Monthly water situation report

England

Summary – May 2014

May has been an above average month in terms of precipitation; England received 160% of the May long term average (LTA). Rainfall totals for the time of year were classed as *normal* or *above normal* across the northwest, southeast and southwest of England, and *notably high* or *exceptionally high* across central, east and northeast England. Consequently, soil moisture deficits (SMDs) decreased across the majority of the country. Monthly mean river flows for May were *normal* or *above normal* for the time of year at the majority of sites reported on across England. Groundwater levels decreased at most of our indicator sites during May, but remain at *normal* or higher levels for the time of year at all but two of the sites reported on. Overall reservoir stocks increased during May with storage in England as a whole at 95% of total capacity at the end of the month.

Rainfall

In May, the highest rainfall totals (more than 120 mm) fell across parts of Yorkshire and Derbyshire, whilst the lowest rainfall totals (less than 60 mm) fell across parts of Kent and East Sussex (Figure 1.1).

May rainfall totals were classed as *normal* or *above normal* for the majority of hydrological areas across southeast and southwest England, and also in northwest parts of England. Across the majority of central and northeast parts of England, hydrological areas received rainfall totals that were *notably high* for May. A number of hydrological areas across central and eastern England had *exceptionally high* rainfall totals for the time of year. The cumulative rainfall maps show that rainfall totals over the last three months have been *normal* or *above normal* across most of England. However, the exceptional winter rainfall experienced at the start of this year is evident in the cumulative six month rainfall totals, with the majority of hydrological areas having *exceptionally high* or *notably high* rainfall totals for the six month period ending in May (Figure 1.2).

Rainfall totals for May were above average in all regions of England, with the highest occurring in the northeast at 106 mm and lowest in the southeast of England at 76 mm. Monthly totals as a percentage of the May long term average ranged from 129% in the northwest to 199% in the east. Overall, England received 160% of the LTA rainfall for May (Figure 1.3). It has been the wettest six month period ending in May on record in southeast and southwest England, and across England as a whole, and the second wettest six month period ending in May in central and northwest England.

Soil moisture deficit

At the end of May, soil moisture deficits ranged from zero across parts of Yorkshire and Derbyshire, up to more than 50 mm in parts of Norfolk, Essex and Kent. The majority of south, central and northwest England had SMDs of less than 10 mm, whereas in eastern England SMDs were generally in the region of 11 - 40 mm. End of May SMDs were 26 - 50 mm less than the LTA in the majority of MORECS grid squares covering south and central England, and up to 25 mm less than the LTA in the majority MORECS squares covering the north and east of England (Figure 2.1).

At the beginning of May, SMDs ranged from 2 mm in the southwest to more than 40 mm in the east. Across England, by the end of May, SMDs decreased by up to 20 mm except in the southwest where SMDs increased marginally by 5 mm (Figure 2.2).

River flows

Monthly mean river flows increased compared to April at approximately half of our indicator sites, reflecting the above average rainfall totals received during May across many parts of England. May river flows were *normal* or *above normal* for the time of year at more than two thirds of the sites reported on. Three sites – the Mersey at Ashton Weir, the Itchen at Allbrook and Highbridge and the Darent at Hawley – had *exceptionally high* flows for May, with the latter two reflecting the high groundwater levels in these areas, which makes up a significant component of the river flow at these sites (Figure 3.1).

River flows at the index sites in central and northwest England were *normal* for the time of year. In eastern and southwest England index river flow sites had *above normal* flows for May. The South Tyne at Haydon Bridge in northeast England and the river Thames at Kingston (naturalised) in southeast England had *notably high* flows (Figure 3.2).

Groundwater levels

Groundwater levels decreased at the majority of indicator sites in England during May. At the end of May, groundwater levels were *normal* or higher for the time of year at all but two of the sites reported on; Wetwang in northeast England and Jackaments Bottom in southeast England both had *below normal* levels for the end of May (Figures 4.1 and 4.2). Groundwater levels remain *above normal* or higher for the time of year in the majority of indicator sites in the chalk of southern England. Levels at Skirwith, located in sandstone in northwest England had the highest groundwater levels on record for the end of May. Groundwater levels at Priors Heyes remain *exceptionally high* compared with past levels as the aquifer is recovering from the effects of historic abstraction.

Reservoir storage

During May, reservoir stocks increased at approximately half of the reservoirs and reservoir groups reported on. The largest increase in storage was 5% of total capacity, which occurred in the Derwent Valley supplying Derbyshire and parts of central England, and in the Teesdale Group supplying parts of northeast England. Reservoir stocks remained static at approximately one third of the reservoirs or reservoir groups reported on, and decreased in seven. The largest decrease in storage was 6% of total capacity, which occurred in the NCZ regional group, supplying northwest England and in Bough Beech reservoir which supplies parts of southeast England. Reservoir stocks were classed as *normal* or higher for the time of year at all of the sites reported on. One site, Chew Valley reservoir in southwest England, had stocks classed as *exceptionally high* for the end of May (Figure 5.1).

At a broader scale, overall reservoir stocks increased in central, northeast and southeast England, and decreased or remained static elsewhere. The largest increase was around 3% of total capacity which was seen in northeast England. At the end of May, overall reservoir stocks were lowest in northwest England at 88% of total capacity, and highest in southwest England at 98% of full capacity. Overall reservoir storage for England increased in May to 95% of total capacity (Figure 5.2).

Forward look

June will see spells of fine weather interspersed with unsettled periods. Mid-month will be wetter in the northwest than in southern areas, but overall rainfall is expected to be near-average or slightly above for the time of year. Temperatures are expected to be near average for the time of year overall, higher than average during fine periods, and lower than average during unsettled spells. Longer term, there is no strong signal in the precipitation forecast for June-July-August[1].

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

September 2014: With average (100% of the LTA) rainfall between June and the end of September 2014, cumulative river flows are likely to be *normal* at a third of our modelled sites, and higher at all of the others. With 120% of the LTA rainfall, river flows are likely to be *above normal* or higher at four fifths of the modelled sites. With 80% of the LTA rainfall river flows are likely to be *normal* or higher at all except three of the modelled sites (see Figure 6.1).

March 2015: With average rainfall between June 2014 and the end of March 2015, cumulative river flows are likely to be *normal* at over four fifths of the modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *above normal* or higher at all except one of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *notably low* or lower at a third of the modelled sites (see Figure 6.2).

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

September 2014: All except one of our modelled sites have a greater than expected chance of *above normal* or higher cumulative flows from June to September 2014. Nearly a third of the sites have a greater than expected chance of *normal* flows (see Figure 6.3).

March 2015: Four fifths of all modelled sites have a greater than expected chance of *above normal* or higher cumulative flows from June 2014 to March 2015. Nearly half of the modelled sites have a greater than expected chance of *normal* flows, whilst over a quarter of the modelled sites have a greater than expected chance of *below normal* flows between June 2014 and March 2015 (see Figure 6.4).

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) from June to September 2014, groundwater levels are likely to be *normal* or higher for the time of year at all except 3 modelled sites, and *above normal* or higher at more than half of the modelled sites. With above average rainfall (120% of the LTA) nearly two thirds of the modelled sites are likely to be *above normal* or higher. With 80% of the LTA rainfall, all except four modelled sites are likely to have *normal* or higher groundwater levels for the time of year (see Figure 6.5).

March 2015: With average rainfall (100% of the LTA) from June 2014 to March 2015, 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 *notably high* or higher for the time of year at more than half of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* or lower at a third of our modelled sites (see Figure 6.6).

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

September 2014: more than two thirds of modelled sites have a greater than expected chance of *above normal* or higher groundwater levels for the time of year. A third of the sites have a greater than expected chance of *normal* levels. Only three sites have a greater than expected chance of *below normal* or lower levels for the time of year (see Figure 6.7).

March 2015: Three quarters of the modelled sites have a greater than expected chance of levels being *above normal* or higher for the time of year. More than a third of the modelled sites have a greater than expected chance of *normal* groundwater levels by the end of March 2015 (see Figure 6.8).

Authors: E & B Hydrology Team

From April 2014 we are changing the Environment Agency organisational structure so that we no longer have a Regional tier. Over the period of implementation we will be making changes to how we report the water situation to reflect our new structure. We will continue to report the water situation using Regional boundaries until we fully complete these changes.

