Monthly water situation report

England

Summary – July 2016

The rainfall total for England was below average for the first time in nine months at 72% of the July long term average. Soils were wetter than average across much of England. River flows decreased across most of England, but remain normal or higher for the time of year at all but one site. Groundwater levels decreased at most indicator sites but remain normal or higher for the time of year at all but one site. Reservoir stocks mostly decreased, and overall storage for England was 86% of total capacity.

Rainfall

Rainfall totals for July ranged from less than 10mm in 8 hydrological areas in south-east and south-west England to more than 130 mm in north-west England. Monthly rainfall totals were above the long term average (LTA) for July in parts of north-west and north-east England, but below average elsewhere. More than half of hydrological areas, particularly in south-east and south-west England, received less than half of the July LTA rainfall. The Isle of Wight, River Frome, West Dorset Streams and Otter Sid Axe and Lim hydrological areas all received less than 20% of the July LTA (Figure 1.1).

For the majority of hydrological areas in England, rainfall totals for July were normal or lower for the time of year. Parts of east and south-east England had exceptionally low July rainfall. It was the second driest July on record (since 1910) across parts of Dorset and Hampshire. Over the three month period to the end of July, rainfall totals were above normal to exceptionally high for many parts of England (Figure 1.2).

At the regional scale July rainfall totals ranged from 38% of the LTA in south-west England to 126% in north-west England. Rainfall totals across England as a whole were below average for the first time in nine months at 72% of the July LTA (Figure 1.3).

Soil moisture deficit

Soil Moisture Deficits (SMDs) increased across most of England during July, with the largest increases occurring in east and south-east England. At the end of July SMD values were less than 10mm in parts of Cumbria, Devon and in the headwaters of Welsh catchments that drain to England. Elsewhere, SMDs were mostly between 40 and 110mm, with the driest soils in parts of north-east England (Figure 2.1).

End of month SMDs were smaller than the long term average (LTA) for the end of July across most of England. Parts of east and north-east England however had drier than average soils for the time of year (Figure 2.1).

At a regional scale SMDs increased during July in all areas compared to the previous month. Regional scale SMD values at the end of July ranged from 31mm in north-west England to 81mm in east England (Figure 2.2).

River flows

Monthly mean river flows for July decreased at three quarters of indicator sites across England compared with June. Almost all sites were classed as normal or higher for the time of year. Just over half of the sites were above normal or higher for the time of year (Figure 3.1).

Monthly mean river flows were classed as above normal for the time of year at 3 of the regional index sites covering central, east and north-west England. Monthly mean flows were normal for the time of year at the remaining regional index sites in north-east, south-east and south-west England (Figure 3.2).

Groundwater levels

Groundwater levels decreased at the majority of indicator sites during July. At the end of the month, groundwater levels were normal at just over half of the indicator sites, and were above normal or higher at all but one of the

remaining sites. Groundwater levels at Crossley Hill (Nottinghamshire and Doncaster Permo-Triassic sandstone) remain below normal for the time of year (Figure 4.1).

End of month groundwater levels at the major aquifer index sites were all normal or higher for the time of year. Redlands (Cambridge and Ely Ouse chalk), Jackaments Bottom (Burford Jurassic limestone) and Stonor Park (south-west Chilterns chalk) remain normal for the time of year. Groundwater levels increased very slightly at Heathlanes (Shropshire Sandstone) and remain above normal. Groundwater levels at Skirwith (Carlisle Basin and Eden Valley sandstone), Dalton Holme (Hull & East Riding chalk), Chilgrove (Chichester chalk) and Little Bucket (East Kent Stour chalk) were also above normal for the time of year (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at more than two thirds of reported reservoirs and reservoir groups during July. The largest increases in storage were at Grafham Water (4%) and the Elan Valley Group (4%). The largest decrease in storage was at Blagdon Reservoir where stocks reduced by 20%. More than half of reservoirs and reservoir groups are above 85% of full capacity.

End of month stocks were classed as normal or higher for the time of year at four fifths of reservoirs and reservoir groups. Five reservoirs or reservoir groups supplying parts of central, south-east and south-west England were classed as below normal for the time of year (Figure 5.1).

At the regional scale reservoir stocks at the end of July decreased or remained constant across all of England. The largest decrease of 10% was in south-west England. Month-end regional stocks for the end of July ranged from 75% of total capacity in north-west England, to 94% in central England. Reservoir storage at the end of July for England overall was at 86% of total capacity (Figure 5.2).

Forward look

Changeable weather conditions are expected throughout the second half of August and early September. The period is likely to be wettest in the north-west and drier in the south-east (particularly in early September). For the period August-September-October the chances of above and below average rainfall are fairly balanced[1].

Projections for river flows at key sites[2]

By the end of September 2016 nearly two thirds of modelled sites have a greater than expected chance of normal cumulative flows. By the end of March 2017, nearly two thirds of modelled sites have a greater than expected chance of normal or higher cumulative flows

For scenario based projections of cumulative river flows at key sites by September 2016 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2017 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2016 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2017 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

At the end of September 2016, nearly two thirds of modelled sites have a greater than expected chance of normal groundwater levels for the time of year. At the end of March 2017 four fifths of modelled sites have a greater than expected chance of normal or higher groundwater levels for the time of year

For scenario based projections of groundwater levels in key aquifers in September 2016 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2017 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2016 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2017 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 (www.hydoutuk.net).

Rainfall

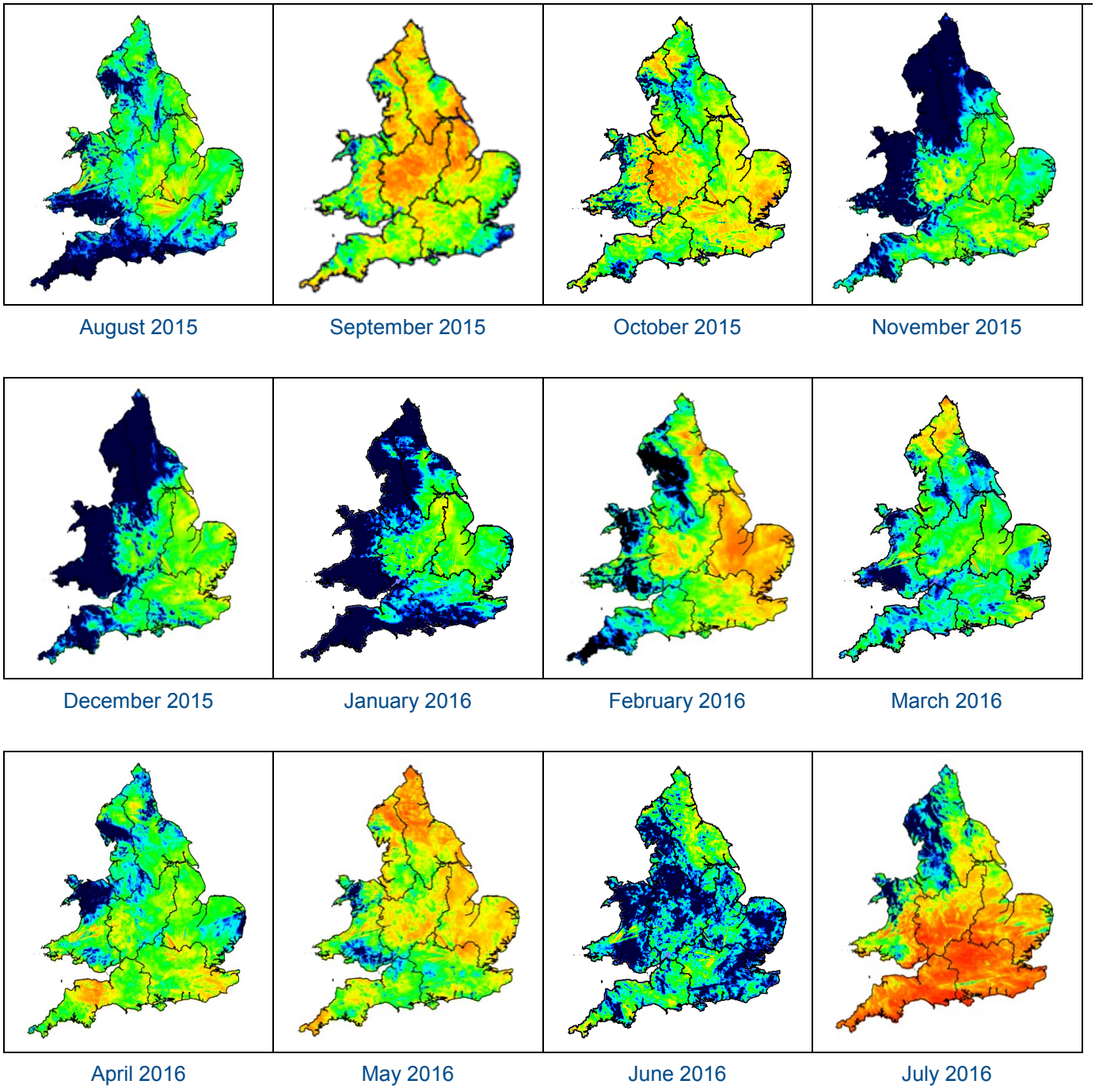


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2016). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

