Hydrological Summary

for the United Kingdom

June 2011

General

Following three months dominated by anticyclonic conditions, a return to frontal weather patterns brought welcome rainfall to most drought-affected areas of England. Whilst this provided some relief from the agricultural stress caused by extremely dry soils, the rainfall was not sufficient to ameliorate the drought conditions significantly. Owing to the high evaporative demands typical of June, effective rainfall was modest and soil moisture deficits continued to develop, contributing to heathland fires (there were reports of major damage to Upton Heath in Dorset). Authorities declared drought status on the 10th in parts of eastern England and areas of the Midlands were considered 'at-risk'. Overall, however, the month was unsettled. The June rainfall resulted in a marked recovery in runoff rates in some areas (e.g. Wales), but only moderate river flow response in the driest areas. Despite some improvement to the water resources situation, the drought is still in evidence, albeit with appreciable local variations in severity. Across much of England, in response to long-term rainfall deficiencies, seasonal recessions continued and river flows and groundwater levels remained well below the June average. Whilst reservoir stocks for England and Wales stood just above average entering July, stocks remained depressed in most reservoirs in southern England (notably in the southwest: Wimbleball equalled its lowest July stocks on record) with decreases also registered in some Pennine reservoirs (Derwent Valley group was 17% below average). With substantially elevated soil moisture deficits a feature across much of England, given only average summer rainfall the decline in runoff, groundwater and reservoir levels can be expected to last well into the autumn, significantly delaying the typical seasonal recovery.

Rainfall

June started fine and dry, with the high pressure which had characterised much of the spring in England continuing into the first week. From then on, conditions became predominantly cyclonic, and the remainder of the month was unsettled, with showery periods interspersed with drier interludes. Rainfall was occasionally prolonged and intense, leading to localised surface water flooding – a heatwave from 25th-27th was terminated with thundery showers in southern and eastern England, with 20mm in an hour reported in parts of East Anglia. In northern Britain, vigorous depressions produced some significant rainfall totals (e.g. 48mm in Edinburgh on the 22nd). Consequently, substantially above average rainfall was registered in Northern Ireland and much of Scotland (with >160% of average in parts of south west and eastern Scotland), but elsewhere the showery conditions (with some thundery activity) contributed to wide spatial variations in the June rainfall totals – and, therefore, significant differences in the intensity of drought conditions – across England and Wales. Above average rainfall was received in Wales, south west and southern England (which registered over 150% in places); June was the first month with above average rainfall since February in the Southern and Thames regions, and only the second month above average since August 2010 for Wessex. Elsewhere, June rainfall was near or below average, with totals falling below 60% of average in parts of the Midlands. As a result, whilst June rainfall moderated medium-term rainfall deficiencies in Wales and parts of southern England, exceptionally low accumulations persist in central and eastern England (Midlands experienced its 3rd driest March-June period in a 103 year record), in stark contrast to the exceptionally high rainfall in Scotland (the 3rd wettest in a 143-year record over the same four-month timeframe).

Runoff

In northern Britain, the healthy runoff rates observed in May continued throughout June, with above average runoff typical across much of Scotland and Northern Ireland and exceptional runoff totals in some catchments (e.g. the Bush and the Ewe, the latter also registered its highest June peak flow on record). On the 22nd, a Flood Warning was in operation on the Almond and Flood Alerts were widespread in eastern Scotland. In contrast, across much of England, many rivers were in recession entering June – continuing a decline which began in February – with some rivers in the Midlands and south west at, or approaching, start-of-June minima. Successive pulses of rainfall caused only muted runoff responses in most eastern catchments, where soil moisture deficits were highest, but more pronounced increases in western Britain and responsive southern catchments. As such, there was marked spatial variation in June runoff totals: runoff returned to the normal range in some catchments in southern England and the Midlands, while in Wales the recovery was even more pronounced, with above average flows now characteristic of most Welsh index rivers. Nevertheless, although the situation has improved markedly, in south Wales and the south west especially, June flows in a majority of catchments in lowland England were still notably low, and drought impacts were increasingly evident in groundwater-fed catchments (e.g. the Coln, which registered half the average runoff for June). Moreover, runoff accumulations over the March-June period were less than 50% of average in a belt from the south west to the Midlands. Total runoff for England and Wales was the second lowest in the 50-year national series (with only 1976 being lower) for this period, and long-term runoff deficiencies continue to accumulate across most of southern and central Britain.

Groundwater

Over southern aquifer areas, above average June rainfall slowed the development of soil moisture deficits (although smds remained above the June average, especially in Sussex and Kent), but in central and eastern England, below average rainfall and higher temperatures contributed to end-of-month smds >40mm above average across most aquifer areas. As would be expected for the time of year, groundwater levels decreased in most index boreholes, although the overall pattern is broadly similar to May. Groundwater levels were in the normal range in some eastern Chalk boreholes, but below average levels were typical for much of the Chalk – declines since May have resulted in below average levels in boreholes in the Yorkshire Wolds. Across central southern England, all Chalk boreholes registered notably low levels for June, with Tilshead on Salisbury Plain recording its second lowest June level in a 39-year record. The relatively dry conditions in central areas contributed to continuing recessions in other major aquifers, with below average levels a feature of most limestone boreholes, and most Permo-Triassic boreholes of the Midlands now reaching notably low levels. With substantially above average smds across most of England, further decline in aquifer levels can be expected through the summer – in some responsive aquifers, natural base levels may be approached before the onset of seasonal recovery in recharge.

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.

