Monthly water situation report

England

Summary – June 2015

June marked a return to drier conditions following a wetter than average May, with rainfall totals across England at 58% of the long term average (LTA). Soil moisture deficits increased by up to 80mm during the month across all areas. End of month SMDs were up to 55mm larger than the LTA across all but the far north-west of England. Monthly mean river flows decreased compared to May at all but two indicator sites, but remain **normal** or higher for the time of year at two-thirds of sites. Groundwater levels decreased during the month at all but one indicator site, but end of month levels remain **normal** or higher at nearly two thirds of sites. Reservoir stocks decreased at all but one site during June and at the end of the month, were **normal** for the time of year at just over half of sites. Overall stocks for England decreased to 87% of total capacity.

Rainfall

June rainfall totals were highest across parts of Cumbria, Cornwall and Devon at between 50 and 80mm. The lowest rainfall totals of between 10 and 20mm occurred across London and parts of Essex, Suffolk, Cambridgeshire and the Thames corridor. June rainfall totals were below the LTA in all hydrological areas, with the majority receiving less than 75% of the LTA. The hydrological areas covering London received just 24% of the LTA, whilst north Cornwall received 94% (Figure 1.1).

June rainfall totals were classed as **normal** or **below normal** for the time of year across the majority of hydrological areas. Those hydrological areas covering parts of East Anglia, London, the Chilterns and the North Downs were classed as **notably low**. Over the 3 month period ending in June, cumulative rainfall totals were broadly **normal** for the time of year in northern England and **below normal** or lower elsewhere. The 6 month cumulative rainfall totals were **below normal** or **notably low** for the time of year across most of England, whilst the 12 month cumulative totals were generally **normal** or **below normal** (Figure 1.2).

At a regional scale, June rainfall totals ranged from 49% of the June LTA in east England to 69% in south-west England. Totals were **normal** for the time of year in central and south-west England, but **below normal** elsewhere. Across England as a whole, rainfall was **below normal** for the time of year at 58% of the June LTA (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) increased by up to 80mm across all areas during June, with the largest increases occurring down the western fringe of England. At the end of June SMDs ranged between 100 and 150mm across most of east and south-east England and parts of the north-east and south-west. End of month SMDs were smallest in the far north-west of England at approximately 20mm. End of month SMDs were up to 50mm larger than average across all but the far north-west of England; SMDs in three MORECS grid squares, covering parts of southern England from Hampshire through to Kent, were approximately 55mm larger than the LTA (Figure 2.1).

At a regional scale, SMDs increased during June by between approximately 30 and 50mm across all regions. The largest increase of just over 50mm occurred in south-west England. End of month SMDs ranged from 62mm in north-west England to 114mm in the south-east. SMDs in east England are similar to those at the end of June 2010 and June 2011 (Figure 2.2).

River flows

Monthly mean river flows decreased compared to May at all but two sites across England; flows on the rivers Tamar and Exe in south-west England increased slightly. Monthly mean flows were classed as **normal** or **above normal** for the time of year at two-thirds of indicator sites. The remaining sites, mainly located in east, south-east and south-west England, were classed as **below normal** or **notably low** for the time of year (Figure 3.1).

Monthly mean river flows were classed as **normal** for the time of year at 5 of the 7 regional index sites; the Bedford Ouse in east England and the naturalised flow on the River Thames in the south-east were classed as **below normal** for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels continued their seasonal decline during June, decreasing at all but one indicator site. At the end of the month, levels were classed as **normal** or higher for the time of year at nearly two thirds of sites. Levels at 7 sites across north-east, south-east and south-west England were **below normal** for the time of year, whilst the levels at Jackaments Bottom (in the Burford Jurassic limestone aquifer) and Tilshead (in the Upper Hampshire Avon chalk aquifer) remained **notably low** for the time of year.

End of month groundwater levels at the major aquifer index sites remained **normal** or higher for the time of year at 5 of the 8 sites. Chilgrove (in the Chichester chalk aquifer) dropped to **below normal** for the time of year, whilst Dalton Holme (in the Hull and East Riding chalk aquifer) and Jackaments Bottom remained **below normal** and **notably low** respectively (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at all reported reservoirs and reservoir groups during June, with the exception of Farmoor Reservoir which remained static. The largest decreases occurred at the Teesdale Group in north-east England (12%), Blagdon Reservoir in south-west England (12%) and Ardingly reservoir in south-east England (10%). End of month stocks were classed as **normal** for the time of year at just over half of all sites; stocks at the remaining sites were classed as **below normal** or lower. As a result of maintenance work, stocks in the Lower Thames Group were classed as **notably low** for the time of year (Figure 5.1).

Regional-scale reservoir stocks decreased by between 4 and 8% across all regions. At the end of June, regional stocks ranged from 84% of total capacity in north-west and south-west England to 94% in central England. Overall reservoir storage for England decreased by 6% to 87% of total capacity (Figure 5.2).

Forward look

July is expected to be warm and dry in many places for much of the month. Intermittent periods of unsettled weather and showers may affect some places through July. Further ahead, for the period July-August-September as a whole, near or below average rainfall is expected. However convective rainfall (i.e. thunderstorms) can significantly affect rainfall totals locally at this time of year[1].

Projections for river flows at key sites [2]

The majority of modelled sites have a greater than expected chance of **below normal** or lower cumulative flows by the end of September 2015. By the end of March 2016, more than a third of sites have a greater than expected chance of **normal** cumulative flows, however the majority also still have an elevated chance of **below normal** or lower cumulative flows.

For scenario based projections of cumulative river flows at key sites by September 2015 see Figure 6.1.
For scenario based projections of cumulative river flows at key sites by March 2016 see Figure 6.2.
For probabilistic ensemble projections of cumulative river flows at key sites by September 2015 see Figure 6.3.
For probabilistic ensemble projections of cumulative river flows at key sites by March 2016 see Figure 6.4.

Projections for groundwater levels in key aquifers [2]

Nearly two thirds of modelled sites have a greater than expected chance of **normal** groundwater levels at the end of September 2015. At the end of March 2016 half of the sites have a greater than expected chance of **normal** groundwater levels.

For scenario based projections of groundwater levels in key aquifers in September 2015 see Figure 6.5.
For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.6.
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2015 see Figure 6.7.
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 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

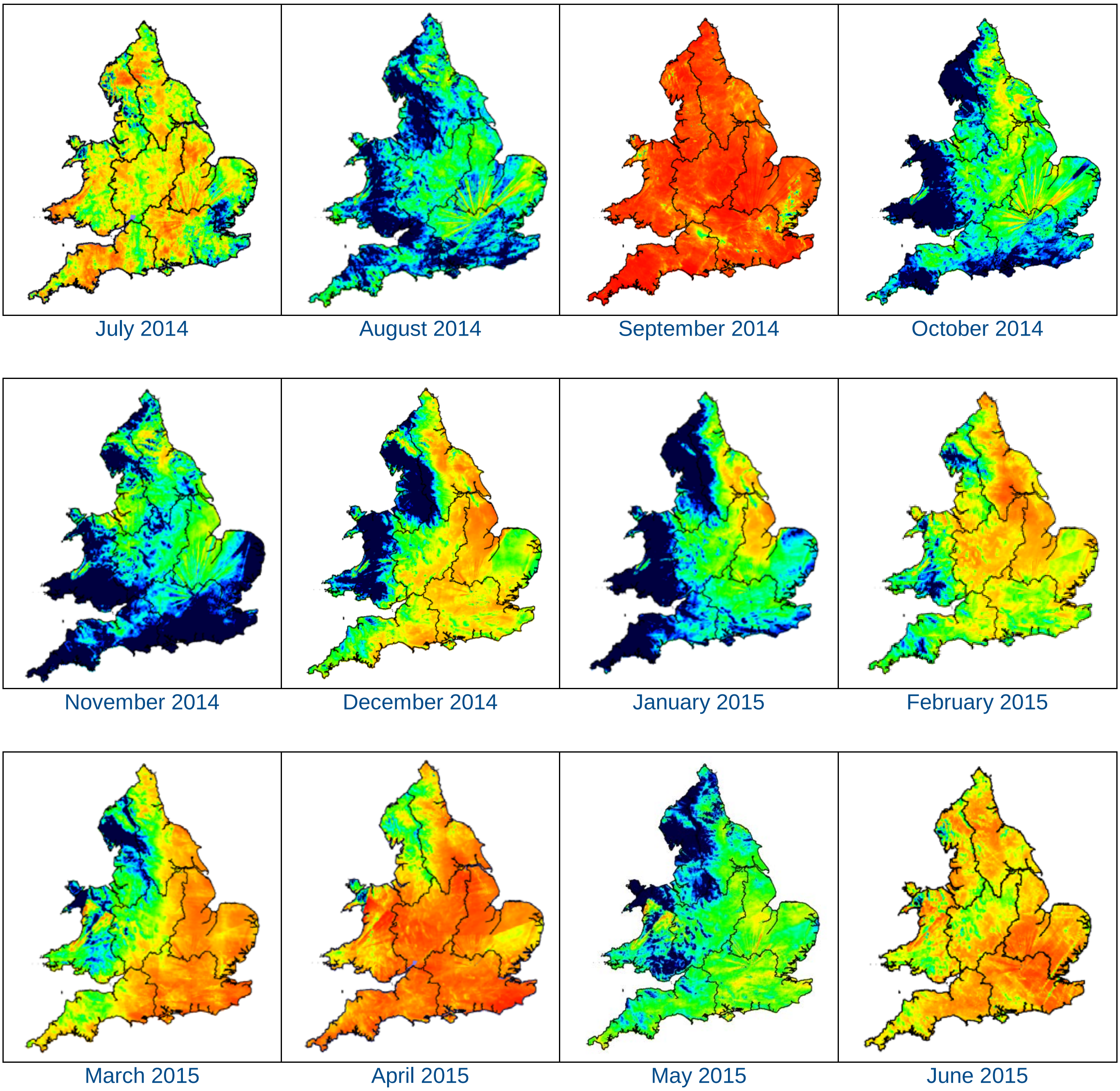
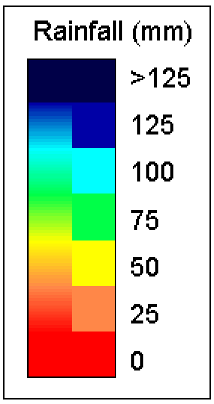


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas.



