Monthly water situation report

England

Summary – November 2021

Rainfall totals for November, for England, were the driest since 1956. Monthly rainfall totals were exceptionally low for the time of year in more than half of the catchments across England. Soil moisture deficits were generally close to or smaller than the long term average for the time of year. River flows decreased at more than two thirds of the indicator sites reported on, although the majority of sites were classed as normal or higher for the time of year. The end of November groundwater levels were classed as normal or higher for the time of year at almost all indicator sites. Reservoir stocks increased during November at nearly two-thirds of the reservoirs and reservoir groups we report on.

Rainfall

The November rainfall total for England was 39mm, which represents 48% of the 1961-1990 long term average (LTA) (45% of the 1981-2010 LTA). The lowest monthly totals were seen in southern and central areas, with higher rainfall totals recorded in north-west and parts of north-east England (Figure 1.1).

Monthly rainfall totals were classed as exceptionally low for the time of year in more than half of the catchments across England, including a large part of south-east and south-west England and parts of central and east England. The majority of remaining catchments were classed as below normal or notably low for the time of year. All except three catchments (all in north-east England) received less than 100% of the LTA rainfall for November. The lowest rainfall total as a proportion of the LTA was over Cuckmere River in East Sussex, with 10mm of rainfall, representing 10% of the November LTA. More than a quarter of catchments received less than 20% of the LTA rainfall for November, mostly in south-east England, and parts of south-west England, where eight catchments had the driest November on record (records start 1891). Nearly a third of all catchments in England experienced the second driest November on record. The highest rainfall total as a proportion of the LTA was over the Tweed catchment (in the Scottish Borders) with 85mm of rainfall representing 112% of the LTA. The 3 month cumulative rainfall totals were classed as normal in the majority of catchments across England, and the 12 month cumulative rainfall totals were classed as normal or higher across most of England (Figure 1.2).

At a regional scale, November rainfall totals ranged from 20% of the LTA in south-east England to 72% of the LTA in north-east England. All regional rainfall totals for November, with the exception of north-east England, were below normal or lower for the time of year (Figure 1.3).

Soil moisture deficit

During November, soil moisture deficits (SMD) decreased across some parts of the country, notably in north-west England, where the near average rainfall caused soils to become wetter. In other areas, particularly east and parts of south-east England, SMD increased, following the below average rainfall received in these areas. End of November SMD values were generally close to or smaller than the LTA for the time of year (soils were wetter than average) across most of England (Figure 2.1). At a regional scale, the end of November SMD were lower than average (soils were wetter) for the time of year across England (Figure 2.2).

River flows

November monthly mean river flows decreased at more than two thirds of the indicator sites we report on, compared to October. Flows at the majority of sites across England were classed as normal for the time of year, apart from the Burn at Burnham in east England, the Itchen at Allbrook and Highbridge and the Ver at Hansteads, in south-east England, and the Upper Avon at Amesbury in south-west England, which were classed as above normal for the time of year. Eight sites, mostly located in the west of the country, were classed as below normal for the time of year, (Figure 3.1).

At the regional index sites, monthly mean flows were classed as normal for the time of year for all sites, with the exception of the Exe at Thorverton in south west England which was classed as below normal (Figure 3.2).

Groundwater levels

Groundwater levels were in recession at more than half of the reported indicator sites during November, however end of month levels were classed as normal or higher for the time of year at all except two of the indicator sites reported on. Jackaments Bottom in the Jurassic limestone and Crow Lady Farm in the Fylde and Preston sandstone were classed as below normal for the time of year (Figure 4.1).

At Priors Heyes (West Cheshire sandstone) and Coxmoor (Permo-Triassic sandstone) the highest end of November levels on record were recorded (records go back to 1972 and 1969 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction (Figure 4.1).

November groundwater levels at the major aquifer index sites ranged from being classed as notably high at Weir Farm (central England) to below normal in the Jurassic limestone at Jackaments Bottom. The chalk index sites at Little Bucket, Stonor Park, Chilgrove, Dalton Holme and Redlands Hall were classed as normal (Figure 4.2).

Reservoir storage

End of November reservoir stocks increased at nearly two-thirds of the reservoirs and reservoir groups we report on. The largest increases of around 15% of total capacity were recorded at several reservoirs or groups, including Derwent Valley (central England), Elan Valley (mid Wales), Chew Valley Lake and Clatworthy reservoir (south-west England). End of month reservoir stocks were classed as normal or higher for the time of year at the majority of reported reservoir sites. Four reservoirs or reservoir groups were classed as notably low for the time of year; (Derwent Valley in central England, Elan Valley and Dee System (Wales), and Teesdale Group in north-east England) although all had an increase in stocks through November (Figure 5.1).

At a regional scale, total reservoir stocks ranged from 75% in south-west England to 81% in south-east England. Total reservoir stocks for England were at 79% of total capacity at the end of October (Figure 5.2).

Forward look

The beginning of December was dominated by the arrival of Storm Barra which brought unsettled, windy conditions to much of the country. Moving into the middle of the month, largely unsettled conditions are expected to remain, with a chance of showers and longer spells of rain. The east has the potential for drier and brighter conditions at times. Cold interludes are likely towards the end of the period as conditions become more settled. Conditions are likely to remain settled around Christmas and towards New Year, with temperatures close to normal for the time of year.

For the 3 month period December to February, there is a slightly higher than normal chance that the period will be wet, and there is almost twice the normal chance it will be mild[1].

Projections for river flows at key sites[2]

By the end of March and end of September 2022, more than half of the modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year. A third of the 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 March and September 2022.

For scenario based projections of cumulative river flows at key sites by March 2022 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2022 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2022 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2022 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

By the end of March 2022, half of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year. By the end of September 2022, less than half of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2022 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2022 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2022 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2022 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

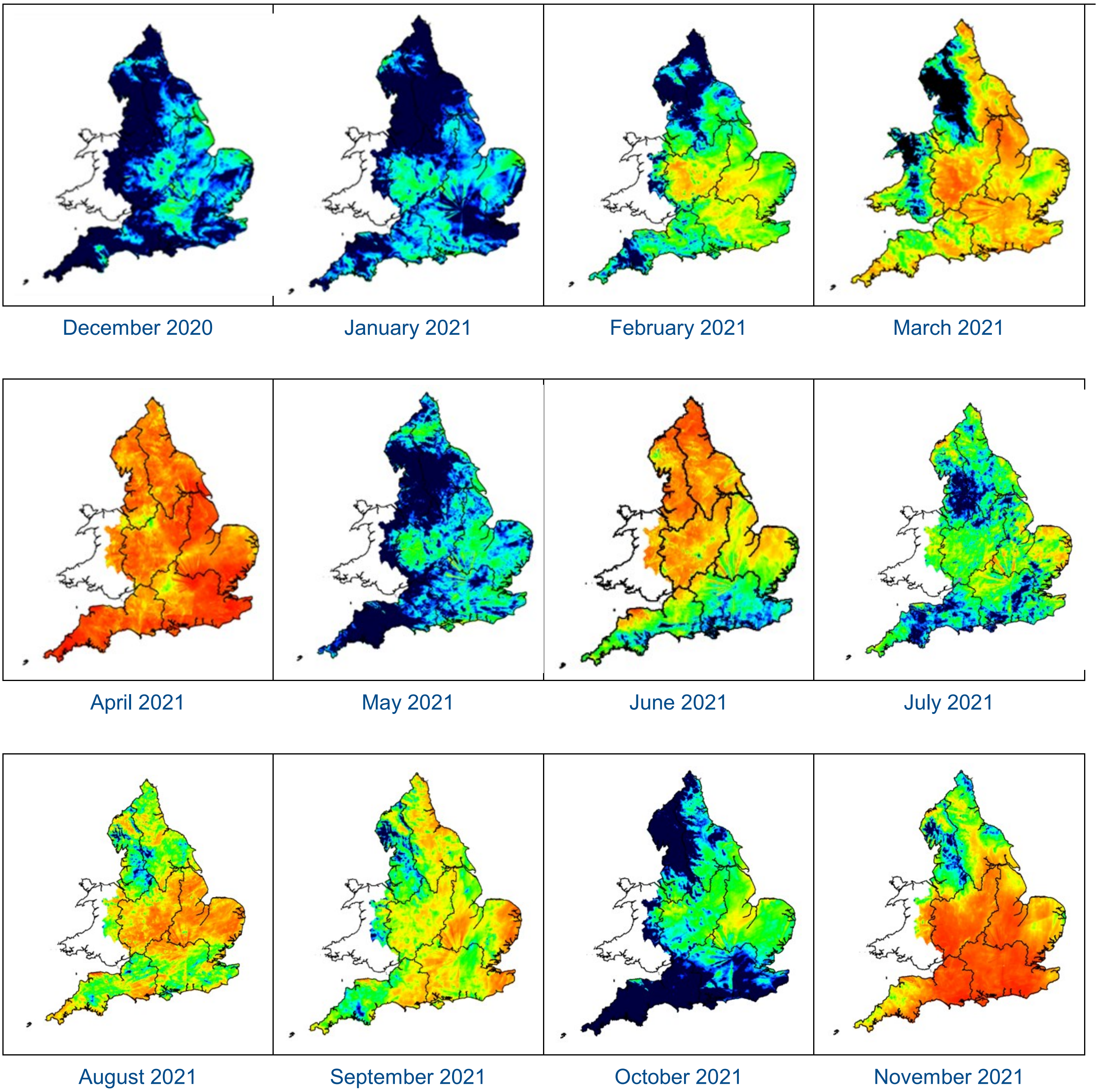
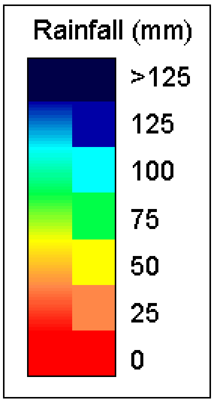


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.