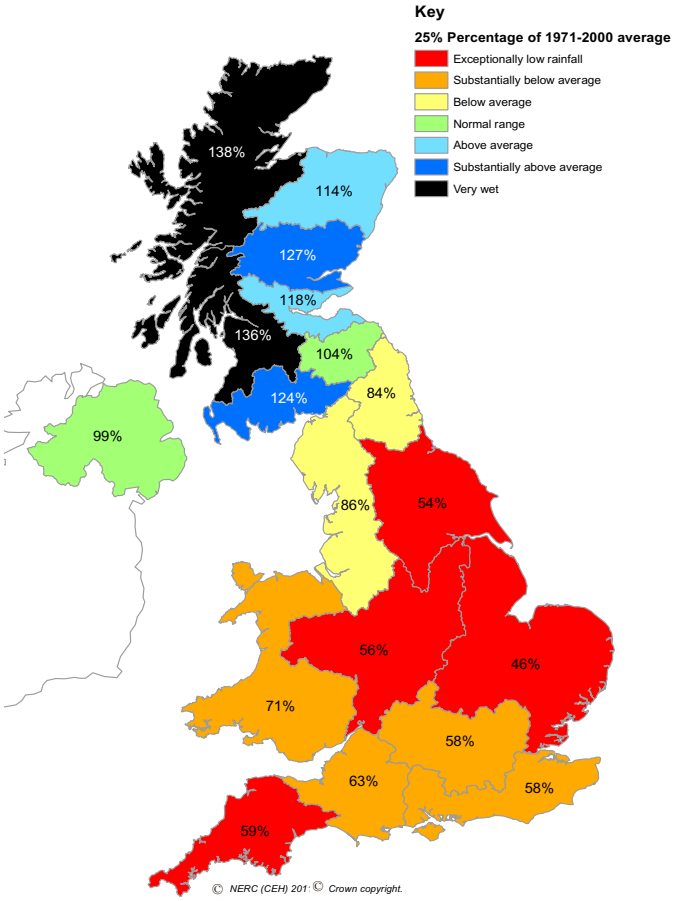
Area	Rainfall	Jun 2011	Mar11 - Jun11	RP	Dec10 - Jun11	RP	Oct10 - Jun11	RP	Dec09 - Jun11	RP
United Kingdom	mm	**83**	269		534		758		1538	
	%	**120**	92	2-5	87	2-5	90	2-5	91	5-10
England	mm	**68**	146		337		502		1123	
	%	**110**	61	15-25	72	10-20	80	5-15	87	5-15
Scotland	mm	**99**	471		837		1153		2133	
	%	**125**	129	15-25	104	2-5	103	2-5	95	2-5
Wales	mm	**108**	257		589		848		1818	
	%	**132**	73	5-15	76	5-15	79	10-15	84	10-20
Northern Ireland	mm	**105**	300		573		785		1628	
	%	**148**	99	2-5	91	2-5	92	2-5	94	2-5
England & Wales	mm	**73**	161		372		550		1219	
	%	**113**	64	15-25	73	10-20	79	5-15	87	5-15
North West	mm	**73**	269		585		832		1647	
	%	**94**	86	2-5	90	2-5	92	2-5	90	5-10
Northumbria	mm	**73**	208		428		668		1351	
	%	**120**	84	2-5	90	2-5	106	2-5	104	2-5
Midlands	mm	**54**	129		276		409		955	
	%	**87**	56	25-40	63	30-50	70	25-40	80	25-40
Yorkshire	mm	**57**	130		329		520		1119	
	%	**90**	54	40-60	70	15-25	83	5-10	87	5-10
Anglian	mm	**57**	89		214		323		849	
	%	**105**	46	30-50	63	30-40	71	10-20	90	2-5
Thames	mm	**74**	124		286		405		953	
	%	**131**	58	10-20	71	10-15	75	5-15	86	5-10
Southern	mm	**83**	126		341		514		1153	
	%	**149**	58	10-20	77	5-10	84	2-5	94	2-5
Wessex	mm	**79**	153		350		502		1105	
	%	**132**	63	10-15	70	10-15	74	12-16	81	15-25
South West	mm	**96**	183		463		699		1541	
	%	**132**	59	20-30	66	15-25	72	15-20	81	15-25
Welsh	mm	**103**	244		558		805		1750	
	%	**129**	71	5-15	74	10-15	77	10-20	84	10-20
Highland	mm	**97**	584		994		1300		2373	
	%	**109**	138	20-30	103	2-5	96	2-5	88	2-5
North East	mm	**99**	307		530		784		1710	
	%	**152**	114	2-5	101	2-5	108	2-5	116	5-10
Tay	mm	**96**	418		750		1095		1990	
	%	**139**	127	5-15	102	2-5	110	2-5	99	2-5
Forth	mm	**88**	355		686		976		1798	
	%	**127**	118	5-10	107	2-5	112	5-10	101	2-5
Tweed	mm	**73**	282		567		820		1605	
	%	**112**	104	2-5	104	2-5	112	2-5	107	2-5
Solway	mm	**122**	444		848		1195		2175	
	%	**155**	124	5-15	108	2-5	110	5-10	99	2-5
Clyde	mm	**115**	571		1023		1417		2483	
	%	**130**	136	20-30	107	2-5	106	2-5	92	2-5

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

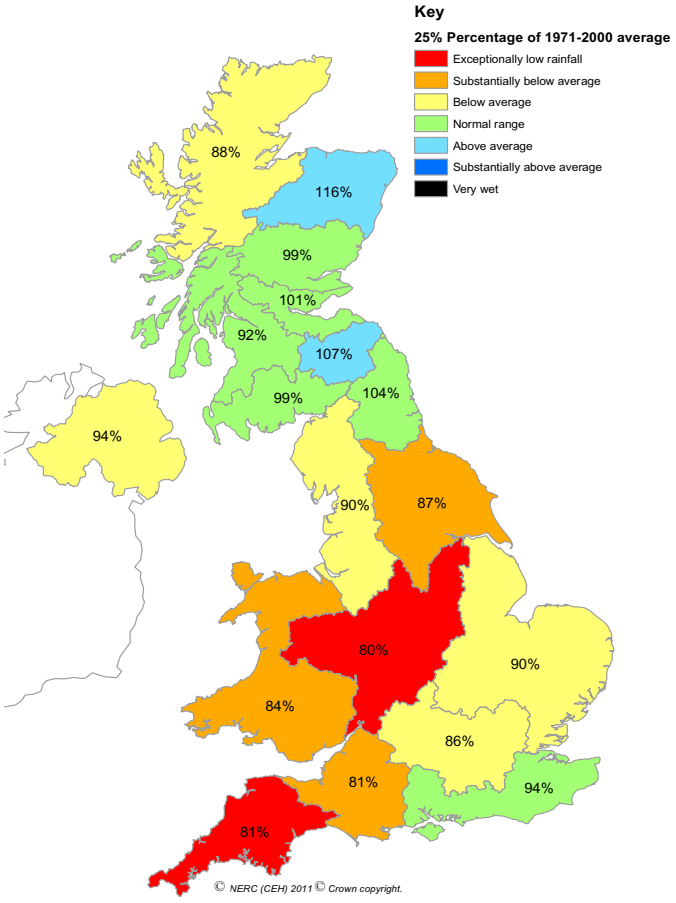
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

