Hydrological Summary
for the United Kingdom

September 2003

General

September was another warm, sunny and, in most areas, dry month. The exceptionally arid end to the summer half-year substantially increased rainfall deficiencies that have been building since late January. The provisional Feb-Sept rainfall total for the UK is the second lowest after 1959 in the last 74 years – testifying to a notable and extensive drought which is most severe in parts of north-eastern Britain and the South-East. Reservoir stocks for E&W have declined by >20% over the last two months (a rare occurrence) and, although generally healthy, are now at their lowest for October since 1996; stocks are relatively modest in Scotland also. River flows were depressed across much of the country in September, approaching long term daily minima in some areas. The limited impact of the drought on water resources, thus far, reflects the relative health of groundwater resources, the very wet late autumn/early winter of 2002/03 and the resilience of water supply provision across the UK. However, with soils still exceptionally dry – across the eastern lowlands especially - the seasonal recovery in runoff and aquifer recharge rates will be significantly delayed. A dry late autumn would make for a considerably more fragile water resources outlook for 2004.

Rainfall

Anticyclonic conditions continued to dominate synoptic patterns throughout much of September. A few notable storm events were reported; on the 19th severe damage was inflicted on the southern Shetlands by an exceptionally intense event; Dover suffered localised flooding on the 27th. Generally however protracted sequences of dry days contributed to very modest September rainfall. Above average rainfall totals were confined to a few, mostly upland, pockets whilst much of the country registered 40-60% of the 1961-90 average, and <20% in substantial parts of southern England. For the UK September was wetter than last year but still among the four driest since 1972. Deficiencies are even more notable over the 2-month timespan – E&W (provisionally) recorded its second driest Aug-Sept in a series from 1766. This very arid episode followed a dry period which stretches back to late January, and significant rainfall deficiencies now extend across all parts of the UK. The most intense drought conditions are found in north-east Scotland where the Feb-Sept total closely approached the lowest 8-month total (for any start month) in a series from 1961, and in the South-East where some catchments registered their 8th successive month with below average rainfall. Over this timespan the Thames basin registered its lowest rainfall since 1929. The estimated return periods for the post-January rainfall deficiency exceeds 20 years over the greater part of the UK.

River flows

Unlike many recent drought episodes, no general recovery in river flows was evident in September as recessions continued in most catchments. Aside from rivers fed by localised storm runoff and a few lowland rivers reliant on groundwater (e.g. the Ver in Bucks), flows were very depressed. The Tweed, Whiteadder, South Tyne, Exe and Yscir were among a number of rivers where flows approached, or eclipsed, previous daily minima. Despite a modest upturn over latter half of the month in northern Britain, monthly totals were also very depressed especially in impermeable catchments; index gauging stations establishing new September minima showed a very wide distribution - from the Aberdeenshire Dee (at Park) to the Exe. Evidence of a dramatic hydrological transformation since the floods of January is provided by the Feb-Sept runoff totals. These are mostly in the lowest quartile with new minima common - the Spey and South Tyne closely approached 8-month minima for any start month. Parched catchments, declining groundwater levels (and the associated drying-up of high level springs) foreshadow low flows in baseflow-fed rivers later in the year.

Groundwater

Contrary to the normal seasonal pattern, soil moisture deficits increased through September across many aquifer outcrop areas. At month-end soils were the driest or second driest, in the 43-year MORECS series over wide areas; previous September maxima were eclipsed by significant margins in parts of southern England. Correspondingly, infiltration was minimal and the, already very protracted, 2003 groundwater level recessions continued. September groundwater levels were especially depressed in parts of the southern Chalk - with the exception of the late summer of 1976 levels at Compton in the South Downs are the lowest in a series from 1893. To the east and north, levels in the Chalk remain considerably healthier – above average in parts of the Chilterns and mostly within the normal early autumn range. Generally, the limestone aquifers present a similar picture, as do a number of the minor eastern aquifers (e.g the Essex gravels and Norfolk Drift). Levels in most of the southern Permo-Triassic sandstones outcrops are also within the normal range but the slower responding Midland and northern outcrops remain close to pre-2000 maxima, albeit the lowest for four or five years in most cases. Smds in early October were the equivalent of 10-14 weeks of residual rainfall across many outcrop areas – in the absence of a very wet late autumn, the window of opportunity for recharge over the coming winter is likely to be narrow, in eastern aquifer units particularly.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Sep 2003	Aug 03-Sep 03	RP	Apr 03-Sep 03	RP	Feb 03-Sep 03	RP	Oct 02-Sep 03	RP
England & Wales	**mm**	**35**	**56**		**319**		**394**		**953**	
	%	**45**	**36**	**50-80**	**78**	**5-15**	**72**	**30-40**	**104**	**2-5**
North West	mm	86	106		443		560		1112	
	%	75	48	20-30	83	5-10	79	5-15	92	2-5
Northumbrian	mm	49	65		291		348		780	
	%	67	42	30-45	73	10-20	66	40-60	91	2-5
Severn Trent	mm	28	43		277		336		739	
	%	44	33	40-60	77	10-20	71	20-30	98	2-5
Yorkshire	mm	56	79		340		406		841	
	%	83	56	5-15	90	5-10	80	5-10	102	2-5
Anglian	mm	20	27		237		277		640	
	%	41	26	110-150	80	5-10	72	15-25	107	2-5
Thames	mm	16	27		209		259		704	
	%	27	23	80-120	64	20-30	60	50-80	102	2-5
Southern	mm	11	31		203		262		772	
	%	16	25	60-90	61	30-45	58	70-100	99	2-5
Wessex	mm	9	25		244		321		872	
	%	13	18	120-170	68	10-20	65	30-45	104	2-5
South West	mm	28	53		372		499		1165	
	%	30	30	50-80	82	5-10	76	5-15	99	2-5
Welsh	mm	60	86		446		580		1297	
	%	52	40	30-45	84	2-5	79	5-15	99	2-5
Scotland	**mm**	**84**	**128**		**480**		**621**		**1187**	
	%	**59**	**49**	**35-50**	**80**	**10-20**	**75**	**30-45**	**83**	**15-25**
Highland	mm	100	163		566		749		1300	
	%	58	55	20-30	83	5-10	77	20-30	74	70-100
North East	mm	41	70		297		365		929	
	%	47	40	60-90	67	30-45	62	>200	95	2-5
Tay	mm	54	80		399		517		1105	
	%	48	39	40-60	79	5-10	73	20-30	90	2-5
Forth	mm	66	91		386		477		979	
	%	60	45	30-45	80	5-10	73	30-40	88	5-10
Tweed	mm	49	63		324		399		890	
	%	55	36	60-90	73	10-20	68	40-60	92	2-5
Solway	mm	83	109		485		633		1315	
	%	58	41	30-45	81	5-10	78	10-20	93	2-5
Clyde	mm	111	162		600		770		1389	
	%	62	52	20-30	87	2-5	81	5-15	82	10-20
Northern Ireland	**mm**	**68**	**89**		**436**		**547**		**1090**	
	%	**69**	**47**	**20-30**	**94**	**2-5**	**87**	**2-5**	**103**	**2-5**

