Hydrological summary

for the United Kingdom

August 2001

General

August was a generally warm but unsettled month with several brief heatwaves and above average rainfall in most regions – intense storms triggered localised flooding in many areas. Rainfall for the UK as a whole was a little above average and long term accumulations for England and Wales remain exceptionally high. Correspondingly reservoir stocks are generally healthy, overall stocks for E&W are around 7% above the early September average - a shade less than at the corresponding time last year. River flows are generally within the normal range but remain very high – for the late summer - in many spring-fed rivers in the South and East. Groundwater levels are generally in seasonal decline but overall groundwater resources remain very healthy. The record late-summer groundwater levels in some areas could, given another wet winter, herald further groundwater flooding in 2001/02 – its likelihood will be significantly influenced by the speed of decline of soil moisture deficits through the autumn.

Rainfall

Across much of the UK, August was characterised by a series of warm anticyclonic interludes punctuated by unsettled spells during which thunderstorms produced significant local damage. Exceptional rainfall events were especially common during the second week (e.g. 55.6 mm at Northolt in 12 hours on the 9th, including 34 mm in < 1 hour) and in the third week - 54 mm was recorded at St Marys (Isles of Scilly) on the 18th. The last 10 days of the month were largely dry in most areas. Frequent convective storms made for limited spatial coherence in monthly rainfall totals. A few catchments in south-west England and in the western Highlands of Scotland reported <50% of the August average whilst several coastal districts in Kent and Essex registered >200%. The Thames basin recorded its 5th wettest August in the last 25 years. National and regional rainfall totals showed rather more coherence; totals for England & Wales, Scotland and Northern Ireland are all close to, or a little above, the August average. Similarly, summer (June-Aug) rainfall was in the normal range in most regions. Longer term rainfall accumulations remain outstanding across much of E&W. The 12-month total ranks second highest (in the Sept-Aug timeframe) after 1876/77 in the 335-year national rainfall series; long-term catchment rainfall records continue to be eclipsed, in the English lowlands particularly. A further reflection of the unusual synoptic patterns experienced over the recent past is the notable long term rainfall deficiency in the Western Isles and the western Highlands of Scotland – stretching back, in some areas, to the spring of 2000.

River Flow

Seasonal recessions were interrupted by localised, mostly urban, flood events (e.g. in Portsmouth on the 9th) and more widespread spates following prolonged frontal rainfall. In Wales, the Tawe reported its second highest August flow – on the 12th - in a record from 1957; notable spates were reported in some East Anglian rivers also (e.g. the Colne). Catchment geology remains very influential in determining flow rates. August runoff was in the normal range in most impermeable western and northern catchments, albeit well below average in a few, e.g. the Taw, Cree and Annacloy. By contrast, flows remain very high in many southern spring-fed rivers where the residual impact of the exceptional 2000/01 recharge is still evident. The Mimram established established a new maximum August mean flow and summer runoff totals are close to the highest on record in many chalk rivers. Runoff accumulations are even more notable over longer timespans. Sept-Aug totals are the highest on record for a clear majority of catchments in E&W, and for some in eastern Scotland and Northern Ireland. Many southern rivers (including the Thames) have established new runoff maxima for any 12-month sequence. By contrast, Sept-Aug runoff for rivers draining west from the Scottish Highlands are amongst the lowest on record.

Groundwater

As over much of preceding year, August rainfall patterns favoured aquifer outcrop areas in eastern and southern England. However, as usual in August, infiltration was minimal and local (but an upturn in groundwater levels was noted in parts of the Norfolk Drift). A steep decline in groundwater levels since the spring has returned them to the normal range across many western and northern outcrops. Levels in the Chalk reflect aquifer characteristics as much as rainfall patterns – being mostly in the normal range in the west but still close to seasonal maxima in many eastern areas – where levels in some minor aquifers (e.g. the Essex Gravels) are at seasonal maxima. Groundwater levels are close to the seasonal mean in most limestone outcrops but remain very high in the Magnesian limestone – this is true of many slower-responding Permo-Triassic sandstones aquifer units also (note: levels at Redbank are influenced by groundwater abstraction). Exceptional early autumn groundwater levels have raised concern that a steep decline in soil moisture deficits could – in the event of a wet winter - foreshadow further groundwater flooding (e.g. in the Chalk of the Chilterns and South Downs). Fortunately smds are currently above average throughout most of the English Lowlands and, given average rainfall should delay the seasonal recovery for around 10-12 weeks.

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	Aug 2001	Jun01-Aug01	RP	Mar01-Aug01	RP	Jan01-Aug01	RP	Sep00-Aug01	RP
England & Wales	mm	**86**	**195**		**442**		**630**		**1270**	
	%	**112**	**96**	**2-5**	**109**	**2-5**	**113**	**2-5**	**139**	**>200**
North West	mm	98	219		448		630		1443	
	%	92	80	2-5	87	2-5	88	2-5	120	10-20
Northumbrian	mm	70	191		340		487		986	
	%	86	93	2-5	86	2-5	91	2-5	116	5-10
Severn Trent	mm	70	175		393		514		1010	
	%	104	97	2-5	111	2-5	108	2-5	134	60-90
Yorkshire	mm	79	174		352		489		1036	
	%	107	90	2-5	93	2-5	95	2-5	126	20-35
Anglian	mm	69	180		371		493		864	
	%	125	116	2-5	125	5-15	129	10-20	145	>>200
Thames	mm	79	163		377		532		1018	
	%	137	100	<2	116	2-5	123	5-15	148	>200
Southern	mm	78	149		370		576		1210	
	%	137	93	2-5	112	2-5	124	5-15	155	>>200
Wessex	mm	75	170		398		569		1157	
	%	113	97	2-5	111	2-5	111	2-5	138	70-100
South West	mm	64	184		458		664		1419	
	%	77	83	2-5	99	2-5	95	2-5	121	10-15
Welsh	mm	119	257		569		773		1635	
	%	118	100	<2	108	2-5	101	2-5	125	20-30
Scotland	mm	**109**	**291**		**478**		**665**		**1394**	
	%	**93**	**98**	**2-5**	**82**	**5-15**	**79**	**10-20**	**97**	**2-5**
Highland	mm	116	332		551		749		1536	
	%	91	100	<2	81	5-10	76	30-40	87	5-10
North East	mm	100	230		396		555		1110	
	%	114	102	2-5	91	2-5	93	2-5	114	5-10
Tay	mm	105	258		436		668		1361	
	%	112	106	2-5	88	2-5	91	2-5	111	2-5
Forth	mm	92	248		410		580		1162	
	%	98	104	2-5	88	2-5	88	2-5	105	2-5
Tweed	mm	80	228		388		541		1072	
	%	91	101	2-5	90	2-5	90	2-5	110	2-5
Solway	mm	97	267		478		680		1605	
	%	81	91	2-5	84	5-10	82	5-10	113	5-10
Clyde	mm	142	370		578		803		1712	
	%	106	110	2-5	88	2-5	83	5-10	101	2-5
Northern Ireland	mm	**100**	**222**		**399**		**520**		**1118**	
	%	**109**	**97**	**2-5**	**88**	**2-5**	**81**	**5-10**	**106**	**2-5**

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 . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

