Hydrological summary
for the United Kingdom

July 2001

General

In weather terms July was a very mixed bag, featuring heatwave interludes and longer autumnal episodes. Thunderstorms – some of violent intensity – were common and spatial variations in rainfall were large; but the UK total was close to the July average. Despite surges in water demand, the decline in reservoir contents through July was moderate and overall stocks for England and Wales are very close to the early August average; stocks in some small impoundments in northern Britain are relatively low. River flows varied widely through the month with some notable summer spates and locally severe flooding. Mean flows were generally within the normal July range, and remain close to monthly maxima in many rivers draining permeable catchments in the English lowlands. Groundwater recessions are continuing but in the slower-responding aquifers levels remain more typical of the late winter. If the rapid decline in soil moisture deficits in early August is followed by average rainfall into the late autumn, groundwater recoveries in many areas are likely to commence at exceptionally high levels.

Rainfall

A high proportion of the July rainfall was convectional in character, in southern Britain particularly, and many notable precipitation totals were reported. 67.4 mm fell in 12 hours in Cardiff on the 3rd/4th and 55 mm was registered in three hours at Pembroke (return period > 50 years). The focus of thundery activity moved eastwards in mid-month; Keyworth (Notts) registered 96 mm in 15hrs on the 17/18th. During the same storm sequence 40.1 mm fell in three hours at Weybourne in Norfolk and at East Sheringham well over 250% of the July average fell in the three days ending on the 20th (RP > 200 years). Areas which missed the brunt of the storms were relatively dry (e.g in northern, and central southern, England); eastern catchments in Northern Ireland and Scotland were generally dry also. By contrast, July rainfall totals exceeded 150% of average across much of East Anglia, the South West and parts of Wales. For E&W as a whole, rainfall was only modestly above average – but it was still the wettest July since 1993, and notwithstanding the dry early summer, the 3rd wettest Jan-July period since 1979. Some catchments in western Scotland registered their first wet month this year and the provisional Jan-July total for Scotland is the lowest since 1955, over the same timespan, NI has had its lowest rainfall since 1953 (though 1975 was almost identical); a reflection of the unusually southerly track of many frontal systems through much of the year.

River Flow

Groundwater-dominated regimes aside, river flows in early July flows were below average across much of the UK, but spates interrupted the seasonal recessions and produced moderate to severe flooding. Widespread thunderstorms in the west produced a sharp increase in runoff rates on the 3rd/4th; urban flooding was also common (e.g. in Wales and Strathclyde) as drainage systems were overwhelmed producing substantial transport disruption. North Wales was badly affected (e.g. at Llandudno and Bala) and the peak flow on the River Dee (at New Inn) established a new maximum in a 31-year record; to the north, the Clyde established a new July maximum flow. Further thunderstorms generated widespread flow recoveries around the 18th, the Teme was among a number of rivers establishing new July maximum flows; local flooding was common in the Midlands and East Anglia. Monthly flows remain close to seasonal maxima in rivers supported primarily by baseflow; the Mimram established a new monthly record for the sixth successive month, and 12-month runoff totals are without precedent in many spring-fed streams. In western and northern parts of the UK (Strathclyde excepted) July mean river flows were mostly below average, notably so for the Lune. For a few rivers, monthly flows have been below average since last December and runoff for the year thus far is depressed – the lowest on record for the Luss and the Bush (NI).

Groundwater

Soil moisture deficits varied erratically throughout the month but increased briskly over the final week. Thunderstorms hot-spots aside, late-October smds were appreciably above average, notably so across the southern Chalk outcrop. Modest local infiltration followed the storms in some areas e.g. in the South-West but, as usual in the late summer, overall groundwater resources changed only modestly through July. An easing of Foot and Mouth restrictions provided a somewhat fuller picture of the varying responsiveness to rainfall patterns over the last six months. Steep declines have left levels in the Jurassic and Carboniferous limestones close to the late summer average. This is true of most western Chalk outcrops also (Killyglen in NI is an exception). However, levels in most of the slower-responding eastern outcrops remain close to, or above, seasonal maxima; new July maxima were established at Stonor and Washpit Farm. Exceptionally high summer levels also typify the slower-responding Permo-Triassic sandstones outcrops and most minor aquifers (including the Norfolk Drift and Essex gravels). Rainfall over the next 10-12 weeks will largely determine the timing of the 2001 recovery; an early onset followed by a wet winter would herald a second lengthy episode of remarkable high water-tables and exceptional winterbourne flows.

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	Jul 2001	May 01-Jul 01	*RP*	Jan 01-Jul 01	*RP*	Aug 00-Jul 01	*RP*	Feb 00-Jul 01	*RP*
England & Wales	**mm**	**67**	**149**		**487**		**1140**		**1581**	
	%	**108**	**78**	**5-10**	**103**	**2-5**	**127**	**30-50**	**123**	**40-60**
North West	mm	65	176		532		1446		1995	
	%	76	73	5-10	88	2-5	120	10-20	118	10-20
Northumbrian	mm	57	137		417		985		1415	
	%	88	73	5-10	92	2-5	115	5-10	115	10-15
Severn Trent	mm	71	165		444		995		1395	
	%	134	97	2-5	108	2-5	132	40-60	127	50-80
Yorkshire	mm	46	128		410		1008		1436	
	%	77	71	5-10	92	2-5	123	10-20	121	20-30
Anglian	mm	75	152		425		840		1169	
	%	152	103	2-5	129	10-20	141	>200	134	>200
Thames	mm	53	122		453		986		1366	
	%	108	76	2-5	121	5-10	143	120-170	137	>200
Southern	mm	50	96		498		1175		1584	
	%	104	62	5-15	123	5-10	151	>>200	143	>>200
Wessex	mm	68	126		494		1142		1587	
	%	132	74	2-5	111	2-5	136	50-80	133	110-150
South West	mm	79	146		599		1428		1942	
	%	115	69	5-10	97	2-5	122	10-20	117	10-20
Welsh	mm	95	200		654		1619		2246	
	%	123	84	2-5	98	2-5	123	15-25	122	30-40
Scotland	**mm**	**97**	**224**		**556**		**1390**		**1980**	
	%	**103**	**84**	**2-5**	**77**	**15-25**	**97**	**2-5**	**99**	**2-5**
Highland	mm	109	279		633		1526		2280	
	%	103	94	2-5	73	30-40	87	5-10	94	2-5
North East	mm	76	162		455		1107		1544	
	%	104	78	5-10	89	2-5	114	5-10	112	5-10
Tay	mm	88	189		563		1362		1883	
	%	114	81	2-5	88	5-10	111	2-5	109	2-5
Forth	mm	86	184		488		1176		1691	
	%	115	84	2-5	86	5-10	106	2-5	108	2-5
Tweed	mm	74	171		461		1109		1557	
	%	102	82	2-5	90	2-5	114	5-10	113	5-10
Solway	mm	93	208		584		1650		2233	
	%	103	80	2-5	82	5-10	116	5-15	113	5-15
Clyde	mm	123	268		661		1701		2361	
	%	113	92	2-5	80	10-15	100	<2	101	2-5
Northern Ireland	**mm**	**59**	**171**		**420**		**1104**		**1521**	
	%	**89**	**82**	**2-5**	**76**	**10-15**	**104**	**2-5**	**102**	**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

