Hydrological Summary
for the United Kingdom

July 2011

General

At the national scale, the July rainfall total was appreciably above average and all regions reported at least 90% of the 1971-2000 average. Thus, the rainfall deficiencies across most of southern Britain were moderated in most regions. However, spatial variations in rainfall within some regions were considerable with below average totals reinforcing meteorological drought conditions in parts of central England. By contrast, many northern rivers were in spate with flood alerts common in mid-month. Correspondingly, overall reservoir stocks declined by less than is normal through July and stocks in index reservoirs across much of northern Britain remain above the late-summer average. However, stocks are seasonally low in Rutland Water, the Derwent Valley reservoirs, and in a number of reservoirs in the South West; early-August stocks for Wimbleball were the lowest since 1992. Relative to the monthly average, runoff rates are significantly healthier than in the late spring but depressed river flows continue to characterise rivers in parts of central and southern England. After almost six months with very meagre infiltration, the hydrological impact of the drought is now clearly evident in the low, to very low, groundwater levels across most of the major aquifer outcrop areas. With end-of-July soil moisture deficits remaining close to record maxima in parts of central England a substantial delay in the seasonal recovery in runoff and recharge rates may be expected. The autumn rainfall will be very influential in determining whether drought stress will extend into 2012.

Rainfall

High pressure dominated synoptic patterns in early and late July – when heatwave conditions were experienced in parts of southern England. The middle of the month was much more unsettled with vigorous frontal systems bringing substantial rainfall to most regions. Some notable storm totals were reported (triggering several landslides): intense rainfall curtailed the Scottish Open golf championship on the 9th and, on the 18th, a 24-hr total of 97mm was recorded at Capel Curig. Generally however, few frontal systems penetrated to central England and much of the July rain fell as showers. There was thus only limited spatial coherence in the monthly rainfall totals. At the national scale, July rainfall was above average for the 5th successive year. Much of north-east Britain was especially wet with rainfall exceeding twice the July average in some areas (e.g. the Cairngorms). But rainfall gradients were very steep and parts of north-west Scotland (including the islands) recorded less than half the average rainfall. More notably in the context of the drought, parts of central England reported <75% (falling to <50% in places), as did parts of Cornwall and Dorset. Broadly speaking, rainfall accumulations over the medium term show a persistent, if uneven, exaggeration in the north-south rainfall gradient across the UK. Provisional data indicate that Scotland reported its highest May-July rainfall whilst, in the March-July timeframe, England registered its lowest rainfall for 15 years. Rainfall deficiencies over the last five months are most notable in the Midlands and Yorkshire (provisionally reporting their 4th and 5th lowest March-July rainfall respectively since 1921). Some parts of the Midlands have recorded only 2 months with above average rainfall in the last 20 months.

River flows

Spatial and temporal variations in river flows during July were unusually large for mid-summer. Flood Alerts were common in Scotland on the 6th and again on the 17th when the Ness closely approached its highest July daily flow in a 39-yr series; urban flash flooding also occurred in a zone extending south to north-east England. Moderate summer spates were widespread in responsive catchments to the south – providing a welcome, albeit temporary, recovery in flows after very sustained recessions in most catchments. In Scotland, notably high July runoff characterised many rivers draining to the North Sea; the Ness exceeded its previous maximum. Runoff throughout most of Wales was healthy also but generally flows were below the monthly average throughout most of the English Lowlands and the South West. Evidence of the drought's development can be traced back to the end of 2009 but, currently, its impact is best demonstrated over the March-July period this year. In this timeframe, estimated runoff from England & Wales is the lowest since the extreme drought of 1976 with the Tone, Kenwyn and Mole establishing new runoff minima in series of 51, 43, and 37 years respectively. A zone of especially depressed runoff extends from Cornwall to the Humber. The low flows, often accompanied by low oxygen levels, necessitated further fish rescues e.g. in the River Tarrant (Dorset) and River Redlake (Shropshire); aeration equipment was also deployed (e.g. in the Hatfield Waste Drain near Doncaster).

Groundwater

Soils are close to saturation across most of northern Britain but soil moisture deficits remain considerably above the early August average across the outcrops of most major aquifers. The dryness of the soils precluded any significant groundwater replenishment during July and, generally, groundwater level recessions continued. The great majority of index wells and boreholes reported well below average July levels; this was also true of some minor aquifers (e.g. the Suffolk Drift). Exceptionally low levels were recorded in the more responsive southern Chalk outcrops – levels at Chilgrove and Tilshead have closely approached their natural base levels. Importantly, levels in the slower-responding Permo-Triassic sandstones outcrops of the Midlands are also notably low. Generally, the groundwater levels remain above the minima registered during the droughts of the 1990s and the mid-2000s. In many drought episodes, particularly those that intensify through the spring and early summer, their impact on groundwater levels is not fully evident until the latter half of the year. This is certainly true of 2011 when, with end-of-July soil moisture deficiencies across the outcrop areas of most major aquifers >100mm, the seasonal recovery in groundwater levels is unlikely to occur, given average rainfall, before the early winter. The short term outlook is for a further decline in groundwater levels – and an associated flow decline in baseflow dominated rivers and streams.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

