Monthly water situation report

England

Summary – September 2022

Monthly rainfall totals in September were classed as normal for most of the catchments across England, with others being above normal or notably high after above average rainfall was received in these areas. Due to the rainfall, soil moisture deficits began to decline across the country, however soils remain drier than would be expected for this time of year. River flows increased in September at the majority of indicator sites, although many remained below normal or lower for the time of year as they continue to feel the impacts of preceding dry months. Groundwater levels continued to decline at most indicator sites, and many remained below normal or lower for the time of year. Reservoir stocks in September decreased at all reservoirs and reservoir groups we report on except one. At the end of the month reservoir stocks for England were 49%.

Rainfall

The September rainfall total for England was 75.2mm which represents 107% of the 1961-1990 long term average (LTA) for the time of year (110% of the 1991-2020 LTA). The majority of catchments received above average rainfall during September, with the Isle of Wight being the wettest part of the country having received 173% of LTA rainfall for the time of year. The Lower Wye and Little Avon were the driest catchments as they received less than 80% of LTA rainfall. (Figure 1.1)

September rainfall totals were classed as normal for almost two-thirds of catchments across the country, with the other third being above normal or notably high. At a regional scale, September rainfall totals were normal in all regions, with the exception of south-east England which was above normal. England as a whole was normal for the time of year. (Figure 1.2)

England as a whole has had the driest April to September period since 1995 and the fifth driest record (using records from 1891), with east and south-west England both recording the second driest April to September since 1921. The Upper Wye and East Suffolk catchments both recorded their driest April to September period since records began. (Figure 1.3)

Soil moisture deficit

Soil moisture deficits (SMD) began to decline across the country during September as above average rainfall in many areas combined with lower temperature have resulted in soils starting to become wetter. (Figure 2.1) Despite this decline SMD at the end of September remained above average for the time of year across much of the country, with only a few areas seeing wetter than average conditions. Areas in the east have particularly dry soils with deficits still between 100 and 160mm. (Figure 2.2)

River flows

September monthly mean river flows increased at more than three quarters of the indicator sites we report on compared to August. Despite the increase in flows during September, the majority of sites were classed as below normal or lower for the time of year. The lowest monthly mean flow for September were recorded on the River Yare at Colney (records began 1970). A third of sites were classed as normal for the time of year, following increases in flows. (Figure 3.1)

At the majority of the regional index sites monthly mean flows were classed as below normal as high SMDs still persist across many areas. At Haydon Bridge on the South Tyne monthly mean flows were classed as normal, while at Kingston on the River Thames naturalised monthly mean flows were classed as notably low. (Figure 3.2)

Groundwater levels

At the end of September groundwater levels had decreased at more than three quarters of reported indicator sites. The majority of end of month groundwater levels were classed as normal or lower, with only three sites recording end of month levels higher than would be expected for the time of year. These sites were all in the

sandstone aquifers of north west England and were some of the only sites to record an increase in groundwater levels since the end of August.

Major aquifer sites continued to show a varied picture. All index sites in chalk aquifers were below normal or lower, with Chilgrove in the West Sussex Chalk recording an exceptionally low end of month groundwater level for the second consecutive month. In contrast Weir Farm in the Bridgnorth Sandstone was normal, and Skirwith in the Carlisle Basin Sandstone was above normal for the time of year. Jackaments Bottom in the Burford Jurassic Limestone of the Cotswolds was notably low for the time of year having recorded exceptionally low groundwater levels since June (Figures 4.1 and 4.2).

Reservoir storage

At the end of September reservoir stocks decreased at all except one of the reservoirs and reservoir groups we report on. Only the Lower Lee reservoir group saw a small increase in stocks during September. Six reservoirs or reservoir groups (Abberton, Clywedog, Carsington and Ogston, Wimbleball, Clatworthy, Bough Beech) saw a decline of 10% or more in their stocks in comparison to the end of August. (Figure 5.1) End of month reservoir stocks were below normal or lower in all except one reservoir or reservoir group. Following an increase in stocks, the Lower Lee group ended September with above normal stocks. Nearly half of reservoirs were exceptionally low for the time of year with Ardingly, Derwent valley, Elan valley, Stithians, Colliford and Wimbleball reservoirs the lowest recorded for the end of September.

At a regional scale, total reservoirs stocks ranged from 33% in south-west England to 62% in east England. Total reservoir stocks for England were at 49% of total capacity at the end of September. For the south-west and England these totals are the lowest on record for the end of September since records started in 1988. (Figure 5.2)

Forward look

Early October was characterised by unsettled weather for most areas with northern and western area England receiving heavier periods of rainfall. The unsettled weather is forecast to continue throughout the middle of October with further bands of rain expected across England with some drier spells in between. Overall the west and northwest is likely to see the heaviest and most frequent rain, whilst the east will experience more of the sunnier spells. Rain is often likely to be accompanied by strong winds with an increased risk of gales in exposed areas. Temperatures will be generally close to average for the time of year. There is an increasing chance of some more settled weather for late October, although it may be accompanied by colder conditions with chances of mist, fog and frost more likely.

For the three month period from October to December for the UK, there is a chance of warmer than average conditions although near average temperatures are most likely. Near average rainfall most probable with a slight increase in the likelihood of drier conditions with the heaviest and most widespread rainfall in the northern and western UK[1].

Projections for river flows at key sites[2]

By the end of March 2023 almost all modelled sites have a greater than expected chance of cumulative river flows being below normal or lower for the time of year. By the end of September 2023, the majority of sites have a greater than expected chance of cumulative river flows being normal or lower for the time of year.

For scenario based projections of cumulative river flows at key sites by March 2023 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2023 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2023 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2023 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

By the end of March 2023 more than half of all modelled sites have a greater than expected chance of groundwater levels being normal for the time of year. By the end of September 2023 three quarters of modelled sites have a greater than expected chance of groundwater levels being normal or lower for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2023 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2023 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2023 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2023 see Figure 6.8

Authors: National Water Resources Hydrology Team

1 Source: Met Office
2 Information produced by the Hydrological Outlook, a partnership between UK Centre for Ecology and Hydrology, British Geological Survey, Met Office, Environment Agency and other devolved agencies.

Rainfall

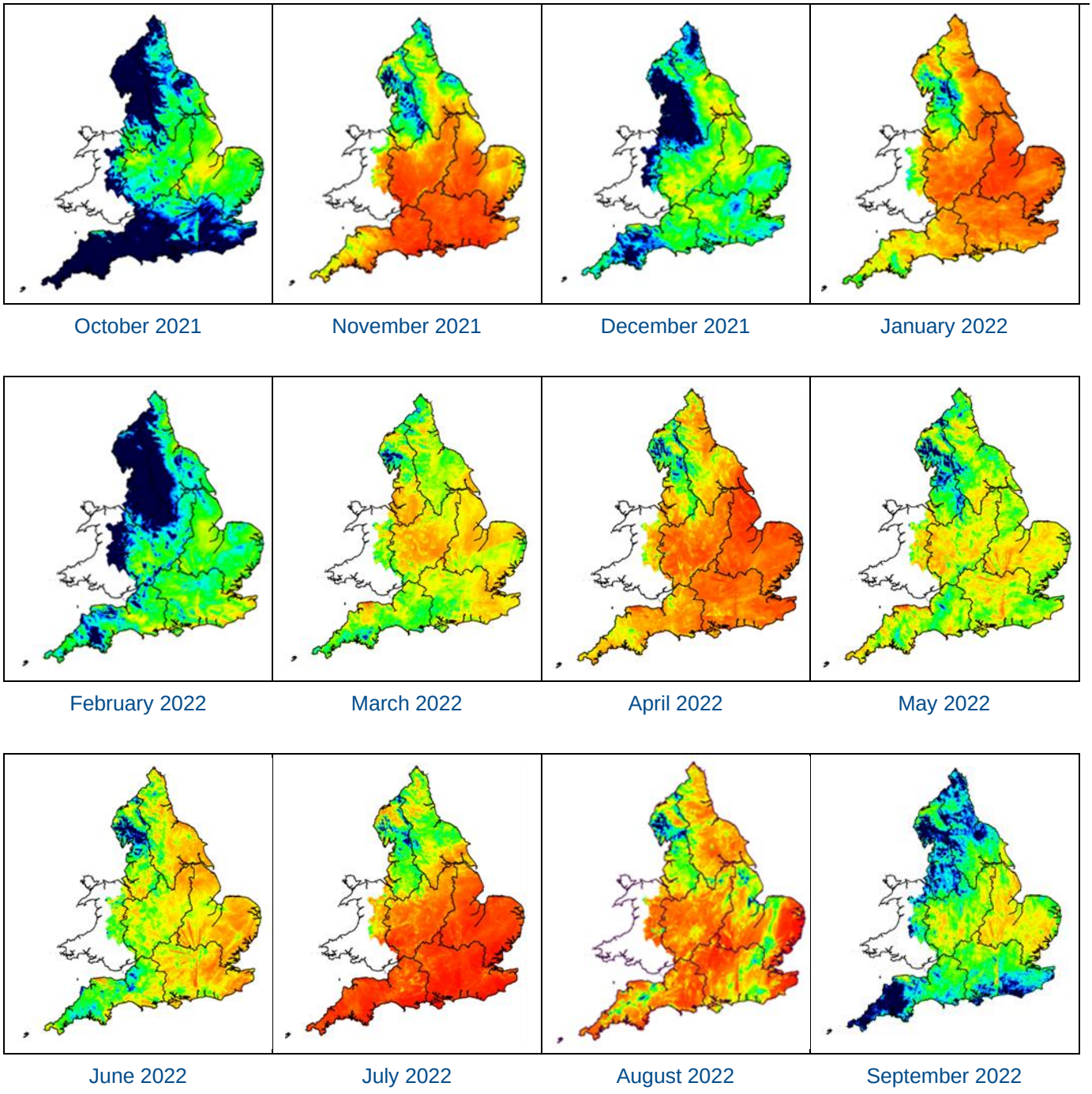


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2022). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2022.