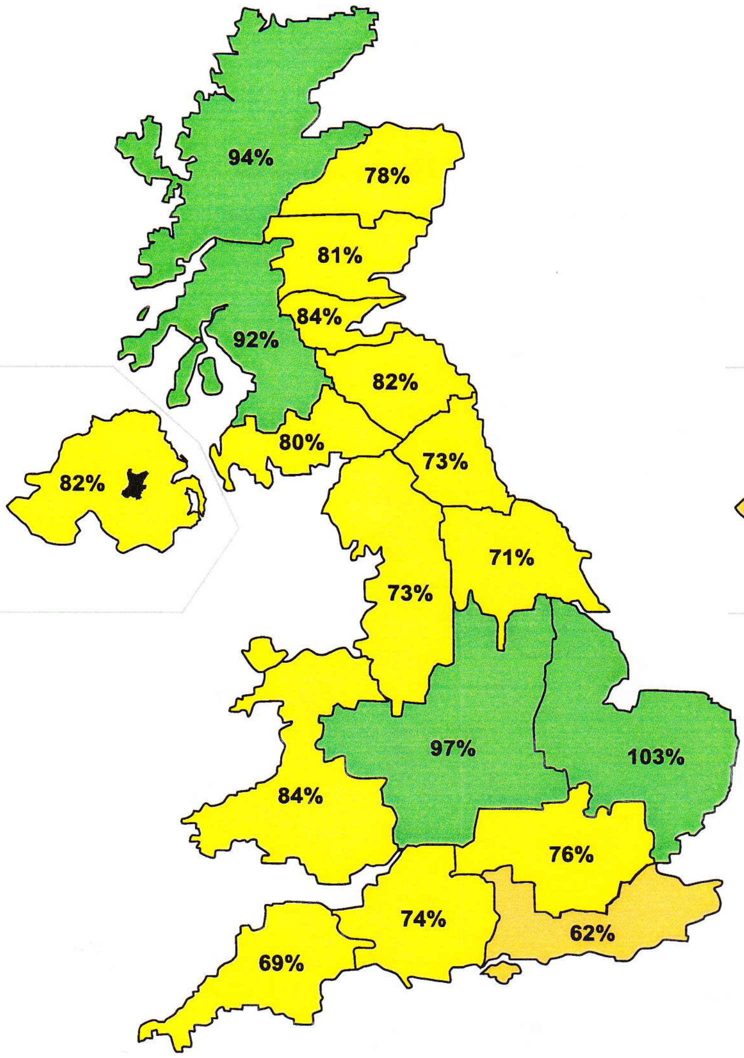
Above average

Normal range

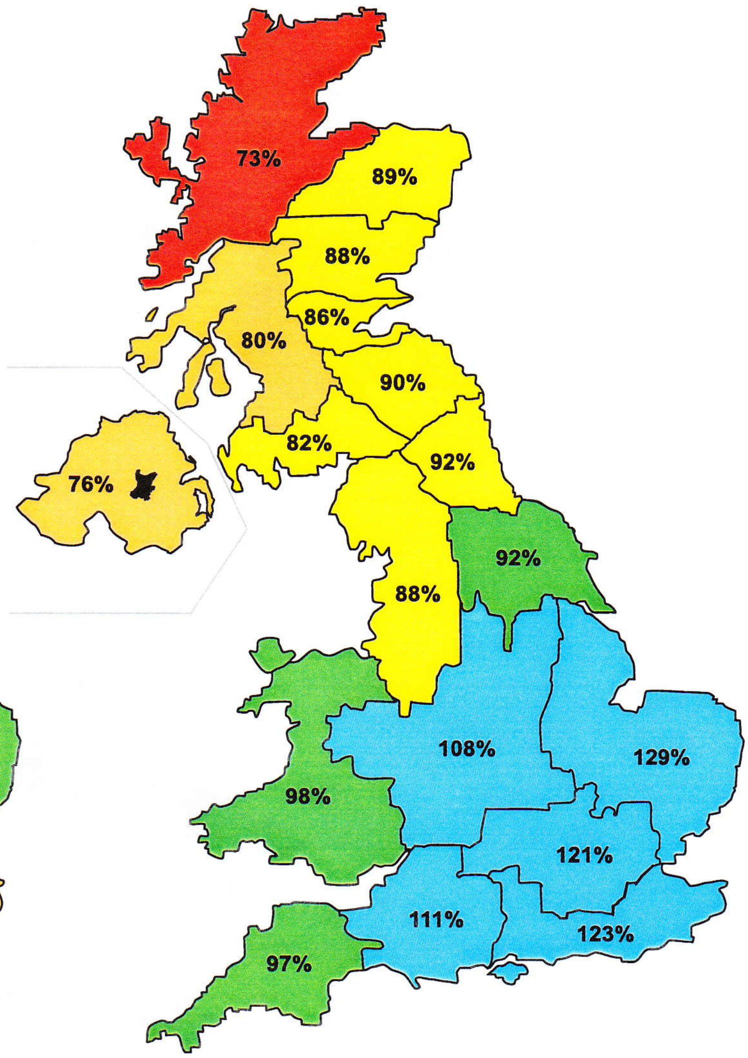
Below average

Substantially below average

Exceptionally low rainfall



May 2001 - July 2001

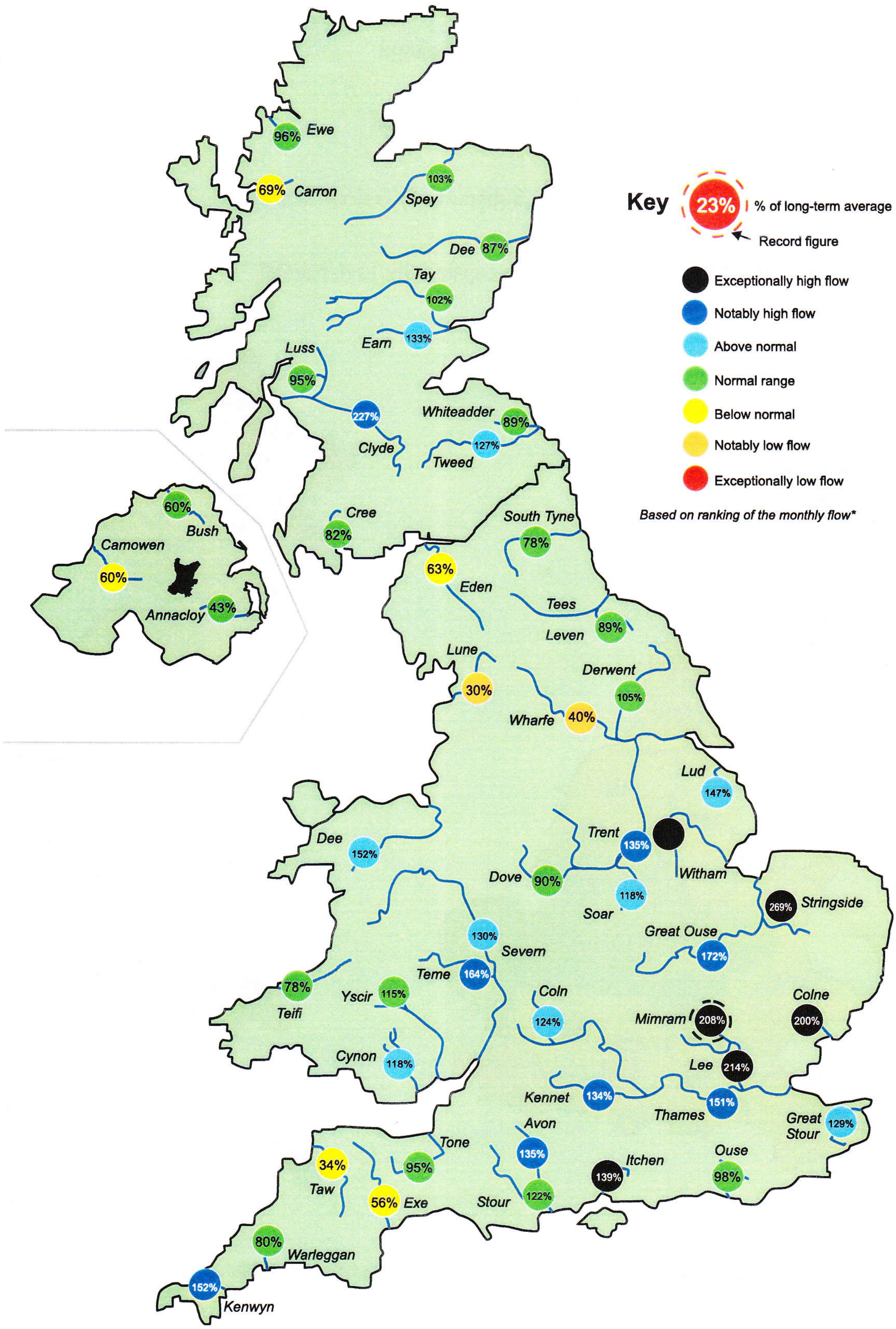


January 2001 - July 2001

Rainfall accumulation maps

Notwithstanding the July storms, rainfall over the last three months has been appreciably below average in most regions – notably so in the South East where for many catchments the May-July rainfall total ranks amongst the four