Hydrological Summary
for the United Kingdom

July 2010

General

July was a month of exceptional spatial contrasts in rainfall and river flow patterns. At the national scale, July was the wettest month of the year thus far; more significantly, the highest rainfall totals broadly coincided with the regions of highest water resources stress. In north-west England, western Scotland and north Wales, the rain (helped by the thin soils and steep slopes which aid runoff), generated exceptional mid-summer increases in reservoir stocks, easily the highest on record for July for several major reservoirs in the Lake District; in Scotland the July level increase in Loch Katrine was also unprecedented (in a 17-year series). However, overall reservoir stocks for England &Wales for early August were the 2nd lowest since 1996 with well below average stocks in some index reservoirs in the southern Pennines, central Wales and the South West. July runoff was considerably above average for the UK as a whole and flood alerts were common mid-month but river flows are still depressed in some responsive southern, central and eastern catchments where soils remain notably dry (with associated agricultural stress). Generally, groundwater level recessions continued throughout the major aquifer outcrop areas but groundwater levels, whilst mostly below average, are still within the normal range in most areas. Over much of the UK, the 2010 drought moderated significantly through July but rainfall deficiencies increased in many eastern and southern catchments. In such areas above average late summer and autumn rainfall will be required to ensure that the seasonal recoveries in river flow, recharge rates and reservoir stocks are not be substantially delayed.

Rainfall

Low pressure dominated synoptic patterns across much of the country during July and Atlantic frontal systems brought substantial rainfall to many western and northern areas. 24-hr totals of 74mm was recorded at Auchincruive (Ayrshire) on the 4th and Hawarden (Flintshire) registered 68mm on the 21st. In Snowdonia, Capel Curig reported an exceptional 360mm July total. The UK as a whole experienced its 4th successive wet July as large areas of western and northern Britain registered more than twice the July rainfall average. However, the normal regional contrasts in rainfall totals were greatly exaggerated: Provisionally, Scotland reported its 2nd wettest July in 70 years and, crucially in relation to the water resources outlook, north-west England had its 6th wettest July in a series from 1914. However, many of the weather fronts weakened markedly as they moved east and, as a consequence, large parts of the English Lowlands recorded less than half the July average rainfall; monthly totals falling below 10mm in some southern and eastern districts. The marked spatial contrast in rainfall amounts impacted directly on drought intensities across the country. For north-west England, the July rainfall (60% more than in the previous three months combined) was a very timely moderating factor. By contrast the lack of recent rainfall contributed to the 4th driest April-July period in the last 90 years for the Thames region; in this timeframe large deficiencies also extend across much of eastern, central and southern England. Notwithstanding the above average July rainfall, the first seven months of 2010 were the 6th driest for England & Wales in a 96-yr record.

River flows

Depressed river flows characterised many responsive UK rivers at the beginning of July (for example, the Clyde, Tweed, Tay and Mourne fell below previous early-July minima). However recessions were briskly reversed in most western and northern catchments heralding some notable summer spates in mid-July; the Welsh Dee recorded its 2nd highest July flow since 1954 and the Tay its 2nd highest in 25 years. Flood Watches were common (in a summer context) across northern Britain particularly and urban flash flooding incidents (e.g. in Liverpool and Swansea on the 20th) were widely reported, often associated with substantial transport disruption. Notably high July runoff totals characterised many western and northern rivers – the 2nd highest in a 46-yr series for the Conwy. In contrast, across the English Lowlands the limited rainfall and exceptionally dry soils ensured that any river flow recoveries were very muted and July runoff totals were well below average in some catchments (e.g. the 2nd lowest since 1976 for the Little Ouse and the lowest since 1995 for the Tone). Such catchments aside, flows in most lowland rivers remain within the normal range (groundwater making a valuable contribution in many). The drought's hydrological impact is much more evident when accumulated runoff over the Jan-July period is considered. Away from the English Lowlands runoff for the majority of index rivers over the year thus far is 30% or more below average and the lowest on record in some western rivers draining mountainous catchments (e.g. the Nevis and upper Welsh Dee).

Groundwater

Although the sustained July rainfall and seasonally moderate evaporation demands left soil moisture deficits below the late-July average across much of western and northern Britain, soils remained substantially drier than average across the outcrop areas of most major aquifers. Correspondingly, recharge in July was largely confined to some notably wet localities (e.g. in north Wales, the Eden Valley and Devon). Generally, the seasonal recessions in groundwater levels continued through the month with the relative depression of the water table reflecting the responsiveness of the individual aquifer units. In the faster-responding aquifers (e.g. the Carboniferous Limestone, Middle Jurassic and western Chalk outcrops) levels are low (but appreciably above drought minima) whilst levels in the slower-responding aquifers (e.g. much of the Permo-Triassic sandstones and the eastern Chalk outcrops) remain within the normal range – and estimated overall storage throughout the Chalk aquifer is only moderately below the late summer average. Levels in most minor aquifers (e.g. the Anglian Drift) are also fairly typical of the late summer. The well above average late-July soil moisture deficits in parts of southern, central and north-eastern England are likely, however, to cause an appreciable delay in the seasonal onset of recharge later in the year.

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.

