Hydrological Summary
for the United Kingdom

October 2003

General

Significant rainfall during the last week of October provided a welcome break in the drought but rainfall deficiencies increased considerably over the month. With the exception of the 1959 and 1975/76 droughts the Feb-Oct rainfall total (provisional) for the UK was the lowest 9-month accumulation for 74 years. Drought conditions, with seasonally depressed river flows, were exceptionally extensive by late October. The very limited early autumn rainfall resulted in a record Aug-Nov decline in reservoirs stocks. At a time when recoveries are normally gathering momentum, overall stocks for E&W are around 22% below the monthly average; only in 1995 have early November stocks been lower (in a 15-year record). The deterioration in the water resources outlook triggered calls for restraint in water usage and the activation of a range of low flow alleviation measures. The relatively even spatial intensity of the drought and, in much of the English Lowlands, reasonably healthy groundwater resources moderated the drought's impact through the summer. However the exceptionally dry late-October soils (which hampered late harvesting in eastern England) underline the need for sustained late autumn/early winter rainfall. This is essential to generate a belated recovery in river flows and aquifer recharge rates. The water resources outlook will require careful monitoring through the coming winter.

Rainfall

An extremely dry spell, beginning in early August, continued into late October before several active frontal systems produced significant rainfall, on the 31st especially when some localities registered 20-30 mm. Some areas in central southern England had more rain in the six days to the 2nd Nov than in the preceding 12 weeks. Nonetheless, October rainfall totals were well below average across much of the UK; several monthly minima were established (e.g. Solwaybank in Dumfries and Galloway reported its lowest October total in a 43-year record). Importantly from a resources perspective, many reservoir gathering grounds (including the Pennines) recorded below half the average October rainfall. In almost all regions this reinforced the already substantial rainfall deficiencies. For the Aug-Oct period, Scotland and Northern Ireland both registered their 2nd lowest total on record (after 1972). But the deterioration in the resources outlook is as much a reflection of the very limited rainfall since January. For E&W, the Feb-Oct total was the second lowest, after 1959, since 1921. The drought affects much the greater part of the UK – return periods for Feb-Oct rainfall exceed 50 years over wide areas (see page 2) - but there are appreciable regional and local variations; an especially intense drought afflicts parts of the Thames basin – provisionally the Feb-Oct rainfall for the west London area is likely to have been the second lowest in a series from 1697.

River flow

Very protracted seasonal river flow recessions continued through much of October and flows declined below late-October minima in some rivers (e.g. the Tawe, Tay and Luss Water). Short-lived spates at month end provided some relief but October runoff totals were depressed across much of the UK. Rivers draining impermeable western and northern catchments were characterised by exceptional low October mean flows – the lowest since 1972 in much of northern Britain and Northern Ireland. Rivers registering new monthly runoff minima showed a very wide distribution (from the Dorset Stour to the Nevis in western Scotland) and runoff was below 30% of average in many basins. A longer historical perspective is provided by the Severn where only in 1947 was the October flow lower – in an 83-year record. A measure of the hydrological severity of the drought in northern Britain is provided by the June-Oct runoff for the Aberdeenshire Dee which was the lowest for **any** five-month sequence in as series from 1929. Generally 5-month totals are close to long term minima in impermeable catchments across much of the country. As yet, flows are less severely depressed in the English Lowlands where the residual benefit of groundwater support can still be recognised. But as recessions continue and baseflow contributions decline, very low early winter flows may be anticipated.

Groundwater

Soil moisture deficits decreased briskly around month end but were still among the highest on record (for October) across most aquifer outcrop areas. Correspondingly, October recharge was minimal. The absence of significant recharge over the last nine months has produced a dramatic decline in groundwater levels – one with few modern parallels (1995 was comparable). But there are important spatial variations in the current health of groundwater resources. In the south-western Chalk, water-tables in some areas are approaching natural base levels (e.g. at Chilgrove) and a number of wells have been reported as dry. To the east and north, groundwater levels in the Chalk are mostly below average but still in the normal range; a few (e.g. in the Chilterns) remain a little above average. The delayed onset of the 2003 seasonal recovery is particularly evident in the Limestone aquifers where levels are generally well below average - but still considerably above drought minima. This remains true of many minor aquifers and most boreholes in the slower responding Permo-Triassic sandstones outcrops report levels within the normal late-autumn range. As with many summer/autumn droughts, the role of groundwater has assumed an increased importance in relation to resources and the aquatic environment. However, its beneficial effect is lessening and the window of opportunity for winter recharge is narrowing across most outcrop areas. Rainfall over the next 8-10 weeks will heavily influence the 2004 groundwater resources outlook, in the east especially.

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Oct 2003	Aug 03-Oct 03	RP	Jun 03-Oct 03	RP	Feb 03-Oct 03	RP	Nov 02-Oct 03	RP
England & Wales	**mm**	**68**	**124**		**273**		**462**		**877**	
	%	**78**	**51**	**30-45**	**74**	**5-15**	**73**	**30-40**	**96**	**2-5**
North West	mm	50	156		318		610		993	
	%	39	45	50-80	62	30-40	73	20-30	83	5-15
Northumbrian	mm	54	118		234		402		700	
	%	71	51	30-45	66	20-30	67	50-80	82	5-15
Severn Trent	mm	53	96		221		389		668	
	%	83	49	30-45	72	5-15	73	20-30	89	2-5
Yorkshire	mm	45	123		267		451		766	
	%	61	57	15-25	80	5-10	78	10-20	93	2-5
Anglian	mm	44	71		204		321		592	
	%	87	46	30-50	80	5-10	74	10-20	99	2-5
Thames	mm	40	67		166		299		647	
	%	65	38	50-80	59	30-40	61	60-90	94	2-5
Southern	mm	57	88		181		318		745	
	%	71	43	30-50	59	30-40	60	80-120	96	2-5
Wessex	mm	58	83		208		378		780	
	%	73	38	50-80	64	10-20	66	30-45	93	2-5
South West	mm	92	146		327		591		1087	
	%	80	50	30-40	76	5-10	77	10-20	93	2-5
Welsh	mm	88	174		351		668		1176	
	%	64	49	30-45	69	10-20	76	10-20	90	2-5
Scotland	**mm**	**77**	**204**		**359**		**698**		**1090**	
	%	**49**	**49**	**120-170**	**60**	**110-150**	**71**	**110-150**	**76**	**60-90**
Highland	mm	110	273		438		859		1257	
	%	56	55	35-50	63	50-80	73	35-50	71	150-250
North East	mm	84	154		233		450		817	
	%	87	57	30-45	57	110-150	66	150-250	84	5-15
Tay	mm	33	113		251		550		944	
	%	25	34	>>200	51	120-170	66	70-100	77	20-30
Forth	mm	43	134		276		520		836	
	%	37	42	150-250	60	50-80	68	80-120	75	30-50
Tweed	mm	57	120		238		456		763	
	%	60	44	80-120	58	50-80	67	70-100	79	20-30
Solway	mm	51	159		341		684		1146	
	%	32	38	150-250	57	60-90	70	30-50	81	10-20
Clyde	mm	66	229		442		836		1265	
	%	34	45	110-150	62	40-60	73	30-45	75	40-60
Northern Ireland	**mm**	**53**	**142**		**314**		**600**		**955**	
	%	**47**	**47**	**40-60**	**71**	**10-20**	**81**	**5-15**	**90**	**2-5**