lowest since 1976. The more southerly route taken by most active frontal systems in 2001 is reflected in the SE/NW contrast in percentage rainfall for the year thus far.

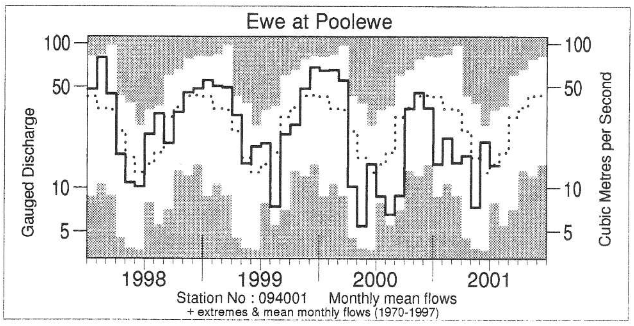
River flow . . . River flow . . .

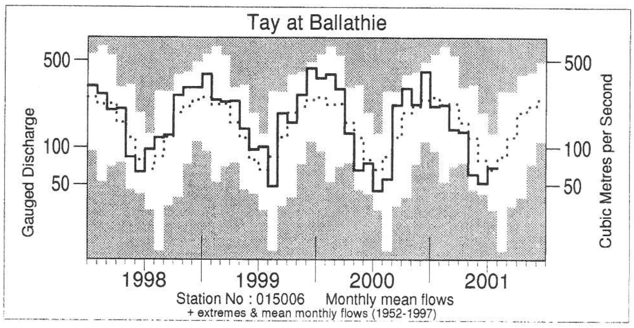


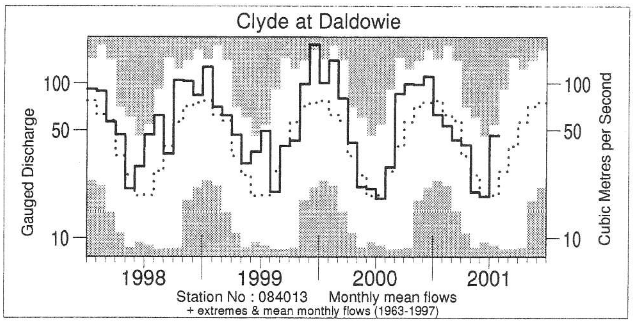
River flows - July 2001

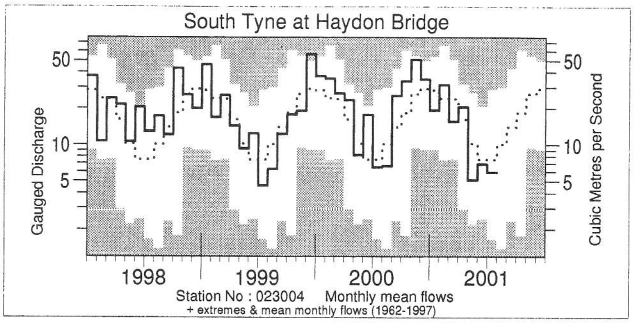
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

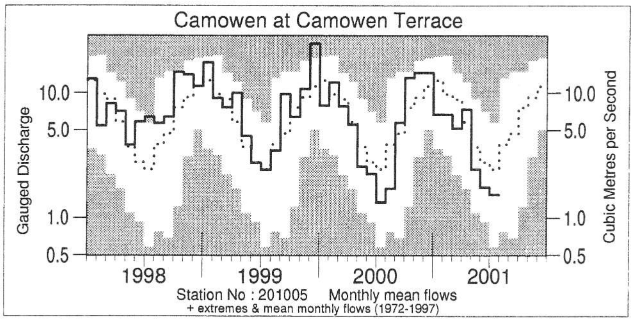
River flow . . . River flow . . .

