Hydrological Summary

for the United Kingdom

November 2005

General

November began with mild, boisterous and wet autumnal weather conditions but synoptic patterns produced very much colder weather over the final week. High flows, with modest floodplain inundations, were common during the first fortnight but steep recessions then became established in most rivers. As usual in November, reservoir stocks increased briskly in most western and northern areas and, despite some essential drawdown to moderate the flood risk, overall stocks for England and Wales were appreciably above average in early December. Importantly however, stocks continued to decline in a few South Eastern impoundments (e.g. Bewl) and, reflecting rainfall deficiencies over the post Oct-2004 period, remain seasonally low in the drought affected regions. Groundwater recharge during November was generally healthy in the west and north but the absence of a significant recovery in large parts of the eastern Chalk has resulted in very meagre flows in spring-fed streams, and reinforced the drought's focus on the South East. For much the greater part of the UK the water resources outlook is healthy but in parts of southern and central England the winter and early spring rainfall will need to be appreciably above average to allay concern about water supply and environmental stress in the summer of 2006.

Rainfall

Synoptic patterns in November were initially cyclonic, bringing substantial rainfall on a westerly/south westerly airflow. Upland western catchments were especially wet – Capel Curig (north Wales) recorded around 200mm in 7 days – but from around the 11th, high pressure predominated until the final week when frontal incursions brought an Arctic airflow across most of the UK. The associated snowfall (reaching Cornwall on the 25th) caused massive transport disruption – 270 schools were closed in Wales on the 27th. However, in a few parts of the English Lowlands precipitation was largely restricted to fog-drip over the latter half of the month. November precipitation totals exhibited large spatial variations, but generally exceeded the average in a broad band from the South West to eastern Scotland where, locally, totals exceeded twice the monthly average (e.g. in parts of the Grampians). By contrast, Northern Ireland and south western Scotland were relatively dry and, of greater water resources significance, below average totals characterised much of the English Lowlands; parts of Kent registered <40%. Autumn (Sep-Nov) rainfall totals were moderately above average in most regions but, unhelpfully in relation to the drought, the driest areas (reporting <80%) were in the South East. Here, a number of catchments have registered only one or two months with above average rainfall since October 2004. In this 13-month timespan, the E&W rainfall total is the 3rd driest since 1975/76 (1988/89 and 1995/96 were drier). More significantly, large parts of the South-East registered their 2nd lowest total (after 1988/89) since 1933/34; with the greater part of the overall deficiency built up during the winter months the impact on runoff and aquifer recharge has been substantial.

River Flows

November flows exhibited a very wide range especially in responsive catchments. The late October recovery in runoff continued; spate conditions and Flood Warnings were common during the first 10 days – culminating on the 9th when the Rivers Gwilli and Dewi Fawr (in South Wales) both registered their highest levels on record. Flooding was locally severe (e.g. in Haverfordwest) and the saturated soils triggered a number of landslides (e.g. near Bethesda and Ebbw Vale). On the Severn, demountable flood barriers were employed at Bewdley and Worcester. More generally, storm debris and leaf-fall contributed to local drainage problems. From mid-month, recessions were steep – aided by frozen upland catchments – and, by month end, flows were approaching early winter minima (e.g. in the Forth) in many responsive catchments. After many months (31 for the Lambourn) of below average flows, runoff rates in many spring-fed streams were also depressed. Such impermeable catchments aside, November runoff totals were mostly within the normal range. A more revealing picture of the drought's persistence and severity is provided by the runoff accumulations since October 2004. Deficiencies of well over 30% characterise many southern and central catchments, and are unprecedented for a few rivers in the South-East (e.g. the Medway and Sussex Ouse).

Groundwater

With November rainfall favouring the west and north, where soils were close to saturation, substantial infiltration produced strong groundwater level recoveries in most sandstone and limestone aquifers (levels increased by >20m at Alstonfield). Very helpful recoveries were also registered in much of the western Chalk (e.g. at Ashton Farm and West Woodyates). But no seasonal upturn was evident during November in much of the central and eastern Chalk outcrops – or for some Permo-Triassic sandstones aquifer units – where soil moisture deficits mostly remained above average in late November. Although November groundwater levels at most index wells were in the normal range, continuing recessions have left notably low levels in the Permo-Triassic sandstones of the Midlands and in parts of the central and eastern Chalk. At the Redlands, Stonor and Little Bucket index wells November levels were seasonally depressed, and close to drought minima. For the Chalk as a whole there has been a modest increase in groundwater resources since October when overall resources were estimated at their lowest since the autumn of 1997. In order for groundwater to exercise a strong moderating influence on any potential summer drought (in the English Lowlands) in 2006, above average rainfall will be needed over Dec-April period – to help ensure that the 2006 recessions begins from near-average spring peaks.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Nov 2005	Sep 05-Nov 05	RP	May 05-Nov 05	RP	Jan 05-Nov 05	RP	Nov 04-Nov 05	RP
England & Wales	**mm**	**88**	**282**		**519**		**763**		**883**	
	%	**95**	**109**	**2-5**	**98**	**2-5**	**93**	**2-5**	**88**	**5-10**
North West	mm	**123**	419		718		1086		1300	
	%	**98**	113	2-5	99	2-5	100	<2	97	2-5
Northumbrian	mm	**94**	303		547		885		979	
	%	**109**	128	5-10	107	2-5	113	5-10	103	2-5
Severn Trent	mm	**69**	226		440		634		721	
	%	**97**	111	2-5	98	2-5	92	2-5	86	5-10
Yorkshire	mm	**83**	254		476		736		823	
	%	**102**	112	2-5	98	2-5	98	2-5	90	2-5
Anglian	mm	**40**	168		384		522		592	
	%	**68**	105	2-5	105	2-5	95	2-5	89	2-5
Thames	mm	**52**	186		360		510		596	
	%	**79**	98	2-5	88	2-5	81	5-10	78	10-20
Southern	mm	**49**	184		365		531		627	
	%	**58**	78	2-5	81	5-10	76	10-20	72	30-40
Wessex	mm	**74**	235		454		664		773	
	%	**88**	98	2-5	95	2-5	88	2-5	82	5-10
South West	mm	**138**	385		654		966		1132	
	%	**108**	114	2-5	102	2-5	92	2-5	86	5-10
Welsh	mm	**160**	461		748		1122		1335	
	%	**111**	115	2-5	99	2-5	94	2-5	90	2-5
Scotland	**mm**	**171**	**494**		**894**		**1479**		**1792**	
	%	**109**	**107**	**2-5**	**106**	**2-5**	**112**	**5-10**	**110**	**5-10**
Highland	mm	**242**	681		1114		1887		2349	
	%	**123**	111	2-5	113	5-10	122	25-35	121	30-40
North East	mm	**147**	330		634		1008		1163	
	%	**142**	110	2-5	104	2-5	108	2-5	103	2-5
Tay	mm	**149**	423		756		1287		1472	
	%	**117**	110	2-5	104	2-5	111	2-5	104	2-5
Forth	mm	**100**	347		648		1120		1297	
	%	**86**	99	2-5	96	2-5	109	2-5	103	2-5
Tweed	mm	**95**	349		599		973		1085	
	%	**98**	121	5-10	101	2-5	107	2-5	99	2-5
Solway	mm	**132**	493		818		1305		1552	
	%	**91**	110	2-5	98	2-5	101	2-5	98	2-5
Clyde	mm	**154**	537		1003		1645		2040	
	%	**83**	95	2-5	99	2-5	105	2-5	105	2-5
Northern Ireland	**mm**	**79**	**305**		**579**		**943**		**1111**	
	%	**74**	**95**	**2-5**	**91**	**2-5**	**95**	**2-5**	**92**	**2-5**