[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

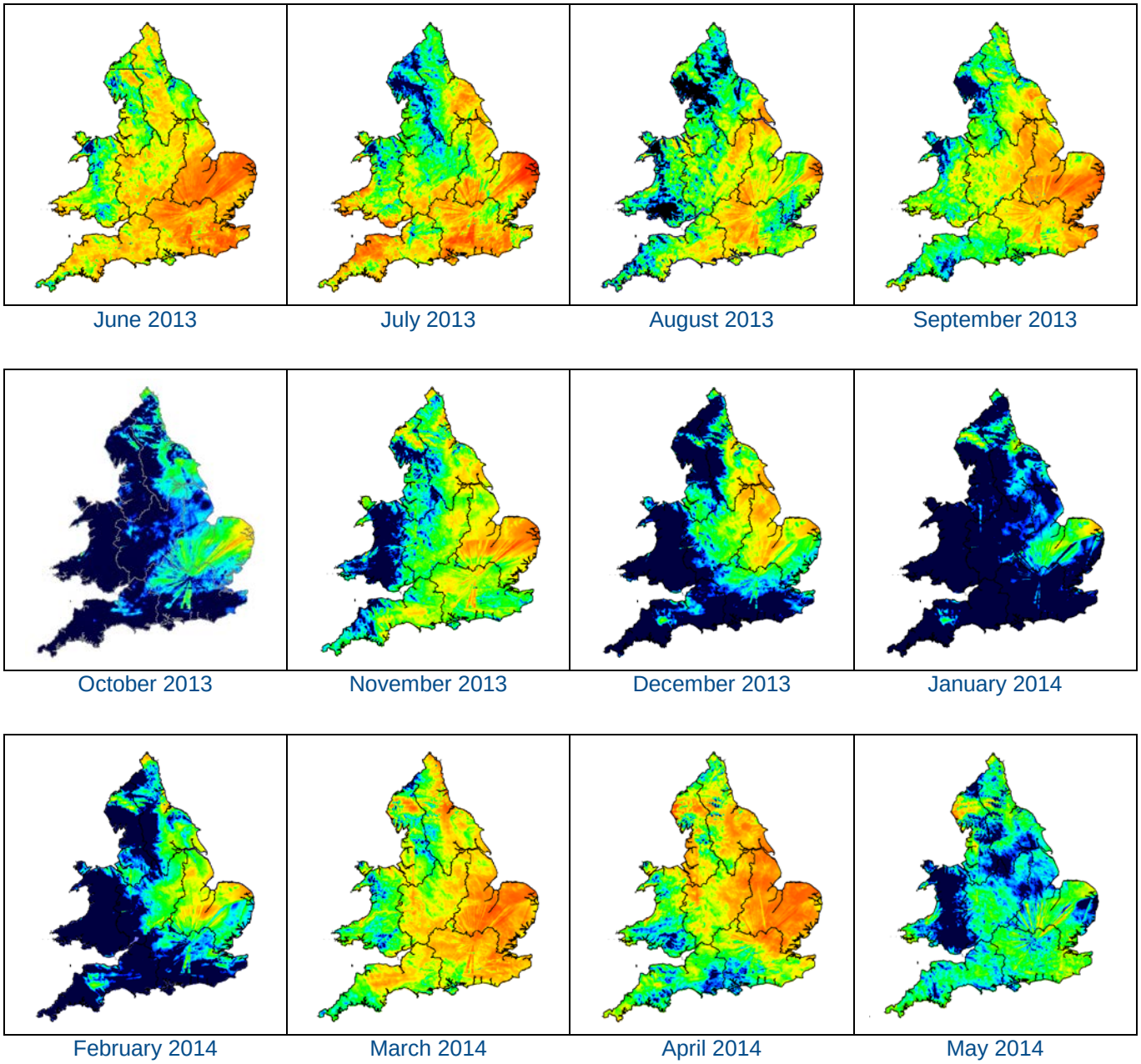


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

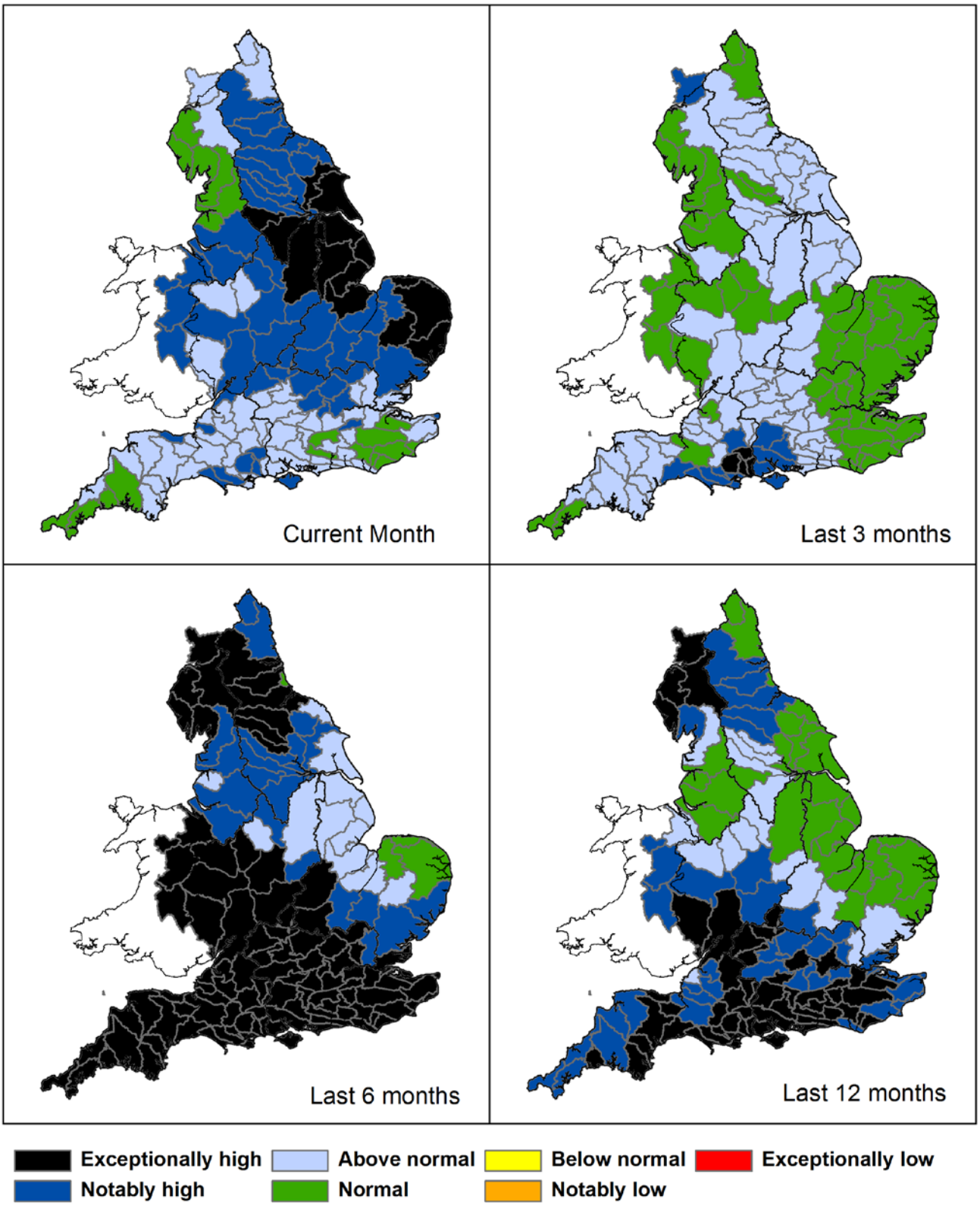


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 May), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data 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.

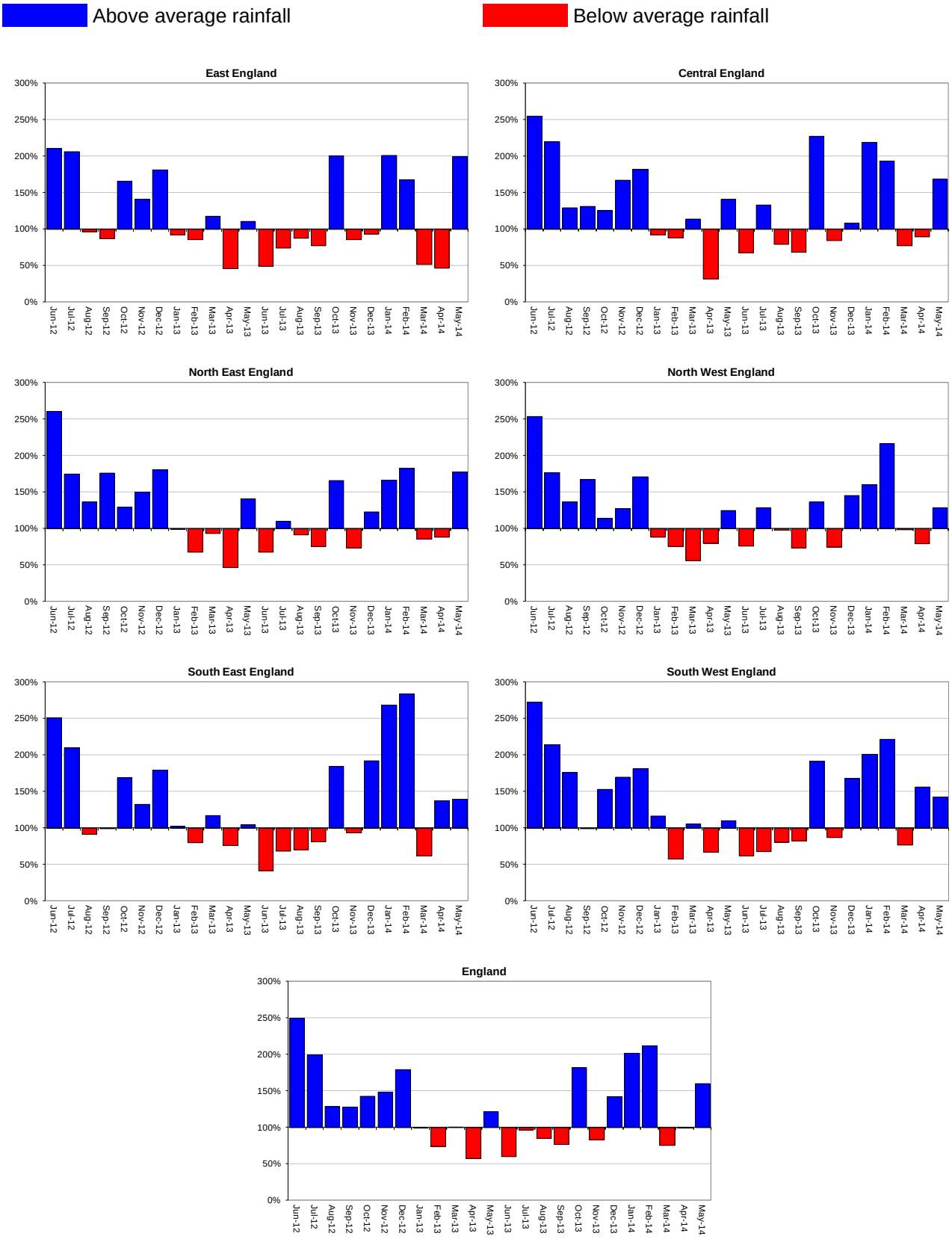


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

Soil moisture deficit

End of April 2014 [1]	End of May 2014 [2]