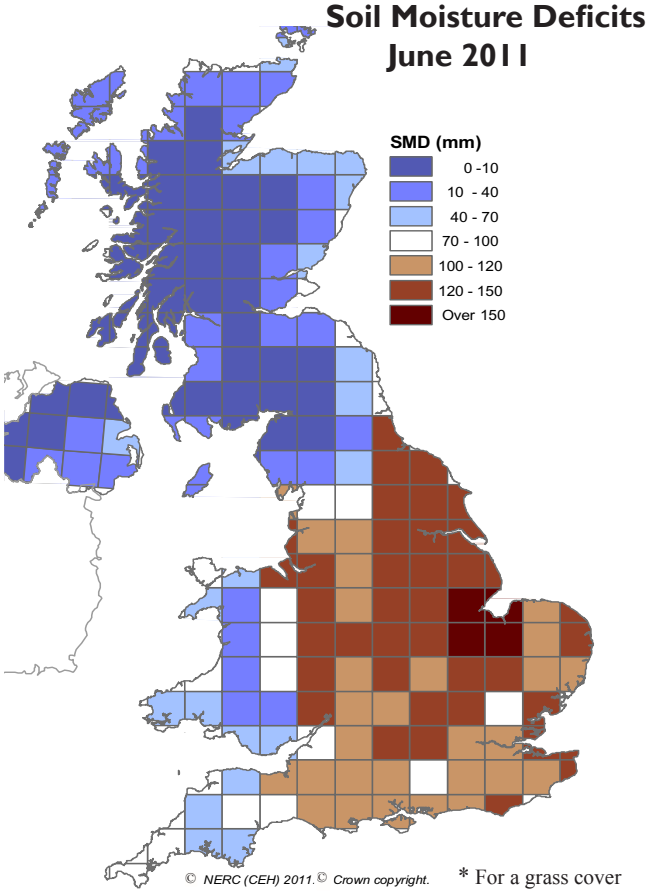
March - June 2011



December 2009 - June 2011



Soil Moisture Deficits June 2011



* For a grass cover

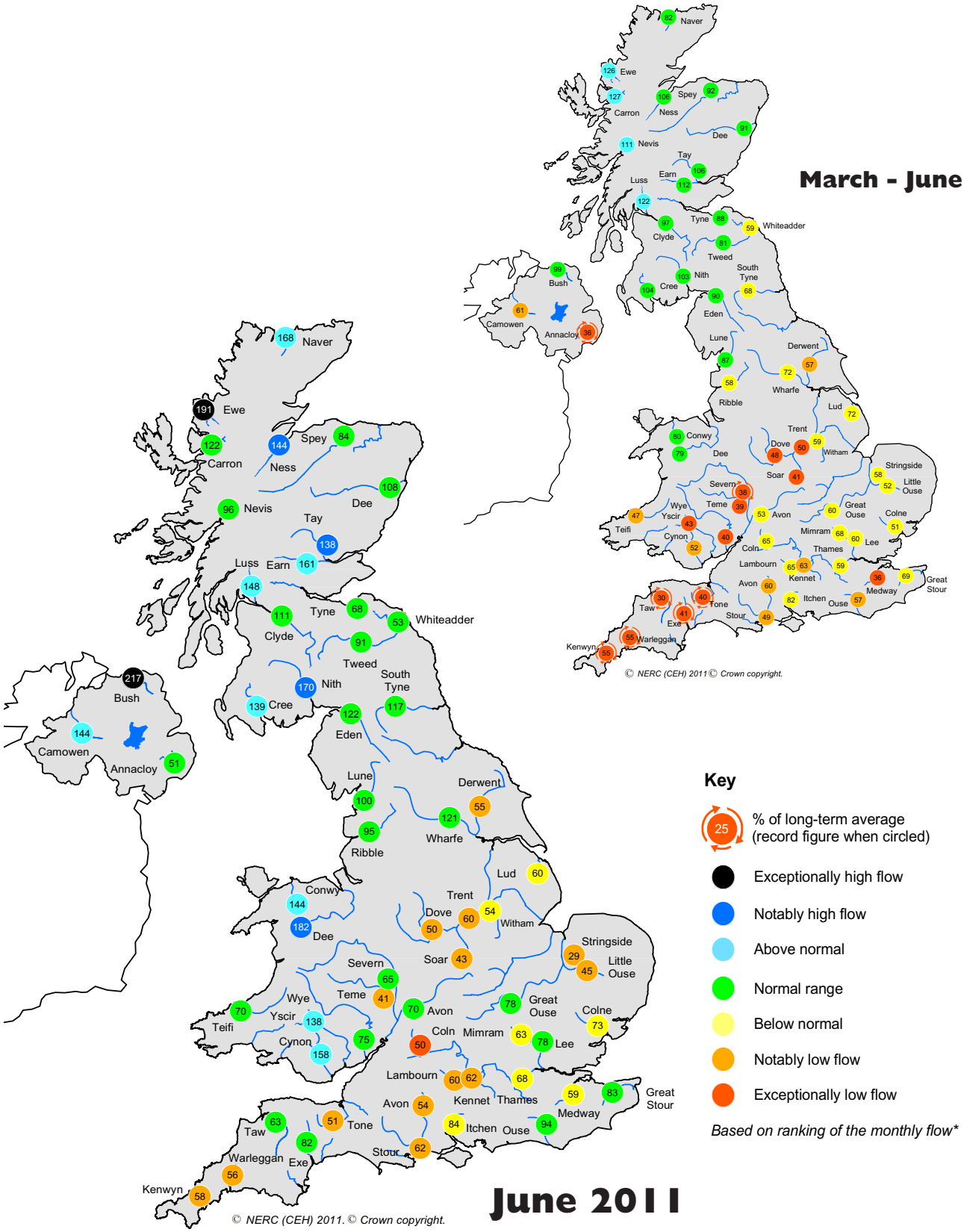
Met Office Weather forecast

Updated: 12:08 on Thursday 14 July 2011

UK Outlook for Tues 19 Jul to Thurs 28 Jul 2011
Tuesday will remain unsettled, with showers and longer spells of rain, heavy at times. Also, winds will be strong at times, with gales possible along some western and southern coasts. Temperatures will be below average and feel positively cool in the wind and rain. The following days will see some short-lived drier and brighter interludes but it will remain generally unsettled, with further showers or longer spells of rain, and it will still be cool and windy at times. Into the second week many parts will remain unsettled although there is an indication that some southern and southwestern parts may become less unsettled later. Temperatures during this time are likely to be below average at first, but it may become warm at times across southern, eastern and central parts.

UK Outlook for Fri 29 Jul to Fri 12 Aug 2011:
Indications are that the weather will remain fairly unsettled across the north of the country but with drier periods in the south. Temperatures should be close to normal for many, but perhaps fall a little below across the west of the UK. Central and southern parts are most favoured for above average temperatures. Rainfall amounts are expected to be a little below normal generally, with eastern parts of England perhaps staying the driest. Sunshine amounts during the same period look to be near-normal for most, but perhaps rising a little above average across the south of the UK.
For further details please visit:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_alltext.html

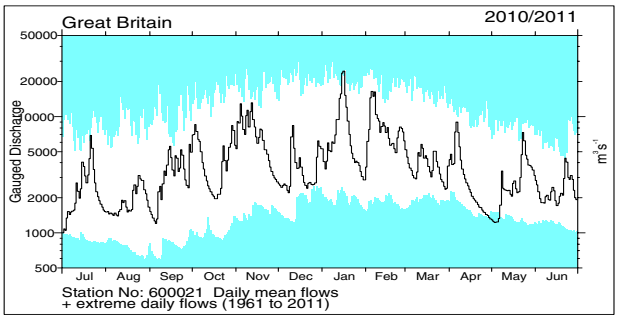
River flow . . . River flow . . .

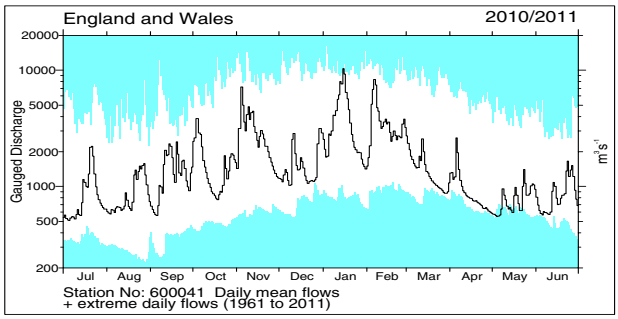


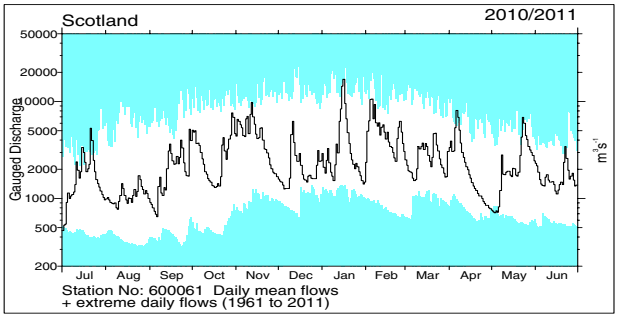
River flows

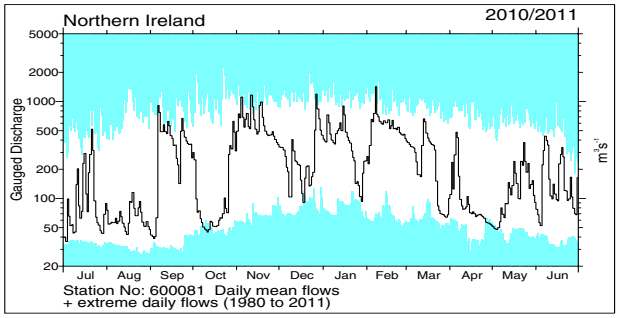
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

