Hydrological Summary
for the United Kingdom

September 2005

General

September began with Indian Summer conditions and high evaporative demands but weather patterns were much more autumnal by month end. Despite the recent damp complexion to both the weather and the landscape the drought re-intensified during September across many southern areas, and short term deficiencies increased in some regions (e.g. eastern Scotland). For England and Wales as a whole, rainfall over the Nov-Sept period is the 2nd lowest since 1975/76 and exceptional accumulated deficiencies characterize parts of southern Britain. Nonetheless, levels are holding up well in a number of major pumped storage impoundments and overall reservoir stocks (for E&W) are only around 4% below average. However, in the South, some important reservoir stocks have fallen below 45% (<30% at Weir Wood, E. Sussex); hosepipe bans and other restrictions remain in place in the South East. Thunderstorms caused some notable flash flooding during September but, generally, river flow recessions continued and monthly runoff totals were very low in many catchments. Groundwater levels are now considerably below average throughout almost all major aquifers and depressed in most index wells in the South (particularly the South Downs). The very dry early autumn soils in the drought-affected regions imply a delay in the seasonal recoveries in runoff and recharge – emphasizing the need for a wet winter to allay concern about the water resources outlook for 2006.

Rainfall

With high pressure predominating, much of the UK enjoyed notably warm and dry conditions over the first fortnight. However convective storms produced some very sharp local downpours. Thunderstorms triggered many power failures on the 1st (e.g. in northern England) and on the 10th at Chieveley (Oxon) a storm total of 87mm was recorded in around 2hrs; an exceptional event with a return period in excess of 500 yrs. Thereafter, frontal incursions became more common, producing some notable falls in the North-West particularly; on the 13th Lusa (Skye) reported 104mm. With some parts of the country remaining very dry until near month end, large spatial contrasts were a feature of September rainfall totals. Much of north-west Scotland (including the Islands) reported >150%; similar anomalies characterised parts of East Anglia. But the eastern Cairngorms managed <35% and similar shortfalls extended across parts of southern England (e.g. Wilts and the Isle of Wight). Regional totals for the summer half-year (Apr-Sept) were mostly in the normal range (albeit below average) but last month's rainfall served to refocus the most severe drought conditions across southern England. Rainfall deficiencies since Oct 2004 exceed 40% in a few localities (e.g. in Hampshire) and 11-month totals in a zone from Dorset to Kent (parts of Cornwall and SE Wales also) are mostly below 70%. Some Thames sub-catchments have registered 11 successive months with below average rainfall and for some southern areas only 1975/76 has been drier, in this timeframe, in the last 50 years.

River flows

Newsworthy urban flooding (e.g. in parts of west London on the 9/10th) was a regular feature during September and a few fluvial spates were reported (e.g. in Yorkshire and western Scotland). Generally however recessions continued, being particularly protracted in the most drought-affected areas. Away from western Scotland, almost all index rivers registered well below average runoff. Flows were depressed in eastern Scotland, South Wales and, most notably, southern England. The Itchen (where groundwater augmentation began late in the month), Test and Otter (Devon) registered new September runoff minima and the Thames flow was very similar to the early autumn flows in the major droughts (1959, 1976, 1990 and 1996/97) since the depressed runoff of the 1940s. The warm conditions encouraged algal blooms (e.g. on the Itchen and Medway) and further fish rescues were triggered by the shrinkage of ponds and wetlands. Low runoff resulted in the closure of part of the Leeds-Liverpool canal. Of broader water resources significance are the catchment runoff deficiencies since last October. For many southern catchments (including the Medway, Piddle, and Kenwyn) the Nov-Sept totals rank 2nd lowest on record. In Northern Ireland, outflows from Lough Neagh are the lowest in a 25-yr series.

Groundwater

September rainfall moderated soil moisture deficits over some parts of the eastern Chalk and limestone aquifers but, contrary to the normal seasonal pattern, SMDs increased across many central and southern outcrop areas, ending the month among the highest on record in some areas (e.g. Hampshire). Infiltration was therefore minimal and groundwater level recessions continued in virtually all index wells and boreholes. With few exceptions September groundwater levels were considerably below average with particularly depressed levels in the southern Permo-Triassic sandstones, Upper Greensand and Chalk outcrops. At Chilgrove and Compton, in the South Downs, September levels in the Chalk were similar those of Sept 1934; only 1976 has seen lower levels in time series of >100 years. To the north, Chalk levels were less depressed but still commonly at their lowest level, for any month, since the sustained drought of 1995-97. Correspondingly, many higher level springs have failed and some groundwater dependant habitats are stressed (e.g. Swanbourne Lake, Sussex).

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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Area	Rainfall	Sep 2005	Jul 05-Sep 05	RP	Apr 05-Sep 05	RP	Nov 04-Sep 05	RP	Feb 04-Sep 05	RP
England & Wales	**mm**	**68**	**205**		**384**		**669**		**1403**	
	%	**87**	**94**	**2-5**	**94**	**2-5**	**81**	**10-20**	**96**	**2-5**
North West	mm	**106**	261		510		986		1965	
	%	**90**	83	2-5	94	2-5	91	2-5	102	2-5
Northumbrian	mm	**78**	214		426		754		1535	
	%	**105**	96	2-5	105	2-5	95	2-5	109	5-10
Severn Trent	mm	**55**	172		329		551		1209	
	%	**85**	91	2-5	90	2-5	78	10-20	97	2-5
Yorkshire	mm	**73**	210		382		642		1365	
	%	**105**	101	2-5	98	2-5	84	5-10	101	2-5
Anglian	mm	**63**	191		318		487		1031	
	%	**125**	123	2-5	105	2-5	88	2-5	104	2-5
Thames	mm	**51**	155		274		461		1004	
	%	**86**	91	2-5	83	2-5	72	20-30	88	5-10
Southern	mm	**38**	159		267		482		1038	
	%	**55**	90	2-5	79	5-10	68	30-50	84	5-15
Wessex	mm	**39**	150		326		578		1202	
	%	**54**	78	2-5	89	2-5	75	10-20	89	5-10
South West	mm	**77**	208		449		824		1662	
	%	**82**	83	2-5	97	2-5	77	10-20	89	5-10
Welsh	mm	**99**	250		496		973		2006	
	%	**84**	82	2-5	90	2-5	81	5-15	95	2-5
Scotland	**mm**	**142**	**323**		**664**		**1440**		**2605**	
	%	**99**	**91**	**2-5**	**109**	**2-5**	**110**	**5-10**	**113**	**10-20**
Highland	mm	**201**	449		833		1931		3287	
	%	**119**	111	*2-5*	120	*5-15*	125	*20-30*	121	*20-30*
North East	mm	**44**	178		428		877		1765	
	%	**48**	68	10-20	91	2-5	95	2-5	107	2-5
Tay	mm	**82**	209		551		1131		2230	
	%	**67**	69	5-15	103	2-5	98	2-5	110	5-10
Forth	mm	**83**	184		483		1034		2004	
	%	**74**	64	10-20	97	2-5	101	2-5	110	5-10
Tweed	mm	**62**	174		410		799		1699	
	%	**68**	68	5-15	89	2-5	88	5-10	105	2-5
Solway	mm	**121**	239		578		1180		2313	
	%	**84**	67	5-15	95	2-5	92	2-5	102	2-5
Clyde	mm	**176**	377		777		1680		3026	
	%	**96**	86	2-5	108	2-5	108	2-5	110	5-10
Northern Ireland	**mm**	**91**	**208**		**458**		**898**		**1687**	
	%	**91**	**78**	**2-5**	**96**	**2-5**	**91**	**2-5**	**96**	**2-5**

