Hydrological Summary
for the United Kingdom

General
The seasonally unusual southerly track of the jet stream persisted through the first three weeks of July, bringing more of the unsettled weather which has characterised the late spring and early summer of 2012. Throughout this period, intense downpours led to widespread damaging and disruptive flood episodes (associated with both surface water and fluvial flooding) across large parts of England, southern Scotland and Northern Ireland. In contrast, the absence of frontal systems in the far north led to a continuation of the exceptional dry spell in northwest Scotland. A northward shift in the jet stream from the 20th heralded a change in synoptic patterns: high pressure and warm, dry conditions brought respite to southern and central England, whilst northwest Scotland received welcome rainfall, although contingencies are still in place to manage the water resources stress which persists in the Western Isles. Elsewhere, water resources are healthy – England & Wales reservoir stocks declined slightly following the dry conditions late in the month, but were over 15% above average entering August. Groundwater resources have also continued to recover (leading to the lifting of remaining hosepipe bans in southern England) following the unusual summer recharge, although levels remain low in slowly-responding parts of the Chalk and the Permo-Triassic sandstone. The transformation in water resource status since early April is without any close modern parallel and, with record July levels across the major aquifer areas, an elevated risk of groundwater flooding may be a possibility in vulnerable areas later in the autumn/winter.

July 2012

Rainfall
July started wet as a result of the continuing predominance of low pressure, with a series of fronts and troughs bringing exceptionally wet conditions to much of the UK (northwest Scotland aside) through the first half of the month. Intense rainfalls, often associated with convective activity, were common: in Ayrshire, a storm on the 5th yielded 90mm rainfall in just over 3 hours (including 20.6mm which fell in 15 minutes), causing flash flooding in the Cessnock Water catchment; 23.8 mm was registered in an hour on the 9th at Gorpley, Calderdale (alongside rainfall radar estimates of > 40mm elsewhere in the area) causing significant surface water flooding. Notable falls were also registered over longer durations, particularly from the 6th to the 9th when a slow-moving depression brought heavy rain and flooding to a large area from eastern Scotland through to the southwest of England (e.g. 60.2mm in 12h in Langsett, South Yorkshire, on the 6th; 124mm in 24h in Wilmington, east Devon, on the 6th/7th). Further pulses of rainfall continued through to the 20th, when settled conditions became established in much of England and Wales, whilst the rest of the month remained unsettled in northern and western districts. Despite the dry period, July rainfall totals were exceptional: England and eastern Scotland received around twice the July average rainfall. In contrast, Orkney and parts of the far north of Scotland received < 60%. The accumulated rainfall from April is remarkable – the highest on record (from 1910) by a considerable margin in almost all regions of Great Britain, and provisionally the highest in the England & Wales rainfall series from 1766.

River flows
Following the exceptional June rainfall, soils across much of the UK were close to saturation and many rivers were already at notably high flows at the start of July. Further heavy rainfall early in July therefore triggered rapid flow responses: between the 5th and the 9th, flood alerts were widely distributed (with > 50 flood warnings on the 6th/7th) and flash flooding and floodplain inundations occurred across a large swathe of the UK. As in June, some of the most severe flooding occurred in southern Scotland and northern England (with some localities reporting multiple flood episodes through late June and early July, e.g. Calderdale in West Yorkshire), as well as parts of southern England (e.g. east Devon and Dorset). Flood alerts and localised flooding continued to be a feature of the first half of July (e.g. across southern Britain and the Midlands on the 12th- 14th), before recessions became re-established in the final 10 days across much of the UK. New July maximum peak flows were recorded at 11 index rivers, whilst the Dorset Stour registered its second highest flow, for any month, in a record from 1973. Monthly runoff totals were exceptional and more typical of winter than mid-summer, with new maxima widespread and rivers as far apart as the Tweed, the Exe and the Colne all registering over five times the July average. In contrast, the July runoff from the Ewe (northwest Scotland) was the lowest in a 42-year record. Total July outflows from Scotland were the highest on record (from 1961), and only 2007 has seen greater runoff in the England & Wales series of the same length; however, the runoff for the April – July period was considerably higher than in 2007. The recovery from the depressed runoff of early 2012 has led to a reversal of typical seasonal runoff patterns: the April - July runoff for the Thames was nearly three times the figure for the preceding four months, a ratio which has no close precedent in a record from 1883.

Groundwater
At the start of July, soil moisture deficits (SMDs) were the lowest on record (from 1961) across the Chalk, and amongst the lowest on record in other aquifer areas. The combination of unseasonally wet soils and high rainfall resulted in substantial amounts of recharge. Groundwater levels in the Chalk reached the highest on record for July in Yorkshire, much of the South Downs, south Wiltshire and Dorset, with some groundwater flooding occurring early in the month in the west Dorset area. By the end of the month SMDs had increased (but were still notably low, with only 2007 having lower end of July SMDs) and levels started to fall at some sites in the Chalk. In the slower responding Permo-Triassic sandstones, levels are above average in the northwest and southwest, but average or below in north Wales and the Midlands, where Heathlanes recorded the lowest ever July level at the start of the month (although now rising) and Weeford Flats is dry. Levels in the Magnesian Limestone have risen and are now above average. In the responsive Carboniferous Limestone aquifer, exceptionally high levels were reached (record July values at Greenfield Garage and Alstonfield); this was also the case in the Jurassic limestones. The groundwater resources outlook is now healthy, with below average levels confined to some slower responding boreholes, and further recoveries likely as early summer rainfall in the unsaturated zone reaches the water table. Depending on rainfall over the coming months, groundwater flooding could become an issue later in the year, when the typical season for recharge occurs.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