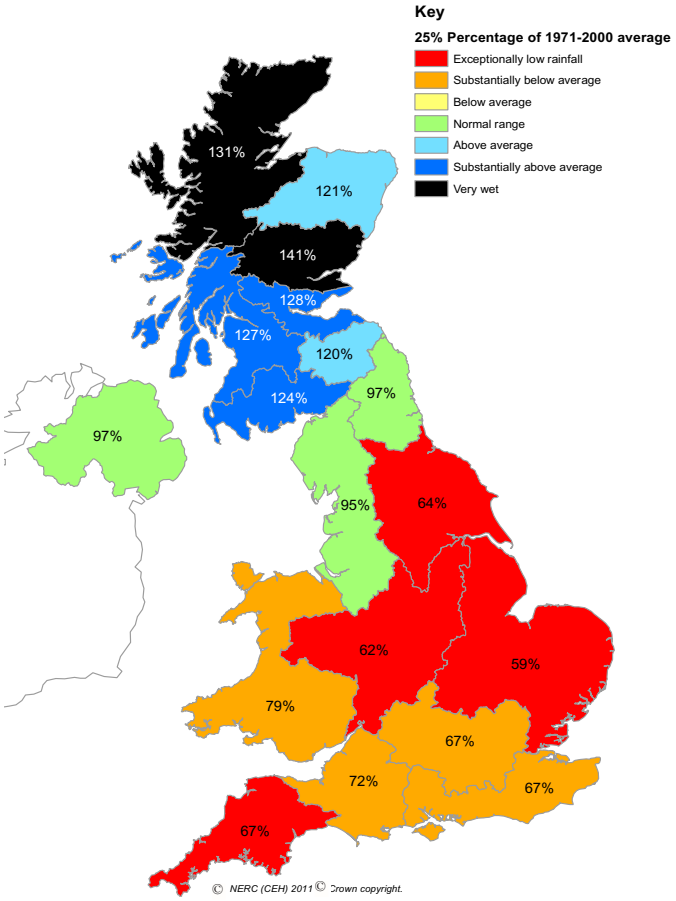
Area	Rainfall	Jul 2011	Mar11 - Jul11	RP	Dec10 - Jul11	RP	Aug10 - Jul11	RP	Dec 09 - Jul11	RP
United Kingdom	mm	**76**	346		611		1047		1615	
	%	**115**	97	2-5	90	2-5	97	2-5	92	5-10
England	mm	**60**	206		397		738		1183	
	%	**115**	71	10-20	76	10-20	90	5-10	88	8-12
Scotland	mm	**103**	576		942		1514		2238	
	%	**120**	128	25-40	105	2-5	105	2-5	96	2-5
Wales	mm	**84**	340		672		1189		1901	
	%	**114**	80	8-12	79	8-12	87	5-10	85	10-20
Northern Ireland	mm	**67**	368		640		1078		1696	
	%	**91**	97	2-5	91	2-5	97	2-5	94	2-5
England & Wales	mm	**63**	224		435		800		1282	
	%	**115**	73	10-20	77	10-20	89	5-10	88	8-12
North West	mm	**97**	369		685		1172		1747	
	%	**124**	95	2-5	94	2-5	100	<2	92	5-10
Northumbria	mm	**91**	296		517		916		1440	
	%	**159**	97	2-5	97	2-5	110	2-5	106	2-5
Midlands	mm	**44**	173		320		611		999	
	%	**90**	62	30-40	66	40-60	81	10-15	80	30-40
Yorkshire	mm	**59**	191		390		735		1179	
	%	**111**	64	30-45	74	20-30	90	2-5	88	8-12
Anglian	mm	**50**	139		265		554		900	
	%	**111**	59	20-30	69	25-40	92	2-5	91	5-10
Thames	mm	**50**	173		336		617		1003	
	%	**116**	67	10-15	75	10-15	88	5-10	88	5-10
Southern	mm	**51**	176		392		714		1203	
	%	**115**	67	10-15	81	5-10	91	2-5	95	2-5
Wessex	mm	**56**	207		405		721		1160	
	%	**119**	72	8-12	74	10-15	83	5-10	82	15-25
South West	mm	**68**	249		529		978		1607	
	%	**110**	67	20-30	69	15-25	81	8-12	81	20-30
Welsh	mm	**82**	326		640		1140		1832	
	%	**115**	79	10-15	78	12-16	86	5-10	85	10-20
Highland	mm	**97**	681		1091		1695		2470	
	%	**103**	131	20-30	103	2-5	99	2-5	89	2-5
North East	mm	**93**	406		630		1120		1809	
	%	**140**	121	2-5	107	2-5	118	5-10	117	5-10
Tay	mm	**149**	566		898		1466		2139	
	%	**202**	141	25-40	111	2-5	116	5-10	103	2-5
Forth	mm	**118**	476		808		1297		1920	
	%	**166**	128	12-16	113	5-10	115	5-10	104	2-5
Tweed	mm	**121**	402		687		1112		1725	
	%	**187**	120	5-10	112	2-5	117	5-10	110	2-5
Solway	mm	**108**	552		957		1539		2283	
	%	**124**	124	8-12	110	2-5	109	5-10	100	<2
Clyde	mm	**101**	670		1123		1808		2582	
	%	**94**	127	10-20	105	2-5	104	2-5	92	2-5

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

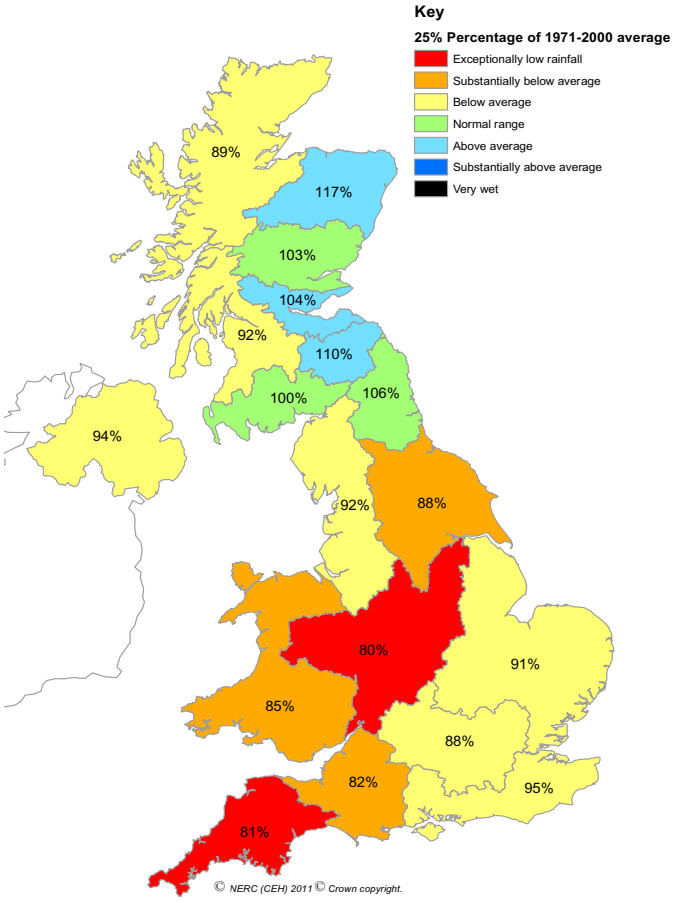
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic 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 March 2011 are provisional.

Rainfall . . . Rainfall . . .