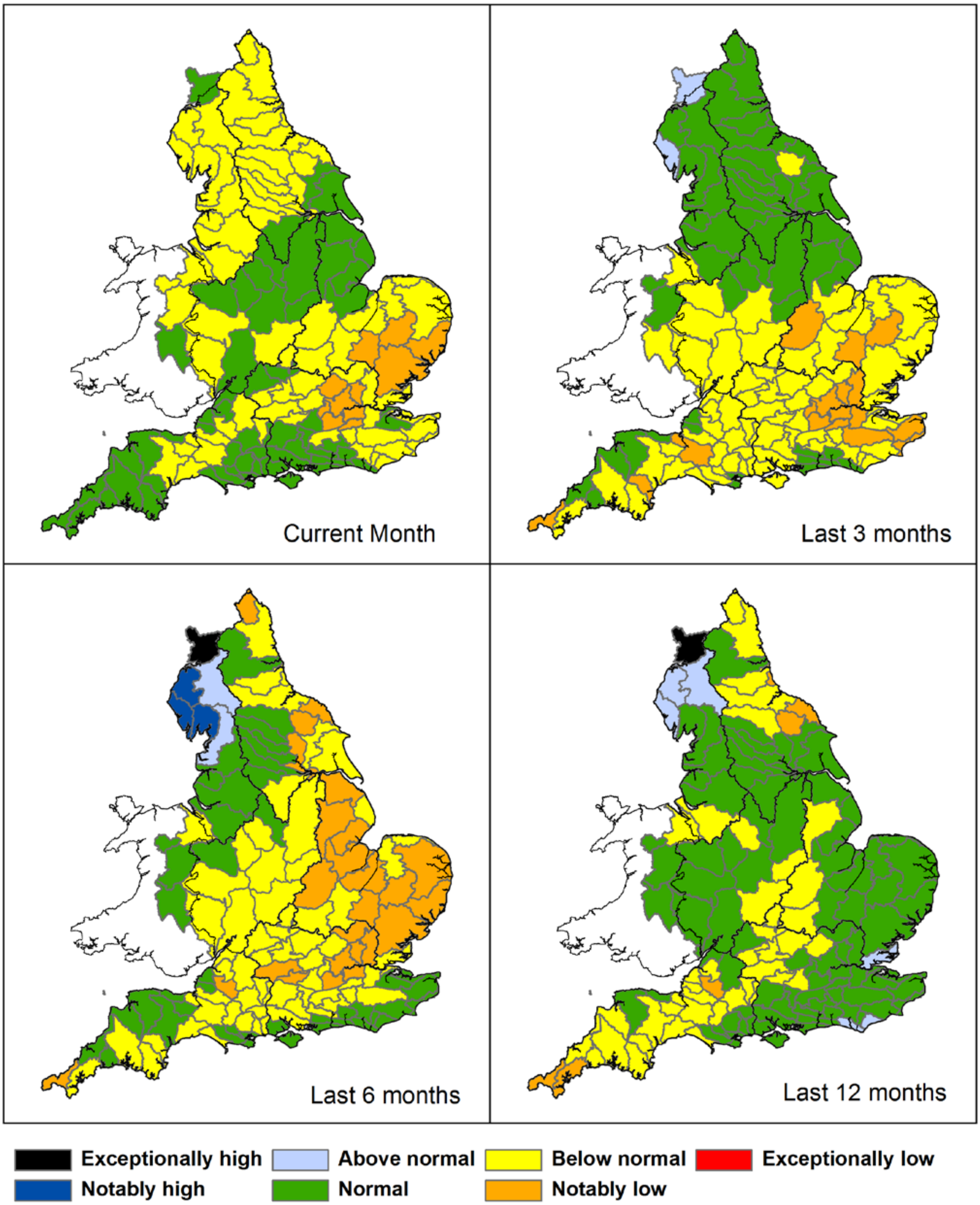


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 June), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2015)*. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