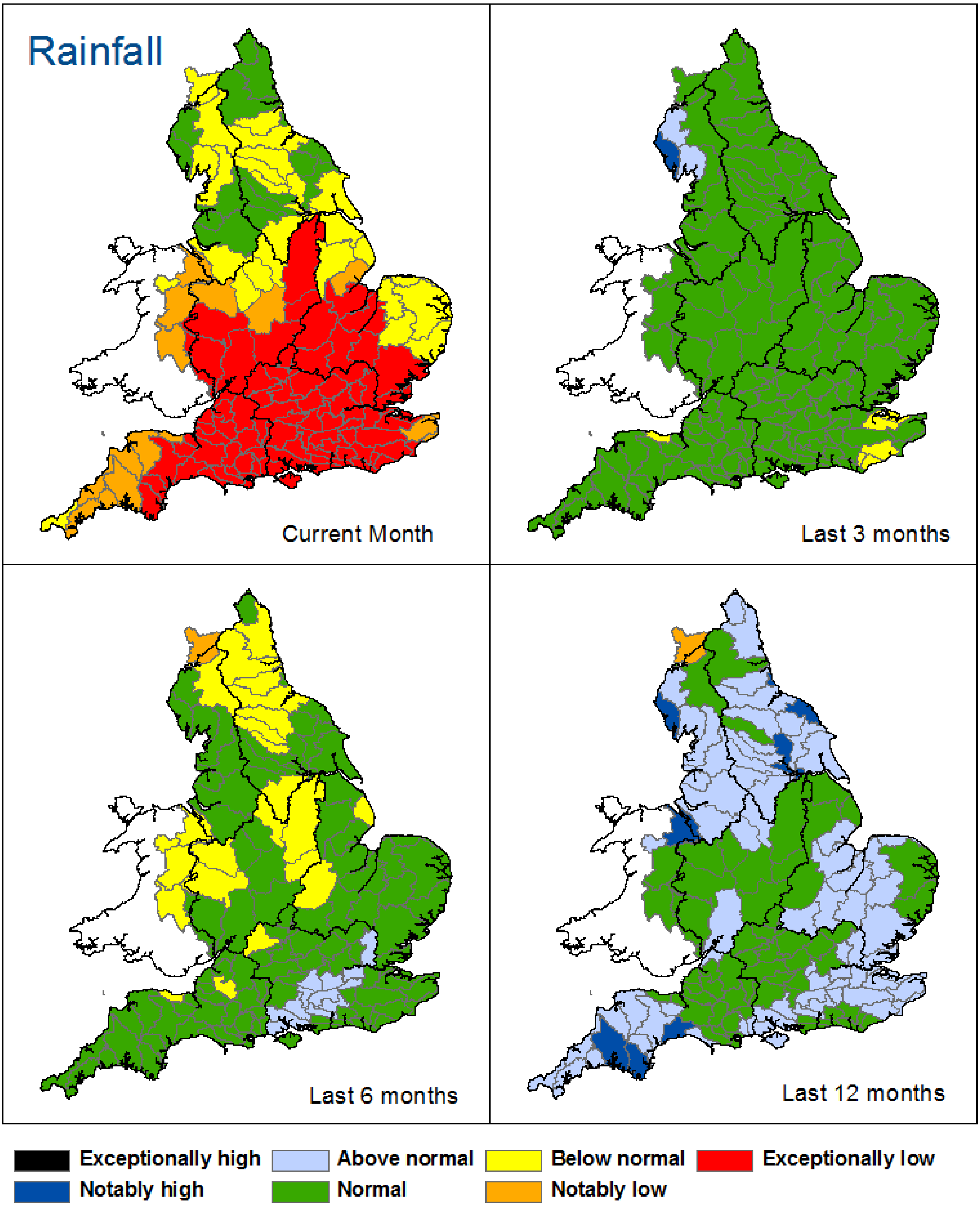


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 November), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2021).* 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, 2021.

Rainfall charts

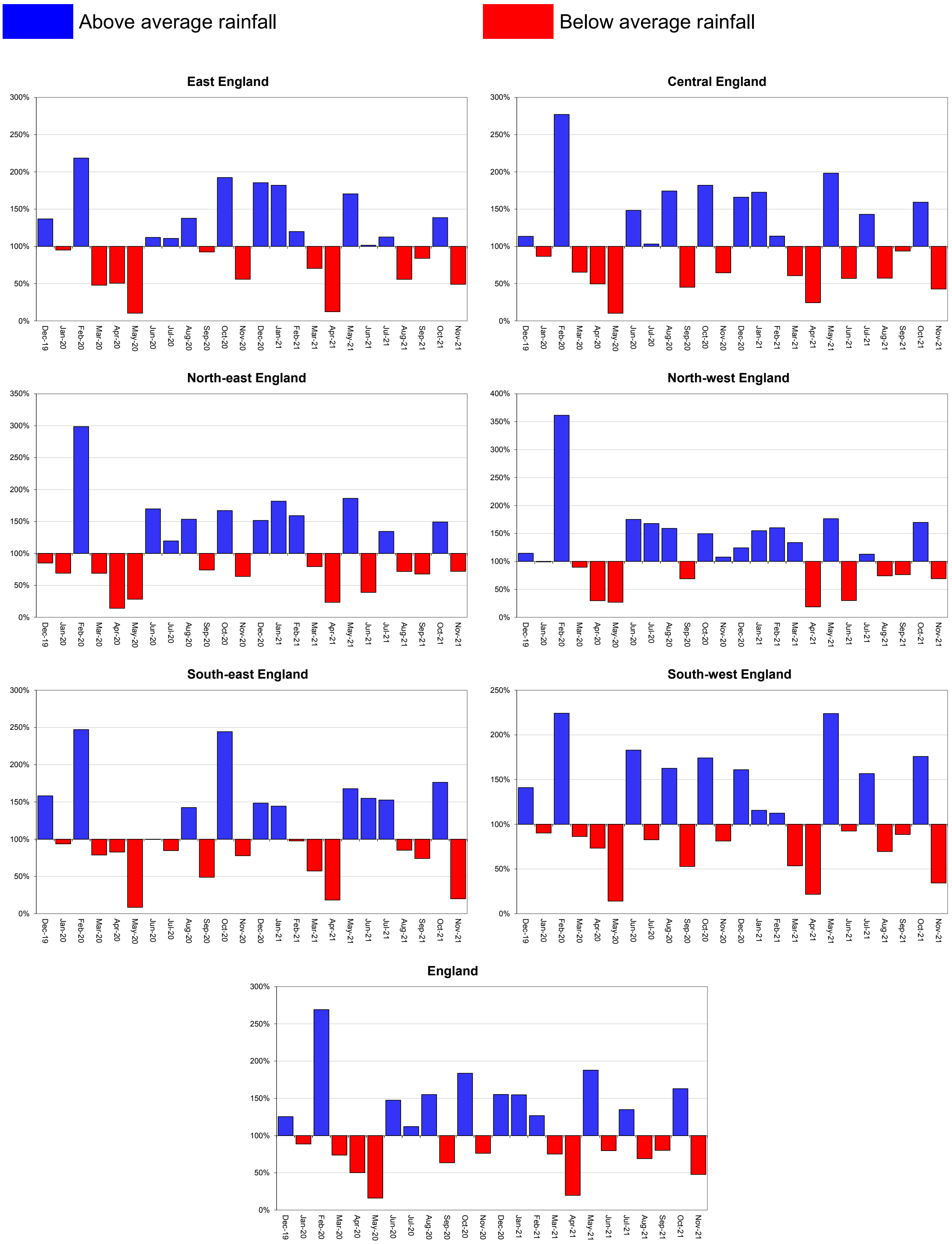
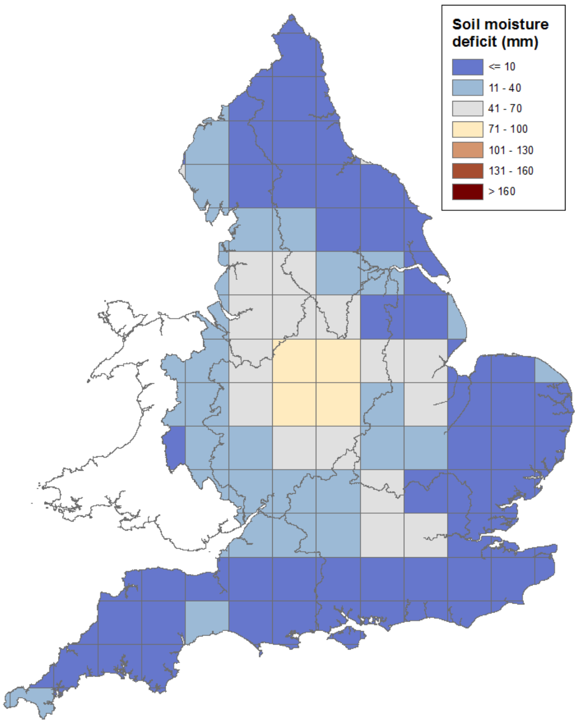
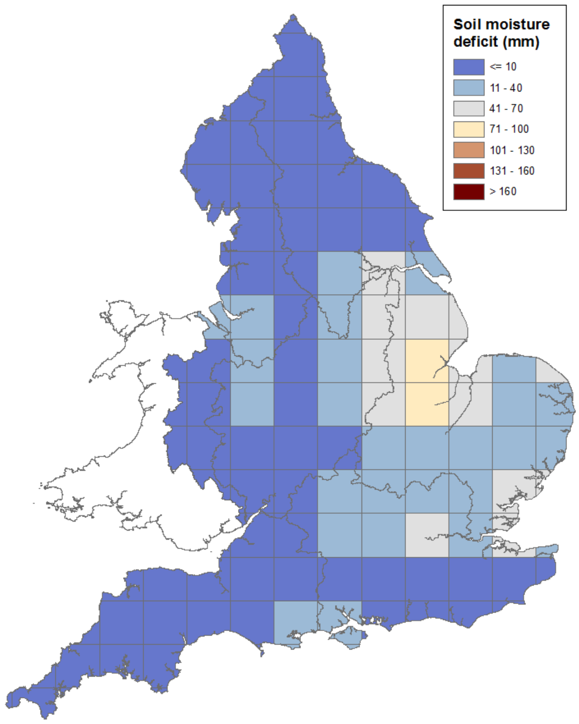