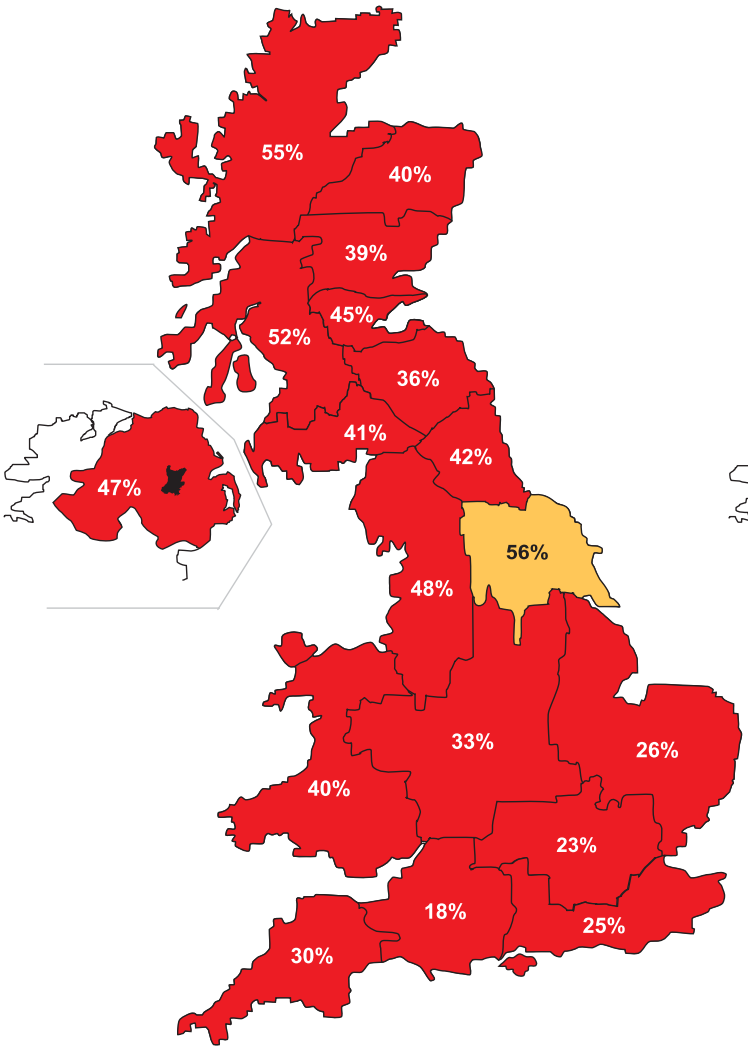
RP = Return period

 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.

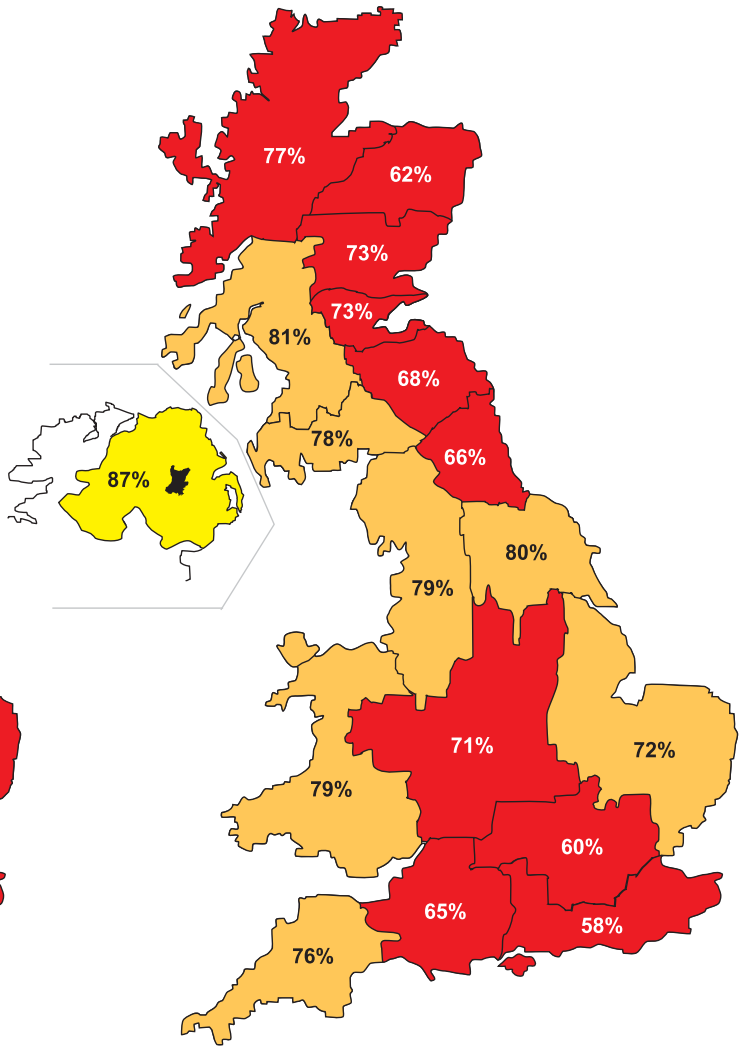
Rainfall . . . Rainfall . .

