Hydrological summary

for Great Britain

December 1997

General

Following above average autumn rainfall an exceptionally wet interlude beginning in the second week of December has greatly improved the water resources outlook in all but parts of eastern England (mostly dependant on groundwater). Stocks in almost all index reservoirs increased briskly from mid-month and overall stocks for E&W were well above average by early January. As importantly, the period from mid December has been the most productive episode for groundwater replenishment for three years; levels are rising rapidly in most outcrop areas. Flood warnings were widespread around the turn of the year and saturated catchments remain vulnerable to further rain, in the west and north especially. Depressed groundwater levels in a zone centred on Cambridgeshire and Hertfordshire (plus some more northerly localities) testify to the continuing impact of the long term rainfall deficiency but average rainfall through until April should restore water-tables, and spring flows, to within the normal range.

Rainfall

After several cold interludes in the first fortnight, December was mild and increasingly unsettled with very boisterous conditions around year-end when severe gales, mostly on a south-westerly airflow, caused considerable structural damage. Generally, daily rainfalls totals were not outstanding - in part due to the rapid progress of the frontal systems - but in southern Britain some areas registered well over twice the seasonal average for the three weeks beginning around the 17th. Rain-shadow effects were, however, also evident - contributing to the relatively modest December rainfall totals registered in some areas eg parts of the lower Severn Valley and central southern England. Regional rainfall totals for December were well within the normal range throughout Britain but above average over much of the Chalk outcrop. Oct.-Dec. rainfall totals were notably low in parts of northern Scotland but significantly above average in most regions of southern Britain. For E&W as a whole, the wet conclusion to 1997 boosted the annual rainfall total to 94% of average; 1997 totals were also close to the 1961-90 average in all regions. In such circumstances, and given the recovery in runoff and infiltration rates since the late autumn, the long term regional rainfall deficiencies - although still exceptional - are now of limited relevance to the water resources prospects for 1998.

River Flow

In broad terms, the seasonal runoff recovery stalled during early December but gathered considerable momentum thereafter. By year-end bankfull flows characterised most catchments and flood warnings were widespread; gales produced significant tidal flooding, in the south and west especially. Runoff rates continued to climb during early January and floodplain inundations (mostly minor) were very common. Many rivers (eg the Itchen) registered their highest flows of 1997 around year-end, and in southern Britain early January peak flows were the highest for nearly three years in a few catchments. Most catchments in western and northern Britain - and many impermeable catchments in the English lowlands - recorded above average December runoff. Some spring-fed rivers also exceeded the monthly average; for the first time in 23 and 33 months repectively on the Coln and the Lud. By contrast, rivers sustained by groundwater in SE Britain, where soil moisture deficits remained significant through most of the month, responded in a characteristically sluggish manner. December flows on the Mimram were the third lowest in a 46-year record and runoff for 1997 only marginally exceeds the minimum on record (for 1973). A substantial minority of index catchments - from the Carron (Highland Region) to the Hampshire Avon registered their second lowest annual runoff on record; for a few, including the Medway and Little Ouse, the only lower annual runoff total is that for 1996.

Groundwater

Remaining soil moisture deficits were briskly eliminated in most outcrop areas by mid-December allowing very substantial infiltration over the ensuing four weeks. By year end levels in most areas were climbing steeply. (The notable recent replenishment is not reflected in all the hydrographs featured in this report - some readings were taken in early December and water-table response can lag behind infiltration by many weeks.) At year-end levels in most limestone aquifers were well above average - in the Cotswolds especially. In some western and southern Chalk outcrops the recent recoveries have been dramatic; water-table rises in parts of Dorset exceeded the average annual range. Similarly, levels at Rockley rose from near record autumn minimum to appreciably above average by the second week of January. By contrast, in parts of central and eastern England seasonally dry soils delayed infiltration (until beyond year-end in a few cases) and levels in the Chalk of the Chilterns, the Lee basin, Cambridgeshire and Suffolk (and a few other eastern outcrops), remained very depressed - unprecedented to the north of London. Depressed December levels also typified many of the more northerly Permo-Triassic sandstones outcrops and a number of boreholes in the Midlands (especially those in the slower responding confined zones). However, with substantial recent infiltration healthy water-table recoveries may be anticipated given rainfall in the normal range over the January-April period; this is true of the eastern Chalk also.

Institute of Hydrology

British Geological Survey

Rainfall accumulations and return period estimates

Area	Rainfall	Dec 1997	Oct 97-Dec 97	RP	Jul 97-Dec 97	RP	Jan 97-Dec 97	RP	Apr 95-Dec 97	RP
England & Wales	**mm**	**96**	**277**		**453**		**846**		**2088**	
	%	**103**	**103**	**2-5**	**94**	**2-5**	**94**	**2-5**	**85**	**30-50**
North West	mm	148	320		557		1096		2587	
	%	120	85	2-5	82	5-10	91	2-5	78	>200
Northumbrian	mm	110	235		378		817		2068	
	%	135	97	2-5	82	5-10	96	2-5	88	10-15
Severn Trent	mm	67	215		370		728		1754	
	%	87	101	2-5	93	2-5	97	2-5	84	20-35
Yorkshire	mm	94	222		379		757		1845	
	%	113	94	2-5	87	2-5	92	2-5	82	40-60
Anglian	mm	70	182		299		566		1369	
	%	128	111	2-5	94	2-5	95	2-5	83	30-50
Thames	mm	63	210		345		616		1568	
	%	89	106	2-5	95	2-5	89	2-5	82	30-40
Southern	mm	95	327		450		764		1838	
	%	116	133	5-10	107	2-5	98	2-5	86	10-20
Wessex	mm	85	304		504		858		2218	
	%	91	119	2-5	113	2-5	102	2-5	97	2-5
South West	mm	118	433		684		1162		2978	
	%	85	114	2-5	109	2-5	99	2-5	94	2-5
Welsh	mm	127	409		671		1236		3089	
	%	83	95	2-5	92	2-5	94	2-5	86	15-25
Scotland	**mm**	**172**	**390**		**658**		**1411**		**3599**	
	%	**114**	**85**	**2-5**	**81**	**5-15**	**98**	**2-5**	**92**	**5-15**
Highland	mm	188	398		729		1693		4190	
	%	95	67	10-20	73	20-35	96	2-5	87	30-40
North East	mm	99	307		500		1032		2779	
	%	106	106	2-5	93	2-5	106	2-5	104	2-5
Tay	mm	167	407		609		1262		3225	
	%	131	108	2-5	92	2-5	103	2-5	97	2-5
Forth	mm	129	290		476		1089		2777	
	%	117	86	2-5	77	5-15	98	2-5	91	5-10
Tweed	mm	132	284		448		1003		2530	
	%	142	101	2-5	84	5-10	103	2-5	95	2-5
Solway	mm	216	461		745		1390		3558	
	%	146	103	2-5	93	2-5	98	2-5	91	5-10
Clyde	mm	208	464		778		1568		4078	
	%	116	84	2-5	80	5-15	92	2-5	88	15-25