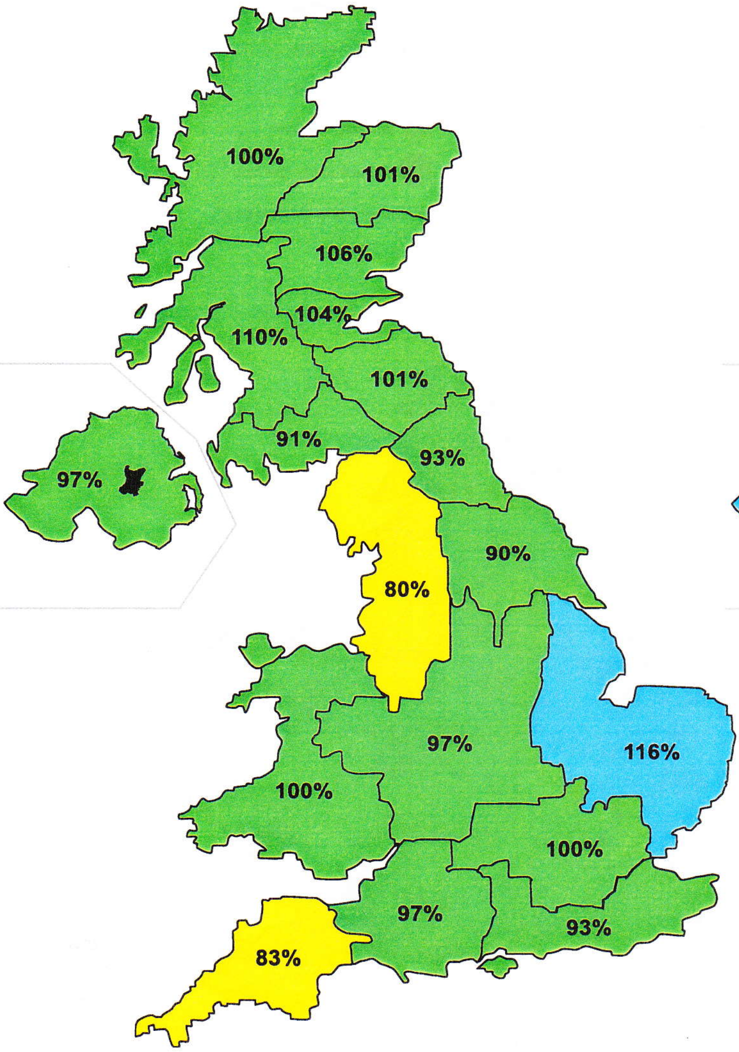
Above average

Normal range

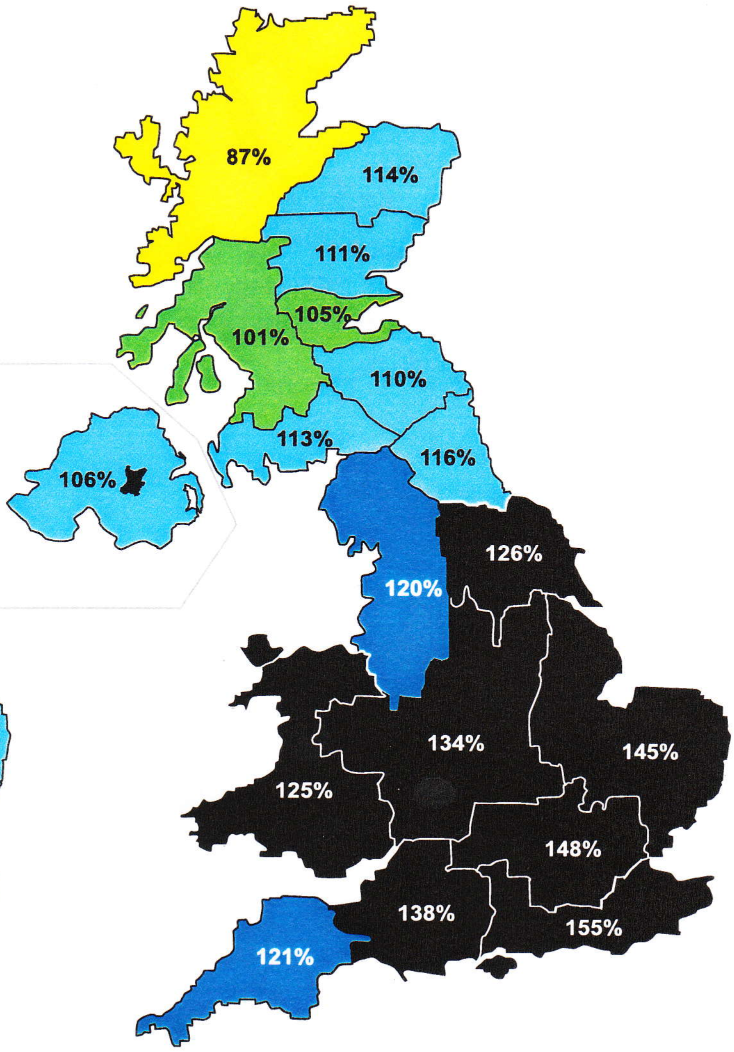
Below average

Substantially below average

Exceptionally low rainfall



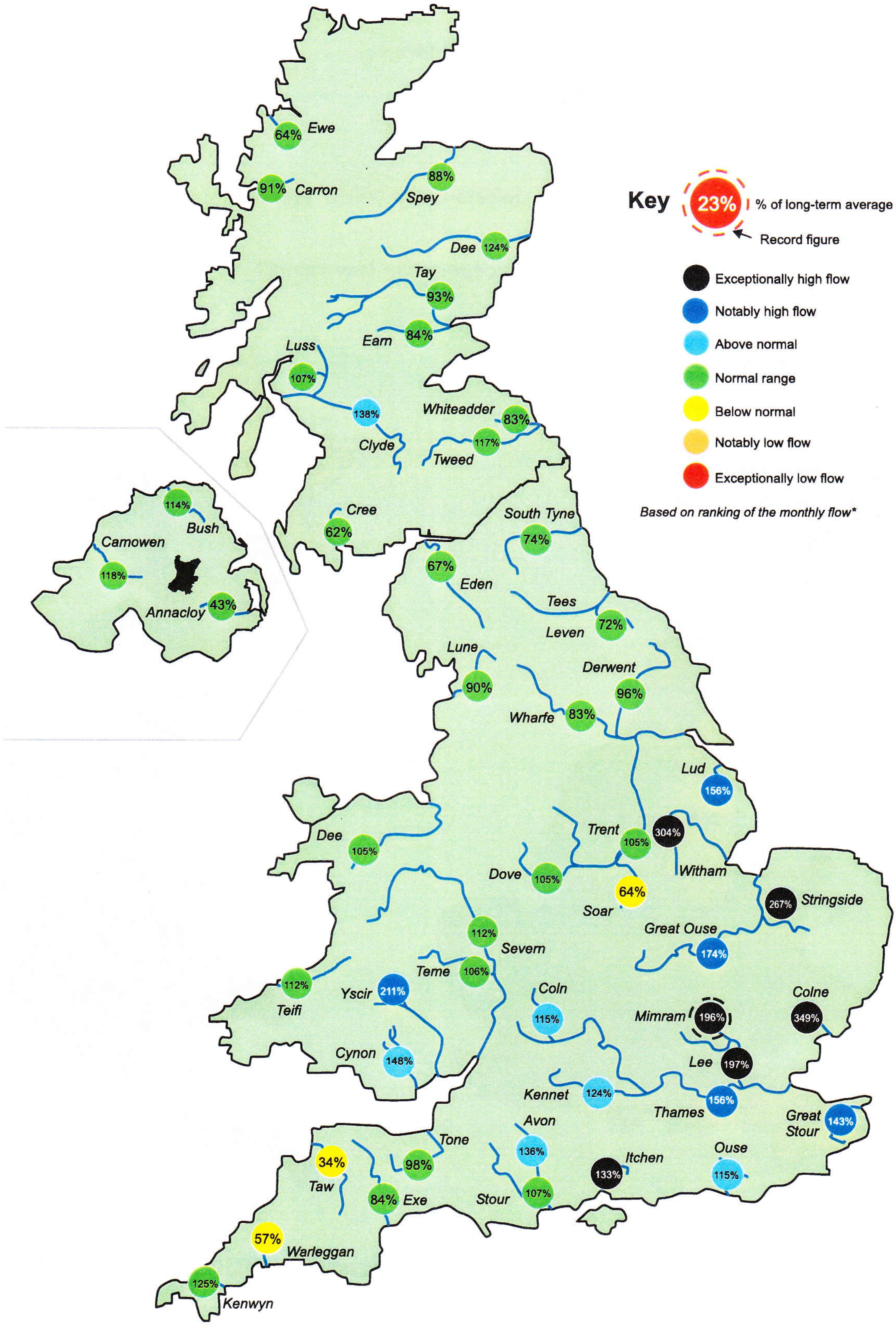
June 2001 -August 2001



September 2000 - August 2001

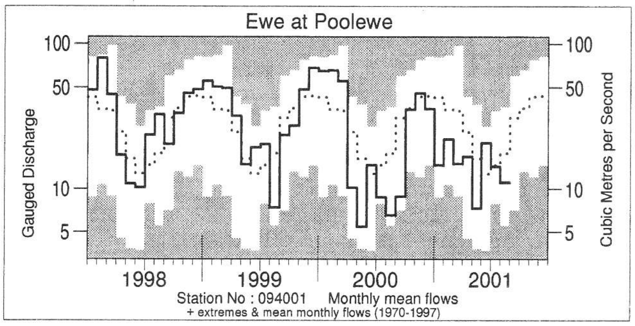
Rainfall accumulation maps

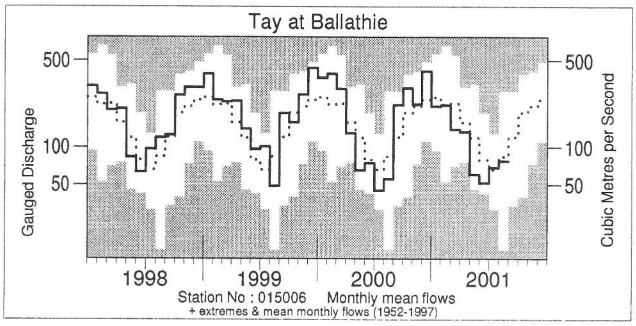
Provisional summer (June-August) rainfall totals are marginally below the 1961-90 average for England and Wales, Scotland and Northern Ireland, and close to the average in all regions, the