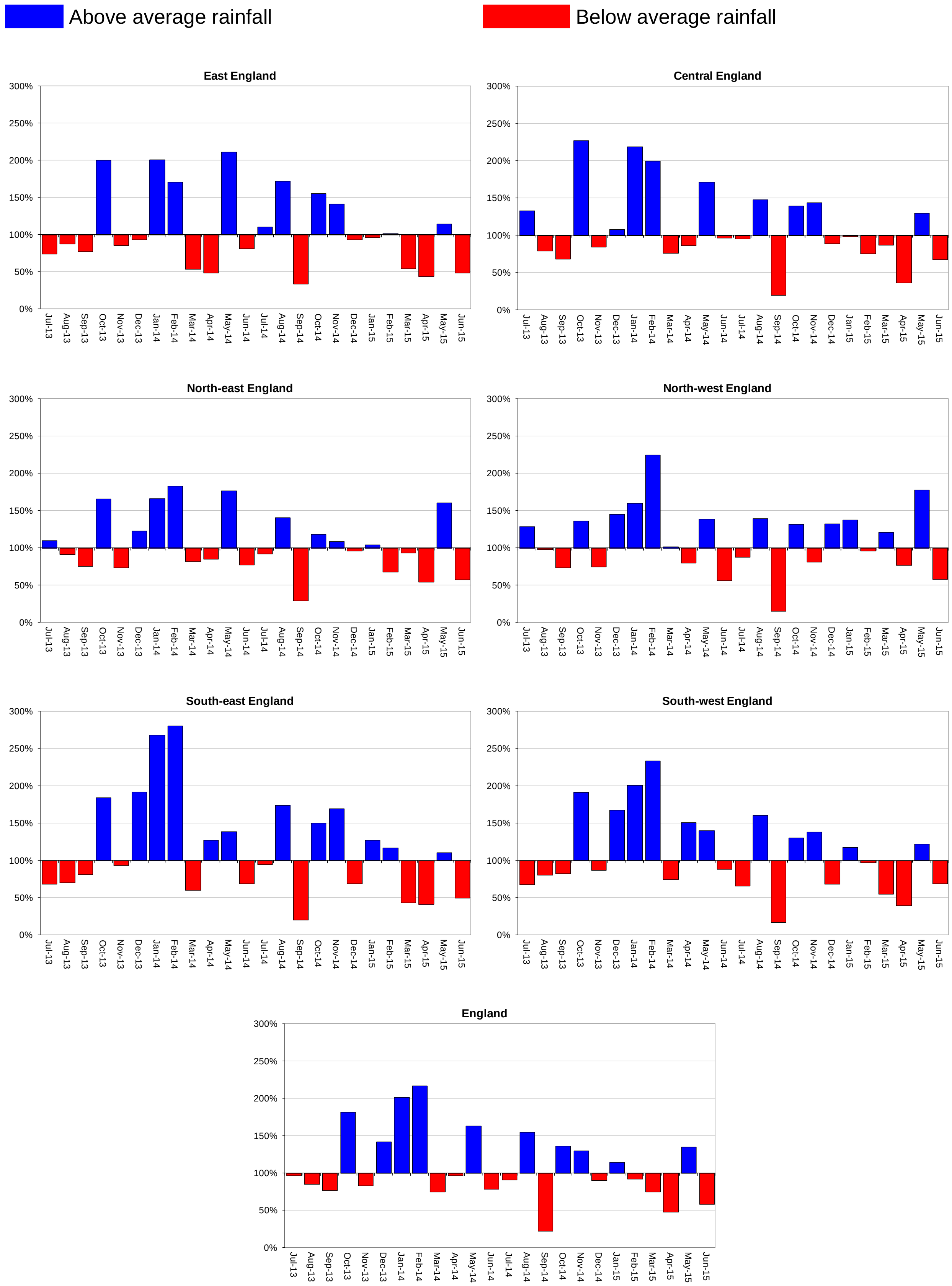


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

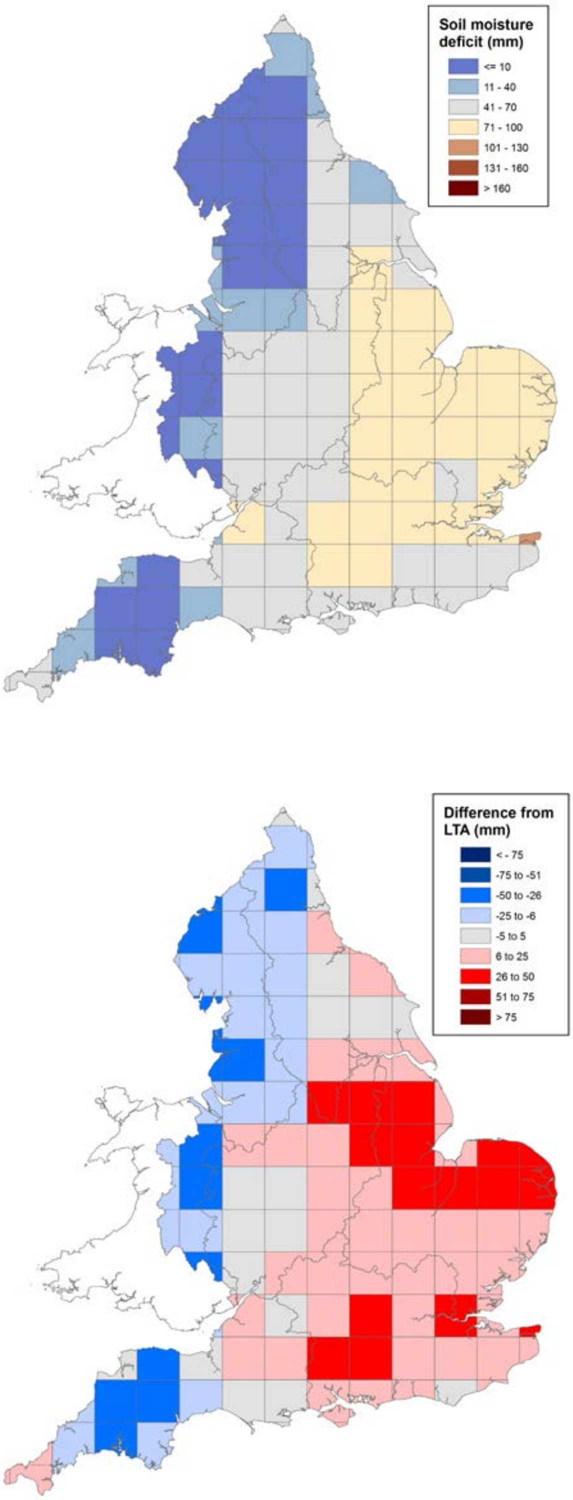
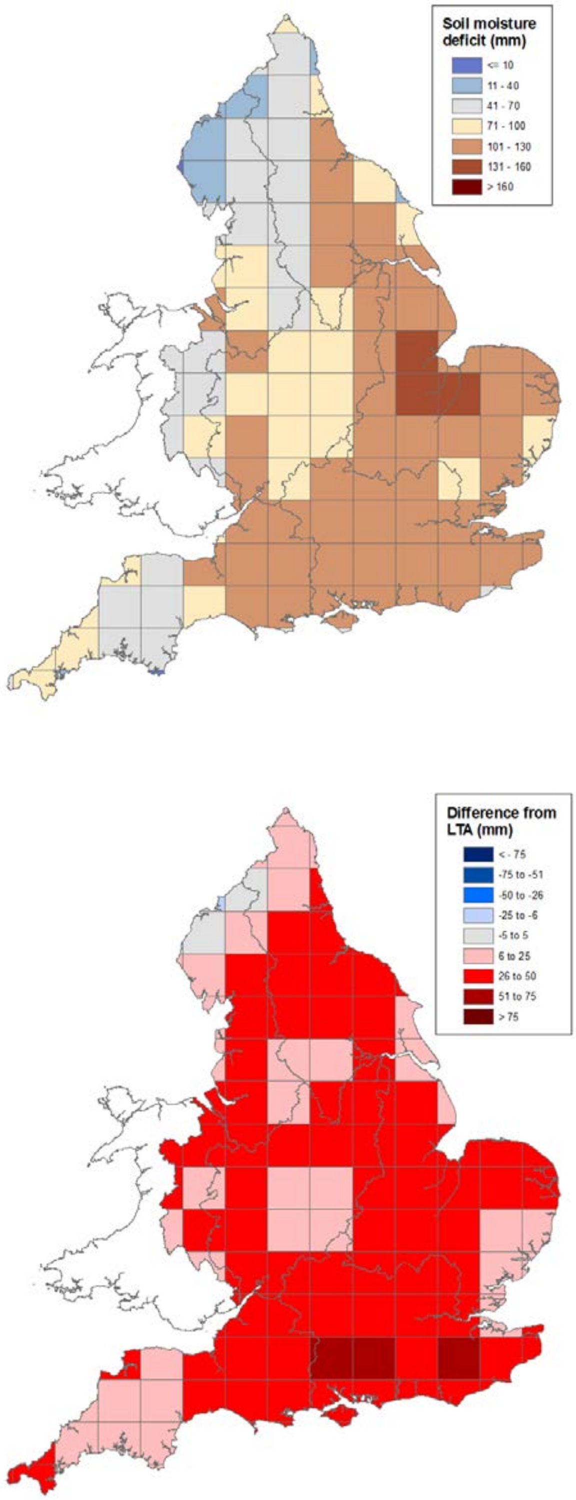
End of May 2015 [1]	End of June 2015 [2]
	

Figure 2.1: Soil moisture deficits for weeks ending 02 June[1] (left panel) and 30 June [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, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

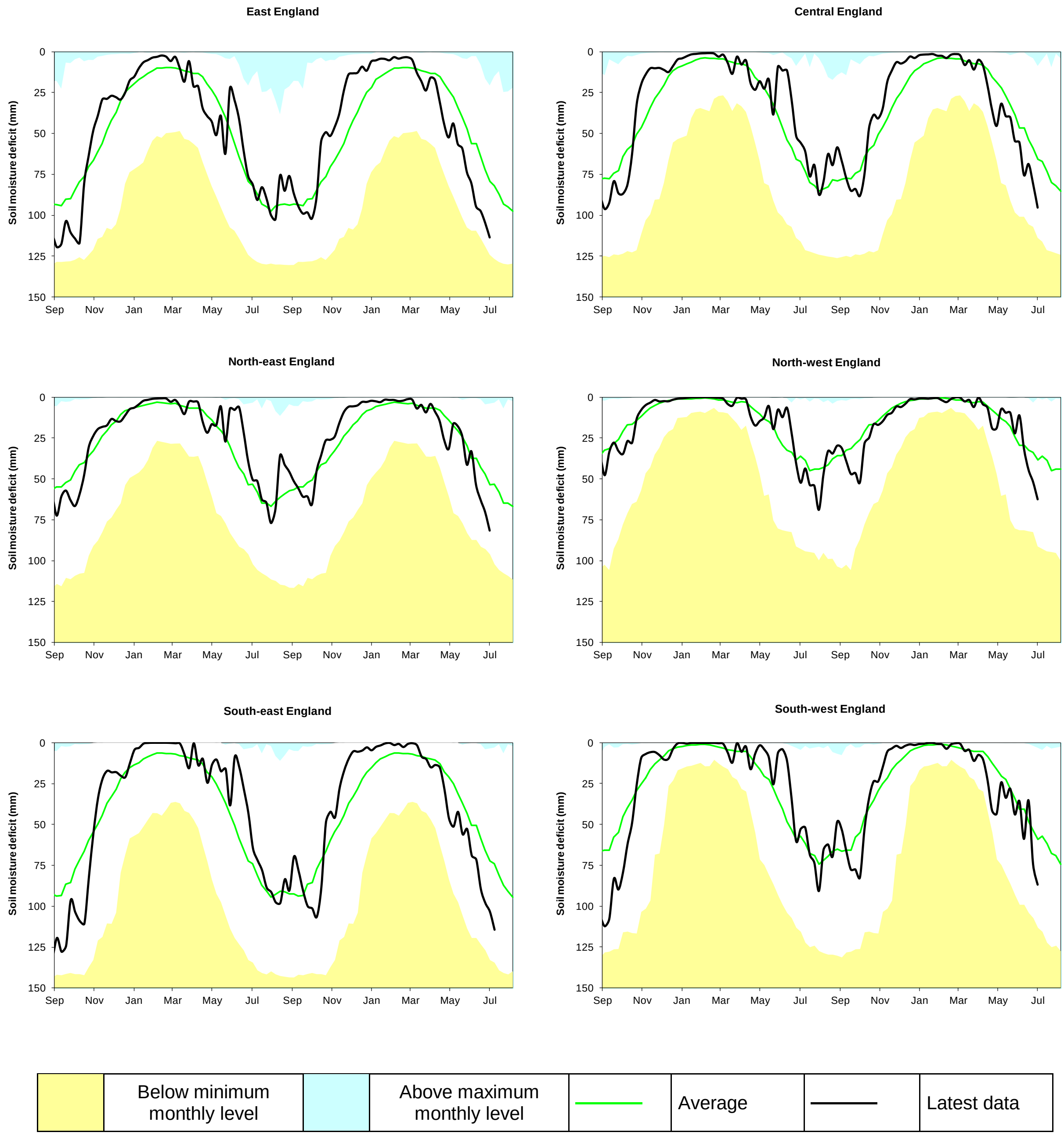
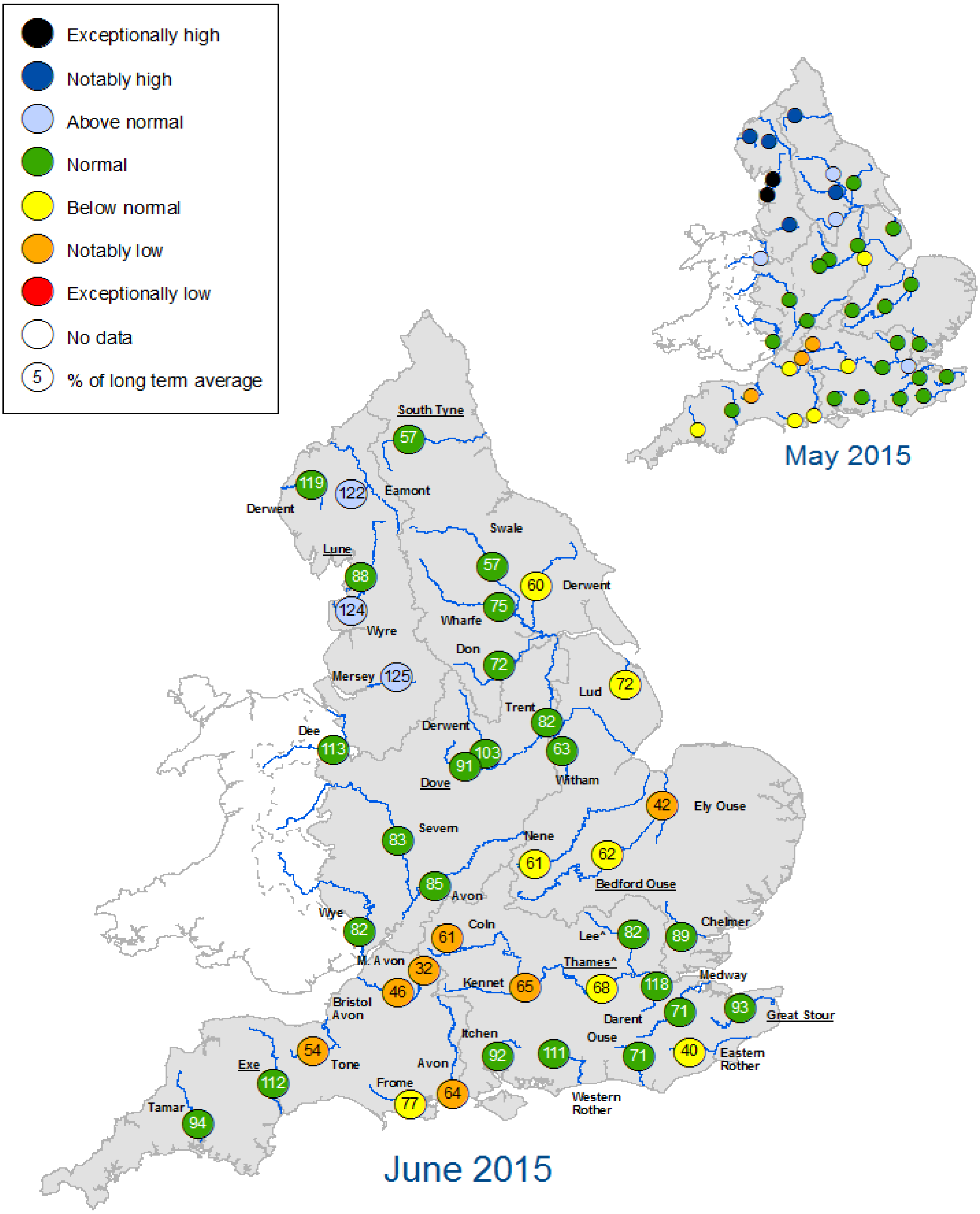