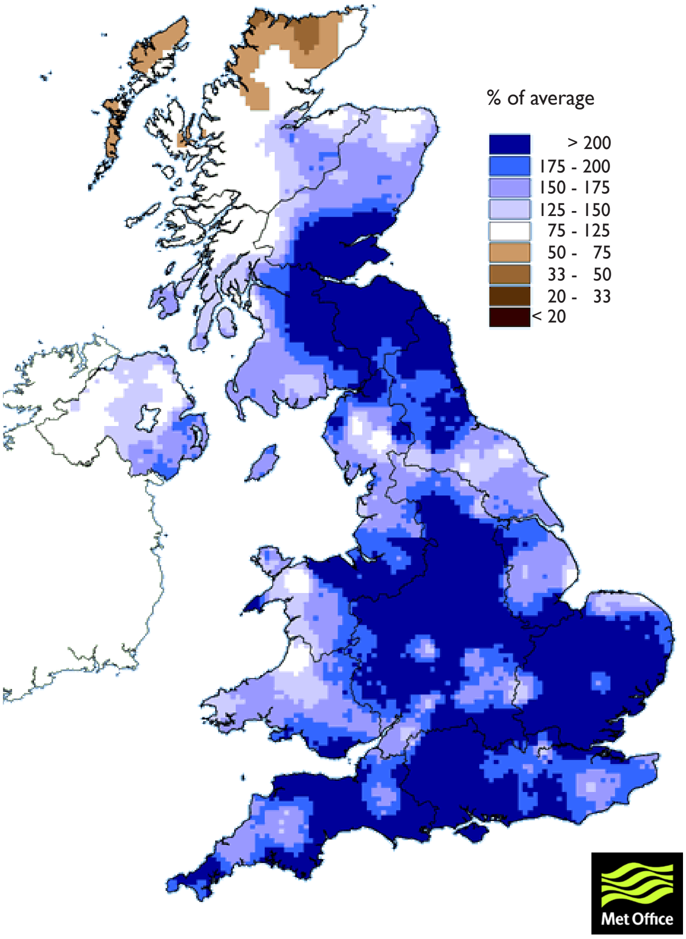
Area	Rainfall	July 2012	Apr12 - Jul12	RP	Feb12 - Jul12	RP	Aug11 - Jul12	RP	Feb11 - Jul12	RP
United	mm	**116**	455		547		1262		1726	
Kingdom	%	**175**	171	>>100	124	15-25	116	15-25	113	10-20
England	mm	**109**	438		492		903		1189	
	%	**210**	196	>>100	141	>100	110	2-5	102	2-5
Scotland	mm	**128**	462		623		1808		2551	
	%	**148**	145	40-60	110	2-5	126	80-120	127	>100
Wales	mm	**128**	571		660		1431		1921	
	%	**173**	182	>100	123	5-10	104	2-5	101	2-5
Northern	mm	**95**	389		473		1286		1794	
Ireland	%	**127**	137	8-12	102	2-5	116	15-25	114	25-40
England &	mm	**112**	457		515		975		1290	
Wales	%	**203**	193	>>100	138	50-80	109	2-5	102	2-5
North West	mm	**144**	518		609		1436		1977	
	%	**184**	179	>>100	128	10-20	122	10-20	120	15-25
Northumbria	mm	**124**	504		550		1007		1395	
	%	**216**	214	>>100	152	>100	121	8-12	117	5-10
Midlands	mm	**110**	426		473		794		1037	
	%	**223**	194	>100	142	30-50	105	2-5	95	2-5
Yorkshire	mm	**101**	455		505		938		1240	
	%	**190**	199	>>100	143	30-45	115	2-5	106	2-5
Anglian	mm	**95**	363		407		642		834	
	%	**212**	190	>>100	149	>100	106	2-5	95	2-5
Thames	mm	**94**	406		452		749		969	
	%	**218**	199	>>100	148	>100	107	2-5	96	2-5
Southern	mm	**98**	407		454		802		1036	
	%	**219**	202	>>100	144	35-50	103	2-5	95	2-5
Wessex	mm	**110**	459		511		927		1198	
	%	**235**	210	>>100	144	80-120	107	2-5	98	2-5
South West	mm	**128**	533		604		1259		1608	
	%	**208**	194	>>100	127	10-15	104	2-5	96	2-5
Welsh	mm	**125**	562		647		1381		1846	
	%	**175**	184	>100	125	5-10	104	2-5	100	2-5
Highland	mm	**92**	392		629		2091		2933	
	%	**97**	110	2-5	95	2-5	122	30-50	123	35-50
North East	mm	**109**	457		509		1153		1649	
	%	**164**	177	>100	127	5-10	121	8-12	122	10-20
Tay	mm	**146**	518		603		1586		2325	
	%	**198**	183	>100	118	5-10	125	20-30	131	>>100
Forth	mm	**182**	556		641		1514		2172	
	%	**256**	207	>>100	139	35-50	134	80-120	136	>>100
Tweed	mm	**174**	572		632		1321		1854	
	%	**270**	224	>>100	156	>100	138	>100	136	>100
Solway	mm	**159**	550		698		1845		2612	
	%	**183**	171	>100	125	10-20	131	>100	133	>>100
Clyde	mm	**166**	519		727		2304		3200	
	%	**155**	142	15-25	109	2-5	133	>100	133	>100

% = percentage of 1971-2000 average *RP = Return period*

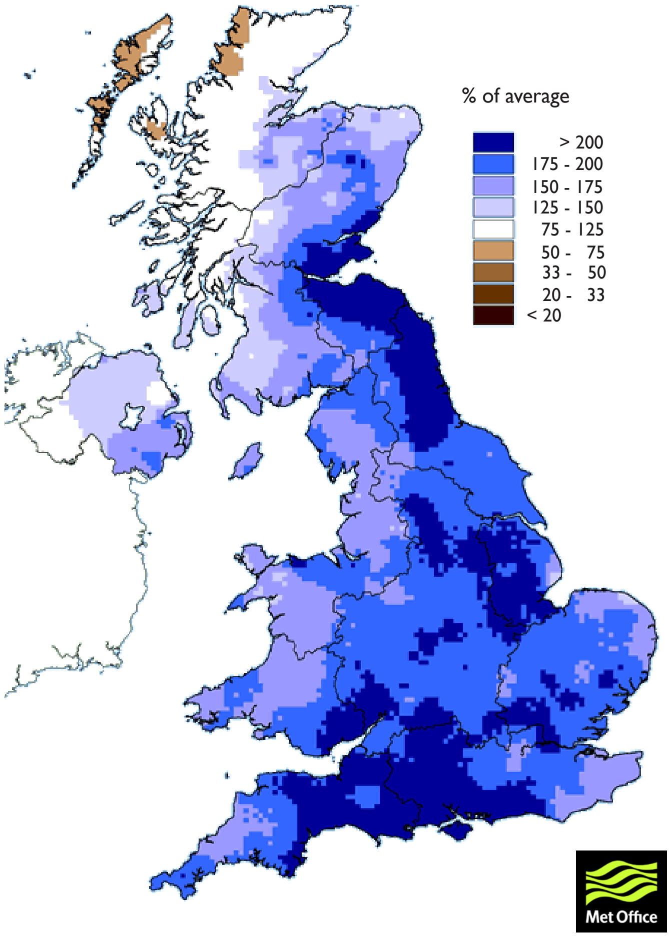
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. All monthly rainfall totals since December 2011 are provisional.

Rainfall . . . Rainfall . . .

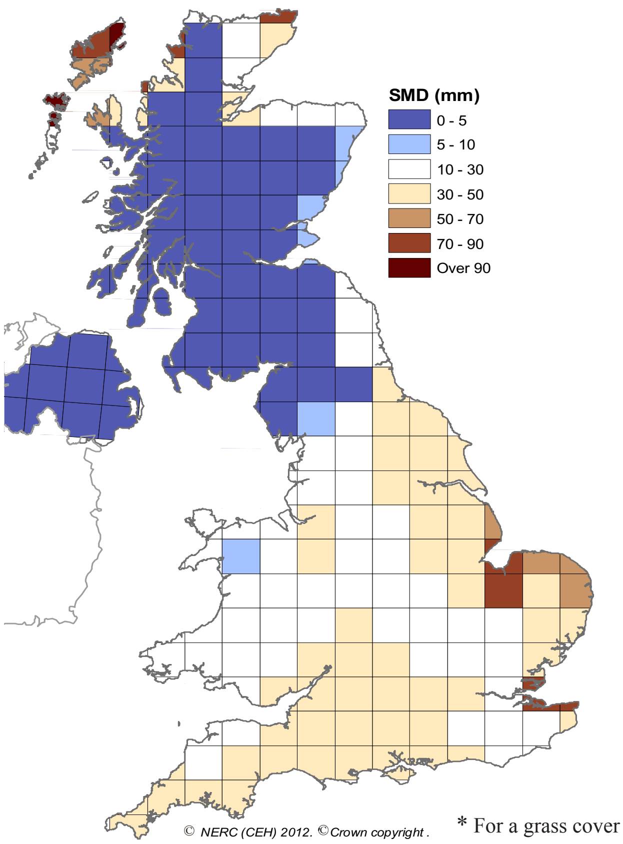
July 2012 rainfall as % of 1971-2000 average



April 2012 - July 2012 rainfall as % of 1971-2000 average



MORECS Soil Moisture Deficits*
July 2012



* For a grass cover

Met Office
3-month outlook
Updated: August 2012

For the UK averaged rainfall, the predicted probabilities slightly favour above-normal values during August, although the spread of probabilities is large. Given the wet soils across the UK, additional August rainfall has the potential to cause greater impacts than would normally be expected.