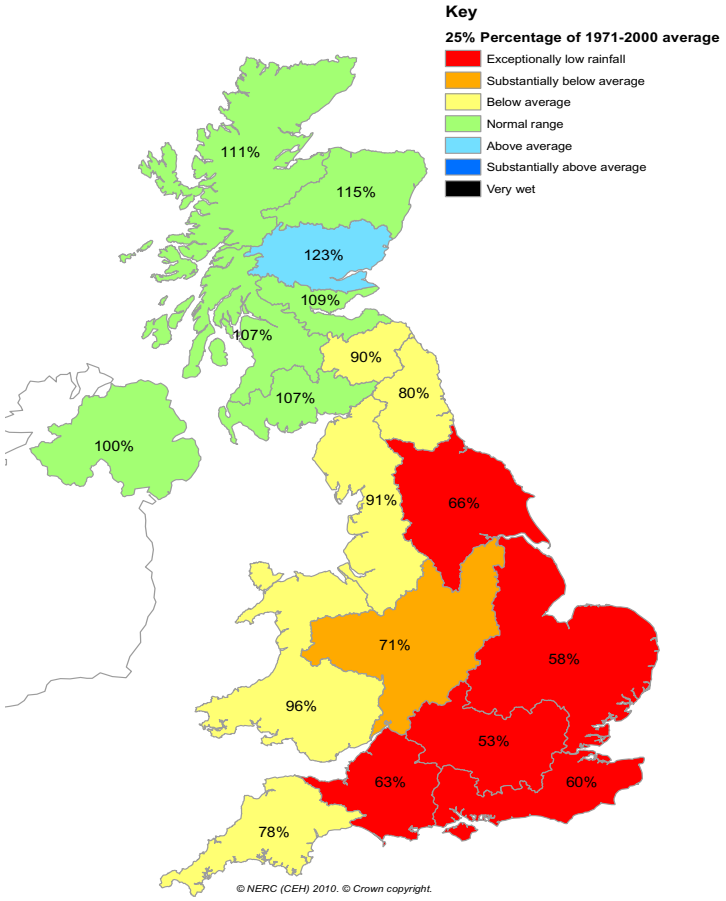
Area	Rainfall	Jul 2010	Apr10 - Jul10	RP	Jan10 - Jul10	RP	Nov09 - Jul10	RP	Aug09 - Jul10	RP
England & Wales	**mm**	**74**	**175**		**384**		**677**		**852**	
	%	**134**	**74**	**10-20**	**82**	**5-15**	**103**	**2-5**	**95**	**2-5**
North West	mm	**160**	262		473		876		1171	
	%	**205**	91	5-10	79	10-20	103	2-5	100	<2
Northumbrian	mm	**98**	189		439		735		916	
	%	**171**	80	5-10	99	2-5	120	5-10	110	2-5
Severn Trent	mm	**51**	155		314		518		650	
	%	**104**	71	10-20	77	10-20	93	2-5	86	5-10
Yorkshire	mm	**63**	151		361		622		780	
	%	**119**	66	25-40	83	5-10	103	2-5	96	2-5
Anglian	mm	**32**	111		274		444		546	
	%	**72**	58	25-40	84	5-10	101	2-5	91	2-5
Thames	mm	**24**	108		299		539		656	
	%	**56**	53	30-45	80	5-10	105	2-5	94	2-5
Southern	mm	**28**	121		369		701		830	
	%	**62**	60	15-25	93	2-5	123	5-10	106	2-5
Wessex	mm	**39**	137		342		632		797	
	%	**84**	63	20-30	76	5-15	99	2-5	92	2-5
South West	mm	**92**	215		501		877		1101	
	%	**150**	78	5-10	81	5-10	97	2-5	91	2-5
Welsh	mm	**147**	291		546		999		1270	
	%	**206**	96	2-5	82	10-20	103	2-5	96	2-5
Scotland	**mm**	**168**	**350**		**624**		**989**		**1487**	
	%	**195**	**110**	**2-5**	**85**	**5-10**	**94**	**2-5**	**103**	**2-5**
Highland	mm	**181**	395		684		1032		1615	
	%	**191**	111	2-5	79	5-10	82	5-10	94	2-5
North East	mm	**135**	297		576		855		1227	
	%	**203**	115	2-5	115	2-5	124	10-20	129	35-50
Tay	mm	**171**	348		594		954		1381	
	%	**232**	123	2-5	89	2-5	102	2-5	109	2-5
Forth	mm	**149**	294		543		863		1226	
	%	**210**	109	2-5	92	2-5	104	2-5	108	2-5
Tweed	mm	**131**	230		518		854		1142	
	%	**204**	90	2-5	102	2-5	121	10-20	120	5-15
Solway	mm	**167**	343		614		1081		1598	
	%	**192**	107	2-5	86	2-5	106	2-5	114	5-15
Clyde	mm	**202**	390		668		1119		1737	
	%	**188**	107	2-5	77	5-15	89	2-5	100	<2
Northern Ireland	**mm**	**133**	**284**		**533**		**830**		**1152**	
	%	**180**	**100**	**<2**	**91**	**2-5**	**102**	**2-5**	**104**	**2-5**

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

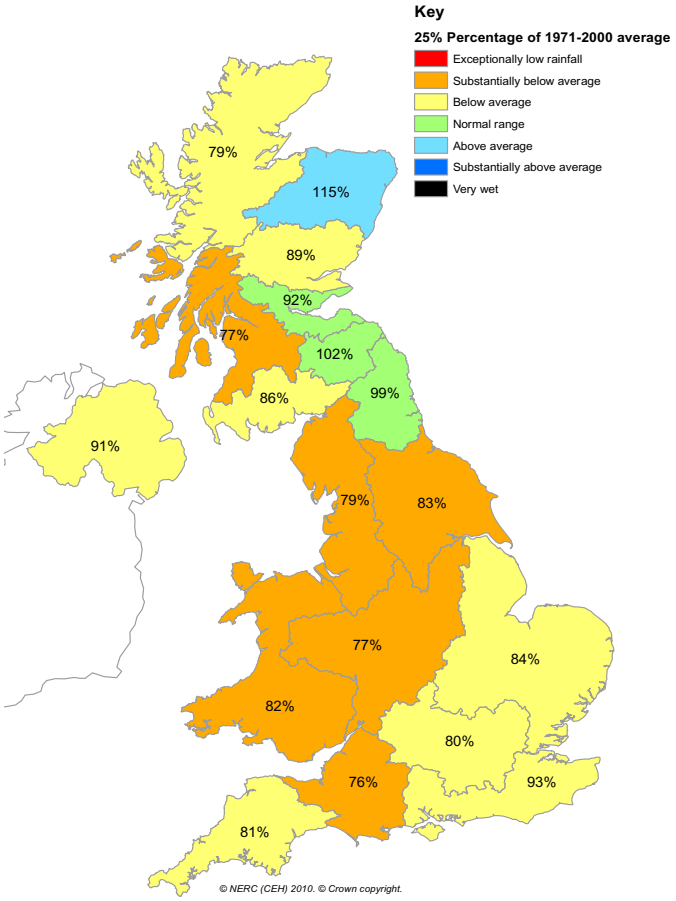
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1913; 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 February 2010 are provisional.

Rainfall . . . Rainfall . . .

