Hydrological Summary
for the United Kingdom

December 2005

General

December was largely dry but with wet interludes early and late in the month. Most of the drought-affected areas registered <80% of the average December rainfall. Spate conditions were common early in the month but the subsequent steep river flow recessions ensured that December runoff totals were generally well below average – contributing to depressed long-term accumulations over wide areas. Nonetheless, overall reservoir stocks for England and Wales are very close to the early January average and generally above average in most of Scotland and Northern Ireland. Importantly however, stocks are depressed in parts of southern England (the lowest on record for the turn of the year for Bewl Reservoir). Groundwater levels are rising in most major aquifers but recoveries are still awaited in much of eastern England (and parts of the Midlands). The water resources outlook is healthy across much of the UK but a combination of sustained low runoff, depressed groundwater levels and the narrow margin between resources and demand underlines the vulnerability of the South East to a continuation of drought conditions. Rainfall over the next 12 weeks will be very influential in determining the scale of water resources and ecological stress during 2006.

Rainfall

North-western Britain apart, synoptic patterns in December were again largely dominated by high pressure which limited the penetration of rain-bearing Atlantic frontal systems. The month began wet – rainfall totals of >30mm were common on the 1st/2nd (e.g.at Odiham and Wallingford). The rain was particularly welcome in the drought-affected areas but heralded a notably dry episode: many localities (e.g. Oxford) reported <1mm of rainfall over a three-week period. Unsettled conditions then returned, with significant snowfall (including 12cm at Aylesham, Kent) which caused severe transport disruption (in East Yorks especially). Above average December precipitation totals were largely confined to Northern Ireland and eastern Scotland. Large parts of eastern England registered <60% of average; the Lake District was dry also. Britain reported its 4th driest December since 1975. More significantly, long term rainfall deficiencies are substantial across much of England and Wales, and exceptional in the South East where rainfall over the last 14 months is the lowest (in this timeframe) since 1932/33 over wide areas. Deficiencies exceed 25% for much of the Southern Region with pockets of greater drought severity in parts of Sussex and Kent (e.g. Penhurst). Considering dry spells starting in any month, significantly larger 14-month deficiencies have occurred in the past (e.g. in 1975/76 and 1988/89) but a distinguishing feature of the current drought is the disproportionate contribution of the crucial winter months to the overall rainfall deficiency.

River Flows

December began with very healthy flows in most rivers draining impermeable catchments and flood alerts were common on the 2nd (e.g. in the South West); local flooding (e.g. in Belfast) and a few landslides were reported. Steep river flow recessions then became established and daily flows were approaching late-December minima by the final week in many responsive catchments (from the Aberdeenshire Dee to the Mole). Minor runoff recoveries were a feature of the final few days (snowmelt was a contributory factor in many areas) but December runoff totals were depressed over wide areas. The Nith registered its 2nd lowest December runoff in 42 years and many rivers reported their lowest since 1995 or 1996. A more appropriate measure of the drought's hydrological impact is provided by the runoff totals for 2005. The Jan-Dec total for the Sussex Ouse is, marginally, the lowest for any 12-month accumulation in a series from 1965 and, for many southern catchments, 2005 ranks among the three lowest annual totals on record. December flows were particularly meagre in many Chalk rivers – the 3rd lowest in a 52-yr record for the Mimram – and the associated decline in baseflows has been accompanied by a substantial contraction in the stream network and consequent (temporary) loss of aquatic habitat.

Groundwater

December rainfall was considerably below average in most aquifer outcrop areas and residual soil moisture deficits reduced its effectiveness in many eastern areas. However, the limited precipitation was mostly moderate-intensity and associated with slow-moving frontal systems – ideal for infiltration and belated seasonal recoveries in parts of the Chalk were initiated. Brisk groundwater level increases were reported from some southern Chalk outcrops (e.g. West Woodyates) but, as yet, there has been no appreciable upturn in the Yorkshire Wolds, Norfolk Chalk or the Chilterns where levels at Stonor are close to long term minima. Overall storage in the Chalk is very substantially below the early winter average but considerably healthier than in late-1991 or late-1996. Seasonal recoveries in the limestone aquifers have been erratic but levels were mostly in the normal range for December (the Magnesian Limestone in Yorkshire is an exception). Levels in the Permo-Triassic sandstones exhibit wide spatial variability, reflecting both rainfall patterns and aquifer characteristics (many aquifer units respond very slowly). Levels in most western outcrops are in the normal range but, after modest recharge in successive winters, Morris Dancers reported its 2nd lowest Dec. level on record and Weeford Flats remains dry. The Jan-Mar period is normally the most productive for recharge to much of the drought-affected region – in the absence of above average rainfall over the next three months there is a high likelihood of exceptionally depressed groundwater levels by the autumn in parts of the English Lowlands.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . .

Met Office

Rainfall accumulations and return period estimates

Area	Rainfall	Dec 2005	Nov 05-Dec 05	RP	Apr 05-Dec 05	RP	Jan 05-Dec 05	RP	Nov 04-Dec 05	RP
England & Wales	**mm**	**71**	**159**		**669**		**834**		**954**	
	%	**75**	**85**	**2-5**	**98**	**2-5**	**91**	**2-5**	**86**	**5-10**
North West	mm	**70**	193		878		1141		1355	
	%	**56**	77	2-5	95	2-5	94	2-5	92	2-5
Northumbrian	mm	**52**	146		699		932		1026	
	%	**63**	87	2-5	107	2-5	108	2-5	99	2-5
Severn Trent	mm	**52**	122		552		687		774	
	%	**67**	81	2-5	95	2-5	89	2-5	84	5-10
Yorkshire	mm	**47**	130		617		790		877	
	%	**57**	79	2-5	98	2-5	95	2-5	88	5-10
Anglian	mm	**34**	74		445		545		614	
	%	**61**	65	5-10	95	2-5	90	2-5	86	5-10
Thames	mm	**59**	111		459		560		646	
	%	**82**	81	2-5	86	2-5	80	10-15	77	15-25
Southern	mm	**65**	114		488		606		703	
	%	**79**	68	5-10	83	5-10	77	15-25	74	25-40
Wessex	mm	**86**	161		610		752		861	
	%	**91**	90	2-5	97	2-5	88	2-5	83	5-10
South West	mm	**132**	269		884		1092		1258	
	%	**94**	100	<2	104	2-5	92	2-5	86	5-10
Welsh	mm	**117**	277		974		1237		1450	
	%	**75**	92	2-5	98	2-5	92	2-5	88	5-10
Scotland	**mm**	**97**	**268**		**1115**		**1578**		**1891**	
	%	**62**	**86**	**2-5**	**103**	**2-5**	**107**	**2-5**	**106**	**2-5**
Highland	mm	**119**	361		1365		2001		2463	
	%	**61**	92	2-5	107	2-5	115	5-15	116	10-20
North East	mm	**78**	225		790		1084		1239	
	%	**80**	112	2-5	102	2-5	105	2-5	101	2-5
Tay	mm	**81**	230		963		1358		1542	
	%	**61**	88	2-5	103	2-5	105	2-5	99	2-5
Forth	mm	**66**	166		826		1200		1377	
	%	**58**	72	5-10	98	2-5	105	2-5	100	<2
Tweed	mm	**60**	154		761		1038		1150	
	%	**62**	80	2-5	101	2-5	103	2-5	96	2-5
Solway	mm	**87**	219		1044		1399		1646	
	%	**58**	74	5-10	98	2-5	97	2-5	95	2-5
Clyde	mm	**112**	266		1262		1770		2165	
	%	**61**	72	5-10	98	2-5	101	2-5	102	2-5
Northern Ireland	**mm**	**108**	**187**		**798**		**1070**		**1238**	
	%	**98**	**86**	**2-5**	**98**	**2-5**	**97**	**2-5**	**94**	**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 August 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