% = percentage of 1961-90 average *RP = Return period*

The monthly rainfall figures* provided by the Met Office are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation. **All monthly totals since May 2005 are provisional (see page 12).** 1961-2003 regional monthly totals were revised by the Met Office in 2004. 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. Most of 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 and those for the Highland region take account of ranking positions. 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

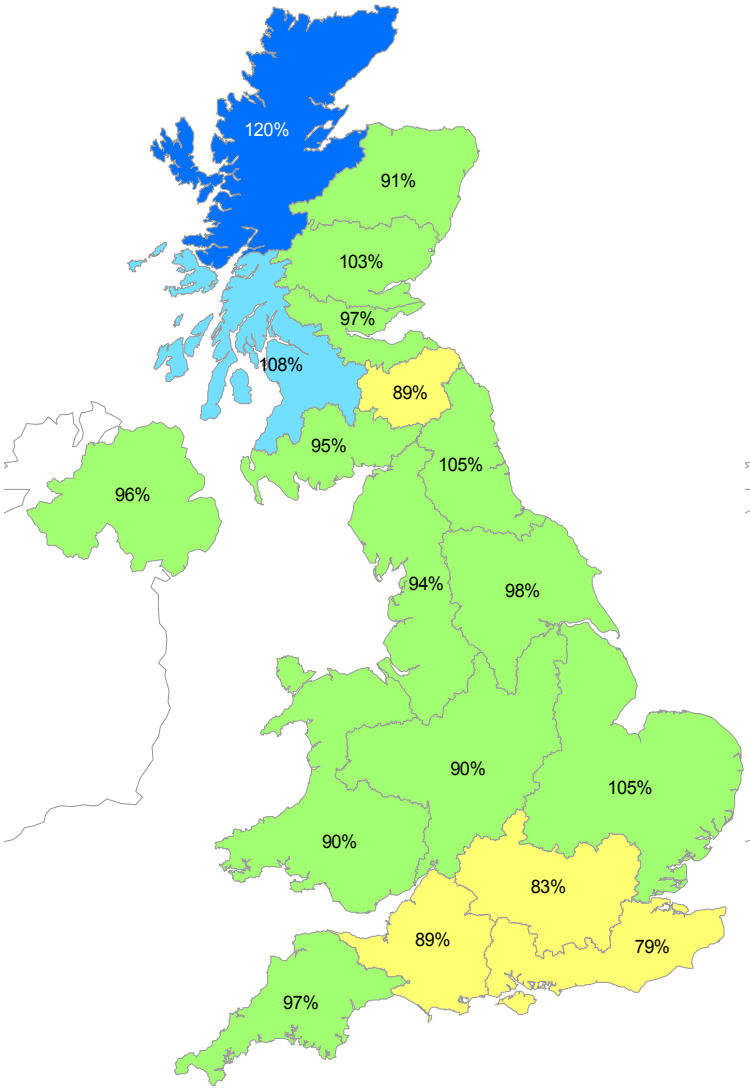
Above average

Normal range

Below average

Substantially below average

Exceptionally low rainfall



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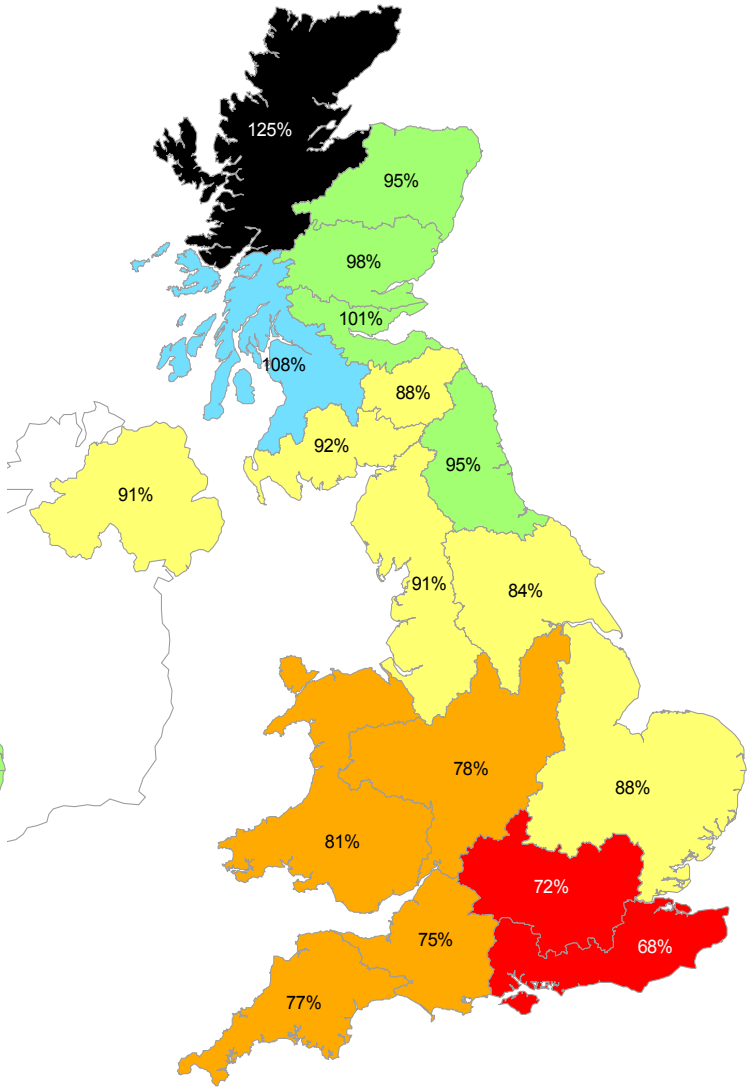
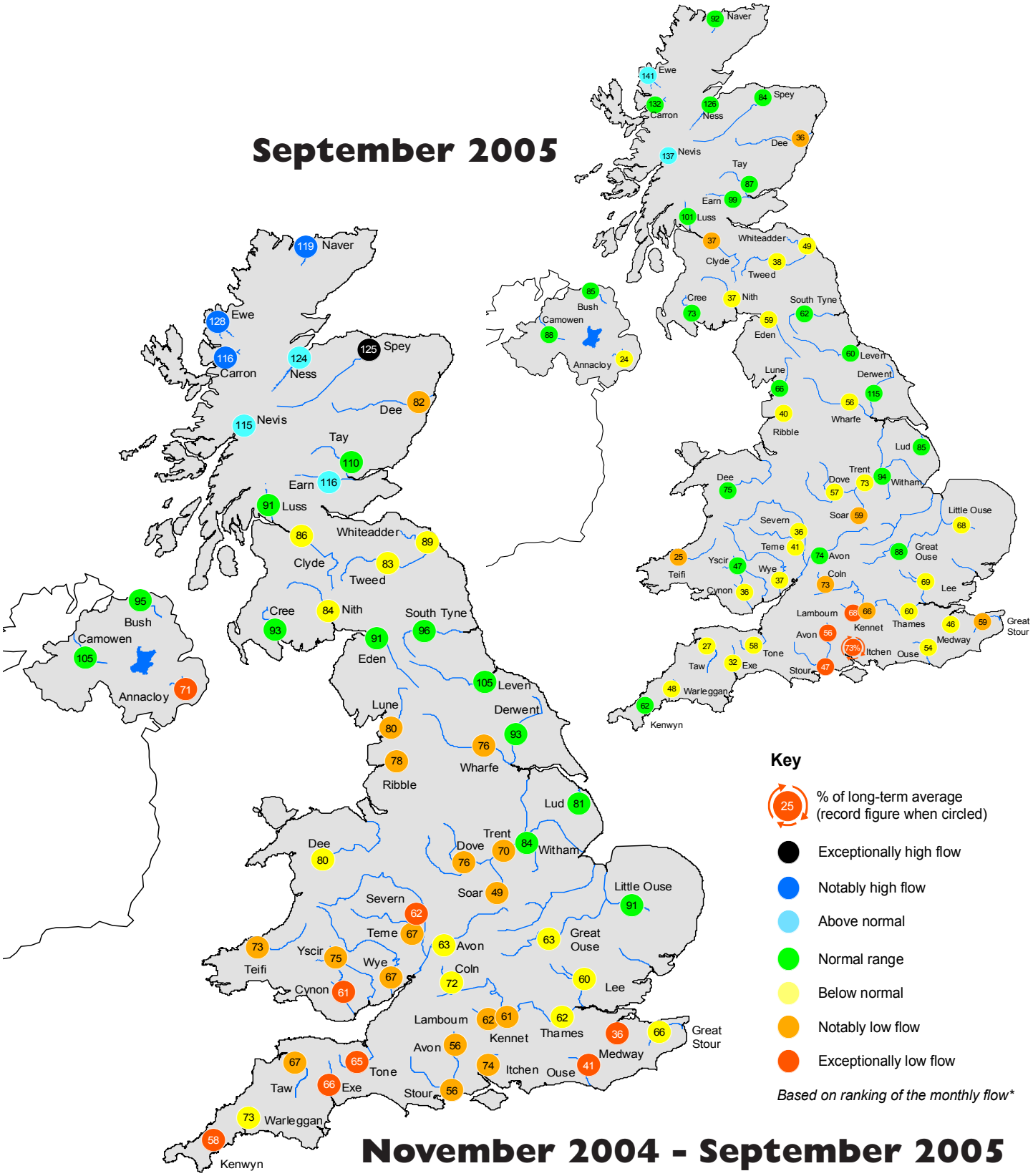


