Hydrological Summary

for the United Kingdom

February 2010

General

February was another exceptionally cold month – contributing to the coldest winter for the UK since 1978/79 (1962/63 for Scotland). Snowfall was again common but with high pressure predominating until late in the month, precipitation totals were below average across most upland gathering grounds in western Britain. The limited rainfall, together with frozen headwaters, resulted in very modest inflows to most major reservoirs. Stocks are relatively depressed in many Scottish reservoirs; Loch Katrine registered its lowest early-March stocks in a series from 1994 (but the exceptional snowpack storage should enhance the spring replenishment). Well below average stocks also characterise parts of northern England but overall stocks for England & Wales are only marginally below the early spring average. Runoff patterns exhibited wide spatial variations: exceptionally low flows characterised much of northern and western Britain but flood alerts were common across much of England & Wales towards month end. Precipitation patterns generally favoured the outcrop areas of the major aquifers and groundwater levels were mostly within, or above, the normal February range. With very settled, and dry, weather patterns during early March the water resources outlook, in many northern regions particularly, would certainly benefit from the re-establishment of a sustained westerly airflow.

Rainfall

Persistent anticyclonic conditions ensured that rain-bearing Atlantic frontal systems had a limited impact on UK weather until late in February. With winds mainly from the north-east quadrant, snow and sleet constituted a substantial proportion of the total precipitation, particularly in the northern hills. Blizzards were common in Scotland; by the 6th, 60cm of snow had accumulated in parts of the Cairngorms and drifting produced higher totals later in the month when transport and power disruptions were severe (e.g. in Perthshire); on the 24th, avalanches in Glencoe resulted in two fatalities. Sub-Arctic conditions also extended to southern England: Windlesham (Surrey) reported 29cm of snow on the 2nd, and 32cm was reported at Malham (North Yorks) as the storm moved north. Active Atlantic weather systems did track across the country during the fourth week generating substantial rainfall; e.g. 40mm at Herstmonceux (East Sussex) on 22/23rd, and >50mm in parts of Jersey on the 27/28th (when a very destructive depression caused severe damage in parts of France). Relative to the monthly average, February precipitation totals exhibited a very clear, and unusual, east-west decline. Whilst much of eastern Britain was exceptionally wet (e.g. London, parts of Kent and the east coast of Scotland), February rainfall totals were notably low for the second successive year in many western catchments. At the national scale, winter (Dec-Feb) rainfall was the 2nd lowest since 1995/96 but, provisionally, Scotland recorded its driest winter since 1963/64 and Northern Ireland its 2nd driest since 1970/71.

River flows

River flows were in recession during much of February but spate conditions were common during the final week; these were most persistent in southern Britain – where increasing groundwater contributions were a significant influence in many permeable catchments. By month-end, over 100 Flood Watches were in operation, across much of England & Wales (a few of which related to tidal flooding), together with several Flood Warnings (e.g. on the Nene and Yorkshire Ouse); the spate conditions extended into early March. In contrast, frozen headwaters contributed to notably low mid-month flows in many Scottish rivers (e.g. the Luss and the Earn; the latter established a new February minimum daily flow on the 22nd – in a series from 1948). Provisionally, the February runoff from Scotland was the lowest since 1986 and the Ness, Tay and Forth were among many rivers reporting their 2nd lowest February flow on record. By contrast, sustained high flows over the final week (e.g. in the Mole and Essex Colne) ensured that February runoff totals were above average throughout most of the English Lowlands. Broadly, this geographical distinction is replicated for the winter runoff totals: in western Scotland the Nevis and Luss established new Dec-Feb runoff minima whilst winter mean flows were above average across much of eastern, central and southern England. Runoff accumulations are generally healthy (parts of western Scotland aside) for periods exceeding six months.

Groundwater

Soils remained close to saturation throughout the month but, as earlier in the winter, snowpack storage and frozen ground inhibited infiltration rates. Nonetheless, with precipitation totals generally favouring the outcrop areas of the major aquifers – in the South East particularly – there was substantial replenishment to the Chalk whilst only very modest replenishment to many western and northern Permo-Triassic sandstones outcrops. The frozen soil conditions have made for erratic recharge through the winter but February groundwater levels in the Chalk outcrops were generally close to, or above, the late winter average. Despite moderate declines in some, mostly northern, areas this remains true of most limestone aquifers also. Unsurprisingly, given their geographical spread, the Permo-Triassic sandstone outcrops present a less spatially coherent picture in relation to groundwater resources: healthy levels characterise some southern index boreholes (e.g. Bussels) but steep recent declines have been recorded in some responsive northern outcrops (e.g. Newbridge). Considering England & Wales as a whole however, levels in the majority of index wells remain within the normal range. With soil moisture deficits beginning to develop in early March, rainfall patterns over the next 6-8 weeks will be very influential in determining the groundwater resources outlook for the summer.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

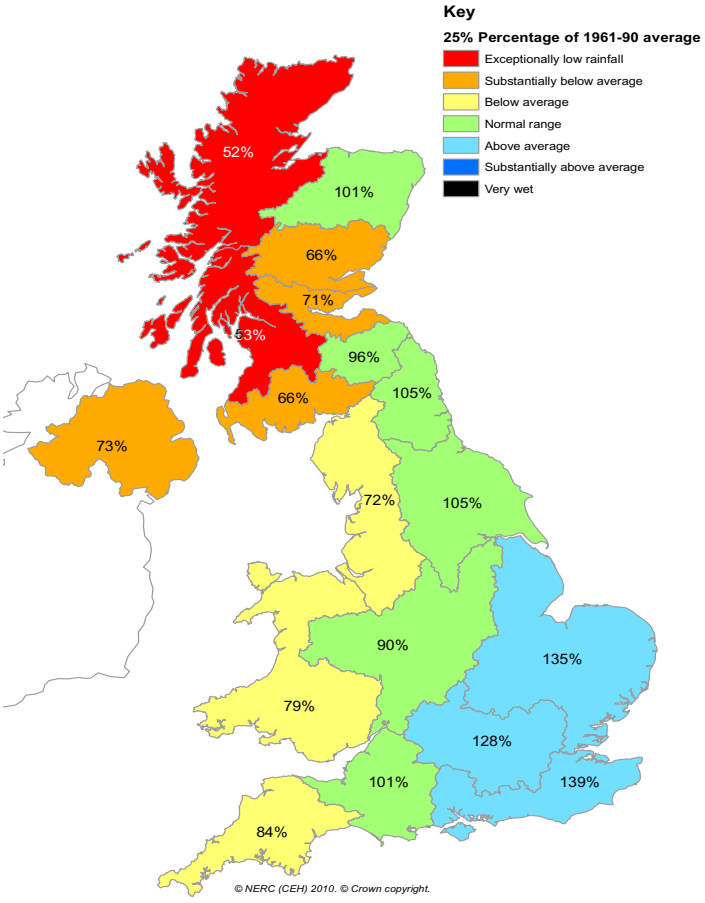
Area	Rainfall	Feb 2010	Dec 09 - Feb 10	RP	Sep 09 - Feb 10	RP	Jun 09 - Feb 10	RP	Mar 09 - Feb 10	RP
England & Wales	**mm**	**72**	**244**		**550**		**815**		**964**	
	%	**112**	**98**	**2-5**	**109**	**2-5**	**115**	**2-5**	**106**	**2-5**
North West	mm	**56**	235		684		1061		1286	
	%	**70**	72	5-10	98	2-5	109	2-5	106	2-5
Northumbrian	mm	**70**	238		551		864		994	
	%	**117**	105	2-5	119	5-10	128	20-30	115	5-10
Severn Trent	mm	**50**	184		402		658		790	
	%	**92**	90	2-5	99	2-5	111	2-5	103	2-5
Yorkshire	mm	**71**	231		518		771		904	
	%	**122**	105	2-5	116	2-5	119	5-10	108	2-5
Anglian	mm	**75**	195		353		528		615	
	%	**199**	135	5-10	116	2-5	114	2-5	102	2-5
Thames	mm	**80**	235		456		633		740	
	%	**172**	128	2-5	122	2-5	118	2-5	106	2-5
Southern	mm	**113**	304		613		748		866	
	%	**208**	139	5-10	135	5-10	122	5-10	110	2-5
Wessex	mm	**79**	253		561		802		927	
	%	**120**	101	2-5	115	2-5	120	2-5	109	2-5
South West	mm	**93**	322		720		1059		1281	
	%	**91**	84	2-5	100	<2	112	2-5	107	2-5
Welsh	mm	**63**	317		807		1201		1428	
	%	**62**	79	5-10	101	2-5	112	2-5	106	2-5
Scotland	**mm**	**77**	**260**		**816**		**1244**		**1596**	
	%	**73**	**62**	**10-20**	**93**	**2-5**	**106**	**2-5**	**109**	**5-10**
Highland	mm	**78**	260		899		1333		1783	
	%	**61**	52	15-25	85	2-5	96	2-5	102	2-5
North East	mm	**84**	273		707		1031		1239	
	%	**121**	101	2-5	124	10-20	128	35-50	120	30-45
Tay	mm	**76**	249		776		1168		1470	
	%	**77**	66	5-15	102	2-5	114	5-10	114	5-15
Forth	mm	**85**	222		651		1023		1264	
	%	**104**	71	5-10	98	2-5	113	5-10	110	5-10
Tweed	mm	**74**	256		629		990		1156	
	%	**106**	96	2-5	113	2-5	126	20-30	115	5-15
Solway	mm	**56**	268		811		1363		1694	
	%	**55**	66	5-15	95	2-5	118	10-20	118	25-40
Clyde	mm	**82**	264		921		1457		1901	
	%	**66**	53	20-35	87	2-5	103	2-5	109	5-10
Northern Ireland	**mm**	**62**	**223**		**584**		**942**		**1218**	
	%	**77**	**73**	**10-20**	**93**	**2-5**	**108**	**2-5**	**111**	**5-10**

