Hydrological summary

for the United Kingdom

March 2000

General

Overall, March was another mild month and, apart from north-western Britain, a dry one. Parts of the English lowlands recorded less than 30% of average rainfall and March concluded a winter half-year where rainfall patterns again favoured the wetter northern and western regions of the UK. The limited rainfall and seasonally high evaporative demands in March greatly restricted aquifer recharge and reservoir replenishment was also a fraction of that in February. Nonetheless, overall stocks for England and Wales remain very healthy and most reservoirs remain close to capacity. In Northern Ireland however, stocks are low in Silent Valley (a reflection of the meagre winter rainfall). River flows declined through March but monthly runoff totals were within the normal range as were most groundwater levels. The late spring is often pivotal in water resources terms; the balance between rainfall and evaporation over the next 6-8 weeks will largely shape the prospects for the summer, in the eastern lowlands especially.

Rainfall

Weather conditions were unsettled - and notably cool - early and late in the month but much of the intervening period was exceptionally dry – and warm - with high pressure dominant. From the 3rd, some southern districts registered little more than a trace of rainfall over the following three weeks. For March as a whole, above average rainfall was largely restricted to NW Scotland where a few raingauges reported >150% of the monthly average. Most of England received below half of the 1961-90 average and some central districts (beyond the reach of occasional showers penetrating from the east) recorded less than 10 mm (e.g. Wallingford); the Thames Valley reported its fourth driest March since 1961. Parts of Cornwall were notably dry also as were eastern catchments in Northern Ireland which had its second driest March since 1973. Winter half-year (Oct-Mar) precipitation totals again exceeded the average by a wide margin in Scotland. Eleven of the wettest 12 winter half-years in a series from 1869 now cluster in the last 20 years. Regional winter rainfall totals for England and Wales were less statistically outstanding but of greater resources significance. Much of the English lowlands reported between 80%-90% of average with some catchments (e.g. the lower Trent basin) recording their third lowest winter total since 1972/73. Over the 12-month timespan regional rainfall totals throughout the UK are close to the long term mean.

River flows

March saw very wide spatial and temporal variations in runoff rates. Spates continued from February but flows declined steeply thereafter and notably low March flows were reported in the last week – especially in impermeable eastern catchments (but significant recoveries were generated in early April). Mean flows in March were appreciably above average in NW Britain but very modest in many responsive eastern rivers; the Whiteadder and Leven both registered their third lowest March runoff on record. In Northern Ireland, flows in rivers draining to the Irish Sea were depressed also. A broad exaggeration in the west-to-east runoff gradient is even more evident for the winter half-year as a whole. Many rivers draining the Scottish Highlands recorded their fifth successive month with above average runoff, and winter half-year runoff totals were unprecedented for a number of catchments (including the Spey and Ewe). For the Clyde, provisional data indicate that the Nov-Mar runoff total is the highest for any 5-month sequence in a record from 1963. In contrast to this abundance, Oct-Mar totals for many eastern rivers (including the Annacloy in NI which established a new winter half-year minimum) rank amongst the lowest quartile. A few (including the Medway and Dover Beck) reported < 65% of average winter runoff, reflecting high winter evaporation and dry soils as well as low rainfall.

Groundwater

Well below average rainfall (over most major outcrop areas) and high evaporative demands made for very limited infiltration during March. Late-March soil moisture deficits were around twice the average in some parts of eastern England, in such areas the heavy early April rainfall was particularly welcome. Despite erratic recharge through the winter, groundwater levels in most major aquifers are close to the seasonal average. In the Chalk, levels have remained mostly close to the seasonal average throughout the last year, albeit, significantly below average in some eastern aquifer units (e.g. in Herts and Cambs). Near average groundwater levels also characterise some of the minor eastern aquifers (e.g. the Essex Gravels and Suffolk Crag). Levels declined during March in the principal limestone aquifers but remain well within the normal range; this is true of most Permo-Triassic sandstones outcrops also but levels continue to be depressed in some central and eastern outcrops. (Morris Dancers - where recharge has been moderate over successive winters, and abstraction is a factor - provides an extreme example; groundwater levels have remained close to, or below, previous minima for over two years).

Centre for Ecology & Hydrology

CEH Wallingford (formerly the Institute of Hydrology)

British Geological Survey

Rainfall . . . Rainfall . . . Rainfall.

Rainfall accumulations and return period estimates

Area	Rainfall	Mar 2000	Jan 00-Mar 00	RP	Oct 99-Mar 00	RP	Jul 99-Mar 00	RP	Apr 99-Mar 00	RP
England & Wales	**mm**	**34**	**175**		**464**		**706**		**919**	
	%	**48**	**79**	**2-5**	**94**	**2-5**	**100**	**2-5**	**103**	**2-5**
North West	mm	60	296		707		973		1246	
	%	63	101	2-5	106	2-5	100	2-5	104	2-5
Northumbrian	mm	39	180		436		635		869	
	%	56	85	2-5	96	2-5	94	2-5	102	2-5
Severn Trent	mm	25	132		376		599		803	
	%	41	71	5-10	95	2-5	103	2-5	106	2-5
Yorkshire	mm	29	134		364		548		776	
	%	42	65	10-20	82	5-10	85	5-10	94	2-5
Anglian	mm	18	91		255		449		608	
	%	38	68	5-10	86	2-5	99	2-5	102	2-5
Thames	mm	17	113		309		531		713	
	%	30	68	5-10	85	2-5	100	2-5	103	2-5
Southern	mm	23	127		371		602		766	
	%	37	64	5-10	84	2-5	97	2-5	98	2-5
Wessex	mm	34	159		445		692		902	
	%	49	72	5-10	93	2-5	104	2-5	108	2-5
South West	mm	38	224		622		879		1152	
	%	38	66	5-10	87	2-5	91	2-5	98	2-5
Welsh	mm	63	322		805		1160		1445	
	%	59	93	2-5	103	2-5	108	2-5	110	5-10
Scotland	**mm**	**117**	**496**		**1057**		**1377**		**1706**	
	%	**94**	**131**	**10-20**	**126**	**20-35**	**116**	**5-10**	**119**	**20-35**
Highland	mm	177	722		1481		1821		2209	
	%	109	151	60-90	138	70-100	123	20-35	126	50-75
North East	mm	58	236		601		815		1057	
	%	74	98	2-5	113	2-5	105	2-5	109	2-5
Tay	mm	86	405		880		1173		1467	
	%	79	116	2-5	121	5-10	116	5-10	119	10-20
Forth	mm	81	353		774		1009		1288	
	%	86	121	5-10	123	10-20	111	2-5	116	5-15
Tweed	mm	55	237		553		760		1019	
	%	70	96	2-5	105	2-5	98	2-5	105	2-5
Solway	mm	98	426		934		1267		1620	
	%	84	114	2-5	113	2-5	108	2-5	114	5-10
Clyde	mm	136	594		1295		1662		2013	
	%	93	131	10-20	129	15-30	116	5-10	119	10-20
Northern Ireland	**mm**	**57**	**224**		**617**		**935**		**1160**	
	%	**64**	**81**	**2-5**	**103**	**2-5**	**110**	**2-5**	**110**	**5-10**