November 2004 - September 2005

Rainfall accumulation maps

The regional rainfall totals for the summer half-year are all within the normal range, albeit with significant anomalies at the north-west and south-east extremeties of the UK. The Anglian region has now registered six wetter-than-average Apr-Sept periods since 1996. The NW/SE contrasts are much more notable over the period since Oct. 2004 with clear evidence of the drought's focus across southern Britain.

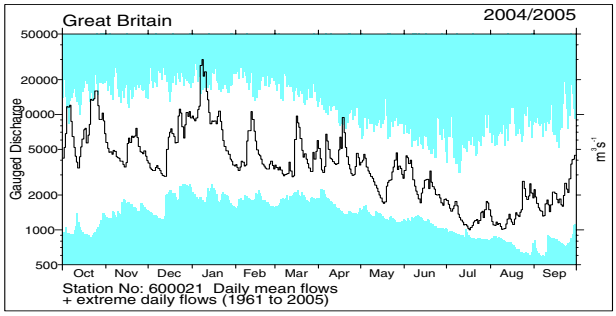
River flow . . . River flow . . .

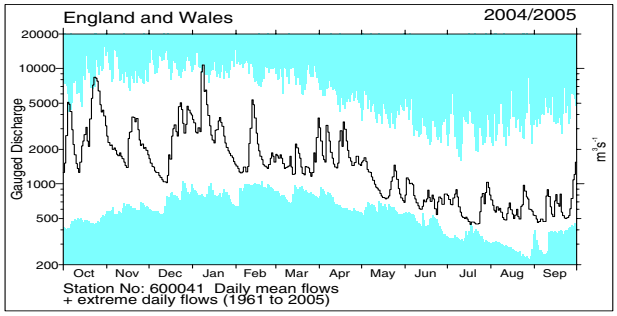


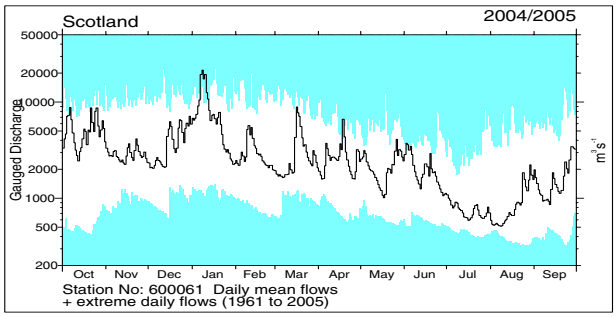
River flows

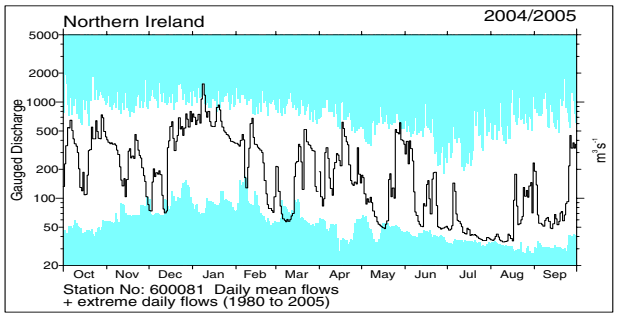
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

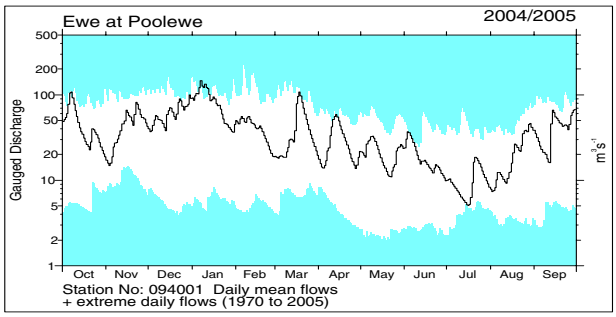
River flow . . . River flow . . .