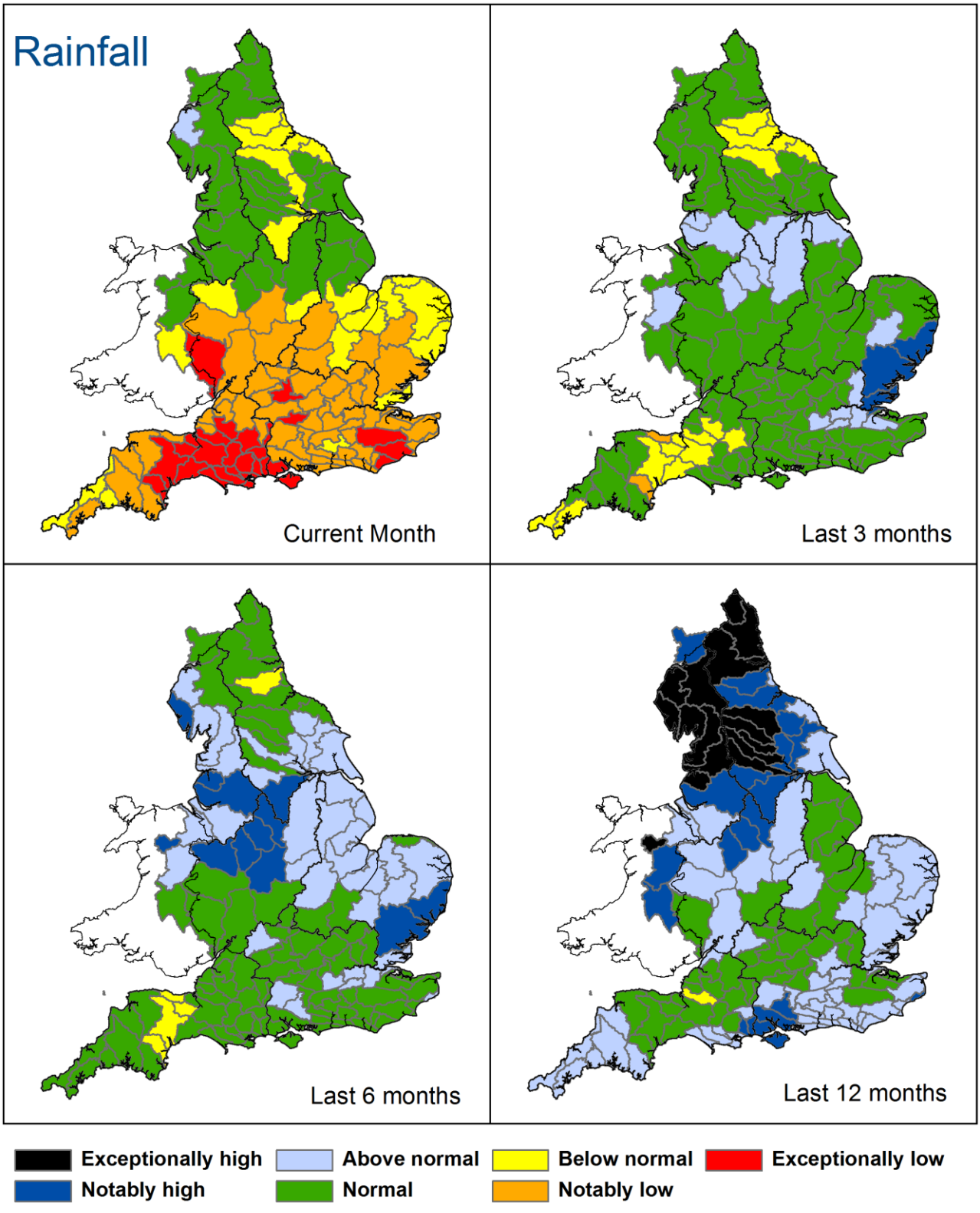


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 July), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2016)*. Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

Rainfall charts

Above average rainfall

Below average rainfall

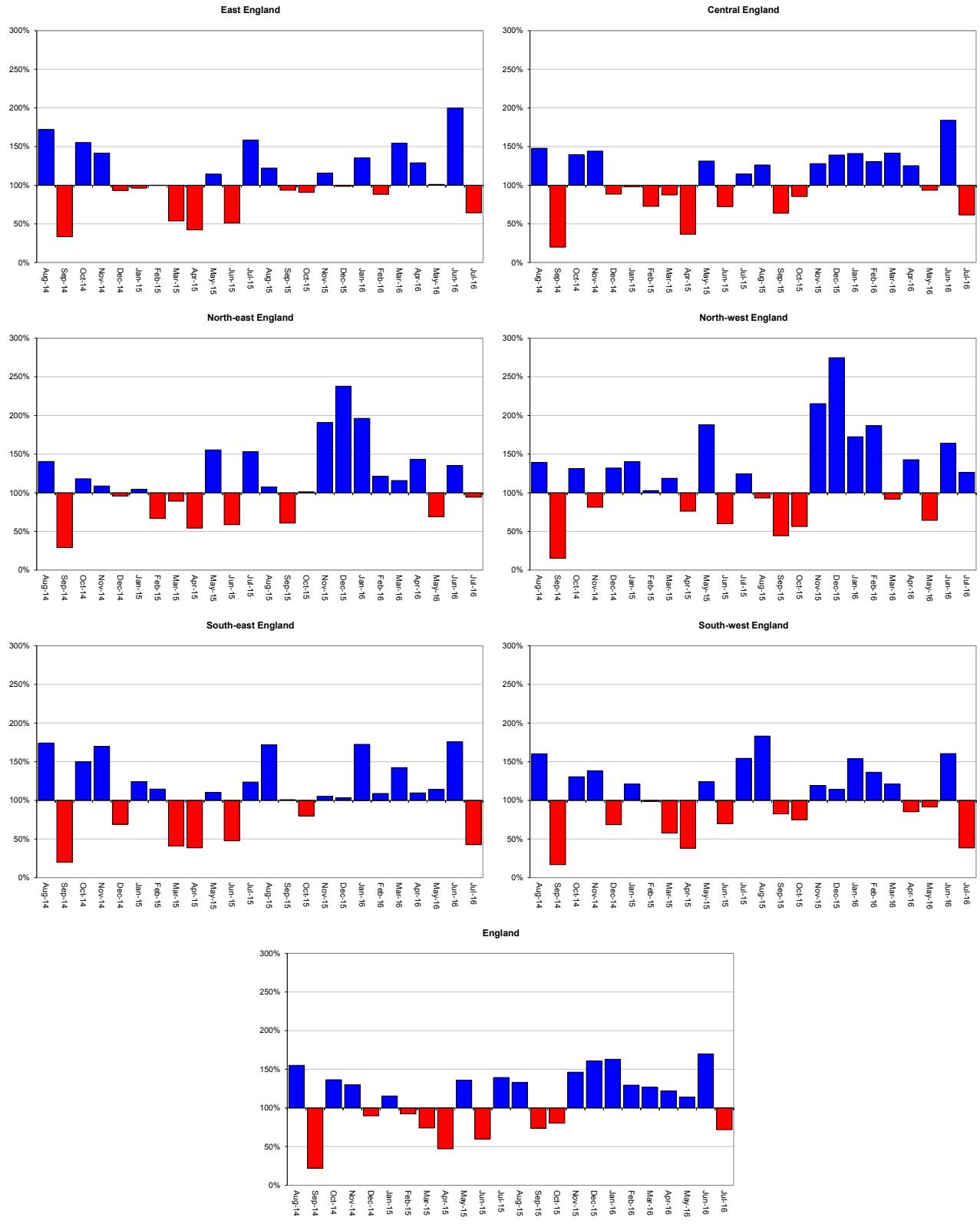


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2016).

Soil moisture deficit

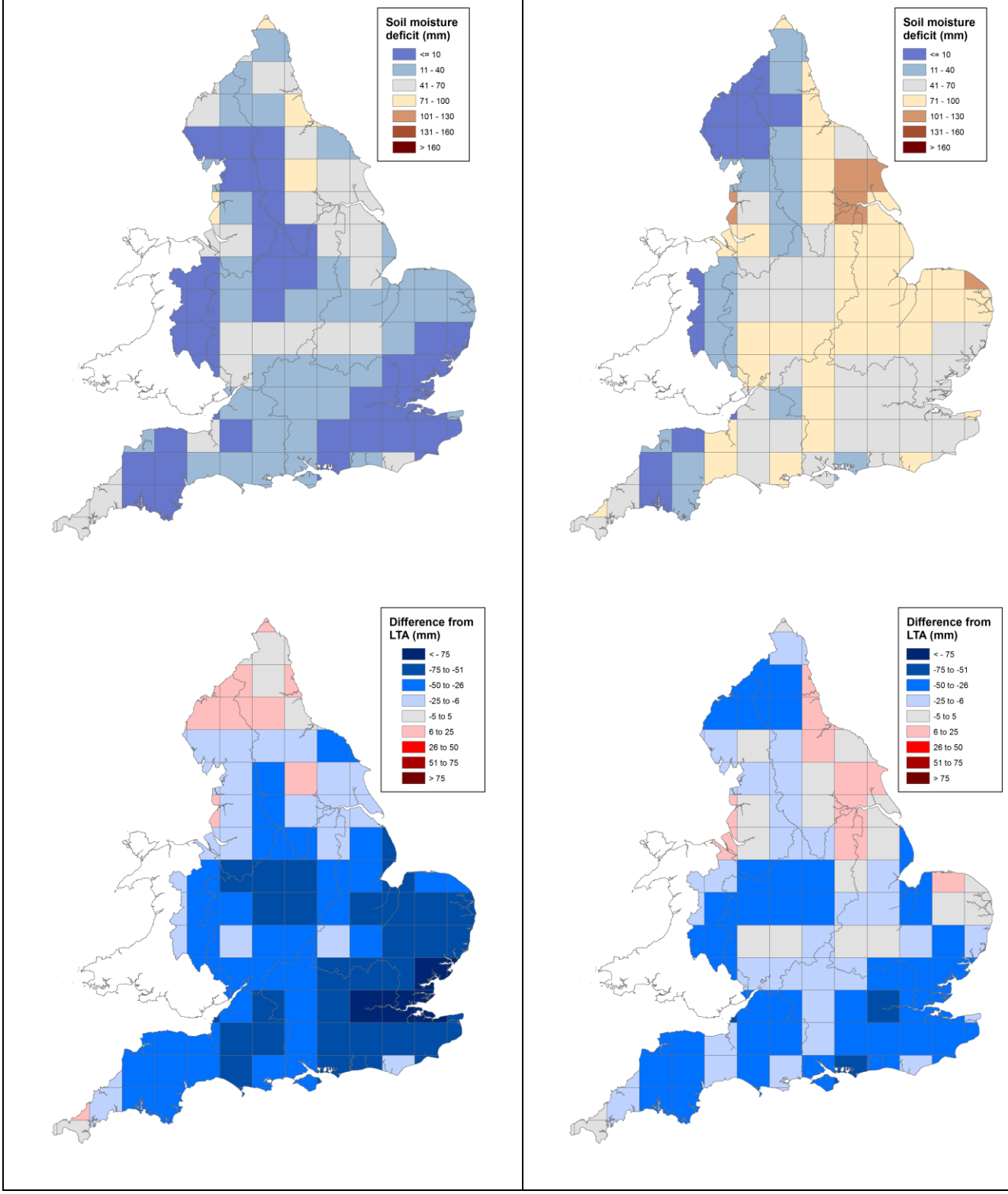
End of June 2016[1]	End of July 2016[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 28 June 2016 [1] (left panel) and 02 August 2016 [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, 2016). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016

