Hydrological Summary

for the United Kingdom

October 2011

General

October was an exceptionally mild month but the spatial distribution of the rainfall was again remarkable – triggering flooding in many western and northern regions but increasing long term rainfall deficiencies across much of the English Lowlands where drought conditions are severe in some areas. Whilst Northern Ireland registered its 2nd wettest October on record, a few places in the South East recorded less than a quarter of the average monthly rainfall. High runoff rates in the gathering grounds of most upland reservoirs helped maintain healthy stocks and, despite drawdowns to provide additional flood storage, estimated overall stocks for Scotland, Wales and Northern Ireland remain well above average. However, exceptionally dry autumn soils in central, southern and eastern England – which caused problems for lifting and sowing crops – continue to delay the seasonal recovery in runoff rates. Correspondingly inflows to many gravity-fed reservoirs were meagre and early-November stocks were more than 20% below average in some central and southern impoundments (e.g. Ardingly, Clatworthy and Wimbleball,) Several index rivers recorded new minimum October mean flows and, more notably, March-October runoff totals are depressed in a broad zone extending through the Midlands and the South West. After very sustained recessions, groundwater levels are well below average in almost all but the most northerly index wells. Resort to tankered supplies was required after the failure of springs and private wells in Shropshire, and in Wiltshire, the Tilshead borehole went dry at the end of October – for the first time since the intense drought of 1976. Above average late autumn and winter rainfall is needed in much of central, southern and eastern England to secure a healthy water resources outlook by the spring of 2012.

Rainfall

The persistence of a high pressure extending west from the continent resulted in most rain-bearing Atlantic frontal systems following tracks to the west and north of the English Lowlands throughout much of October. Correspondingly, storms were frequent in Northern Ireland and western Scotland where daily rainfall totals of >50mm were relatively common (e.g. Cluanie Inn 57mm on the 22nd and Tyndrum 58.4mm on 29th) and in the South West Cardinham (on Bodmin Moor) recorded 67.2mm on 24th. By contrast, rainfall was limited across much of the Midlands, East Anglia and the South East, particularly early in the month; at Wallingford 2mm was recorded over the first two weeks. Much of the South East reported less than half of the average monthly rainfall, adding to an extended sequence of moderate rainfall totals. Rainfall deficiencies for March-October are notably high across large parts of southern Britain, particularly for the Midland region where the 8-month rainfall total closely matched the lowest on record (1995) in a 101-year series. In this timeframe, pockets of particularly severe drought can be found in Shropshire, the Cotswolds and across the East Midlands (see Page 3) where some localities received less than half the average rainfall. The unusual spatial partitioning of the 2011 rainfall is underlined by the contrast with Scotland where the previous maximum March-October rainfall was exceeded by a very wide margin. To the south, the hydrological impact of the current drought reflects rainfall deficiencies that can be traced back to December 2009.

River Flows

River flow patterns in October defy easy categorisation: notable flooding occurred in Northern Ireland, sustained spate conditions were common in northern Britain and urban flash flood events were widespread late in the month. More notably, exceptionally low autumn flows characterised many central and southern rivers and the continuing contraction in the stream network has resulted in a significant, albeit temporary, loss of aquatic habitat. In Northern Ireland a sequence of notable spates culminated, on the 24th, in severe flooding (e.g. in Antrim and Tyrone) and widespread road closures. This event contributed to new maxima October runoff totals for the majority of index gauging stations across the province. High runoff also characterised much of western Scotland where the Cree reported its 3rd highest October mean flow in a series from 1963. In stark contrast, flow recessions continued across the English Lowlands where October runoff for the Little Ouse, Soar, Teme, Winterbourne (Berks) and Hampshire Avon all fell below previous minima. In runoff terms the intensity of the drought in southern Britain is underlined by the accumulated deficiencies over the March-October period. A significant proportion of index catchments, including the Wye, Severn, Otter, Tone and Medway (each with long records) have registered new accumulated runoff minima. After protracted recessions, flows in many baseflow-dominated streams are very depressed as inflows from higher level springs and seepages cease; in some rivers (e.g. the Itchen) flow augmentation schemes are operating.

Groundwater

Whilst soils in almost all northern and western areas remain close to saturation, the warm and sunny October (and the associated evaporation demands) resulted in end-of-month soil moisture deficits exceeding 100mm (for a grass cover) over large parts of the central, southern and eastern England. In these regions soils were, generally, the driest for late October since 1978. Correspondingly, recharge in the outcrop areas of most major aquifers was meagre. Some local recoveries in groundwater levels were recorded: In Northern Ireland and southern Scotland the exceptional rainfall triggered further rises at both Killyglen and Newbridge. Generally however, recessions continue and groundwater levels in almost all index boreholes are below, to well below, the late October average. Particularly depressed levels characterise the western Chalk where, in the more responsive wells and boreholes, natural base levels are being approached over wide areas. At Tilshead the well is dry and levels at Rockley (Wilts) are very close to the lowest on record. Spring failures as a result of falling groundwater levels have been widely reported (e.g. in Shropshire, Lincolnshire and Somerset). Considering the major aquifers together groundwater resources across southern Britain are at their lowest since the end of the 1995-97 drought. Above average late autumn and winter rainfall will be needed to wet-up lowland soils and thence generate a recovery in groundwater levels to within the normal spring range.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

