Note : much of the hydrometric data featured in this report is provisional; the Foot and Mouth outbreak has also restricted the amount of data available.

Hydrological summary for the United Kingdom

April 2001

General

Across much of the UK hydrological conditions in April would have been viewed as remarkable in any context other than that of the preceding seven months. Rainfall was again well above average for England and Wales and, although flooding did not approach the scale of that experienced in Oct-Dec 2000, many additional runoff records were established, reinforcing the recent redefinition of high flow regimes, especially in southern Britain. Similarly, unprecedented groundwater levels characterised many of the slower responding aquifer units - following the most outstanding groundwater recharge season of modern times. Parts of Scotland have been dry over the last five months but accumulated rainfall totals for most regions of the UK remain remarkably high. This is reflected in the overall reservoir stocks for England and Wales – currently around 97% of capacity (for the fourth May in succession) and the water resources outlook – generally – is exceptionally healthy.

Rainfall

The relentless passage of low pressure systems since the early autumn of 2000 – most tracking across central and southern Britain – continued in April. Generally, rainfall was well distributed through the month and whilst parts of northern Scotland (the Western Isles in particular) and Northern Ireland reported below average rainfall, most of England and Wales exceeded 150% with an especially wet zone trending south-east from the Mersey estuary. Although April was much wetter in 1998 and 2000, the 2001 total still ranks amongst the wettest half dozen for England and Wales since 1935. Nonetheless, the monthly total was substantially lower than for each of the final four months of 2000 – testimony to the extraordinary precipitation patterns experienced over the recent past. Accumulated rainfall over the Jan-April period (for E&W) was very much lower than for the preceding four months but it is still the wettest start to a year since 1951. More notably, the Sept 2000-April 2001 rainfall total exceeds the previous highest in this timeframe by a very wide margin. It also establishes a new wettest eight-month sequence for E&W in a series from 1766 – again, clearly eclipsing the previous maximum. Over this timespan, rainfall in parts of the South-East are comparable with those of the Highland Region of Scotland – a rare circumstance.

River flow

Catchments remained saturated through most of April and spates early in the month provided modest echoes of the flooding through the preceding autumn and winter. Generally however, April was notable for the maintenance of exceptionally high river flows rather than the incidence of severe flooding. By the second week of the month, brisk recessions had become established in most northern and western rivers and depressed monthly runoff totals characterised a few impermeable catchments (e.g. the River Ewe and, in Northern Ireland, the River Bush). In stark contrast, rivers sustained primarily from groundwater remained near to bankfull with mean flows commonly more than twice the April average. Many lowland rivers in England established new maximum April runoff totals – including the Thames in a record from 1883; unprecedented April totals were also reported for some more responsive rivers, e.g. the Dove, Lymington (Hants) and Kenwyn. Since the early autumn the period over which near bankfull (or higher) flows have been maintained is truly exceptional – without precedent in the 118-year record for the Thames. Correspondingly, accumulated runoff totals testify to the singular nature of runoff in the recent past. Runoff totals for the period since last September are the highest on record for any 7-month sequence for the great majority of gauging stations in England and Wales (plus some others) – with accumulated runoff around twice the *annual* average in some south-eastern catchments. Accumulated runoff totals are outstanding in many areas over timespans extending beyond three years.

Groundwater

Accelerating evaporative demands in lateApril/early May – and the associated development of soil moisture deficits - may (in the east) have signalled the end of the most productive recharge season on record. Effective rainfall totals of two to three times the average for April contributed to recharge totals since the early autumn which are unprecedented over very wide areas. Groundwater levels in the more responsive Chalk outcrops fell during April but wells and boreholes with levels still clearly above pre-2000 maxima exhibited a wide distribution. Levels remain exceptional in the Magnesian Limestone and continue to rise throughout parts of the Permo-Triassic sandstones. In many boreholes the range of recorded variation has been significantly extended over the last four months (e.g. at Heathlanes); At Weeford Flats, the borehole was dry in early 1999 but levels are now approaching the long term maximum in a series from 1966. The extremely high groundwater levels have sustained unprecedented flows in spring-fed rivers (e.g. the Ewelme Brook which drains from the Chilterns), and been associated with widespread 'clearwater' flooding (in southern England especially). Significant flows have been noted in many 'dry' valleys and, locally, drainage systems have been overwhelmed; significant basement flooding and transport disruption have been persistent problems. A brisk decline in groundwater levels may now be anticipated but the water supply outlook for the summer and autumn remains very healthy.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall accumulations and return period estimates

Area	Rainfall	Apr 2001	Jan 01-Apr 01	RP	Nov 00-Apr 01	RP	Sep 00-Apr 01	RP	May 00-Apr 01	RP
England & Wales	**mm**	**93**	**339**		**631**		**927**		**1180**	
	%	**155**	**120**	**5-10**	**135**	**30-40**	**147**	**>200**	**132**	**70-100**
North West	mm	113	356		739		1169		1524	
	%	159	98	2-5	121	5-10	137	40-60	127	30-45
Northumbrian	mm	81	280		539		779		1037	
	%	145	104	2-5	124	5-15	133	30-45	122	10-20
Severn Trent	mm	93	279		532		775		1000	
	%	169	116	2-5	137	20-35	150	150-250	133	50-80
Yorkshire	mm	94	282		546		829		1075	
	%	158	107	2-5	128	20-35	146	120-170	131	40-60
Anglian	mm	76	272		447		643		848	
	%	164	151	35-50	153	110-150	164	>>200	142	>200
Thames	mm	81	331		565		817		1023	
	%	162	154	30-50	162	150-250	173	>>200	148	>>200
Southern	mm	74	402		700		1036		1251	
	%	139	161	50-80	168	>200	183	>>200	161	>>200
Wessex	mm	82	368		673		956		1178	
	%	154	134	5-15	149	50-80	159	>200	141	110-150
South West	mm	107	454		848		1209		1482	
	%	155	111	2-5	126	5-15	137	35-50	126	20-30
Welsh	mm	132	454		904		1316		1668	
	%	165	106	2-5	125	5-15	135	35-50	127	30-45
Scotland	**mm**	**72**	**332**		**683**		**1055**		**1350**	
	%	**95**	**73**	**10-20**	**90**	**2-5**	**100**	**<2**	**94**	**2-5**
Highland	mm	82	354		759		1141		1447	
	%	90	62	35-50	78	10-15	85	5-10	82	10-20
North East	mm	52	294		584		849		1100	
	%	86	97	2-5	118	5-10	125	15-25	113	5-10
Tay	mm	57	374		708		1067		1355	
	%	93	91	2-5	108	2-5	118	5-10	110	2-5
Forth	mm	65	305		581		887		1177	
	%	110	87	2-5	102	2-5	111	2-5	106	2-5
Tweed	mm	74	290		564		821		1117	
	%	129	96	2-5	115	5-10	122	10-15	115	5-10
Solway	mm	100	376		816		1301		1663	
	%	129	83	2-5	110	2-5	125	10-20	117	5-15
Clyde	mm	87	393		798		1302		1641	
	%	103	73	10-15	89	2-5	103	2-5	97	2-5
Northern Ireland	**mm**	**67**	**249**		**544**		**834**		**1087**	
	%	**105**	**73**	**5-10**	**99**	**2-5**	**110**	**2-5**	**103**	**2-5**

RP = Return period

The monthly rainfall figures* are copyright of The Met. Office and may not be passed on to any unauthorised person or organisation. **All monthly totals since December 1998 are provisional (see page 12).** 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 England & Wales and Scotland rainfall series can exaggerate the relative wetness of the recent past. *See page 12. The rainfall figures presented here are derived from different raingauge networks to those used to derive the CRU data series (now updated by the Hadley Centre).

