

# Hydrological summary

## *for the United Kingdom*

### General

August began in very unsettled vein - intense storms triggered flooding (mostly localised) in many parts of the UK. Exceptional surface runoff was also a factor in a cryptosporidium outbreak which affected water supplies to parts of Glasgow early in the month. Thunderstorms continued but frontal rainfall was very limited over the last three weeks. This, together with high evaporative losses and increased water demand (e.g. for garden watering) resulted in the usual significant decline in reservoir stocks through August. Nonetheless, stocks in almost all index reservoirs remain considerably above the late summer average, and overall stocks for England and Wales were the third highest – for early September - in a record from 1988; stocks for Northern Ireland were the highest in a series from 1995. As usual in August groundwater replenishment was minimal but late-summer groundwater levels were around, or above, average throughout most major aquifers. The increase in soil moisture deficits over the last five weeks may delay the seasonal recovery in runoff and recharge rates in some areas but the general water resources outlook remains healthy.

### Rainfall

The August rainfall patterns were very uneven both spatially and through the month. Extremely wet weather at the end of July continued into August - in Yorkshire, raingauges at Fylingdales and Leeming registered 114.6 mm and 91.2 mm respectively for the rain-day ending on the 1<sup>st</sup>, and many exceptional 7-day totals (to the 5<sup>th</sup> August) were reported across much of eastern Britain particularly. In the 1-hour timeframe, Perth registered 30 mm on the 6<sup>th</sup> whilst Olney (Bucks) recorded a remarkable 63 mm on the 7<sup>th</sup> (estimated return period > 500 years). The 9<sup>th</sup>-12<sup>th</sup> was also very unsettled (but central Europe fared much worse – south of Dresden a rainfall total of 312 mm was recorded over 24 hours on the 12<sup>th</sup> – establishing a new daily record for Germany, and triggering devastating flooding over wide areas). A rare (during this summer) eastwards extension of the Azores high pressure cell produced very settled and warm conditions towards month end. Nonetheless, August rainfall totals in a few parts of eastern Britain (e.g. in Yorkshire) exceeded twice the long term average. Generally however August was relatively dry, notably so in parts of central southern England, central Wales and north-west Scotland where rainfall totals fell below 40% in some localities. Northern Ireland reported its driest August since 1995. Summer (Jun-Aug) rainfall was moderately above average for the UK as a whole but some of the driest catchments in eastern England exceeded the average for the sixth successive year. By contrast, many parts of Wales and the South-West had a relatively dry summer. However, for the year thus far - and over the 12-month timespan - regional rainfalls remain above, to well above, average.

### River Flow

August began with exceptionally high runoff rates (for the late summer) in many responsive western and northern rivers; the seasonally unusual flood threat was exacerbated by the frequency of intense storm events which overwhelmed local drainage systems. Particularly notable spates were recorded for rivers draining the Pennines and the North York Moors. The Wharfe exceeded its previous August maximum in a 47-year record on the 2<sup>nd</sup>; at Scarborough a caravan park was evacuated and North Yorkshire was afflicted by several further flood episodes during the next 10 days. Convictional

storms then generated severe local flooding in the South causing substantial transport disruption – on the 7<sup>th</sup> the rail network in London was badly affected. Thereafter, sustained recessions resulted in river flows falling significantly below average by month end across much of southern Britain. Relative to the monthly average, August runoff totals exhibited wide geographical contrasts. In some eastern rivers (including the Dee, Derwent and Trent) totals were close to long term maxima. By contrast, runoff was depressed in much of Wales and western Scotland – where the Carron reported its second lowest August runoff in a series from 1979. However, most longer term runoff totals (e.g. Jan-Aug) are above average but modest deficiencies remain in some eastern catchments (e.g. in the East Midlands).

### Groundwater

As is normal in August, aquifer recharge was very localised - generally where heavy storms coincided with outcrops with a thin soil cover. In broad terms the August rainfall favoured the Chalk and limestone outcrop areas in the east - but the rain served to moderate soil moisture deficits rather than arrest the seasonal recession in groundwater levels. August levels in the Chalk were well below corresponding levels in 2001 but still mostly above the monthly average. In most eastern outcrops levels are closely approaching the average after a period of two or more years of seasonally high levels; the same is true of most minor aquifers (e.g. the Suffolk Crag). In the slower-responding Permo-Triassic sandstones outcrops levels are also in sustained recession but, in many cases, (e.g. Llanfair DC) levels have only recently returned to pre-2000 maxima. Levels in most of the limestone aquifers are in the normal late-summer range but heavy rainfall triggered an early upturn at Alstonfield - to register a new August maximum in a 28-year record. Overall groundwater resources are healthy, but late-summer soil moisture deficits exhibited notable local variability – this, together with the autumn rainfall, will influence the date of onset of the seasonal recovery, and the length of the 2002/03 recharge season.

August 2002



**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	Aug 2002	Jun 02-Aug 02 RP		Mar 02-Aug 02 RP		Jan 02-Aug 02 RP		Sep 01-Aug 02 RP	
<b>England &amp; Wales</b>	<b>mm %</b>	<b>76 99</b>	<b>225 110</b>	<b>2-5</b>	<b>404 100</b>	<b>&lt;2</b>	<b>603 108</b>	<b>2-5</b>	<b>926 101</b>	<b>2-5</b>
North West	mm %	102 95	303 111	2-5	568 111	2-5	921 129	20-30	1373 114	5-10
Northumbrian	mm %	85 105	242 118	2-5	403 102	2-5	621 116	5-10	941 110	2-5
Severn Trent	mm %	56 84	183 102	2-5	335 95	2-5	507 106	2-5	760 101	2-5
Yorkshire	mm %	114 154	258 134	5-15	404 106	2-5	582 113	2-5	880 107	2-5
Anglian	mm %	57 103	177 114	2-5	301 102	2-5	400 105	2-5	638 107	2-5
Thames	mm %	42 72	169 105	2-5	336 104	2-5	491 113	2-5	738 107	2-5
Southern	mm %	40 70	163 102	2-5	335 102	2-5	513 111	2-5	801 103	2-5
Wessex	mm %	40 61	154 88	2-5	359 100	<2	563 110	2-5	820 98	2-5
South West	mm %	50 59	177 80	2-5	456 99	2-5	772 110	2-5	1116 95	2-5
Welsh	mm %	81 80	212 83	2-5	511 97	2-5	889 116	5-10	1366 104	2-5
<b>Scotland</b>	<b>mm %</b>	<b>87 74</b>	<b>342 115</b>	<b>2-5</b>	<b>662 113</b>	<b>5-10</b>	<b>1103 132</b>	<b>70-100</b>	<b>1711 119</b>	<b>20-30</b>
Highland	mm %	67 53	341 103	2-5	708 105	2-5	1253 126	30-40	1949 111	5-10
North East	mm %	97 111	309 137	10-20	488 113	2-5	713 119	5-15	1103 113	5-10
Tay	mm %	106 113	362 148	20-35	676 136	30-40	1097 149	>200	1529 124	20-35
Forth	mm %	105 111	341 143	20-30	614 132	20-35	956 144	>200	1312 118	10-20
Tweed	mm %	81 92	278 123	5-10	480 111	2-5	778 130	20-35	1101 113	5-10
Solway	mm %	115 96	371 127	5-10	721 126	10-20	1174 142	120-170	1662 117	5-15
Clyde	mm %	99 74	401 119	2-5	809 123	10-20	1350 140	150-250	1946 115	5-10
<b>Northern Ireland</b>	<b>mm %</b>	<b>56 61</b>	<b>272 119</b>	<b>2-5</b>	<b>571 126</b>	<b>10-20</b>	<b>858 134</b>	<b>30-50</b>	<b>1182 112</b>	<b>5-10</b>