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 May 2015 and June 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic May and June monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

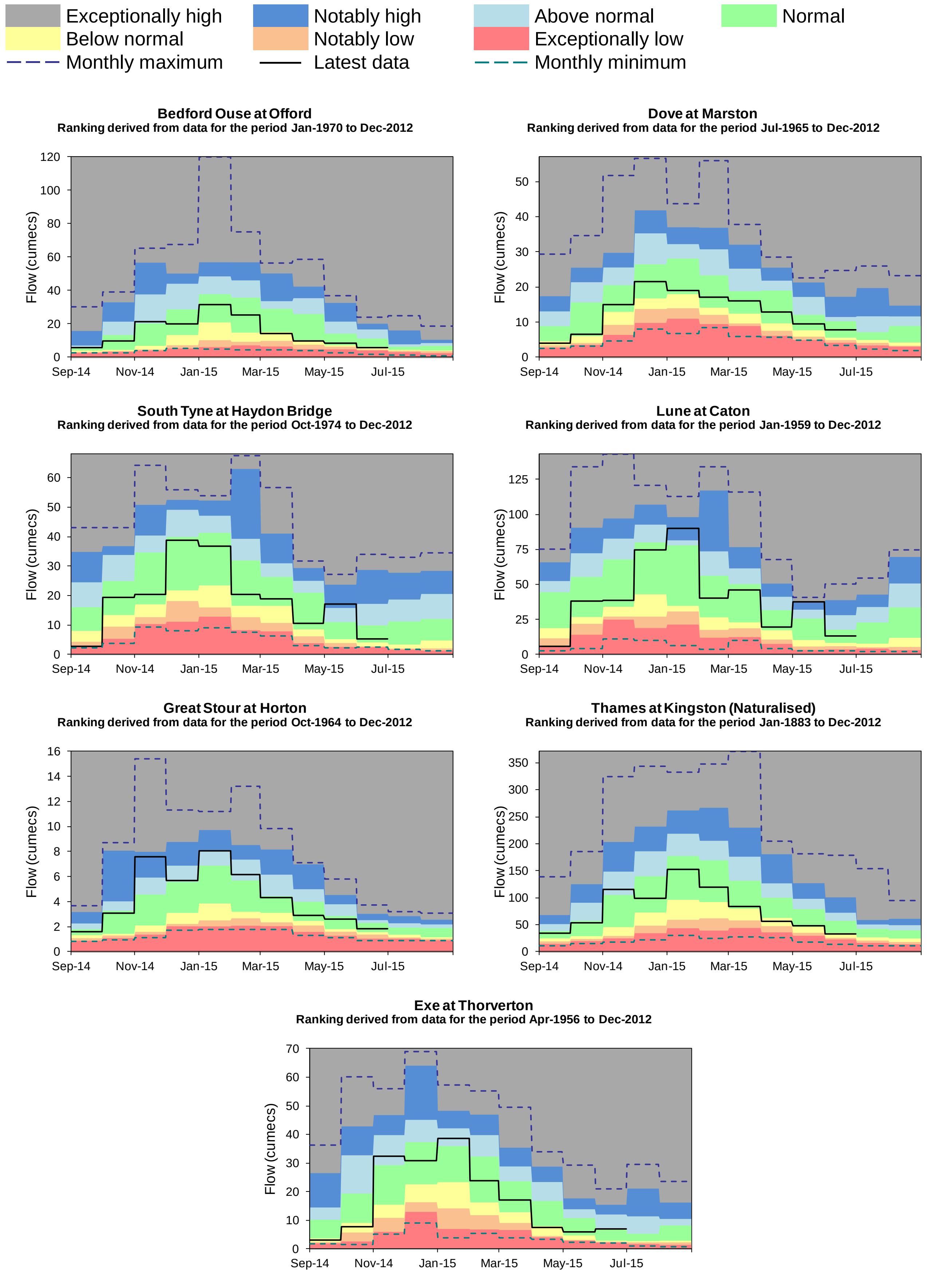
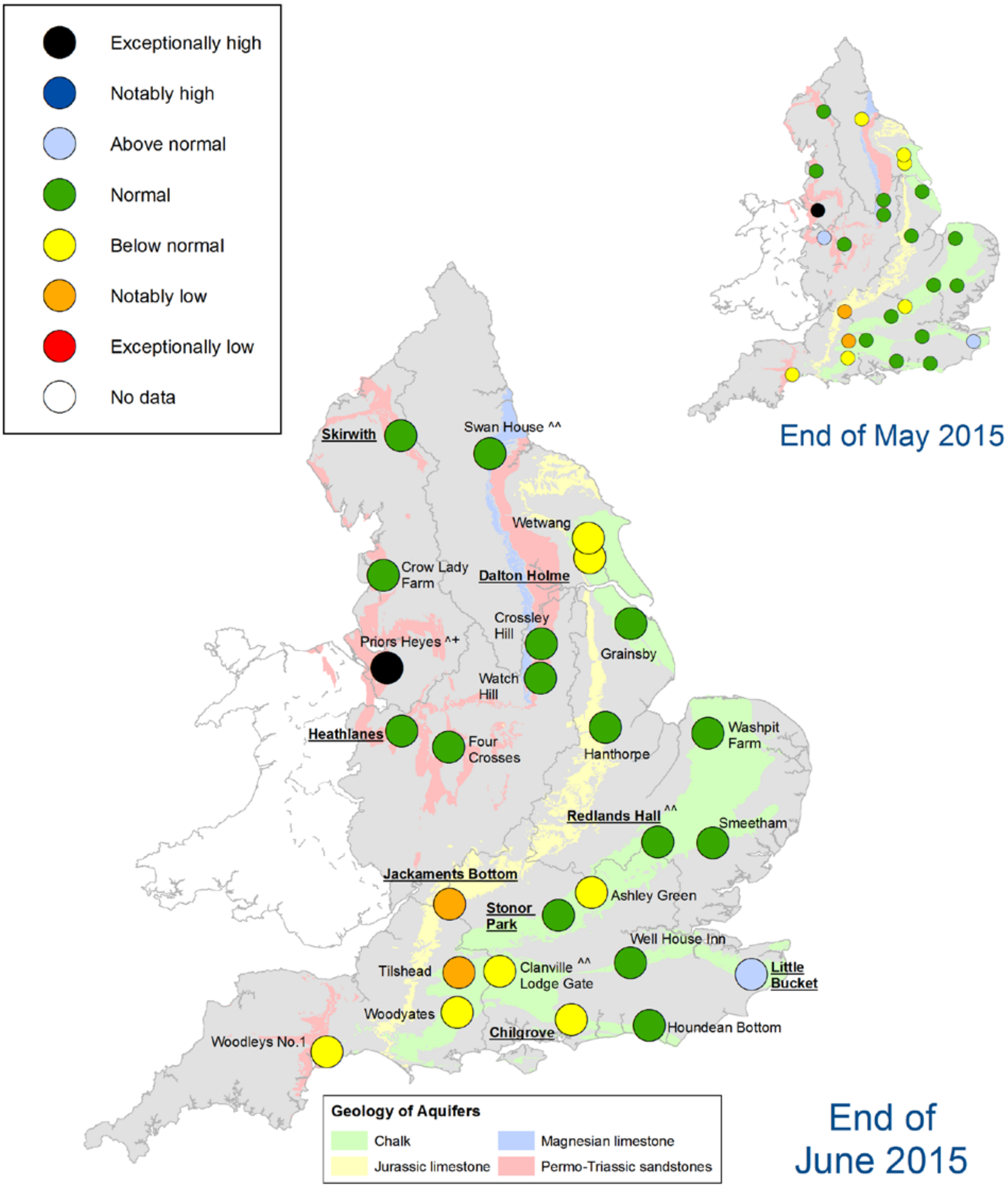


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 May 2015 and June 2015, classed relative to an analysis of respective historic May and June levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