%= % of 1961-90

RP = Return period

 Recent monthly rainfall figures for the Scottish regions have ben compiled using data provided by the Scottish Environment Protection Agency. The return period estimates are based on tables provided by the Meteorological Office (see Tabony, R.C., 1977, *The variability of long duration rainfall over Great Britain*, Scientific Paper No. 37) and relate to the specified span of months only, (return periods may be up to an order of magnitude less if n-month periods beginning in any month are considered). The tables reflect rainfall over the period 1911-70 and assume a stable climate. Artifacts in the England & Wales and Scotland rainfall series can exaggerate the relative wetness of the recent past.

Rainfall . . . Rainfall . . . Rainfall

Key

00% Percentage of 1961-90 average

Very wet

Substantially above average

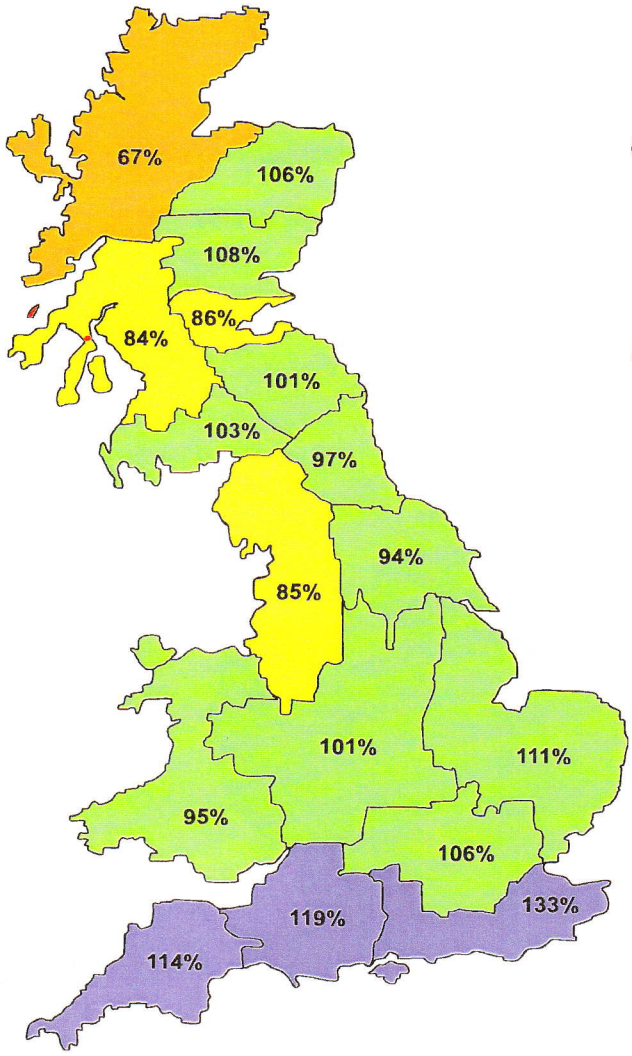