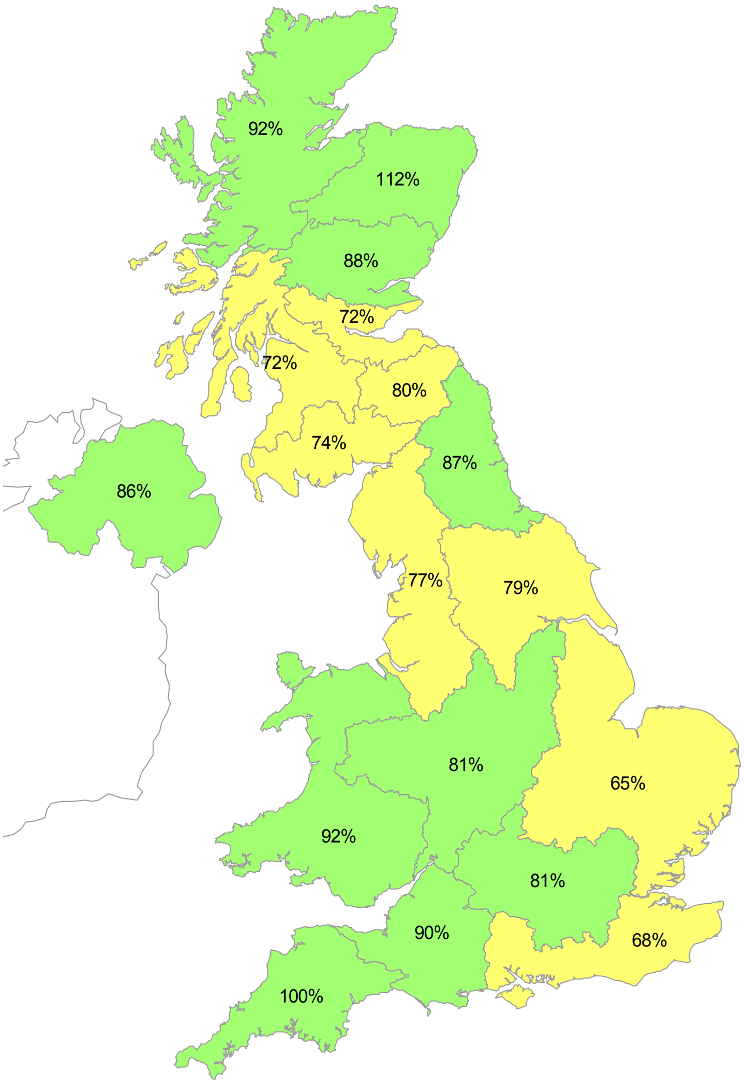
Above average

Normal range

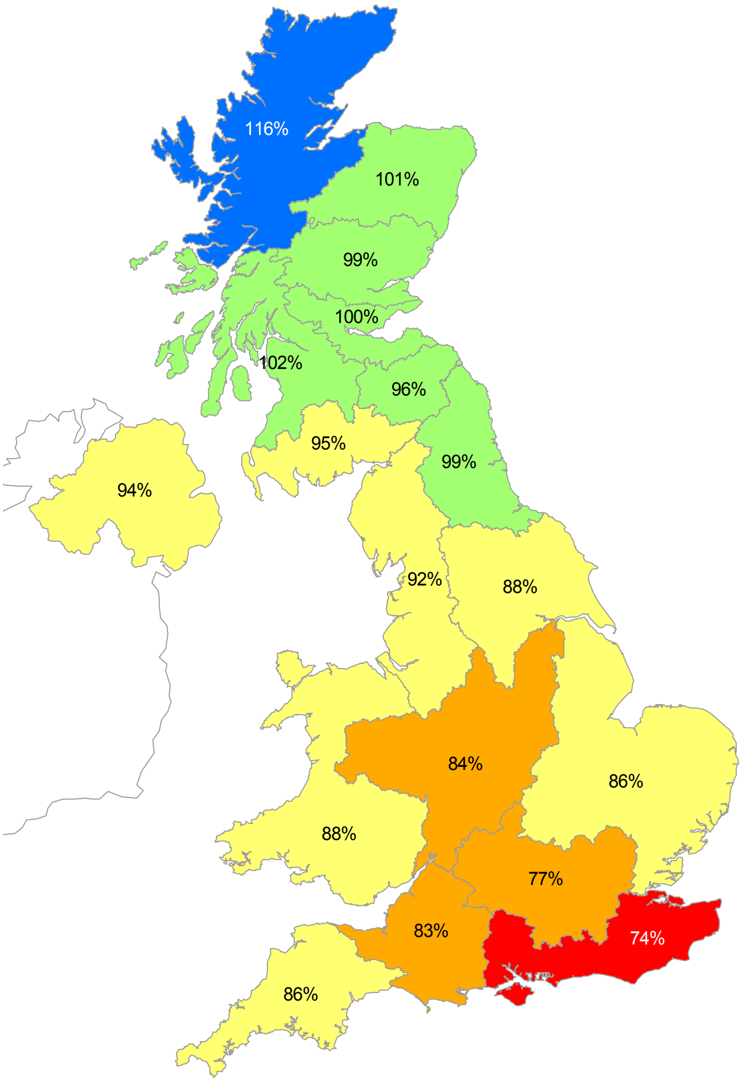
Below average

Substantially below average

Exceptionally low rainfall



November 2005 - December 2005



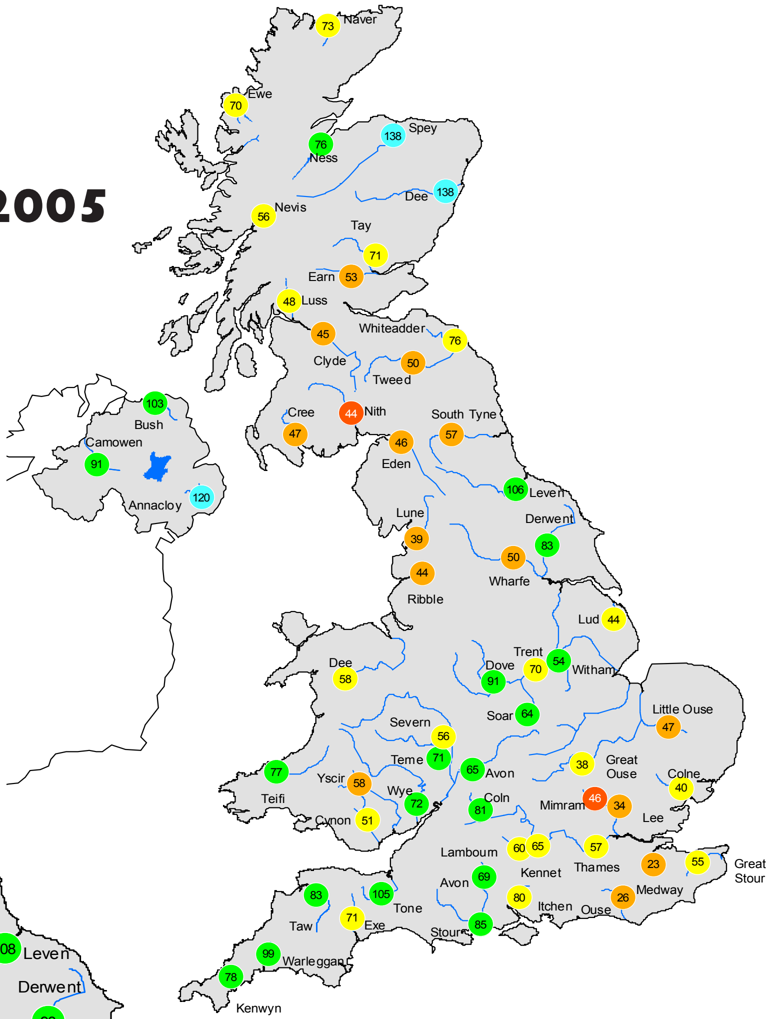
November 2004 - December 2005

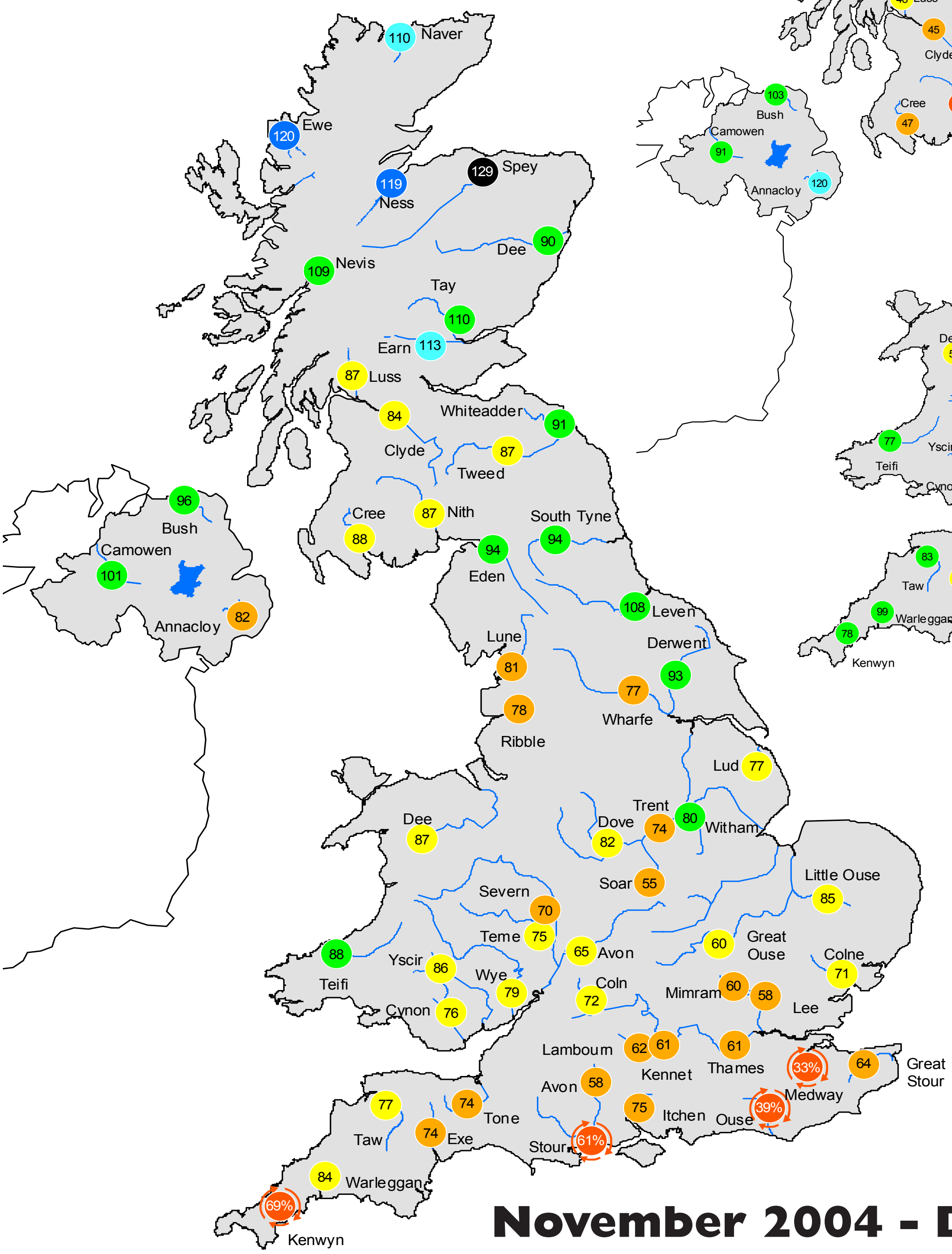
Rainfall accumulation maps

For most of the UK the combined November-December rainfall was considerably below average, for the second successive year in much of England and Wales. For the Southern Region, only in 1988-89 have successive Nov-Dec periods produced lower combined rainfall total since 1932-33. The 14-month