South-West and North-West being relatively dry. Overall, the summer represents a return to normality following a lengthy period dominated by unusual synoptic patterns – with many rain-bearing frontal systems following more southerly tracks than normal. As a consequence September-August rainfall totals are remarkably high across most of southern Britain, the South-East especially

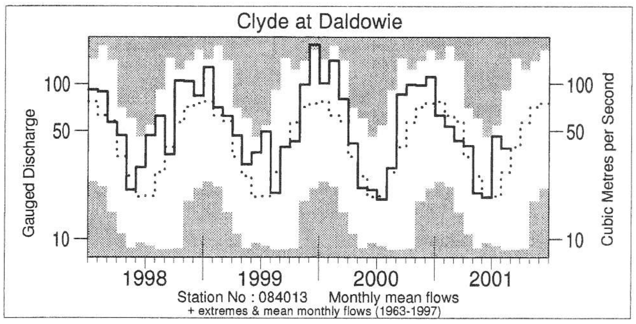


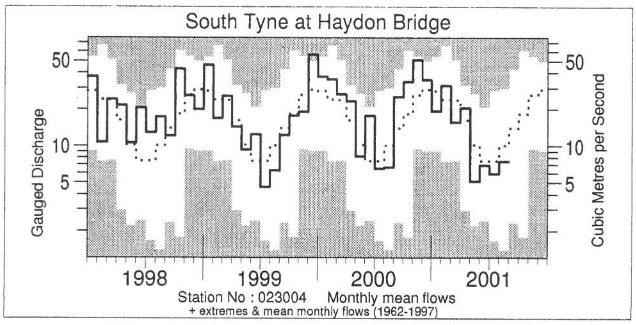
River flows - August 2001

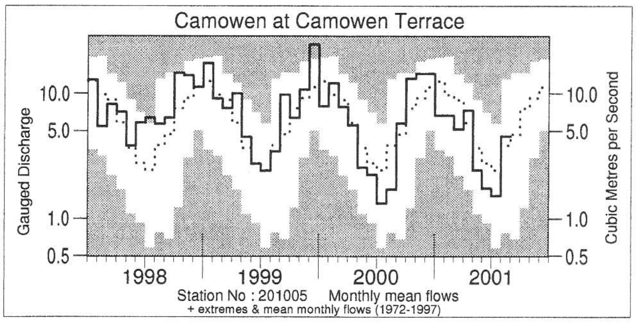
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

