Monthly water situation report

England

Summary – July 2014

July rainfall was below average in England as a whole at 93% of the long term average. Rainfall totals were classed as **below normal** for the time of year in the southwest, but **normal** elsewhere. Soil moisture deficits increased across most of the country, and only decreased in areas where heavy, localised showers occurred. Monthly mean river flows for July were **normal** or higher for the time of year at four fifths of the indicator sites across England. Groundwater levels decreased at all but one of our indicator sites, but remain **normal** or higher for the time of year at all sites. Reservoir stocks decreased across the country during July, with overall storage in England as a whole at 83% of total capacity at the end of the month.

Rainfall

During July, the highest rainfall totals (more than 80 mm) fell across parts of Cumbria, Lancashire and in Essex, whilst the lowest rainfall totals (less than 25 mm) fell across parts of Oxfordshire, and on the Isle of Wight (Figure 1.1).

July rainfall totals were classed as **normal** for the time of year at nearly two thirds of hydrological areas across England; rainfall totals across Essex catchments were **notably high**, and totals were **above normal** in hydrological areas covering parts of Norfolk, Suffolk, Kent and East Sussex. In the remaining hydrological areas across parts of central, southern, southwest England and in the far north, rainfall totals were **below normal**. In some areas of Devon, Cornwall and Hampshire, rainfall totals were classed as **notably low** for the time of year. Cumulative rainfall totals for the three months ending in July were **normal** or higher for much of England, although parts of the northwest, the far southeast and far southwest of England were **below normal**. The exceptional rainfall in February is still influencing the cumulative six month rainfall totals, with much of England classed as **above normal** to **exceptionally high** (Figure 1.2).

Rainfall totals for July were below average in all but one region of England. Monthly totals as a percentage of the July long term average (LTA) ranged from 72% in the southwest to 121% in eastern England. Overall, England received 93% of the July LTA rainfall (Figure 1.3). It has been the wettest nine month period on record (starting in 1910) ending in July in southeast and southwest England.

Soil moisture deficit

Soil moisture deficits (SMDs) increased across most of England during July with the exception of parts of Cumbria, Essex and the Thames estuary where sufficient rainfall caused a decrease in them. By the end of the month, SMDs ranged from just over 30 mm in parts of Cumbria, to 140 mm in parts of Norfolk. End of July SMDs were in the range 71 to 130 mm across most of central, southern and eastern England, whereas deficits in the north and west of England were mostly in the range 41 to 70 mm (Figure 2.1).

End of July SMDs were 6 to 50 mm smaller than the LTA in MORECS grid squares covering parts of the east coast, southeast and central England. In contrast, SMDs in some MORECS grid squares on the southwest coast, Welsh border, and in Lancashire and north Cumbria were 26 to 75 mm greater than the LTA (Figure 2.1).

Regionally at the end of June, SMDs ranged from 50 mm in the northeast to 81 mm in the east. By the end of July, SMDs ranged from 69 mm in the northwest to 100 mm in the east, with the greatest increase of almost 40 mm occurring in the southwest (Figure 2.2).

River flows

Monthly mean river flows decreased compared to June at all but four of our indicator sites; flows in these four catchments increased in response to convective rainfall events through the month. July river flows were **normal** or higher at four fifths of our indicator sites. The remaining river flows were **below normal** with the exception of the River Wyre in the northwest, where July flows were **notably low** for the time of the year (Figure 3.1).

River flows at the index sites in east and southeast England were **above normal** for the time of year. In southwest, northwest and northeast England, monthly mean river flows at the index sites were **below normal** for the time of year, whilst in central England flows were **normal** (Figure 3.2).

Groundwater levels

Groundwater levels continued to decline at all except one indicator site during July. At Crossley Hill (Nottinghamshire & Doncaster Permo-Triassic sandstone aquifer) in central England, levels remained constant through July. At the end of July, 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 impact of the wet winter continues to have an influence (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** at the remaining two (Figure 4.2).

Reservoir storage

As expected for this time of year, reservoir stocks decreased during July at all reported reservoirs and reservoir groups. Decreases ranged from 2% to 17%. At Derwent Valley, supplying parts of central England stocks decreased by 15%, at the NCZ regional group in northwest England stocks decreased by 11%, and at Grafham in eastern England, stocks decreased by 9% in July. These three reservoirs and reservoir groups are now classed as **below normal** for the time of year. Despite the decreases, elsewhere all reservoirs and reservoir groups remain **normal** or higher for the time of year (Figure 5.1).

Overall reservoir stocks decreased across all regions of England, with the largest decrease of 12% occurring in central England. Elsewhere the decreases ranged from 5% in the southeast to 11% in the northwest. At the end of July, overall reservoir stocks were lowest in the northwest at 64% of total capacity and highest in the southeast at 93%. Overall reservoir storage for England decreased by 7% during July to 83% of total capacity (Figure 5.2).

Forward look

Unsettled conditions are likely to continue through to mid August, with wet spells interspersed with brighter but showery conditions and temperatures near or slightly below normal. Towards the end of August, unsettled conditions are likely to continue in the north, whereas the south will see drier and brighter weather with near normal temperatures. Longer term, for the period August-September-October, above average temperatures are more likely than below average temperatures. There is a slightly higher likelihood of above average rainfall during this period[1].

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

September 2014: With average (100% of the LTA) rainfall between August and the end of September 2014, cumulative river flows are likely to be **normal** at more than four fifths 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 nearly two thirds 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 **below normal** at nearly a third of the modelled sites (Figure 6.1).

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

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

September 2014: Almost four fifths of our modelled sites have a greater than expected chance of **normal** cumulative flows from August to September 2014. More than one third of our modelled sites have a greater than expected chance of **above normal** or higher cumulative flows. Eight sites have a greater than expected chance of **below normal** or lower cumulative flows from August to September 2014 (Figure 6.3).

March 2015: Half of our modelled sites have a greater than expected chance of **above normal** cumulative flows from August 2014 to March 2015. Around half of our modelled sites have a greater than expected chance of **below normal** or lower cumulative flows between August 2014 and March 2015 (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 August to 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) all except one of the modelled sites are likely to be **normal** or higher. With 80% of the LTA rainfall, all except two of the modelled sites are likely to have **normal** or higher groundwater levels for the time of year (Figure 6.5).

March 2015: With average rainfall (100% of the LTA) from August 2014 to March 2015, groundwater levels are likely to be **normal** or higher at all but two of the modelled sites. With above average rainfall (120% of the LTA), levels are likely to be **notably high** or higher 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 for the time of year at more than one third of the modelled sites (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 quarter of the sites have a greater than expected chance of **normal** groundwater levels (Figure 6.7).

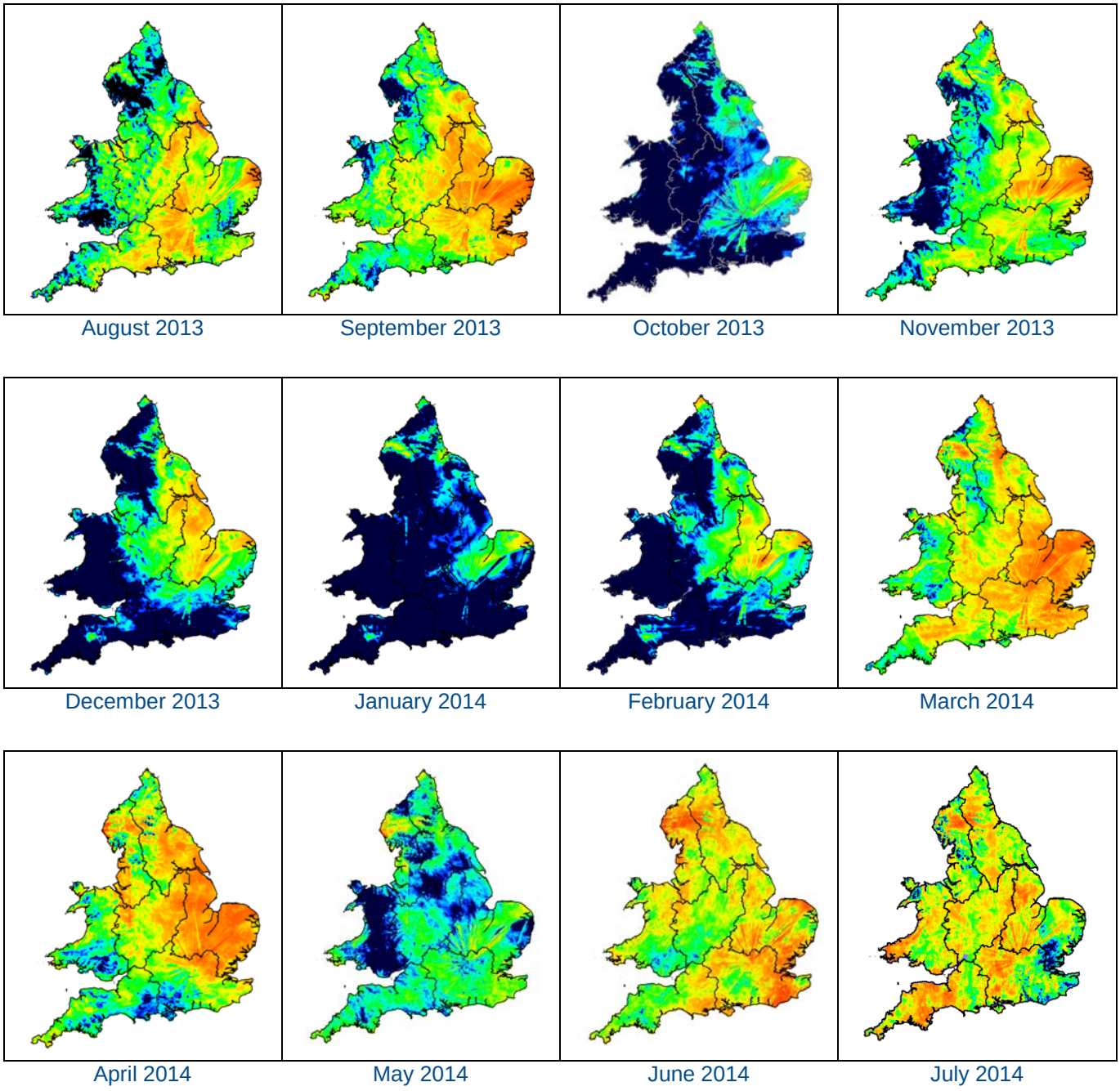
March 2015: More than two thirds of the modelled sites have a greater than expected chance of groundwater levels being **above normal** or higher for the time of year. Just under one third of modelled sites have a greater than expected chance of **normal** groundwater levels by the end of March 2015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

