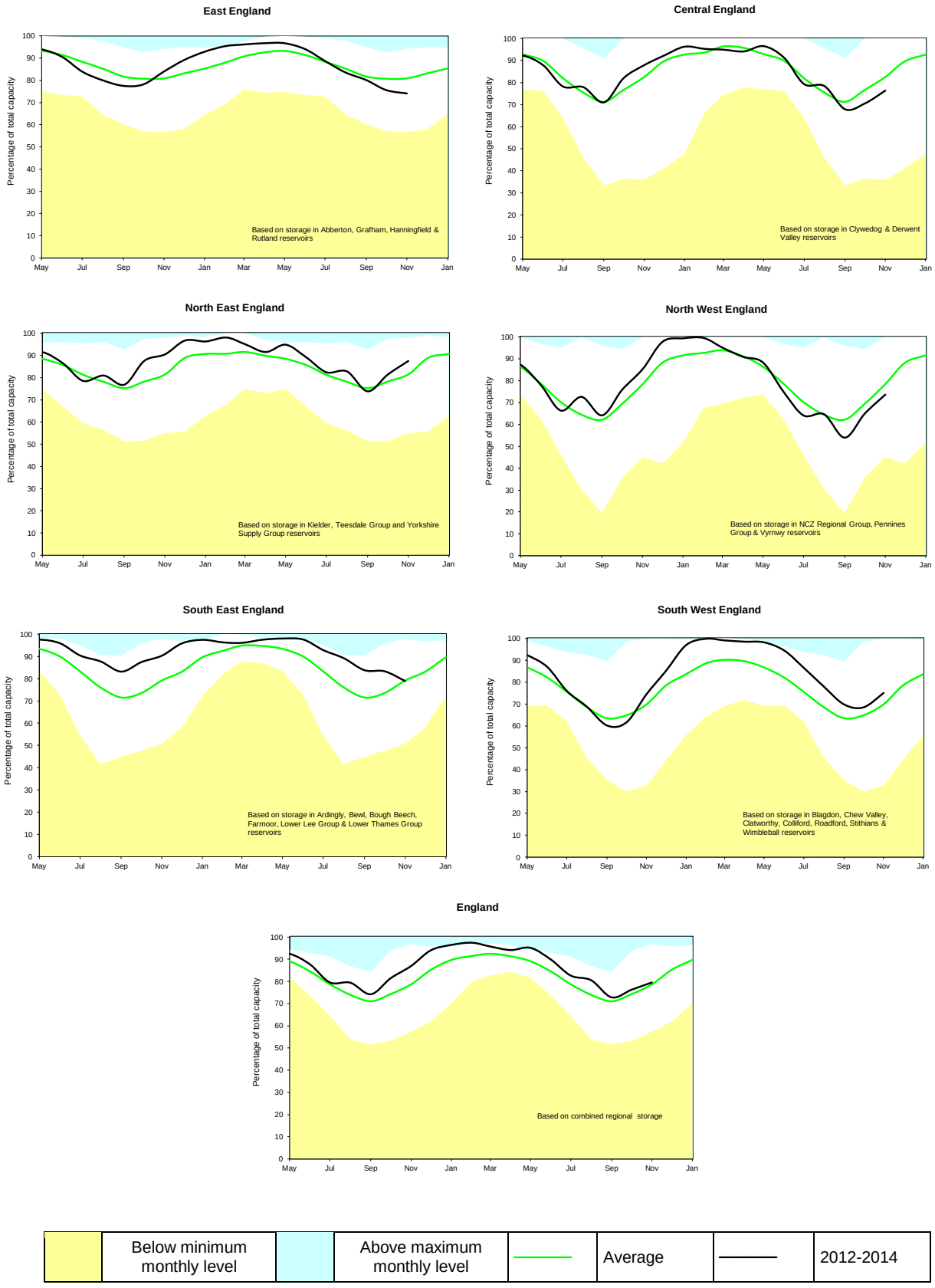



**Figure 5.2**: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

# Forward look – river flow

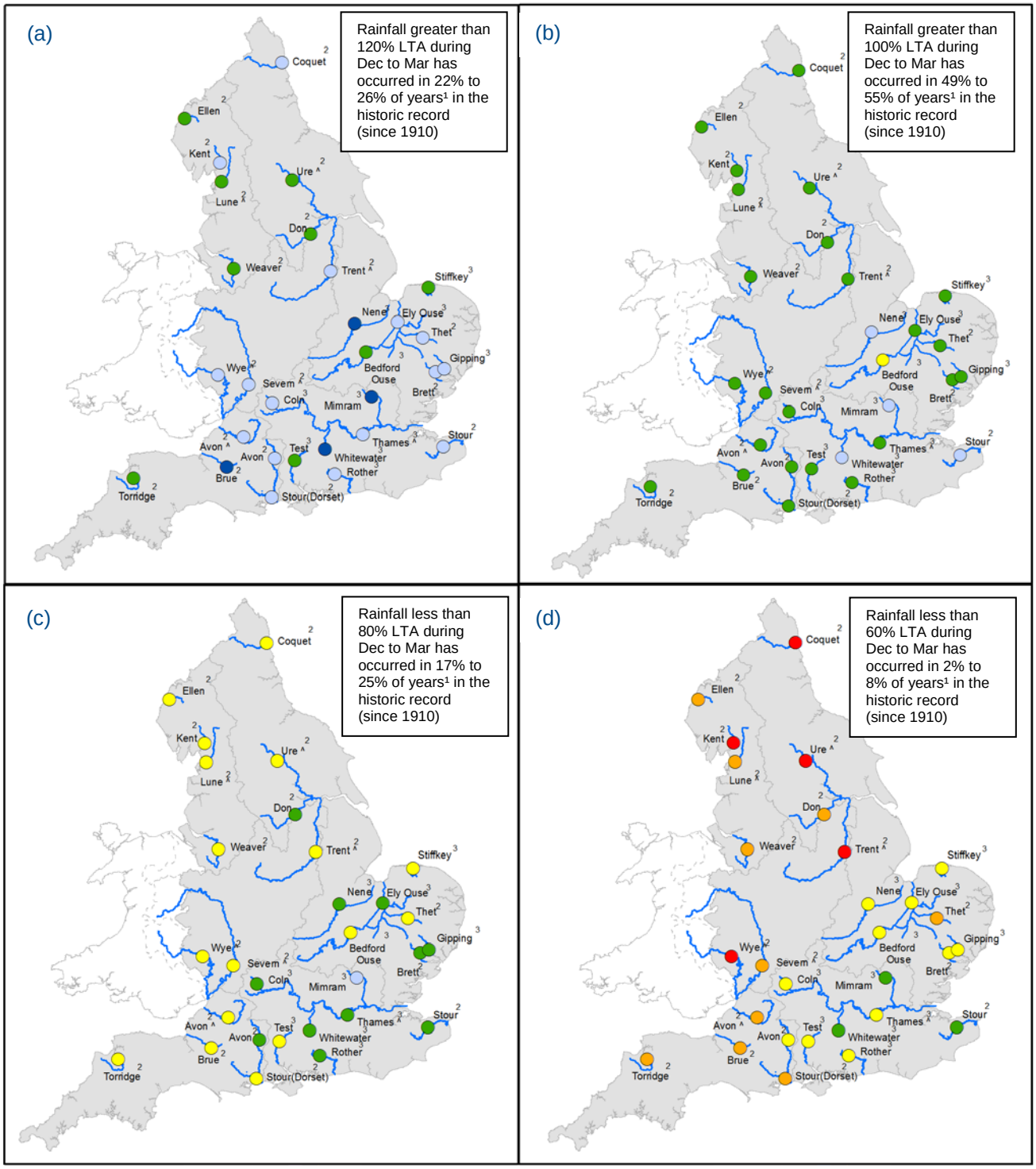



**Figure 6.1**: Projected river flows at key indicator sites up until the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2014 and March 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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