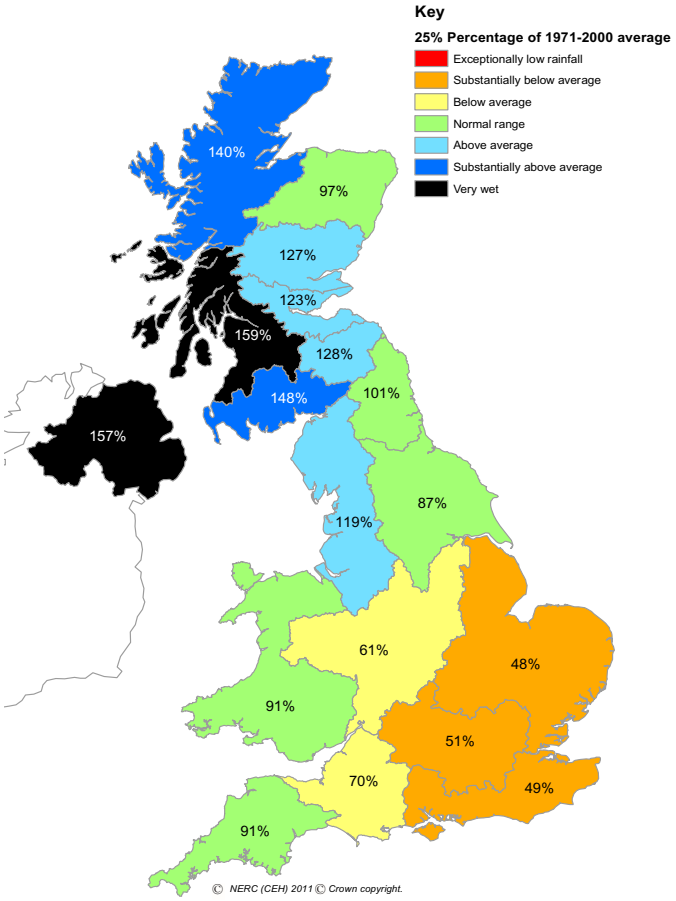
Area	Rainfall	Oct 2011	Sep11 - Oct11	RP	Mar11 - Oct11	RP	Nov10 - Oct11	RP	Dec09 - Oct11	RP
United Kingdom	mm	**123**	229		685		1073		1953	
	%	**109**	110	2-5	106	2-5	99	2-5	95	2-5
England	mm	**63**	116		405		688		1382	
	%	**78**	76	2-5	80	12-16	84	10-15	89	10-15
Scotland	mm	**205**	394		1138		1671		2800	
	%	**134**	138	10-20	136	>100	116	10-20	103	2-5
Wales	mm	**122**	243		673		1145		2234	
	%	**83**	92	2-5	85	5-10	83	10-15	86	15-20
Northern Ireland	mm	**208**	328		764		1183		2092	
	%	**181**	157	70-100	113	2-5	107	2-5	99	2-5
England & Wales	mm	**72**	134		442		751		1499	
	%	**79**	79	2-5	81	12-16	84	10-15	88	12-16
North West	mm	**135**	272		784		1240		2162	
	%	**107**	119	2-5	110	2-5	105	2-5	97	2-5
Northumbria	mm	**80**	147		567		955		1711	
	%	**106**	101	2-5	109	2-5	115	2-5	108	2-5
Midlands	mm	**49**	84		303		516		1129	
	%	**69**	61	5-10	63	>100	68	>100	78	>100
Yorkshire	mm	**83**	127		414		730		1402	
	%	**109**	87	2-5	82	8-12	90	5-10	91	5-10
Anglian	mm	**28**	53		252		431		1012	
	%	**49**	48	12-16	63	35-50	71	35-50	88	5-10
Thames	mm	**31**	68		311		526		1140	
	%	**43**	51	8-12	70	10-20	75	15-25	85	10-15
Southern	mm	**38**	78		330		632		1357	
	%	**43**	49	5-10	70	15-25	81	8-12	92	2-5
Wessex	mm	**58**	114		414		698		1366	
	%	**67**	70	2-5	80	8-12	81	10-15	83	20-35
South West	mm	**121**	205		545		967		1903	
	%	**96**	91	2-5	80	8-12	80	10-20	83	20-30
Welsh	mm	**118**	232		646		1093		2152	
	%	**83**	91	2-5	84	8-12	83	10-15	86	15-20
Highland	mm	**237**	473		1326		1874		3115	
	%	**131**	140	10-20	137	80-120	109	5-10	97	2-5
North East	mm	**90**	184		754		1137		2157	
	%	**89**	97	2-5	127	8-12	120	5-10	120	10-15
Tay	mm	**155**	314		1062		1596		2635	
	%	**116**	127	5-10	145	>100	126	20-30	110	2-5
Forth	mm	**145**	276		936		1438		2380	
	%	**123**	123	5-10	138	40-60	127	30-40	111	5-10
Tweed	mm	**121**	225		798		1254		2121	
	%	**127**	128	2-5	136	10-20	131	20-35	117	8-12
Solway	mm	**236**	414		1125		1726		2856	
	%	**152**	148	15-25	136	35-50	123	20-30	107	5-10
Clyde	mm	**307**	563		1406		2057		3318	
	%	**162**	159	50-80	140	>100	119	15-20	101	2-5

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

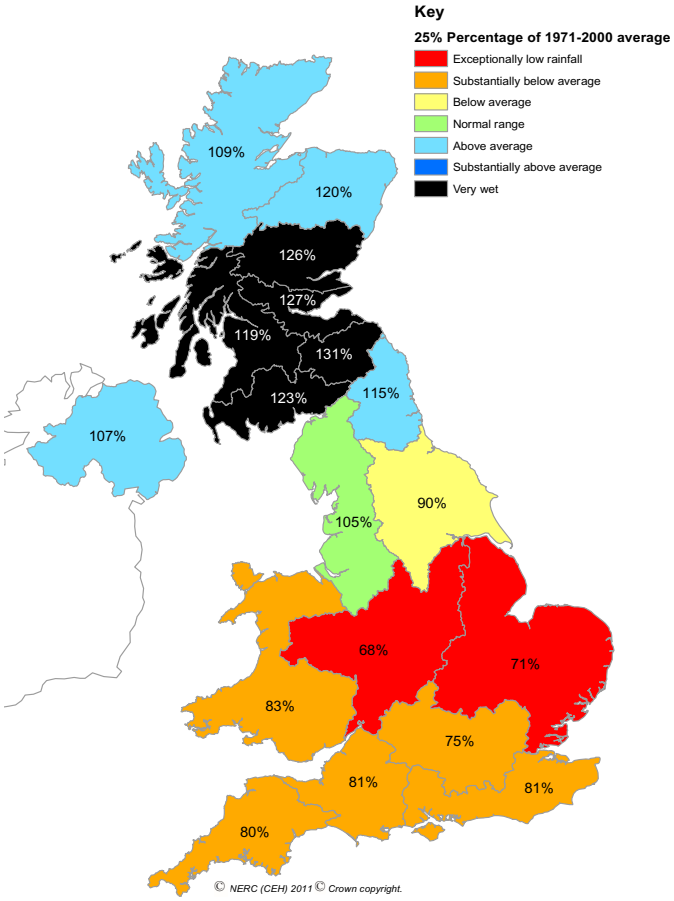
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic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

Rainfall . . . Rainfall . . .