Authors: E & B Hydrology Team

From April 2014 we have changed 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



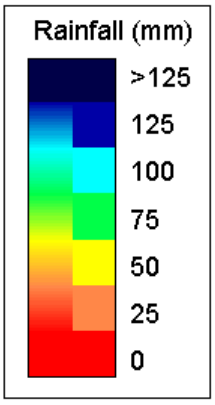


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

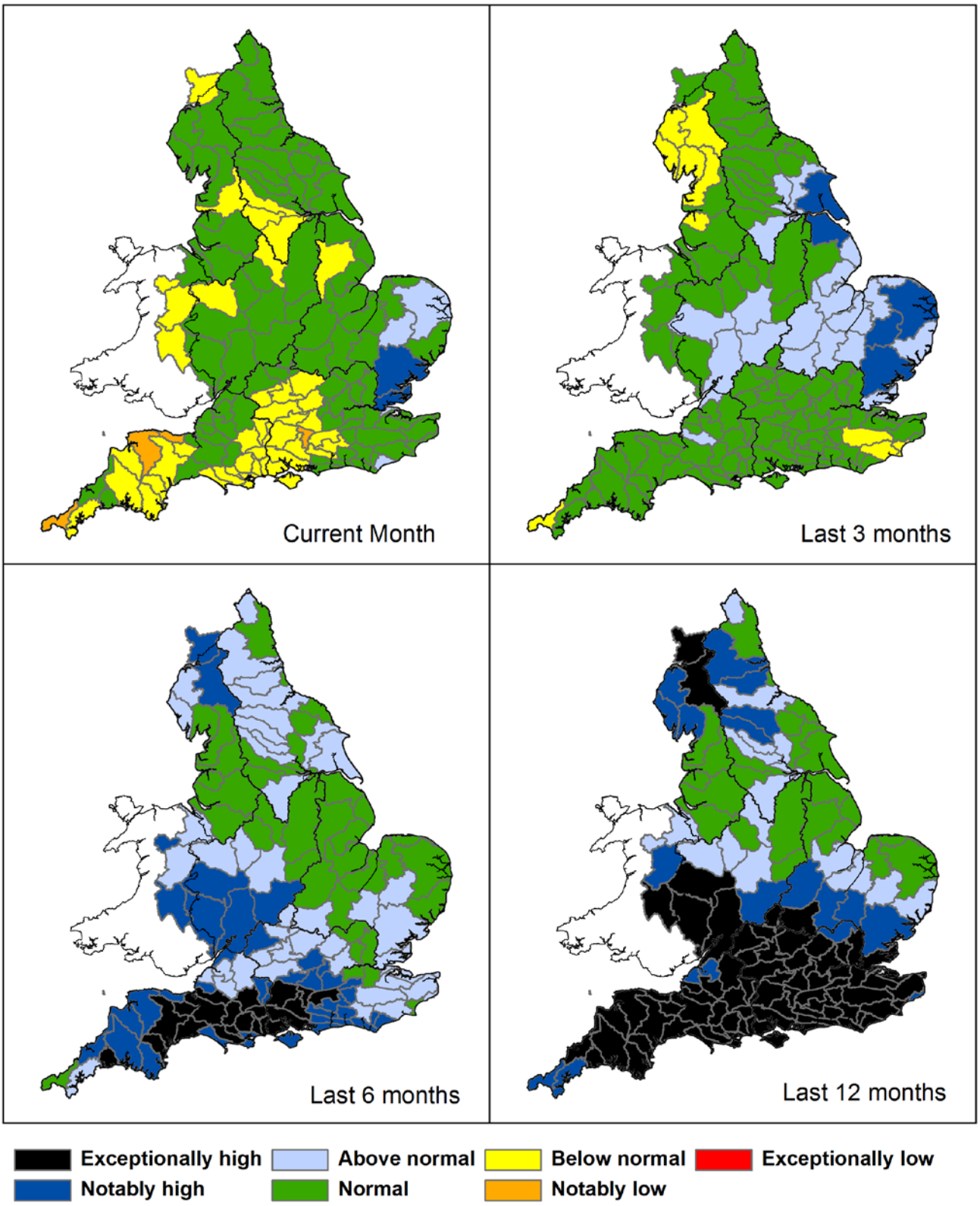


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31st July), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre)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