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

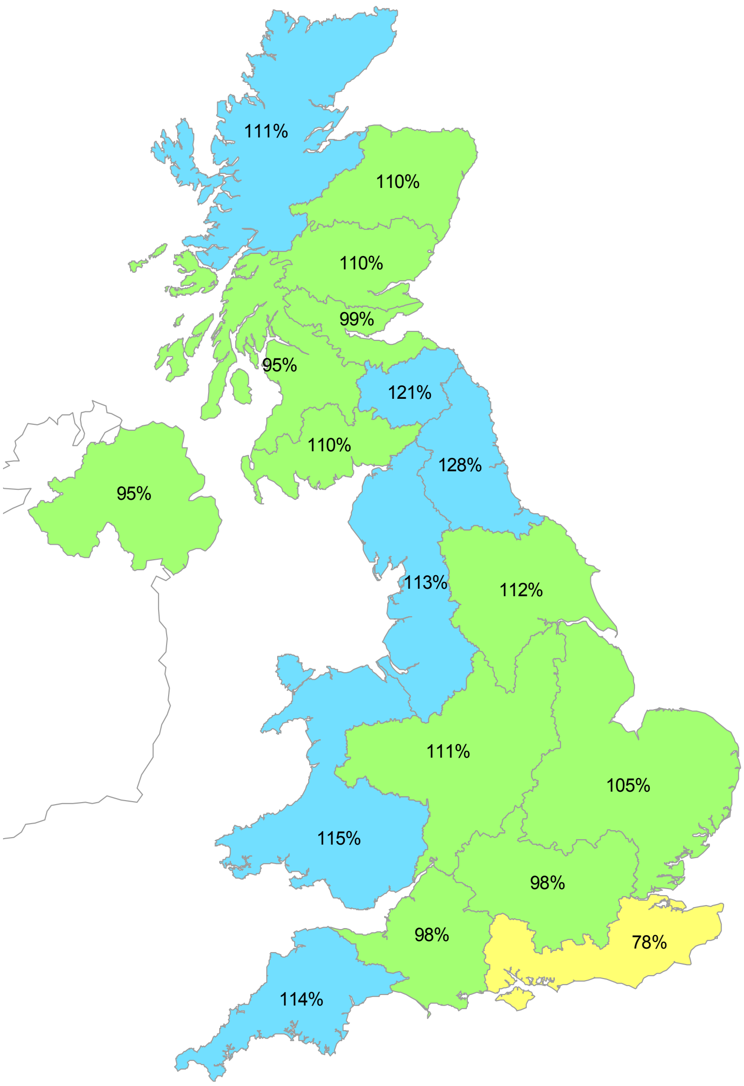
The monthly rainfall figures* provided by the Met Office (National Climate Information Centre) are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since June 2005 are provisional (see page 12).** 1961-2003 regional monthly totals were revised by the Met Office in 2004. The figures for England & Wales are derived by the Hadley Centre and are updates of the homogenised series developed by the Climate Research Unit; the other national figures are derived from different raingauge networks to those used to derive the CRU data series. Most of the return period estimates are based on tables provided by the Met Office (see Tabony, R. C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered); RP estimates for Northern Ireland are based on the tables for north-west England and those for the Highland region take account of ranking positions. The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts, in the Scottish rainfall series in particular, can exaggerate the relative wetness of the recent past. *See page 12.

Rainfall . . . Rainfall . . .

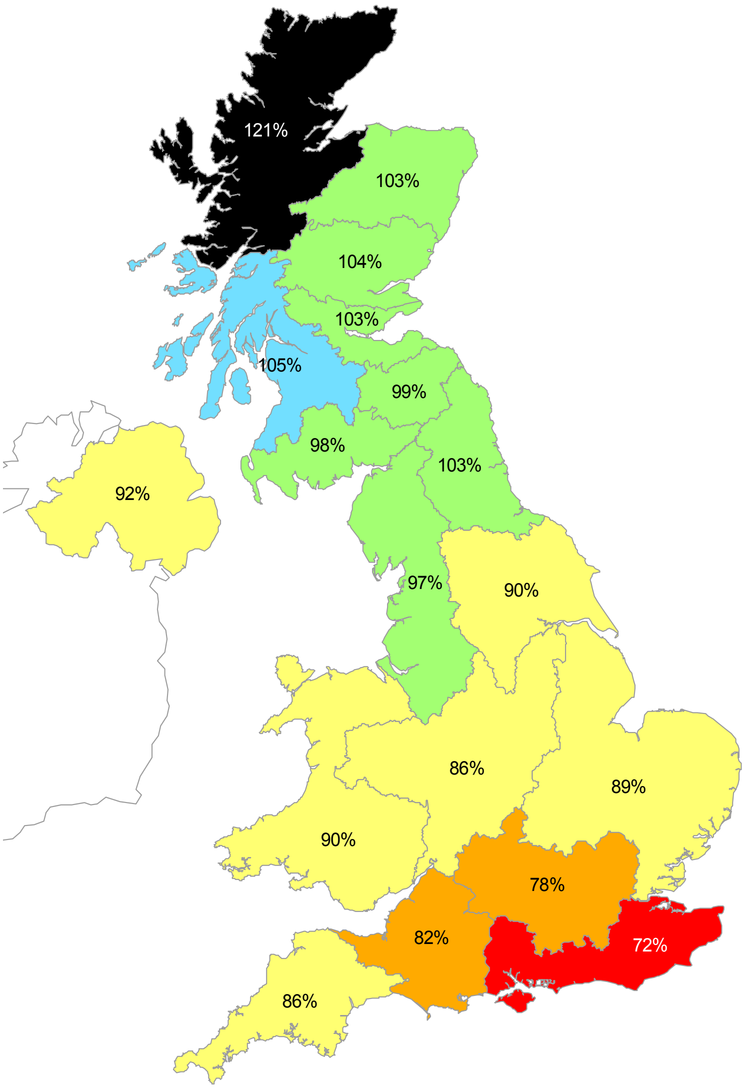
Key

00% Percentage of 1961-90 average

- Very wet
- Substantially above average
- Above average
- Normal range
- Below average
- Substantially below average
- Exceptionally low rainfall