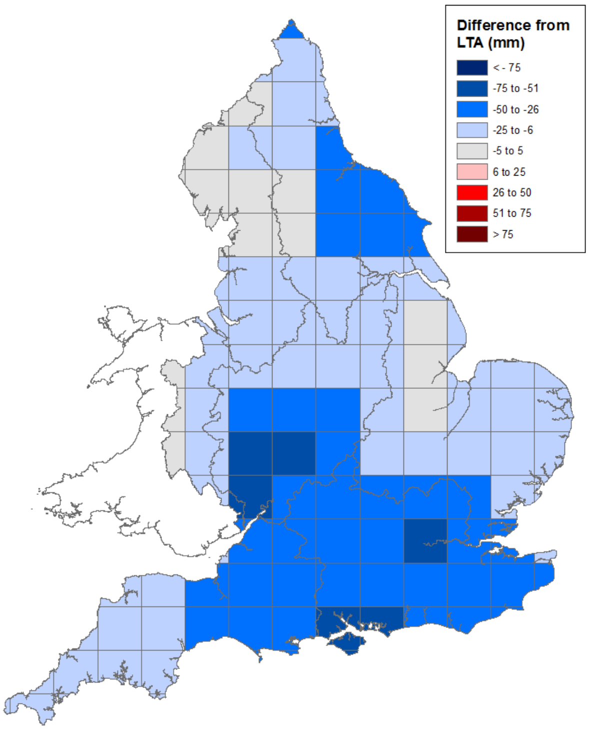
Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

End of October 2021[1]	End of November 2021[2]







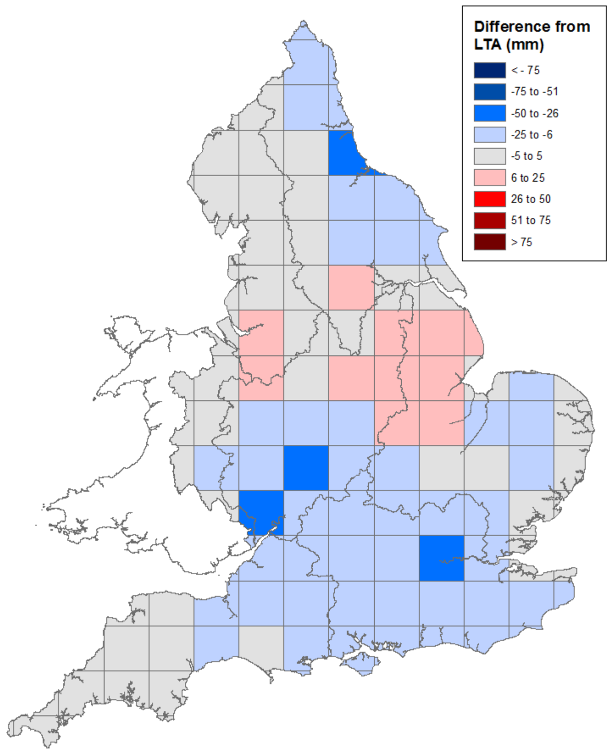


Figure 2.1: Soil moisture deficits for weeks ending 2 November 2021 [1] (left panel) and 30 November 2021 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2021). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021

Soil moisture deficit charts

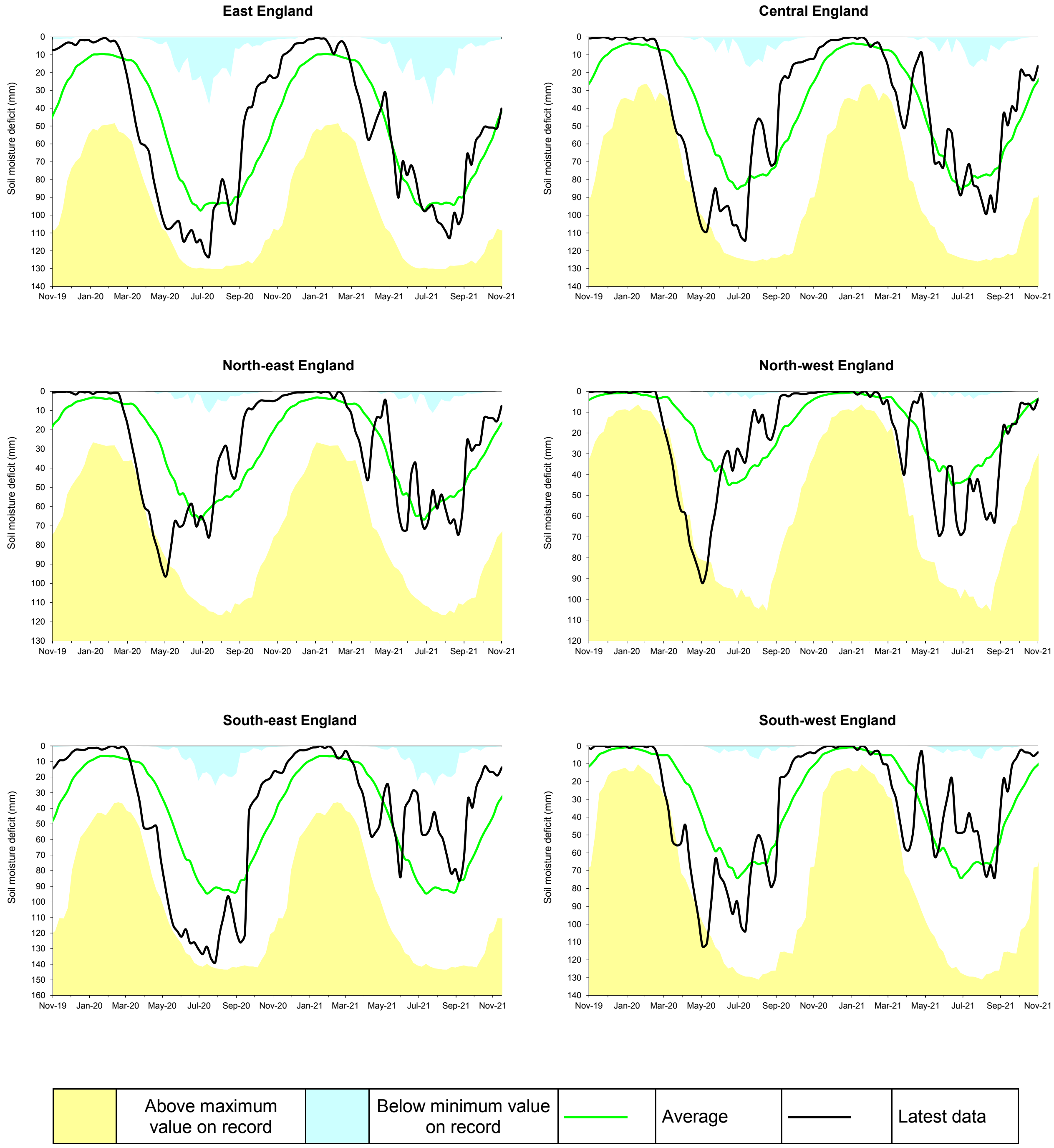
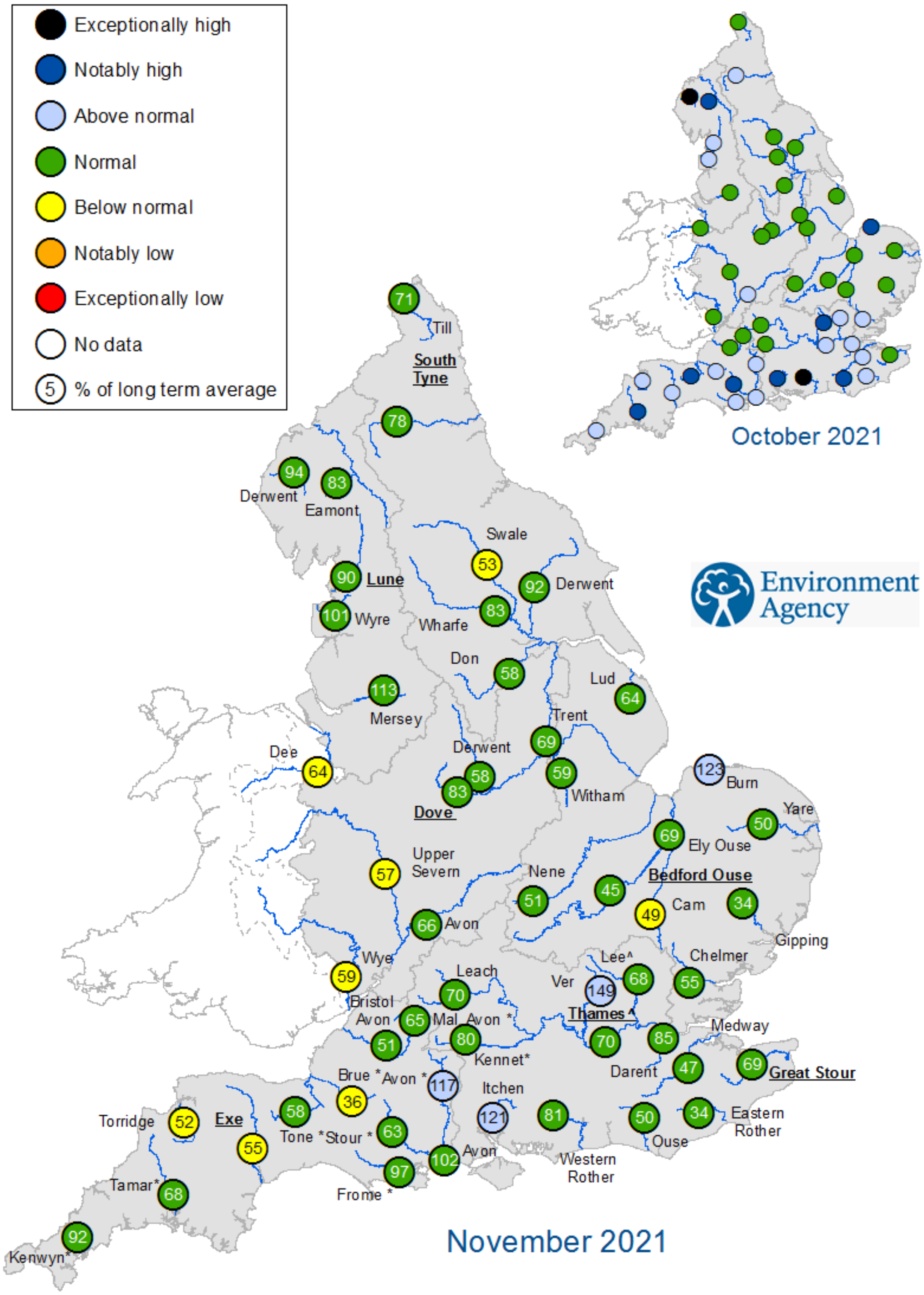