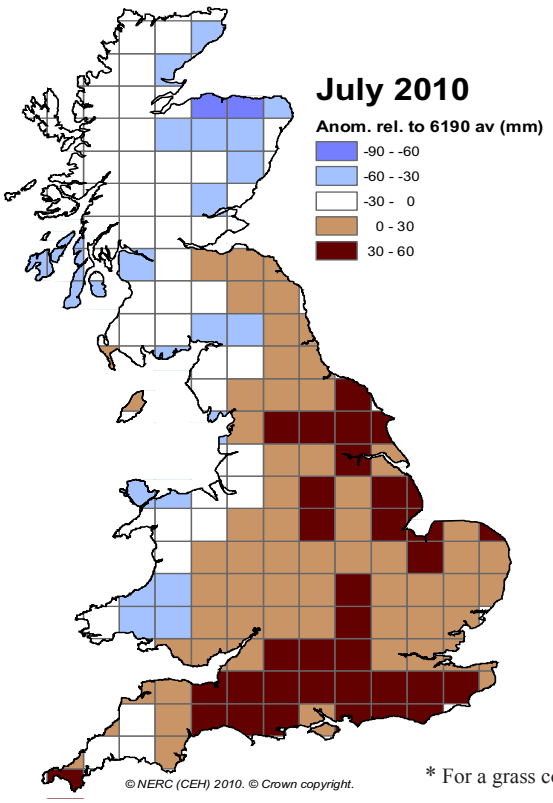
April - July 2010



January - July 2010



MORECS Soil Moisture Deficits *



* For a grass cover

Met Office Weather forecast

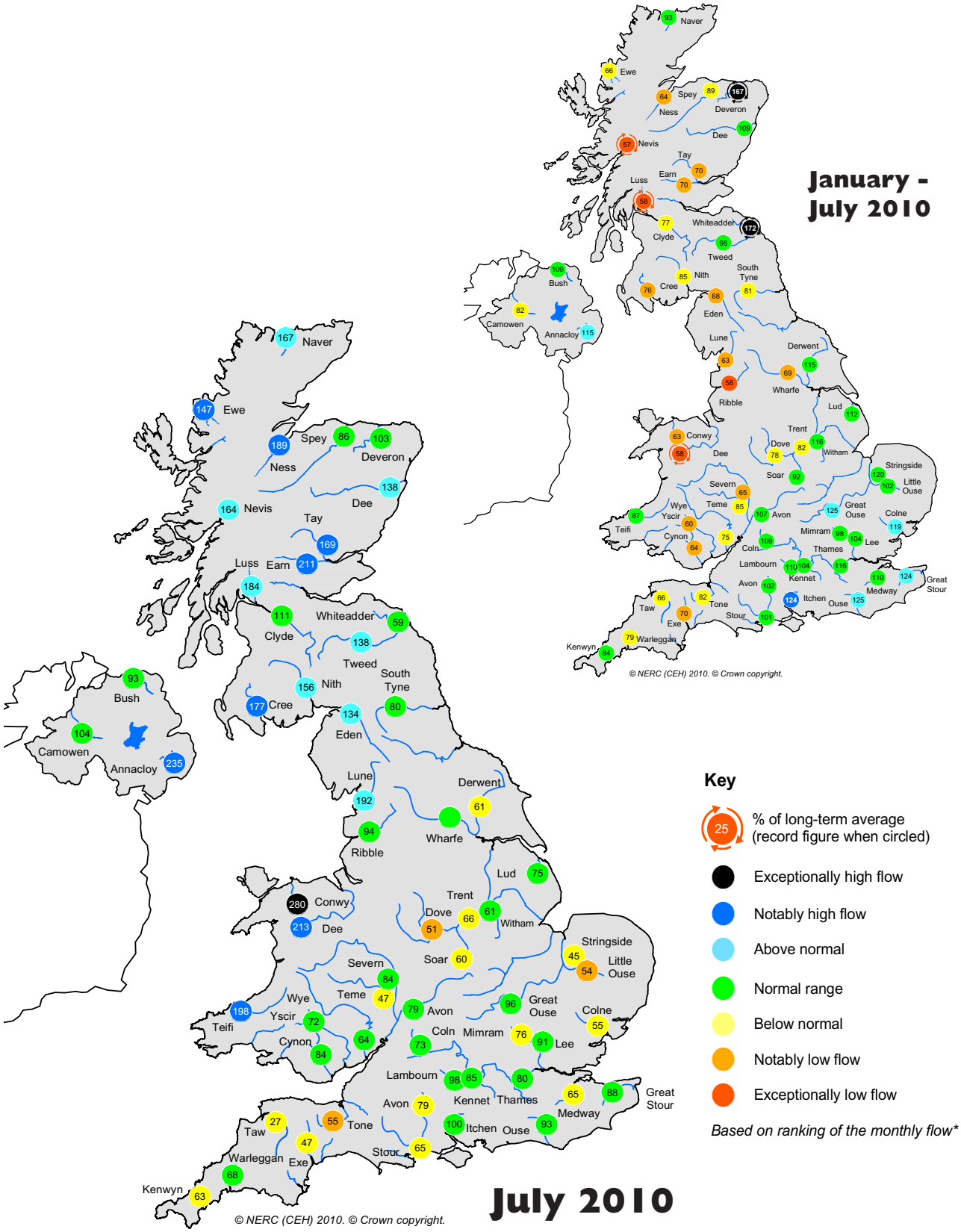
Updated: 12:21 on Thurs 12 Aug 2010

UK Outlook for Tues 17 Aug to Thurs 26 Aug 2010:
Unsettled weather conditions will affect many parts of the UK throughout the period, with the heaviest and most persistent rain the east at first and, most probably, to the north, west and southwest later. There will be some drier and brighter weather at times too, the best of this is likely to be in the west and northwest initially, then more likely across central, eastern and southern parts later. Daytime temperatures will be close to average for the time of year, although it will be rather cool in areas affected by more persistent rain. Southern and southwestern parts of the UK may become warm at times later in the forecast period when some improvement is expected.

UK Outlook for Fri 27 Aug to Fri 10 Sep 2010:
The north and northwest of the UK will continue to see further spells of rain or showers, perhaps extending further south at times, whilst an emphasis on mainly dry, bright and increasingly warm weather is expected for the south. Rainfall amounts should be mainly average or below average across most of England, Wales and southern Scotland, but may end up being slightly above average in the far north and west of Scotland. Temperatures are likely to continue to be average or slightly above average for most of the UK, but warmer in the south.

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

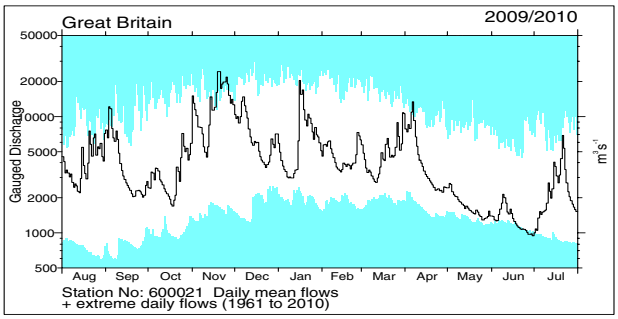
River flow . . . River flow . . .

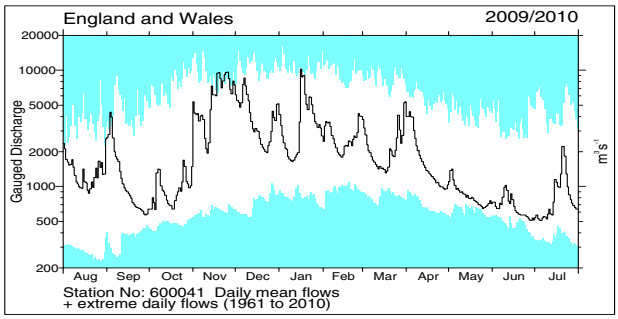


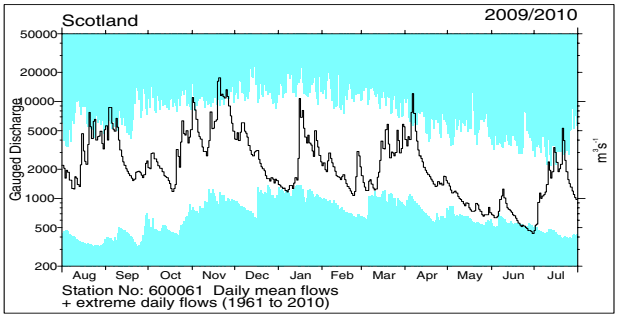
River flows

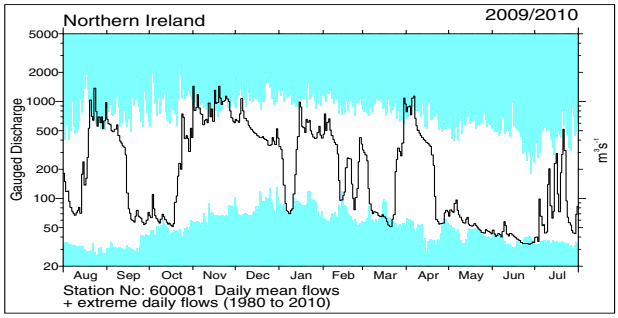
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

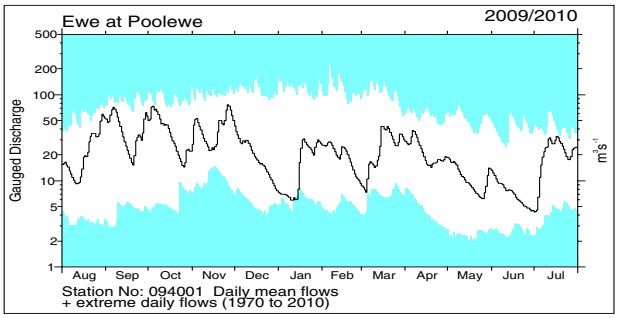
River flow . . . River flow . . .