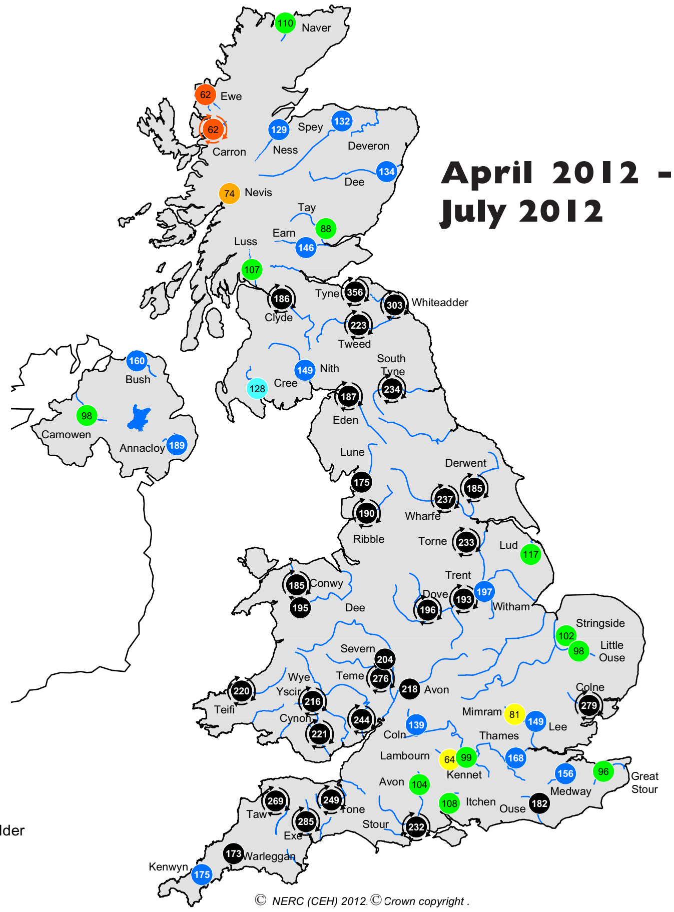
For the August – October period, predictability is low due to a lack of indications of any dominant circulation type, and the forecast does not differ substantially from climatology.

The probability that UK rainfall for August – September – October will fall into the driest quintile category is around 20%, whilst the probability that it will fall into the wettest quintile category is 20% (the 1971 – 2000 climatological probability for each of these categories is 20%).

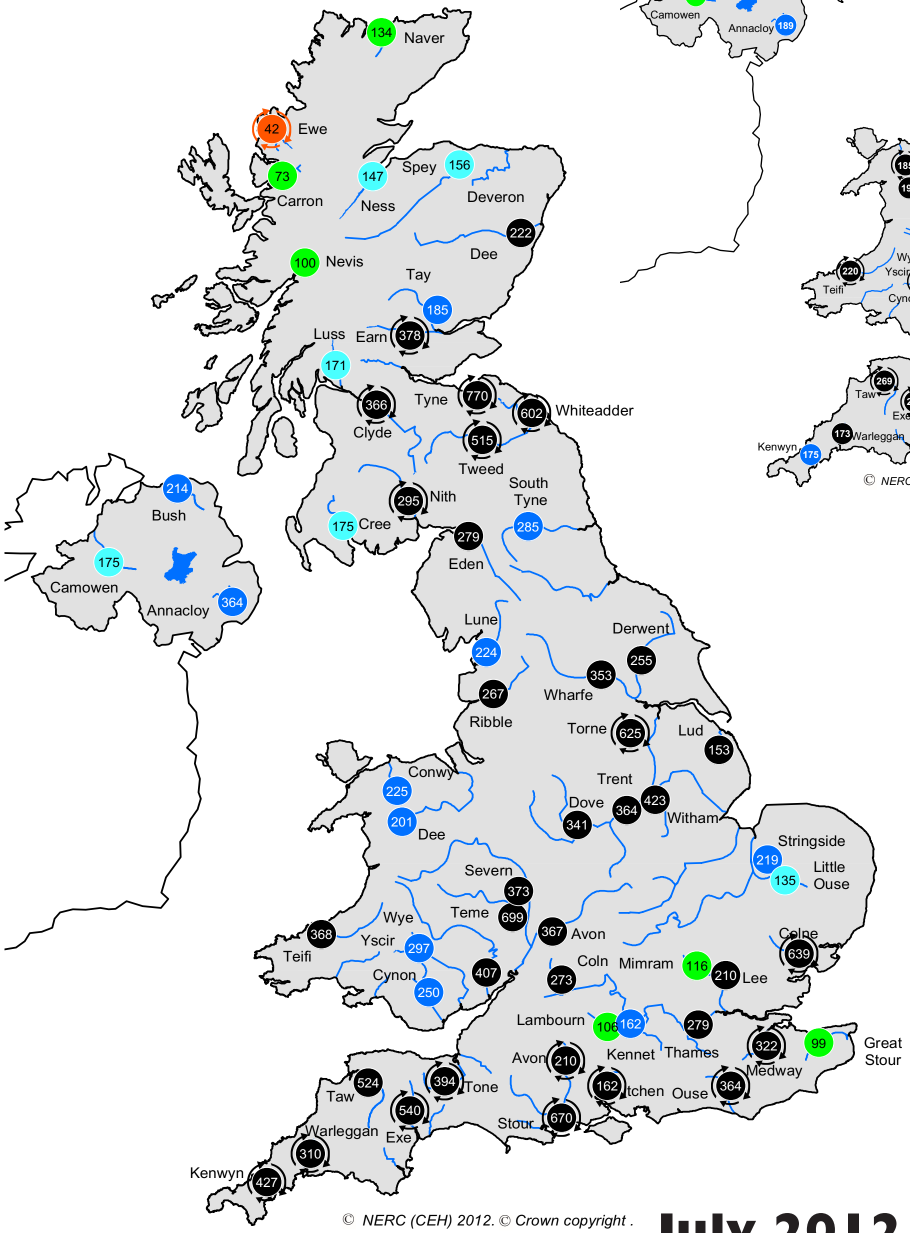
The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

River flow . . . River flow . . .



April 2012 - July 2012



July 2012

Key

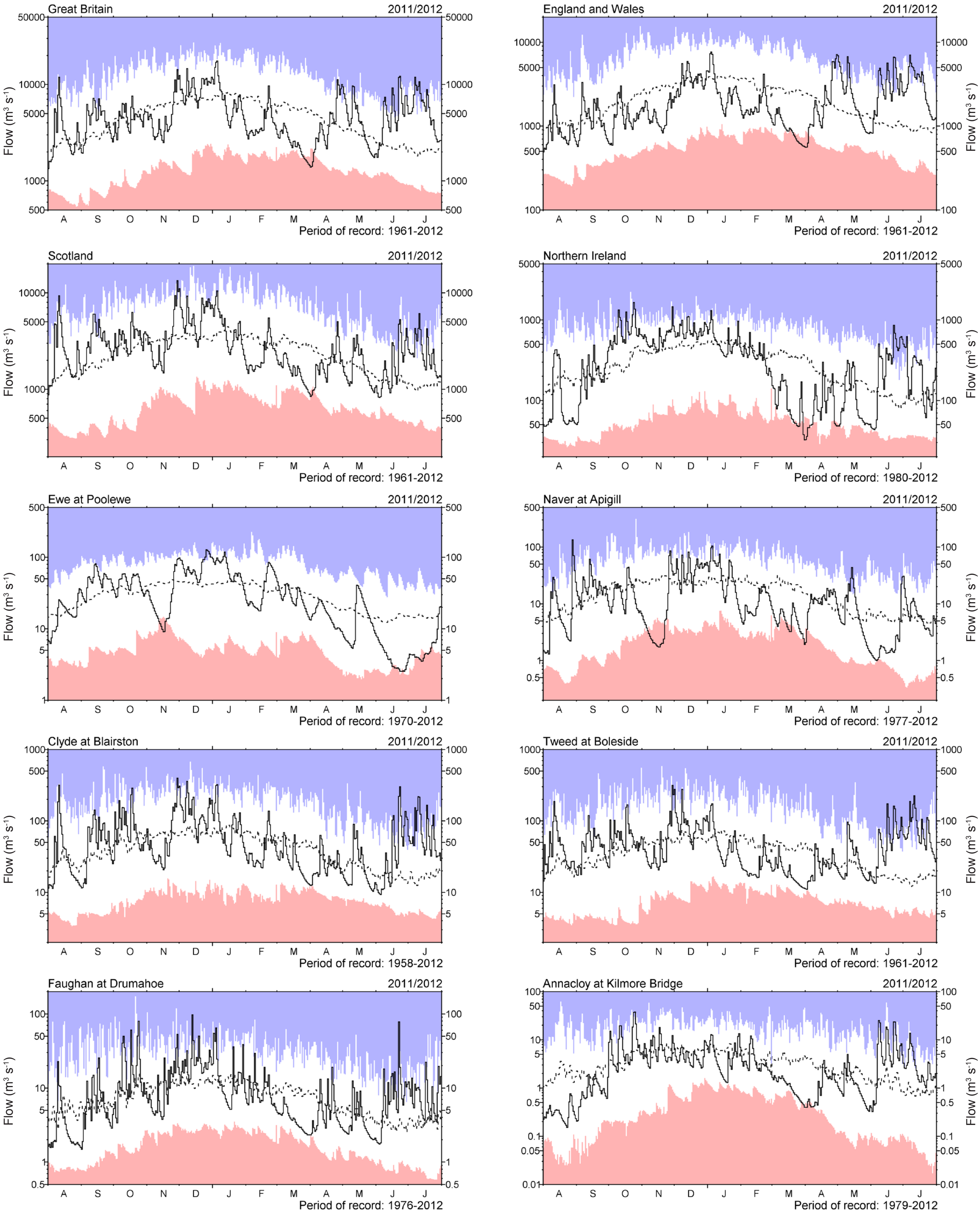
- 25 — % of long-term average (record figure when circled)
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

