Hydrological Summary
for the United Kingdom

March 2003

General
March was a remarkably sunny month with exceptional daytime temperatures and correspondingly high evaporation demands. It was also a notably dry month, continuing an arid interlude which now extends over nine weeks in some areas. This has transformed the hydrological picture. The parched catchment conditions (for the spring) has greatly reduced the risk of flooding but may also signal an early end to the recharge season, in eastern aquifers particularly. Across much of western and northern Britain river flow recessions were unusually steep – by the second week of April flows in many rivers were around seasonal minima. Fortunately, the wet autumn and winter produced a very healthy resources situation in early 2003. Reservoir stocks in most major impoundments declined modestly during March but overall stocks for England and Wales remain close to the seasonal average (but relatively depressed in a few smaller reservoirs, e.g. in western Scotland). Despite little replenishment in March, overall groundwater resources also remain healthy – in the Permo-Triassic sandstones especially. However, the early onset of the seasonal recessions in river flows is likely to herald notably low flows in impermeable lowland catchments in the event of a dry summer.

Rainfall
Following a dry latter half of February, several vigorous Atlantic frontal systems brought significant rainfall to most areas in early March - many western upland catchments reported notable falls - on the 7/8th, Capel Curig (Gwynedd) registered 111 mm in 36 hrs (including 80 mm in 12 hrs). However, from the middle of the second week, high pressure dominated synoptic patterns and many areas reported long sequences of days with precipitation restricted to fog-drip. In some parts of southern England (e.g. the Lambourn Valley) no rainfall was recorded over the last 24 days of March. Rainfall totals for March were below average throughout mainland UK (Skye was an exception). Northern Ireland registered its driest March since 1973 and, in Britain, rainfall deficiencies were generally greatest in the driest regions of the country - some sheltered southern and eastern catchments reported monthly rainfall totals of less than 15 mm. A notably dry interlude can be traced back to the second week of February – since when large areas of eastern and southern Britain have recorded <25% of average rainfall. The combined February and March rainfall totals are the lowest for 30 years in parts of eastern Scotland, and notably low in much of eastern England. Longer term accumulations remain very depressed in much western and northern Scotland but the winter half-year (Oct-March) rainfall total for E&W is the 7th wettest in last 60 years (most regional totals are also significantly above average).

River Flow
Substantial storm rainfall totals in late Feb/early March triggered significant spates in some western catchments; the Annacloy in Northern Ireland reported its highest March peak flow on the 1st and flood warnings were issued in Wales during the second week. Thereafter recessions were protracted in many rivers draining impermeable catchments – flows declining to well below average by early April; the Luss and Tawe were among a significant number of rivers where flows fell below previous late March/early April daily minima. March runoff totals reflect a balance between healthy flow rates early in March and relatively depressed flows (for the spring) around month-end – most totals were in the 40-80% range. Exceptions included the Naver (northern Scotland) which registered its lowest March runoff in a 26-year record and, importantly, many spring-fed rivers in the English Lowlands where the continuing benefit of heavy groundwater recharge during last winter is evident. March runoff for the Mimram was >150% of average; the 30th successive month with above average flows. Very healthy three-3 and 6-month runoff totals in such rivers contrast with modest accumulations in neighbouring clay catchments and, more starkly, with accumulations for many rivers in north and west Scotland. Runoff for the Carron (at New Kelso) over the last eight months is considerably below any previous August-March total in a 24-yr record. Significant late-spring rainfall is needed to arrest the current recessions and avoid exceptionally low early summer flows in responsive catchments

Groundwater
Driven by evaporative demands >25-30% above average over wide areas, soil moisture deficits increased rapidly through March and at month-end were the highest in the 42-year MORECS series in some (mostly western and northern) areas. Correspondingly, infiltration was modest - less than 30% of the March average in some eastern aquifer outcrop areas. However, as is often the case in the spring, the differing responsiveness of individual aquifer units can present (seemingly) conflicting signals. In the Chalk, steep late winter/early spring declines in groundwater levels at some index boreholes (e.g. West Woodyates, Rockley) contrast with continuing recoveries in some of the deeper eastern wells (e.g. Therfield). Despite the paucity of recent recharge, levels remain above average throughout most of the Chalk aquifer. Brisk recessions in most limestone aquifers has left late-spring groundwater levels close to the seasonal average. Like the Chalk, levels in the Permo-Triassic outcrops reflect the local aquifer characteristics but, in many outcrop areas, current levels reflects recharge patterns over several years. Correspondingly, March levels remained very high in most midland and northern outcrops (note: the Redbank borehole is affected by abstraction).

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Mar 2003	Jan 03-Mar 03	RP	Oct 02-Mar 03	RP	Jul 02-Mar 03	RP	Apr 02-Mar 03	RP
England & Wales	**mm**	**38**	**168**		**636**		**846**		**1031**	
	%	**51**	**73**	**5-10**	**126**	**10-20**	**117**	**5-10**	**113**	**5-10**
North West	mm	66	214		669		925		1230	
	%	70	73	5-10	100	<2	95	2-5	102	2-5
Northumbrian	mm	33	144		489		686		871	
	%	47	67	5-15	107	2-5	102	2-5	102	2-5
Severn Trent	mm	33	121		462		632		792	
	%	54	65	5-15	116	2-5	109	2-5	105	2-5
Yorkshire	mm	32	136		501		749		899	
	%	47	66	5-15	114	2-5	117	5-10	109	2-5
Anglian	mm	20	110		402		578		700	
	%	43	82	2-5	135	20-30	128	15-25	118	5-15
Thames	mm	24	129		495		639		814	
	%	42	78	2-5	137	15-25	121	5-10	118	5-10
Southern	mm	25	145		569		721		900	
	%	40	73	5-10	128	5-15	117	5-10	116	5-10
Wessex	mm	35	164		628		778		973	
	%	50	74	5-10	132	10-20	117	5-10	116	5-10
South West	mm	43	226		793		942		1199	
	%	44	67	5-10	110	2-5	98	2-5	102	2-5
Welsh	mm	73	248		851		1032		1336	
	%	69	71	5-10	109	2-5	96	2-5	102	2-5
Scotland	**mm**	**84**	**309**		**707**		**967**		**1292**	
	%	**67**	**82**	**5-10**	**85**	**5-10**	**81**	**10-20**	**90**	**5-10**
Highland	mm	114	413		735		989		1326	
	%	70	86	2-5	68	30-50	67	150-250	75	50-80
North East	mm	42	183		632		905		1097	
	%	54	75	5-10	119	5-10	116	5-10	113	5-10
Tay	mm	71	246		706		971		1300	
	%	65	71	5-10	97	2-5	96	2-5	106	2-5
Forth	mm	50	204		594		842		1148	
	%	53	70	5-15	95	2-5	93	2-5	104	2-5
Tweed	mm	44	177		566		789		1018	
	%	56	72	5-10	107	2-5	102	2-5	105	2-5
Solway	mm	79	279		830		1109		1521	
	%	68	75	5-10	101	2-5	94	2-5	107	2-5
Clyde	mm	94	341		789		1076		1506	
	%	64	75	5-10	78	5-15	75	20-35	89	5-10
Northern Ireland	**mm**	**46**	**203**		**655**		**854**		**1201**	
	%	**53**	**73**	**5-10**	**110**	**2-5**	**100**	**<2**	**113**	**5-10**