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

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

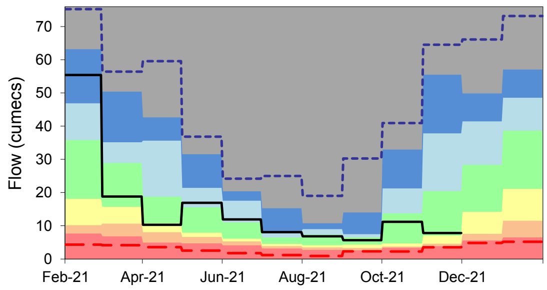
Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for October 2021 and November 2021, expressed as a percentage of the respective long term average and classed relative to an analysis of historic October and November monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

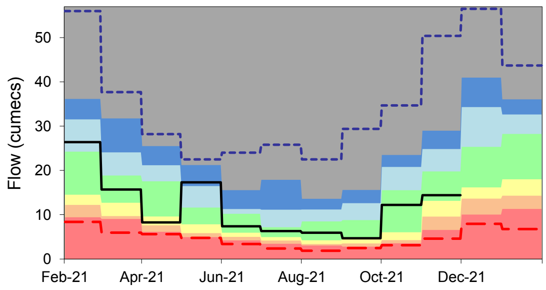
River flow charts

Exceptionally high	Notably high	Above normal	Normal
Below normal	Notably low	Exceptionally low	
Monthly maximum	Latest data	Monthly minimum	

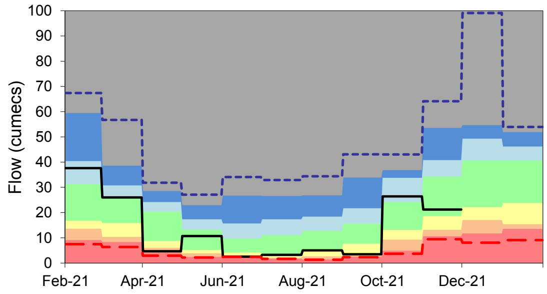
Offord, BEDFORD OUSE
Ranking derived from data for the period Jan-1972 to Dec-2017



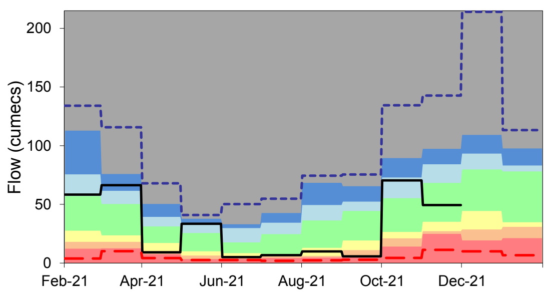
Marston-on-Dove, DOVE
Ranking derived from data for the period Jul-1965 to Dec-2017



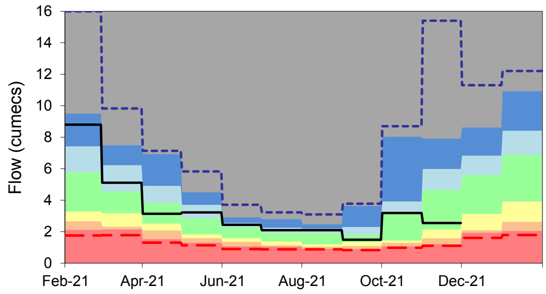
Haydon Bridge, SOUTH TYNE
Ranking derived from data for the period Oct-1974 to Dec-2017



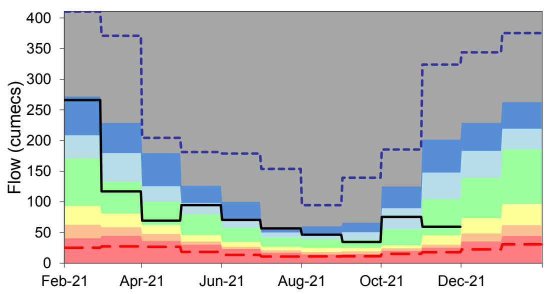
Caton, LUNE
Ranking derived from data for the period Jan-1959 to Dec-2017



Horton, GREAT STOUR
Ranking derived from data for the period Oct-1964 to Dec-2017



Kingston, THAMES
Ranking derived from data for the period Jan-1883 to Dec-2017



Thorverton, EXE
Ranking derived from data for the period Apr-1956 to Dec-2017

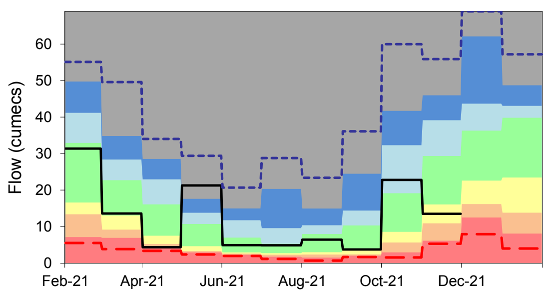
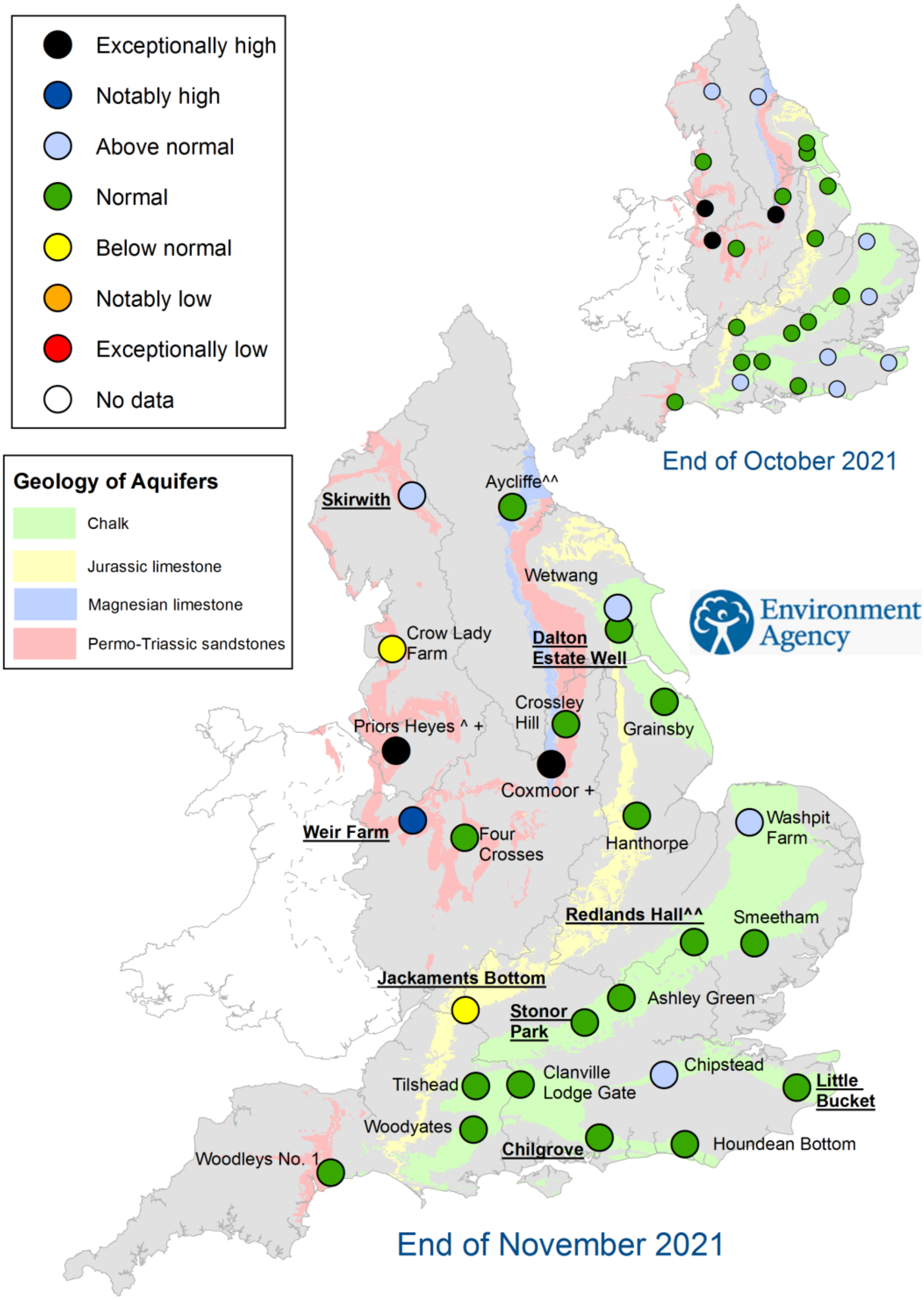


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 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 October 2021 and November 2021, classed relative to an analysis of respective historic October and November levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC.