% = percentage of 1961-90 average *RP = Return period*

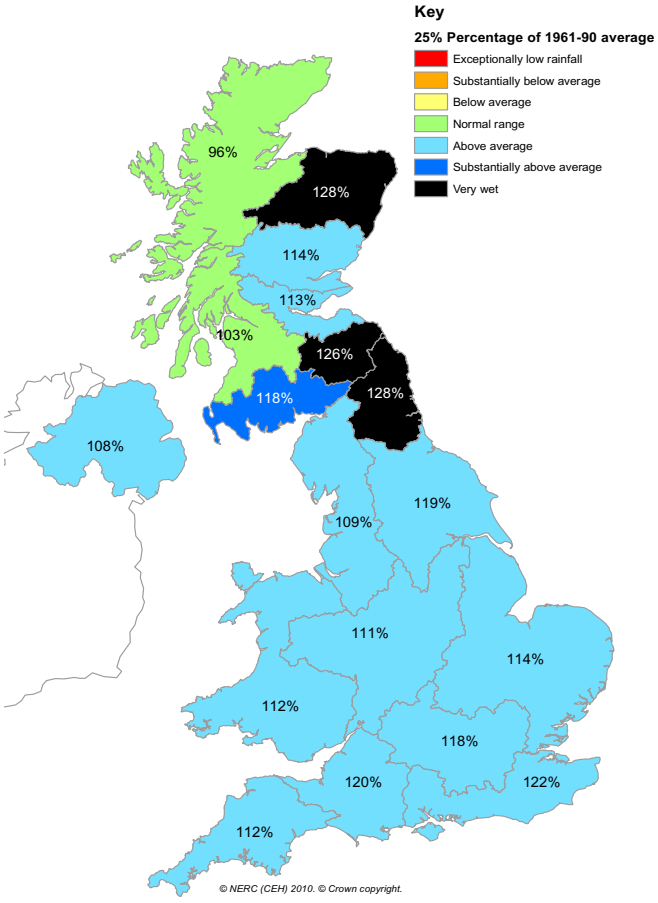
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and derived following the method described in: Tabony, R. C. 1977, *The variability of long duration rainfall over Great Britain*. Met Office Scientific Paper no. 37. The estimates reflect climatic variability since 1913 and assume a stable climate. 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 September 2009 are provisional. **The significant proportion of snowfall through the winter implies that the precipitation totals are likely to be underestimates.**

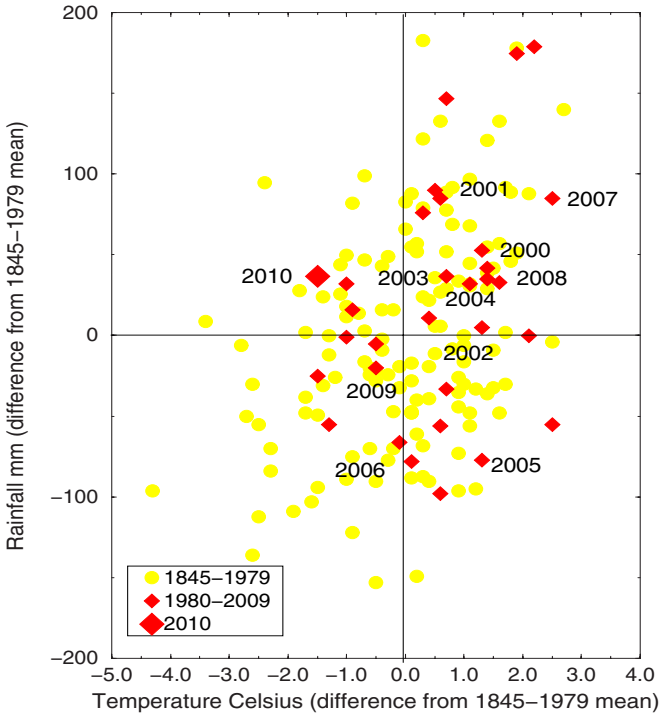
Rainfall . . . Rainfall . . .

December 2009 - February 2010



June 2009 - February 2010





This diagram shows E&W winter (Dec-Feb) rainfall and Central England Temperatures anomalies over the last 255 years; plotting positions for the post-1979 winters are shown as red diamonds.