Key

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



August 2003 - September 2003

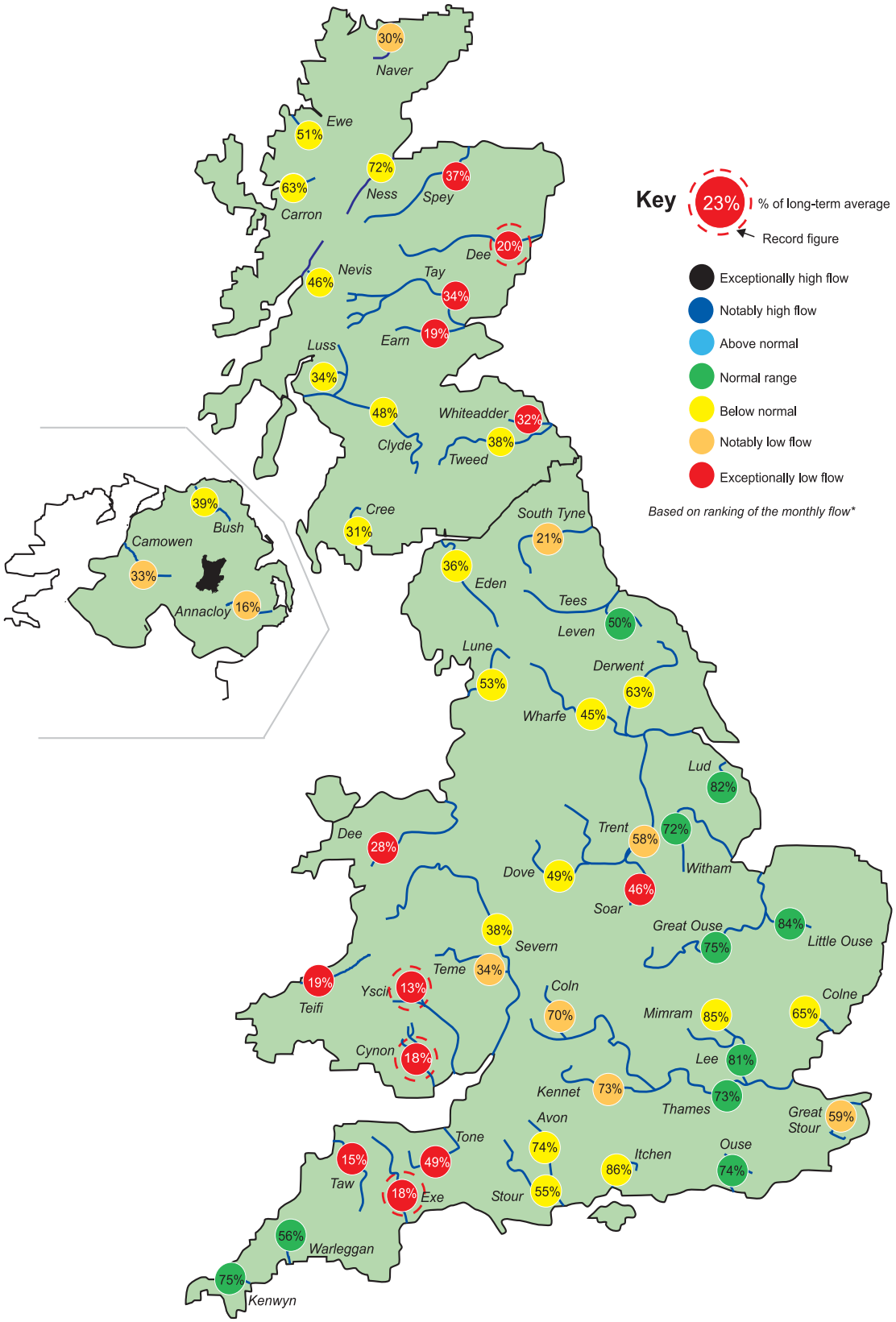


February 2003 - September 2003

Rainfall accumulation maps

The combined August and September rainfall totals confirm the exceptional aridity of the late summer and early autumn. For most regions of the UK the two-month total is the lowest in the regional rainfall series (which start in 1961) - across southern Britain the previous minima have been eclipsed by wide margins. Greater regional variation in drought intensity is evident for the February-September period but rainfall deficiencies are substantial across the UK, and equivalent to around threee months rainfall in parts of southern England.

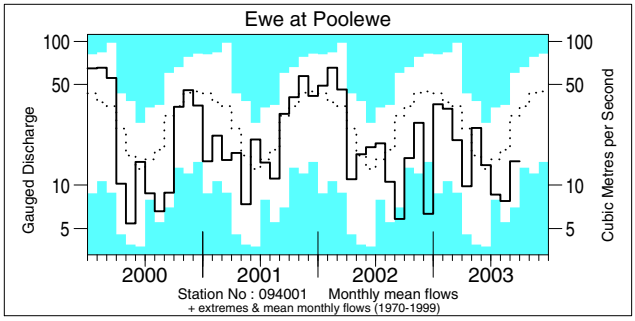
River flow . . . River flow . . .

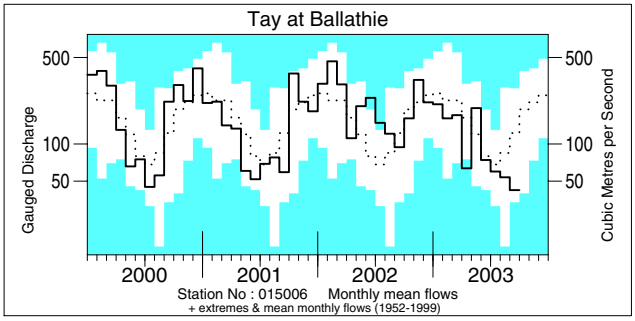


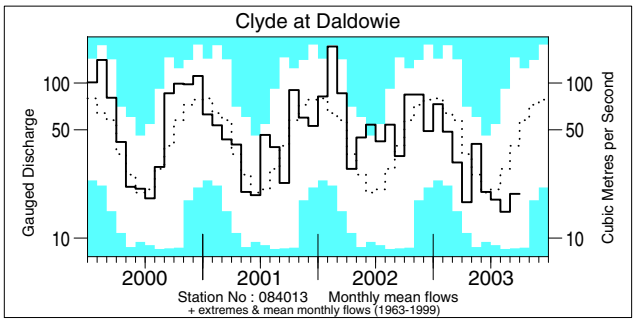
River flows - September 2003

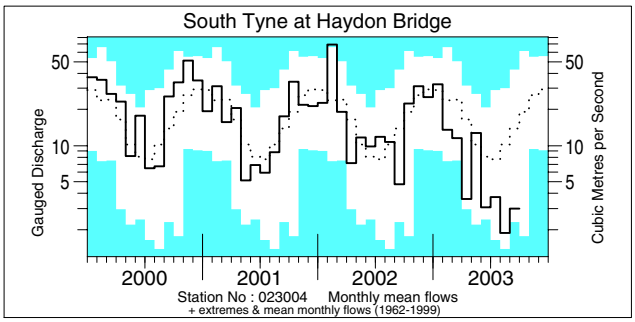
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

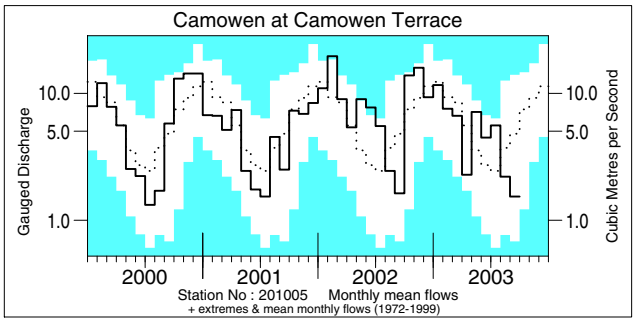
River flow . . . River flow . . .