Groundwater level charts

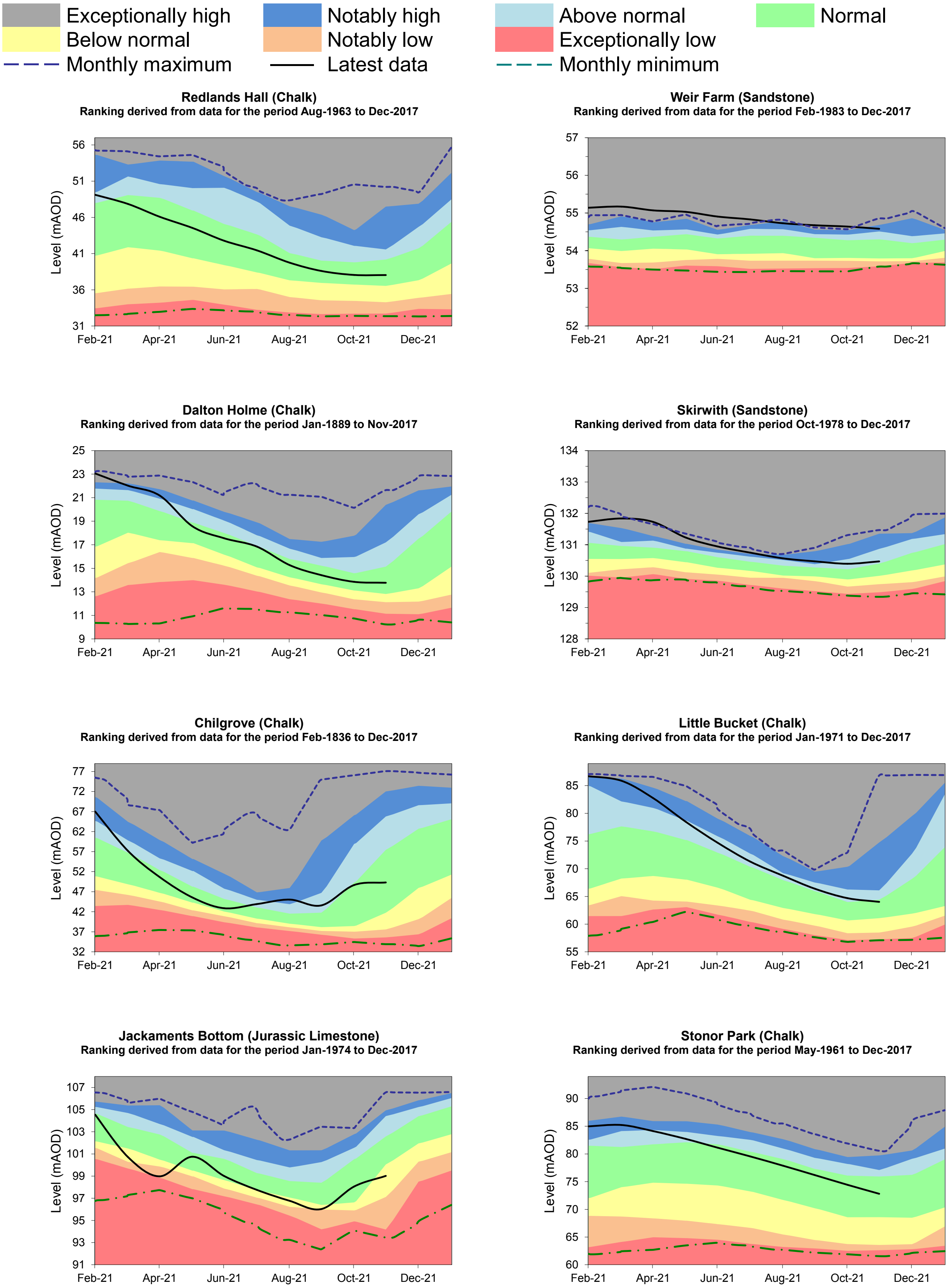
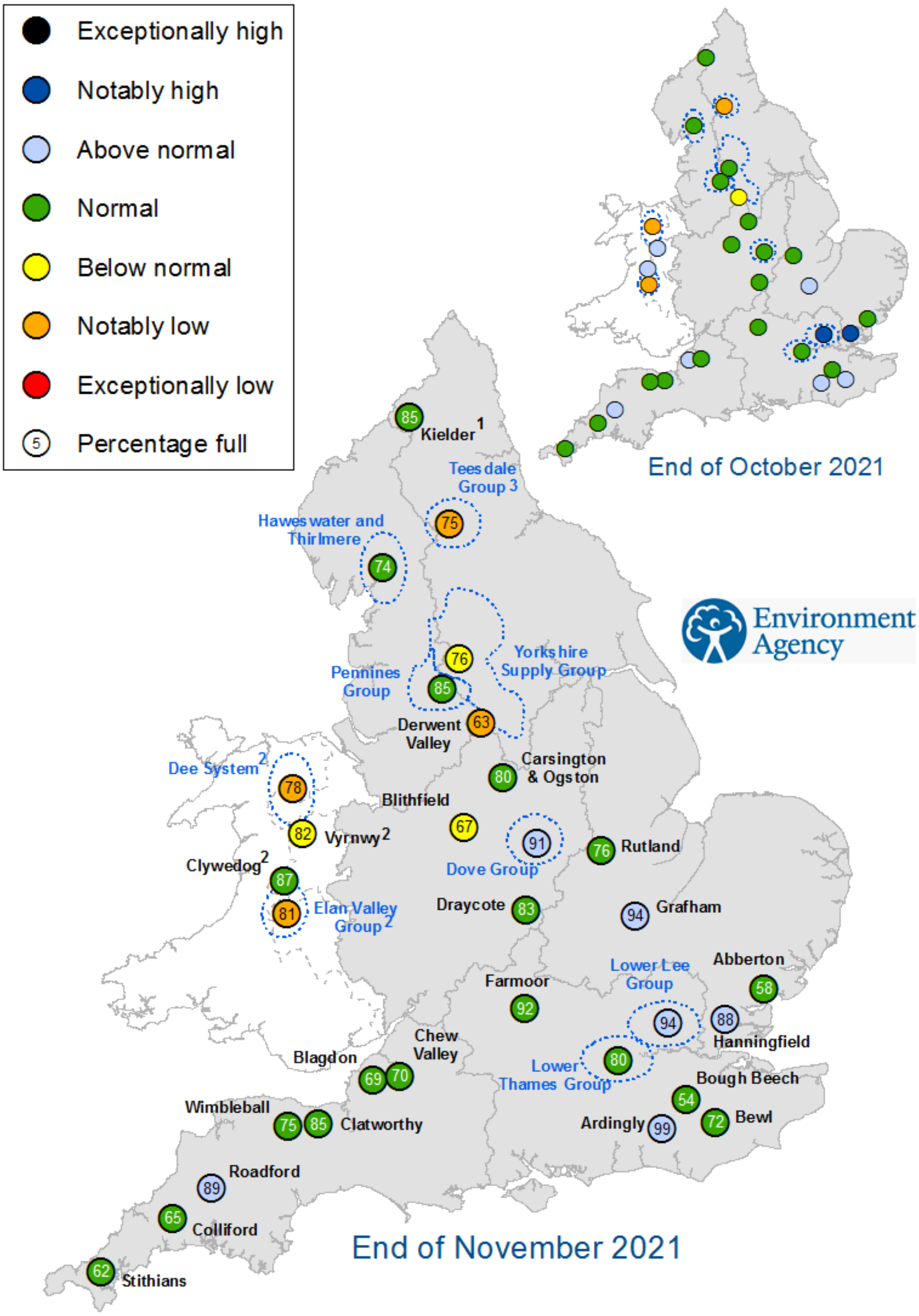


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

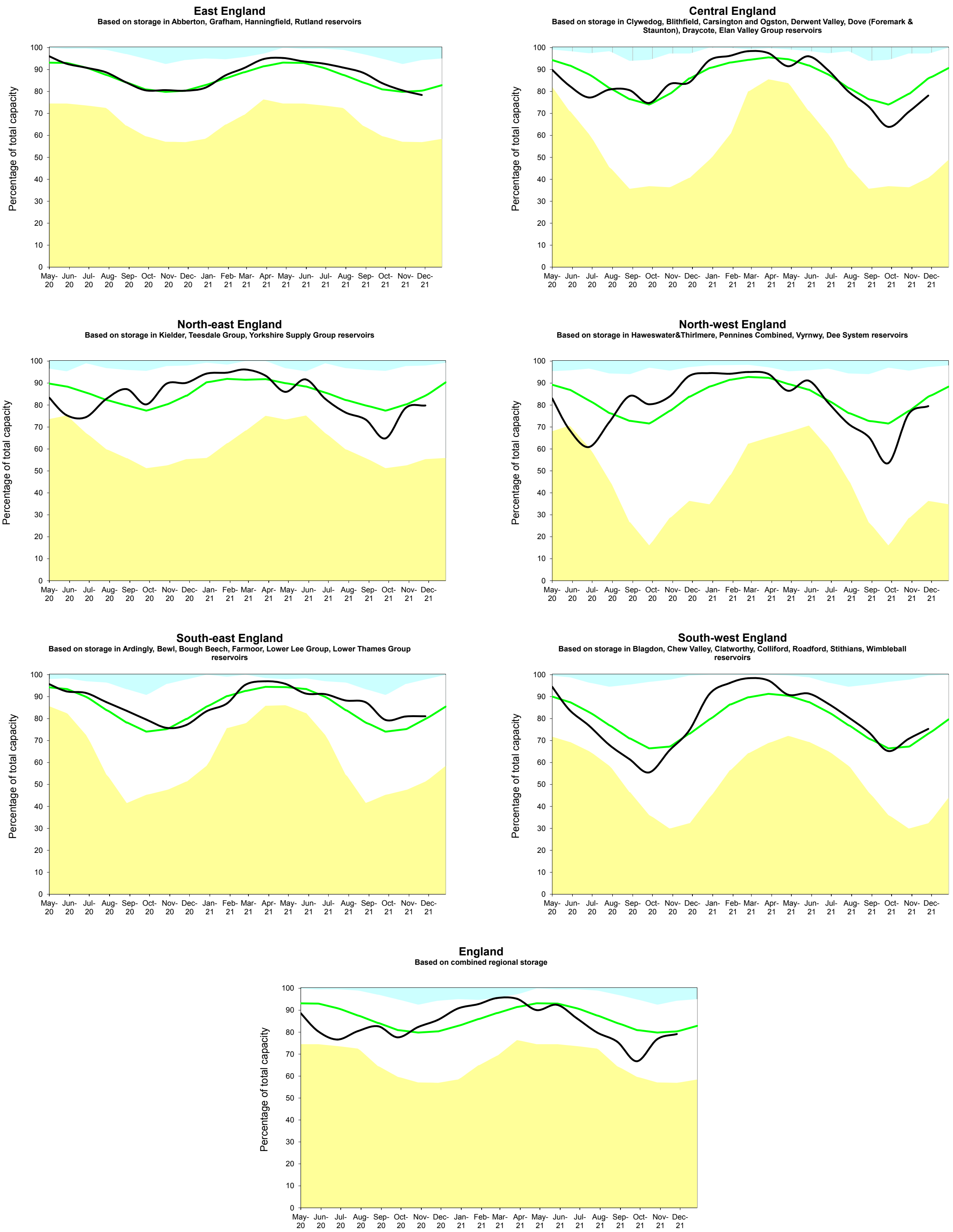
Reservoir storage



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
3. Current levels in the Teesdale Group have been drawn down for maintenance and safety inspections

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of October 2021 and November 2021 as a percentage of total capacity and classed relative to an analysis of historic October and November 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