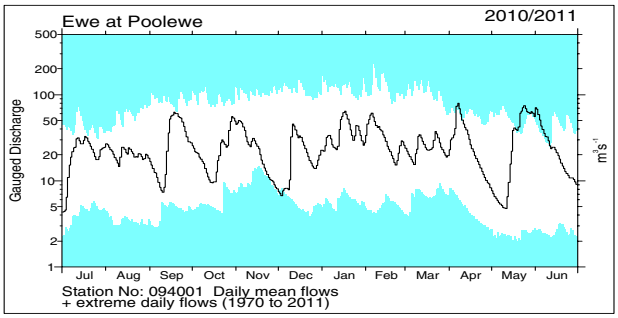
River flow . . . River flow . . .

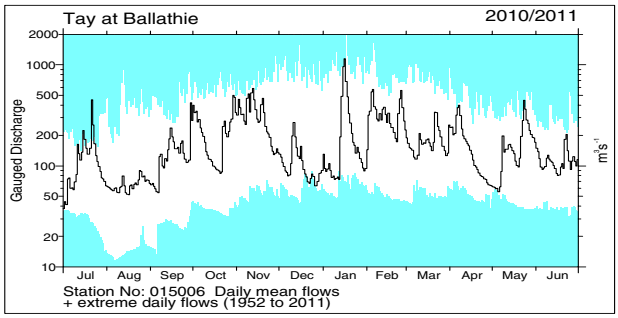


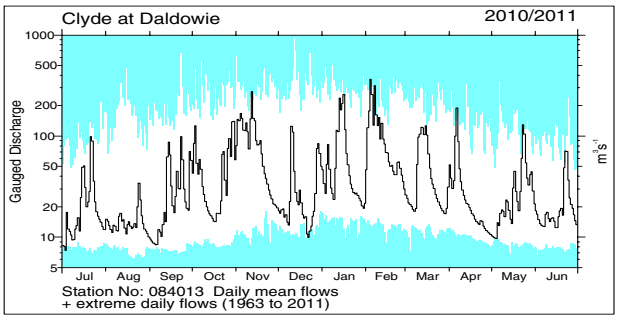


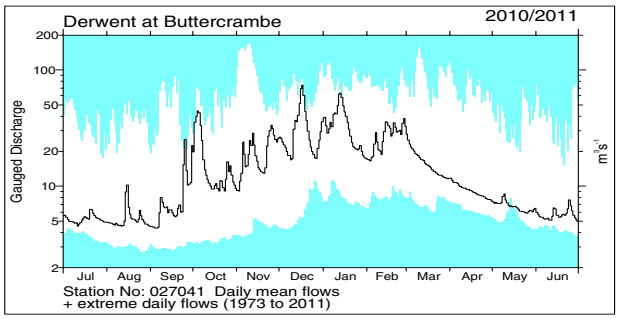


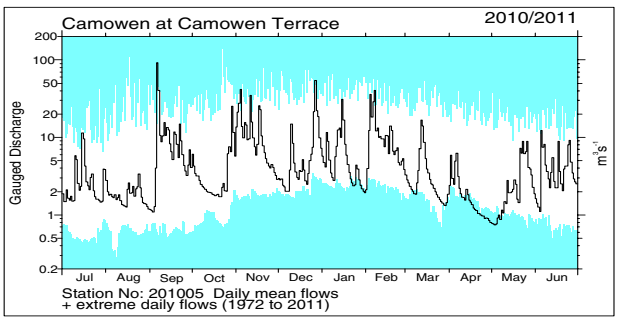


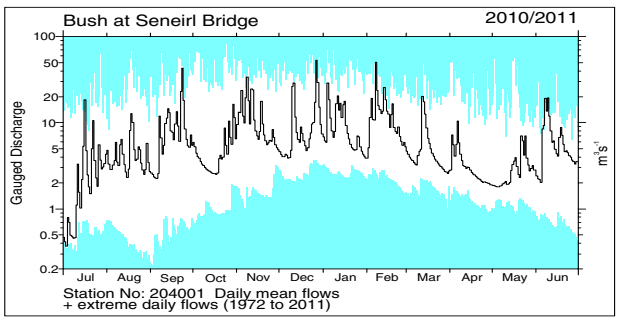








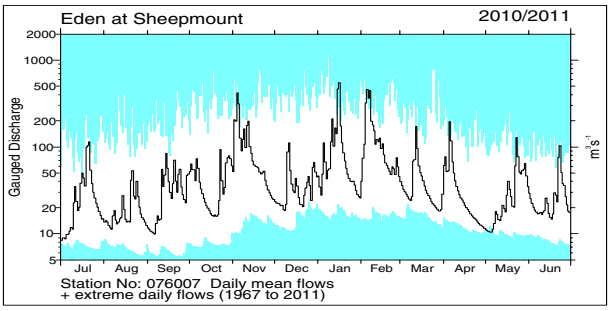


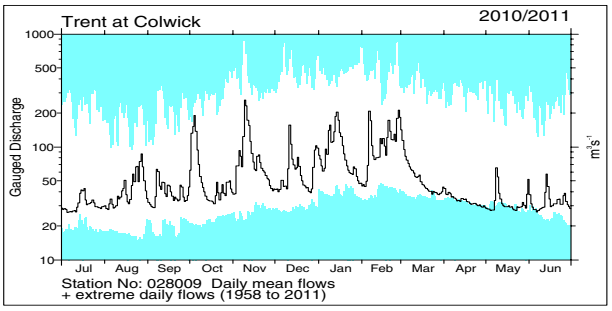


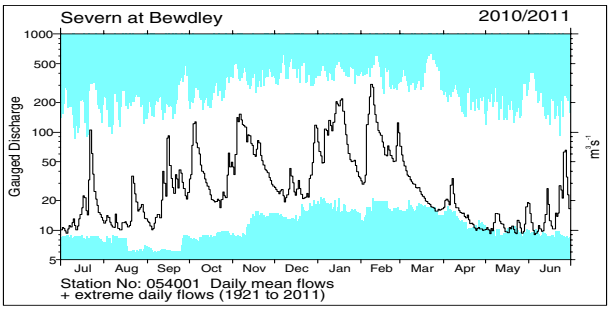
River flow hydrographs

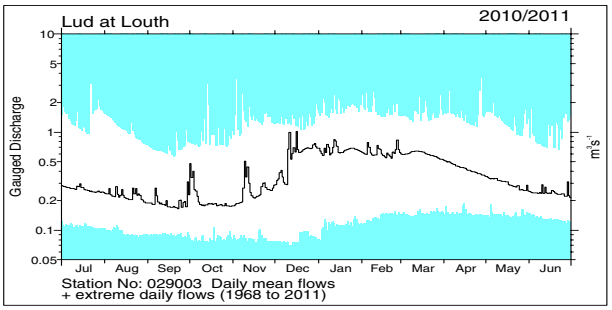
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to July 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

