Hydrological Summary

for the United Kingdom

August 2011

General

After a warm start August was a cool and unsettled month ending another wet summer at the national scale. However, spatial variations in the summer rainfall were very substantial and rainfall deficiencies continued to build in central England (and some peripheral areas) where notable drought conditions persist. Overall reservoir stocks for the UK are appreciably above the early autumn average but, importantly, stocks remain relatively depressed in parts of the Midlands and the South West; the lowest since 1996 and 1995 for the Derwent Valley and Wimbleball reservoirs respectively. As usual, the dryness of late-summer soils precluded any significant aquifer recharge and groundwater level recessions continued, leaving late-August groundwater levels well below average over wide areas. River flows in August spanned a very wide range. Flood Alerts were common in the 2nd week and notably high August runoff characterised parts of Scotland. By contrast, in parts of southern Britain flows in index rivers were notably low and accumulated runoff totals over the last six months are depressed in most central and southern catchments. In rainfall terms, the drought has substantially decreased in spatial extent since the spring but with the bulk of the summer rainfall accounted for by evaporation losses, a wet autumn is required to generate a sustained seasonal recovery in the depressed runoff and, particularly, recharge rates across the drought-affected areas.

Rainfall

After heatwave conditions at the beginning of the month, synoptic patterns became very unsettled and both frontal and convective rainfall events were common. However the varying tracks of the low pressure systems and the showery nature of much of the rainfall made for a very uneven rainfall distribution. Some notable 24-hr rainfalls were registered e.g. 77mm at Malham Tarn on the 10/11th and 79mm at Caversham (Berks) on the 18th. Generally northern Britain was wet (the Scottish Islands excepted) but to the south some notably low August rainfall totals were recorded; Shrewsbury reported a meagre 12mm. For the UK as a whole, the summer (June-August), was the coolest since 1993 and rainfall was above average for the fifth year in succession. However, regional rainfall contrasts remain exceptional: over the March-August period provisional data indicate that Scotland registered its 2nd highest rainfall (after 2009) in a series from 1910; in the same timeframe, and despite the wet summer, England and Wales both reported rainfall totals of only around 80% of average. The dryness of some central areas is particularly notable. For the Midlands the combined spring/summer rainfall was the 4th lowest on record. Moreover, longer term rainfall deficiencies can be traced back to December 2009. The accumulated deficiency over the last 21 months has been exceeded only during the extreme droughts of 1933/34 and 1975/76. Large long term rainfall deficiencies persist in the South West and Wales also.

River flows

August was a month of exceptional spatial variations in river flow. Flood Warnings were widespread in mainland Scotland during the 2nd week when, on the 11th, the Ness exceeded its previous highest August flow. Flash flooding was widely reported (e.g. in Goole on the 3rd and at many localities in central southern England on the 18th) and Flood Alerts were in operation on several London rivers on the 25th. Exceptionally high August runoff totals characterised most Scottish rivers draining to the North Sea but in southern Britain runoff was generally well below average. Mean August flow in the Coln (Cotswolds) was the lowest since the remarkably intense drought of 1976. Generally however, short-lived spates helped ensure that August flows remained considerably above drought minima and estimated outflows from England & Wales have increased each month since May, an unusual circumstance. The drought's impact is most evident in runoff accumulation over longer timespans. Throughout southern Britain (parts of Northern Ireland also) runoff totals over the March-August period are depressed, and the lowest on record for the Severn, Brue, Kenwyn and Annacloy. Some southern spring-fed rivers have registered 16 successive months with below average flows and further evidence of the decline in baseflows is provided by the early cessation of flows in some winterbournes (e.g. the Till in Wiltshire).

Groundwater

Dry soil conditions, and the associated lack of recharge, imply that, in groundwater terms, droughts are rarely moderated through the late summer and early autumn. Whilst late-August soils were close to saturation throughout much of northern Britain (where the groundwater recession at the Newbridge borehole has been arrested), above average late-August soil moisture deficits extend across the majority of the outcrop areas of the major aquifers in England. Correspondingly, groundwater levels continued to fall and, with few exceptions (e.g. the deep and slow responding Therfield Well), late August levels were substantially below average. In some of the more responsive Chalk wells (e.g. Rockley and Tilshead) August levels are the lowest since 1976. In these, and some limestone wells (e.g. Alstonfield) and Permo-Triassic sandstone wells (e.g. Weeford Flats), natural base levels have been closely approached. Some water supply problems from private wells (e.g. in Shropshire) have been reported. More generally, groundwater levels are similar to those registered during the sustained droughts of the 1990s. The late summer and early autumn reduction in soil moisture deficits is helpful but with seasonal groundwater level recoveries unlikely before the late autumn (in the English Lowlands), and needing to be generated from a very low base, the groundwater resources outlook will require close monitoring.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