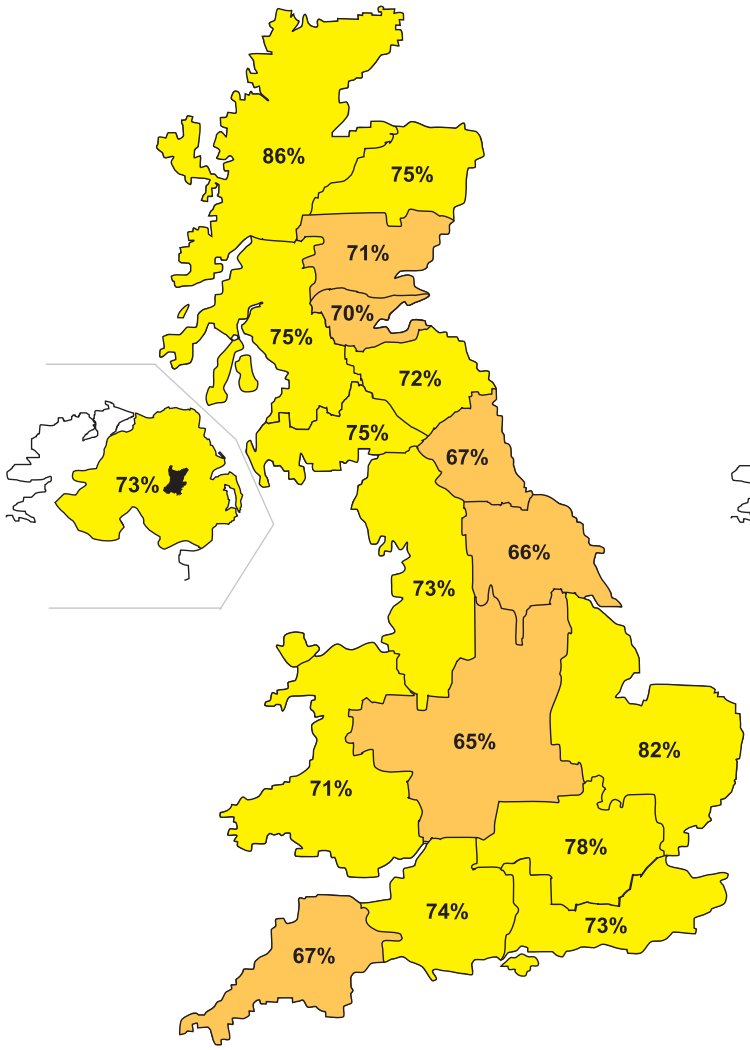
RP = Return period

 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 Met 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.

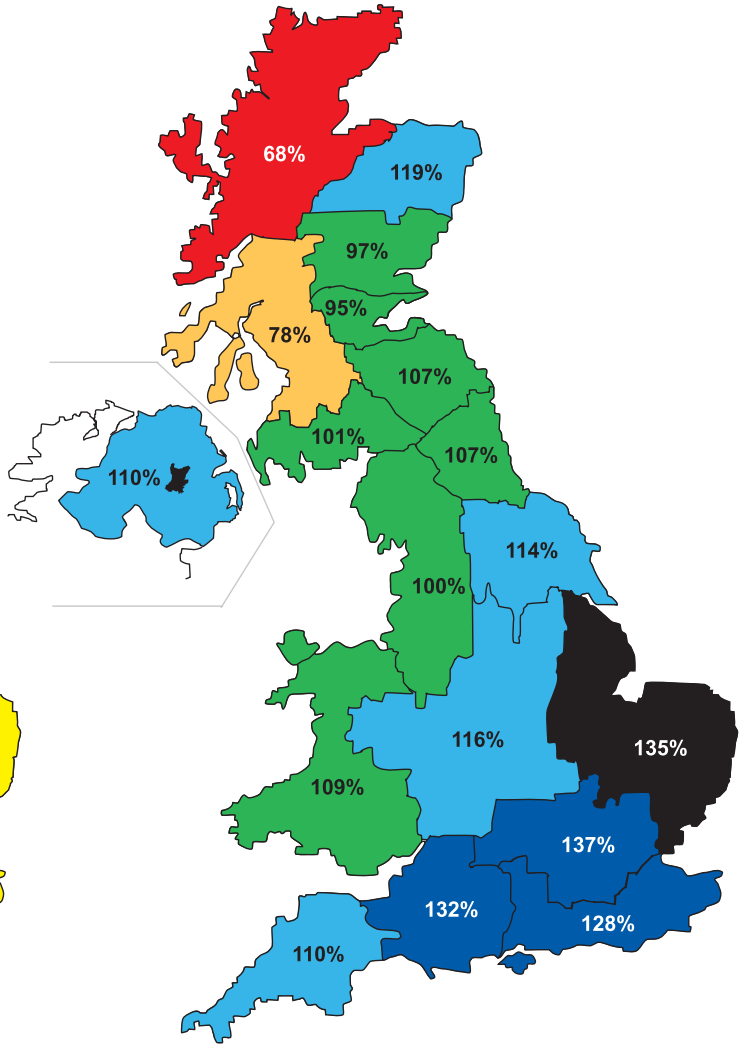
Rainfall . . . Rainfall . .