RP = Return period

The monthly rainfall figures\* are copyright of The Met Office and may not be passed on to, or published by, any unauthorised person or organisation. All monthly totals since December 1998 are provisional (see page 12). 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. The return period estimates are based on tables provided by the Meteorological 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. 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



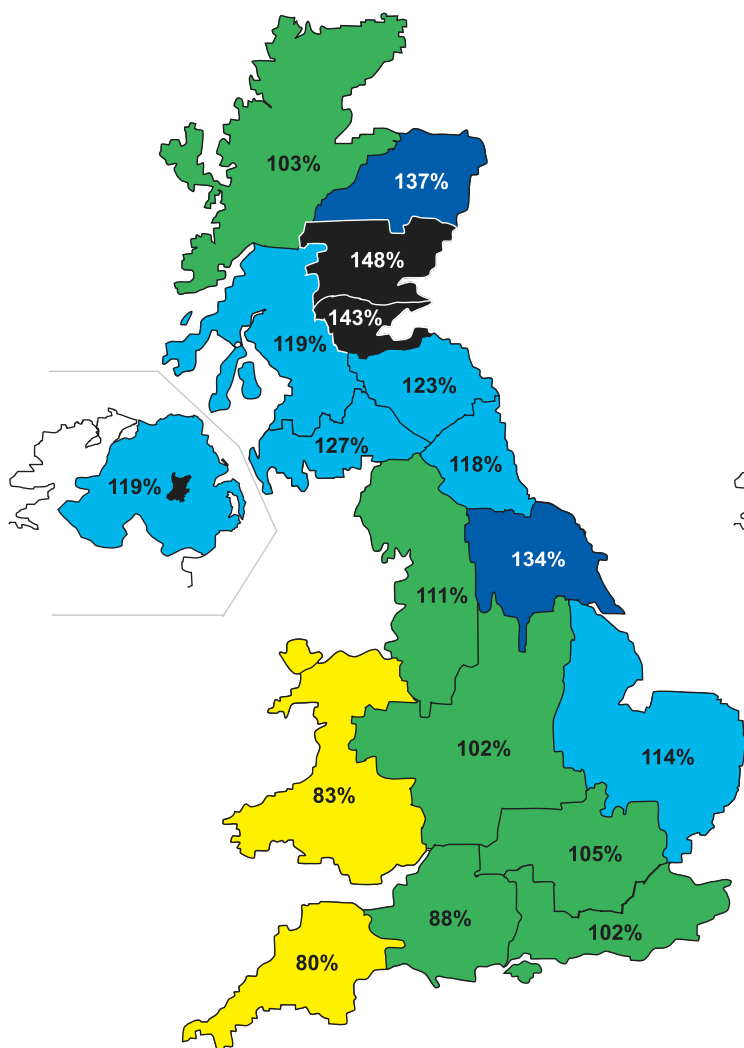
Below average



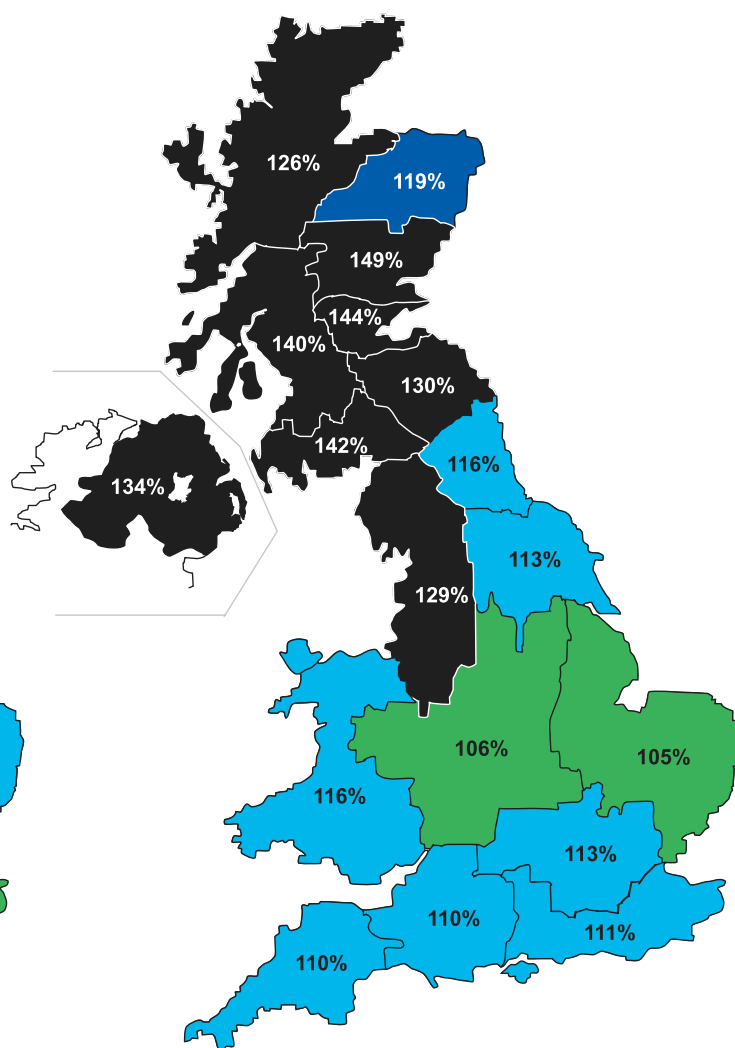
Substantially below average



Exceptionally low rainfall



**June 2002 - August 2002**

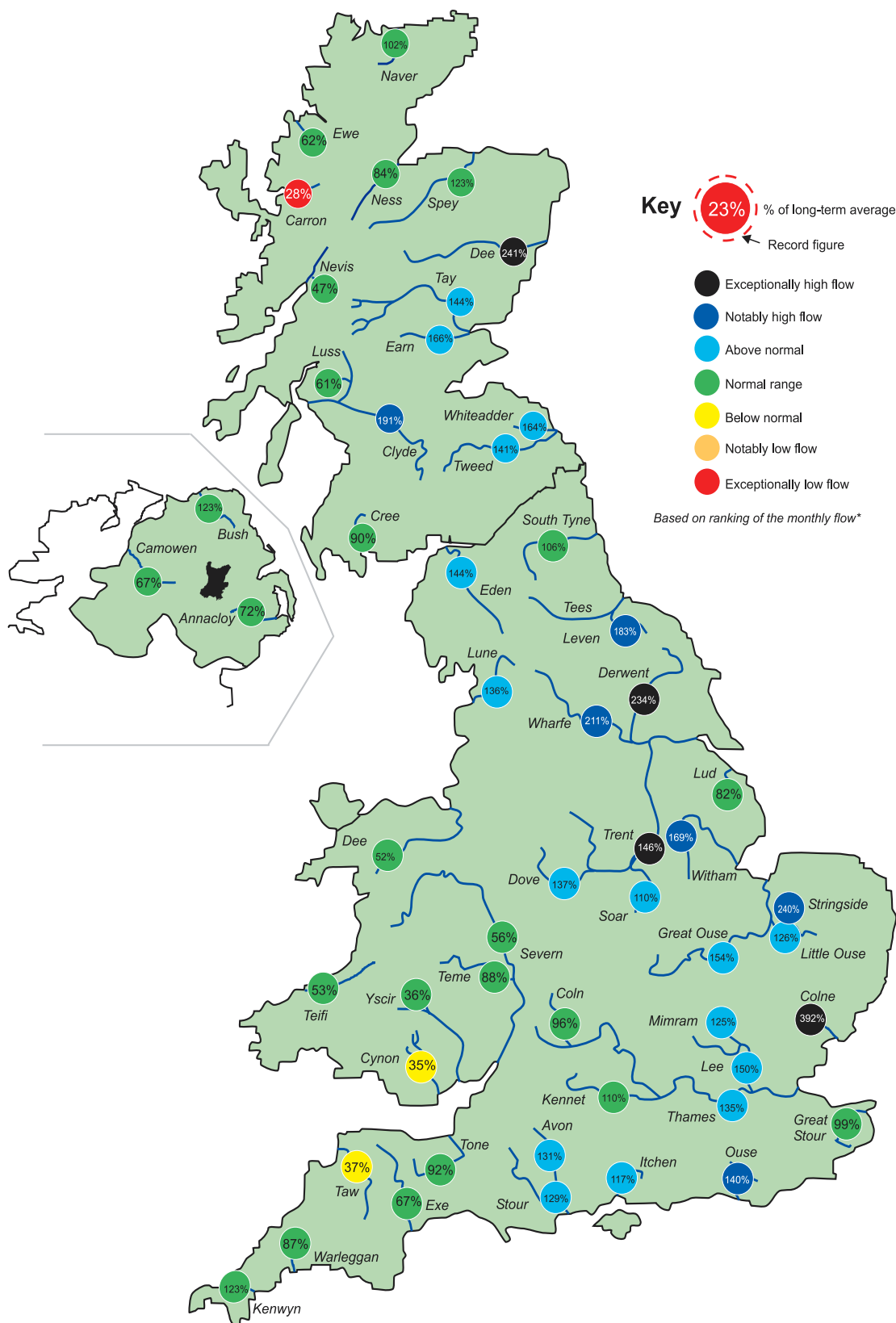