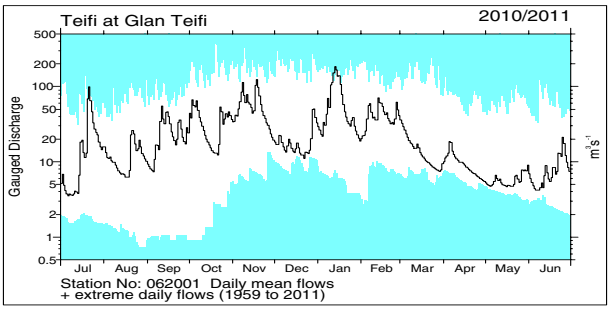
River flow . . . River flow . . .

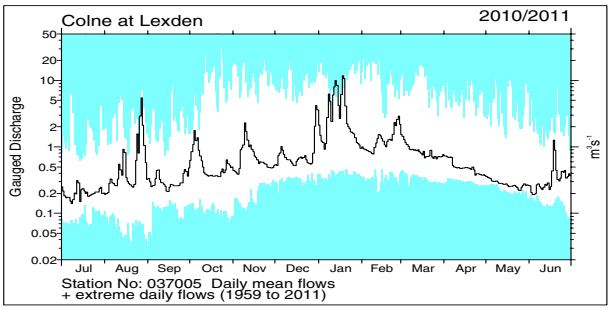


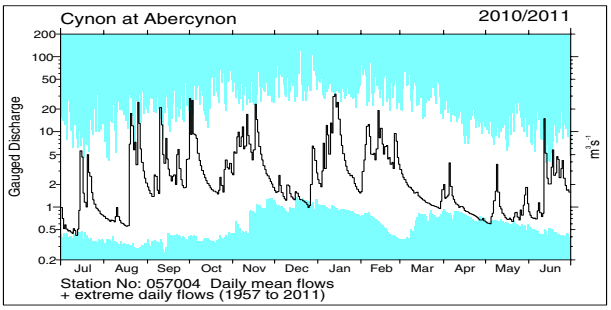


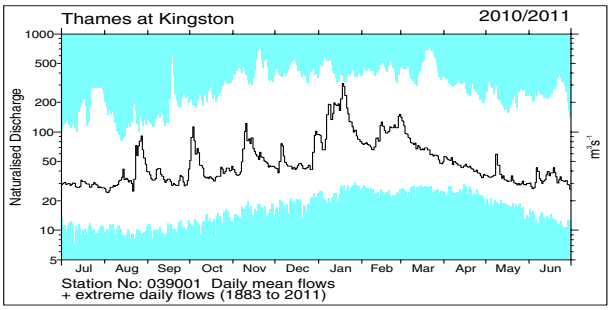


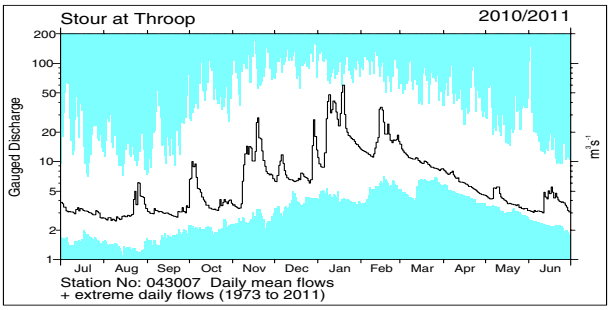


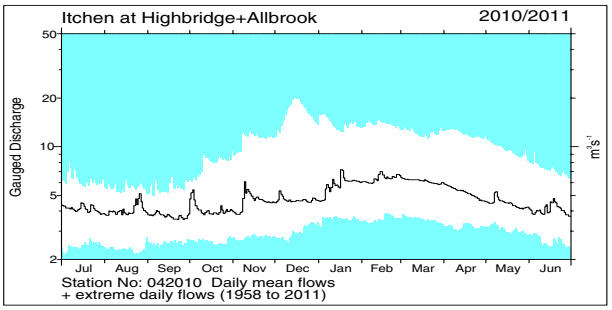












Notable runoff accumulations (a) Mar 2011 - Jun 2011 (b) Dec 2009 - Jun 2011

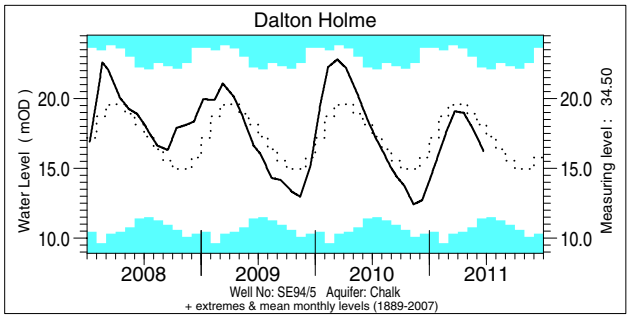
	River	%lta	Rank
a)	Trent	50	2/53
	Dove	48	2/50
	Soar	41	2/40
	Mole	47	1/37
	Medway	36	2/51
	Exe	41	1/55
	Otter	55	2/49
	Dart	46	1/53
	Warleggan	55	1/42

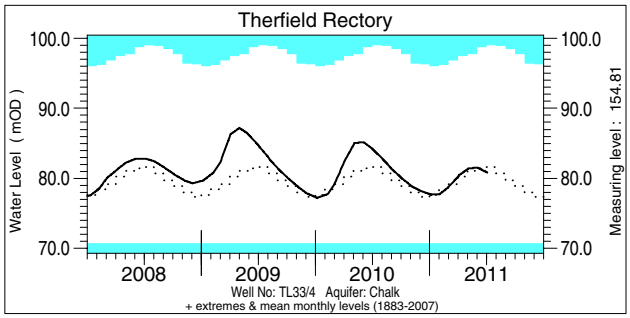
	River	%lta	Rank
a)	Kenwyn	55	1/43
	Tone	40	1/51
	Brue	37	1/47
	Severn	38	1/90
	Teme	39	2/41
	Wye	40	3/75
	Leven	146	44/48
	Lagan	47	3/39
	Annacloy	36	1/32

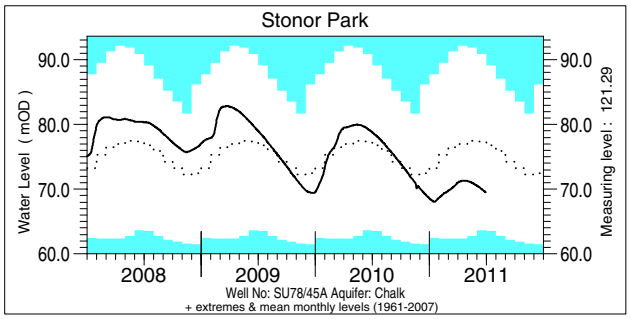
	River	%lta	Rank
b)	Tyne (Spilmersford)	147	44/44
	Whiteadder	139	41/41
	Taw	65	1/52
	Yscir	70	2/37
	Luss	82	2/29
	Nevis	73	1/28
	Carron	70	1/31
	Ewe	78	2/40