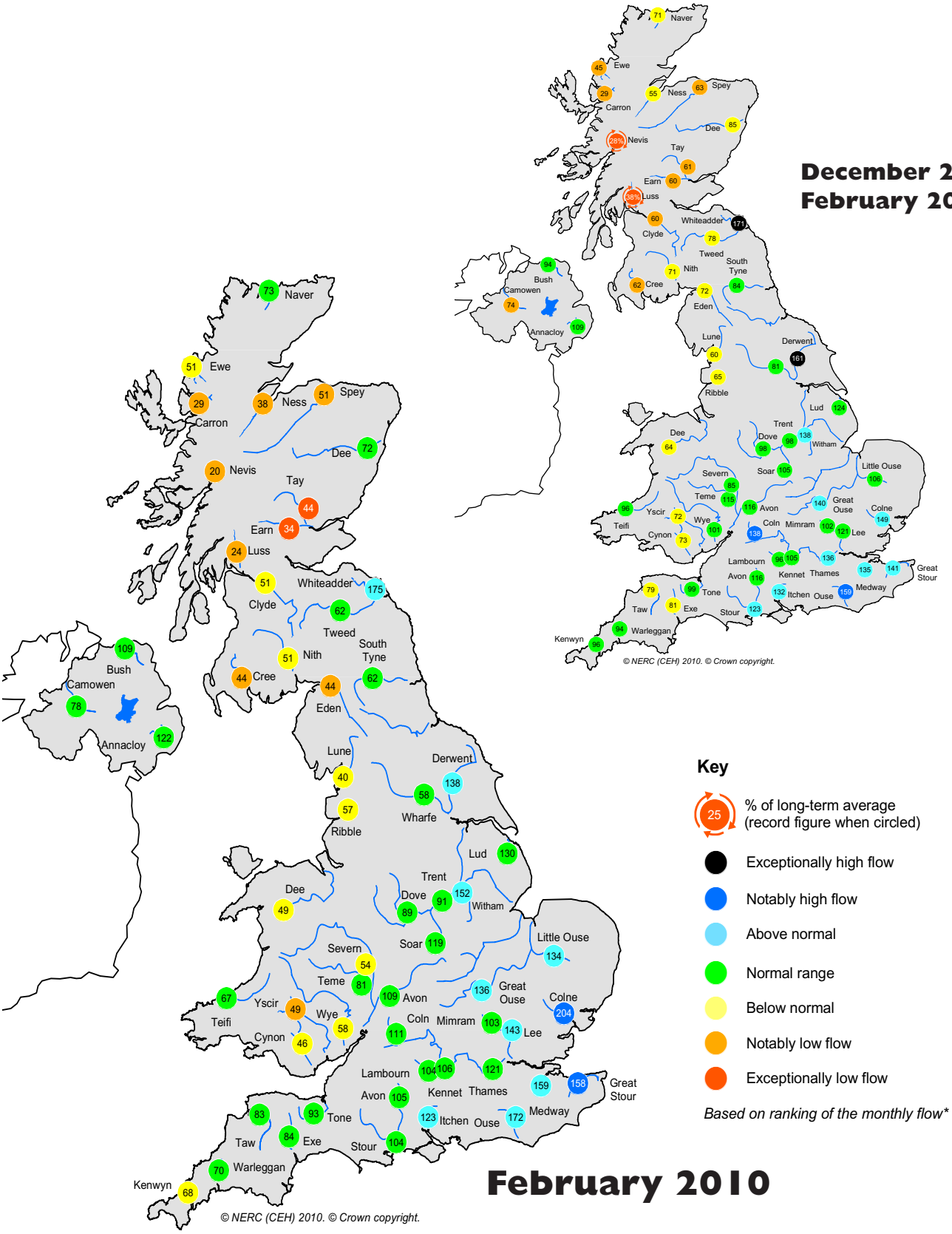
Met Office Weather forecast

Updated: 1130 on Wed 10 Mar 2010

UK Outlook for Mon 15 Mar - Wed 24 Mar 2010:
Outbreaks of rain or drizzle are likely across northwestern parts of the UK, but it should be drier for the rest of the country, with variable cloud and some clear or sunny spells. Unsettled conditions are then expected to spread to most parts of the UK from Wednesday (17th) with outbreaks of rain but also some drier and brighter interludes. Some snow over Scottish mountains at times. Temperatures should be near normal at first, with a risk of patchy overnight frost and fog, but perhaps become slightly above normal later, especially in the far south. Winds may be strong to gale force around exposed coastal areas. For the rest of the period, unsettled conditions are likely to continue with temperatures around the seasonal average.

UK Outlook for Thur 25 Mar - Thur 8 Apr 2010:
Unsettled weather is likely to continue towards the end of the month for many parts of the UK, with some wet and windy weather possible but also some drier and brighter periods. Temperatures are likely to remain near normal for late March, but perhaps become rather warm across southern and eastern parts for a time, with less frost likely. As we go into the beginning of April it looks like unsettled conditions with outbreaks rain and some drier and brighter interludes may affect many parts. Temperatures will remain close to normal with overnight frost becoming increasingly confined to sheltered inland parts.

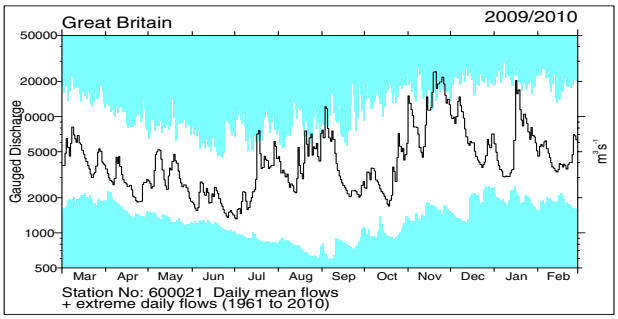
River flow . . . River flow . . .

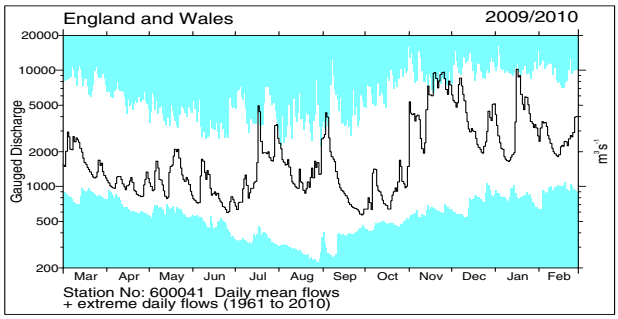


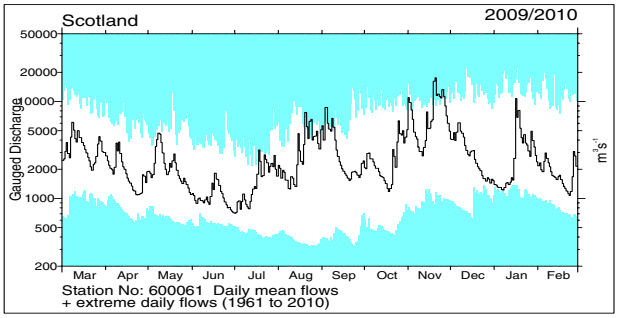
River flows

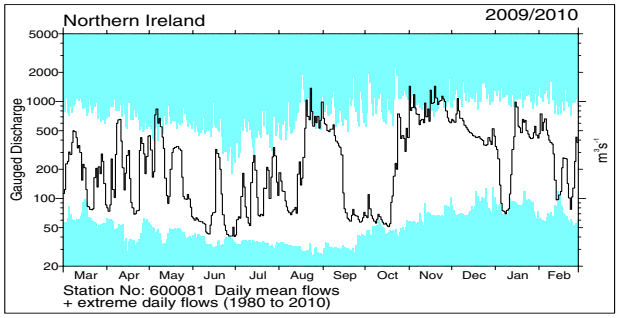
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

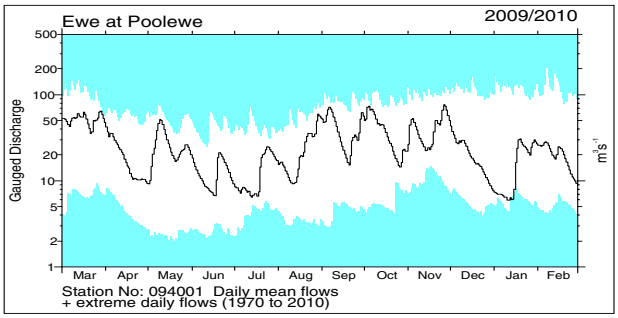
River flow . . . River flow . . .