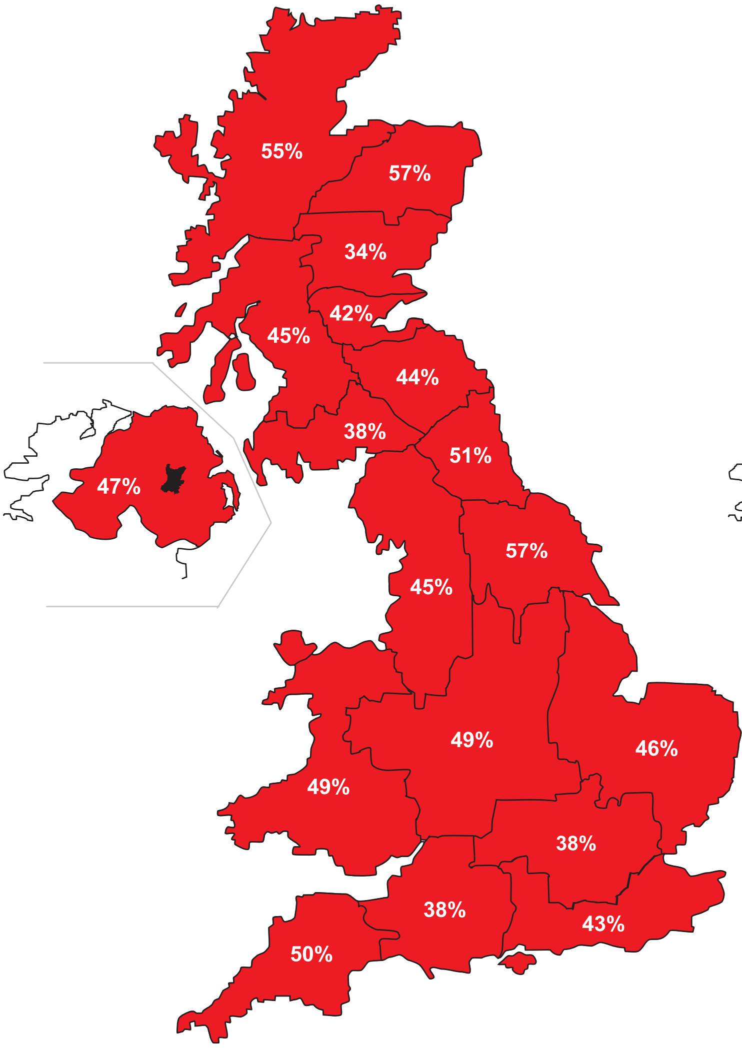
RP = Return period

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.

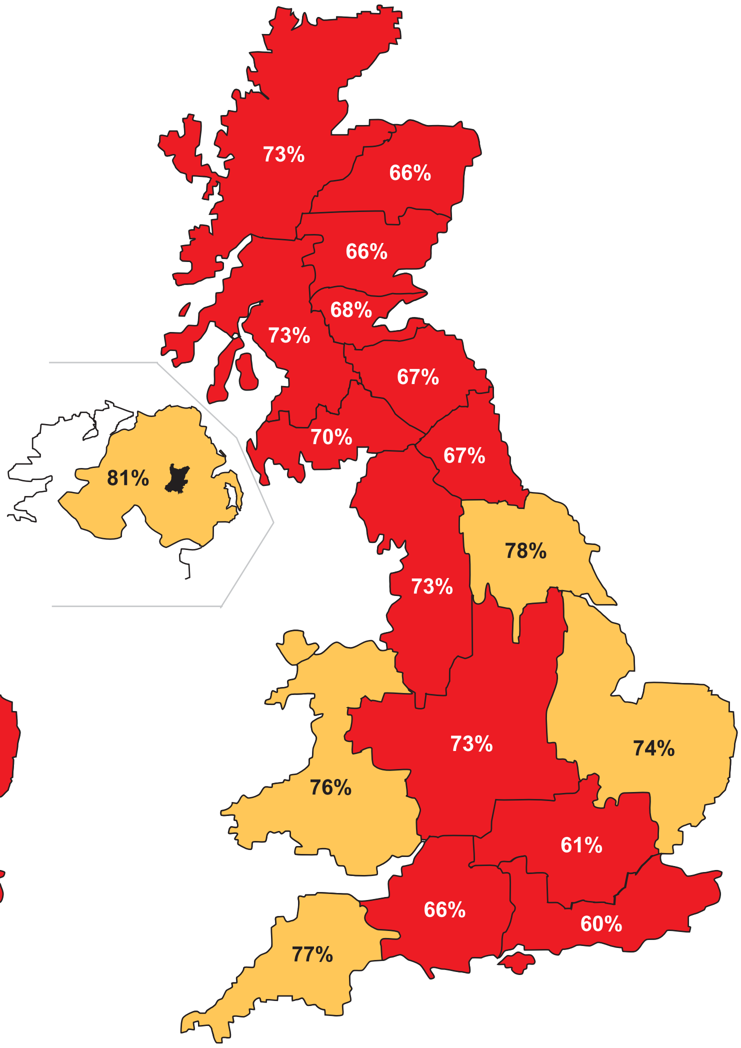
Rainfall . . . Rainfall . .