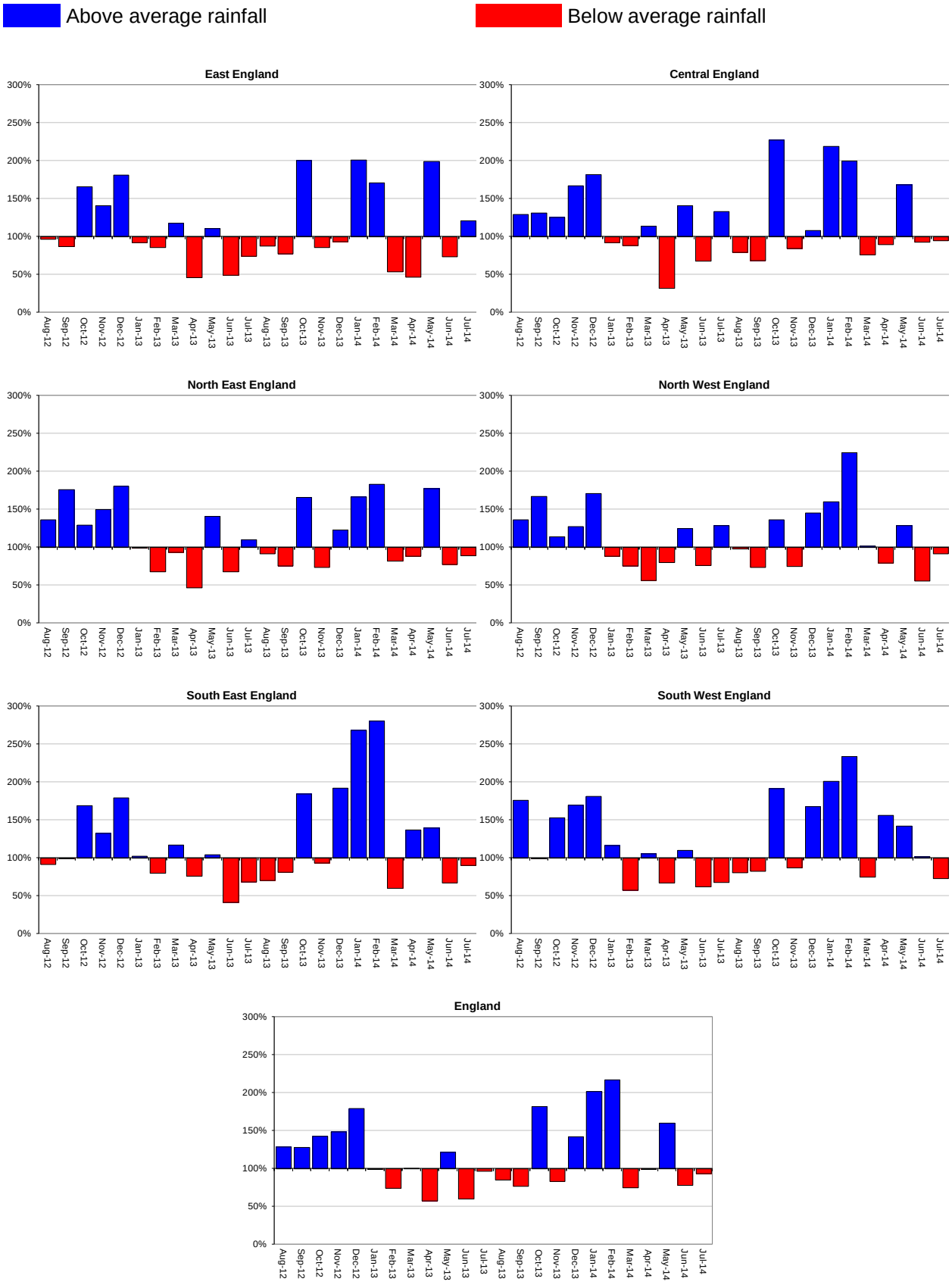


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

Soil moisture deficit

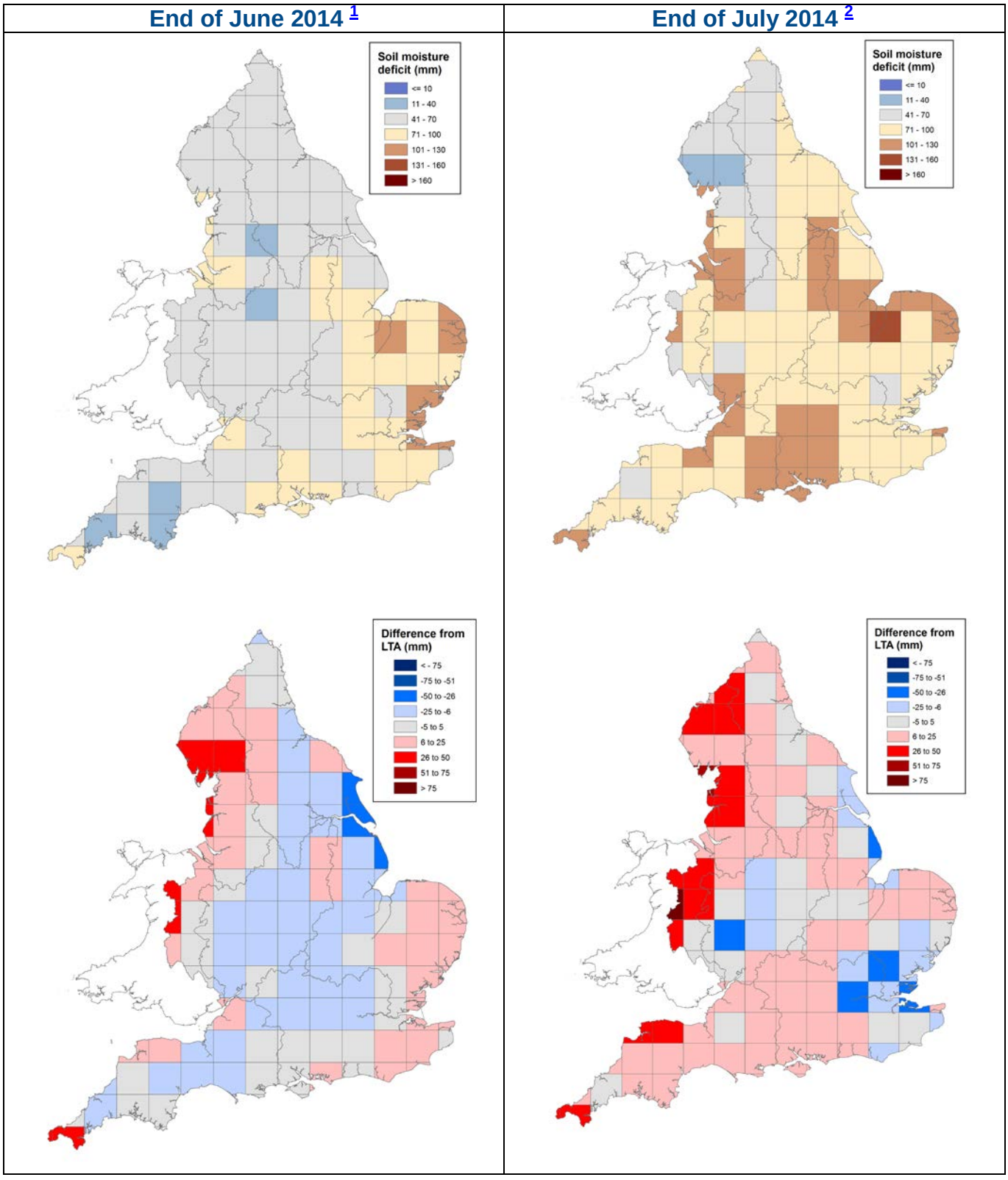


Figure 2.1: Soil moisture deficits for weeks ending 01 July 2014 [1] (left panel) and 30 July 2014 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014

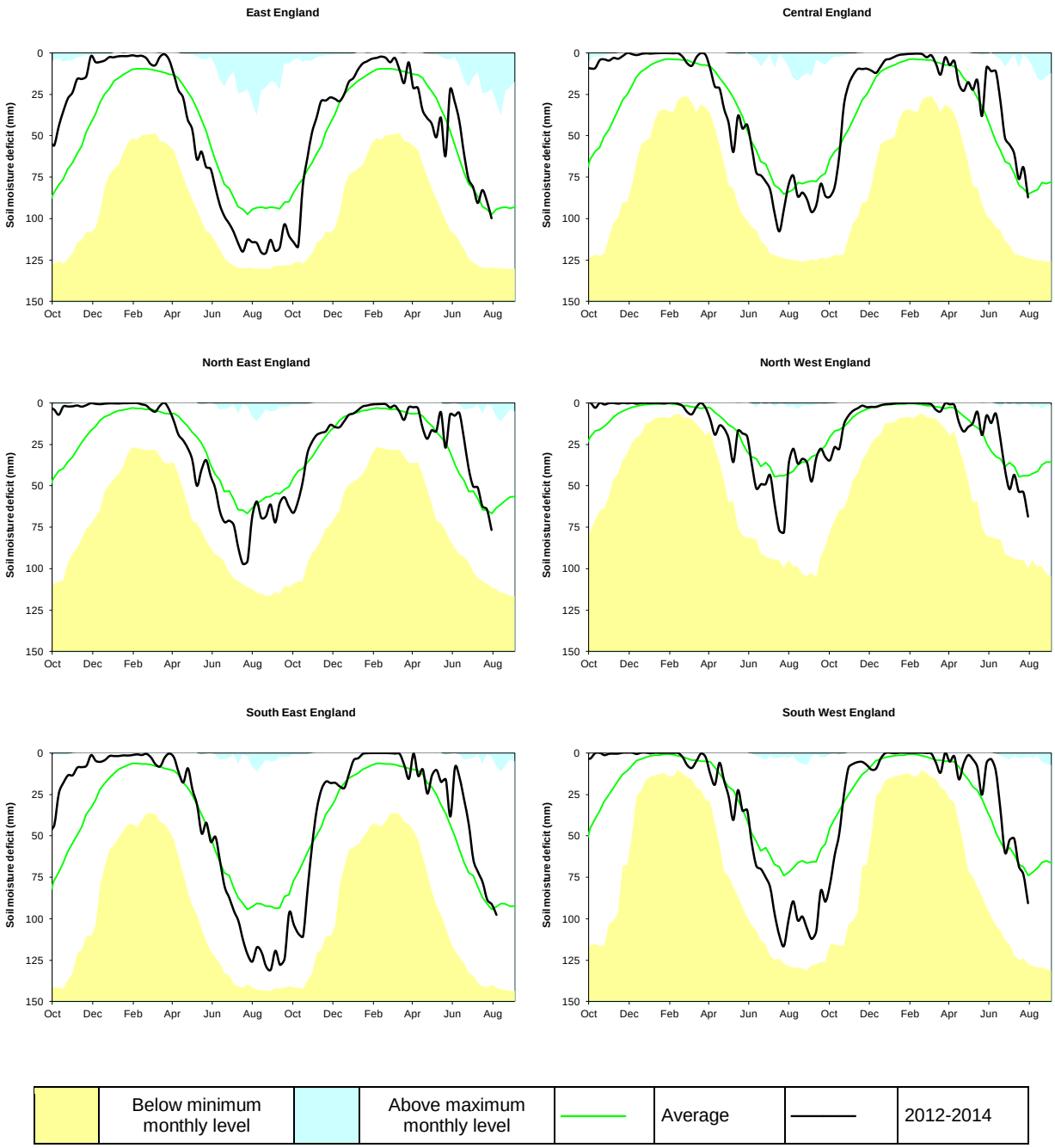
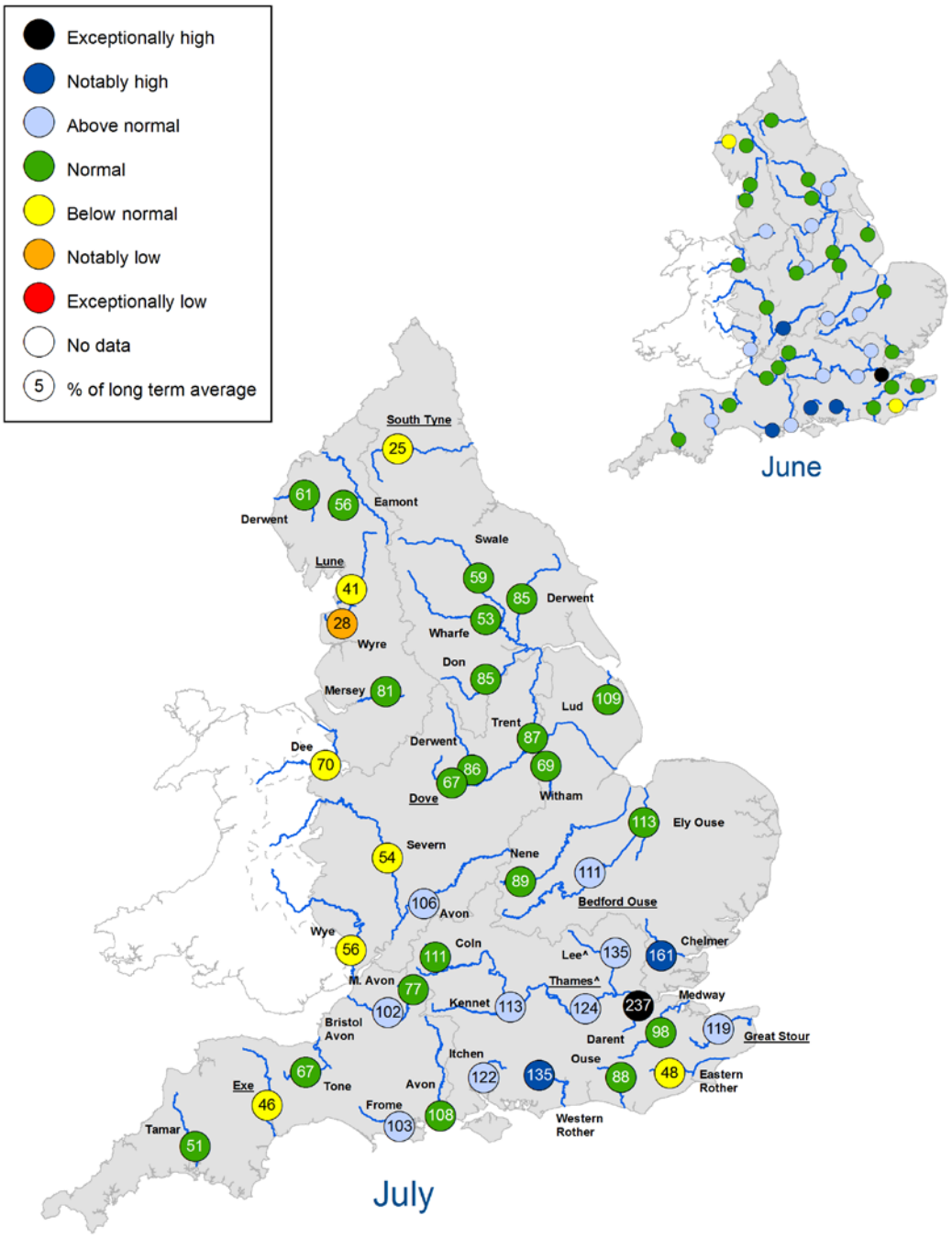


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2014).