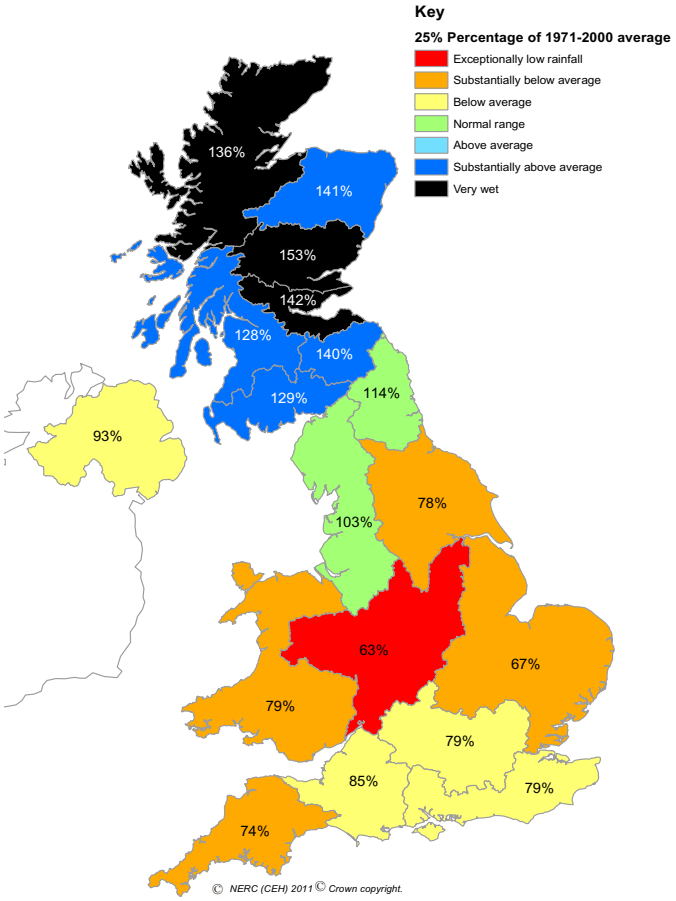
Area	Rainfall	Aug 2011	Jun11 - Aug11	RP	Mar11 - Aug11	RP	Jan11 - Aug11	RP	Dec09 - Aug11	RP
United Kingdom	mm	**106**	265		452		669		1721	
	%	**131**	123	2-5	103	2-5	105	2-5	93	5-10
England	mm	**79**	206		285		441		1262	
	%	**122**	116	2-5	80	8-12	89	5-10	90	8-12
Scotland	mm	**164**	366		740		1044		2402	
	%	**165**	138	5-10	135	60-90	125	10-20	99	2-5
Wales	mm	**80**	273		422		701		1983	
	%	**79**	106	2-5	80	10-15	89	5-10	85	15-25
Northern Ireland	mm	**67**	240		435		638		1763	
	%	**74**	102	2-5	93	2-5	95	2-5	93	5-10
England & Wales	mm	**79**	215		304		477		1361	
	%	**113**	114	2-5	80	5-15	89	5-10	89	5-15
North West	mm	**127**	297		498		776		1876	
	%	**134**	118	2-5	103	2-5	112	2-5	94	5-10
Northumbria	mm	**133**	297		427		601		1571	
	%	**188**	157	5-10	114	2-5	116	2-5	110	2-5
Midlands	mm	**45**	144		216		335		1042	
	%	**72**	82	2-5	63	30-50	71	20-30	80	40-60
Yorkshire	mm	**90**	206		282		443		1270	
	%	**137**	113	2-5	78	5-15	88	5-10	90	5-10
Anglian	mm	**54**	161		193		292		953	
	%	**104**	107	2-5	67	10-20	77	10-15	92	5-10
Thames	mm	**73**	197		246		378		1076	
	%	**134**	128	2-5	79	5-10	89	2-5	90	5-10
Southern	mm	**75**	209		250		414		1277	
	%	**140**	136	2-5	79	5-10	92	2-5	97	2-5
Wessex	mm	**92**	227		300		462		1252	
	%	**140**	131	2-5	85	5-10	90	2-5	85	10-20
South West	mm	**88**	252		337		571		1696	
	%	**107**	116	2-5	74	10-20	82	5-10	82	20-30
Welsh	mm	**78**	263		406		669		1912	
	%	**79**	105	2-5	79	12-16	88	5-10	85	15-25
Highland	mm	**172**	366		855		1186		2644	
	%	**156**	125	2-5	136	30-50	121	5-15	92	2-5
North East	mm	**170**	362		573		736		1977	
	%	**244**	180	20-30	141	15-25	129	8-12	123	10-20
Tay	mm	**176**	420		742		1036		2315	
	%	**212**	186	20-35	153	50-80	138	20-35	107	2-5
Forth	mm	**166**	372		646		926		2089	
	%	**203**	167	10-20	142	25-40	138	20-35	108	2-5
Tweed	mm	**172**	366		573		806		1896	
	%	**232**	180	10-20	140	10-20	139	20-30	116	5-10
Solway	mm	**152**	382		708		1061		2438	
	%	**143**	140	5-10	129	10-15	130	20-30	102	2-5
Clyde	mm	**165**	381		834		1226		2747	
	%	**131**	118	2-5	128	10-20	123	10-15	94	2-5

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

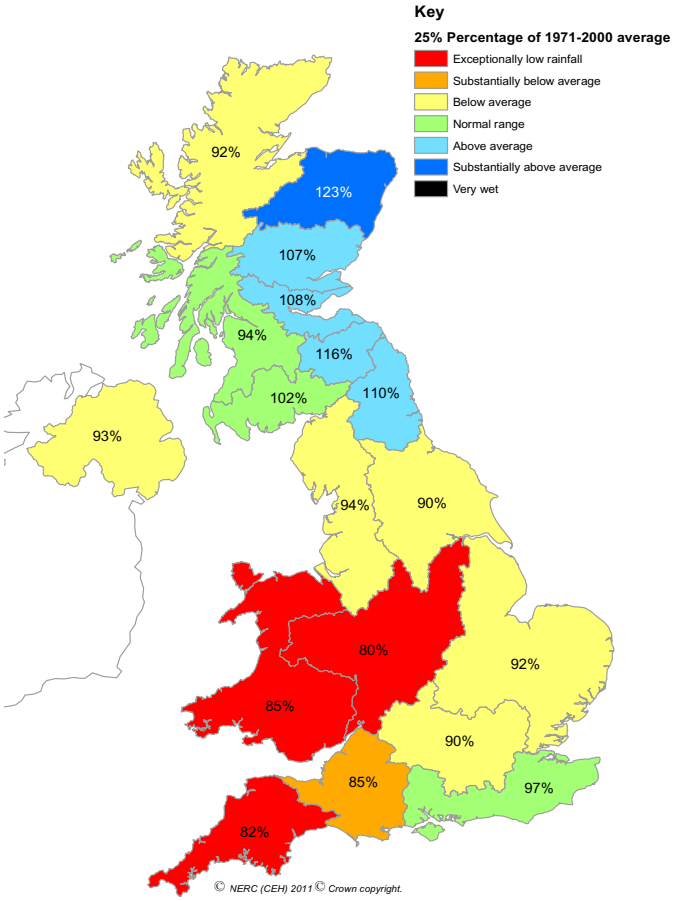
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