*Based on ranking of the monthly flow**

River flows

*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

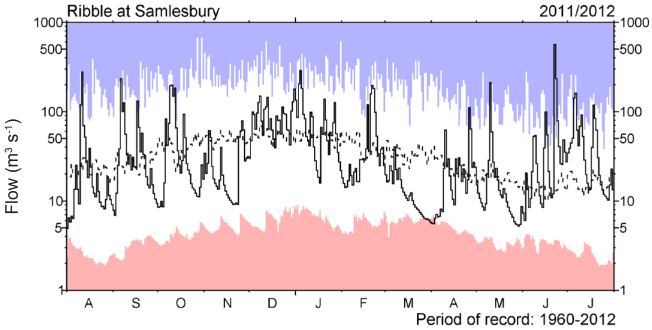
River flow . . . River flow . . .

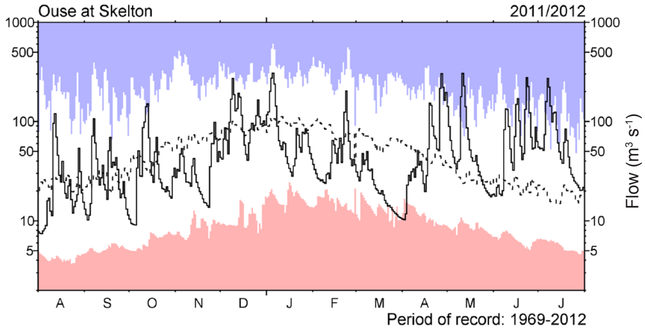


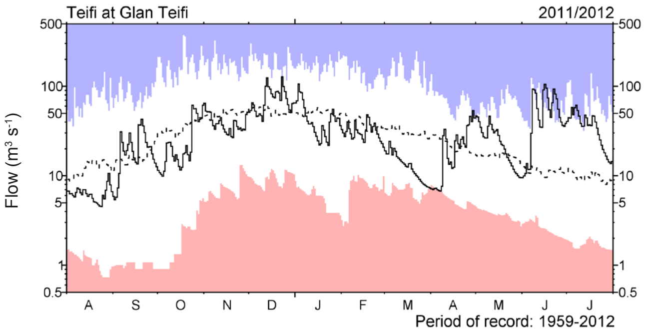
River flow hydrographs

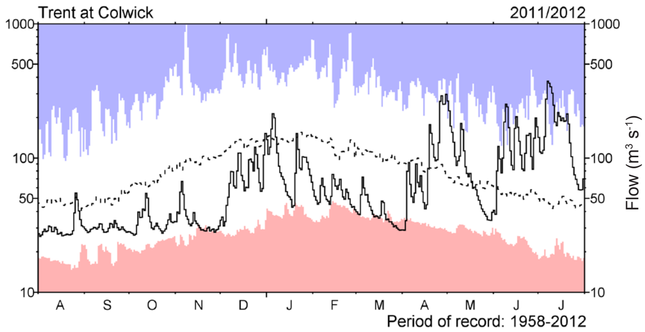
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2011 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

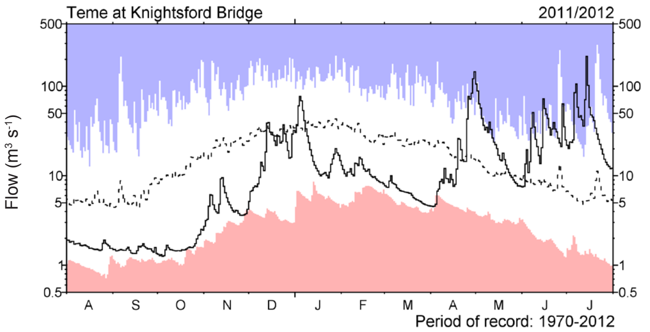
River flow . . . River flow . . .

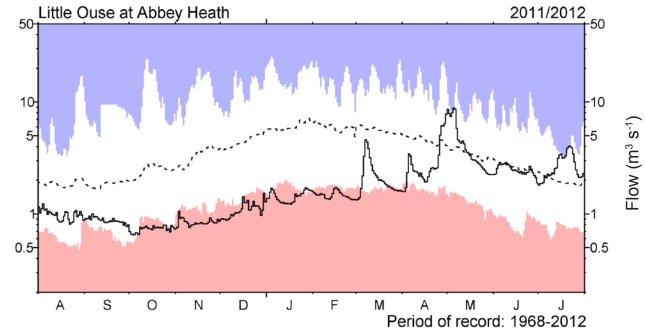


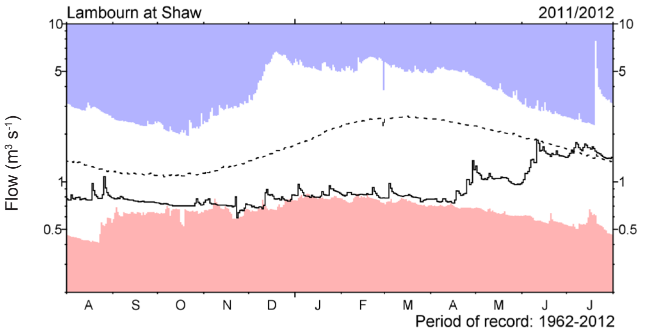


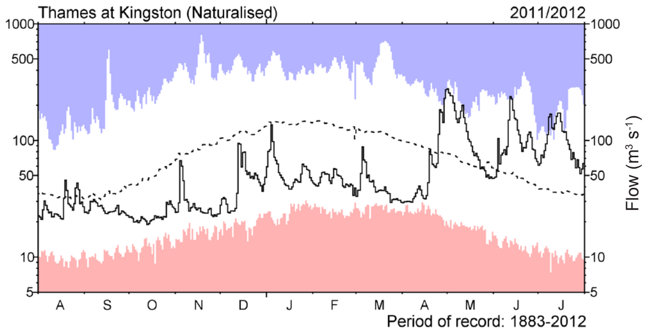


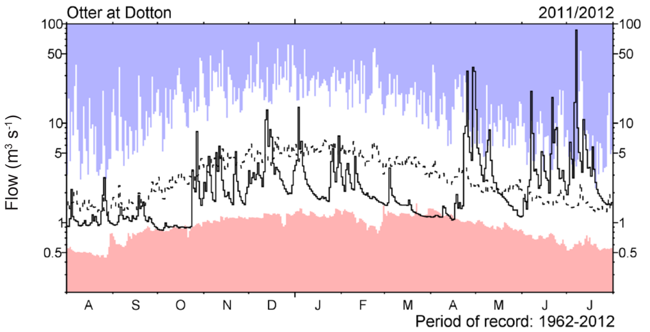


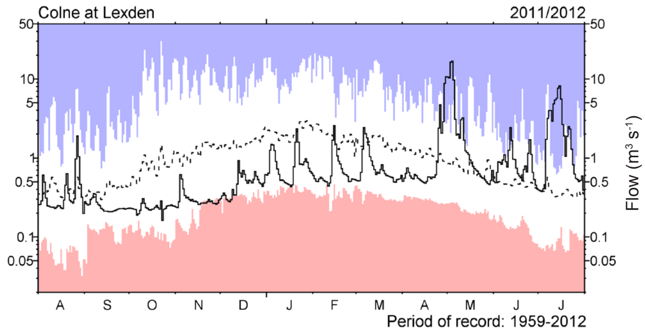












Notable runoff accumulations (a) April 2012 - July 2012, (b) August 2011 - July 2012, (c) February 2011 - July 2012