rainfall map confirms both the sustained exaggeration in the north-west to south-east rainfall gradient across the UK and the focus of the drought in the South East.

River flow . . . River flow . . .

December 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

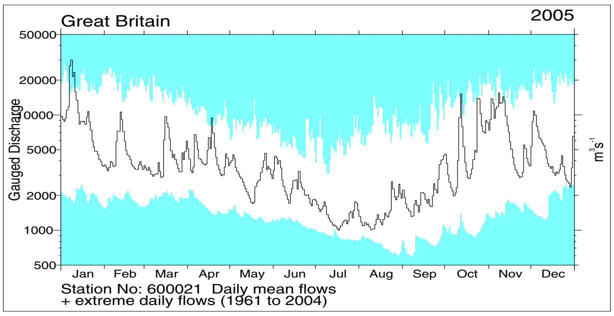
*Based on ranking of the monthly flow**

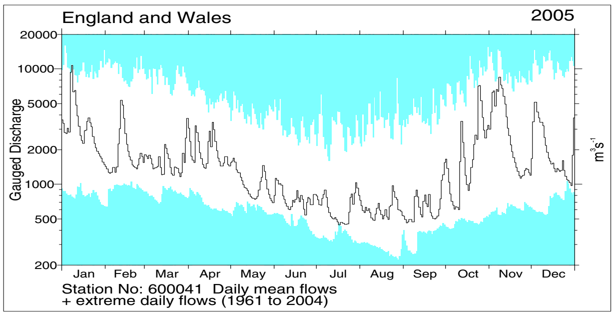
November 2004 - December 2005

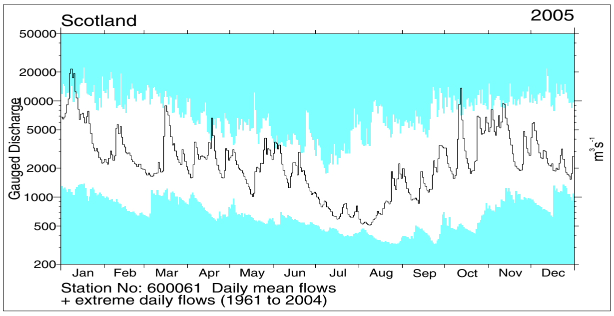
River flows

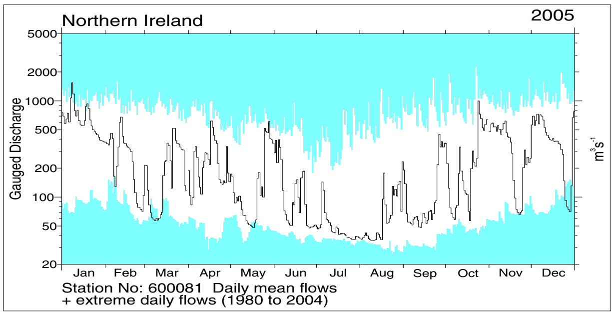
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

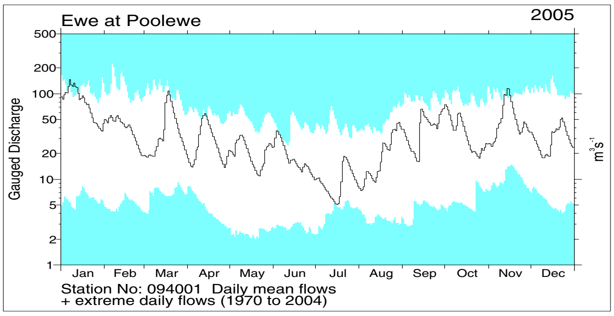
River flow . . . River flow . . .

