Hydrological Summary

for the United Kingdom

General

June was a warm and very showery month with heat-wave conditions during the final week. Nationally, the June rainfall was only modestly below average but convective storms contributed to notable spatial variations in rainfall totals. Sustained rainfall early in the month produced very valuable early summer replenishment to many upland reservoirs and, nationally, reservoir stocks fell by <5% over the month. There were significant declines in some smaller reservoirs (e.g. Ardingly) and Vyrnwy stocks are seasonally low, but despite substantial medium term rainfall deficiencies and increased water demand (e.g. due to irrigation), stocks in almost all index reservoirs are within 10% of the early July average. For England & Wales overall stocks are modestly (2%) above the early summer average. Intense local downpours triggered flash flooding in many localities during June and short-lived spates were common but the very dry soil conditions and high evaporative demands impacted on river flows. Correspondingly, June runoff totals were mostly below average. In many outcrop areas, groundwater levels were also below average but mostly well within the normal early summer range. Rainfall totals for 2009 thus far for Scotland and Northern Ireland are near-average but provisional data indicate that the January-June period for England & Wales was the 3rd driest since 1976. The relative health of water resources reflects, in part, abundant rainfall during the late summer and autumn of 2008.

June 2009

Rainfall

High pressure dominated synoptic patterns for the greater part of June but after a dry start cyclonic conditions brought substantial rainfall to most areas. On the 6th, Exeter recorded 93mm in 12 hrs (including 27.2mm in 1 hr) and a 24-hr total of 78mm was reported for Cardiff; three-day rainfall totals exceeding 50mm were common in the western uplands of Britain. Further torrential downpours, many associated with thunderstorms, were reported around mid-month (e.g. 59mm was recorded in 2-hrs near Cambridge on the 15th). Subsequently, anticyclonic conditions became entrenched, in southern Britain especially – resulting in arid episodes which extended beyond three weeks in some central southern areas. The frequency of convective storms contributed to exceptional spatial variability in rainfall totals for June (and implies limited confidence in provisional regional assessments based on relatively sparse raingauge networks). Generalising broadly, well above average June totals characterised much of the Midlands and parts of north east Britain. By contrast, rainfall fell below 50% of average in parts of the South East and the western extremities of Britain; Cornwall was especially dry. The Southern Region registered its 5th lowest March-June rainfall since 1956 and for a few areas (e.g. in north-east England), June was the 8th successive month with below average rainfall. In the November-June timeframe, England & Wales reported its 6th lowest rainfall total in the last 50 years.

Flows

Flow patterns in most index rivers featured a continuation of the late spring recessions interrupted in the second week by spate conditions before a further decline in flows into July. Generally flows remained within the normal summer range but although dry soils and low antecedent flows exerted a moderating influences, flood alerts were in operation in some catchments across southern Britain around the 7th (e.g. on the Exe and Rhymney) with further alerts on the 10th (e.g. in rivers draining the southern Pennines). Flash flooding incidents were rather more common as local drainage capacities were overwhelmed in many areas (e.g. Pontypridd on the 6th and Bishop Auckland on the 15th). Recessions became re-established during the latter half of the month and river flows were depressed in some responsive rivers around month end; the lowest late-June flows since 1988 were registered on the Clyde. June outflows from Great Britain were around 80% of the monthly average and, although runoff patterns were spatially very variable, most index rivers reported June runoff totals in the 50-100% range. Runoff totals for the January-June period are also appreciably below average in most areas – notably so for the upper Dee in north Wales. In contrast to the extremely high summer flows during 2007 and 2008, flows in many spring-fed streams and rivers have fallen below the early summer average and, given the dryness of the soils, recessions can de expected to extend into the late autumn (in southern catchments particularly).

Groundwater

With above average soil moisture deficits (smds) across most aquifer outcrop areas for much of June, infiltration was restricted to a few localities which caught the brunt of the storm activity. Following notably steep spring recessions, June groundwater levels were mostly within the normal range but with substantial regional, and more local, variations. Throughout much of the southern Chalk, levels are considerably below average (note however, that most index wells reported very close to the end of June, consequently the rankings shown on page 9 may overstate the recent decline in aquifer storage). Levels were below the June average in most limestone aquifers also – notably so in the Jurassic limestone of the Cotswolds (see Ampney Crucis). In the Permo-Triassic sandstones, levels at Newbridge (southern Scotland) are tracking very close to the lowest on record (in a short series) but levels in the much more extensive sandstone outcrops in the Midlands are mostly well within the normal range. The spatially incoherent June rainfall means that soil moisture conditions form more of a mosaic than any recognisable geographical pattern but, in many aquifer outcrop areas, end-of-June smds were 30-50mm above average. Correspondingly, the seasonal onset of recharge in the autumn may well be delayed, in the English Lowlands particularly.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