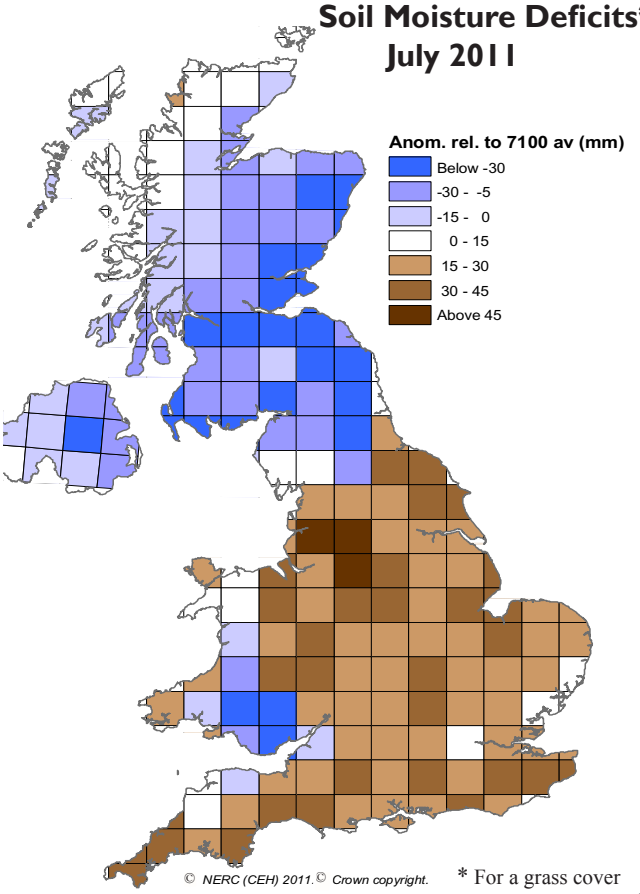
March - July 2011



December 2009 - July 2011



Soil Moisture Deficits* July 2011



* For a grass cover

Met Office Weather forecast

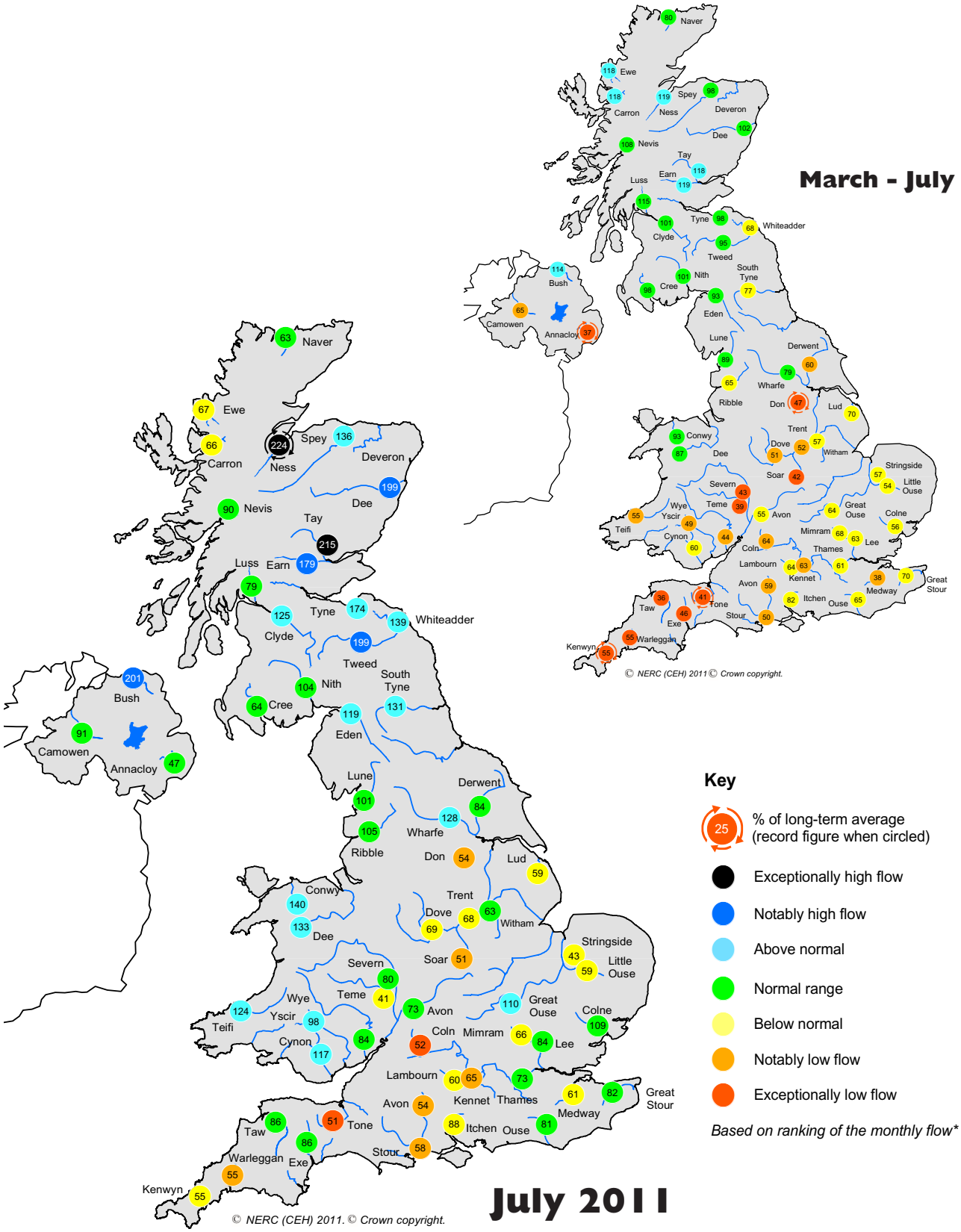
Updated: 12:11 on Friday 12 August 2011

UK Outlook for Weds 17 Aug to Fri 26 Aug 2011:
The period starts rather wet and unsettled over many parts, with spells of rain moving erratically eastwards towards the weekend. Near-average temperatures for most will be tempered towards the northwest by the brisk wind here at times. Meanwhile, southeastern parts of the country look favoured for the warmest weather, however this comes coupled with an increasing chance of heavy or thundery showers at times up to and over the weekend. At the same time, other parts of the UK should see fairer weather, with a few showers but also some bright or sunny spells. The final week of the period should again see unsettled weather spread into the northwest, with the UK as a whole most likely seeing a return to unsettled conditions, with winds from the westerly quadrant.

UK Outlook for Sat 27 Aug to Sat 10 Sep 2011:
A generally unsettled period, with little in the way of dominant weather patterns. Both rainfall and sunshine amounts for the UK should be near-average for late summer, with the southeast of England the one exception to this, being most likely wetter and cloudier than normal. Mean, minimum and maximum temperatures will most likely be below average across the country, perhaps closest to normal in some central and western parts, whilst the southeast may even fall well-below normal at times.

For further details please visit:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_alltext.html

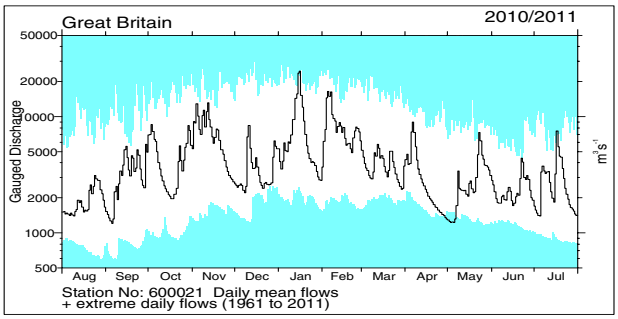
River flow . . . River flow . . .

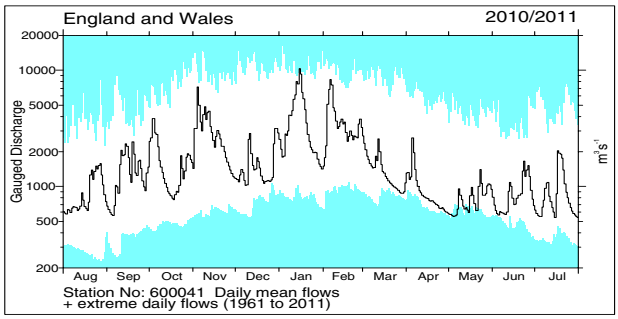


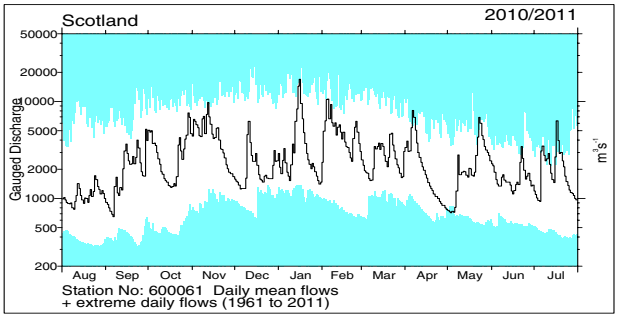
River flows

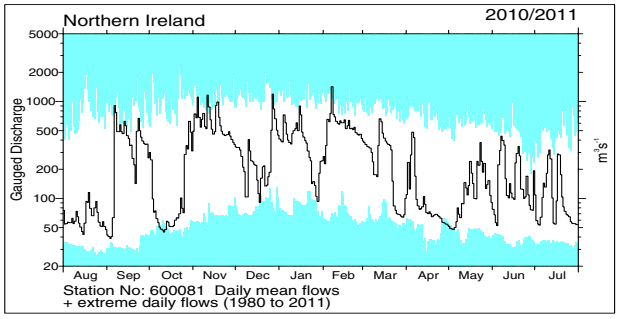
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much 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.