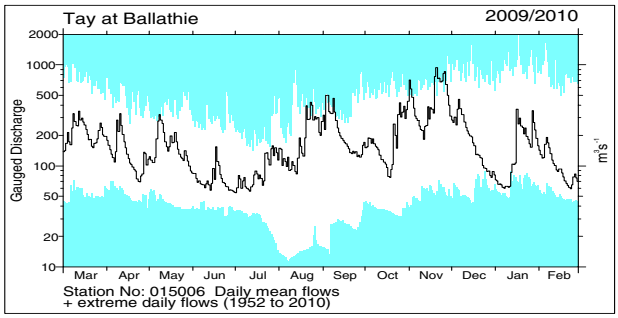


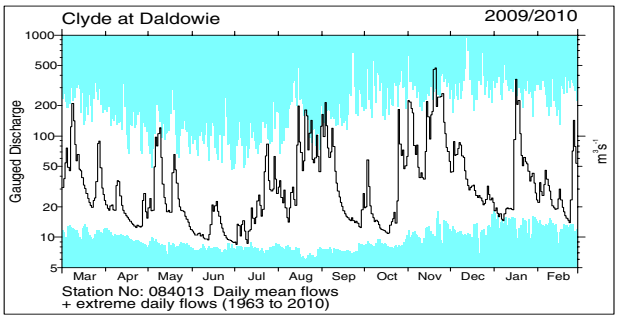


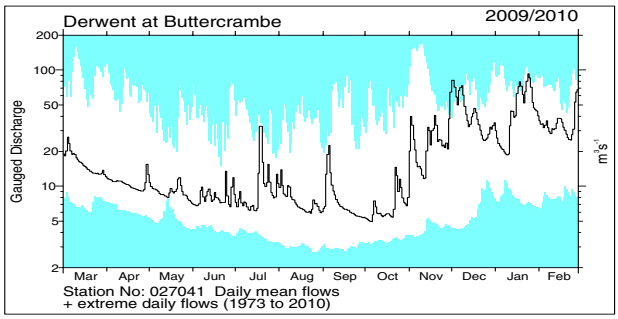


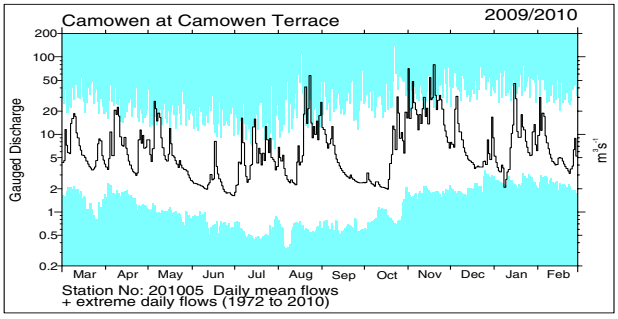


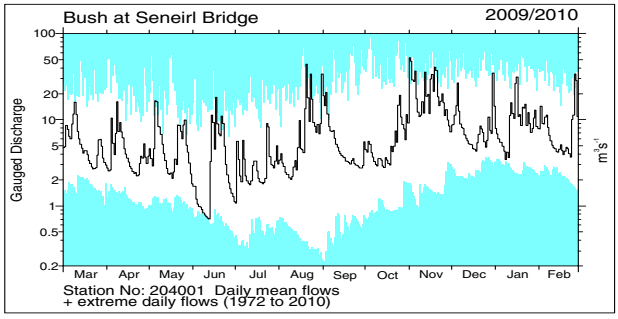








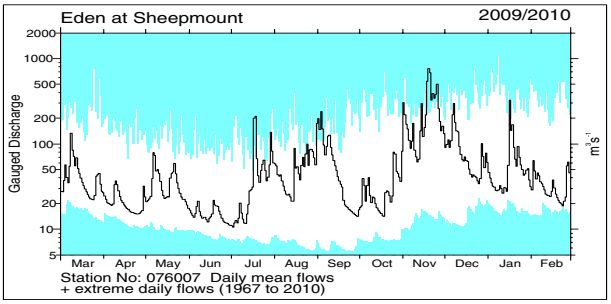


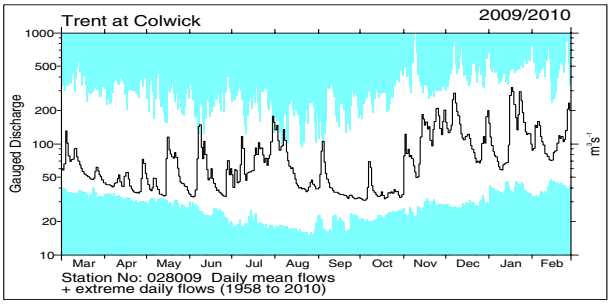


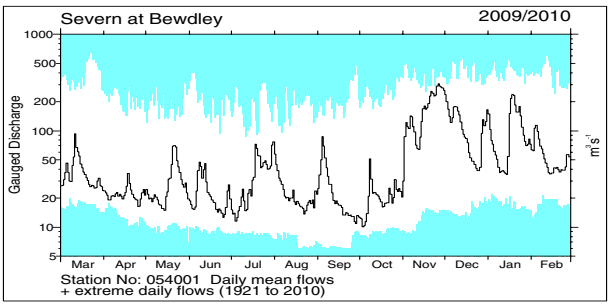
River flow hydrographs

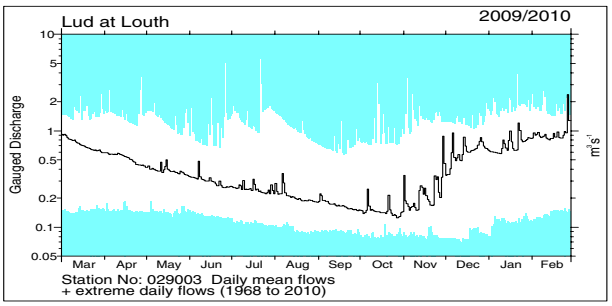
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to March 2009 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

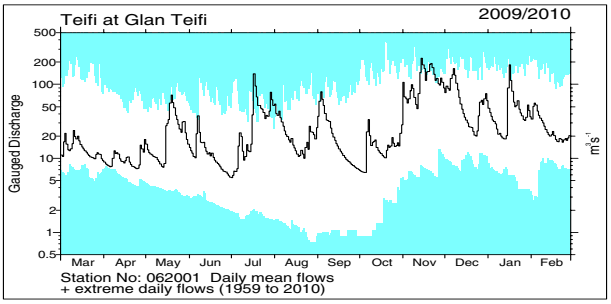
River flow . . . River flow . . .