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

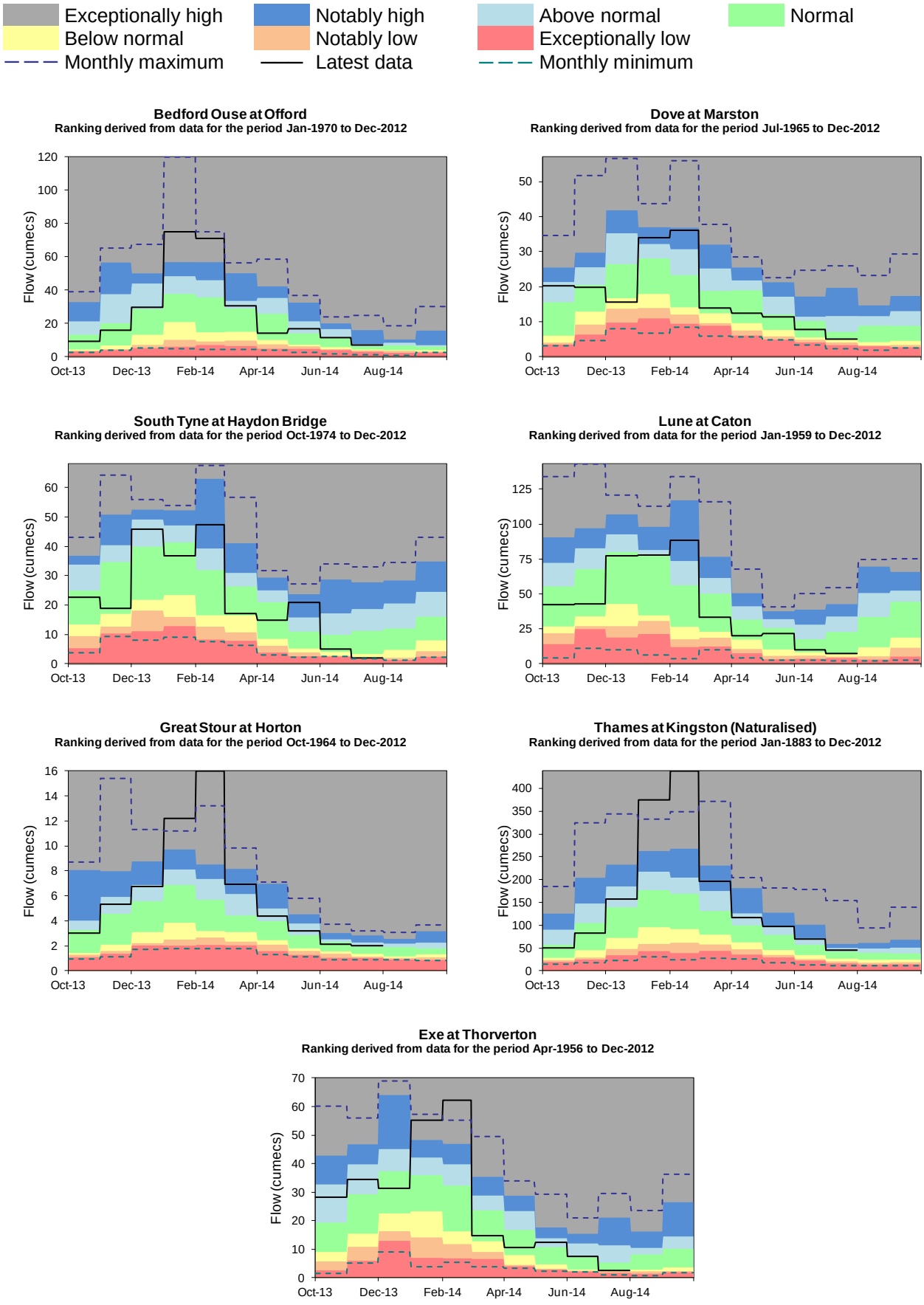
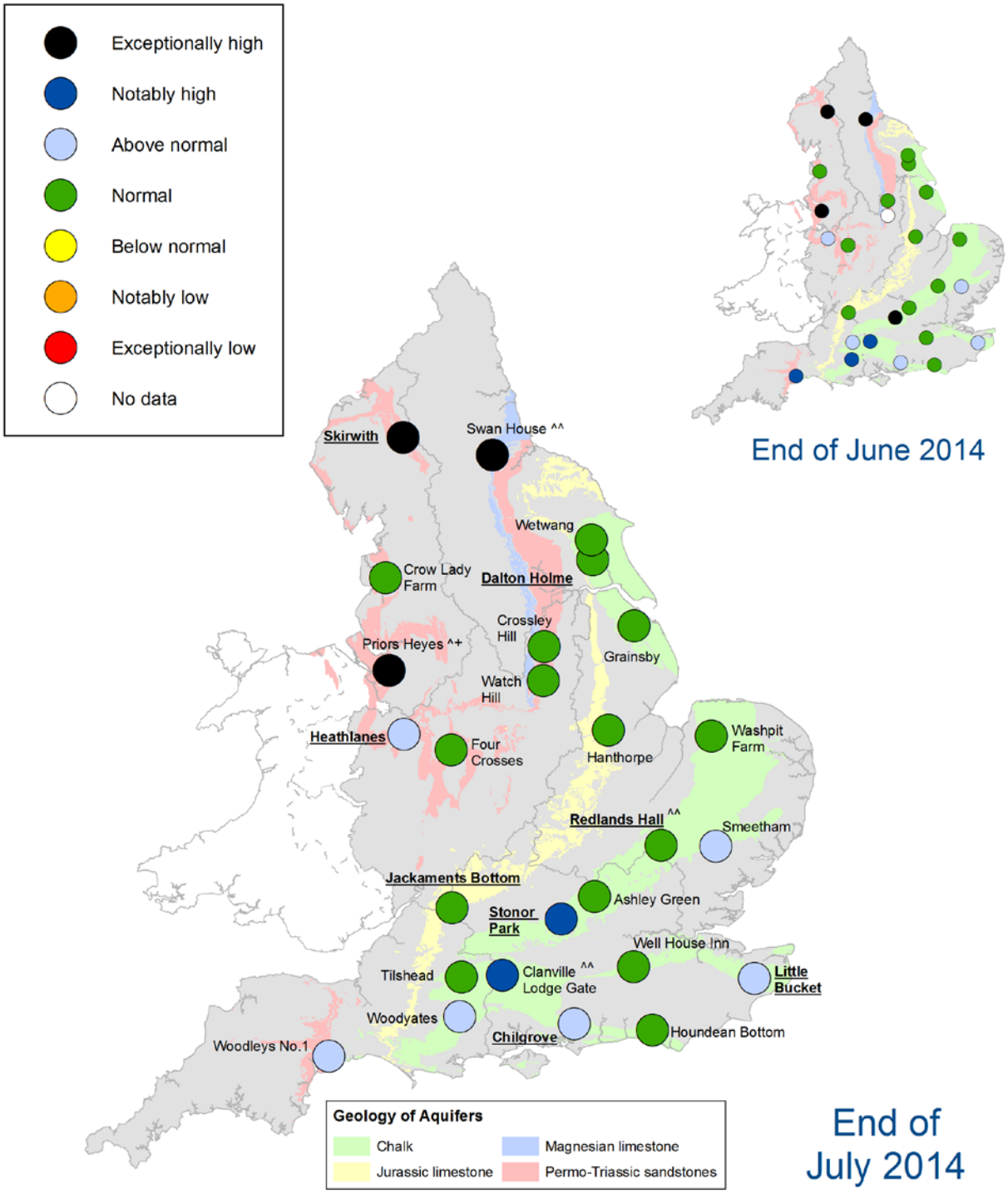


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 June 2014 and July 2014, classed relative to an analysis of respective historic June and July 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.