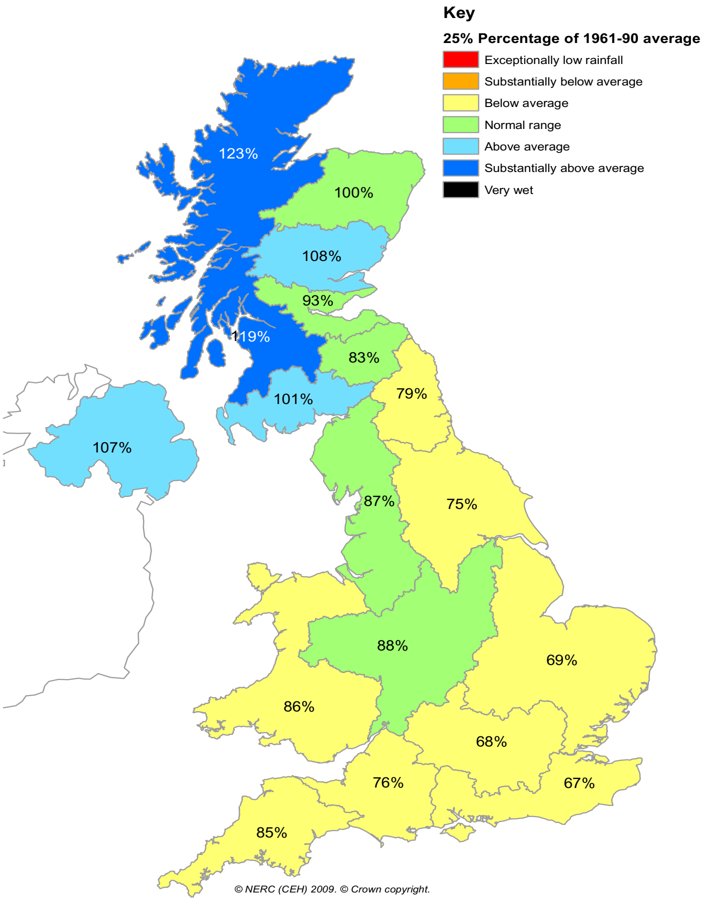
Area	Rainfall	Jun 2009	Mar 09 - Jun 09		Jan 09 - Jun 09		Nov 08 - Jun 09		Jul 08 - Jun 09	
England & Wales	**mm**	**59**	**207**		**347**		**498**		**941**	
	%	**92**	**79**	**2-5**	**84**	**5-10**	**83**	**5-10**	**104**	**2-5**
North West	mm	65	283		435		624		1283	
	%	79	87	2-5	83	5-10	81	5-10	105	2-5
Northumbrian	mm	67	202		319		447		955	
	%	108	79	2-5	80	5-10	79	5-10	110	2-5
Severn Trent	mm	76	207		311		443		824	
	%	127	88	2-5	86	2-5	86	2-5	107	2-5
Yorkshire	mm	56	189		293		429		856	
	%	90	75	2-5	76	5-15	78	5-15	103	2-5
Anglian	mm	44	134		232		343		601	
	%	85	69	5-10	82	2-5	86	2-5	99	2-5
Thames	mm	44	149		279		403		688	
	%	79	68	5-10	84	2-5	86	2-5	98	2-5
Southern	mm	32	151		322		473		754	
	%	58	67	5-10	89	2-5	89	2-5	96	2-5
Wessex	mm	58	185		346		492		879	
	%	100	76	5-10	87	2-5	85	2-5	103	2-5
South West	mm	55	265		491		676		1272	
	%	78	85	2-5	88	2-5	82	5-10	107	2-5
Welsh	mm	80	306		499		716		1414	
	%	98	86	2-5	83	5-10	79	5-15	105	2-5
Scotland	**mm**	**71**	**429**		**672**		**954**		**1559**	
	%	**83**	**113**	**5-10**	**105**	**2-5**	**100**	**<2**	**106**	**5-10**
Highland	mm	78	546		854		1251		1876	
	%	79	123	10-20	113	2-5	109	5-10	108	5-10
North East	mm	82	294		454		634		1034	
	%	118	100	<2	98	2-5	95	2-5	100	<2
Tay	mm	73	371		572		778		1297	
	%	96	108	2-5	97	2-5	91	2-5	101	2-5
Forth	mm	55	286		436		583		1172	
	%	76	93	2-5	86	2-5	79	5-15	102	2-5
Tweed	mm	61	235		389		532		1117	
	%	90	83	2-5	86	2-5	82	5-10	111	5-10
Solway	mm	64	373		608		851		1621	
	%	75	101	2-5	97	2-5	92	2-5	113	5-15
Clyde	mm	72	516		776		1091		1843	
	%	75	119	5-10	104	2-5	98	2-5	105	2-5
Northern Ireland	**mm**	**56**	**325**		**490**		**654**		**1243**	
	%	**76**	**107**	**2-5**	**98**	**2-5**	**91**	**2-5**	**113**	**5-10**

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

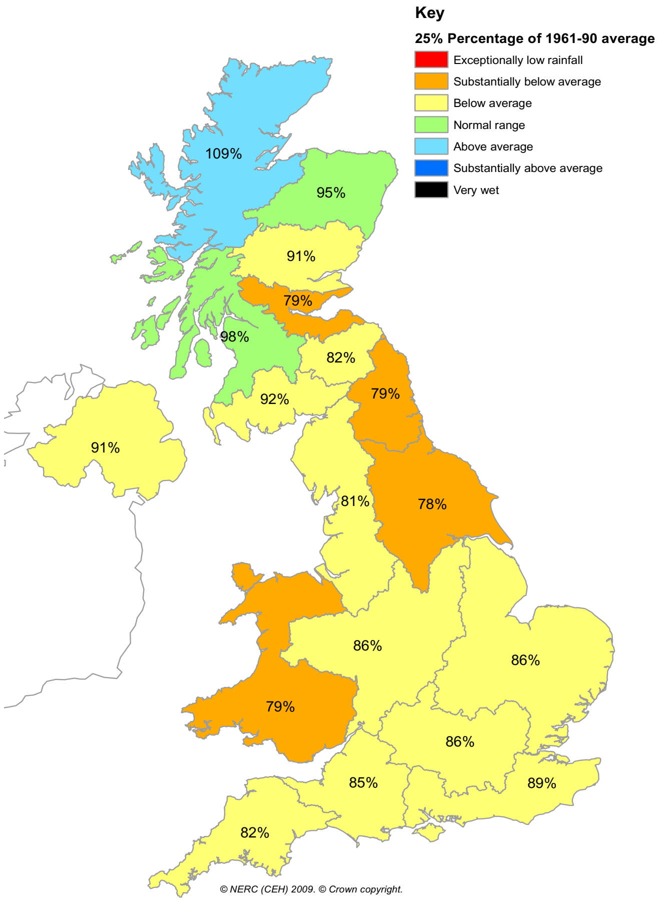
Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and derived following 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 November 2008 are provisional.

Rainfall . . . Rainfall . . .

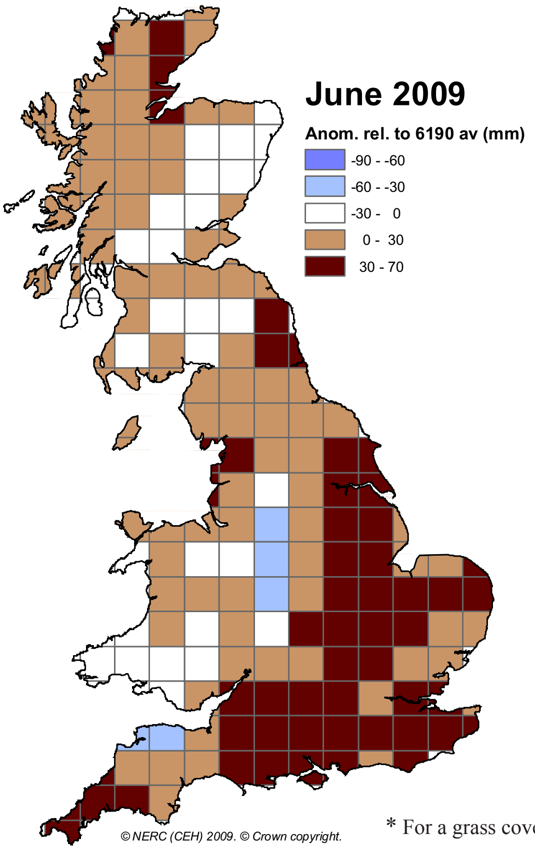
March - June 2009



November 2008 - June 2009



MORECS Soil Moisture Deficits *



* For a grass cover

Met Office
Summer 2009 forecast

Forecast for the Summer 2009: updated 30 June 2009

Temperature
For the UK and much of Europe temperatures for the rest of the summer are likely to be above average.

Rainfall
For the rest of summer, rainfall is likely to be near average over the UK. A repeat of the very wet summers of 2007 and 2008 remains unlikely.