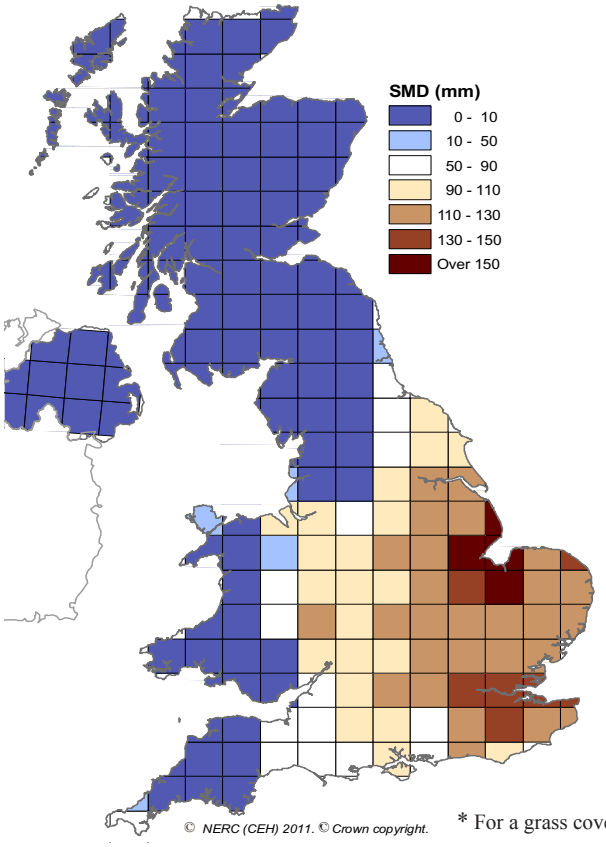
September - October 2011



November 2010 - October 2011

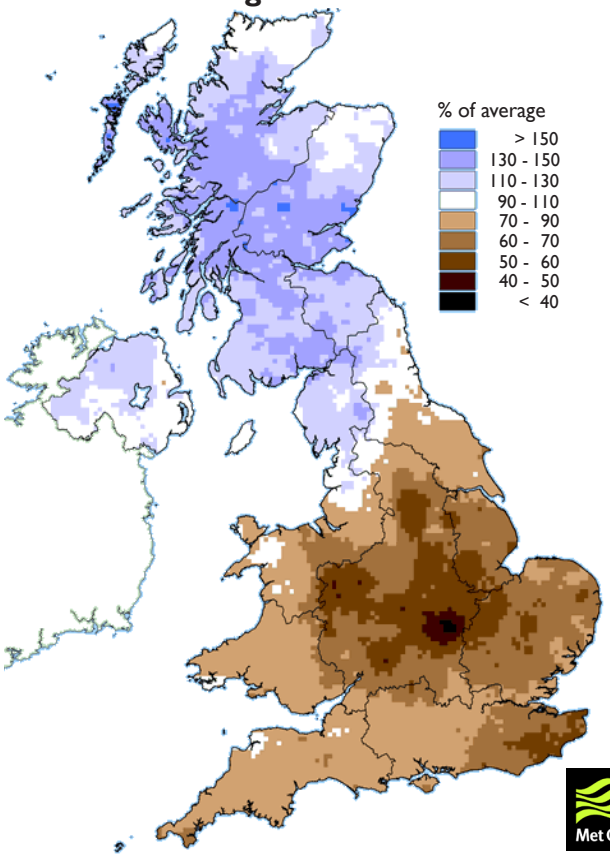


Soil Moisture Deficits* October 2011

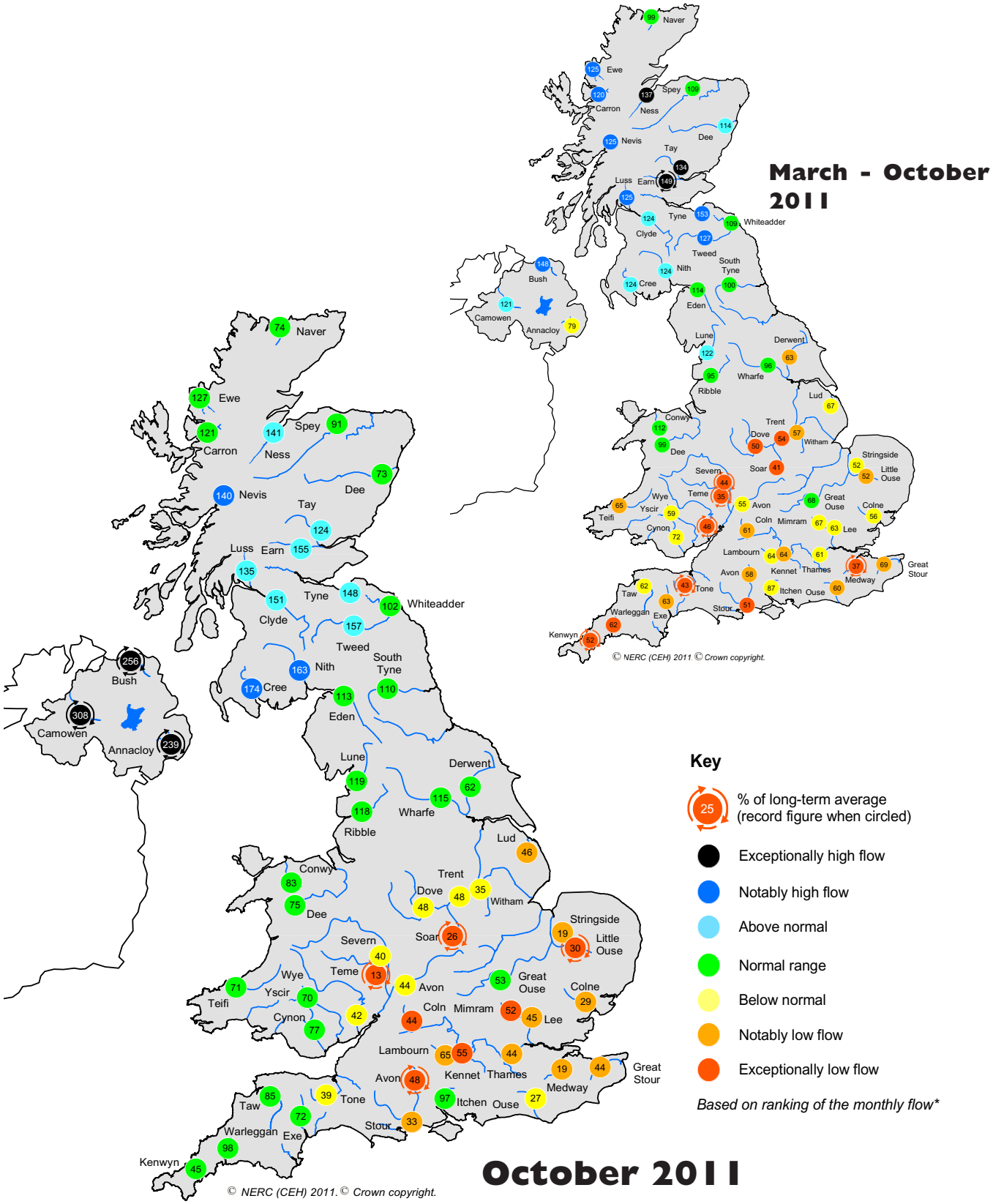


* For a grass cover

March - October 2011 rainfall as % of 1971-2000 average



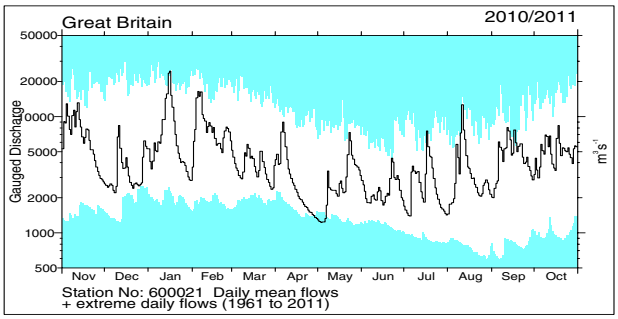
River flow . . . River flow . . .

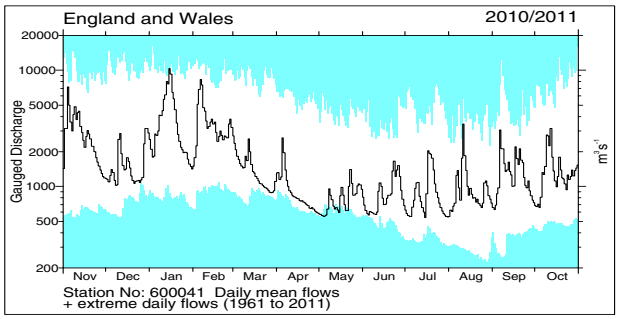


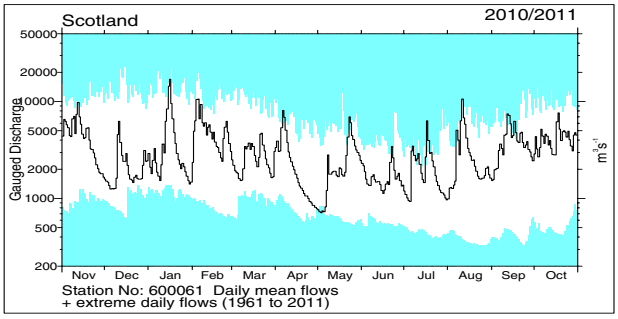
River flows

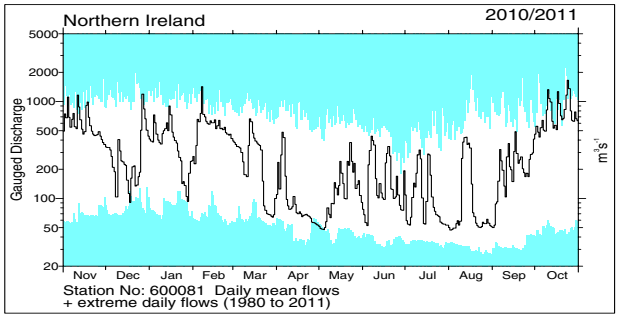
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