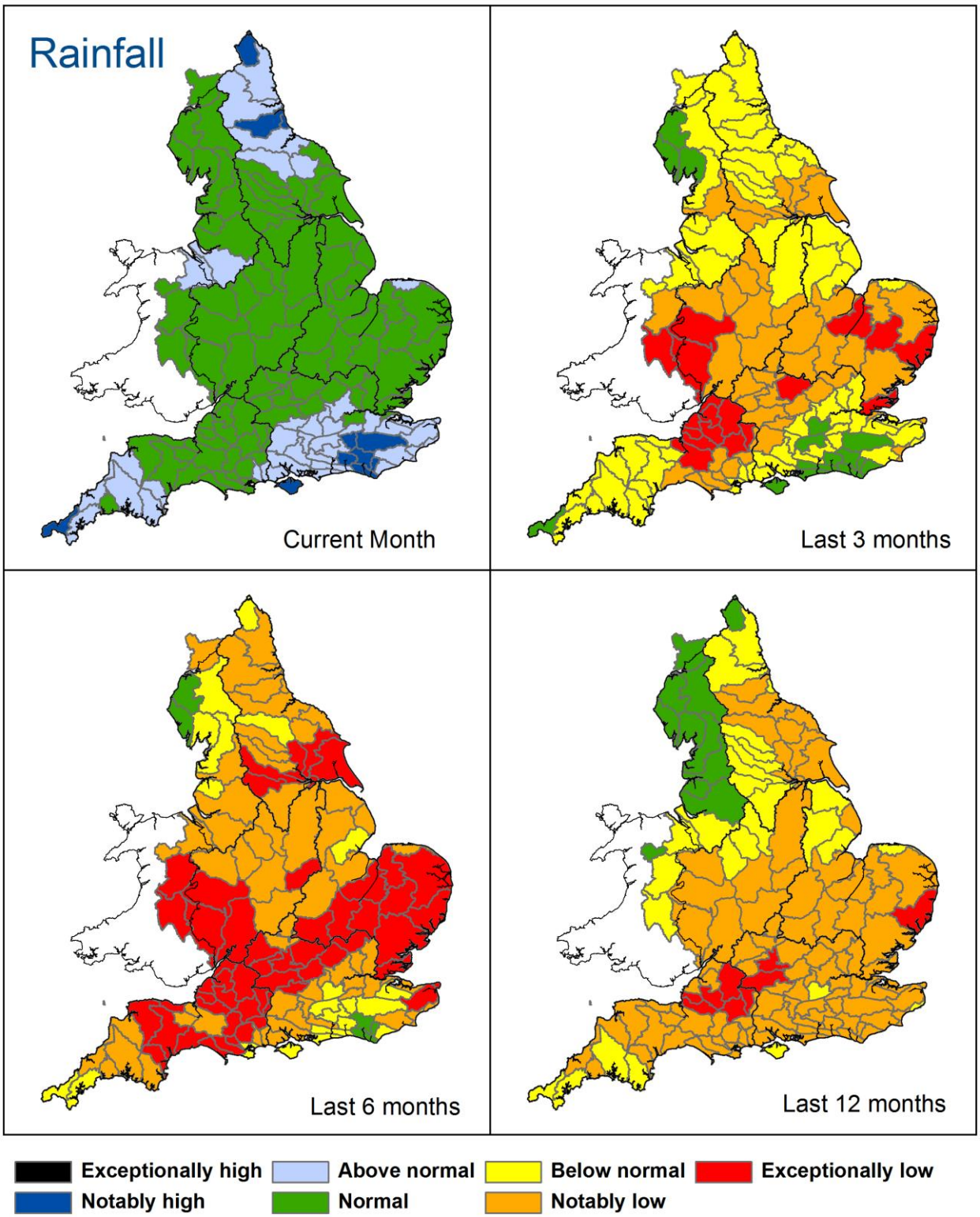


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 September), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2022).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100024198, 2022.

Rainfall charts

Above average rainfall

Below average rainfall

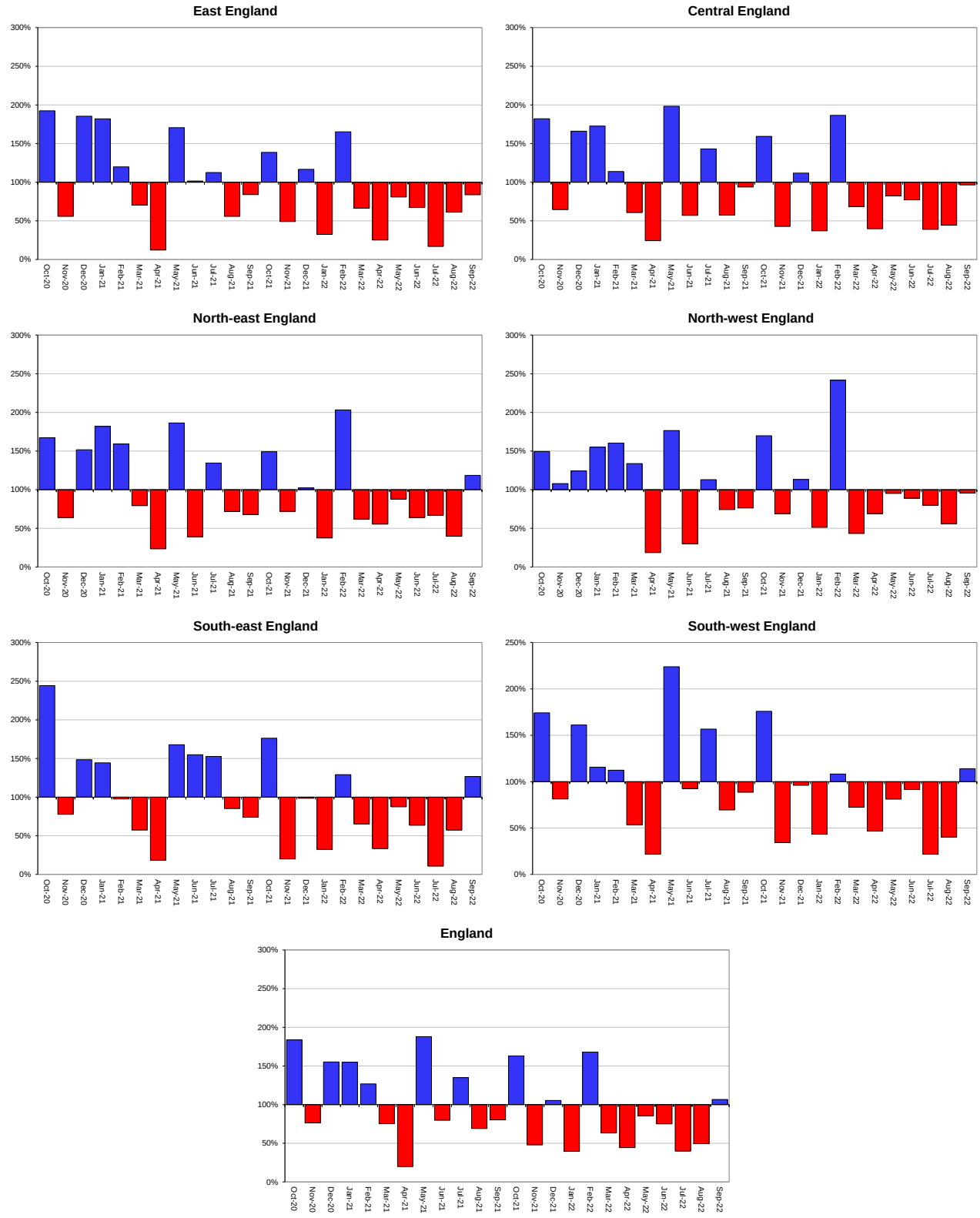


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2022).

Soil moisture deficit

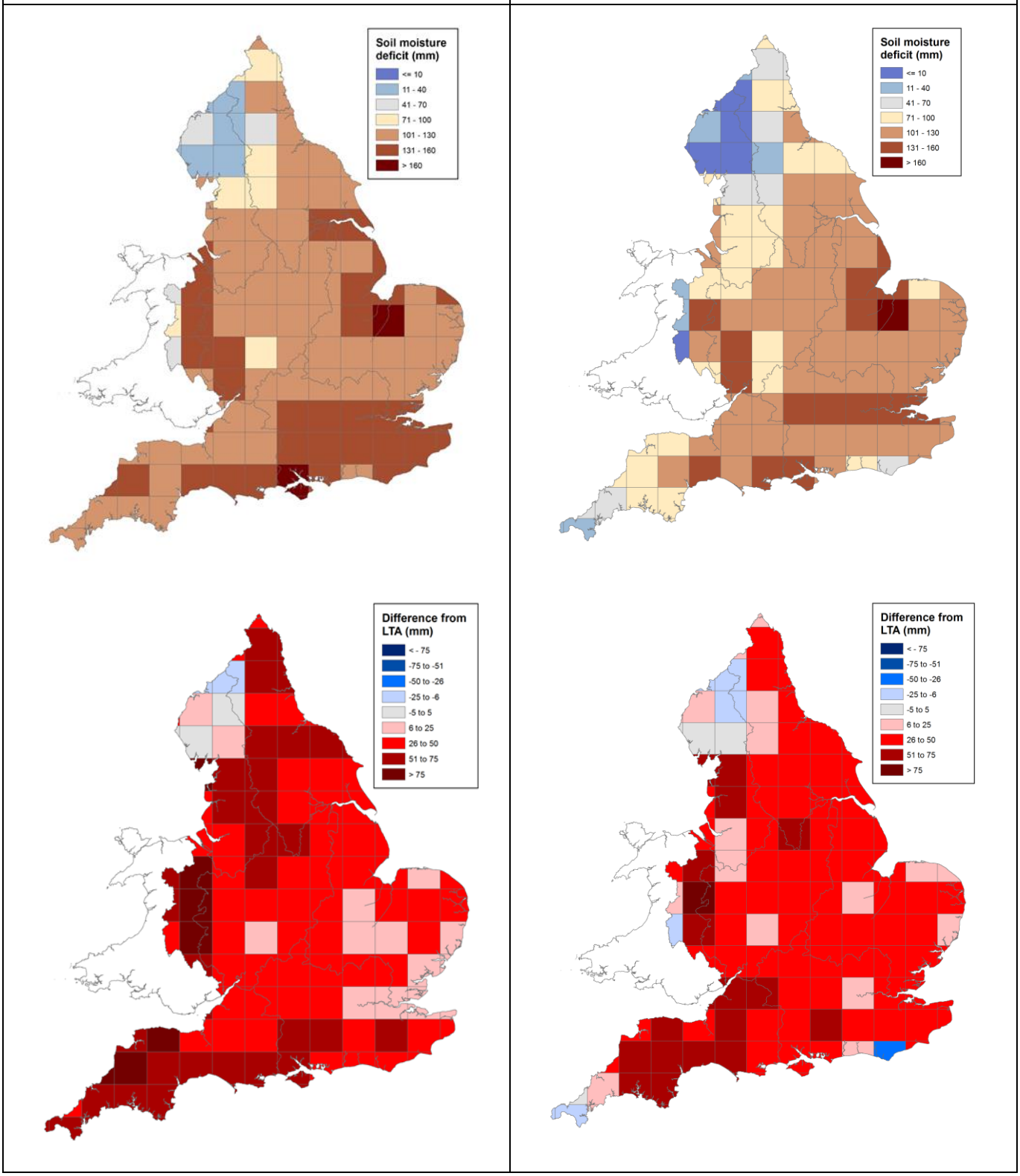
End of August 2022[1]	End of September 2022[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 30 August 2022 [1] (left panel) and 27 September 2022 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2022). Crown copyright. All rights reserved. Environment Agency, 100024198, 2022