September 2005 - November 2005



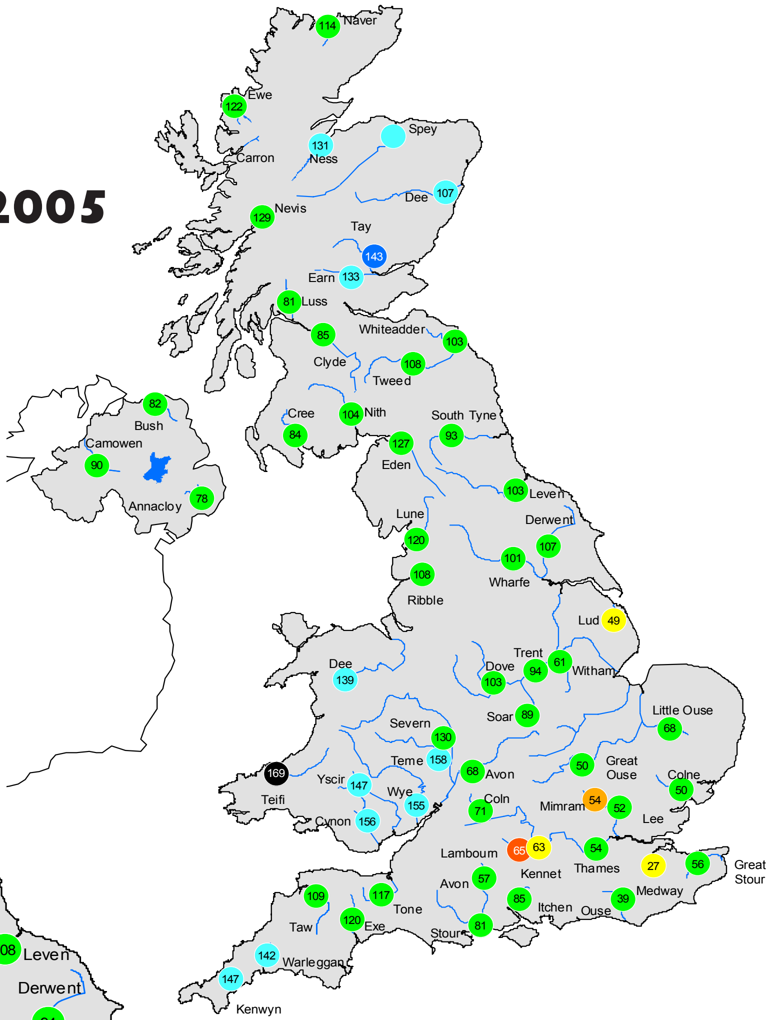
November 2004 - November 2005

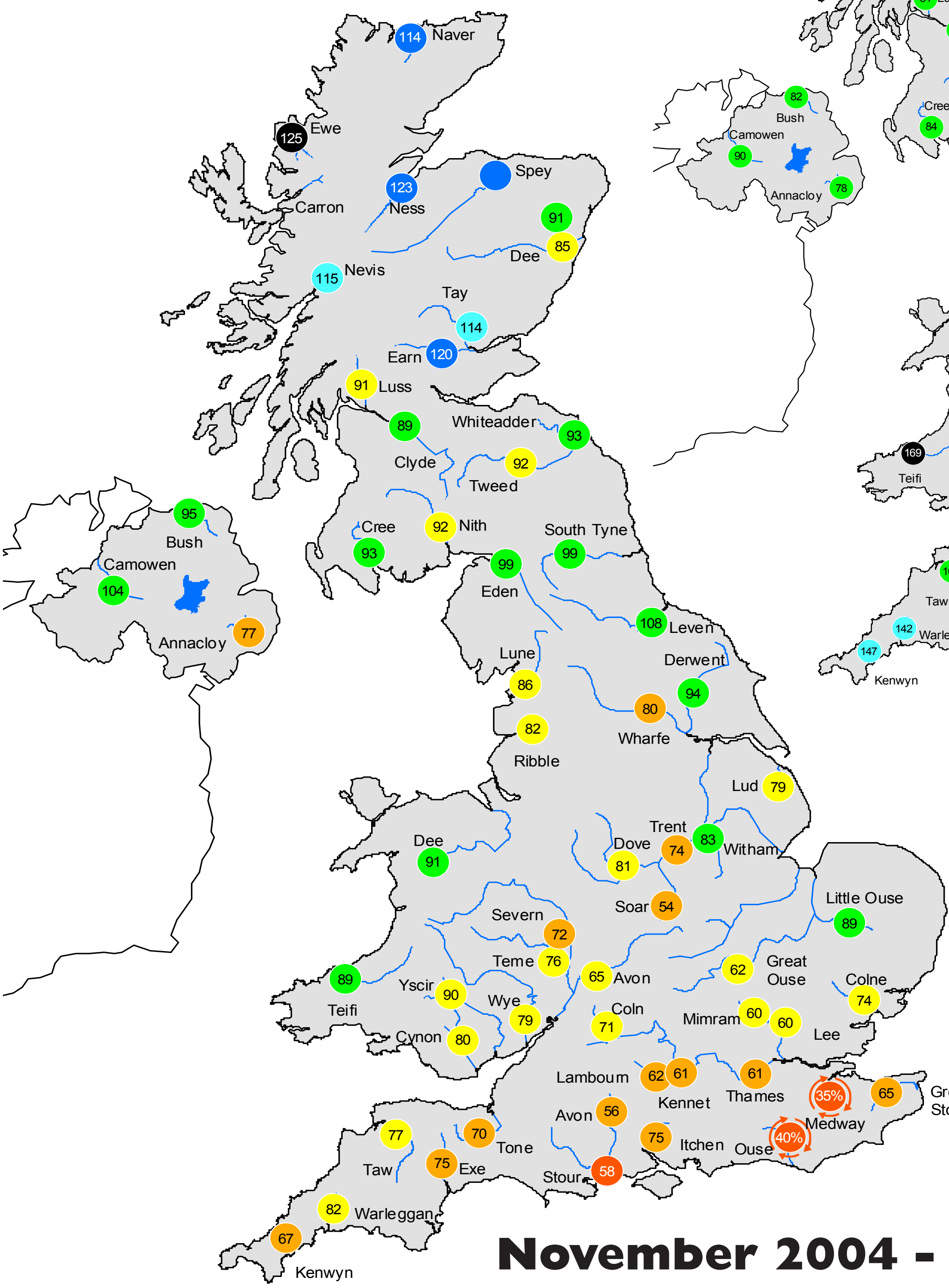
Rainfall accumulation maps

The Sept-Nov rainfall for the UK added to a cluster of recent wet autumns; eight of the last nine have registered above average rainfall. North-eastern England was especially wet, recording its highest autumn rainfall since 1984. Reflecting the preferred tracks of most Atlantic low pressure systems since the autumn of 2004, accumulated rainfall totals for northern Scotland are also notably wet (the Nov-2004 to Nov-2005 total vying with 1991/92 as the wettest in a series from 1914). The relative paucity of frontal rainfall over the 13-month period is very evident across southern England where deficiencies similar to that of Southern Region would be expected, on average, only once every 30-40 years.

River flow . . . River flow . . .

November 2005





November 2004 - November 2005

Key

25 % of long-term average (record figure when circled)

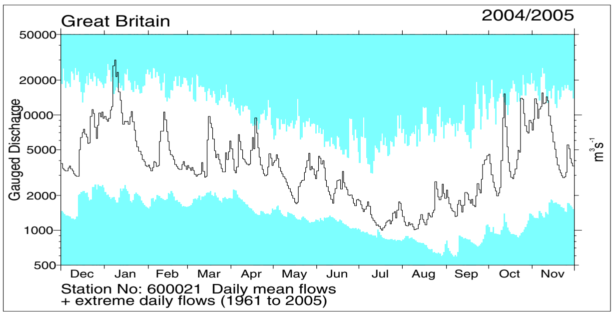
- Exceptionally high flow
- Notably high flow
- Above normal
- Normal range
- Below normal
- Notably low flow
- Exceptionally low flow

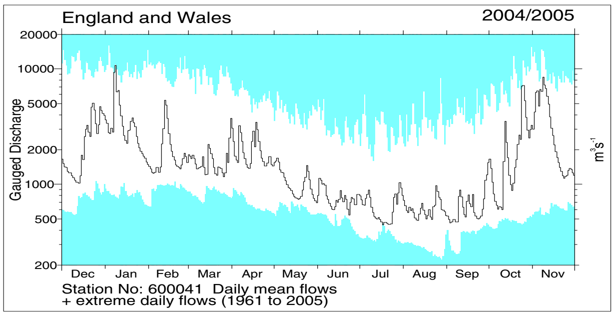
*Based on ranking of the monthly flow**

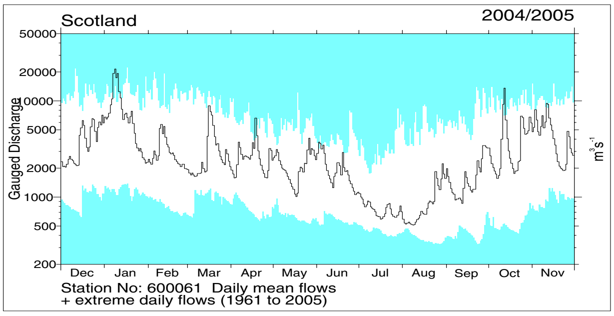
River flows

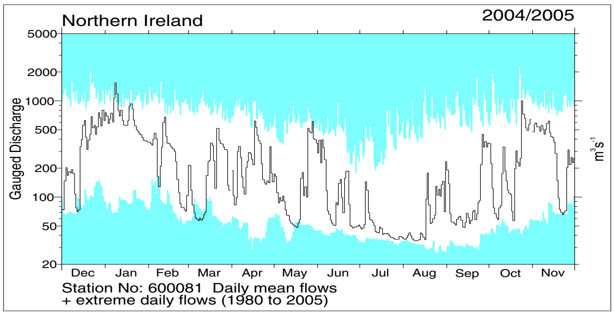
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

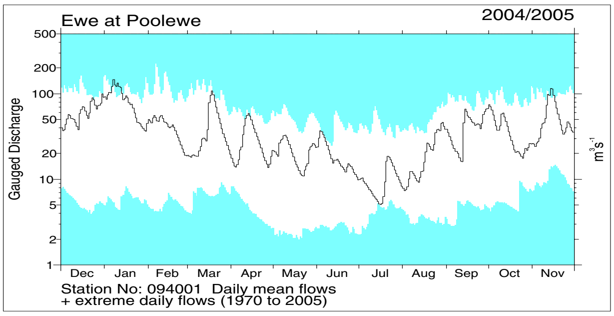
River flow . . . River flow . . .