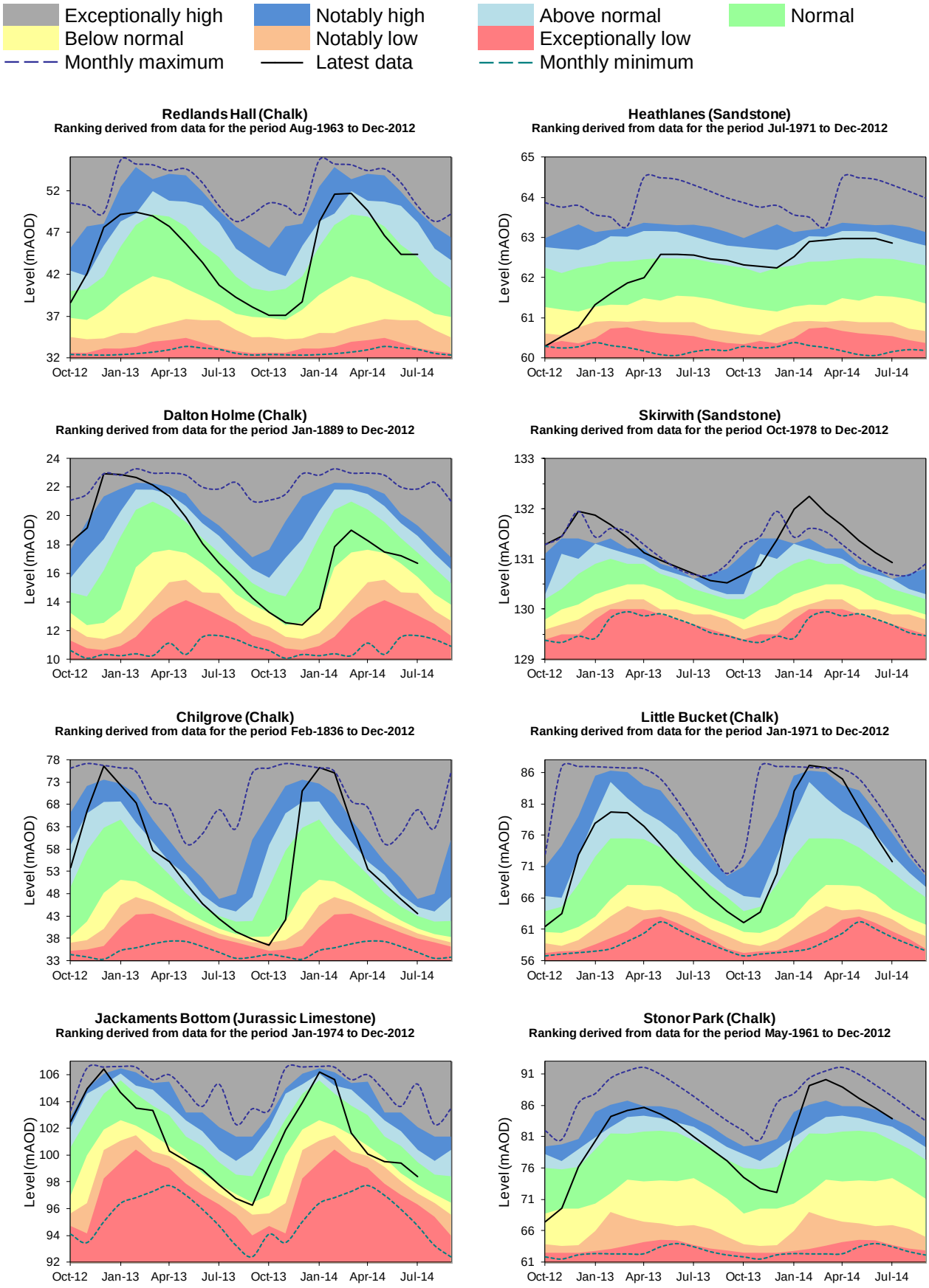
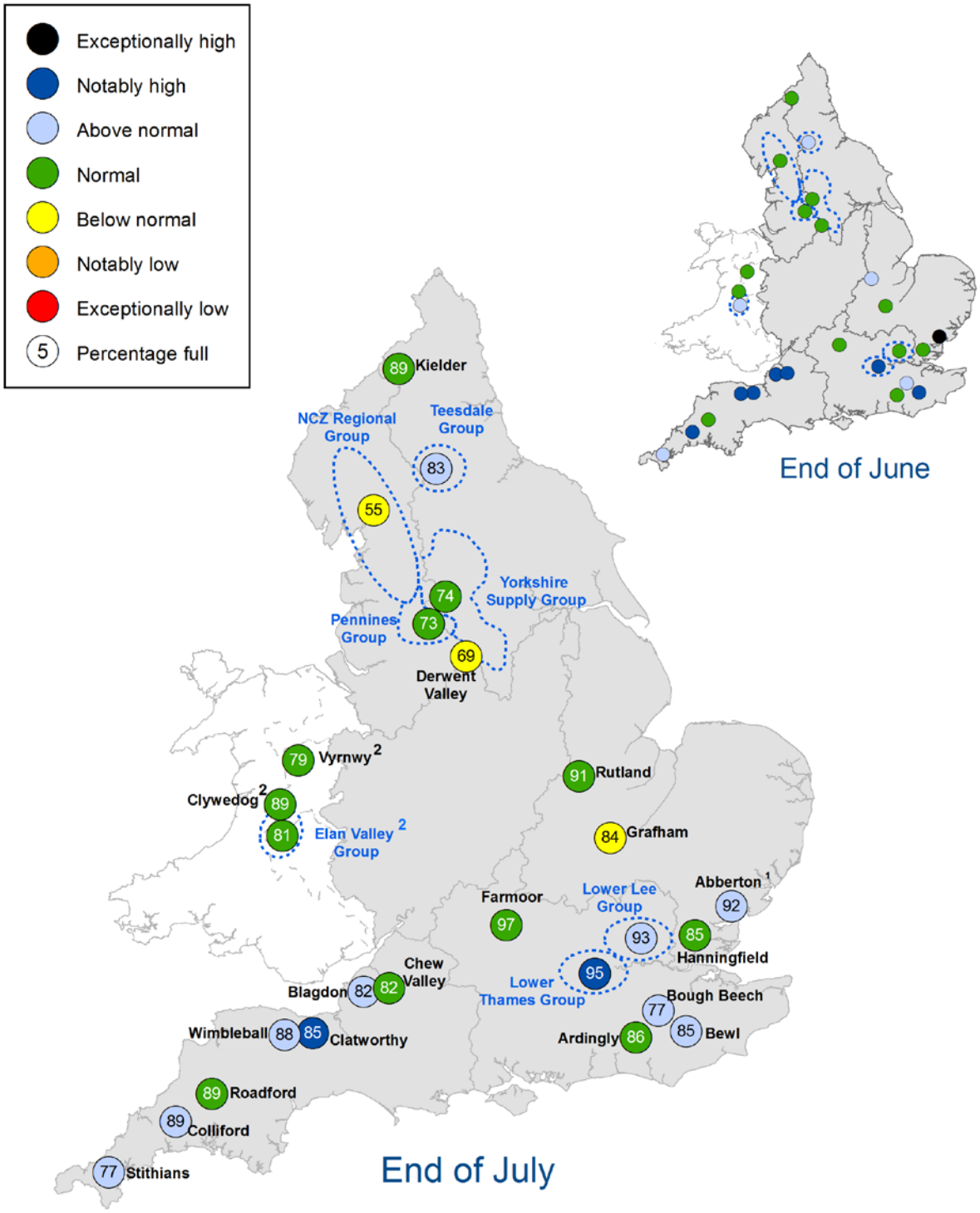


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

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 June 2014 and July 2014 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, 2014.