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 - October 2003

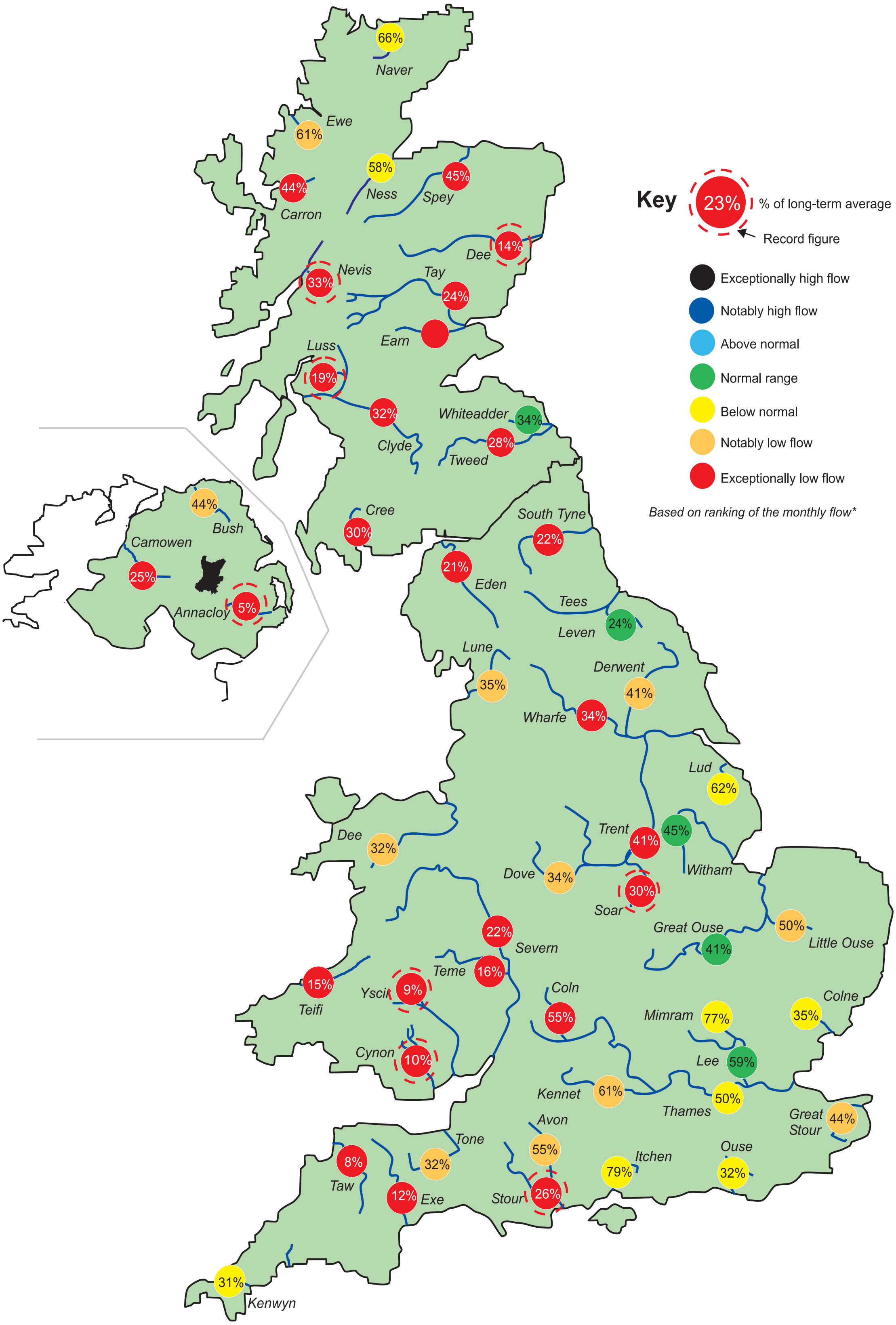


February 2003 - October 2003

Rainfall accumulation maps

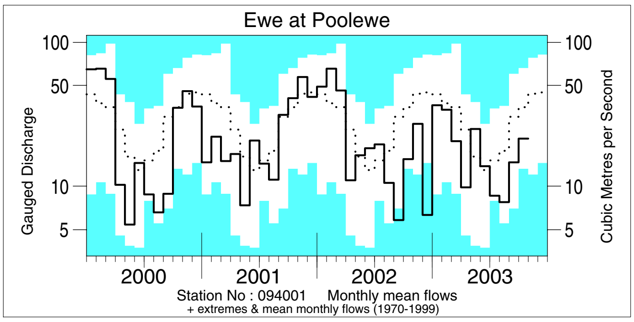
The last three months add a third oustandingly dry August-Oct period for the UK (the others are in 1972 and 1947) - in a rainfall series from 1900. In this timeframe, the rainfall deficiencies show a remarkable spatial consistency, with most regions registering <50% of average rainfall. Generally, the rainfall deficiencies over the February-October period are of greater water resources significance; in this timespan particularly severe droughts have developed across the South-East and in parts of north-eastern Britain.

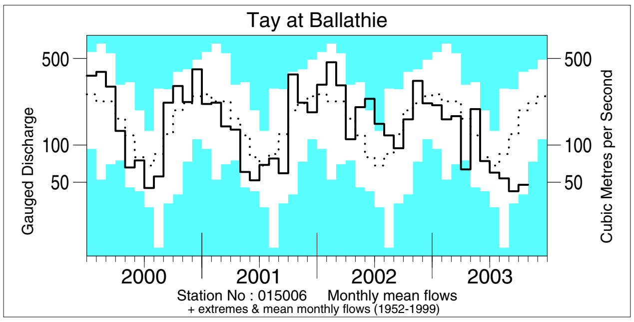
River flow . . . River flow . . .

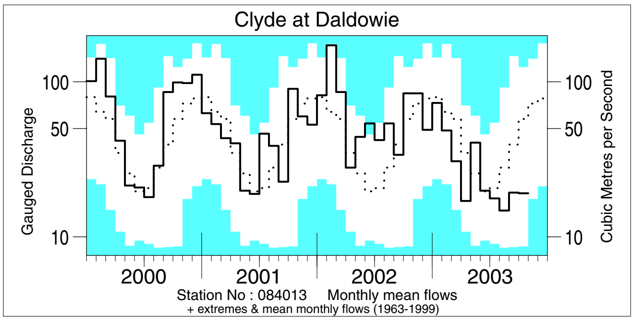


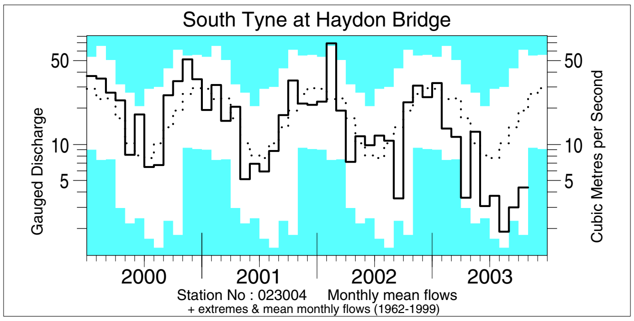
River flows - October 2003

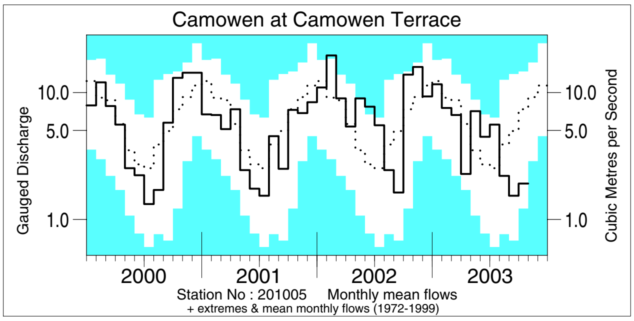
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much 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.