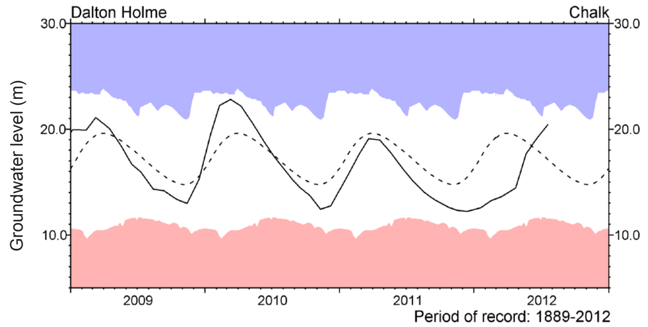
	River	%lta	Rank
a)	Deveron	181	53/53
b)	Wallington	289	59/59
c)	Lymington	339	52/52
d)	Otter	231	50/50
e)	Dart	216	54/54
f)	Brue	258	48/48
g)	Usk (Chain Br)	210	56/56
h)	Tawe	206	54/54

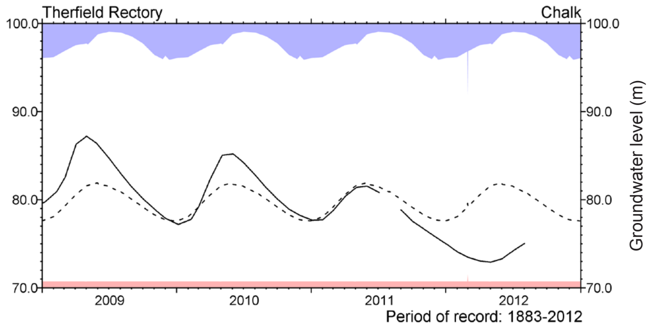
	River	%lta	Rank
a)	Tyne (Scot.)	168	63/64
b)	Tweed	135	52/52
c)	Tyne (Bywell)	130	51/51
d)	Lune	131	48/50
e)	Nith	132	54/54
f)	Clyde (Blairston)	148	50/50
g)	Faughan	135	34/35

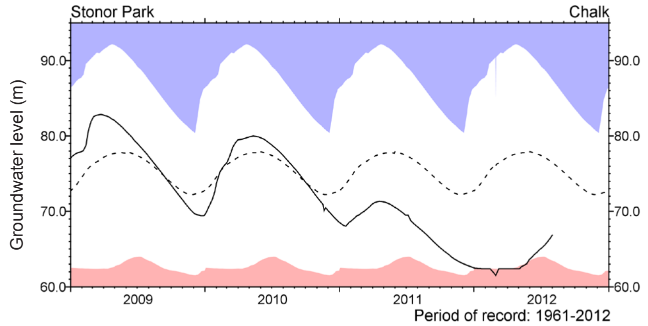
	River	%lta	Rank
a)	Earn	137	64/64
b)	Little Ouse	54	3/40
c)	Kennet	63	3/50
d)	Medway	48	2/47
e)	Avon	59	1/47
f)	Cree	125	48/48
g)	Mourne	126	29/29
h)	Bush	142	37/37

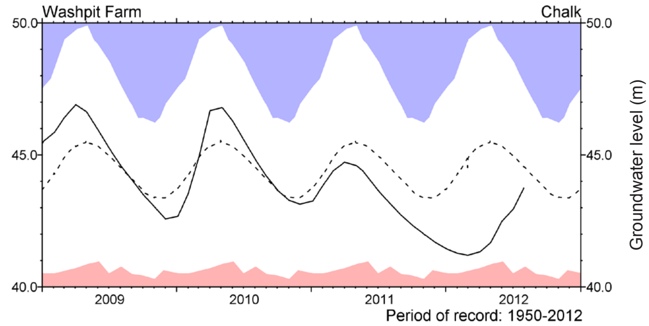
lta = long term average; Rank 1 = lowest on record