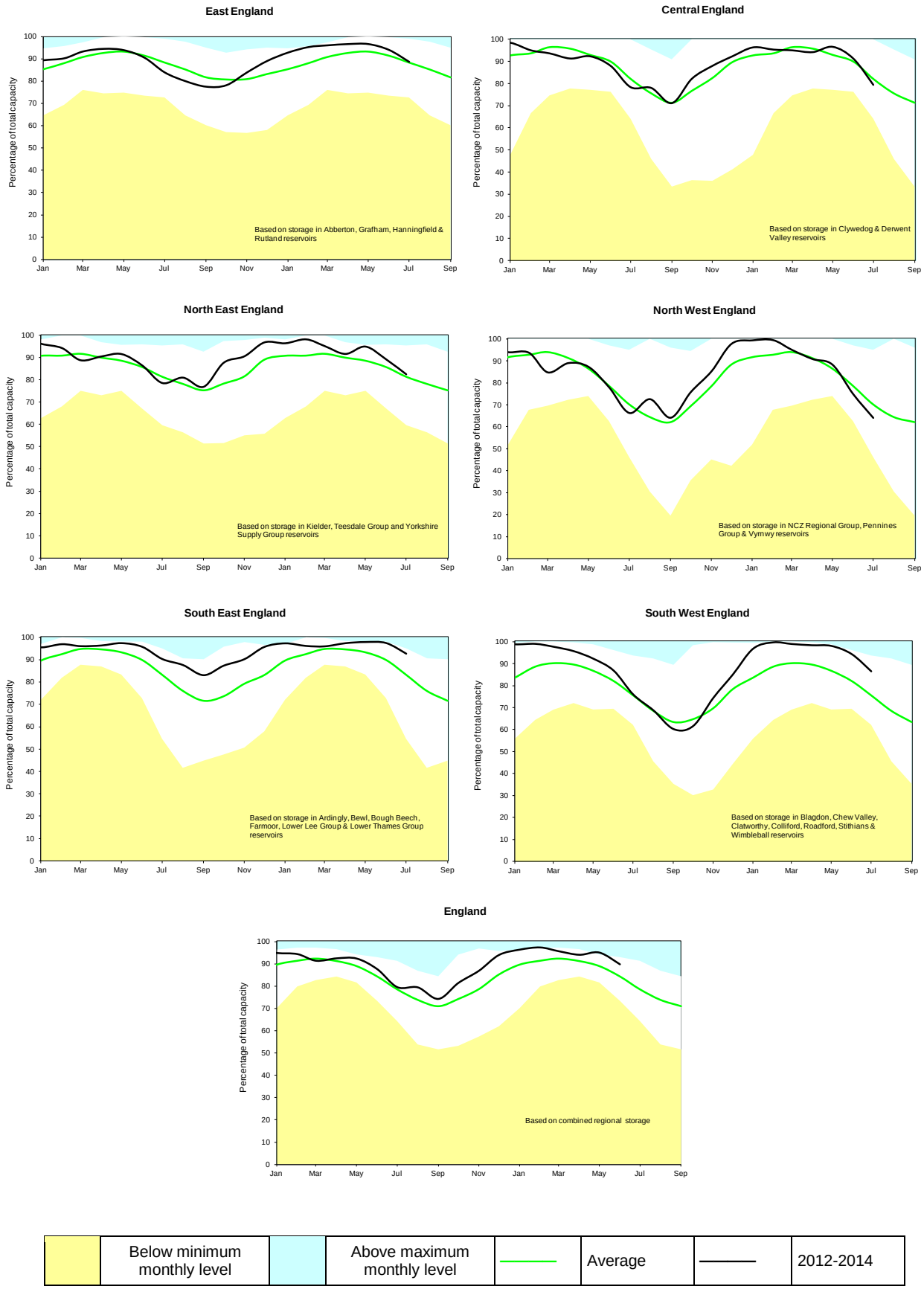


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

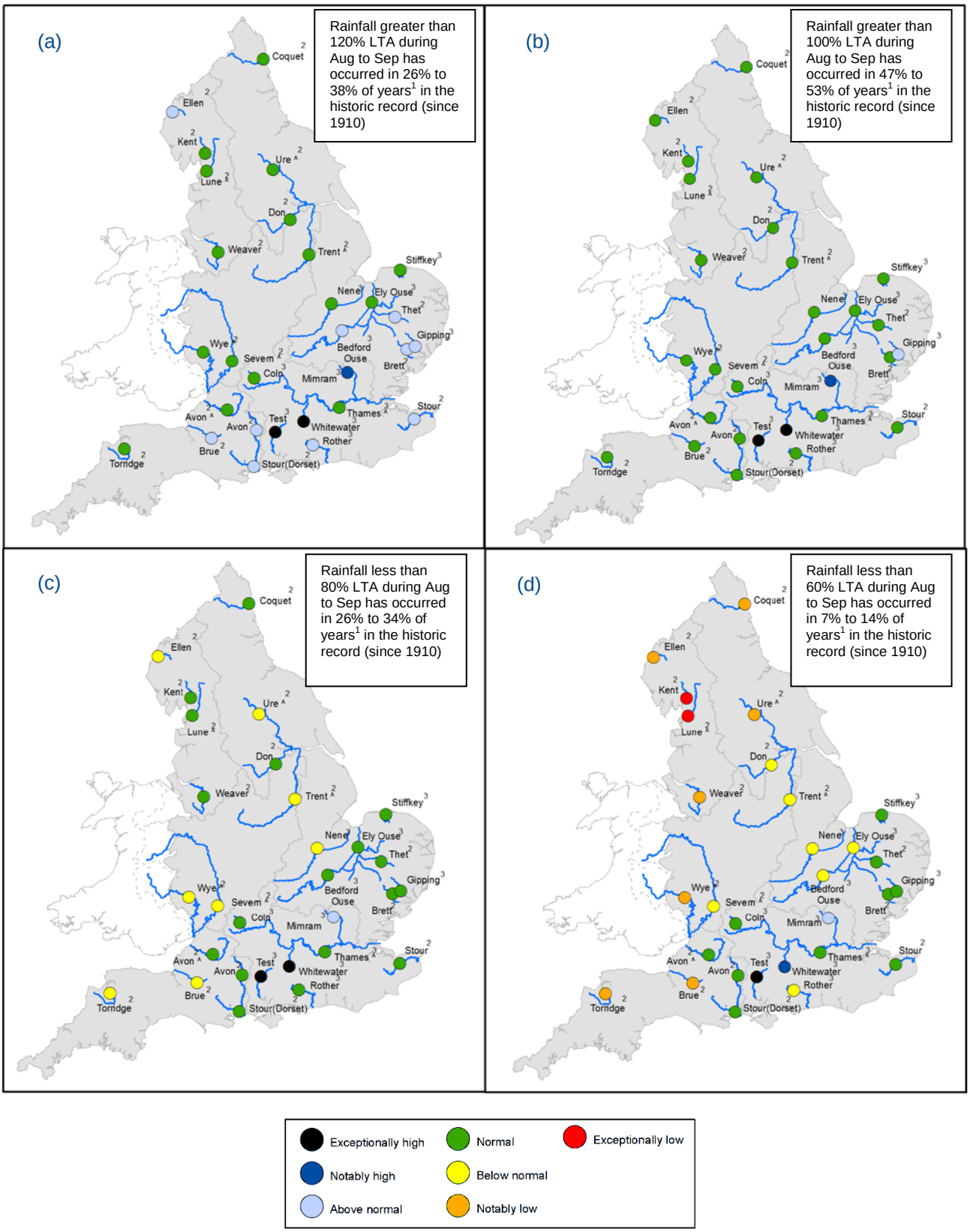
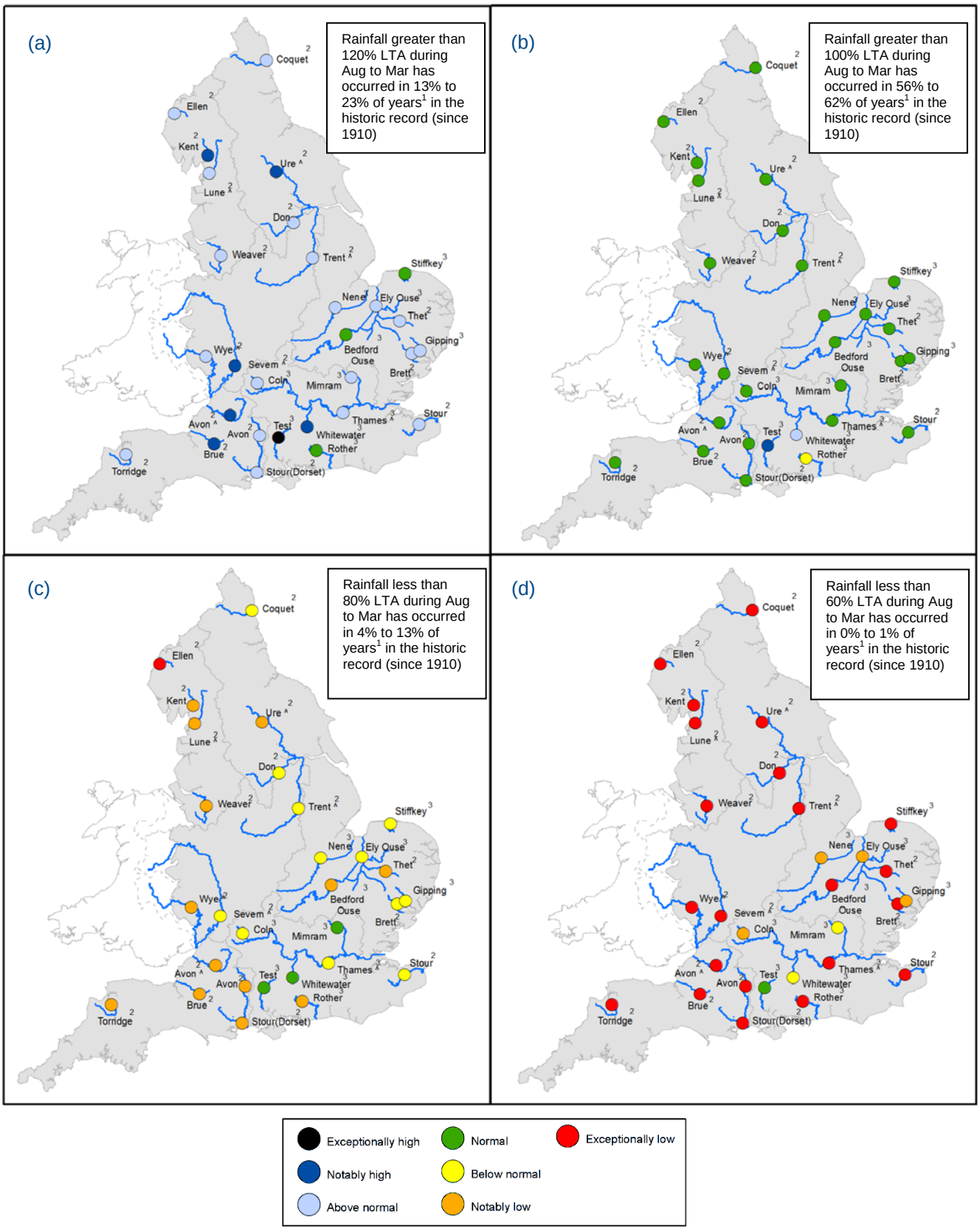


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2014 and September 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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



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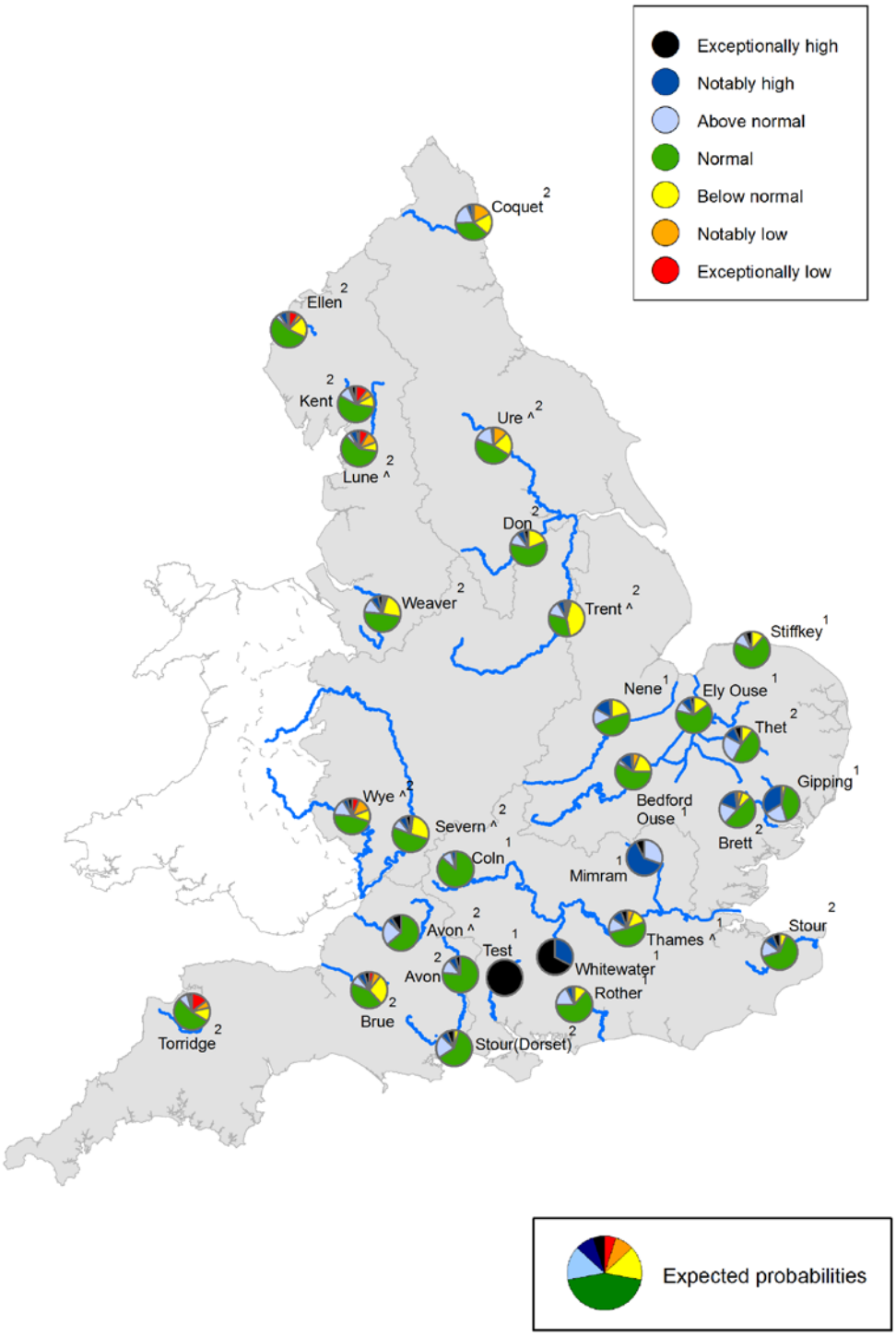