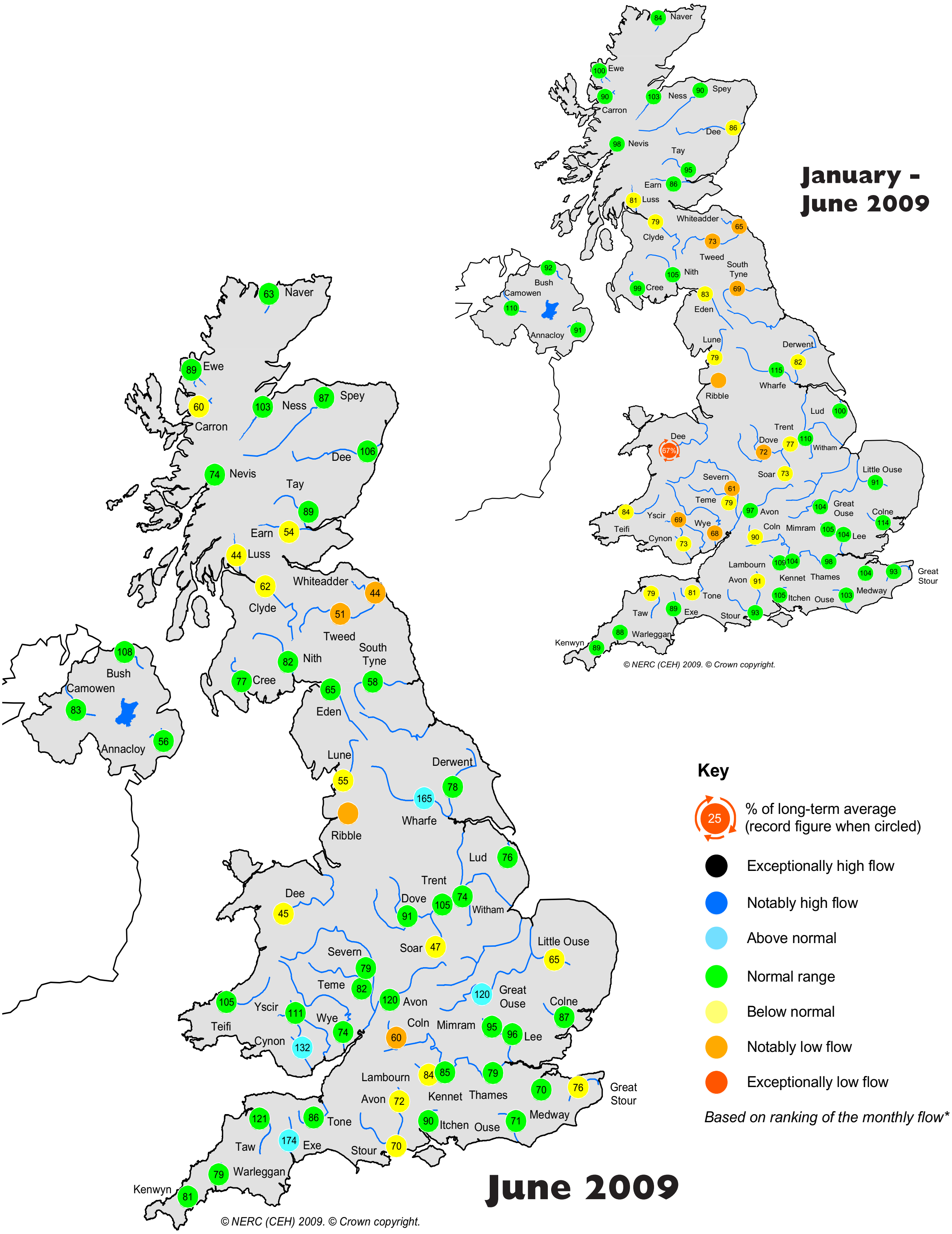
Over other parts of western Europe rainfall is likely to be near average or above average, while below-average rainfall is favoured over much of eastern Europe.

Updates and reviews of the forecast
An update to the summer forecast will be issued by 11 a.m. on 29 July 2009.

For further details please visit:

http://www.metoffice.gov.uk/science/creating/monthsahead/seasonal/2009/summer.html

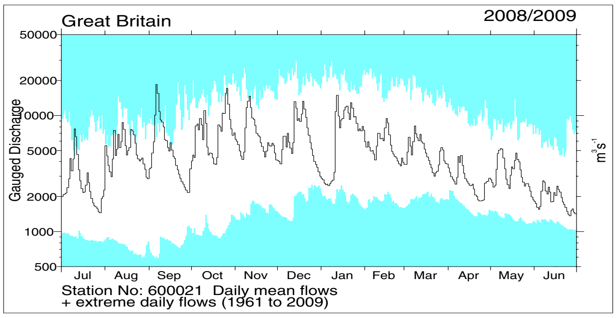
River flow . . . River flow . . .

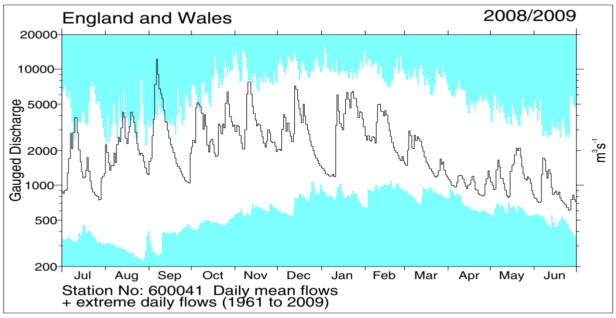


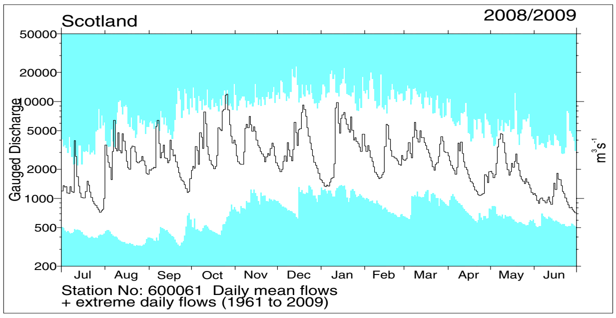
River flows

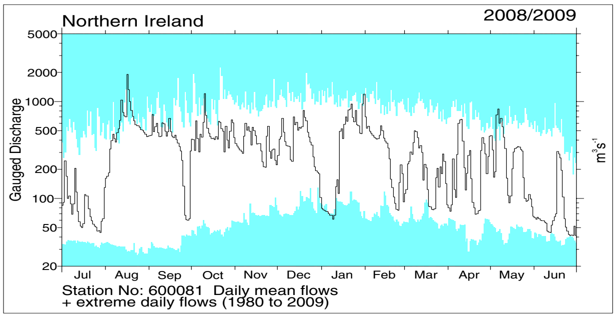
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

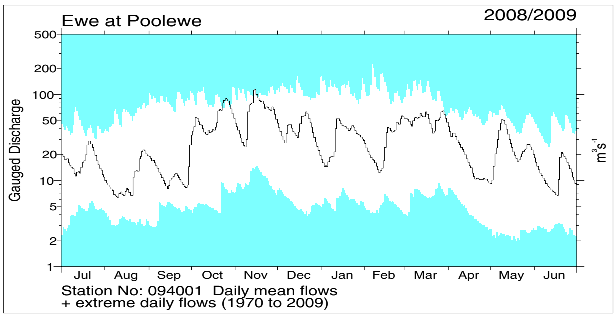
River flow . . . River flow . . .