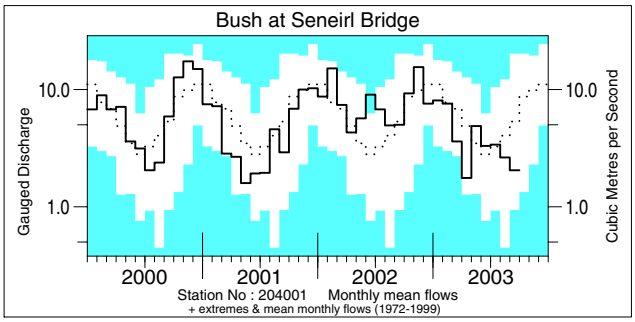


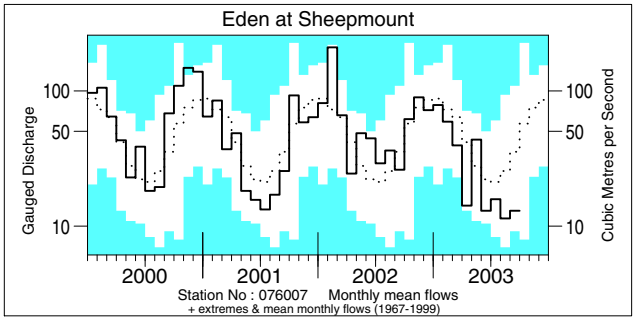


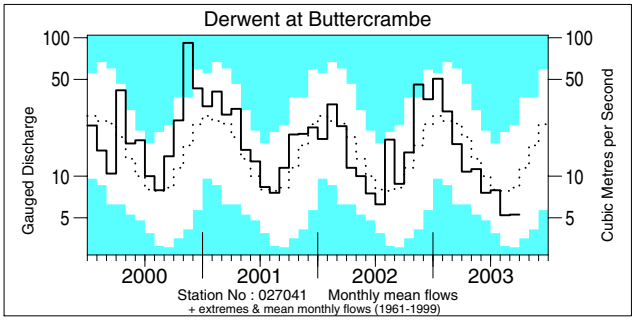


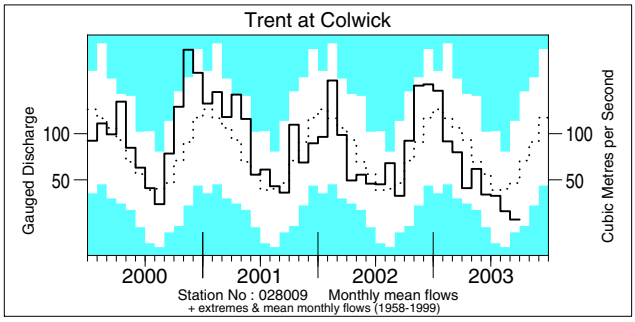


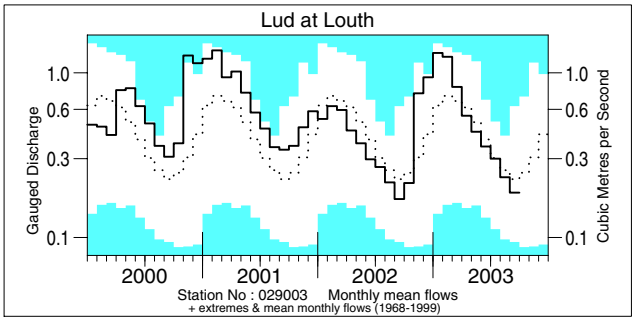








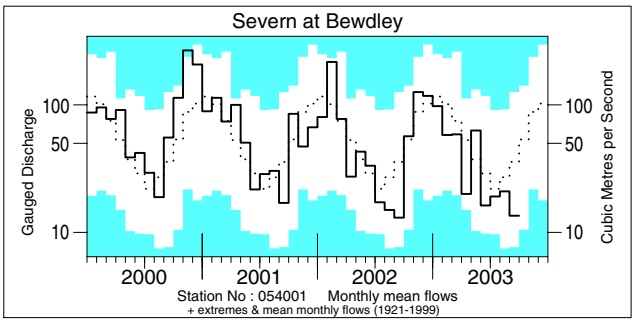


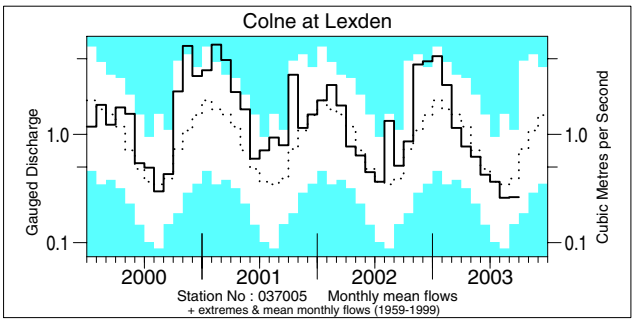


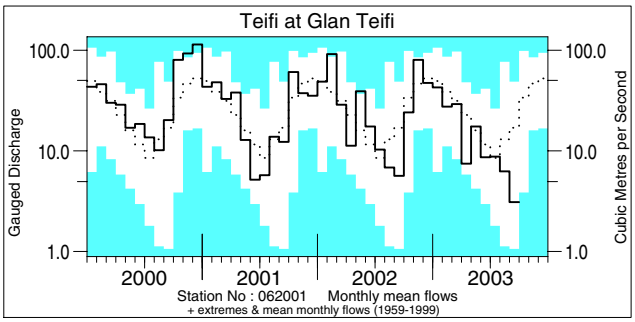
Monthly river flow hydrographs

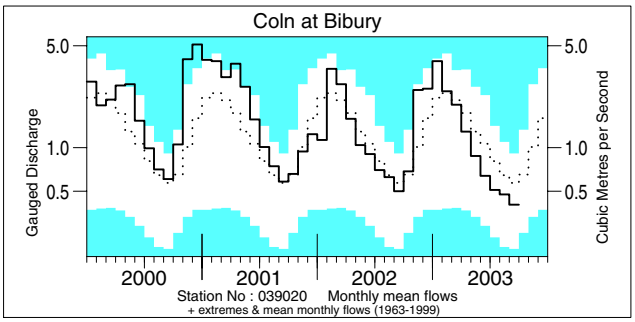
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/ minimum range are indicated where the bold trace enters the shaded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

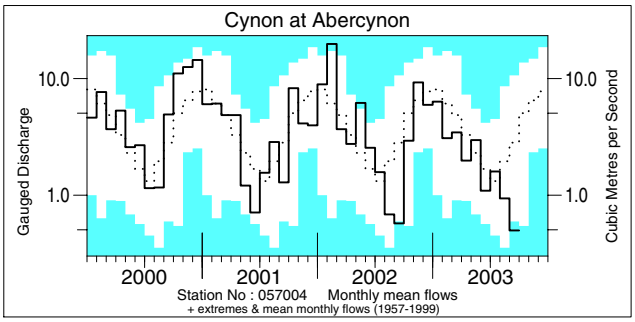
River flow . . . River flow . . .