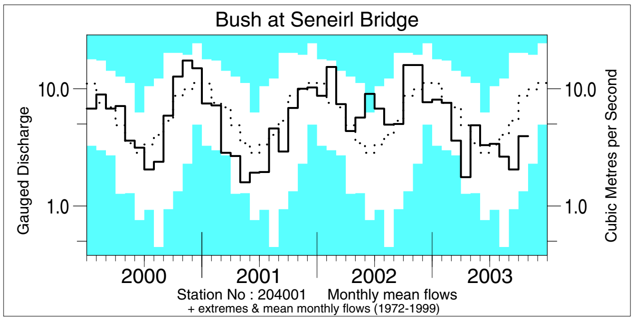


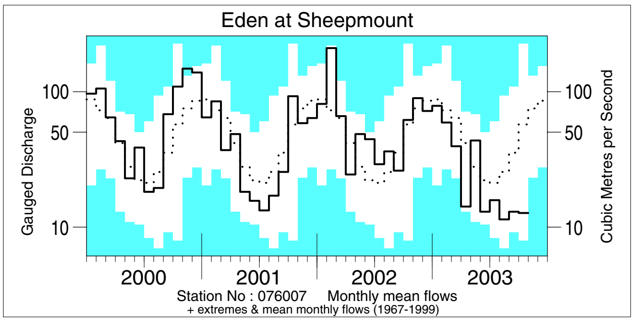


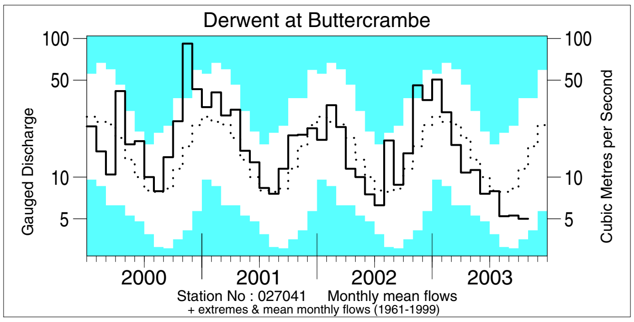


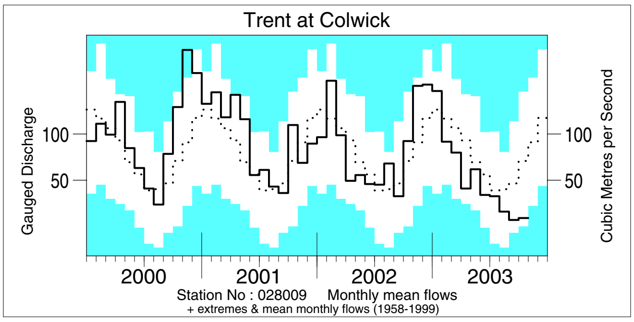


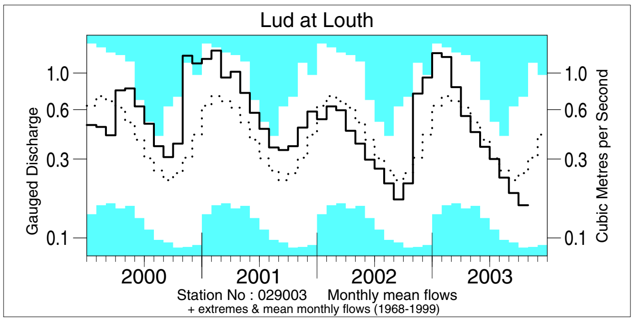








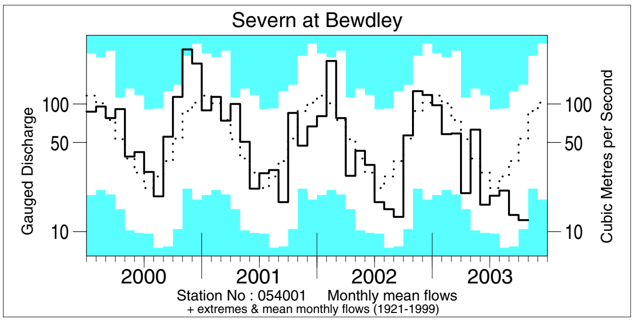


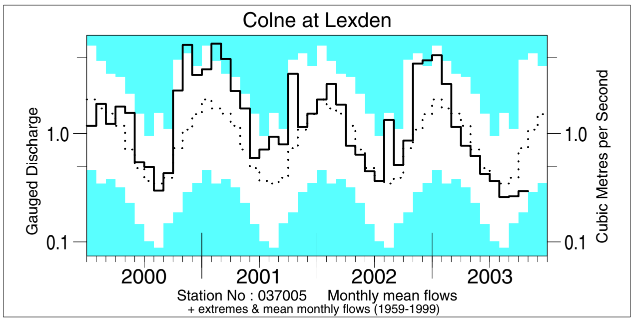


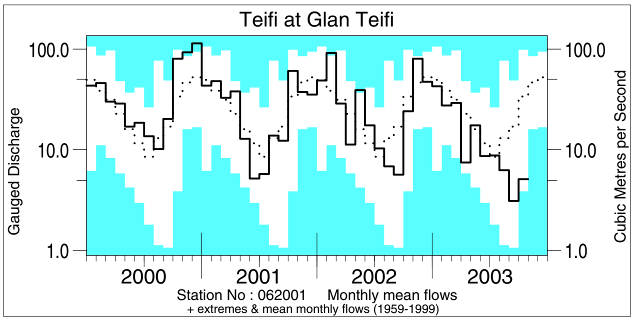
Monthly river flow hydrographs

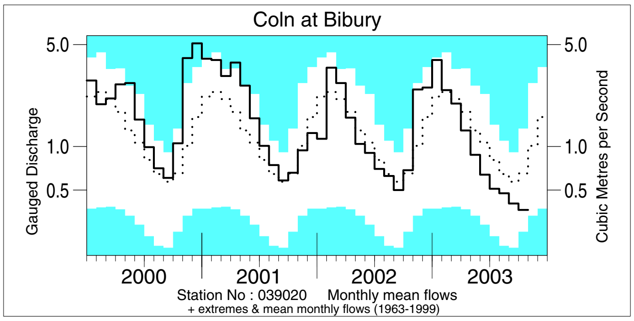
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 2000 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded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

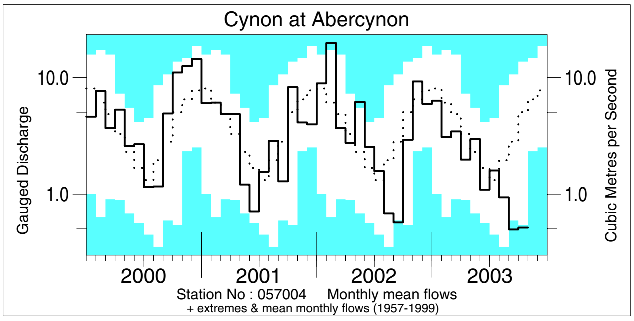
River flow . . . River flow . . .