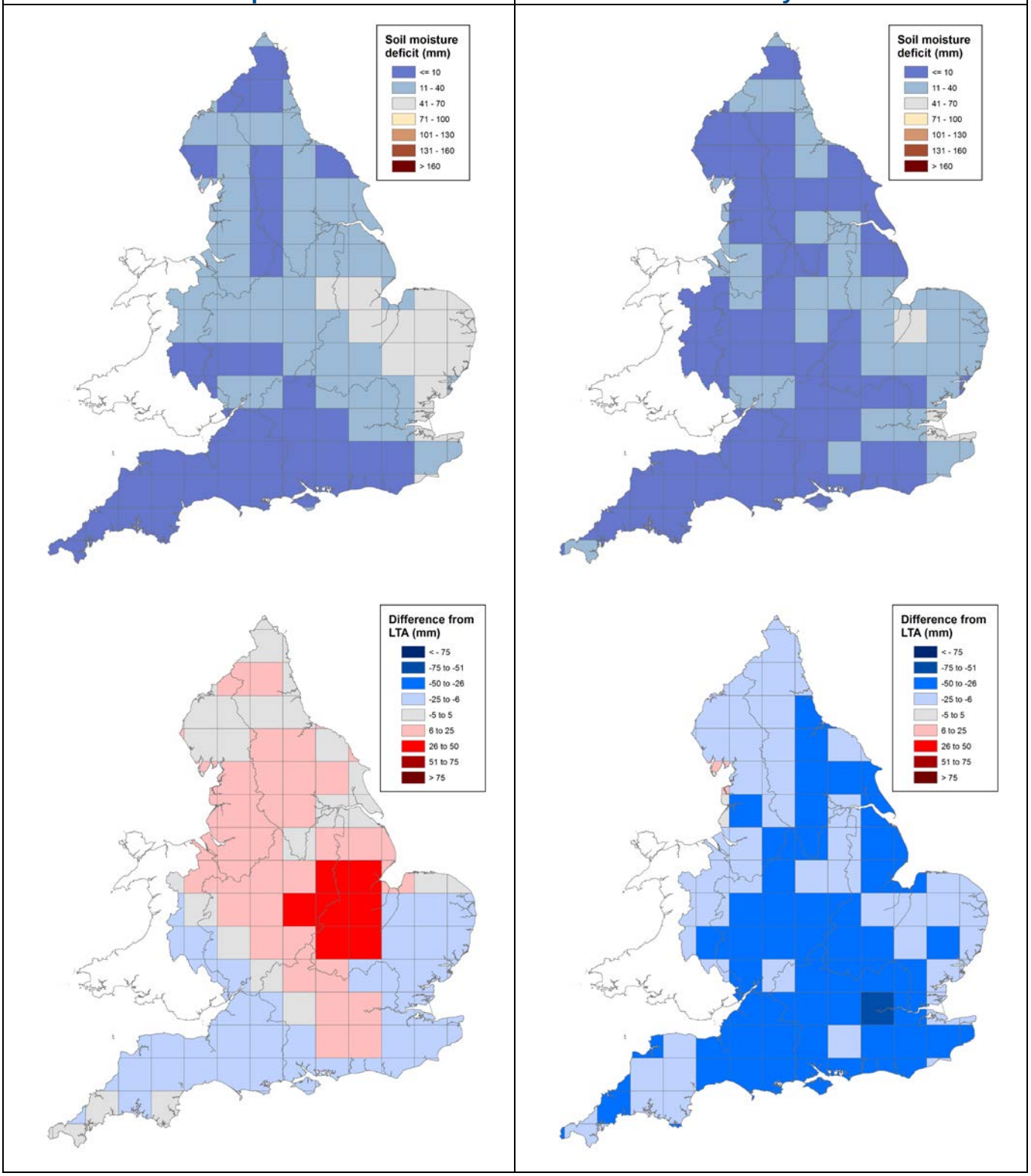


Figure 2.1: Soil moisture deficits for weeks ending 29 April 2014[1] (left panel) and 27 May 2014[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014

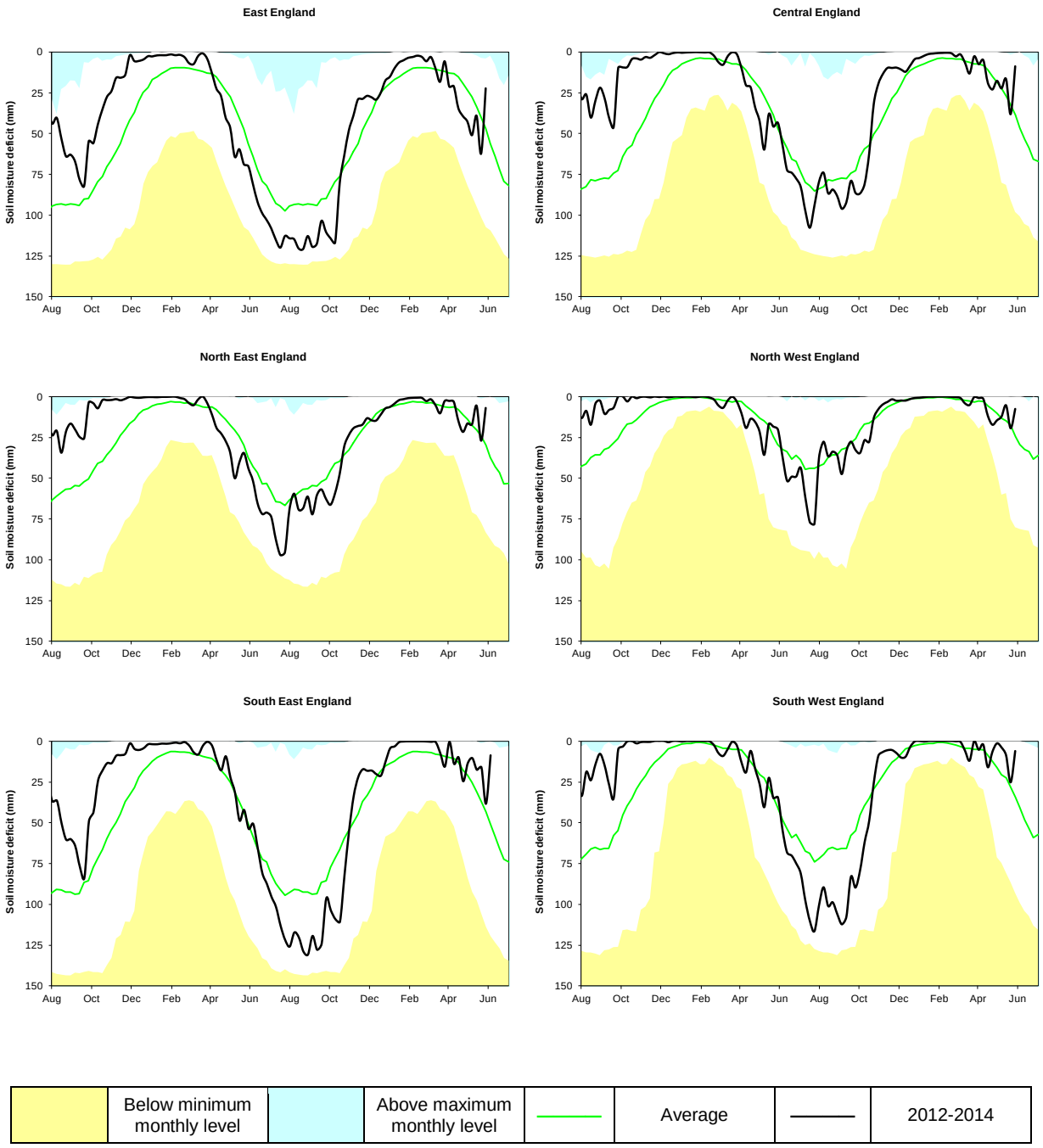
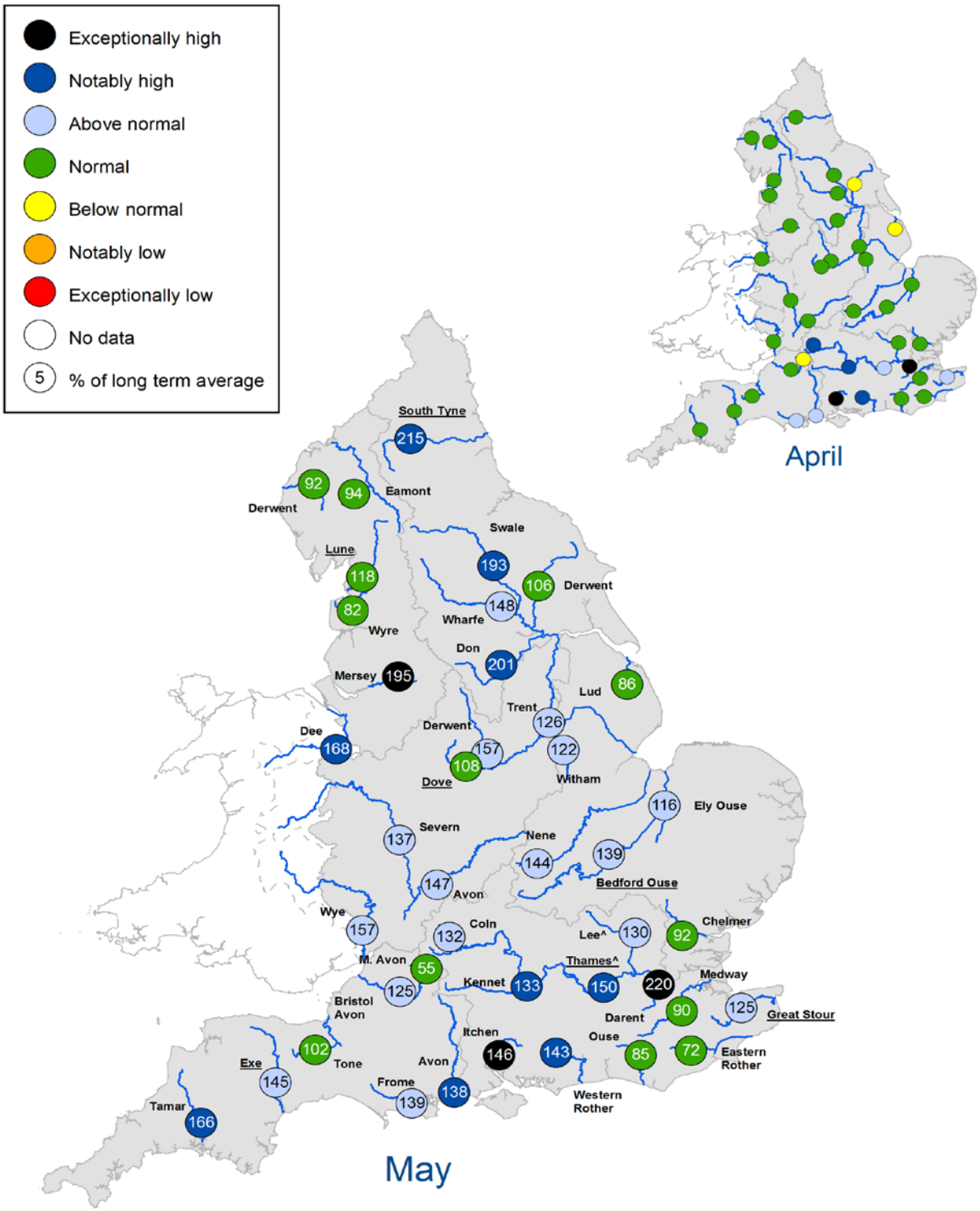


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2014).