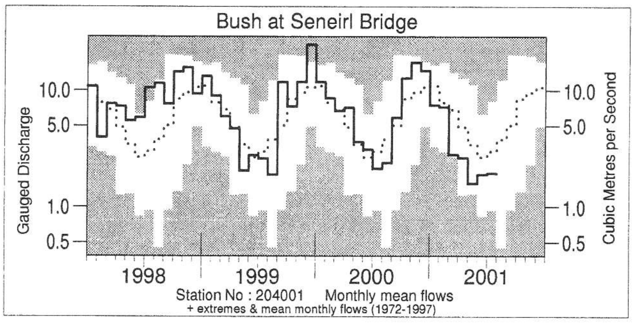


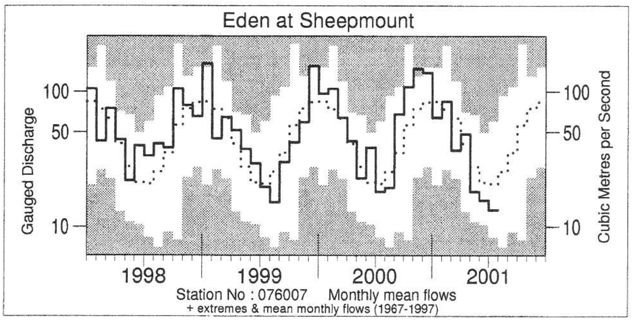


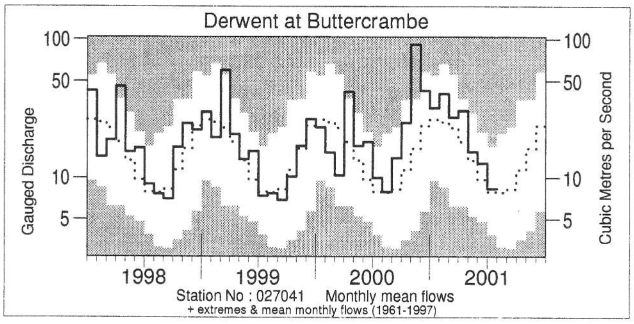


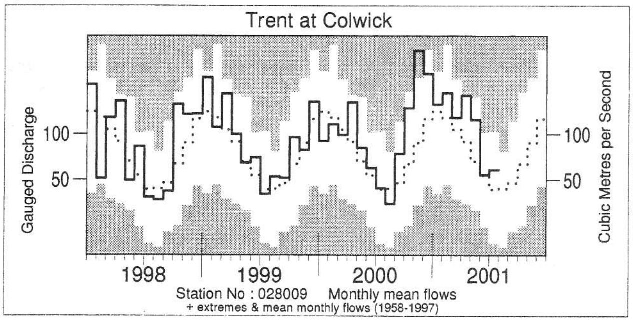


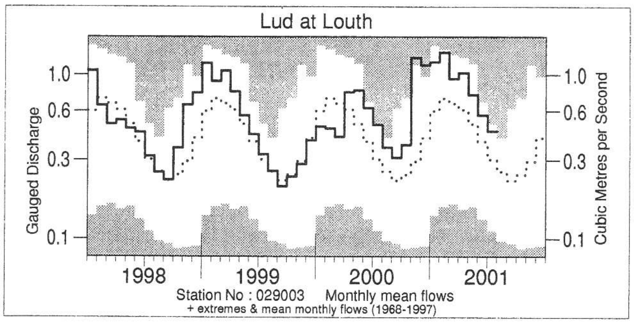








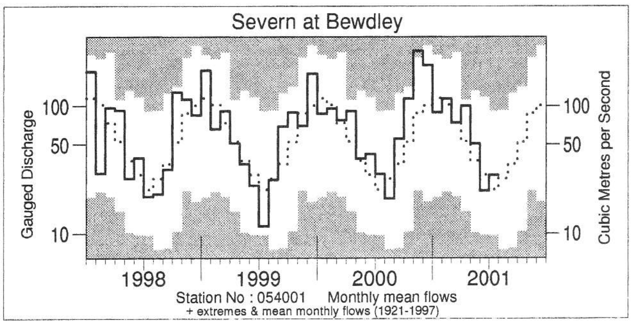


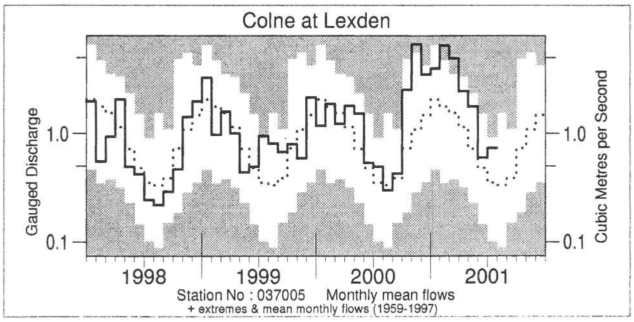


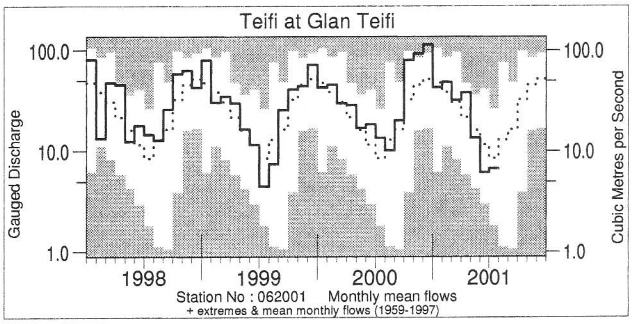
Monthly river flow hydrographs

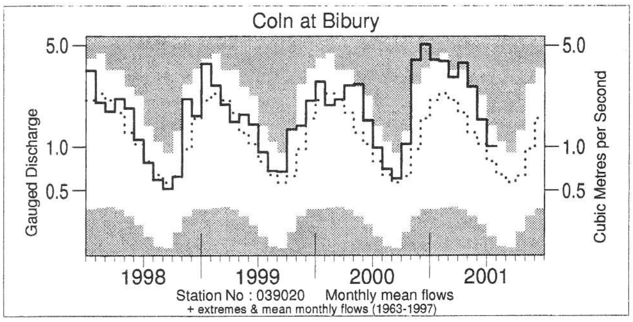
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

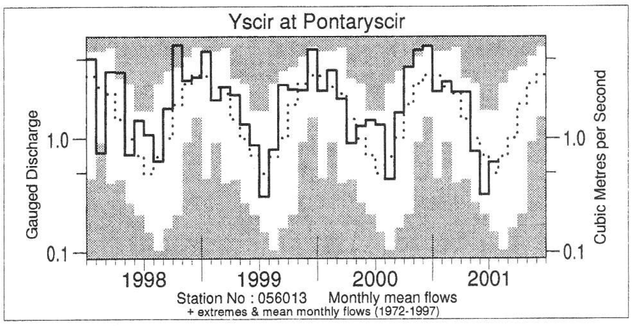
River flow . . . River flow . . .