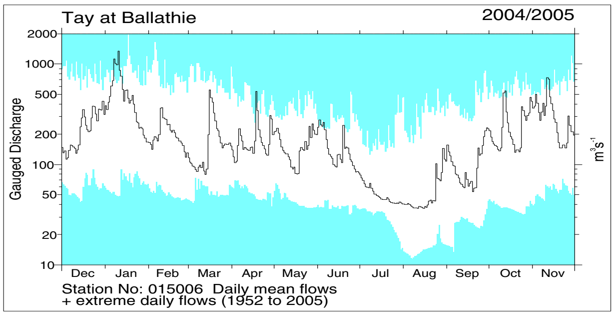


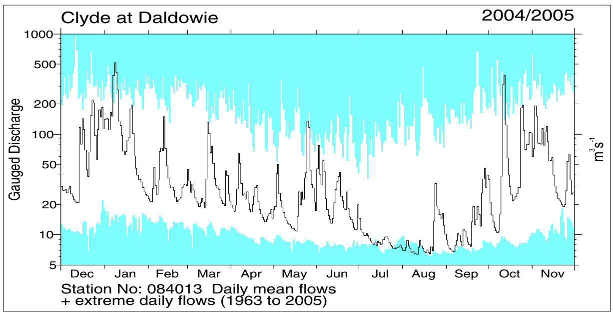


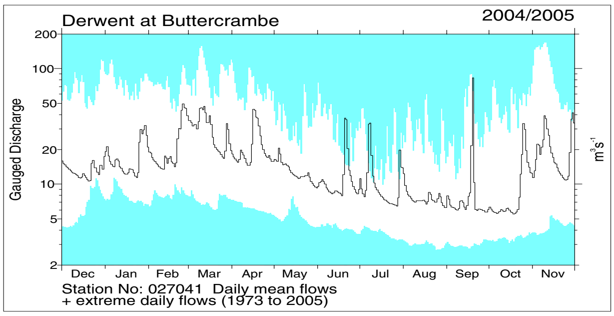


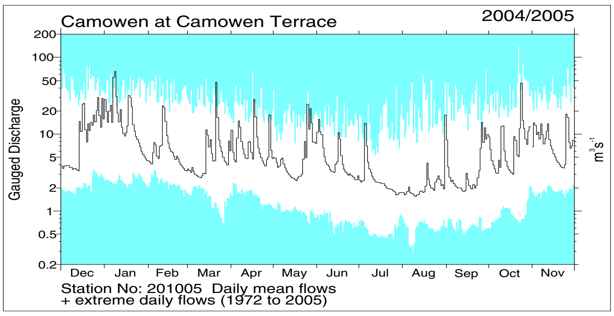


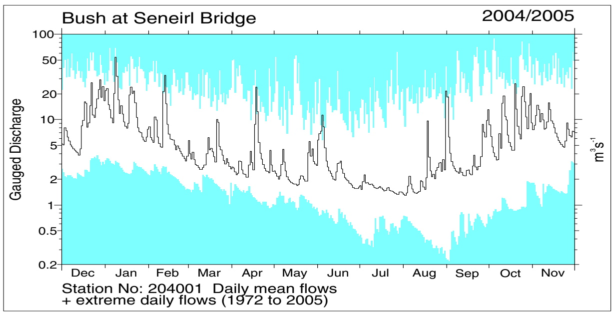








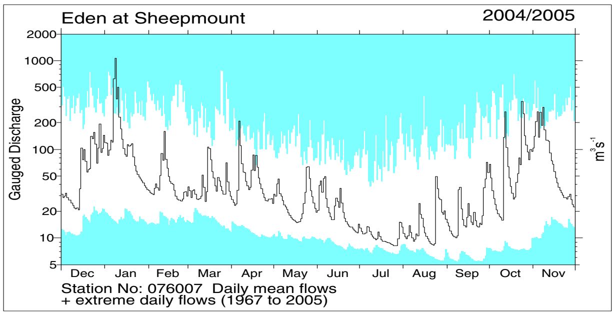


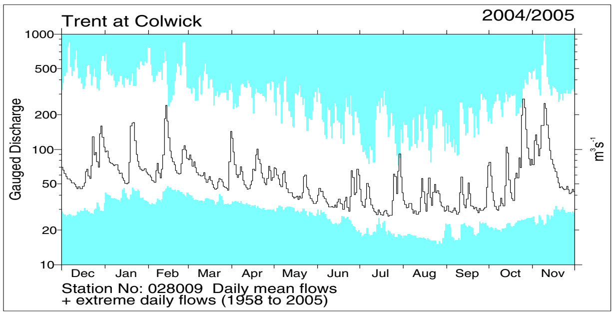


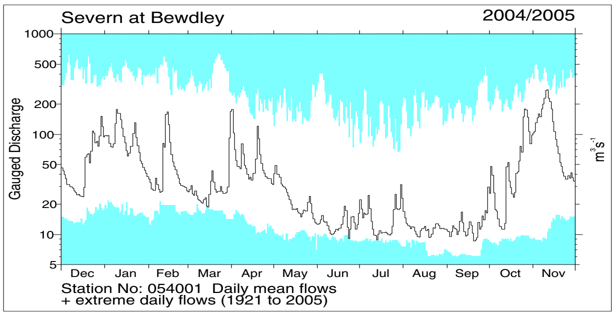
River flow hydrographs

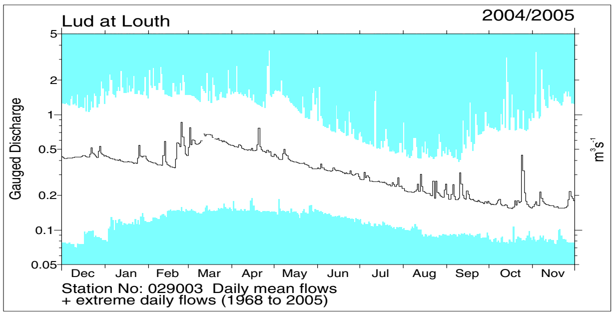
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to December 2004 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

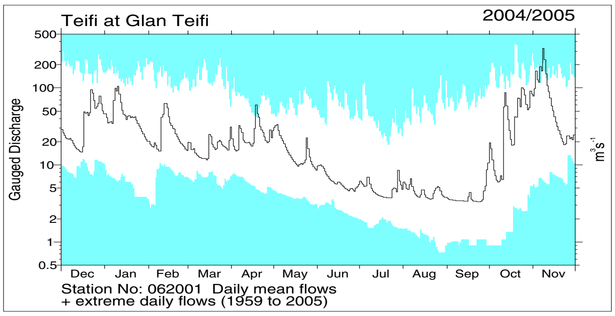
River flow . . . River flow . . .