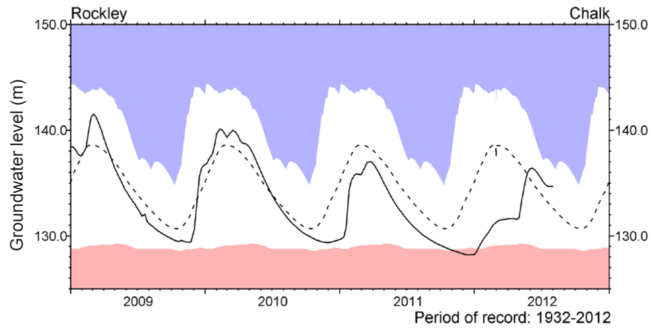
Groundwater . . . Groundwater

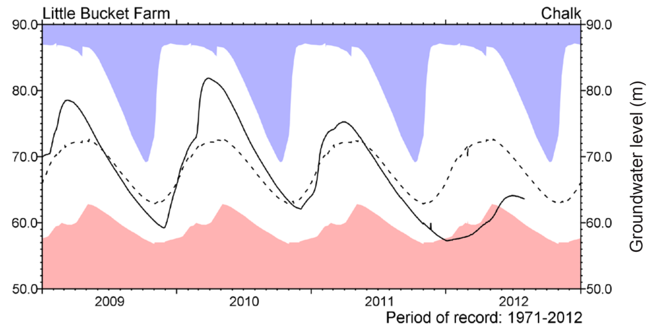


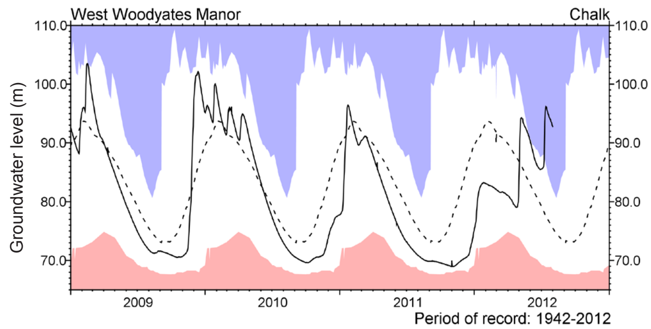


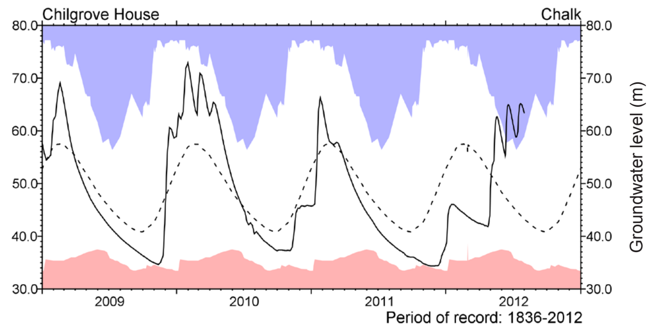


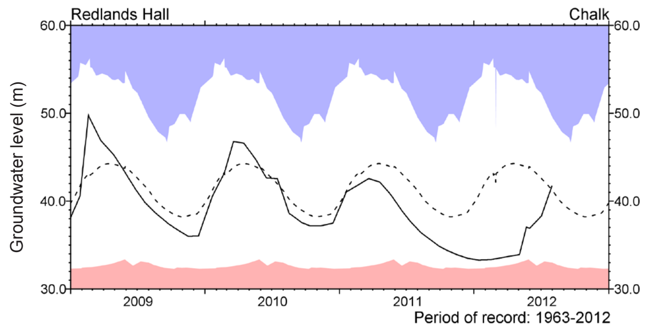


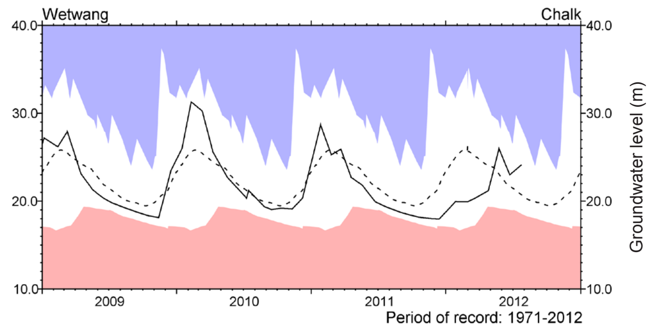






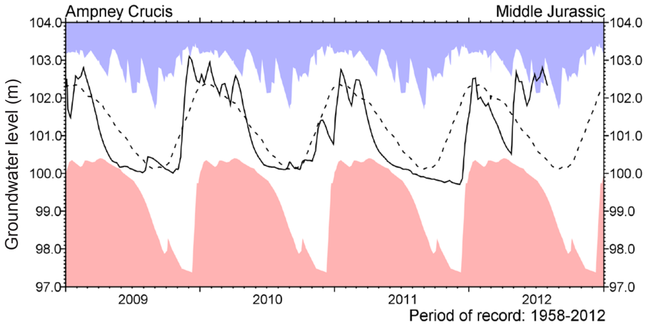


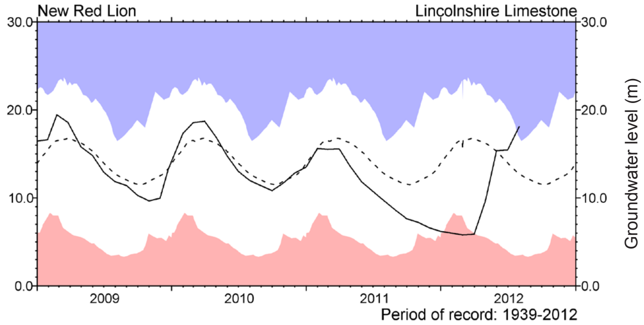


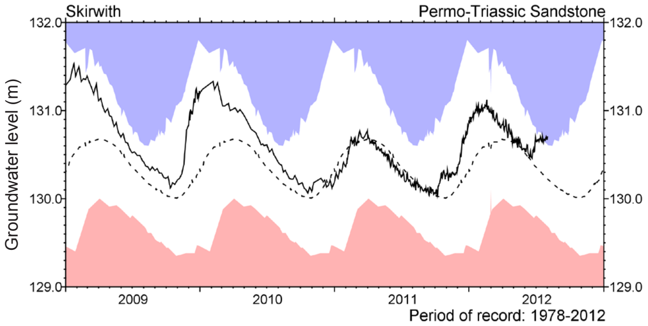


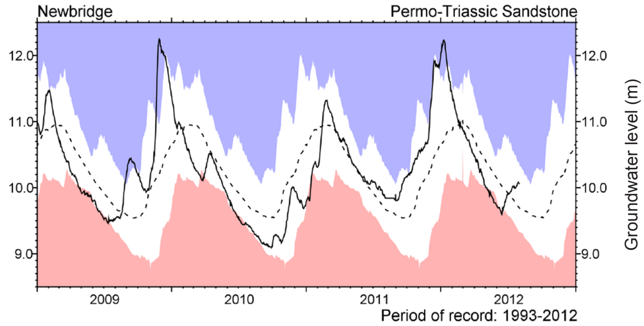
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation. The latest recorded levels are listed overleaf.