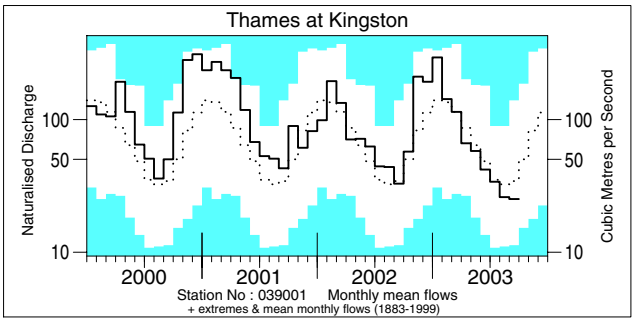


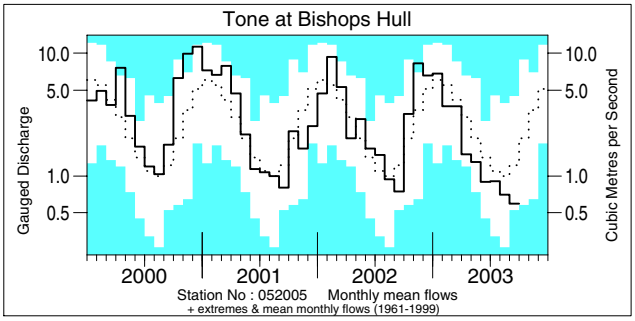


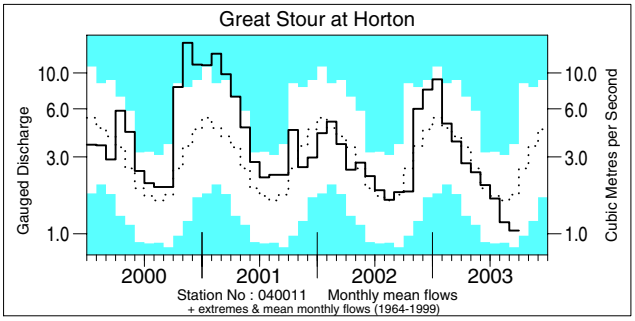


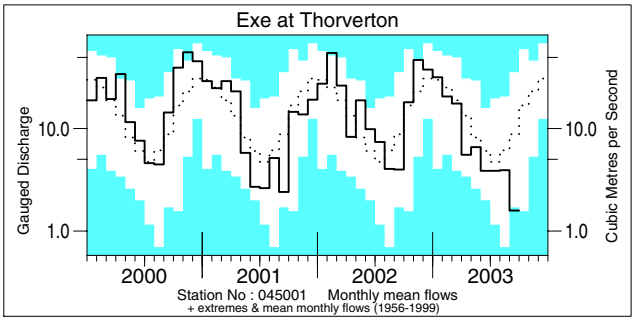


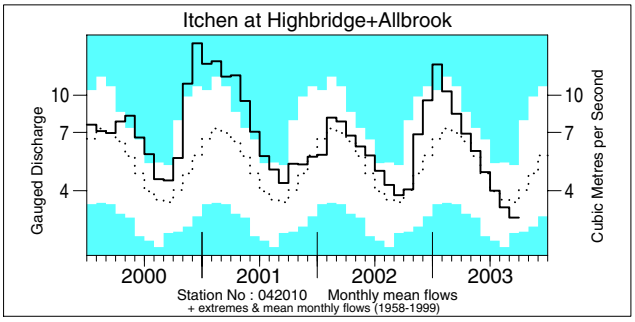










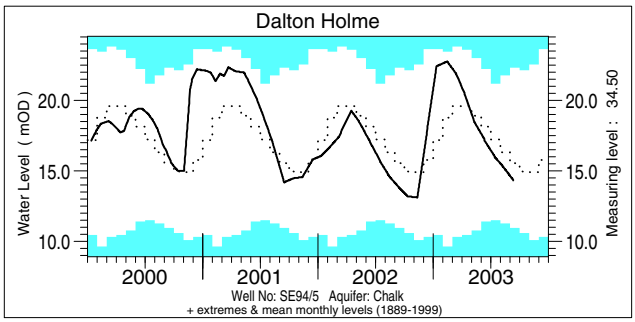


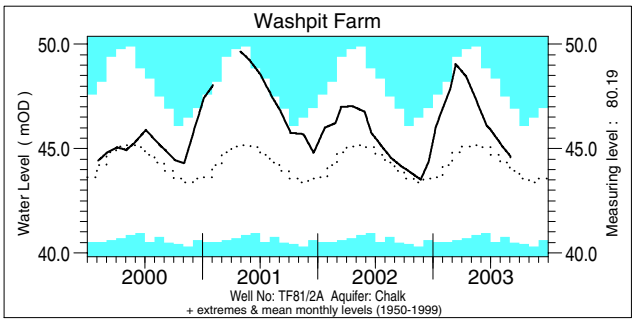
Notable runoff accumulations (a) August 2003 - September 2003, (b) February 2003 - September 2003

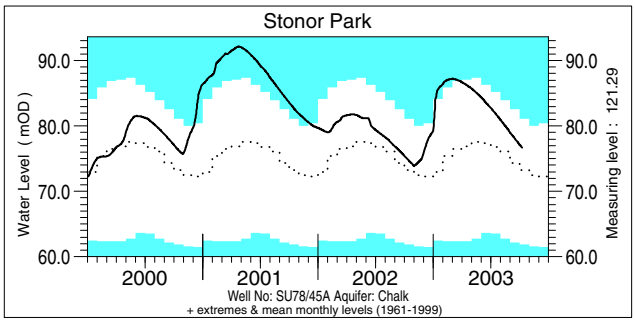
	River	%lta	Rank	River	%lta	Rank		River	%lta	Rank
a)	Deveron	29	1/42	Cynon	31	3/45	b)	Ness	63	2/31
	Dee (Park)	25	1/31	Tawe	21	3/46		Spey	61	1/51
	Tyne	35	2/38	Dee (New Inn)	27	2/35		S.Tyne	46	1/40
	Whiteadder	35	1/34	Eden	40	3/36		Taw	53	3/45
	Soar	45	1/33	Nevis	48	2/21		Teme	61	2/33
	Wallington	24	2/51	Naver	34	2/27		Luss	67	2/25
	Lymington	21	3/41	Annacloy	17	4/24		Carron	54	1/25
	Otter	63	3/41							
	Yscir	25	3/32							

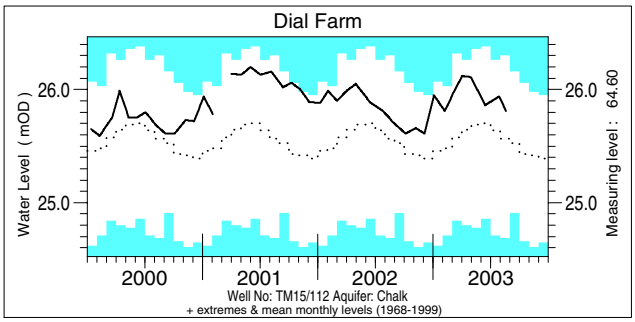
lta = long term average
Rank 1 = lowest on record