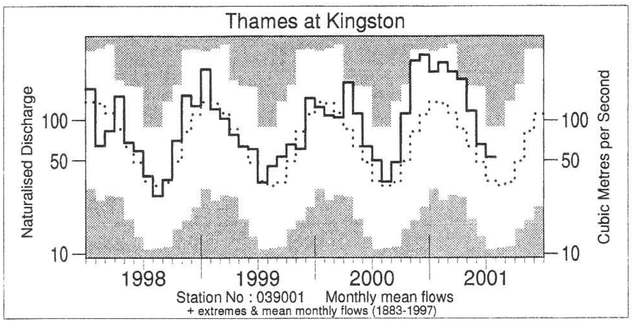


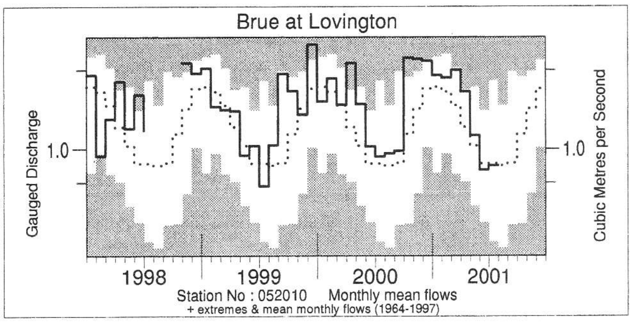


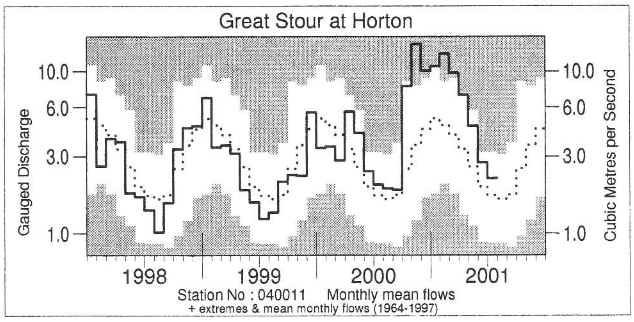


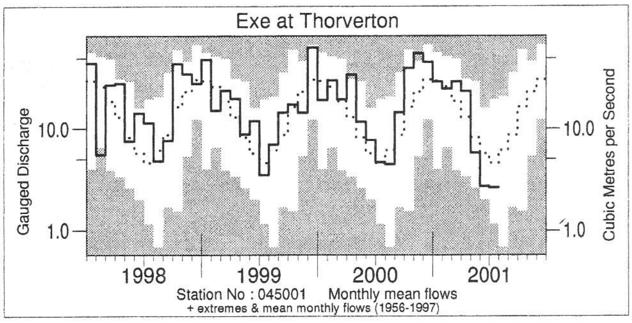


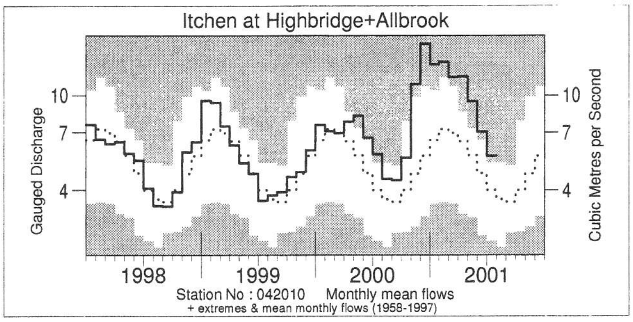










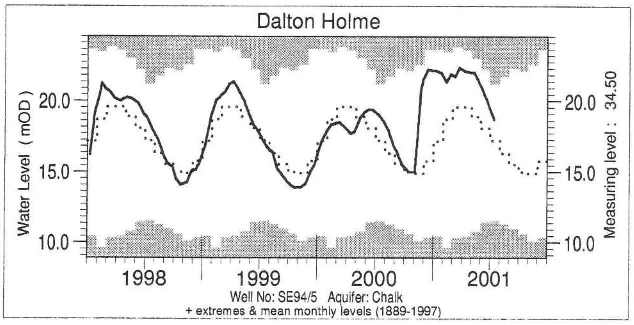


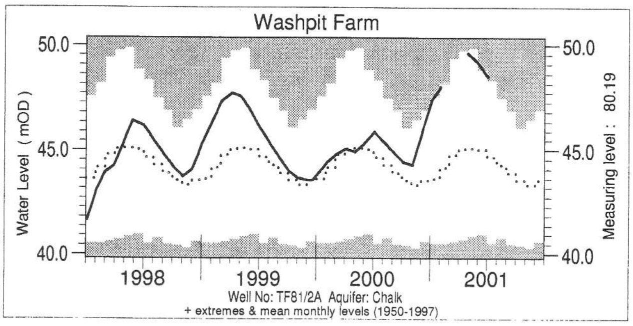
Notable runoff accumulations (a) May 2001 - July 2001, (b) January 2001 - July 2001

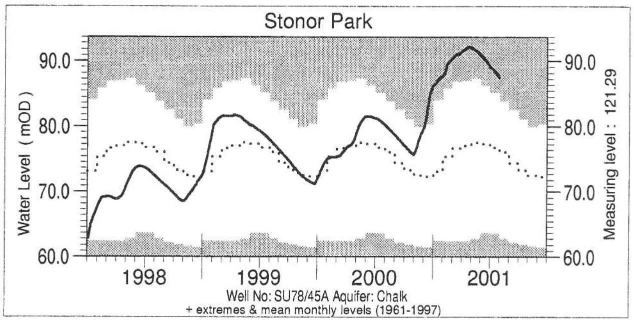
	River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a)	Mimram	230	49/49	Blackwater	197	49/49	Piddle	163	37/37
	Itchen	151	43/43	Kennet	181	40/40	Otter	137	39/39
(b)	Stringside	186	35/35	Gt Stour	205	35/35	Luss	64	1/23
	Colne	246	42/42	Wallington	202	48/48	Bush	64	1/29

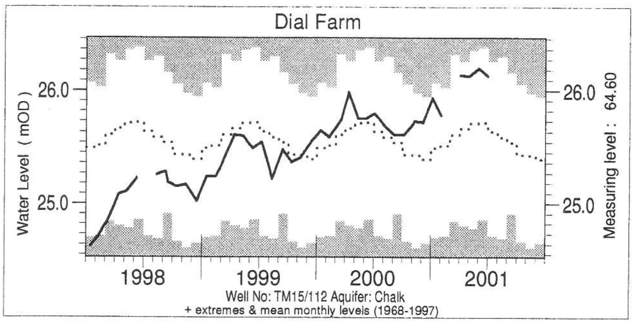
lta = long term average
Rank 1 = lowest on record