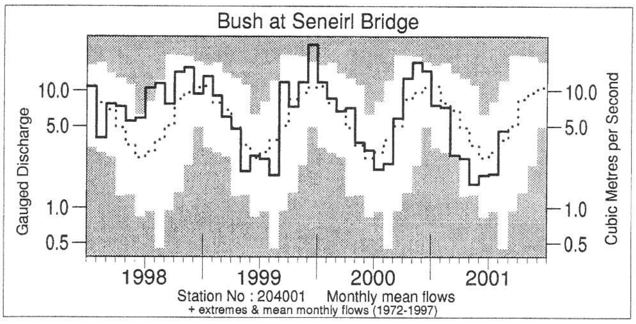


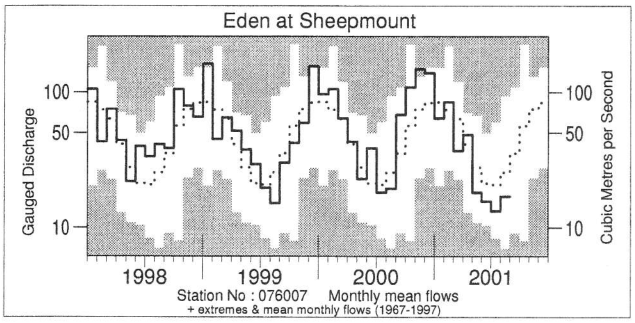


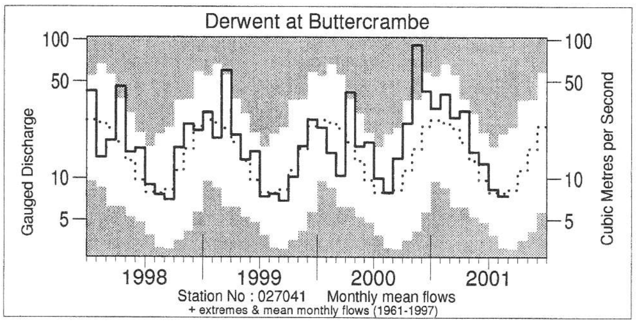


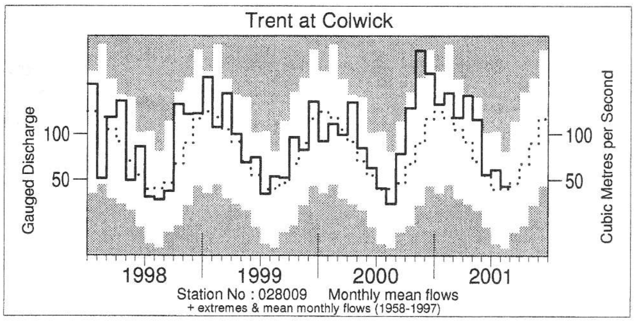


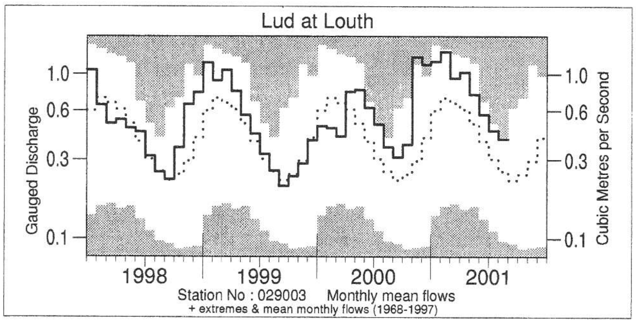








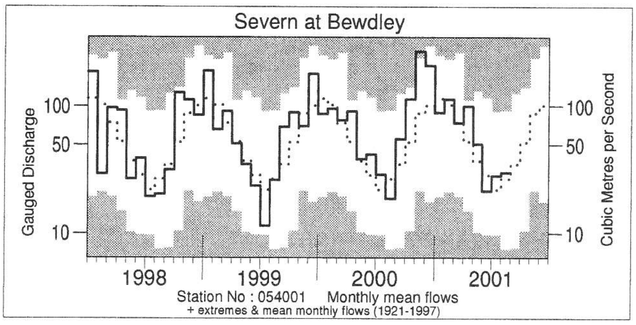


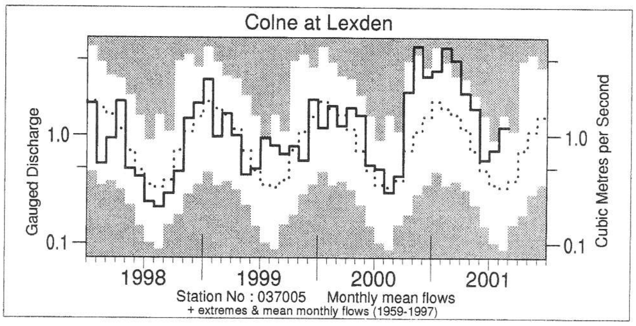


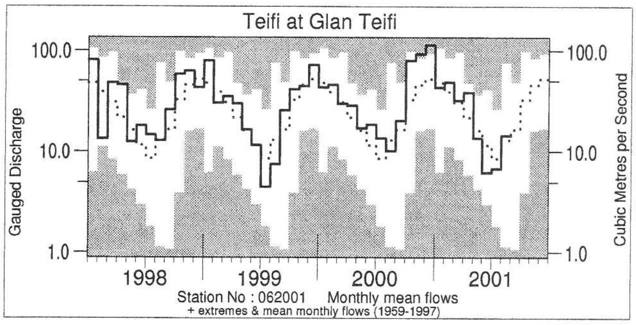
Monthly river flow hydrographs

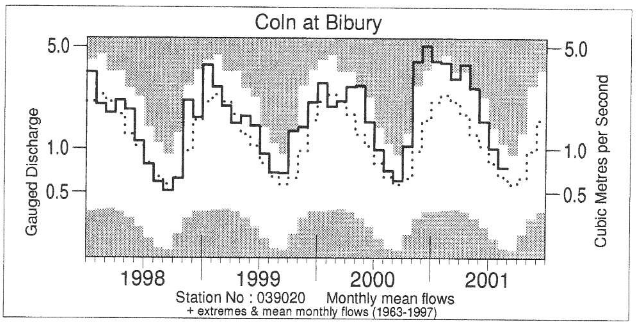
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1998 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

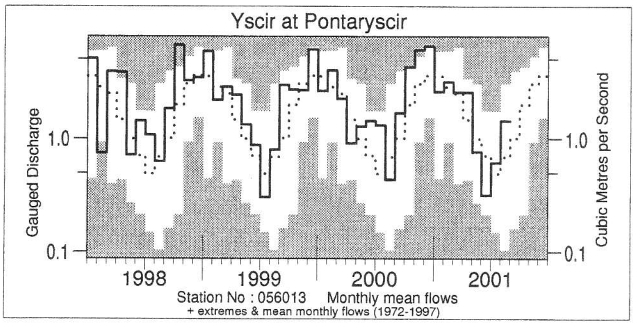
River flow . . . River flow . . .