	Below minimum monthly level		Above maximum monthly level		Average		Latest data

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

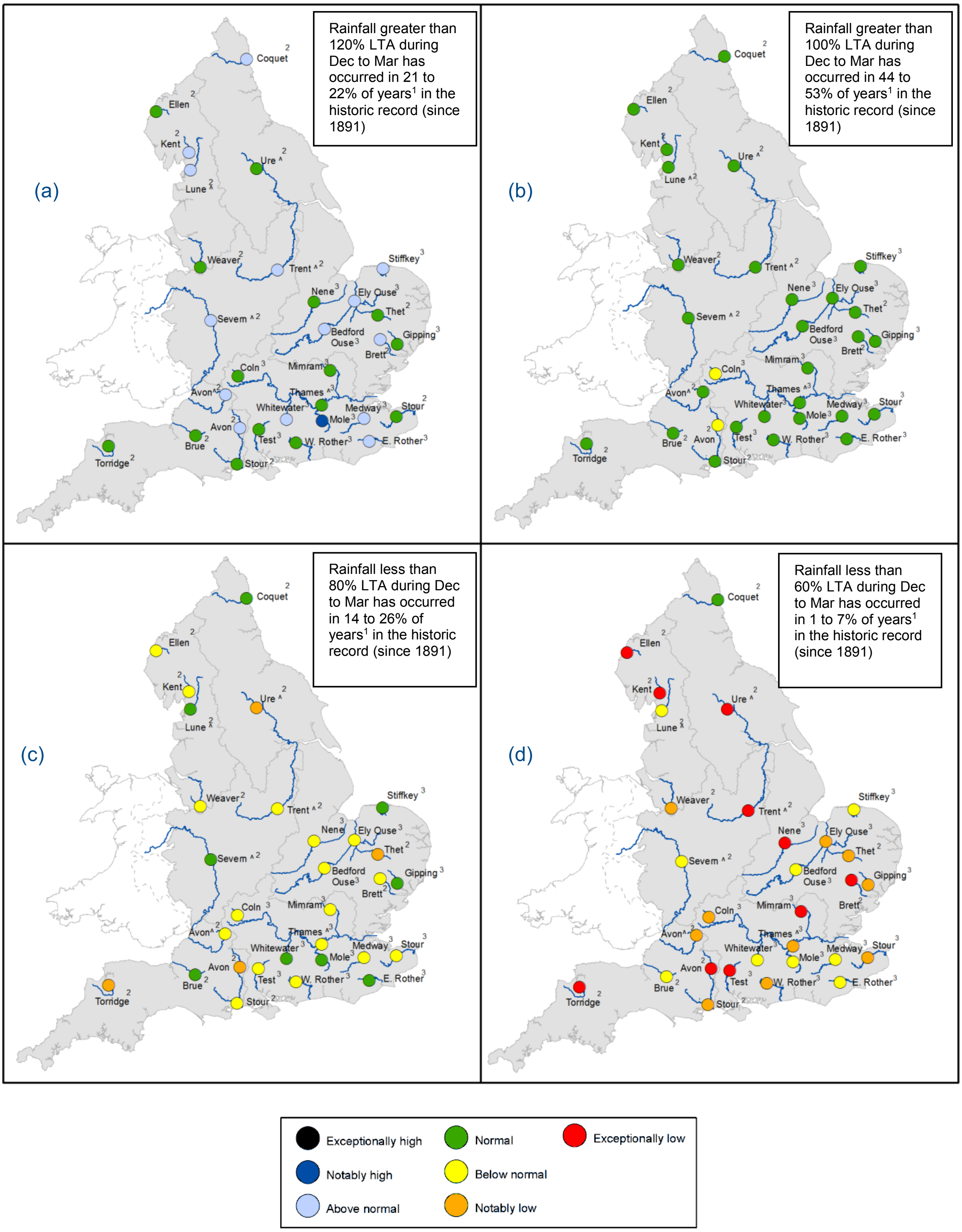


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2021 and March 2022 (Source: UK Centre for Ecology and Hydrology, Environment Agency)

[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*

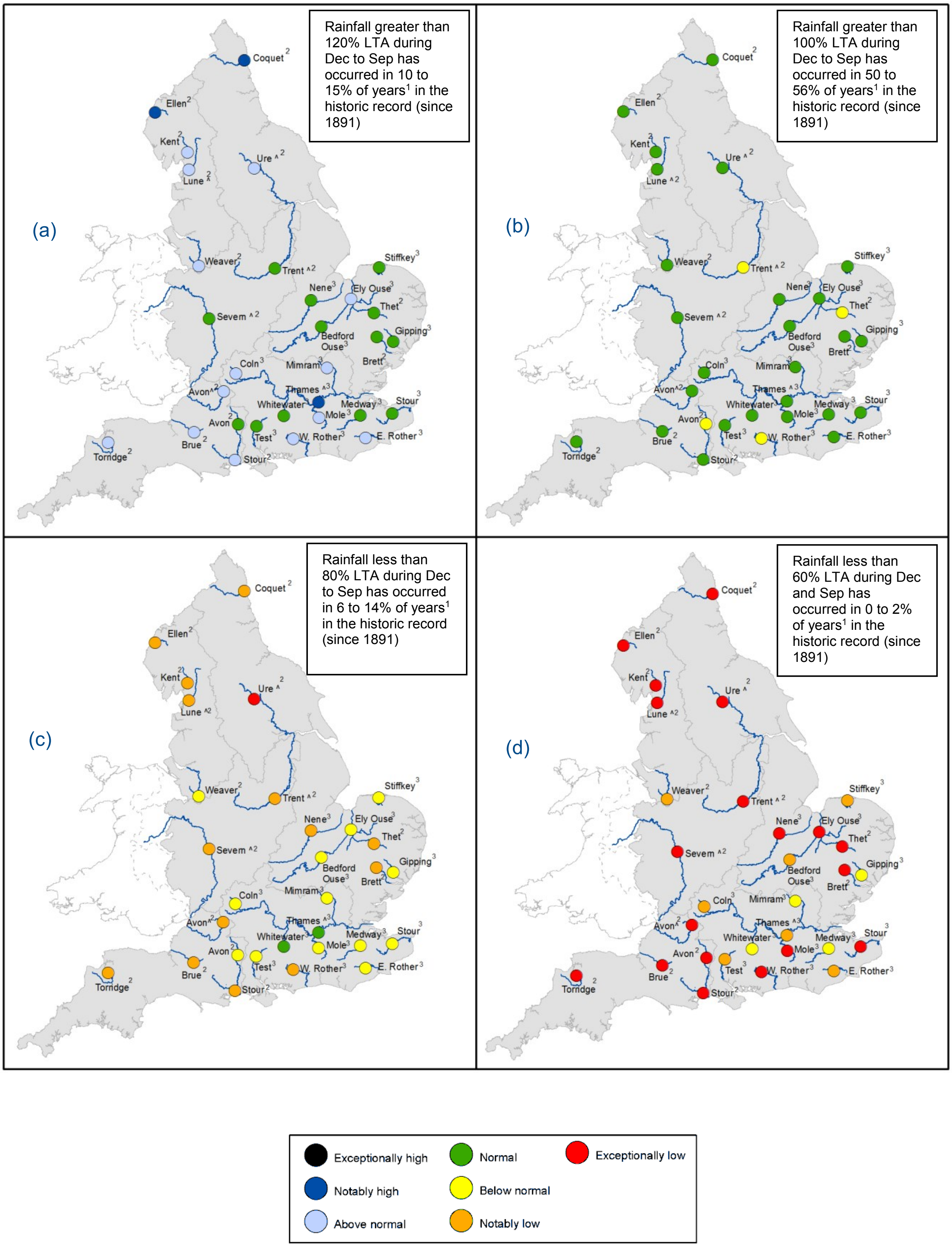


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2021 and September 2022 (Source: UK Centre for Ecology and Hydrology, Environment Agency)

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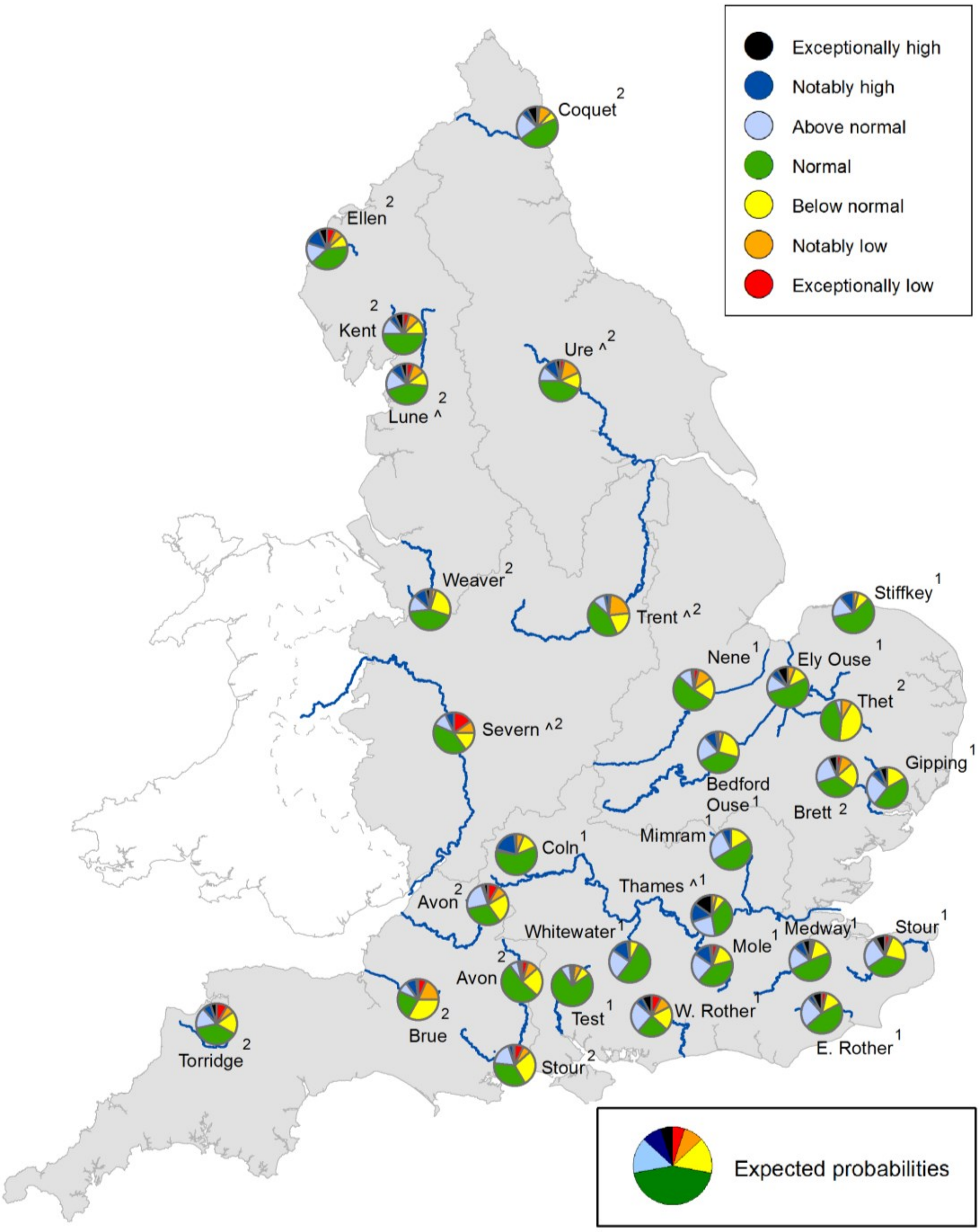