Soil moisture deficit charts

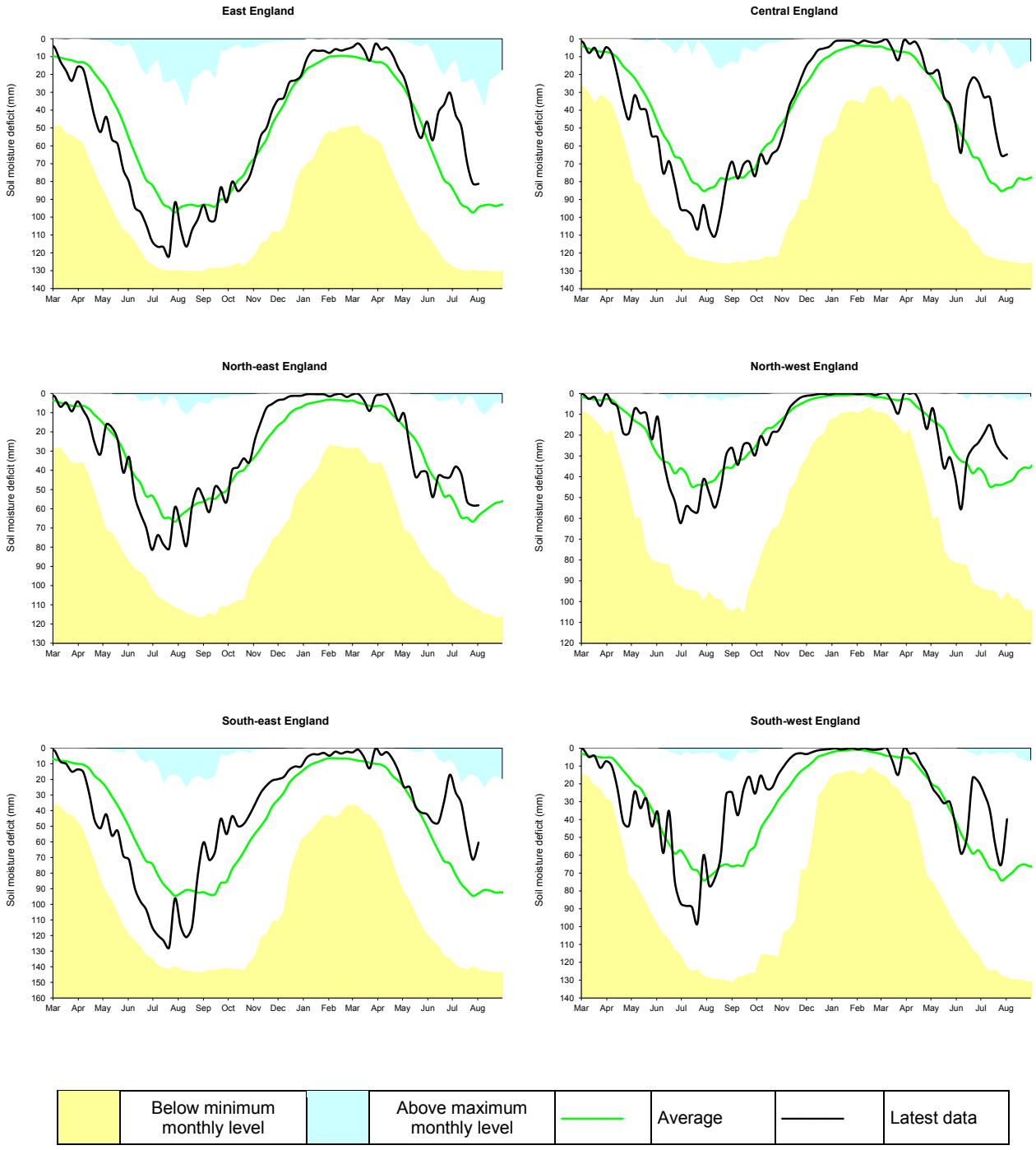
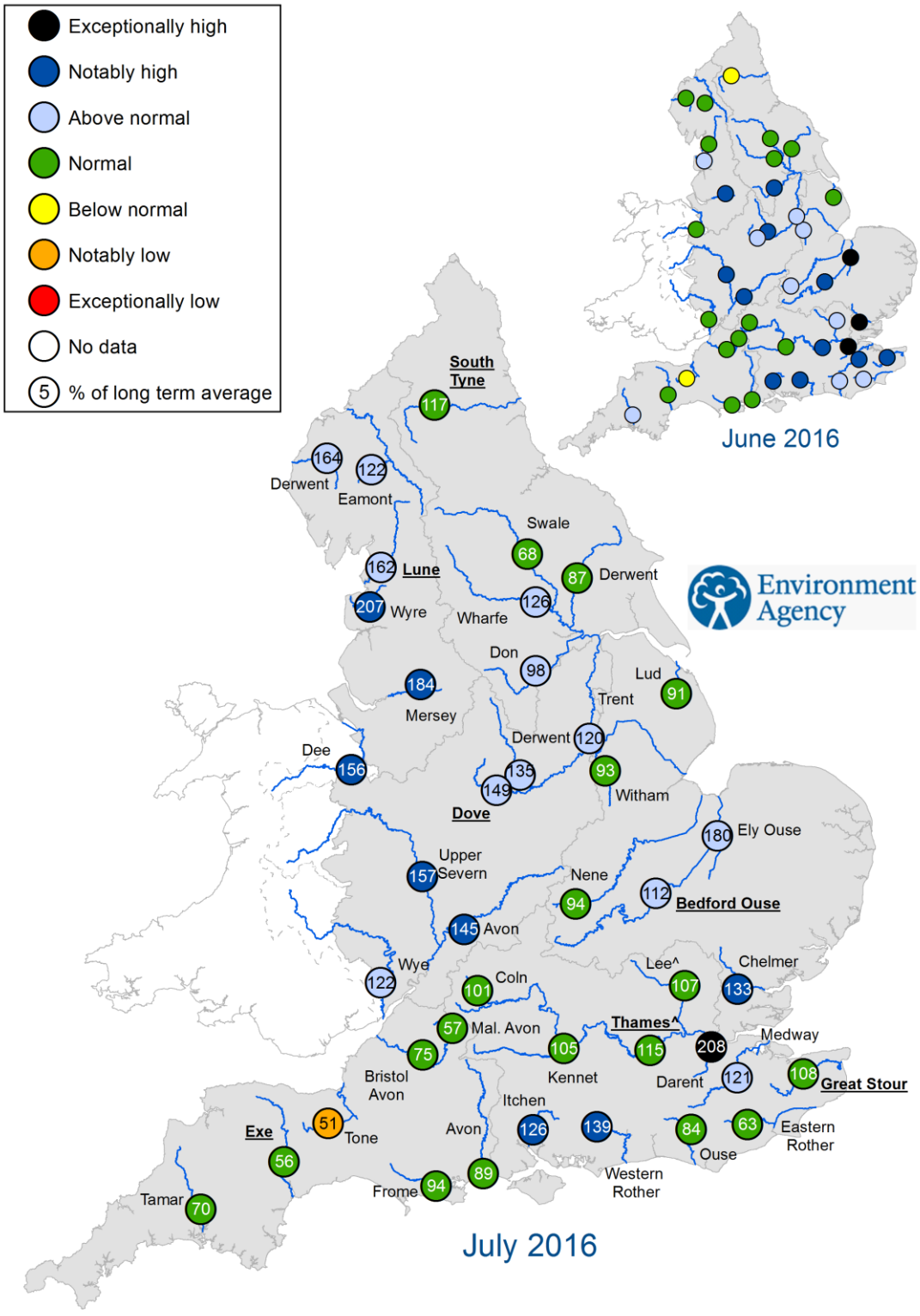


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2016).