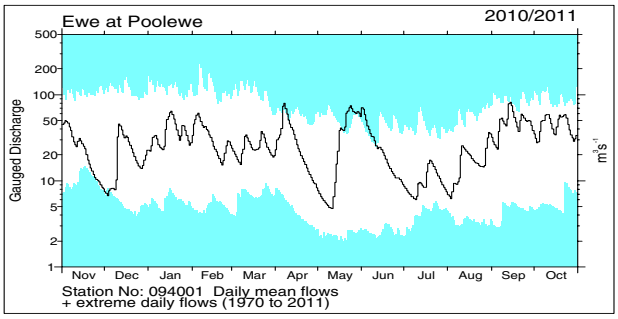
River flow . . . River flow . . .

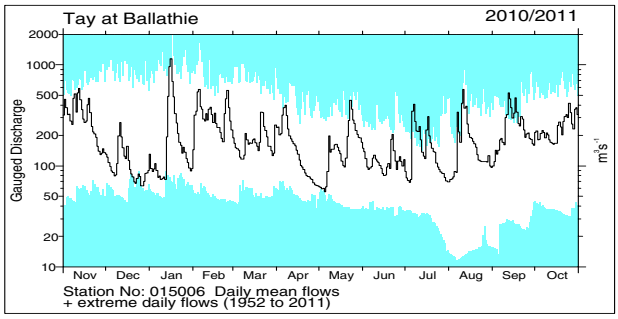


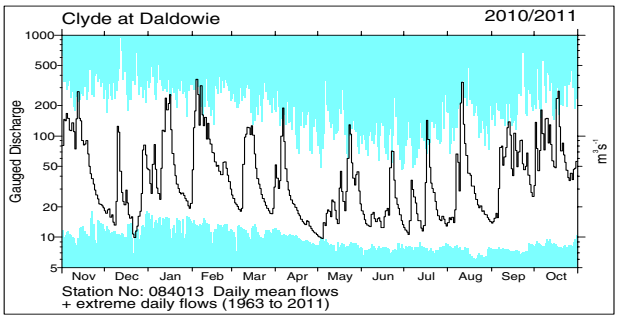


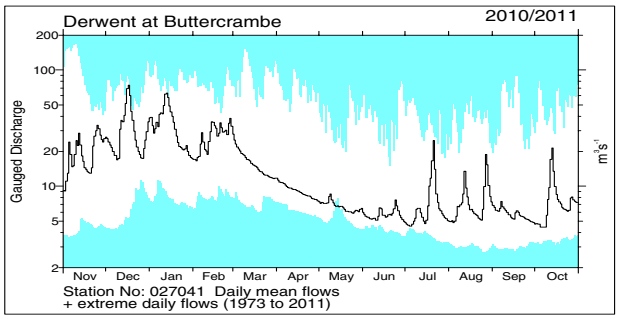


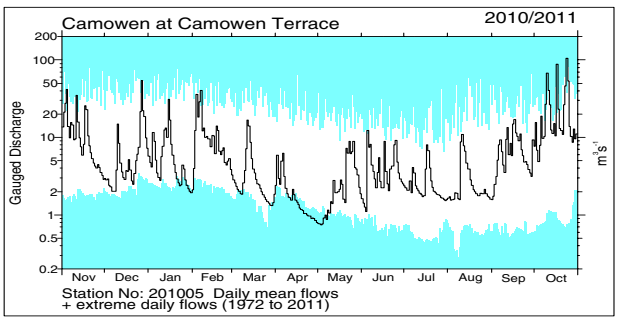


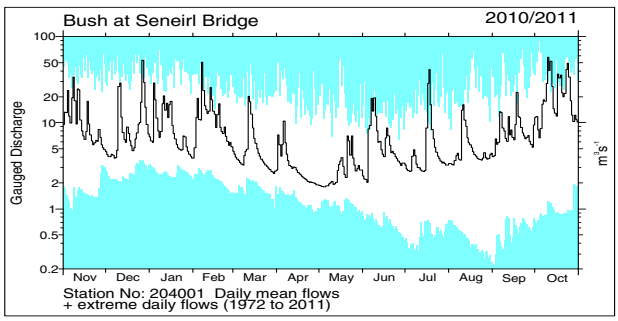








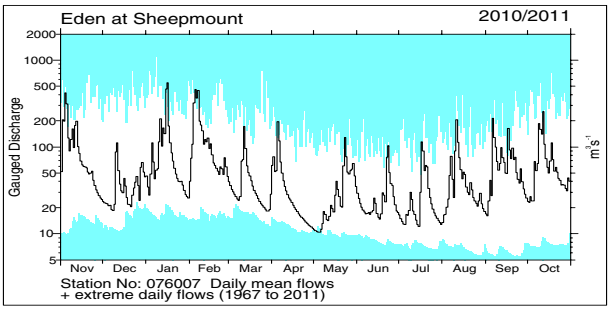


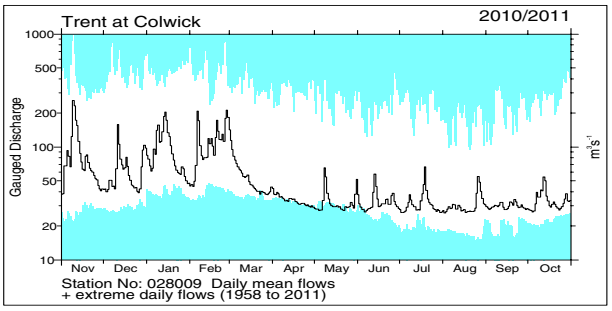


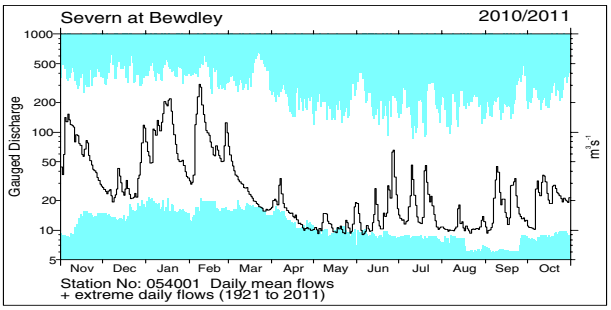
River flow hydrographs

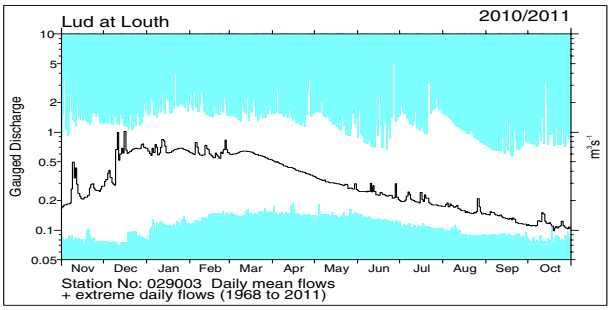
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to November 2010 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