Soil moisture deficit charts

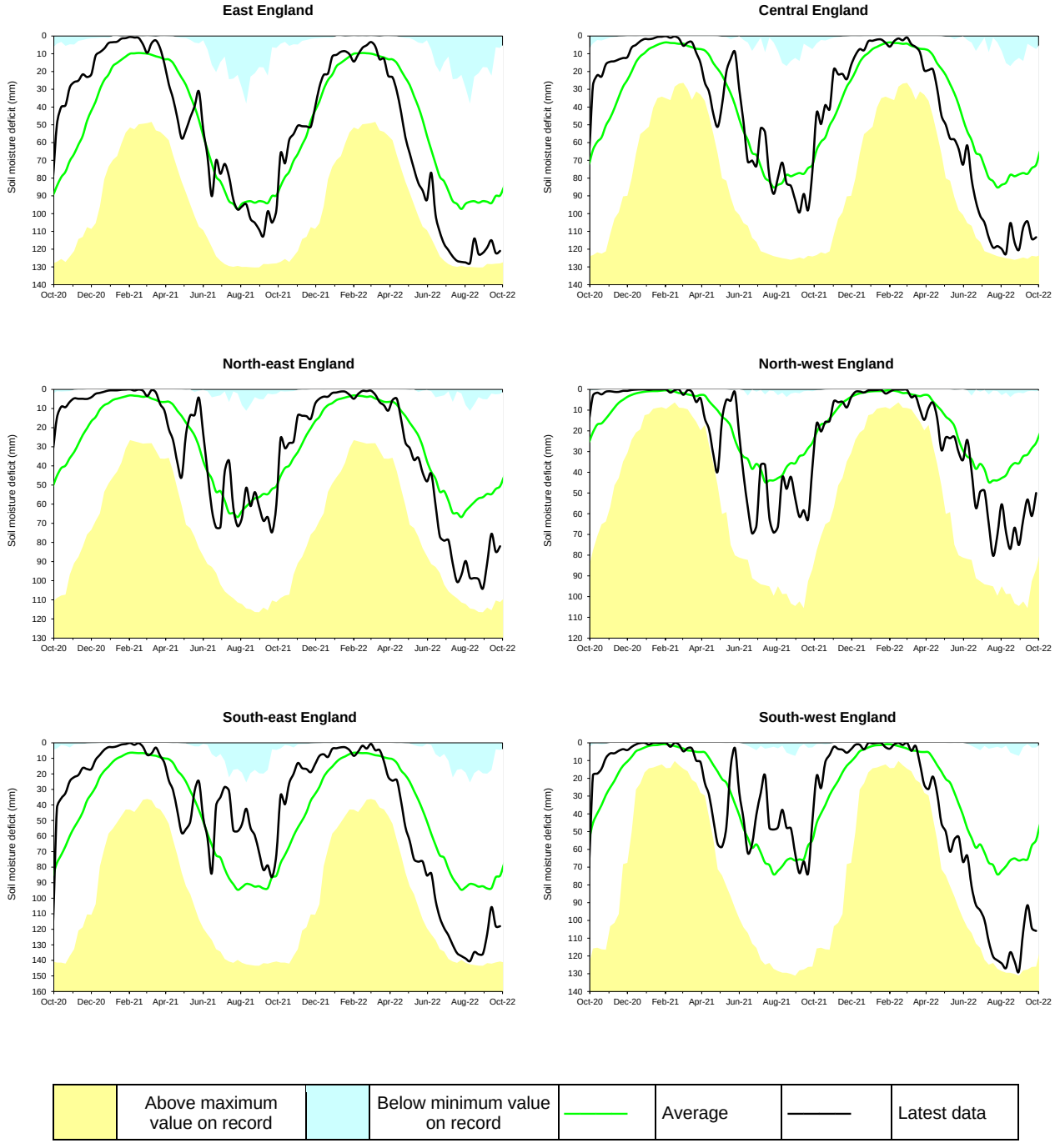
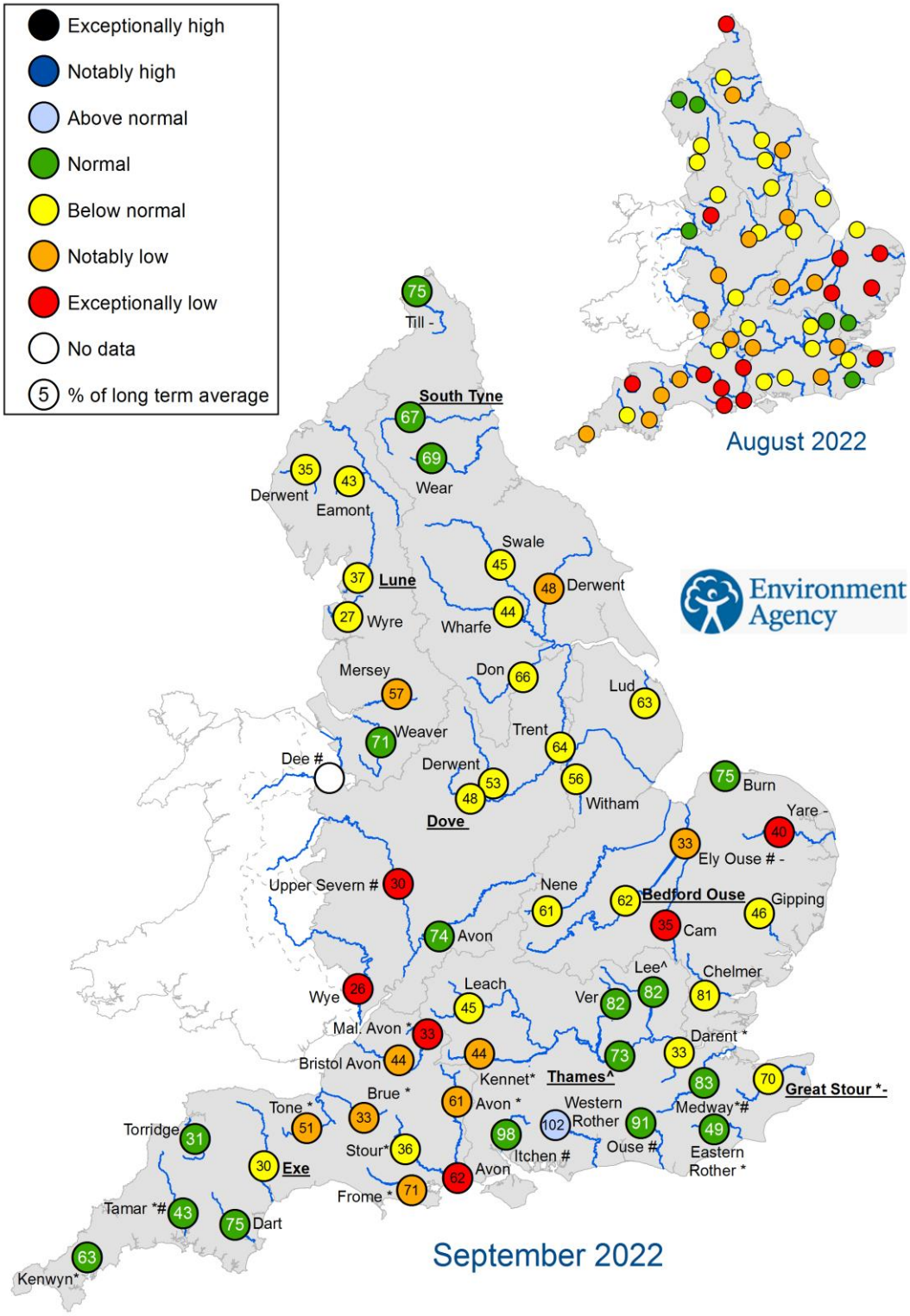


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2022).

River flows



^ "Naturalised" flows are provided for the River Thames at Kingston and the River Lee at Feildes Weir

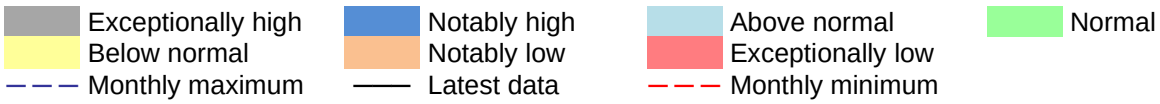
+/- Monthly mean flow is the highest/lowest on record for the current month (note that record length varies between sites)

* Flows may be overestimated at these sites – data should be treated with caution

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 August 2022 and September 2022, expressed as a percentage of the respective long term average and classed relative to an analysis of historic August and September monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2022.