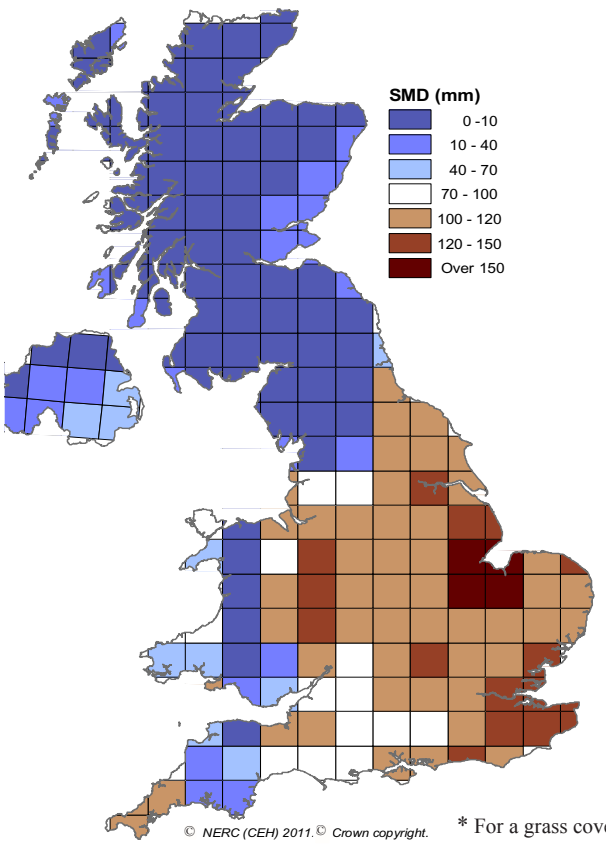
March - August 2011



December 2009 - August 2011

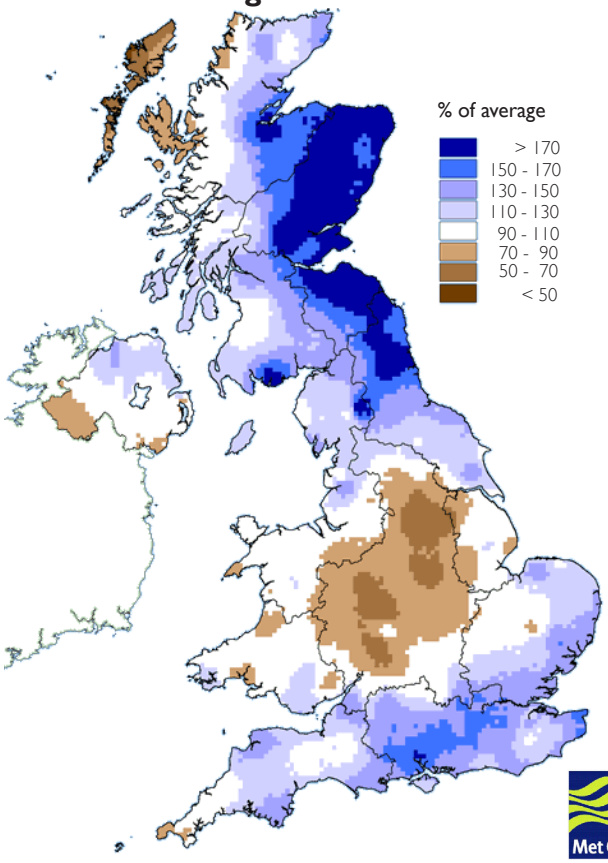


Soil Moisture Deficits* August 2011

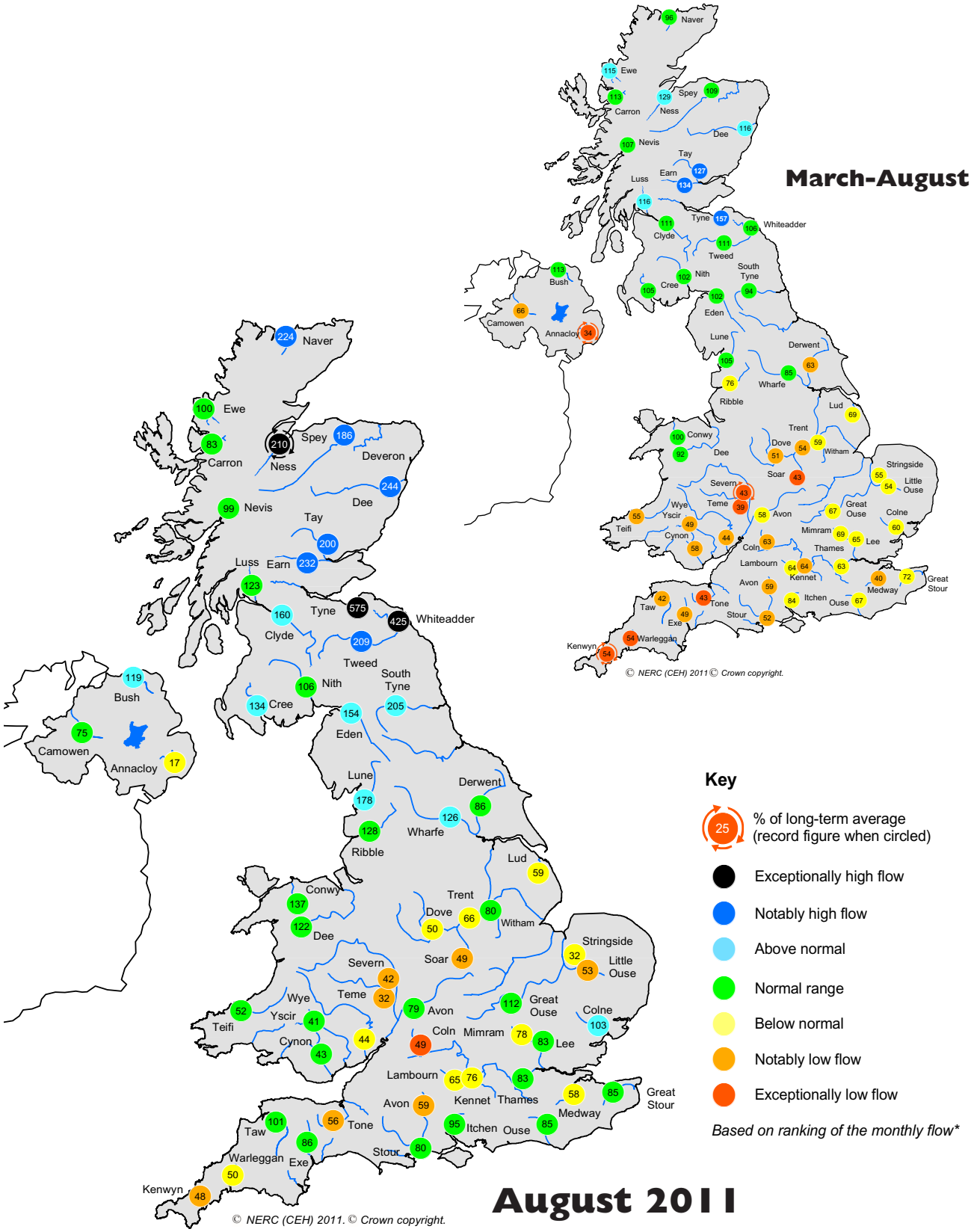


* For a grass cover

June - August 2011 rainfall as % of 1971-2000 average



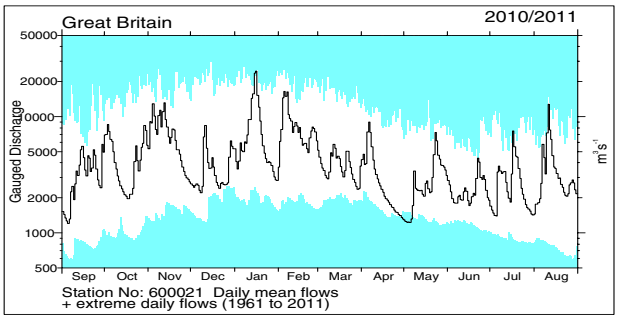
River flow . . . River flow . . .

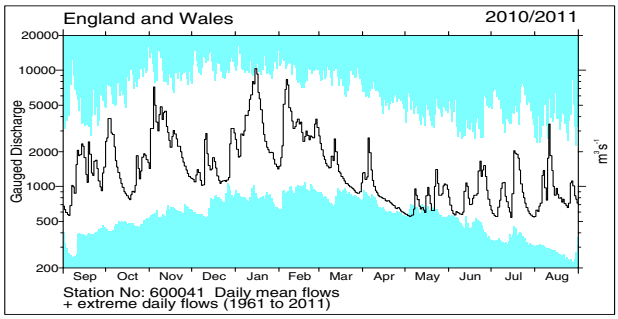


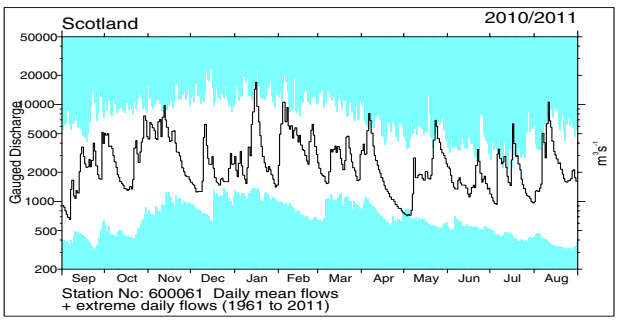
River flows

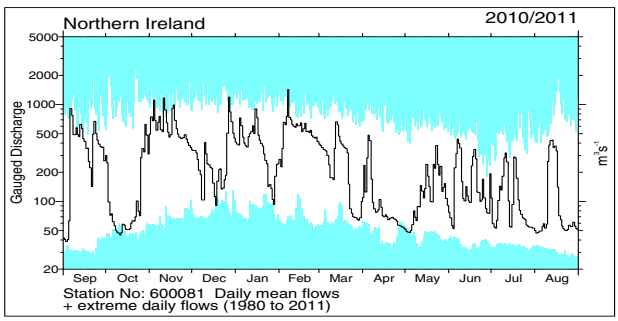
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

