Hydrological summary

for the United Kingdom

October 2001

General

October was a wet and remarkably warm month – the warmest October in the Central England Temperature series which begins in 1659. Some small impoundments (e.g. Stithians in Cornwall) aside, reservoir stocks recovered smartly through the month and, nothwithstanding flood drawdown releases in a few western reservoirs, overall stocks for England and Wales are around 12% above average for early November. Groundwater resources are also very healthy. Exceptionally high groundwater levels, in the east especially, combined with the above average October rainfall and a steep decline in soil moisture deficits, have underlined the current high vulnerability to flooding. Spates were common in October with significant lowland flooding in the fourth week. Catchments are close to saturation and groundwater levels rising again in most areas; above average winter rainfall would make for a protracted period of high flood risk.

Rainfall

In most regions, October was dominated by the passage of low pressure systems, frontal rainfall was plentiful and dry interludes were of very limited duration. Several notably wet spells were of particular hydrological importance. Many localities across the UK registered > 20 mm on the 7th (e.g. Preston 45 mm, Herstmonceux 43 mm) and the three days beginning on the 19th were even wetter. A significant proportion of East Anglia reported around the monthly average rainfall in this episode. Some rainfall totals were exceptional: Cambridge registered 90.4 mm in 18 hours (return period > 100 yrs) and Clavering (Essex) 62.6 in 15 hours. At month-end, a 177 mm 48-hour total was reported for Lochcarron (Highland Region). October rainfall was below average in the western fringes of the UK only; parts of Northern Ireland recorded 80% of the 1961-90 average. Rainfall totals exceeded 150% of average across much of Scotland whilst parts of the English lowlands exceeded 200%. Great Britain registered its third wettest October in the last 25 years (but 2000 and 1998 were much wetter). Regional three-month rainfall totals are mostly within the normal range but notably high across the English lowlands – adding to a cluster of exceptionally wet August-October periods since 1997. Longer term rainfall accumulations, which moderated over the late spring and summer, are again exceptional across much of E&W. The Sept 2000-Oct 2001 total established (marginally) a new 14-month maxima in the 235-year E&W rainfall series.

River flow

Heavy rain and diminishing soil moisture deficits fuelled a strong seasonal recovery in flow rates across almost all of the UK during October. Spate conditions were common around the 6/7th and then, more generally, around the 20/21st - triggering flood warnings in many catchments; exceptional October flows – with some mudslides (e.g. at Lochcarron) – were reported from Highland Region around month-end. On the 8th, the South Tyne recorded its highest October flow since 1967 and severe flooding was experienced in the Cam basin on the 21/22nd; record levels were reported for a number of lowland rivers (e.g. Chelmer in Essex, the Ash and Stort in Herts). Below average runoff totals for October were largely confined to western catchments (e.g. the Bush in Northern Ireland and Kenwyn in Cornwall). To the east, runoff totals were mostly well above average. Lowland spring flows are more typical of the late winter than the late autumn. The Lee – boosted by exceptional inflows from its tributaries – recorded a similar mean flow to Oct 2000 (and 1993); only 1987 and 1903 have produced significantly higher October runoff in a series from 1883. With the exception of a few areas (e.g. the South-West) three-month runoff totals are generally well above average – and unprecedented in some eastern groundwater-fed rivers. Longer term accumulations are outstanding over wide areas. The Luss, in western Scotland, registered its lowest Nov-Oct runoff on record, but initial analyses indicate that new Nov-Oct maxima were established in more than 70% of gauging stations in E&W, including the Thames which has a 118-year flow record.

Groundwater

Rainfall during October once again favoured eastern aquifer outcrop areas – many reporting > 150% of the monthly average. Evaporation losses were appreciably above average but soil moisture deficits declined briskly and, by early November, had been eliminated in all but the easternmost (and a few central) areas. The seasonal recovery began with groundwater levels close to the highest on record in the eastern Chalk and across many Permo-Triassic sandstones outcrops (e.g. in the Midlands and North Wales). In the Chalk, a clear distinction can be drawn between the western (and some northerly) outcrops – where levels are close to the seasonal average – and the central and easterly outcrops (which are less responsive) where levels are close to or above seasonal maxima. Levels in the more responsive limestone aquifers are rising briskly and are close to seasonal maxima in parts of the Carboniferous Limestone; this is also true of most minor aquifers (e.g. the Essex Gravels). Seasonality is less evident in many Permo-Triassic sandstone aquifers units, and levels can reflect recharge over many years. Exceptional recharge since the summer of 1997 is reflected in the unprecedented levels in many outcrops (e.g. Llanfair, Heathlanes). There is a significant risk of groundwater flooding during the coming winter.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
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Rainfall . . . Rainfall . . . Rainfall. .

Rainfall accumulations and return period estimates

Area	Rainfall	Oct 2001	Aug01-Oct01	RP	May01-Oct01	RP	Jan01-Oct01	RP	Nov00-Oct01	RP
England & Wales	**mm**	**138**	**302**		**453**		**846**		**1165**	
	%	**159**	**125**	**5-10**	**104**	**2-5**	**117**	**5-10**	**128**	**35-50**
North West	mm	166	387		563		919		1302	
	%	129	111	2-5	95	2-5	96	2-5	108	2-5
Northumbrian	mm	105	265		402		683		942	
	%	138	115	2-5	96	2-5	100	<2	110	2-5
Severn Trent	mm	110	240		405		684		937	
	%	172	123	2-5	111	2-5	113	2-5	124	15-25
Yorkshire	mm	110	283		411		693		957	
	%	150	132	5-10	104	2-5	105	2-5	117	5-10
Anglian	mm	82	232		384		657		832	
	%	161	150	20-30	127	5-15	136	50-80	140	150-250
Thames	mm	119	259		381		712		946	
	%	191	145	10-20	112	2-5	129	15-25	137	60-90
Southern	mm	137	298		395		797		1095	
	%	171	145	10-20	109	2-5	130	20-30	141	110-150
Wessex	mm	138	250		376		743		1048	
	%	175	115	2-5	97	2-5	112	2-5	125	10-20
South West	mm	151	260		406		860		1254	
	%	130	89	2-5	81	5-10	94	2-5	107	2-5
Welsh	mm	202	402		602		1056		1506	
	%	148	114	2-5	102	2-5	104	2-5	115	5-10
Scotland	**mm**	**210**	**410**		**634**		**966**		**1317**	
	%	**134**	**99**	**2-5**	**93**	**2-5**	**85**	**5-15**	**92**	**2-5**
Highland	mm	254	476		755		1109		1514	
	%	128	96	2-5	95	2-5	82	10-20	86	5-10
North East	mm	150	332		493		787		1077	
	%	155	122	5-10	103	2-5	101	2-5	111	5-10
Tay	mm	214	389		578		952		1286	
	%	164	115	2-5	101	2-5	97	2-5	105	2-5
Forth	mm	157	311		495		799		1075	
	%	136	98	2-5	92	2-5	90	2-5	97	2-5
Tweed	mm	132	280		451		741		1015	
	%	139	103	2-5	94	2-5	94	2-5	105	2-5
Solway	mm	202	397		604		981		1421	
	%	128	95	2-5	89	2-5	87	5-10	100	<2
Clyde	mm	239	476		744		1137		1542	
	%	124	94	2-5	93	2-5	85	5-10	91	2-5
Northern Ireland	**mm**	**107**	**256**		**427**		**676**		**971**	
	%	**94**	**85**	**2-5**	**84**	**5-10**	**79**	**10-20**	**92**	**2-5**