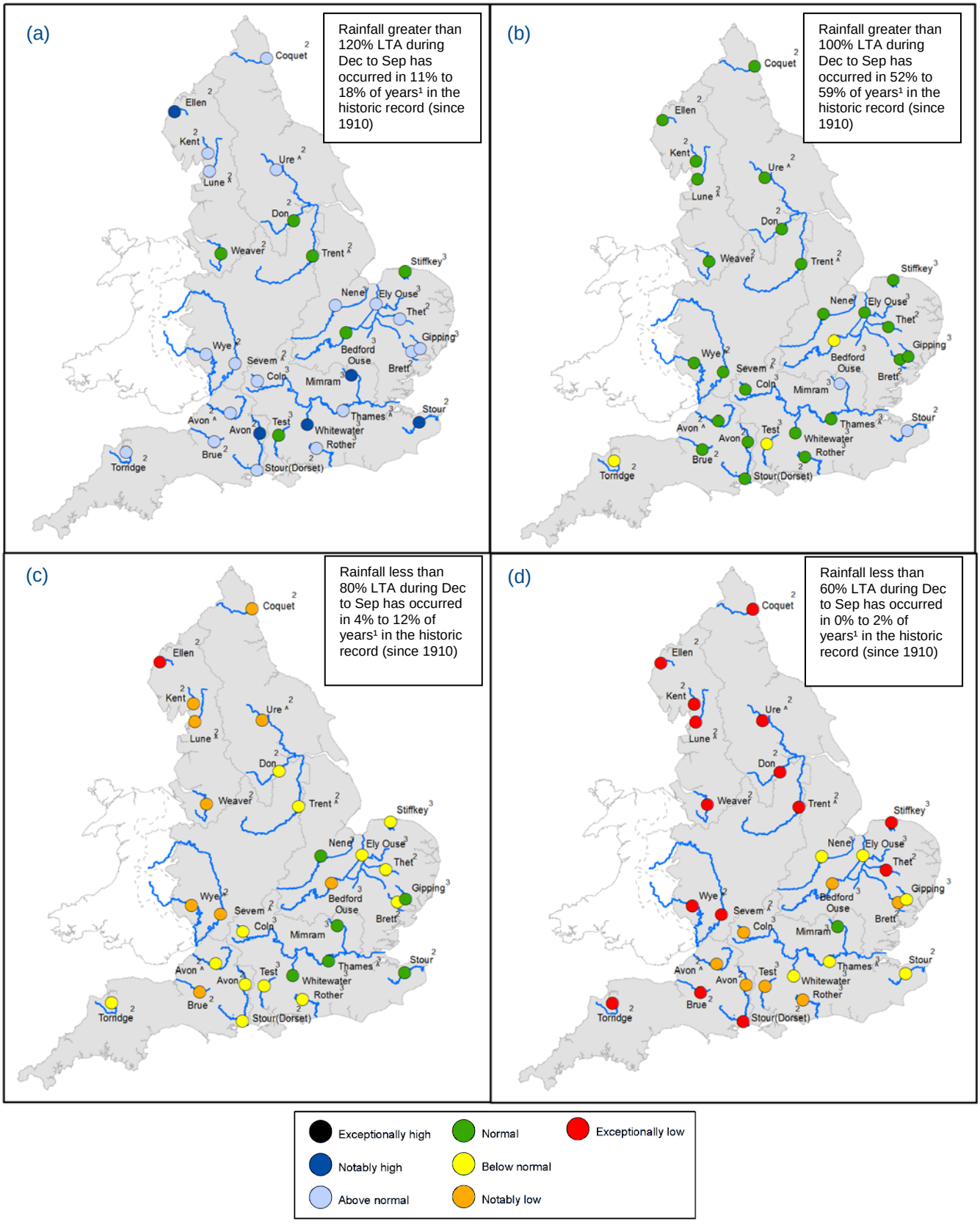



**Figure 6.2**: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2014 and March 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