**January 2002 - August 2002**

## Rainfall accumulation maps

Regional rainfall totals for June-August period were mostly above average - Scotland had its second wettest summer since 1992 but parts of the South West had their lowest summer rainfall for seven years. Notwithstanding below average August rainfall, totals for January-August are exceptionally high for Scotland (provisionally the second highest in a series from 1869) and Northern Ireland (the highest in a record from 1900).

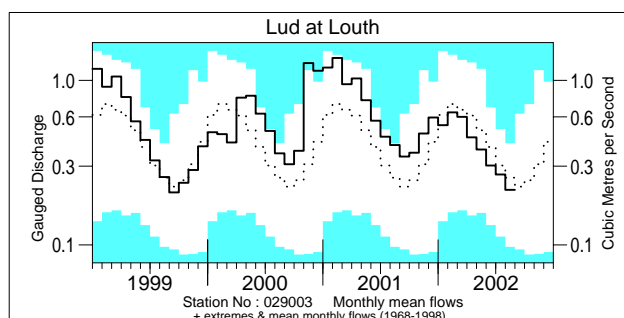
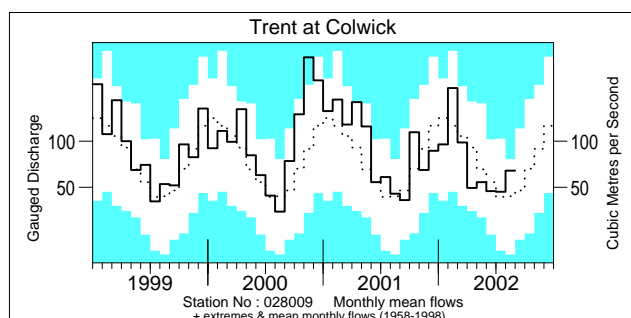
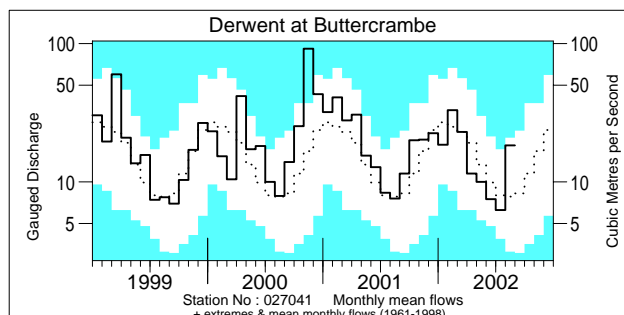
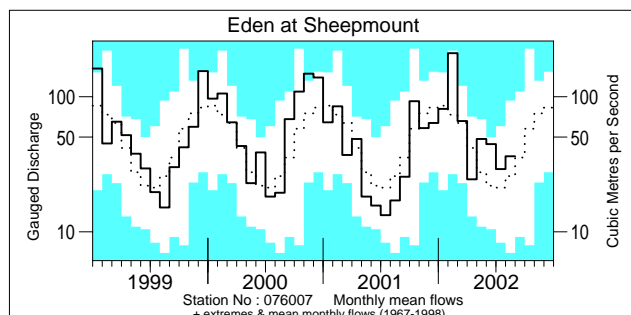
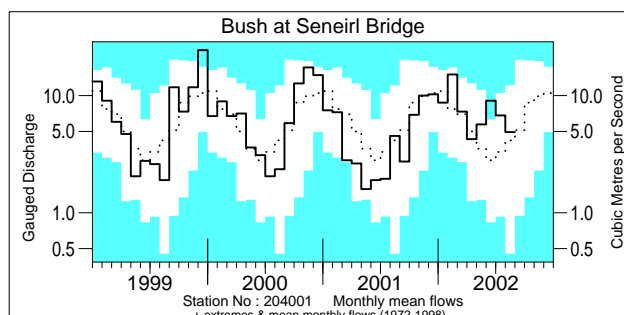
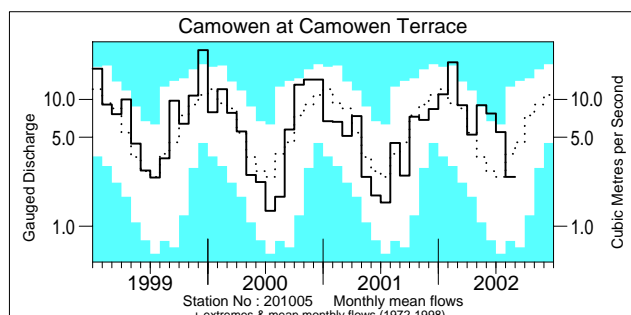
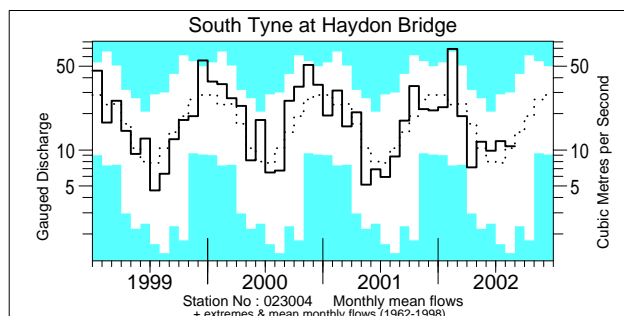
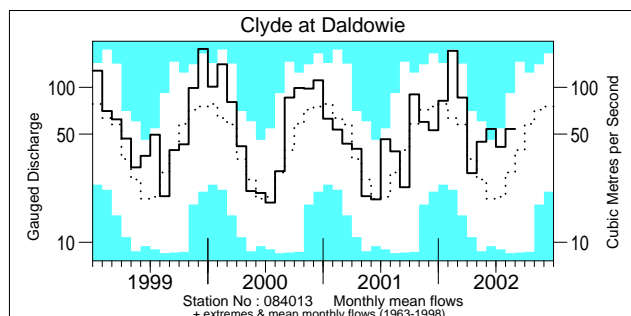
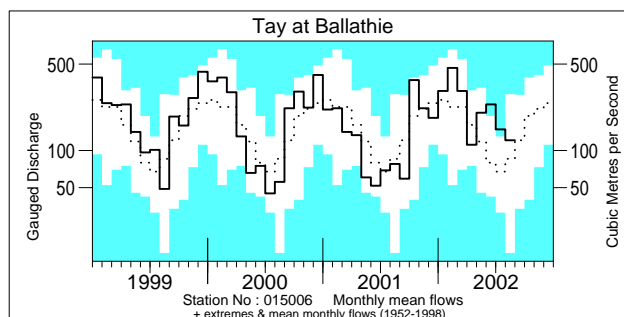
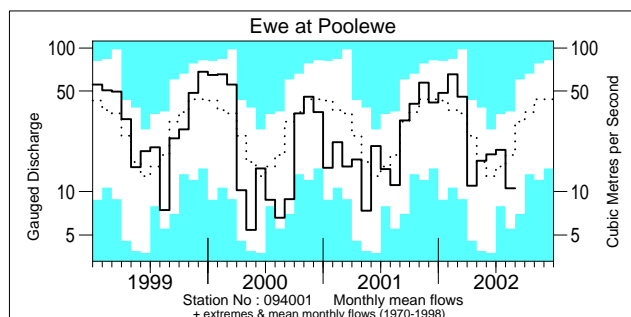
*River flow . . . River flow . . .*