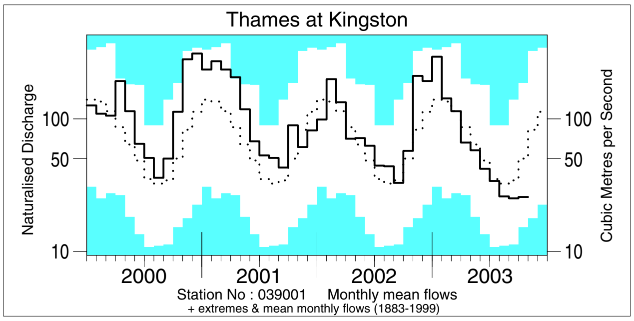


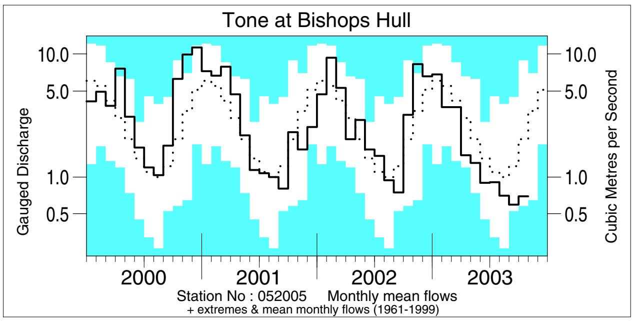


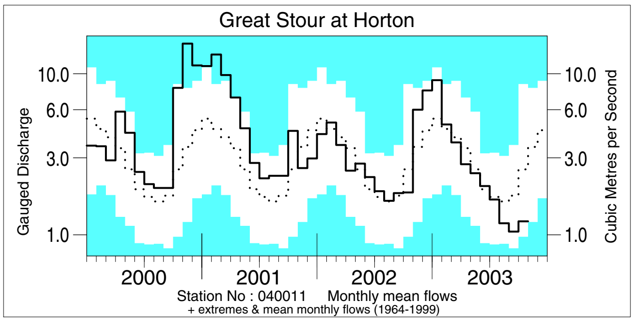


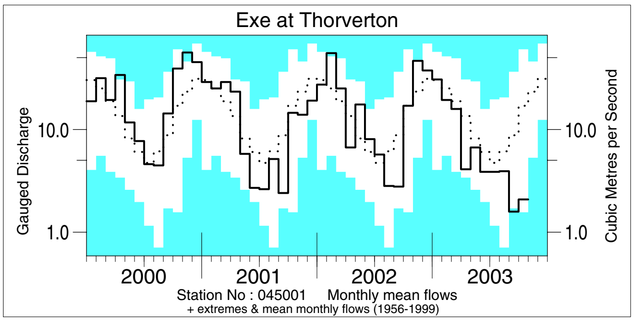


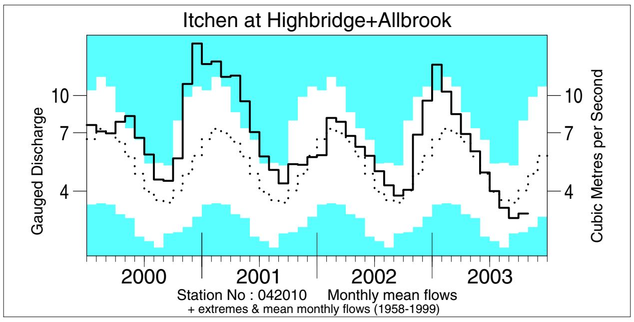










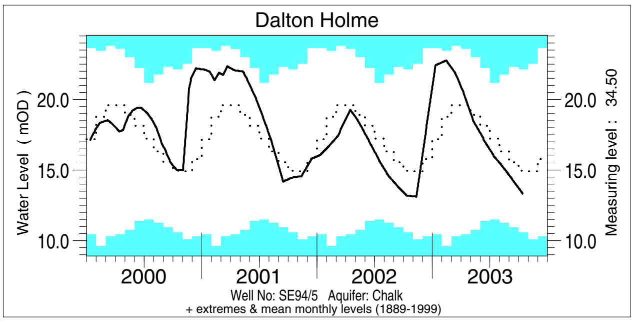


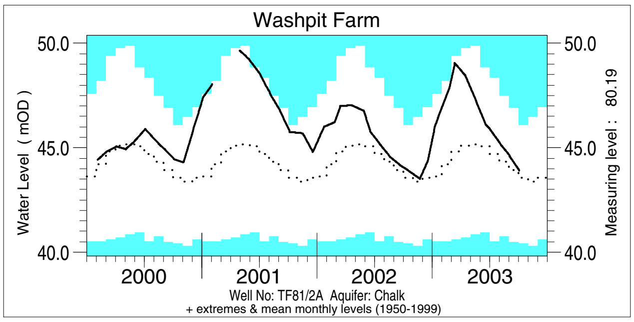
Notable runoff accumulations (a) August 2003 - October 2003, (b) June-October 2003

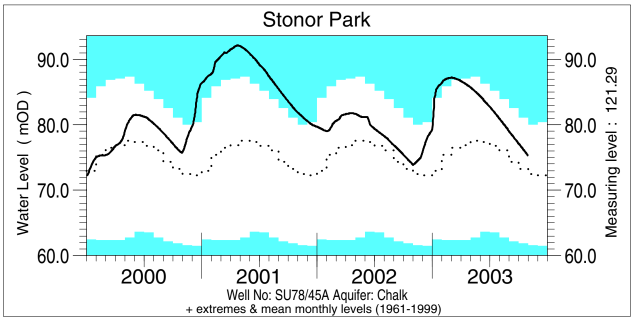
	River	%lta	Rank		River	%lta	Rank	River	%lta	Rank
a)	Dee (Park)	20	1/31	b)	Ness	71	1/31	Eden	42	1/36
	Tay	36	1/51		Spey (Boat o'Brig)	43	1/51	Nith	34	1/46
	Soar	38	1/33		Dee (Woodend)	34	1/74	Cree	44	1/40
	Otter	53	1/41		S. Tyne	27	1/40	Luss	53	1/25
	Cynon	20	1/44		Taw	23	1/45	Nevis	54	1/21
	Teifi	23	1/45		Yscir	31	1/32	Carron	52	1/25
	Annacloy	10	1/24		Tawe	38	1/45	Ewe	61	1/33
					Dee (New Inn)	42	1/34			

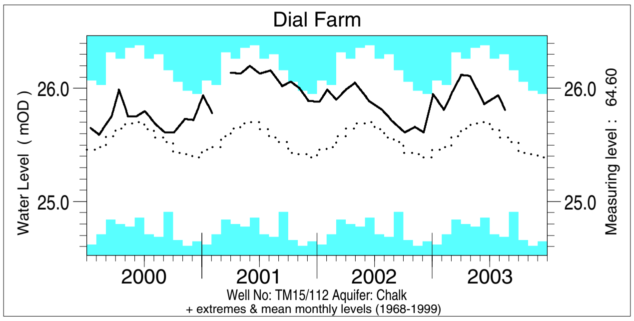
lta = long term average
Rank 1 = lowest on record