RP = Return period

 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 . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

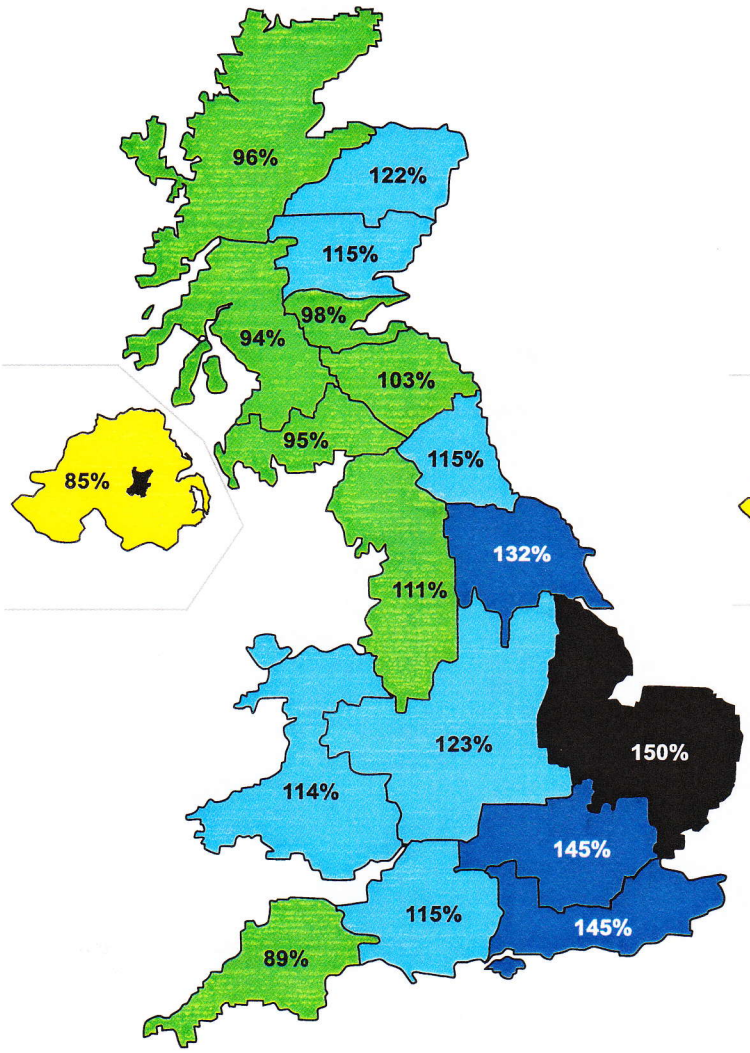
Above average

Normal range

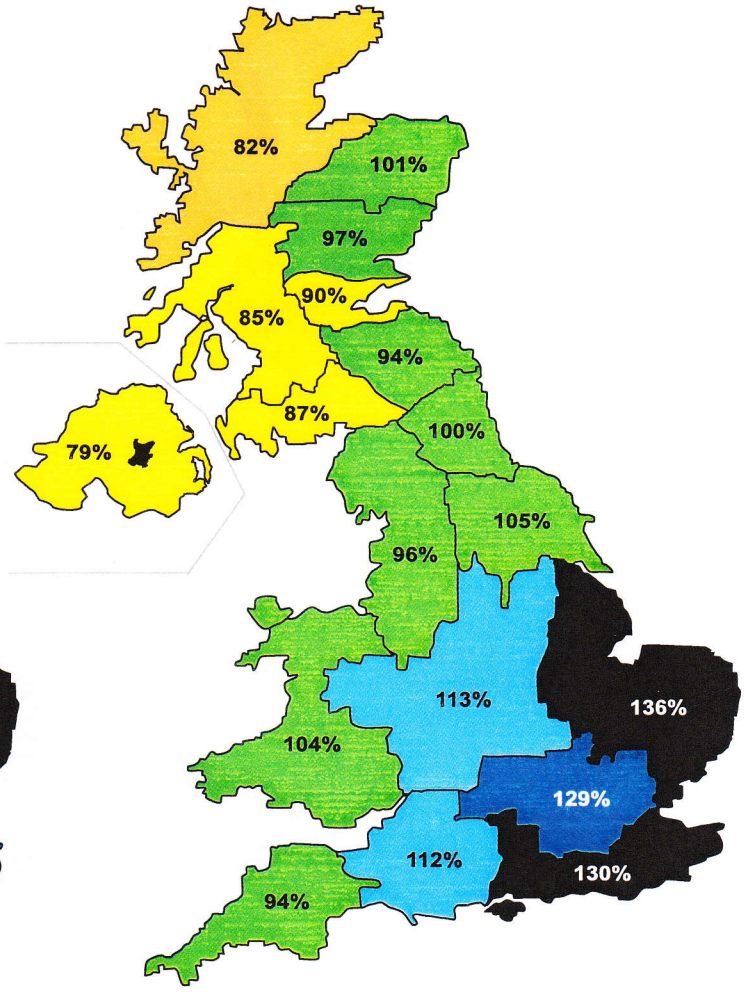
Below average

Substantially below average

Exceptionally low rainfall



August 2001 -October 2001

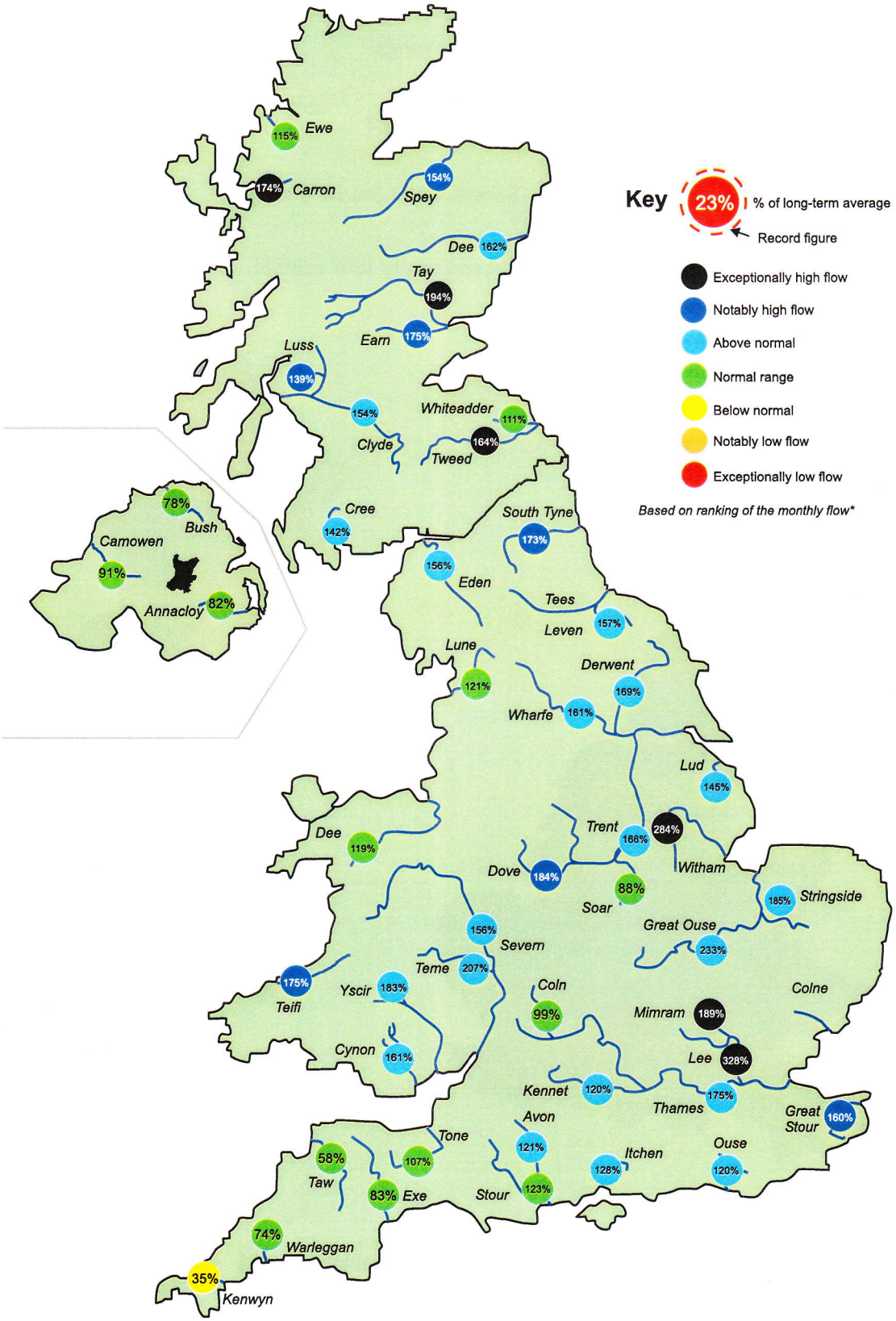


January 2001 -October 2001

Rainfall accumulation maps

Rainfall for the UK as a whole was considerably above average for the August - October period and is modestly above average for the year thus far. The nationwide picture obscures