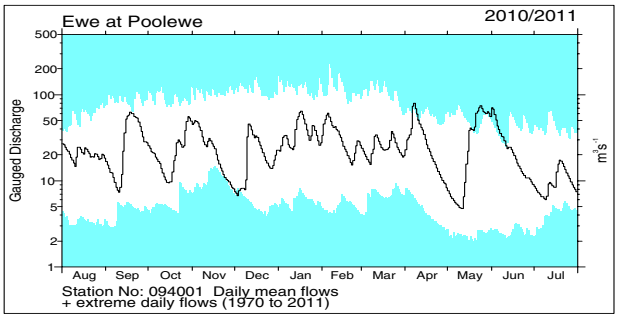
River flow . . . River flow . . .

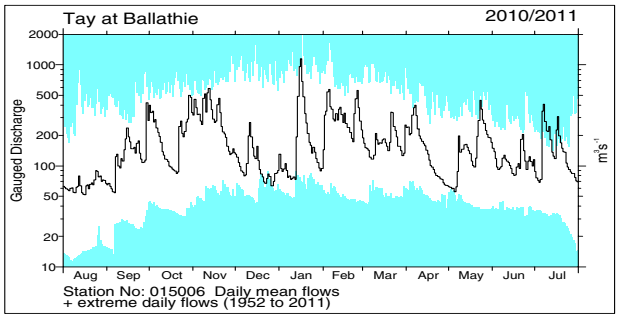


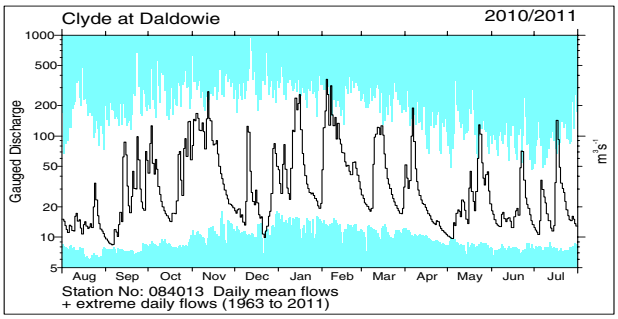


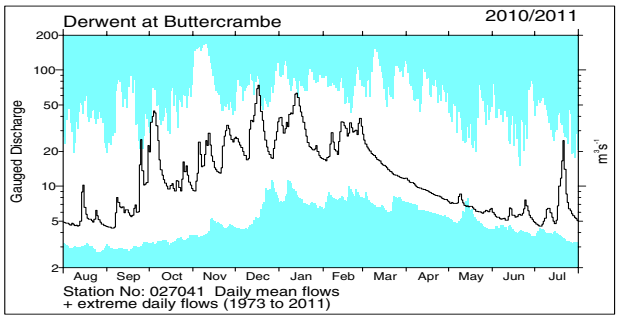


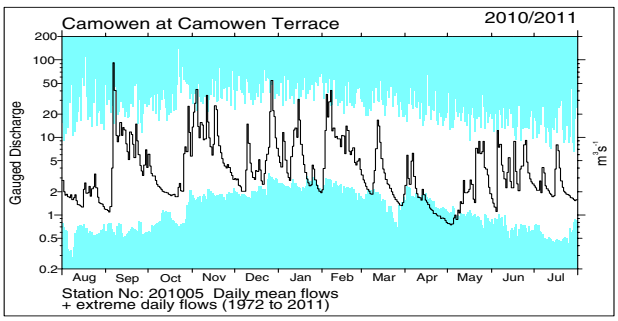


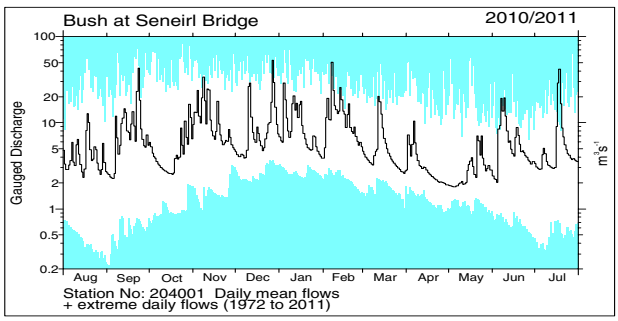








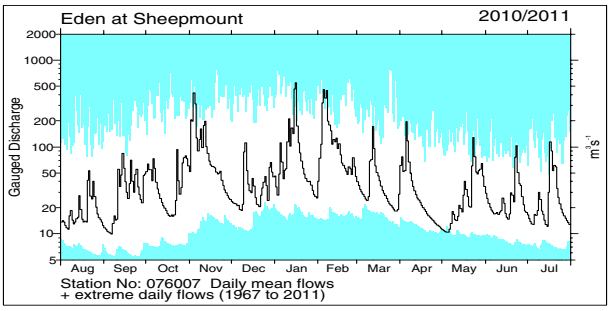


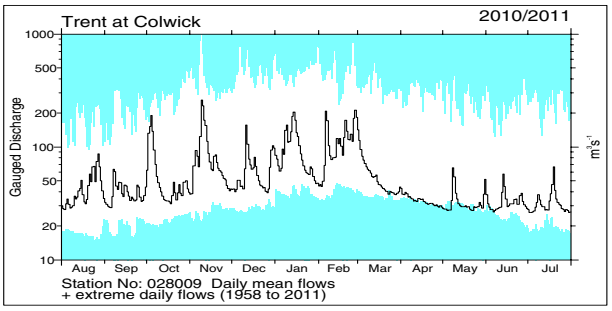


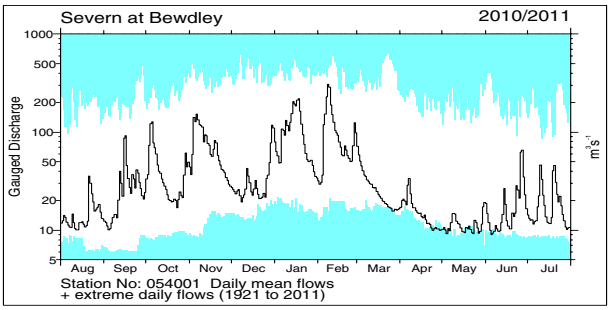
River flow hydrographs

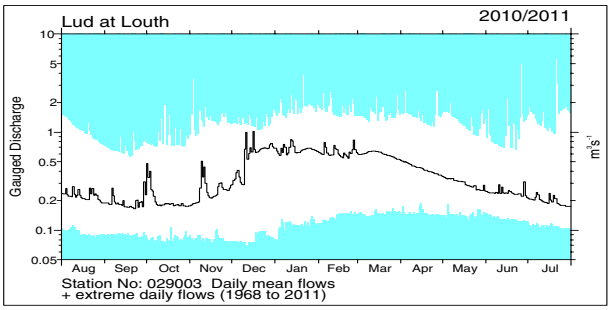
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

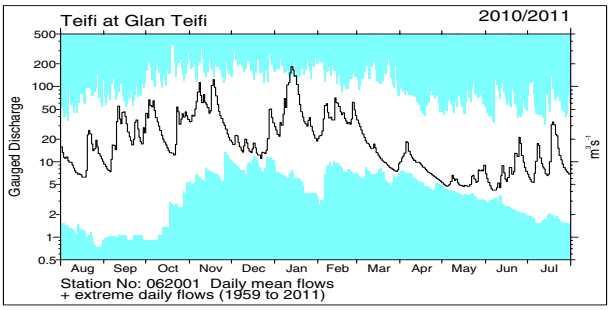
River flow . . . River flow . . .