Above average

Normal range

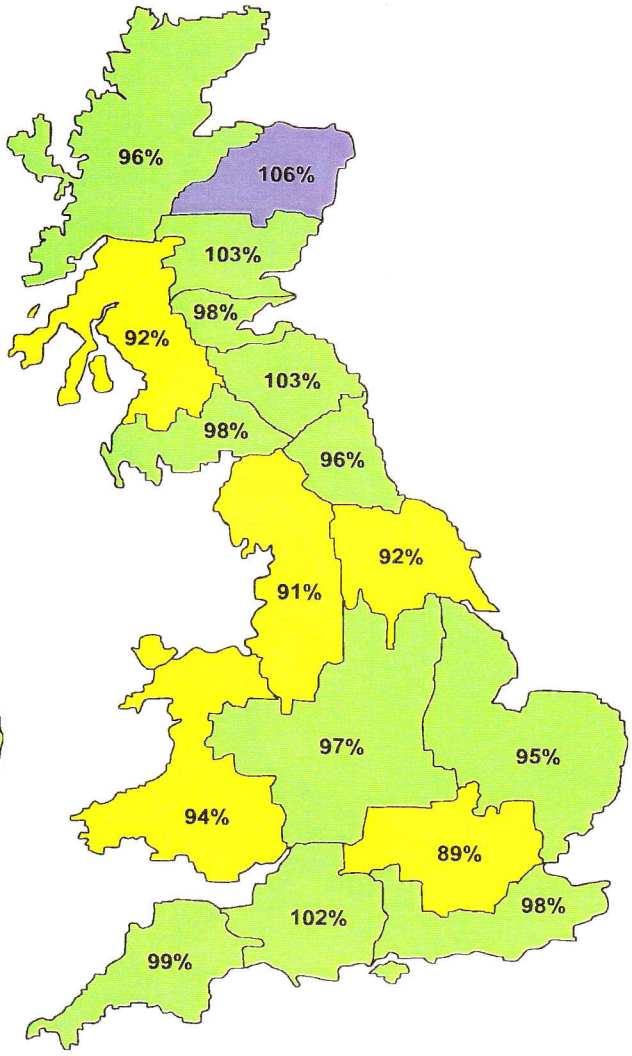
Below average

Substantially below average

Exceptionally low rainfall



October 1997 - December 1997

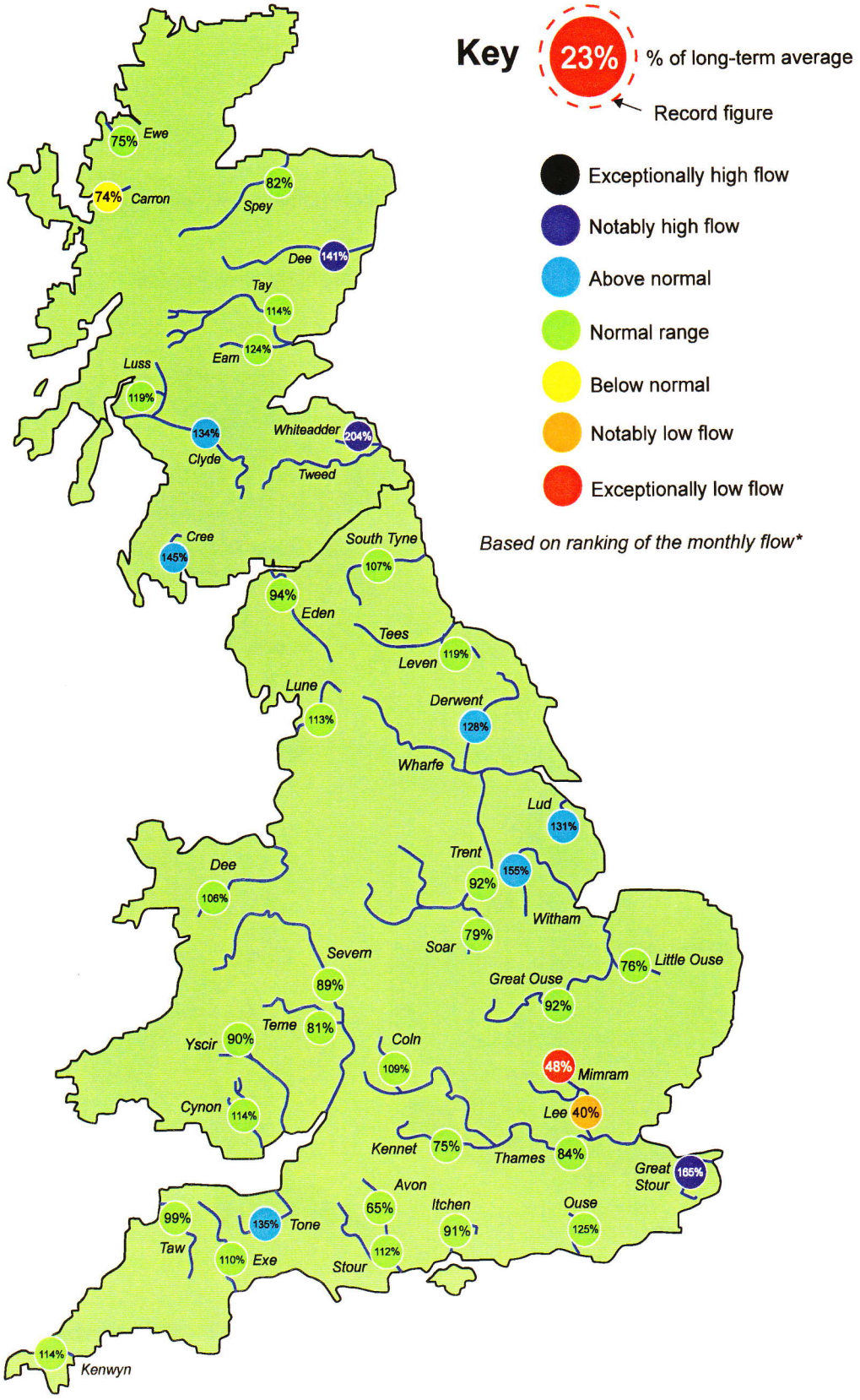


January 1997 - December 1997

Rainfall accumulation maps

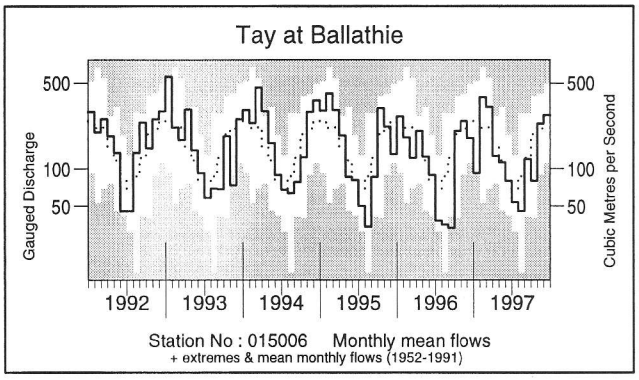
In much of England, long term (2-3 year) rainfall deficiencies - which remain exceptional in a number of regions - are very unlikely to be fully made up in 1998. However, apart from a few areas in the English lowlands, hydrological conditions now generally reflect rainfall patterns over much shorter timespans; the wettest regions over the last three months broadly coincide with those areas where the latter phases of the 1995-97 drought achieved their greatest severity.

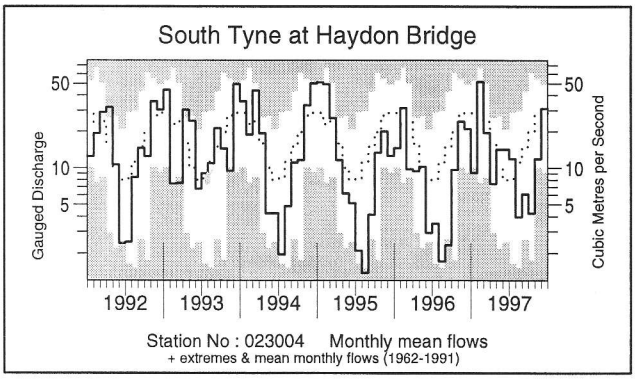
River flow . . . River flow . . .