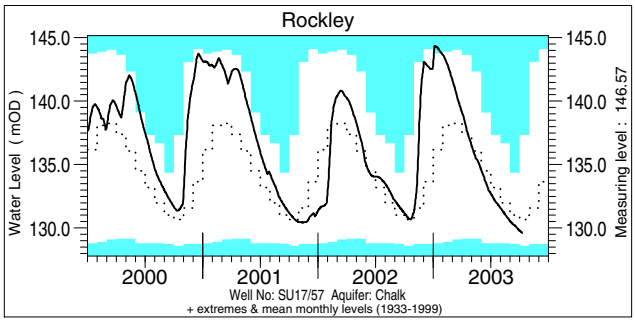
Groundwater . . . Groundwater

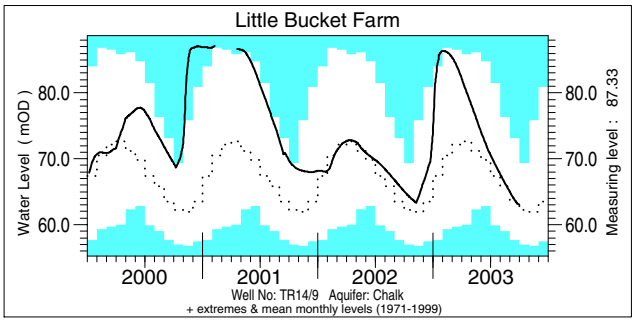


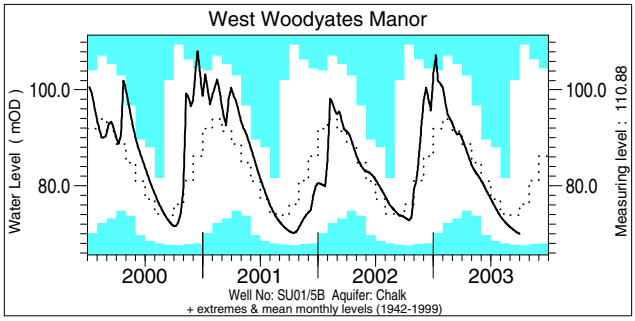


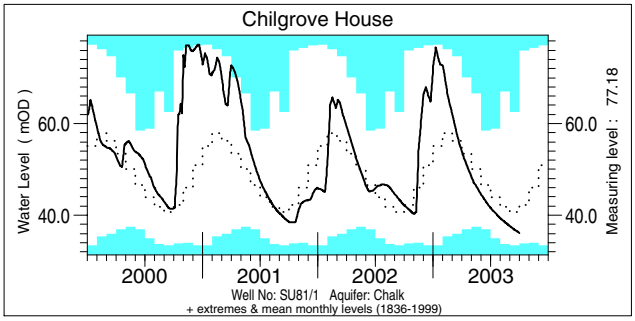


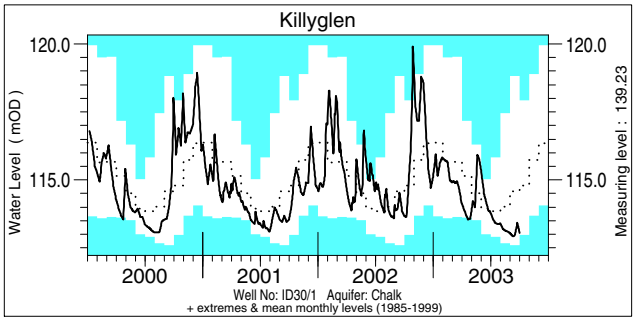


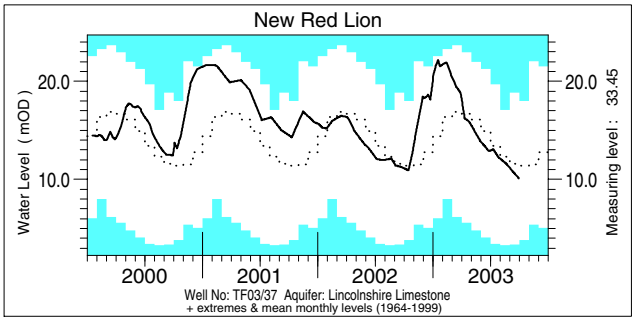






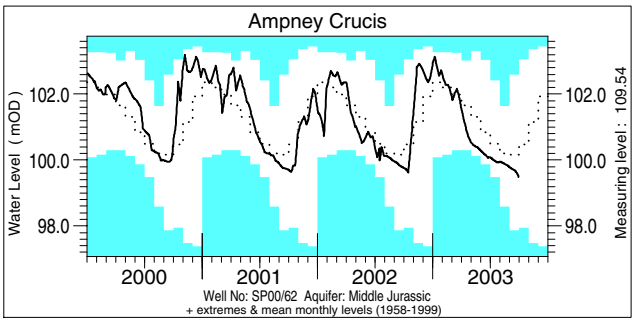


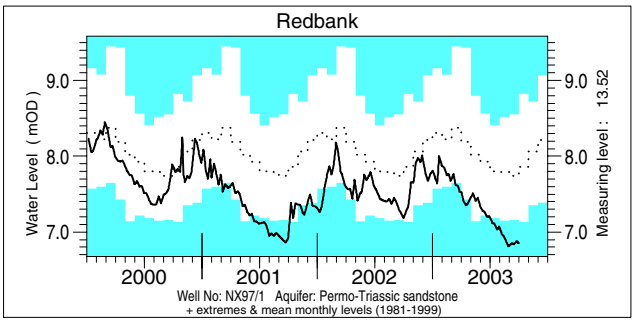


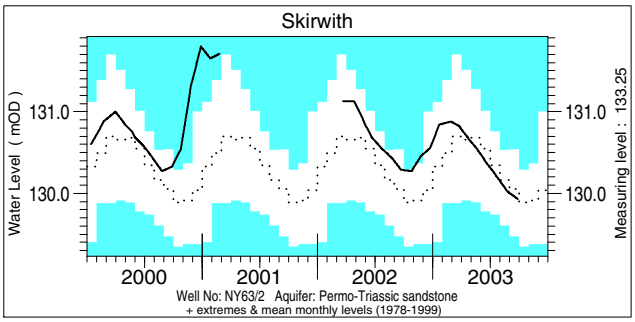


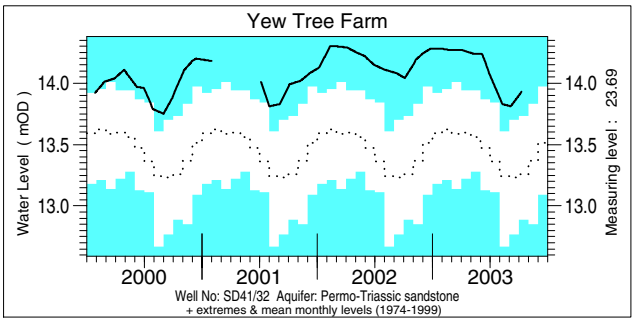
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