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

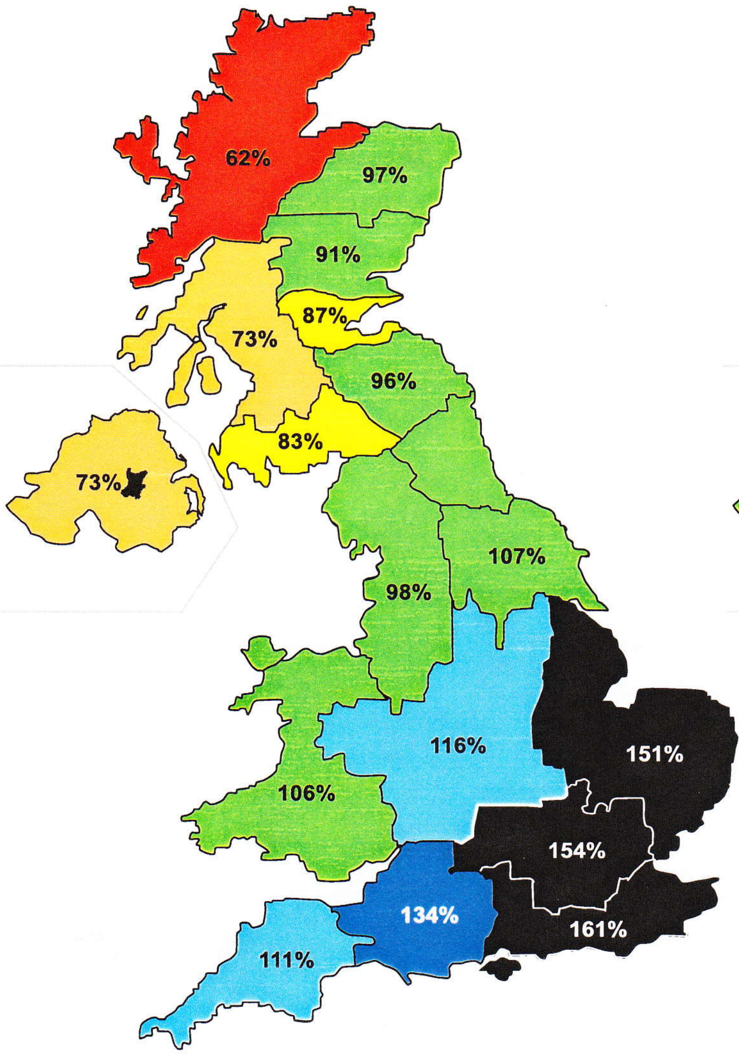
Above average

Normal range

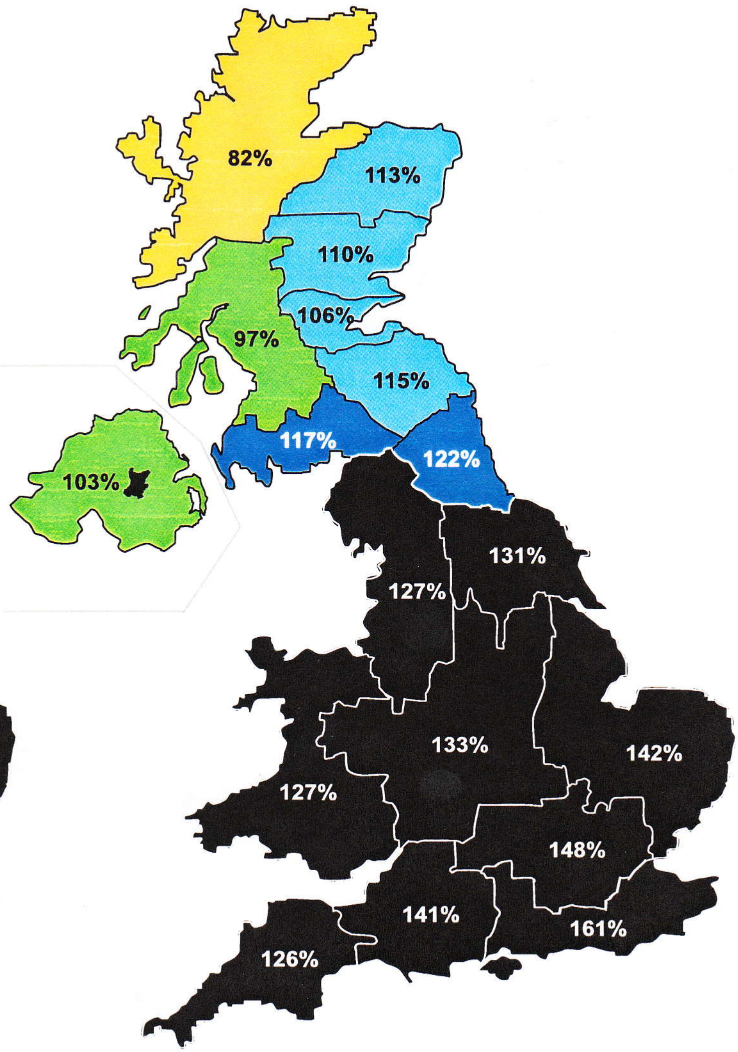
Below average

Substantially below average

Exceptionally low rainfall



January 2001 - April 2001

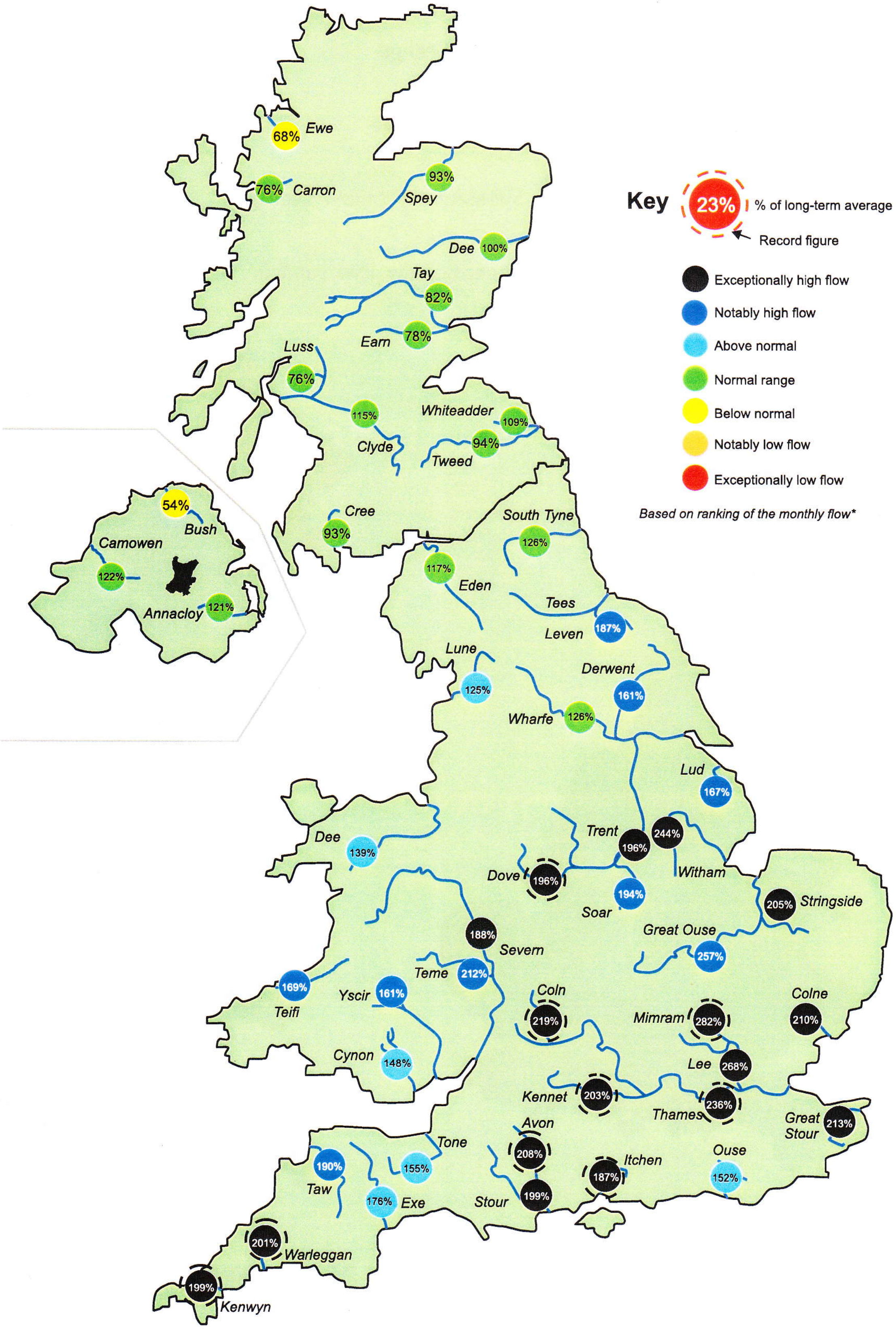


May 2000 - April

Rainfall accumulation maps

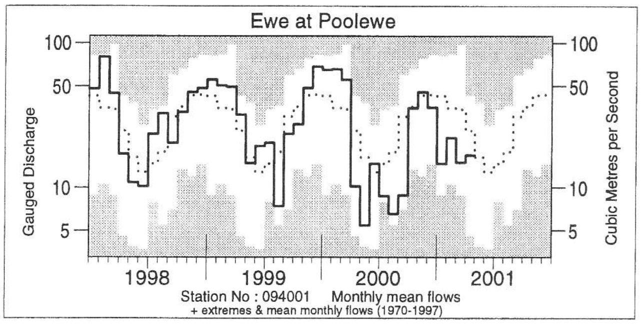
Whilst south-eastern regions of Britain have been very wet over the January-April period, Northern Ireland has had its driest start to the year since 1964; parts of western Scotland have been exceptionally dry also. Regional rainfall