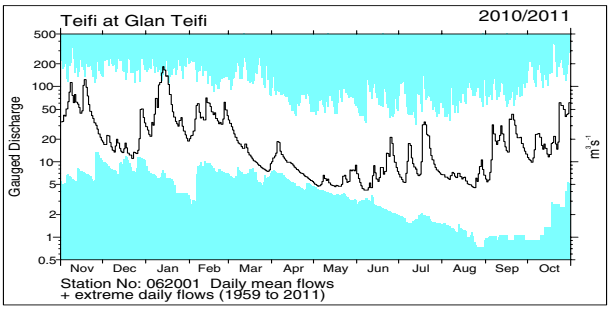
River flow . . . River flow . . .

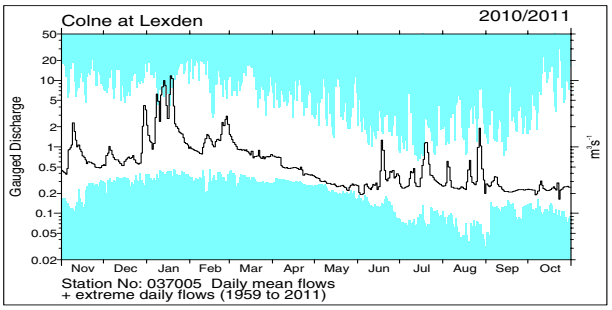


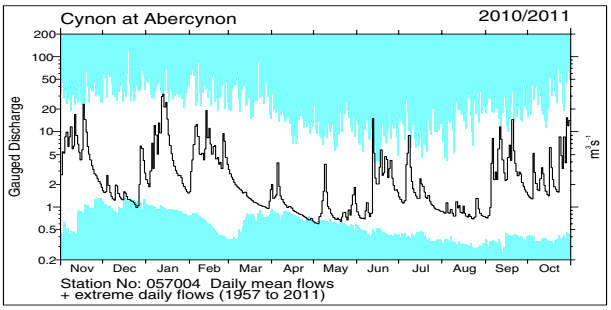


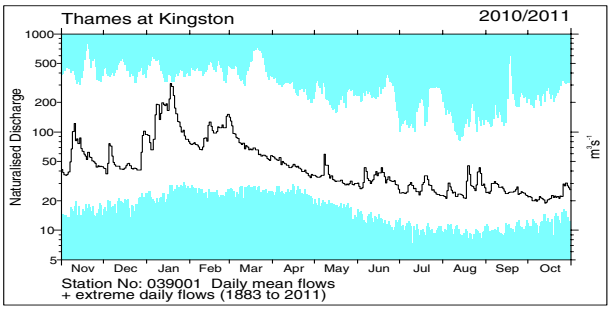


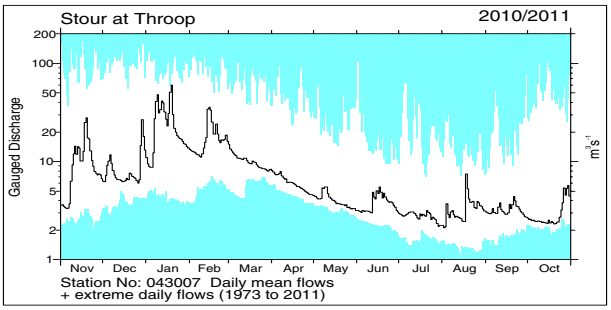


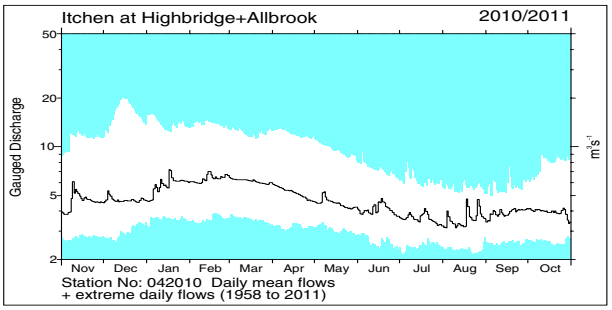












Notable runoff accumulations (a) September - October 2011, (b) March - October 2011

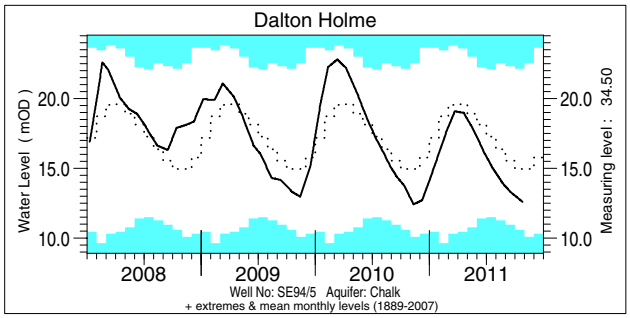
	River	%lta	Rank
a)	Ness	154	38/39
	Earn	179	64/64
	Forth	159	30/31
	Torne	51	2/41
	Soar	34	2/41
	Little Ouse	38	2/42
	Coln	50	2/48
	Avon (Amesbury)	53	2/47
	Clyde (Blairston)	172	51/52
	Camowen	236	40/40
	Mourne	205	30/30

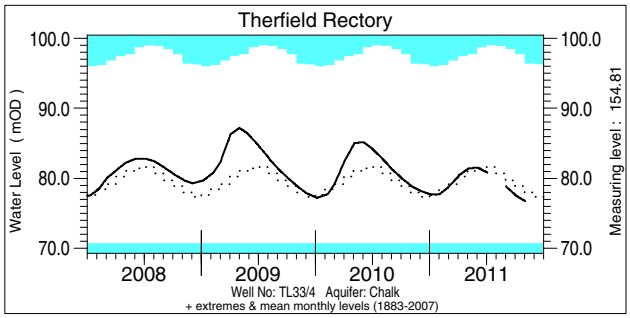
	River	%lta	Rank
b)	Tay	134	57/59
	Trent	54	2/53
	Dove	50	2/50
	Mole	51	1/36
	Medway	37	1/49
	Stour	51	2/39
	Otter	58	1/49
	Warleggan	62	2/42
	Kenwyn	52	1/43

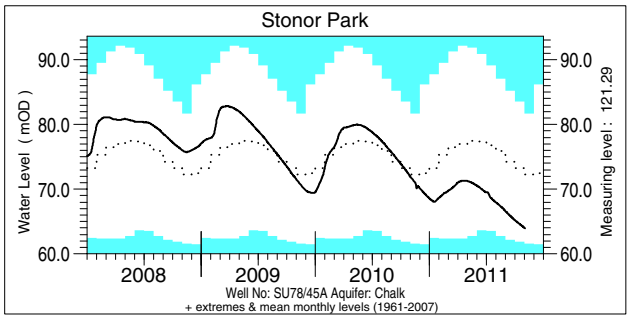
	River	%lta	Rank
b)	Tone	43	1/51
	Brue	38	1/46
	Severn	44	1/90
	Teme	35	1/41
	Wye	46	1/75
	Luss	125	32/33
	Nevis	125	28/29
	Bush	148	36/38