Key

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



January 2003 - March 2003

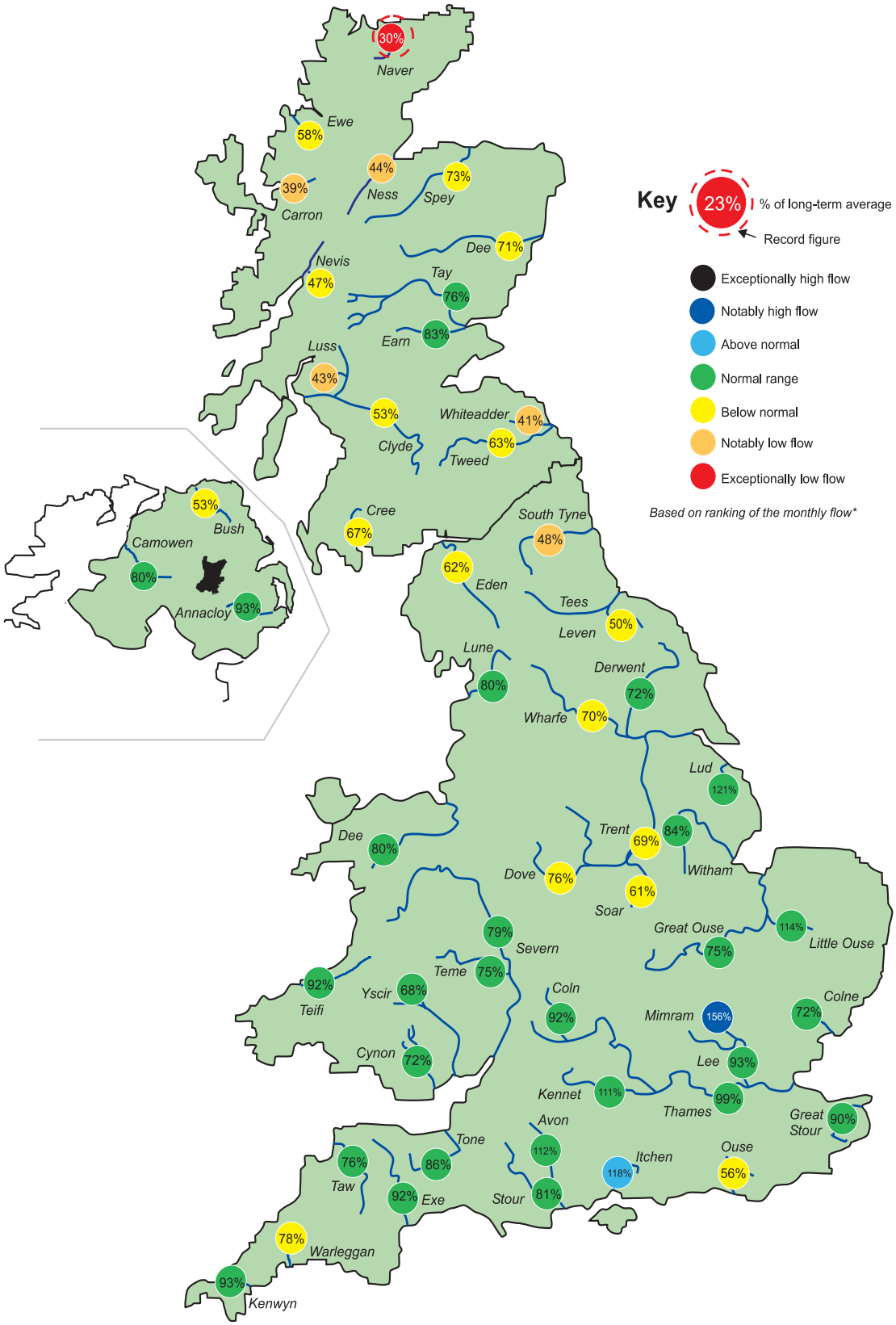


October 2002 - March 2003

Rainfall accumulation maps

Rainfall for the year thus far is well below average in all regions of the UK; for England and Wales as a whole the January-March period is the second driest since 1976 and rainfall deficiencies since mid February are very notable. By contrast, winter half-year rainfall totals exceed the long-term average throughout southern Britain – notably so across much of the English Lowlands – and are within the normal range in Northern Ireland and in much of Scotland (but rainfall deficiencies are exceptional over a range of timeframes in the Highland Region).

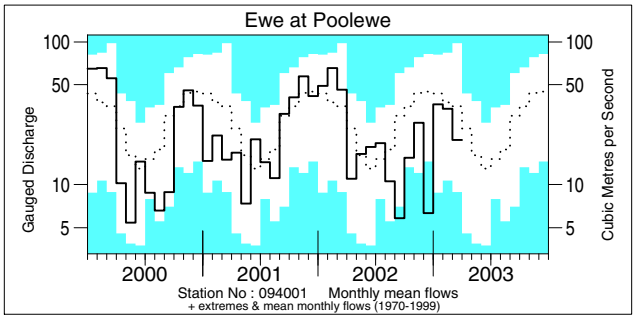
River flow . . . River flow . . .

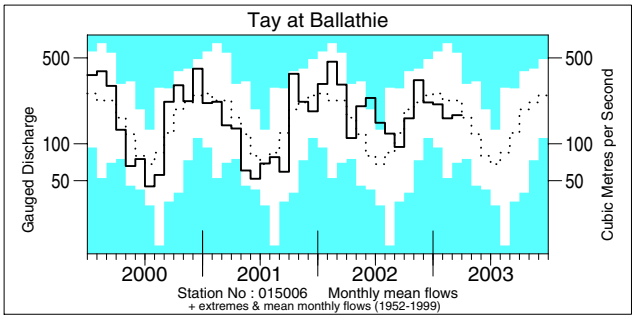


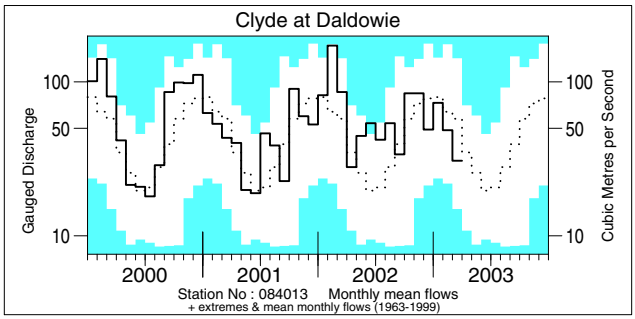
River flows - March 2003

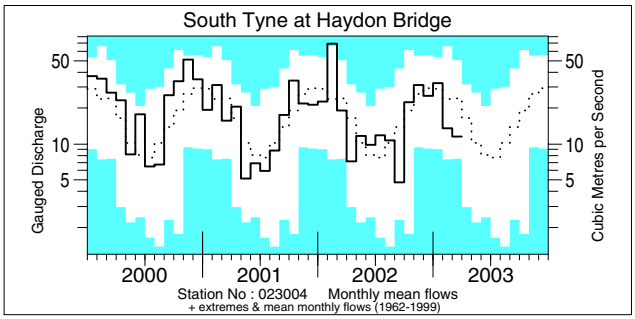
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

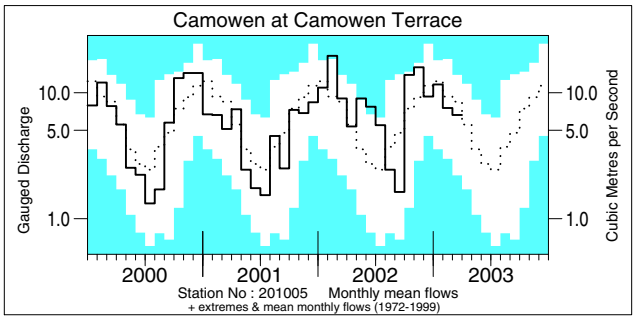
River flow . . . River flow . . .