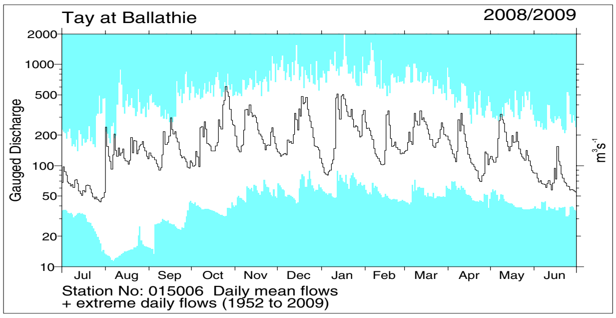


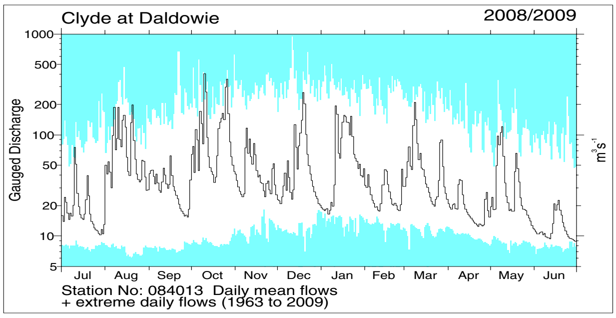


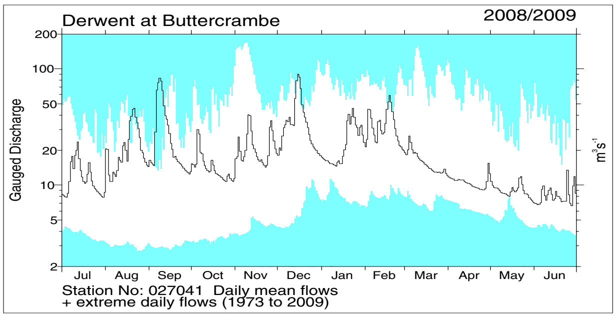


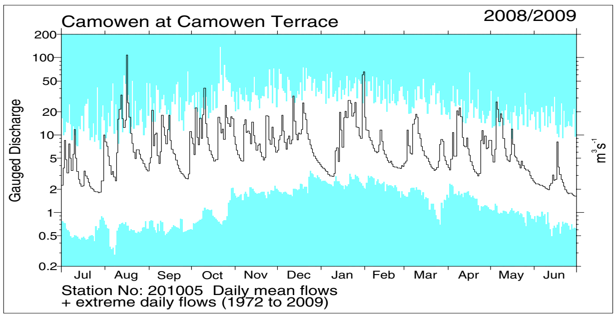


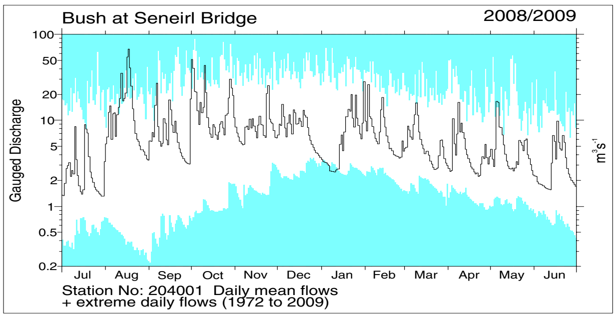








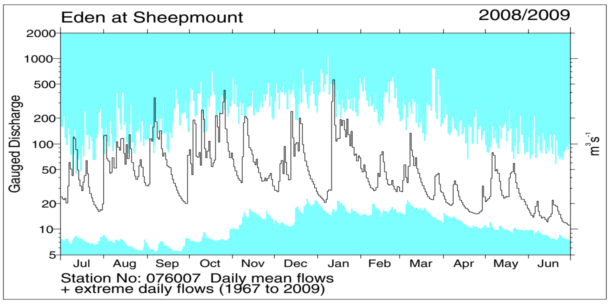


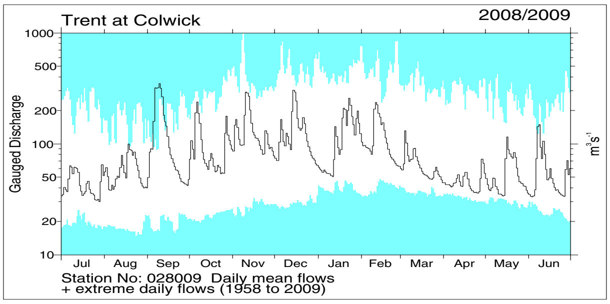


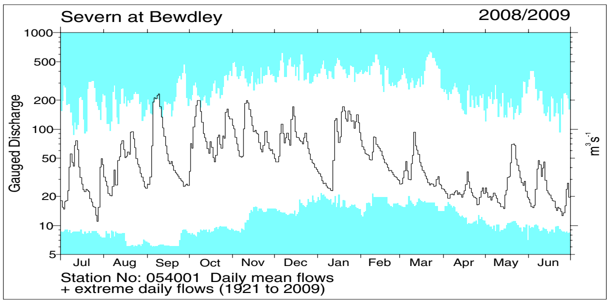
River flow hydrographs

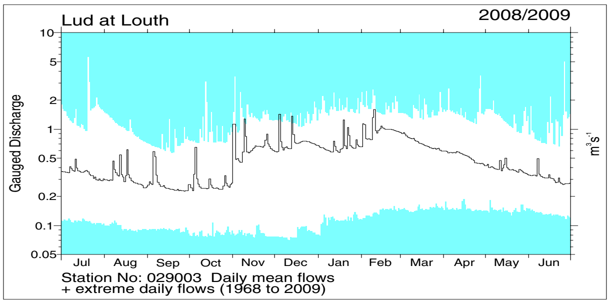
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to July 2008 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

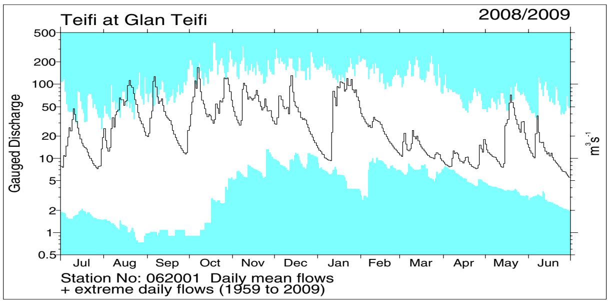
River flow . . . River flow . . .