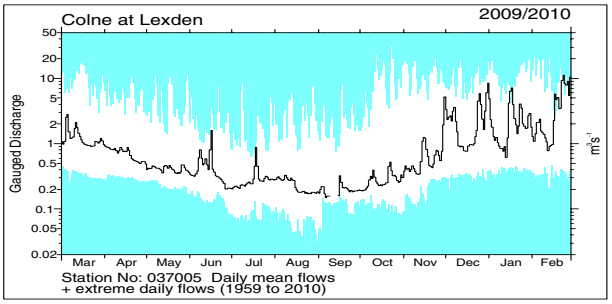


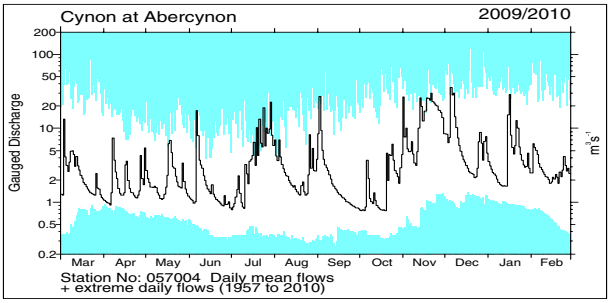


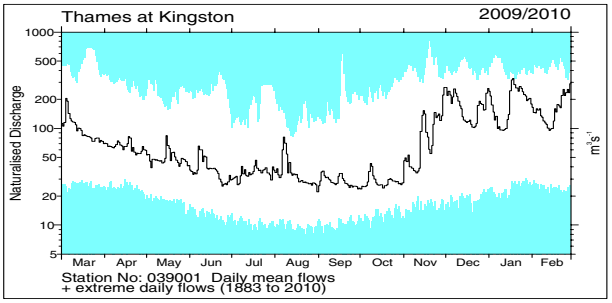


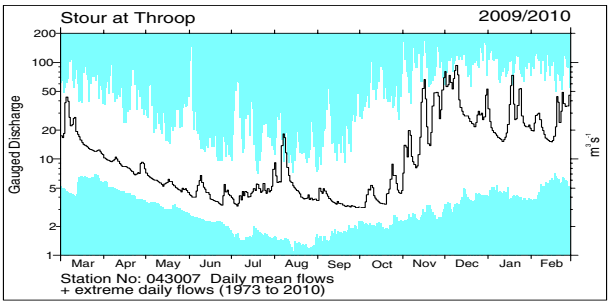


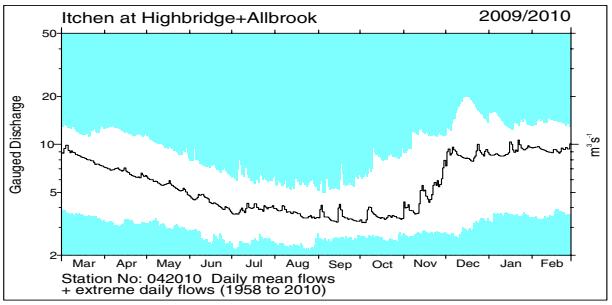












Notable runoff accumulations (a) December - February 2010, (b) March 2009 - February 2010

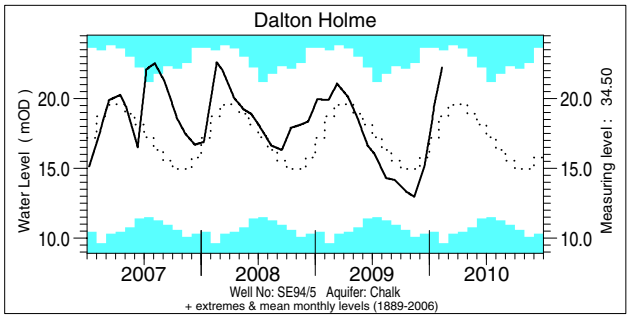
	River	%lta	Rank
a)	Deveron	158	50/50
	Forth	41	1/29
	Tyne (Spilmersford)	164	43/45
	Whiteadder	171	40/41
	Derwent	161	48/49
	Dover Beck	167	32/35
	Blackwater	163	56/58
	Mole	170	34/36

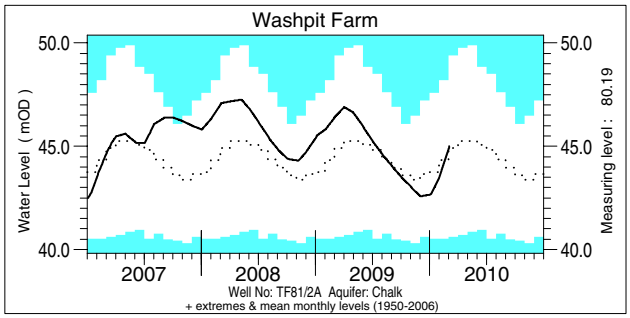
	River	%lta	Rank
a)	Cree	62	3/47
	Luss	38	1/31
	Nevis	28	1/28
	Carron	29	2/31
	Ewe	45	3/40
	Mourne	65	2/28
	Faughan	66	3/34

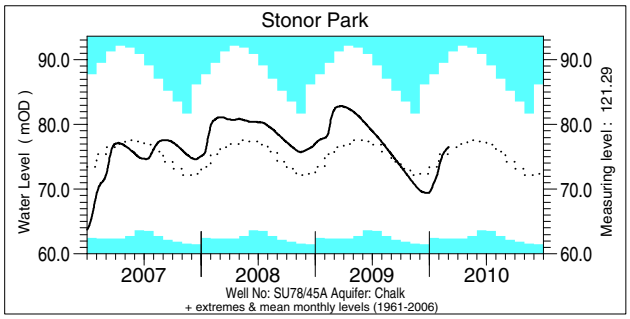
	River	%lta	Rank
b)	Nith	127	51/52
	Camowen	124	34/36
	Annacloy	121	26/30

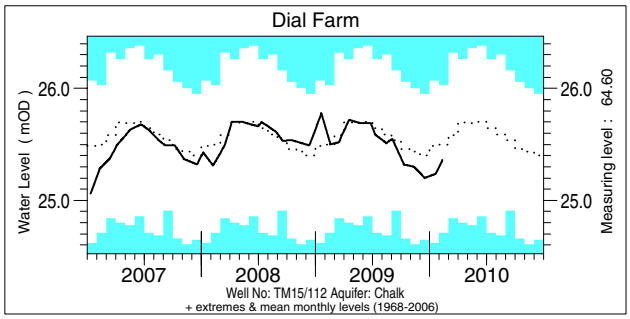
lta = long term average
Rank 1 = lowest on record