River flow charts



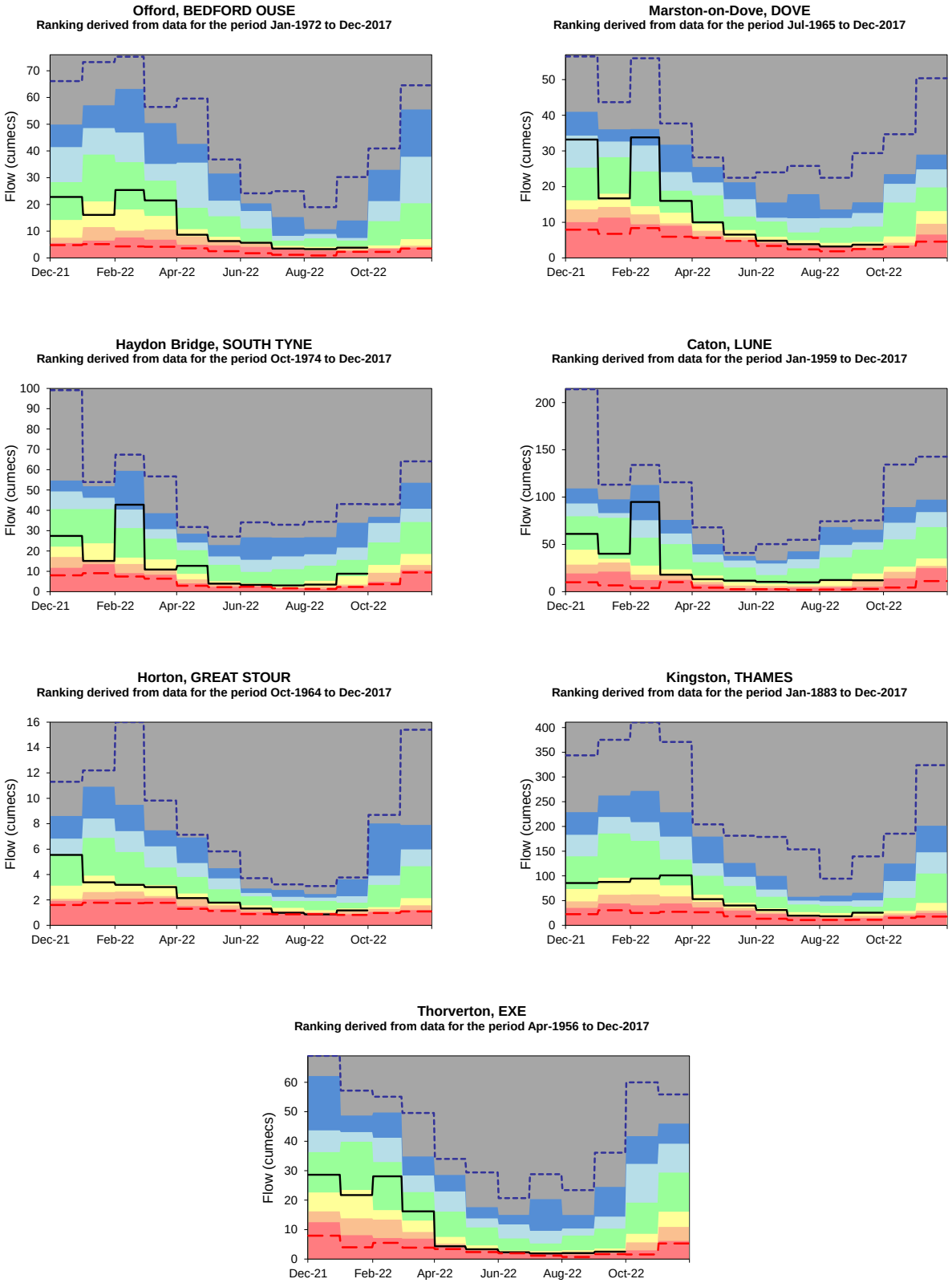
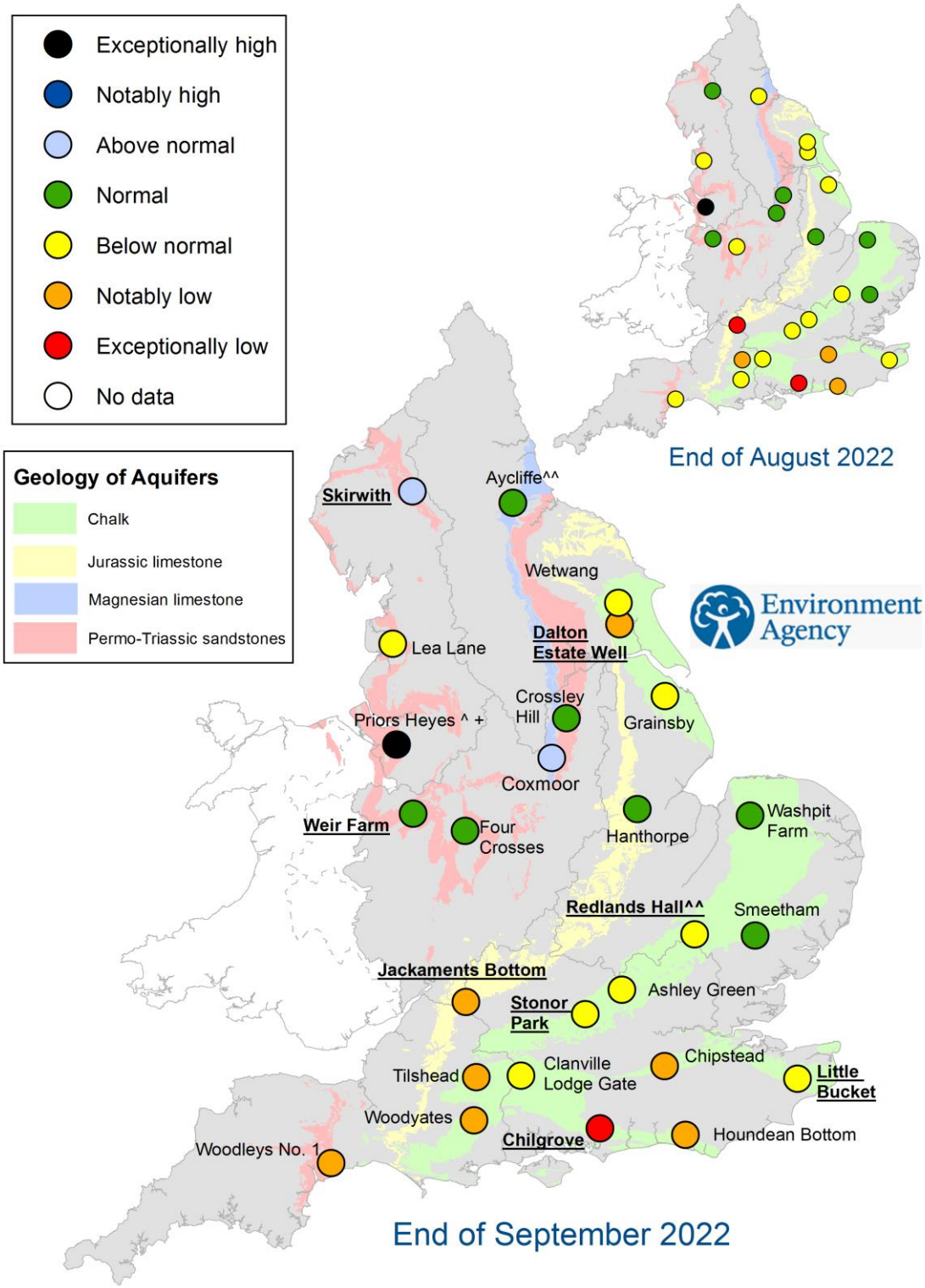


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

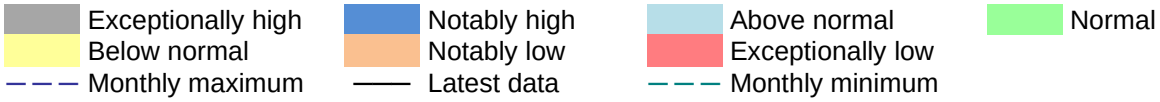
Groundwater levels

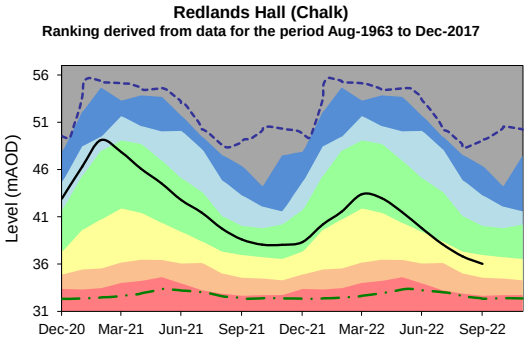


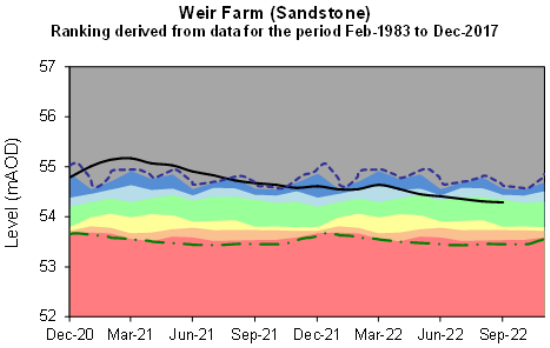
^ The level at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction
^^ Sites are manually dipped at different times during the month. They may not be fully representative of levels at the month end
+/- End of month groundwater level is the highest/lowest on record for the current month (note that record length varies between sites). Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

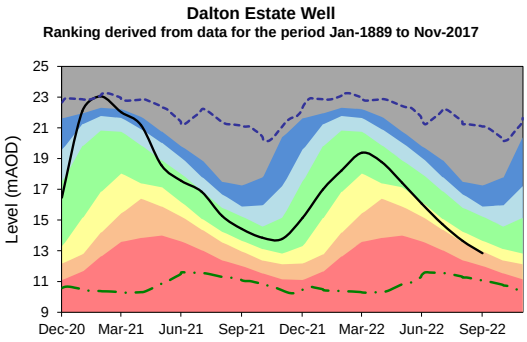
Figure 4.1: Groundwater levels for indicator sites at the end of August 2022 and September 2022, classed relative to an analysis of respective historic August and September levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2022.