major regional differences. Rainfall for England and Wales has been above average in every month bar two since July 2000 and accumulatioed totals remain remarkable; new n-month maxima have been established across most timespans from three to more than 30 months.

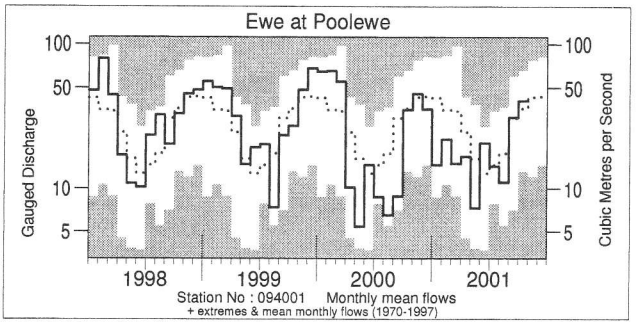
River flow . . . River flow . . .

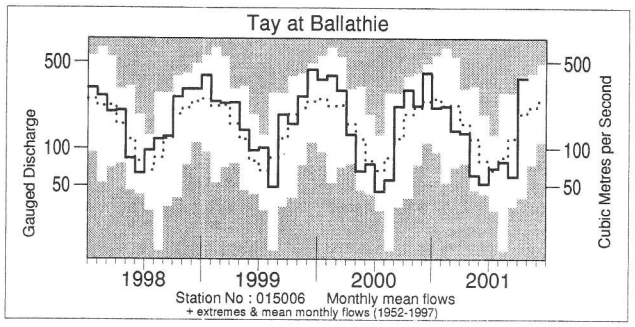


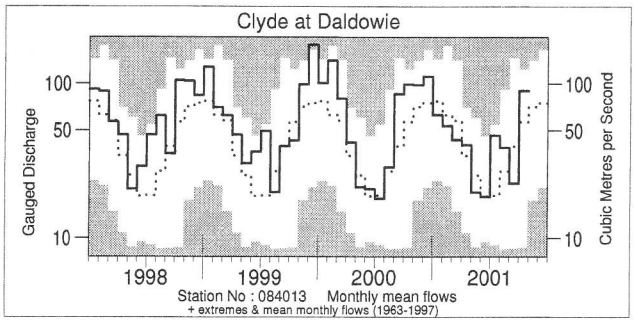
River flows - October 2001

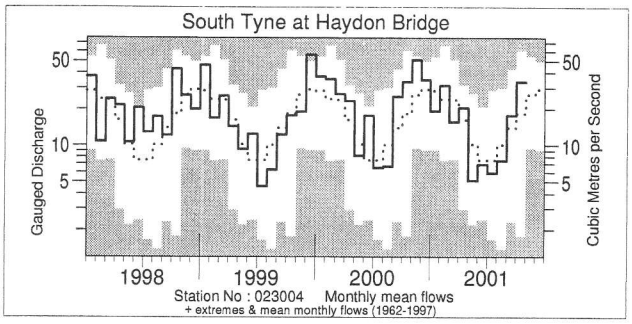
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

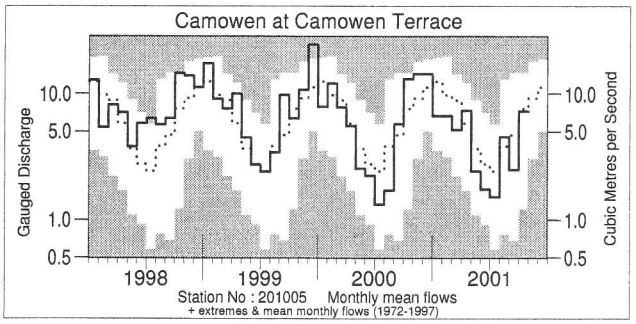
River flow . . . River flow . . .