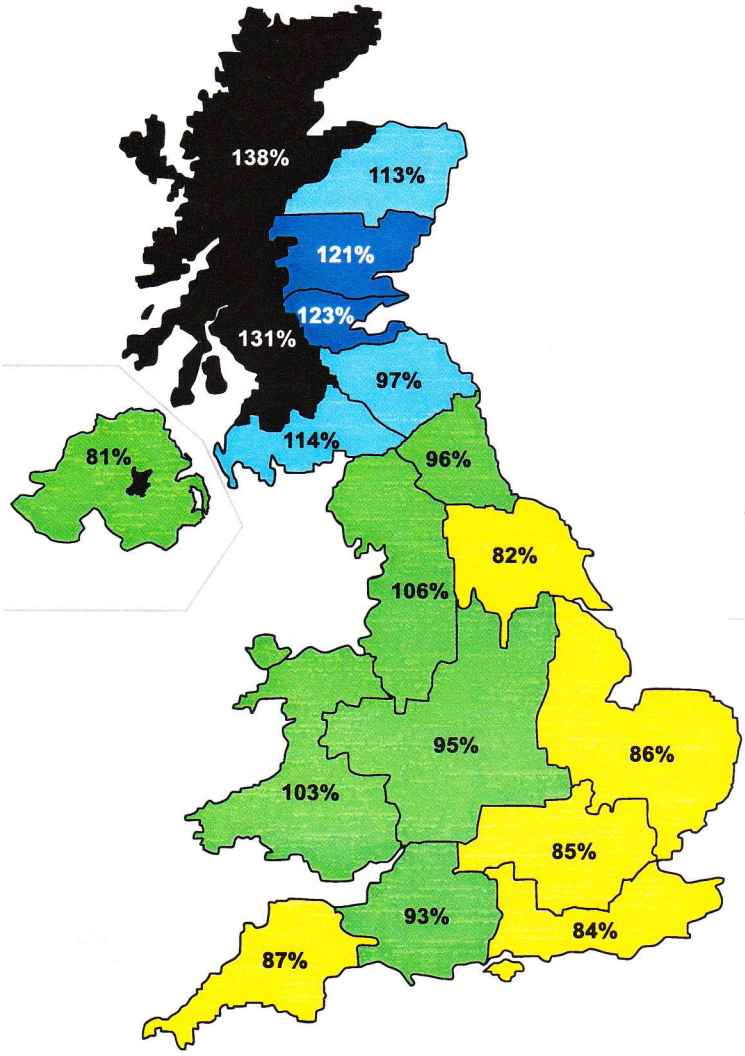
RP = Return period

 All monthly totals since July 1998 are provisional (see page 12). Recent monthly rainfall figures for the Scottish regions have been compiled using data provided by the Scottish Environment Protection Agency. 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.

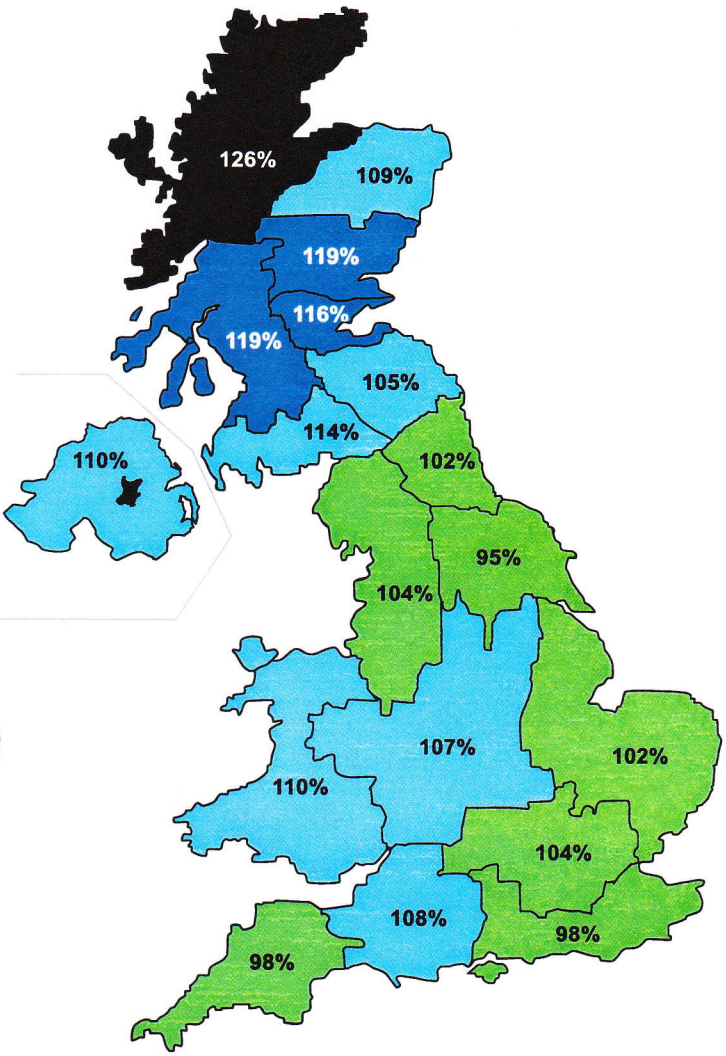
Rainfall . . . Rainfall . . . Rainfall

Key

00%	Percentage of 1961-90 average		Normal range
	Very wet		Below average
	Substantially above average		Substantially below average
	Above average		Exceptionally low rainfall