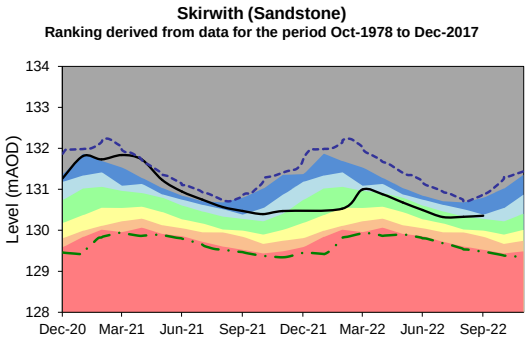
Groundwater level charts

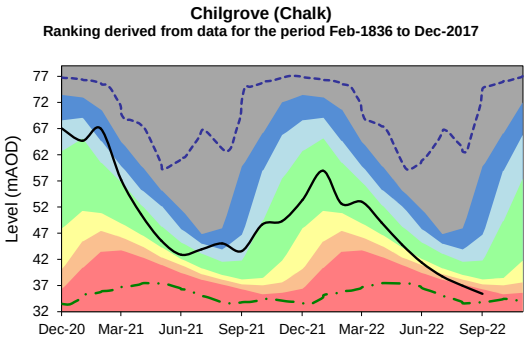


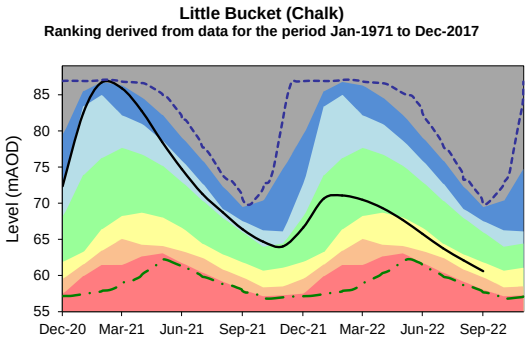


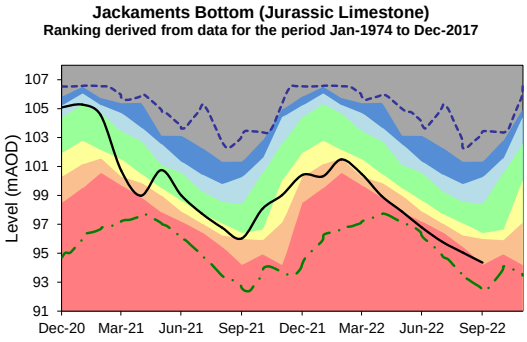












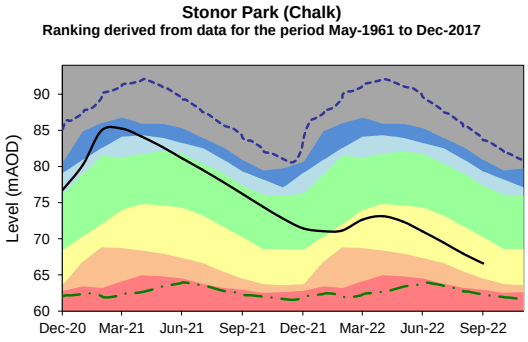
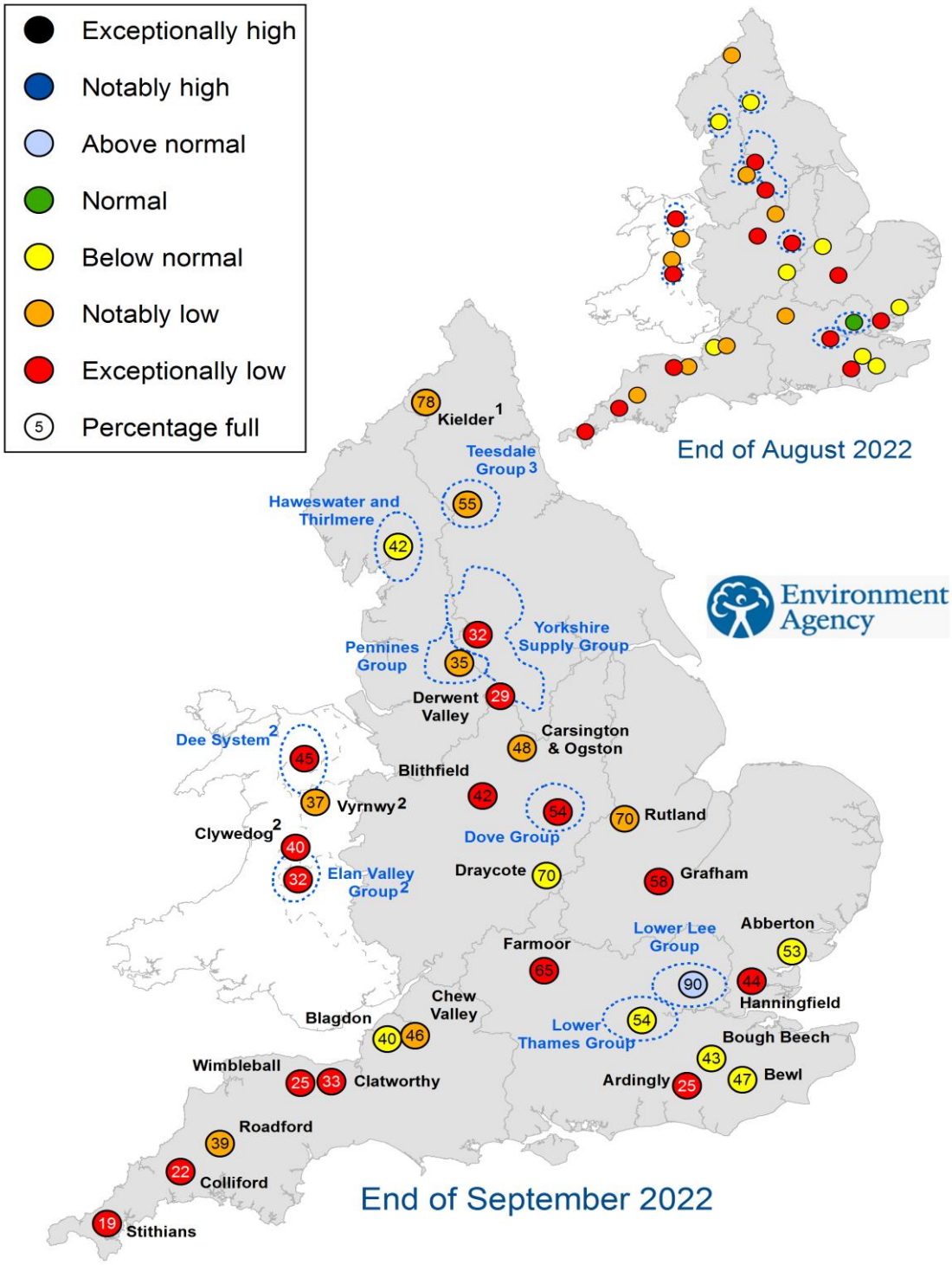


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2022).

Reservoir storage



1. Current levels at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve
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 August 2022 and September 2022 as a percentage of total capacity and classed relative to an analysis of historic August and September 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