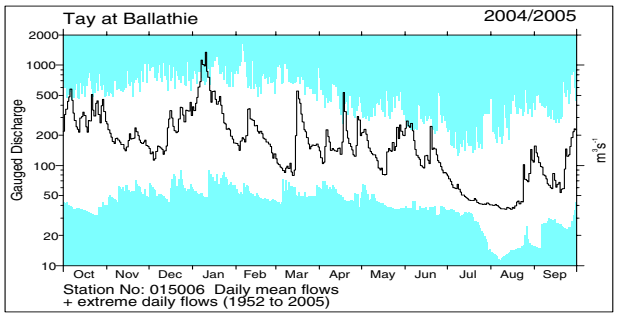


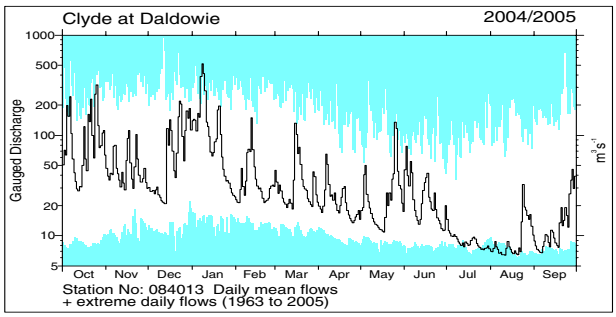


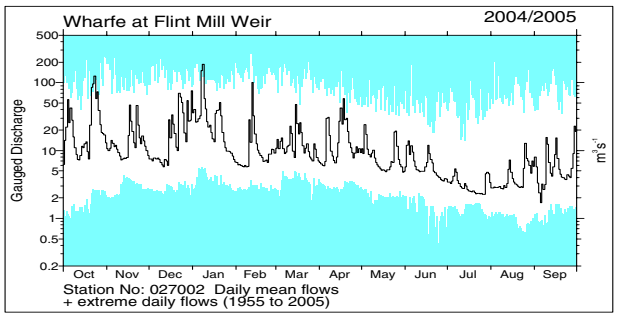


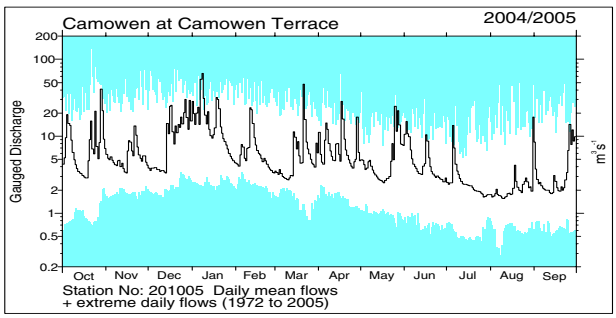


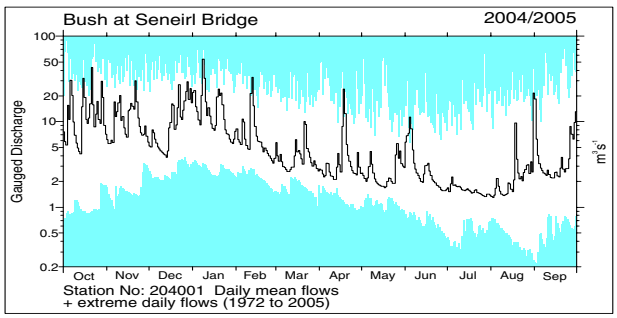








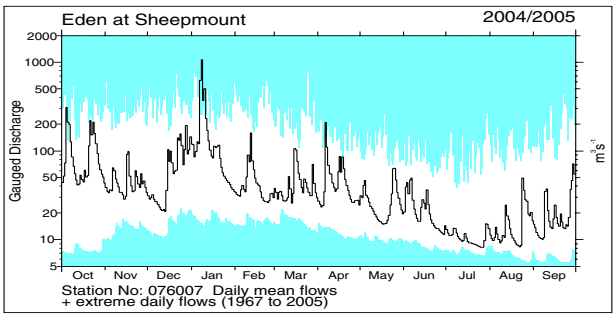


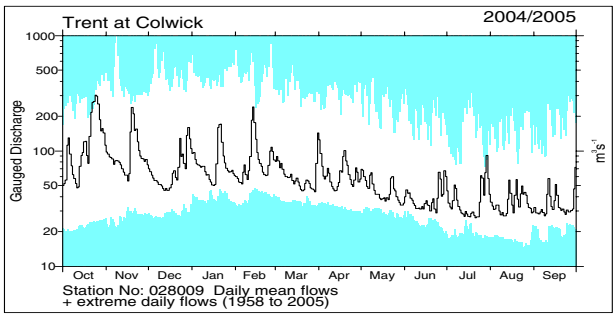


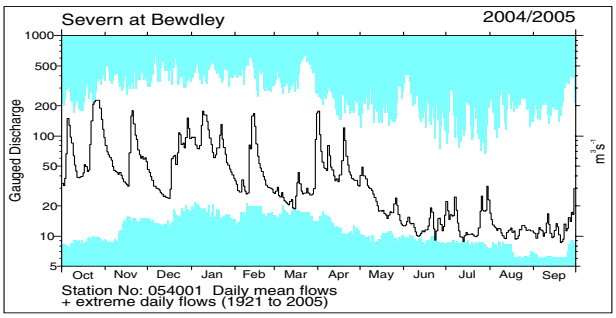
River flow hydrographs

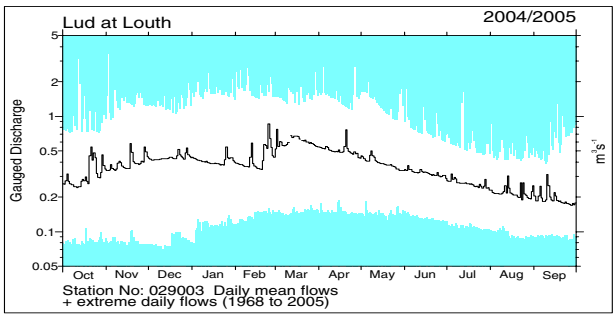
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to October 2004 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

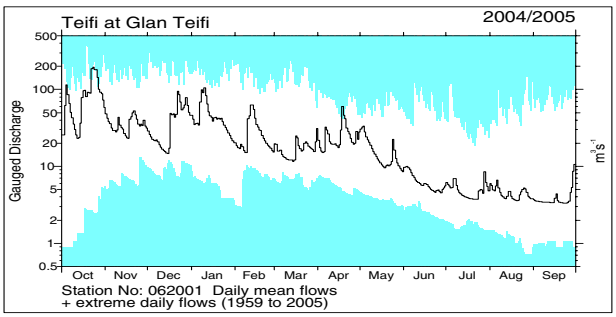
River flow . . . River flow . . .

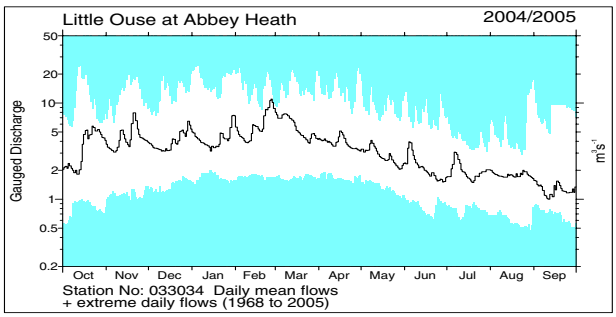


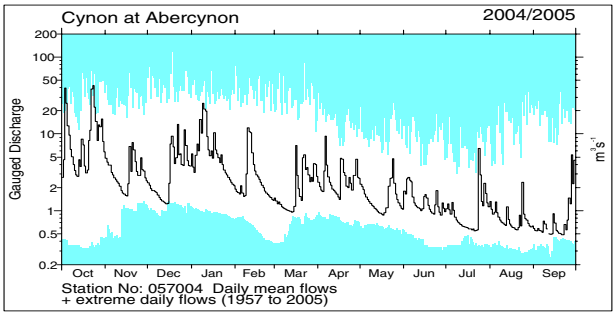


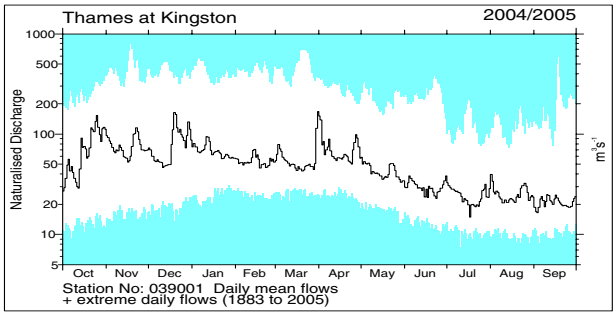


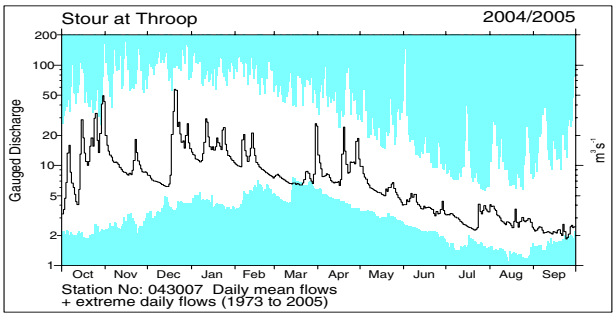


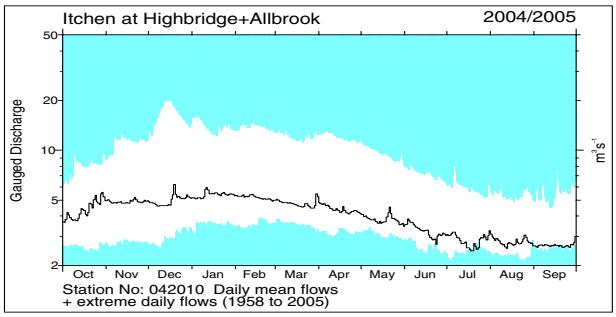












Notable runoff accumulations (a) July 2005 - September 2005, (b) November 2004 - September 2005