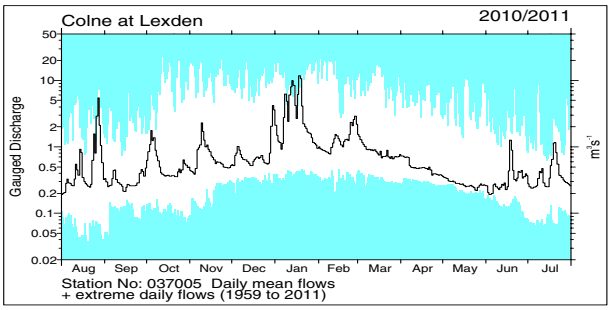


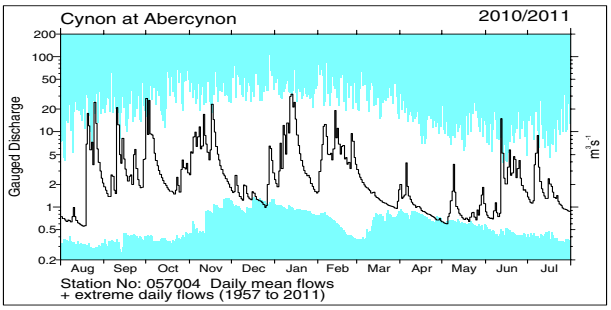


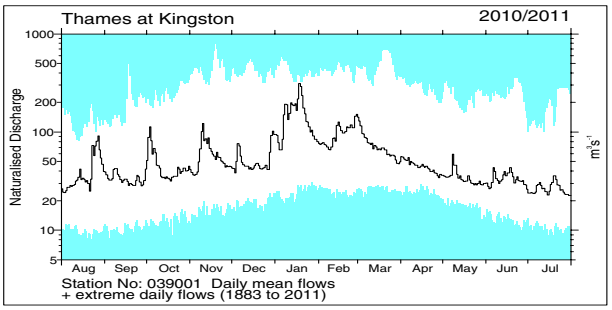


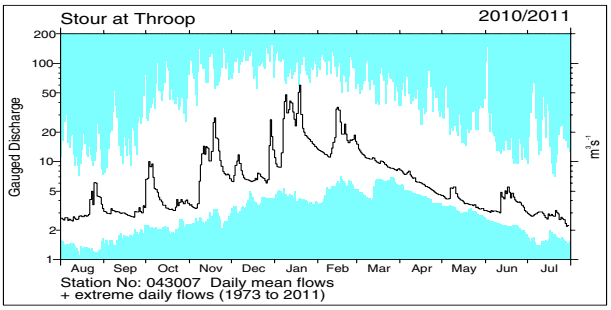


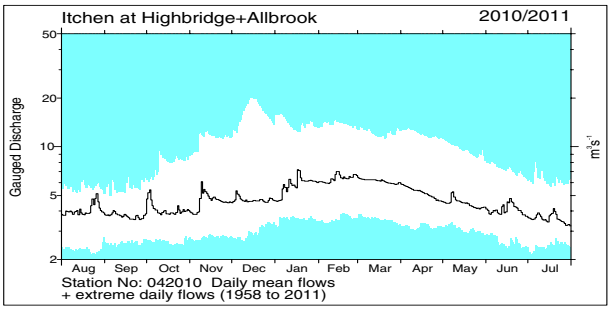












Notable runoff accumulations (a) Mar 2011 - Jul 2011 (b) Dec 2009 - Jul 2011

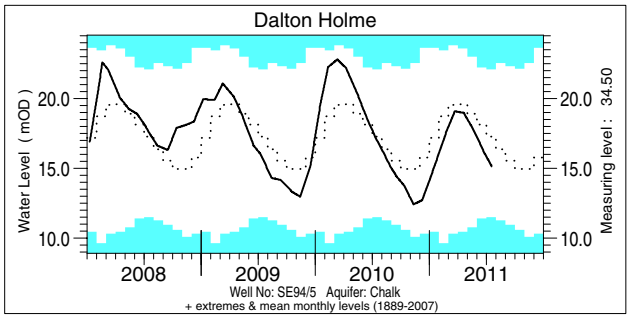
	River	%lta	Rank
a)	Don (Doncaster)	47	1/49
	Trent	52	3/53
	Dove	51	3/50
	Soar	42	2/40
	Mole	53	1/37
	Medway	38	3/51
	Lymington	39	3/51
	Stour (Throop)	50	3/39
	Exe	46	2/55
	Otter	57	2/49

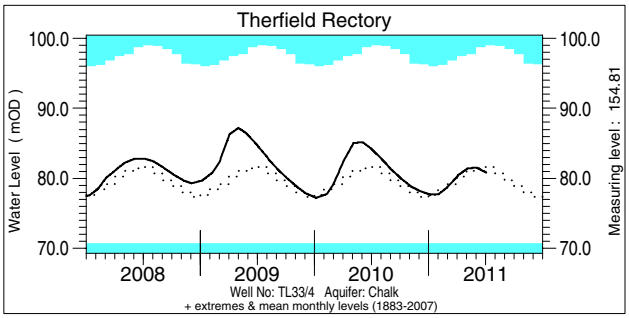
	River	%lta	Rank
a)	Warleggan	55	2/42
	Kenwyn	55	1/43
	Tone	41	1/51
	Brue	37	1/47
	Severn	43	2/90
	Teme	39	2/41
	Lagan	48	3/39
	Annacloy	37	1/32

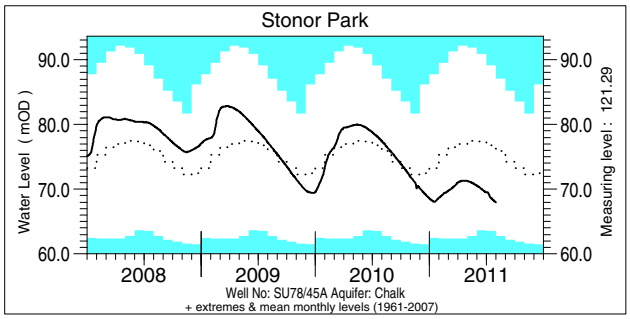
	River	%lta	Rank
b)	Tyne (Spilmersford)	148	44/44
	Whiteadder	139	41/41
	Taw	65	2/52
	Yscir	70	2/37
	Luss	82	2/29
	Nevis	74	1/28
	Carron	70	1/31
	Ewe	78	2/40

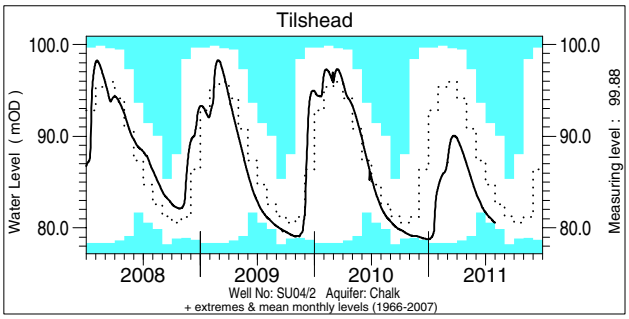
lta = long term average
Rank 1 = lowest on record