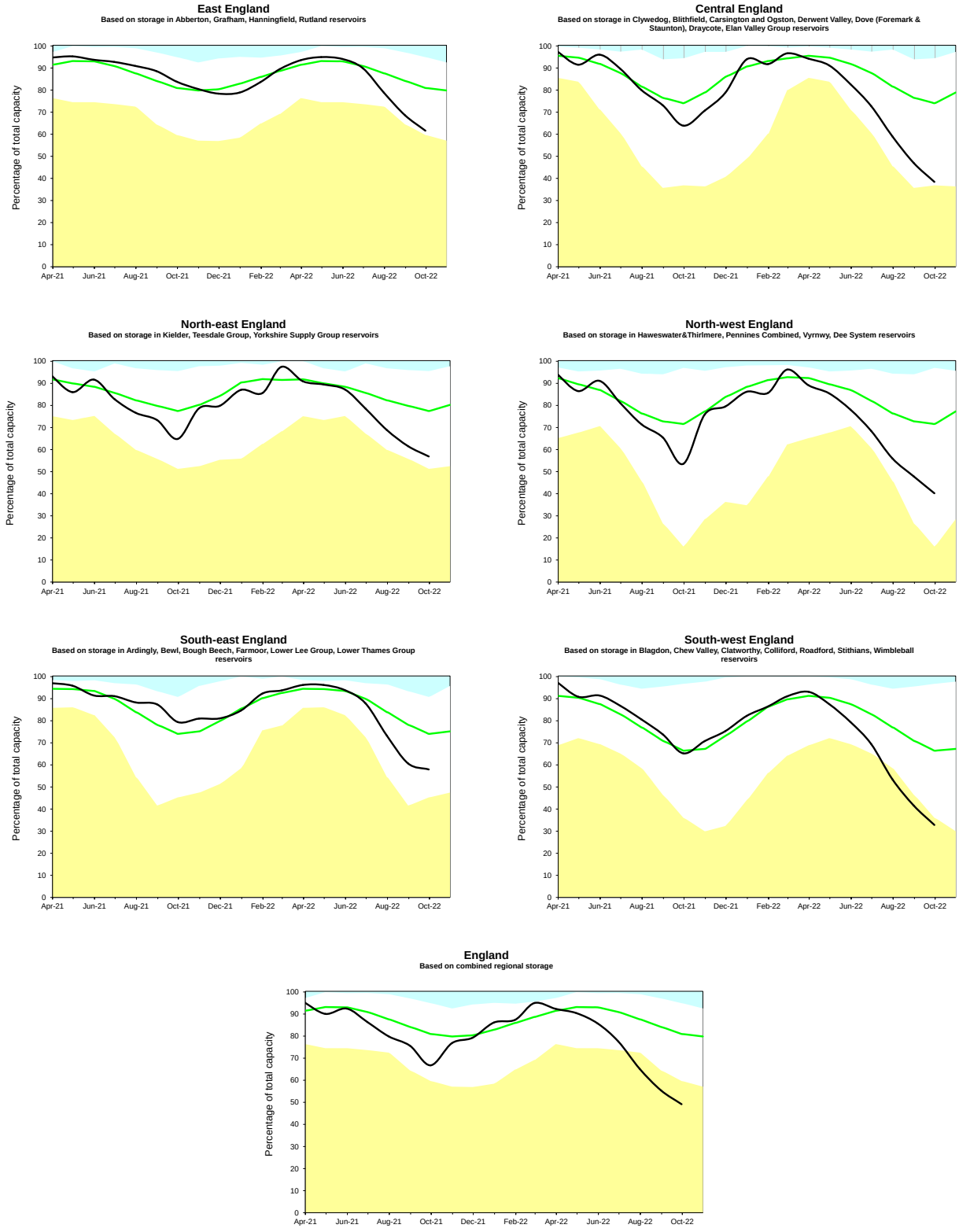


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

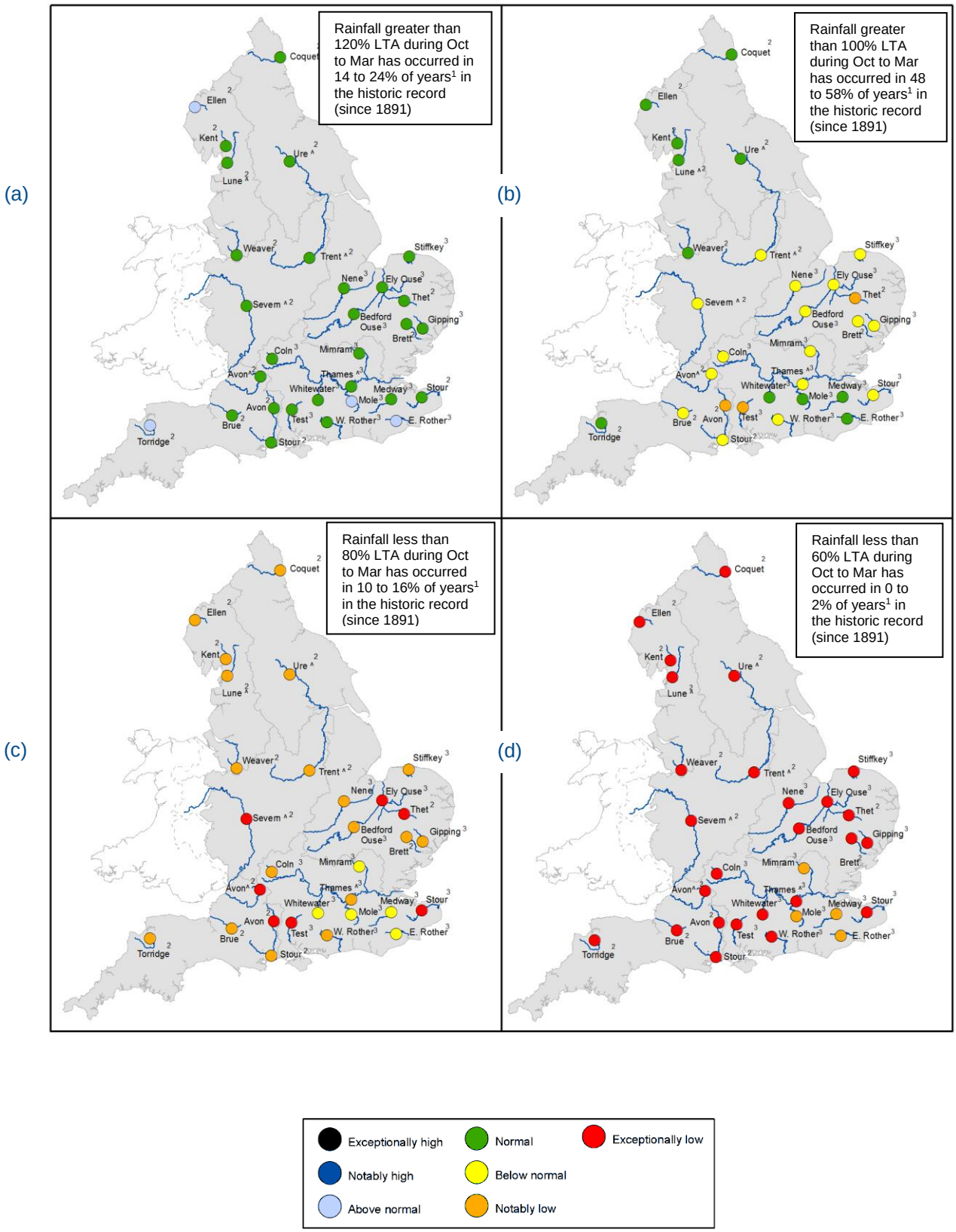
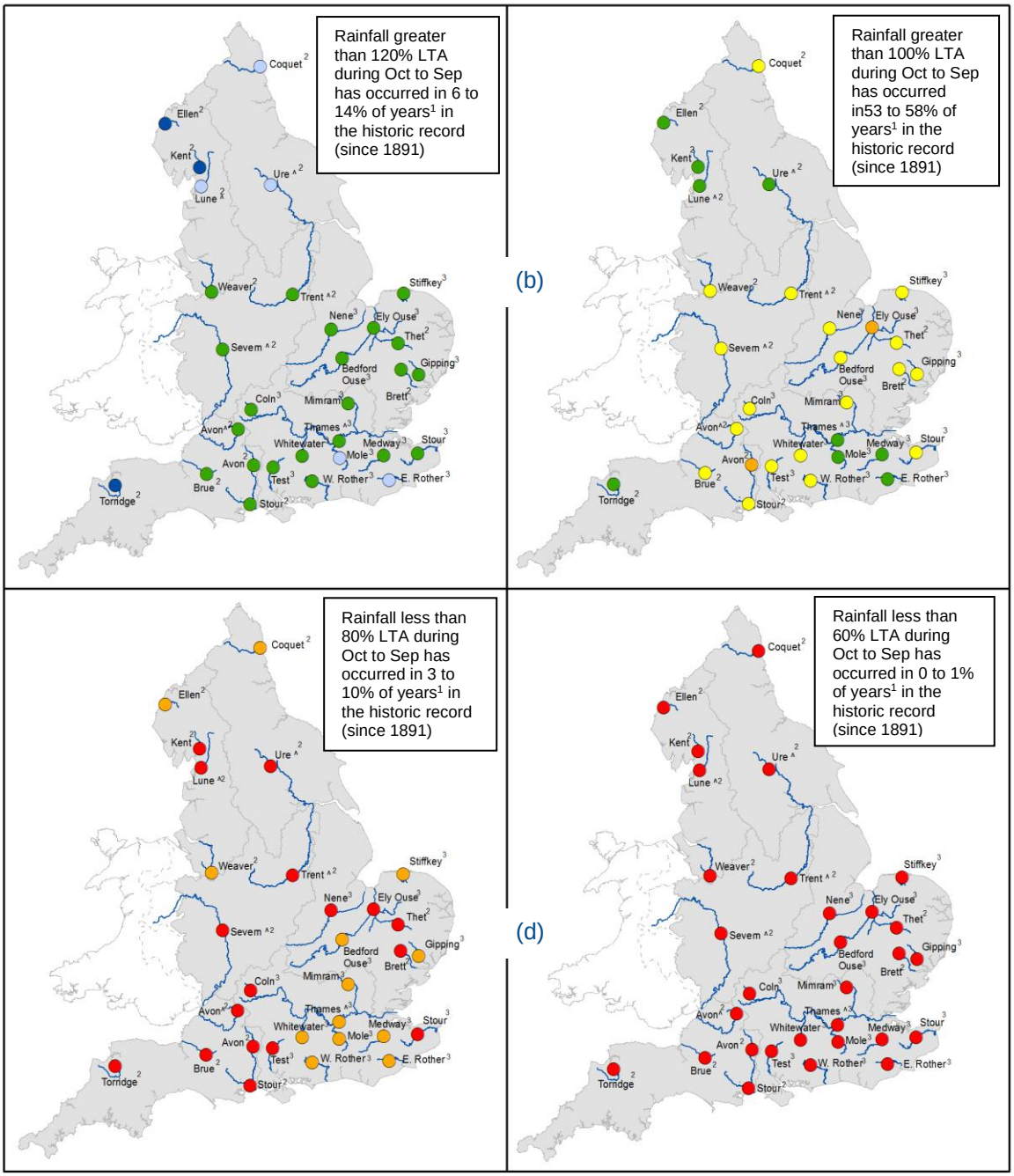


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2023. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2022 and March 2023 (Source: UK Centre for Ecology and Hydrology, Environment Agency)

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



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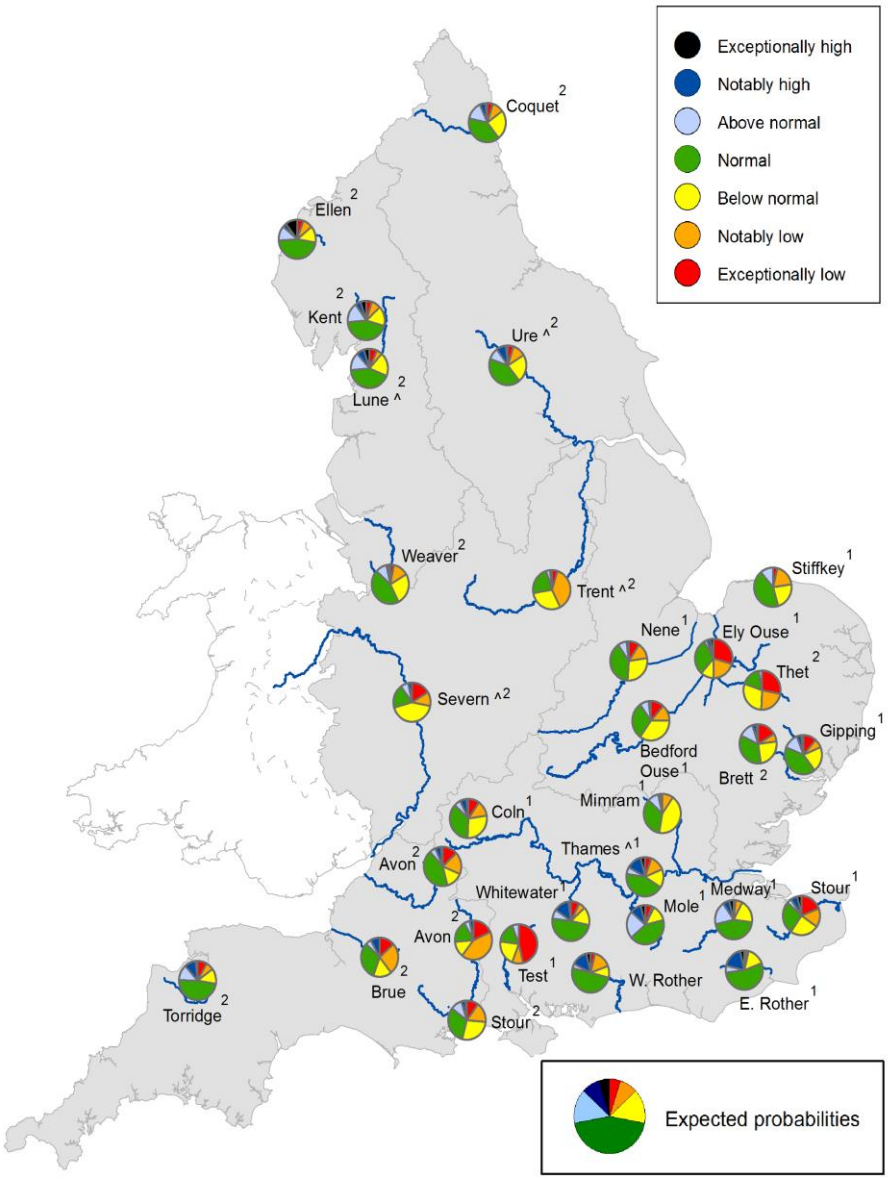

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2023. 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: UK Centre for Ecology and Hydrology, Environment Agency).

