Hydrological Summary

for the United Kingdom

September 2010

General

Weather patterns in September were typically autumnal with Atlantic frontal systems bringing significant pulses of rainfall to most areas. The UK registered its wettest September since 2000 but rainfall totals were below average across much of central and southern England. In most areas, soil moisture deficits declined briskly over the month (and into October). Accordingly, river flows increased smartly; spate conditions and flood alerts were relatively common and inflows to most upland reservoirs were substantial. Overall stocks for England & Wales registered their highest September increase on record, and now stand appreciably above average. However, stocks continued their seasonal decline in much of southern England and remain relatively low (but well above drought minima) in a few, mostly southern, impoundments (e.g. Wimbleball and Clatworthy). Below average rainfall, together with continuing soil moisture deficits across most outcrop areas of the major aquifers, meant that groundwater levels recessions were maintained – September levels being typically a little below the monthly average. The wetness of the late summer and early autumn has substantially moderated medium term regional rainfall deficiencies and in some, mostly western, areas the focus of hydrological stress has shifted from drought to flood risk. However, in much of the English Lowlands, above average late autumn rainfall would be particularly welcome to initiate and maintain groundwater level recoveries.

Rainfall

High pressure dominated synoptic patterns at the beginning of the month but, thereafter, the weather became a much more unsettled mix: a sequence of Atlantic frontal systems punctuated by brief incursions of sub-tropical and arctic air masses. Low pressure systems tracked most commonly across western and northern regions, generating some notable rainfall events – including 24-hr totals of 62mm at Sennybridge (Powys) on the 10th and 67mm at Hunsterton (Ayrshire) on the 23rd; at Lough Fea (County Tyrone), 95mm was recorded in 48 hrs over the 5-7th. This latter storm contributed to Northern Ireland's 2nd wettest September since 1981; much of eastern Britain (coastal areas of north-east Scotland in particular) was also wet. By contrast, relatively few low pressure systems tracked across south-east England and September rainfall totals fell below 50% of average in some, mostly coastal, localities in Kent and East Sussex. At the national scale, the July-September period has been notably wet for the third successive year. As a consequence, accumulated rainfall totals for almost all regions have returned to within the normal range over a range of durations (see page 2). There are exceptions: the post March-2010 period remains appreciably drier than average in much of central and southern England (Yorkshire also). In this timeframe, many catchments in the Wessex region reported their 2nd lowest rainfall in the last 15 years. By contrast, September added a further wet month to an exceptional cluster for the North East region of Scotland (the Oct-Sept rainfall total is the 2nd highest since 1916).

River Flows

Climatic contrasts normally ensure that seasonal recoveries in river flows occur earlier in western and northern rivers than in the English Lowlands; September's rainfall pattern generally reinforced this tendency. In most responsive catchments, flows continued to decline early in the month but then recovered briskly, heralding frequent spate conditions and, mostly modest, floodplain inundations in many areas. On the 7th, the Camowen recorded its highest September flow in a 38-yr record and flood alerts (mostly Flood Watches) were widespread on the 13-15th, 23-24th and again late in the month. Flash flooding was also common, and generally had greater impact (e.g. in Dundee on the 7th and Londonderry on the 23rd). Estimated total outflows from England & Wales were above the monthly average for the first time this year and September catchment runoff totals exceeded the average throughout most of Wales, Northern Ireland and eastern Scotland. Runoff totals were relatively depressed, but still well above drought minima, in a number of groundwater-fed southern rivers and streams, and many winterbournes remain dry. Summer and early autumn runoff normally contributes only a fraction of the annual total; correspondingly, strong echoes of the large runoff deficiencies built up earlier in the year remain evident in the medium term runoff accumulations for many western catchments. In western Scotland, the Jan-Sept runoff total for the Luss is the lowest in a 35-year series.

Groundwater

The wet September served to eliminate soil moisture deficits in much of western and northern Britain but rainfall across most major aquifer outcrop areas was appreciably below average (declining to <70% over many Chalk outcrops). As a consequence, smds remained above average in some central and southern areas, and generally sufficient to preclude anything other than local infiltration. Thus, while seasonal groundwater level recoveries are underway in a few western index wells and boreholes (see Killyglen and Bussels for example), groundwater level recessions continued through September across the generality of outcrop areas. Throughout the majority of the eastern Chalk, early autumn groundwater levels were close to the average for the time of year but relatively depressed levels characterised a number of index wells in central southern England (e.g. at Tilshead). Levels in the limestone aquifers were also generally close to the seasonal norm but still in gentle recession. A similar generalisation applies to most Permo-Triassic sandstones outcrops – but in southern Scotland levels at Newbridge had declined to their lowest for five years. Late-September smds were the equivalent of more than eight weeks average effective rainfall in some areas (e.g. Kent and parts of the north Midlands). In these areas particularly, above average late-autumn rainfall is needed to avoid substantially depressed early winter groundwater levels.