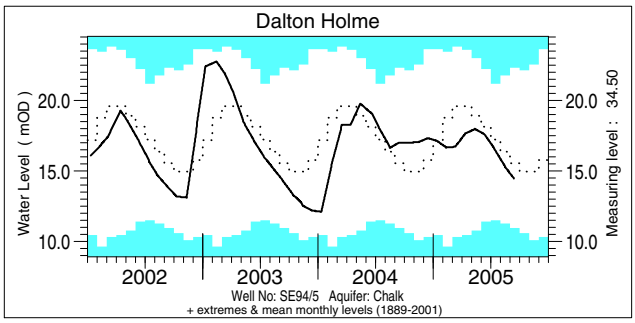
	River	%lta	Rank
a)	Dee (Park)	45	3/33
	Kennet	69	4/44
	Test	67	2/48
	Itchen	73	2/47
	Avon (Amesbury)	64	4/41
	Ribble	35	3/46
	Nith	32	4/48
	Clyde (Daldowie)	37	3/42

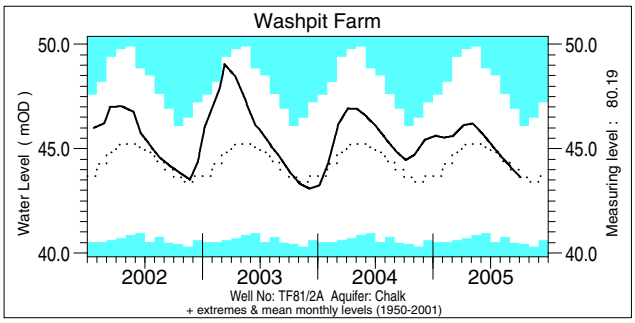
	River	%lta	Rank
b)	Spey (Boat o'Brig)	125	52/53
	Soar	49	3/34
	Medway	36	2/44
	Ouse (Gold Bridge)	41	2/41
	Wallington	39	2/50
	Piddle	60	2/41
	Exe	66	3/49

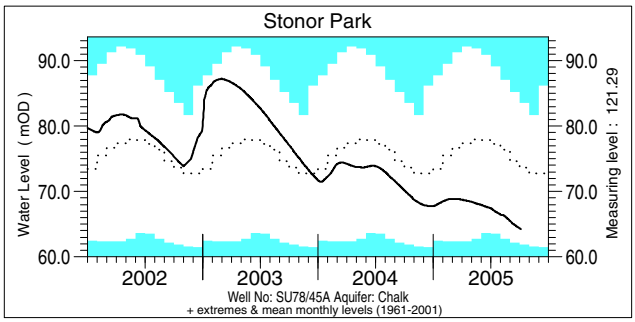
River	%lta	Rank
Kenwyn	58	2/37
Cynon	61	3/47
Ewe	128	33/35
Naver	119	26/28
Faughan	78	2/29
L Bann	74	1/25
Annacloy	71	2/25

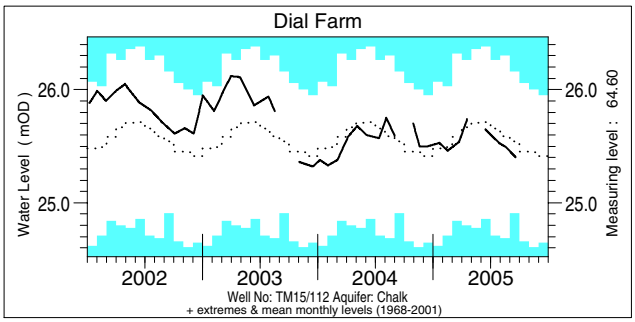
lta = long term average
Rank 1 = lowest on record