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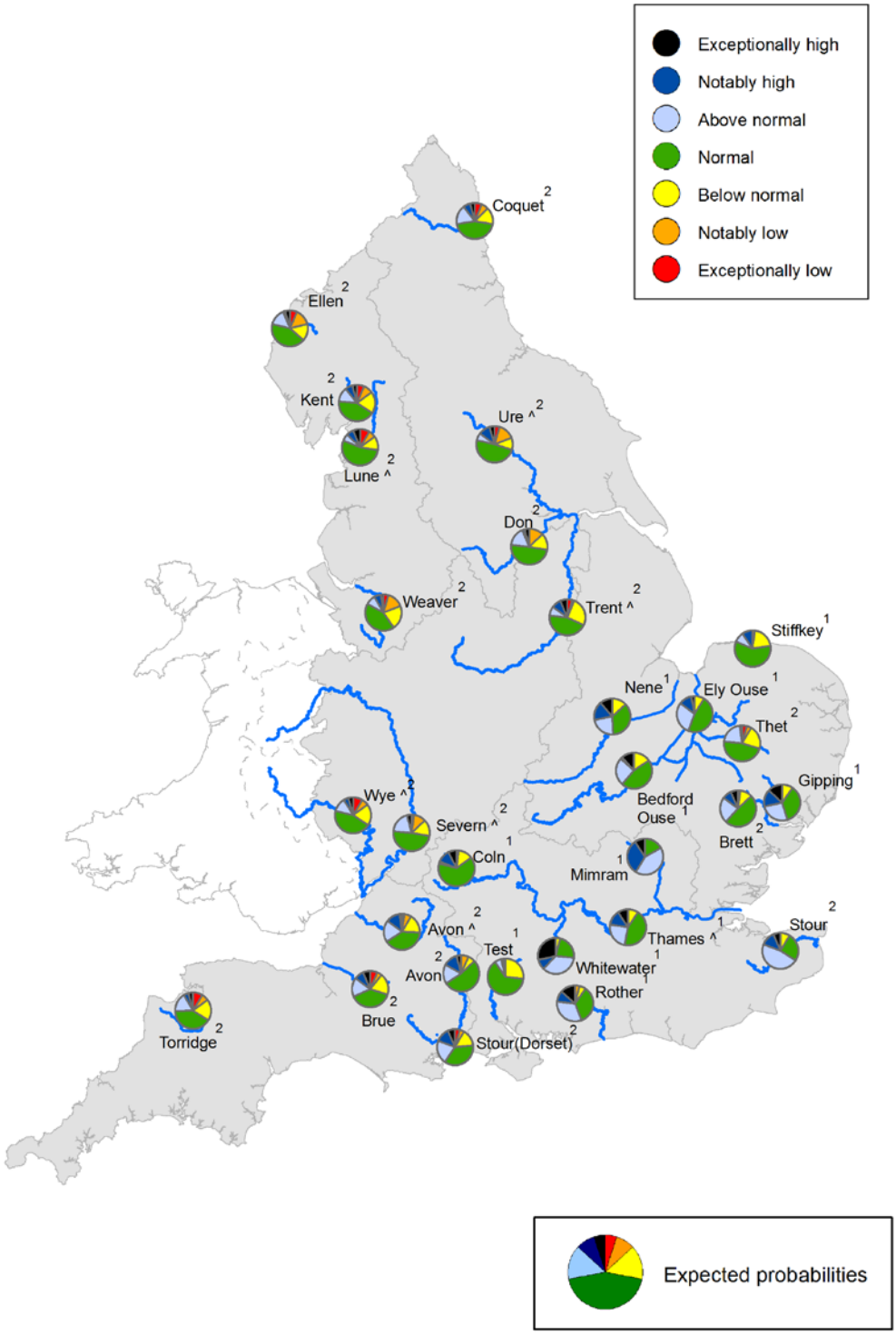
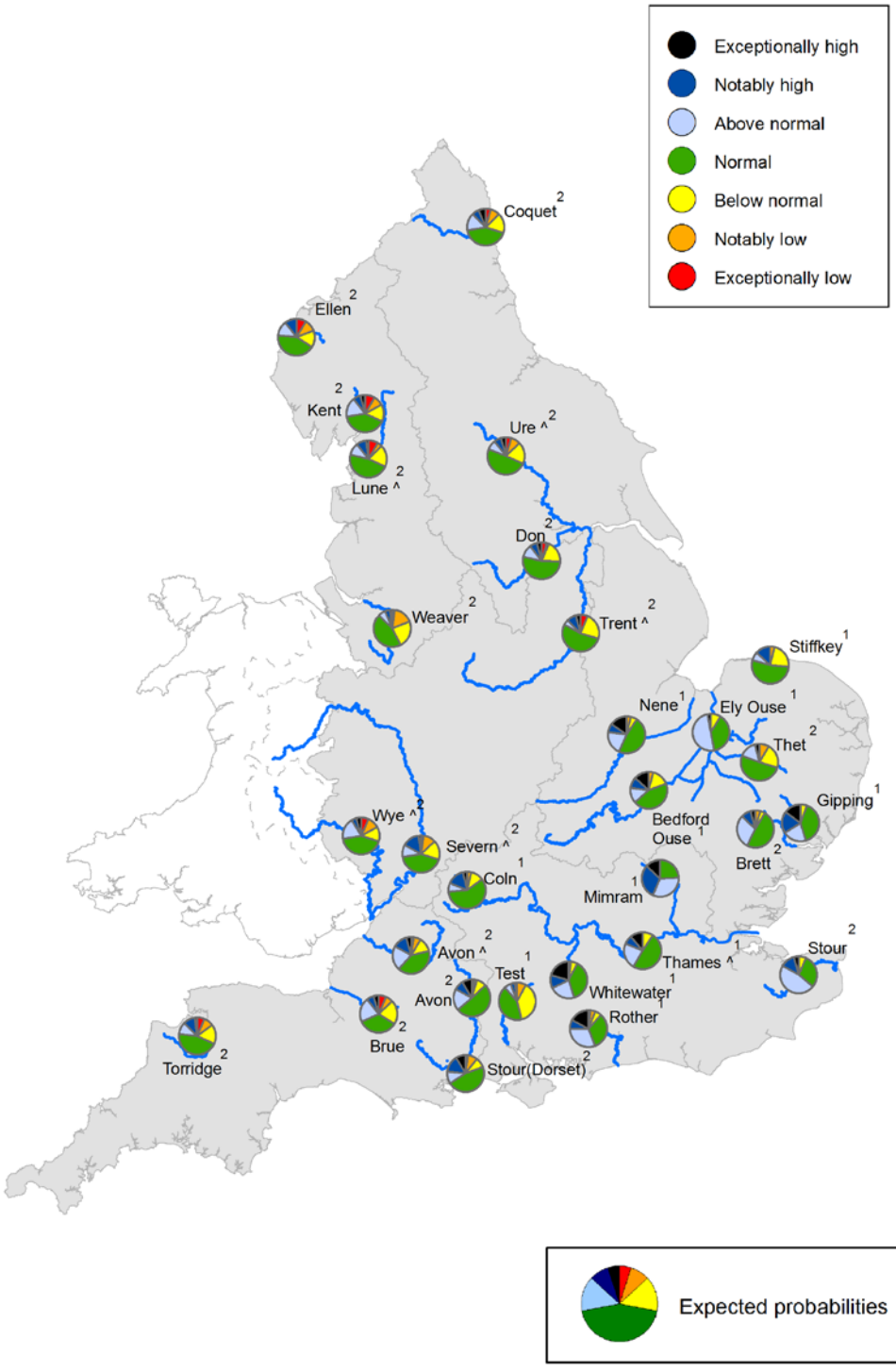



*Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels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




*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 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

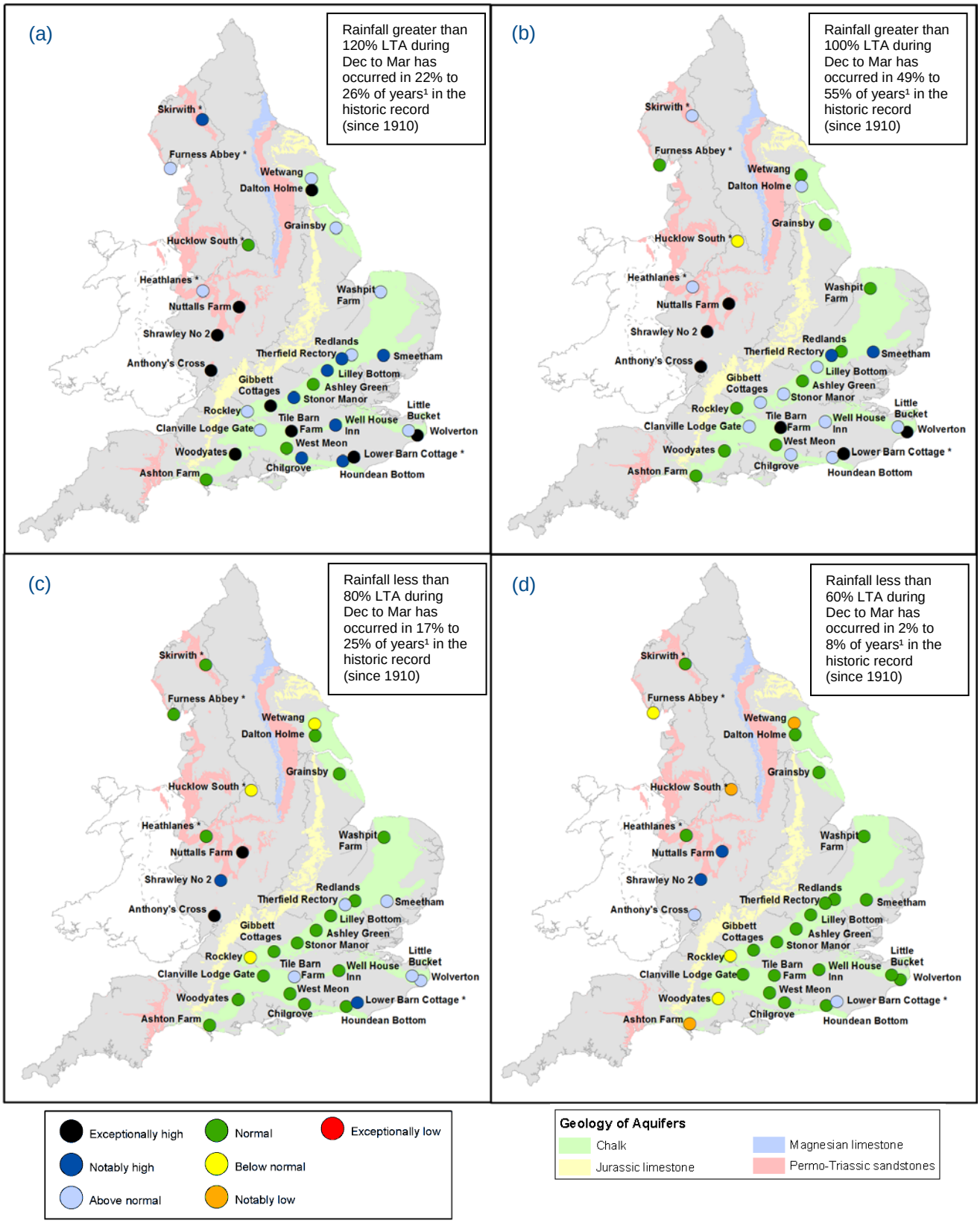



**Figure 6.5**: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2014 and March 2015 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2014.