## River flows - August 2002

\*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.

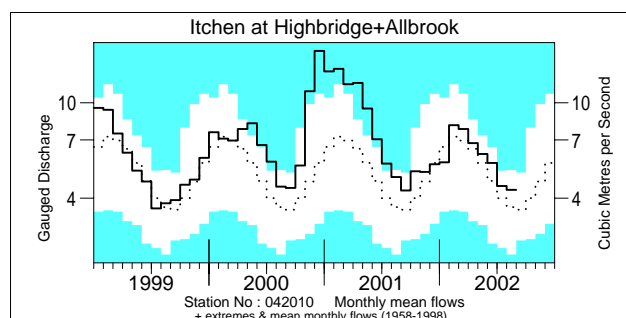
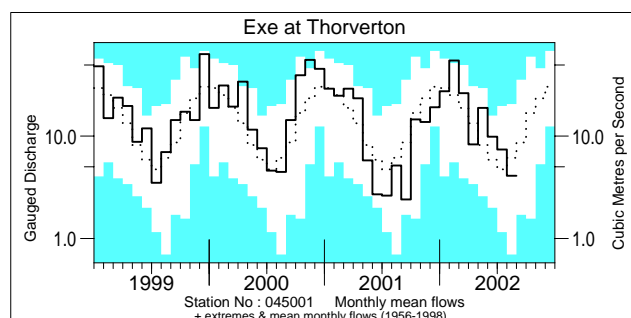
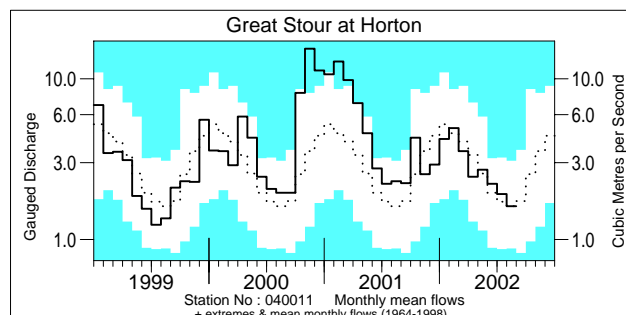
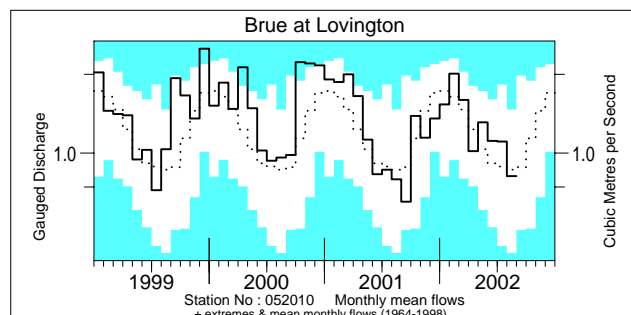
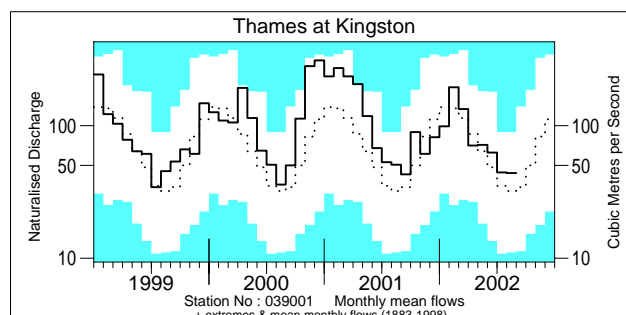
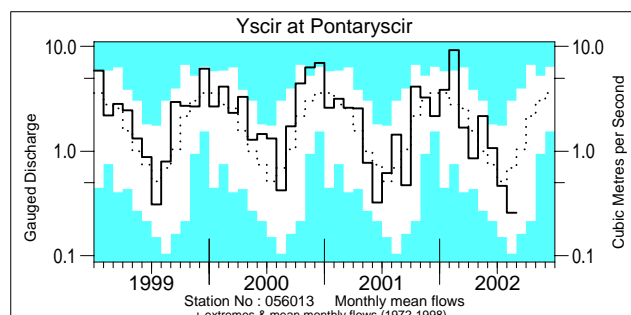
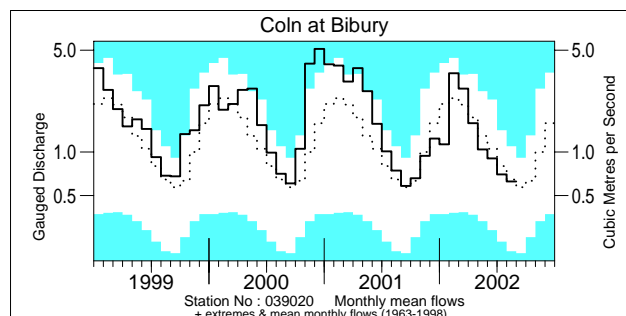
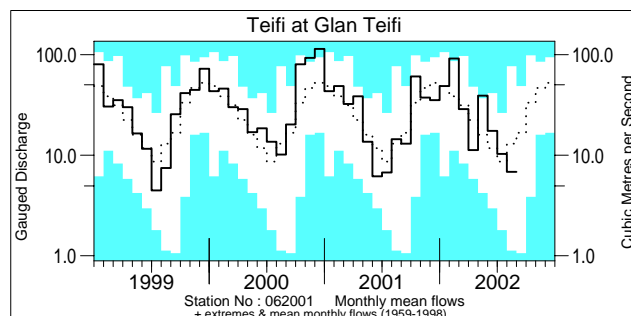
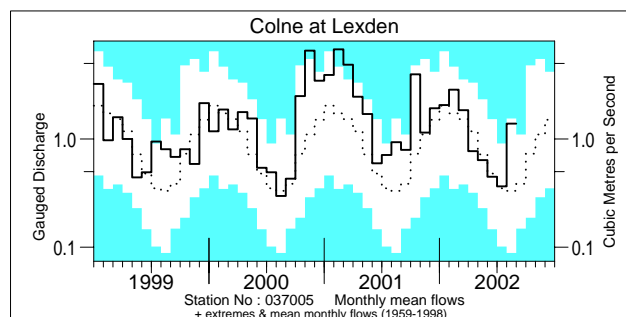
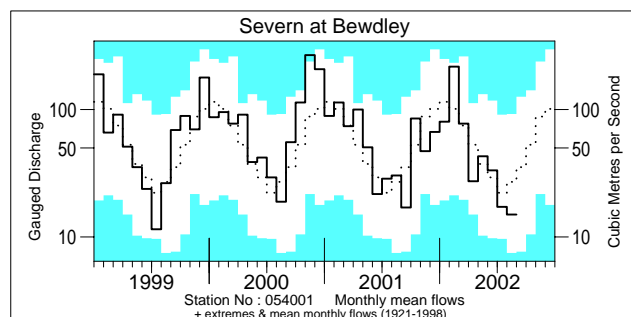
# River flow . . . River flow . . .