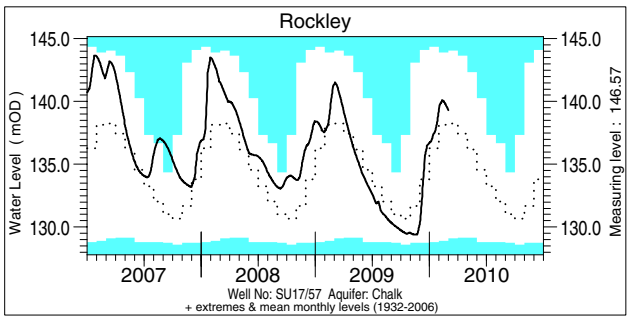
Groundwater . . . Groundwater

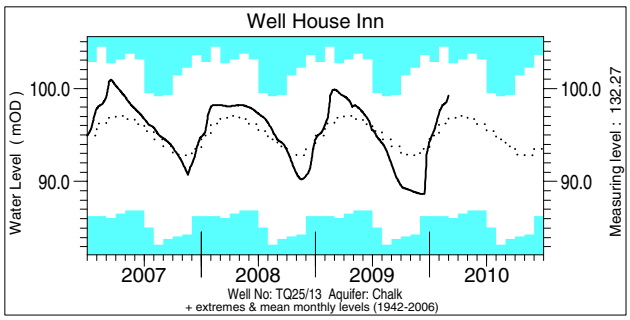


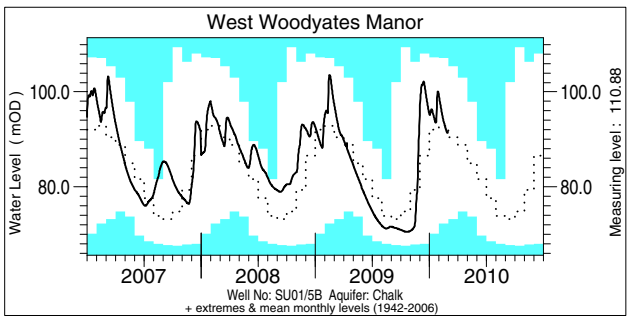


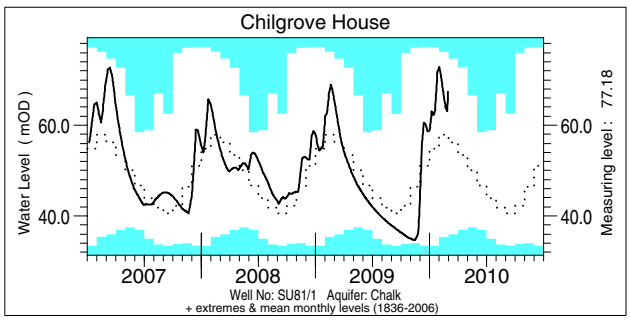


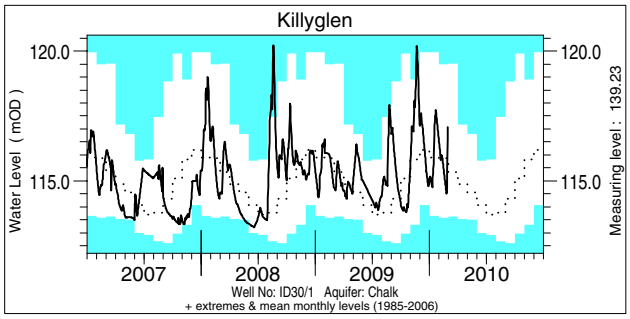


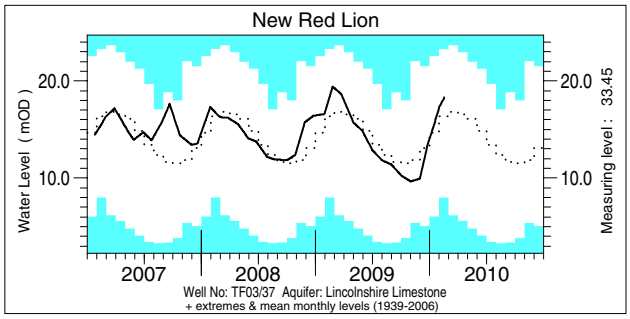






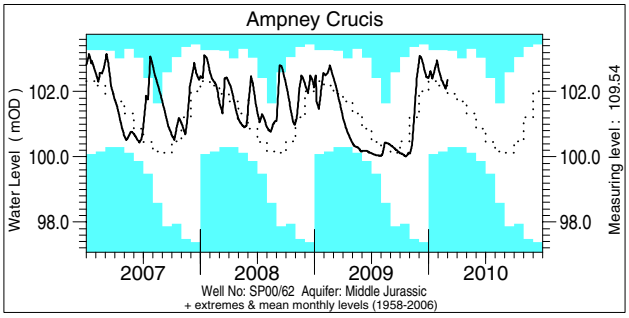


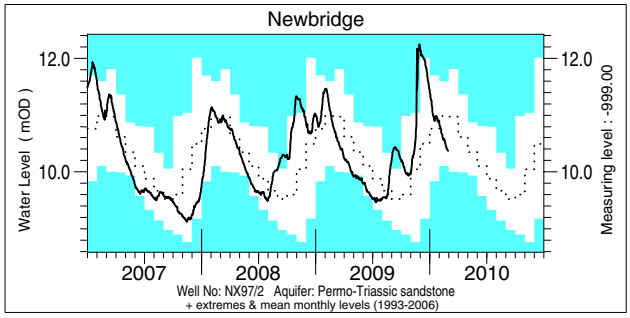


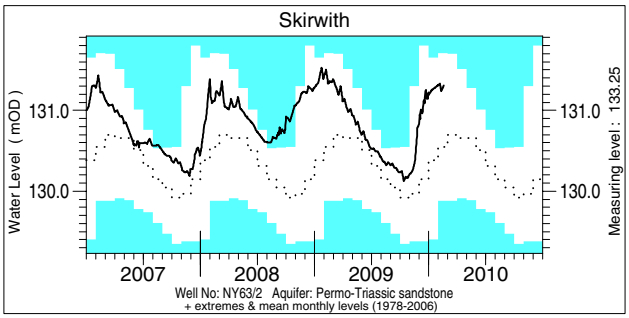


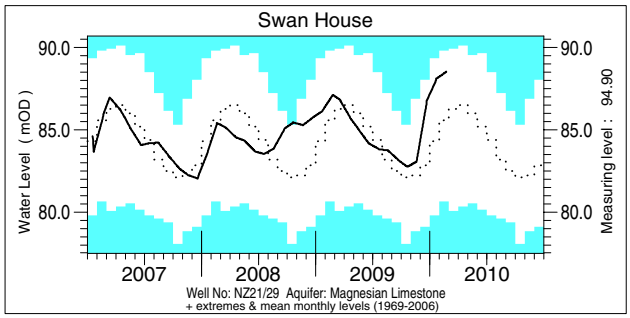
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