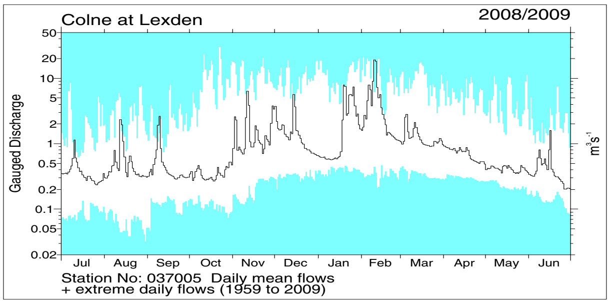


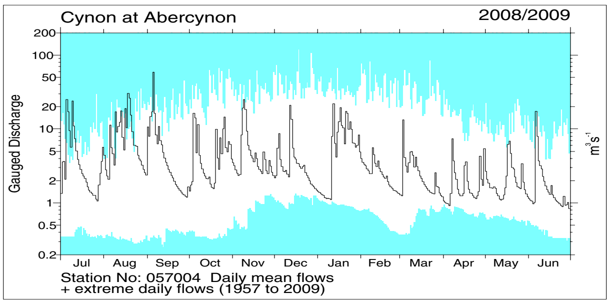


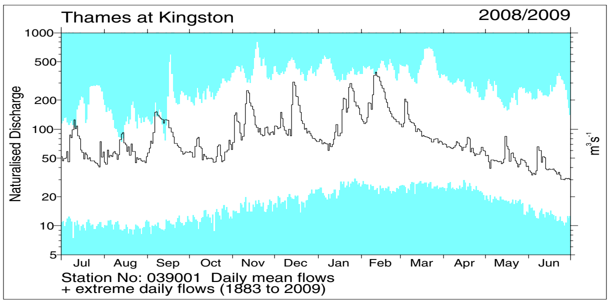


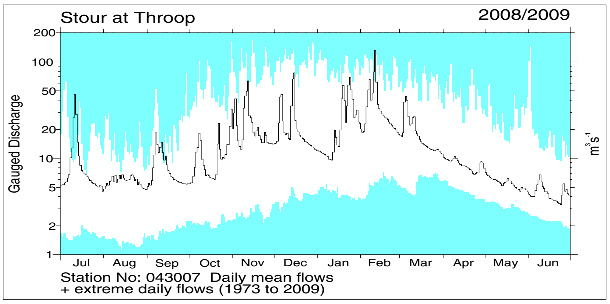


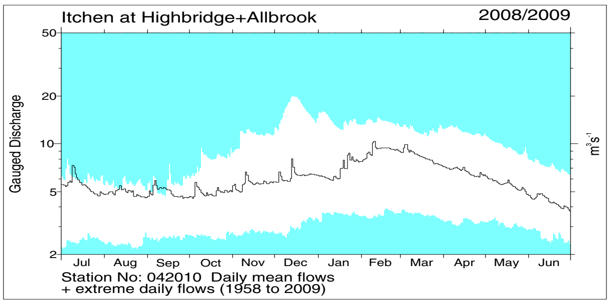












Notable runoff accumulations (a) March - June 2009, (b) January - June 2009, (c) November 2008 - June 2009

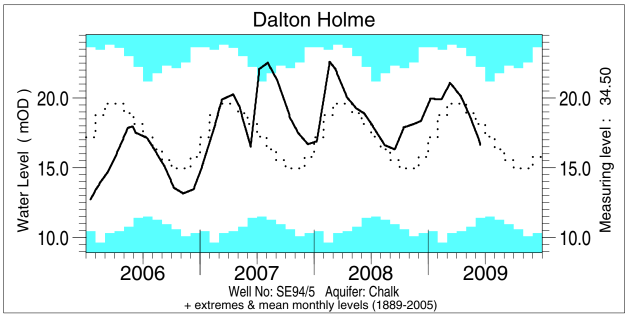
	River	%lta	Rank
a)	Tweed (Norham)	60	4/50
	Whiteadder	43	3/40
	Tyne (Bywell)	60	4/52
	Trent	70	=6/51
	Soar	44	3/38
	Tone	64	5/49
	Brue	56	5/45
	Teme	55	4/39

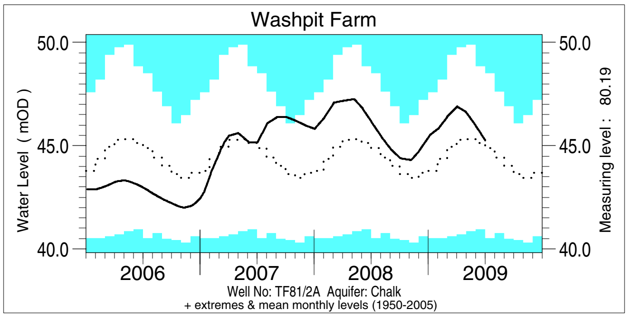
	River	%lta	Rank
b)	S Tyne	69	4/47
	Dove	72	6/48
	Severn	61	5/88
	Wye	68	8/73
	Dee (New Inn)	67	1/40
	L Bann	80	5/29

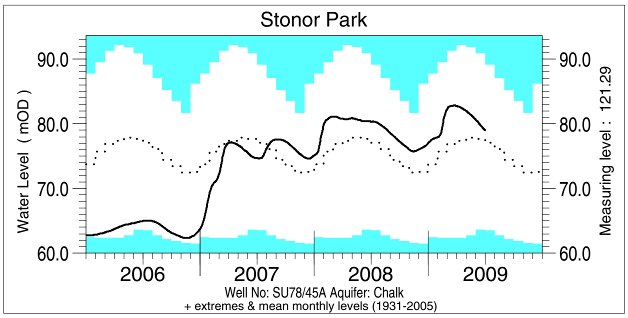
	River	%lta	Rank
c)	Tweed (Boleside)	77	3/48
	Dart	85	9/51
	Yscir	71	2/36
	Lune	80	6/47
	Luss	79	2/29
	Lagan	69	3/36

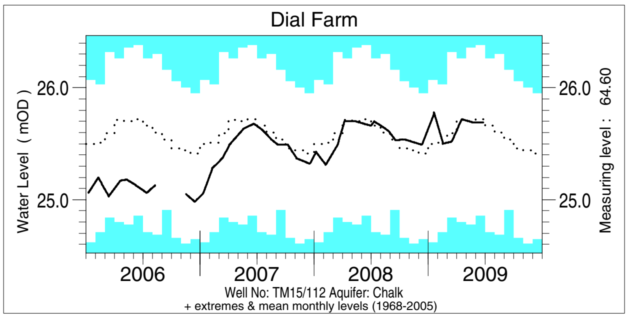
lta = long term average
Rank 1 = lowest on record