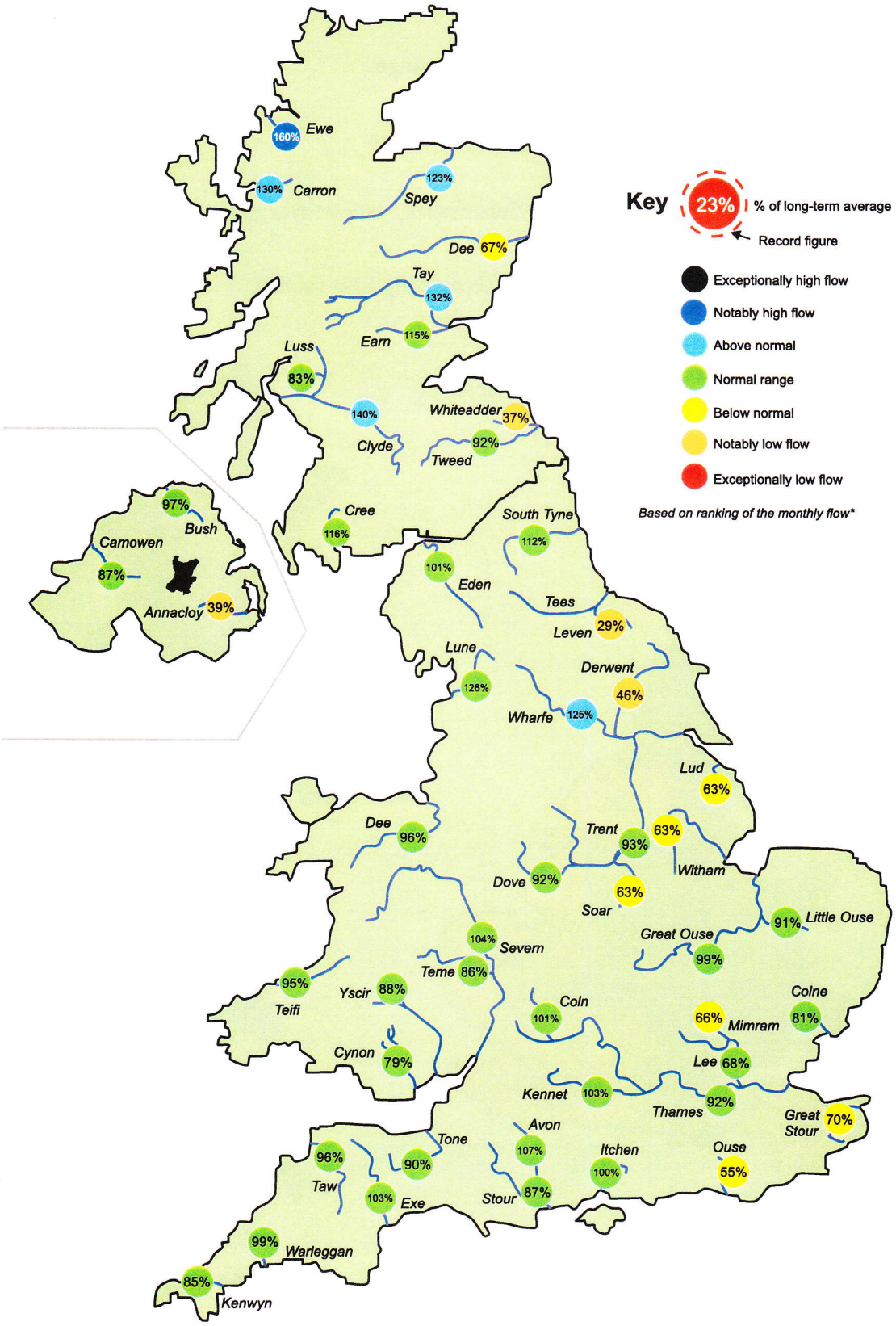
October 1999 - March 2000



April 1999 - March 2000

Rainfall accumulation maps

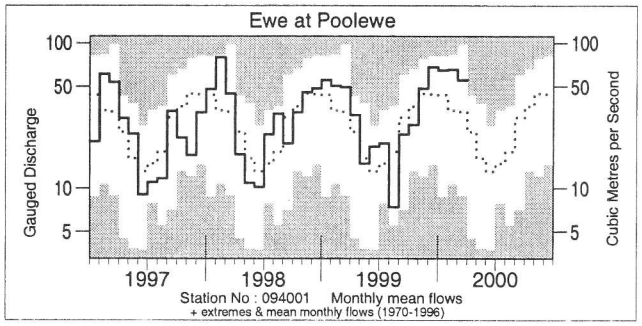
The provisional UK rainfall total for the October 1999 - March 2000 period is close to the long term average but the map testifies to a clear strengthening of the NW/SE rainfall gradient over the winter half-year; a similar but less clear-cut tendency is evident over the last 12 months.

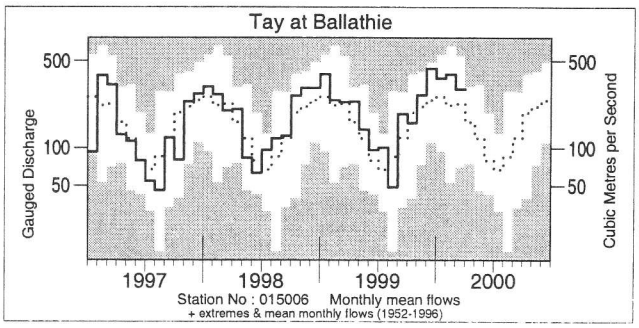


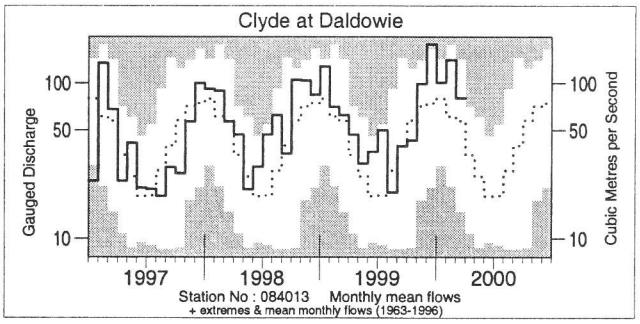
River flows - March 2000

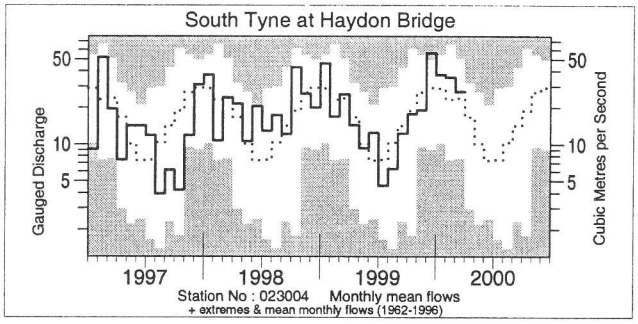
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