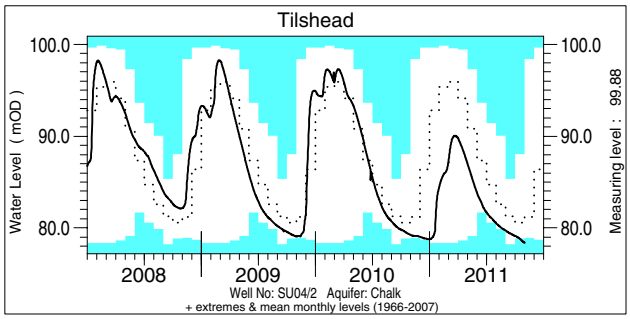
lta = long term average
Rank 1 = lowest on record

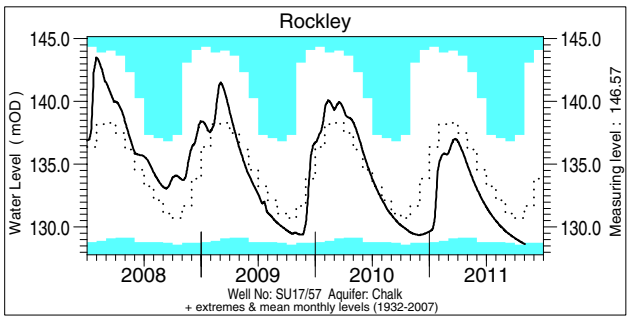
Groundwater . . . Groundwater

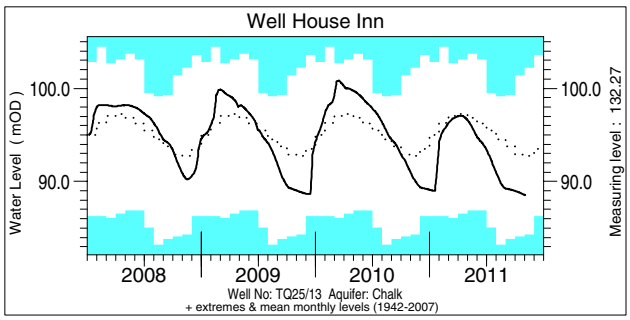


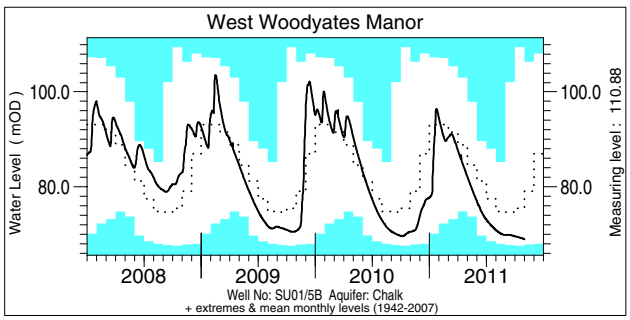


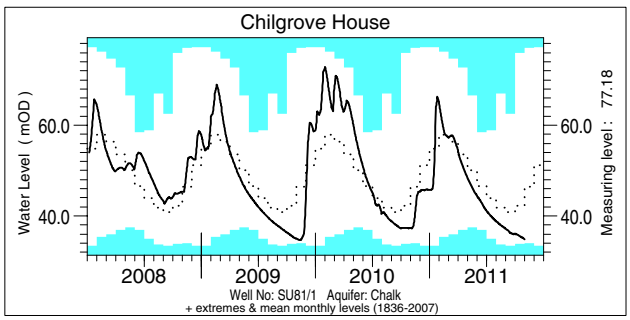


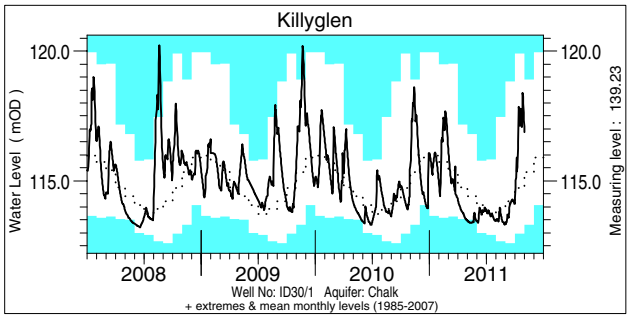


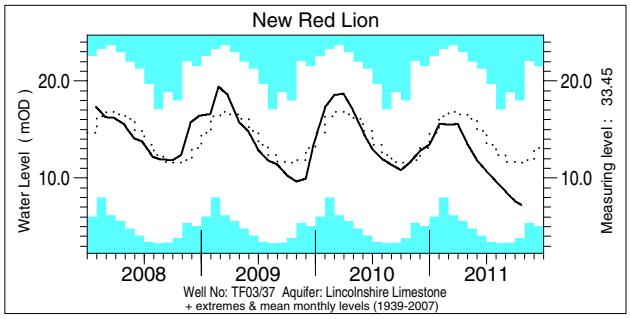






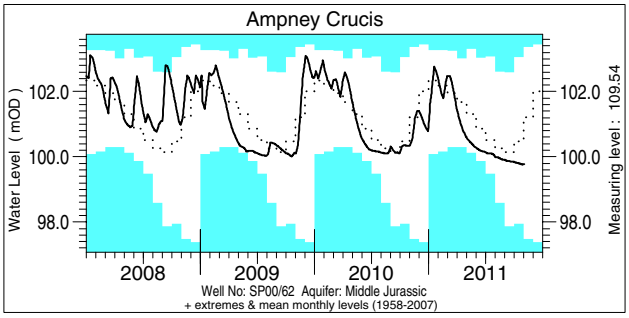


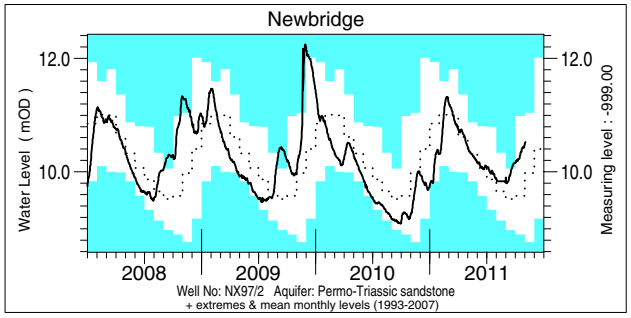


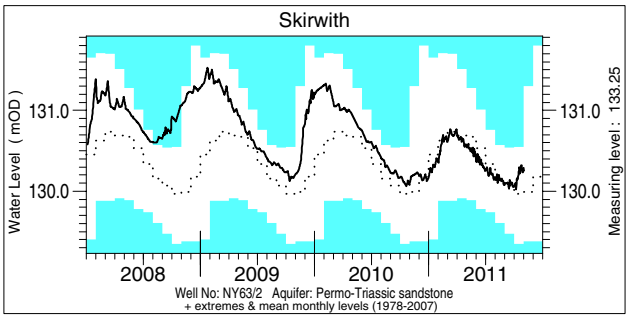


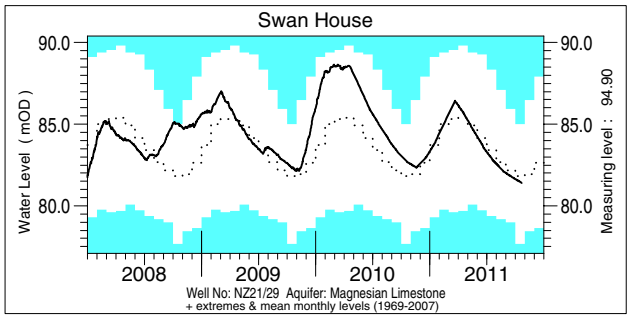
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation. The latest recorded levels are listed overleaf.