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

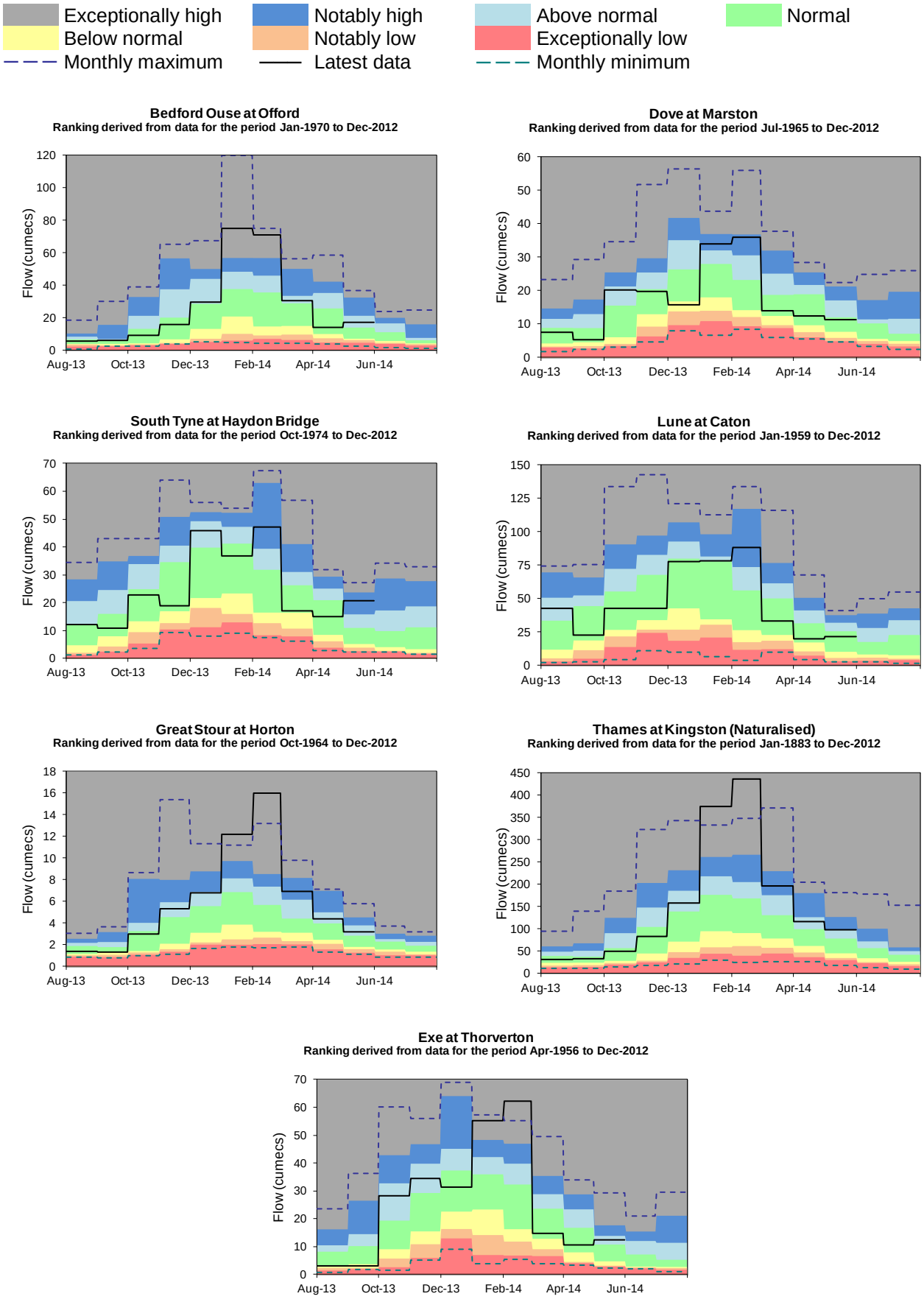
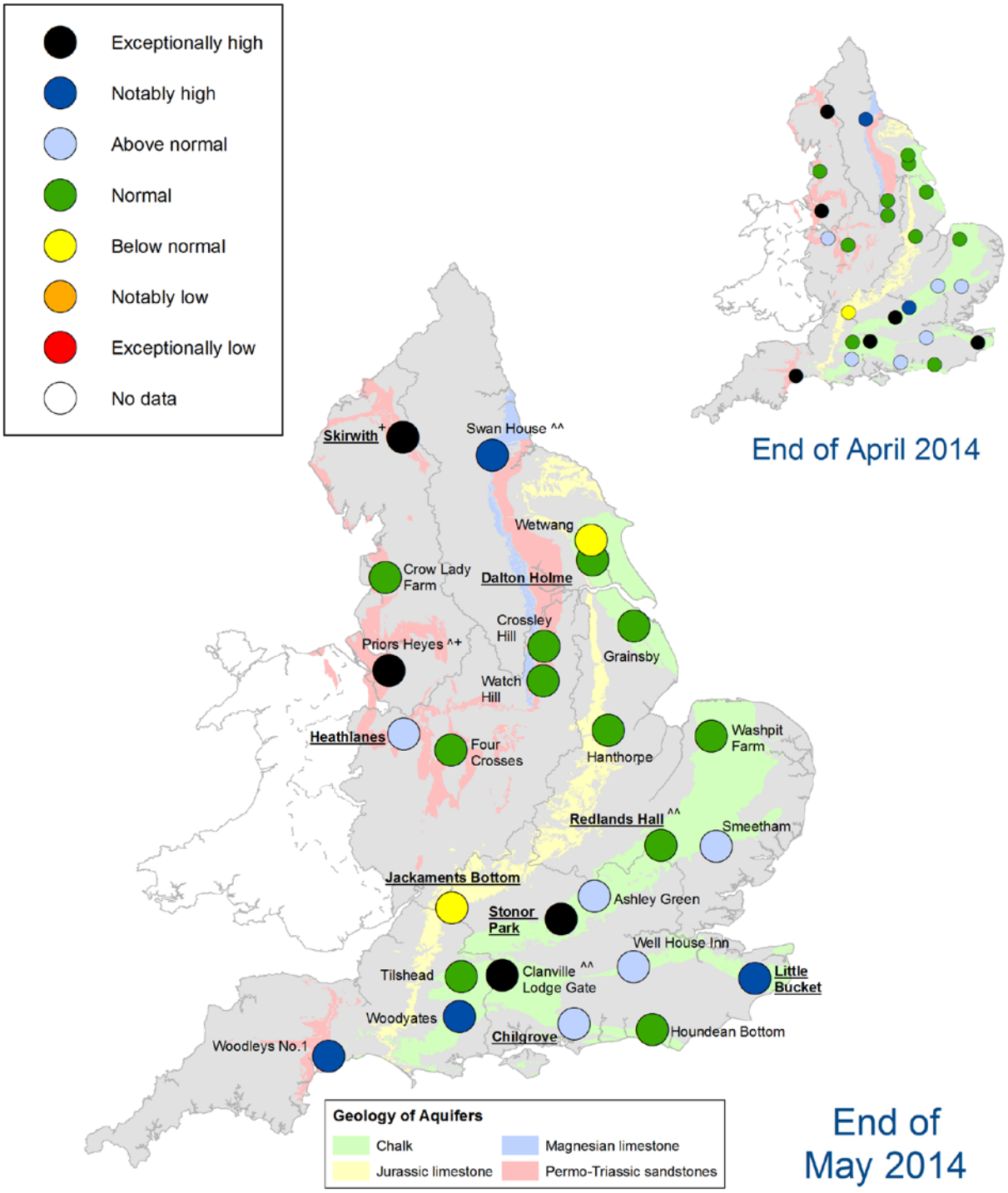


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 April 2014 and May 2014, classed relative to an analysis of respective historic April and May 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.