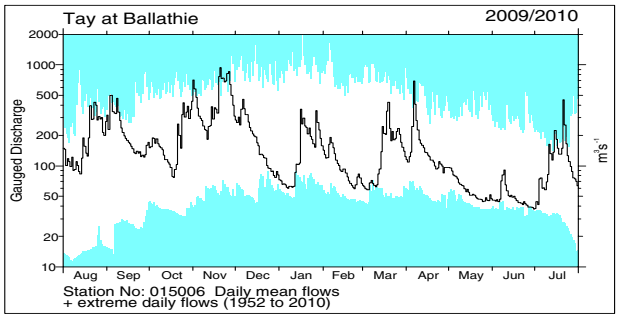


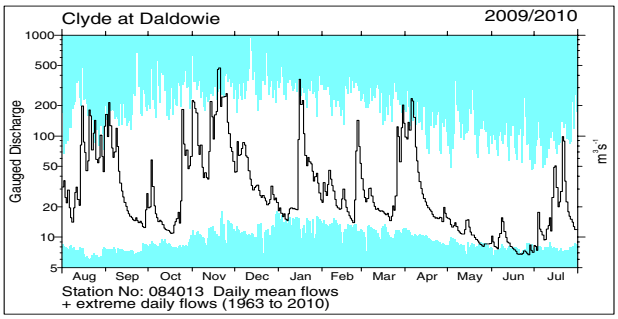


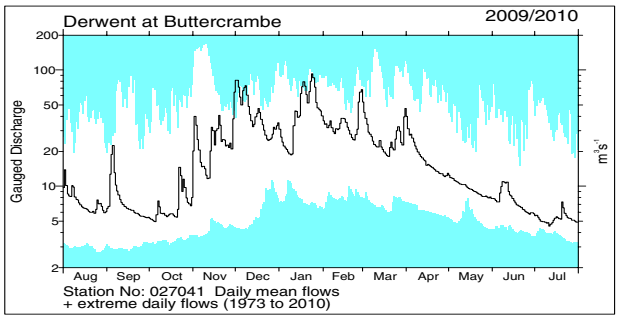


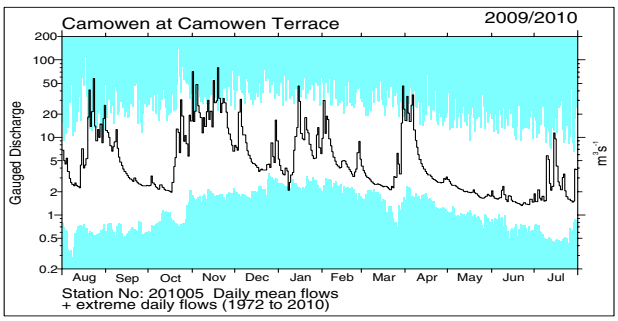


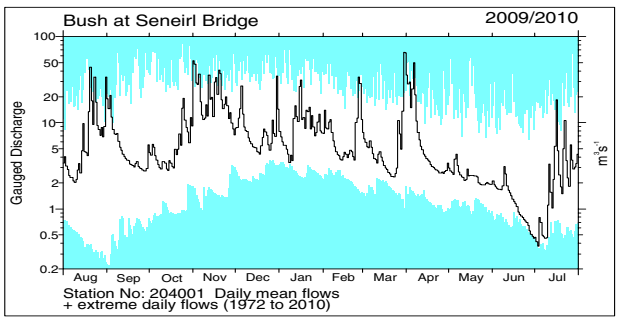








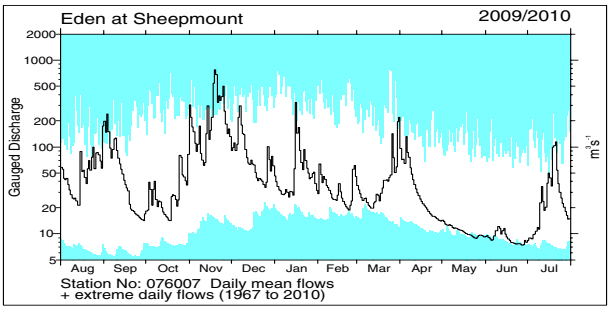


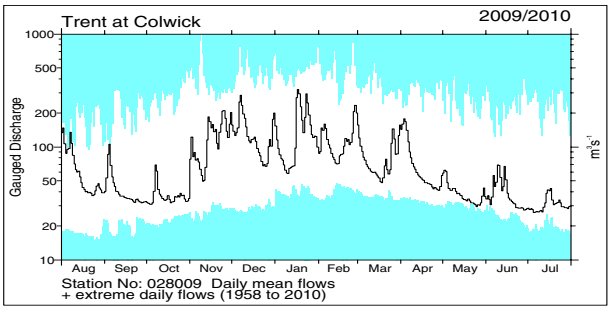


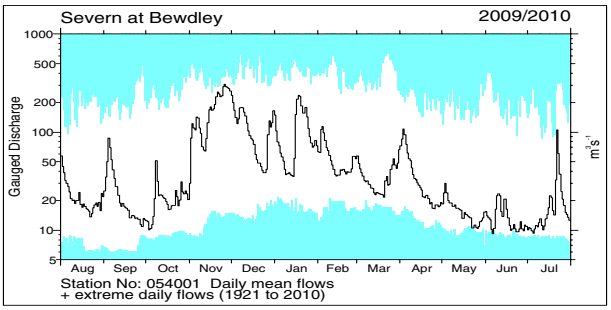
River flow hydrographs

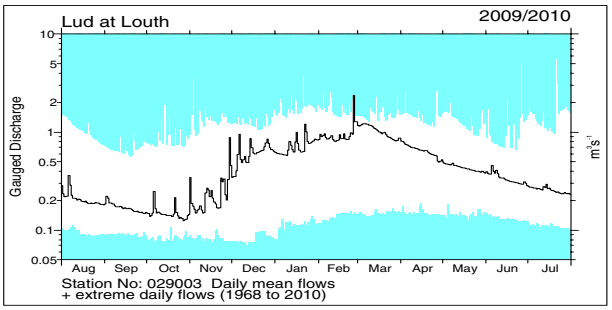
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

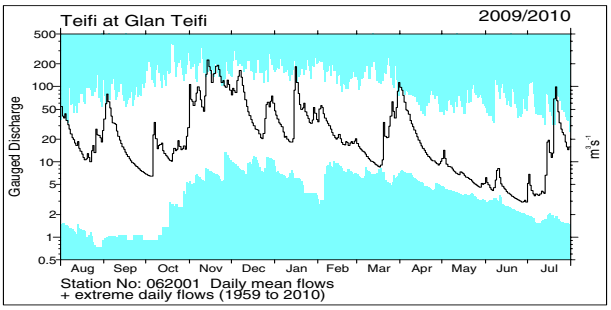
River flow . . . River flow . . .