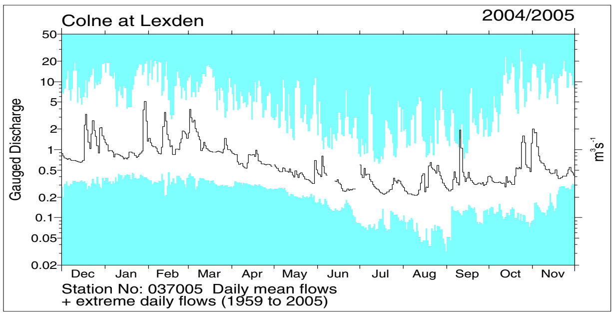


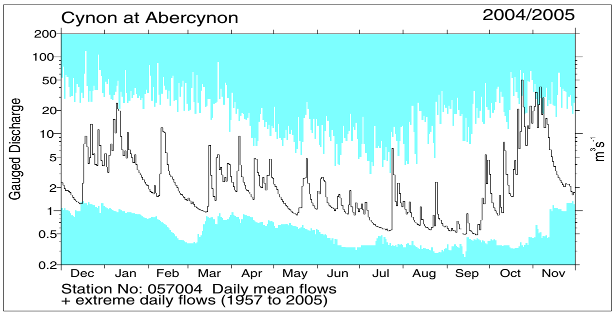


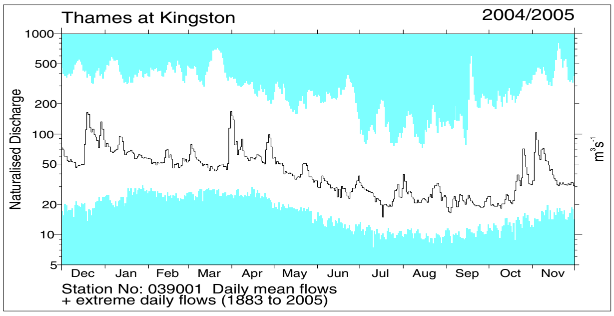


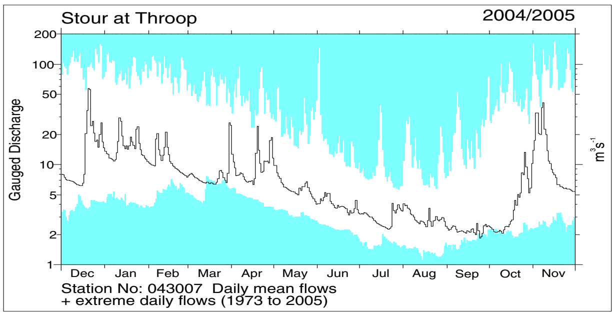


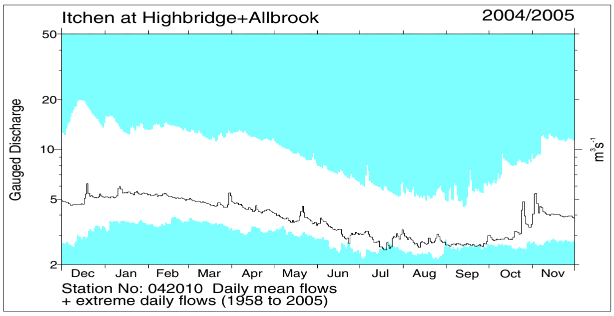












Notable runoff accumulations (a) Sep - Nov 2005, (b) Jan-Nov 2005, (c) Nov 2004 - Nov 2005

a)

River	%lta	Rank
Mimram	54	4/53
Kennet	64	6/44
Lambourn	68	3/43
Medway	31	9/44
Test	67	4/48
Avon (Amesbury)	57	5/41
Faughan	63	4/30

b)

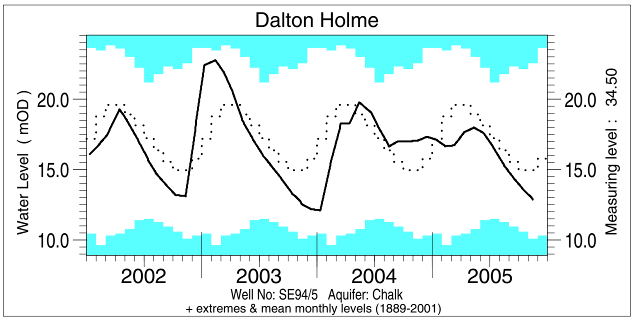
River	%lta	Rank
Soar	55	3/34
Thames (naturalised)	57	10/123
Coln	62	4/42
Wallington	43	2/50
Test	63	3/47
Itchen	72	4/47
Tone	71	4/44

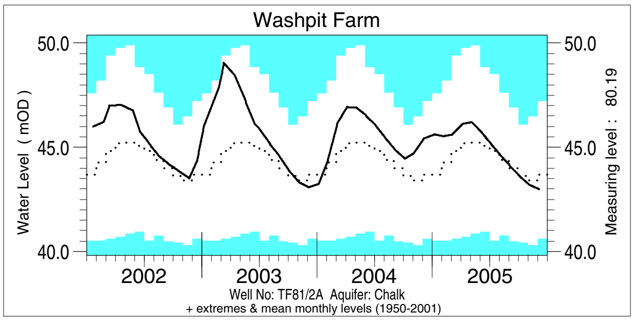
c)

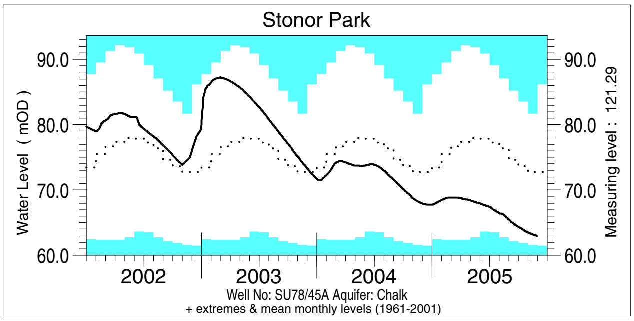
River	%lta	Rank
Mole	56	1/29
Medway	35	1/42
Ouse (Gold Bridge)	40	1/40
Otter	69	2/43
Ewe	125	34/35
Faughan	76	2/29
L Bann	77	2/25

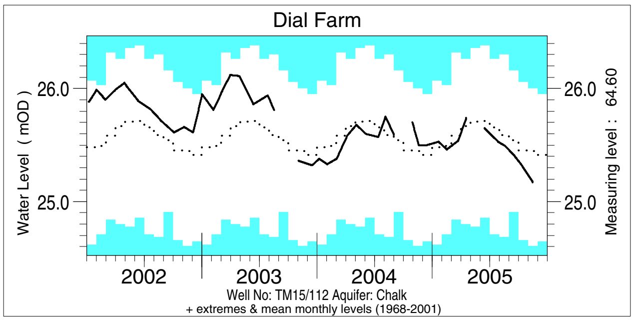
lta = long term average
Rank 1 = lowest on record