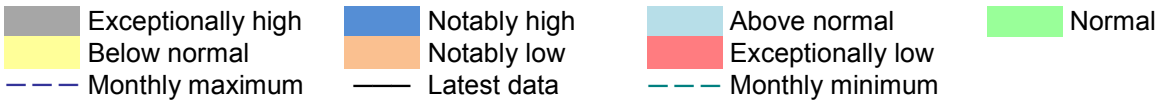
River flows

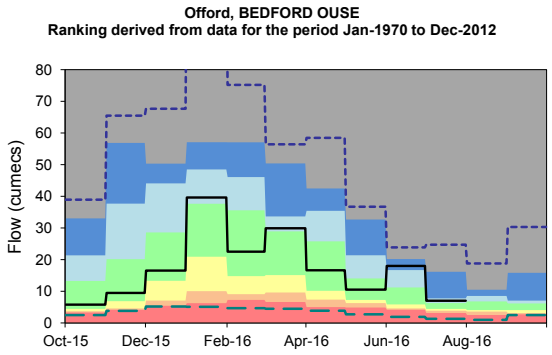


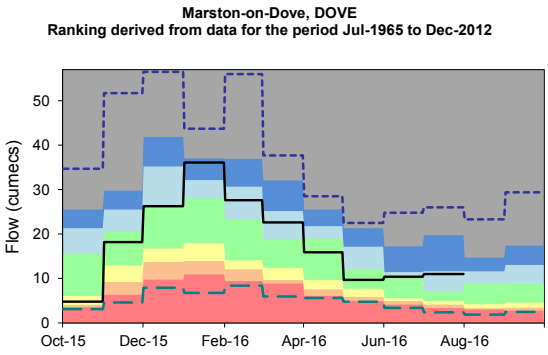
^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'
Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

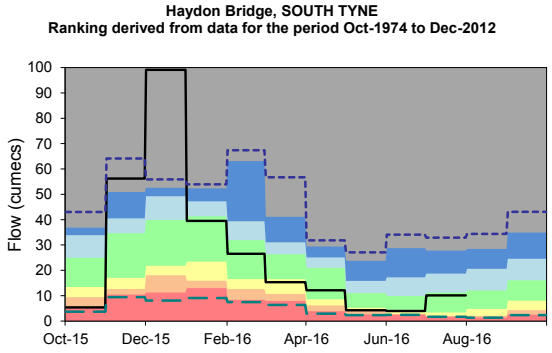
Figure 3.1: Monthly mean river flow for indicator sites for June 2016 and July 2016, expressed as a percentage of the respective long term average and classed relative to an analysis of historic June and July monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

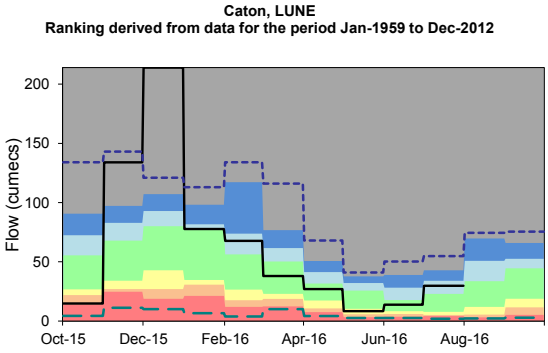
River flow charts

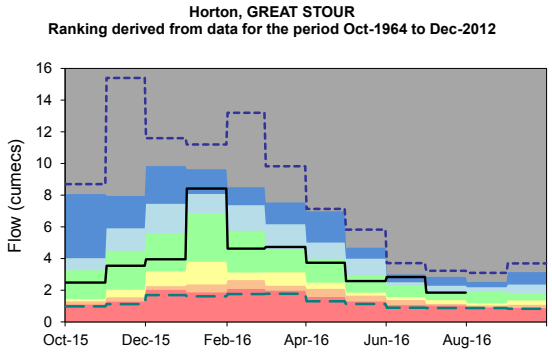


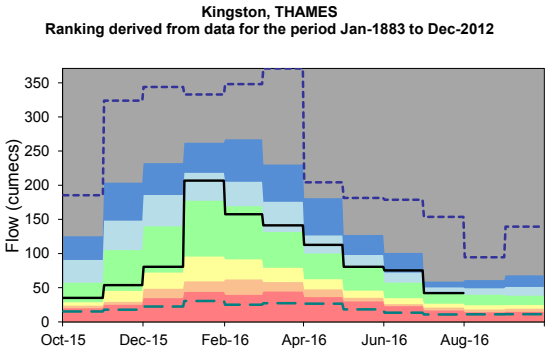












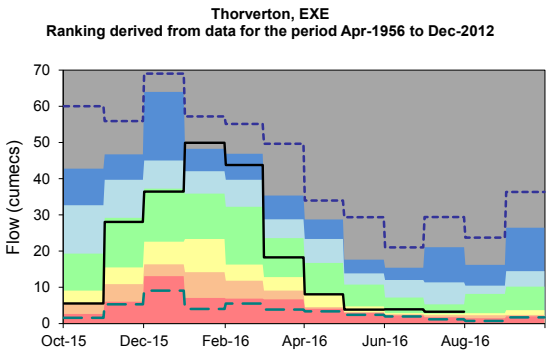
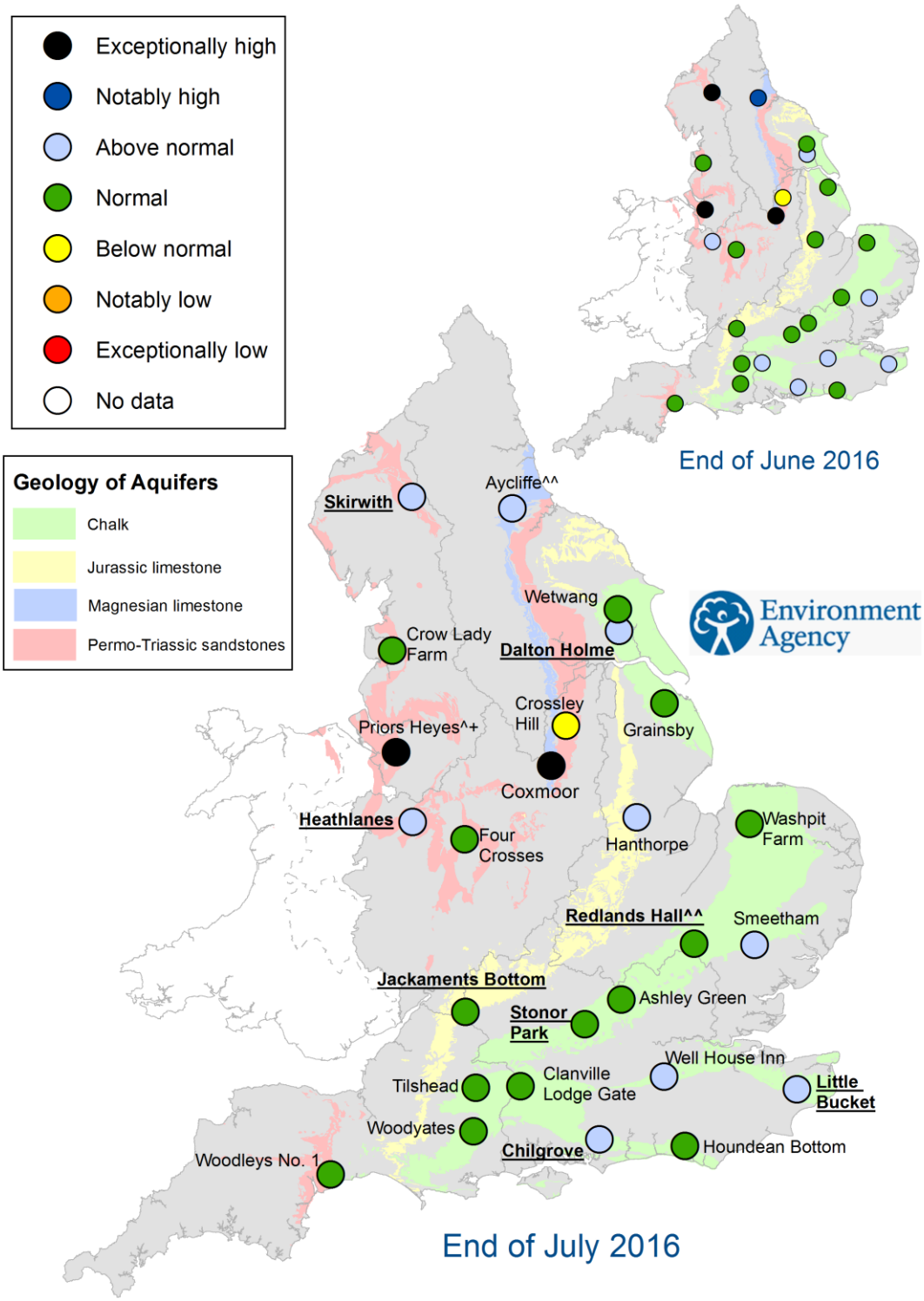


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
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 2016 and July 2016, 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, 2016.