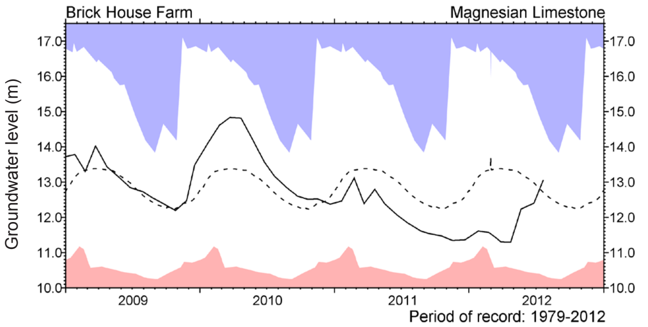
Groundwater . . . Groundwater

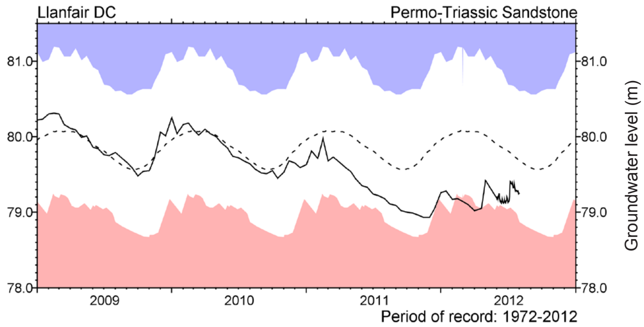


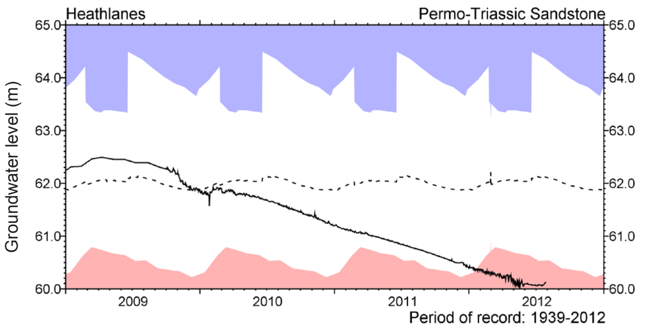


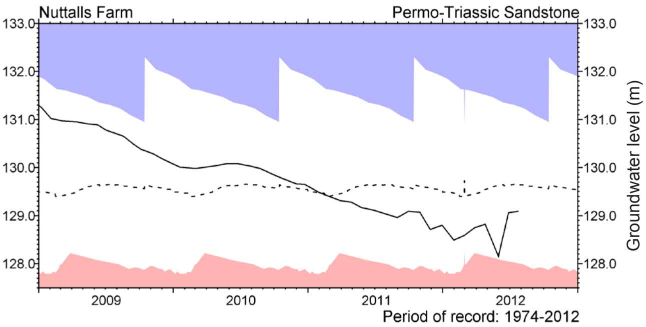


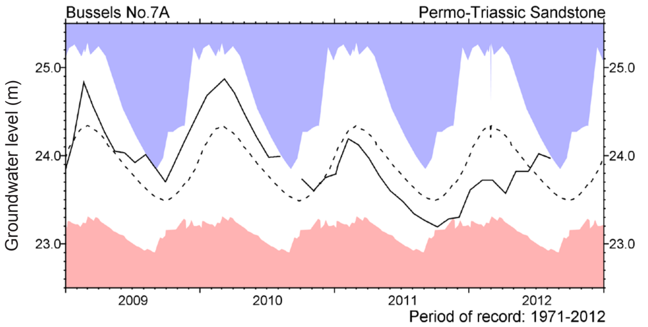


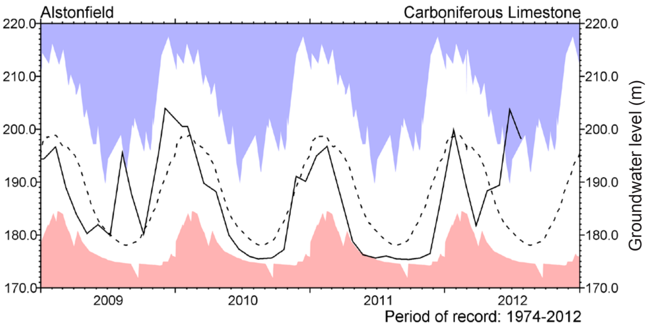










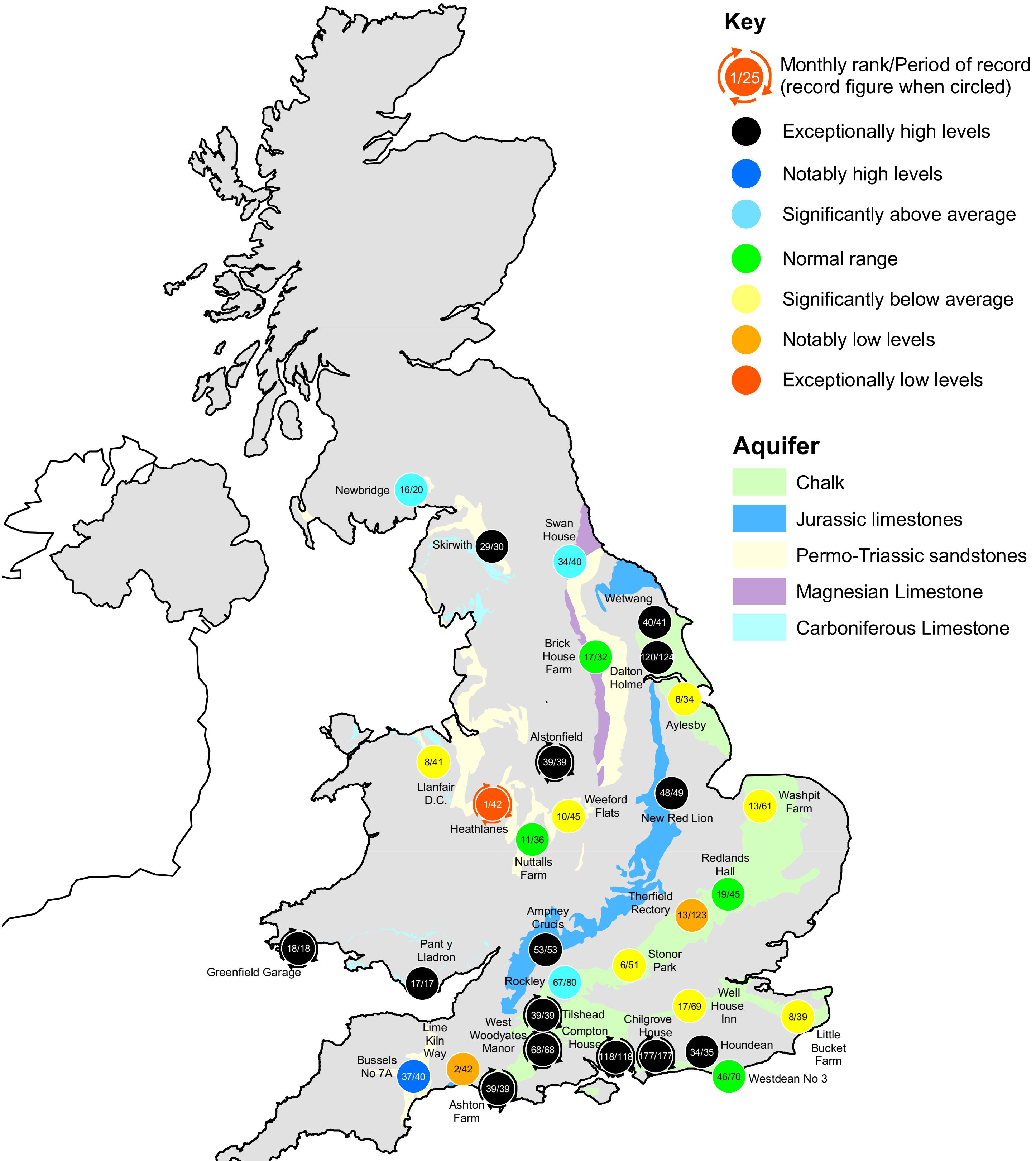


Groundwater levels July / August 2012

Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.
Dalton Holme	20.40	19/07	17.21	Chilgrove House	63.26	31/07	43.55	Brick House Farm	13.04	20/07	12.80
Therfield Rectory	75.02	01/08	81.49	Greenfield Garage	11.84	31/07	8.51	Llanfair DC	79.25	31/07	79.75
Stonor Park	66.84	31/07	77.03	New Red Lion	18.07	31/07	13.13	Heathlanes	60.12	27/07	62.09
Tilshead	92.88	31/07	84.87	Ampney Crucis	102.34	31/07	100.46	Nuttalls Farm	129.09	23/07	129.63
Rockley	134.68	31/07	133.20	Newbridge	10.06	31/07	9.78	Bussels No.7a	23.97	08/08	23.73
Well House Inn	95.67	31/07	95.73	Skirwith	130.70	01/08	130.30	Alstonfield	198.24	25/07	179.45
West Woodyates	92.78	31/07	76.91	Swan House	85.19	17/07	83.32				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - July 2012

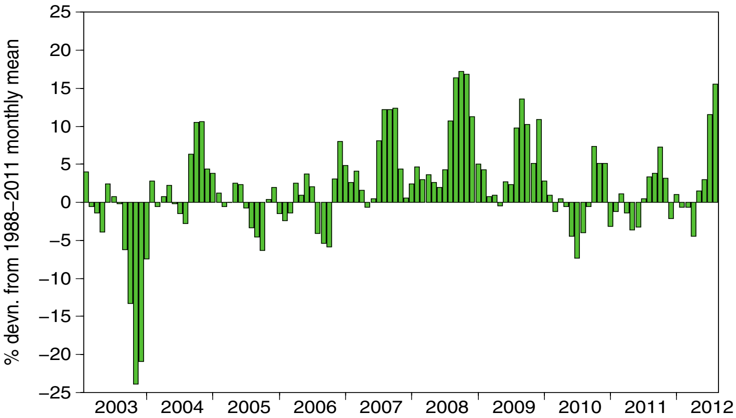
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. Rankings – and the designation of period of record maxima and minima – need to be interpreted with caution; where the latest monthly mean values are based on one or two level measurements only, their recording dates can be very influential, particularly during periods of relatively rapid change. Rankings may be omitted where they are considered misleading.

Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

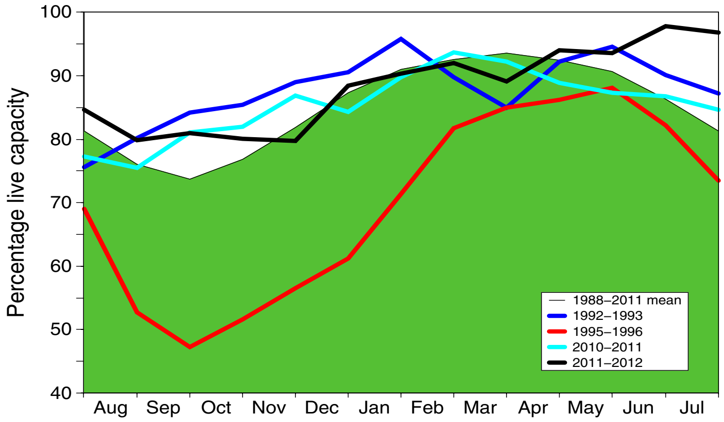
ii. Yew Tree Farm levels are now received quarterly.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