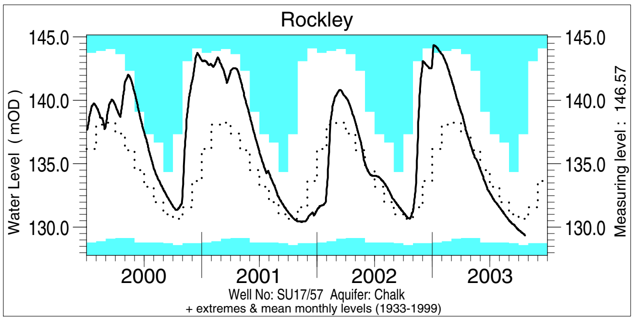
Groundwater . . . Groundwater

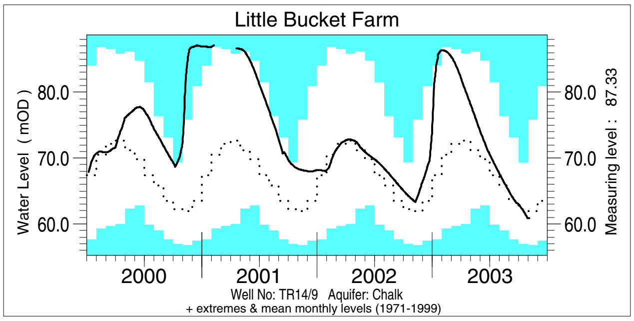


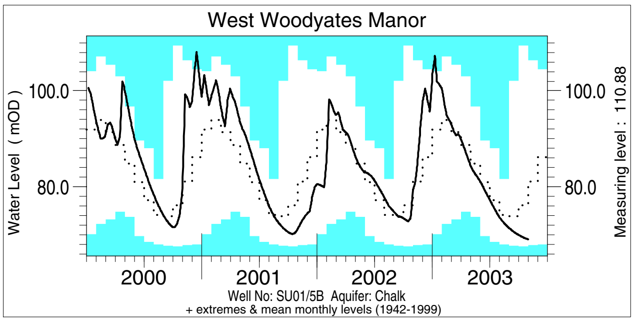


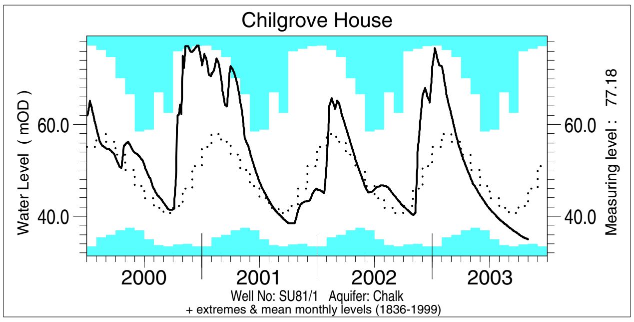


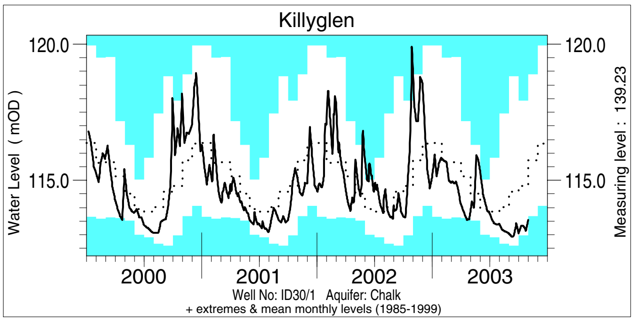


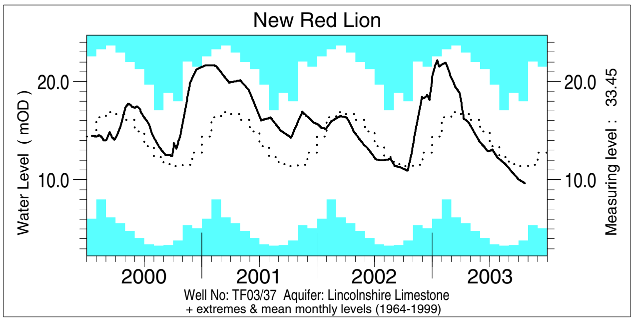






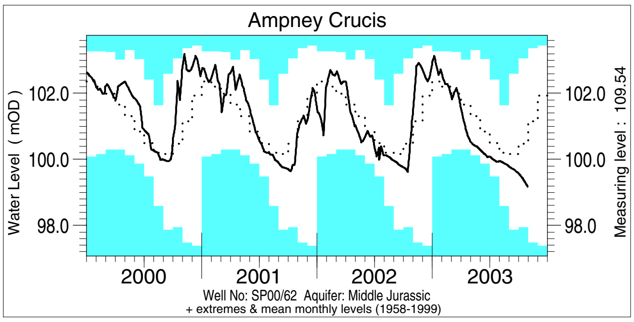


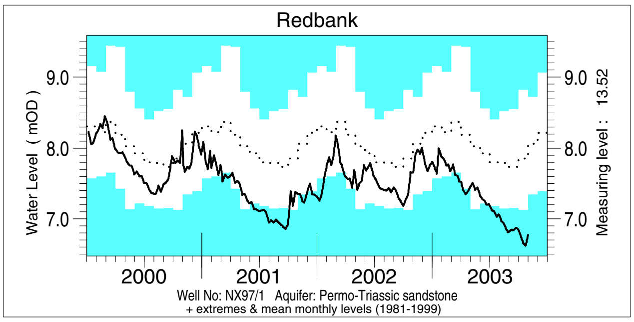


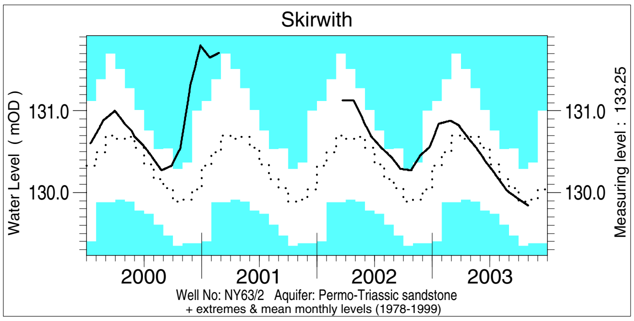


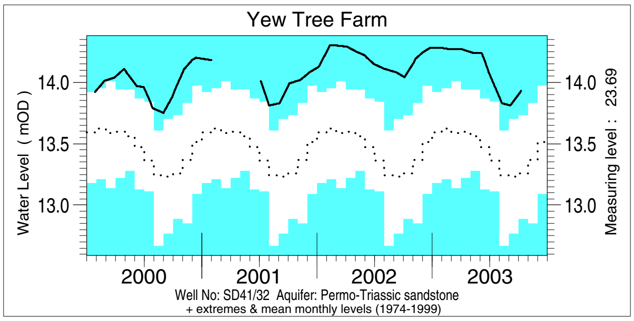
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