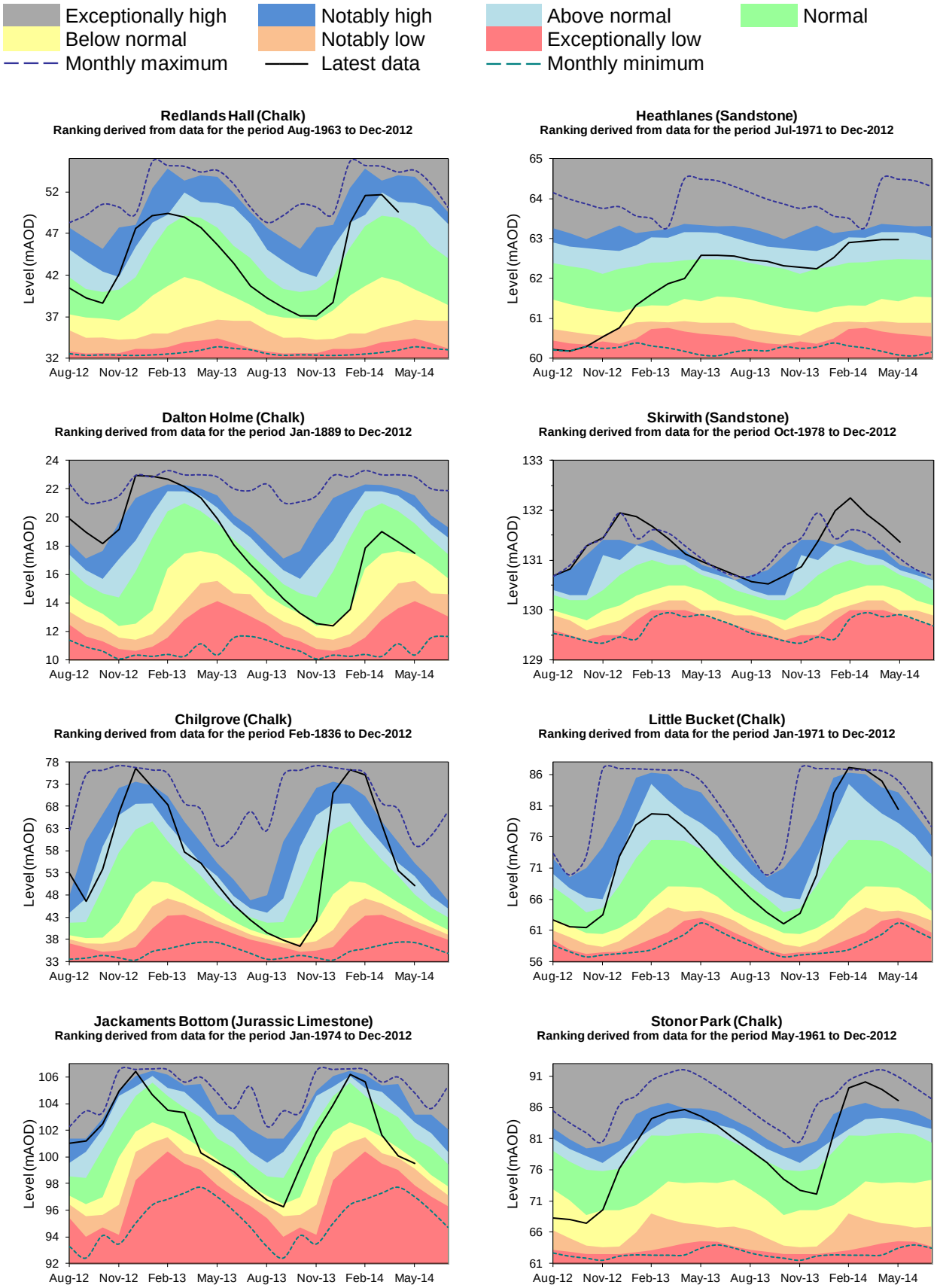
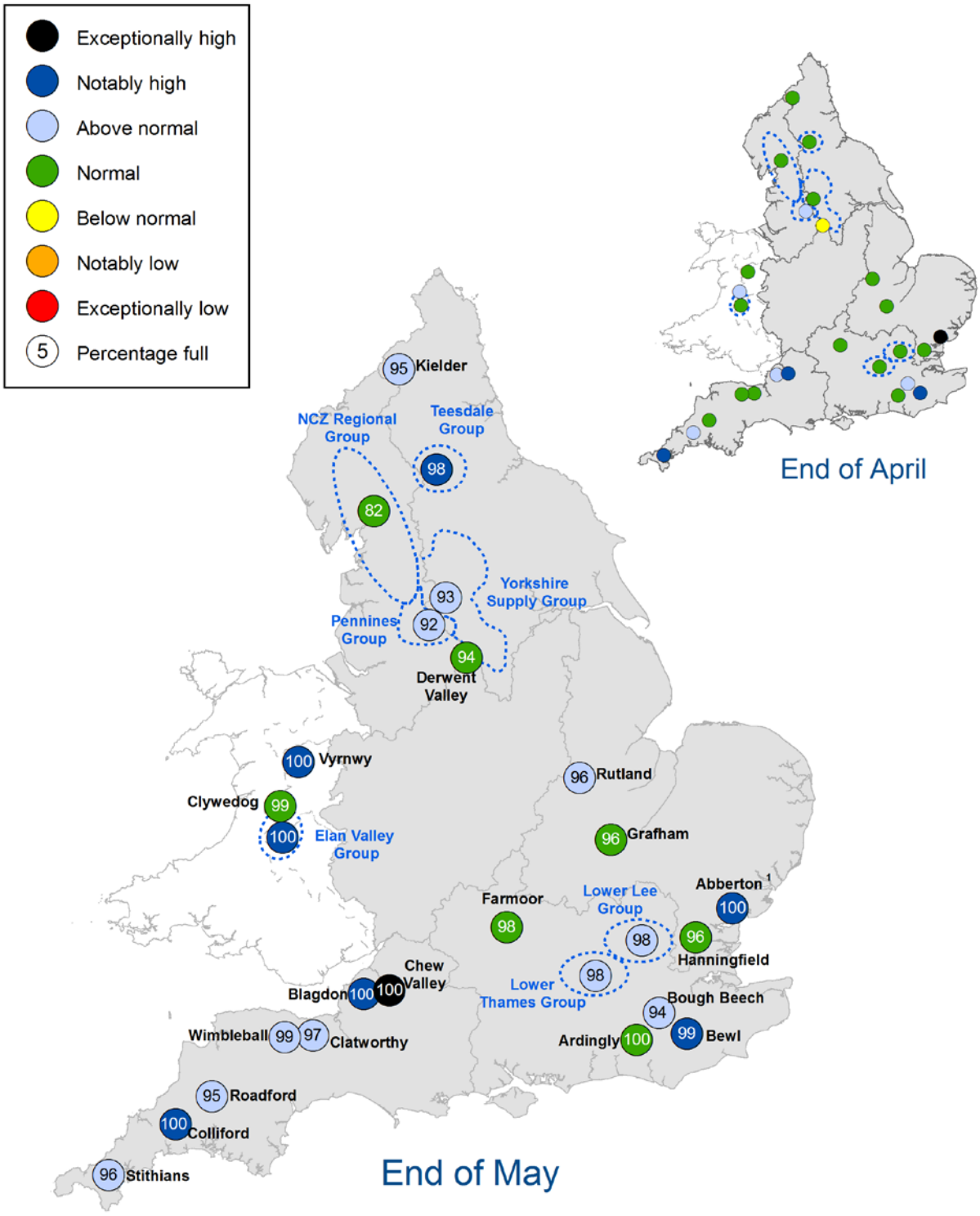


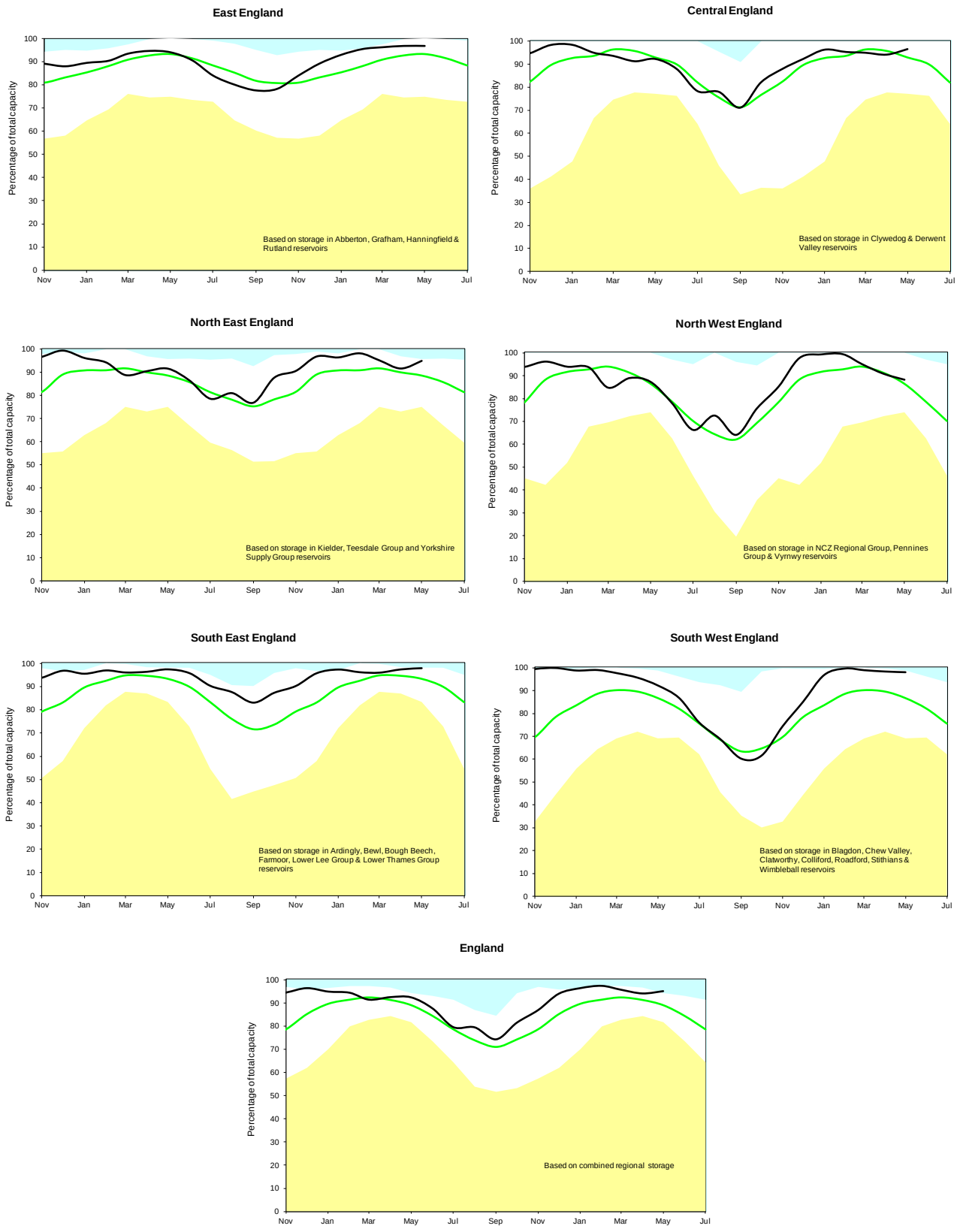
Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