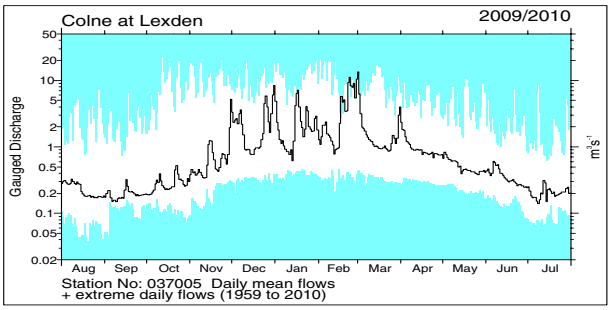


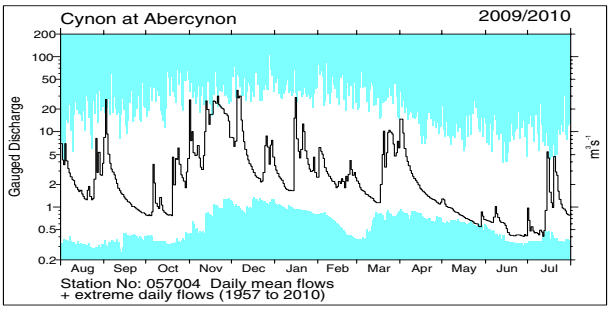


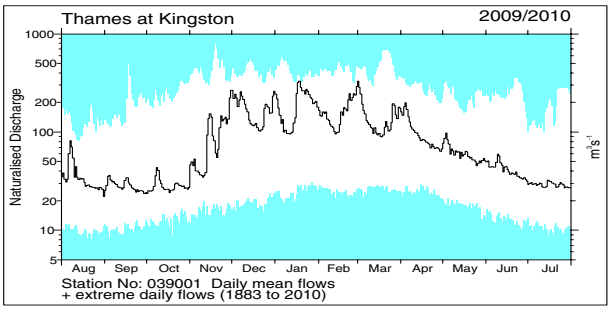


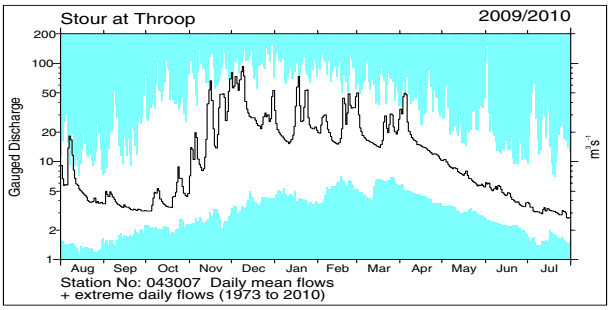


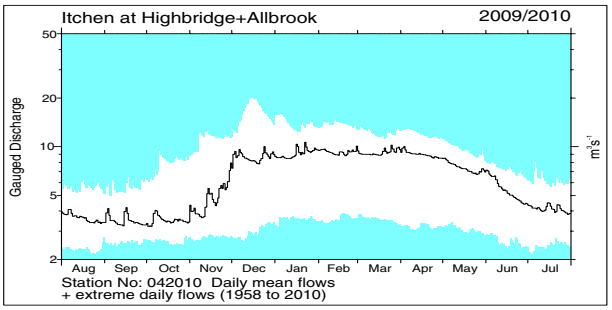












Notable runoff accumulations (a) May- July 2010 (b) January - July 2010

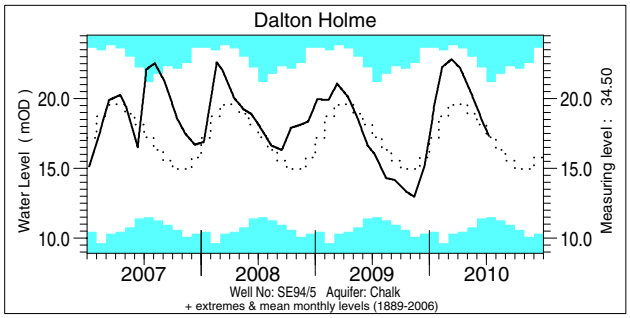
	River	%lta	Rank
a)	S Tyne	50	3/47
	Dove	55	4/49
	Mole	58	4/37
	Exe	41	3/55
	Taw	28	3/52
	Tone	58	4/50
	Brue	40	4/46
	L Bann	49	4/30

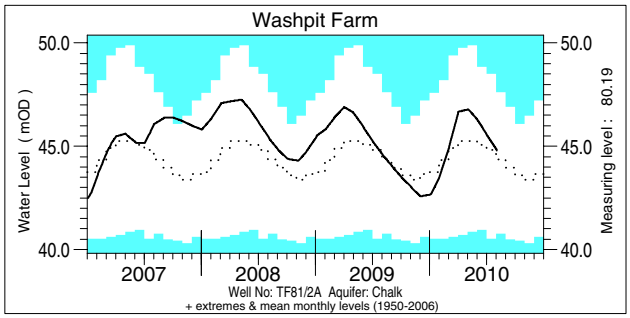
	River	%lta	Rank
b)	Deveron	167	50/50
	Tay	70	3/58
	Forth	56	1/29
	Tyne (Spilmersford)	173	46/46
	Whiteadder	172	41/41
	Yscir	60	3/38
	Conwy	63	3/43
	Dee (New Inn)	58	1/41

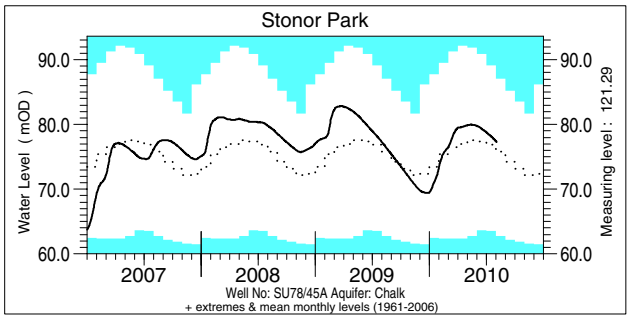
	River	%lta	Rank
b)	Ribble	58	2/50
	Lune	63	3/50
	Cree	76	4/47
	Luss	58	1/32
	Nevis	57	1/28
	Mourne	73	3/28

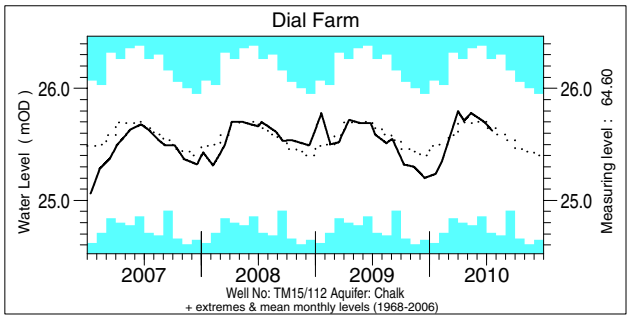
lta = long term average
Rank 1 = lowest on record