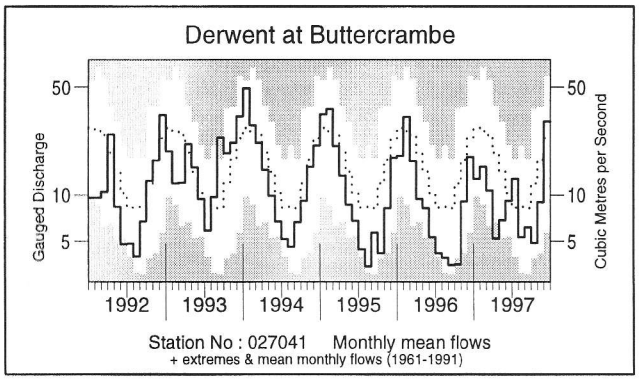


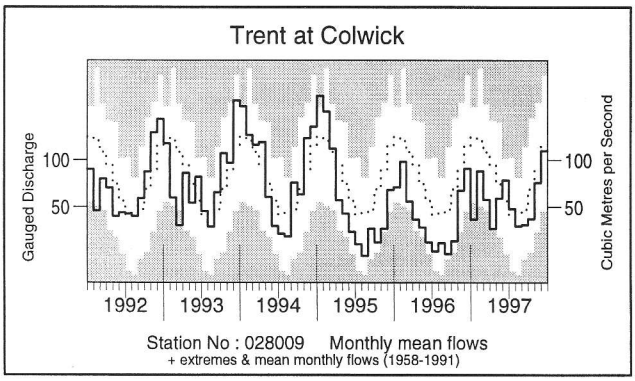
River flows - December 1997

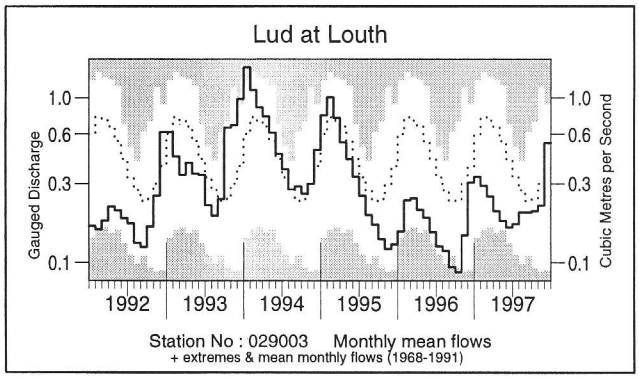
Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much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