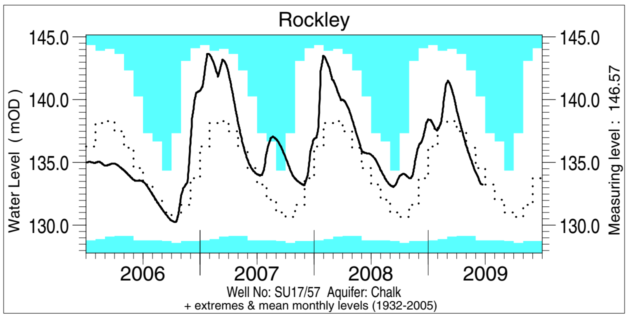
Groundwater . . . Groundwater

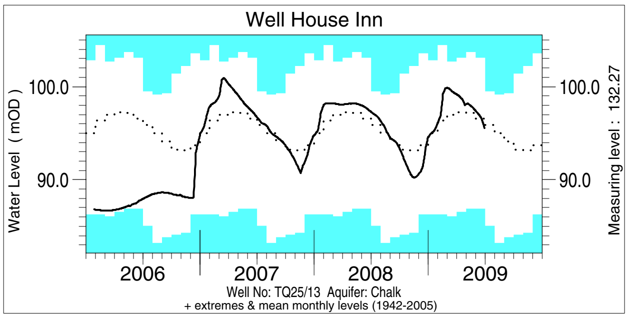


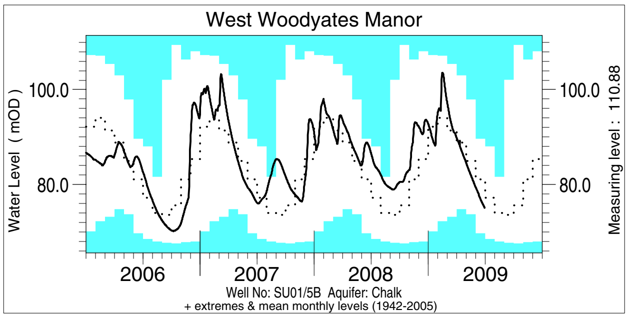


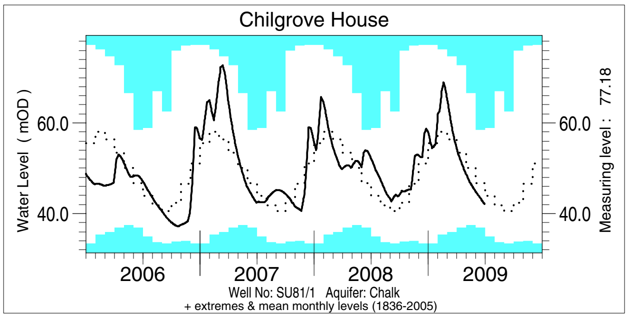


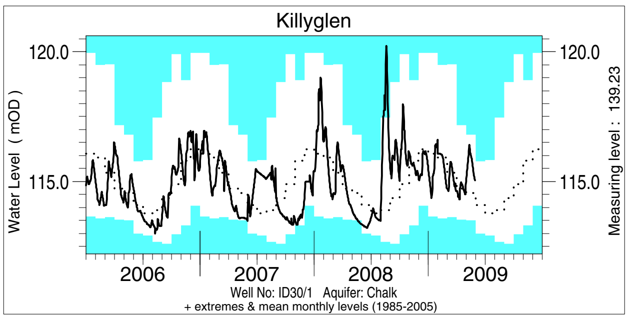


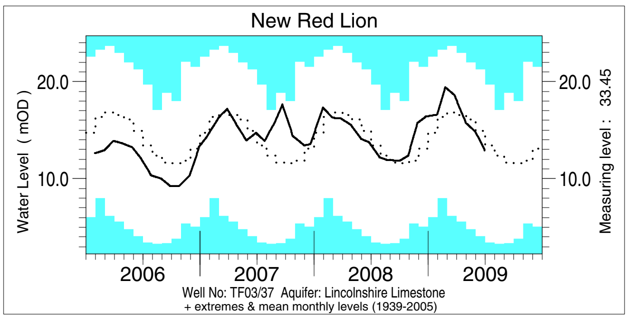






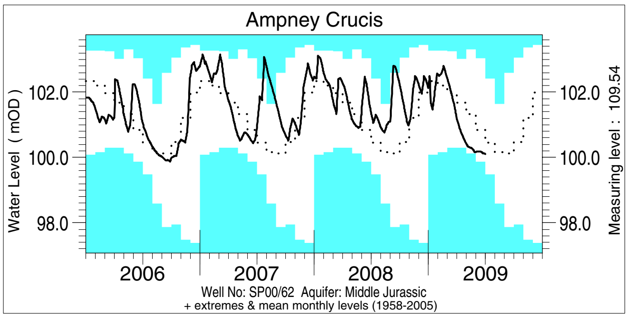


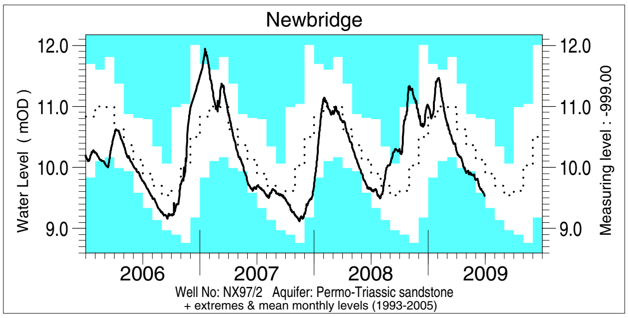


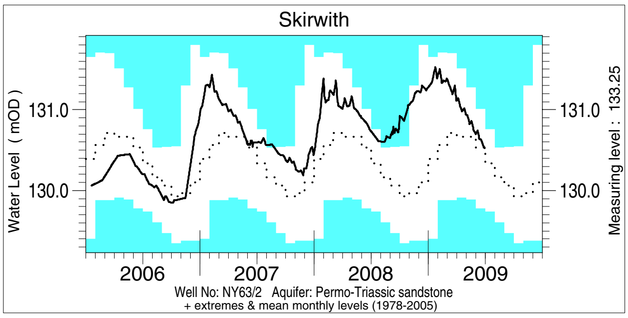


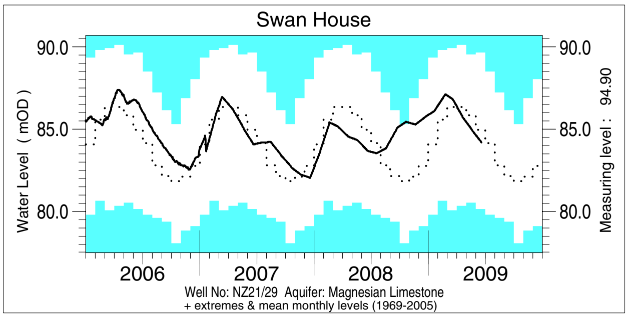
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