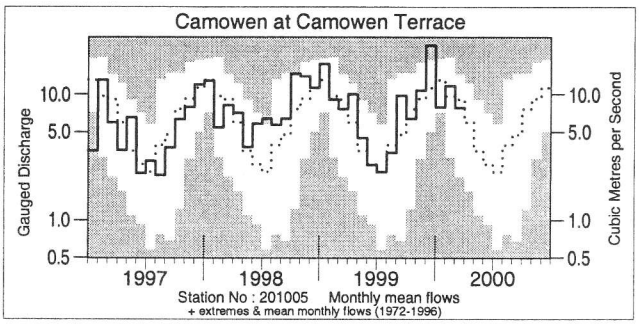
River flow . . . *River flow . . .*

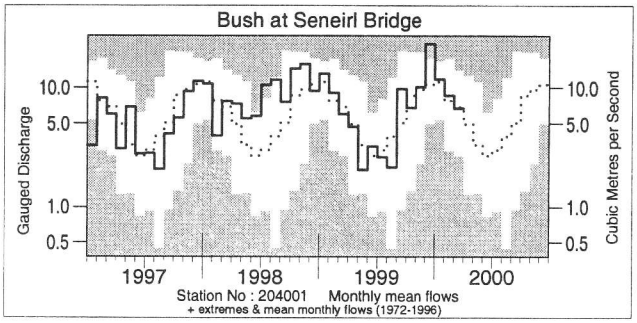


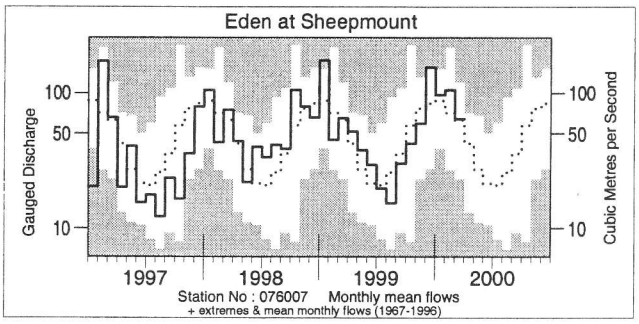


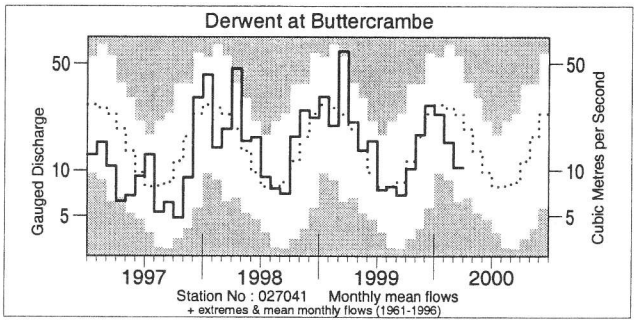


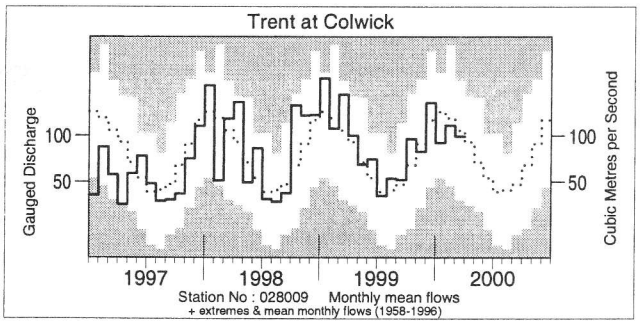


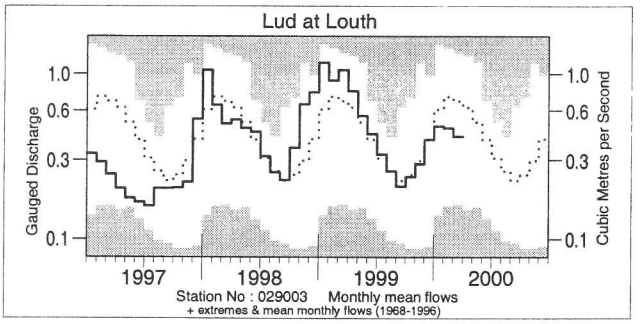








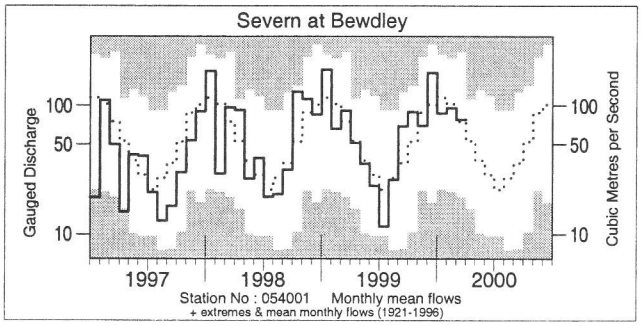


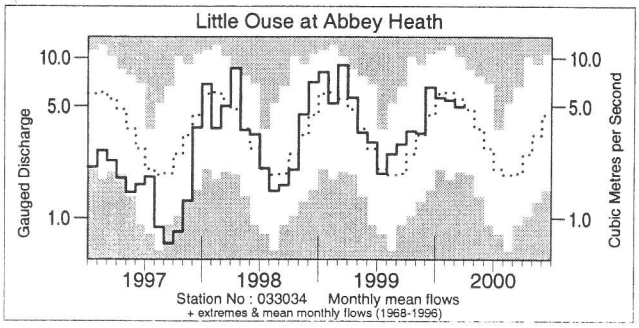


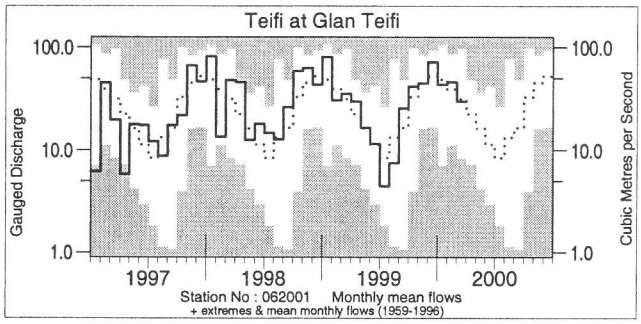
Monthly river flow hydrographs

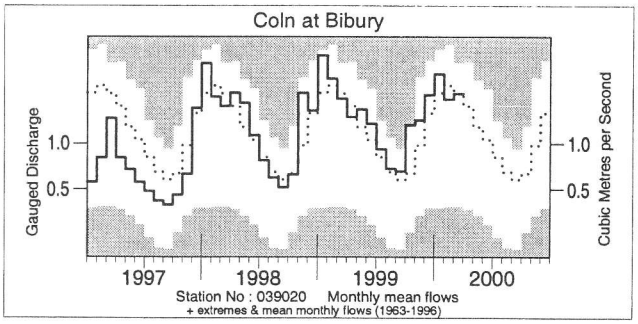
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1997 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

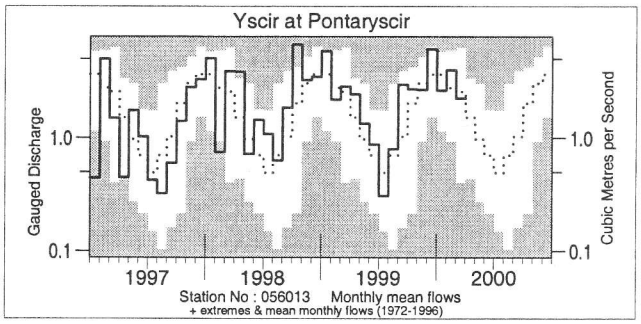
River flow . . . River flow . . .