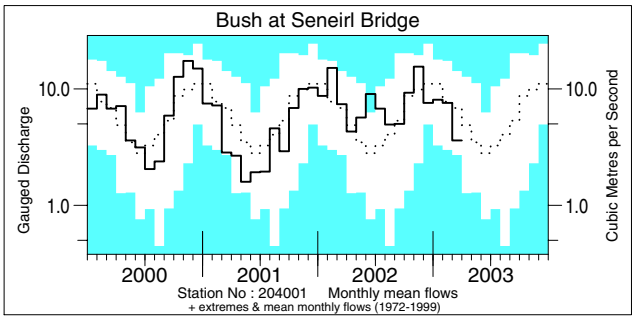


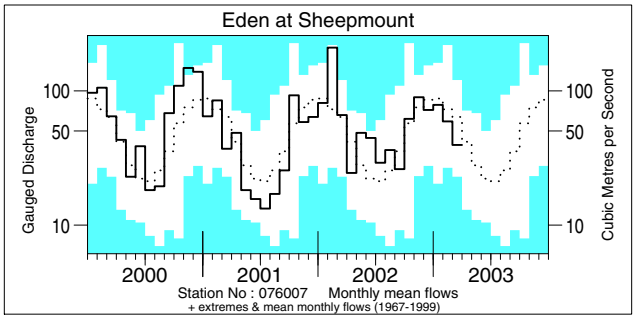


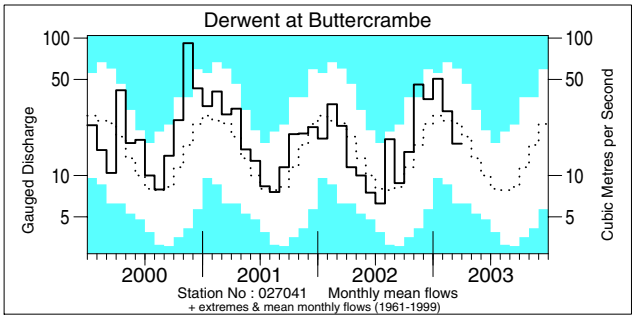


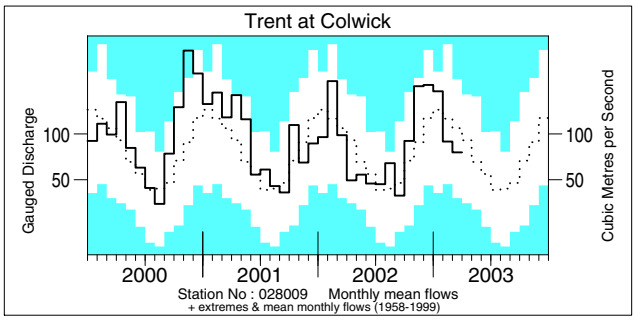


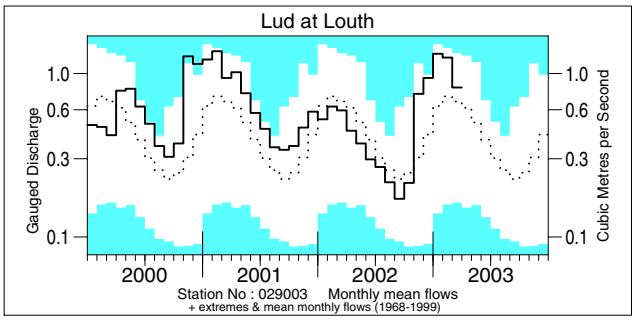








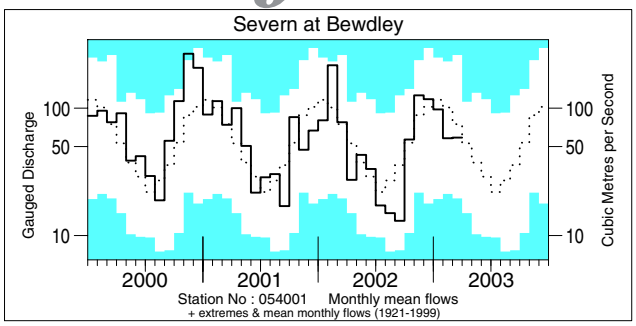


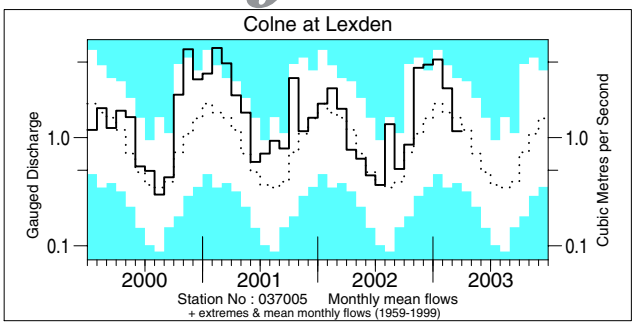


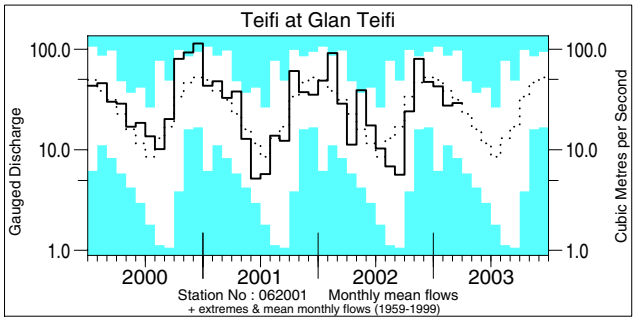
Monthly river flow hydrographs

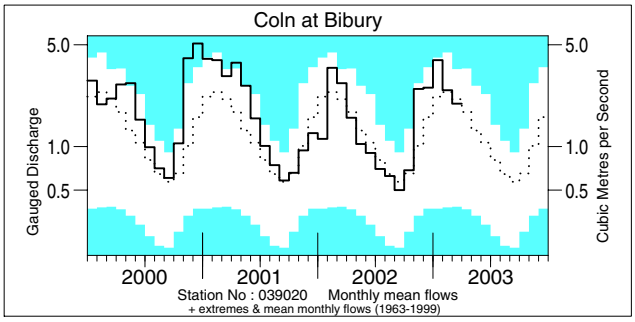
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded areas.

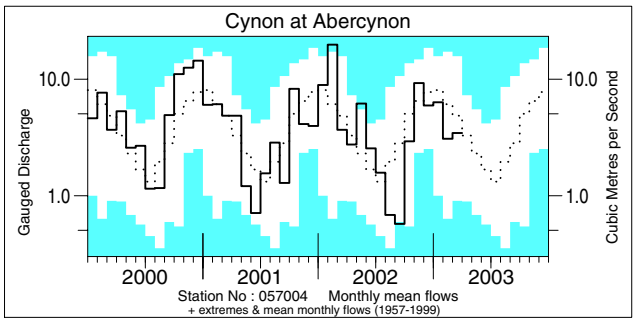
River flow . . . River flow . . .