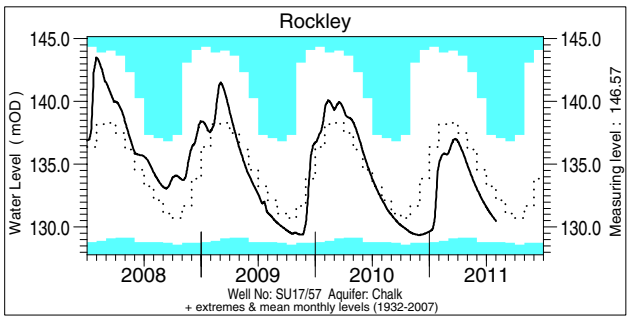
Groundwater . . . Groundwater

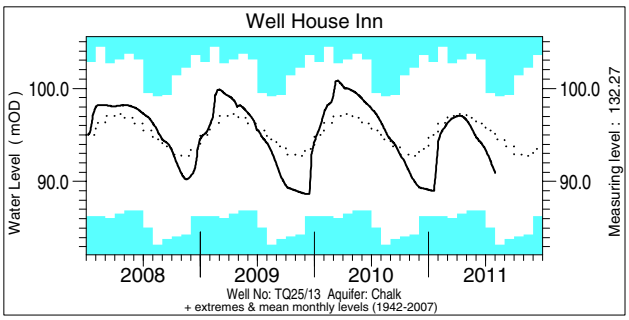


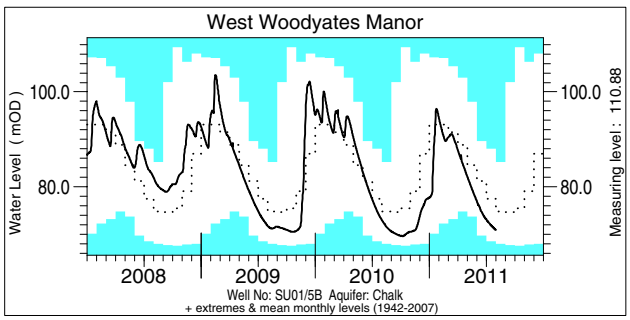


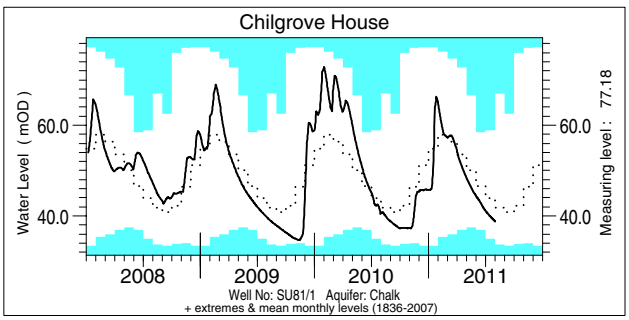


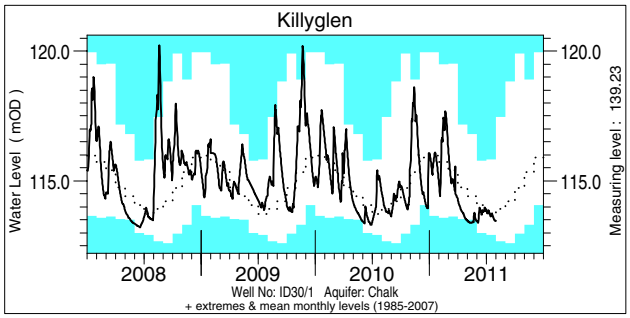


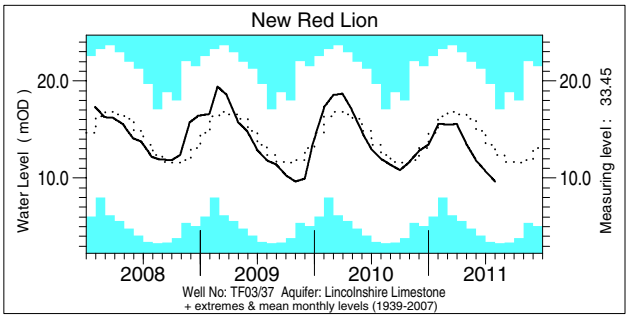






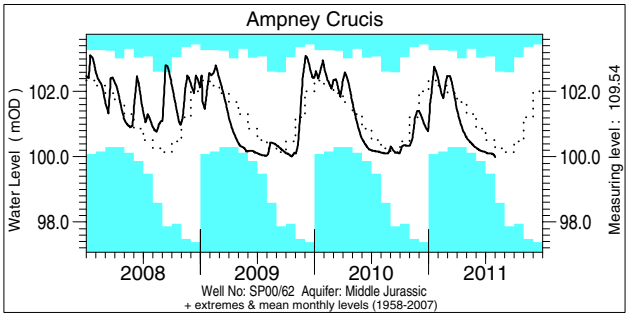


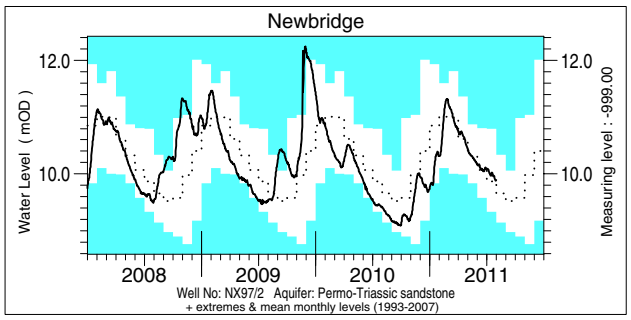


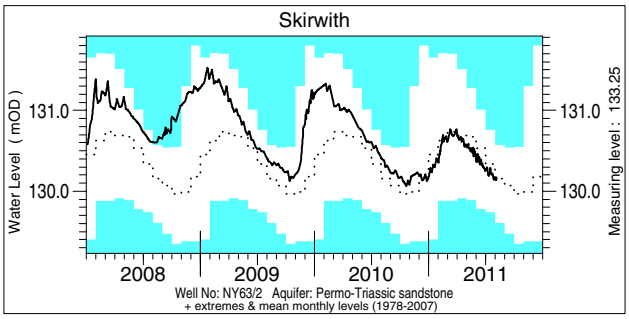


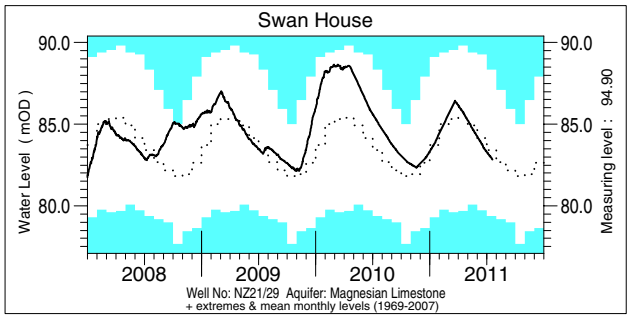
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined 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 – the latest recorded levels are listed overleaf.