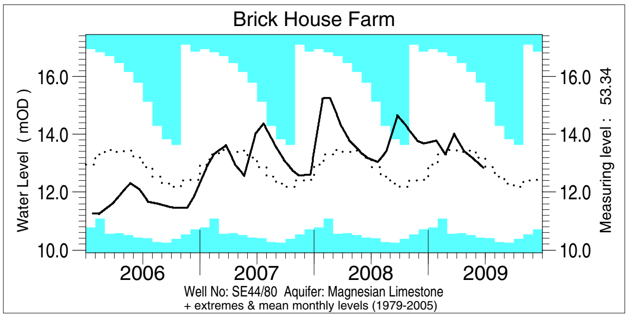
Groundwater . . . Groundwater

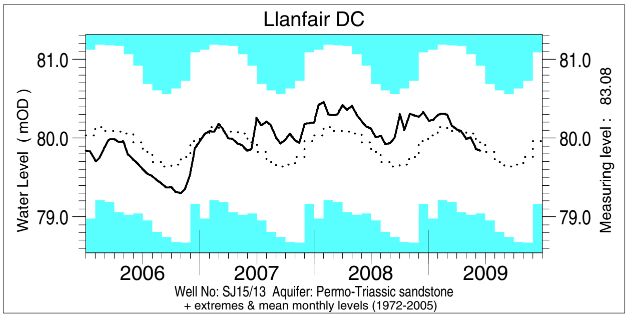


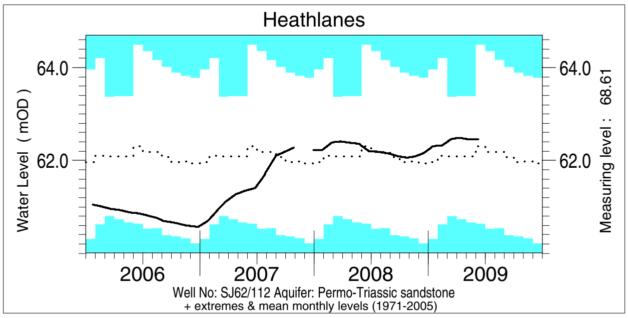


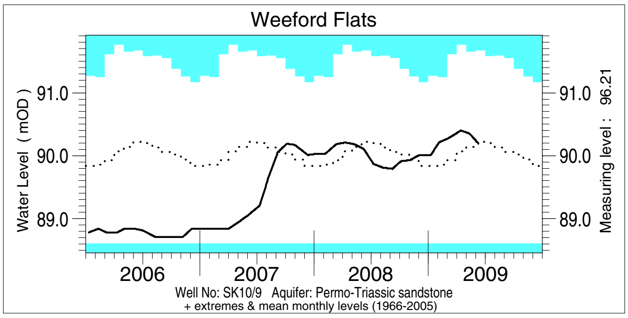


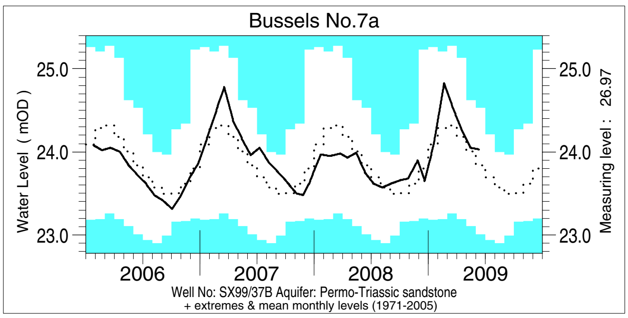


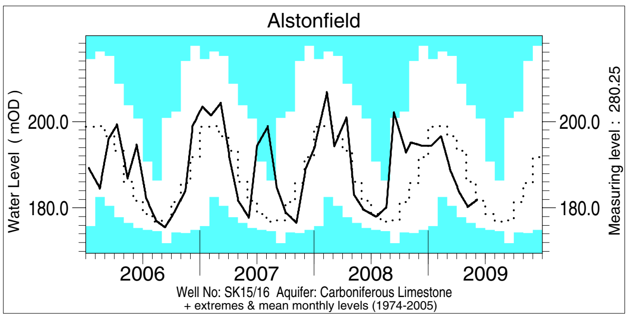












Groundwater levels June / July 2009

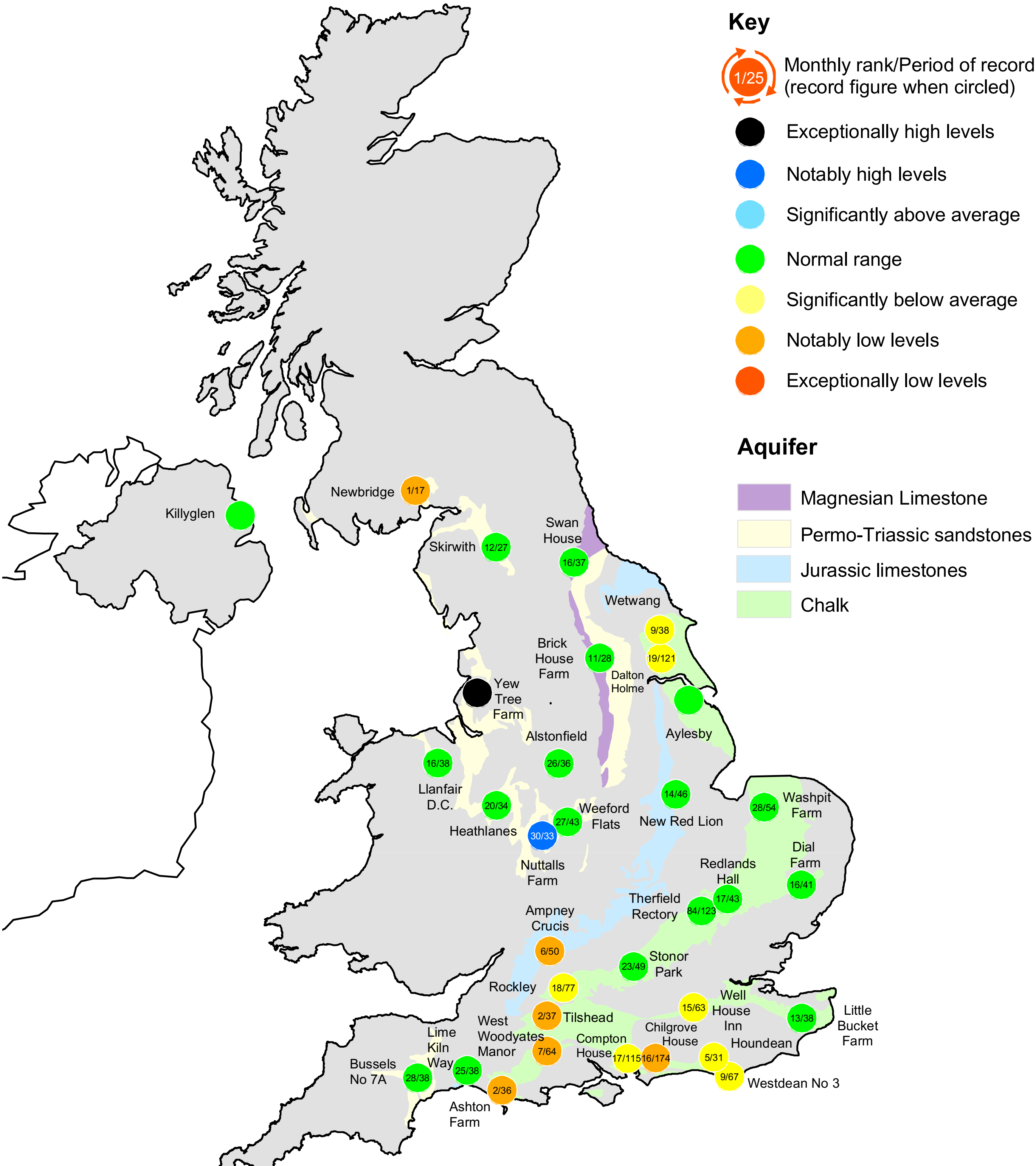
Borehole	Level	Date	Jun. av.
Dalton Holme	16.66	16/06	18.12
Washpit Farm	45.24	02/07	45.20
Stonor Park	79.00	01/07	77.70
Dial Farm	25.69	26/06	25.69
Rockley	133.23	23/06	134.58
Well House Inn	95.54	29/06	96.45
West Woodyates	75.05	30/06	81.03