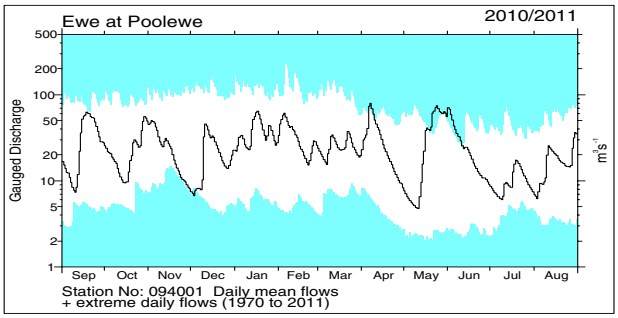
River flow . . . River flow . . .

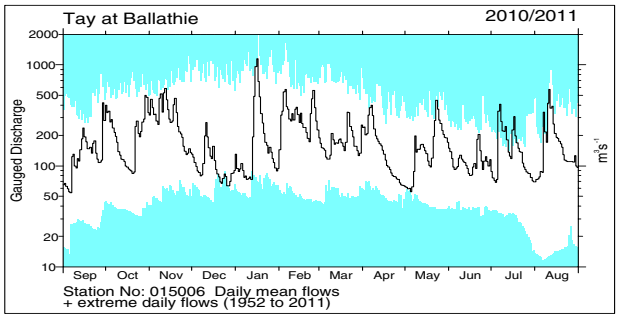


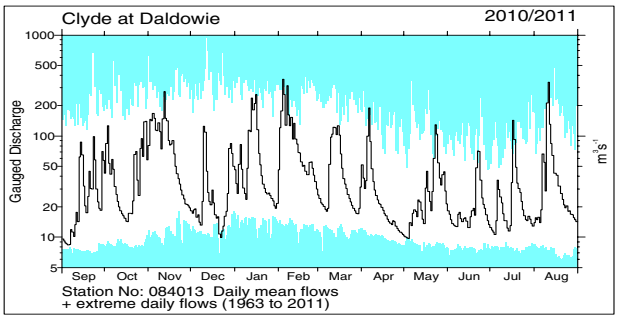


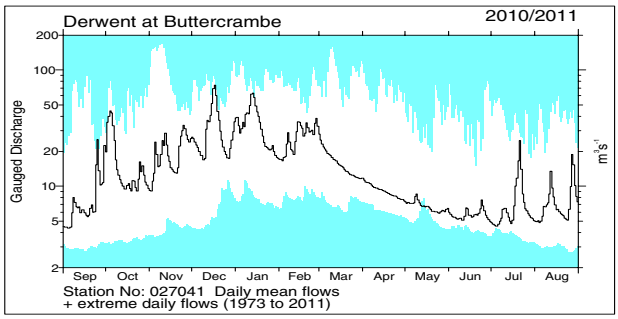


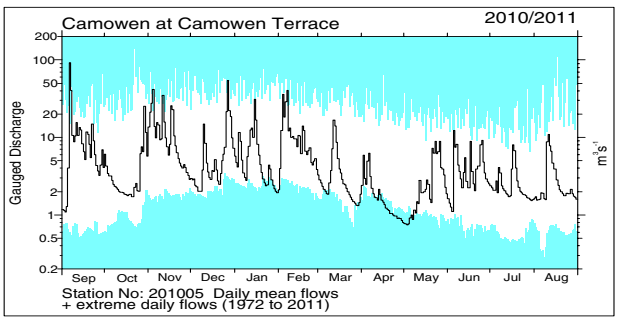


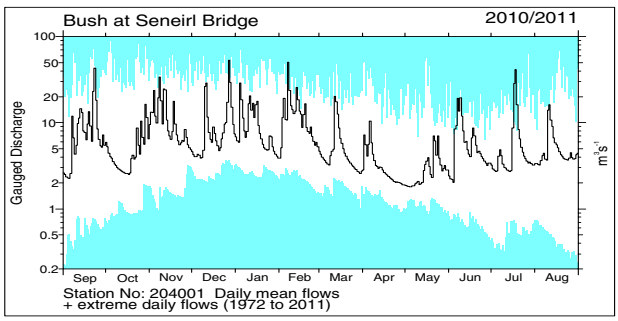








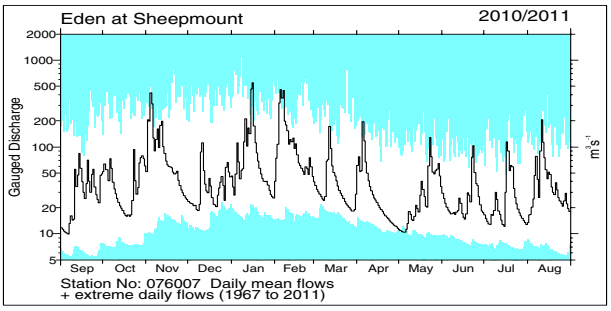


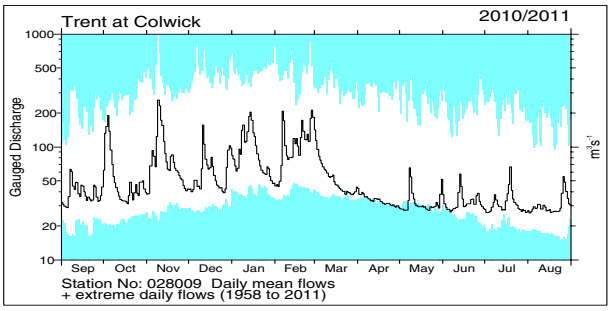


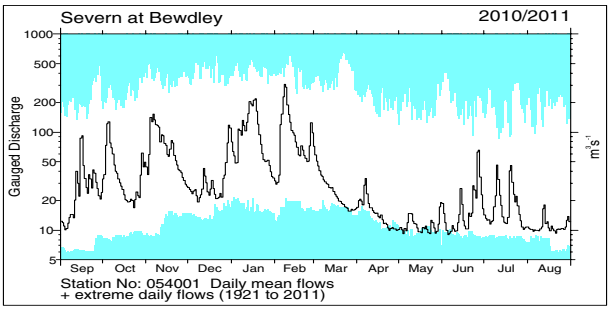
River flow hydrographs

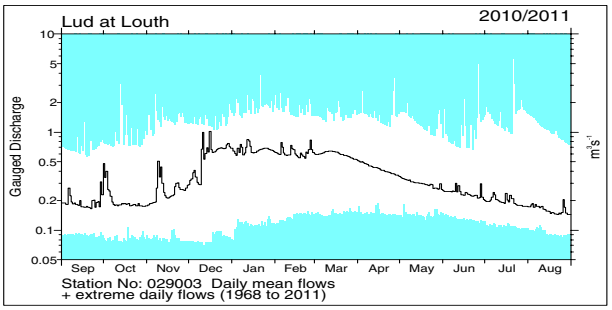
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to September 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

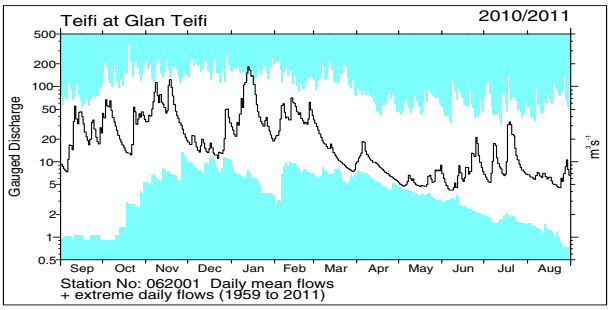
River flow . . . River flow . . .