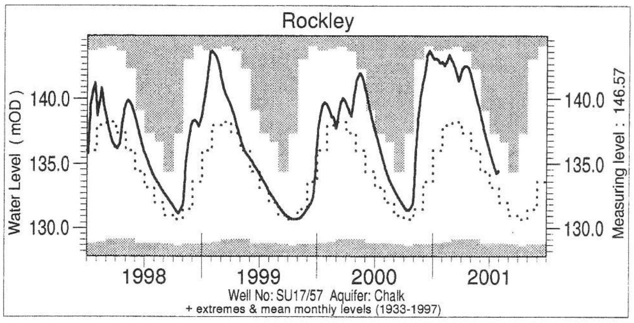
Groundwater . . . Groundwater

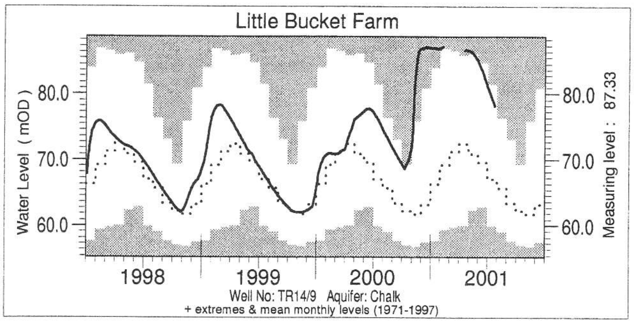


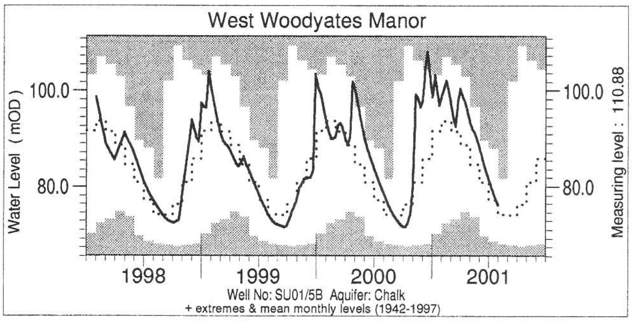


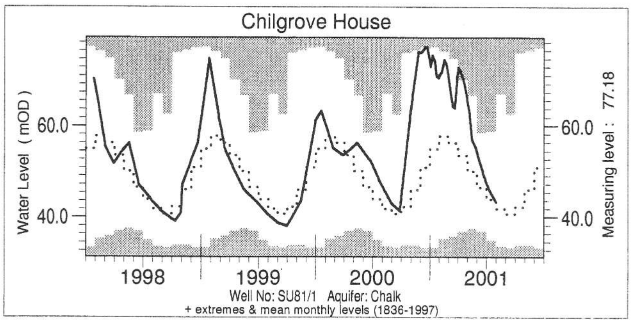


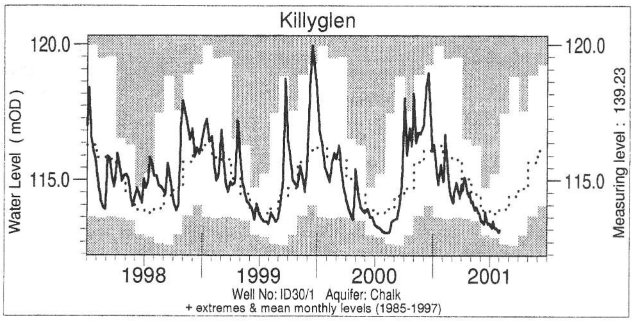


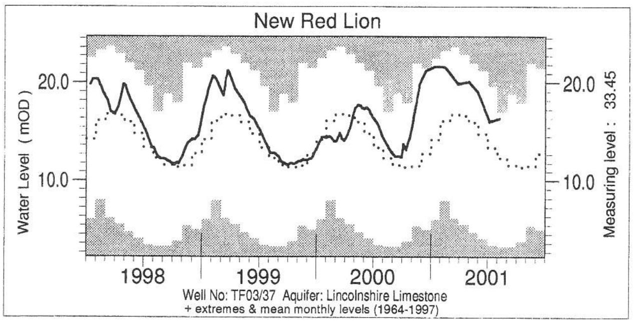








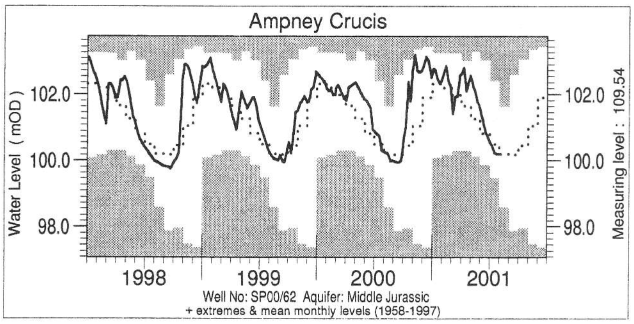


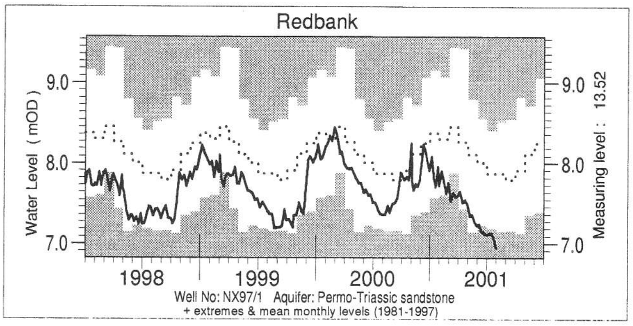


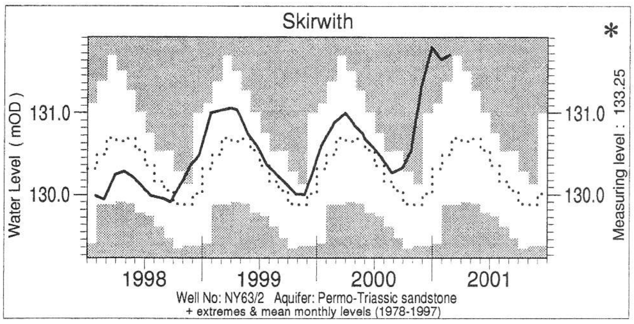
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

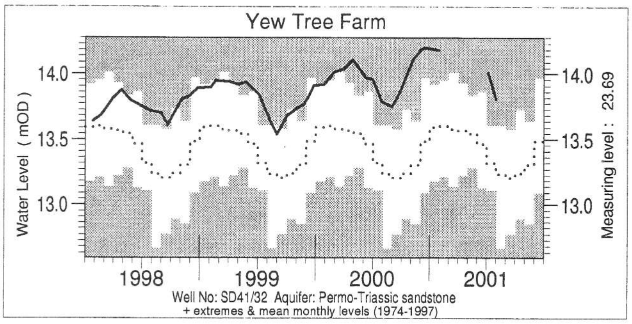
* No March - July groundwater levels available.