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2022. 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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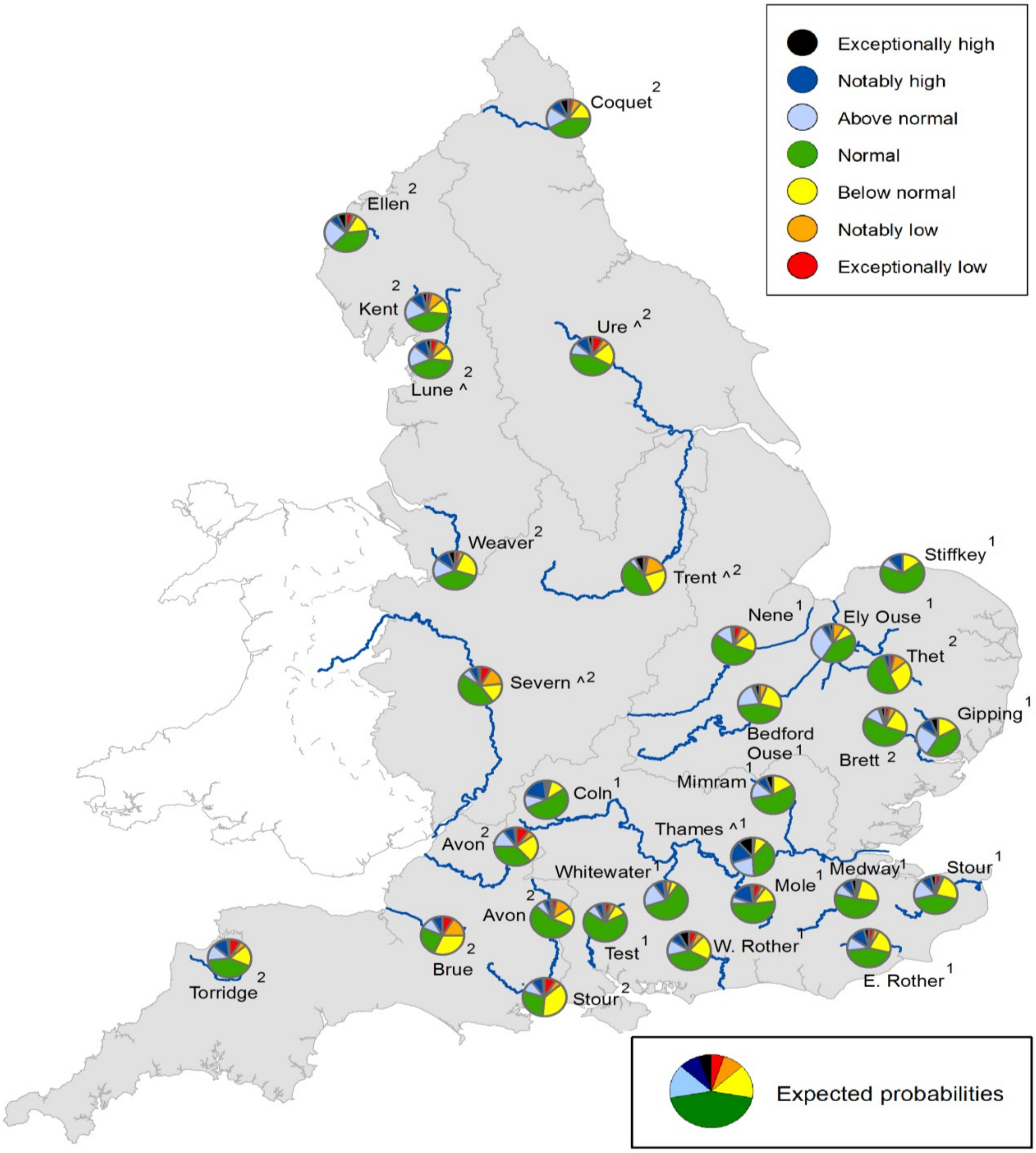
^"Naturalised" flows are projected for these sites



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 September 2022. 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
[2] Projections for these sites are produced by UK CEH
^"Naturalised" flows are projected for these sites

Forward look: groundwater

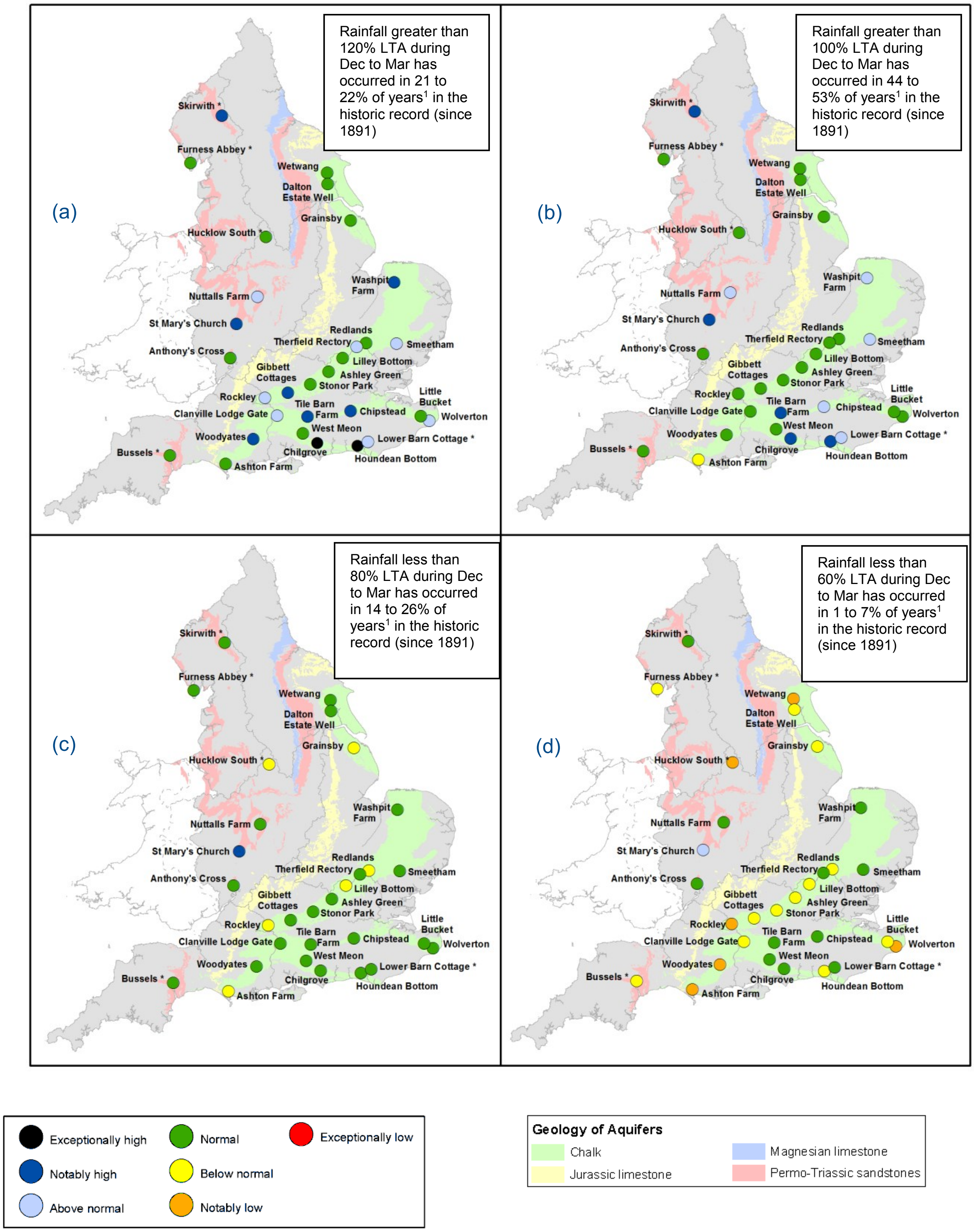


Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2021.