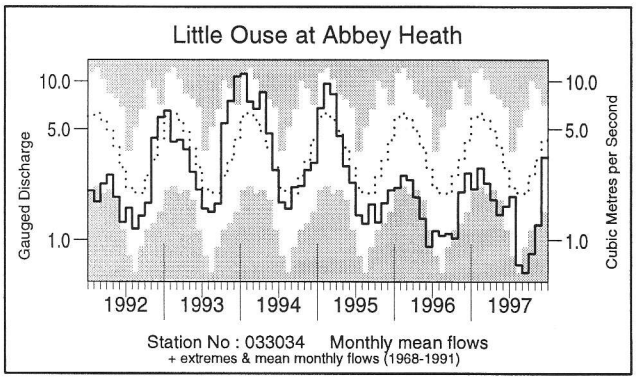


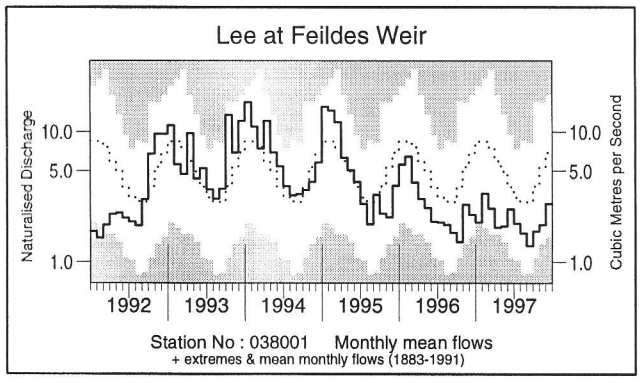


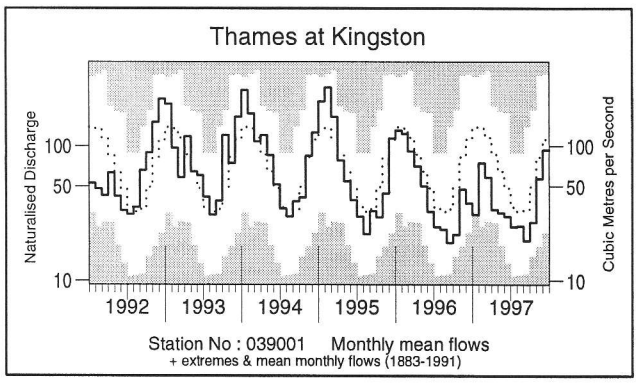








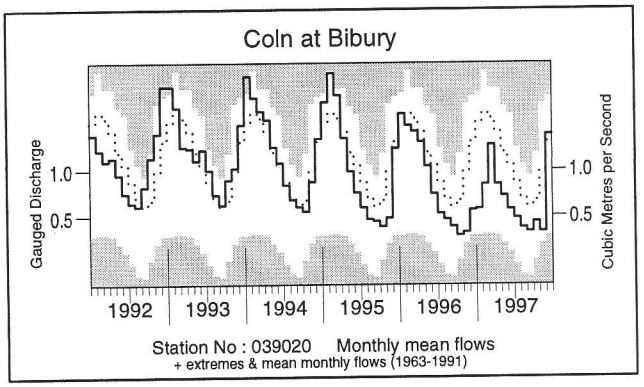


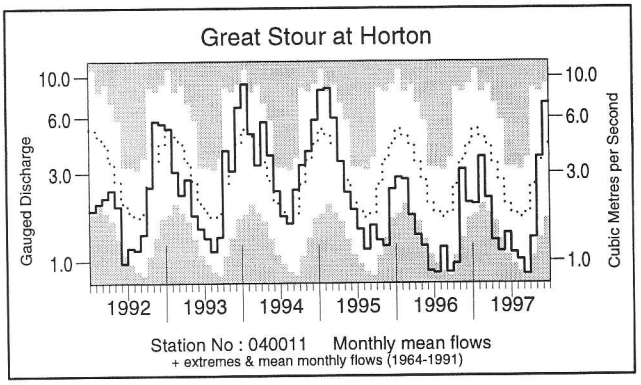


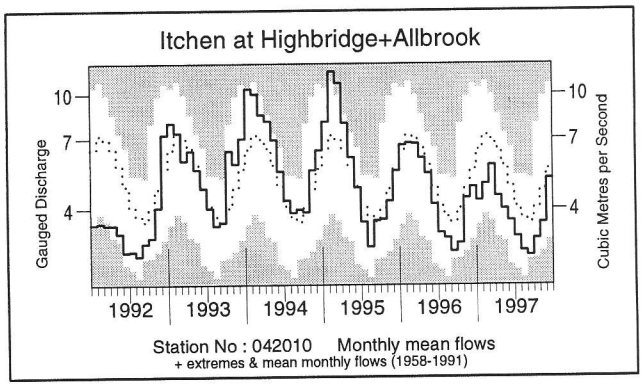
Monthly river flow hydrographs

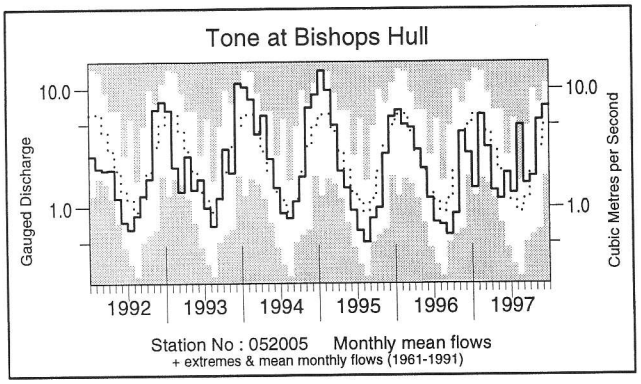
The river flow hydrographs show the monthly mean flow (bold trace), the long term average monthly flow (dotted trace) and the maximum and minimum flow prior to 1992 (shown by the shaded areas). Monthly flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas.

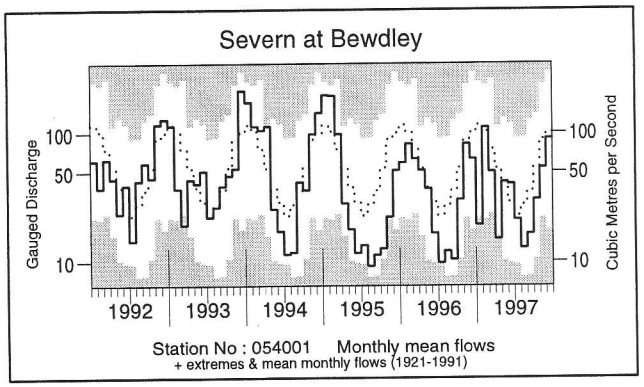
River flow . . . River flow . . .

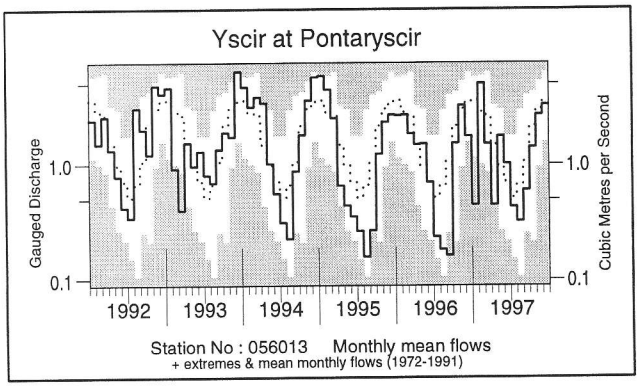


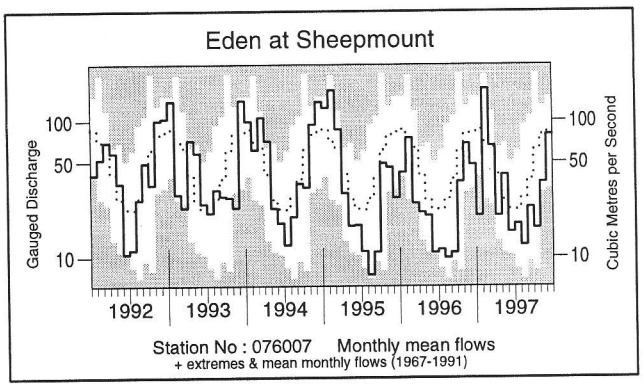


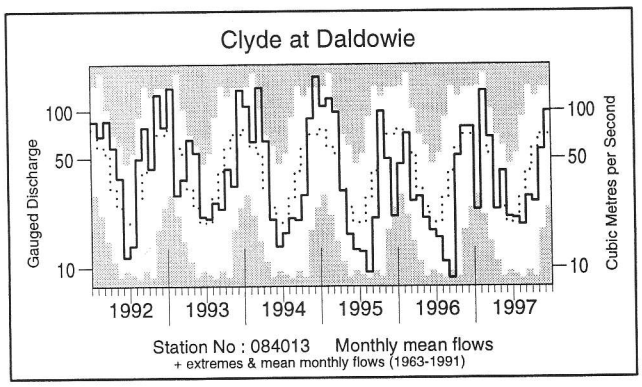












Notable runoff accumulations October - December 1997 (a); January 1997 - December 1997 (b)

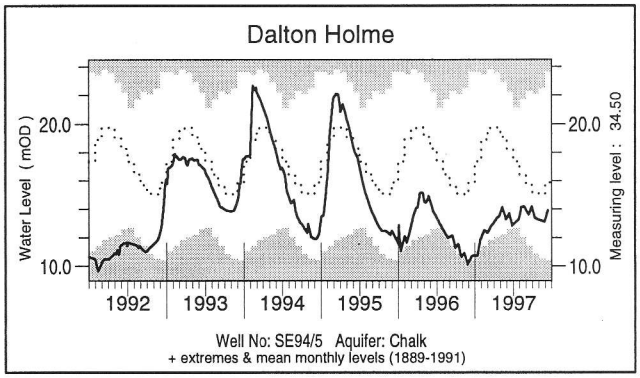
(a) River	%lta	Rank
Carron	55	1/19
Mimram	50	3/45
S.Tyne	64	4/36
Test	71	4/41
Ewe	58	3/27
Dee	**114**	**21/25**

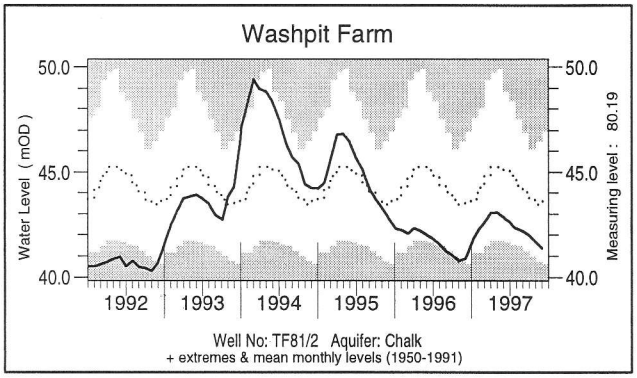
Maximum accumulations are emboldened.