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

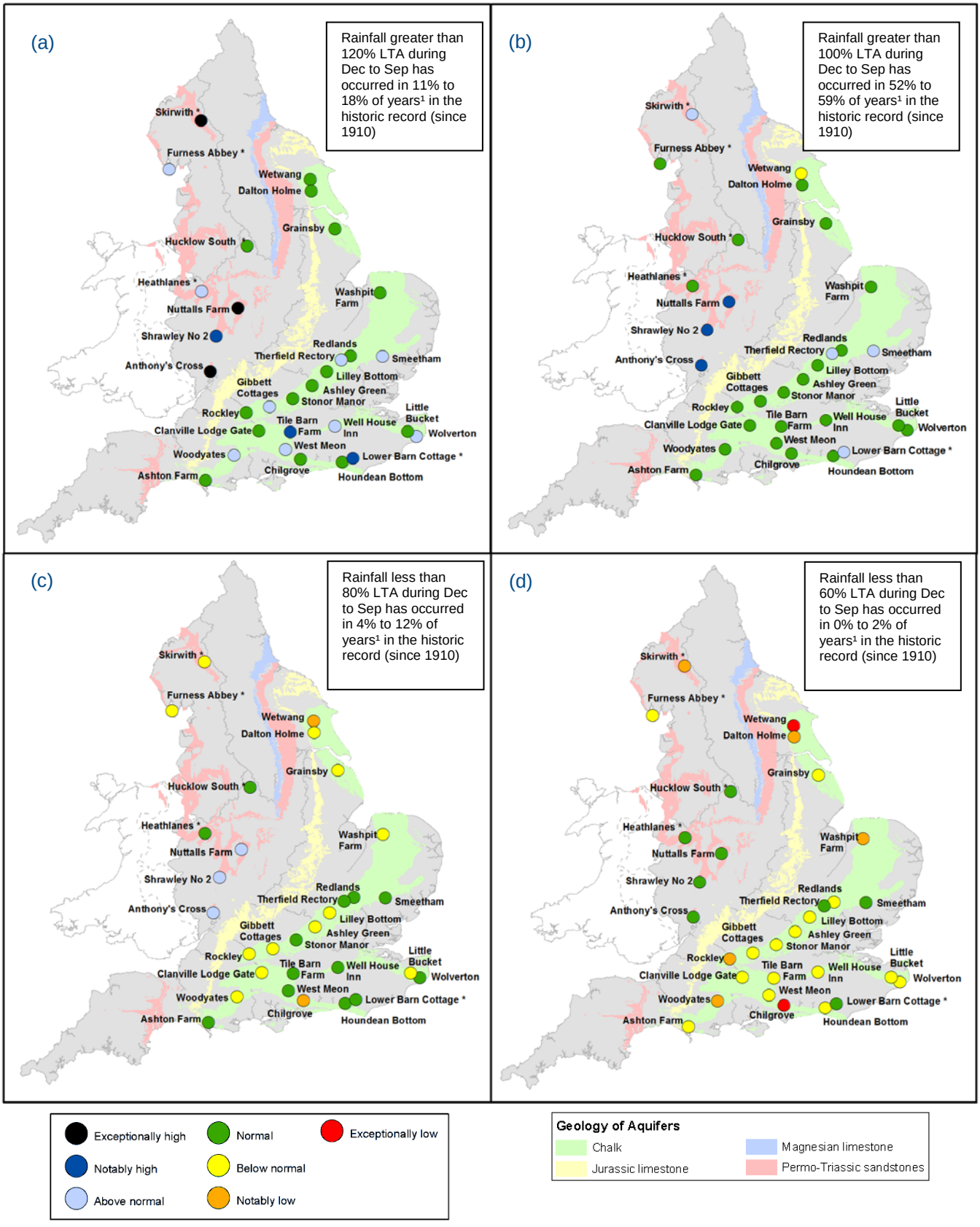



**Figure 6.6**: Projected groundwater levels at key indicator sites at the end of September 2015 Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2014 and September 2015 (Source: Environment Agency) Geological map reproduced with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