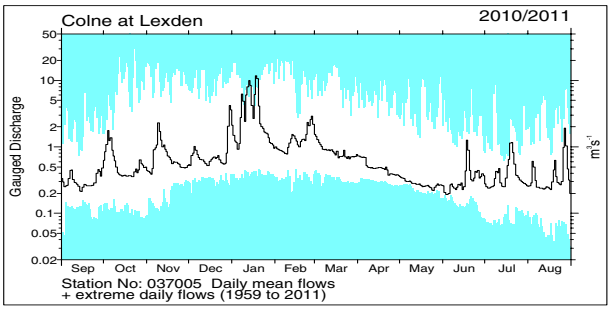


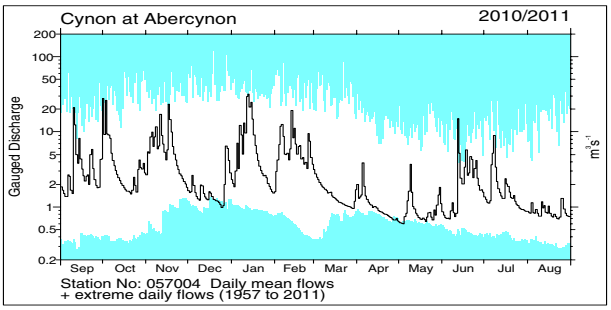


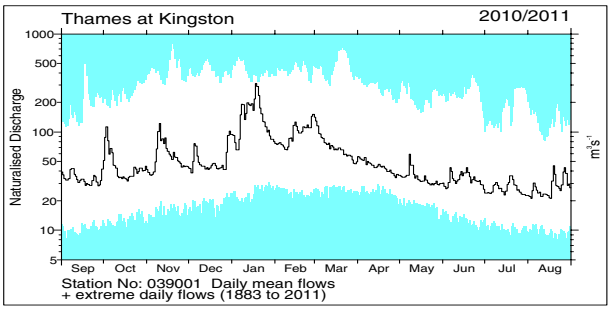


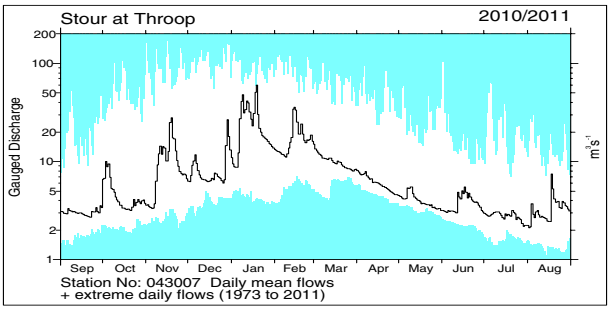


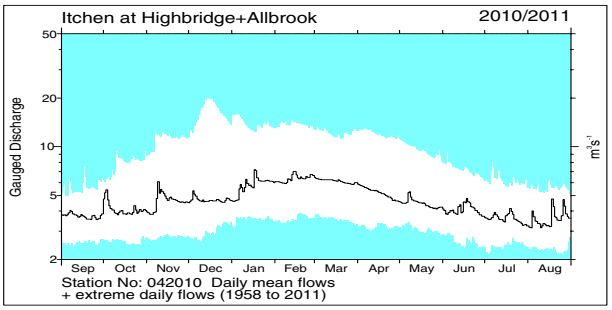












Notable runoff accumulations (a) Jun - Aug 2011 (b) Mar - Aug 2011 (c) Dec 2009 - Aug 2011

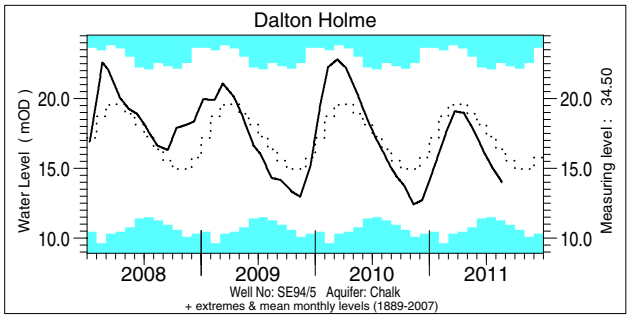
	River	%lta	Rank
a)	Ness	187	39/39
	Dee (Park)	177	37/39
	Tay	182	57/59
	Earn	192	61/64
	Little Ouse	52	3/41
	Coln	51	2/48
	Test	68	4/53
	Avon (Amesbury)	56	3/47

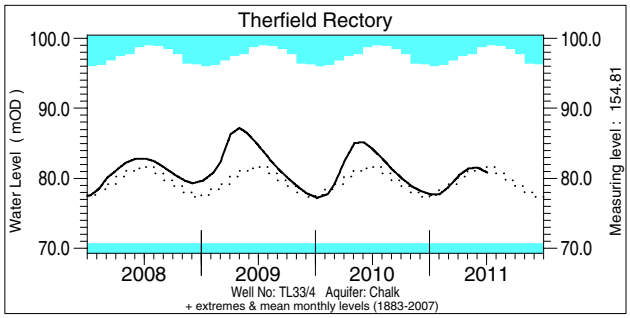
	River	%lta	Rank
b)	Soar	43	2/40
	Mole	57	2/37
	Otter	58	2/49
	Kenwyn	54	1/43
	Tone	43	2/51
	Brue	39	1/46
	Severn	43	1/90
	Teme	39	2/41
	Annacloy	34	1/32

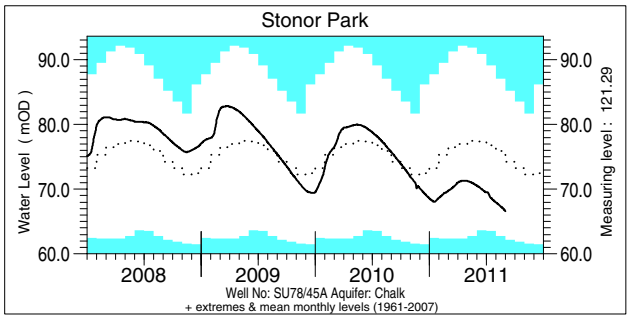
	River	%lta	Rank
c)	Tyne (Spilmersford)	161	43/43
	Whiteadder	145	41/41
	Taw	66	2/52
	Yscir	70	2/37
	Nevis	74	2/28
	Carron	71	1/31
	Ewe	79	2/40