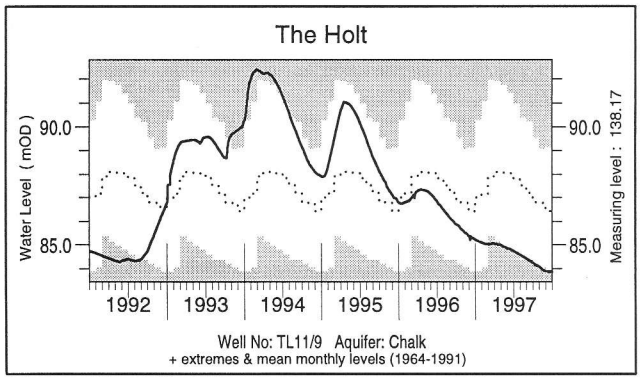
(b) River	%lta	Rank	River	%lta	Rank
Luss Water	86	1/19	Medway	56	2/34
Dover Beck	61	2/20	Test	63	2/39
Soar	54	2/26	Brue	71	3/33
L.Ouse	48	2/29	Avon	47	2/32
Mimram	45	2/45	Stour	77	2/25
Kennet	53	2/36	Carron	80	2/19

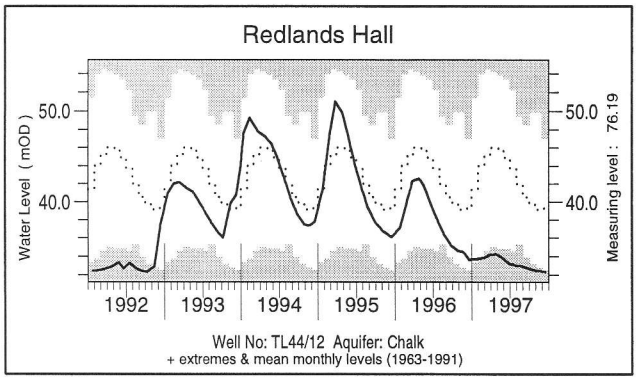
lta = long term average
Rank 1 = lowest on record