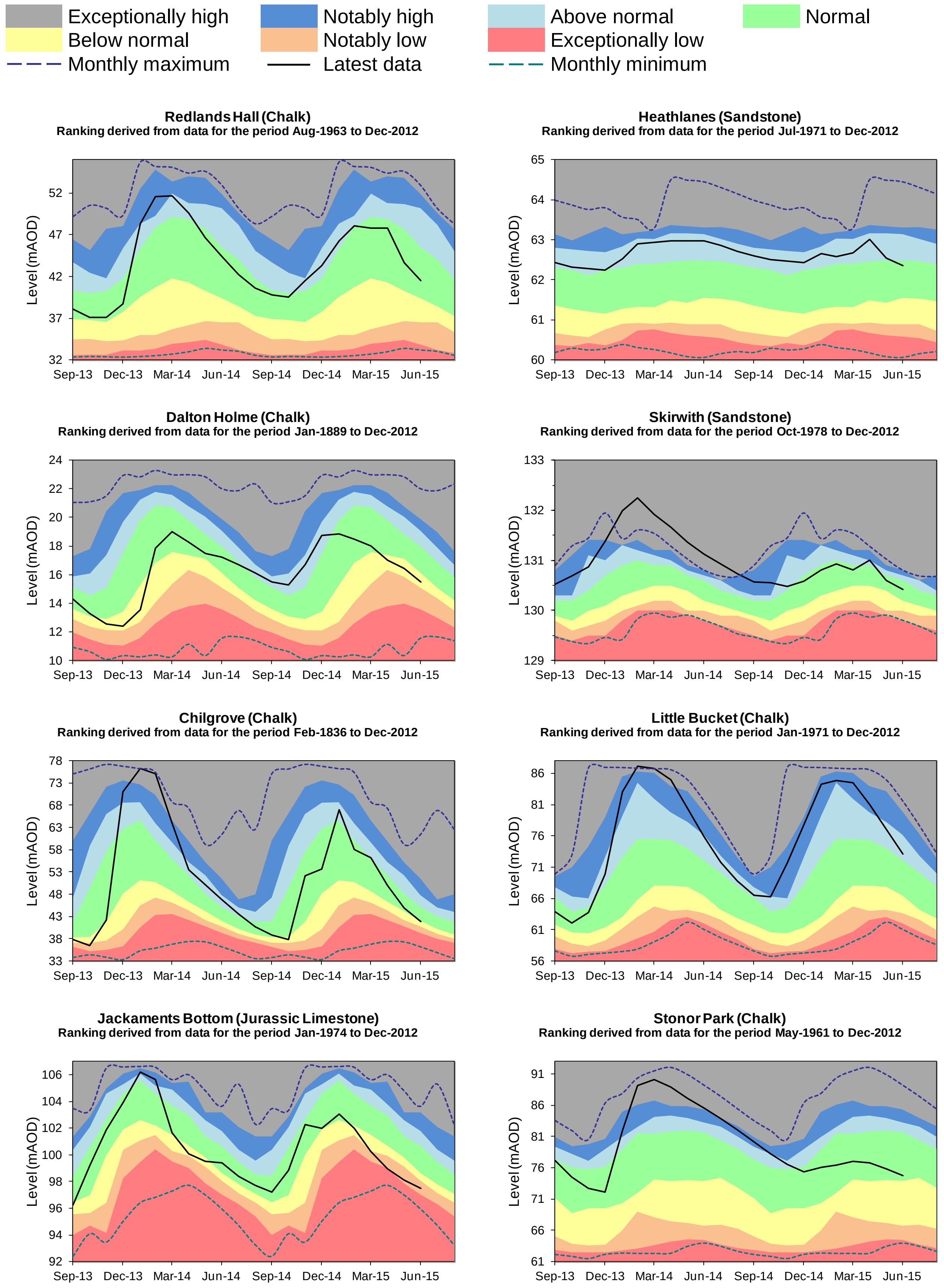
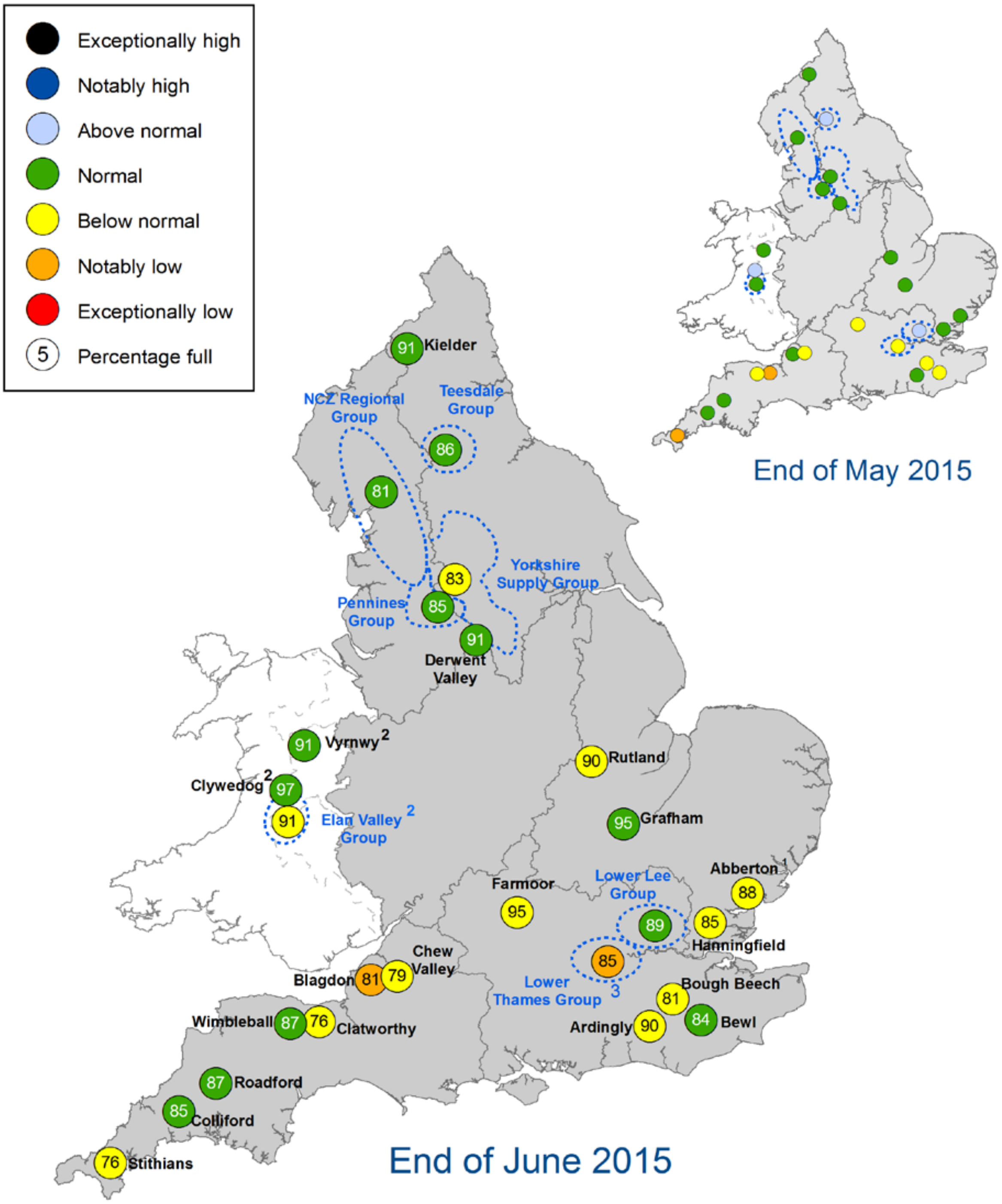


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

Reservoir storage



1. Water levels at Abberton Reservoir in Essex have been affected by engineering work to increase capacity
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to central and northwest England
3. Stocks in the Lower Thames Group have been affected by maintenance work

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of May 2015 and June 2015 as a percentage of total capacity and classed relative to an analysis of historic May and June 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.