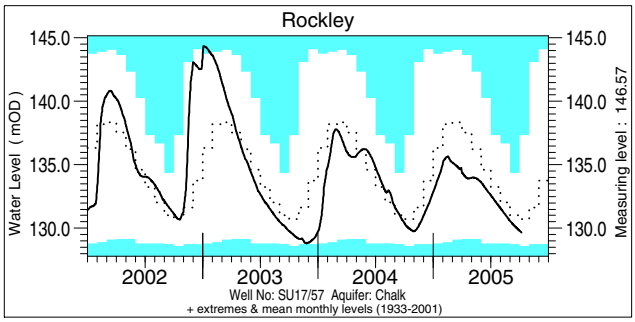
Groundwater . . . Groundwater

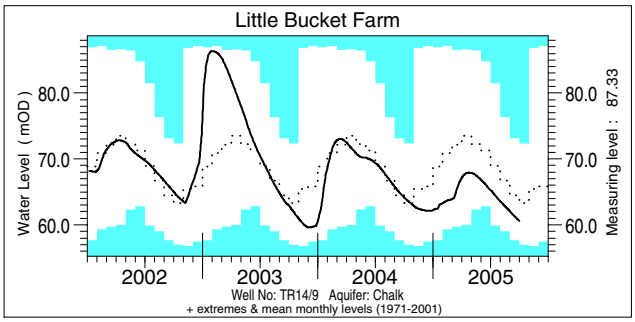


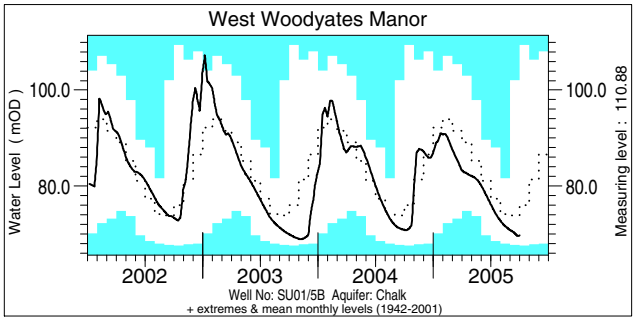


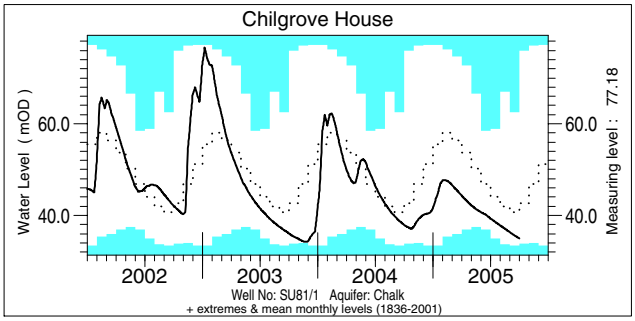


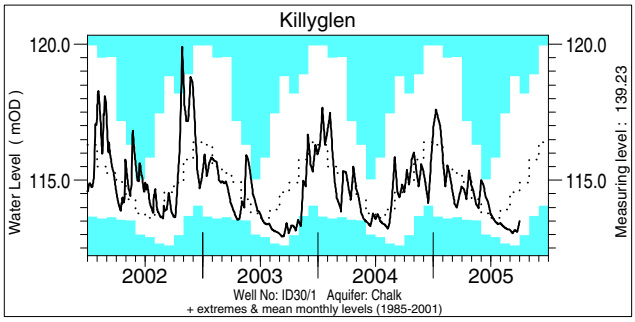


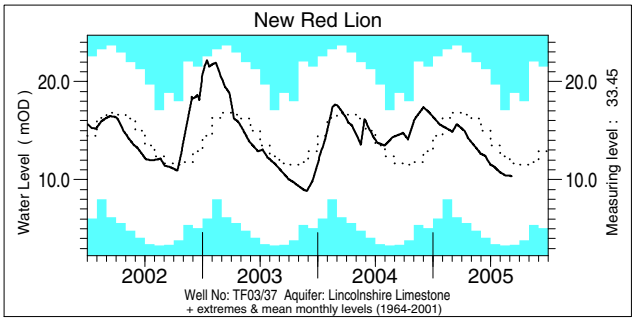






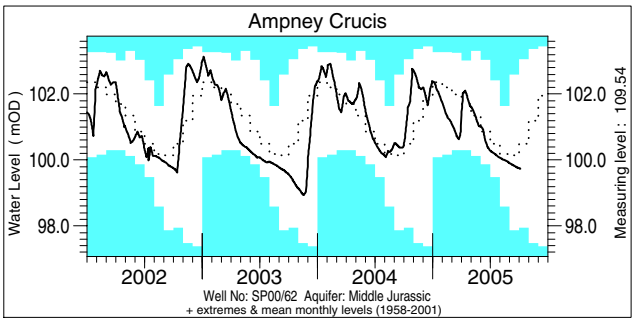


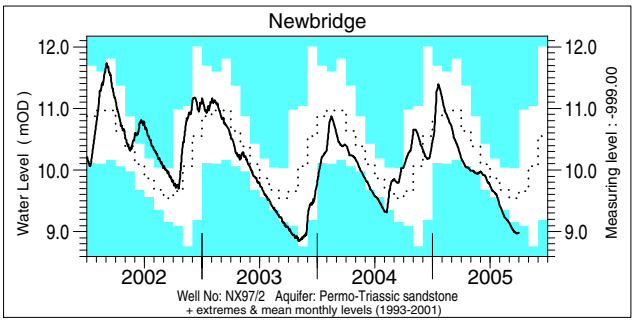


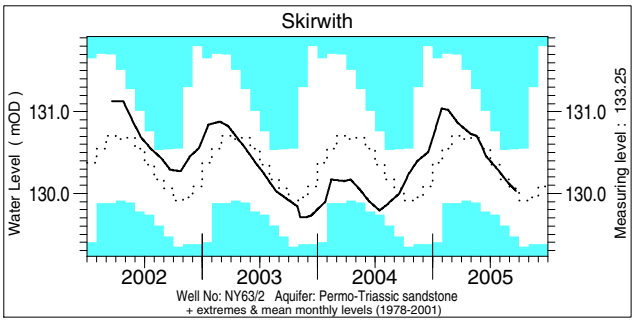


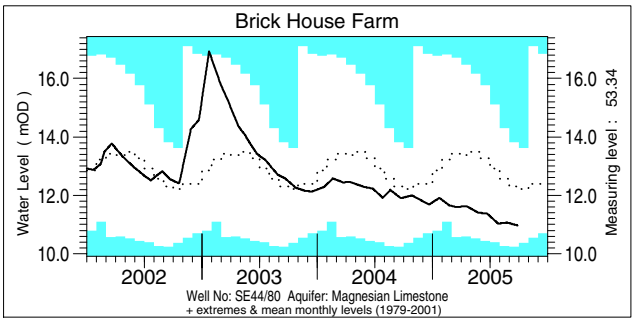
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined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