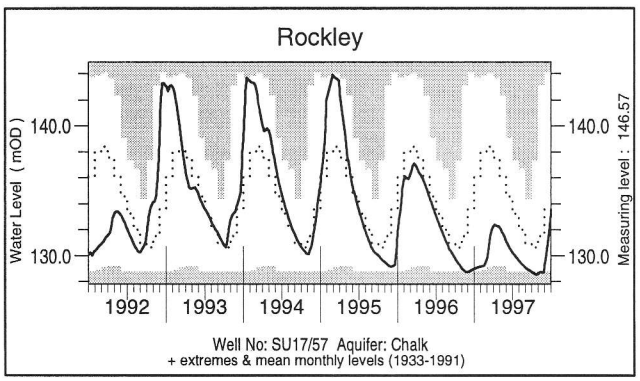
Groundwater . . . Groundwater

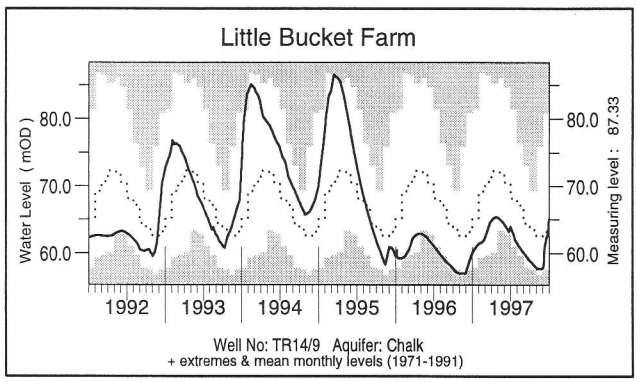


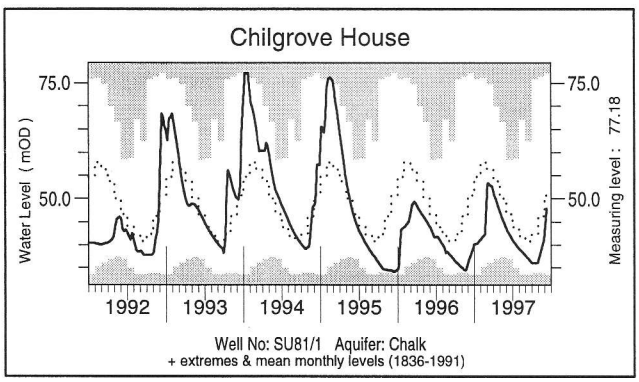


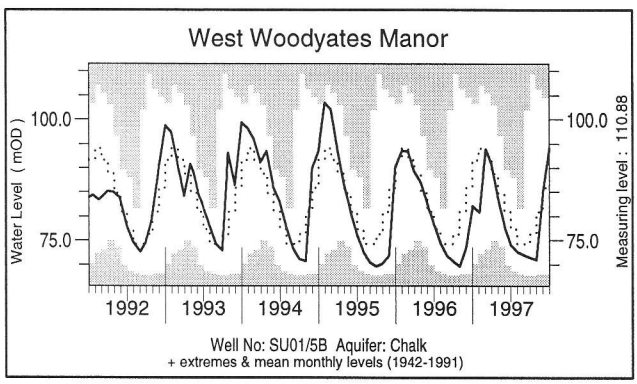








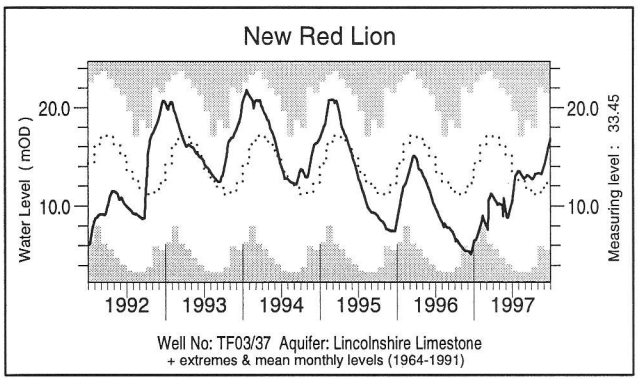


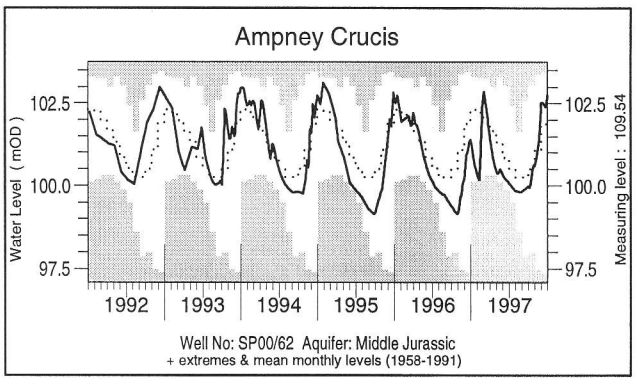


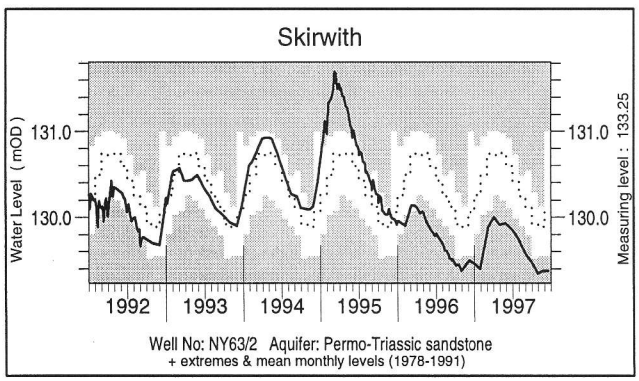
What is groundwater?

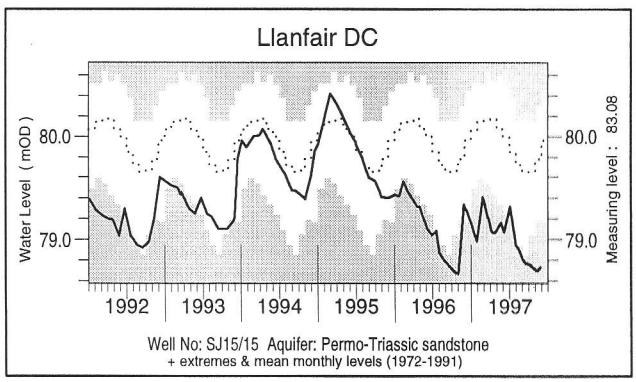
Groundwater is stored in the natural water bearing rock strata (or aquifers) which are found mostly in southern and eastern England (see page 11) where groundwater is the major water supply source. Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment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