## Monthly river flow hydrographs

The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1999 (shown by the shaded areas). Monthly 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) June 2002 - August 2002, (b) January 2002 - August 2002

River	%Ita	Rank
a) Tay	213	50/50
Earn	261	55/55
Blackwater	157	49/50
Mole	183	28/29
Leven (Glasgow)	222	39/39
Carron	82	7/24
Bush	197	27/29

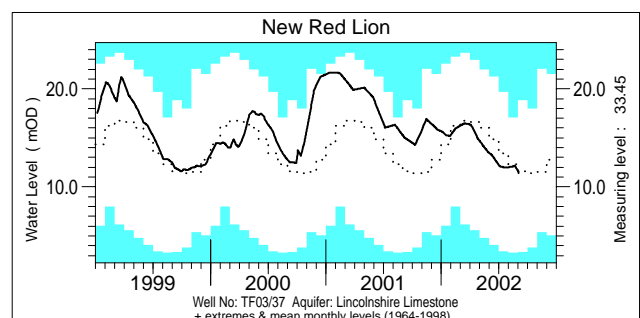
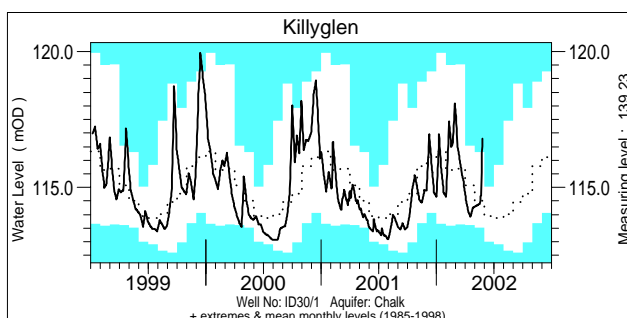
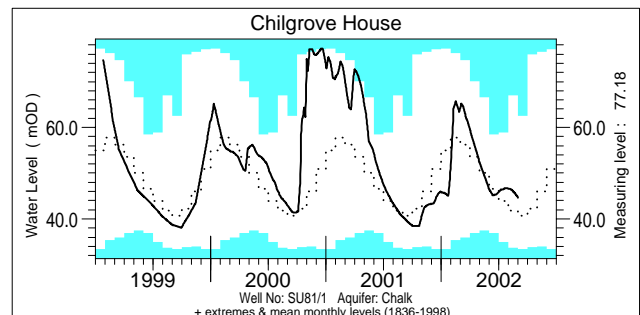
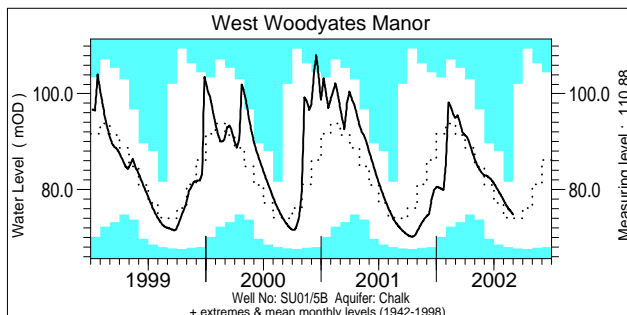
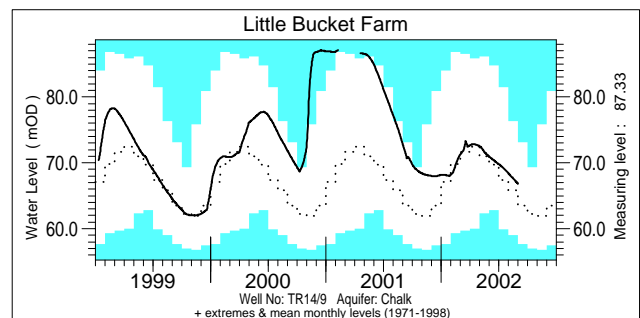
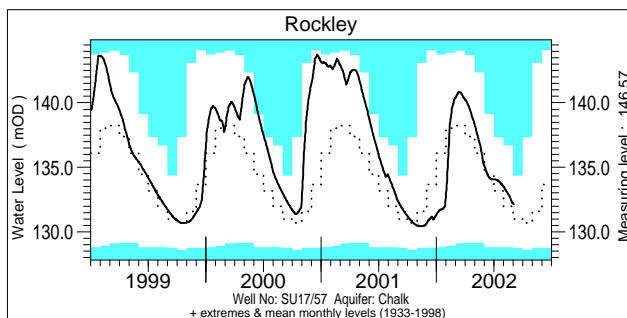
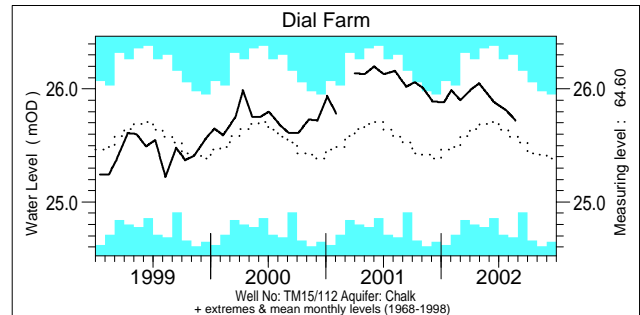
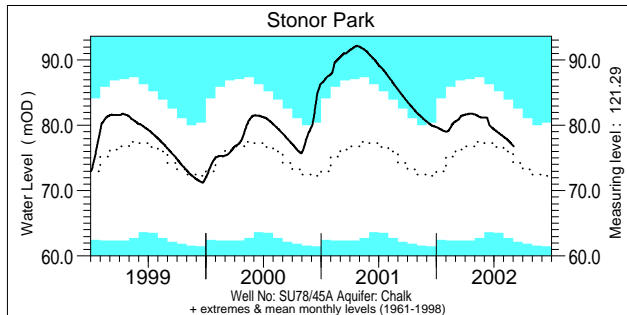
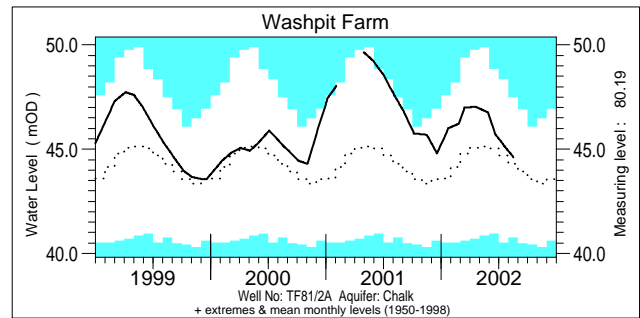
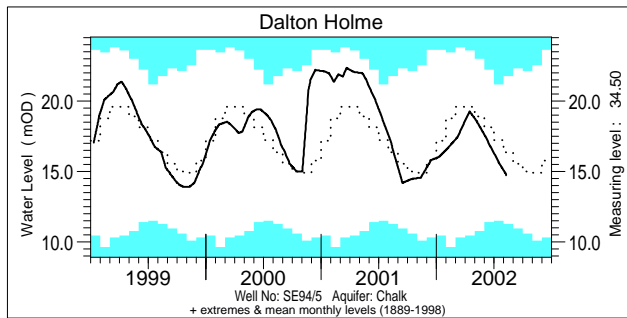
River	%Ita	Rank
b) Dee	119	29/30
Tweed	137	41/42
Leven (Clevl.)	70	9/42
Wharfe	138	46/47
Exe	136	45/46
Dart	141	44/44
Yscir	138	30/30