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

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

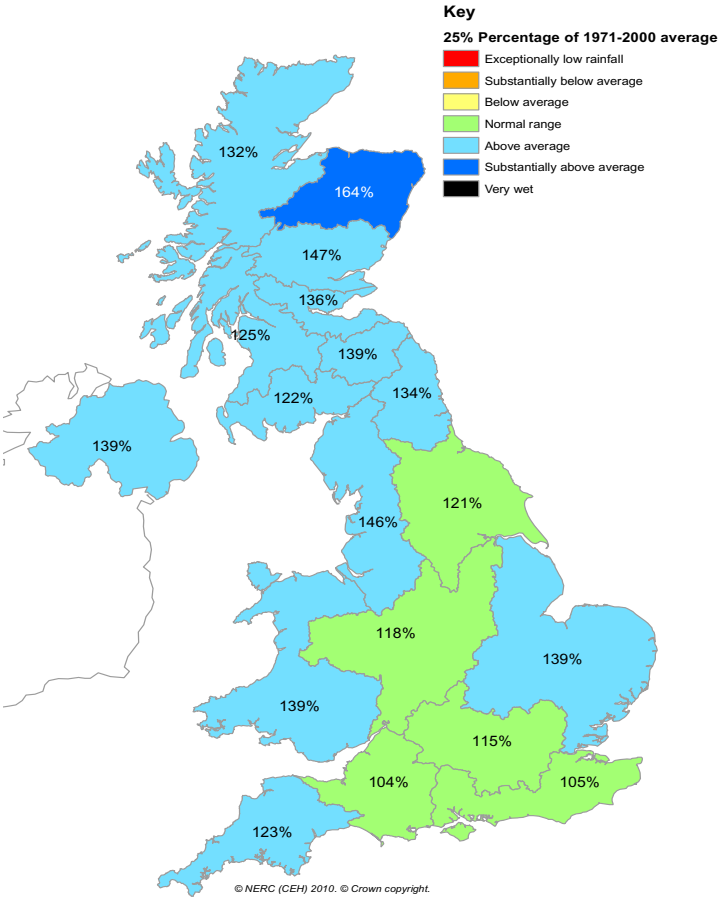
Area	Rainfall	Sep 2010	Jul10 - Sep10	RP	Apr10 - Sep10	RP	Jan10 - Sep10	RP	Oct 09 - Sep10	RP
England & Wales	**mm**	**88**	**260**		**360**		**569**		**938**	
	%	**113**	**128**	**2-5**	**94**	**2-5**	**93**	**2-5**	**105**	**2-5**
North West	mm	**156**	404		505		711		1217	
	%	**152**	146	5-10	104	2-5	89	5-10	103	2-5
Northumbrian	mm	**93**	266		355		597		956	
	%	**133**	134	2-5	94	2-5	102	2-5	115	2-5
Severn Trent	mm	**67**	211		315		473		736	
	%	**99**	118	2-5	90	2-5	88	5-10	97	2-5
Yorkshire	mm	**100**	227		314		520		850	
	%	**146**	121	2-5	87	5-10	91	2-5	104	2-5
Anglian	mm	**61**	211		288		451		666	
	%	**111**	139	5-10	97	2-5	104	2-5	110	2-5
Thames	mm	**49**	185		267		458		744	
	%	**77**	115	2-5	83	2-5	93	2-5	106	2-5
Southern	mm	**51**	178		269		520		923	
	%	**71**	105	2-5	82	5-10	100	<2	118	5-10
Wessex	mm	**59**	196		292		497		871	
	%	**77**	104	2-5	81	5-10	84	5-10	101	2-5
South West	mm	**100**	299		419		710		1198	
	%	**101**	123	2-5	92	2-5	89	2-5	99	2-5
Welsh	mm	**140**	393		538		793		1369	
	%	**123**	139	2-5	104	2-5	90	5-10	104	2-5
Scotland	**mm**	**152**	**423**		**602**		**880**		**1412**	
	%	**115**	**133**	**5-10**	**109**	**2-5**	**91**	**2-5**	**98**	**2-5**
Highland	mm	**167**	478		688		978		1529	
	%	**105**	132	5-10	110	2-5	86	2-5	89	2-5
North East	mm	**133**	368		524		813		1263	
	%	**151**	164	10-20	126	2-5	124	5-10	133	>100
Tay	mm	**142**	395		563		817		1329	
	%	**126**	147	5-10	118	2-5	95	2-5	105	2-5
Forth	mm	**126**	351		498		749		1165	
	%	**120**	136	5-10	109	2-5	97	2-5	103	2-5
Tweed	mm	**106**	304		398		683		1093	
	%	**131**	139	2-5	97	2-5	103	2-5	115	5-10
Solway	mm	**143**	386		562		830		1438	
	%	**115**	122	2-5	102	2-5	88	2-5	102	2-5
Clyde	mm	**187**	498		687		972		1606	
	%	**114**	125	5-10	105	2-5	84	5-10	93	2-5
Northern Ireland	**mm**	**164**	**359**		**508**		**765**		**1178**	
	%	**174**	**139**	**5-10**	**108**	**2-5**	**100**	**<2**	**106**	**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 April 2010 are provisional.

Rainfall . . . Rainfall . . .

July - September 2010



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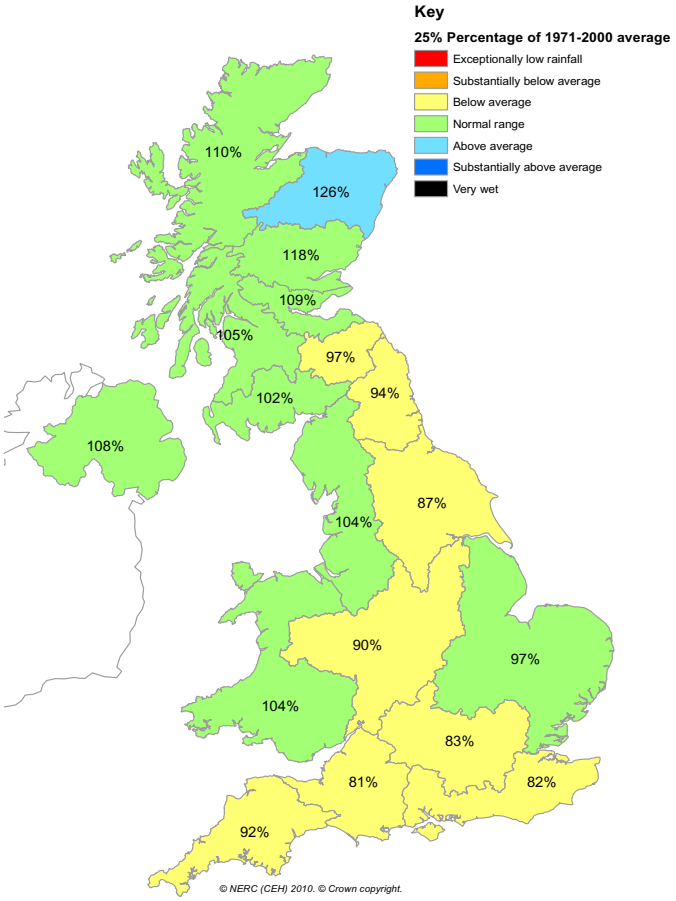