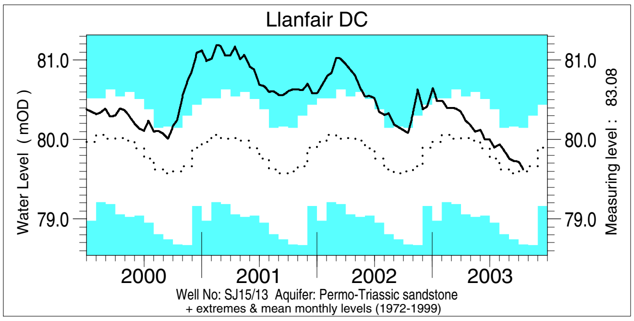
Groundwater . . . Groundwater

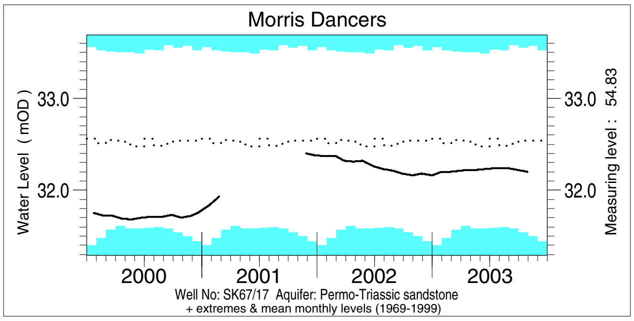


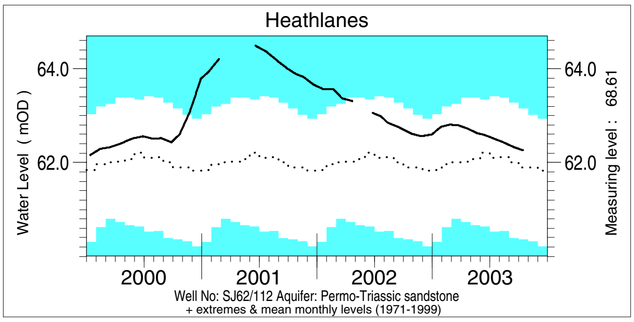


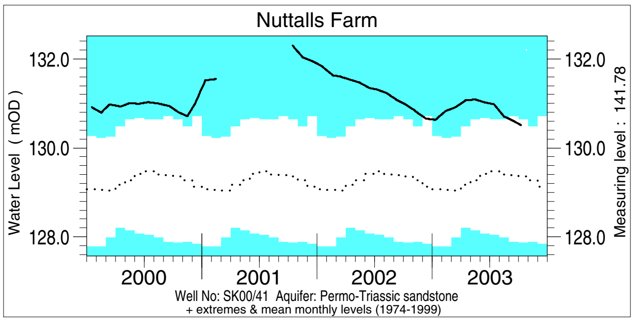


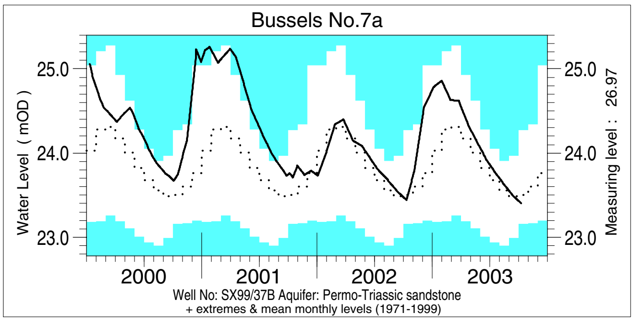


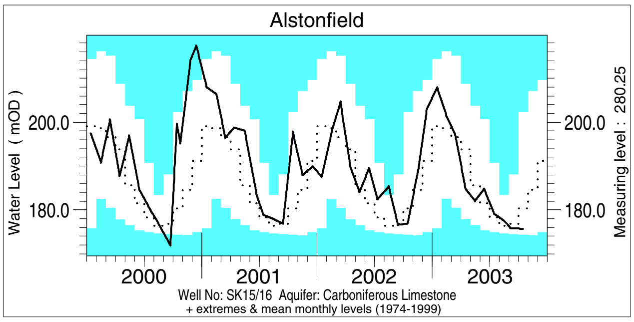










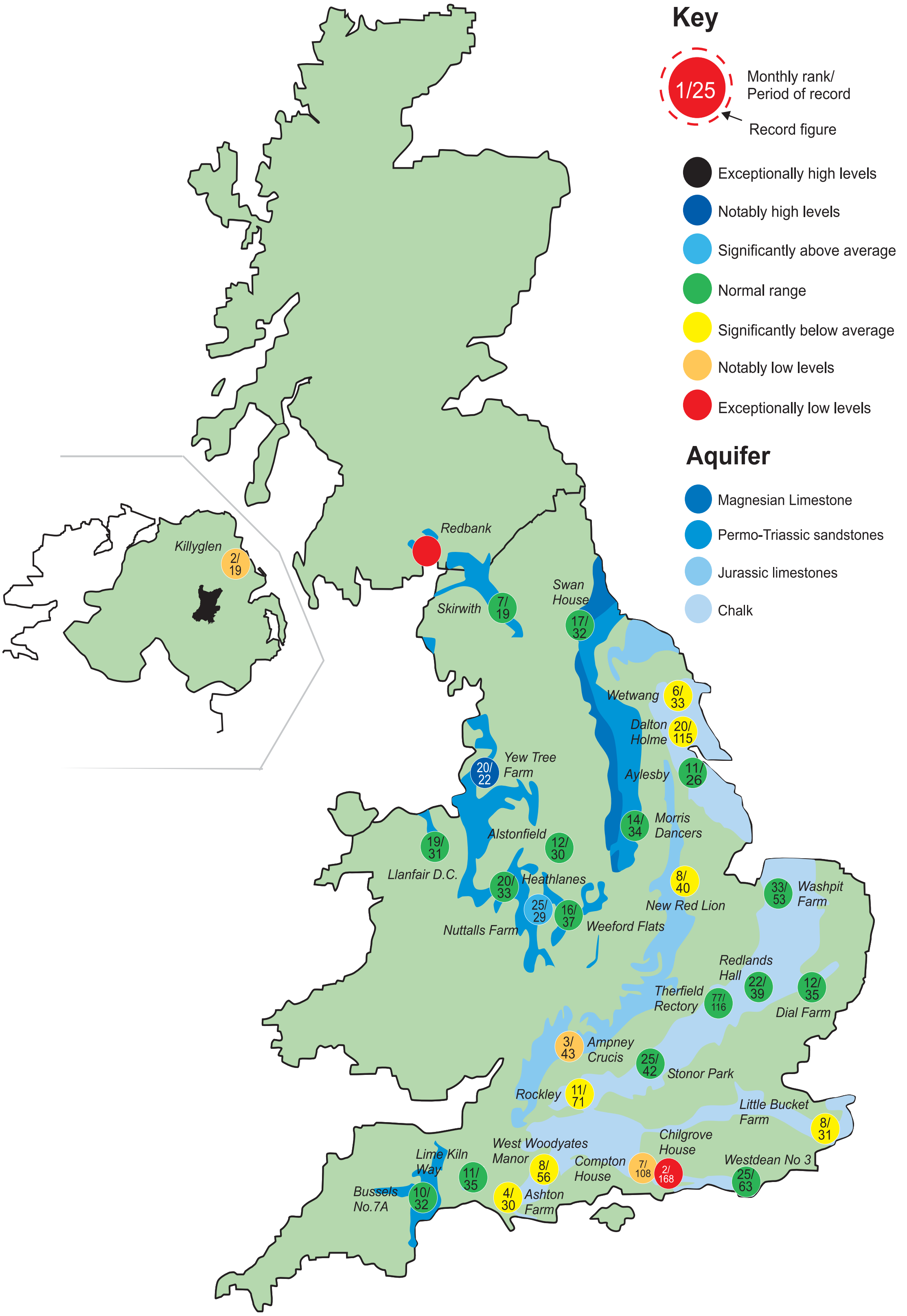


Groundwater levels October 2003 / November 2003

Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.	Borehole	Level	Date	Oct. av.
Dalton Holme	13.32	13/10	14.88	Chilgrove House	34.92	31/10	42.48	Llanfair DC	79.62	15/10	79.54
Washpit Farm	43.89	03/10	43.51	Killyglen	113.55	30/10	114.84	Morris Dancers	32.20	28/10	32.40
Stonor Park	75.32	29/10	73.50	New Red Lion	9.62	21/10	11.57	Heathlanes	62.26	14/10	61.97
Dial Farm	25.36	04/11	25.47	Ampney Crucis	99.17	29/10	100.44	Nuttalls Farm	130.51	08/10	129.61
Rockley	129.37	20/10	130.69	Redbank	6.78	30/10	7.86	Bussels No.7a	23.40	09/10	23.54
Little Bucket Farm	60.87	03/11	63.58	Skirwith	129.84	30/10	129.94	Alstonfield	175.69	15/10	181.17
West Woodyates	69.05	31/10	75.15	Yew Tree Farm	13.93	08/10	13.45				

Levels in metres above Ordnance Datum

Groundwater . . . Groundwater

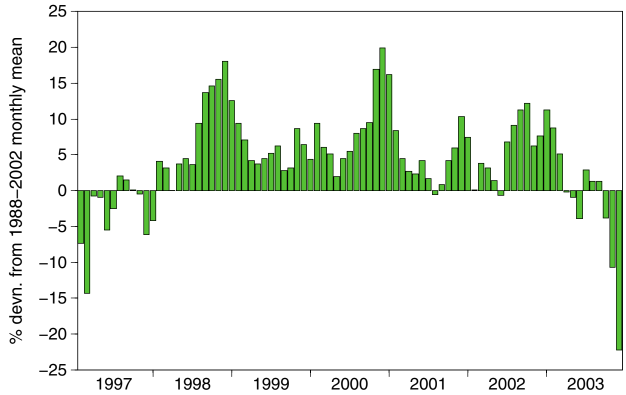


Groundwater levels - October 2003

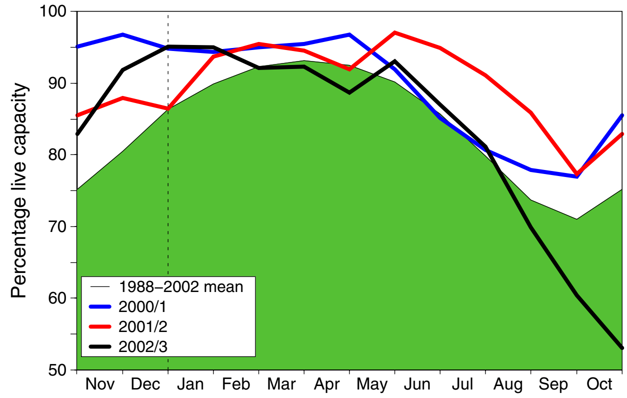
The rankings are based on a comparison between the average level in the featured month (but often only single readings are available) and the average level in each corresponding month on record. They need to be interpreted with caution especially when groundwater levels are changing rapidly or when comparing wells with very different periods of record. Rankings may be omitted where they are considered misleading.