Reservoir storage



1. Water levels are 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 our Midlands and North West regions

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



	Below minimum monthly level		Above maximum monthly level		Average		2012-2014

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

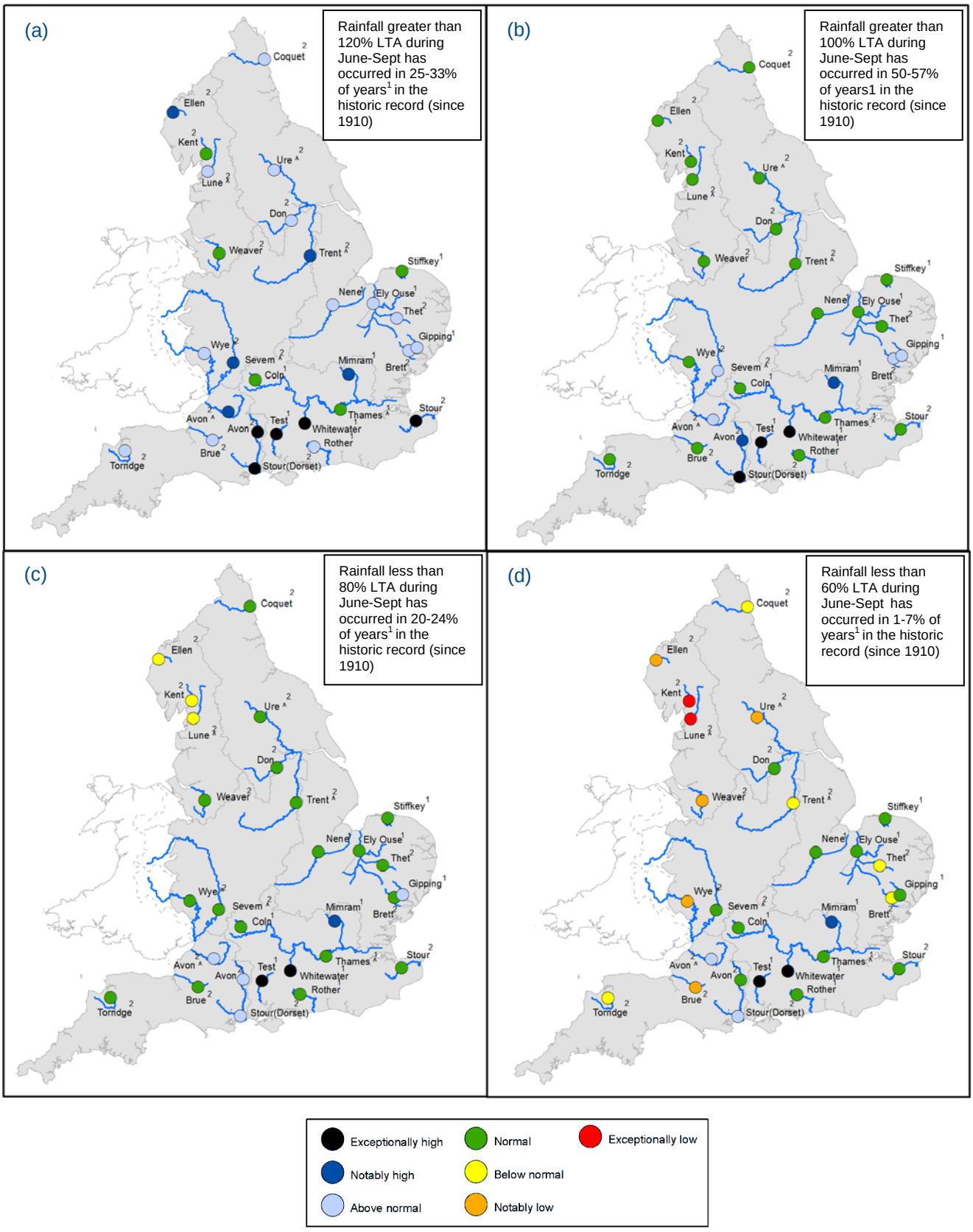
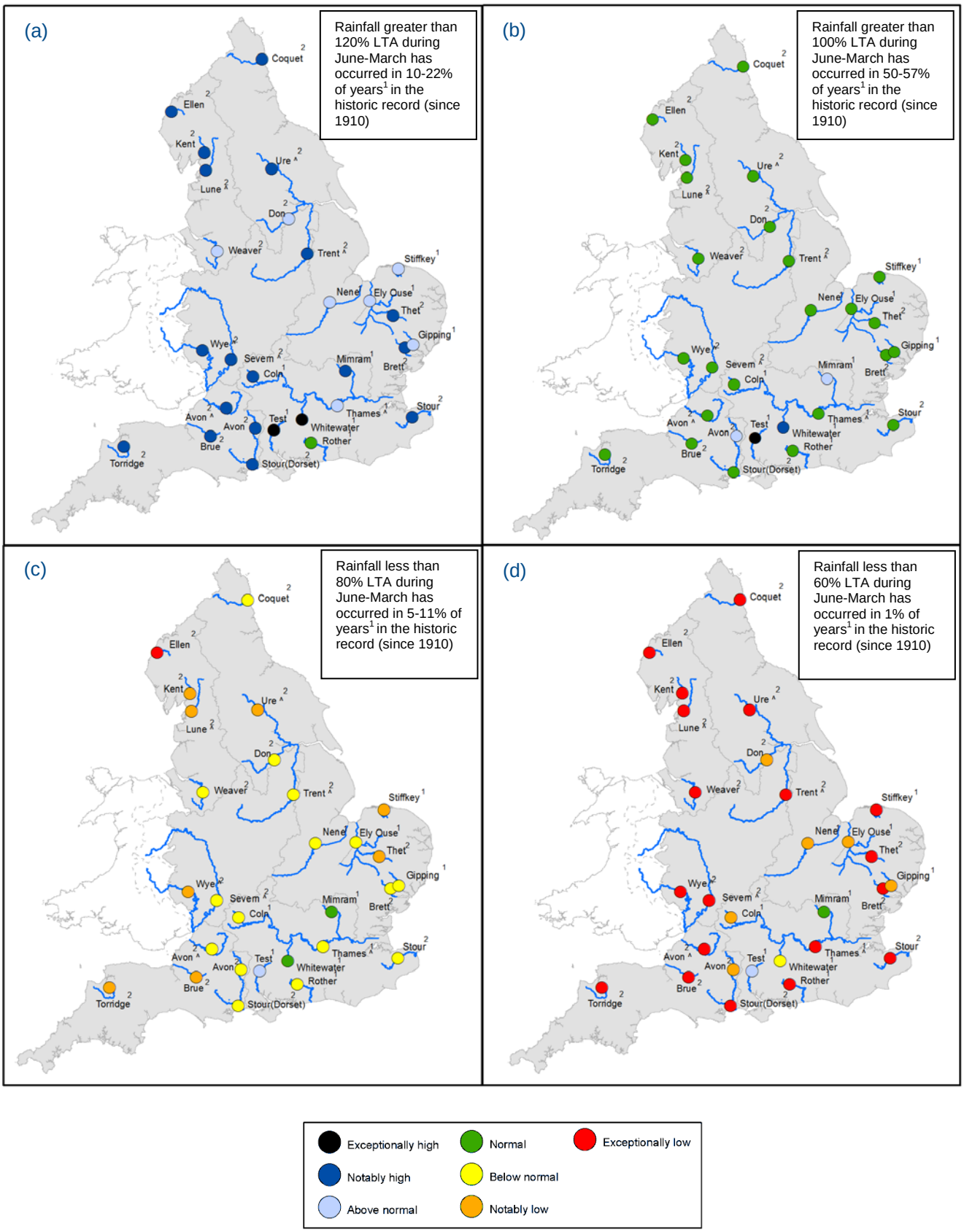


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2014 and September 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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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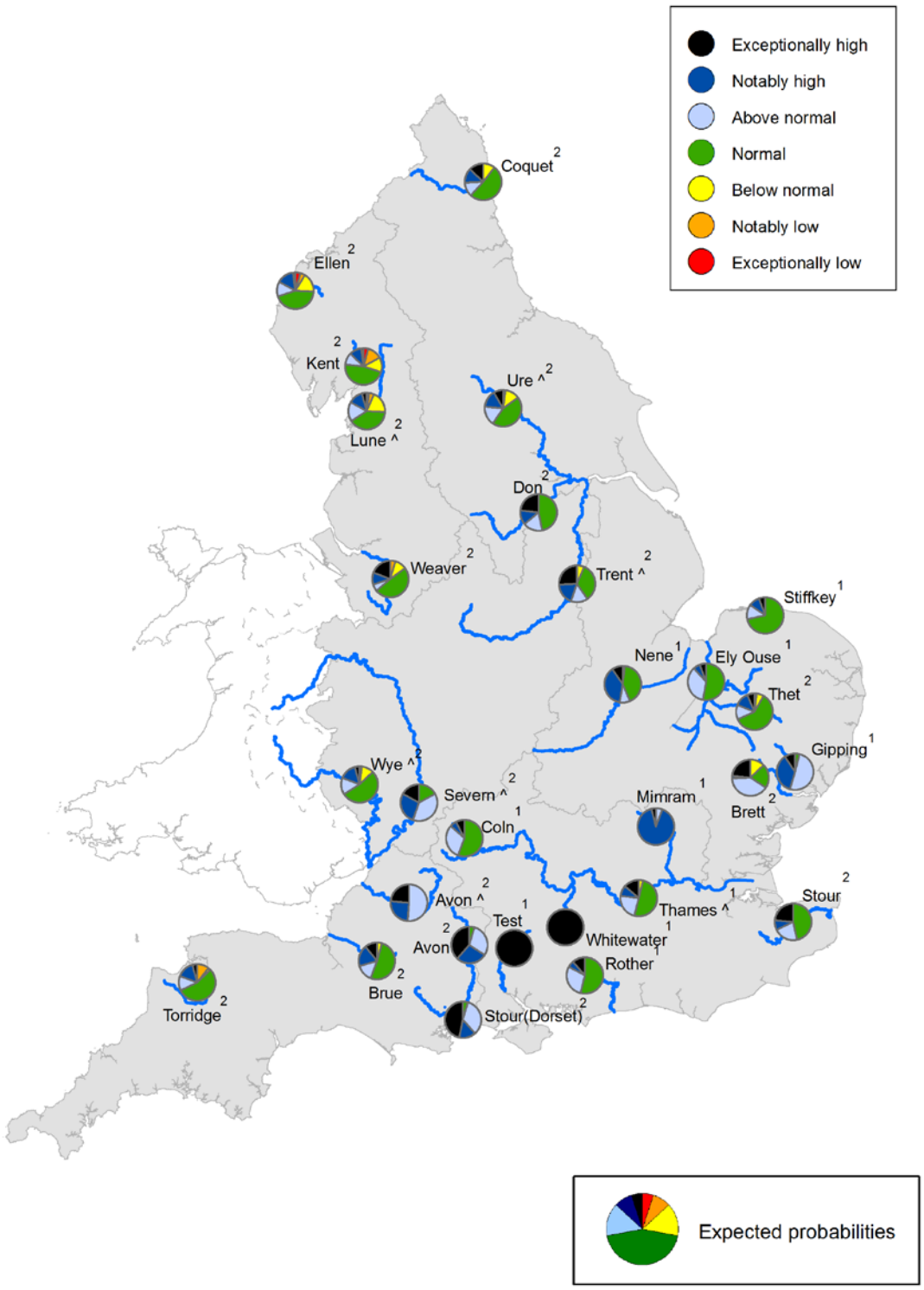