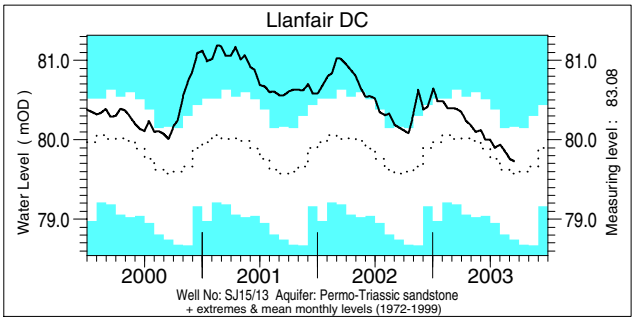
Groundwater . . . Groundwater

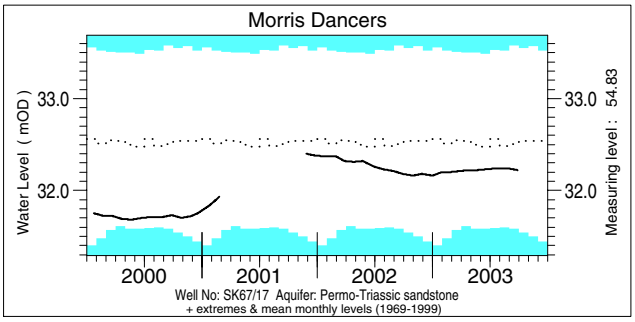


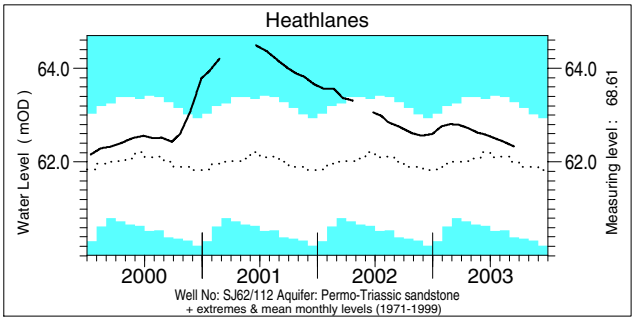


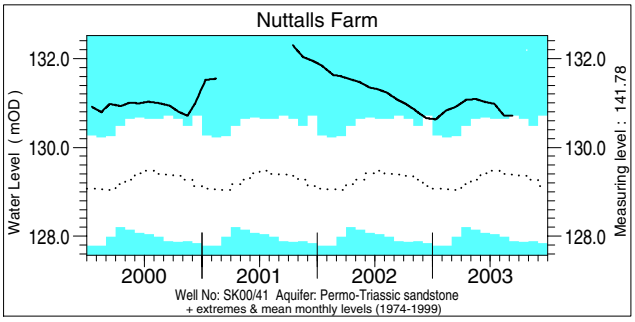


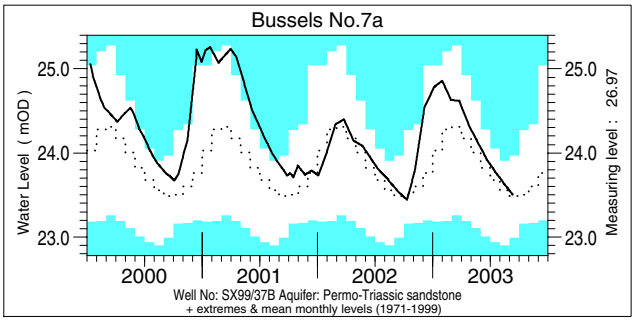


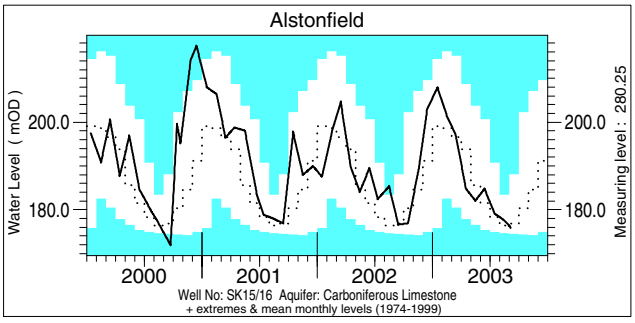










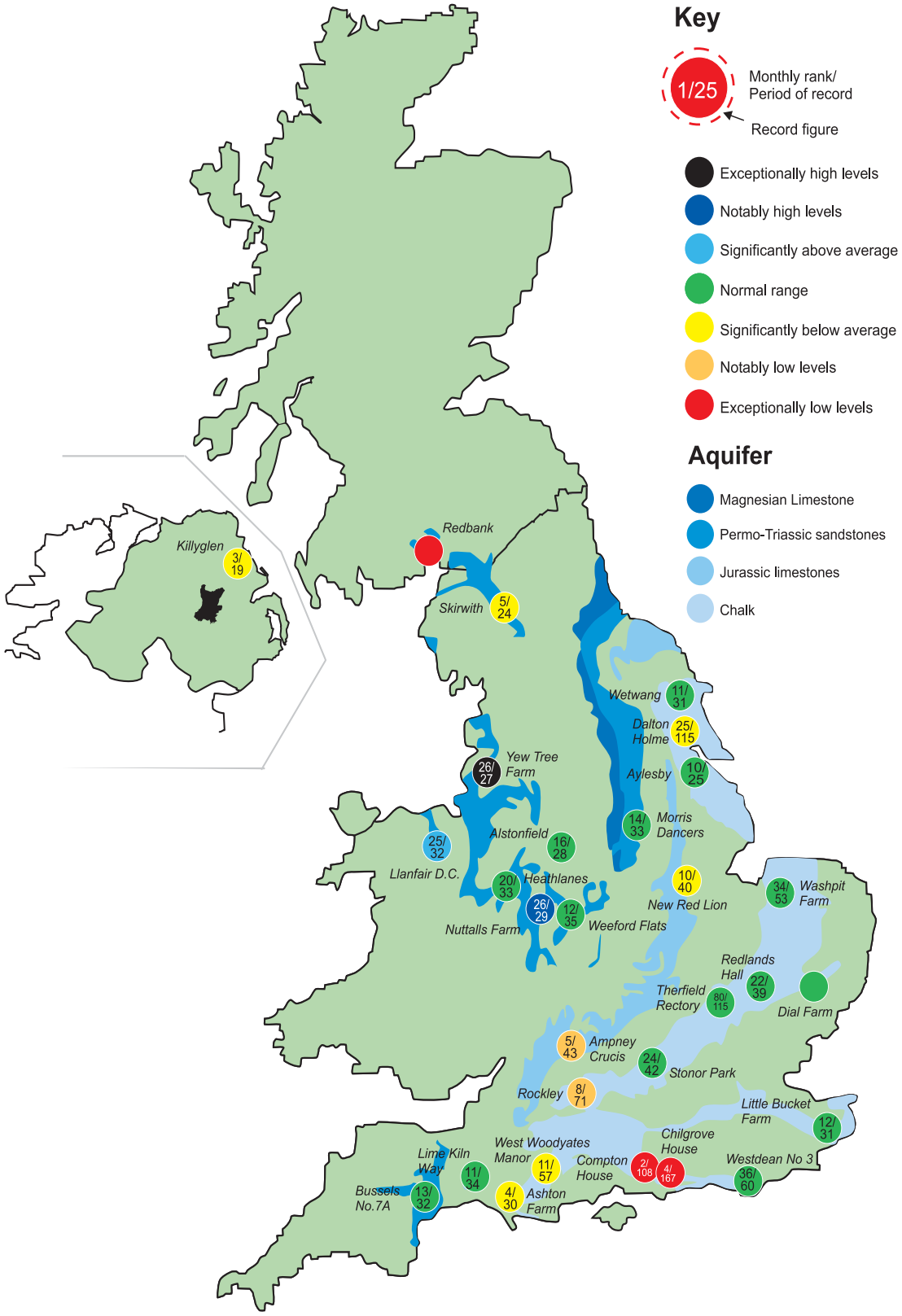


Groundwater levels September 2003 / October 2003

Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.
Dalton Holme	14.33	11/09	15.42	Chilgrove House	36.09	30/09	40.81	Llanfair DC	79.73	15/09	79.53
Washpit Farm	44.59	03/09	43.97	Killyglen	113.05	30/09	114.46	Morris Dancers	32.22	26/09	32.37
Stonor Park	76.66	08/10	74.86	New Red Lion	10.07	29/09	11.65	Heathlanes	62.33	15/09	62.06
Dial Farm	25.81	18/08	25.55	Ampney Crucis	99.49	29/09	100.08	Nuttalls Farm	130.71	11/09	129.57
Rockley	129.63	08/10	131.03	Redbank	6.85	30/09	7.71	Bussels No.7a	23.50	11/09	23.52
Little Bucket Farm	63.01	30/09	64.85	Skirwith	129.93	26/09	130.09	Alstonfield	175.87	05/09	176.75
West Woodyates	69.98	30/09	73.04	Yew Tree Farm	13.93	08/10	13.40				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

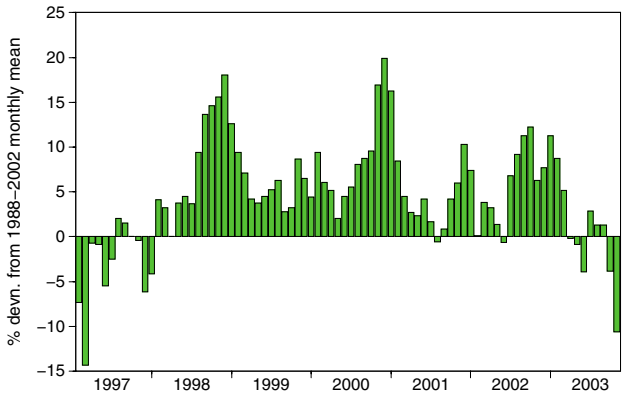


Groundwater levels - September 2003

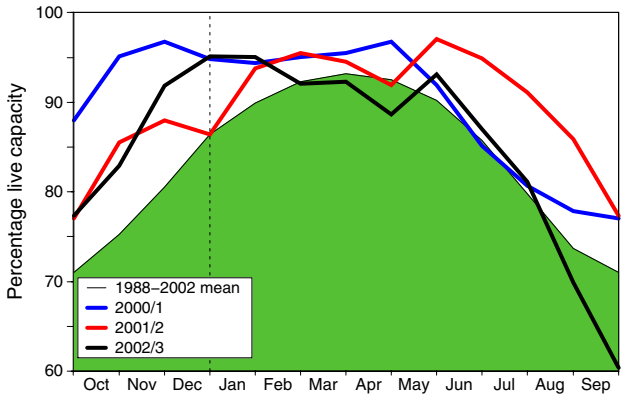
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing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