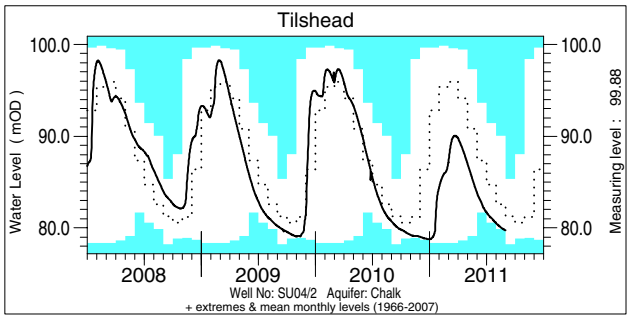
lta = long term average
Rank 1 = lowest on record

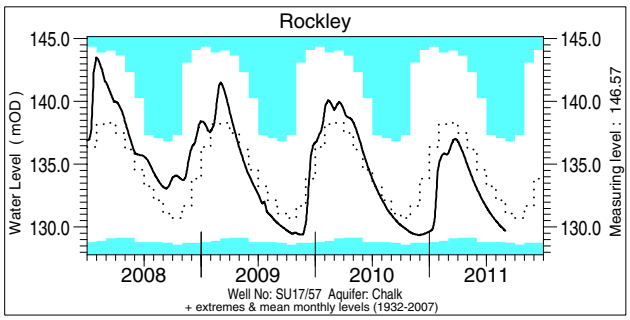
Groundwater . . . Groundwater

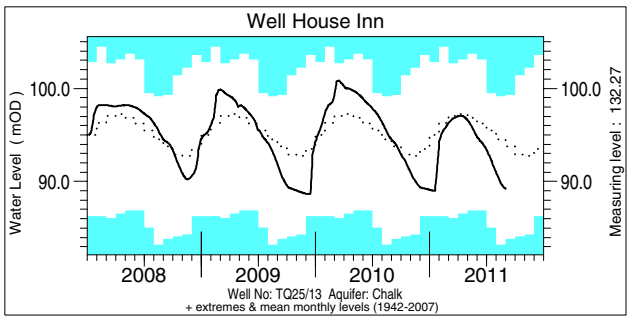


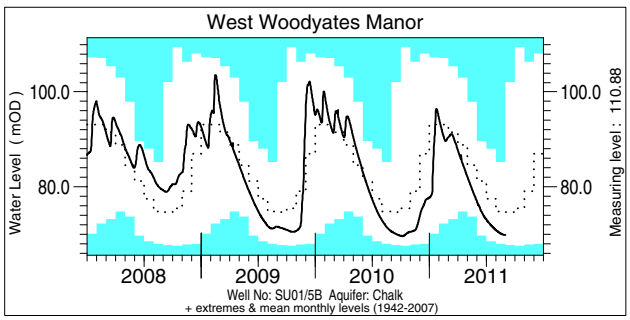


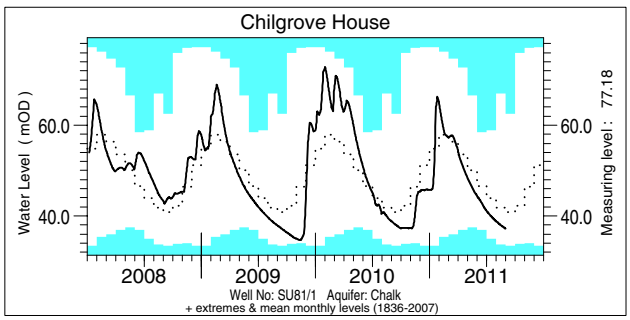


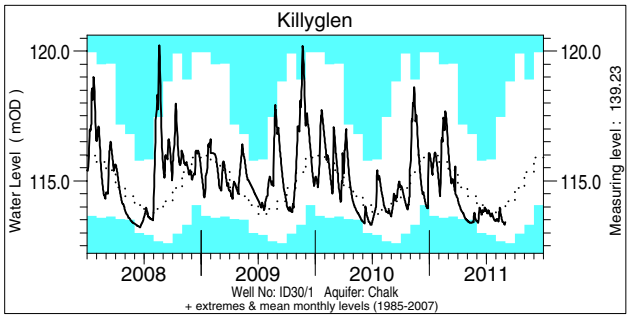


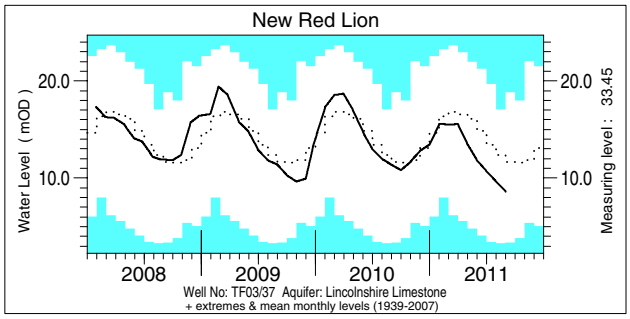






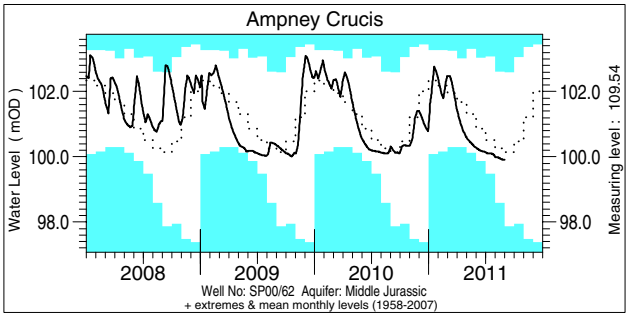


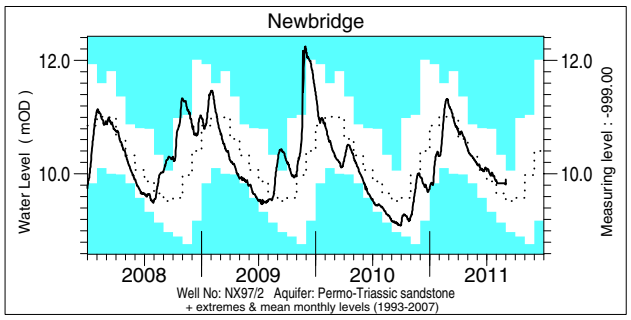


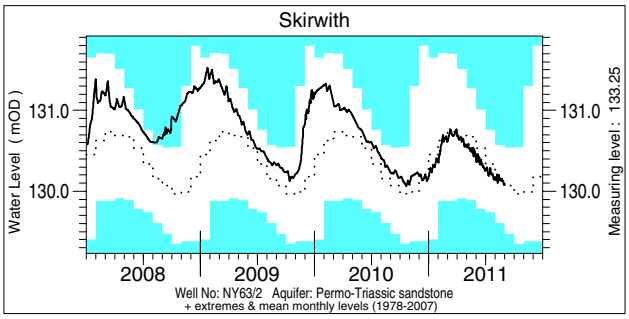


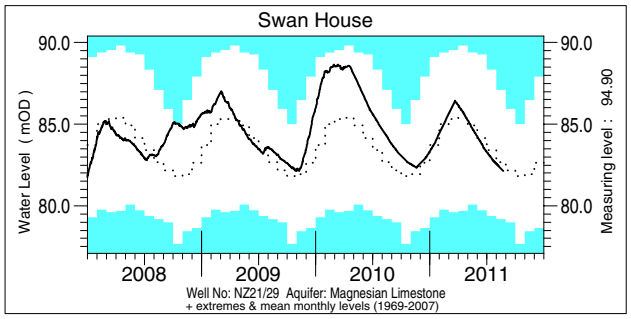
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