totals for the last twelve months serve to emphasise the recent moderation in the normal NW/SE gradient across the country: Scotland had its second driest May-April period in the last 16 years whereas the Thames Valley (most of the South-East also) registered its highest 12-month total, in this timeframe, in a catchment rainfall series from 1883.

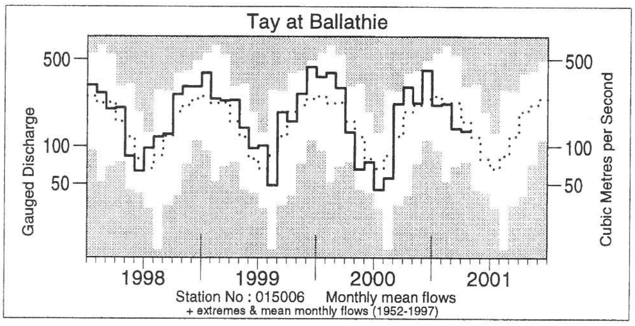
River flow . . . River flow . . .

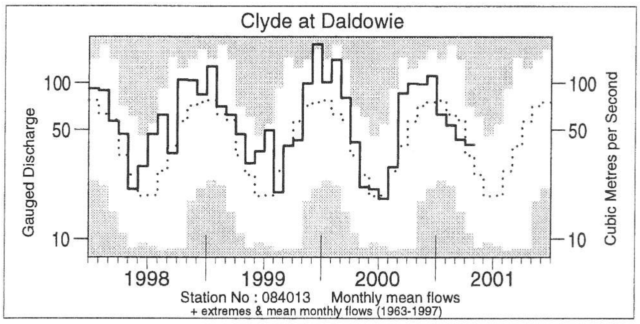


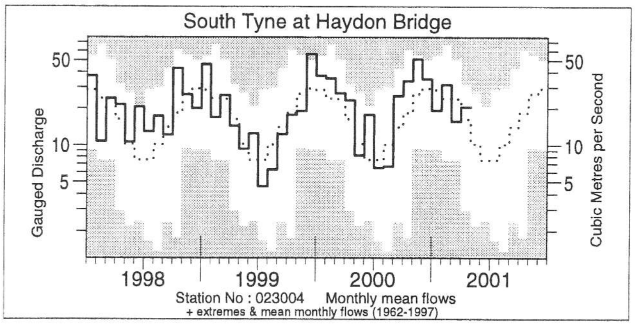
River flows - April 2001

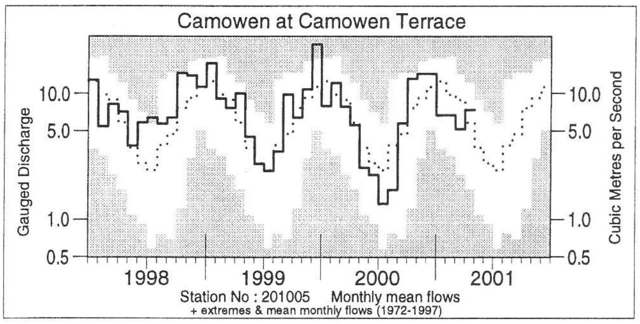
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