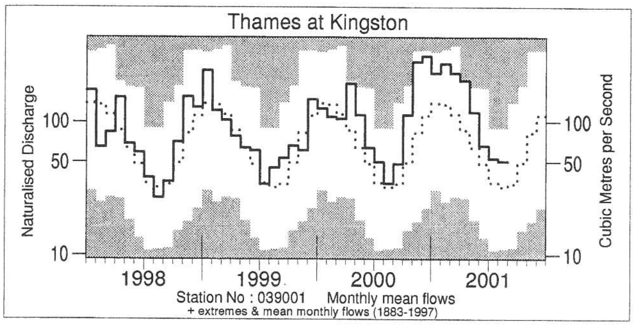


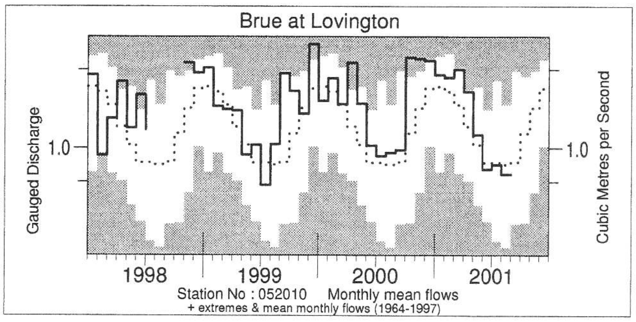


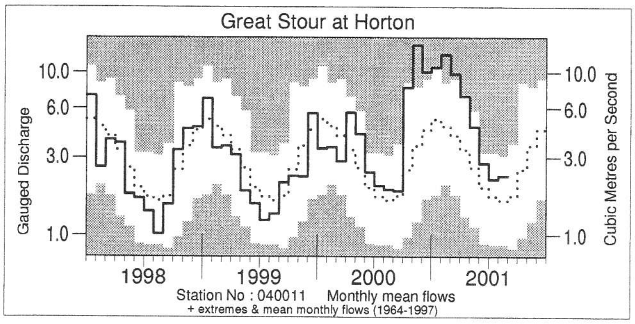


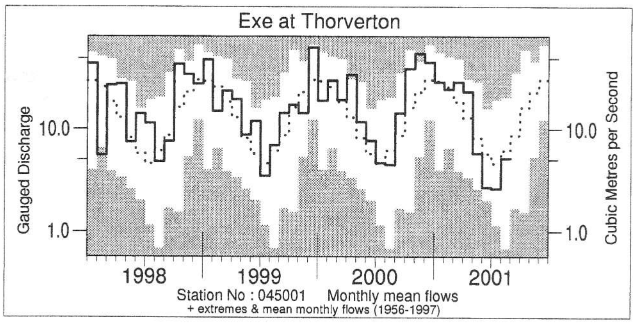


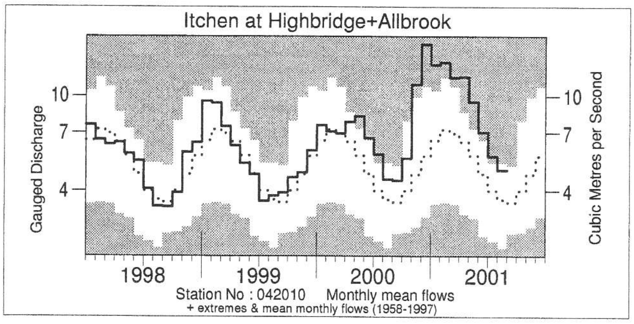










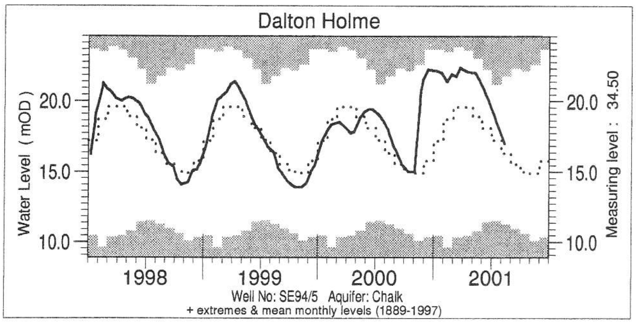


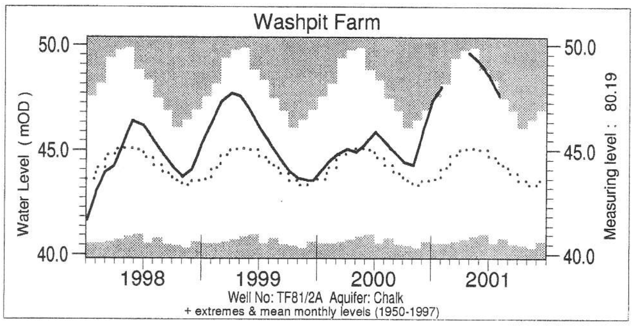
Notable runoff accumulations (a) June 2001 - August 2001, (b) September2000 - August 2001

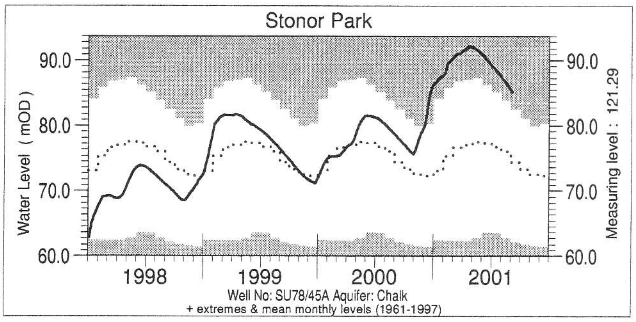
	River	%lta	Rank	River	%lta	Rank	River	%lta	Rank
(a)	Witham	272	43/43	Bedford Ouse	220	68/68	Severn	154	80/80
	Mimram	207	49/49	Lee	263	114/114	Welsh Dee	140	63/63
	Itchen	139	43/43	Thames	210	118/118	Carron	69	2/22
(b	Leven	175	40/40	Wallington	261	44/44	Ewe	69	2/30
	Trent	170	42/42	Dart	148	42/42	Annacloy	152	21/21

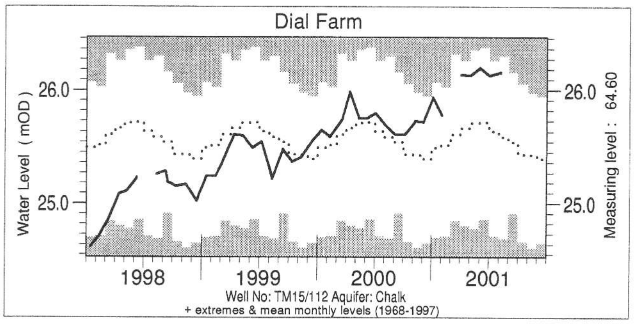
lta = long term average
Rank 1 = lowest on record