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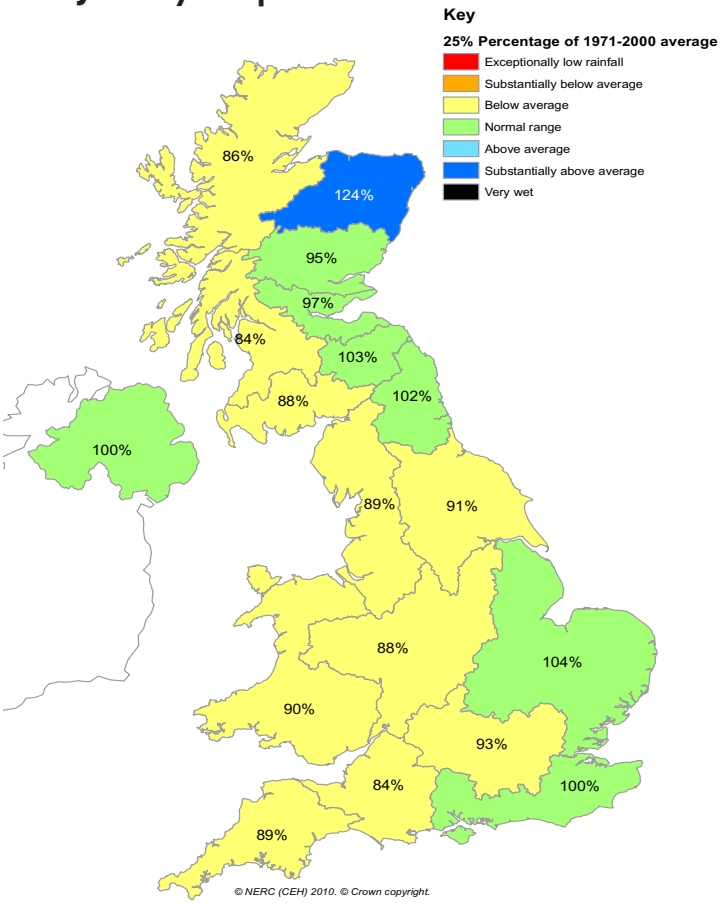
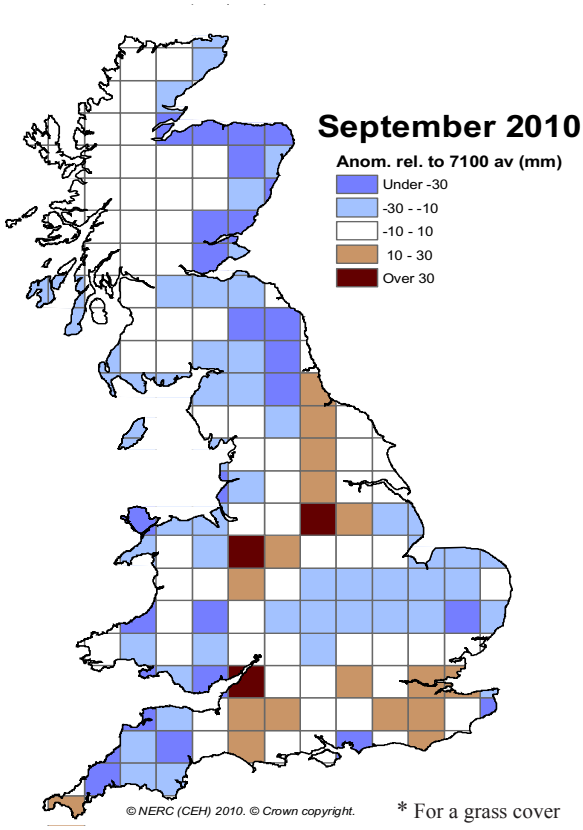
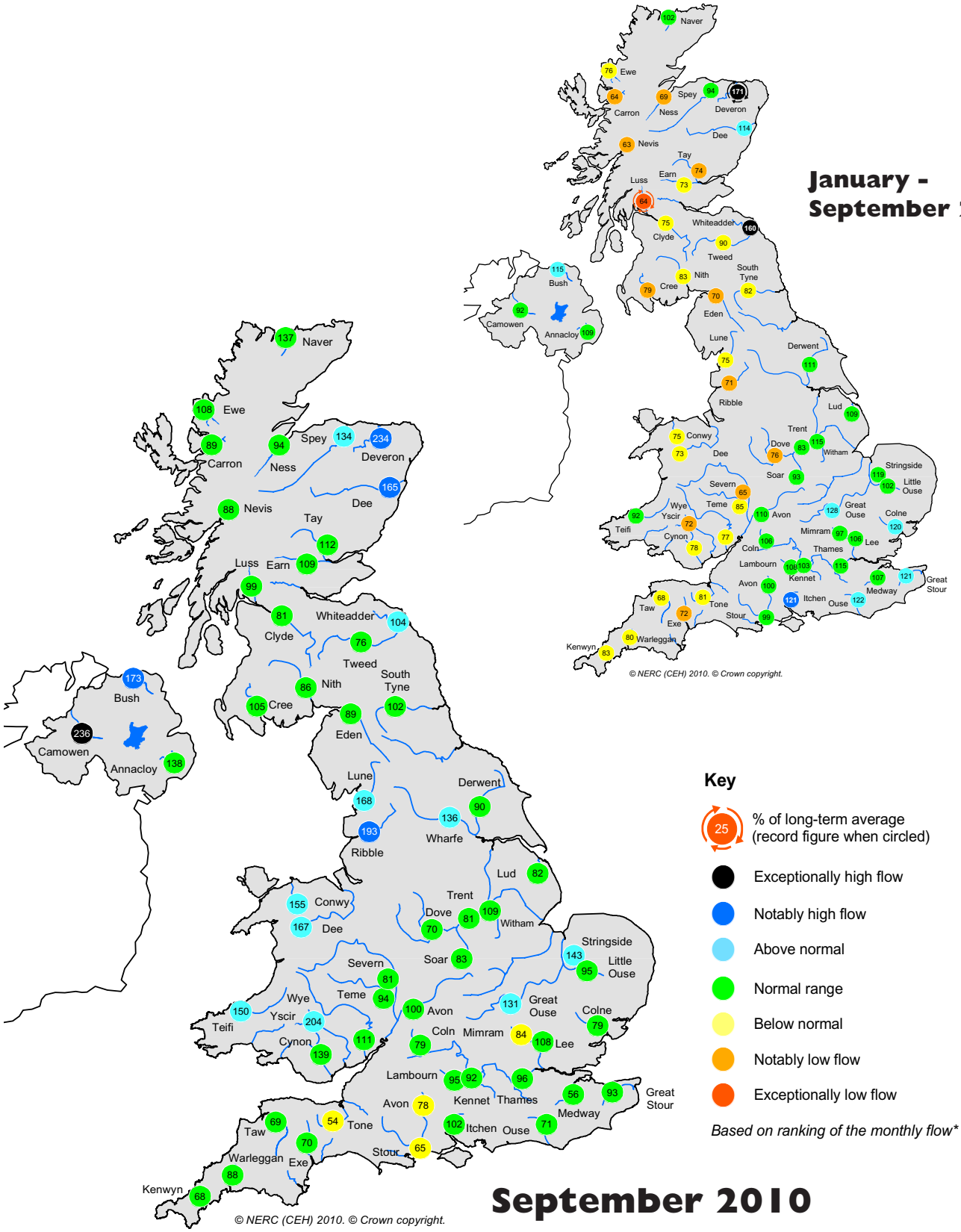


MORECS Soil Moisture Deficits *



* For a grass cover

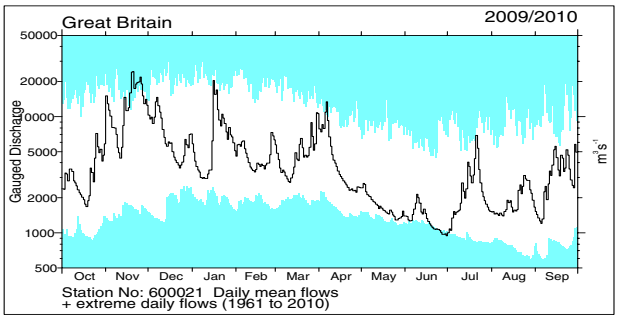
River flow . . . River flow . . .

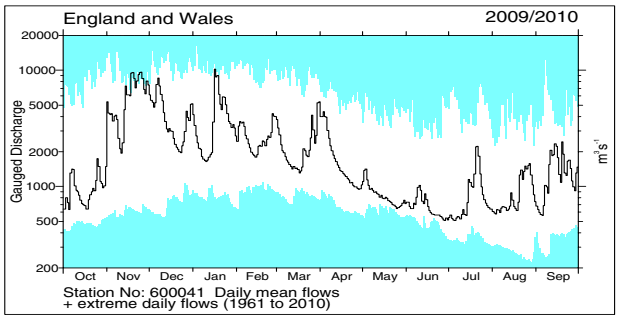


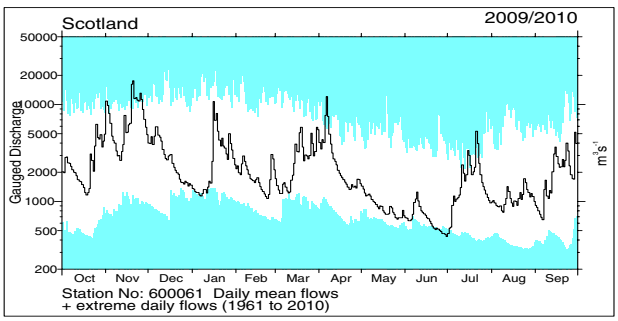
River flows

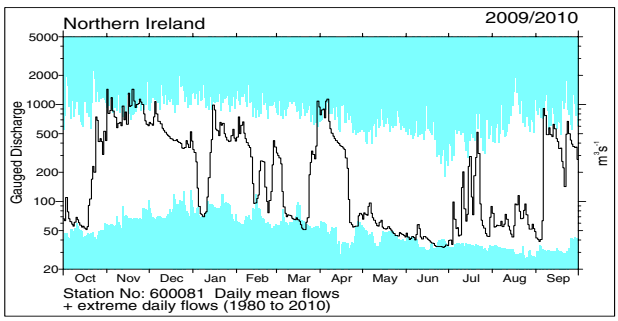
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