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

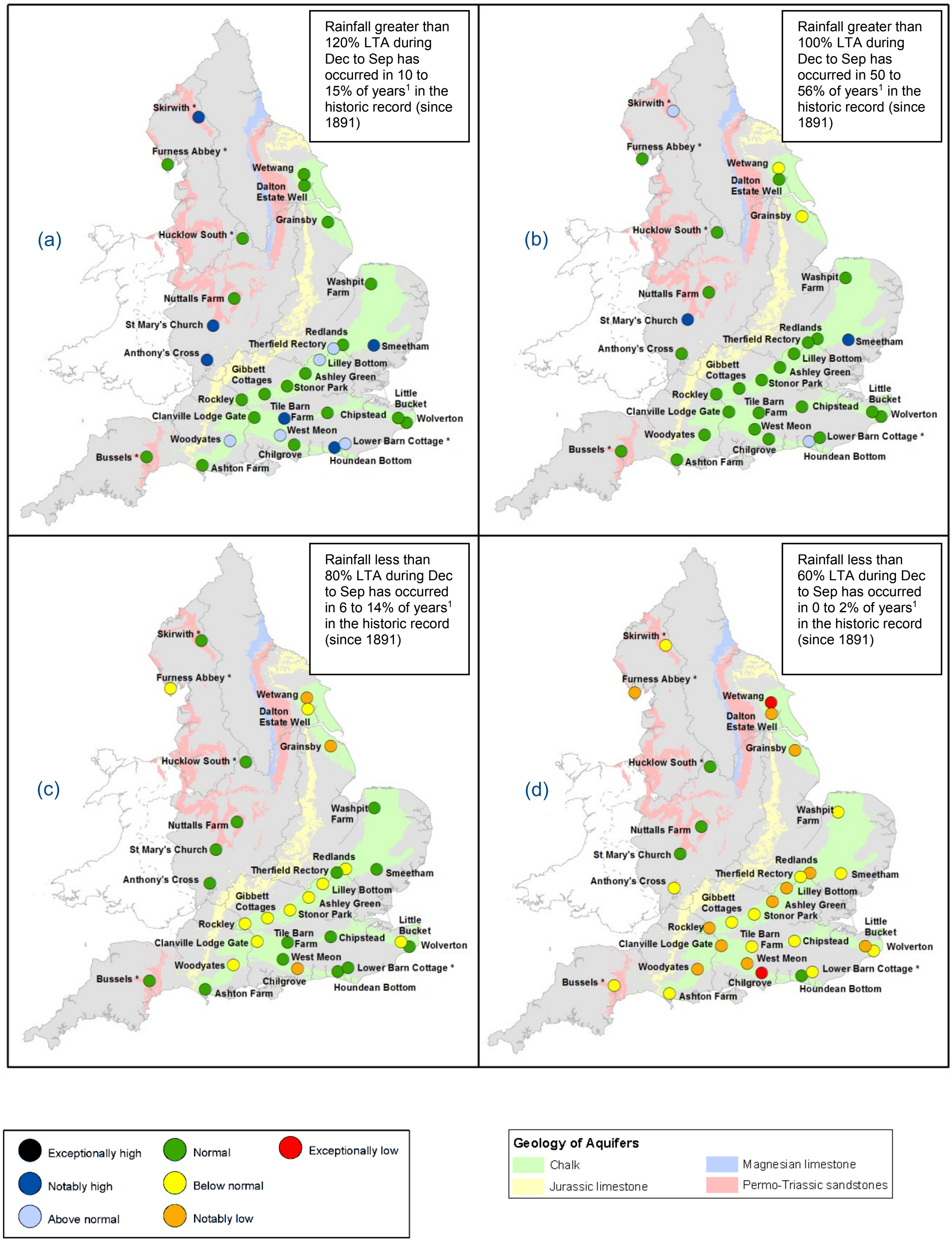
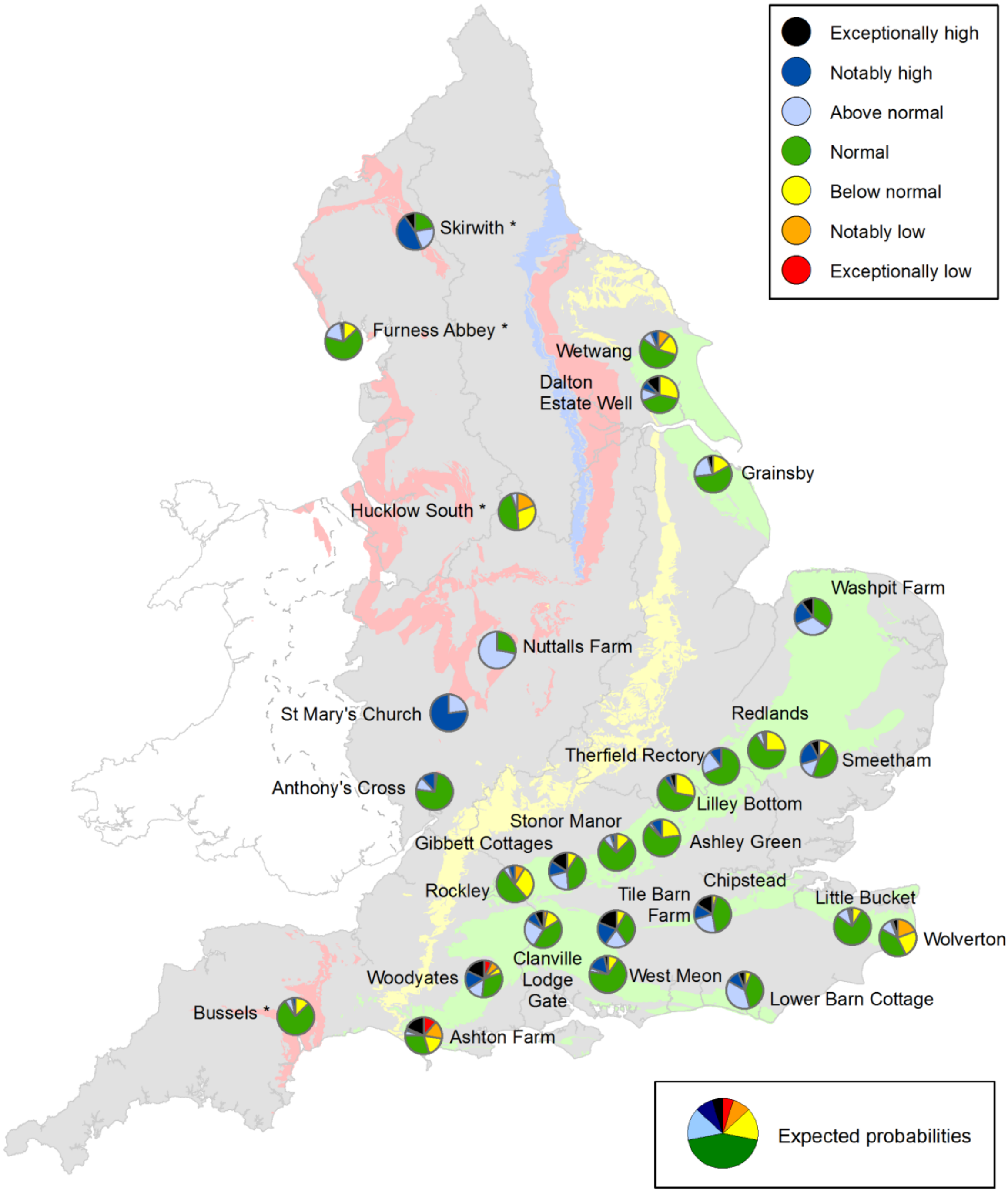


Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2021 and September 2022 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2021.

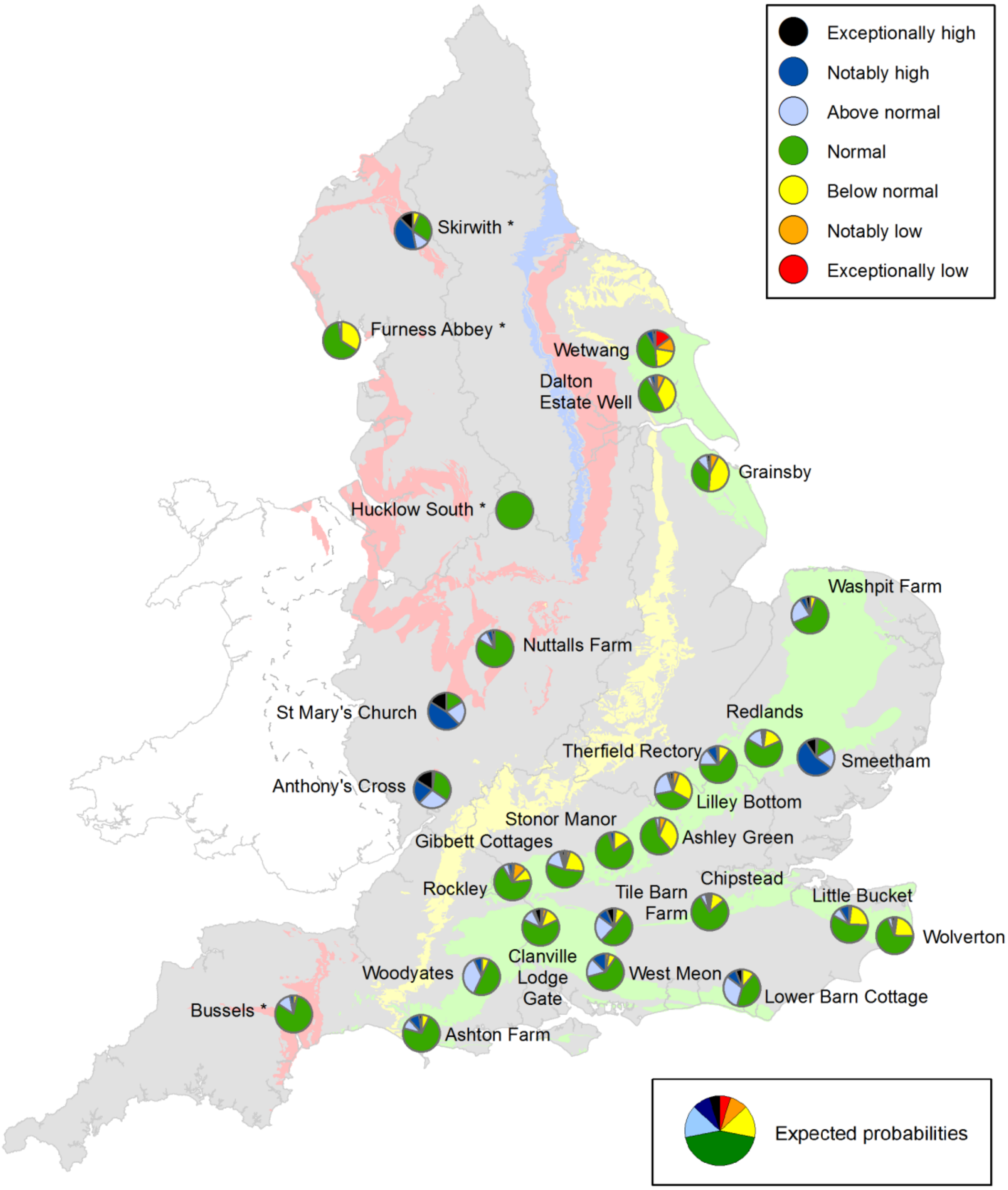
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 2022. 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*



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 2022. 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