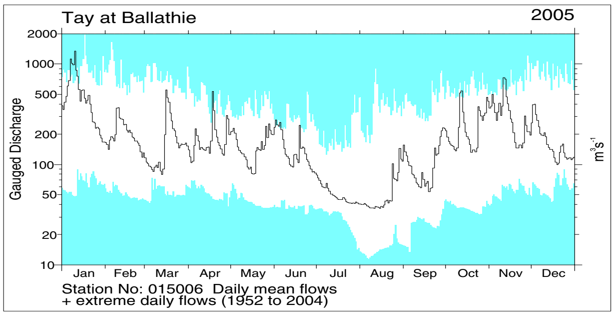


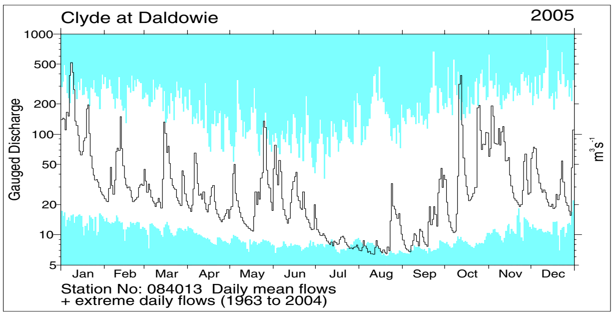


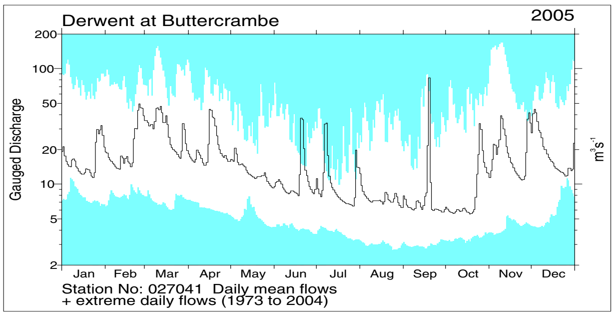


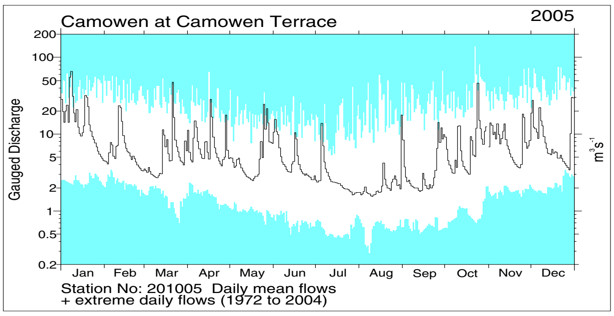


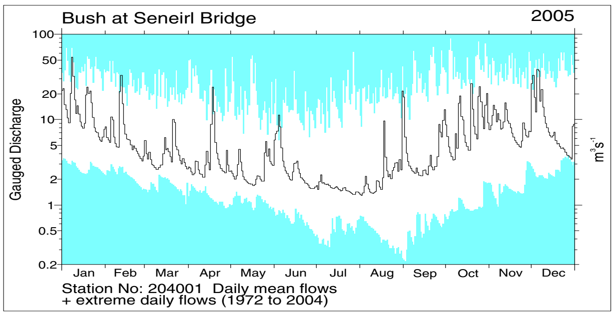








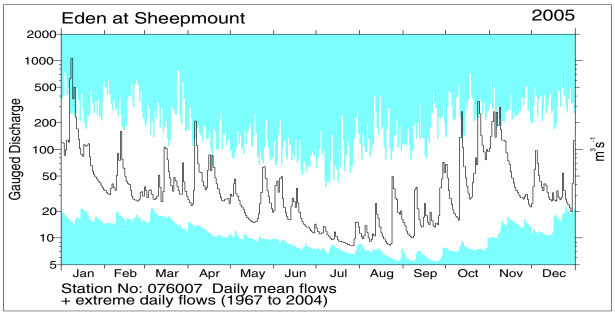


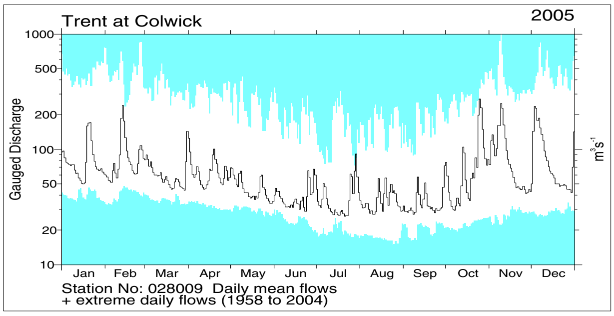


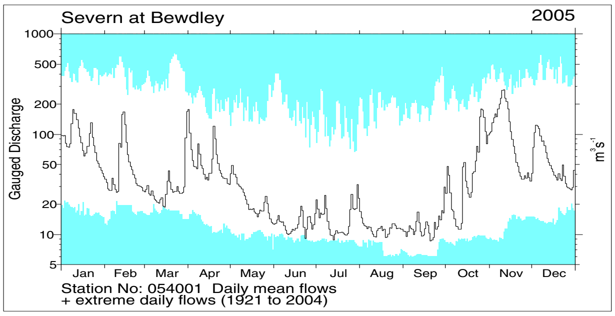
River flow hydrographs

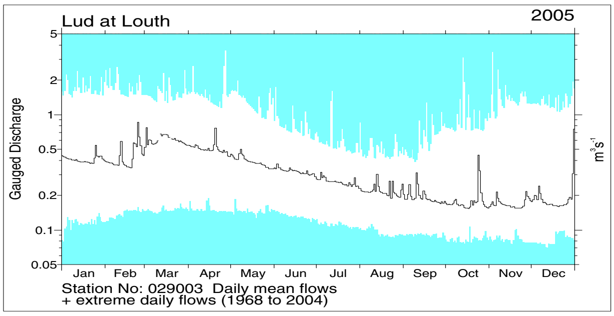
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to January 2005 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

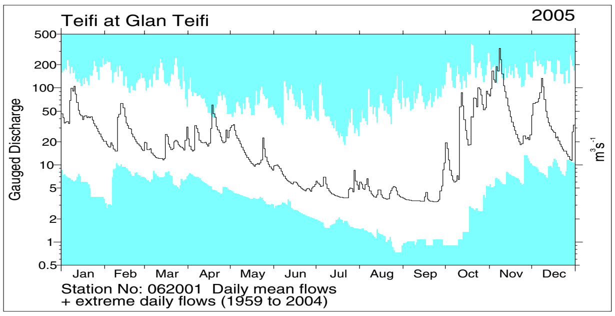
River flow . . . River flow . . .