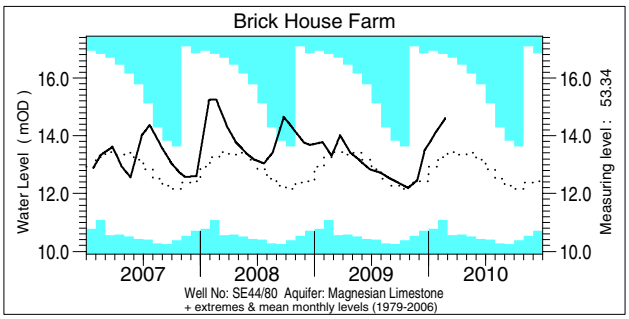
Groundwater . . . Groundwater

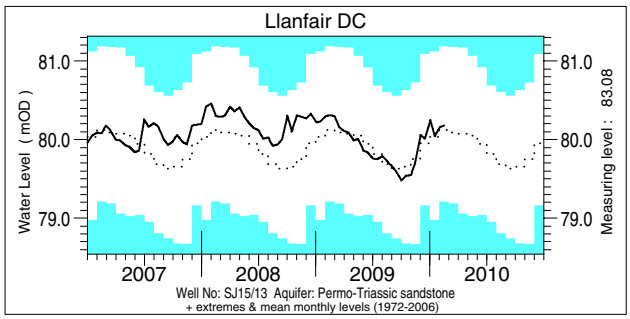


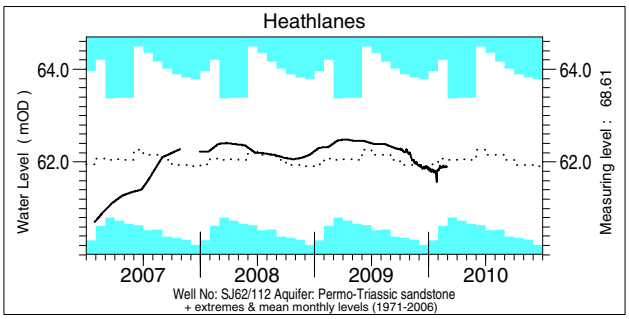


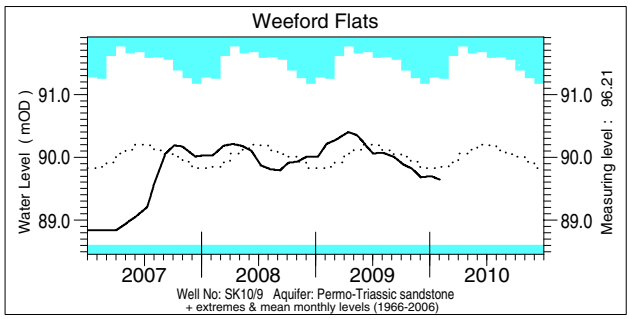


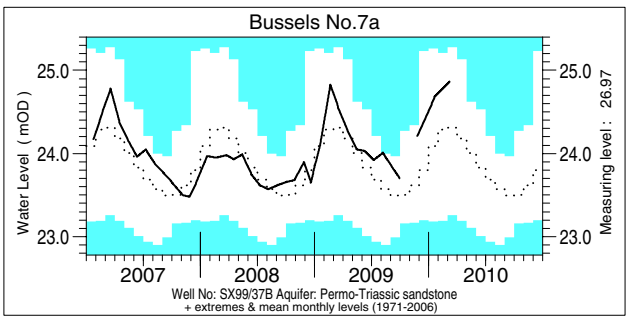


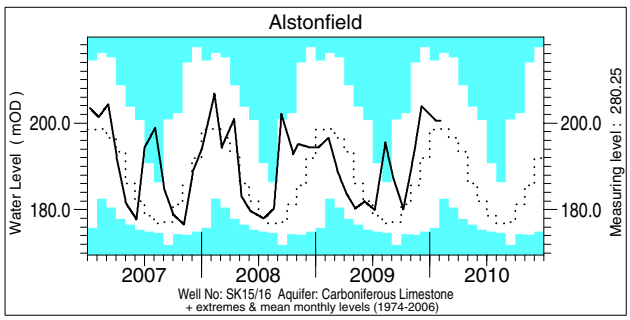






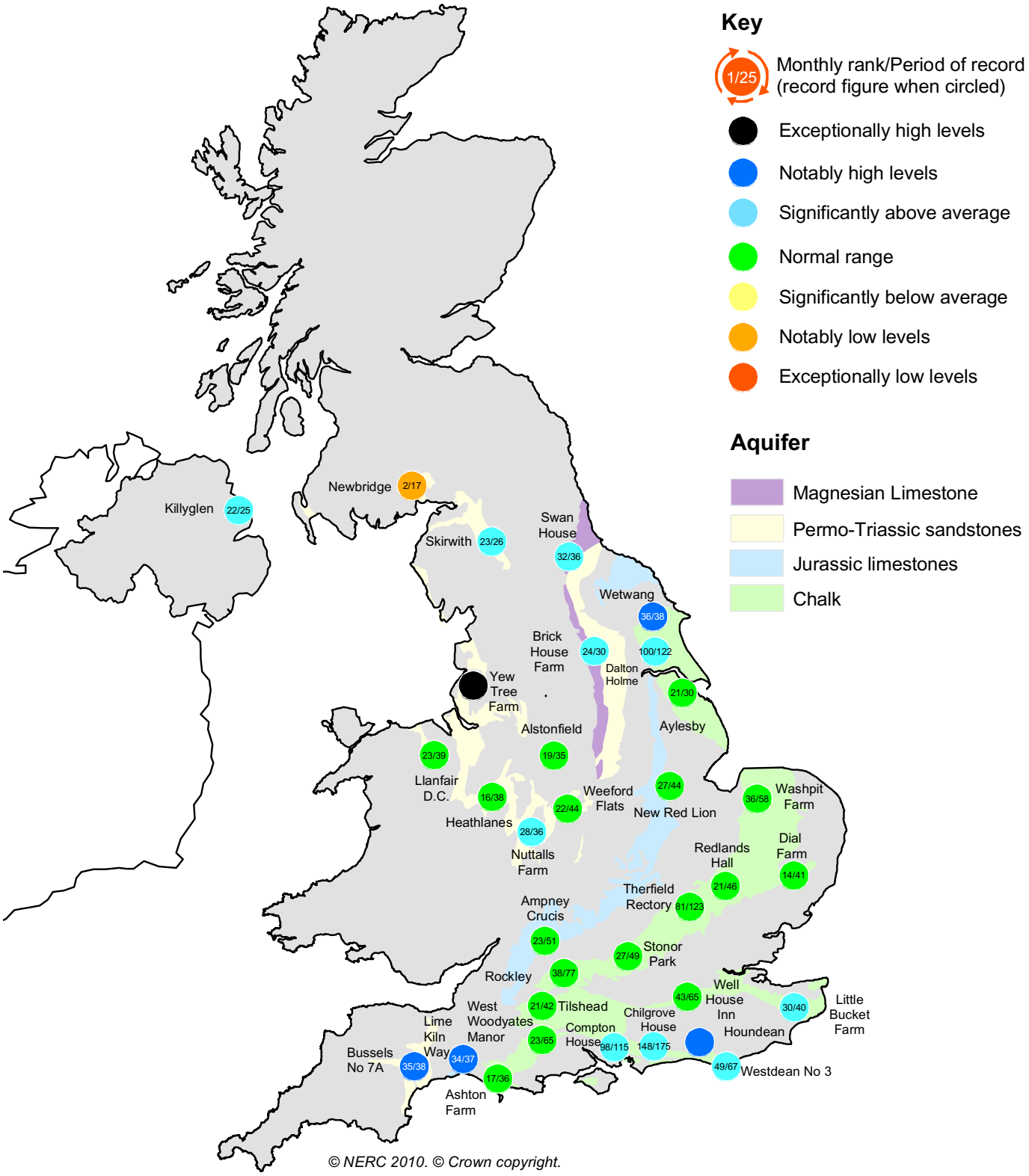






Groundwater levels February / March 2010

Borehole	Level	Date	Feb. av.	Borehole	Level	Date	Feb. av.	Borehole	Level	Date	Feb. av.
Dalton Holme	22.23	09/02	18.70	Chilgrove House	67.48	28/02	57.61	Brick House Farm	14.61	22/02	13.25
Washpit Farm	45.02	04/03	44.44	Killyglen (NI)	117.08	28/02	115.61	Llanfair DC	80.18	15/02	80.07
Stonor Park	76.46	01/03	75.61	New Red Lion	18.31	16/02	16.47	Heathlanes	61.90	28/02	62.00
Dial Farm	25.36	10/02	25.49	Ampney Crucis	102.35	01/03	102.22	Weeford Flats	89.64	02/02	89.67
Rockley	139.30	01/03	138.36	Newbridge	10.37	28/02	10.96	Bussels No.7a	24.87	08/03	24.31
Well House Inn	99.24	01/03	96.31	Skirwith	131.31	17/02	130.68	Alstonfield	200.52	03/02	198.83
West Woodyates	91.65	28/02	93.26	Swan House	88.53	22/02	85.51	*Levels in metres above Ordnance Datum*			



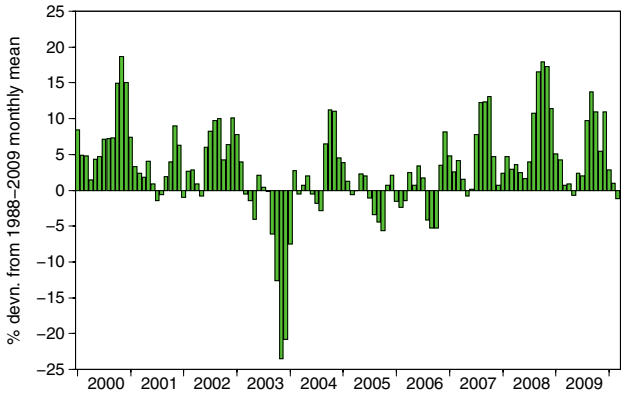
Groundwater levels - February 2010

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.