Groundwater level charts

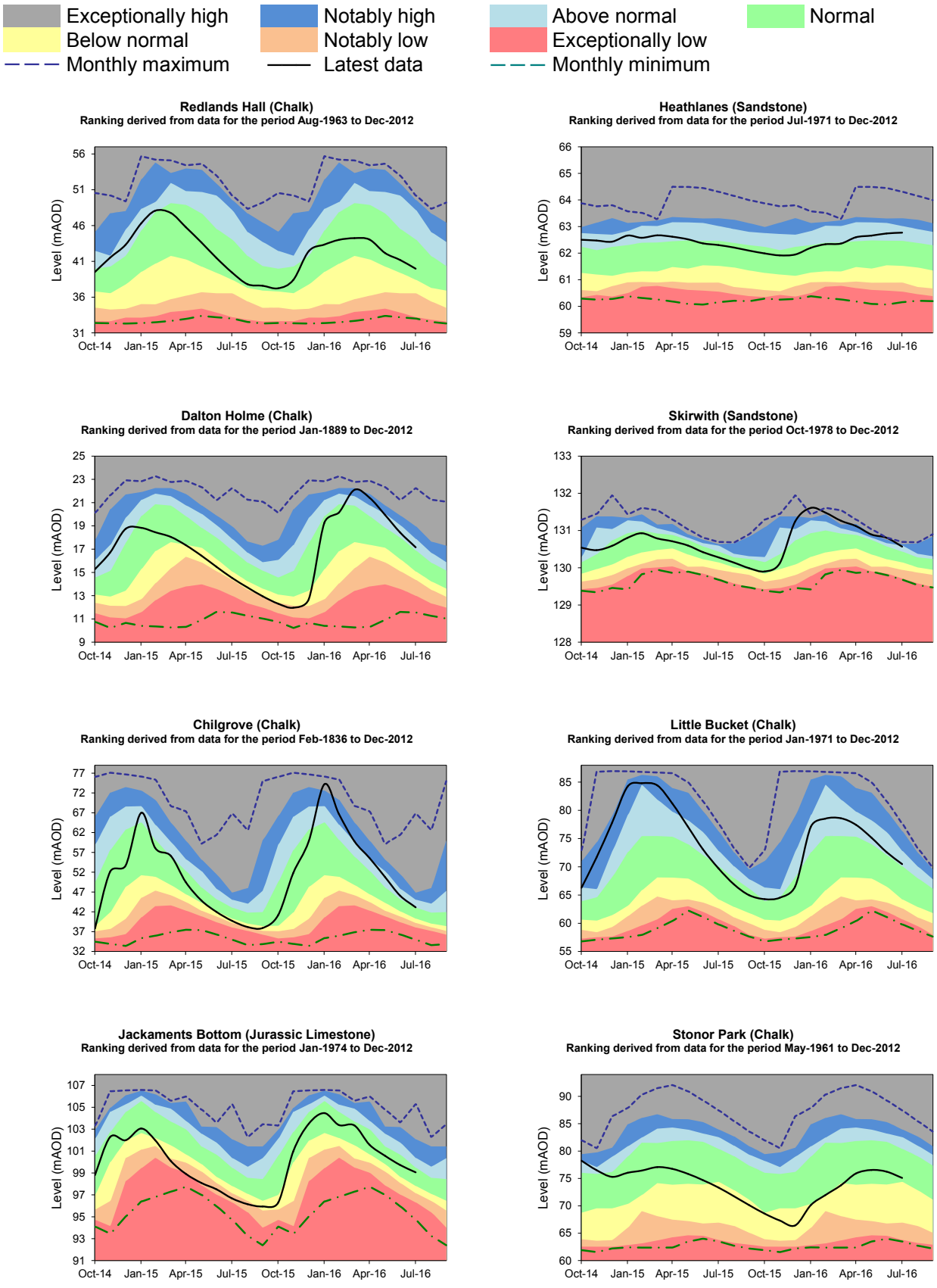
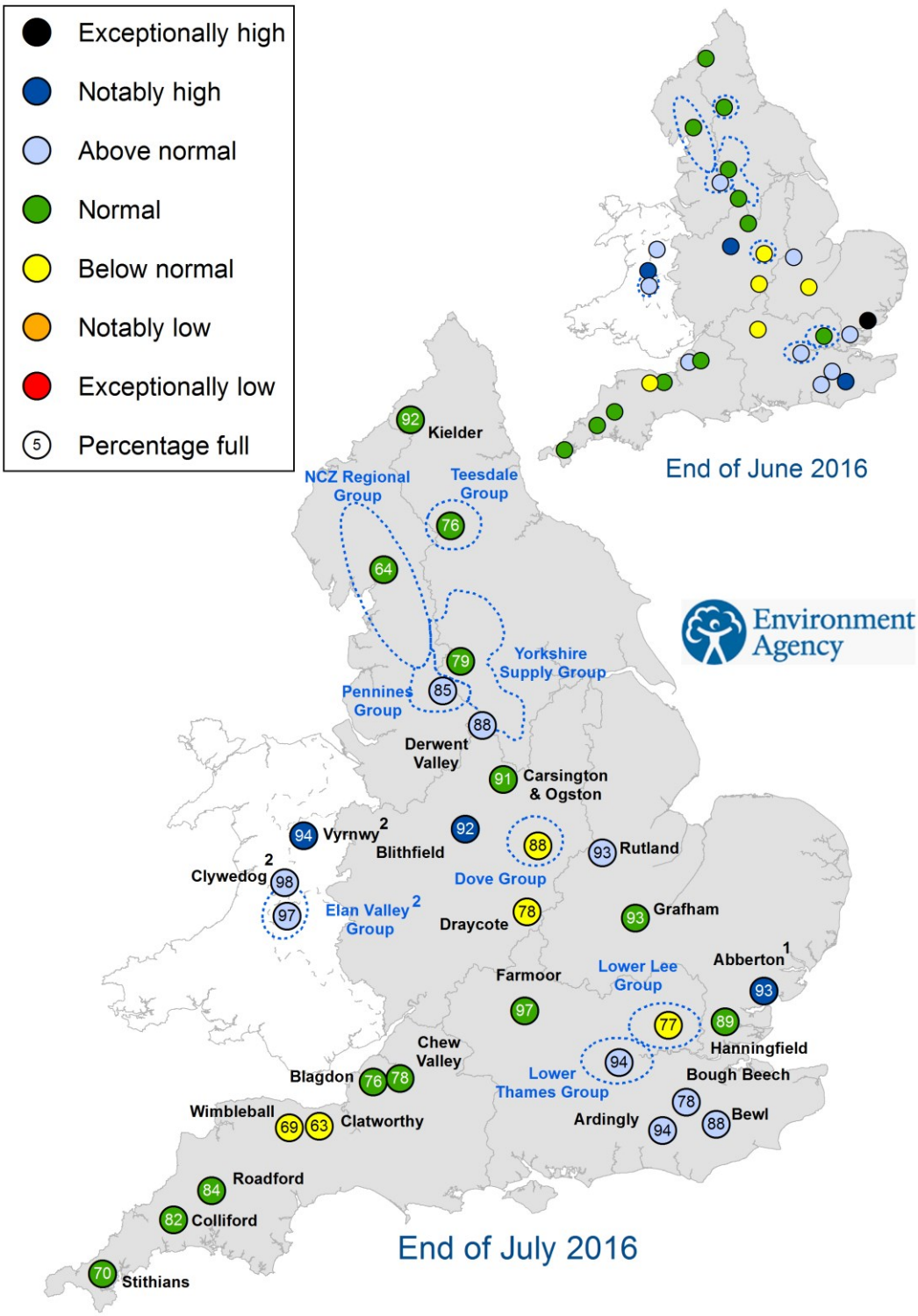


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2016).

Reservoir storage



1. Engineering work at Abberton Reservoir in east England to increase capacity has been completed
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 June 2016 and July 2016 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.