Percentage live capacity of selected reservoirs at start of month

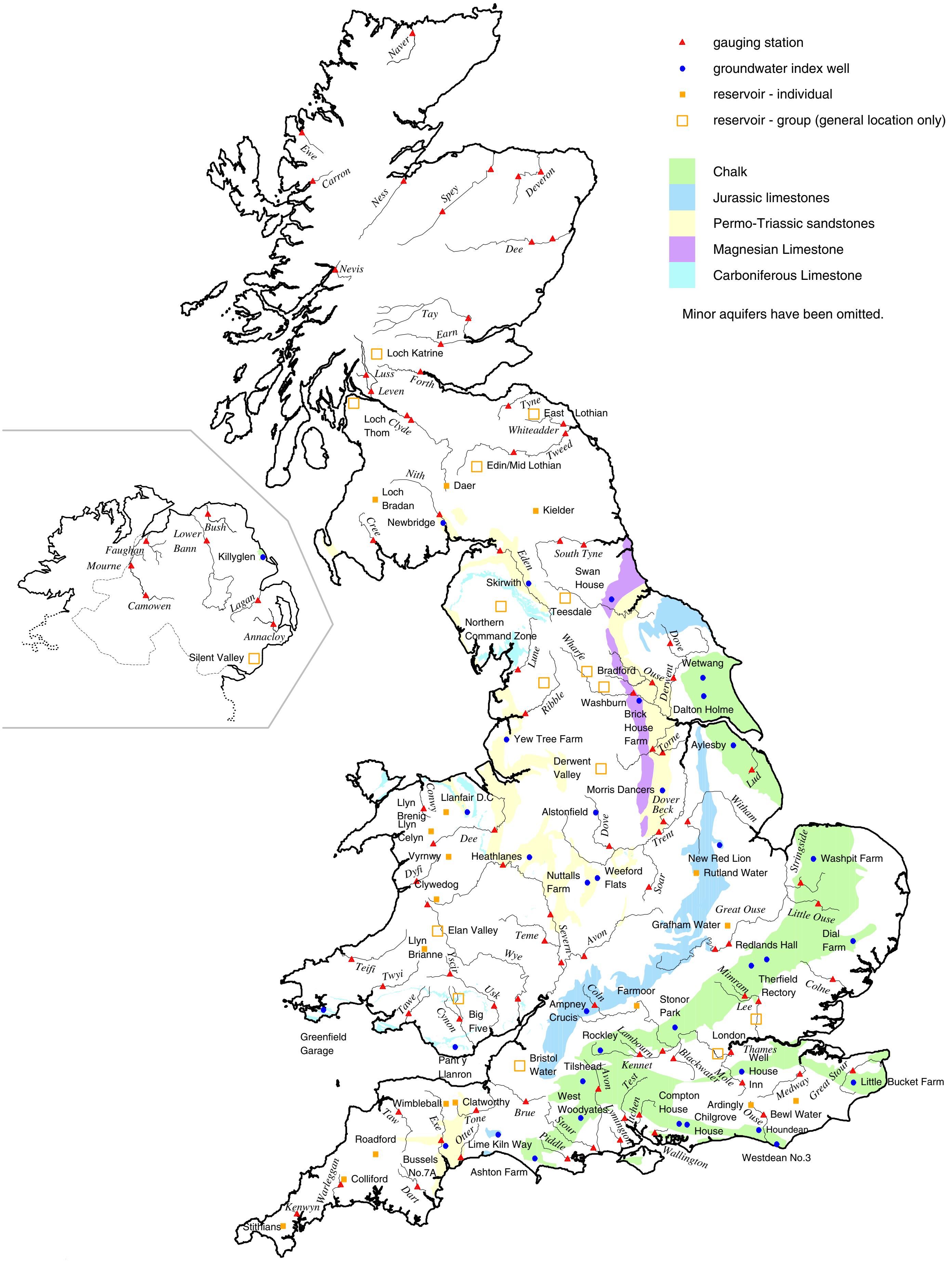
Area	Reservoir		Capacity (Ml)	2012 June	July	Aug	Aug Anom.	Min Aug	Year* of min	2011 Aug	Diff 12-11
North West	N Command Zone	•	124929	80	95	**92**	28	38	1989	75	17
	Vyrnwy		55146	94	99	**98**	21	56	1996	85	13
Northumbrian	Teesdale	•	87936	90	100	**95**	22	45	1989	94	1
	Kielder		(199175)	93	99	**100**	11	66	1989	94	6
Severn Trent	Clywedog		44922	100	98	**94**	8	57	1989	98	-4
	Derwent Valley	•	39525	96	100	**97**	24	43	1996	62	35
Yorkshire	Washburn	•	22035	94	96	**93**	19	50	1995	67	26
	Bradford supply	•	41407	92	99	**97**	26	38	1995	68	29
Anglian	Grafham		(55490)	95	96	**94**	5	66	1997	93	1
	Rutland		(116580)	95	98	**97**	12	74	1995	76	21
Thames	London	•	202828	98	98	**98**	12	73	1990	89	9
	Farmoor	•	13822	99	98	**97**	1	84	1990	99	-2
Southern	Bewl		28170	79	91	**90**	15	45	1990	63	27
	Ardingly*		4685	89	100	**100**	14	65	2005	75	25
Wessex	Clatworthy		5364	96	100	**100**	27	43	1992	63	37
	Bristol WW	•	(38666)	96	97	**98**	23	53	1990	67	31
South West	Colliford		28540	80	83	**86**	9	47	1997	60	26
	Roadford		34500	85	89	**93**	15	46	1996	55	38
	Wimbleball		21320	99	100	**100**	23	53	1992	55	45
	Stithians		4967	93	95	**98**	29	39	1990	62	36
Welsh	Celyn and Brenig	•	131155	100	100	**100**	11	65	1989	95	5
	Brianne		62140	98	100	**100**	11	67	1995	98	2
	Big Five	•	69762	96	100	**98**	21	41	1989	87	11
	Elan Valley	•	99106	95	100	**97**	13	63	1989	94	3
Scotland(E)	Edinburgh/Mid Lothian	•	97639	94	97	**100**	18	51	1998	92	8
	East Lothian	•	10206	100	100	**100**	11	72	1992	100	0
Scotland(W)	Loch Katrine	•	111363	80	73	**88**	14	53	2000	89	-1
	Daer		22412	98	100	**100**	19	58	1994	99	1
	Loch Thom	•	11840	93	93	**95**	12	59	2000	96	-1
Northern Ireland	Total+	•	56920	82	96	**95**	18	54	1995	77	18
	Silent Valley	•	20634	76	100	**97**	25	42	2000	72	25

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2011 period except for West of Scotland and Northern Ireland where data commence in the mid-1990's. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes.

*** The monthly record of Ardingly reservoir stocks is under review.**

Location map . . . Location map



National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP) was instigated in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological survey (BGS) – both are component bodies of the Natural Environment Research Council. The National River Flow Archive (maintained by CEH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

Data Sources

River flow and groundwater level data are provided by the Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).
Reservoir level information is provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

Most rainfall data are provided by the Met Office (address opposite).

To allow better spatial differentiation the monthly rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA.

The monthly, and n-month, rainfall figures have been produced by the Met Office, National Climate Information Centre (NCIC) and are based on gridded data from raingauges. They include a significant number of monthly raingauge totals provided by the EA and SEPA. The Met Office NCIC monthly rainfall series extends back to 1910 and forms the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM. (2005) available at http://www.metoffice.gov.uk/climate/uk/about/Monthly_gridded_datasets_UK.pdf

The regional figures for the current month are based on limited raingauge networks so these (and the return periods associated with them) should be regarded as a guide only.

The Met Office NCIC monthly rainfall series are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

From time to time the Hydrological Summary may also refer to evaporation and soil moisture figures. These are obtained from MORECS, the Met Office services involving the routine calculation of evaporation and soil moisture throughout the UK.

For further details please contact:

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100 Fax: 0870 900 5050
E-mail: enquiries@metoffice.com

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

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Selected text and maps are available on the WWW at http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html
Navigate via Hydrological Summary for the UK.

NATURAL ENVIRONMENT RESEARCH COUNCIL

08/12