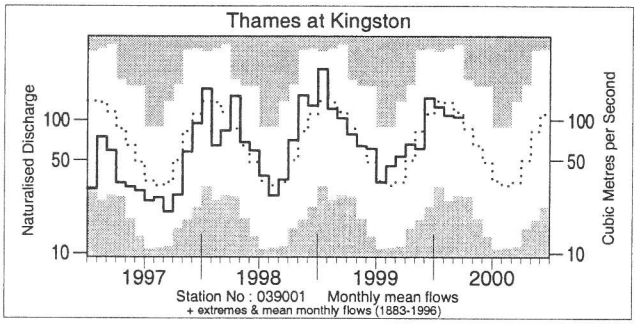


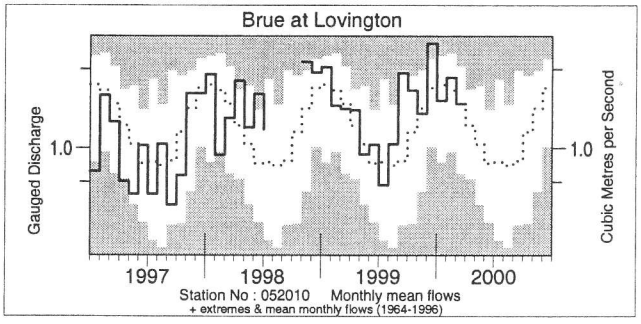


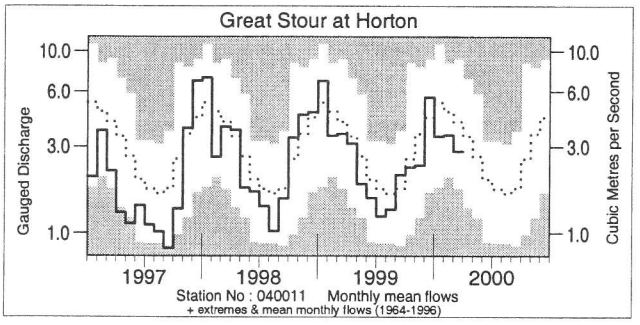


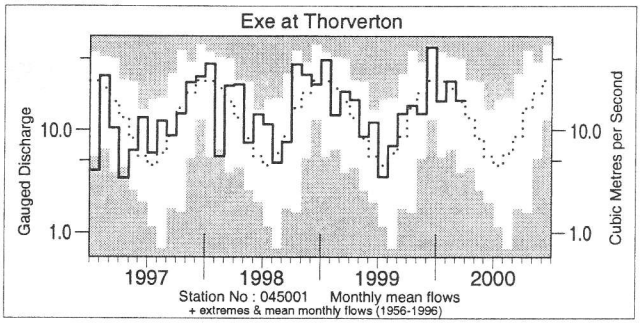


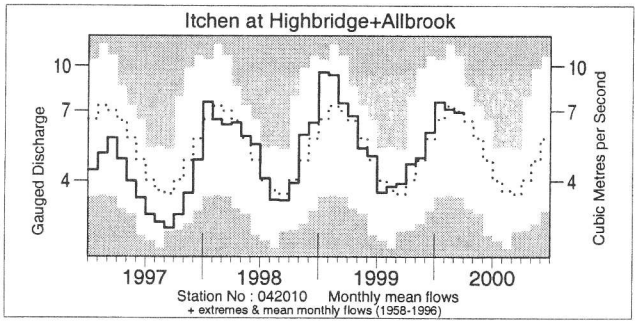












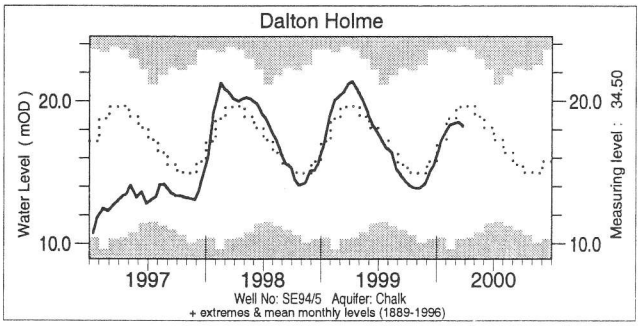
Notable runoff accumulations October 1999 - March 2000 (a); April 1998 - March 2000 (b)

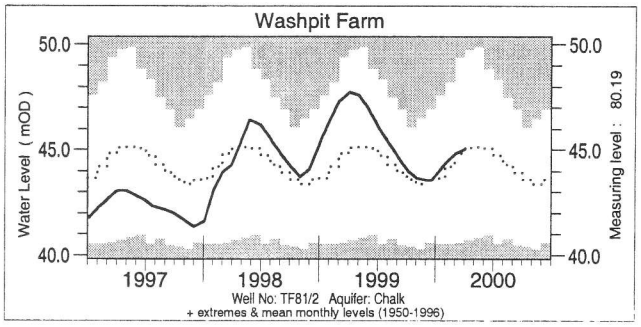
(a) River	%lta	Rank	River	%lta	Rank
Dover Beck	62	5/25	Tay	139	46/48
Medway	49	5/39	Clyde	155	37/37
Lune	129	36/38	Ewe	135	29/29
Spey	139	47/48	Annacloy	66	1/20

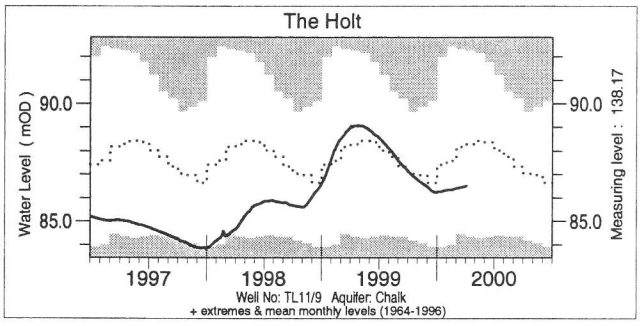
(b) River	%lta	Rank
Spey	126	46/46
Clyde	143	35/35
Naver	125	21/21
Bush	131	23/23

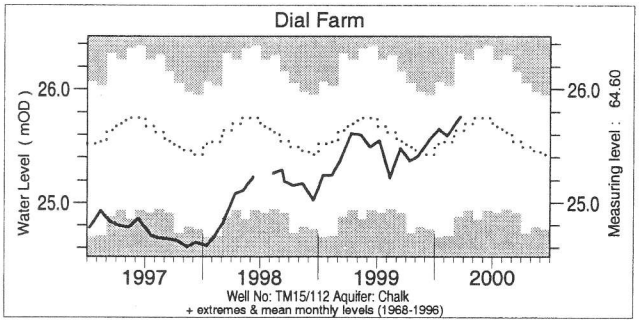
lta = long term average
Rank 1 = lowest on record