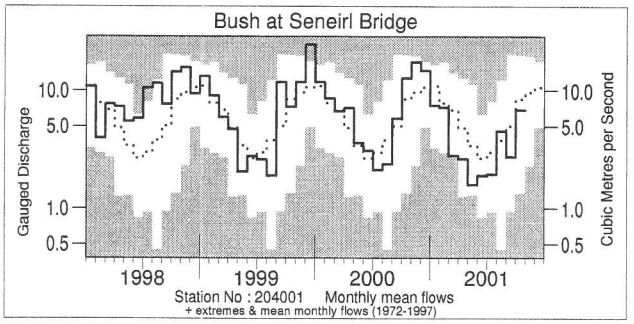


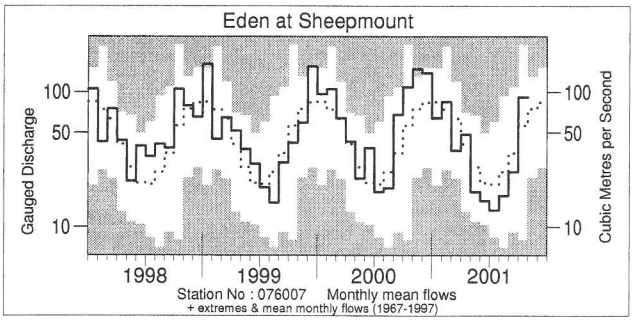


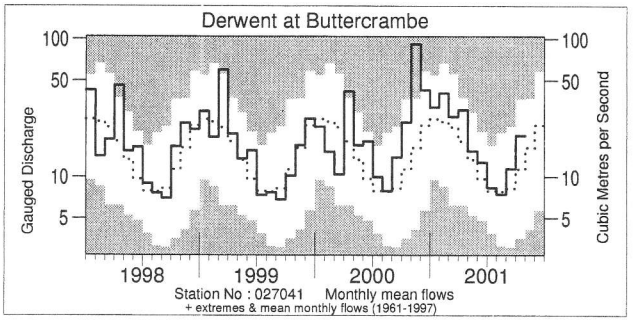


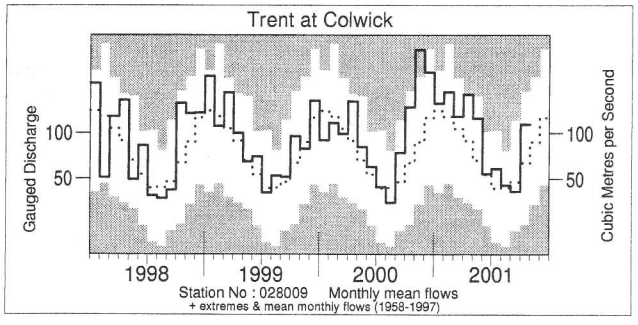


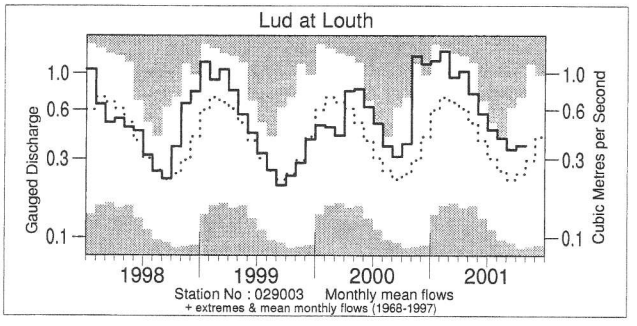








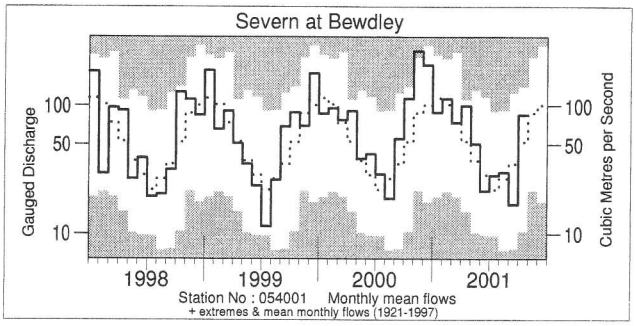


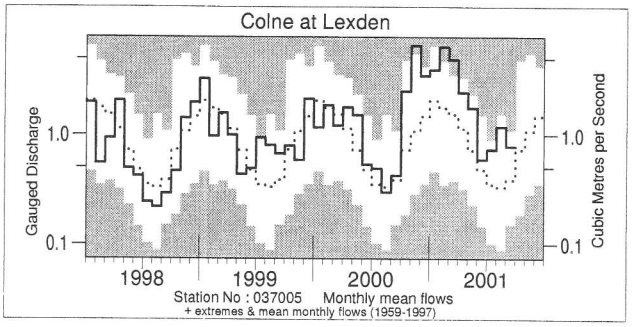


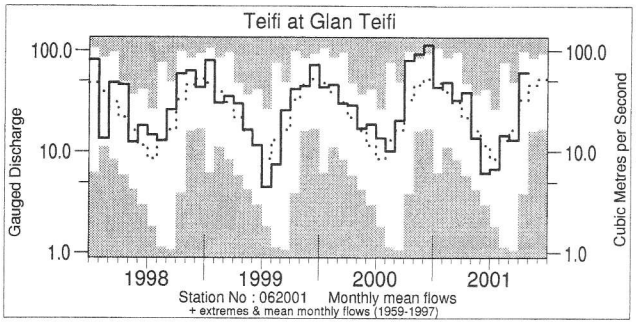
Monthly river flow hydrographs

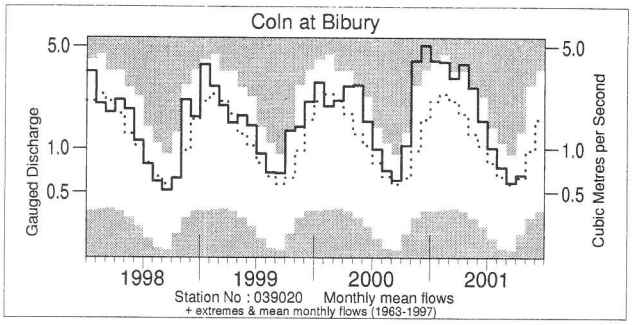
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

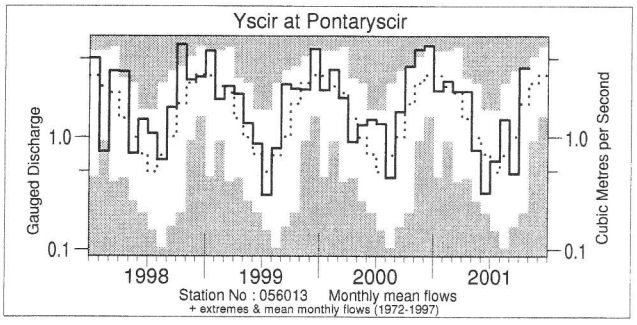
River flow . . . River flow . . .