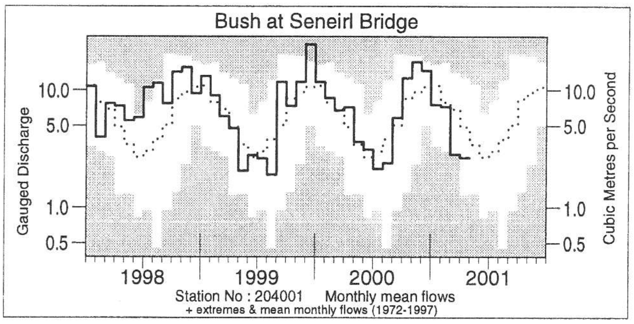


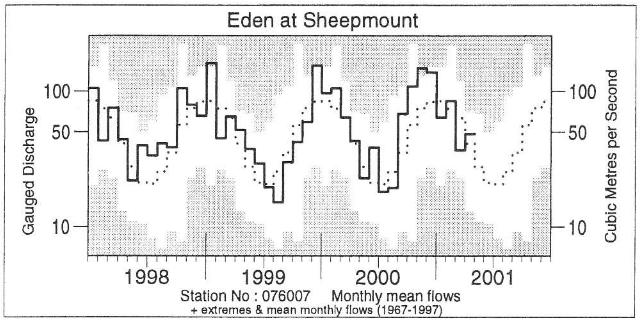


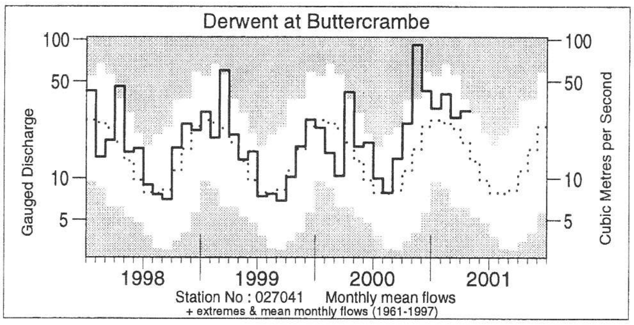


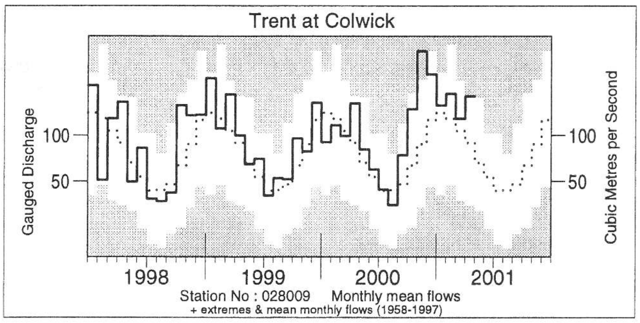


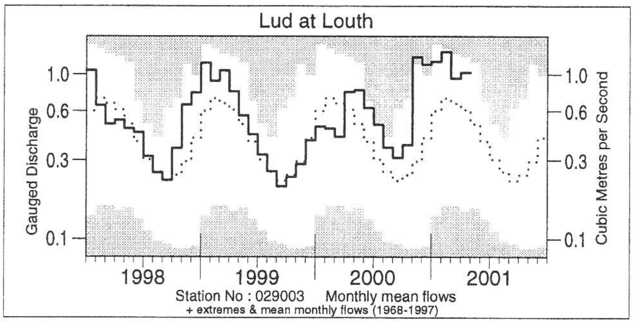








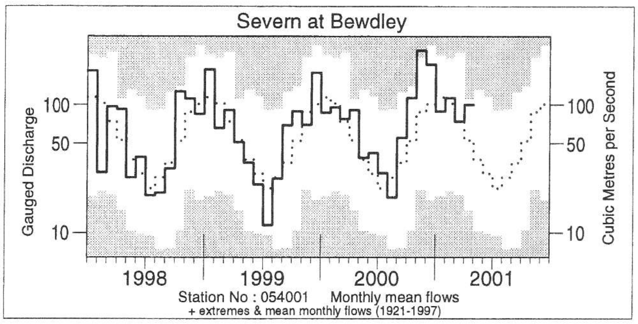


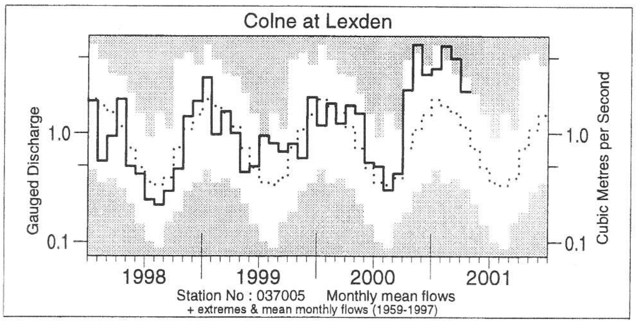


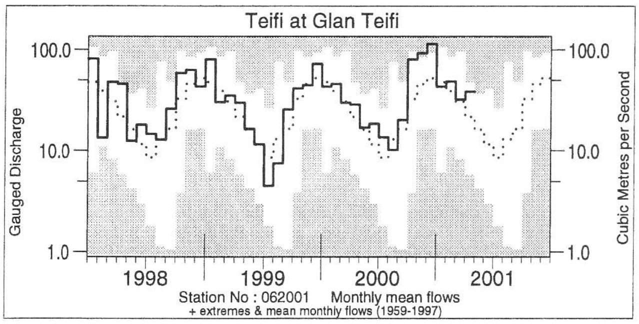
Monthly river flow hydrographs

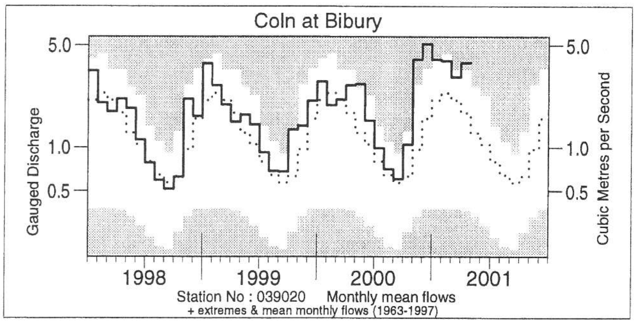
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

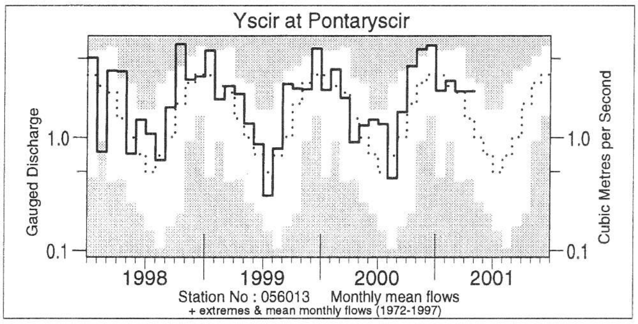
River flow . . . River flow . . .