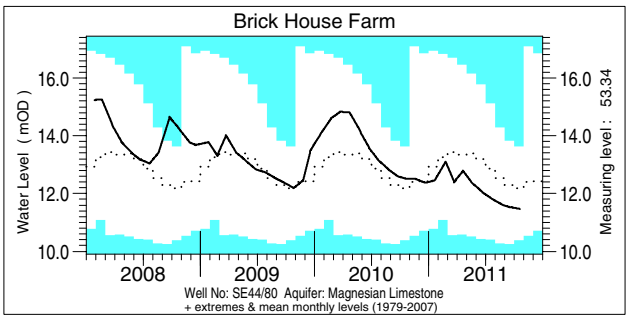
Groundwater . . . Groundwater

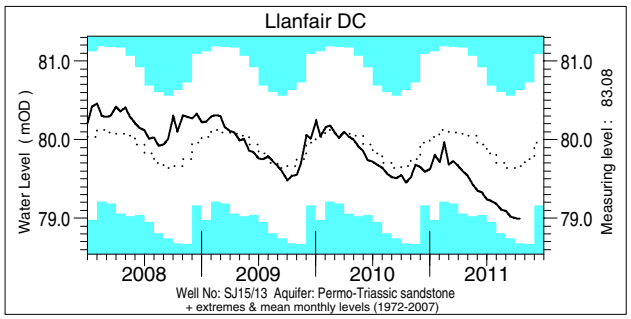


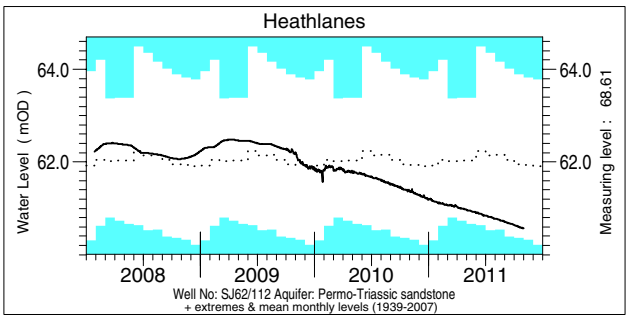


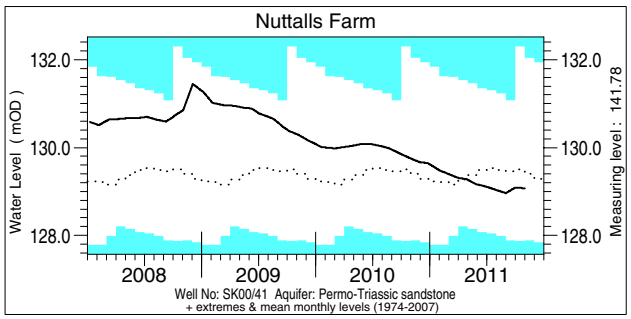


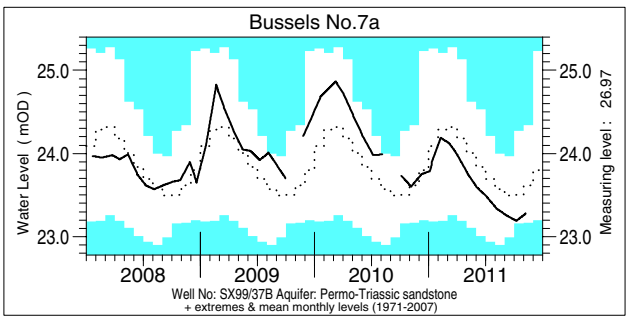


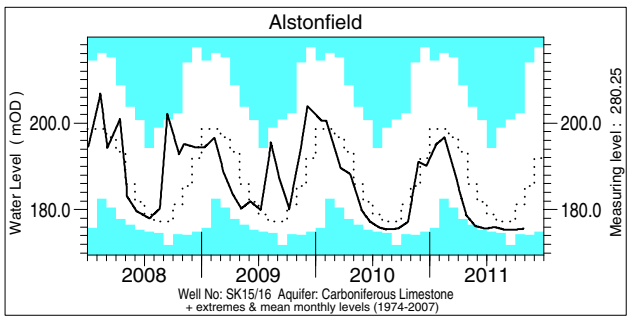








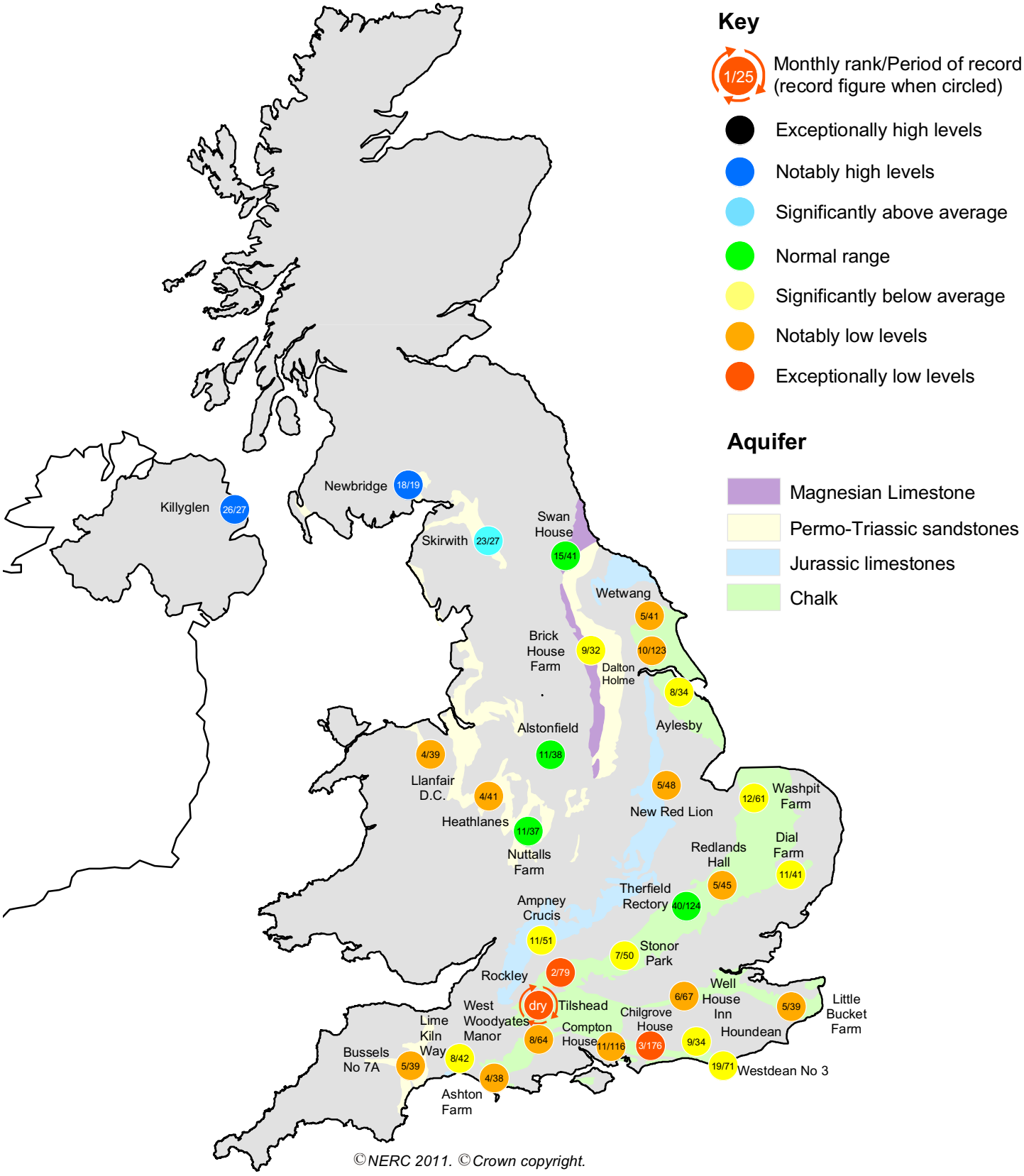




Groundwater levels October / November 2011

Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.	Borehole	Level	Date	Oct av.
Dalton Holme	12.60	24/10	14.90	Chilgrove House	34.83	31/10	42.28	Brick House Farm	11.47	18/10	12.27
Therfield Rectory	76.70	01/11	79.10	Killyglen (NI)	116.87	31/10	114.77	Llanfair DC	78.99	15/10	79.58
Stonor Park	63.93	01/11	73.15	New Red Lion	7.21	21/10	11.58	Heathlanes	60.57	31/10	61.93
Tilshead	78.41	31/10	80.80	Ampney Crucis	99.78	01/11	100.44	Nuttalls Farm	129.07	31/10	129.67
Rockley	128.64	01/11	130.71	Newbridge	10.53	01/11	9.67	Bussels No.7a	23.28	06/11	23.52
Well House Inn	88.53	01/11	93.08	Skirwith	130.29	31/10	130.02	Alstonfield	175.62	26/10	181.31
West Woodyates	68.97	31/10	74.88	Swan House	81.41	20/10	81.89	*Levels in metres above Ordnance Datum*			

Groundwater . . .Groundwater



Groundwater levels - October 2011

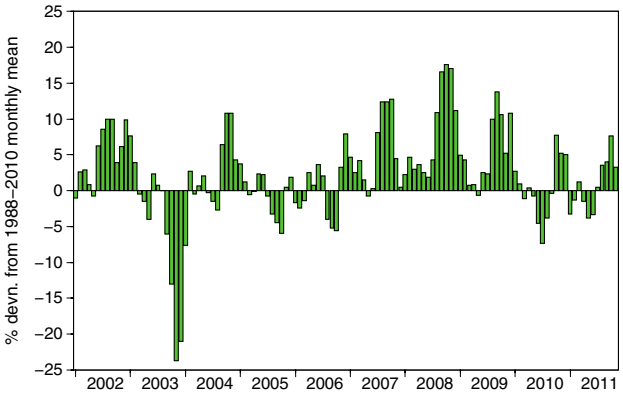
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

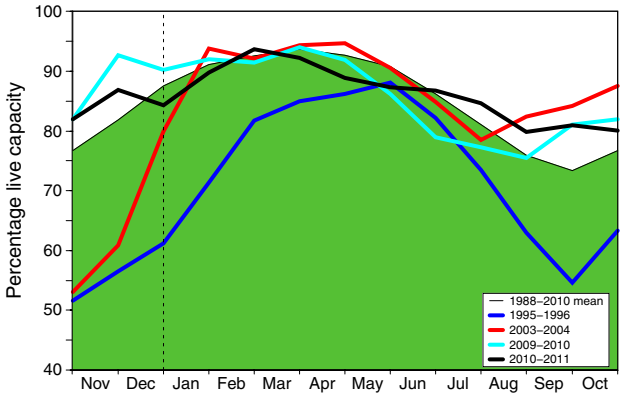
ii. Yew Tree Farm levels are now received quarterly.

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 Sep	Oct	Nov	Nov Anom.	Min Nov	Year* of min	2010 Nov	Diff 11-10
North West	N Command Zone	•	124929	66	78	**80**	14	33	2003	70	10
	Vyrnwy		55146	77	86	**75**	1	25	1995	79	-4
Northumbrian	Teesdale	•	87936	91	93	**91**	18	33	1995	86	5