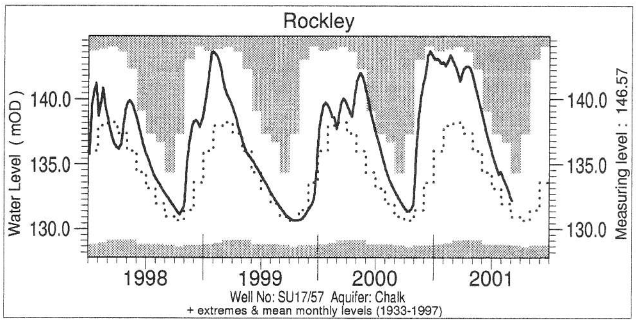
Groundwater . . . Groundwater

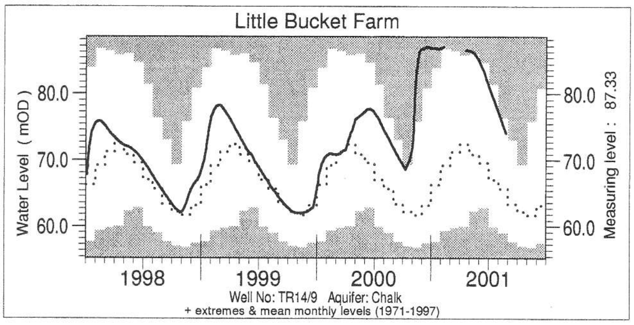


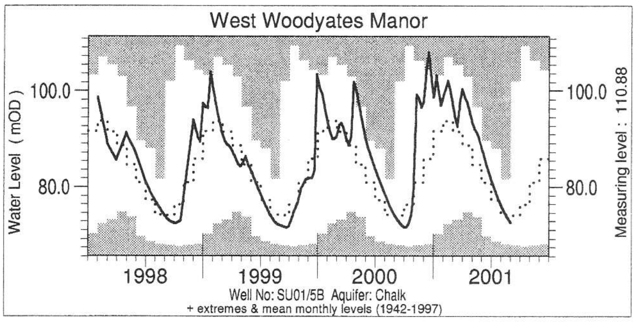


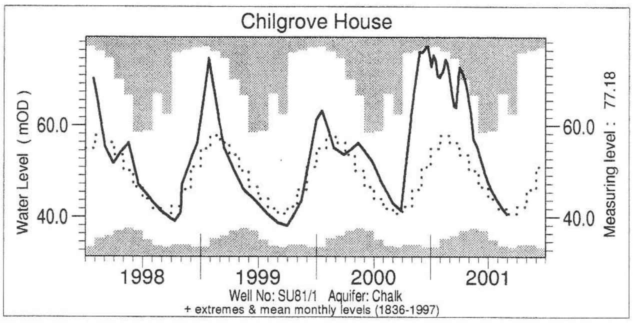


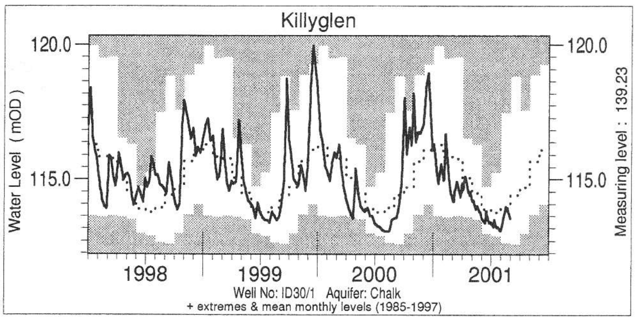


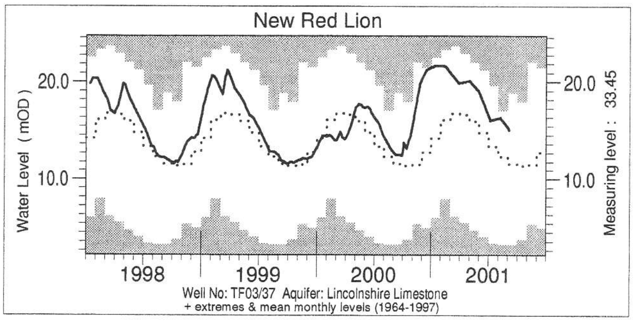






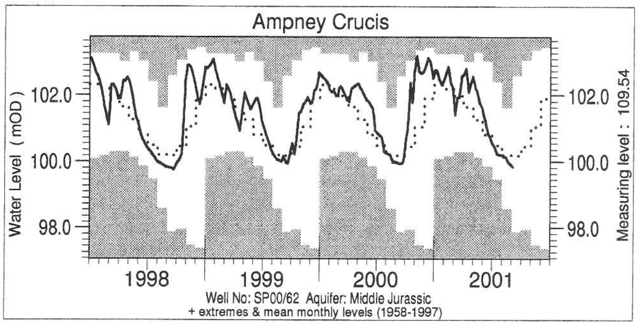


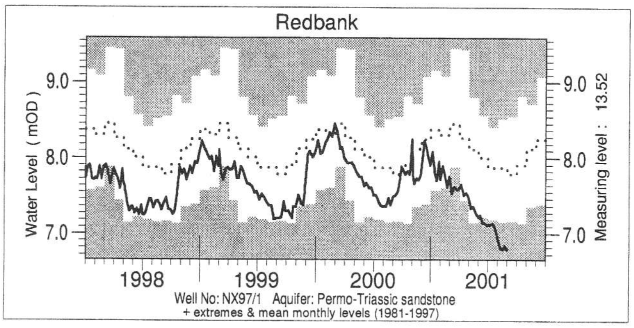


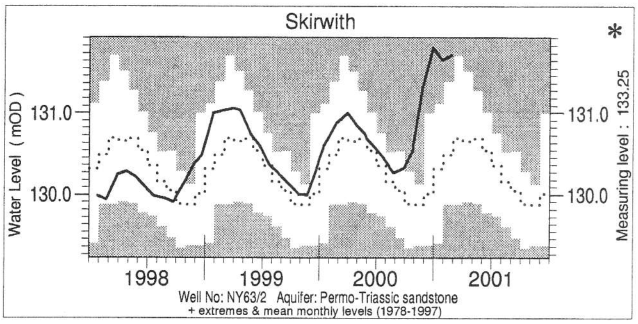


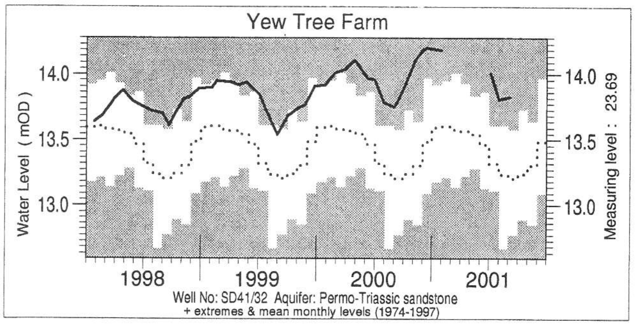
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

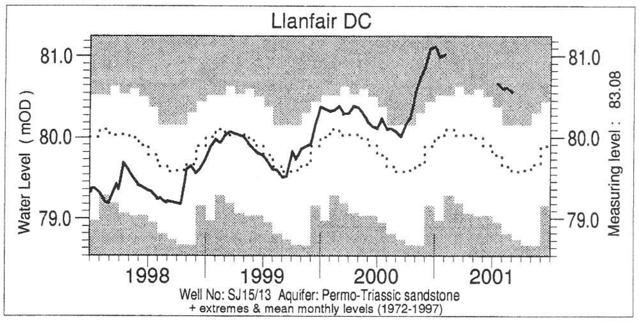
* No March - August groundwater levels available.