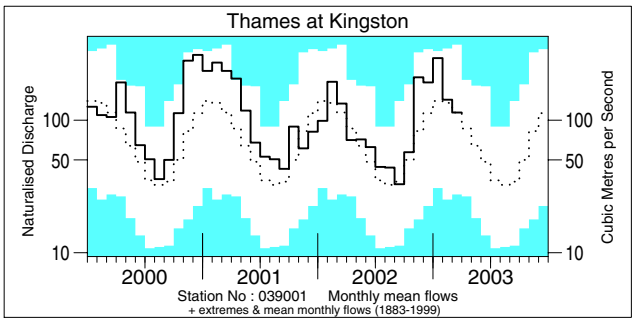


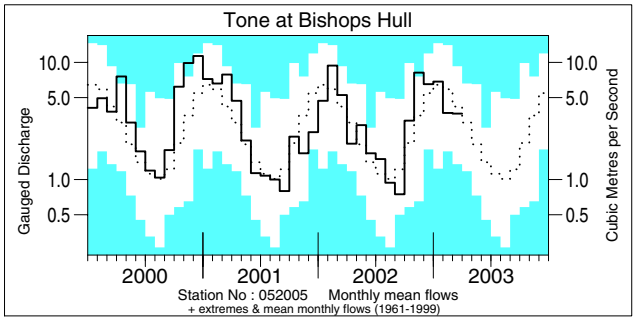


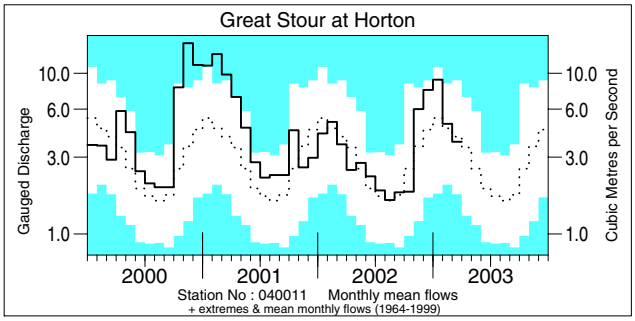


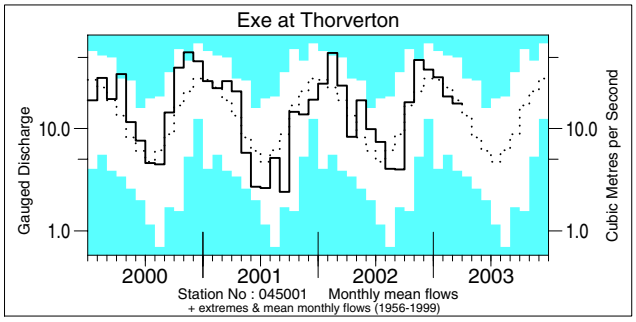


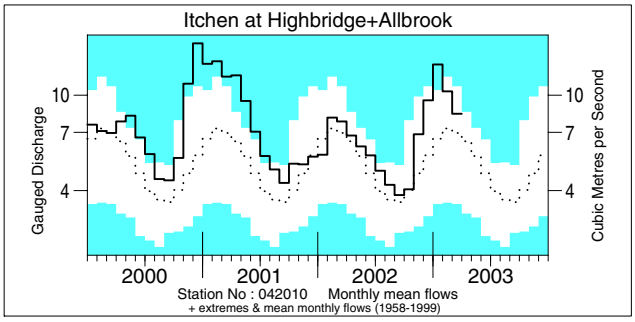












Notable runoff accumulations (a) February 2003 - March 2003, (b) October 2002 - March 2003

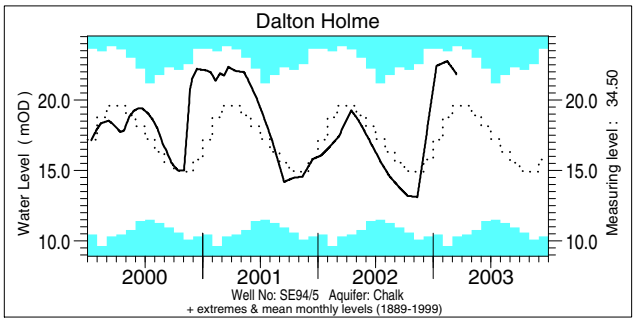
	River	%lta	Rank
a)	Ness	47	2/31
	Whiteadder	45	4/34
	S Tyne	51	4/41
	Lambourn	156	39/41
	Test	144	43/46
	Yscir	65	5/31
	Luss	48	2/26
	Naver	56	2/26

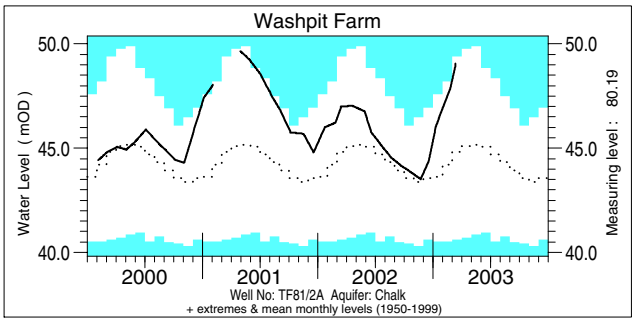
	River	%lta	Rank
b)	Ness	55	1/30
	Deveron	152	40/41
	Dee	141	30/30
	Dover Beck	173	27/28
	Stringside	206	37/37
	Blackwater	163	50/51
	Kennet	169	41/42
	Coln	136	39/40

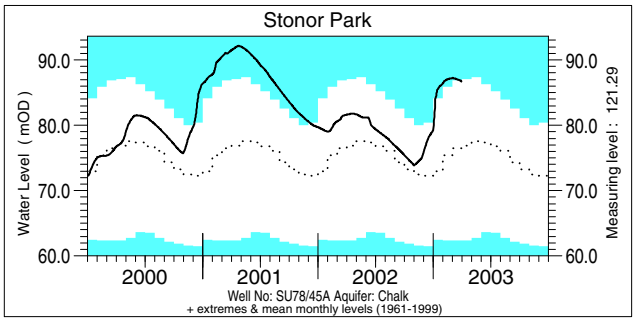
River	%lta	Rank
Hants. Avon	181	37/38
Piddle	158	38/39
Luss	62	1/24
Carron	49	1/24
Ewe	57	2/32
Naver	70	2/26
Nevis	62	2/21
Annacloy	160	22/23

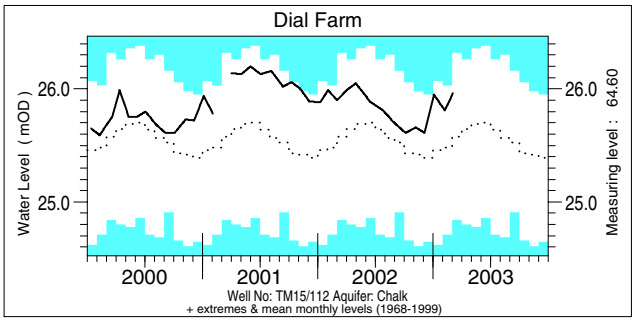
lta = long term average
Rank 1 = lowest on record