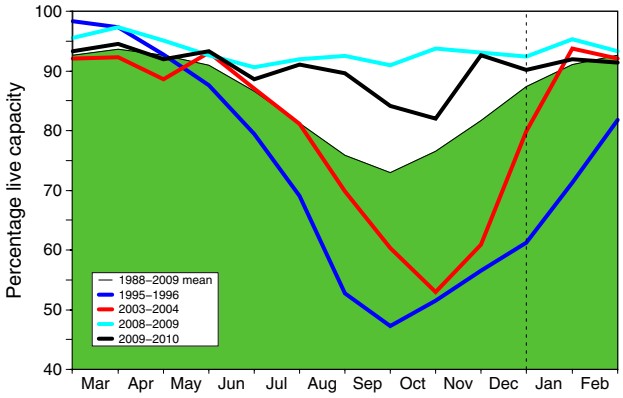
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.

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.

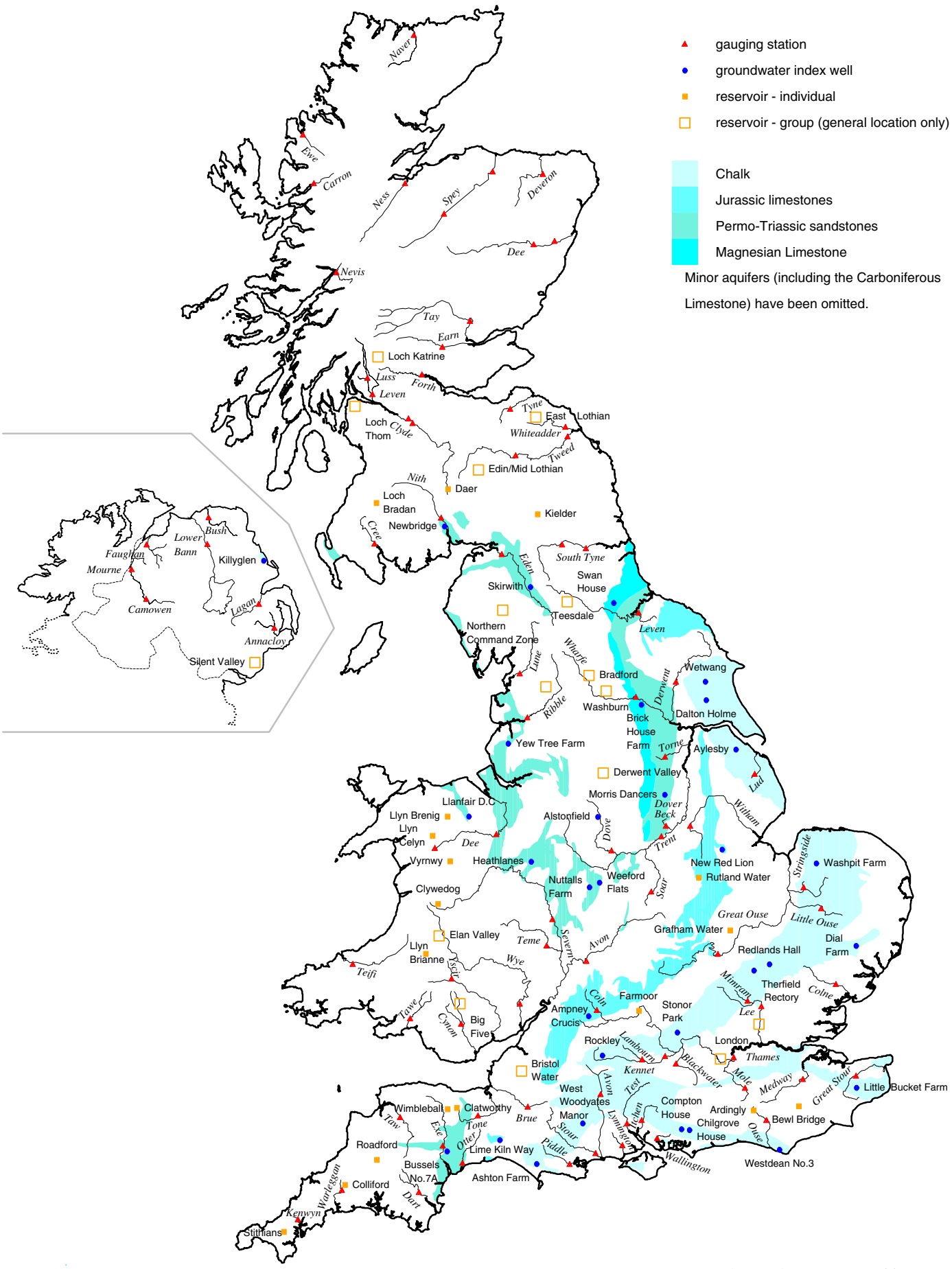
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2010 Jan	Feb	Mar	Mar Anom.	Min Mar	Year* of min	2009 Mar	Diff 10-09
North West	N Command Zone	•	124929	90	86	**80**	-13	78	1996	87	-7
	Vyrnwy		55146	90	96	**93**	-1	59	1996	92	1
Northumbrian	Teesdale	•	87936	87	89	**82**	-9	72	1996	91	-9
	Kielder		(199175)	(87)	(95)	**(90)**	-3	(81)	1993	(90)	0
Severn Trent	Clywedog		44922	79	83	**87**	-3	77	1996	87	0
	Derwent Valley	•	39525	92	100	**100**	5	46	1996	94	6
Yorkshire	Washburn	•	22035	96	96	**98**	6	53	1996	95	3
	Bradford supply	•	41407	98	100	**99**	5	53	1996	97	2
Anglian	Grafham		(55490)	(85)	(85)	**(90)**	2	(72)	1997	(94)	-4
	Rutland		(116580)	(75)	(82)	**(91)**	3	(71)	1992	(91)	0
Thames	London	•	196628	96	92	**90**	-2	83	1988	95	-5
	Farmoor	•	13822	86	73	**79**	-14	64	1991	86	-7
Southern	Bewl		28170	86	97	**100**	15	50	2006	88	12
	Ardingly		4685	97	100	**100**	3	77	2006	100	0
Wessex	Clatworthy		5364	100	100	**95**	-3	82	1992	100	-5
	Bristol WW	•	(38666)	(100)	(95)	**(100)**	8	(65)	1992	(98)	2
South West	Colliford		28540	94	100	**99**	15	57	1997	100	-1
	Roadford		34500	99	94	**94**	10	35	1996	97	-3
	Wimbleball		21320	100	100	**100**	5	72	1996	100	0
	Stithians		4967	100	100	**99**	7	45	1992	100	-1
Welsh	Celyn and Brenig	•	131155	92	96	**99**	2	69	1996	99	0
	Brianne		62140	96	98	**96**	-2	92	2004	96	0
	Big Five	•	69762	89	88	**92**	-4	85	1988	93	-1
	Elan Valley	•	99106	100	100	**97**	-1	88	1993	97	0
Scotland(E)	Edinburgh/Mid Lothian	•	97639	99	100	**98**	3	73	1999	99	-1
	East Lothian	•	10206	100	100	**100**	1	91	1990	99	1
Scotland(W)	Loch Katrine	•	111363	89	86	**76**	-19	76	2010	89	-13
	Daer		22412	99	99	**95**	-4	94	2004	99	-4
	Loch Thom	•	11840	96	95	**95**	-3	90	2004	94	1
Northern Ireland	Total+	•	56920	96	98	**94**	5	81	2004	93	1
	Silent Valley	•	20634	92	96	**91**	7	57	2002	91	0

() 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 196628 Ml as of November 2009.

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 (together with revised 1961-90 averages) 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

03/10