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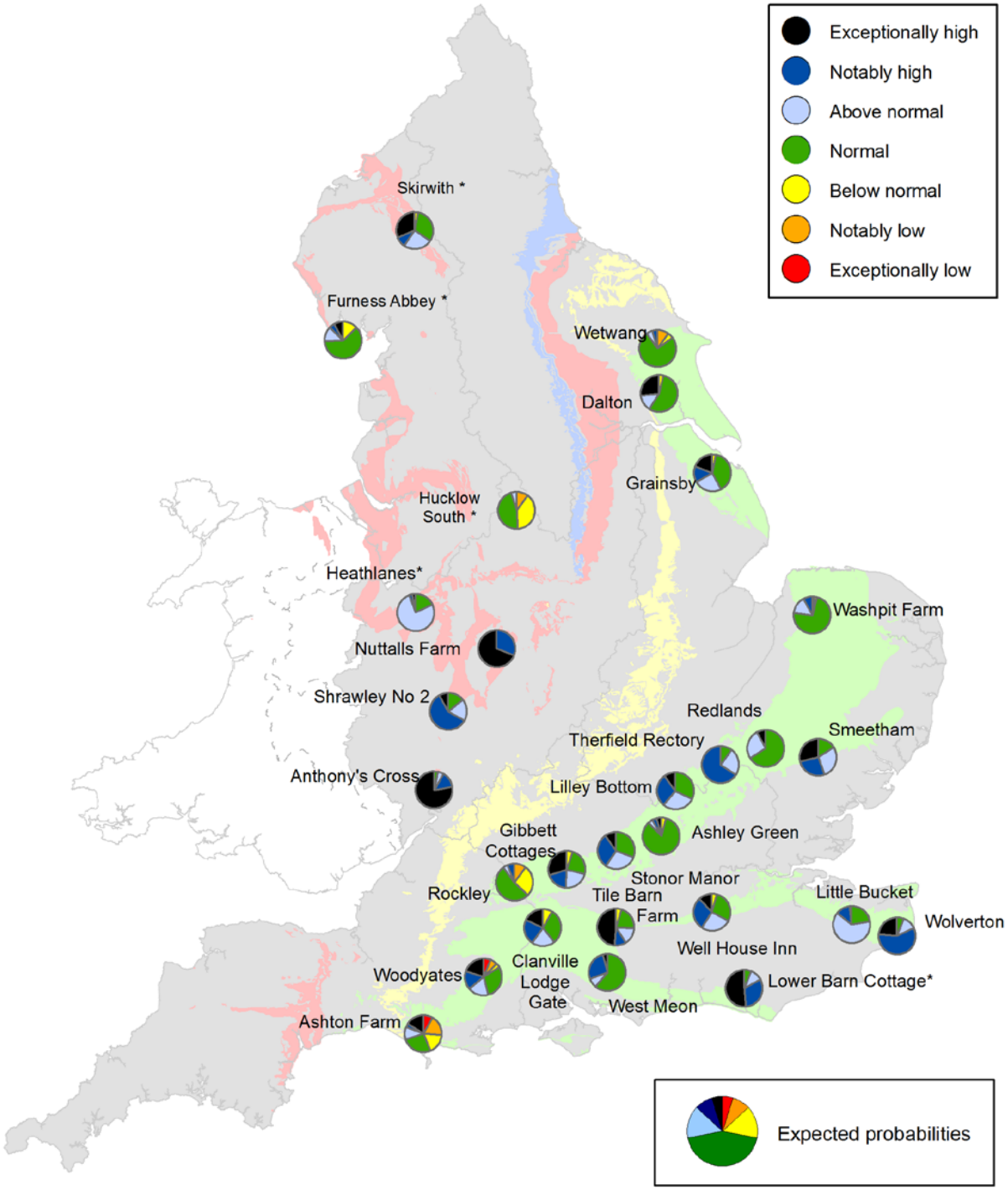
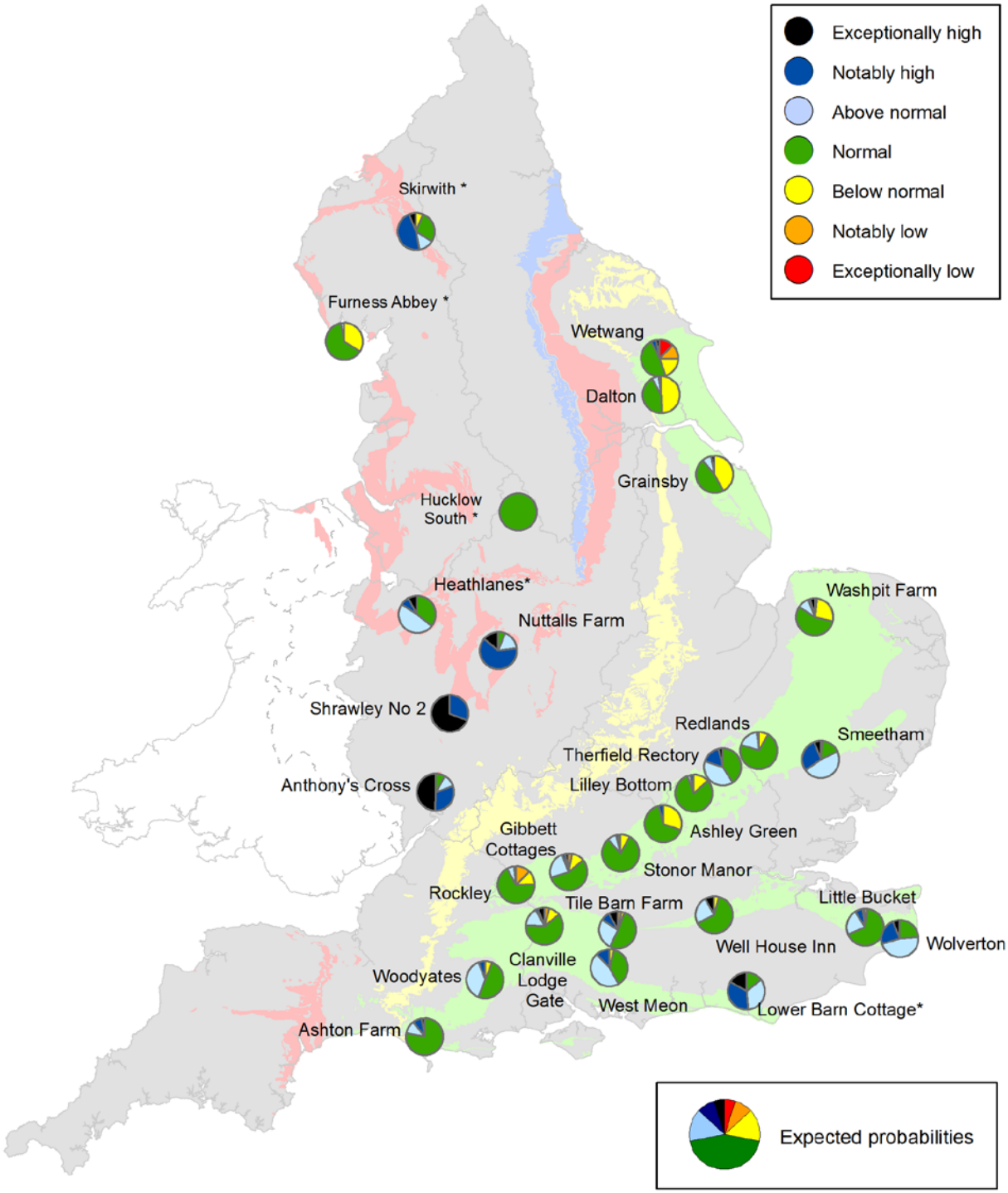
[1] This range of probabilities is a regional analysis




*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 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




*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 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 |