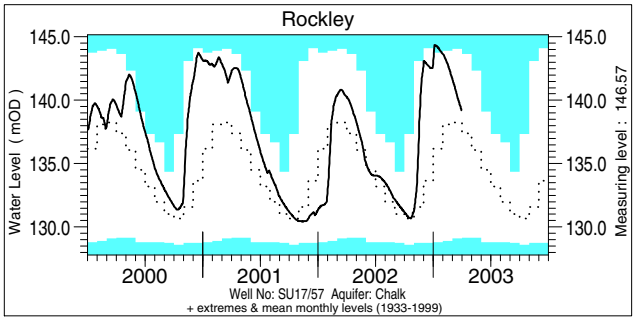
Groundwater . . . Groundwater

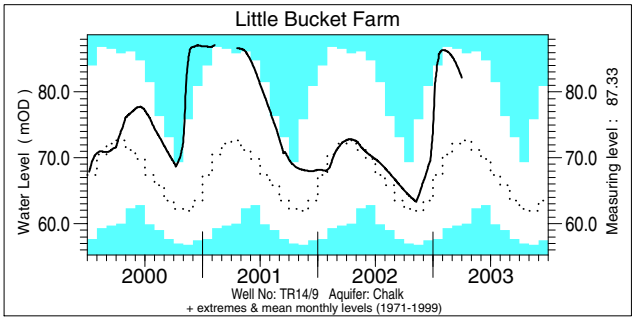


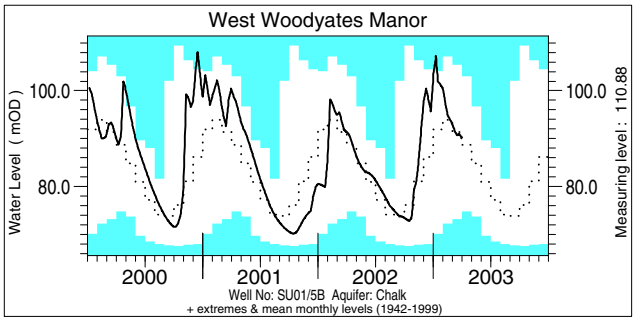


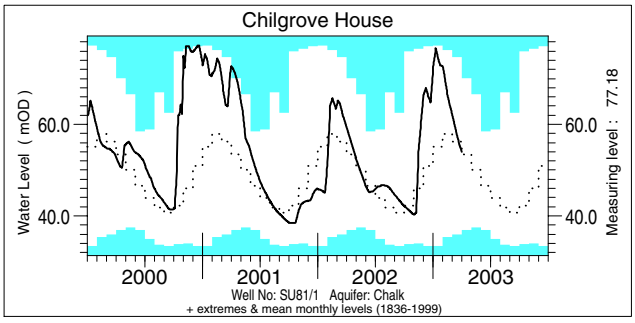


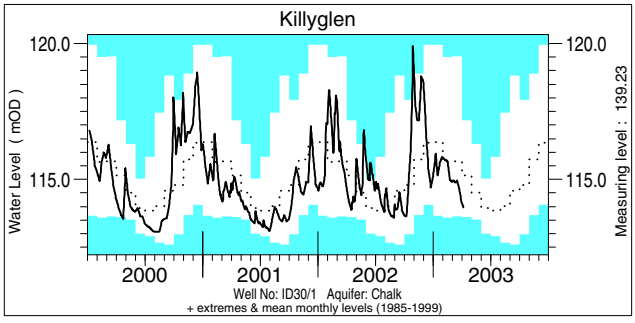


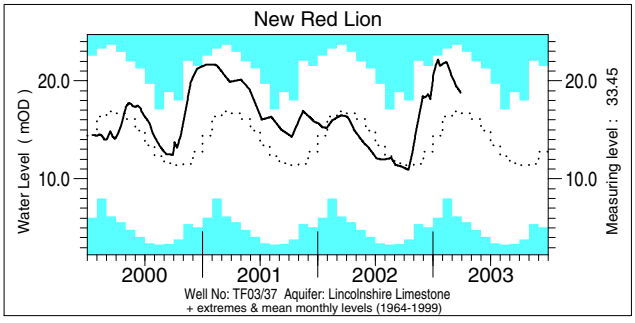






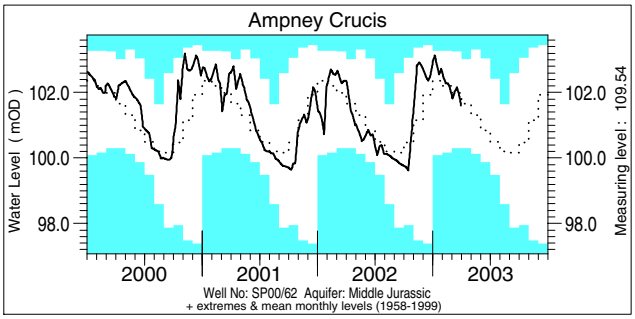


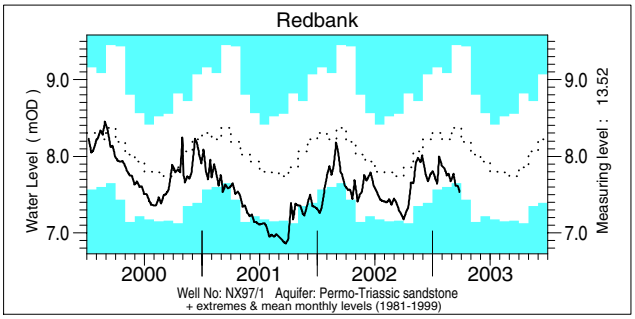


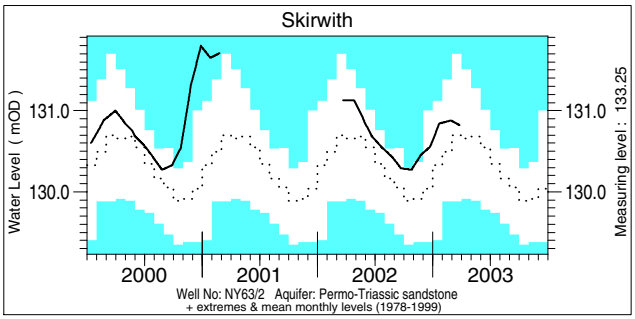


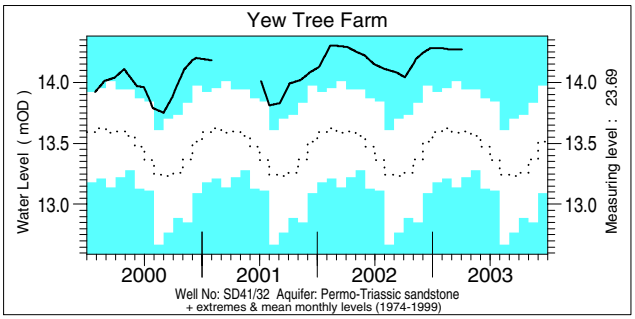
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