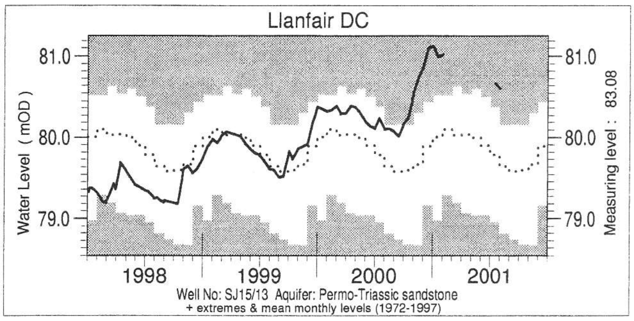
Groundwater . . . Groundwater

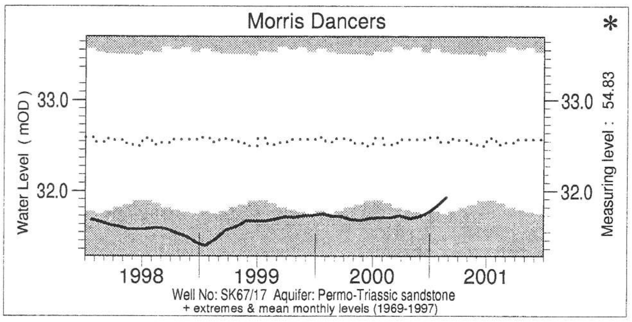


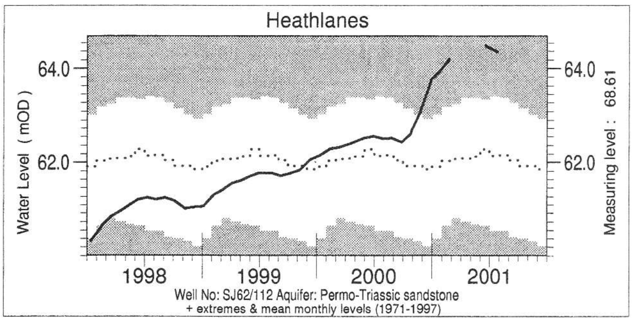


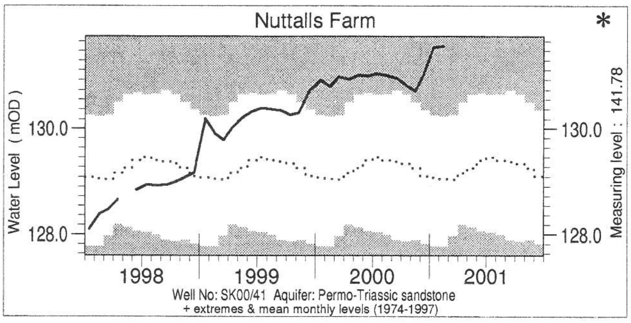


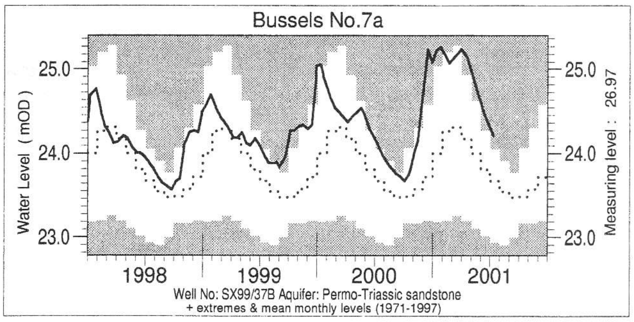


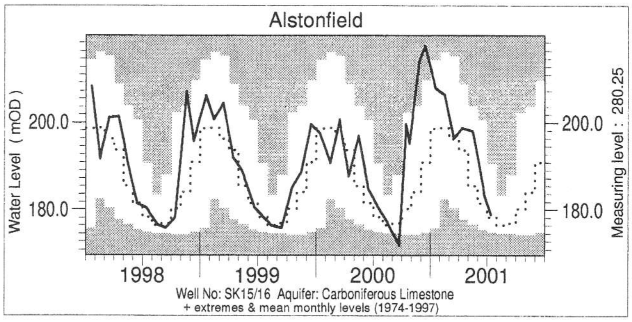












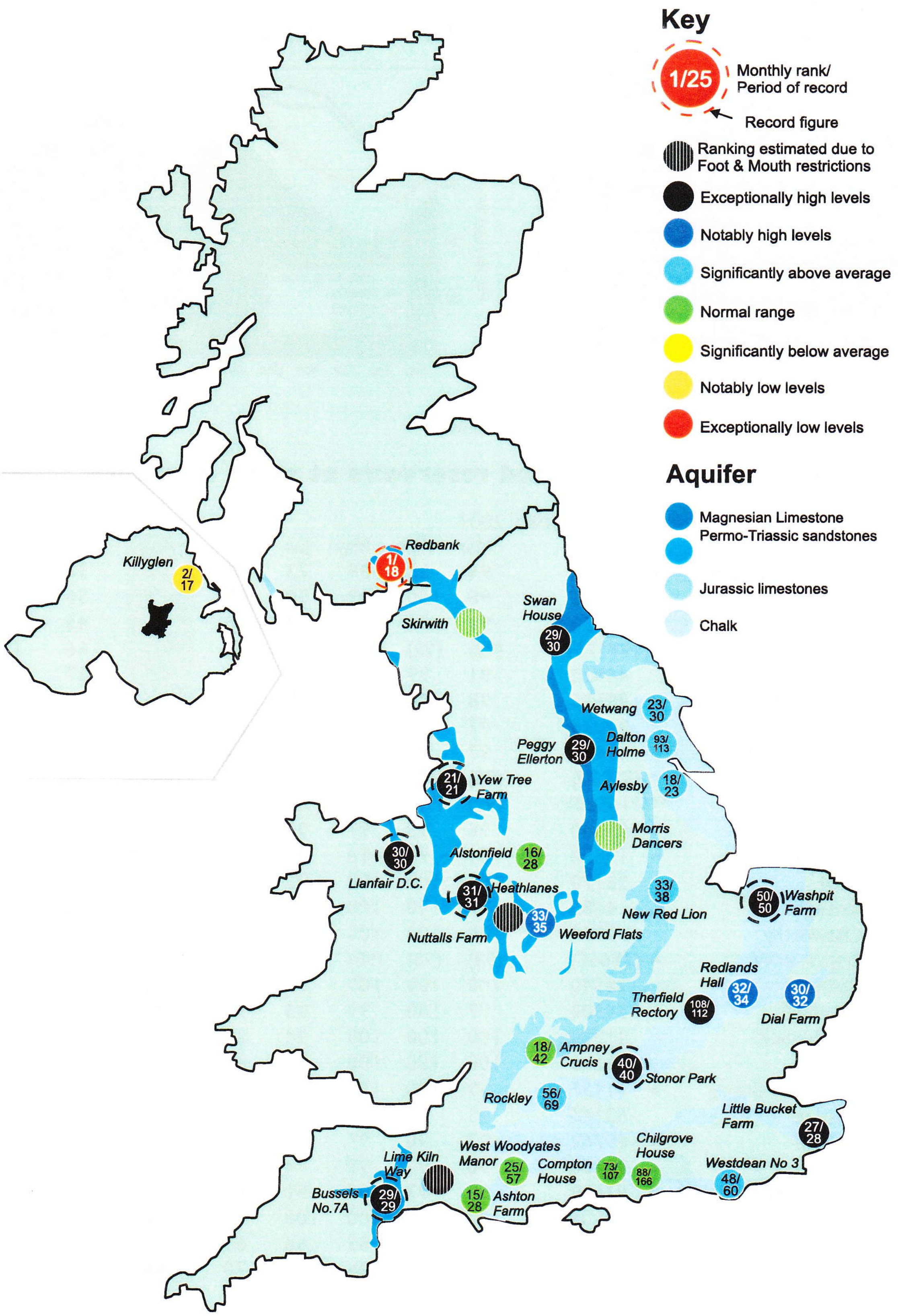
Groundwater levels July / August 2001

Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.	Borehole	Level	Date	Jul. av.
Dalton Holme	18.71	13/07	17.19	Chilgrove House	43.59	29/07	43.57	Heathlanes	64.35	26/07	62.09
Washpit Farm	48.50	04/07	44.79	Killyglen	113.17	02/08	113.78	Bussels No.7a	24.21	12/07	23.71
Stonor Park	87.55	30/07	77.35	New Red Lion	16.34	06/08	13.37	Alstonfield	178.88	13/07	178.94
Dial Farm	26.13	02/07	25.65	Ampney Crucis	100.21	30/07	100.46				
Rockley	134.45	30/07	133.20	Redbank	6.95	31/07	7.83				
Little Bucket Farm	78.18	24/07	68.50	Yew Tree Farm	13.81	31/07	13.18				
West Woodyates	76.16	31/07	76.95	Llanfair DC	80.60	01/08	79.68				

Data missing due to Foot & Mouth restrictions

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater



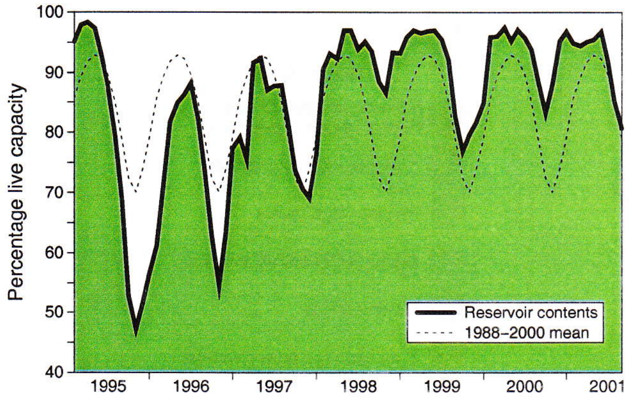
Groundwater levels - July 2001

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.

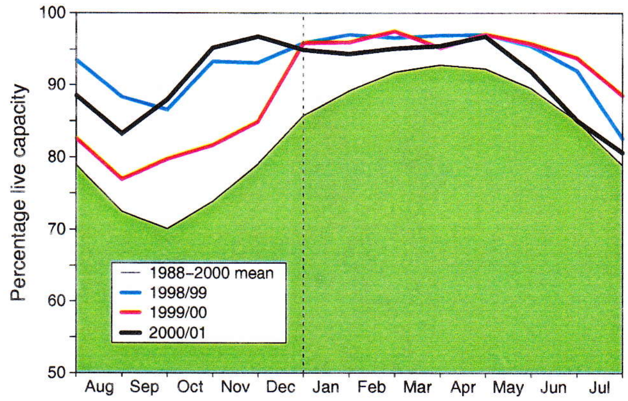
(Note: Redbank is affected by groundwater abstraction)

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)	2001 Mar	Apr	May	Jun	Jul	Aug	Min. Aug	Year* of min
North West	N Command Zone	• 124929	94	85	89	73	61	50	38	1989
	Vyrnwy	55146	98	100	99	90	80	79	56	1996