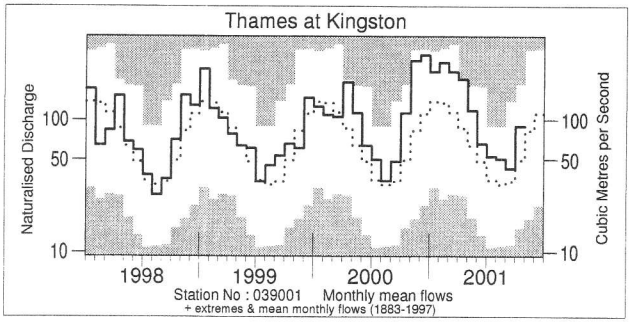


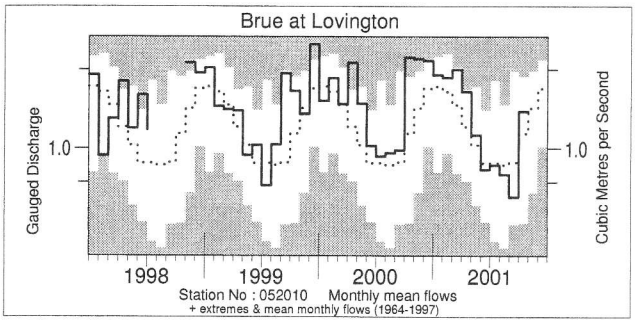


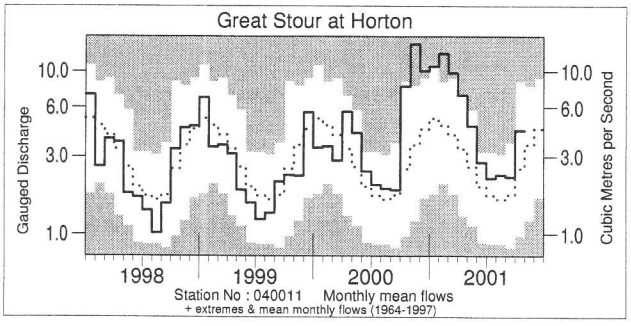


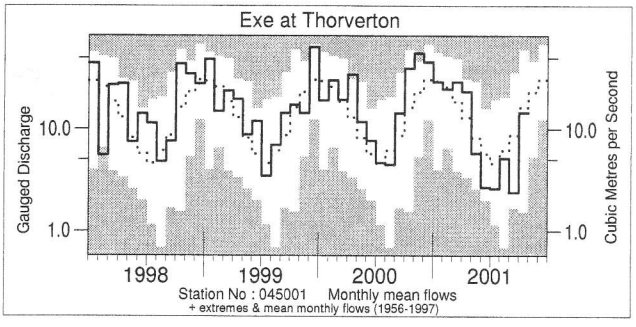


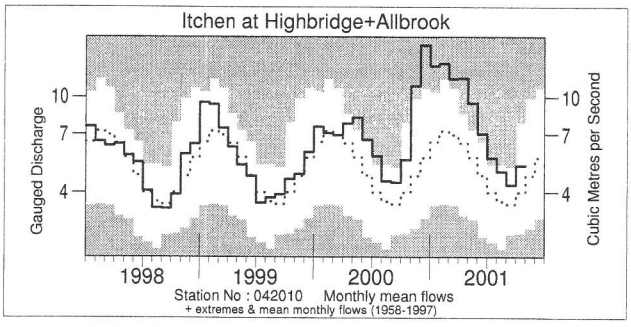










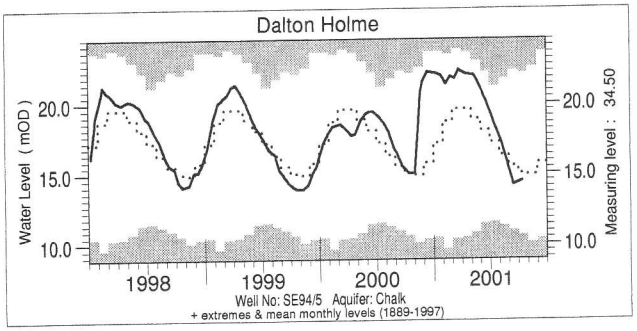


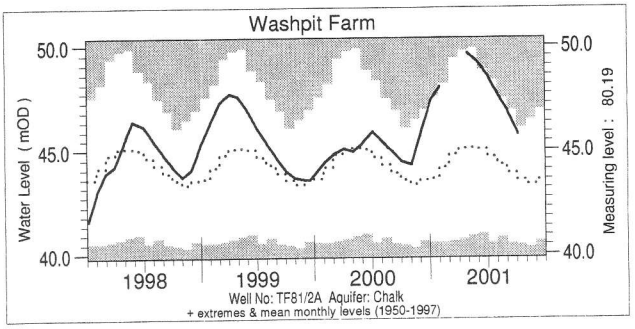
Notable runoff accumulations (a) August 2001 - October 2001, (b) November 2000 - October 2001

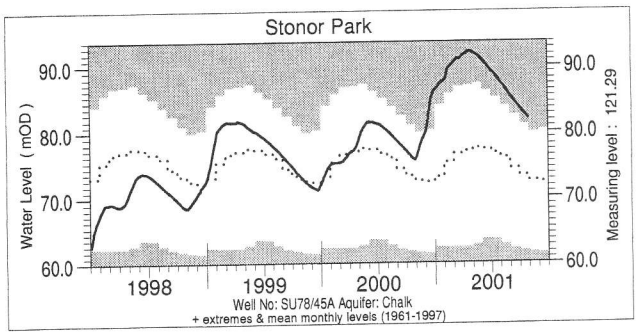
	River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a)	Witham	260	43/43	Stringside	203	33/33	Piddle	177	37/37
	Mimram	187	49/49	Lee	263	115/115	Tone	147	40/40
(b)	York. Leven	173	41/41	Thames	207	118/118	Teme	169	31/31
	Derwent	171	40/40	Medway	183	37/37	Teifi	139	42/42
	Trent	164	43/43	Great Stour	213	34/34	Luss	78	1/21
	Lud	181	33/33	Itchen	179	43/43	Annacloy	131	21/21
	Bedford Ouse	216	68/68	Hants. Avon	202	36/36			

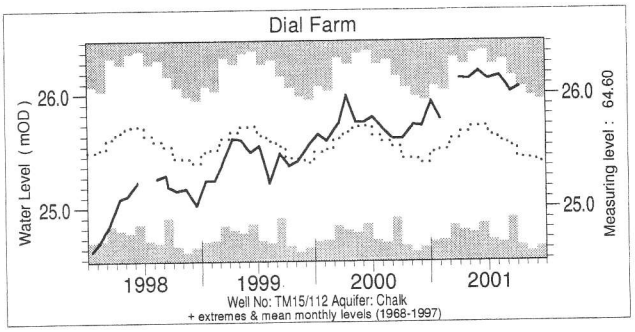
lta = long term average
Rank 1 = lowest on record