River	%Ita	Rank
Cynon	151	44/44
Lune	148	42/42
Eden	144	35/35
Clyde	164	39/39
Luss	131	24/24
Camowen	144	28/29
Annacloy	136	22/23

*Ita = long term average*  
*Rank 1 = lowest on record*

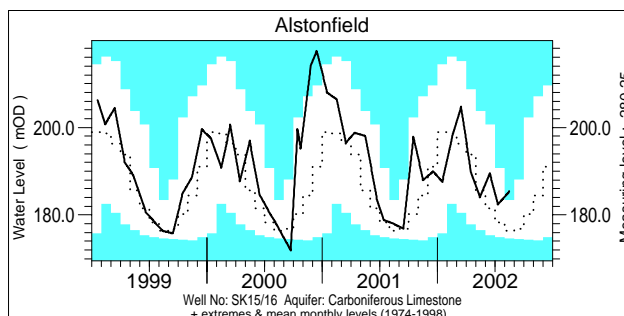
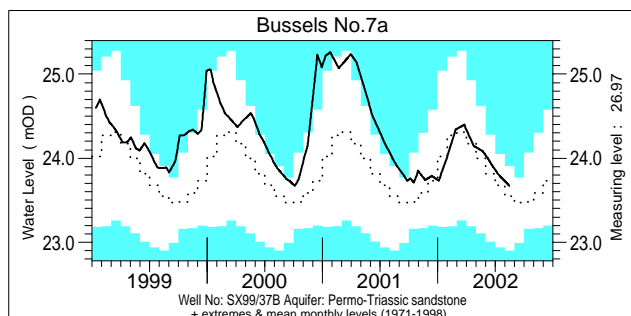
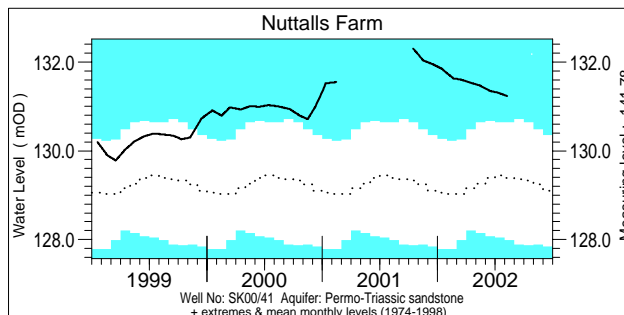
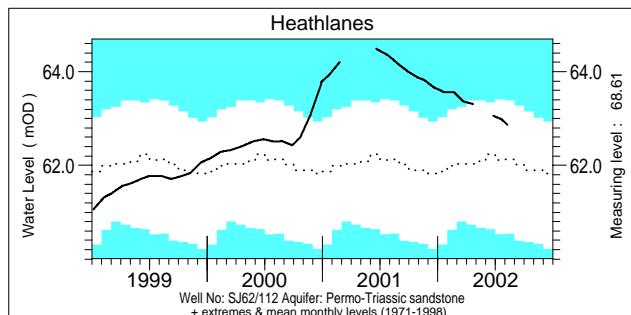
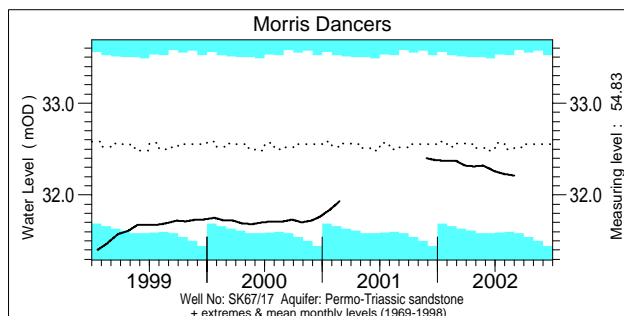
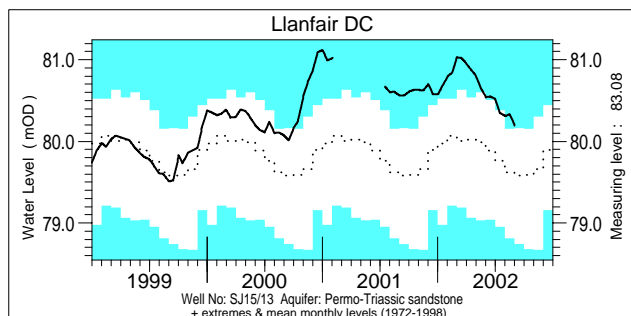
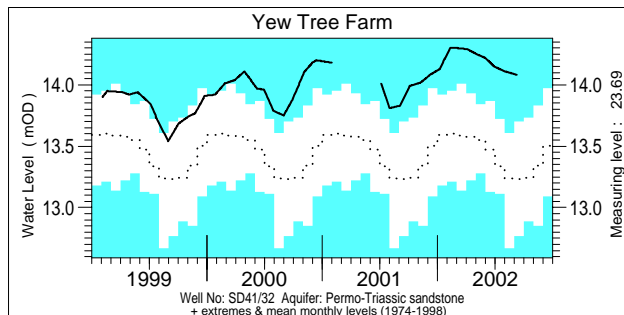
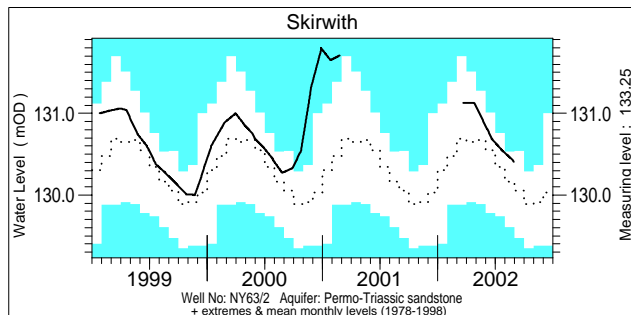
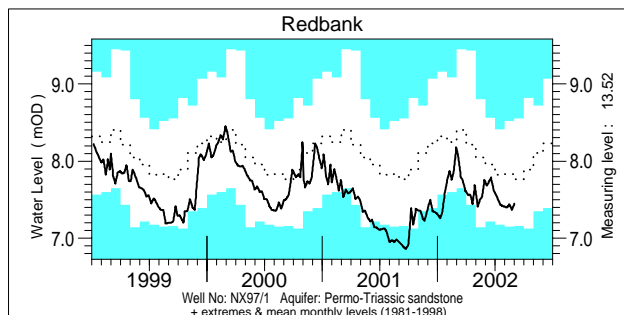
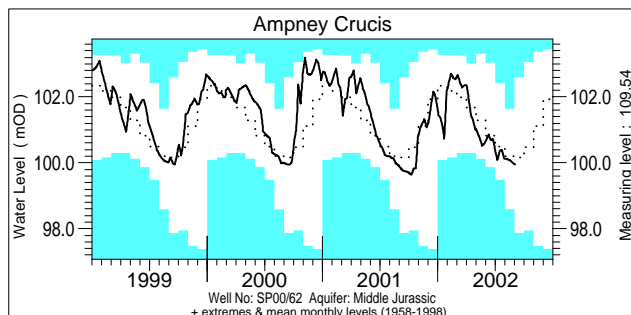