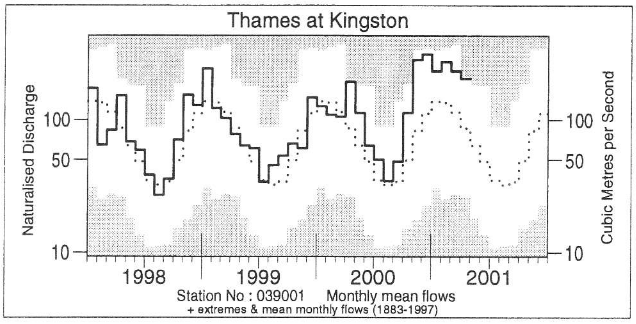


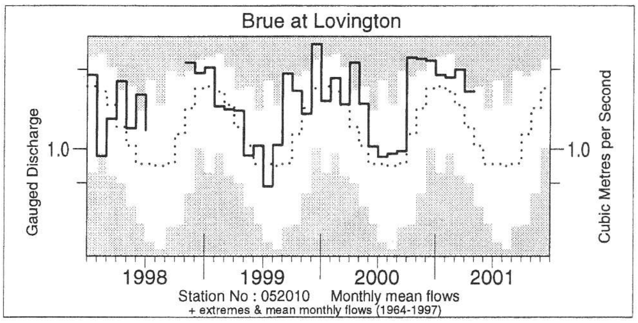


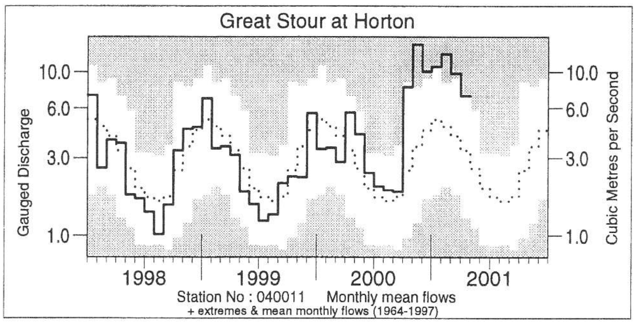


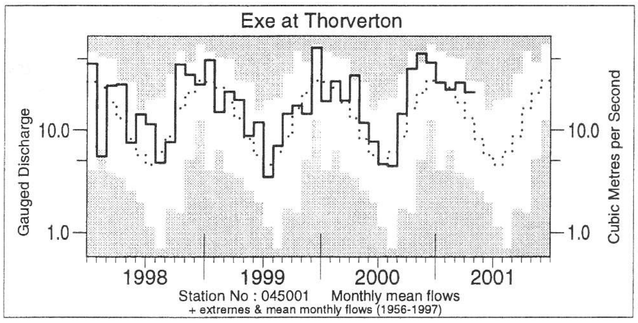


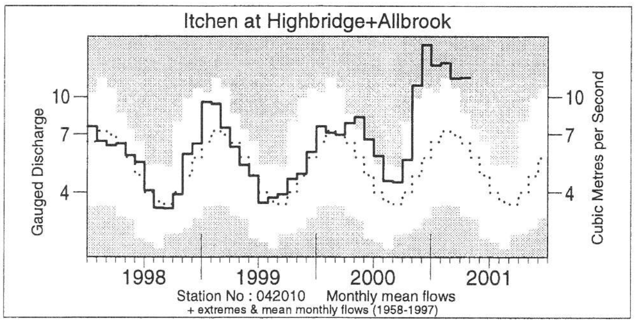










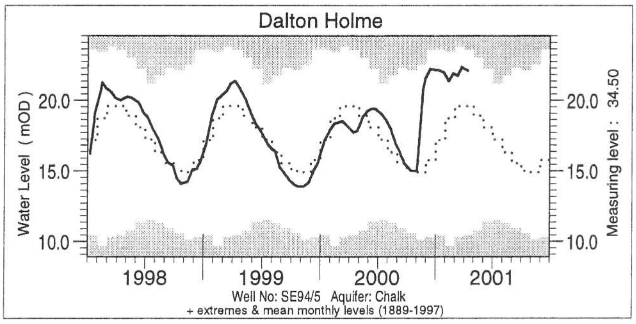


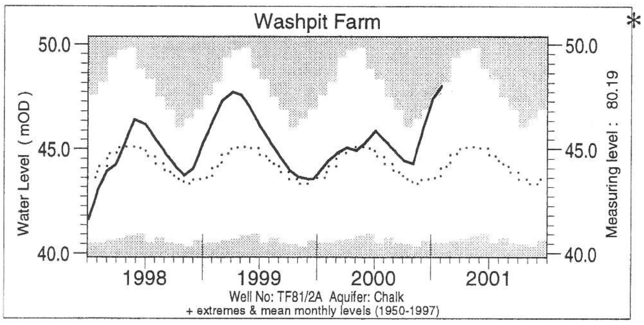
Notable runoff accumulations (a) November 2000 - April 2001, (b) May 2000 - April 2001

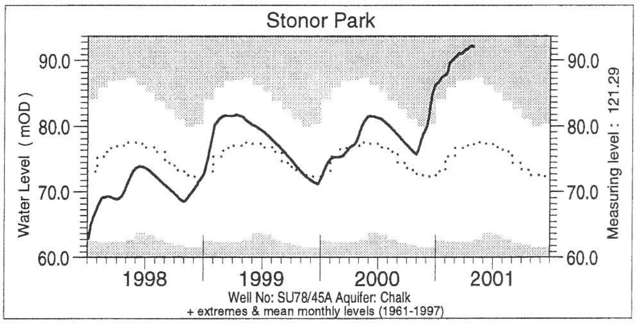
River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a) Lee	280	116/116	Wallington	267	48/48	(b) Ouse	219	68/68
Thames	227	118/118	Avon	231	36/36	Mole	241	26/26
Mimram	245	47/47	Luss	71	1/22	Severn	154	80/80
Great Stour	246	35/35	Annacloy	158	21/21	Dee	146	63/63

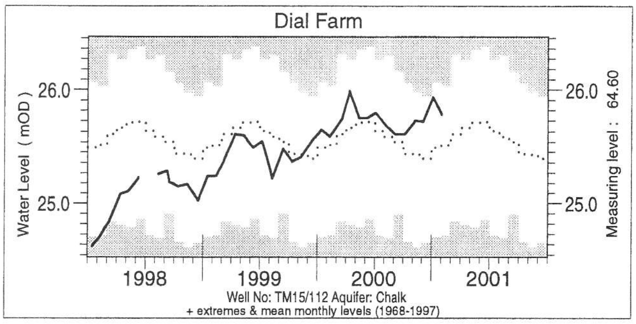
lta = long term average
Rank 1 = lowest on record