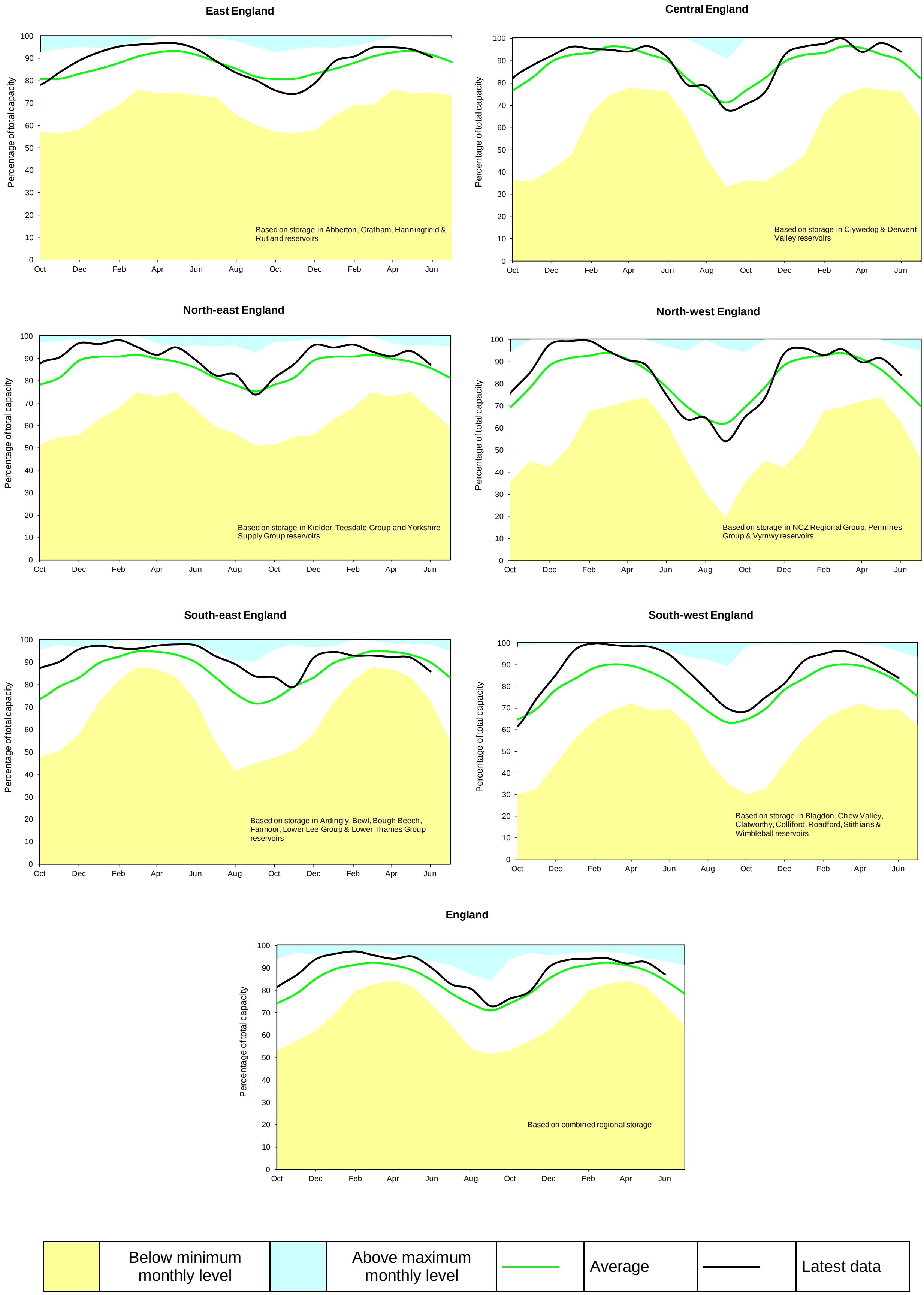


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

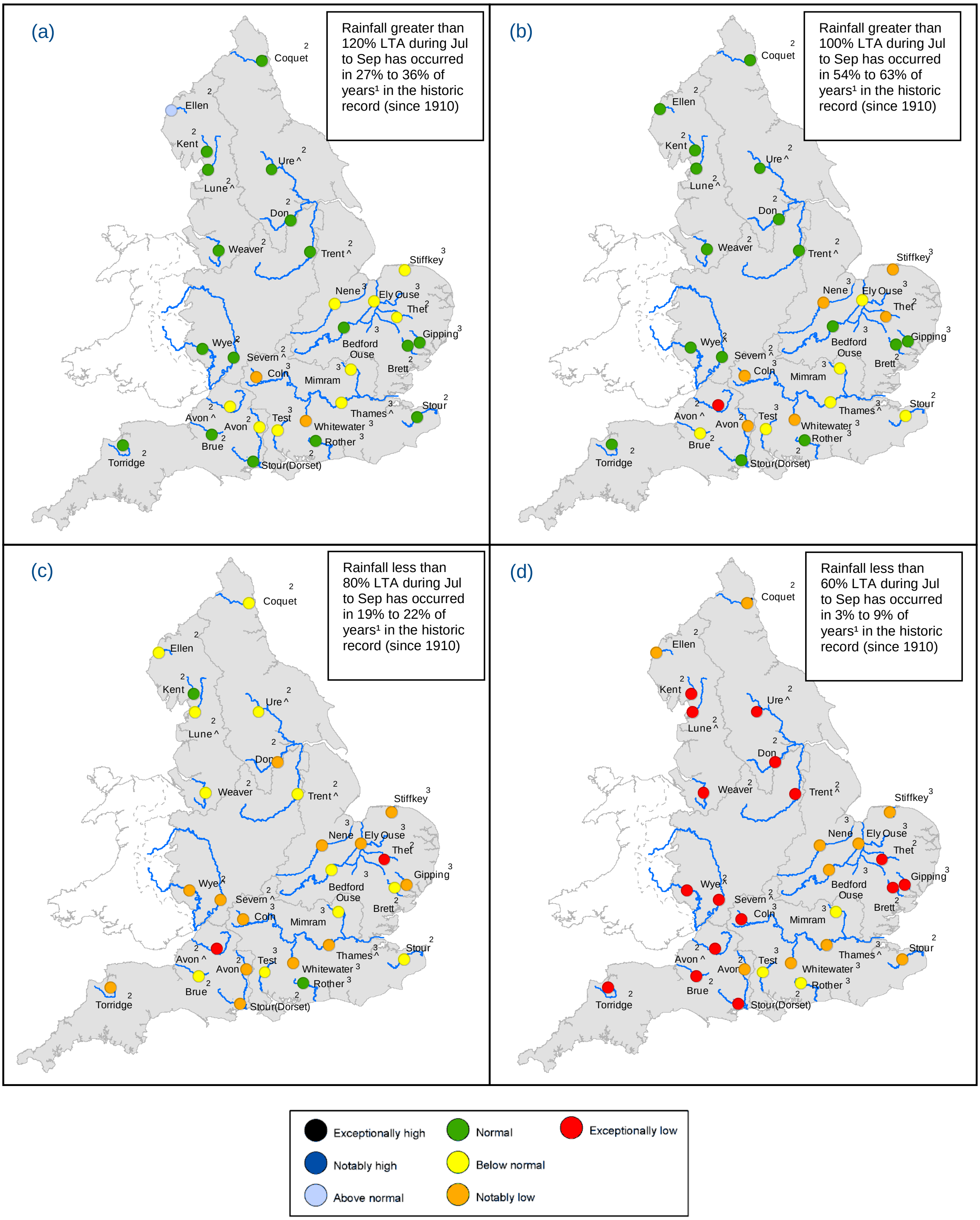


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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