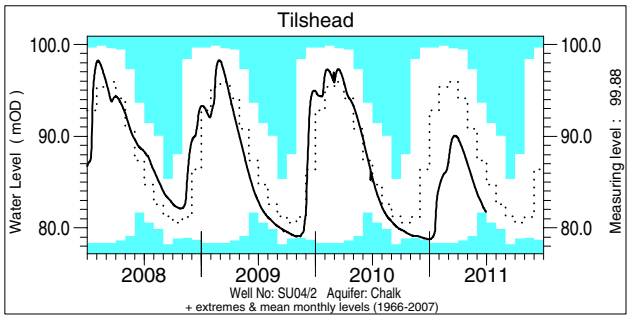
lta = long term average
Rank 1 = lowest on record

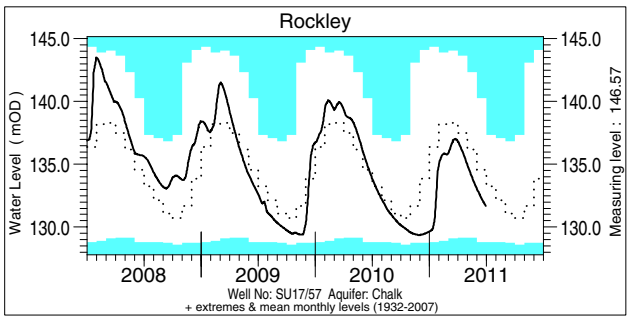
Groundwater . . . Groundwater

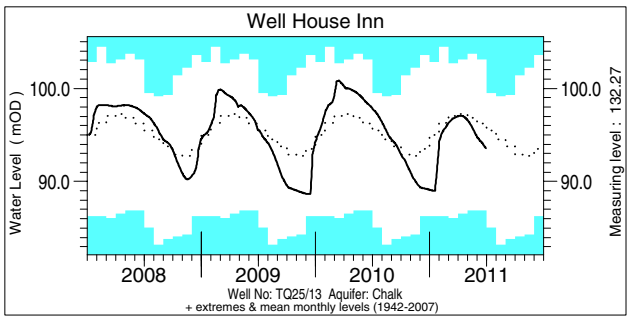


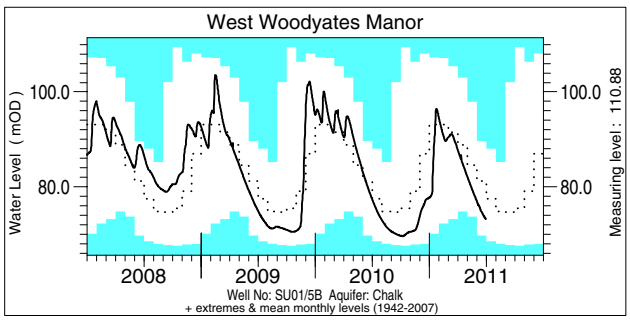


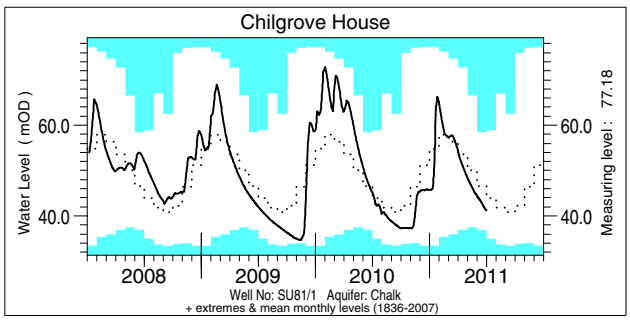


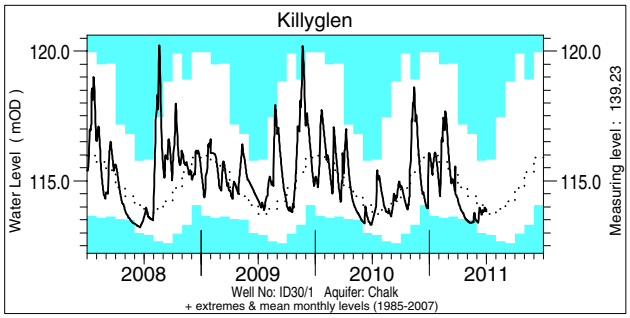


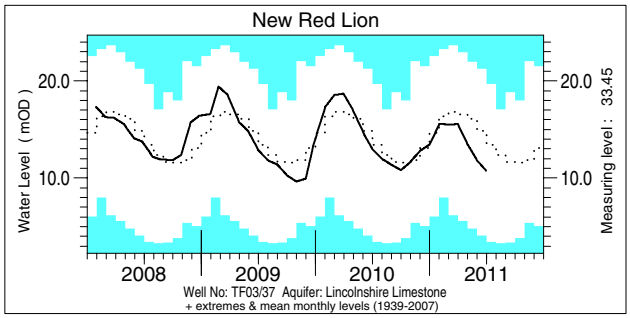






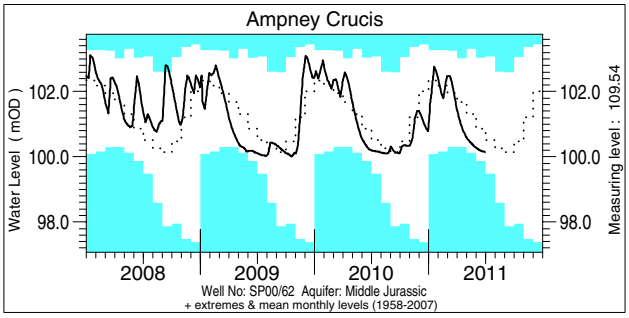


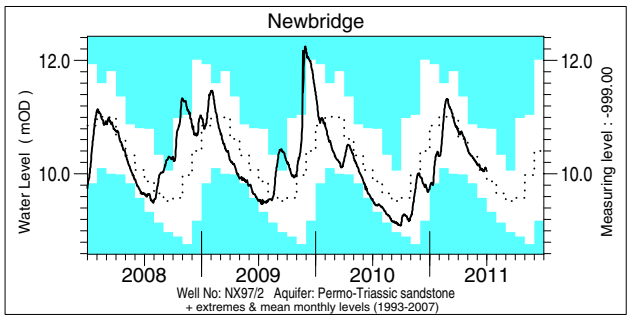


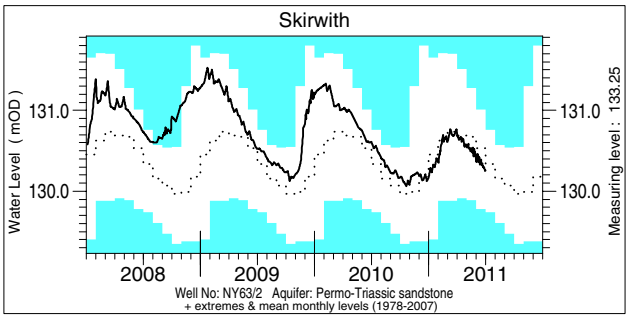


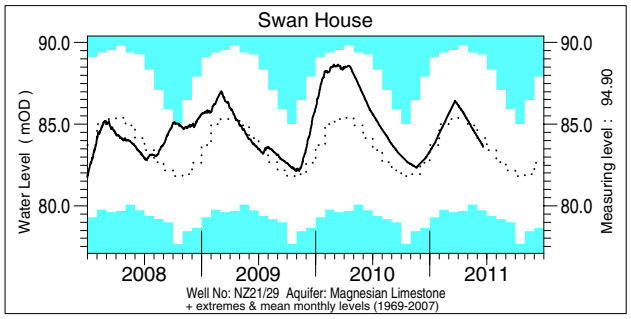
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