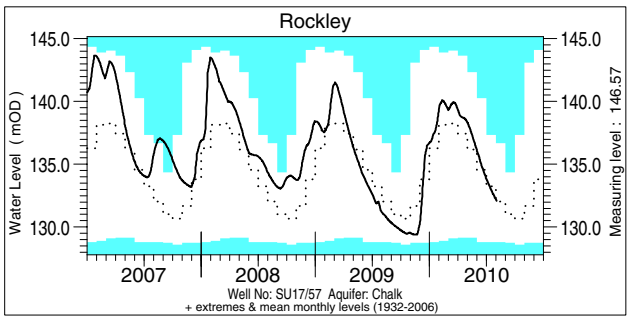
Groundwater . . . Groundwater

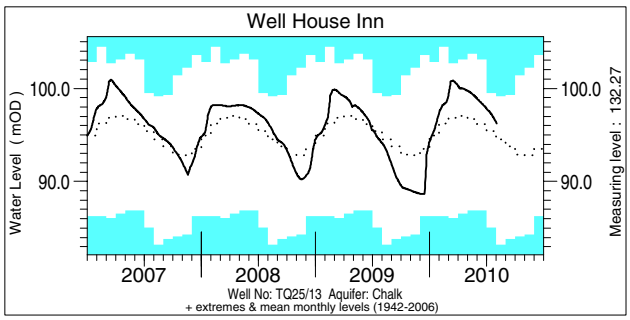


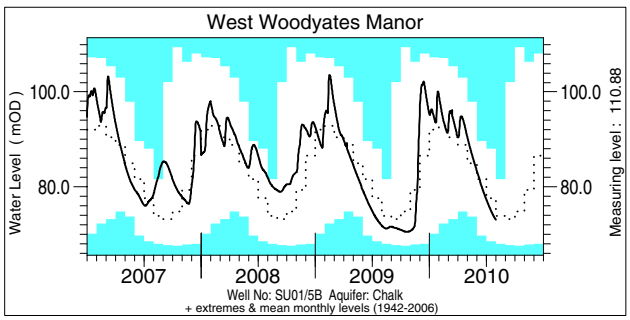


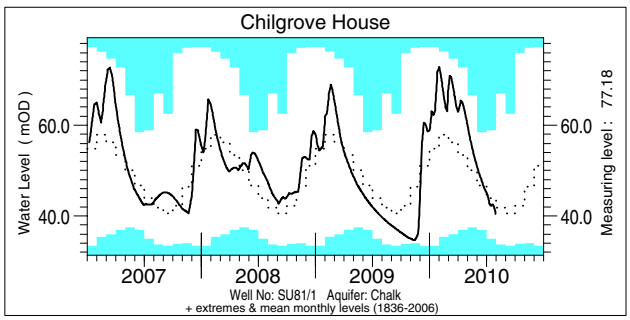


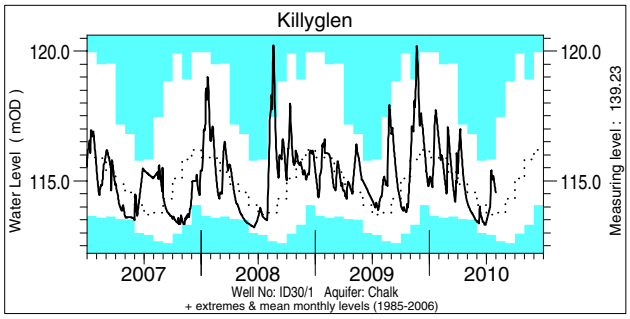


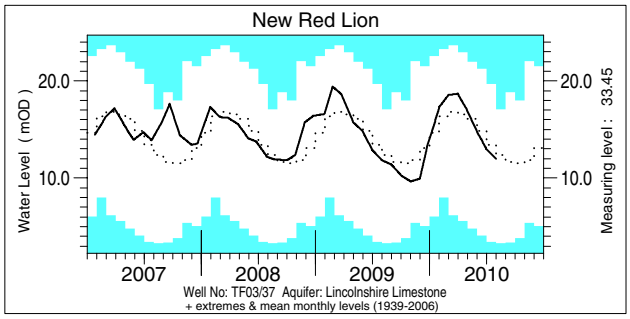






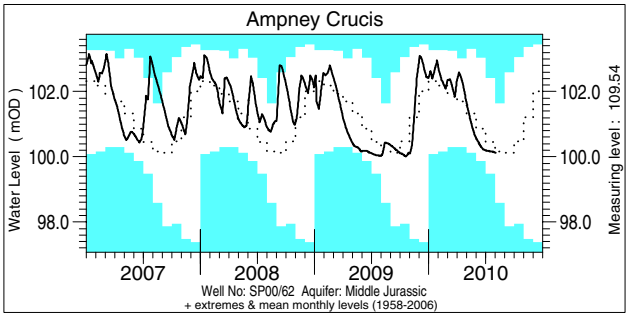


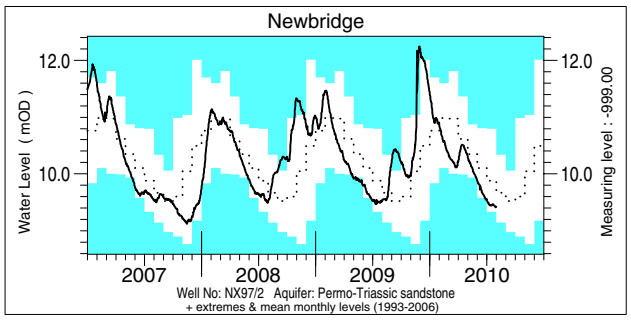


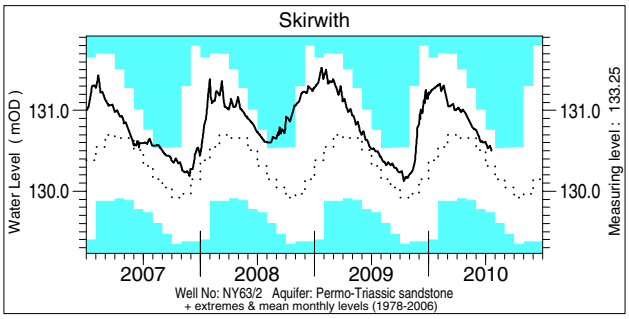


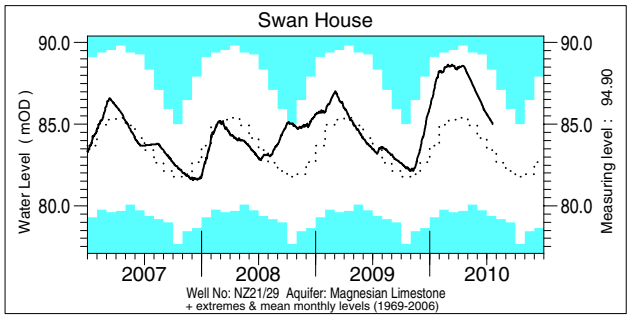
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