Reservoir storage charts

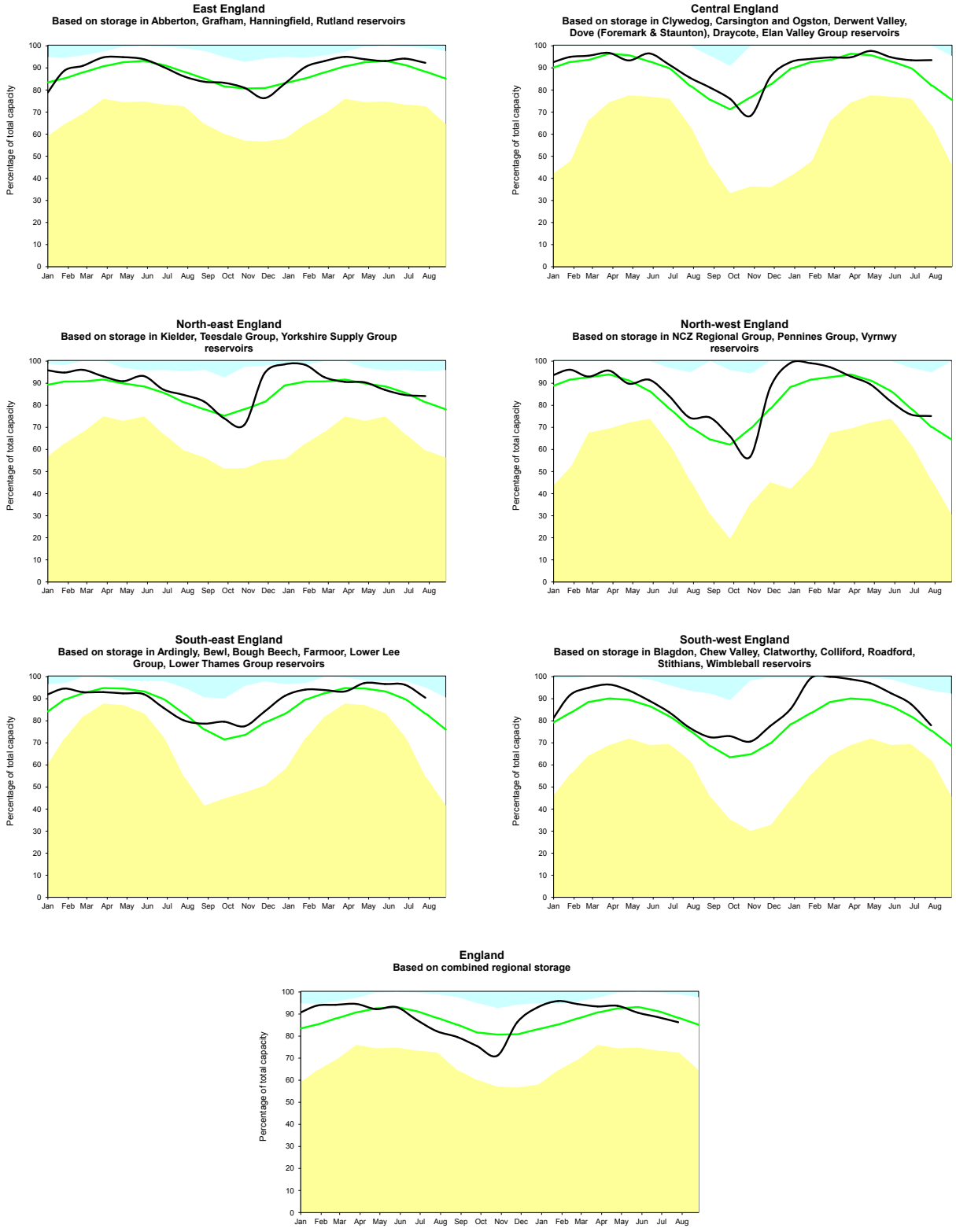


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

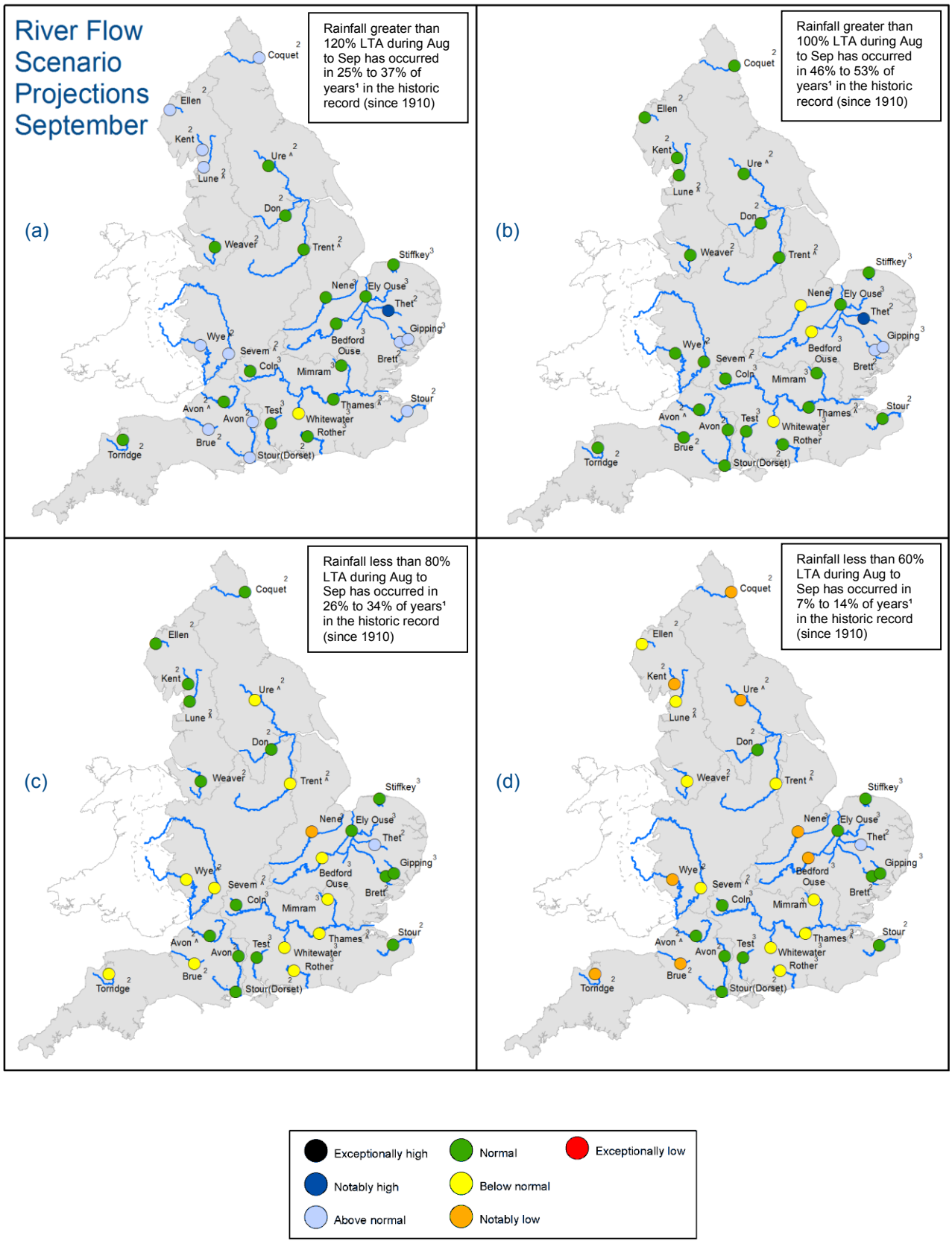


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by CEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*

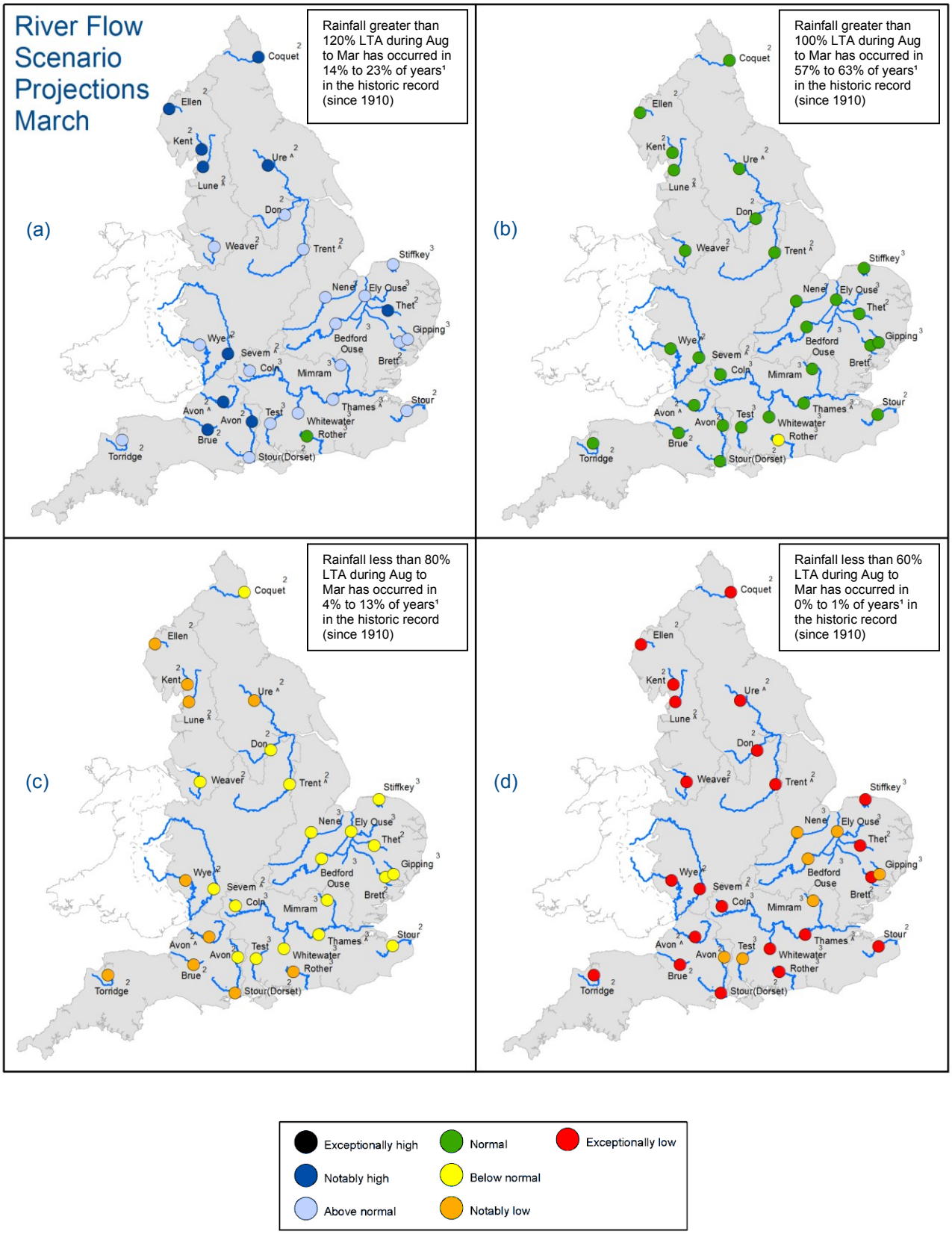


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2016 and March 2017 (Source: Centre for Ecology and Hydrology, Environment Agency)

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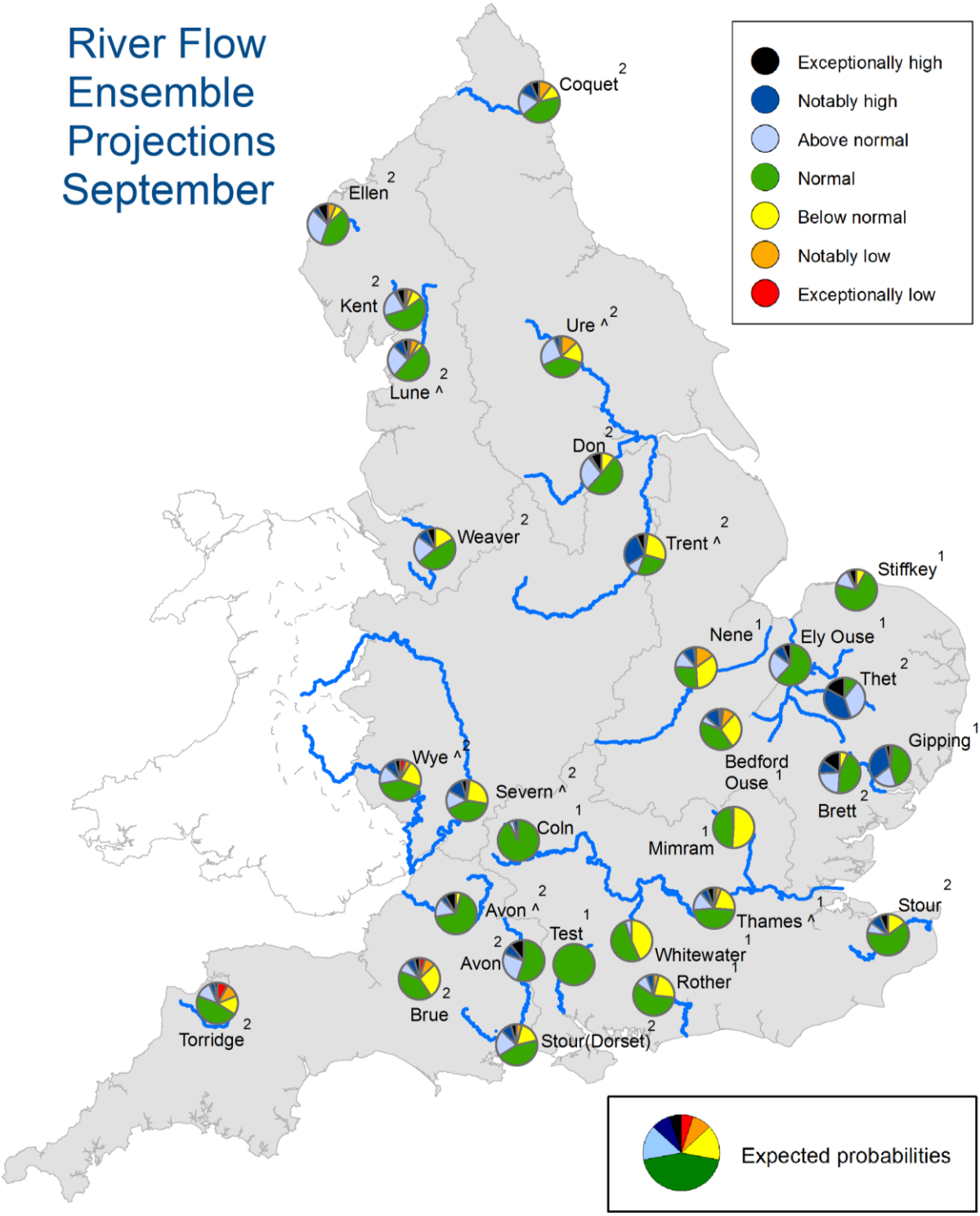