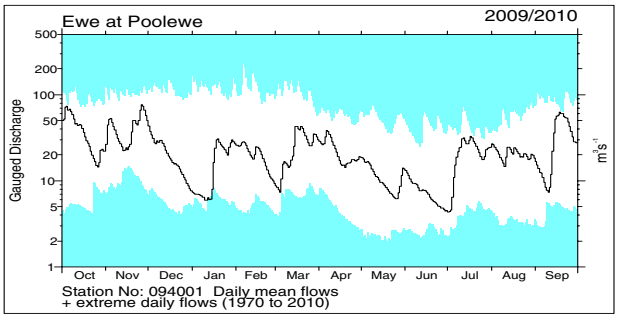
River flow . . . River flow . . .

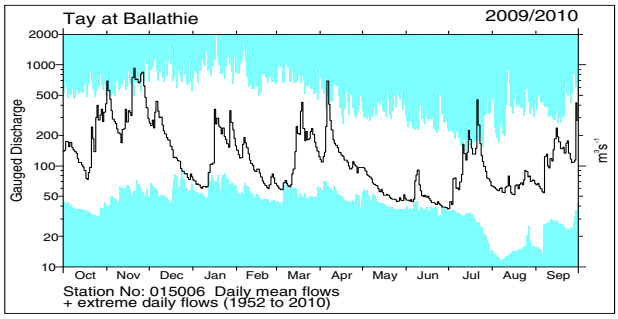


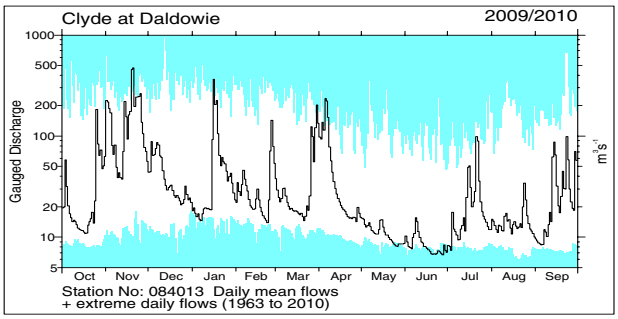


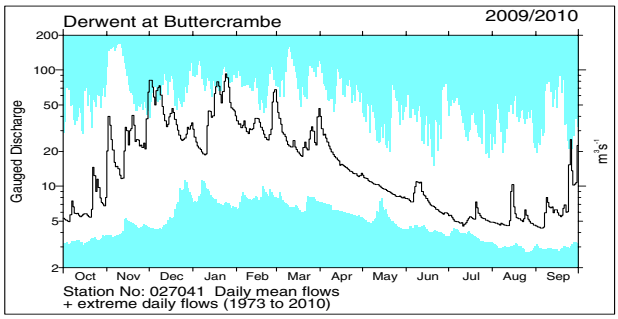


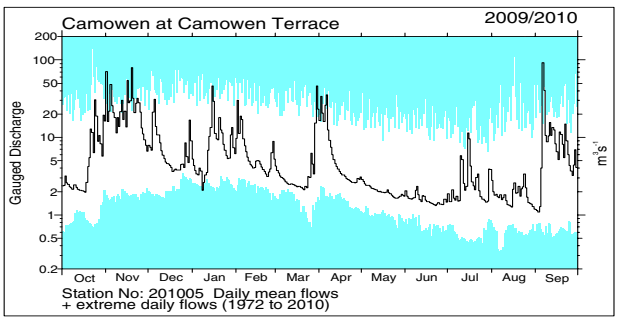


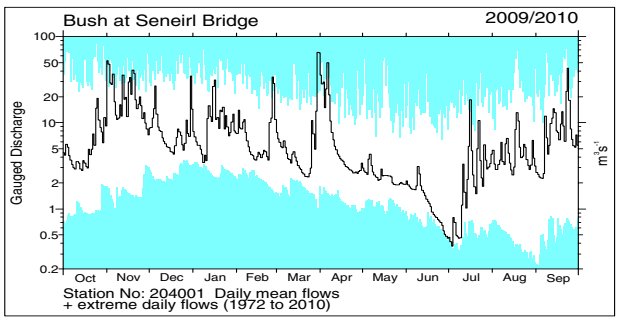








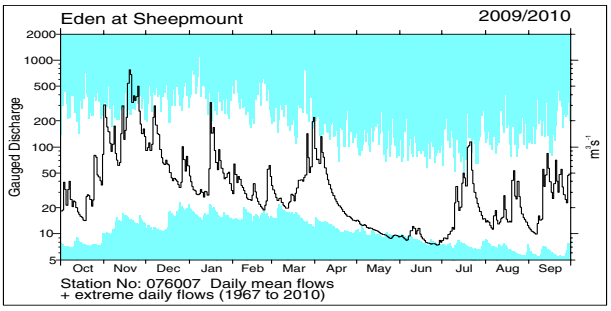


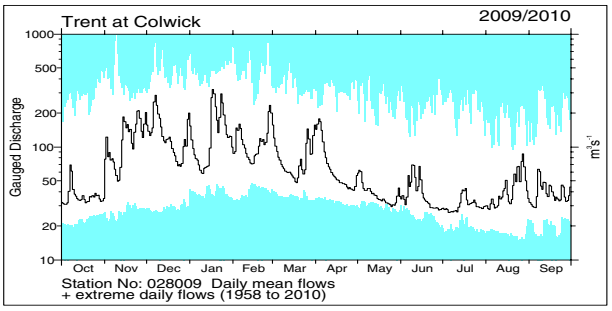


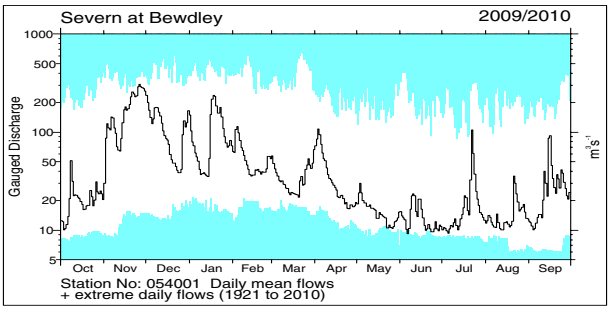
River flow hydrographs

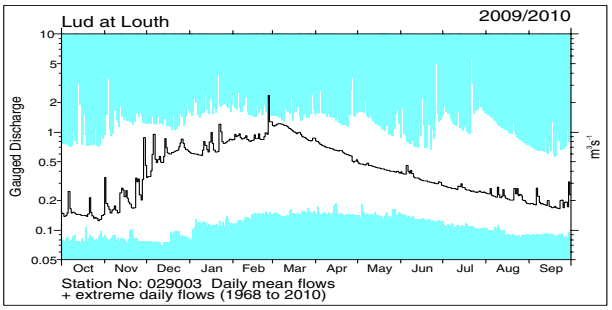
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to October 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