# Groundwater . . . Groundwater



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

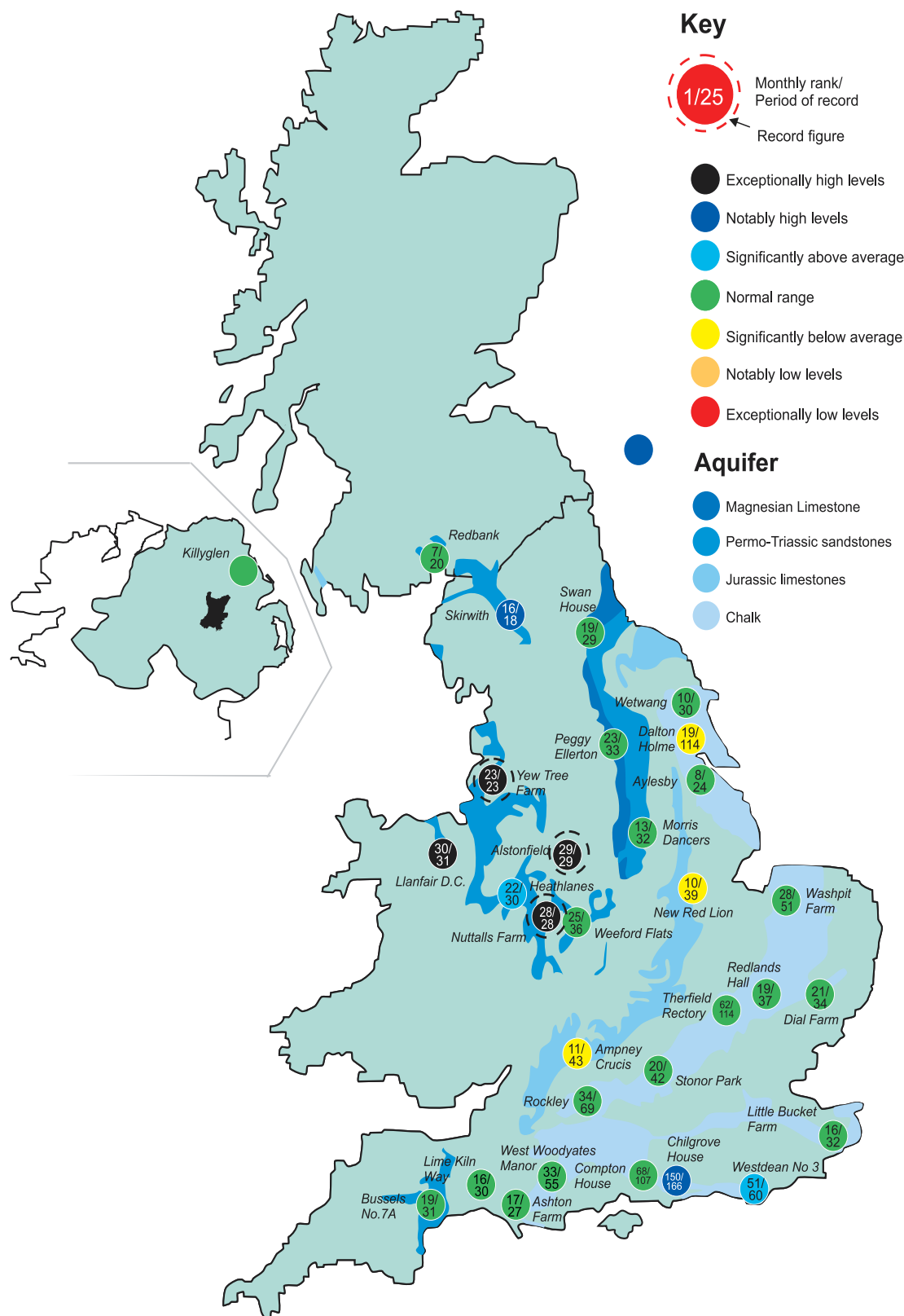


## Groundwater levels August 2002 / September 2002

Borehole	Level Date	Aug. av.	Borehole	Level Date	Aug. av.	Borehole	Level Date	Aug. av.
Dalton Holme	14.75 09/08	16.27	Chilgrove House	44.65 31/08	41.73	Llanfair DC	80.19 01/09	79.59
Washpit Farm	44.61 16/08	44.46	Killyglen	-	-	Morris Dancers	32.21 30/08	32.38
Stonor Park	76.82 02/09	76.20	New Red Lion	11.40 03/09	12.40	Heathlanes	62.86 09/08	62.13
Dial Farm	25.72 23/08	25.58	Ampney Crucis	99.95 02/09	100.17	Nuttalls Farm	131.23 09/08	129.54
Rockley	132.12 02/09	132.02	Redbank	7.45 31/08	7.71	Bussels No.7a	23.67 14/08	23.59
Little Bucket Farm	66.81 31/08	67.12	Skirwith	130.41 29/08	130.17	Alstonfield	185.43 15/08	176.86
West Woodyates	74.82 31/08	73.96	Yew Tree Farm	14.08 09/09	13.19	<i>Levels in metres above Ordnance Datum</i>		



# Groundwater... Groundwater



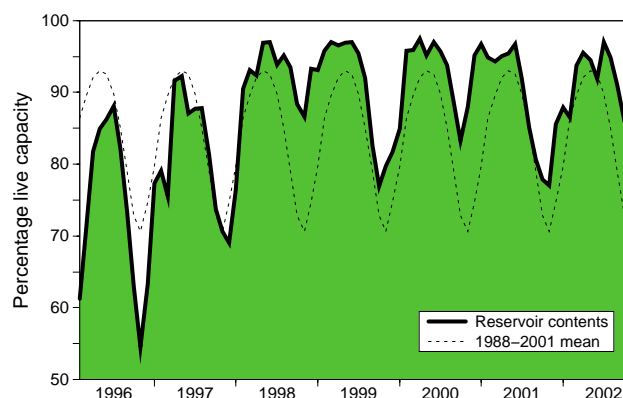
## Groundwater levels - August 2002

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.