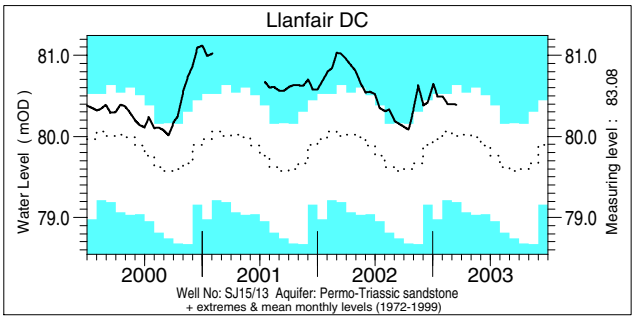
Groundwater . . . Groundwater

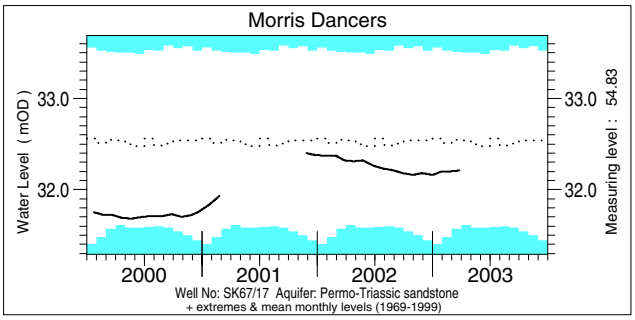


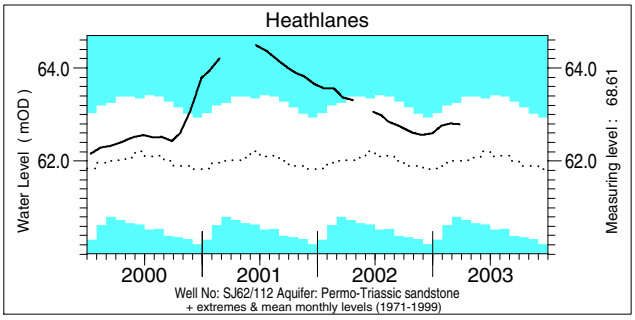


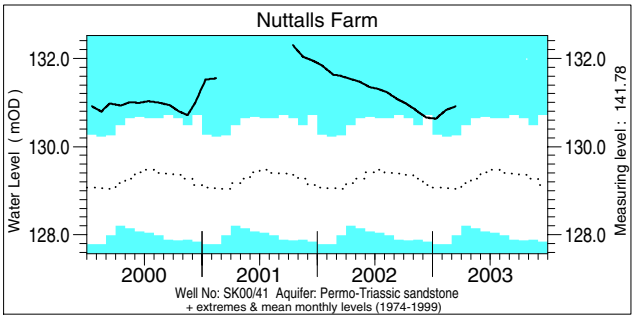


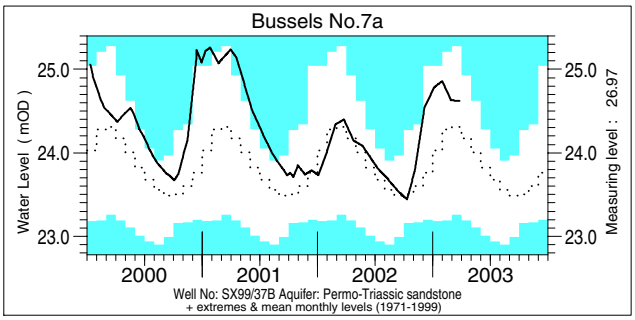


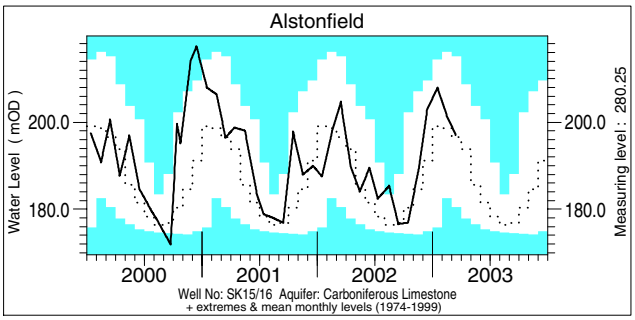










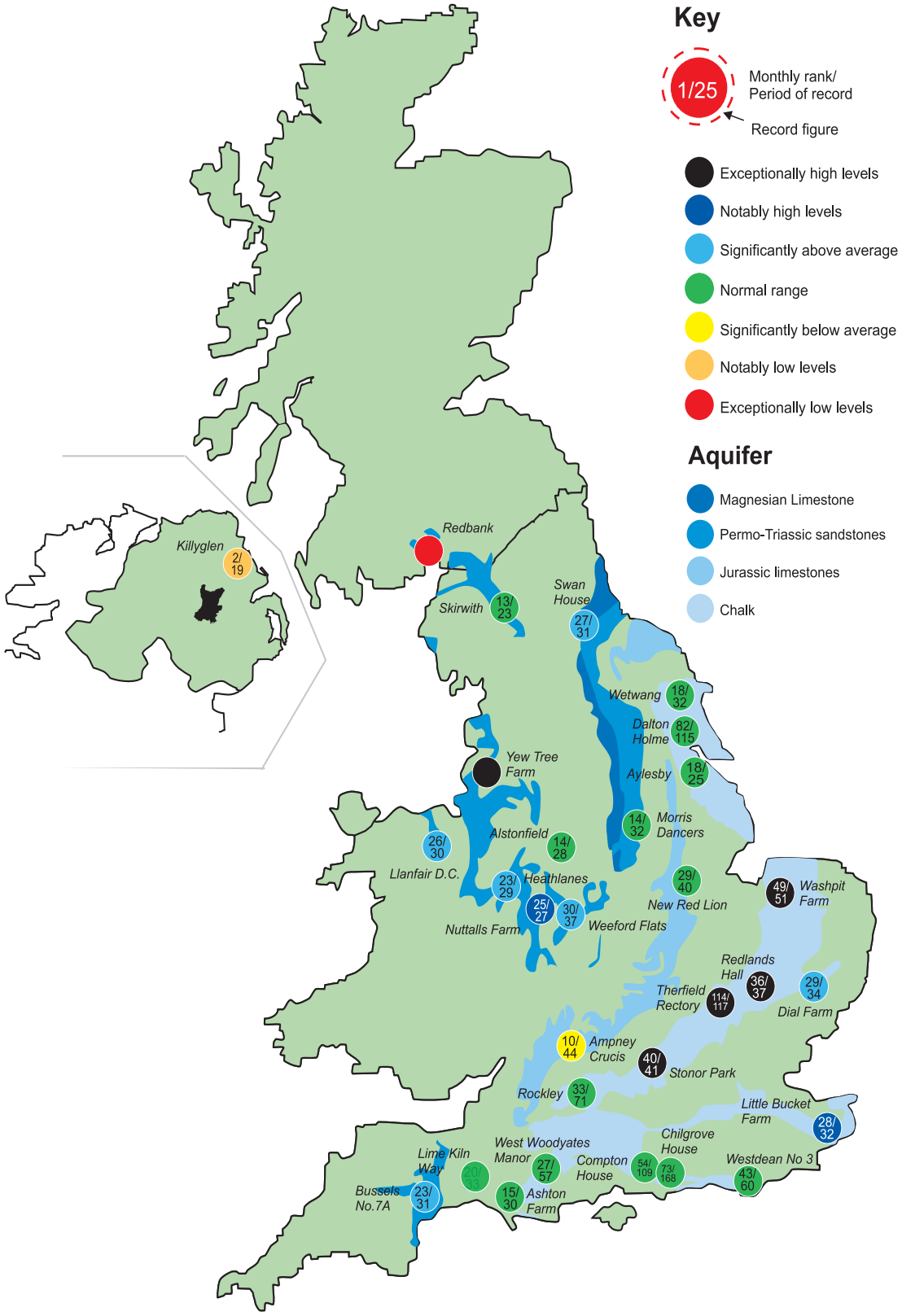


Groundwater levels March 2003 / April 2003

Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.	Borehole	Level	Date	Mar. av.
Dalton Holme	21.83	14/03	19.50	Chilgrove House	54.05	31/03	55.56	Llanfair DC	80.39	15/03	80.00
Washpit Farm	49.05	12/03	44.90	Killyglen	113.96	06/04	115.67	Morris Dancers	32.21	26/03	32.40
Stonor Park	86.72	31/03	76.93	New Red Lion	18.77	28/03	16.66	Heathlanes	62.79	25/03	62.02
Dial Farm	25.96	03/03	25.59	Ampney Crucis	101.60	31/03	102.04	Nuttalls Farm	130.91	13/03	129.34
Rockley	139.20	31/03	138.44	Redbank	7.53	26/03	8.34	Bussels No.7a	24.62	25/03	24.34
Little Bucket Farm	82.21	31/03	71.82	Skirwith	130.82	25/03	130.68	Alstonfield	197.02	14/03	196.55
West Woodyates	90.08	31/03	90.79	Yew Tree Farm	14.27	03/04	13.63				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

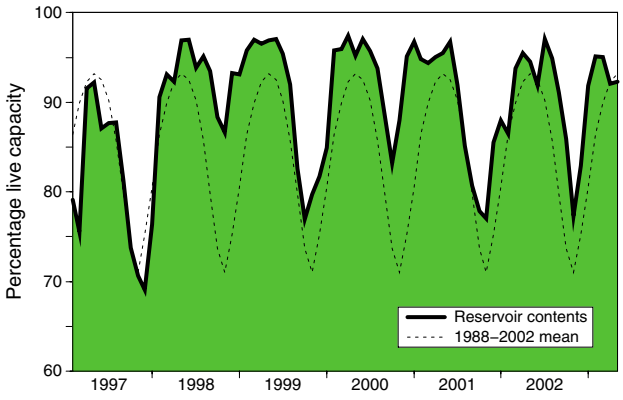


Groundwater levels - March 2003

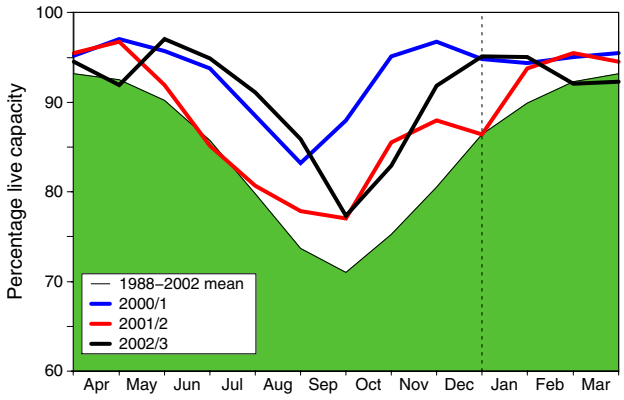
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing 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.