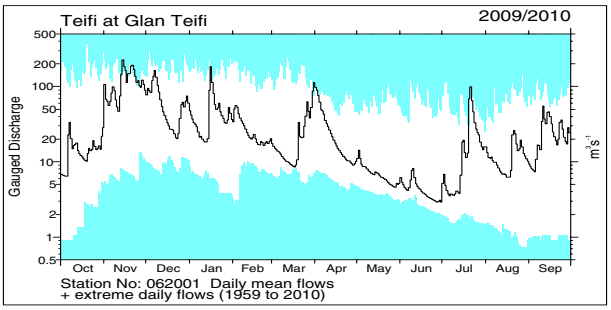
River flow . . . River flow . . .

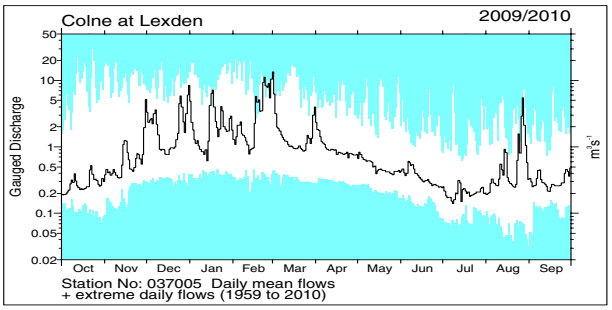


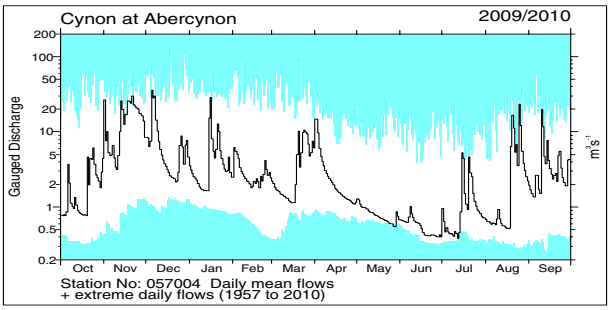


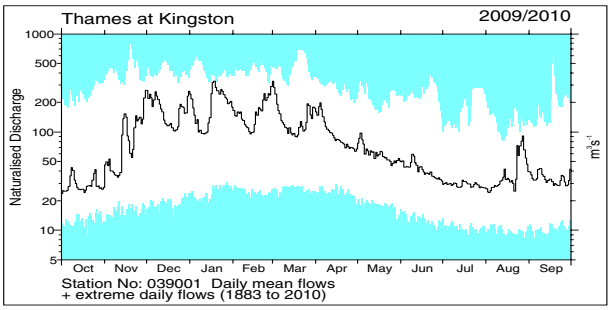


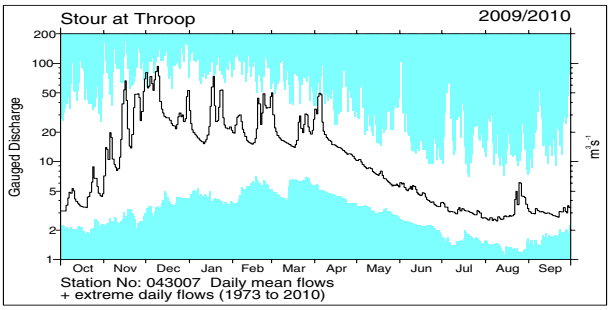


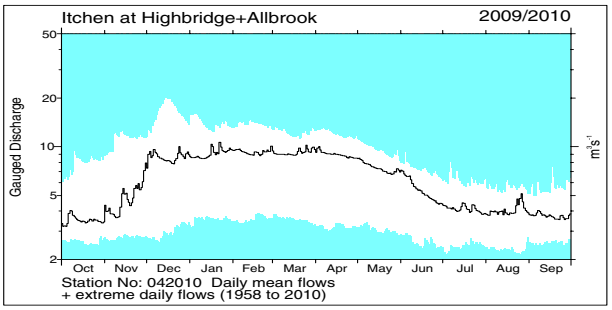












Notable runoff accumulations (a) July- September 2010 (b) January - September 2010

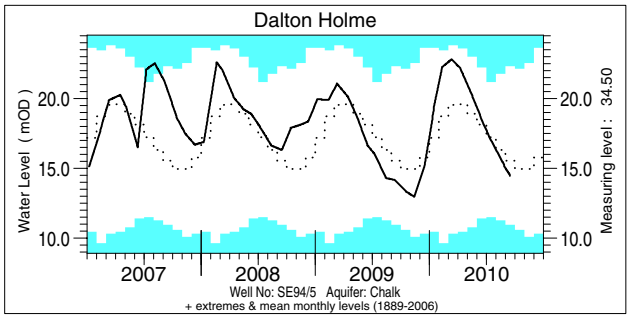
	River	%lta	Rank
a)	Bedford Ouse	145	70/78
	Stour	69	9/38
	Tone	59	5/50
	Brue	36	4/45
	Conwy	161	39/44
	Dee (New Inn)	153	37/42
	Naver	151	28/33
	Camowen	136	33/39

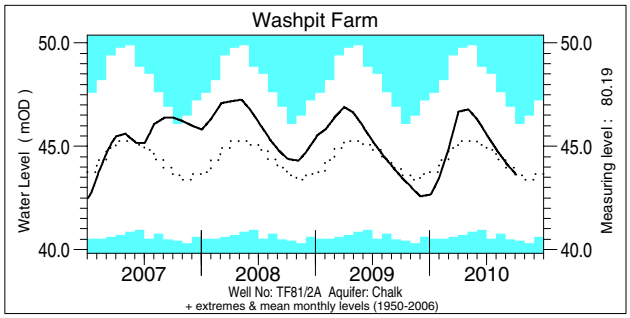
	River	%lta	Rank
b)	Ness	69	4/38
	Deveron	171	50/50
	Forth	61	2/29
	Tyne (Spilmersford)	161	44/45
	Whiteadder	160	40/41
	Yscir	72	4/38
	Dee (Manley Hall)	72	4/73

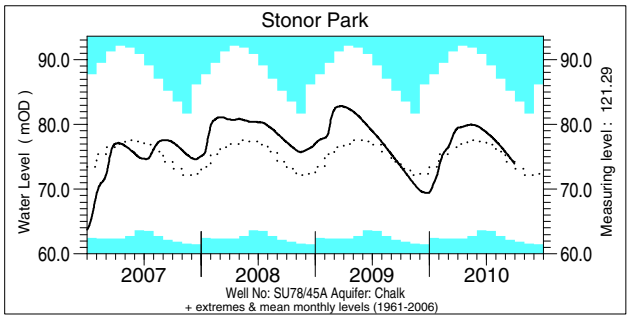
	River	%lta	Rank
b)	Ribble	71	3/50
	Eden	70	5/43
	Luss	64	1/32
	Nevis	63	2/28
	Carron	64	2/32
	Faughan	79	6/34