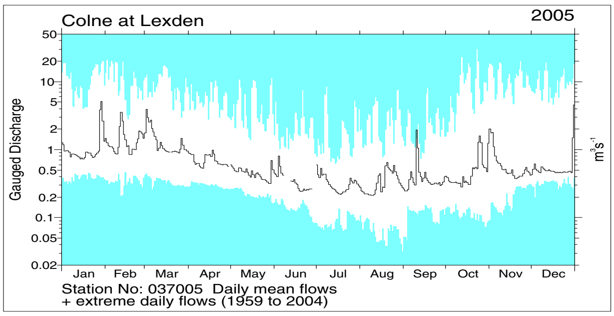


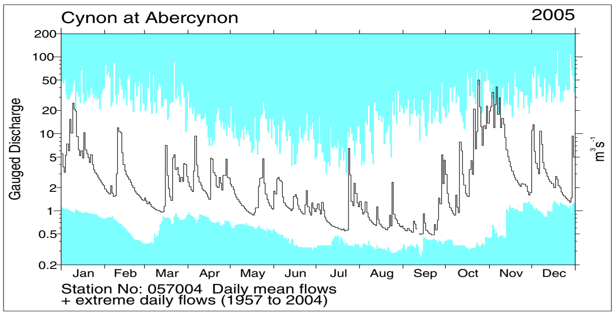


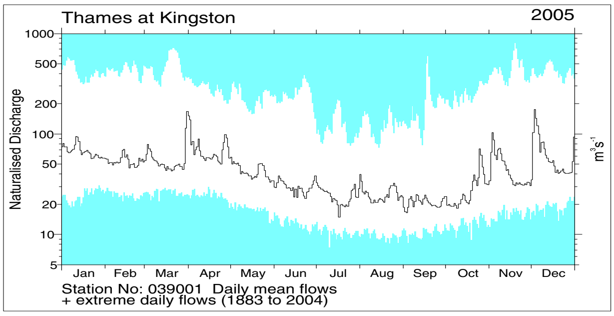


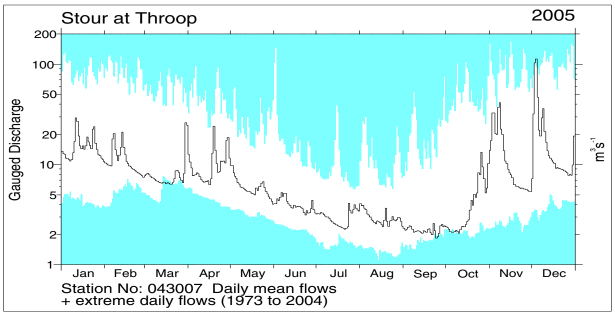


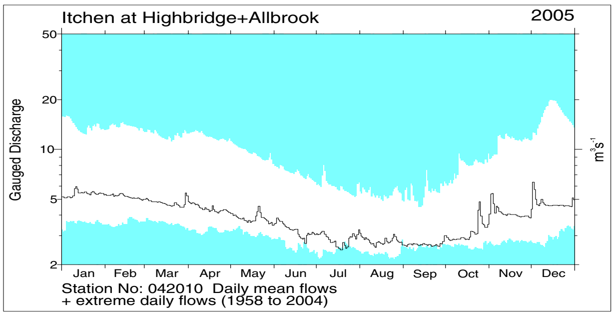












Notable runoff accumulations (a) July - Dec 2005, (b) Jan 2005 - Dec 2005

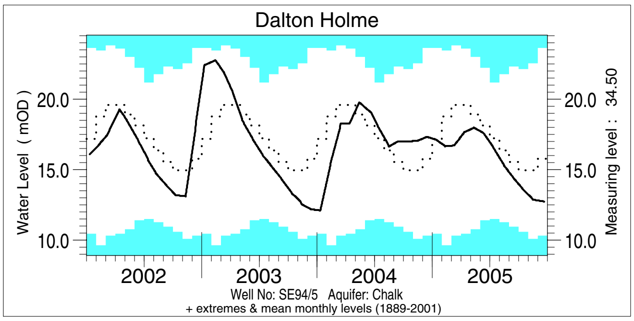
a)

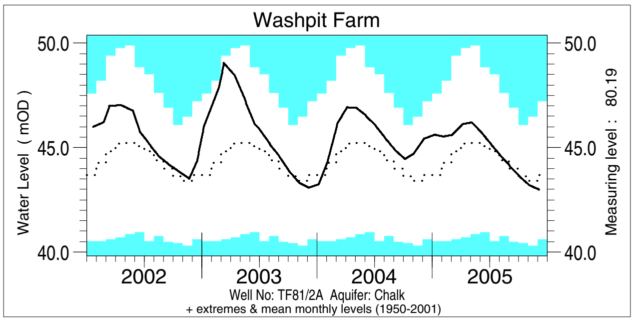
River	%lta	Rank
Forth	73	4/25
Wharfe	70	5/50
Mimram	52	4/52
Lambourn	64	4/43
Test	68	3/48
Ribble	64	5/46
Cree	69	4/42

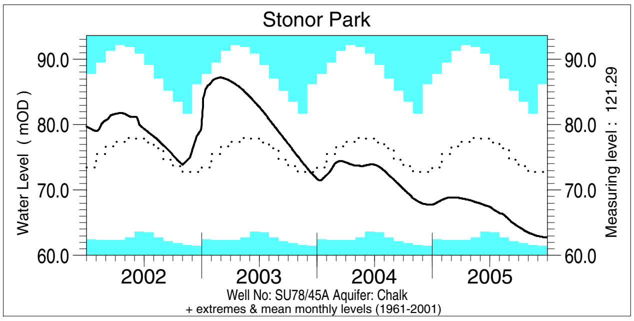
b)

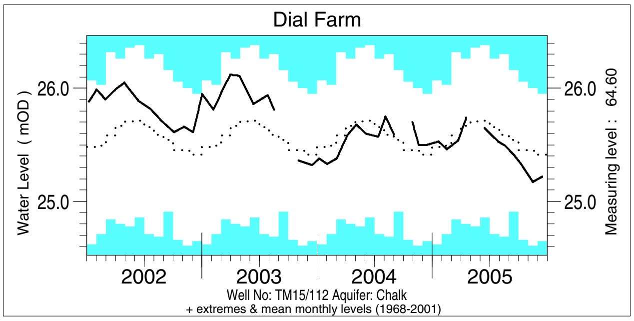
River	%lta	Rank	River	%lta	Rank
Ness	121	29/33	Ouse (Gold Bridge)	40	1/40
Spey (Boat o'Brig)	132	52/53	Wallington	44	2/50
Soar	56	3/34	Avon (Amesbury)	58	3/40
Thames(naturalised)	57	11/123	Stour (Throop)	61	2/33
Blackwater	69	3/53	Piddle	61	2/41
Mole	59	2/30	Ewe	119	31/35
Medway	33	1/42	Faughan	77	3/29

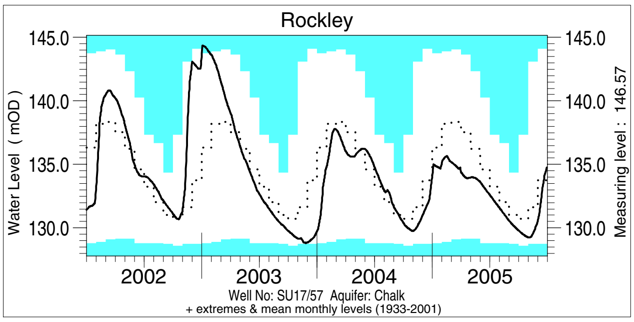
lta = long term average
Rank 1 = lowest on record