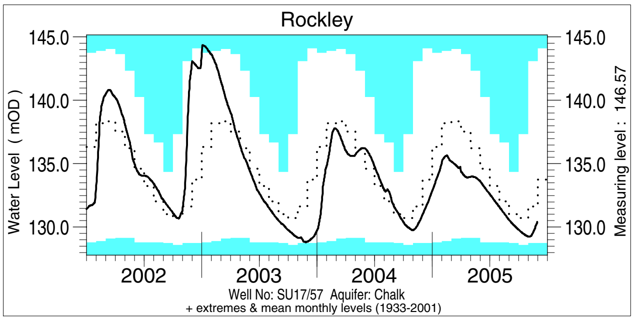
Groundwater . . . Groundwater

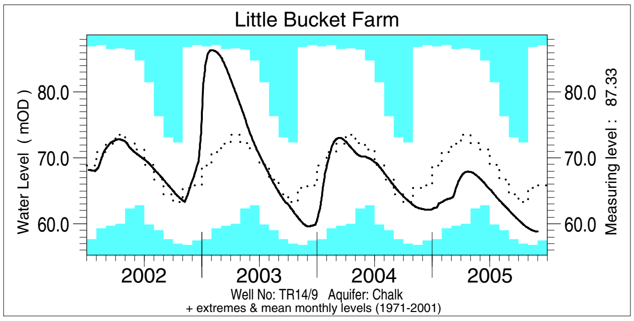


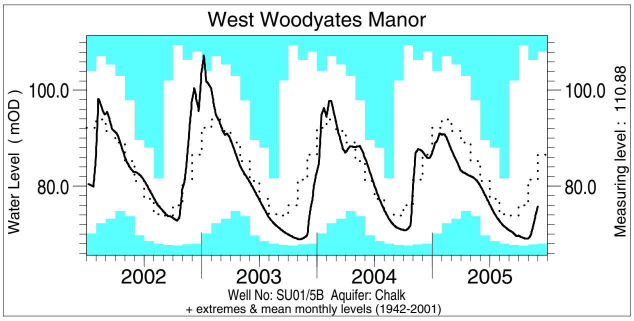


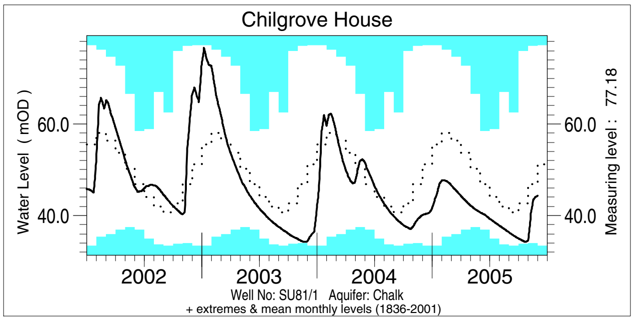


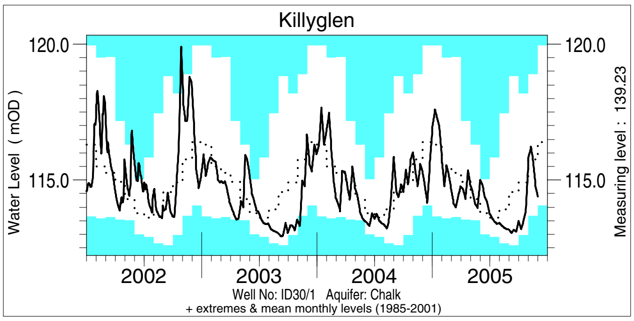


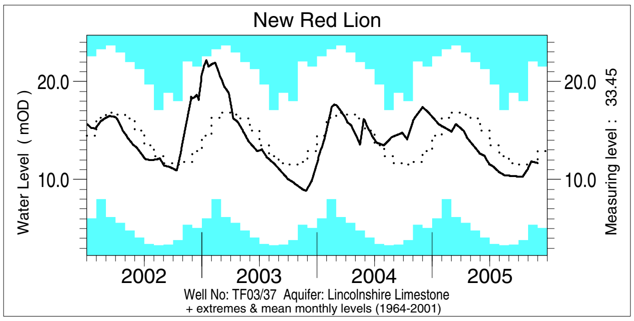






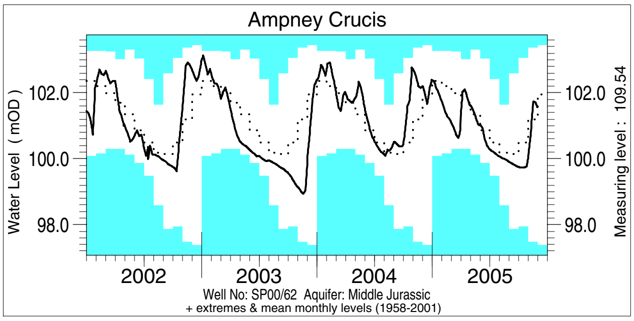


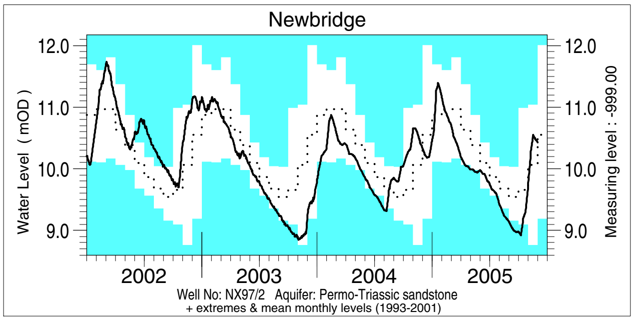


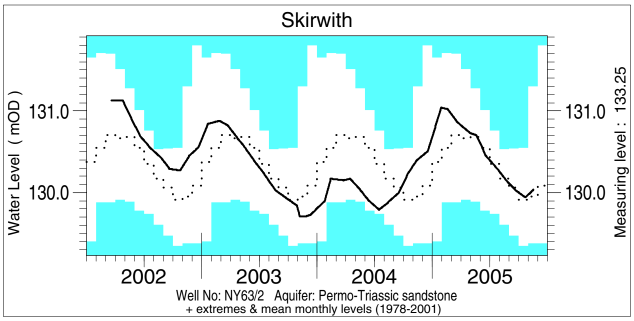


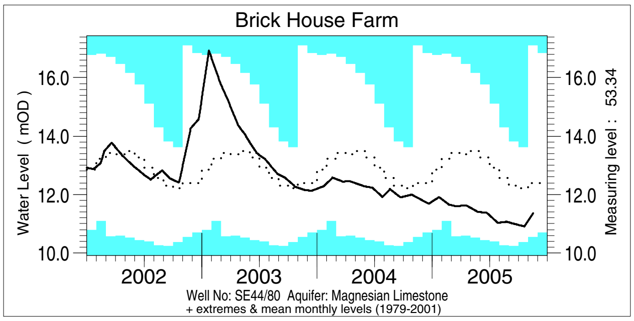
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