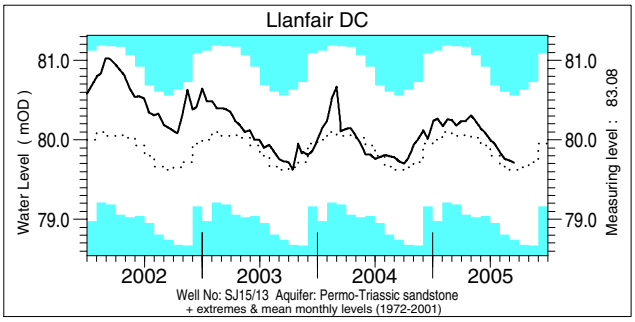
Groundwater . . . Groundwater

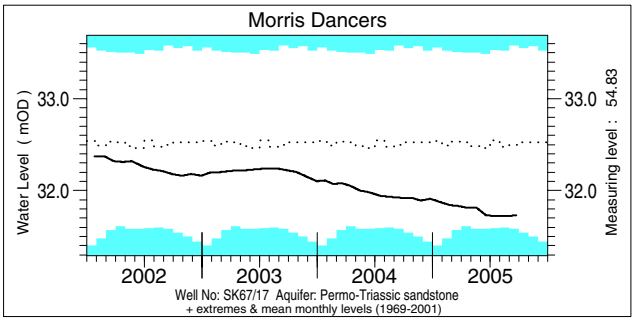


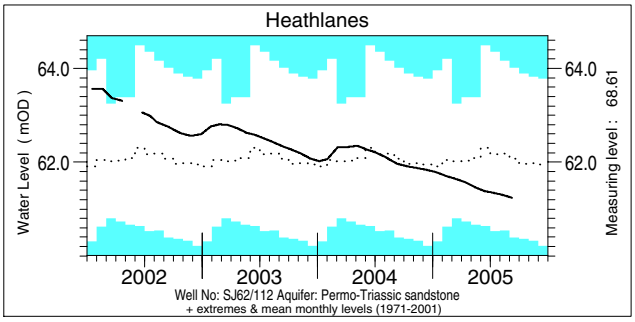


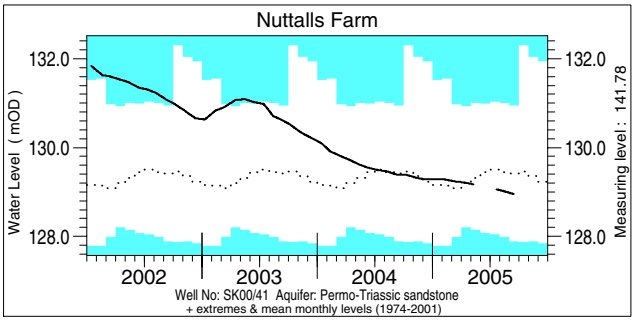


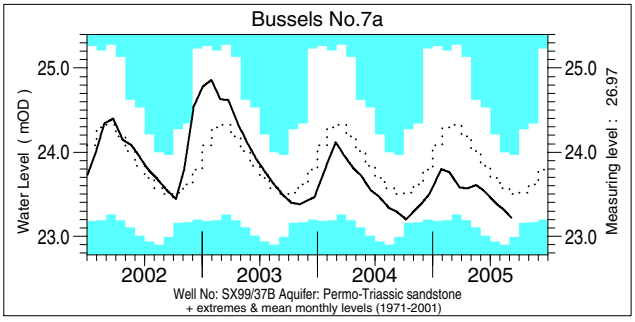


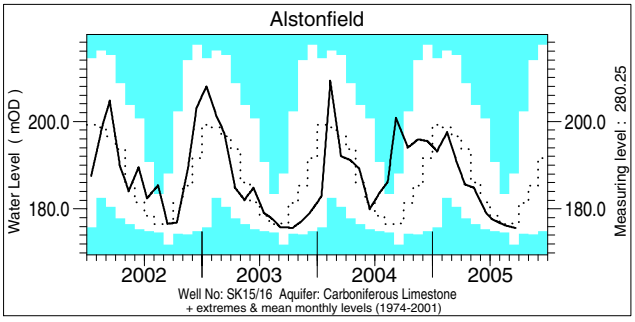










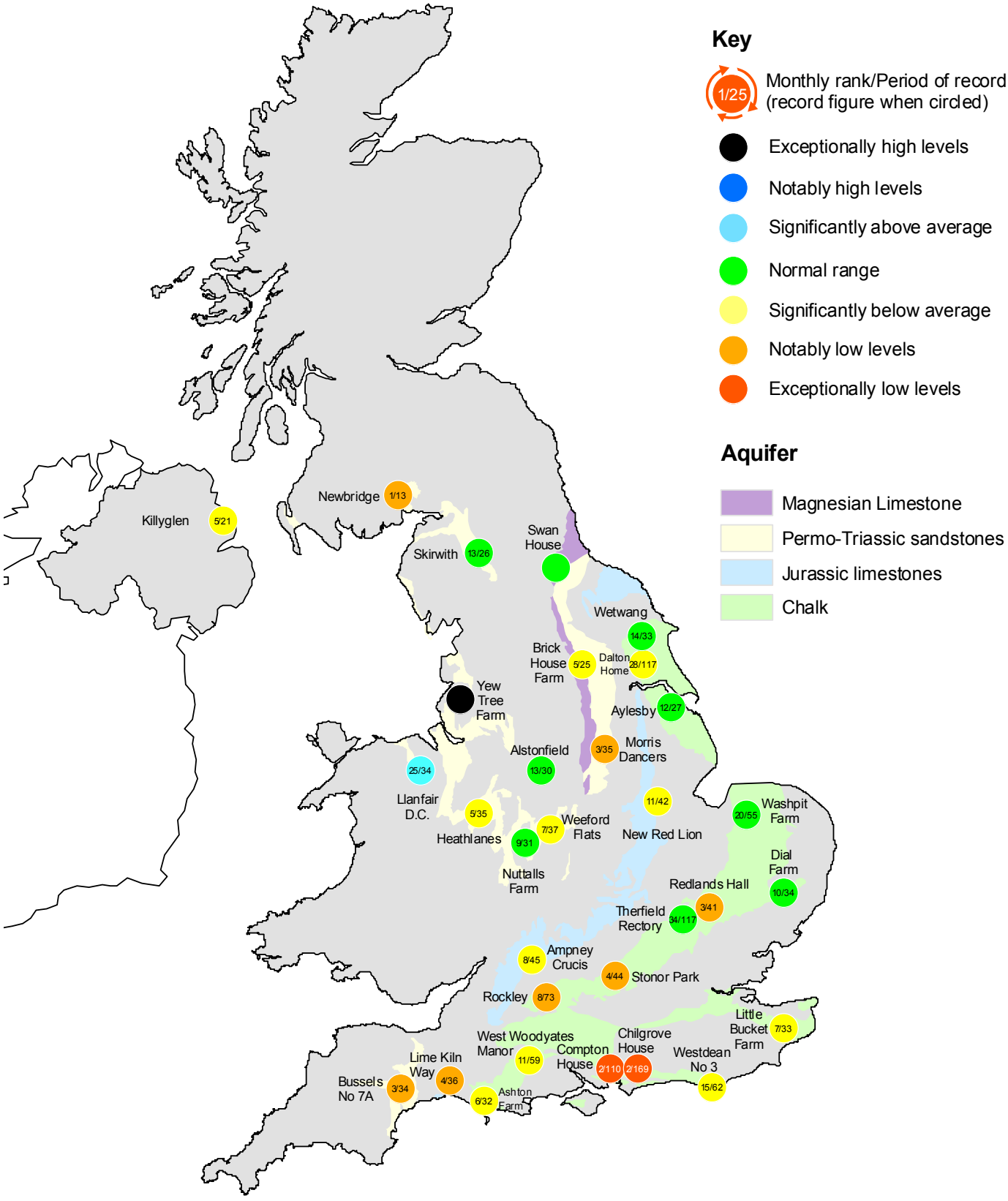


Groundwater levels September / October 2005

Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.	Borehole	Level	Date	Sep. av.
Dalton Holme	14.45	13/09	15.43	Chilgrove House	34.98	30/09	40.77	Llanfair DC	79.71	15/09	79.55
Washpit Farm	43.61	04/10	44.00	Killyglen	113.51	30/09	114.39	Morris Dancers	31.73	22/09	32.36
Stonor Park	64.23	05/10	74.84	New Red Lion	10.37	06/09	11.69	Heathlanes	61.24	08/09	62.06
Dial Farm	25.40	19/09	25.55	Ampney Crucis	99.74	05/10	100.08	Nuttalls Farm	128.95	15/09	129.60
Rockley	129.64	07/10	131.02	Newbridge	8.98	30/09	9.58	Bussels No.7a	23.22	06/09	23.51
Little Bucket Farm	60.59	30/09	64.80	Skirwith	130.03	20/09	130.08	Alstonfield	175.62	21/09	177.55
West Woodyates	69.68	30/09	72.96	Brick House Farm	10.97	26/09	12.32				

Levels in metres above Ordnance Datum

Groundwater . . .Groundwater



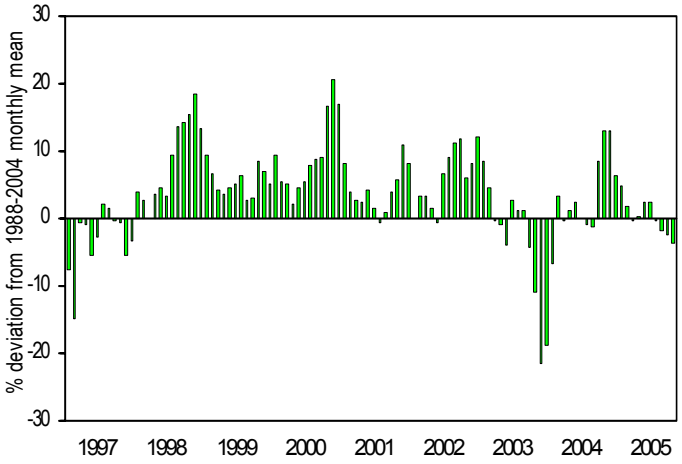
Groundwater levels - September 2005

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.

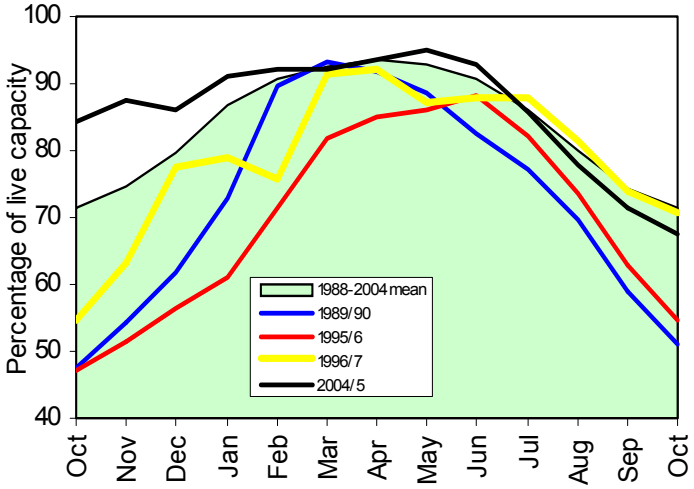
Notes: i. The outcrop areas are coloured according to British Geological Survey conventions.
ii. Yew Tree Farm levels are now received quarterly.