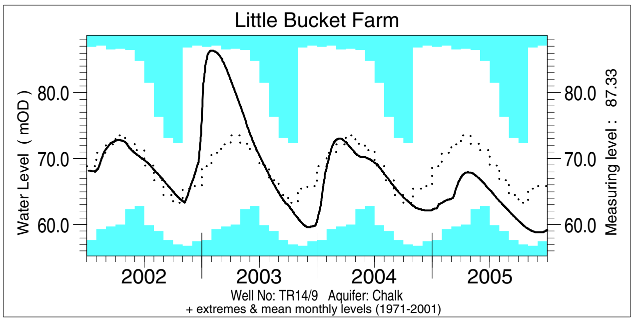


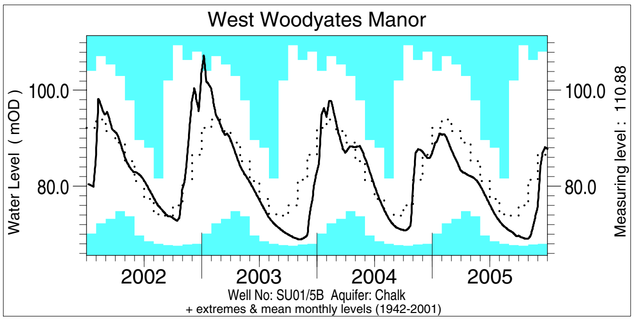


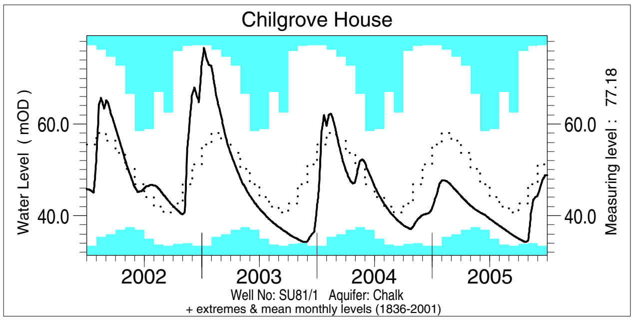


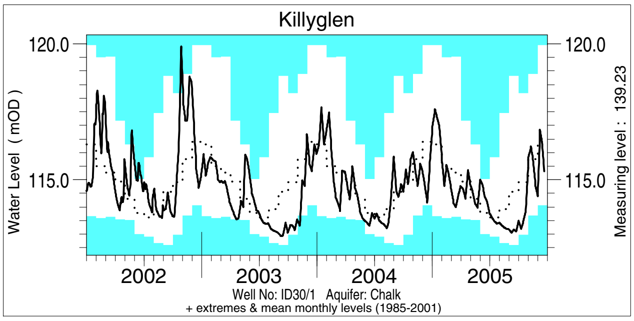


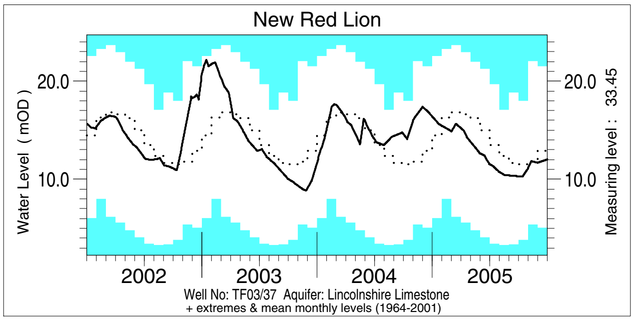






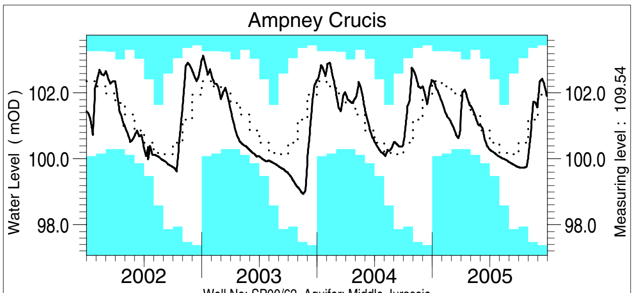




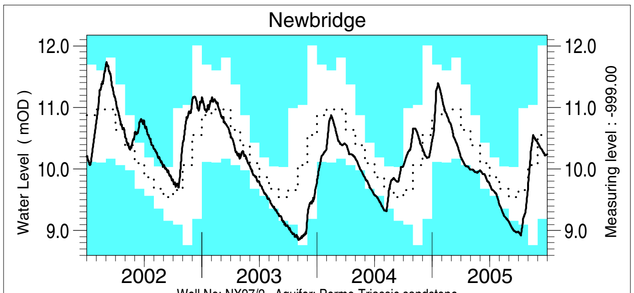


Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

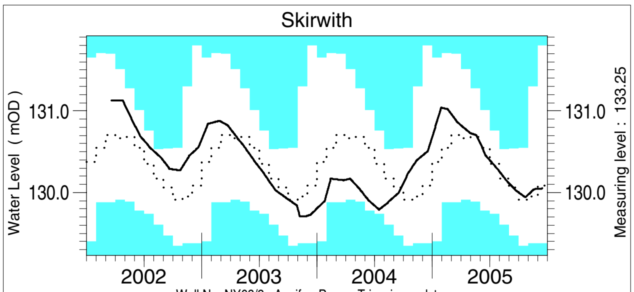
Groundwater . . . Groundwater



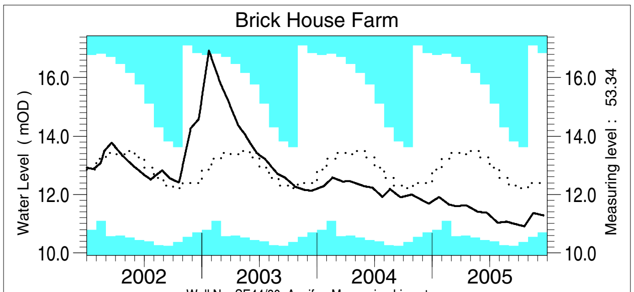
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-2001)



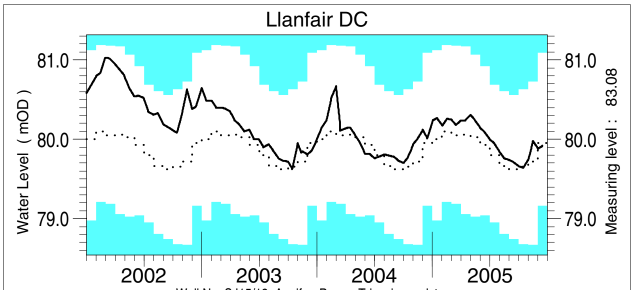
Well No: NX97/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1993-2001)



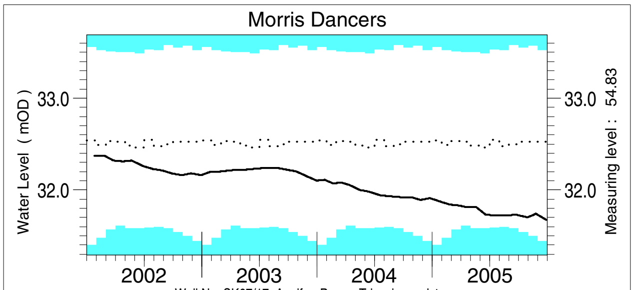
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-2001)



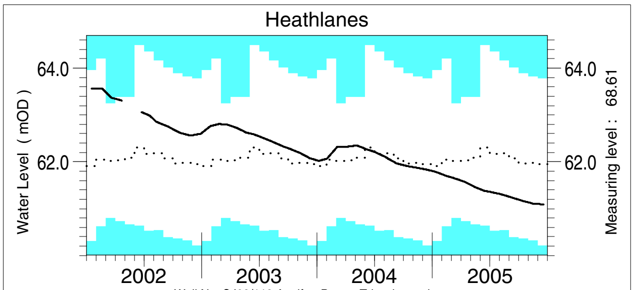
Well No: SE44/80 Aquifer: Magnesian Limestone
+ extremes & mean monthly levels (1979-2001)