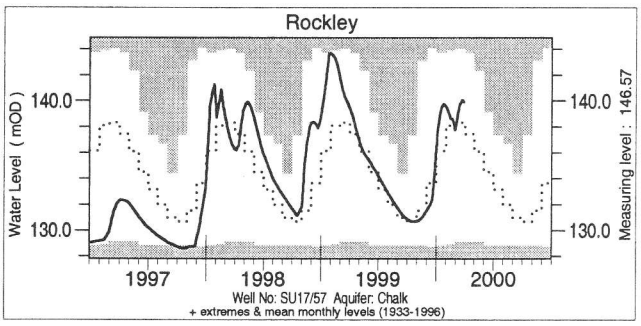
Groundwater . . . Groundwater

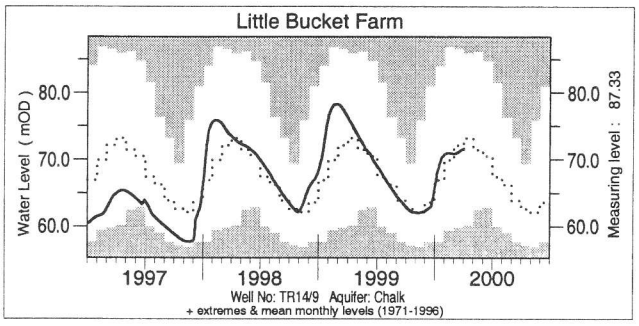


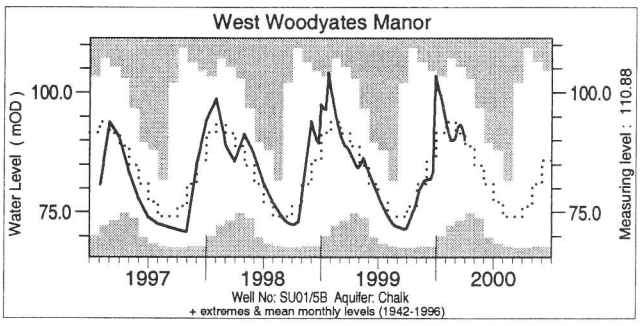


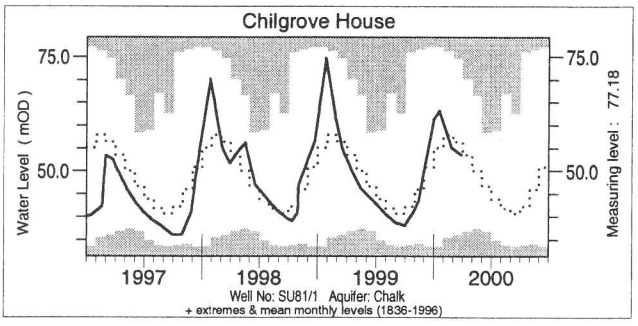


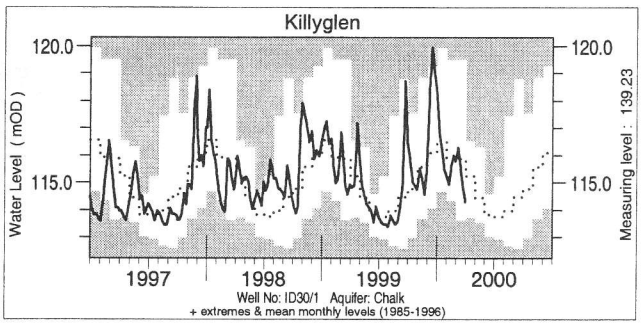


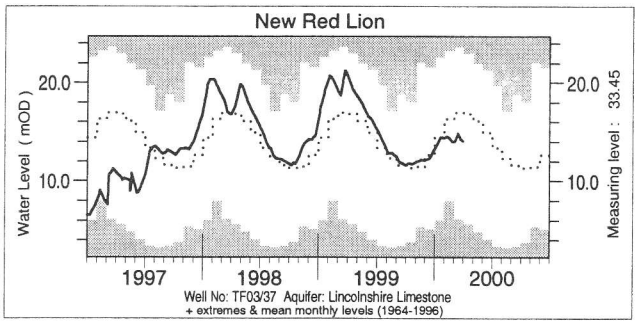








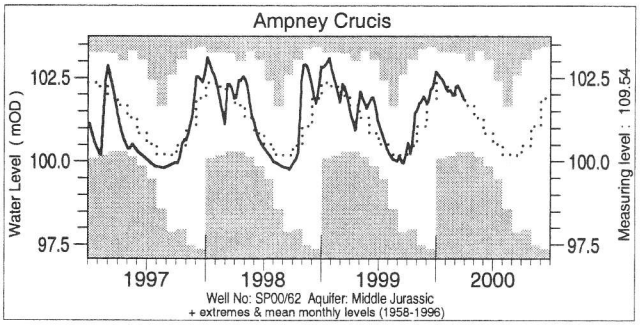


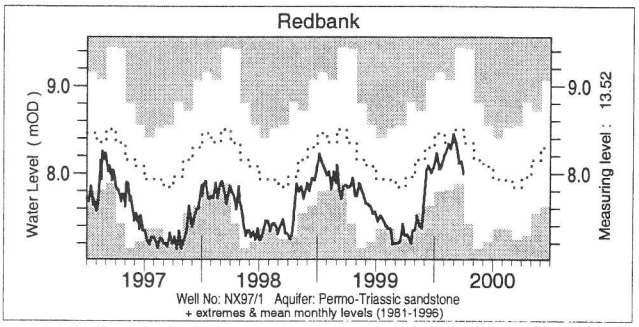


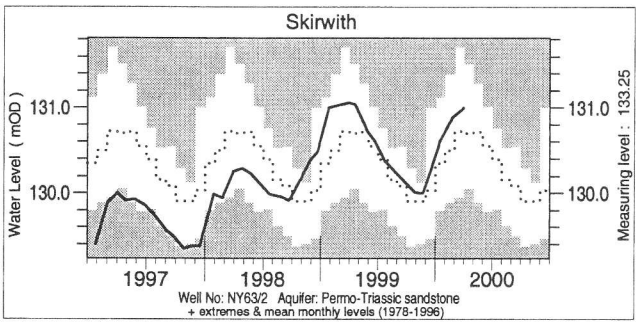
What is groundwater?

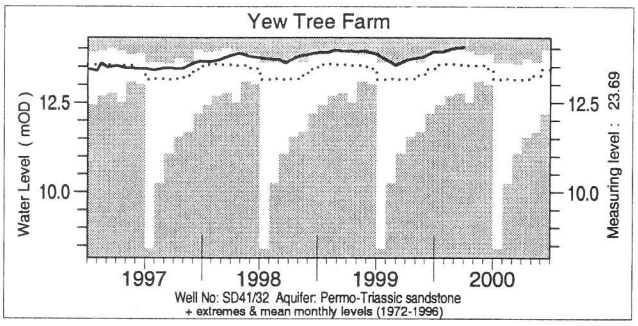
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly max., min. and mean levels are displayed in a similar style to the river flow hydrographs, note that most groundwater levels are not measured continuously — the latest recorded levels are listed overleaf.