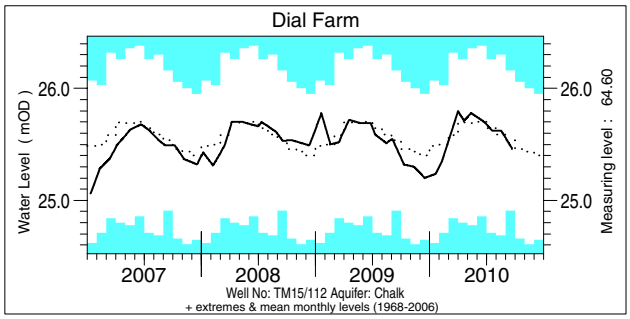
lta = long term average
Rank 1 = lowest on record

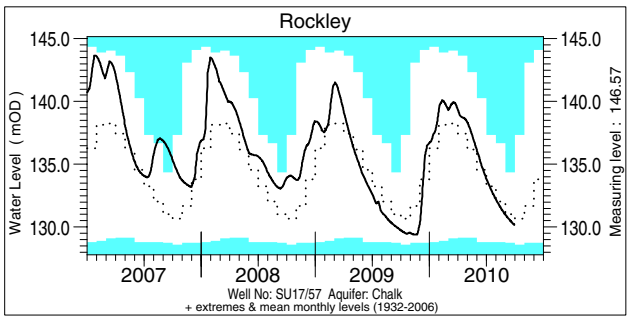
Groundwater . . . Groundwater

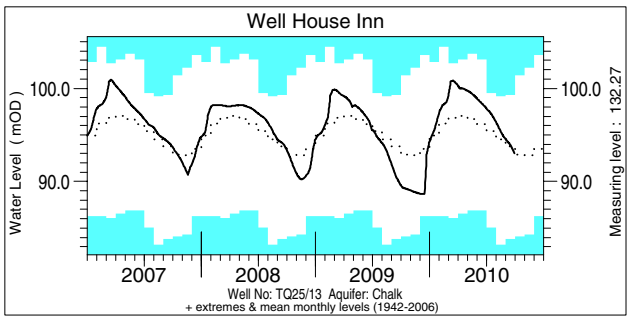


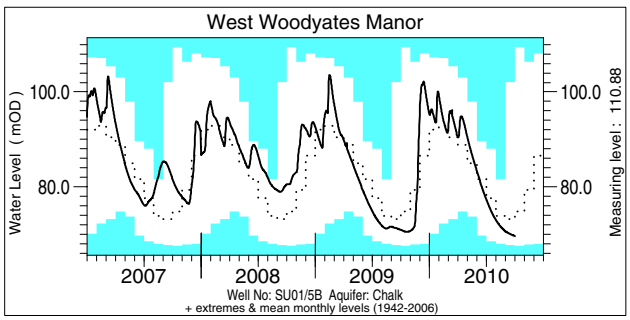


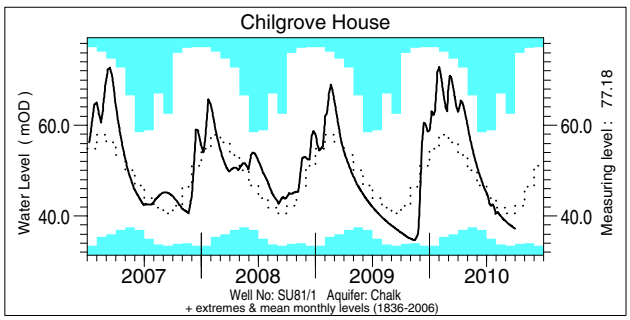


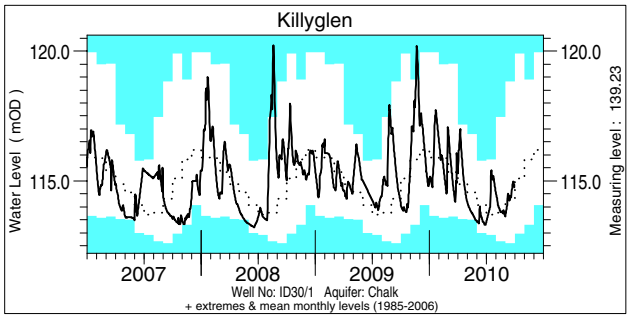


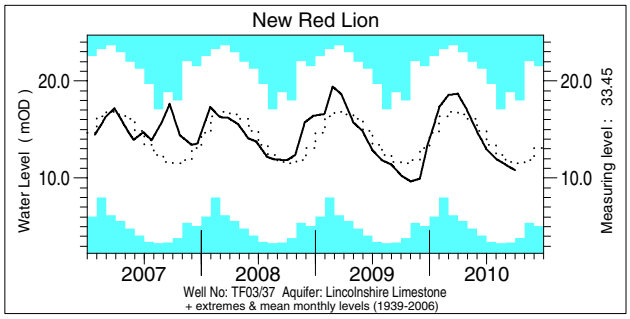






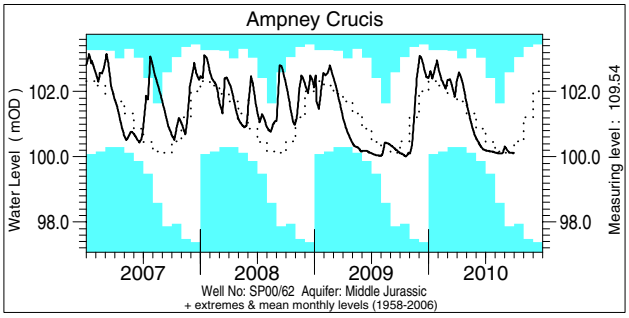


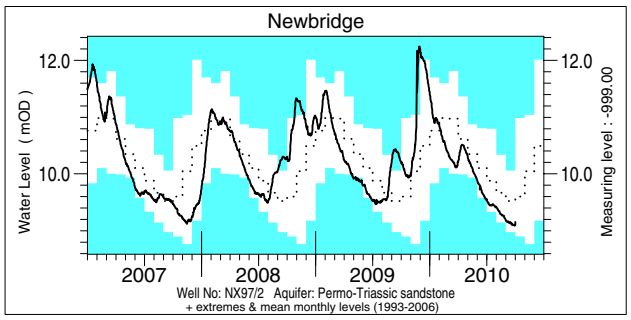


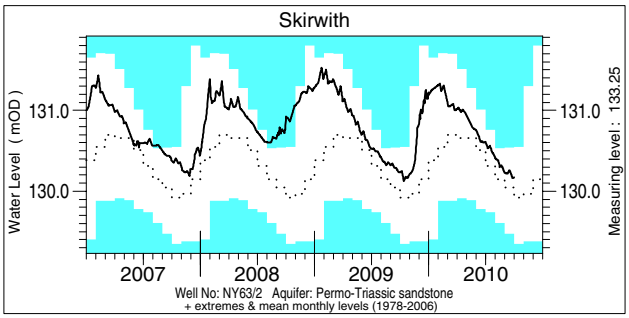


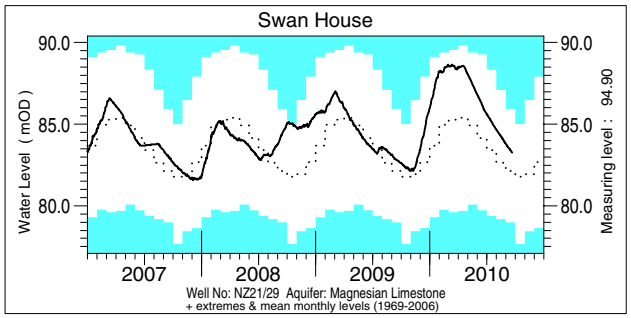
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