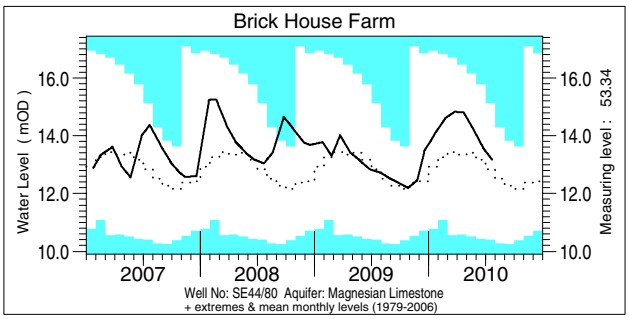
Groundwater . . . Groundwater

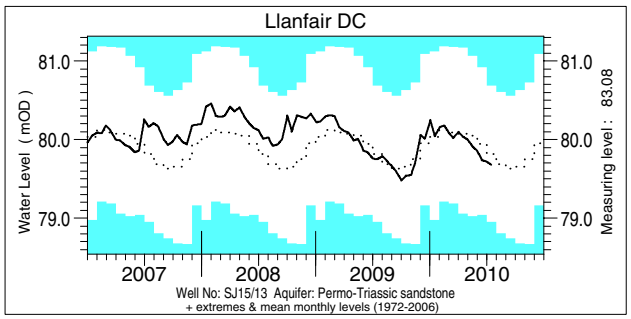


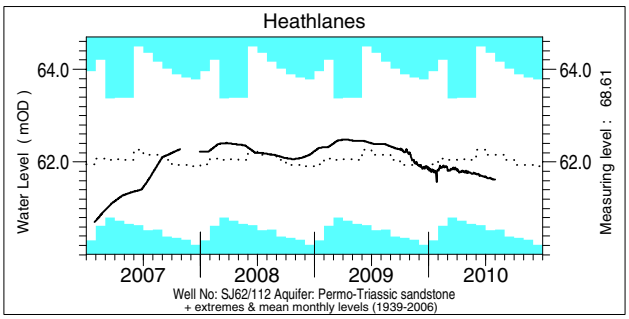


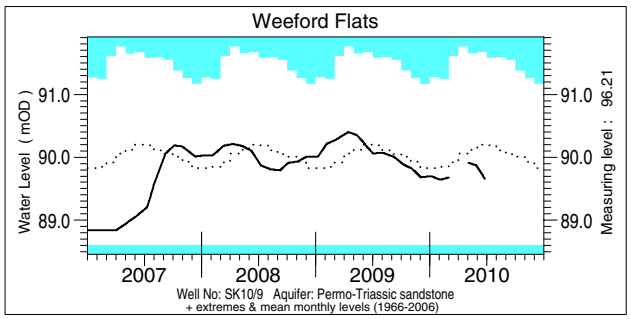


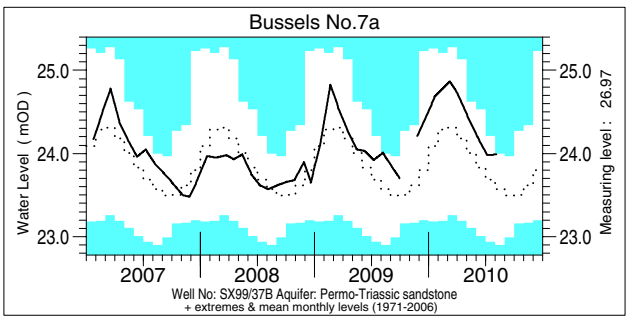


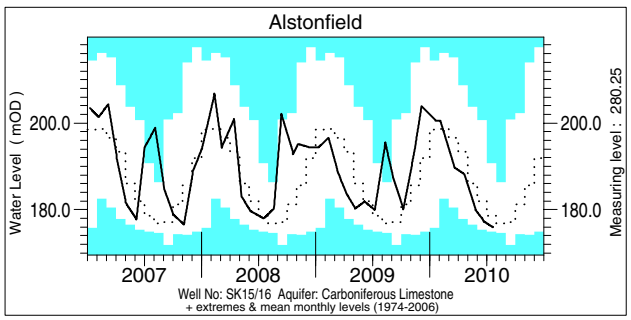








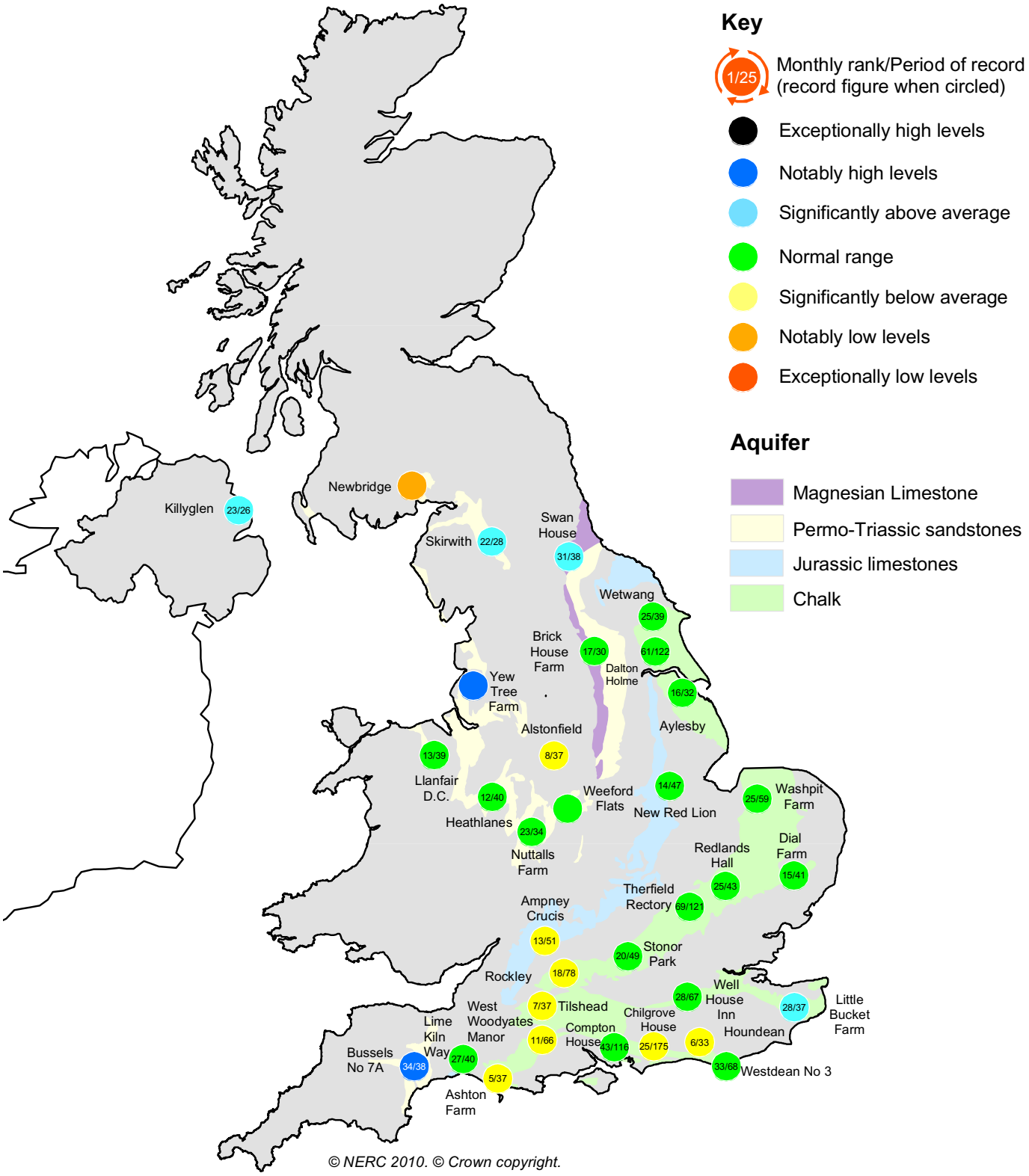




Groundwater levels July / August 2010

Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.
Dalton Holme	17.32	09/07	17.22	Chilgrove House	40.45	30/07	43.58	Brick House Farm	13.16	22/07	12.82
Washpit Farm	44.80	03/08	44.91	Killyglen (NI)	114.56	31/07	113.80	Llanfair DC	79.68	15/07	79.76
Stonor Park	77.27	03/08	77.18	New Red Lion	11.97	31/07	13.23	Heathlanes	61.62	31/07	62.14
Dial Farm	25.62	19/07	25.65	Ampney Crucis	100.12	03/08	100.48	Weeford Flats	89.65	25/06	89.89
Rockley	132.07	03/08	133.23	Newbridge	9.42	31/07	9.79	Bussels No.7a	23.99	05/08	23.73
Well House Inn	96.24	02/08	95.76	Skirwith	130.50	20/07	130.29	Alstonfield	175.91	21/07	179.65
West Woodyates	73.07	31/07	77.02	Swan House	85.01	20/07	83.29				

Levels in metres above Ordnance Datum



Groundwater levels - July 2010

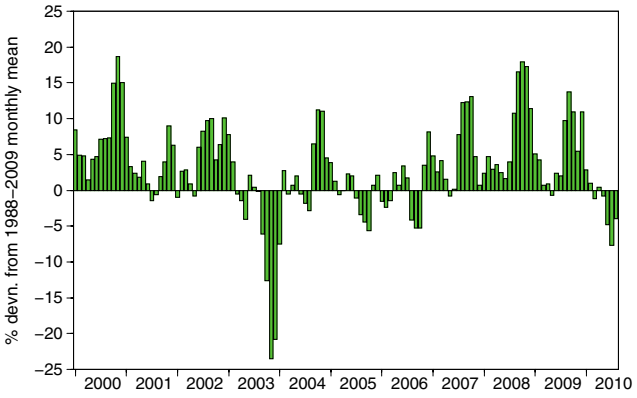
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

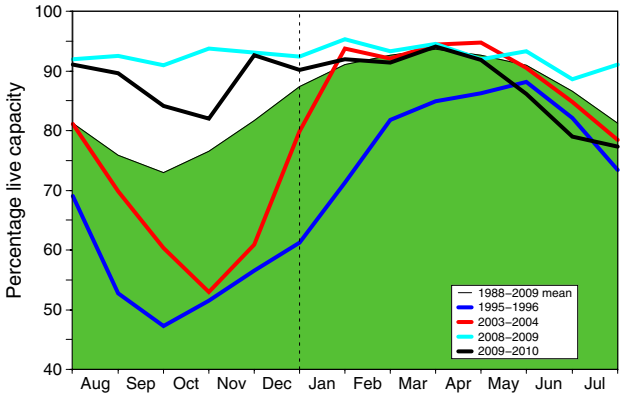
ii. Yew Tree Farm levels are now received quarterly.

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)	2010 Jun	Jul	Aug	Aug Anom.	Min Aug	Year* of min	2009 Aug	Diff 10-09
North West	N Command Zone	•	124929	66	52	**65**	1	**38**	**1989**	82	-17
	Vyrnwy		55146	79	68	**69**	-8	56	1996	78	-9
Northumbrian	Teesdale	•	87936	74	63	**64**	-9	45	1989	96	-32
	Kielder		(199175)	(87)	(84)	**(91)**	3	(66)	1989	(94)	-3
Severn Trent	Clywedog		44922	95	88	**85**	-1	57	1989	100	-15
	Derwent Valley	•	39525	80	68	**61**	-13	43	1996	84	-23
Yorkshire	Washburn	•	22035	80	72	**73**	-1	50	1995	86	-13
	Bradford supply	•	41407	77	65	**64**	-8	38	1995	84	-20
Anglian	Grafham		(55490)	(91)	(92)	**(87)**	-2	(66)	1997	(90)	-3