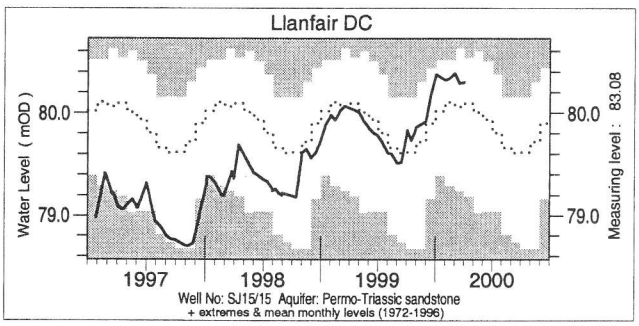
Groundwater . . . Groundwater

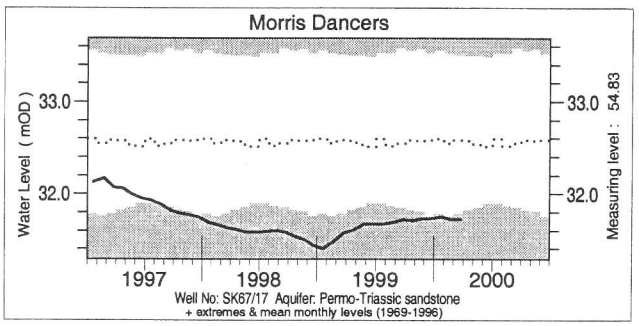


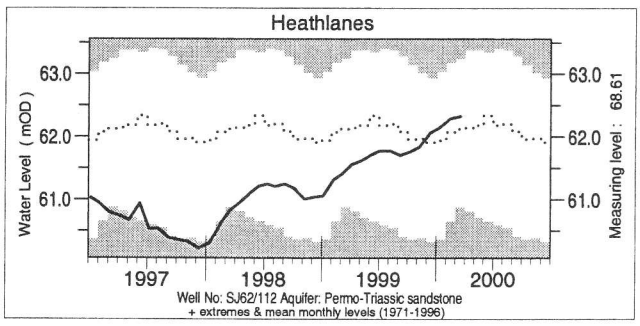


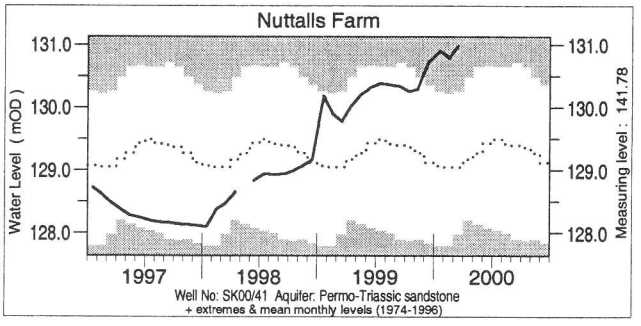


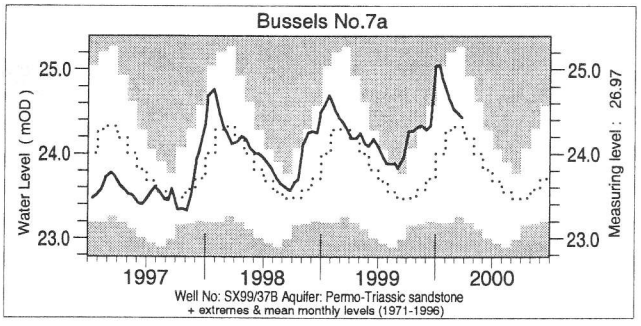


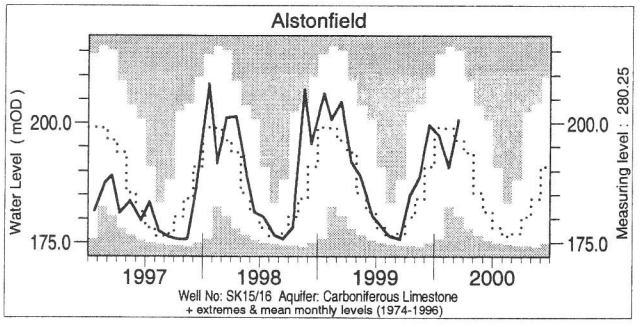








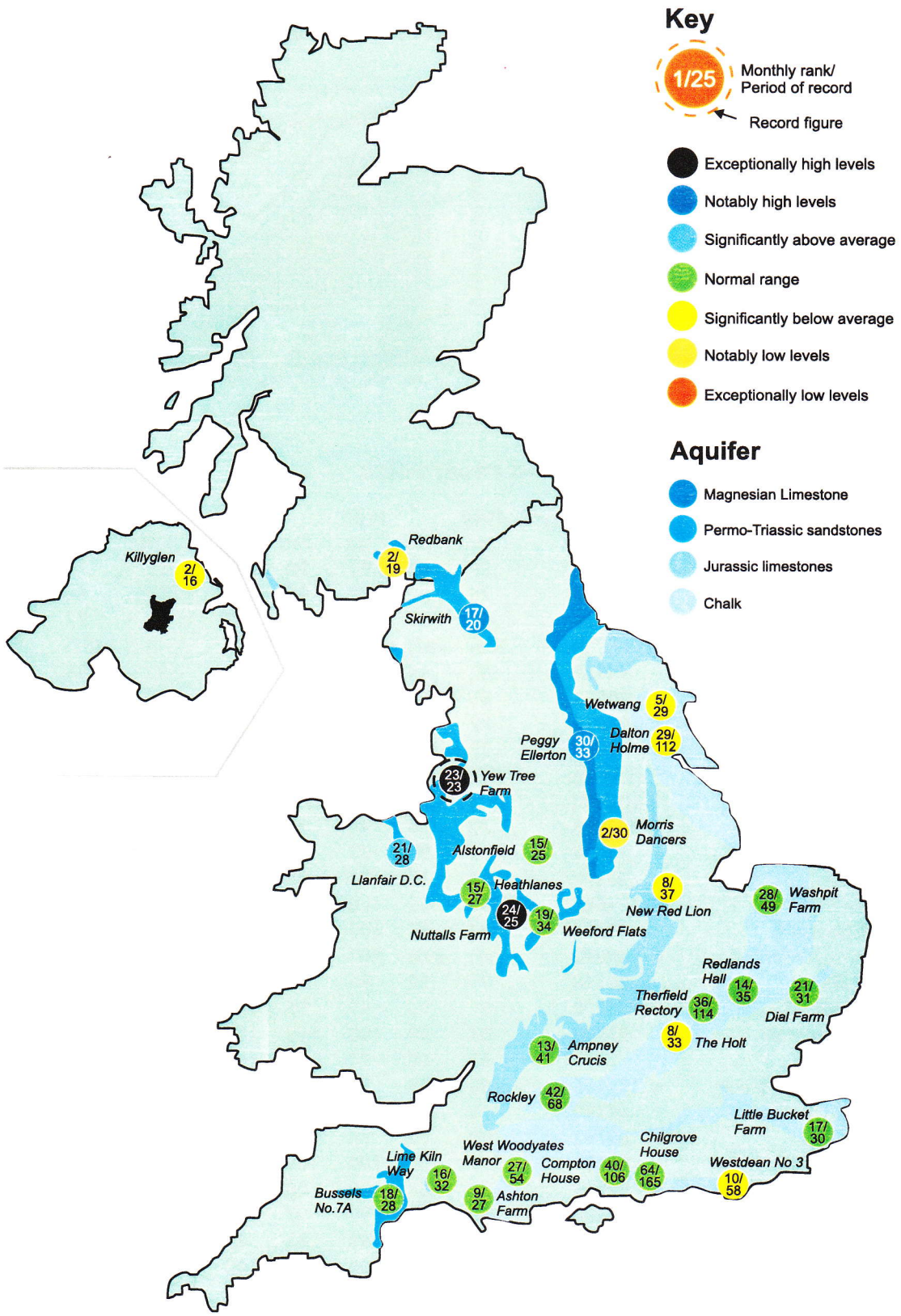




Groundwater levels March/April 2000

Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.	Borehole	Level	Date	Mar av.
Dalton Holme	18.24	24/03	19.49	Chilgrove	53.55	28/03	55.47	Llanfair D.C.	80.30	01/04	79.97
Washpit Farm	45.06	04/04	44.83	Killyglen	114.31	31/03	115.84	Morris Dancers	31.72	23/03	32.49
The Holt	86.50	03/04	87.77	New Red Lion	14.05	29/03	16.50	Heathlanes	62.33	17/03	62.03
Dial Farm	25.76	21/03	25.61	Ampney Crucis	101.88	27/03	102.03	Nuttalls Farm	130.98	13/03	129.18
Rockley	139.94	27/03	138.33	Redbank	8.00	30/03	8.49	Bussels No. 7A	24.43	23/03	24.30
Little Bucket	71.58	01/04	71.52	Skirwith	131.00	31/03	130.64	Alstonfield	200.63	15/03	195.44
West Woodyates	90.16	31/03	90.70	Yew Tree Farm	14.04	30/03	13.57				

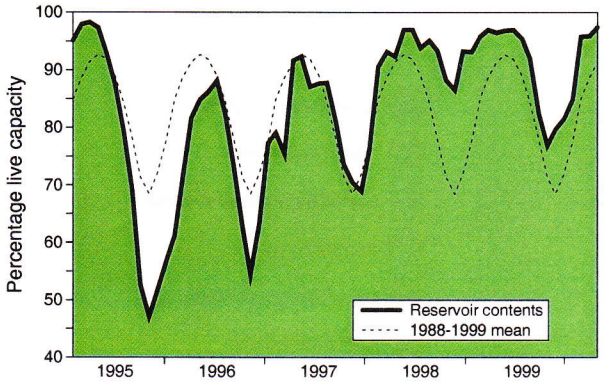
Levels in metres above Ordnance Datum



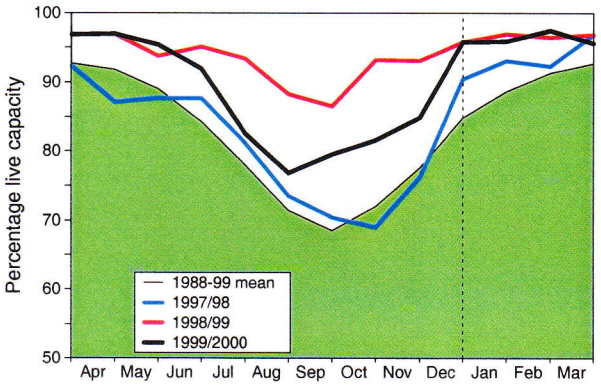
Groundwater levels - March 2000

The rankings are normally based on a comparison of current levels (usually a single reading in a month) with 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.