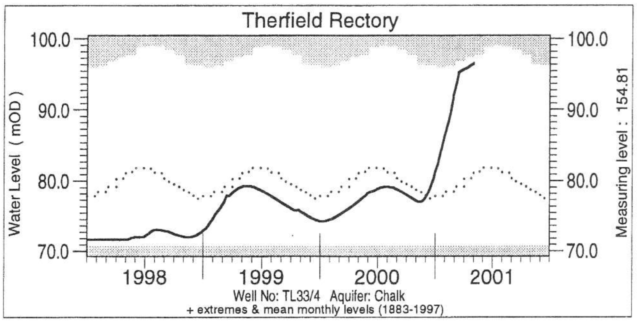
Groundwater . . . Groundwater

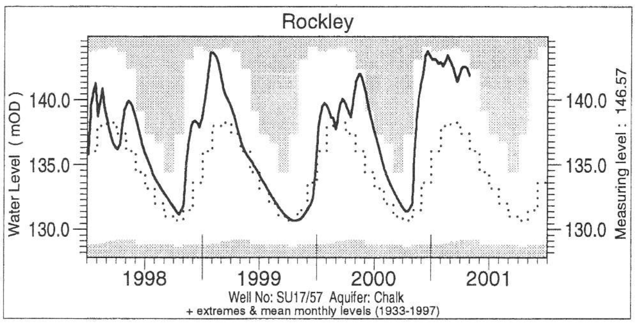


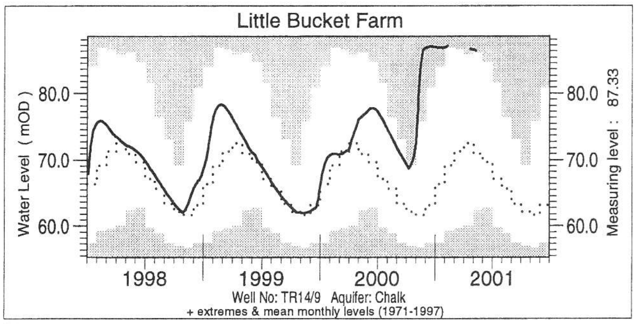


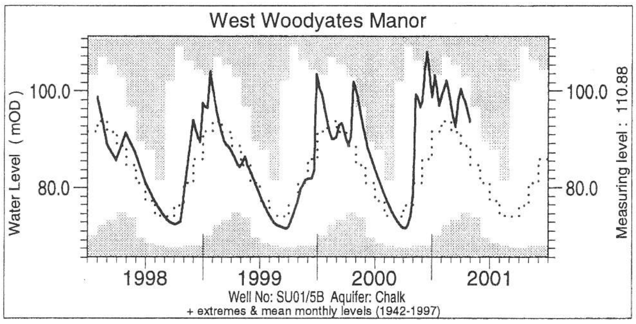


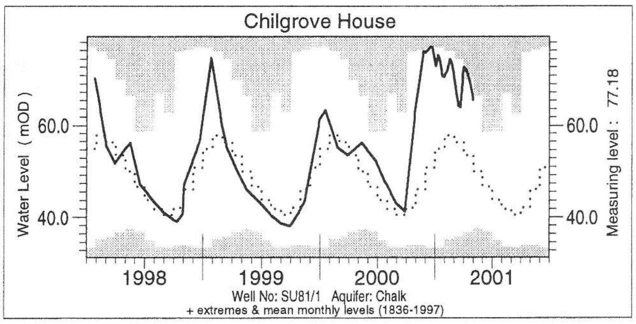


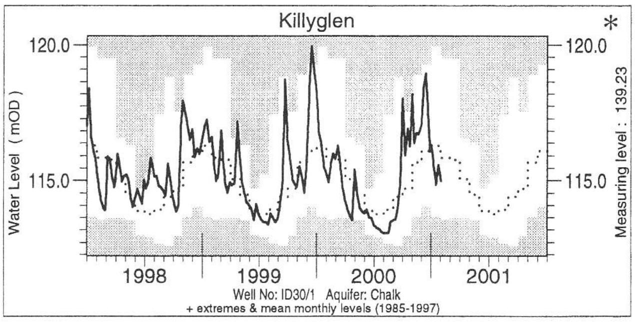








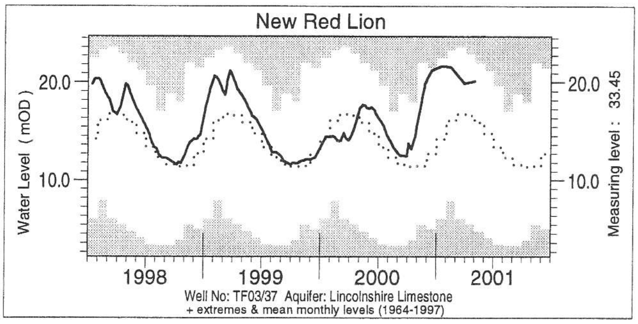




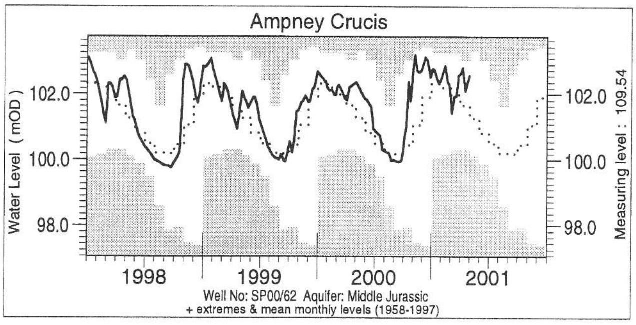
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

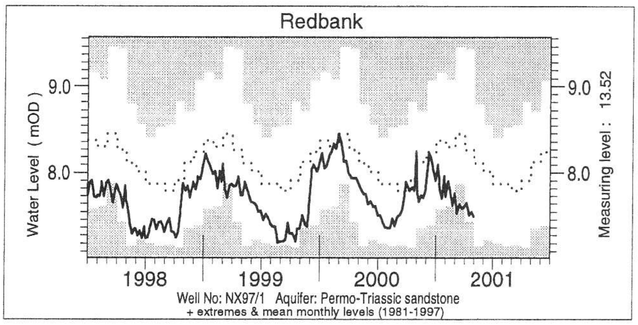
Groundwater . . . Groundwater



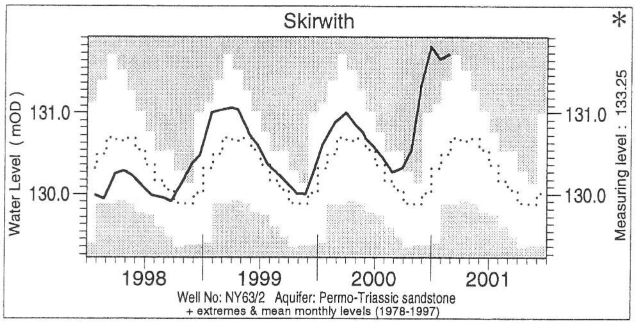
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1997)