Borehole	Level	Date	Jun. av.
Chilgrove House	42.04	30/06	46.04
Killyglen (NI)	115.04	29/05	113.96
New Red Lion	12.92	30/06	14.48
Ampney Crucis	100.11	01/07	100.87
Newbridge	9.53	30/06	10.02
Skirwith	130.52	30/06	130.51
Swan House	84.18	18/06	84.44

Borehole	Level	Date	Jun. av.
Brick House Farm	12.84	25/06	13.13
Llanfair DC	79.84	15/06	79.88
Heathlanes	62.45	09/06	62.19
Weeford Flats	90.19	09/06	89.94
Bussels No.7a	24.03	10/06	23.86
Alstonfield	181.93	05/06	181.65

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



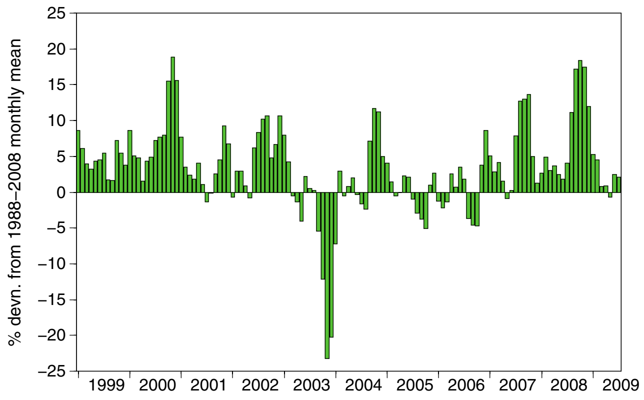
Groundwater levels - June 2009

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.

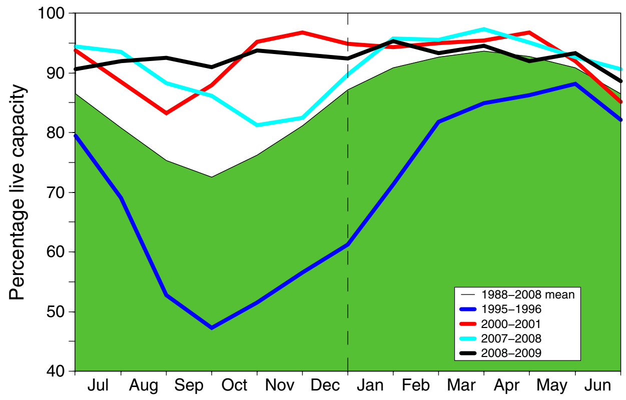
Notes:
i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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)	2009 May	Jun	Jul	Jul Anom.	Min Jul	Year* of min	2008 Jul	Diff 09-08
North West	N Command Zone	•	124929	80	89	**78**	6	58	1995	74	4
	Vyrnwy		55146	85	85	**74**	-9	65	1990	89	-15
Northumbrian	Teesdale	•	87936	95	92	**84**	5	58	1989	88	-4
	Kielder		(199175)	(90)	(94)	**(91)**	(1)	(71)	1989	(94)	-3
Severn Trent	Clywedog		44922	97	100	**100**	6	72	1989	100	0
	Derwent Valley	•	39525	84	84	**79**	-2	53	1996	84	-5
Yorkshire	Washburn	•	22035	86	88	**84**	3	63	1995	85	-1
	Bradford supply	•	41407	85	87	**78**	-1	54	1995	85	-7
Anglian	Grafham		(55490)	(95)	(94)	**(92)**	(-1)	(70)	1997	(95)	-3
	Rutland		(116580)	(90)	(87)	**(85)**	(-4)	(75)	1997	(91)	-6
Thames	London	•	202828	98	99	**95**	4	85	1990	96	-1
	Farmoor	•	13822	95	95	**95**	-3	94	1995	95	0
Southern	Bewl		28170	90	84	**76**	-7	52	1990	95	-19
	Ardingly		4685	100	98	**86**	-10	82	2005	99	-13
Wessex	Clatworthy		5364	84	78	**75**	-8	61	1995	99	-24
	Bristol WW	•	(38666)	(92)	(85)	**(77)**	(-6)	(64)	1990	(87)	-10
South West	Colliford		28540	100	100	**97**	16	51	1997	92	5
	Roadford		34500	92	91	**89**	7	49	1996	88	1
	Wimbleball		21320	96	90	**89**	3	63	1992	96	-7
	Stithians		5205	96	94	**85**	6	53	1990	72	13
Welsh	Celyn and Brenig	•	131155	99	100	**97**	3	77	1996	96	1
	Brianne		62140	95	99	**96**	4	76	1995	89	7
	Big Five	•	69762	89	90	**85**	1	61	1989	90	-5
	Elan Valley	•	99106	94	99	**95**	6	75	1989	89	6
Scotland(E)	Edinburgh/Mid Lothian	•	97639	98	97	**93**	8	54	1998	89	4
	East Lothian	•	10206	100	97	**97**	4	81	1992	99	-2
Scotland(W)	Loch Katrine	•	111363	93	98	**84**	3	61	2001	68	16
	Daer		22412	97	99	**93**	10	62	1994	80	13
	Loch Thom	•	11840	96	96	**95**	10	69	2000	81	14
Northern Ireland	Total+	•	61600	92	95	**86**	4	61	2008	61	25
	Silent Valley	•	20634	84	91	**85**	8	54	1995	58	27

() 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 1988-2008 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) was instigated in 1988 and is undertaken jointly by the Centre for Ecology and Hydrology Wallingford (formerly the Institute of Hydrology - IH) 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 Wallingford) 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.

For further details please contact:

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100 Fax: 0870 900 5050
E-mail: enquiries@metoffice.com

The National Hydrological Monitoring Programme depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged.

Subscription

Subscription to the Hydrological Summaries costs £48 per year. Orders should be addressed to:

Hydrological Summaries
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

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

Selected text and maps are available on the WWW at http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
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