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2016. 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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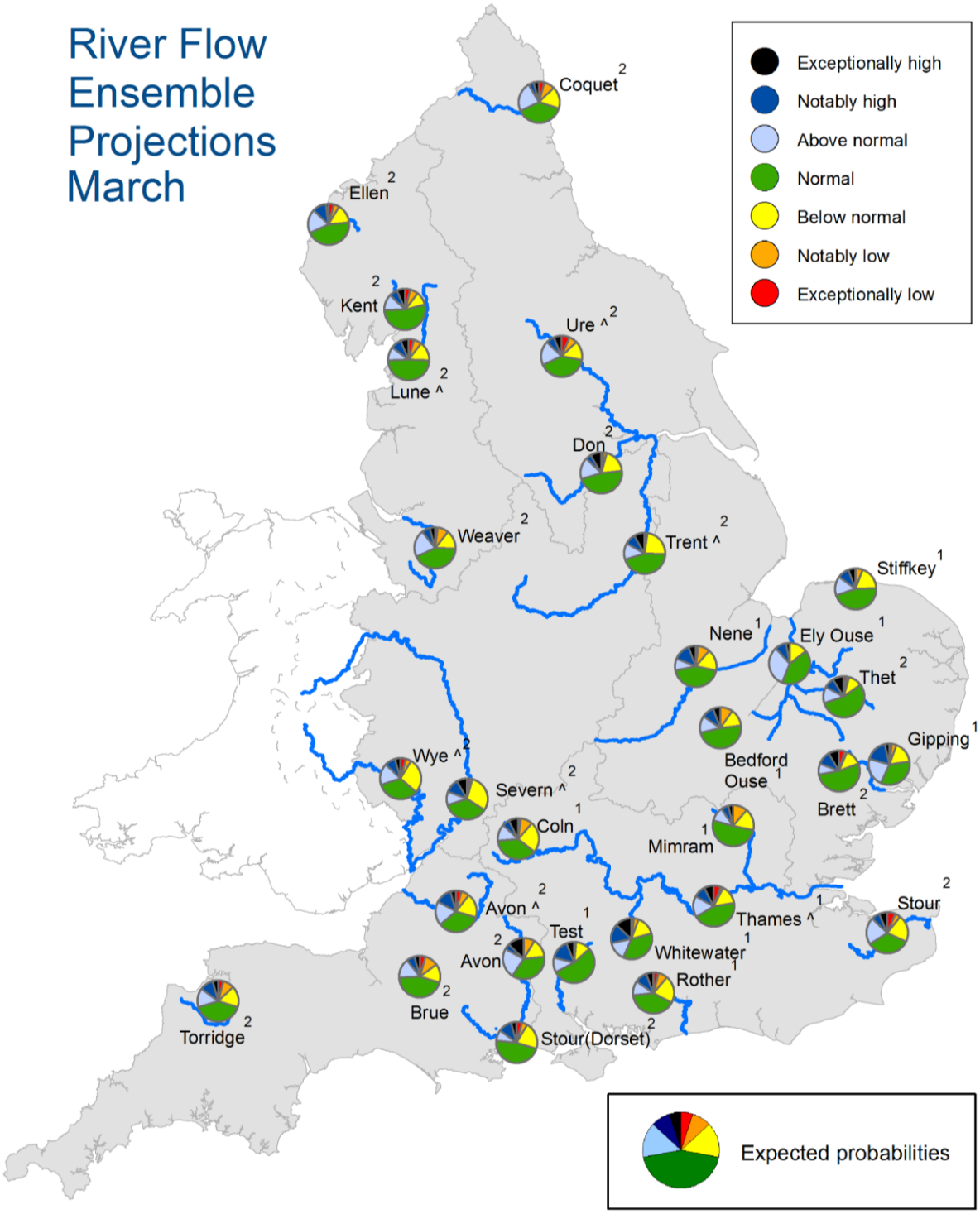
^"Naturalised" flows are projected for these sites



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 2017. 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

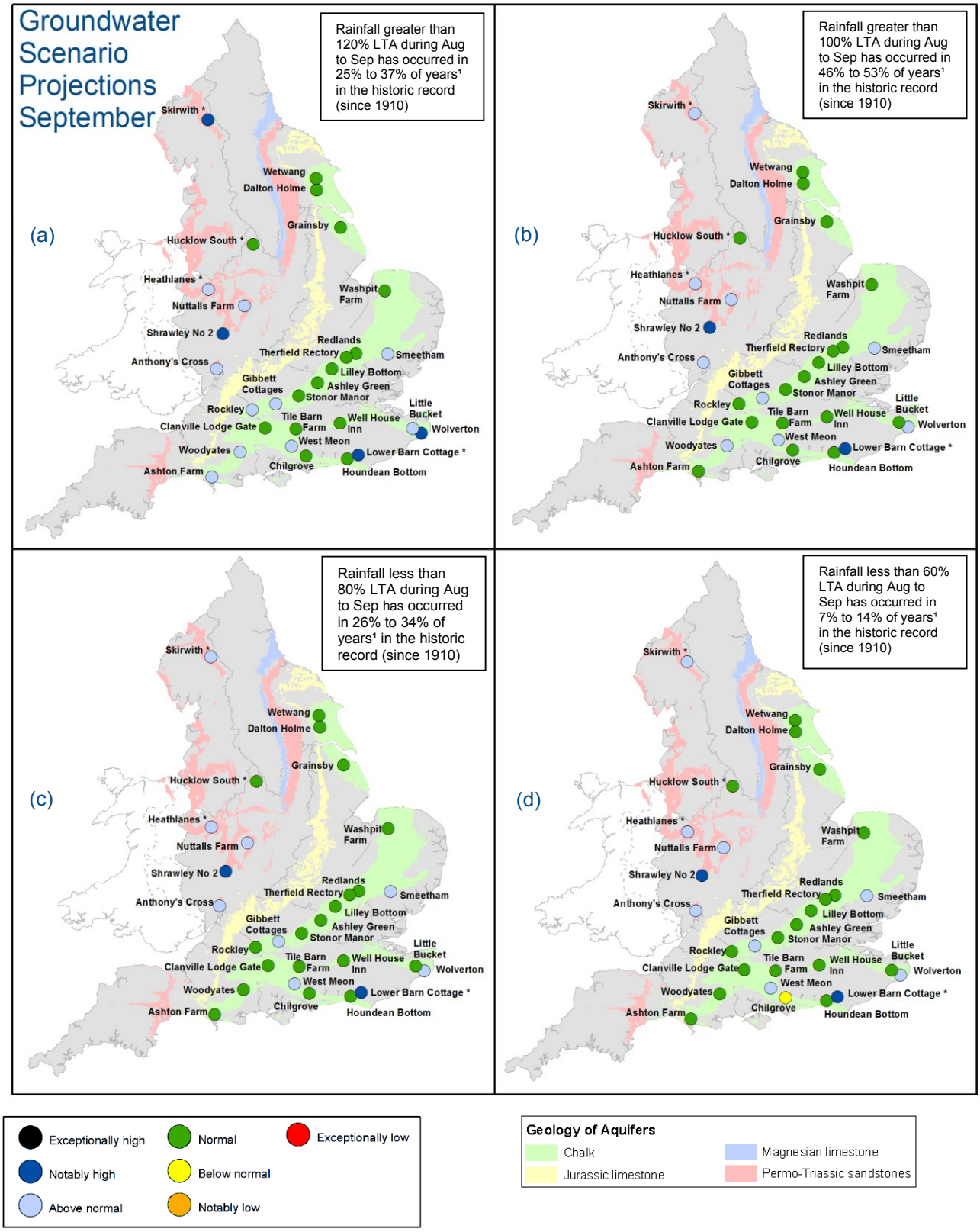


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2016.