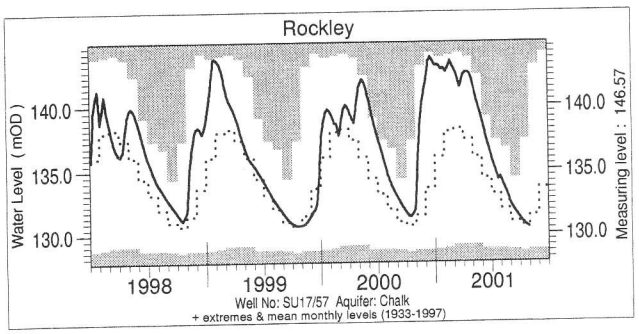
Groundwater . . . Groundwater

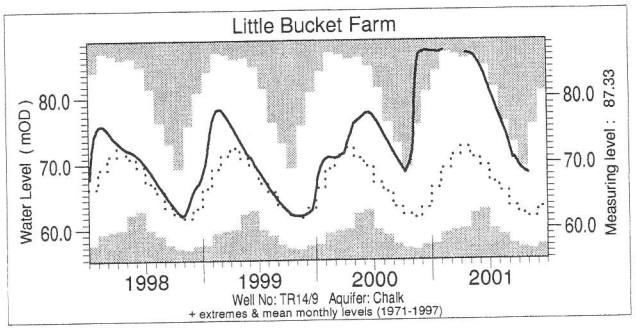


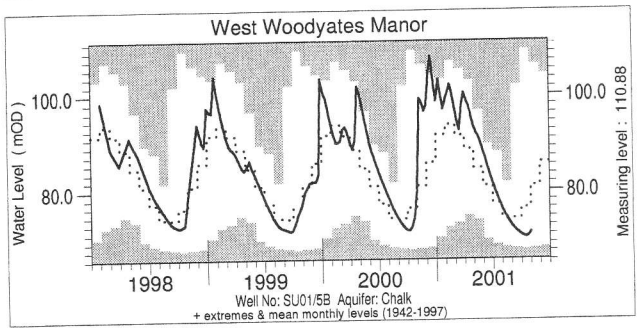


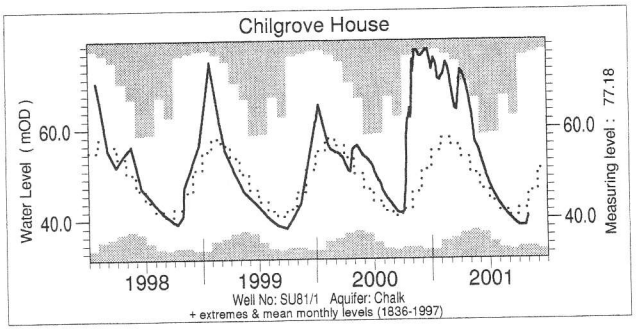


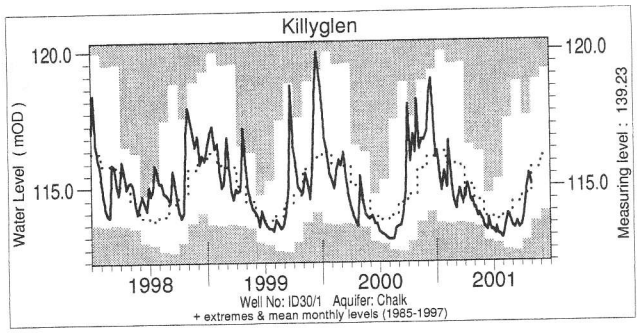


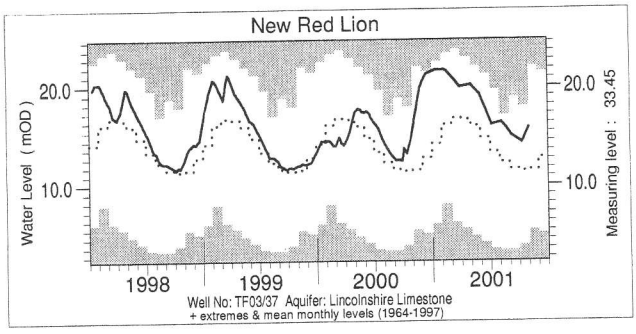








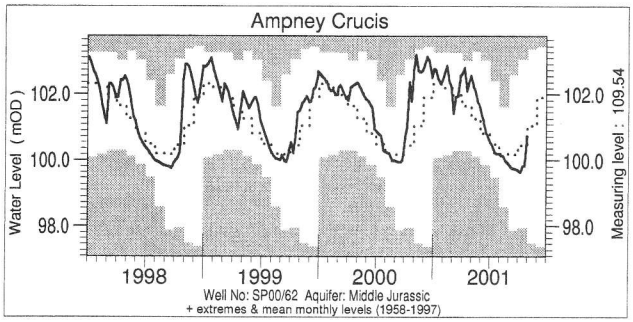


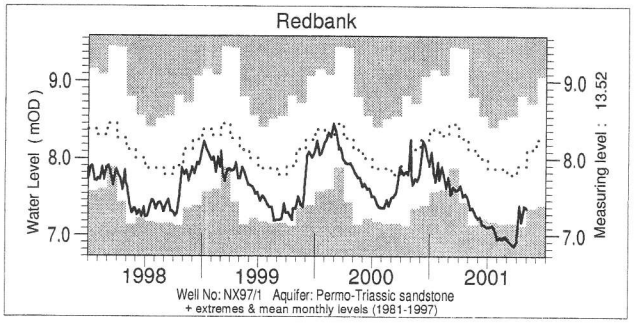


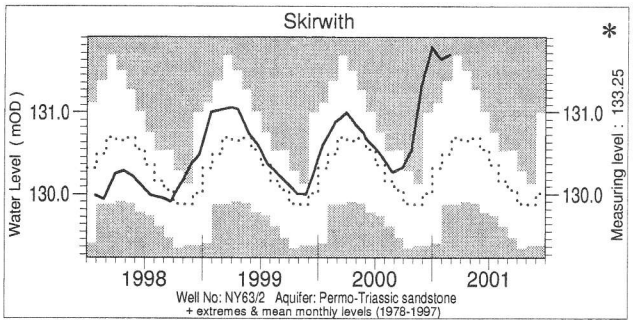
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

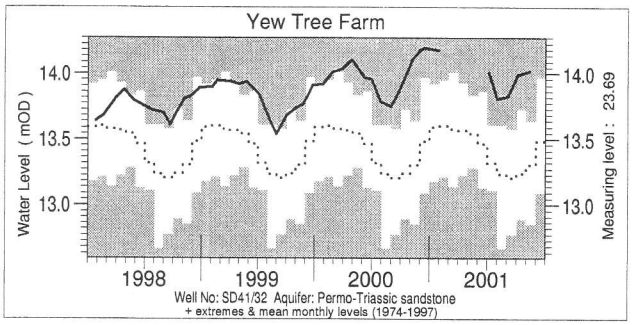
* No March - October groundwater levels available.