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[1] Projections for these sites are produced by the Environment Agency
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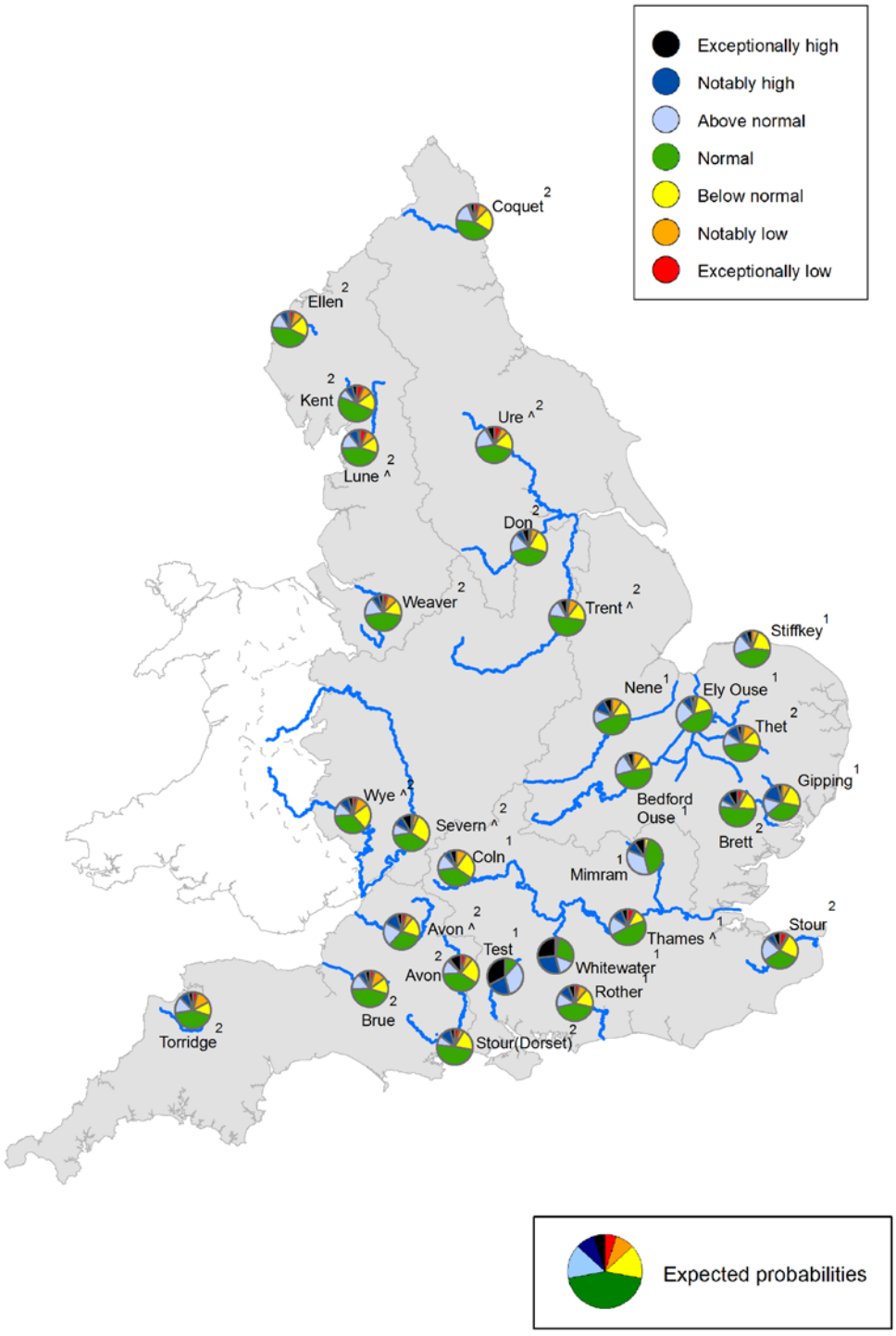

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

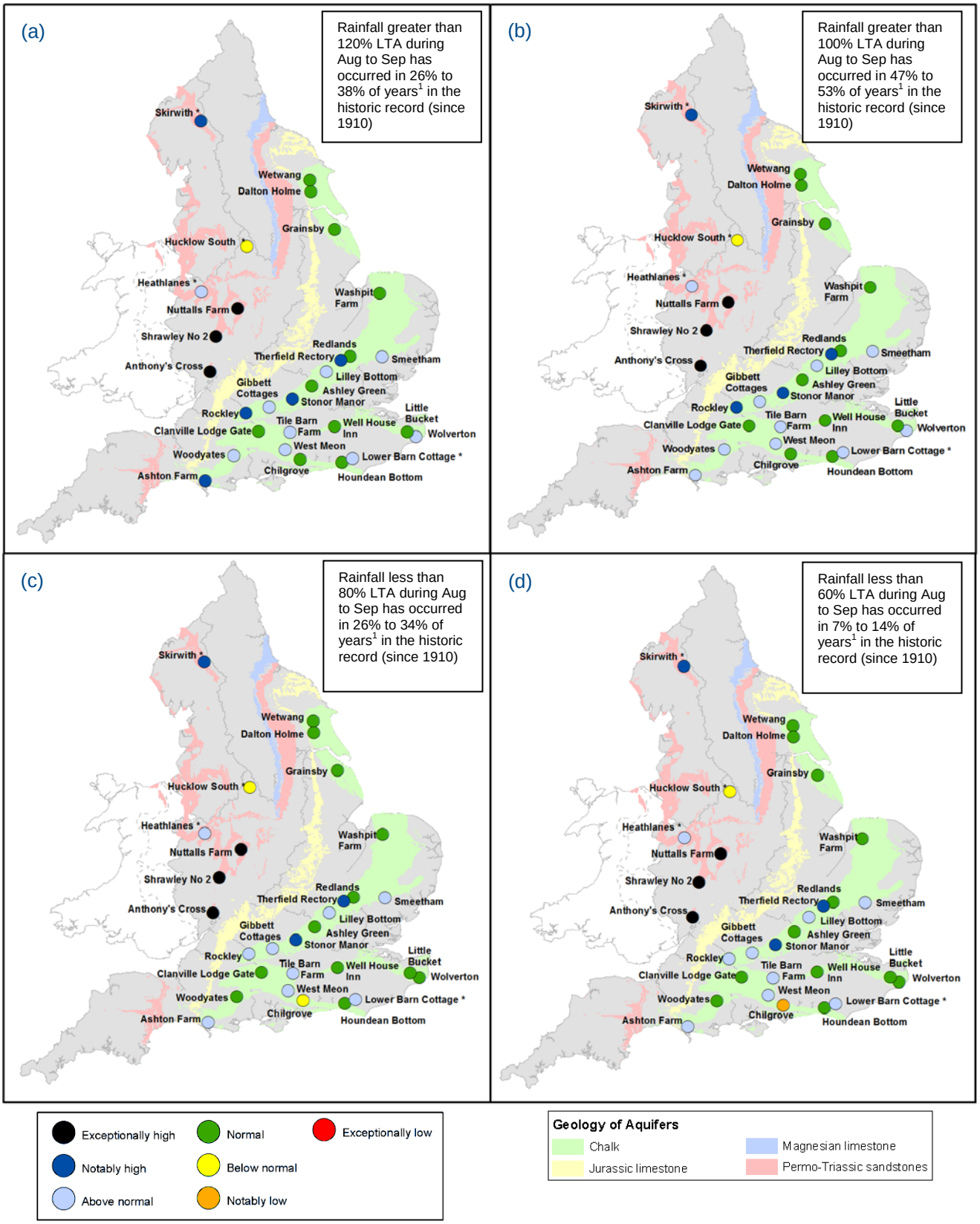

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2014 and September 2014 (Source: Environment Agency) Geological map reproduced with kind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