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

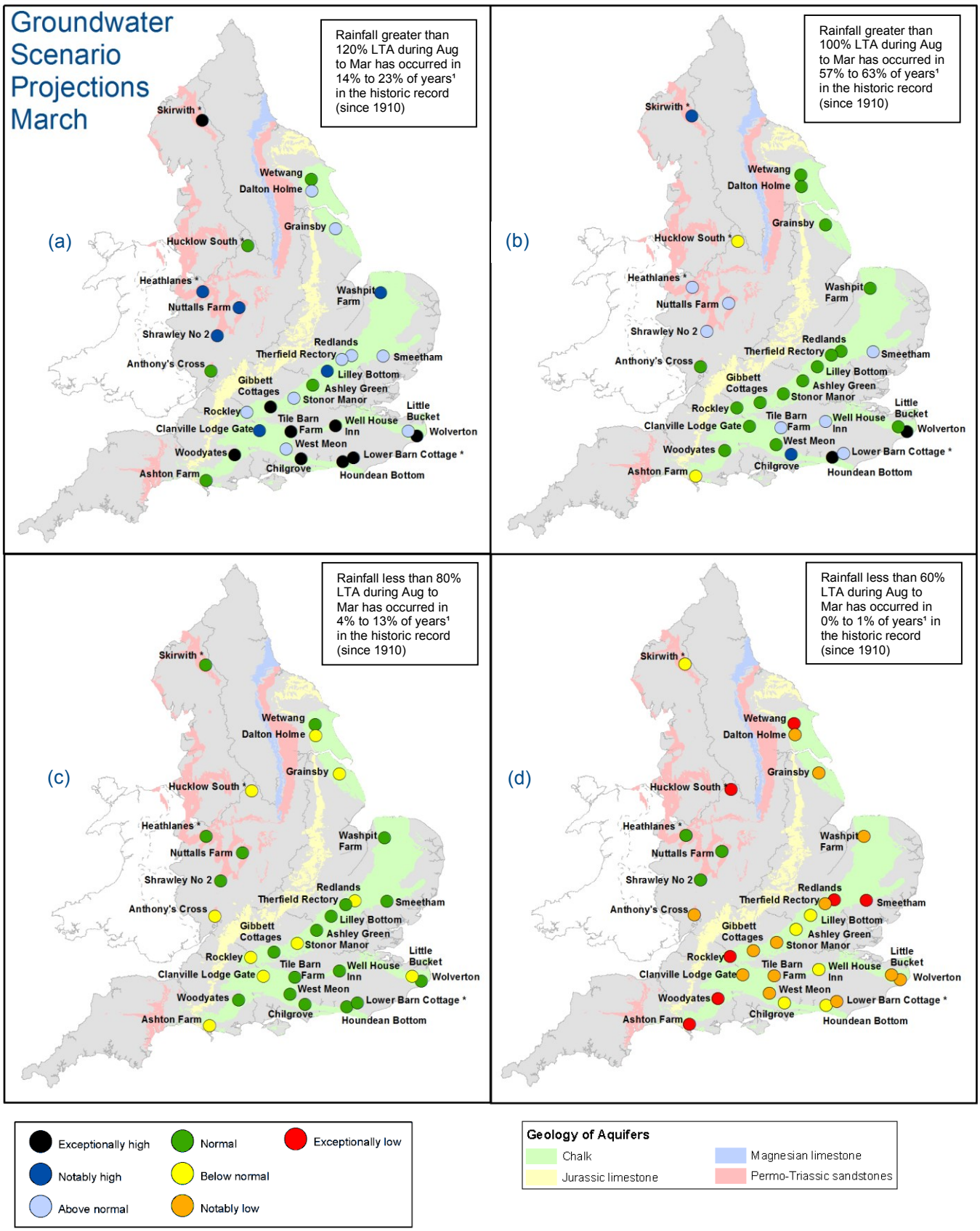
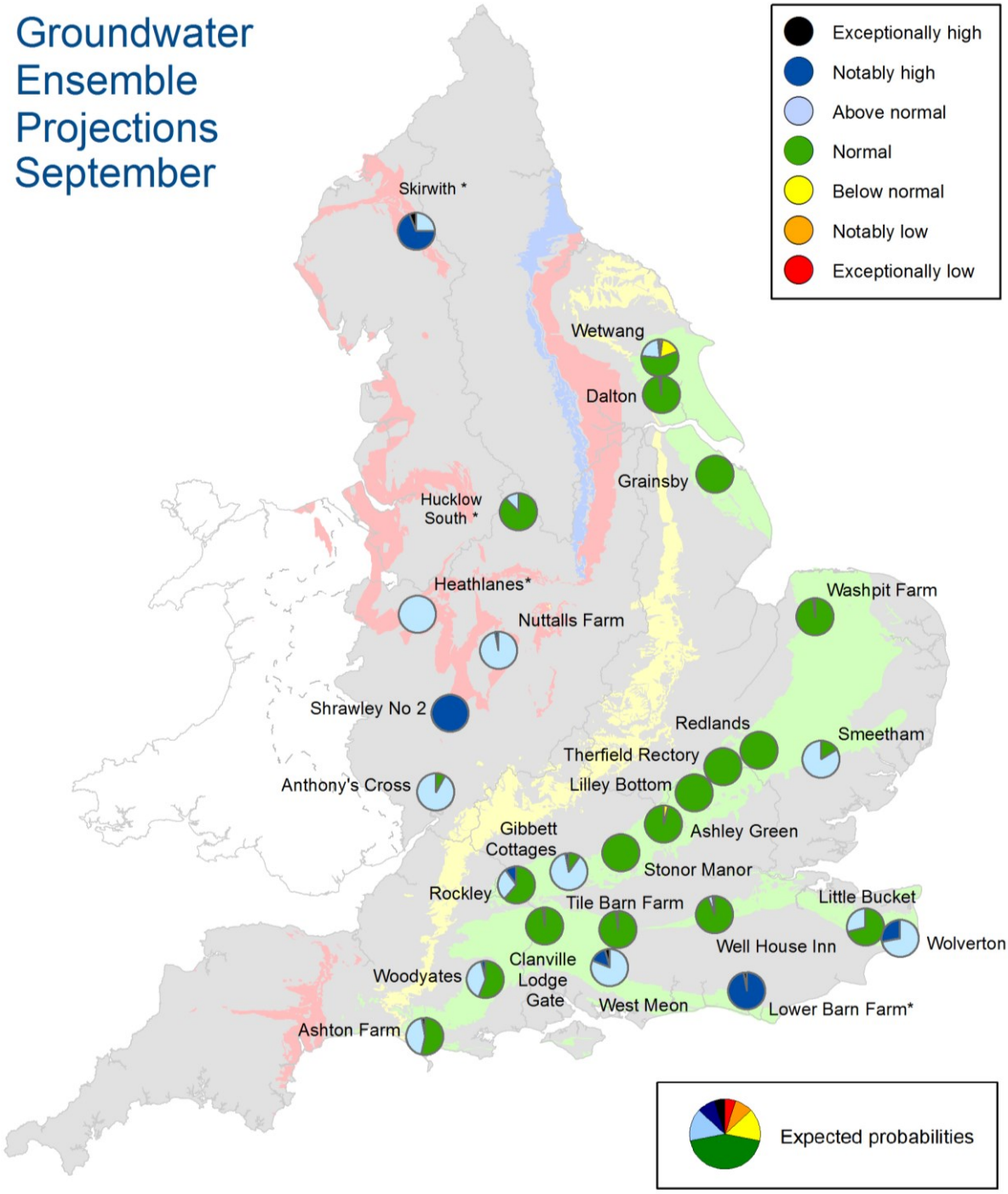


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2016 and March 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2016.

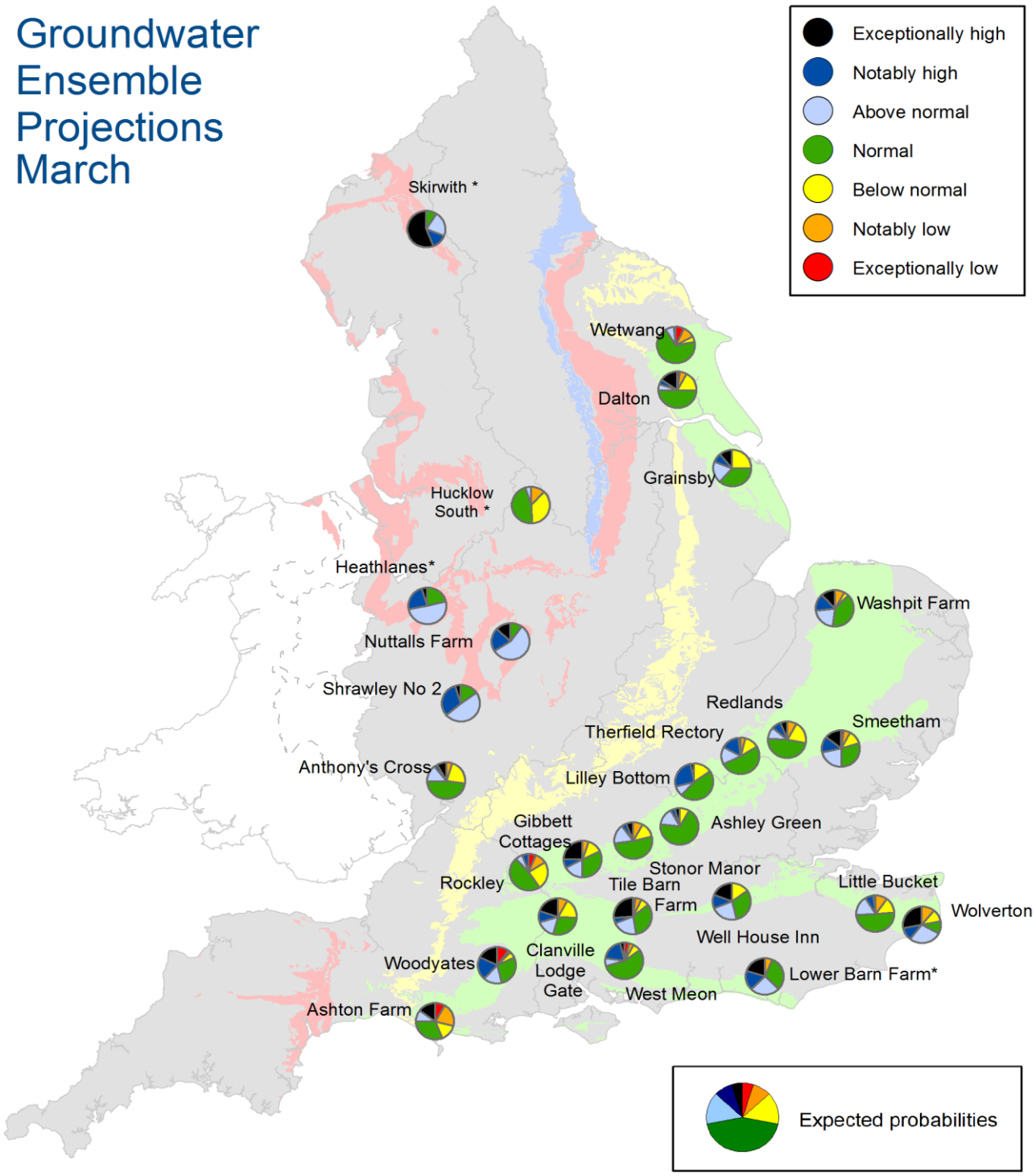
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2016. 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, 2016.

** 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 2017. 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, 2016.

* 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