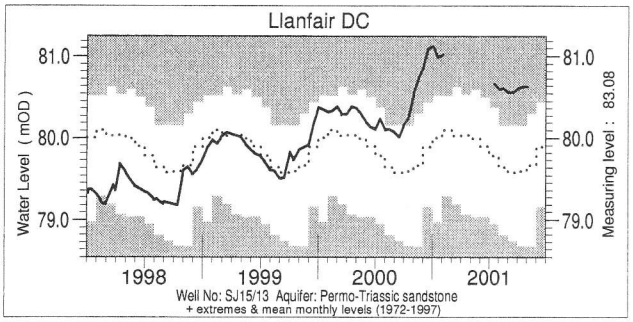
Groundwater . . . Groundwater

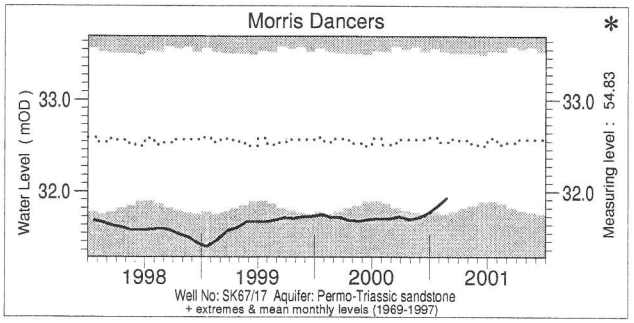


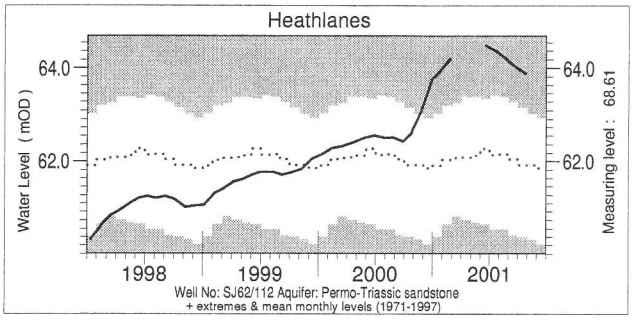


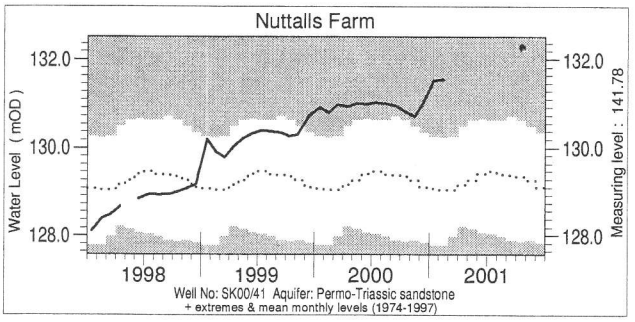


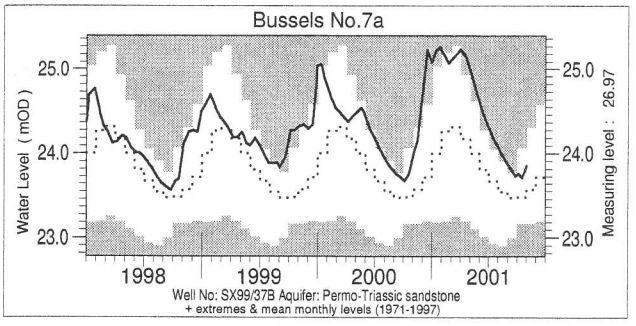


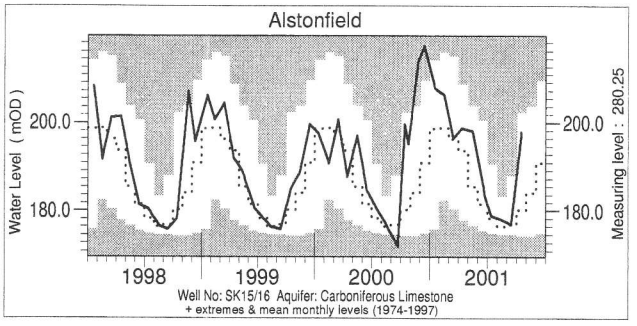












Groundwater levels October / November 2001

Borehole	Level	Date	Oct. av.
Dalton Holme	14.47	12/10	14.90
Washpit Farm	45.76	05/10	43.46
Stonor Park	81.98	29/10	73.24
Dial Farm	26.06	08/10	25.44
Rockley	130.50	29/10	130.68
Little Bucket Farm	68.36	31/10	63.38
West Woodyates	71.18	31/10	75.25

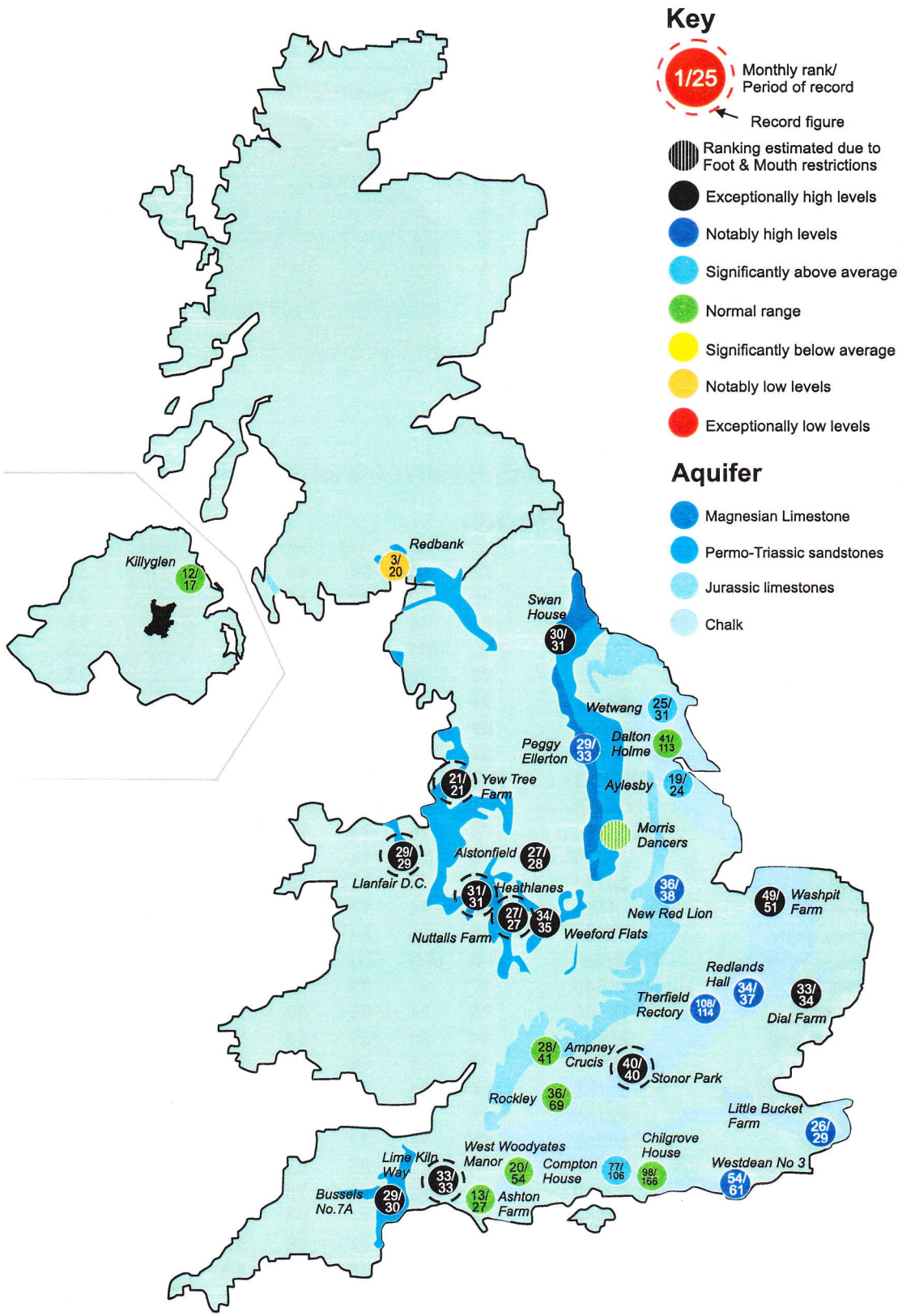
Borehole	Level	Date	Oct. av.
Chilgrove House	40.53	29/10	42.51
Killyglen	115.03	31/10	114.75
New Red Lion	15.79	30/10	11.48
Ampney Crucis	100.74	29/10	100.45
Redbank	7.36	30/10	7.91
Yew Tree Farm	14.02	09/11	13.29
Llanfair DC	80.63	01/11	79.48

Borehole	Level	Date	Oct. av.
Heathlanes	63.89	24/10	61.89
Nuttalls Farm	132.30	15/10	129.46
Bussels No.7a	23.85	30/10	23.53
Alstonfield	197.89	15/10	180.71

Data missing due to Foot & Mouth restrictions

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

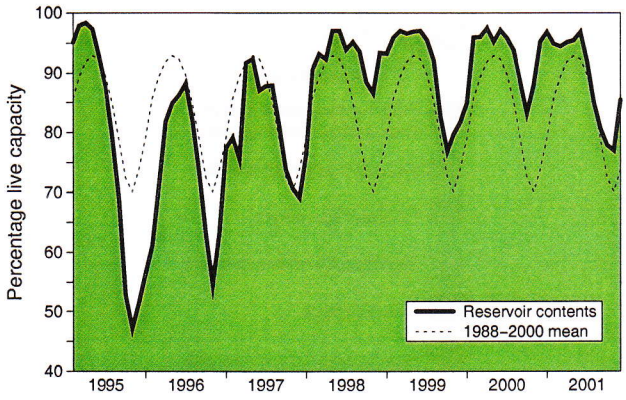


Groundwater levels -October 2001

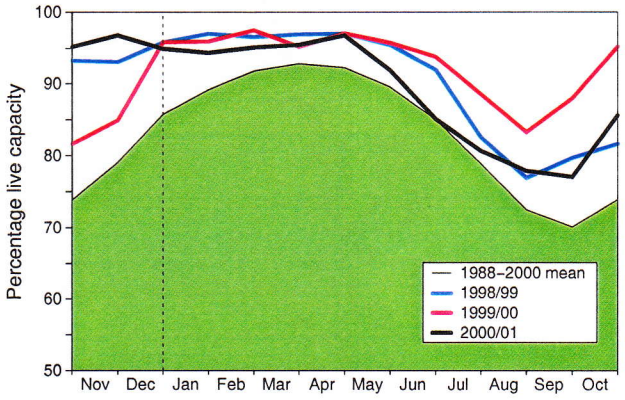
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction)

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.