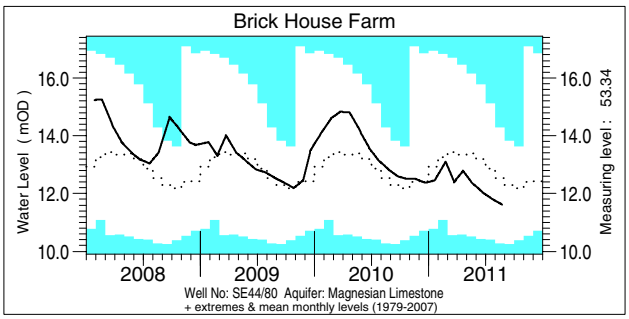
Groundwater . . . Groundwater

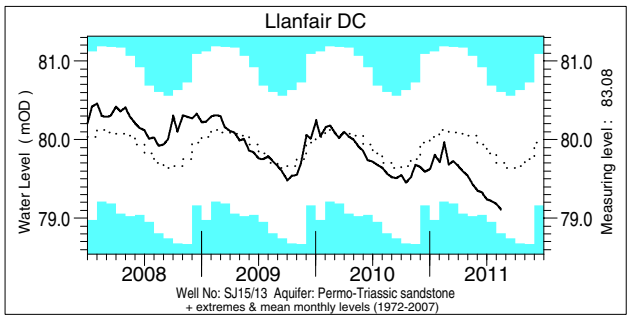


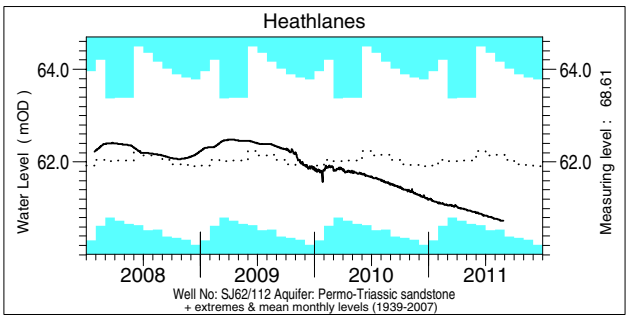


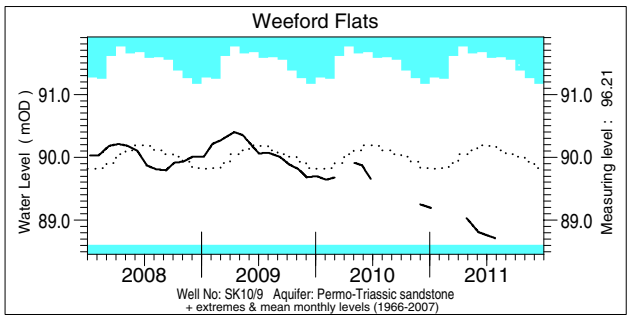


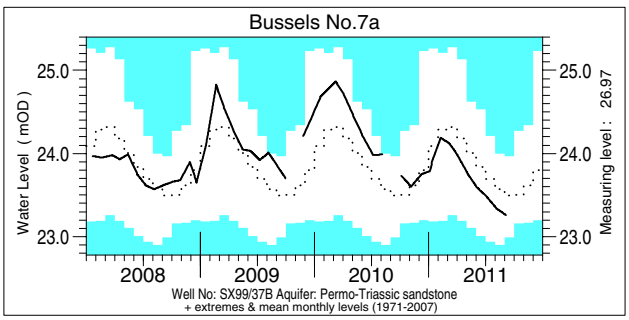


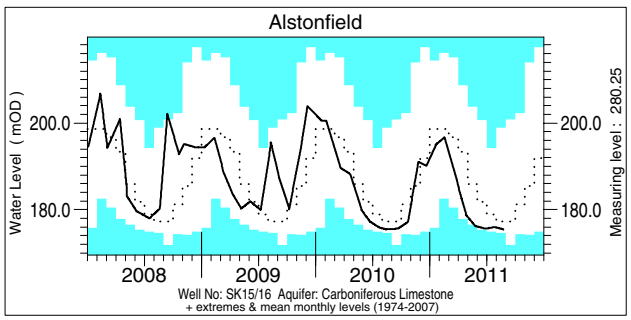












Groundwater levels August / September 2011

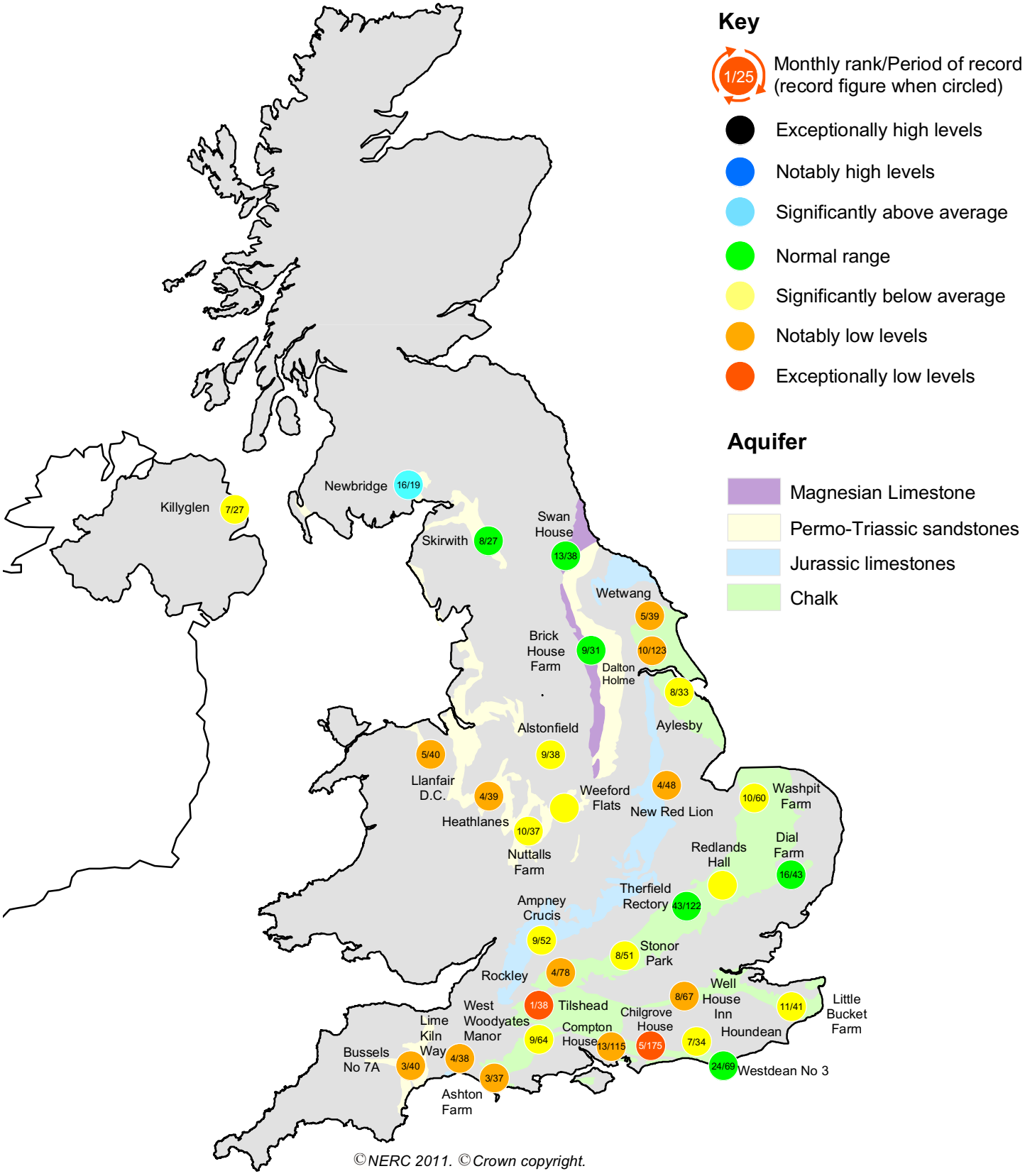
Borehole	Level	Date	Aug av.
Dalton Holme	14.01	19/08	16.27
Therfield Rectory	78.84	01/09	80.93
Stonor Park	66.63	31/08	75.89
Tilshead	79.72	31/08	82.80
Rockley	129.69	31/08	132.07
Well House Inn	89.24	31/08	94.88
West Woodyates	69.86	31/08	74.04