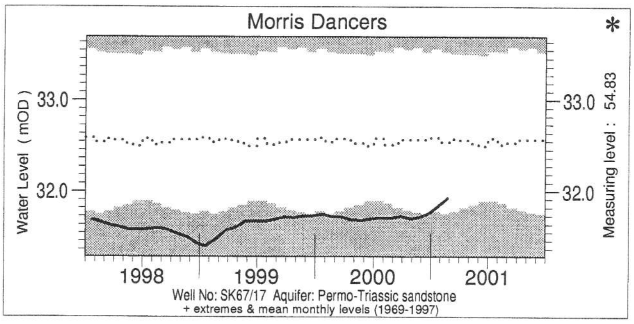


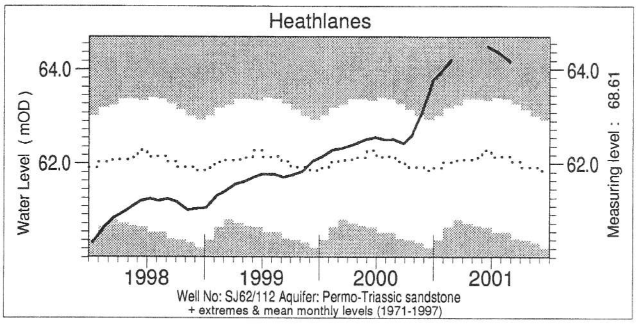


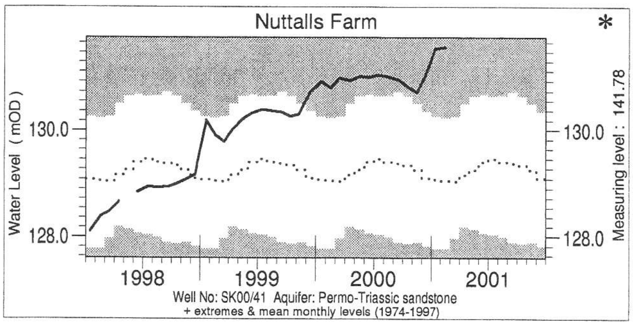


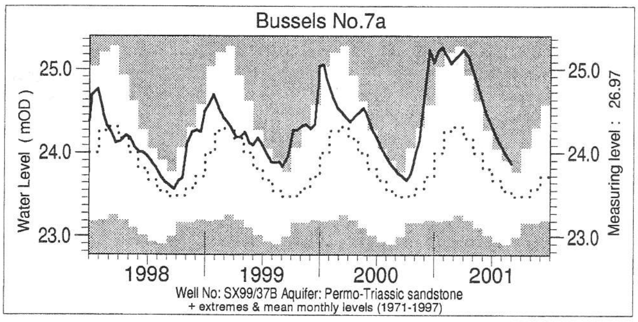


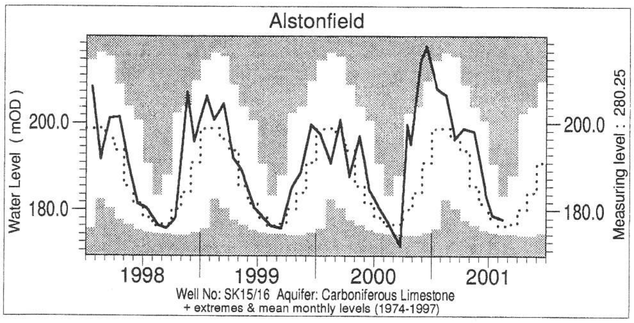










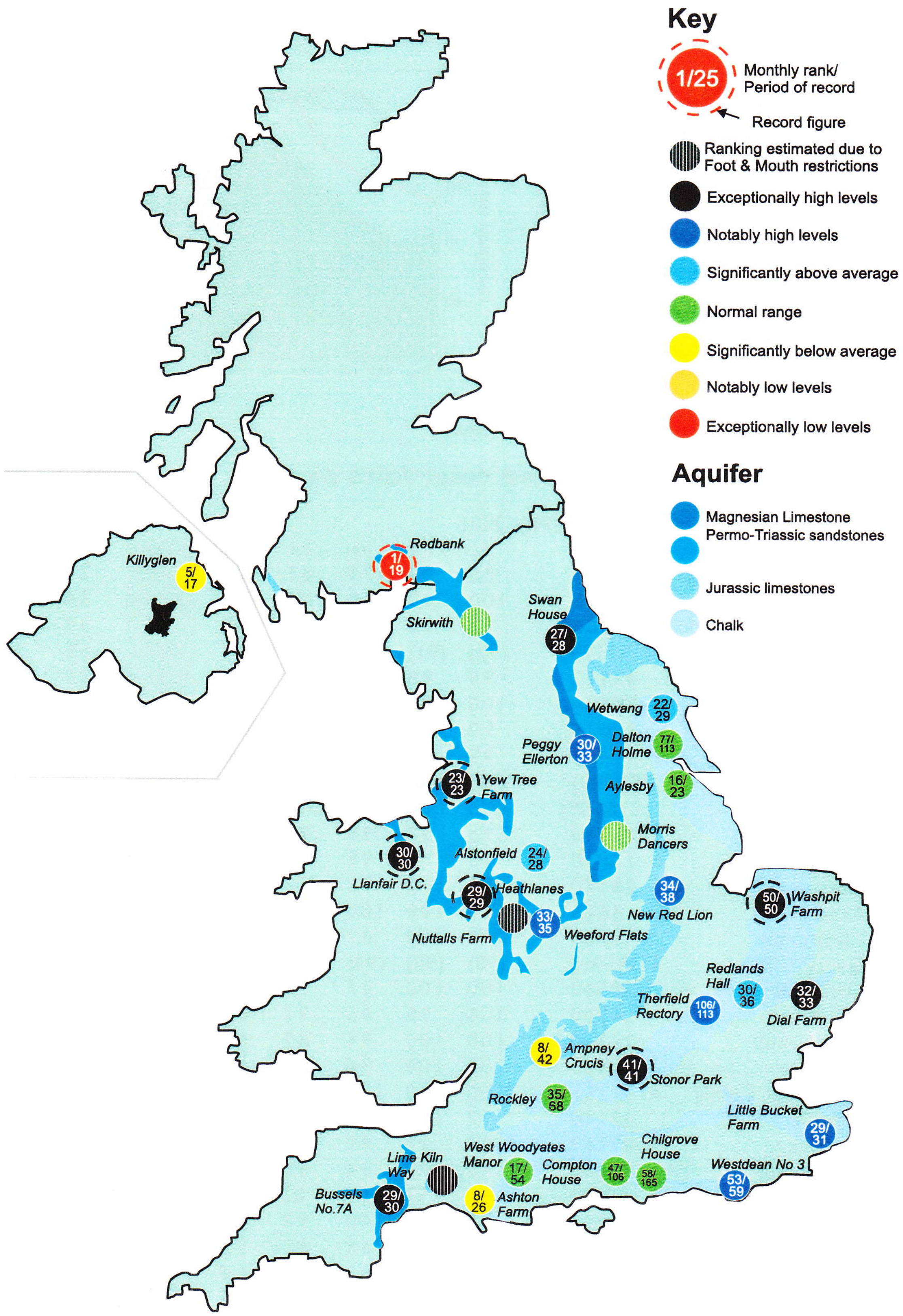


Groundwater levels August / September 2001

Borehole	Level	Date	Aug. av.
Dalton Holme	16.98	10/08	16.26
Washpit Farm	47.62	03/08	44.40
Stonor Park	85.23	04/09	75.95
Dial Farm	26.16	06/08	25.56
Rockley	132.21	04/09	132.00
Little Bucket Farm	74.06	24/08	66.86
West Woodyates	72.49	31/08	73.97
Chilgrove House	40.61	29/08	41.73
Killyglen	113.55	31/08	113.88
New Red Lion	15.05	05/09	12.29
Ampney Crucis	99.85	04/09	100.17
Redbank	6.79	30/08	7.75
Yew Tree Farm	13.83	04/09	13.19
Llanfair DC	80.56	01/09	79.55
Heathlanes	64.17	27/08	62.06
Bussels No.7a	23.87	31/08	23.58
Alstonfield	177.95	15/08	176.82

* Data missing due to Foot & Mouth restrictions

Levels in metres above Ordnance Datum



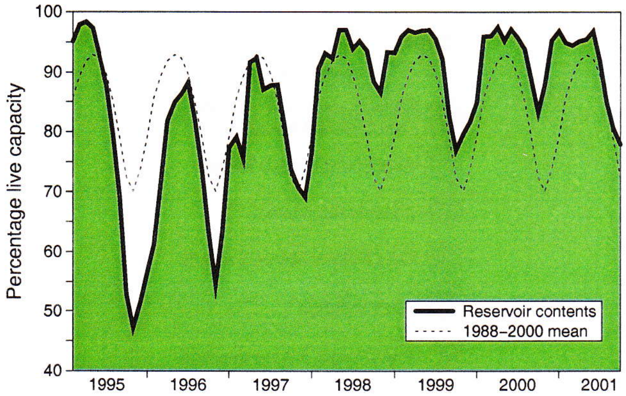
Groundwater levels - August 2001

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.