(Note: Redbank is affected by groundwater abstraction. Revised levels from July 2002 have been used for Compton House)

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.

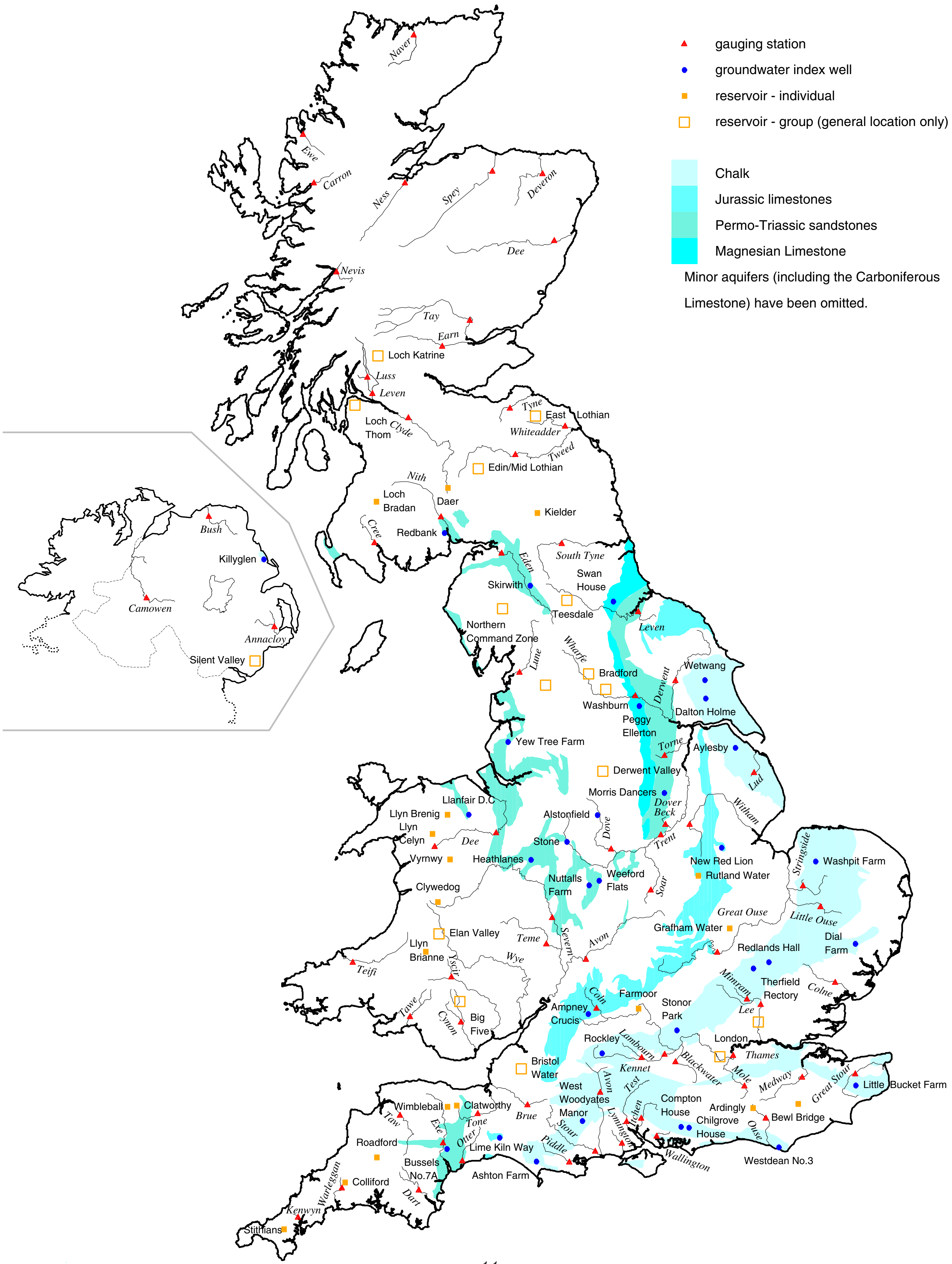
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2003 Jun	Jul	Aug	Sep	Oct	Nov	Min. Nov	Year* of min.
North West	N Command Zone	• 124929	85	69	62	45	37	**33**	33	2003
	Vyrnwy	55146	97	87	82	70	59	**60**	25	1995
Northumbrian	Teesdale	• 87936	75	72	60	48	38	**39**	33	1995
	Kielder	(199175)	(97)	(91)	(86)	(81)	(76)	**(66)**	(63)	1989
Severn Trent	Clywedog	44922	99	97	95	82	69	**61**	38	1995
	Derwent Valley	• 39525	94	80	80	62	40	**29**	15	1995
Yorkshire	Washburn	• 22035	90	82	79	69	58	**46**	15	1995
	Bradford supply	• 41407	95	82	74	58	51	**42**	16	1995
Anglian	Grafham	(55490)	(97)	(95)	(89)	(79)	(72)	**(64)**	(44)	1997
	Rutland	(116580)	(94)	(91)	(87)	(79)	(73)	**(66)**	(59)	1995
Thames	London	• 202340	94	93	87	71	58	**49**	46	1996
	Farmoor	• 13830	91	95	89	71	54	**43**	43	2003
Southern	Bewl	28170	86	79	71	62	55	**48**	33	1990
	Ardingly	4685	100	92	77	53	32	**15**	15	2003
Wessex	Clatworthy	5364	79	65	55	43	25	**14**	14	2003
	Bristol WW	• (38666)	(88)	(79)	(79)	(79)	(79)	**(48)**	(24)	1990
South West	Colliford	28540	81	79	76	71	64	**59**	42	1996
	Roadford	34500	83	79	75	71	63	**53**	18	1995
	Wimbleball	21320	86	77	68	57	46	**34**	26	1995
	Stithians	5205	86	81	76	68	57	**50**	18	1990
Welsh	Celyn and Brenig	• 131155	100	98	93	84	77	**75**	48	1989
	Brianne	62140	100	94	95	85	76	**71**	57	1995
	Big Five	• 69762	96	87	79	64	48	**38**	38	2003
	Elan Valley	• 99106	99	89	76	62	48	**41**	37	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	92	84	76	67	56	**48**	48	2003
	East Lothian	• 10206	91	82	75	67	61	**58**	48	1989
Scotland(W)	Loch Katrine	• 111363	88	84	77	66	54	**40**	40	2003
	Daer	22412	98	70	74	66	55	**42**	42	2003
	Loch Thom	• 11840	95	85	85	77	71	**69**	69	2003
Northern	Total+	•	93	89	84	77	64	**54**	39	1995
Ireland	Silent Valley	• 20634	95	92	86	78	62	**47**	34	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.

The Met Office
FitzRoy Road
Exeter
Devon
EX1 3PB

Tel.: 0870 900 0100
Fax: 0870 900 5050
E-mail: enquiries@metoffice.com

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:

Hydrological Summaries
National Water Archive
CEH Wallingford
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
Tel.: 01491 838800
Fax: 01491 692424
E-mail: nwamail@ceh.ac.uk

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

NATURAL ENVIRONMENT RESEARCH COUNCIL

10/03