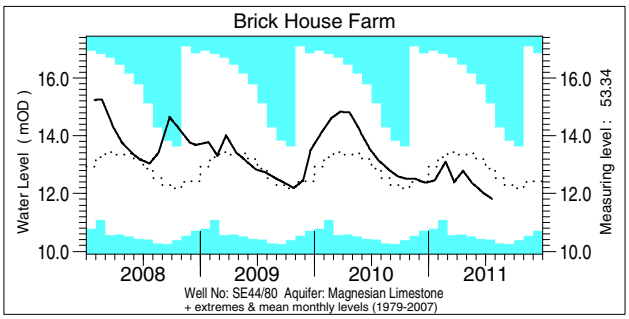
Groundwater . . . Groundwater

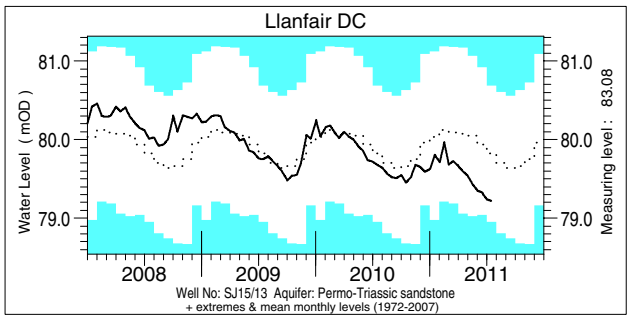


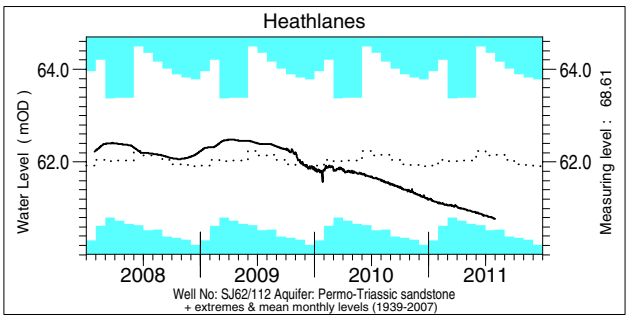


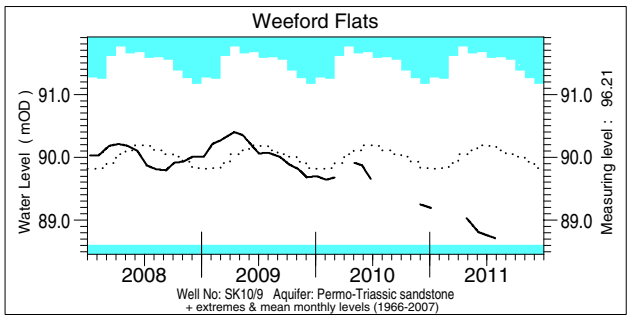


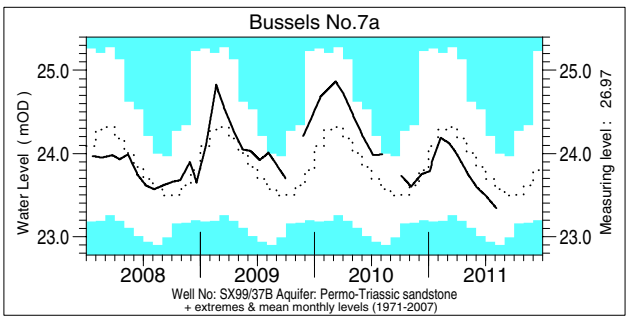


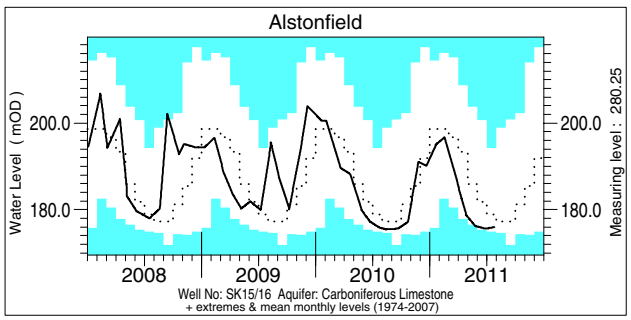








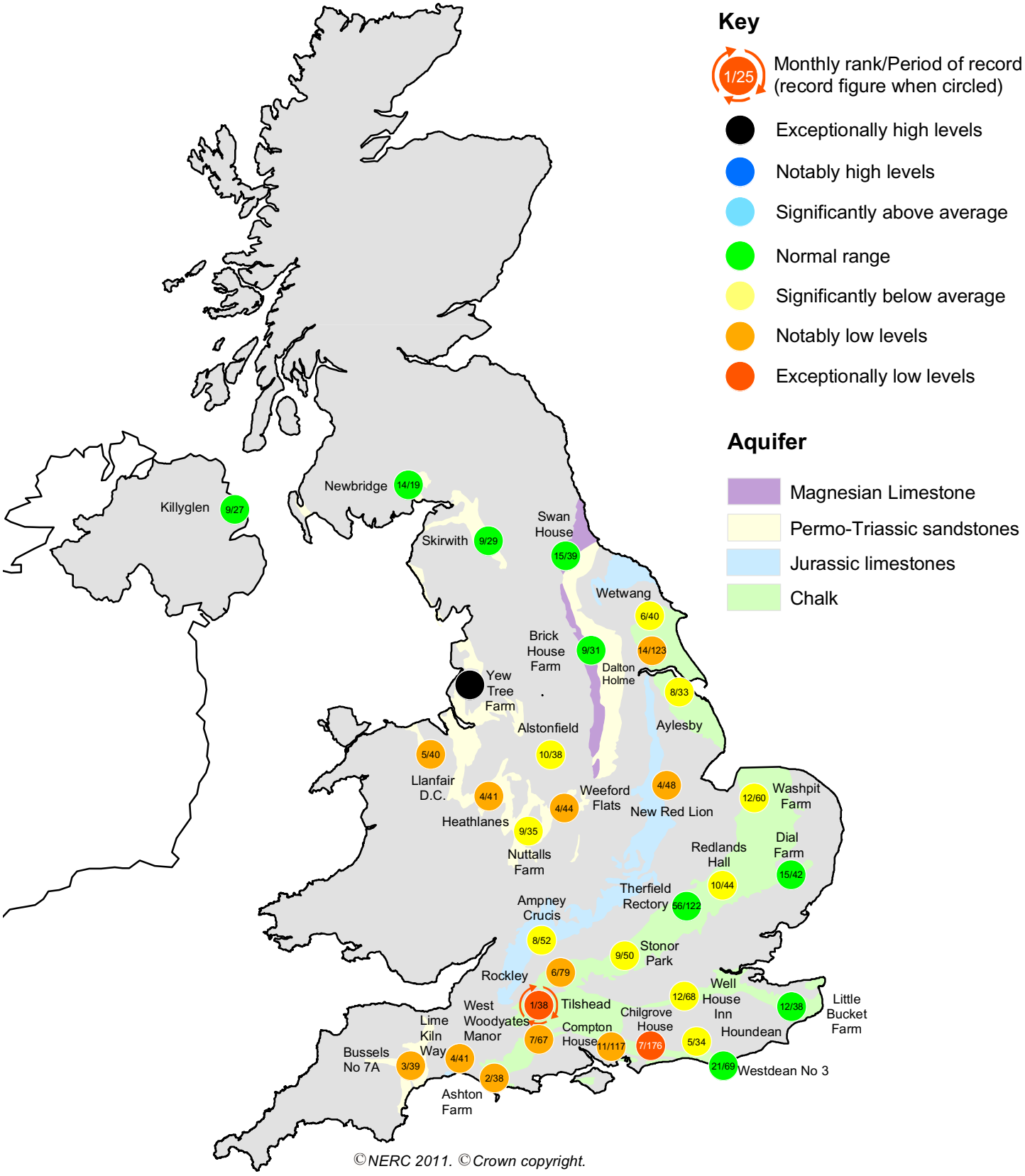




Groundwater levels July / August 2011

Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.
Dalton Holme	15.13	18/07	17.22	Chilgrove House	38.80	01/08	43.58	Brick House Farm	11.82	21/07	12.84
Therfield Rectory	80.80	04/07	81.50	Killyglen (NI)	113.46	31/07	113.85	Llanfair DC	79.22	15/07	79.76
Stonor Park	67.93	01/08	77.20	New Red Lion	9.65	31/07	13.20	Heathlanes	60.78	31/07	62.12
Tilshead	80.56	31/07	84.97	Ampney Crucis	99.99	01/08	100.47	Weeford Flats	88.71	28/07	89.89
Rockley	130.48	01/08	133.23	Newbridge	9.89	31/07	9.77	Bussels No.7a	23.34	04/08	23.73
Well House Inn	90.93	01/08	95.78	Skirwith	130.14	05/08	130.30	Alstonfield	176.00	26/07	179.55
West Woodyates	70.90	31/07	76.99	Swan House	82.83	19/07	83.33	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



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Groundwater levels - July 2011

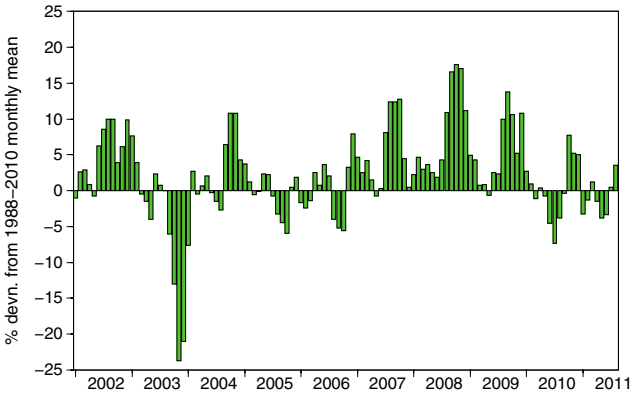
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

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

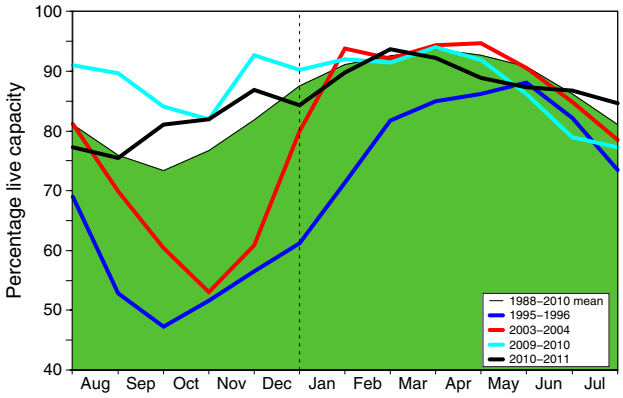
ii. Yew Tree Farm levels are now received quarterly.

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)	2011 Jun	Jul	Aug	Aug Anom.	Min Aug	Year* of min	2010 Aug	Diff 11-10
North West	N Command Zone	•	124929	90	83	**75**	11	38	1989	65	10
	Vyrnwy		55146	83	86	**85**	8	56	1996	69	16
Northumbrian	Teesdale	•	87936	95	93	**94**	22	45	1989	64	30
	Kielder		(199175)	(93)	(94)	**(94)**	5	(66)	1989	(91)	3
Severn Trent	Clywedog		44922	97	100	**98**	12	57	1989	85	13
	Derwent Valley	•	39525	69	63	**62**	-12	43	1996	61	1
Yorkshire	Washburn	•	22035	74	72	**67**	-7	50	1995	73	-6
	Bradford supply	•	41407	80	73	**68**	-3	38	1995	64	4
Anglian	Grafham		(55490)	(91)	(93)	**(93)**	4	(66)	1997	(87)	6
	Rutland		(116580)	(85)	(81)	**(76)**	-9	(74)	1995	(78)	-2
Thames	London	•	202828	93	95	**89**	3	73	1990	86	3
	Farmoor	•	13822	100	100	**99**	3	84	1990	97	2
Southern	Bewl		28170	83	73	**63**	-13	45	1990	71	-8
	Ardingly		4685	92	84	**75**	-11	65	2005	82	-7
Wessex	Clatworthy		5364	73	71	**69**	-5	43	1992	59	10
	Bristol WW	•	(38666)	(78)	(73)	**(67)**	-8	(53)	1990	(69)	-2
South West	Colliford		28540	74	66	**60**	-18	47	1997	80	-20