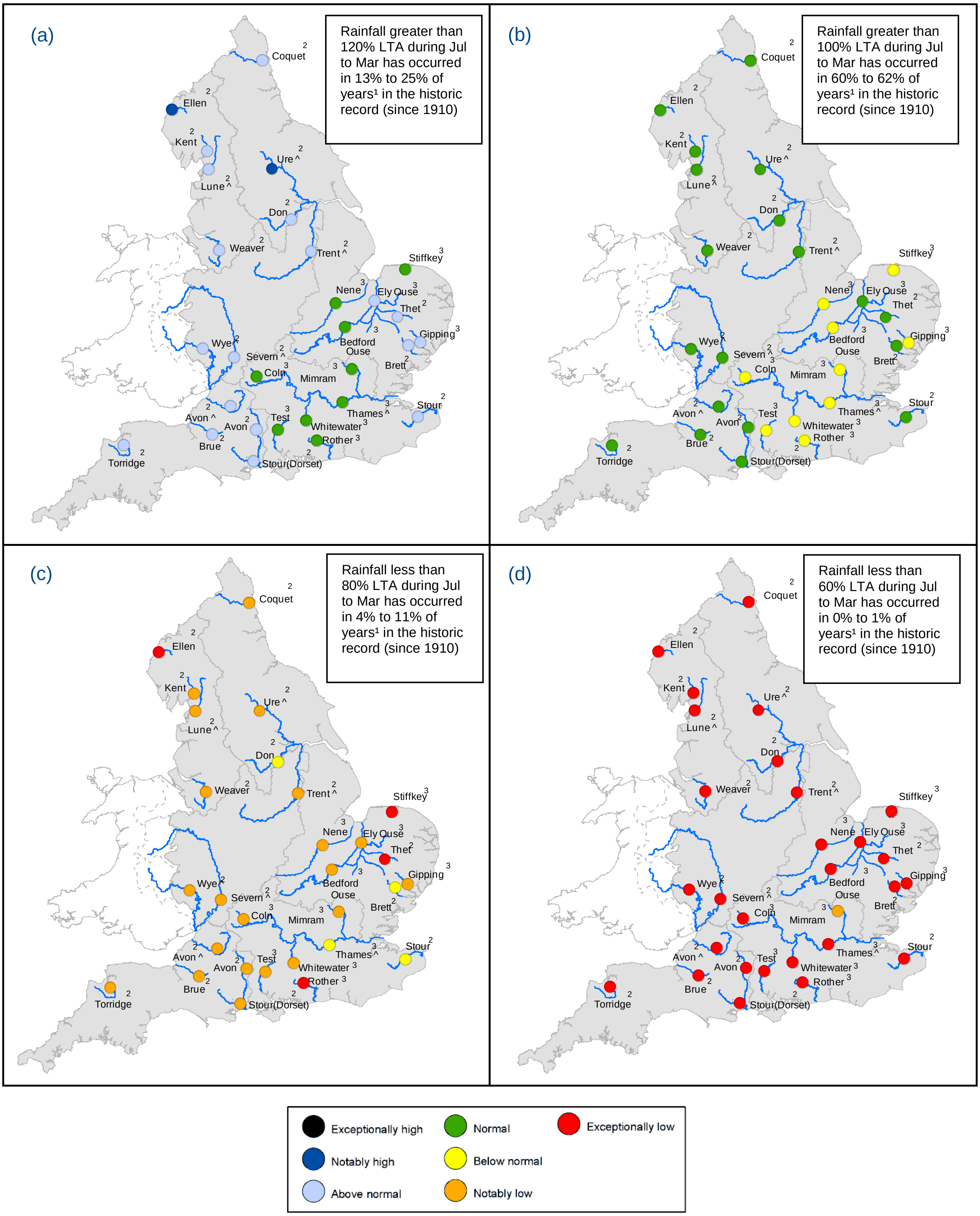


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
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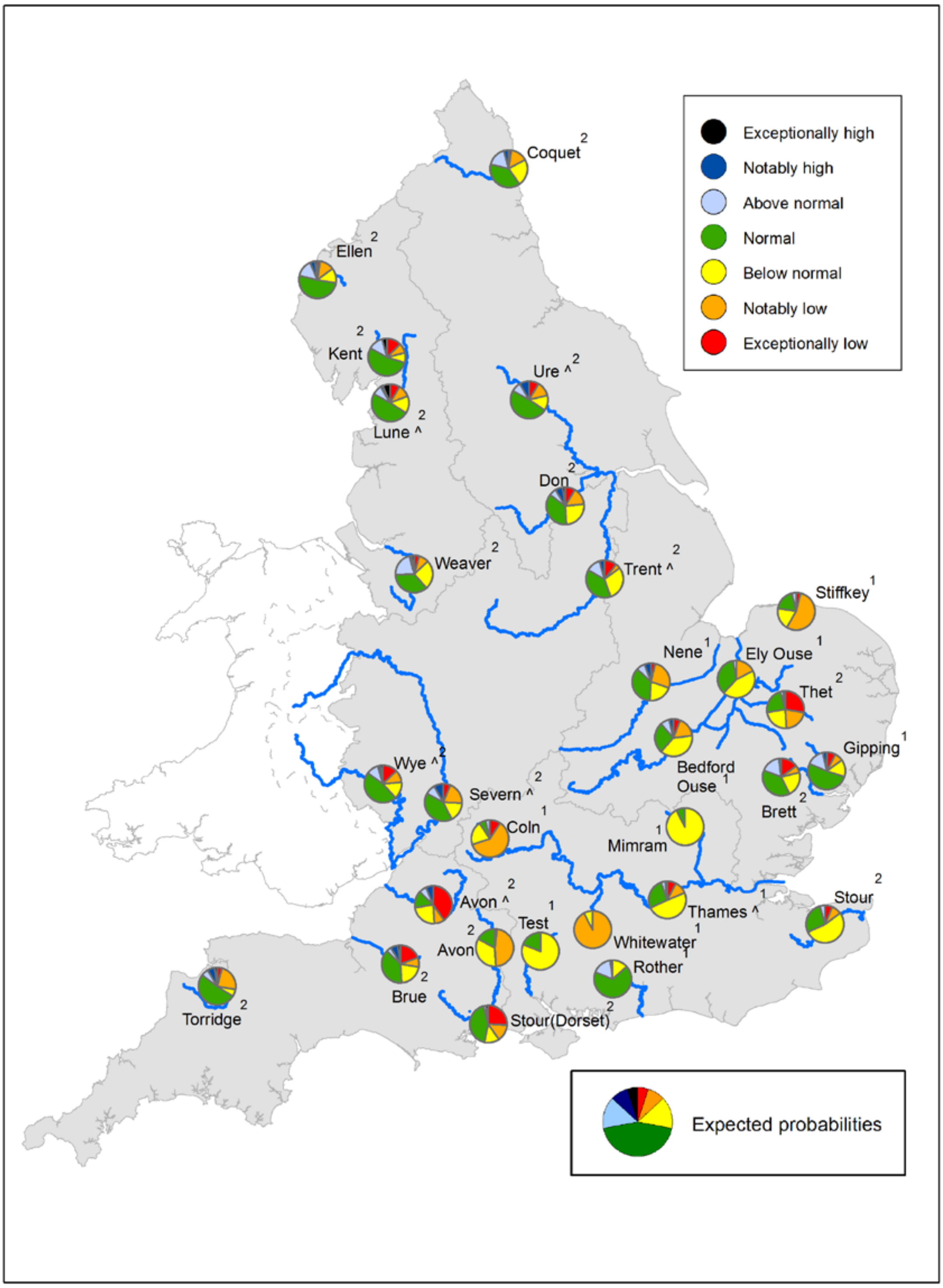
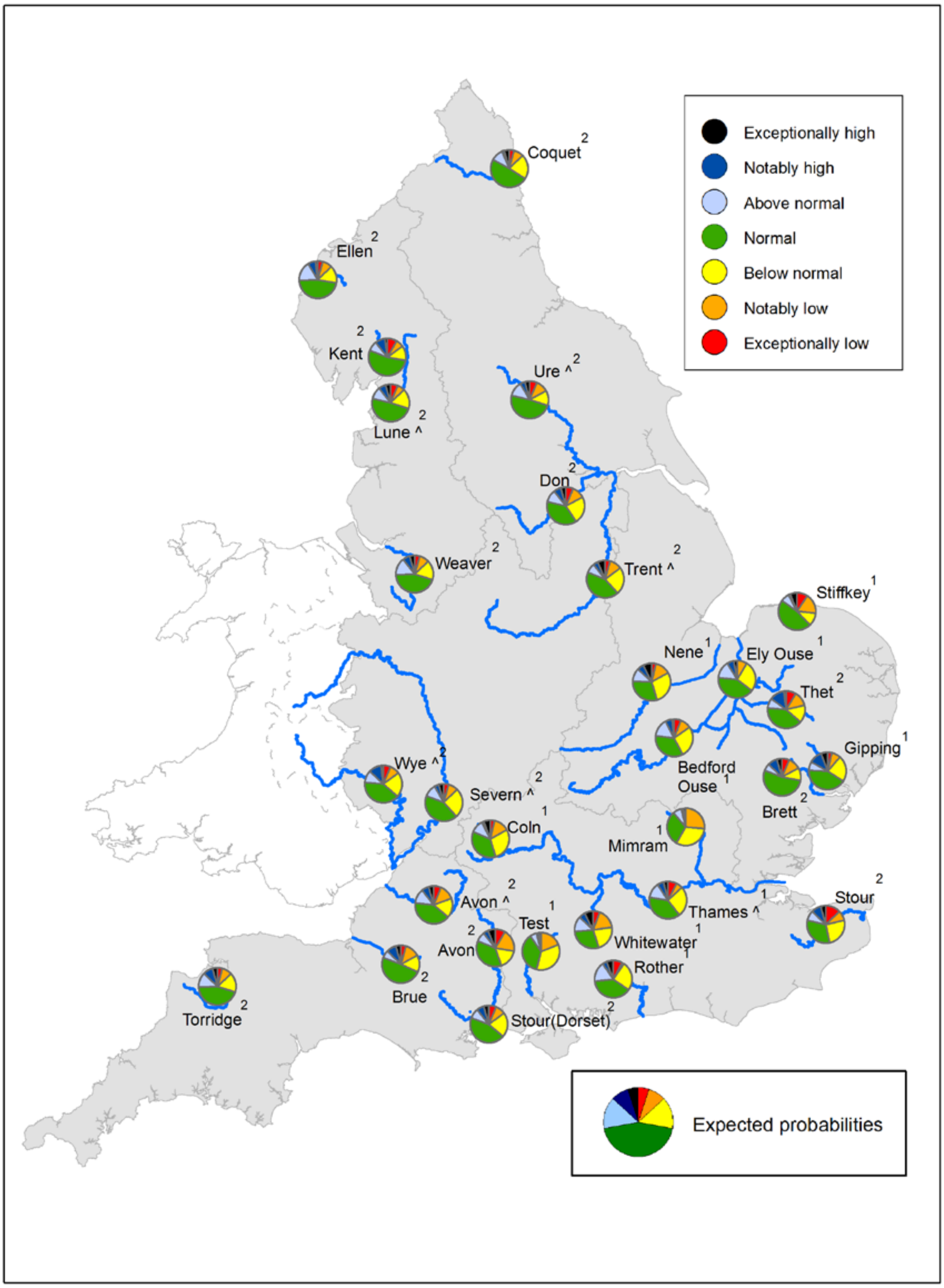
^ "Naturalised" flows are projected for these sites



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 6.3: 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



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 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).

[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

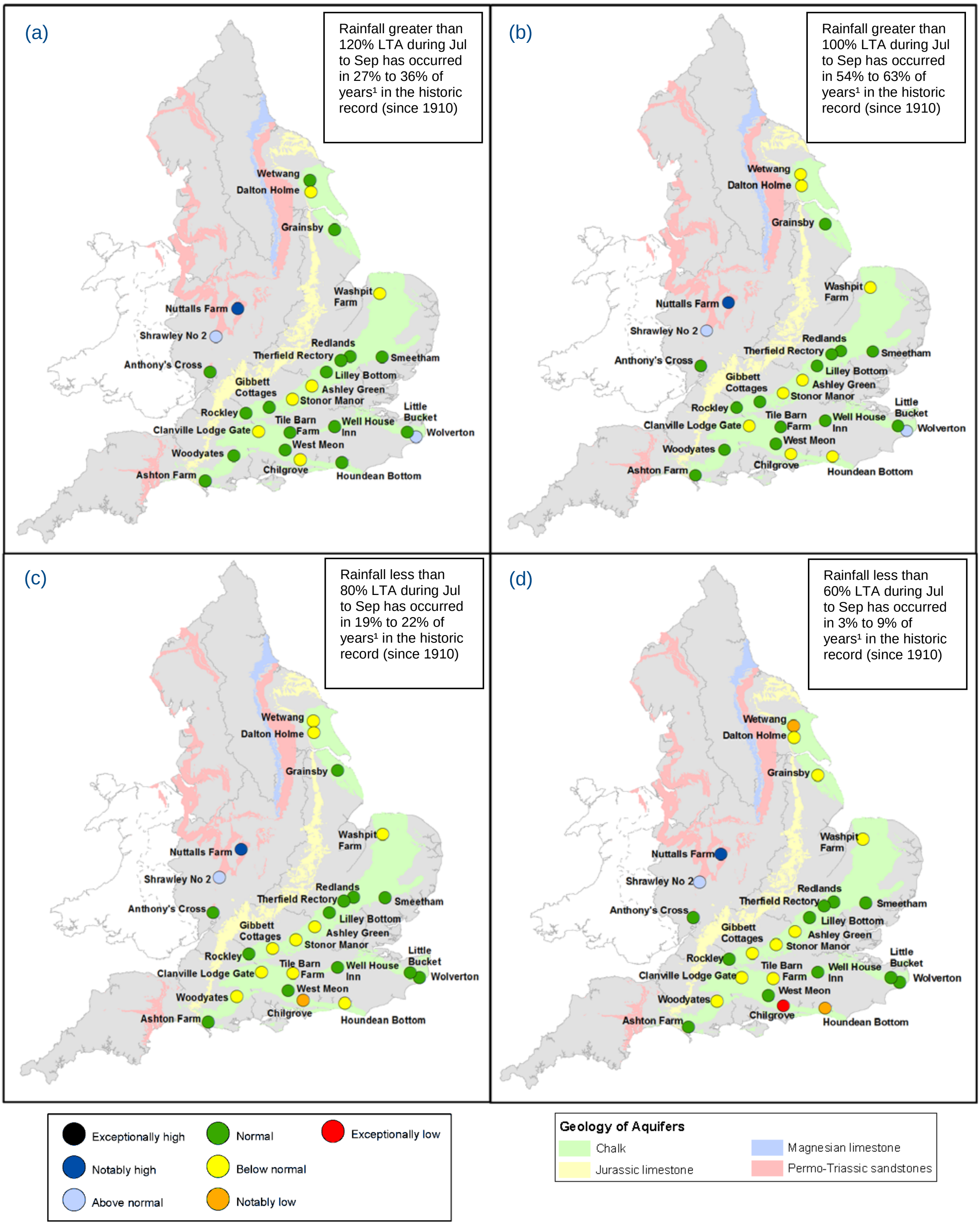


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2015 (Source: Environment Agency) Geological map reproduced with kind permission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