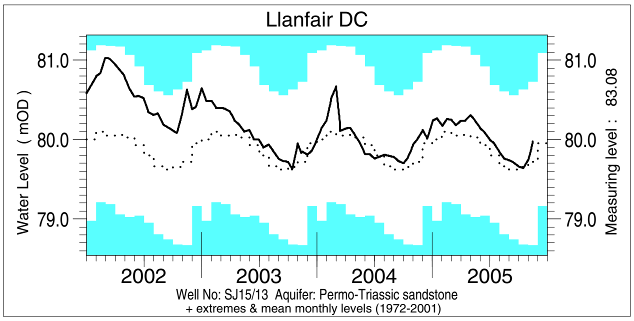
Groundwater . . . Groundwater

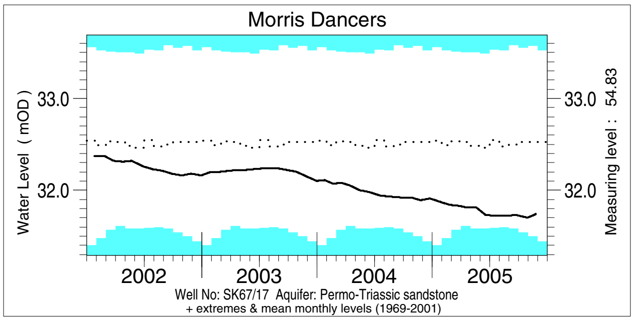


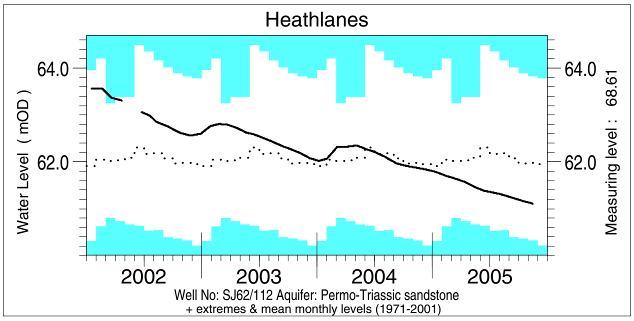


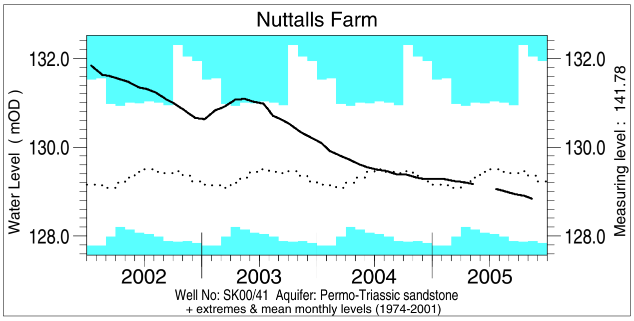


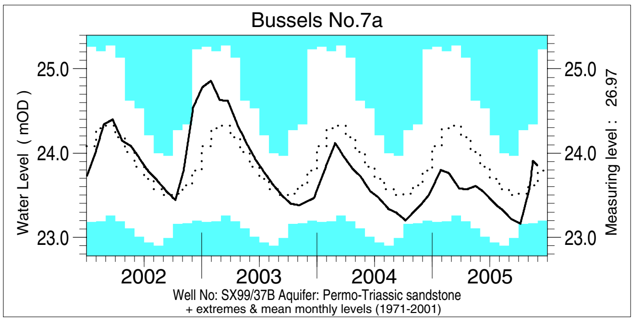


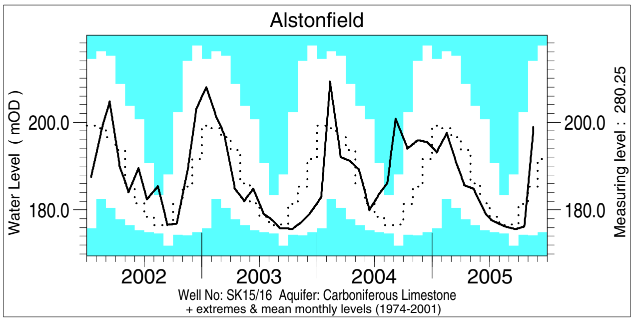








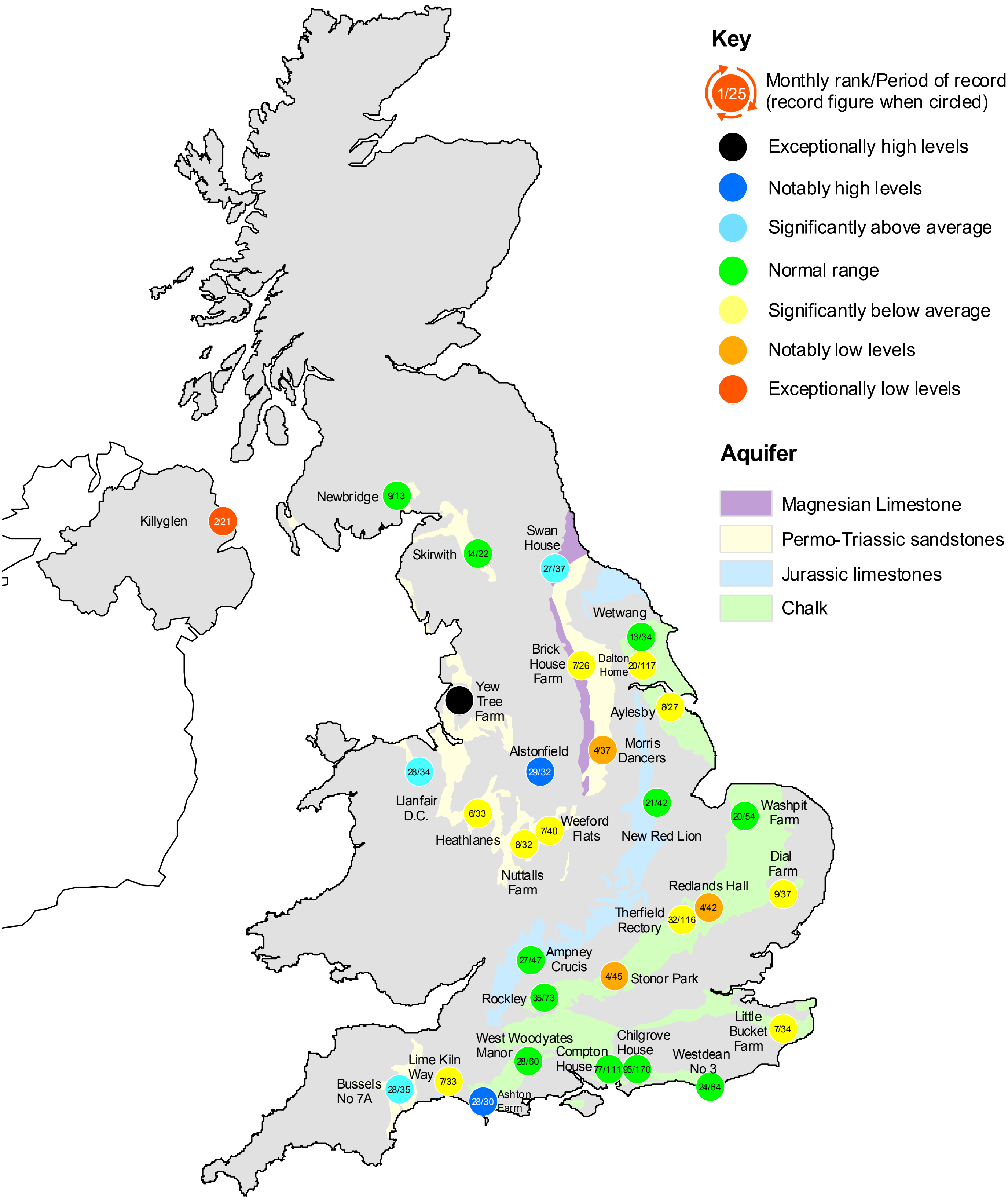




Groundwater levels November/ December 2005

Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.	Borehole	Level	Date	Nov. av.
Dalton Holme	12.88	15/11	14.81	Chilgrove House	44.34	30/11	46.59	Llanfair DC	79.98	15/11	79.67
Washpit Farm	42.99	05/12	43.30	Killyglen	114.40	30/11	115.98	Morris Dancers	31.74	25/11	32.37
Stonor Park	62.97	29/11	72.60	New Red Lion	11.68	30/11	12.26	Heathlanes	61.11	14/11	61.95
Dial Farm	25.17	14/11	25.45	Ampney Crucis	101.56	29/11	101.20	Nuttalls Farm	128.84	11/11	129.57
Rockley	130.43	29/11	131.61	Newbridge	10.43	30/11	10.06	Bussels No.7a	23.85	29/11	23.62
Little Bucket Farm	58.80	30/11	63.19	Skirwith	130.04	17/11	129.99	Alstonfield	198.88	16/11	186.48
West Woodyates	75.75	30/11	81.01	Brick House Farm	11.37	15/11	12.34				

Levels in metres above Ordnance Datum



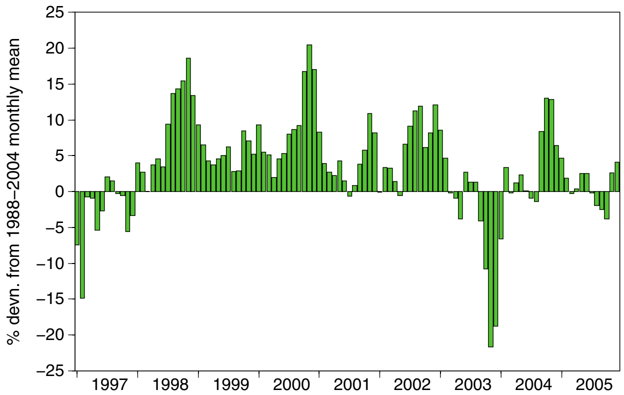
Groundwater levels - November 2005

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.