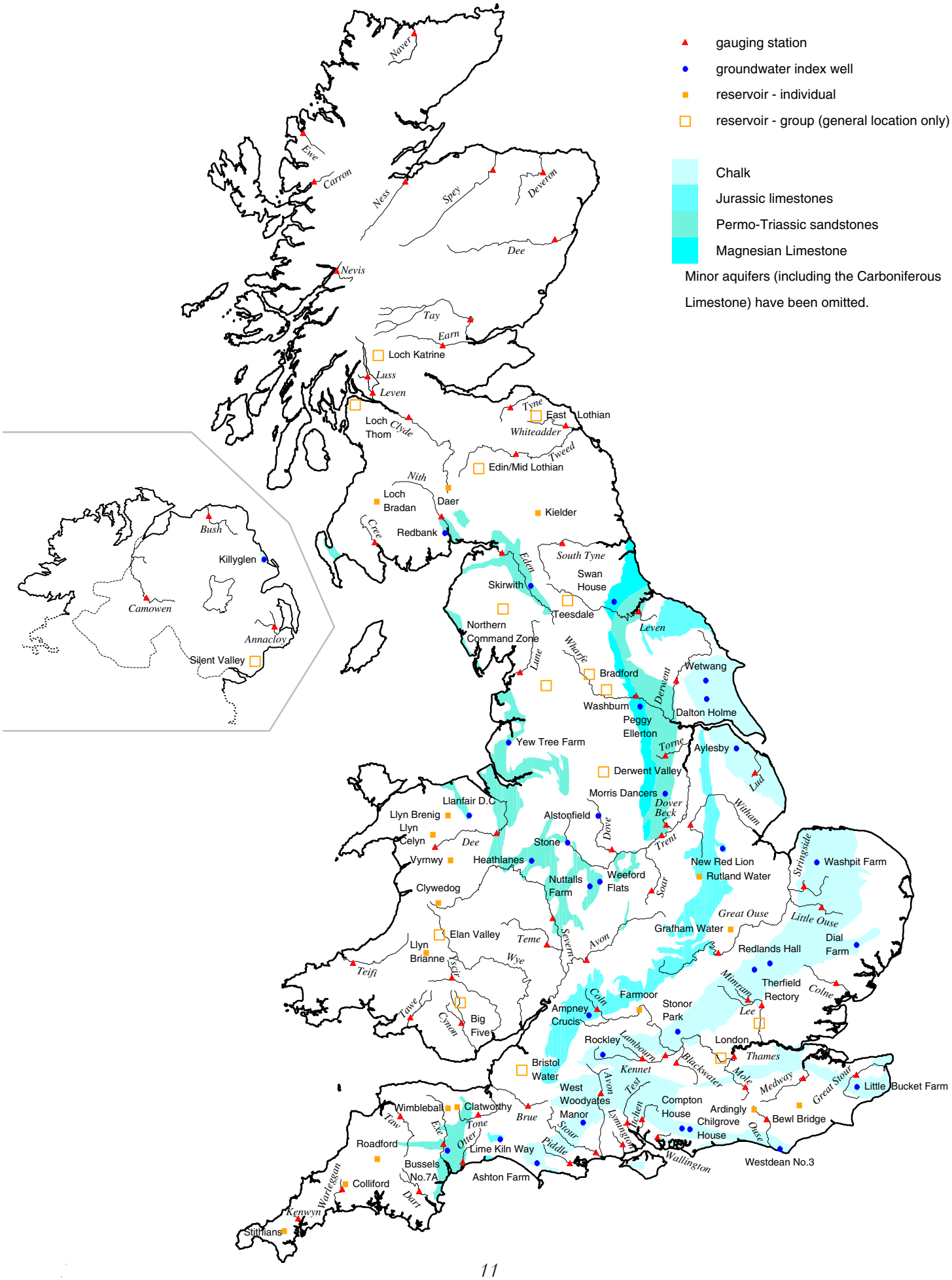
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 May	Jun	Jul	Aug	Sep	Oct	Min. Oct	Year* of min.
North West	N Command Zone	• 124929	74	85	69	62	45	**37**	13	1995
	Vyrnwy	55146	90	97	87	82	70	**59**	26	1995
Northumbrian	Teesdale	• 87936	74	75	72	60	48	**38**	31	1995
	Kielder	(199175)	(92)	(97)	(91)	(86)	(81)	**(76)**	(59)	1989
Severn Trent	Clywedog	44922	97	99	97	95	82	**69**	24	1989
	Derwent Valley	• 39525	86	94	80	80	62	**40**	24	1989
Yorkshire	Washburn	• 22035	78	90	82	79	69	**58**	24	1995
	Bradford supply	• 41407	85	95	82	74	58	**51**	15	1995
Anglian	Grafham	(55490)	(94)	(97)	(95)	(89)	(79)	**(72)**	(46)	1997
	Rutland	(116580)	(95)	(94)	(91)	(87)	(79)	**(73)**	(61)	1995
Thames	London	• 202340	94	94	93	87	71	**58**	53	1997
	Farmoor	• 13830	94	91	95	89	71	**54**	54	2003
Southern	Bewl	28170	90	86	79	71	62	**55**	32	1990
	Ardingly	4685	100	100	92	77	53	**32**	32	2003
Wessex	Clatworthy	5364	86	79	65	55	43	**25**	25	2003
	Bristol WW	• (38666)	(91)	(88)	(79)	(79)	(79)	**(79)**	(31)	1990
South West	Colliford	28540	81	81	79	76	71	**64**	43	1997
	Roadford	34500	87	83	79	75	71	**63**	26	1995
	Wimbleball	21320	92	86	77	68	57	**46**	30	1995
	Stithians	5205	89	86	81	76	68	**57**	22	1990
Welsh	Celyn and Brenig	• 131155	94	100	98	93	84	**77**	39	1989
	Brianne	62140	88	100	94	95	85	**76**	48	1995
	Big Five	• 69762	86	96	87	79	64	**48**	19	1995
	Elan Valley	• 99106	87	99	89	76	62	**48**	34	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	87	92	84	76	67	**56**	43	1998
	East Lothian	• 10206	95	91	82	75	67	**61**	52	1989
Scotland(W)	Loch Katrine	• 111363	87	88	84	77	66	**54**	43	1995
	Daer	22412	89	98	70	74	66	**55**	32	1995
	Loch Thom	• 11840	88	95	85	85	77	**71**	56	1995
Northern Ireland	Total+	•	80	93	89	84	77	**64**	29	1995
	Silent Valley	• 20634	79	95	92	86	78	**62**	27	1995

() 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 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 Environment Agency, the Environment Agency Wales, the Scottish Environment Protection Agency and, for Northern Ireland, 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 (see 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. As with all regional figures based on limited raingauge networks the monthly tables and accumulations (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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Selected text and maps are available on the WWW at
http://www.nerc-wallingford.ac.uk/ih/nrfa/index.htm
Navigate via Water Watch

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