	Rutland		(116580)	(90)	(87)	**(78)**	-7	(74)	1995	(81)	-3
Thames	London	•	202828	96	94	**86**	0	73	1990	95	-9
	Farmoor	•	13822	92	95	**97**	1	84	1990	96	1
Southern	Bewl		28170	94	81	**71**	-5	45	1990	66	5
	Ardingly		4685	100	93	**82**	-4	65	2005	83	-1
Wessex	Clatworthy		5364	87	70	**59**	-15	43	1992	92	-33
	Bristol WW	•	(38666)	(86)	(77)	**(69)**	-6	(53)	1990	(86)	-17
South West	Colliford		28540	94	88	**80**	3	47	1997	95	-15
	Roadford		34500	88	80	**71**	-8	46	1996	92	-21
	Wimbleball		21320	90	79	**66**	-13	53	1992	94	-28
	Stithians		4967	81	79	**66**	-4	39	1990	83	-17
Welsh	Celyn and Brenig	•	131155	93	83	**82**	-6	65	1989	95	-13
	Brianne		62140	89	82	**85**	-4	67	1995	100	-15
	Big Five	•	69762	83	70	**67**	-10	41	1989	95	-28
	Elan Valley	•	99106	86	77	**71**	-13	63	1989	100	-29
Scotland(E)	Edinburgh/Mid Lothian	•	97639	95	81	**83**	1	51	1998	89	-6
	East Lothian	•	10206	99	94	**84**	-4	72	1992	100	-16
Scotland(W)	Loch Katrine	•	111363	70	55	**66**	-8	**53**	**2000**	82	-16
	Daer		22412	85	74	**89**	9	58	1994	90	-1
	Loch Thom	•	11840	98	82	**82**	0	59	2000	95	-13
Northern Ireland	Total+	•	56920	82	73	**83**	6	54	1995	93	-10
	Silent Valley	•	20634	82	74	**90**	19	42	2000	93	-3

() 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 1988-2009 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 London total has been revised to 202828 Ml as of April 2010.

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.

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

[#] Instigated in 1988

NATURAL ENVIRONMENT RESEARCH COUNCIL

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.

Enquiries

Enquiries should be addressed to:

Hydrological Summaries for the UK
Centre for Ecology & Hydrology
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

Tel.: 01491 838800
Fax: 01491 692424
E-mail: nrfa@ceh.ac.uk

Selected text and maps are available on the WWW at
http://www.ceh.ac.uk/data/nrfa/index.html
Navigate via Water Watch

08/10