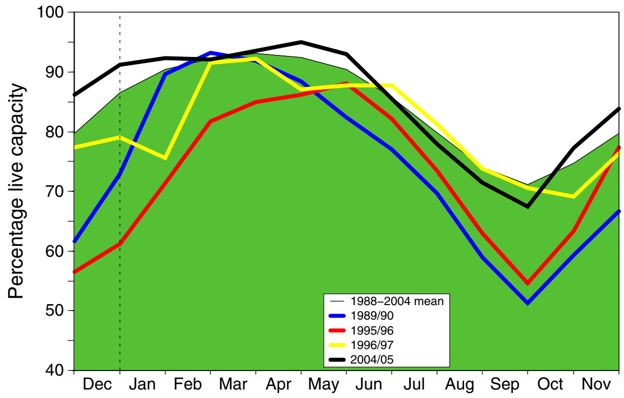
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

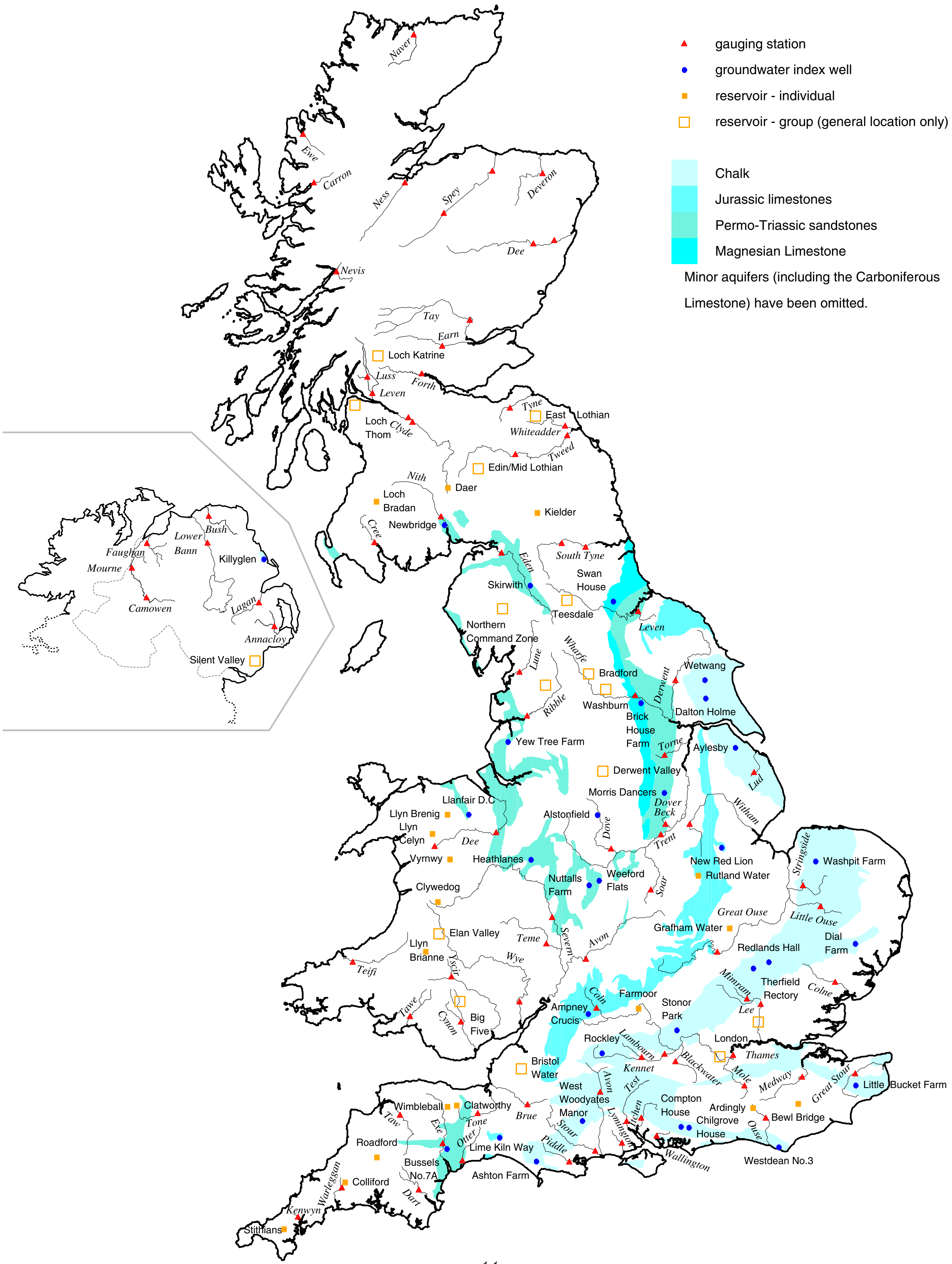
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir		Capacity (Ml)	2005 Aug	Sep	Oct	Nov	Dec	Avg. Dec	Min. Dec	Year* of min.
North West	N Command Zone	•	124929	57	49	52	74	**90**	73	44	1993
	Vyrnwy		55146	75	63	56	82	**88**	79	33	1995
Northumbrian	Teesdale	•	87936	77	69	73	85	**91**	75	39	1995
	Kielder		(199175)	(87)	(89)	(86)	(98)	**(91)**	(85)	(64)	2003
Severn Trent	Clywedog		44922	87	76	70	82	**82**	79	43	1995
	Derwent Valley	•	39525	72	60	55	75	**86**	76	9	1995
Yorkshire	Washburn	•	22035	62	57	57	69	**79**	69	16	1995
	Bradford supply	•	41407	70	57	55	65	**80**	78	20	1995
Anglian	Grafham		(55490)	(86)	(82)	(80)	(79)	**(81)**	(81)	(47)	1997
	Rutland		(116580)	(85)	(82)	(76)	(73)	**(73)**	(79)	(57)	1995
Thames	London	•	202406	80	74	65	65	**80**	79	52	1990
	Farmoor	•	13822	99	98	98	100	**99**	90	52	1990
Southern	Bewl		28170	61	54	44	39	**36**	65	34	1990
	Ardingly		4685	65	56	47	44	**50**	75	23	2003
Wessex	Clatworthy		5364	80	66	53	55	**92**	76	16	2003
	Bristol WW	•	(38666)	(65)	(55)	(47)	(47)	**(59)**	(65)	(27)	1990
South West	Colliford		28540	62	54	45	46	**51**	72	42	1995
	Roadford		34500	66	58	53	57	**63**	72	19	1995
	Wimbleball		21320	83	74	61	62	**73**	72	34	1995
	Stithians		5205	67	54	41	43	**64**	64	29	2001
Welsh	Celyn and Brenig	•	131155	86	78	77	87	**95**	84	50	1995
	Brianne		62140	93	88	82	99	**92**	95	72	1995
	Big Five	•	69762	73	62	54	75	**87**	79	49	1990
	Elan Valley	•	99106	75	67	64	83	**98**	92	47	1995
Scotland(E)	Edinburgh/Mid Lothian	•	97639	85	74	72	80	**94**	83	45	2003
	East Lothian	•	10206	90	78	66	72	**93**	85	38	2003
Scotland(W)	Loch Katrine	•	111363	73	67	81	95	**88**	91	66	2003
	Daer		22412	80	69	69	100	**98**	96	73	2003
	Loch Thom	•	11840	100	100	87	87	**100**	93	72	2003
Northern	Total+	•	67270	75	71	65	80	**85**	82	59	2003
Ireland	Silent Valley	•	20634	74	65	64	82	**92**	72	43	2001

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence - see footnote

Details of the individual reservoirs in each of the groupings listed above are available on request. The featured reservoirs may not be representative of the storage conditions across each region; this can be particularly important during droughts. The storage figures relate to the 1988-2005 period only (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 Department of the Environment (NI). 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 the Northern Ireland Water Service.

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.

*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.

Subscription

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

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

Tel.: 01491 838800
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E-mail: nwamail@ceh.ac.uk

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

NATURAL ENVIRONMENT RESEARCH COUNCIL

12/05