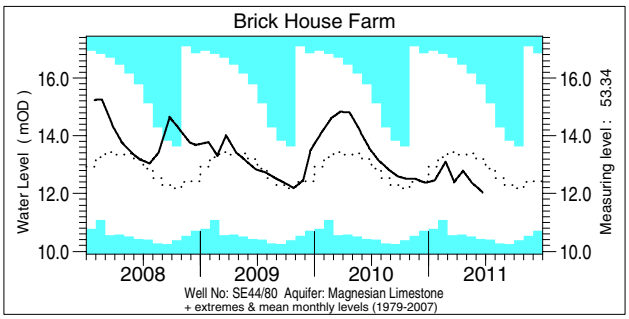
Groundwater . . . Groundwater

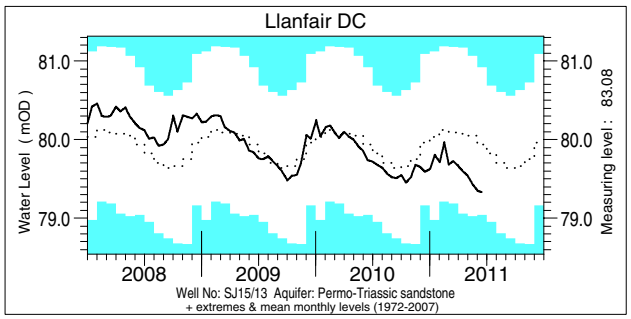


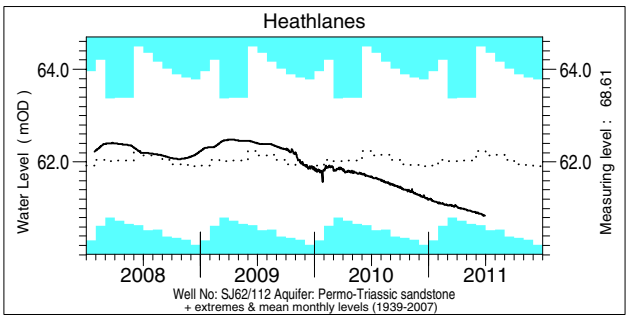


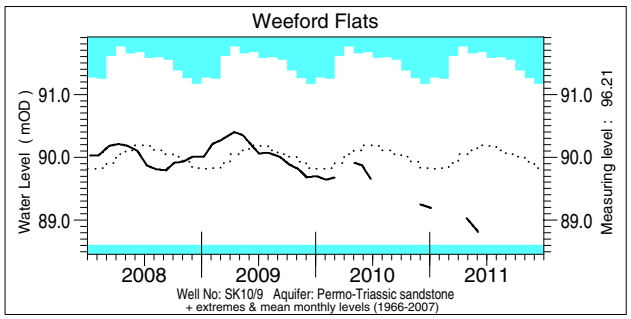


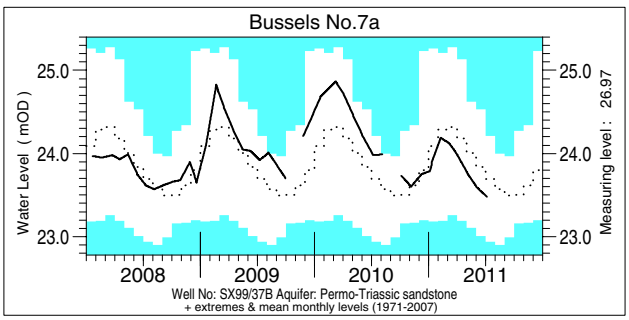


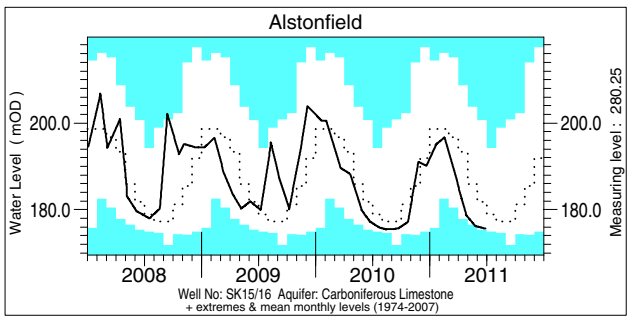








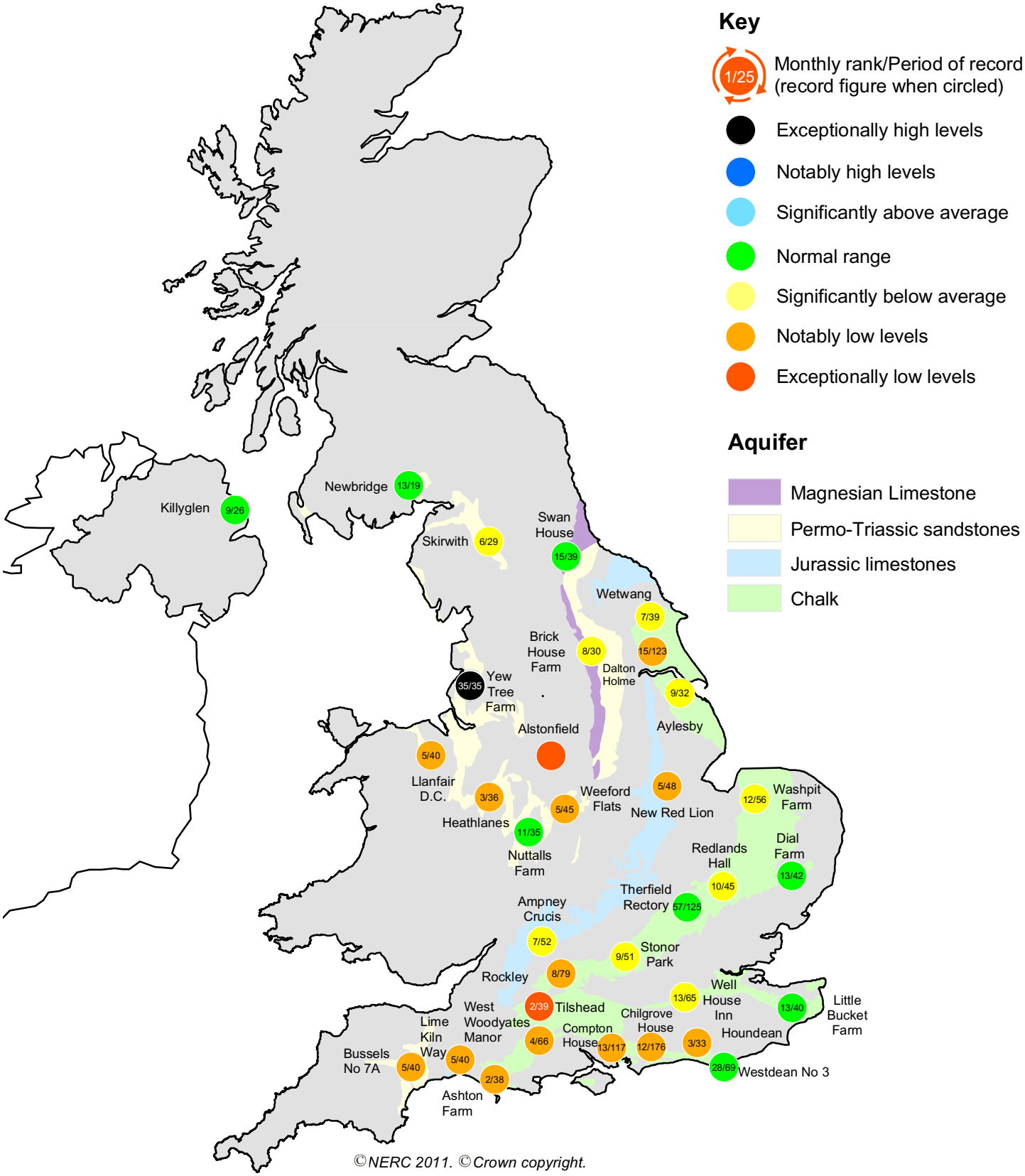




Groundwater levels June / July 2011

Borehole	Level	Date	Jun av.	Borehole	Level	Date	Jun av.	Borehole	Level	Date	Jun av.
Dalton Holme	16.23	22/06	18.11	Chilgrove House	41.20	01/07	46.03	Brick House Farm	12.04	22/06	13.14
Therfield Rectory	80.80	04/07	81.87	Killyglen (NI)	113.82	02/07	113.99	Llanfair DC	79.33	15/06	79.87
Stonor Park	69.49	29/06	77.78	New Red Lion	10.74	30/06	14.42	Heathlanes	60.84	30/06	62.18
Tilshead	81.75	30/06	87.77	Ampney Crucis	100.15	29/06	100.85	Weeford Flats	88.81	03/06	89.94
Rockley	131.68	29/06	134.58	Newbridge	10.08	30/06	9.98	Bussels No.7a	23.48	05/07	23.87
Well House Inn	93.54	29/06	96.49	Skirwith	130.26	01/07	130.52	Alstonfield	175.61	27/06	181.54
West Woodyates	73.20	30/06	80.96	Swan House	83.59	20/06	84.16	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



Groundwater levels - June 2011

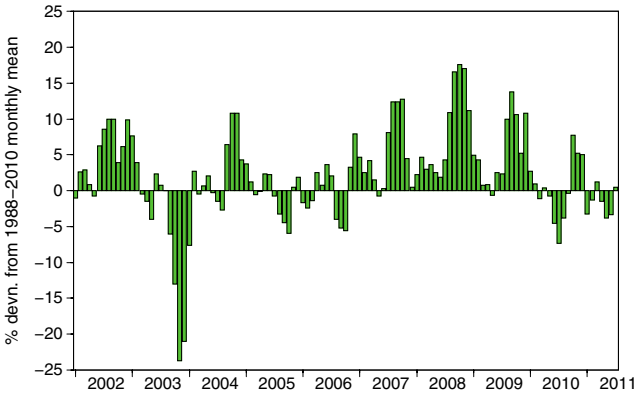
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

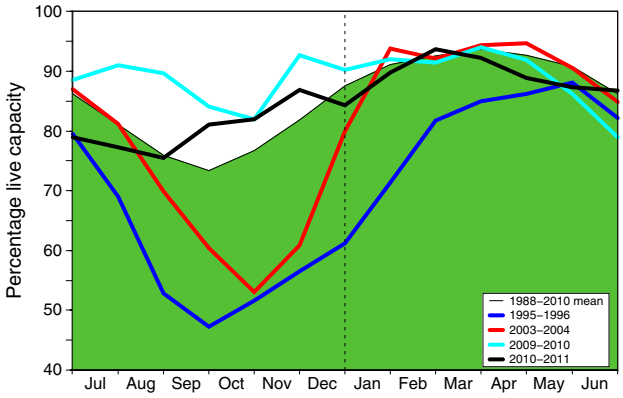
ii. Yew Tree Farm levels are now received quarterly.

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 May	Jun	Jul	Jul Anom.	Min Jul	Year* of min	2010 Jul	Diff 11-10
North West	N Command Zone	•	124929	86	90	**83**	11	52	2010	52	31
	Vyrnwy		55146	87	83	**86**	4	65	1990	68	18