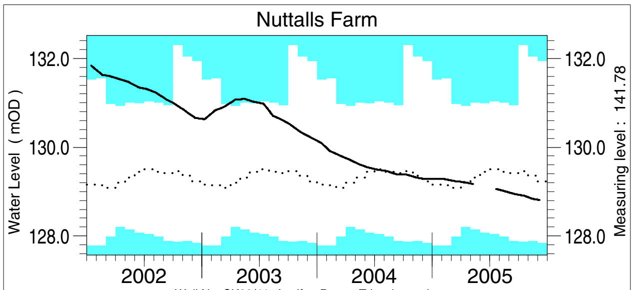
Well No: SJ15/13 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-2001)



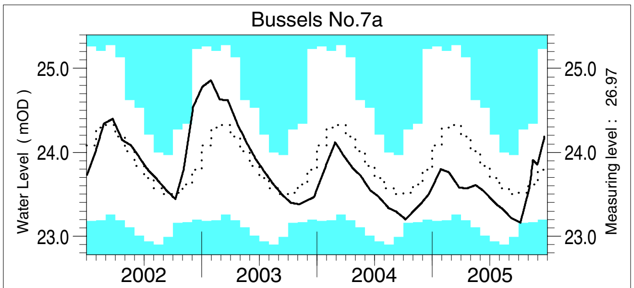
Well No: SK67/17 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1969-2001)



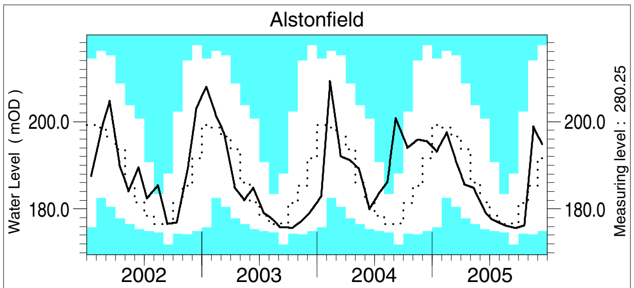
Well No: SJ62/112 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-2001)



Well No: SK00/41 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-2001)



Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-2001)



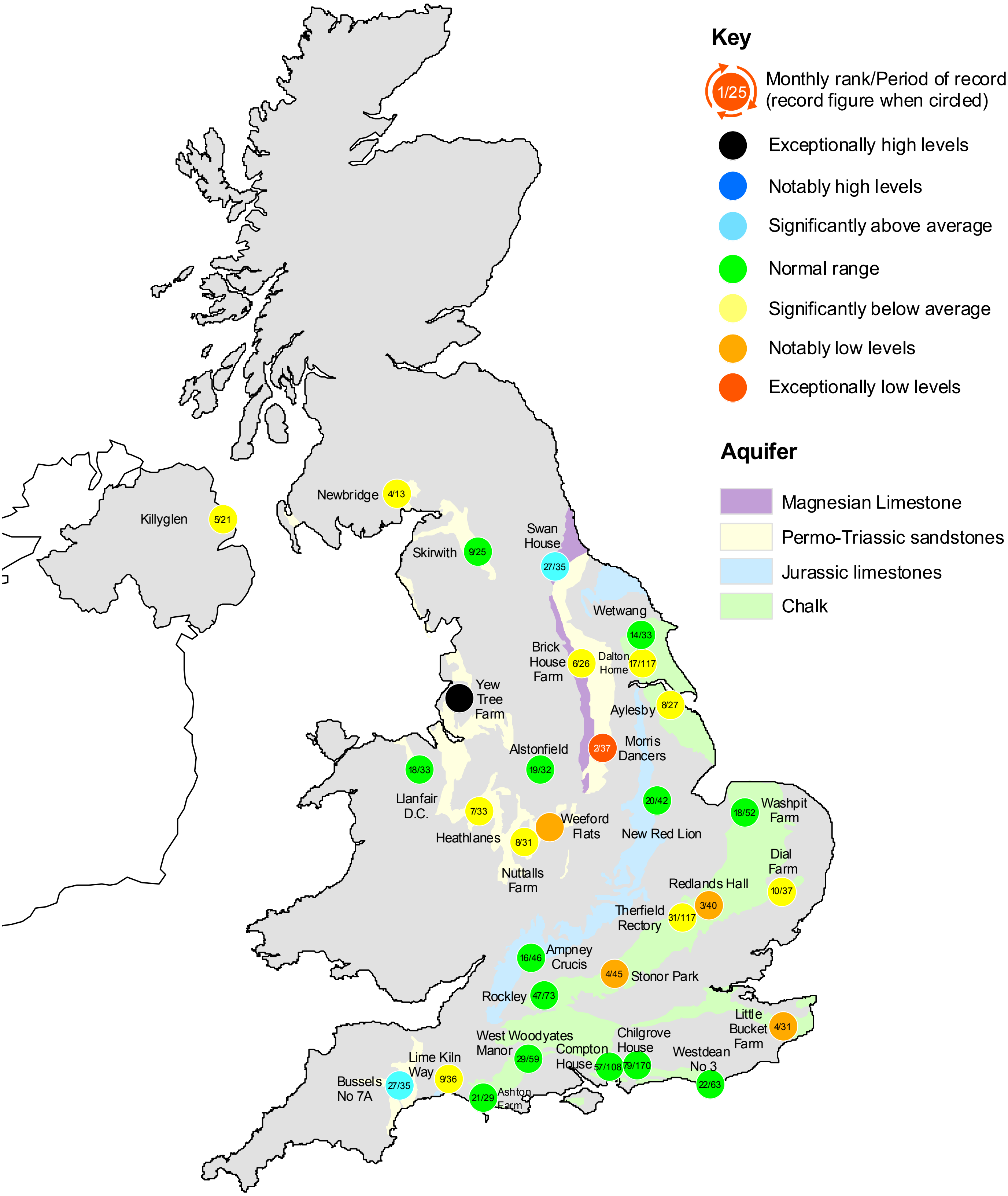
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-2001)

Groundwater levels December 2005/ January 2006

Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.	Borehole	Level	Date	Dec. av.
Dalton Holme	12.74	21/12	15.60	Chilgrove House	48.81	31/12	51.87	Llanfair DC	79.92	15/12	79.87
Washpit Farm	42.88	05/01	43.39	Killyglen	115.32	20/12	116.20	Morris Dancers	31.67	28/12	32.38
Stonor Park	62.80	03/01	72.75	New Red Lion	12.03	31/12	12.96	Heathlanes	61.09	19/12	61.94
Dial Farm	25.22	15/12	25.41	Ampney Crucis	101.84	03/01	101.91	Nuttalls Farm	128.81	06/12	129.50
Rockley	134.74	28/12	133.77	Newbridge	10.15	04/01	10.51	Bussels No.7a	24.19	21/12	23.83
Little Bucket Farm	59.22	31/12	64.71	Skirwith	130.05	15/12	130.23	Alstonfield	194.80	14/12	192.54
West Woodyates	87.75	31/12	86.76	Brick House Farm	11.28	19/12	12.46				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



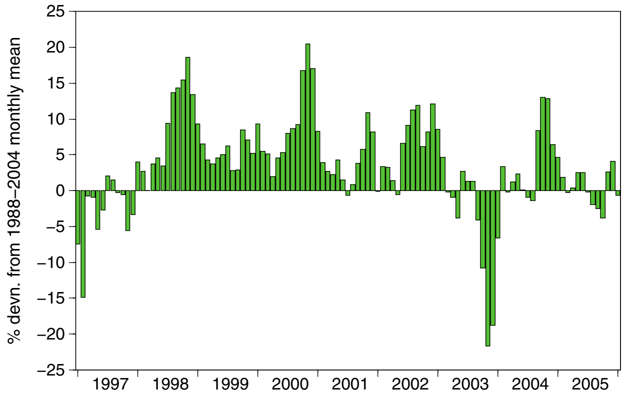
Groundwater levels - December 2005

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.