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.

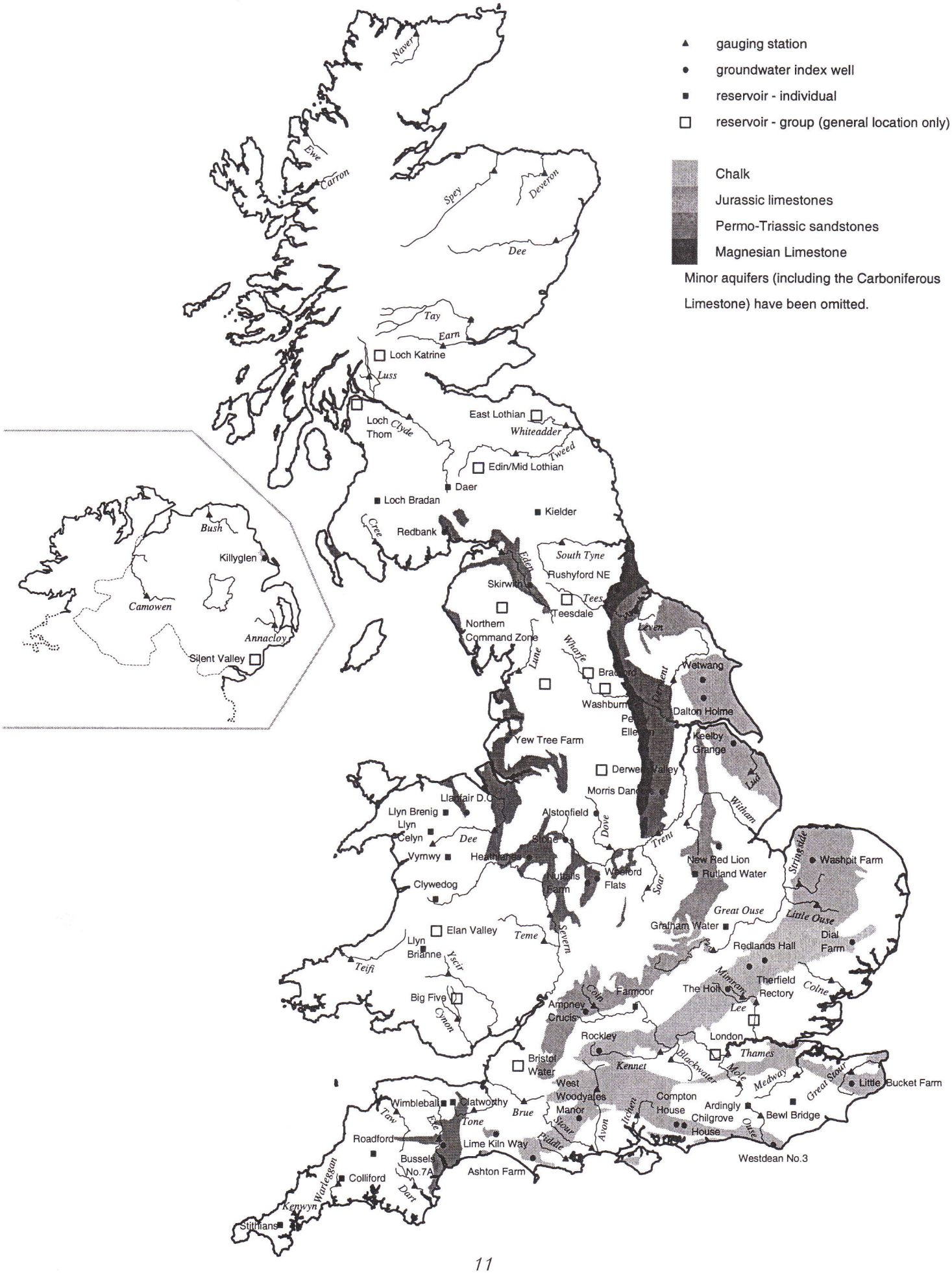
Percentage live capacity of selected reservoirs

Area	Reservoir	Capacity (Ml)	1999 Nov	1999 Dec	2000 Jan	2000 Feb	2000 Mar	Apr	Min. Apr	Year* of min
North West	N Command Zone	• 133375	57	67	93	98	100	92	77	1993
	Vyrnwy	55146	76	82	99	96	96	95	64	1996
Northumbrian	Teesdale	• 87936	68	69	99	97	100	94	77	1996
	Kielder	(199175)	(86)	(87)	(100)	(93)	(97)	(90)	(81)	1993
Severn Trent	Clywedog	44922	82	84	91	88	94	92	86	1996
	Derwent Valley	• 39525	85	84	100	100	100	100	54	1996
Yorkshire	Washburn	• 22035	72	71	99	98	100	94	70	1996
	Bradford supply	• 41407	77	78	99	99	99	93	59	1996
Anglian	Grafham	** (55490)	(92)	(96)	(95)	(94)	(90)	(94)	(77)	1997
	Rutland	**(116580)	(81)	(83)	(88)	(91)	(94)	(95)	(74)	1992
Thames	London	• 206399	79	90	94	95	95	98	88	1990
	Farmoor	• 13843	93	98	77	95	93	100	84	1992
Southern	Bewl	28170	58	54	74	95	98	98	58	1989
	Ardingly	4685	63	65	100	100	100	100	100	1999
Wessex	Clatworthy	5364	87	91	100	98	100	98	82	1992
	Bristol WW	• (38666)	(89)	(89)	(93)	(94)	(96)	(95)	(71)	1992
South West	Colliford	28540	81	82	96	98	100	100	58	1997
	Roadford	34500	91	90	99	95	100	97	37	1996
	Wimbleball	21320	83	88	100	100	100	100	78	1996
	Stithians	5205	63	60	94	98	100	98	52	1992
Welsh	Celyn and Brenig	• 131155	88	89	99	99	100	100	72	1996
	Brianne	62140	98	96	100	98	100	97	90	1993
	Big Five	• 69762	90	92	94	98	97	96	78	1993
	Elan Valley	• 99106	99	100	100	100	100	100	89	1993
East of Scotland	Edinburgh/Mid Lothian	• 97639	73	80	100	98	99	99	71	1998
	East Lothian	• 10206	90	98	99	97	100	97	95	1990
West of Scotland	Loch Katrine	• 111363	92	95	88	85	95	88	88	2000
	Daer	22412	93	100	100	100	100	97	96	1996
	Loch Thom	• 11840	73	84	100	100	100	97	97	2000
Northern Ireland	Silent Valley	• 20634	69	58	61	62	63	57	57	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. Since the discontinuation of The Met. Office's CARP system in July 1998, rainfall figures have been provided by differing methods. Initial rainfall estimates for Scotland and the Scottish regions were derived by IH in collaboration with SEPA. In England and Wales, between July 1998 and May 1999, provisional rainfall figures derive from MORECS*. Beginning with the June 1999 report, provisional rainfall figures for England and Wales, the EA regions and Northern Ireland (from September 1999) 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 SEPA; over the coming months further monthly raingauge totals will be included for selected EA 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 cooperation of all data suppliers is gratefully acknowledged.

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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