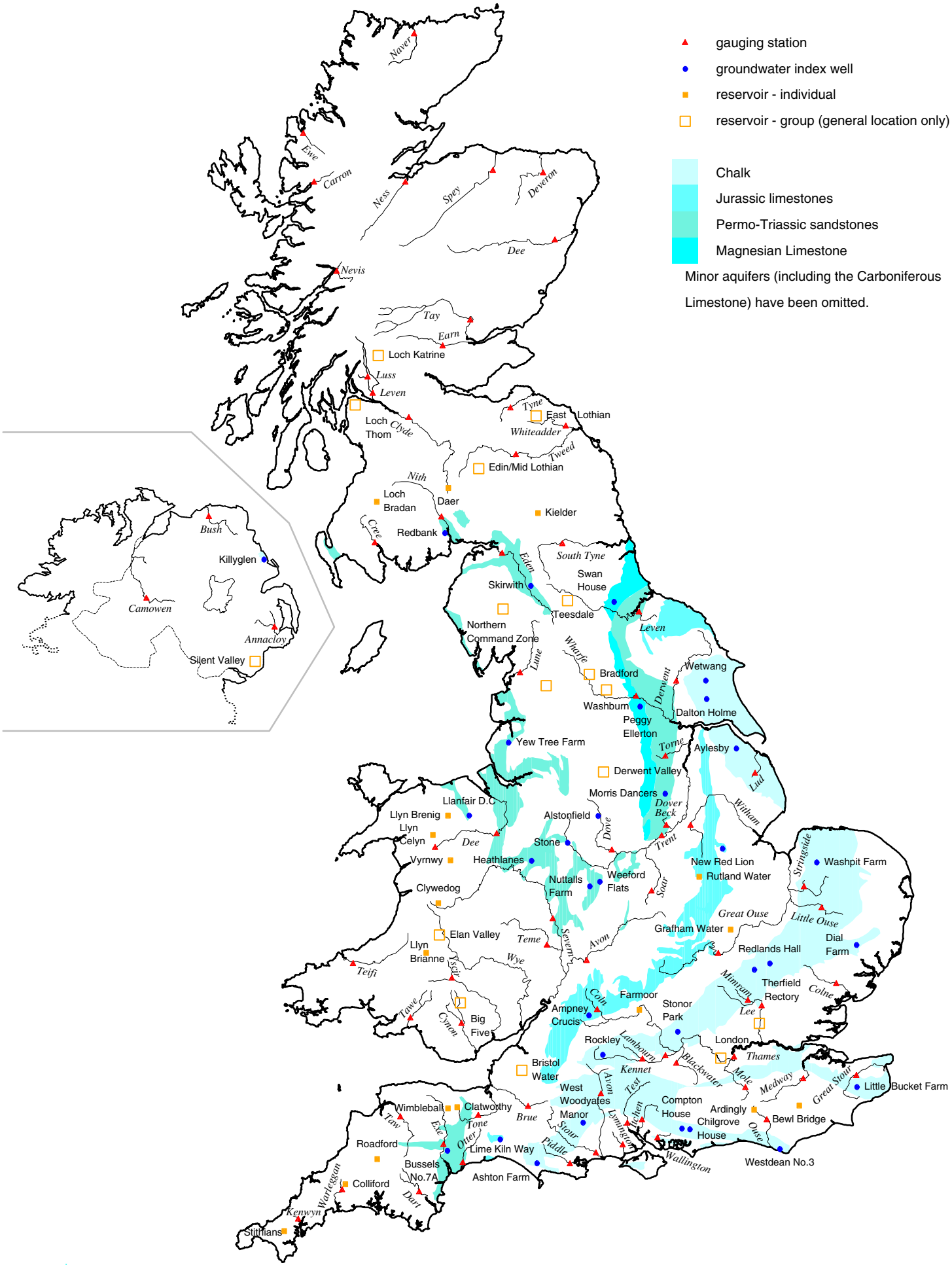
Percentage of live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2002 Nov	2002 Dec	2003 Jan	2003 Feb	2003 Mar	2003 Apr	Min. Apr	Year* of min.
North West	N Command Zone	• 124929	66	79	86	93	89	**88**	77	1993
	Vyrnwy	55146	86	99	99	94	92	**94**	64	1996
Northumbrian	Teesdale	• 87936	89	92	93	93	79	**77**	77	2003
	Kielder	(199175)	(94)	(90)	(99)	(99)	(91)	**(90)**	(81)	1993
Severn Trent	Clywedog	44922	86	78	88	81	85	**96**	86	1996
	Derwent Valley	• 39525	95	99	100	98	98	**96**	54	1996
Yorkshire	Washburn	• 22035	89	90	99	97	97	**90**	70	1996
	Bradford supply	• 41407	95	100	100	100	96	**94**	59	1996
Anglian	Grafham	(55490)	(88)	(90)	(89)	(84)	(86)	**(91)**	(77)	1997
	Rutland	(116580)	(89)	(94)	(93)	(90)	(87)	**(93)**	(74)	1992
Thames	London	• 202340	84	96	97	97	92	**94**	88	1990
	Farmoor	• 13830	83	94	91	91	93	**93**	84	1992
Southern	Bewl	28170	73	80	86	92	92	**92**	58	1989
	Ardingly	4685	88	100	100	100	100	**100**		
Wessex	Clatworthy	5364	73	100	100	100	100	**99**	82	1992
	Bristol WW	• (38666)	(78)	(93)	(99)	(98)	(97)	**(96)**	(71)	1992
South West	Colliford	28540	63	71	78	81	83	**83**	58	1997
	Roadford	34500	82	91	95	92	92	**91**	37	1996
	Wimbleball	21320	80	98	100	100	100	**98**	78	1996
	Stithians	5205	55	84	100	99	100	**96**	52	1992
Welsh	Celyn and Brenig	• 131155	90	94	96	96	99	**98**	72	1996
	Brianne	62140	83	98	99	99	97	**95**	90	1993
	Big Five	• 69762	62	89	96	99	98	**95**	78	1993
	Elan Valley	• 99106	68	100	100	100	99	**96**	89	1993
Scotland(E)	Edinburgh/Mid Lothian	• 97639	89	94	95	99	96	**94**	71	1998
	East Lothian	• 10206	100	99	99	100	98	**96**	95	1990
Scotland(W)	Loch Katrine	• 111363	77	88	89	97	95	**89**	88	2001
	Daer	22412	100	100	100	99	95	**97**	93	2001
	Loch Thom	• 11840	100	100	100	100	100	**94**	93	2001
Northern Ireland	Total+	•	95	100	99	98	96	**94**	83	2002
	Silent Valley	• 20634	93	100	98	98	92	**93**	57	2000

() figures in parentheses relate to gross storage • denotes reservoir groups +excludes Lough Neagh *last occurrence - see footnote

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 1988-2003 period only (except for West of Scotland and Northern Ireland where data commence in the mid-1990's). 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 for Environment, Food and Rural Affairs (Defra), 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, Scottish Water 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.

NATURAL ENVIRONMENT RESEARCH COUNCIL

*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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Selected text and maps are available on the WWW at
http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

03/03