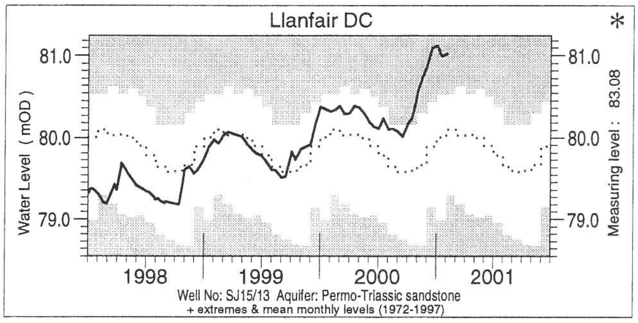
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1997)



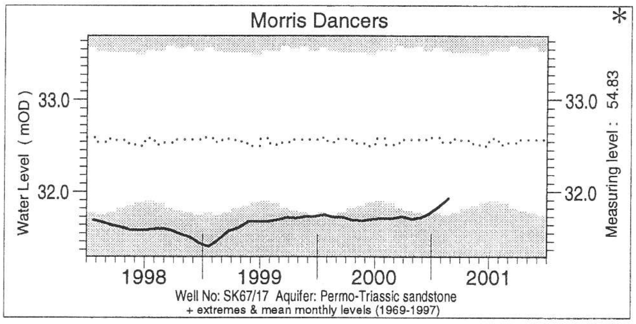
Well No: NX97/1 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1981-1997)



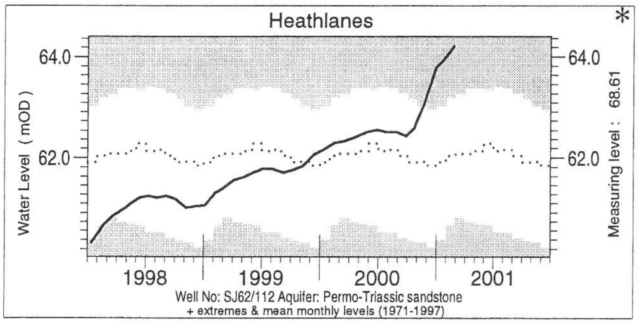
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-1997)



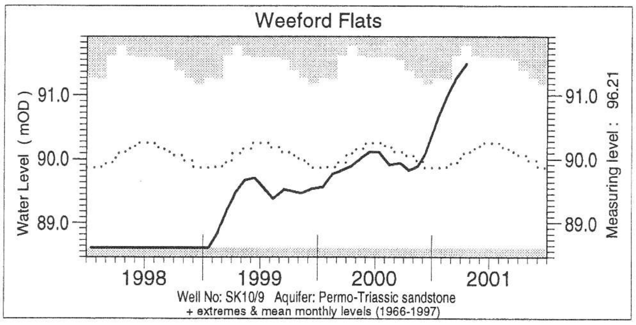
Well No: SJ15/13 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1997)



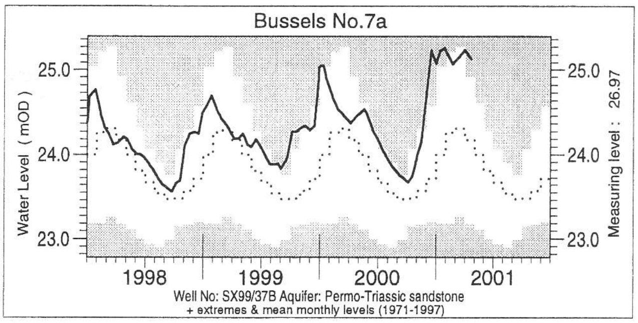
Well No: SK67/17 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1969-1997)



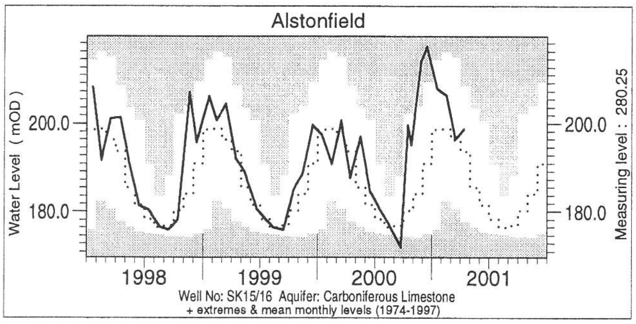
Well No: SJ62/112 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1997)



Well No: SK10/9 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1966-1997)



Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1997)



Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1997)