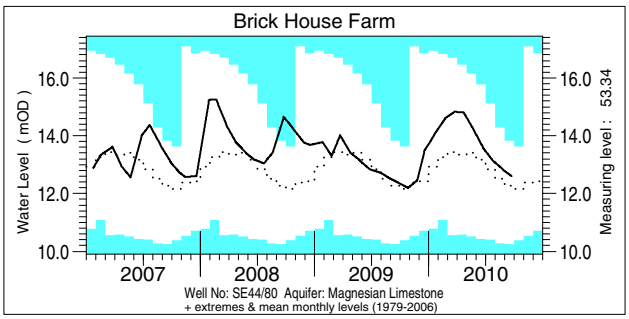
Groundwater . . . Groundwater

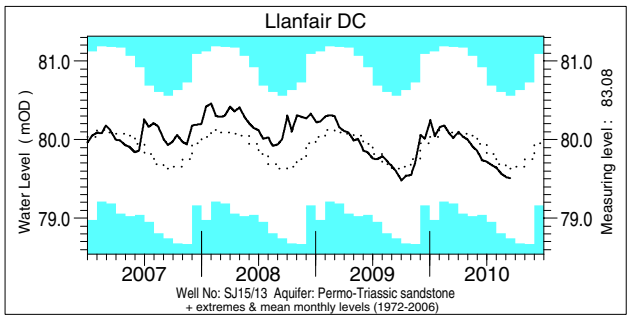


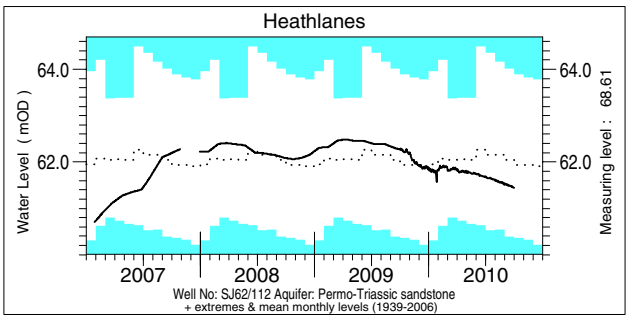


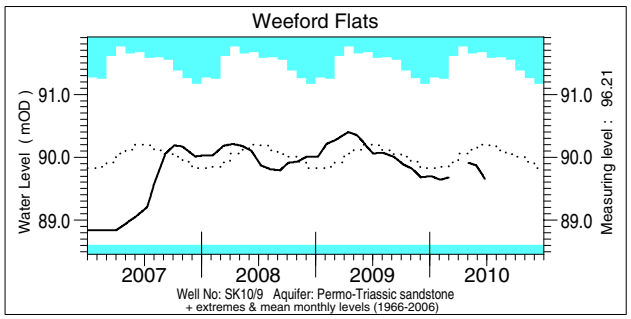


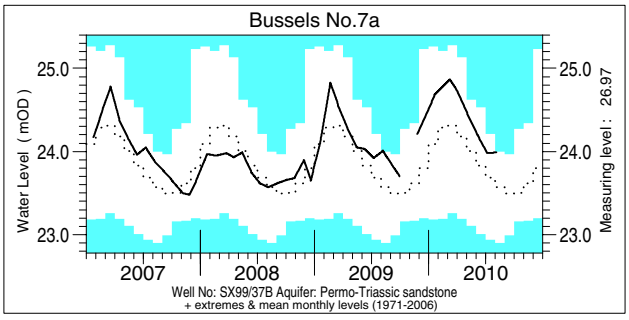


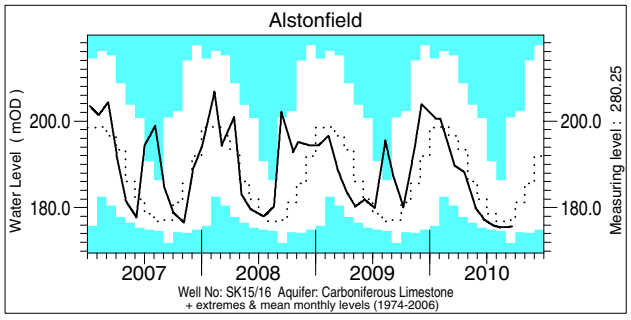








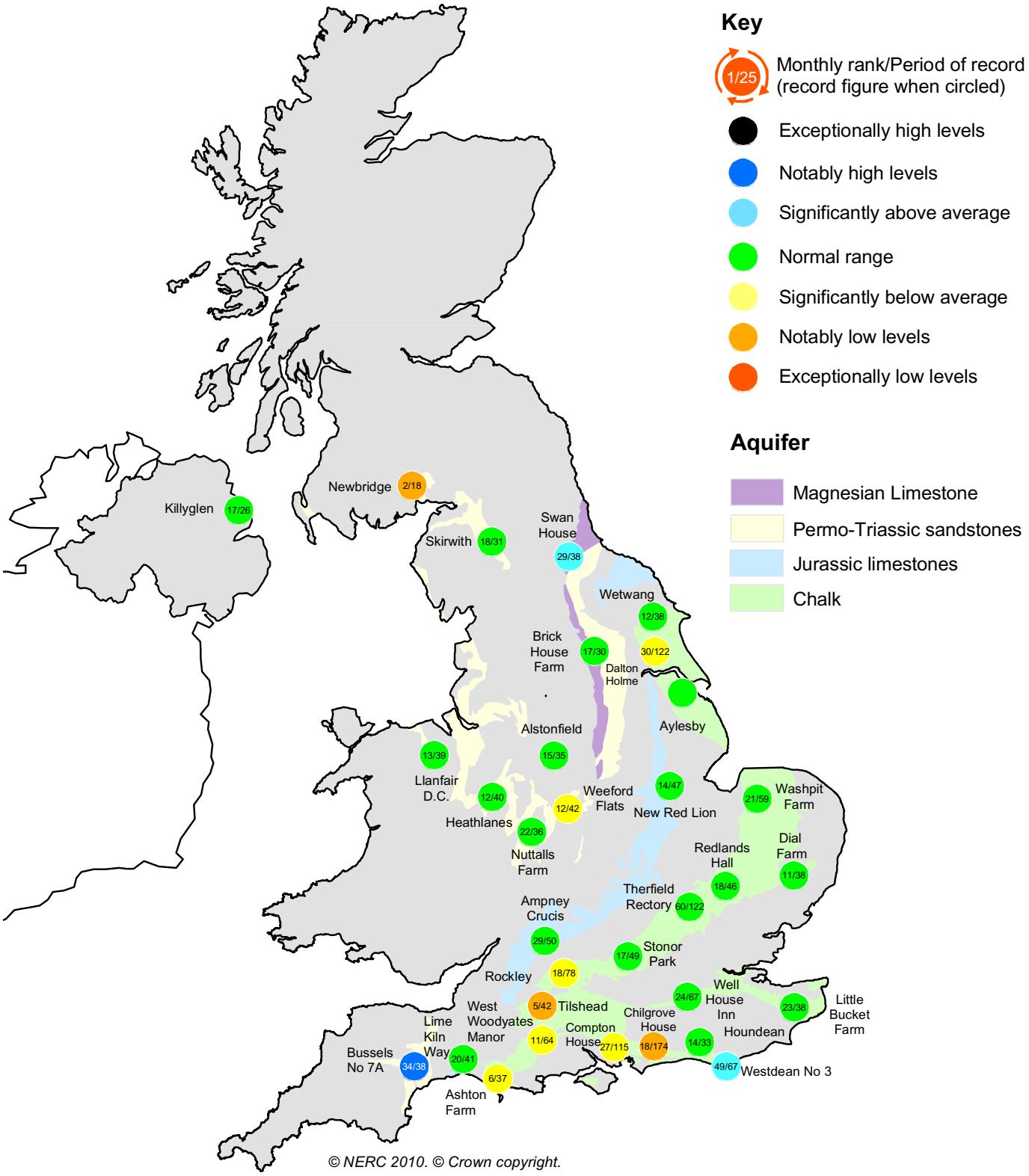




Groundwater levels September / October 2010

Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.
Dalton Holme	14.48	15/09	15.46	Chilgrove House	37.21	30/09	40.75	Brick House Farm	12.60	22/09	12.35
Washpit Farm	43.62	04/10	44.03	Killyglen (NI)	114.75	29/09	114.42	Llanfair DC	79.51	15/09	79.57
Stonor Park	73.96	29/09	74.51	New Red Lion	10.81	30/09	11.71	Heathlanes	61.45	30/09	62.02
Dial Farm	25.46	21/09	25.55	Ampney Crucis	100.10	29/09	100.14	Weeford Flats	89.36	27/09	89.79
Rockley	130.16	29/09	131.09	Newbridge	9.15	01/10	9.60	Bussels No.7a	23.73	05/10	23.52
Well House Inn	93.05	28/09	93.95	Skirwith	130.17	30/09	130.11	Alstonfield	175.64	20/09	178.67
West Woodyates	69.64	30/09	73.14	Swan House	83.26	20/09	82.15	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



Groundwater levels - September 2010

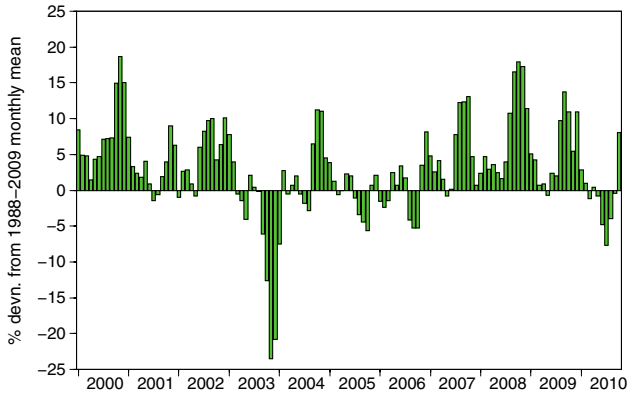
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

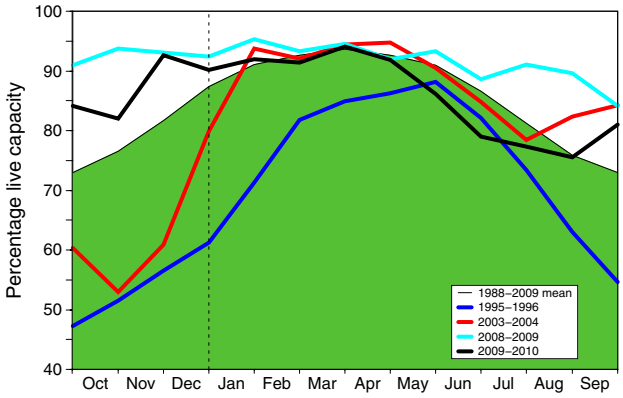
ii. Yew Tree Farm levels are now received quarterly.

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 Aug	Sep	Oct	Oct Anom.	Min Oct	Year* of min	2009 Oct	Diff 10-09
North West	N Command Zone	•	124929	65	61	**69**	13	13	1995	87	-18
	Vyrnwy		55146	69	68	**81**	13	26	1995	75	6
Northumbrian	Teesdale	•	87936	64	62	**80**	14	31	1995	81	-1
	Kielder		(199175)	(91)	(88)	**(89)**	5	(59)	1989	(87)	2
Severn Trent	Clywedog		44922	85	83	**90**	20	24	1989	87	3