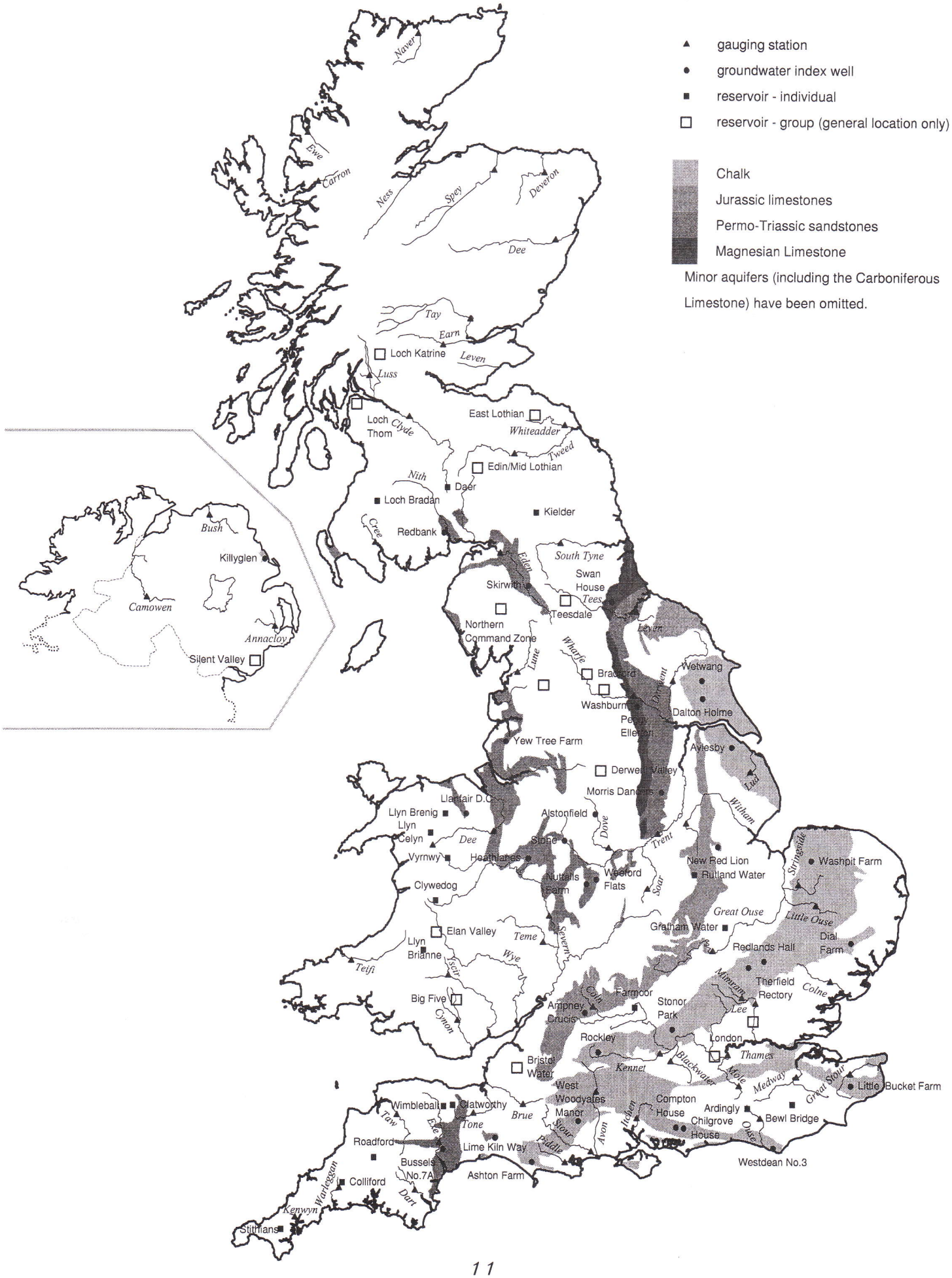
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2001 Jun	Jul	Aug	Sep	Oct	Nov	Min. Nov	Year* of min
North West	N Command Zone	• 124929	73	61	50	44	44	75	38	1993
	Vyrnwy	55146	90	80	79	74	71	86	25	1995
Northumbrian	Teesdale	• 87936	84	76	65	57	63	96	33	1995
	Kielder	(199175)	(90)	(88)	(89)	(87)	(86)	(80)	63	1989
Severn Trent	Clywedog	44922	90	80	61	46	49	73	38	1995
	Derwent Valley	• 39525	97	80	71	69	81	99	15	1995
Yorkshire	Washburn	• 22035	89	81	75	69	69	89	15	1995
	Bradford supply	• 41407	85	77	64	61	64	86	16	1995
Anglian	Grafham	(55490)	(96)	(95)	(94)	(95)	(95)	(93)	44	1997
	Rutland	(116580)	(96)	(90)	(85)	(80)	(78)	(80)	59	1995
Thames	London	• 202340	98	94	91	91	90	90	46	1996
	Farmoor	• 13830	98	98	96	92	94	92	53	1990
Southern	Bewl	28170	98	93	85	79	72	74	33	1990
	Ardingly	4685	100	96	91	70	67	72	33	1996
Wessex	Clatworthy	5364	87	75	64	54	44	67	19	1989
	Bristol WW	• (38666)	(94)	(83)	(75)	(69)	(60)	(61)	24	1990
South West	Colliford	28540	97	91	82	72	62	60	42	1996
	Roadford	34500	95	91	85	80	73	73	18	1995
	Wimbleball	21320	94	82	69	61	50	52	26	1995
	Stithians	5205	94	83	66	51	37	32	18	1990
Welsh	Celyn and Brenig	• 131155	100	96	96	92	92	94	48	1989
	Brianne	62140	94	85	81	86	86	100	57	1995
	Big Five	• 69762	89	76	78	82	77	97	41	1995
	Elan Valley	• 99106	94	86	87	93	93	100	37	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	91	82	80	75	70	89	50	1998
	East Lothian	• 10206	100	93	91	90	84	97	48	1989
West of Scotland	Loch Katrine	• 111363	66	61	57	58	55	85	76	1997
	Daer	22412	81	70	64	55	48	91	70	1997
	Loch Thom	• 11840	74	70	66	66	62	84	73	1999
Northern Ireland	Silent Valley	• 20634	83	72	59	59	47	54	34	1995

() figures in parentheses relate to gross storage • denotes reservoir groups * last occurrence **updated gross capacity

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 1988-2000 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 of the Environment, Transport and the Regions, 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, the West of Scotland and East of Scotland Water Authorities, 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.

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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:

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