Northumbrian	Teesdale	• 87936	91	92	98	84	76	65	45	1989
	Kielder	(199175)	(92)	(92)	(91)	(90)	(88)	(89)	66	1989
Severn Trent	Clywedog	44922	91	99	98	90	80	61	57	1989
	Derwent Valley	• 39525	98	100	100	97	80	71	43	1996
Yorkshire	Washburn	• 22035	97	99	97	89	81	75	50	1995
	Bradford supply	• 41407	97	99	99	85	77	64	38	1995
Anglian	Grafham	** (55490)	(88)	(92)	(96)	(96)	(95)	(94)	66	1997
	Rutland	**(116580)	(92)	(95)	(99)	(96)	(90)	(85)	74	1995
Thames	London	• 202340	96	95	97	98	94	91	73	1990
	Farmoor	• 13830	81	90	98	98	98	96	84	1990
Southern	Bewl	28170	100	100	100	98	93	85	45	1990
	Ardingly	4685	100	100	100	100	96	91	66	1995
Wessex	Clatworthy	5364	100	100	100	87	75	64	43	1992
	Bristol WW	• (38666)	(98)	(98)	(98)	(94)	(83)	(75)	53	1990
South West	Colliford	28540	100	100	100	97	91	82	47	1997
	Roadford	34500	97	100	99	95	91	85	46	1996
	Wimbleball	21320	100	100	100	94	82	69	53	1992
	Stithians	5205	100	100	100	94	83	66	39	1990
Welsh	Celyn and Brenig	• 131155	99	100	100	100	96	96	65	1989
	Brianne	62140	95	97	100	94	85	81	67	1995
	Big Five	• 69762	97	98	97	89	76	78	41	1989
	Elan Valley	• 99106	98	99	99	94	86	87	63	1989
East of Scotland	Edinburgh/Mid Lothian	• 97639	99	97	97	91	82	80	51	1998
	East Lothian	• 10206	100	100	100	100	93	91	72	1992
West of Scotland	Loch Katrine	• 111363	95	88	83	66	61	57	53	2000
	Daer	22412	100	93	96	81	70	64	58	1994
	Loch Thom	• 11840	98	93	89	74	70	66	59	2000
Northern Ireland	Silent Valley	• 20634	96	100	93	83	72	59	42	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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