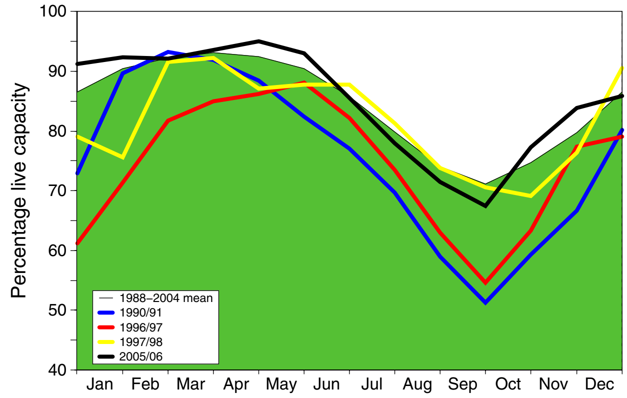
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

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.

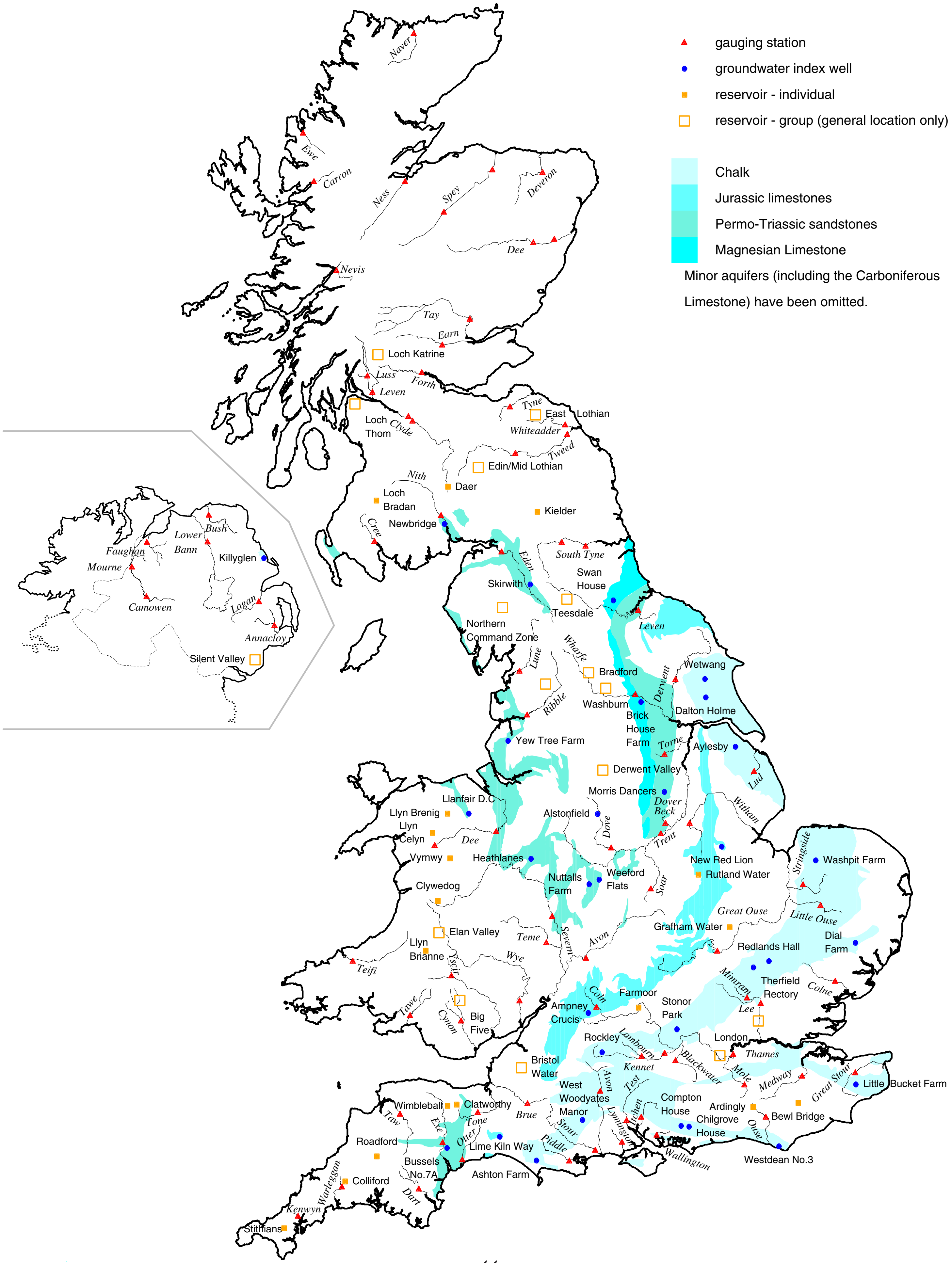
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2005 Sep	Oct	Nov	Dec	2006 Jan	Avg. Jan	Min. Jan	Year* of min.
North West	N Command Zone	• 124929	49	52	74	90	**82**	86	51	1996
	Vyrnwy	55146	63	56	82	88	**85**	90	35	1996
Northumbrian	Teesdale	• 87936	69	73	85	91	**93**	86	41	1996
	Kielder	(199175)	(89)	(86)	(98)	(91)	**(92)**	(91)	(70)	1990
Severn Trent	Clywedog	44922	76	70	82	82	**86**	84	54	1996
	Derwent Valley	• 39525	60	55	75	86	**92**	89	10	1996
Yorkshire	Washburn	• 22035	57	57	69	79	**92**	82	23	1996
	Bradford supply	• 41407	57	55	65	80	**81**	88	22	1996
Anglian	Grafham	(55490)	(82)	(80)	(79)	(81)	**(79)**	(83)	(57)	1998
	Rutland	(116580)	(82)	(76)	(73)	(73)	**(72)**	(82)	(60)	1991
Thames	London	• 202406	74	65	65	80	**87**	85	60	1991
	Farmoor	• 13822	98	98	100	99	**98**	91	71	1991
Southern	Bewl	28170	54	44	39	36	**34**	73	34	2006
	Ardingly	4685	56	47	44	50	**57**	84	41	2004
Wessex	Clatworthy	5364	66	53	55	92	**99**	90	54	2004
	Bristol WW	• (38666)	(55)	(47)	(47)	(59)	**(71)**	(76)	(40)	1991
South West	Colliford	28540	54	45	46	51	**56**	78	46	1996
	Roadford	34500	58	53	57	63	**68**	78	23	1996
	Wimbleball	21320	74	61	62	73	**77**	83	46	1996
	Stithians	5205	54	41	43	64	**74**	76	33	2002
Welsh	Celyn and Brenig	• 131155	78	77	87	95	**94**	92	54	1996
	Brianne	62140	88	82	99	92	**97**	97	76	1996
	Big Five	• 69762	62	54	75	87	**97**	88	67	1996
	Elan Valley	• 99106	67	64	83	98	**100**	96	56	1996
Scotland(E)	Edinburgh/Mid Lothian	• 97639	74	72	80	94	**93**	89	60	1999
	East Lothian	• 10206	78	66	72	93	**93**	94	48	1990
Scotland(W)	Loch Katrine	• 111363	67	81	95	88	**82**	90	80	2004
	Daer	22412	69	69	100	98	**97**	97	83	1996
	Loch Thom	• 11840	100	87	87	100	**100**	97	90	2004
Northern	Total+	• 67270	71	65	80	85	**92**	83	61	2002
Ireland	Silent Valley	• 20634	65	64	82	92	**99**	79	39	2002

() 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 1988-2006 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
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Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

Tel.: 01491 838800
Fax: 01491 692424
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

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01/06