Reservoirs . . . Reservoirs . . .

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



These plots are based on the England and Wales figures listed below.

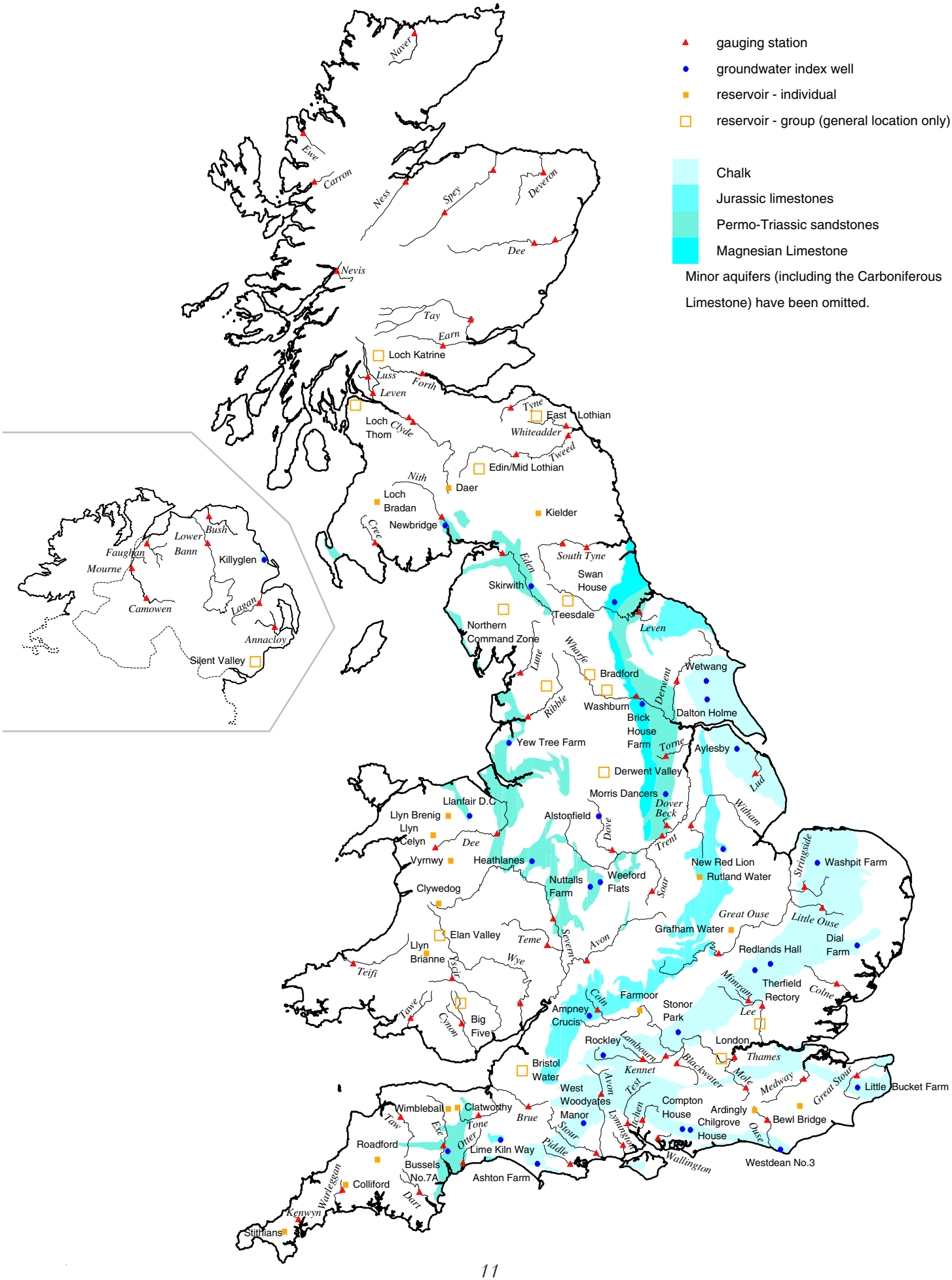
Percentage live capacity of selected reservoirs at start of month

Area	Reservoir	Capacity (Ml)	2005 Jun	Jul	Aug	Sep	Oct	Avg. Oct	Min. Oct	Year* of min.
North West	N Command Zone	• 124929	86	72	57	49	**52**	52	13	1995
	Vyrnwy	55146	94	84	75	63	**56**	67	26	1995
Northumbrian	Teesdale	• 87936	95	87	77	69	**73**	62	31	1995
	Kielder	(199175)	(94)	(90)	(87)	(89)	**(86)**	(84)	(59)	1989
Severn Trent	Clywedog	44922	100	97	87	76	**70**	68	24	1989
	Derwent Valley	• 39525	92	83	72	60	**55**	61	24	1989
Yorkshire	Washburn	• 22035	77	69	62	57	**57**	61	24	1995
	Bradford supply	• 41407	93	80	70	57	**55**	63	15	1995
Anglian	Grafham	(55490)	(93)	(89)	(86)	(82)	**(80)**	(81)	(46)	1997
	Rutland	(116580)	(95)	(89)	(85)	(82)	**(76)**	(78)	(61)	1995
Thames	London	• 202406	98	89	80	74	**65**	74	53	1997
	Farmoor	• 13822	99	99	99	98	**98**	88	54	2003
Southern	Bewl	28170	78	69	61	54	**44**	64	32	1990
	Ardingly	4685	98	82	65	56	**47**	64	32	2003
Wessex	Clatworthy	5364	94	87	80	66	**53**	52	25	2003
	Bristol WW	• (38666)	(82)	(75)	(65)	(55)	**(47)**	(59)	(31)	1990
South West	Colliford	28540	71	67	62	54	**45**	67	43	1997
	Roadford	34500	73	71	66	58	**53**	70	26	1995
	Wimbleball	21320	93	88	83	74	**61**	61	30	1995
	Stithians	5205	87	79	67	54	**41**	54	22	1990
Welsh	Celyn and Brenig	• 131155	100	96	86	78	**77**	78	39	1989
	Brianne	62140	100	94	93	88	**82**	82	48	1995
	Big Five	• 69762	91	82	73	62	**54**	64	19	1995
	Elan Valley	• 99106	94	83	75	67	**64**	75	34	1995
Scotland(E)	Edinburgh/Mid Lothian	• 97639	99	96	85	74	**72**	75	43	1998
	East Lothian	• 10206	100	96	90	78	**66**	78	52	1989
Scotland(W)	Loch Katrine	• 111363	100	94	73	67	**81**	71	43	1995
	Daer	22412	100	94	80	69	**69**	70	32	1995
	Loch Thom	• 11840	100	100	100	100	**87**	77	56	1995
Northern Ireland	Total+	• 67270	89	86	75	71	**65**	68	29	1995
	Silent Valley	• 20634	93	86	74	65	**64**	60	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 1988-2005 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 (NHMP) 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. A significant number of additional monthly raingauge totals are provided by the EA and SEPA to help derive the contemporary regional rainfalls. Revised monthly national and regional rainfall totals for the post-1960 period (together with revised 1961-90 averages) were made available by the Met Office in 2004; these have been adopted by the NHMP. 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 Met 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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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

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