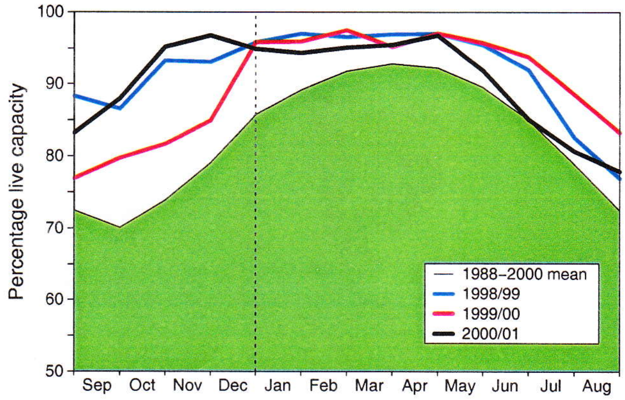
(Note: Redbank is affected by groundwater abstraction)

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.

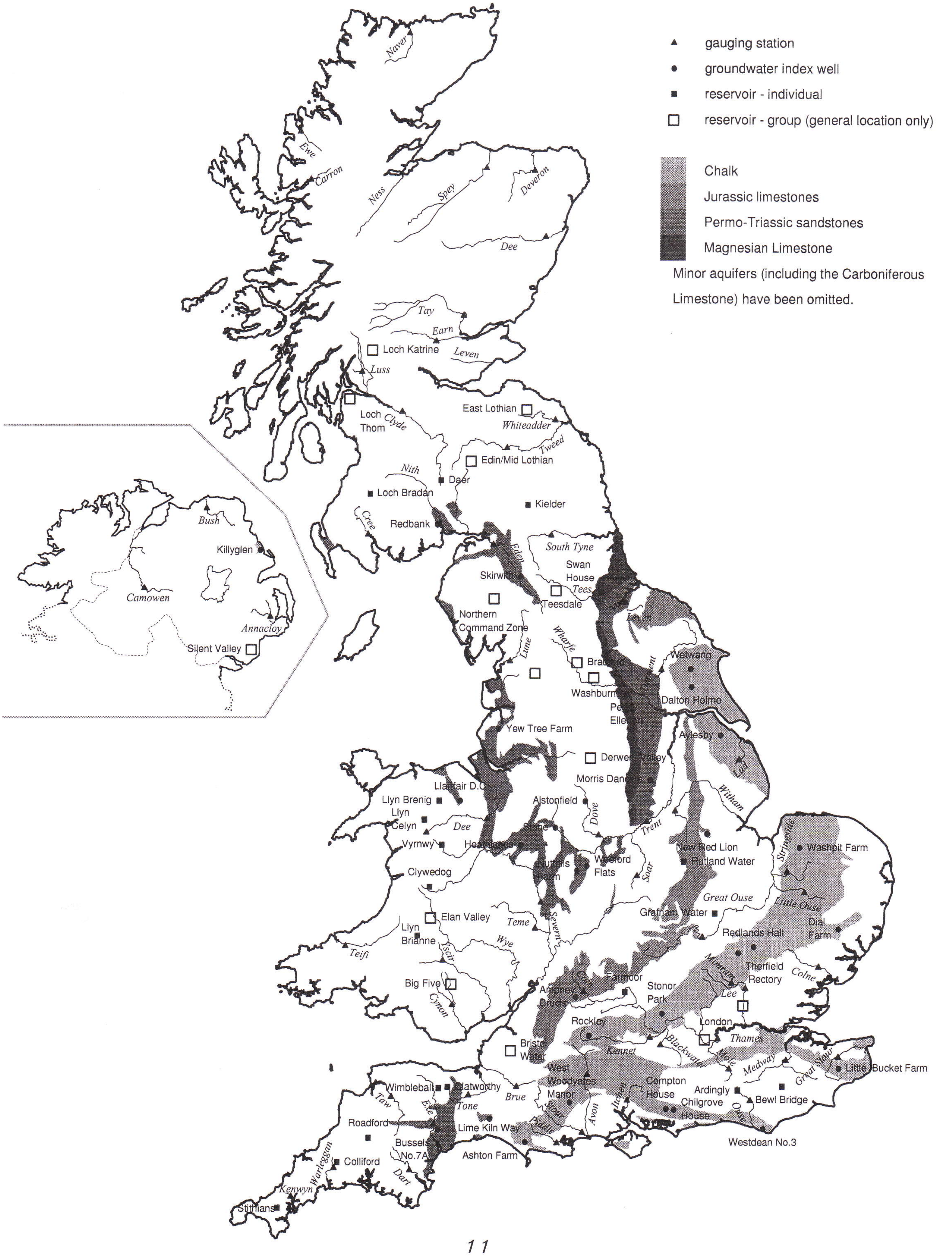
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2001 Apr	May	Jun	Jul	Aug	Sep	Min. Aug	Year* of min
North West	N Command Zone	•124929	85	89	73	61	50	44	24	1995
	Vyrnwy	55146	100	99	90	80	79	74	36	1995
Northumbrian	Teesdale	• 87936	92	98	84	76	65	57	39	1991
	Kielder	(199175)	(92)	(91)	(90)	(88)	(89)	(87)	66	1989
Severn Trent	Clywedog	44922	99	98	90	80	61	46	38	1989
	Derwent Valley	• 39525	100	100	97	80	71	69	34	1995
Yorkshire	Washburn	• 22035	99	97	89	81	75	69	34	1995
	Bradford supply	• 41407	99	99	85	77	64	61	21	1995
Anglian	Grafham	(55490)	(92)	(96)	(96)	(95)	(94)	(95)	59	1997
	Rutland	(116580)	(95)	(99)	(96)	(90)	(85)	(80)	66	1995
Thames	London	•202340	95	97	98	94	91	91	62	1995
	Farmoor	• 13830	90	98	98	98	96	92	64	1995
Southern	Bewl	28170	100	100	98	93	85	79	38	1990
	Ardingly	4685	100	100	100	96	91	70	47	1996
Wessex	Clatworthy	5364	100	100	87	75	64	54	31	1995
	Bristol WW	•(38666)	(98)	(98)	(94)	(83)	(75)	(69)	43	1990
South West	Colliford	28540	100	100	97	91	82	72	43	1997
	Roadford	34500	100	99	95	91	85	80	40	1995
	Wimbleball	21320	100	100	94	82	69	61	40	1995
	Stithians	5205	100	100	94	83	66	51	30	1990
Welsh	Celyn and Brenig	•131155	100	100	100	96	96	92	49	1989
	Brianne	62140	97	100	94	85	81	86	55	1995
	Big Five	• 69762	98	97	89	76	78	82	29	1995
	Elan Valley	• 99106	99	99	94	86	87	93	46	1995
East of Scotland	Edinburgh/Mid Lothian	• 97639	97	97	91	82	80	75	45	1998
	East Lothian	• 10206	100	100	100	93	91	90	63	1989
West of Scotland	Loch Katrine	•111363	88	83	66	61	57	58	50	2000
	Daer	22412	93	96	81	70	64	55	41	1995
	Loch Thom	• 11840	93	89	74	70	66	66	58	1997
Northern Ireland	Silent Valley	• 20634	100	93	83	72	59	59	33	2000

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

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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