	Derwent Valley	•	39525	61	57	**63**	-1	24	1989	76	-13
Yorkshire	Washburn	•	22035	73	71	**81**	16	24	1995	78	3
	Bradford supply	•	41407	64	58	**72**	6	15	1995	76	-4
Anglian	Grafham		(55490)	(87)	(87)	**(92)**	10	(46)	1997	(84)	8
	Rutland		(116580)	(78)	(75)	**(75)**	-3	(61)	1995	(73)	2
Thames	London	•	202828	86	87	**87**	11	53	1997	84	3
	Farmoor	•	13822	97	98	**97**	8	54	2003	84	13
Southern	Bewl		28170	71	64	**55**	-8	32	1990	51	4
	Ardingly		4685	82	76	**71**	5	32	2003	64	7
Wessex	Clatworthy		5364	59	49	**39**	-18	25	2003	83	-44
	Bristol WW	•	(38666)	(69)	(62)	**(54)**	-8	(31)	1990	(65)	-11
South West	Colliford		28540	80	74	**74**	6	38	2006	94	-20
	Roadford		34500	71	68	**68**	-3	26	1995	89	-21
	Wimbleball		21320	66	57	**52**	-14	30	1995	87	-35
	Stithians		4967	66	56	**52**	-3	22	1990	78	-26
Welsh	Celyn and Brenig	•	131155	82	83	**91**	11	39	1989	88	3
	Brianne		62140	85	86	**95**	11	48	1995	96	-1
	Big Five	•	69762	67	75	**91**	25	19	1995	91	0
	Elan Valley	•	99106	71	67	**81**	5	34	1995	96	-15
Scotland(E)	Edinburgh/Mid Lothian	•	97639	83	78	**77**	0	43	1998	88	-11
	East Lothian	•	10206	84	74	**69**	-11	52	1989	100	-31
Scotland(W)	Loch Katrine	•	111363	66	55	**63**	-11	43	1995	94	-31
	Daer		22412	89	84	**88**	12	32	1995	97	-9
	Loch Thom	•	11840	82	79	**79**	-1	56	1995	95	-16
Northern Ireland	Total+	•	56920	83	76	**91**	18	29	1995	91	0
	Silent Valley	•	20634	90	81	**93**	27	27	1995	92	1

() 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.

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

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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/index.html
Navigate via Water Watch

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