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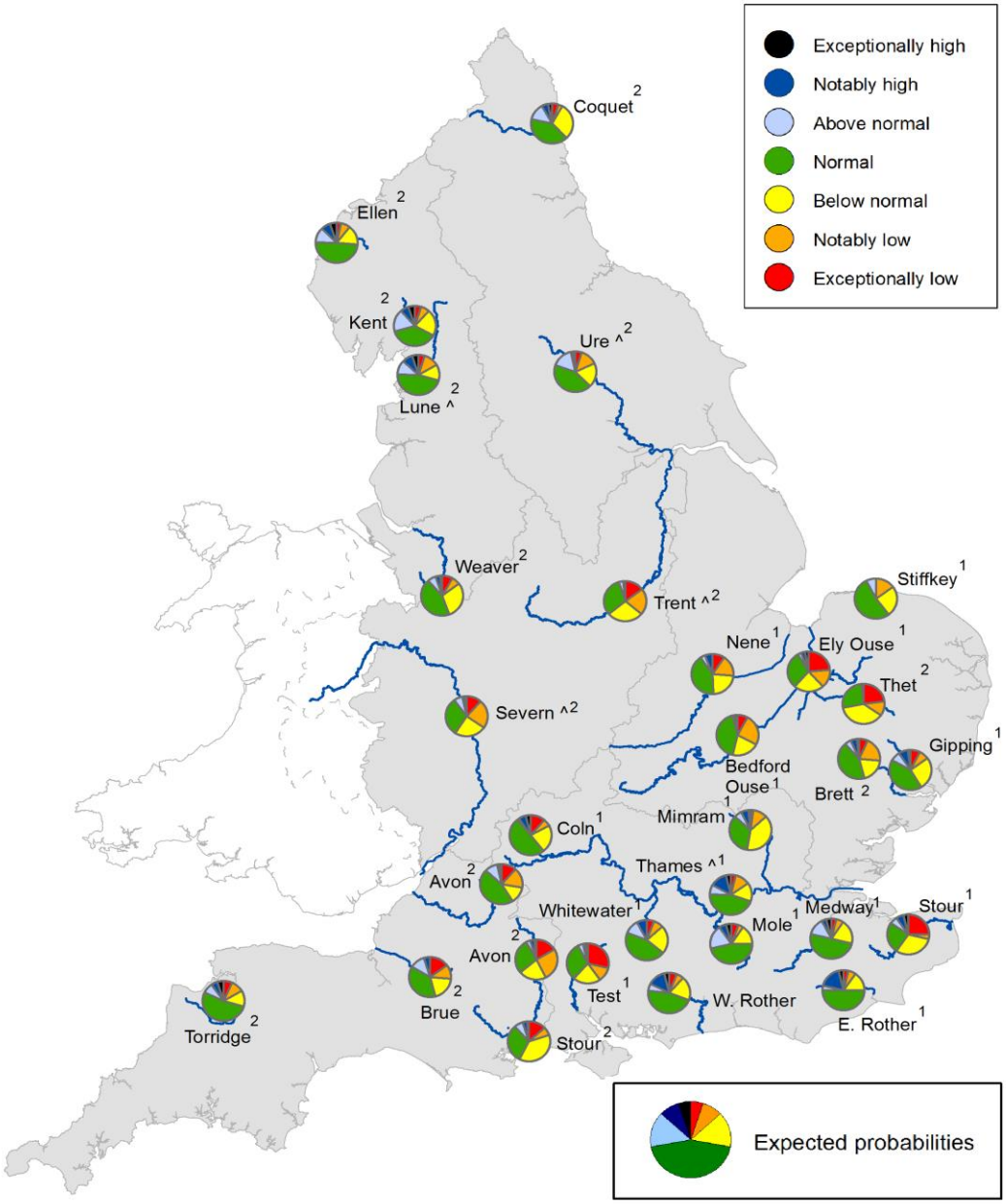

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2023. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: UK Centre for Ecology and Hydrology, Environment Agency).

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

Forward look: groundwater

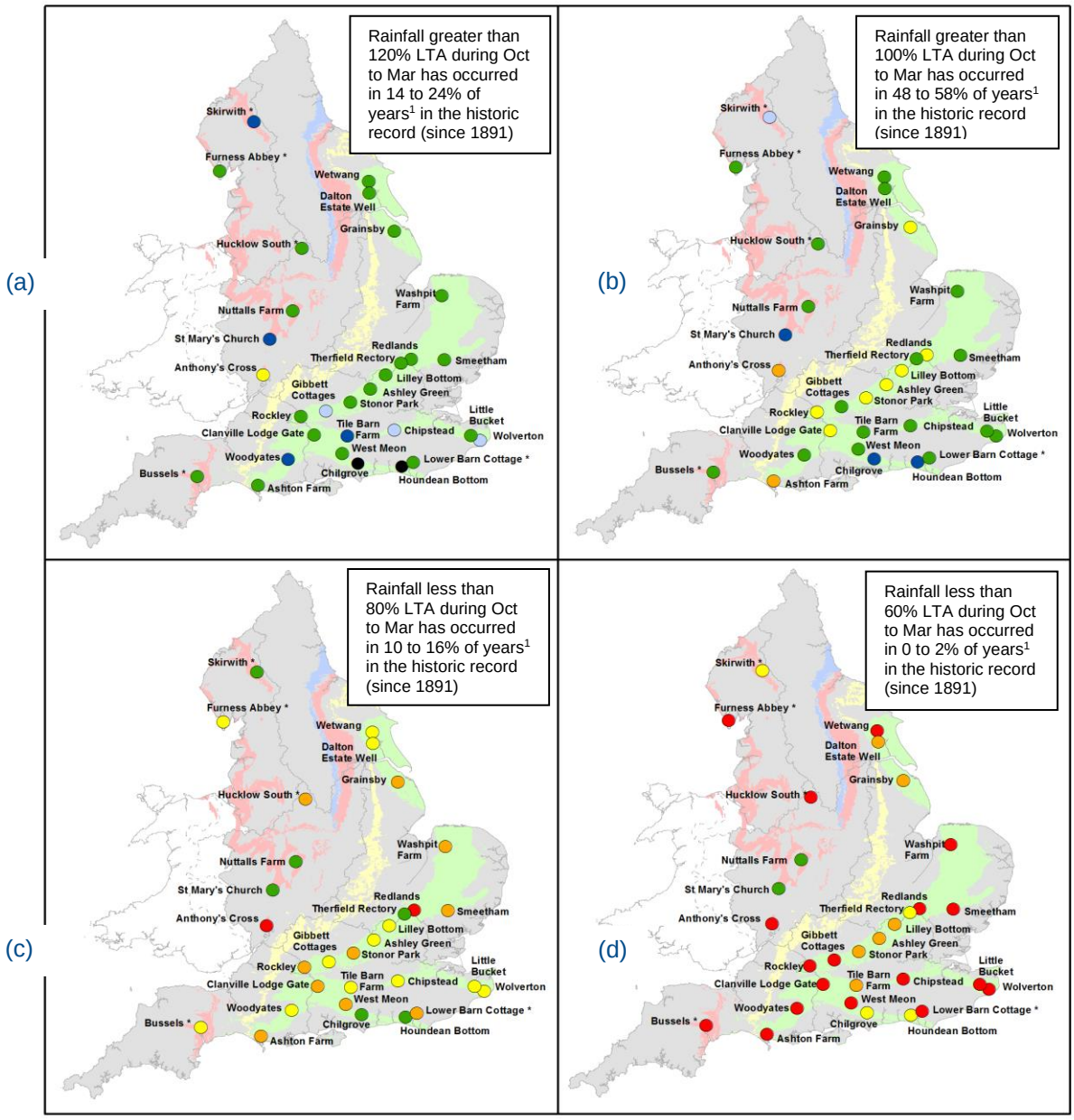

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2023. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2022 and March 2023 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2022.