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

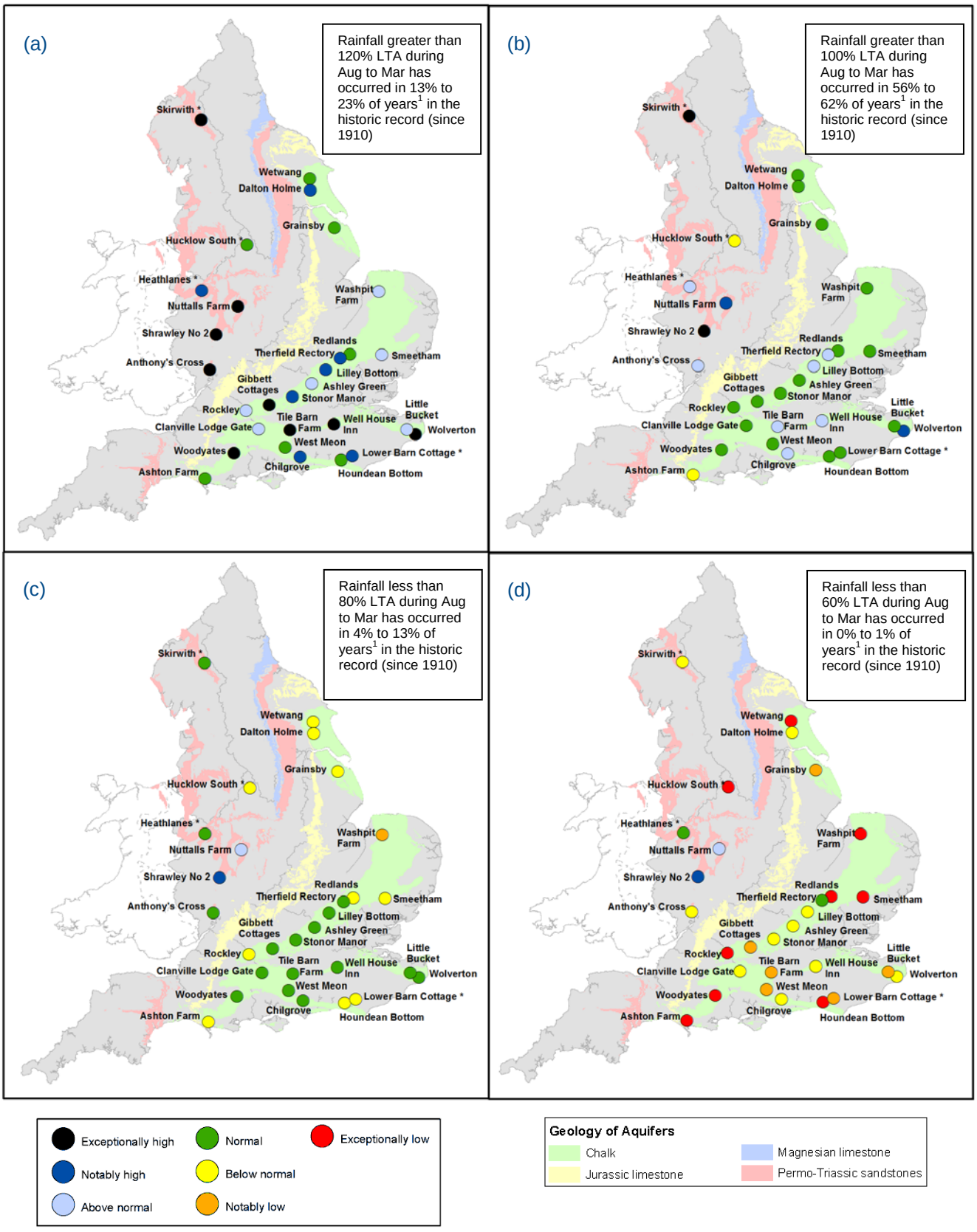

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2014 and March 2015. (Source: Environment Agency) Geological map reproduced with kind permission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

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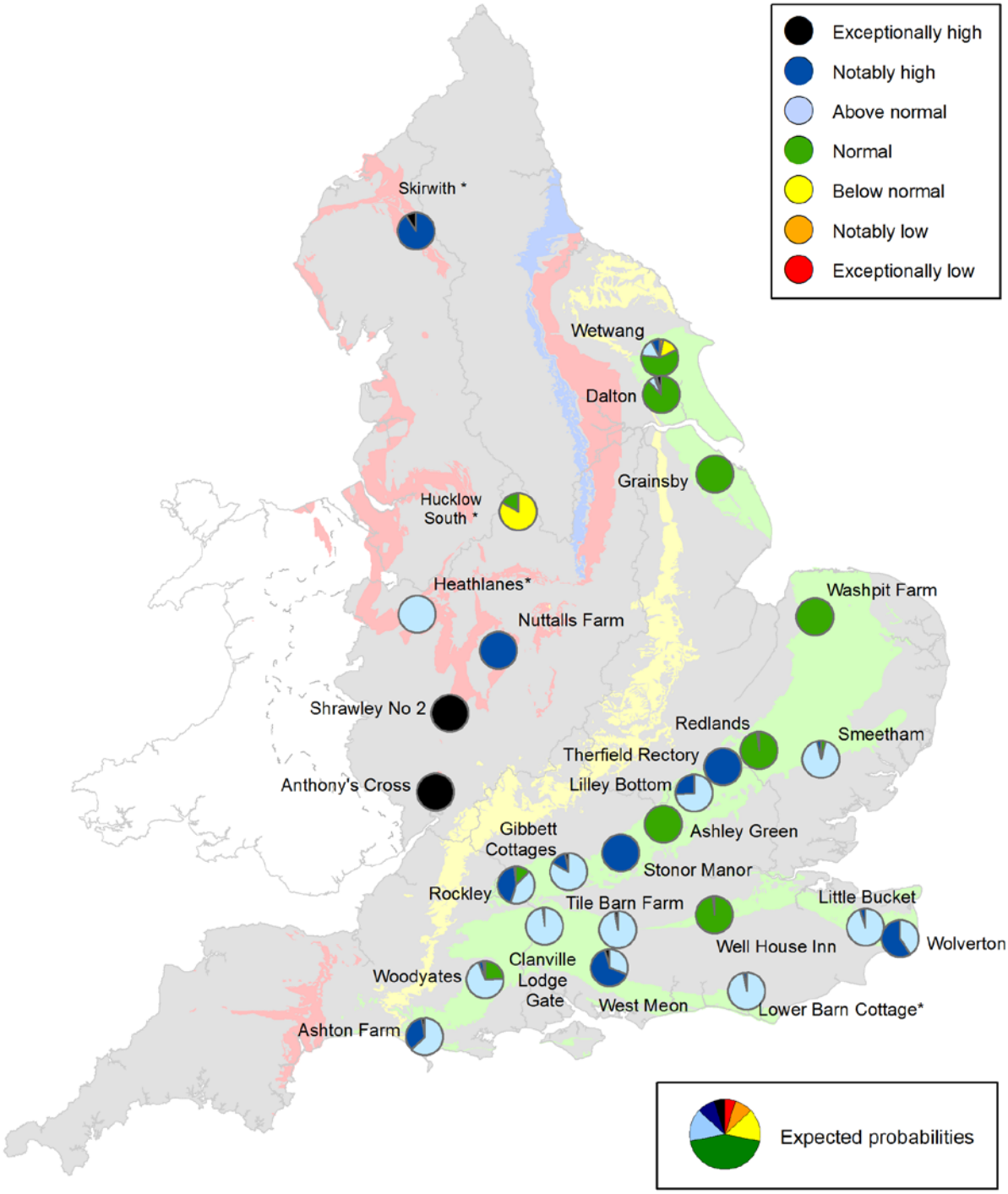
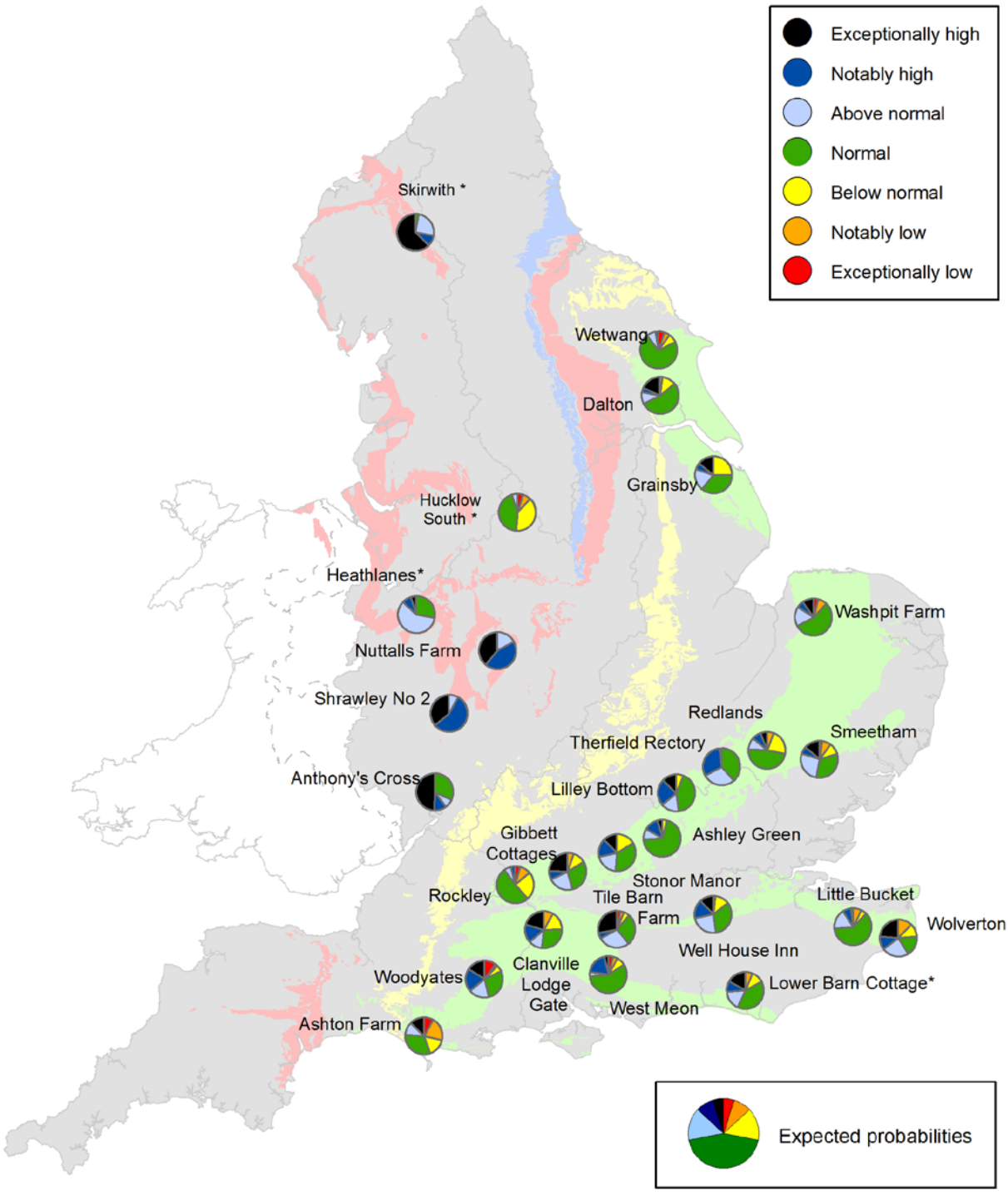
[1] This range of probabilities is a regional analysis



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 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