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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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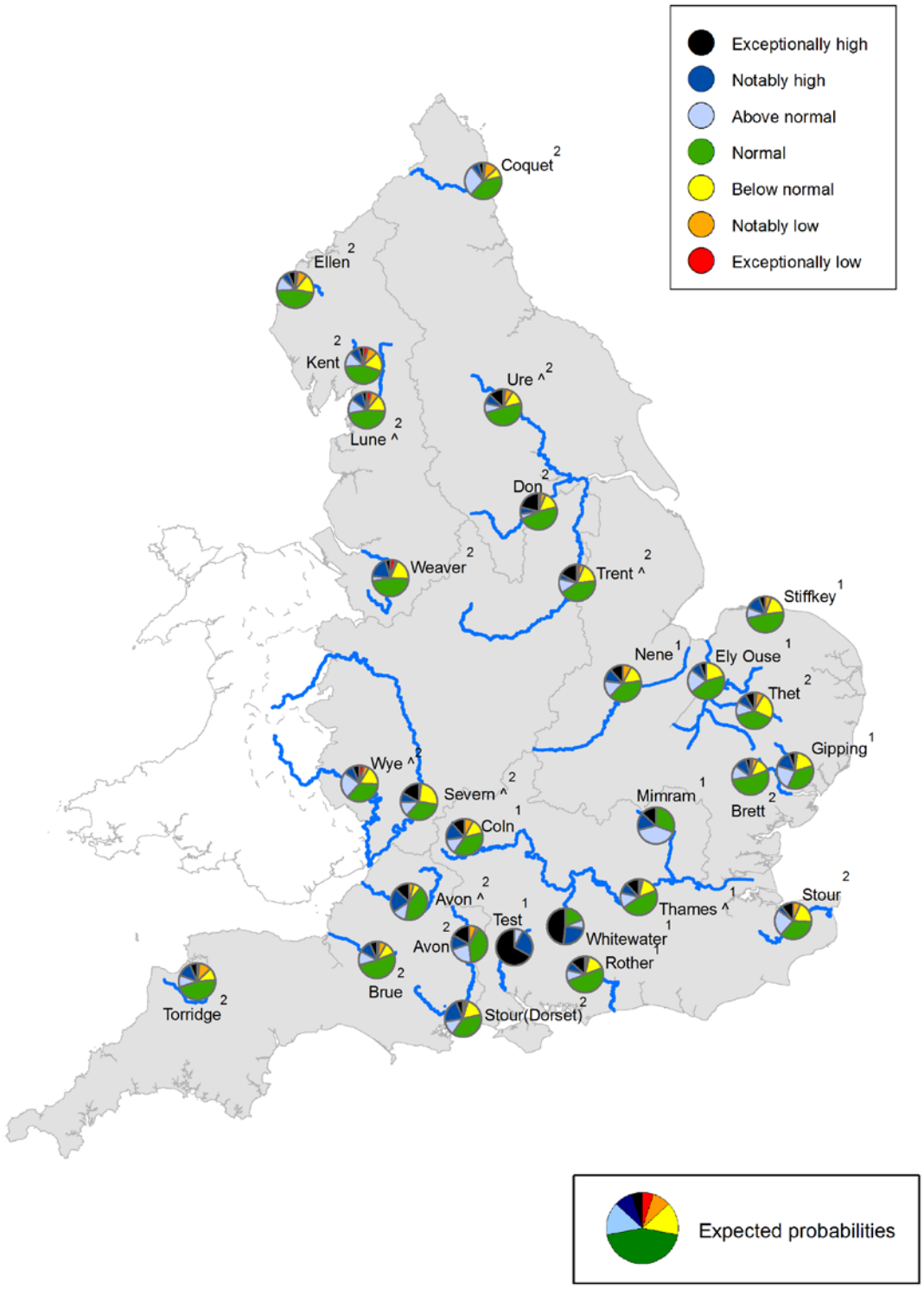
^ "Naturalised" flows are projected for these sites'



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 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).

^ "Naturalised" flows are projected for these sites
[1] Projections for these sites are produced by the Environment Agency,[2] Projections for these sites are produced by CEH

Forward look - groundwater

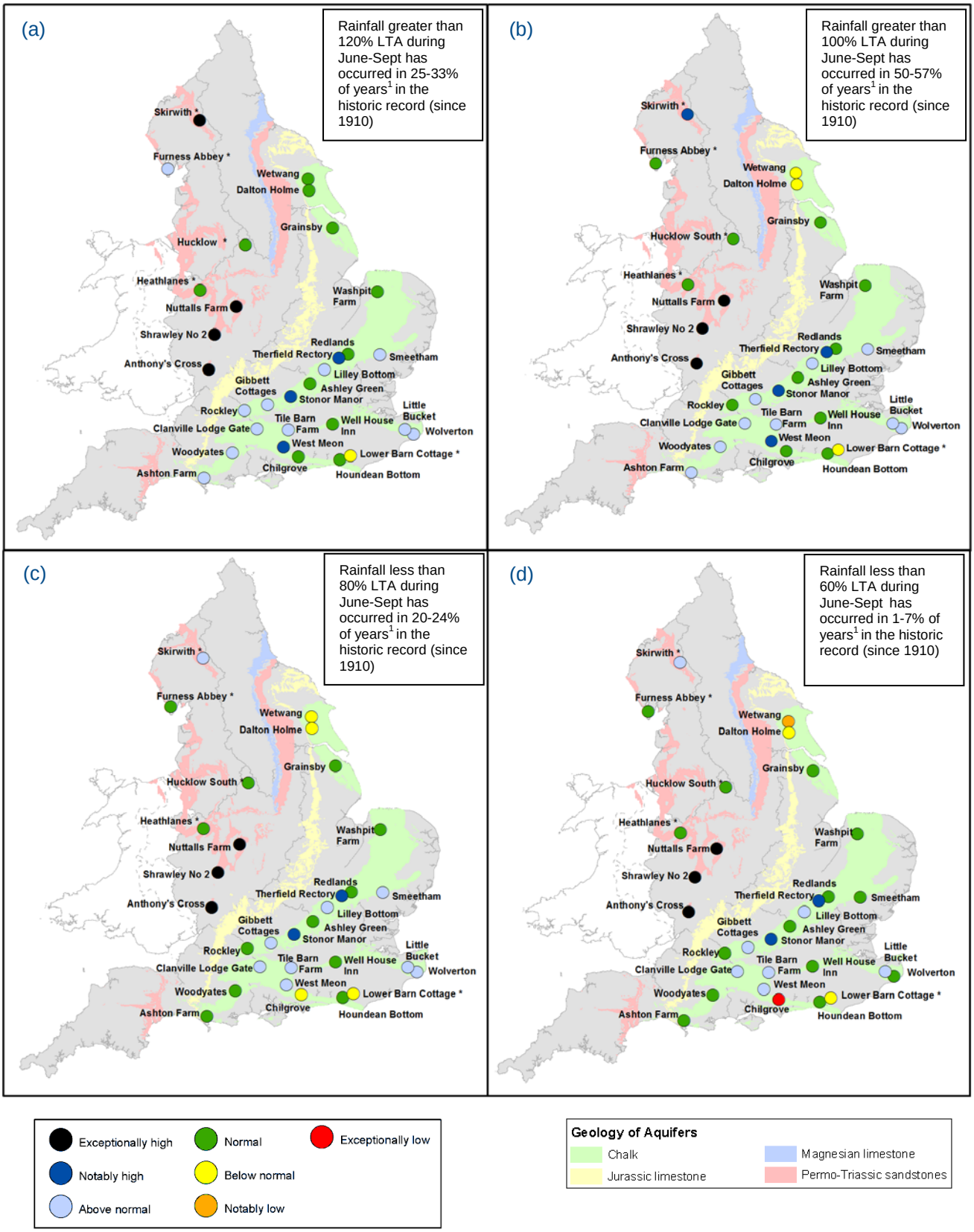


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2014 and September 2014 (Source: Environment Agency) Geological map reproduced with kind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