	Roadford		34500	68	60	**55**	-24	46	1996	71	-16
	Wimbleball		21320	74	63	**55**	-23	53	1992	66	-11
	Stithians		4967	80	71	**62**	-7	39	1990	66	-4
Welsh	Celyn and Brenig	•	131155	96	97	**95**	7	65	1989	82	13
	Brianne		62140	84	89	**98**	9	67	1995	85	13
	Big Five	•	69762	79	87	**87**	11	41	1989	67	20
	Elan Valley	•	99106	81	85	**94**	11	63	1989	71	23
Scotland(E)	Edinburgh/Mid Lothian	•	97639	94	91	**92**	10	51	1998	83	9
	East Lothian	•	10206	99	94	**100**	12	72	1992	84	16
Scotland(W)	Loch Katrine	•	111363	92	95	**89**	16	53	2000	66	23
	Daer		22412	99	99	**99**	19	58	1994	89	10
	Loch Thom	•	11840	95	100	**96**	14	59	2000	82	14
Northern Ireland	Total+	•	56920	80	82	**77**	0	54	1995	83	-6
	Silent Valley	•	20634	75	78	**72**	0	42	2000	90	-18

() 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 1988-2010 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.

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Location map . . . Location map

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National Hydrological Monitoring Programme

The National Hydrological Monitoring Programme (NHMP)[#] is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), the Rivers Agency (RA) in Northern Ireland, and the Office of Water Services (OFWAT).

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.

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.

Rainfall

Most rainfall data are provided by the Met Office (see opposite). To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA and SEPA. Following the discontinuation of the Met Office's CARP system in July 1998, the areal rainfall figures have been derived using several procedures, including initial estimates based on MORECS[*]. Recent figures have been produced by the Met Office, National Climate Information Centre (NCIC), using a technique similar to CARP. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period were made available by the Met Office in 2004; these have been adopted by the NHMP. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (and the return periods associated with them) should be regarded as a guide only.
The monthly rainfall figures are provided by the Met Office (National Climate Information Centre) and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

[#] Instigated in 1988
[*]MORECS is the generic name for the Met Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

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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.

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08/11