Borehole	Level	Date	Aug av.
Chilgrove House	37.17	31/08	41.71
Killyglen (NI)	113.40	31/08	114.08
New Red Lion	8.59	31/08	12.35
Ampney Crucis	99.91	31/08	100.22
Newbridge	9.90	31/08	9.63
Skirwith	130.08	31/08	130.20
Swan House	82.12	22/08	82.75

Borehole	Level	Date	Aug av.
Brick House Farm	11.61	23/08	12.55
Llanfair DC	79.11	15/08	79.65
Heathlanes	60.73	26/08	62.09
Weeford Flats	88.71	28/07	89.82
Bussels No.7a	23.26	04/09	23.61
Alstonfield	175.45	23/08	178.51

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



Groundwater levels - August 2011

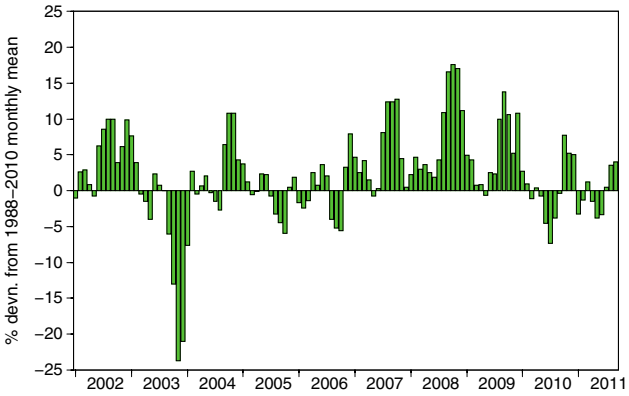
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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.

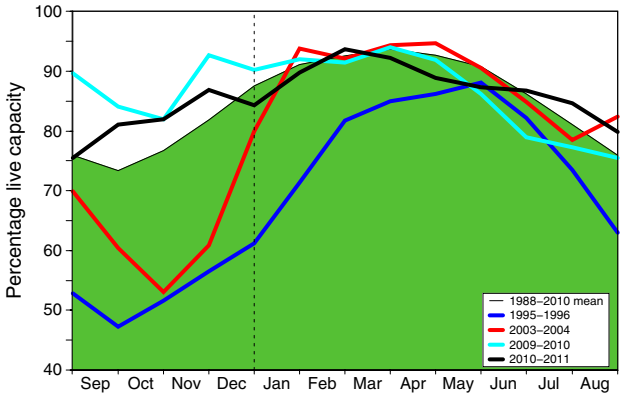
ii. Yew Tree Farm levels are now received quarterly.

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 Jul	Aug	Sep	Sep Anom.	Min Sep	Year* of min	2010 Sep	Diff 11-10
North West	N Command Zone	•	124929	83	75	**66**	8	24	1995	61	5
	Vyrnwy		55146	86	85	**77**	6	36	1995	68	9
Northumbrian	Teesdale	•	87936	93	94	**91**	24	38	1995	62	29
	Kielder		(199175)	(94)	(94)	**(93)**	6	(66)	1989	(88)	5
Severn Trent	Clywedog		44922	100	98	**80**	3	38	1989	83	-3
	Derwent Valley	•	39525	63	62	**56**	-11	34	1995	57	-1
Yorkshire	Washburn	•	22035	72	67	**69**	0	34	1995	71	-2
	Bradford supply	•	41407	73	68	**73**	7	21	1995	58	15
Anglian	Grafham		(55490)	(93)	(93)	**(90)**	5	(59)	1997	(87)	3
	Rutland		(116580)	(81)	(76)	**(73)**	-8	(66)	1995	(75)	-2
Thames	London	•	202828	95	89	**86**	6	62	1995	87	-1
	Farmoor	•	13822	100	99	**98**	5	64	1995	98	0
Southern	Bewl		28170	73	63	**57**	-12	38	1990	64	-7
	Ardingly		4685	84	75	**61**	-12	47	1996	76	-15
Wessex	Clatworthy		5364	71	63	**49**	-15	31	1995	49	0
	Bristol WW	•	(38666)	(73)	(67)	**(62)**	-6	(43)	1990	(62)	0
South West	Colliford		28540	66	60	**50**	-22	43	1997	74	-24
	Roadford		34500	60	55	**53**	-20	40	1995	68	-15
	Wimbleball		21320	63	55	**47**	-24	40	1995	57	-10
	Stithians		4967	71	62	**51**	-10	30	1990	56	-5
Welsh	Celyn and Brenig	•	131155	97	95	**94**	13	49	1989	83	11
	Brianne		62140	89	98	**94**	8	55	1995	86	8
	Big Five	•	69762	87	87	**76**	6	29	1995	75	1
	Elan Valley	•	99106	85	94	**83**	6	46	1995	67	16
Scotland(E)	Edinburgh/Mid Lothian	•	97639	91	92	**91**	13	45	1998	78	13
	East Lothian	•	10206	94	100	**100**	17	63	1989	74	26
Scotland(W)	Loch Katrine	•	111363	95	89	**92**	23	50	2000	55	37
	Daer		22412	99	99	**99**	24	41	1995	84	15
	Loch Thom	•	11840	100	96	**96**	16	58	1997	79	17
Northern Ireland	Total+	•	56920	82	77	**72**	-4	40	1995	76	-4
	Silent Valley	•	20634	78	72	**66**	-3	33	2000	81	-15

() 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.

Location map . . . Location map

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.

09/11