[1] This range of probabilities is a regional analysis

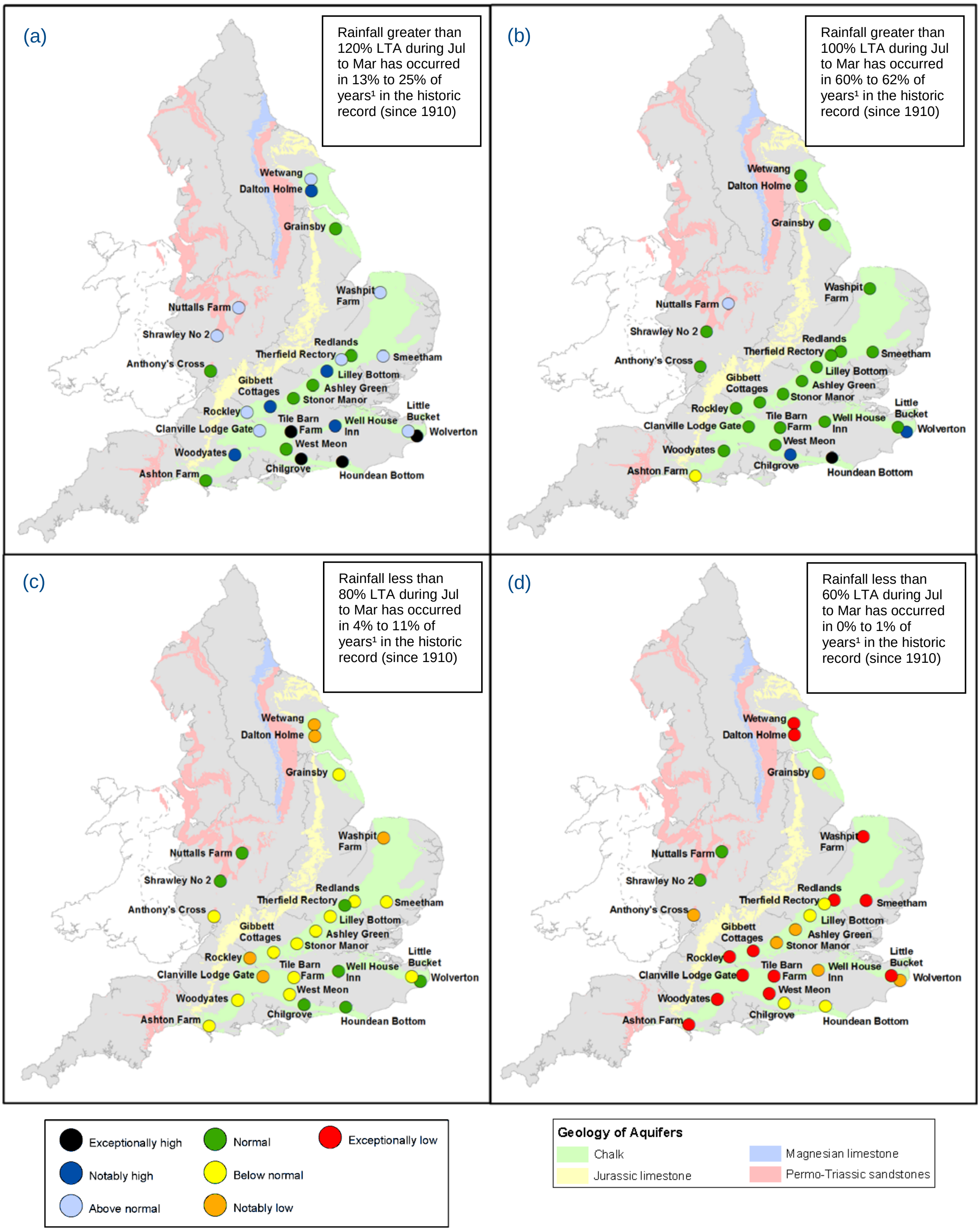
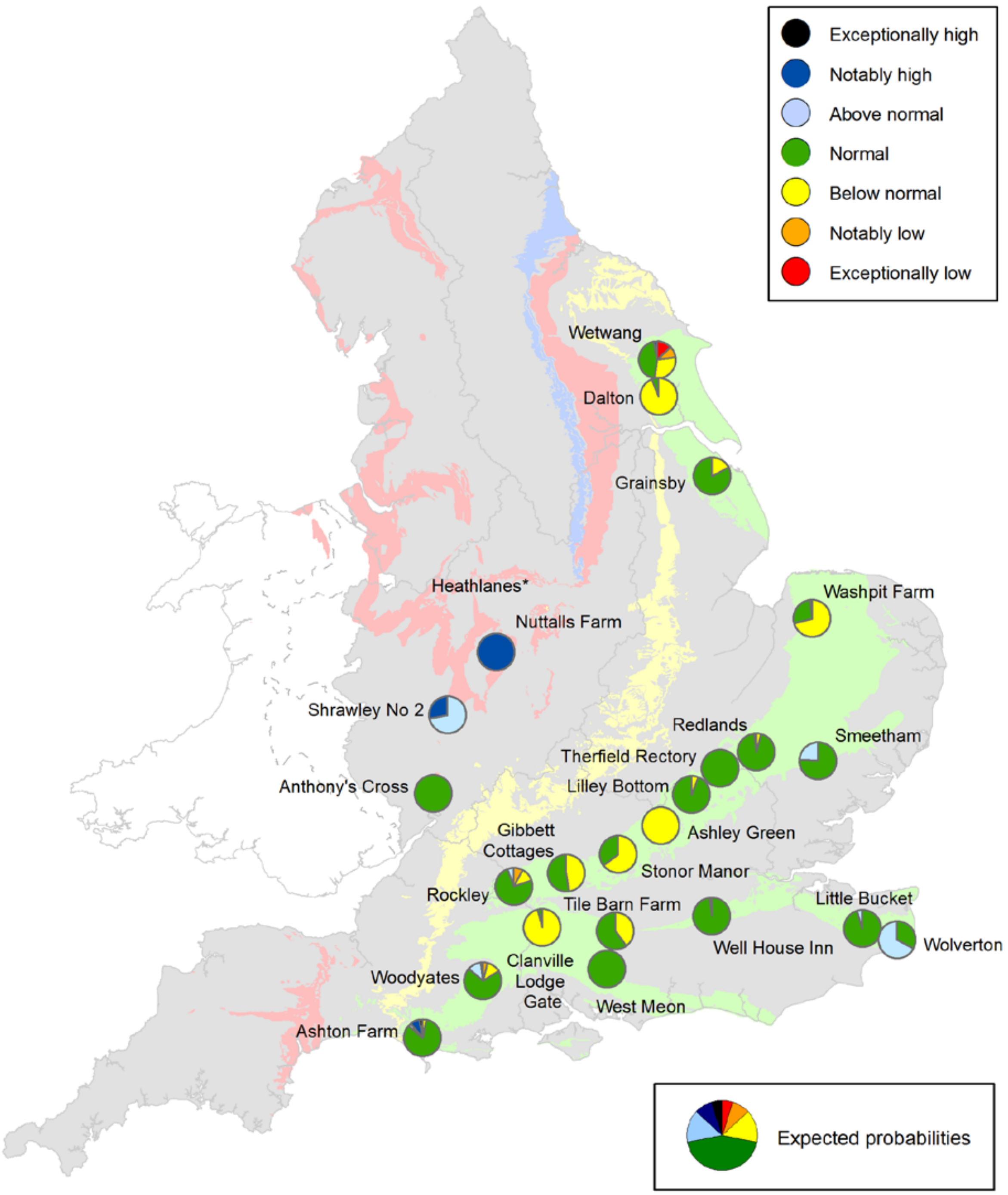


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2015.

[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 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, 2015.

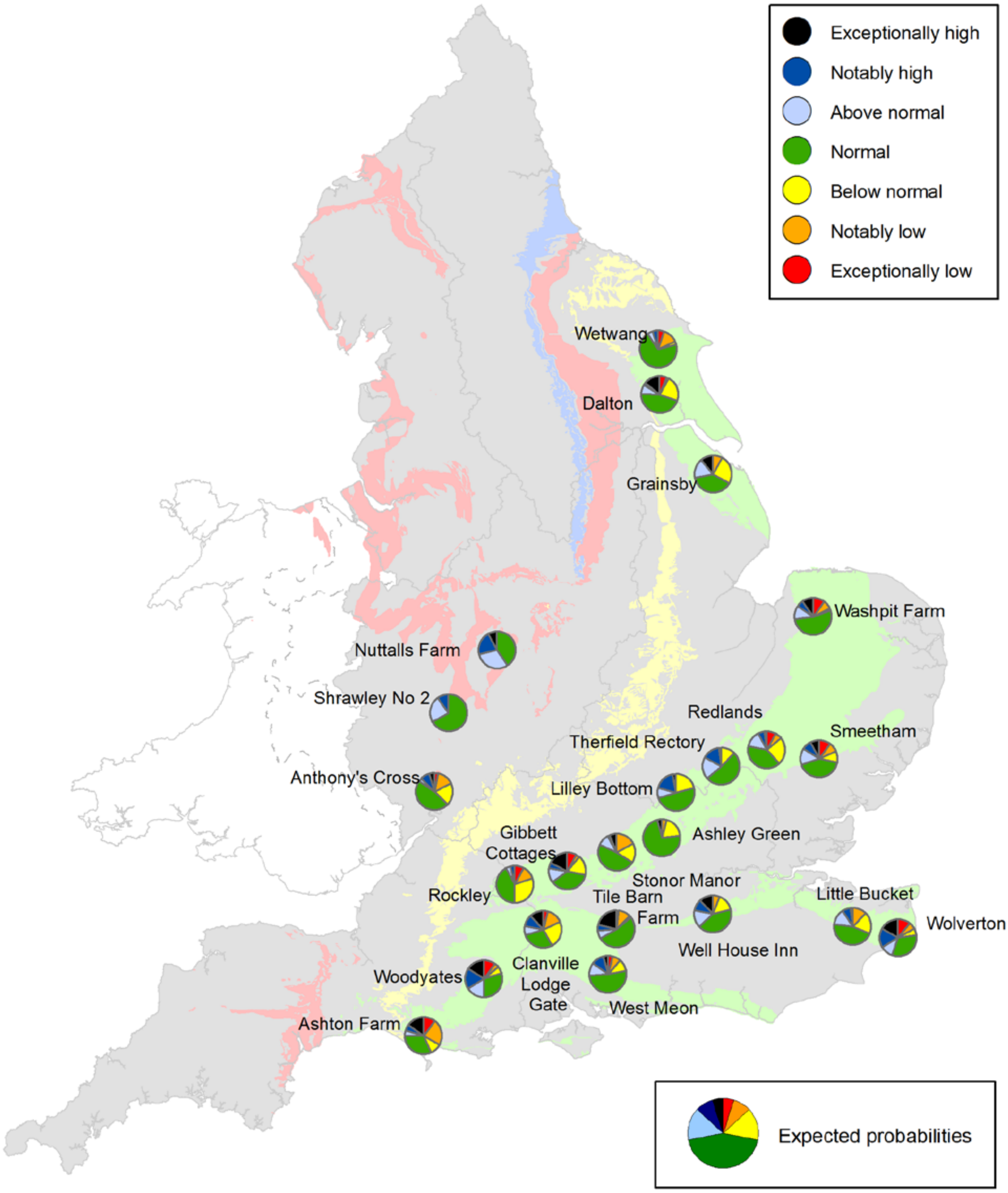


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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2016. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the 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, 2015.

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