Northumbrian	Teesdale	•	87936	88	95	**93**	14	58	1989	63	30
	Kielder		(199175)	(90)	(93)	**(94)**	4	(71)	1989	(84)	10
Severn Trent	Clywedog		44922	97	97	**100**	6	72	1989	88	12
	Derwent Valley	•	39525	77	69	**63**	-17	53	1996	68	-5
Yorkshire	Washburn	•	22035	80	74	**72**	-9	63	1995	72	0
	Bradford supply	•	41407	83	80	**73**	-5	54	1995	65	8
Anglian	Grafham		(55490)	(90)	(91)	**(93)**	0	(70)	1997	(92)	1
	Rutland		(116580)	(89)	(85)	**(81)**	-7	(75)	1997	(87)	-6
Thames	London	•	202828	96	93	**95**	4	85	1990	94	1
	Farmoor	•	13822	100	100	**100**	3	94	1995	95	5
Southern	Bewl		28170	92	83	**73**	-9	52	1990	81	-8
	Ardingly		4685	99	92	**84**	-11	82	2005	93	-9
Wessex	Clatworthy		5364	84	73	**71**	-11	61	1995	70	1
	Bristol WW	•	(38666)	(83)	(78)	**(73)**	-9	(64)	1990	(77)	-4
South West	Colliford		28540	82	74	**66**	-16	51	1997	88	-22
	Roadford		34500	74	68	**60**	-22	49	1996	80	-20
	Wimbleball		21320	84	74	**63**	-23	63	2011	79	-16
	Stithians		4967	88	80	**71**	-8	53	1990	79	-8
Welsh	Celyn and Brenig	•	131155	96	96	**97**	3	77	1996	83	14
	Brianne		62140	89	84	**89**	-3	76	1995	82	7
	Big Five	•	69762	85	79	**87**	3	61	1989	70	17
	Elan Valley	•	99106	83	81	**85**	-4	75	1989	77	8
Scotland(E)	Edinburgh/Mid Lothian	•	97639	93	94	**91**	5	54	1998	81	10
	East Lothian	•	10206	99	99	**94**	0	81	1992	94	0
Scotland(W)	Loch Katrine	•	111363	85	92	**95**	16	55	2010	55	40
	Daer		22412	96	99	**99**	16	62	1994	74	25
	Loch Thom	•	11840	96	95	**100**	15	69	2000	82	18
Northern Ireland	Total+	•	56920	83	80	**82**	0	61	2008	73	9
	Silent Valley	•	20634	80	75	**78**	1	54	1995	74	4

() 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.

07/11