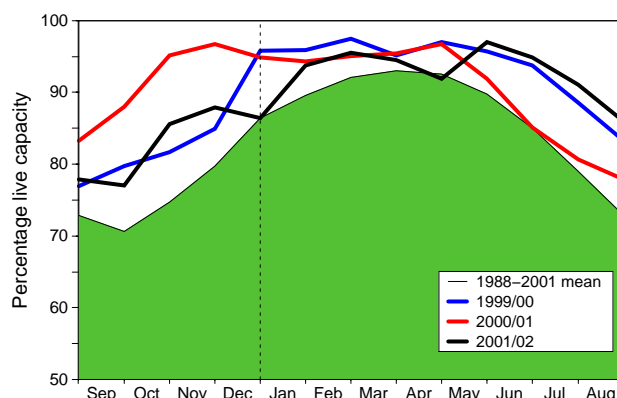
(Note: Redbank is affected by groundwater abstraction, recent levels at Killyglen are under review)

# 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

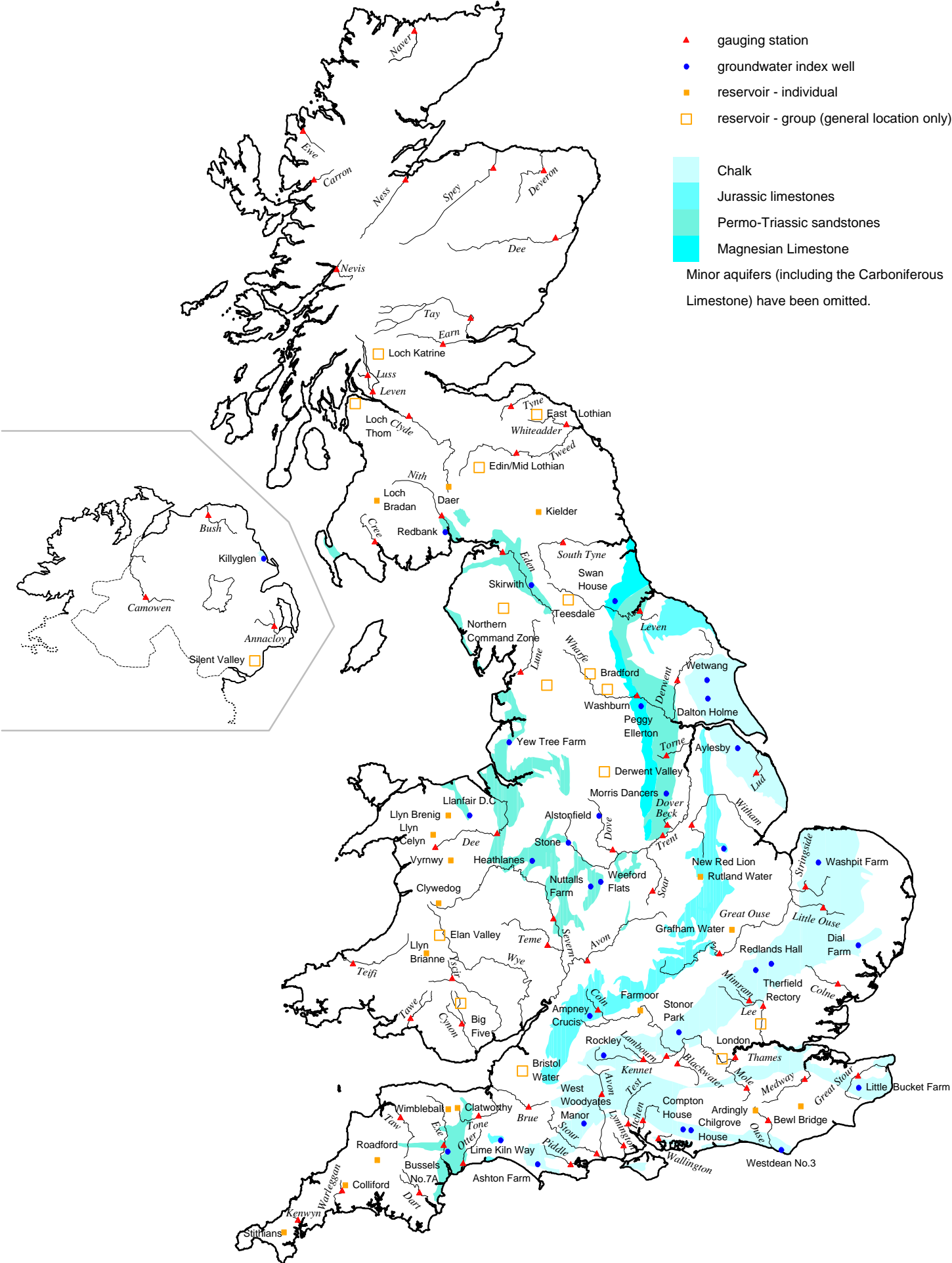
Area	Reservoir	Capacity (MI)	2002					Sep	Min. Sep	Year* of min
			Apr	May	Jun	Jul	Aug			
North West	N Command Zone	• 124929	97	89	100	97	88	78	24	1995
	Vyrnwy	55146	100	94	99	95	90	77	36	1995
Northumbrian	Teesdale	• 87936	97	89	98	95	88	87	39	1991
	Kielder	(199175)	(92)	(91)	(98)	(94)	(90)	(91)	(66)	1989
Severn Trent	Clywedog	44922	94	98	99	98	92	85	38	1989
	Derwent Valley	• 39525	98	88	85	81	80	84	34	1995
Yorkshire	Washburn	• 22035	91	85	91	89	81	84	34	1995
	Bradford supply	• 41407	96	84	95	95	93	92	21	1995
Anglian	Grafham	(55490)	(89)	(91)	(94)	(96)	(95)	(94)	(59)	1997
	Rutland	(116580)	(92)	(94)	(95)	(92)	(90)	(88)	(66)	1995
Thames	London	• 202340	92	93	97	97	94	92	62	1995
	Farmoor	• 13830	87	95	90	96	95	95	64	1995
Southern	Bewl	28170	98	95	95	93	89	85	38	1990
	Ardingly	4685	100	100	100	99	99	98	47	1996
Wessex	Clatworthy	5364	100	89	100	97	91	76	31	1995
	Bristol WW	• (38666)	(98)	(93)	(95)	(93)	(89)	(78)	(43)	1990
South West	Colliford	28540	82	81	84	84	80	74	43	1997
	Roadford	34500	94	91	94	93	97	90	40	1995
	Wimbleball	21320	100	97	100	97	94	86	40	1995
	Stithians	5205	88	85	86	83	76	68	30	1990
Welsh	Celyn and Brenig	• 131155	98	99	100	99	98	93	49	1989
	Brianne	62140	97	89	100	99	96	89	55	1995
	Big Five	• 69762	94	90	98	94	89	69	29	1995
	Elan Valley	• 99106	97	93	100	95	90	75	46	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	98	94	99	100	94	92	45	1998
	East Lothian	• 10206	100	100	96	98	89	96	63	1989
West of Scotland	Loch Katrine	• 111363	99	95	100	99	96	83	50	2000
	Daer	22412	100	99	100	99	99	97	41	1995
Northern Ireland	Loch Thom	• 11840	98	95	100	100	95	94	58	1997
	Silent Valley	• 20634	59	65	81	90	81	79	33	2000

() figures in parentheses relate to gross storage • denotes reservoir groups

\* 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 minimum storage figures relate to the 1988-2002 period only (except for West of Scotland and Northern Ireland where data commence in 1994 and 1993 respectively). 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 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 regional divisions of the EA (England and Wales) and SEPA (Scotland), data for Northern Ireland are provided by 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 (address 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. An initiative is underway with The Met Office to provide more accurate areal figures and, since October 1999, to include more raingauges in the analysis. A significant number of additional monthly rainfall totals are currently being provided by the Environment Agencies; over the coming months further monthly raingauge totals will be included for selected regions. Until the access to these additional data has stabilised the regional figures (and the return periods associated with them) should be regarded as a guide only.

\*MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain.

The Met Office  
Johnson House  
London Road  
Bracknell  
RG12 2SY  
Tel.: 01344 856849  
Fax: 01344 854906

*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  
Fax: 01491 692424

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

© This document is copyright and may not be reproduced without the prior permission of the Natural Environment Research Council.