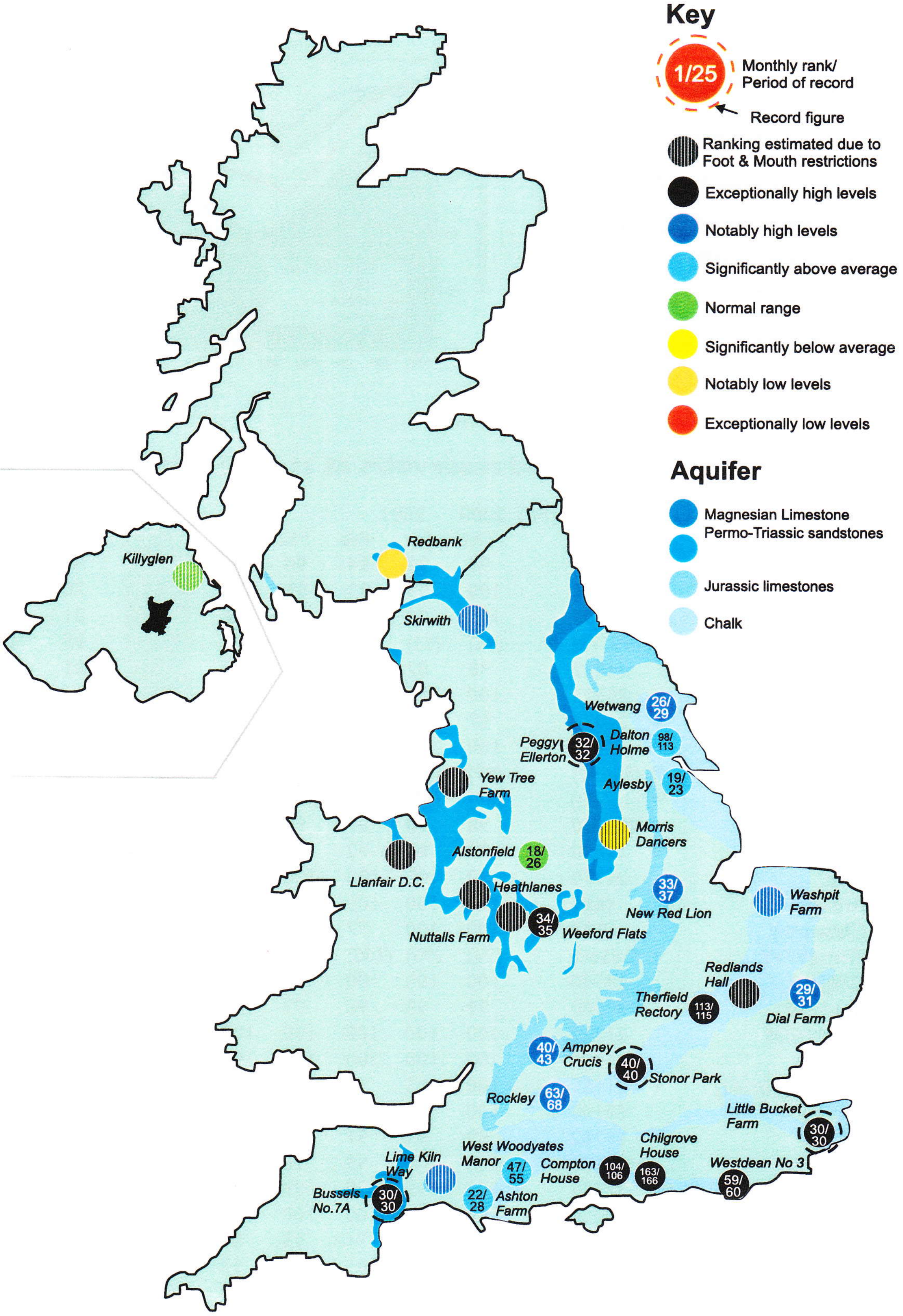
Groundwater levels April / May 2001

Borehole	Level	Date	Apr. av.	Borehole	Level	Date	Apr. av.	Borehole	Level	Date	Apr. av.
Dalton Holme	22.07	12/04	19.50	Chilgrove	65.56	30/04	52.23	Dial Farm	26.14	02/04	25.65
Wetwang	27.58	12/04	23.87	Weeford Flats	91.49	19/04	89.86	Westdean No.3	03.48	01/05	02.06
Therfield Rectory	96.57	02/05	80.37	New Red Lion	20.12	01/05	16.54	Little Bucket Farm	86.63	23/04	71.91
Ashton Farm	70.42	30/04	69.35	Ampney Crucis	102.57	30/04	101.72				
Aylesby	20.11	24/04	20.11	Redbank	8.25	30/04	7.49				
Peggy Ellerton	37.57	17/04	34.52	Alstonfield	198.78	12/04	193.50				
West Woodyates	93.66	30/04	88.36	Bussels No. 7A	25.13	19/04	24.16				

Data Missing due to Foot & Mouth restrictions

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

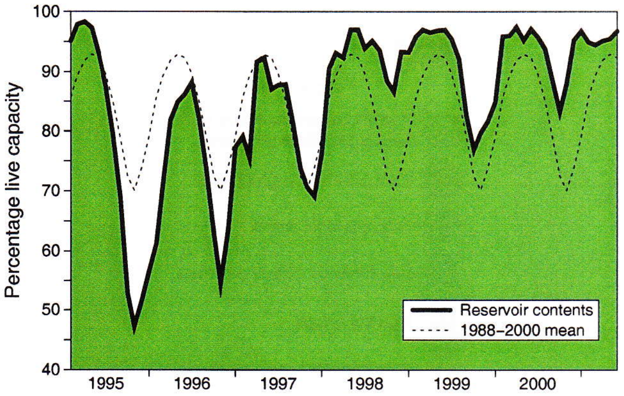


Groundwater levels - April 2001

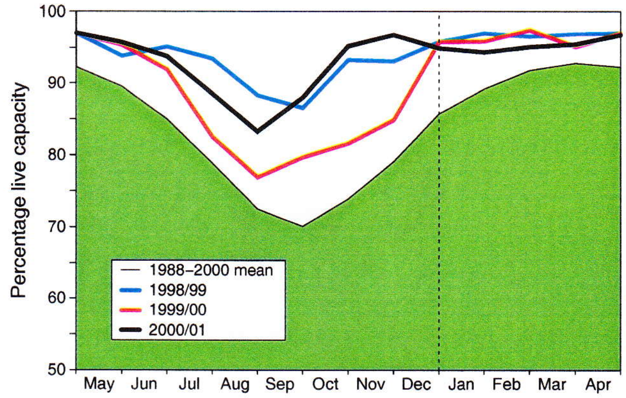
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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)	2000 Dec	2001 Jan	Feb	Mar	Apr	May	Min. May	Year* of min
North West	N Command Zone	• 124929	96	95	94	94	85	89	80	1996
	Vyrnwy	55146	100	93	93	98	100	99	70	1996
Northumbrian	Teesdale	• 87936	100	99	97	91	92	98	81	1996
	Kielder	(199175)	(95)	(93)	(91)	(92)	(92)	(91)	85	1990
Severn Trent	Clywedog	44922	98	82	82	91	99	98	85	1988
	Derwent Valley	• 39525	100	100	94	98	100	100	54	1996
Yorkshire	Washburn	• 22035	97	89	95	97	99	97	76	1996
	Bradford supply	• 41407	100	99	99	97	99	99	60	1996
Anglian	Grafham	** (55490)	(89)	(88)	(88)	(88)	(92)	(96)	73	1997
	Rutland	**(116580)	(89)	(89)	(86)	(92)	(95)	(99)	72	1997
Thames	London	• 202340	98	98	97	96	95	97	86	1990
	Farmoor	• 13830	90	80	72	81	90	98	81	2000
Southern	Bewl	28170	98	100	100	100	100	100	63	1990
	Ardingly	4685	100	100	100	100	100	100		
Wessex	Clatworthy	5364	100	100	97	100	100	100	81	1990
	Bristol WW	• (38666)	(99)	(95)	(100)	(98)	(98)	(98)	85	1990
South West	Colliford	28540	100	100	100	100	100	100	56	1997
	Roadford	34500	99	98	98	97	100	99	41	1996
	Wimbleball	21320	100	100	100	100	100	100	79	1992
	Stithians	5205	100	100	100	100	100	100	65	1992
Welsh	Celyn and Brenig	• 131155	100	95	97	99	100	100	75	1996
	Brianne	62140	100	94	97	95	97	100	86	1997
	Big Five	• 69762	89	94	97	97	98	97	85	1997
	Elan Valley	• 99106	100	100	99	98	99	99	91	1997
East of Scotland	Edinburgh/Mid Lothian	• 97639	100	99	99	99	97	97	62	1998
	East Lothian	• 10206	100	100	100	100	100	100	89	1992
West of Scotland	Loch Katrine	• 111363	98	90	94	95	88	83	83	2001
	Daer	22412	100	100	100	100	93	96	91	1995
	Loch Thom	• 11840	100	100	100	98	93	89	89	2001
Northern Ireland	Silent Valley	• 20634	85	100	95	96	100	93	58	2000

()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 where data commence in 1994). 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; the Hydrological Summaries for the autumn and early winter of 2000/2001, in particular, stand as a testimony to the assistance provided by many hydrometric personnel working in exceptionally challenging circumstances.

Subscription

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

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Selected text and maps are available on the WWW at http://www.nwl.ac.uk/ih

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