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

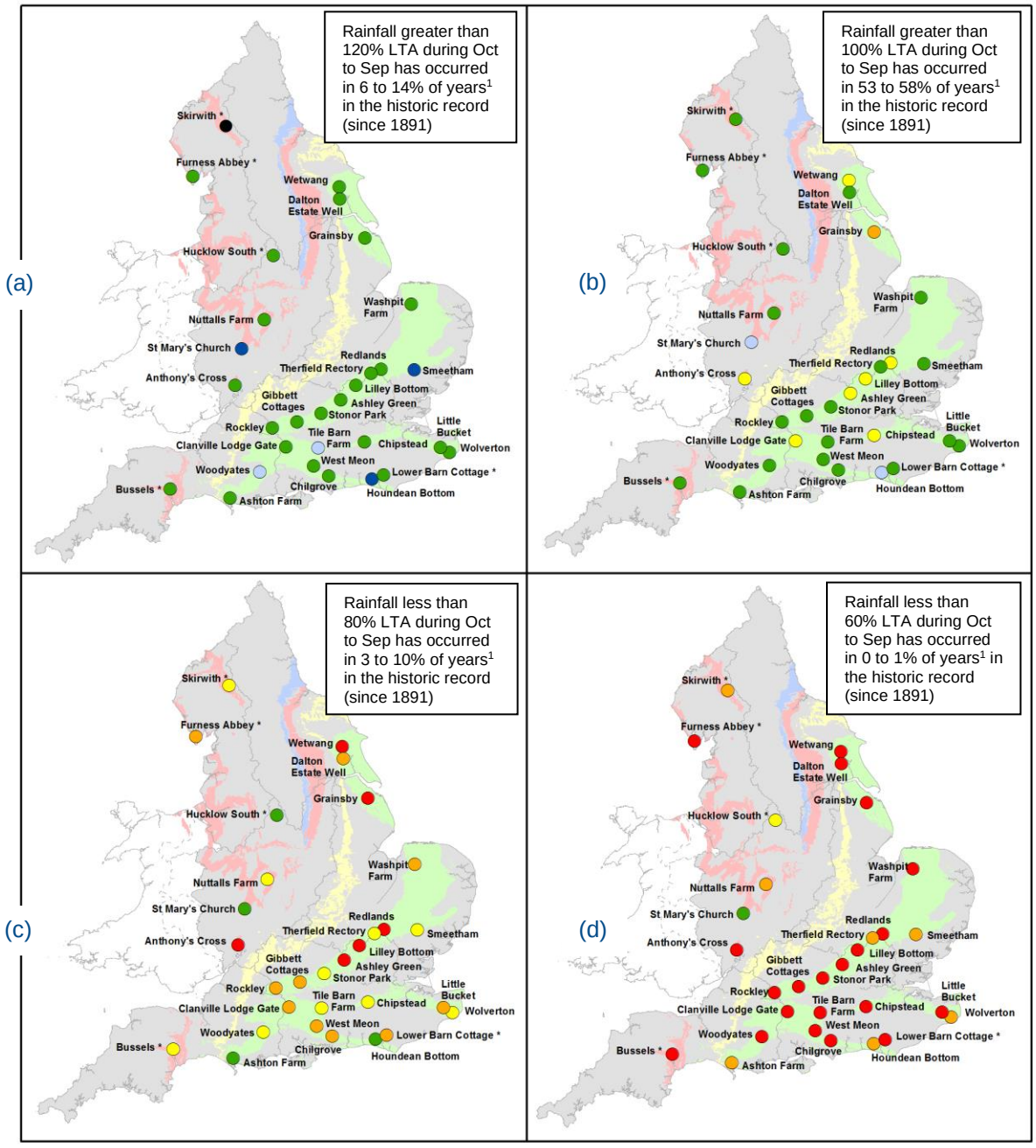

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2023. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2022 and September 2023 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2022.

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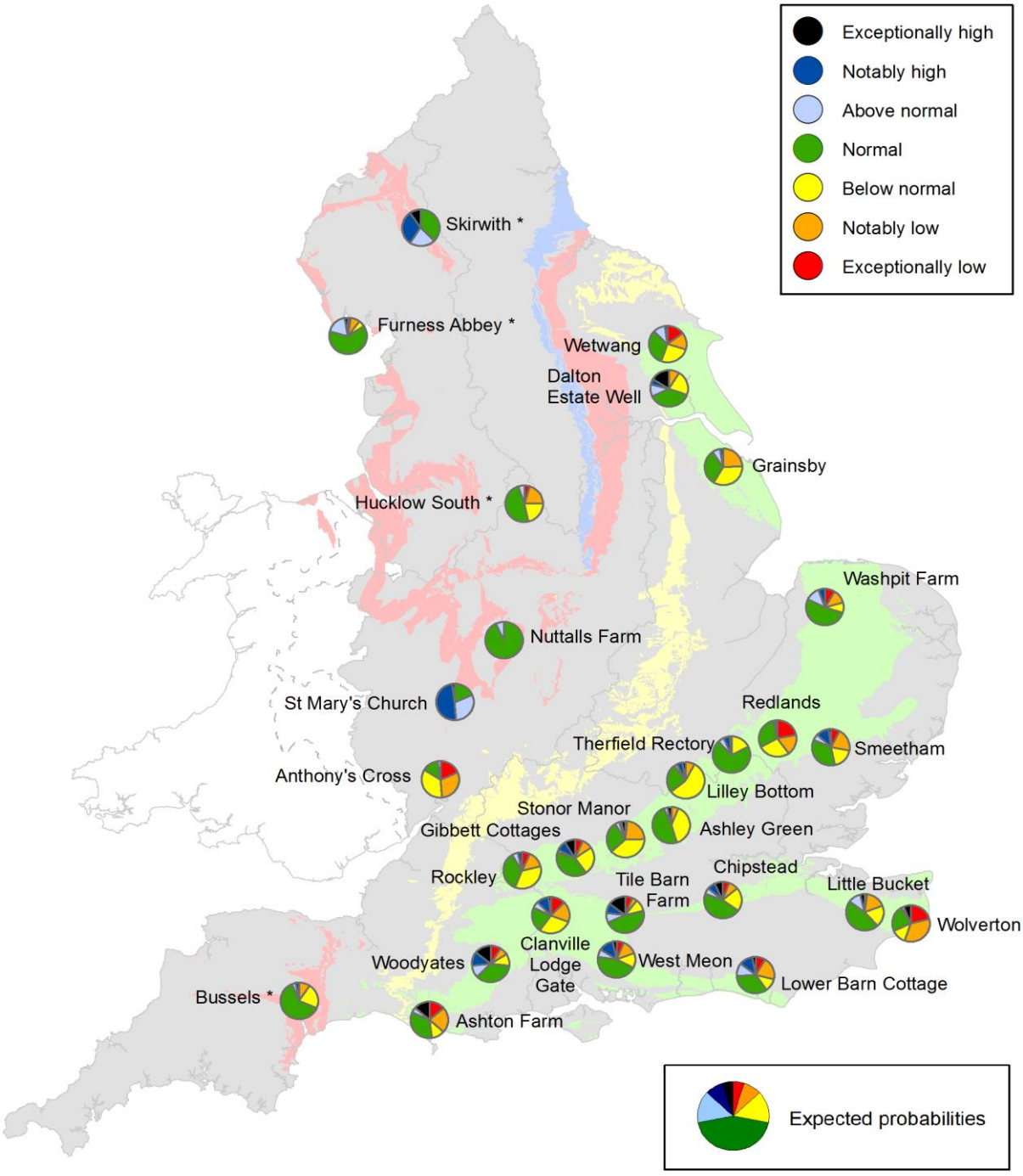
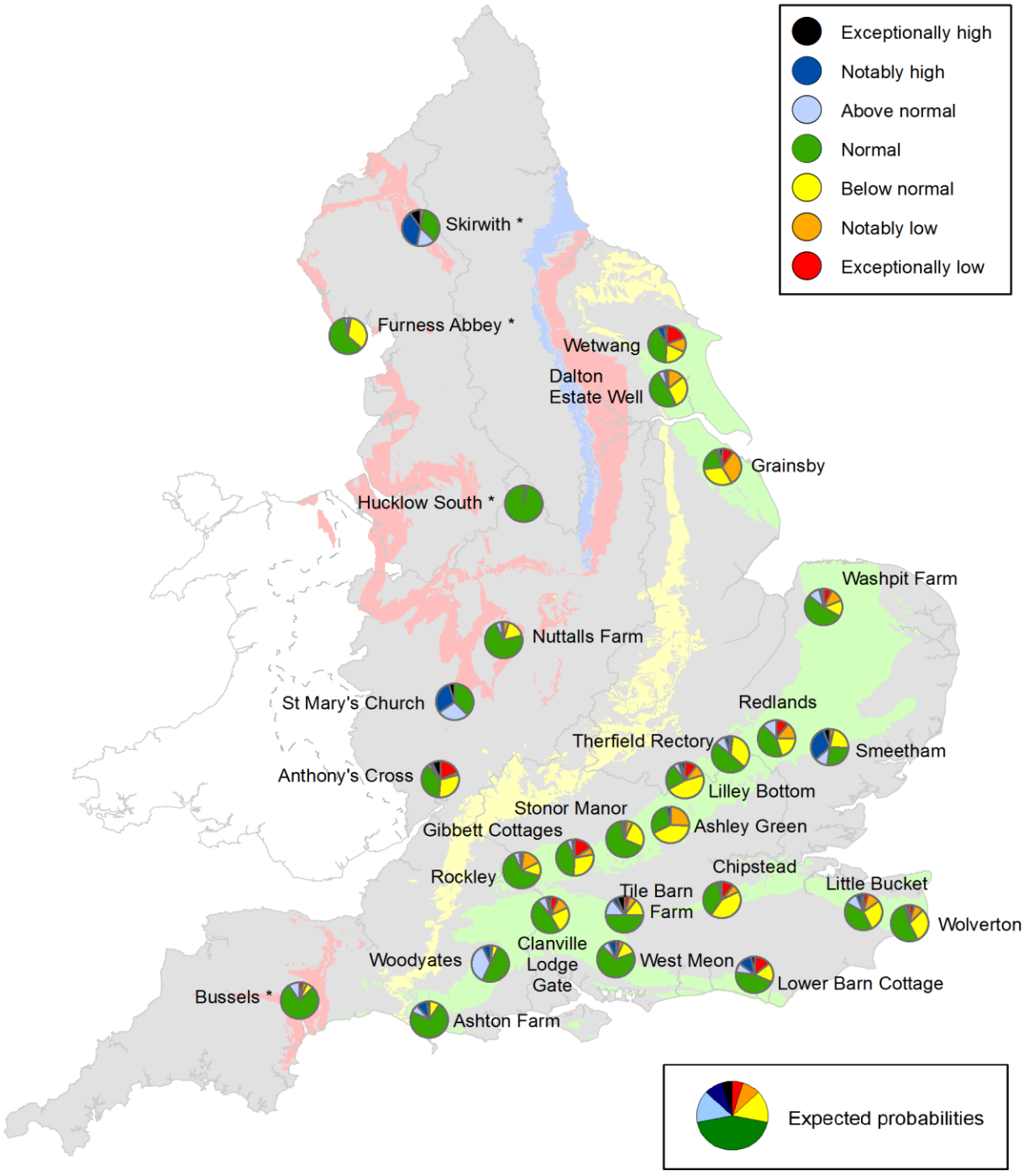
[1] This range of probabilities is a regional analysis



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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2023. 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, 100024198, 2022.

** Projections for these sites are produced by BGS*



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

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2023. 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, 100024198, 2021.

* 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. For rainfall and soil moisture deficit, the period refers to 1961 to 1990, unless otherwise stated. For other parameters, the period may vary according to data availability
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