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

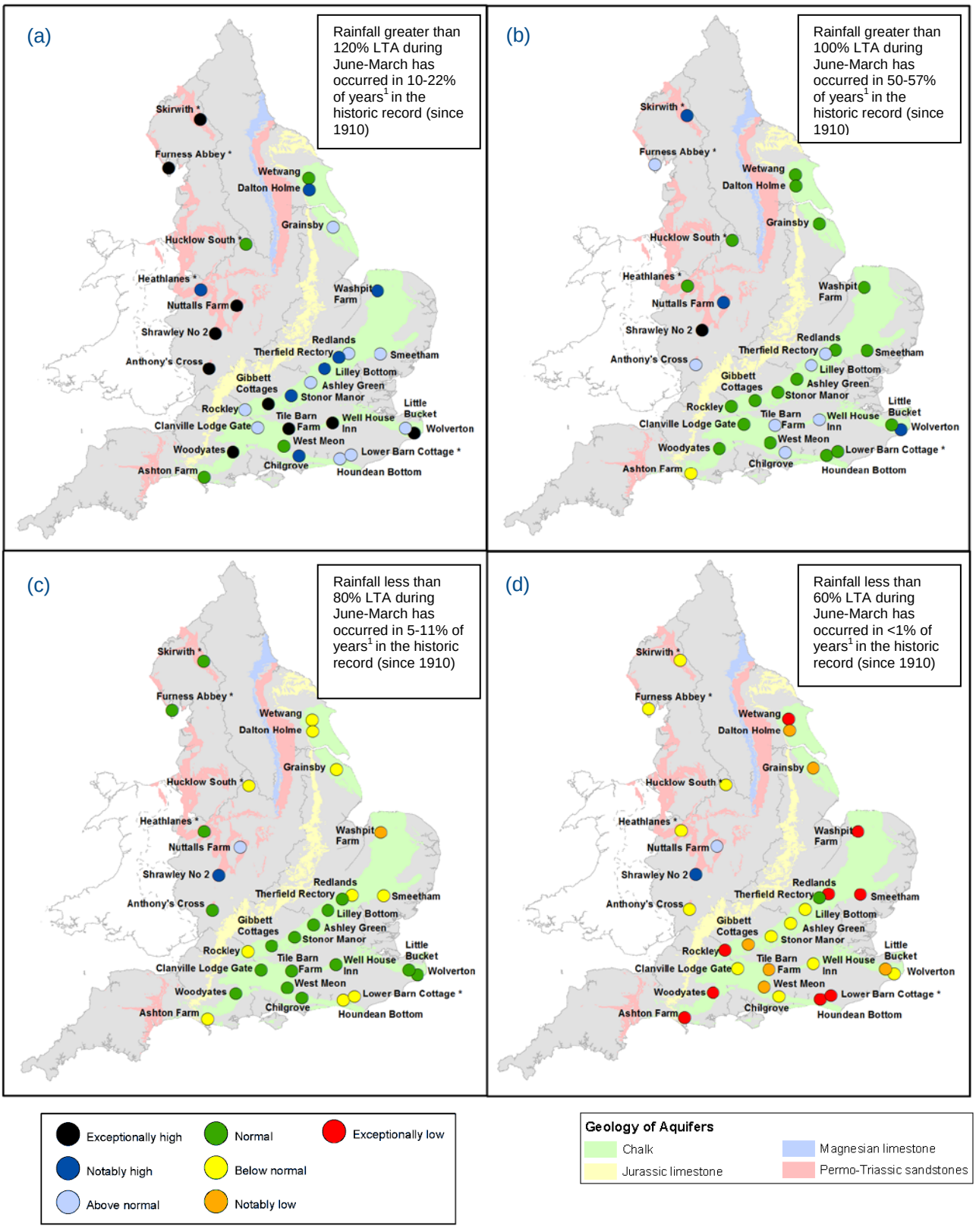


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2014 and March 2015 (Source: Environment Agency) Geological map reproduced with kind permission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

* Projections for these sites are produced by BGS
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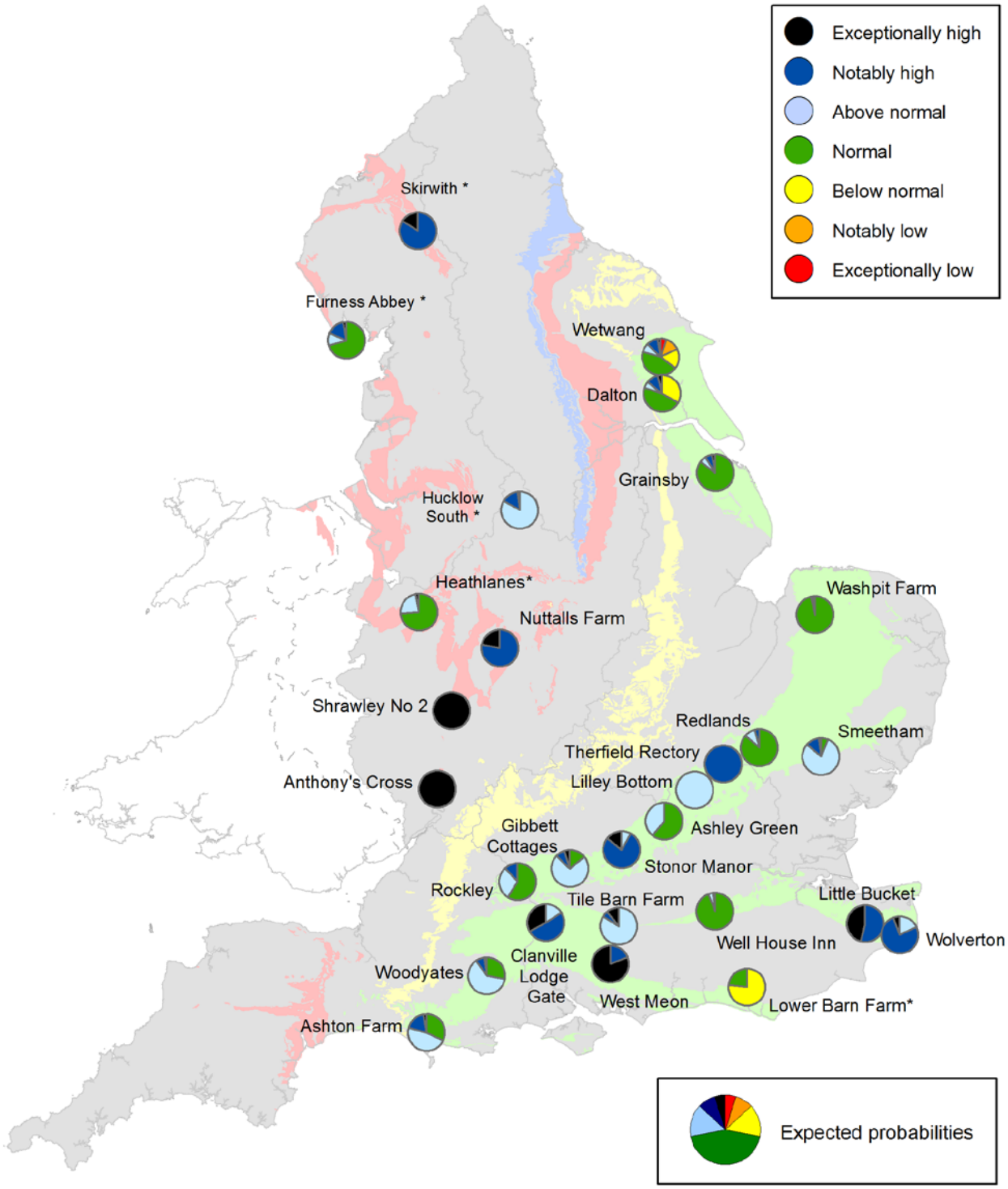
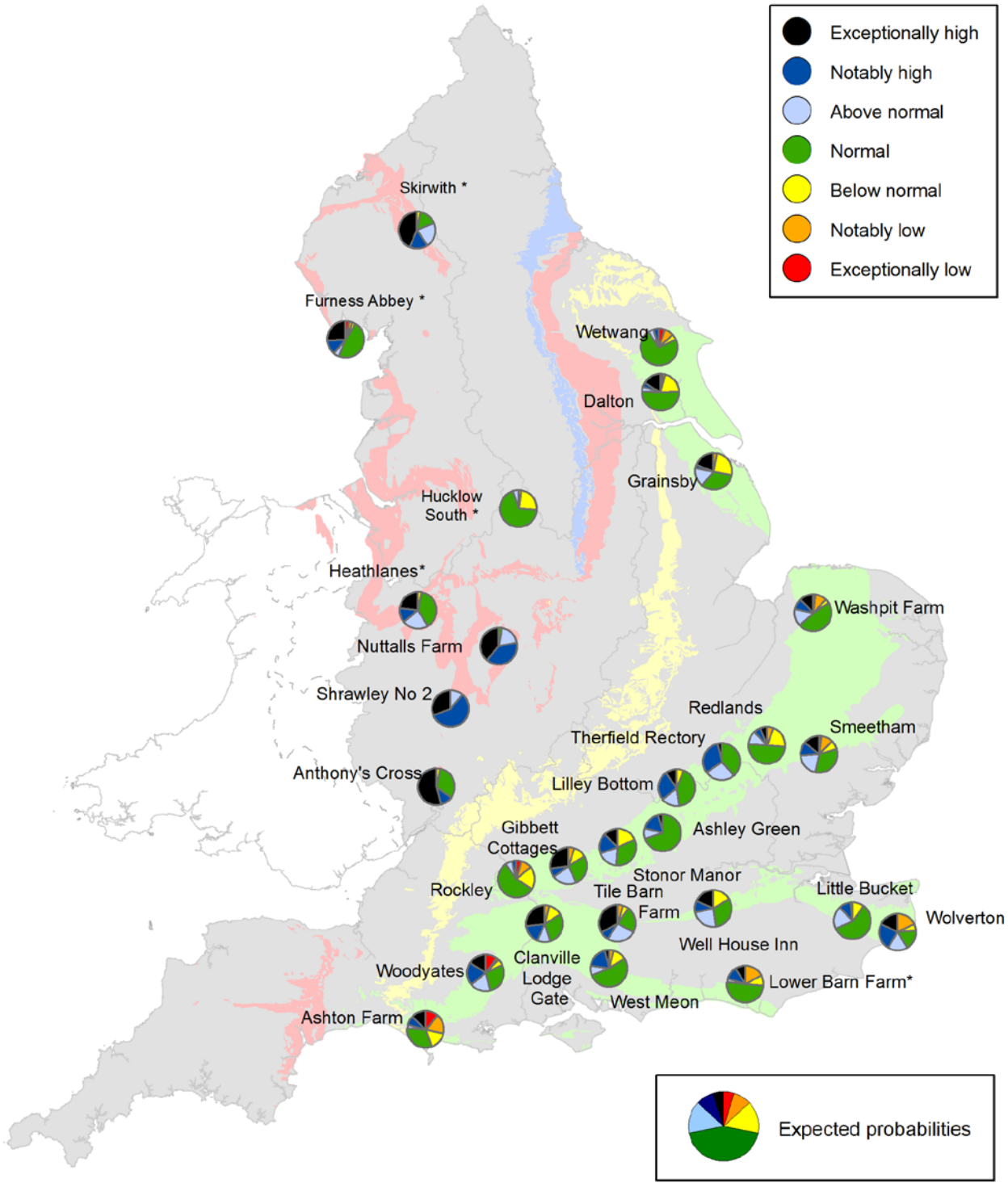


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 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