	Kielder		(199175)	(93)	(91)	**(90)**	4	63	1989	89	1
Severn Trent	Clywedog		44922	80	87	**86**	10	38	1995	85	1
	Derwent Valley	•	39525	56	53	**75**	4	15	1995	70	5
Yorkshire	Washburn	•	22035	69	71	**81**	13	15	1995	75	6
	Bradford supply	•	41407	73	76	**86**	15	16	1995	70	16
Anglian	Grafham		(55490)	(90)	(89)	**(84)**	2	44	1997	95	-11
	Rutland		(116580)	(73)	(70)	**(66)**	-11	59	1995	75	-9
Thames	London	•	202828	86	80	**69**	-8	46	1996	89	-20
	Farmoor	•	13822	98	93	**85**	-4	43	2003	99	-14
Southern	Bewl		28170	57	50	**43**	-17	33	1990	48	-5
	Ardingly		4685	61	48	**34**	-32	15	2003	68	-34
Wessex	Clatworthy		5364	49	37	**33**	-29	14	2003	36	-3
	Bristol WW	•	(38666)	(62)	(57)	**(53)**	-8	24	1990	50	3
South West	Colliford		28540	50	48	**49**	-21	38	2006	75	-26
	Roadford		34500	53	54	**56**	-15	18	1995	67	-11
	Wimbleball		21320	47	44	**44**	-23	26	1995	51	-7
	Stithians		4967	51	44	**39**	-17	18	1990	51	-12
Welsh	Celyn and Brenig	•	131155	94	96	**93**	10	48	1989	94	-1
	Brianne		62140	94	98	**100**	9	57	1995	97	3
	Big Five	•	69762	76	85	**93**	19	38	2003	92	1
	Elan Valley	•	99106	83	90	**100**	15	37	1995	84	16
Scotland(E)	Edinburgh/Mid Lothian	•	97639	91	97	**100**	20	48	2003	79	21
	East Lothian	•	10206	100	100	**100**	18	38	2003	98	2
Scotland(W)	Loch Katrine	•	111363	92	96	**95**	10	40	2003	93	2
	Daer		22412	99	99	**100**	10	42	2003	99	1
	Loch Thom	•	11840	96	95	**100**	11	66	2007	95	5
Northern Ireland	Total⁺	•	56920	72	78	**93**	13	39	1995	87	6
	Silent Valley	•	20634	66	73	**88**	15	34	1995	89	-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 1988-2010 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.

11/11