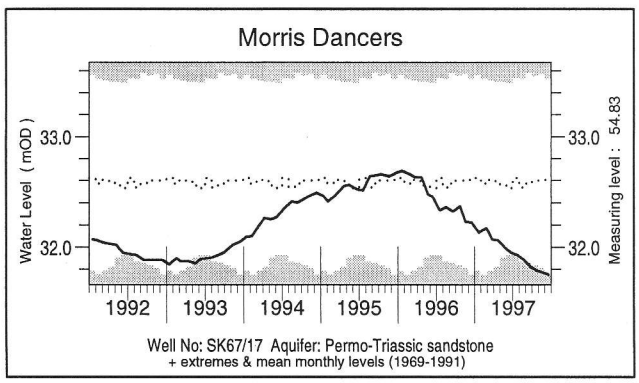
Groundwater . . . Groundwater

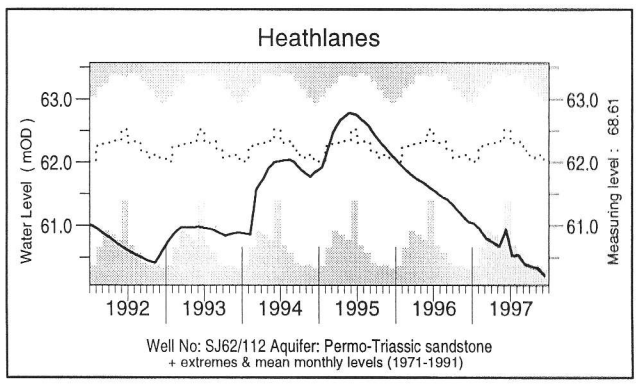


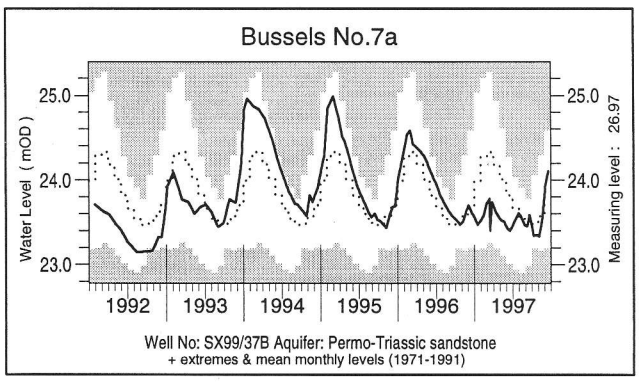


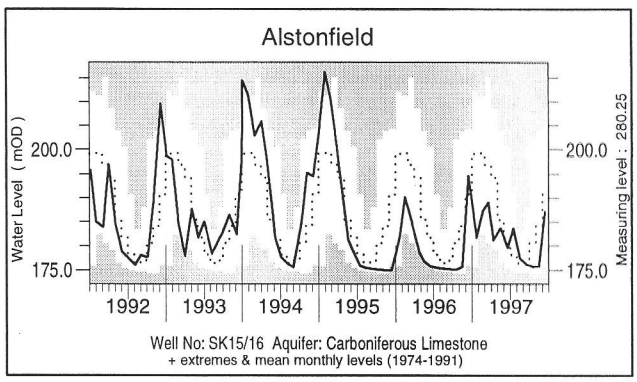












Groundwater levels December/January 1997/98

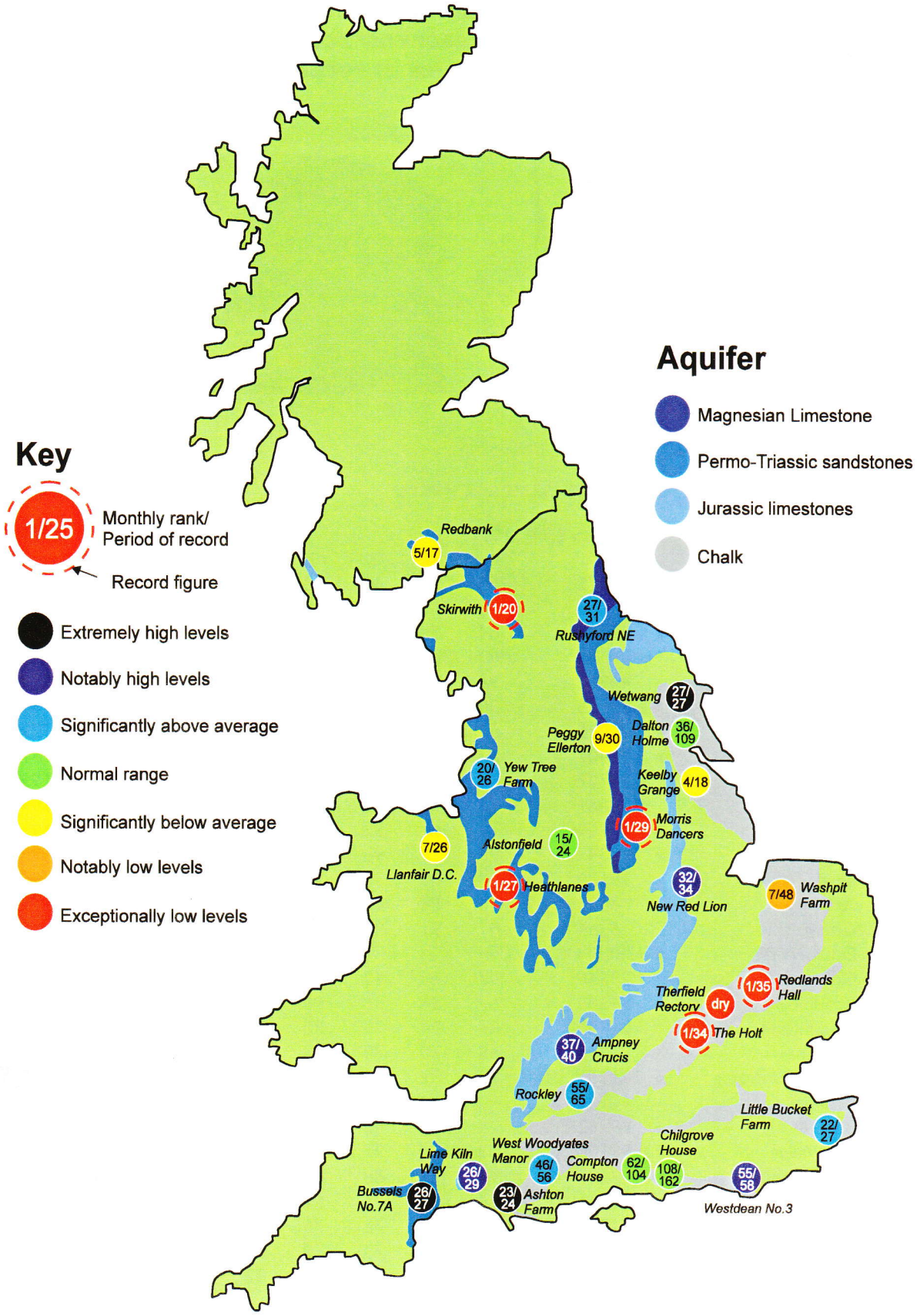
Borehole	Level	Date	Dec av.
Dalton Holme	13.91	12/12	14.79
Washpit Farm	25.63	05/01	43.17
The Holt	83.87	31/12	86.87
Redlands Hall	32.30	16/12	38.22
Ashton Farm	71.20	31/12	66.20
Little Bucket	65.10	29/12	62.32

Borehole	Level	Date	Dec av.
Chilgrove	47.88	09/12	46.50
W Woodyates	94.18	31/12	80.53
New Red Lion	16.79	30/12	11.66
Ampney Crucis	102.8	31/12	101.1
Skirwith	129.4	17/12	129.9

Borehole	Level	Date	Dec av.
Llanfair DC	79.33	06/01	79.55
Morris Dancers	31.75	19/12	32.48
Heathlanes	60.22	09/12	61.84
Bussels	24.11	18/12	23.57
Alstonfield	187.2	12/12	184.1

Levels in metres above Ordnance Datum

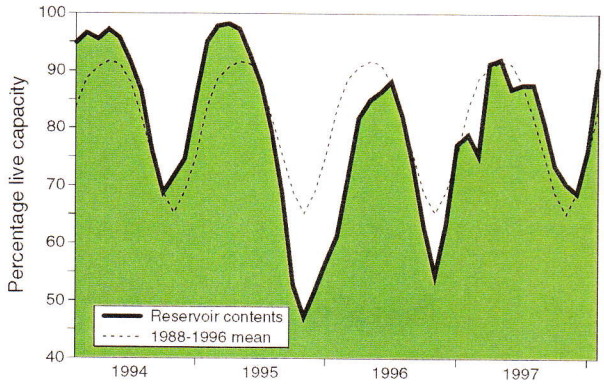
Groundwater . . . Groundwater



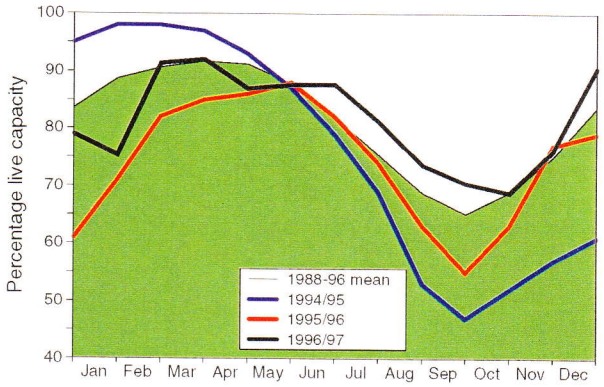
Groundwater levels - December 1997

The rankings are based on a comparison of current levels (usually a single reading in a month) with the average level in each corresponding month on record. Caution needs to be exercised when interpreting the ranking, especially during periods of rapid changes in groundwater level.

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



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



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

Percentage live capacity of selected reservoirs

Area	Reservoir	Capacity (Ml)	1997 Aug	Sep	Oct	Nov	Dec	1988 Jan	Min. Jan	Year* of min
NorthWest	N Command Zone	• 133375	66	53	60	53	64	95	51	1996
	Vyrnwy	55146	75	65	61	59	67	100	35	1996
Northumbrian	Teesdale	• 87936	84	74	73	65	73	96	41	1996
	Kielder	(199175)	(94)	(85)	(82)	(82)	(75)	(95)	(70)	1990
Severn Trent	Clywedog	44922	91	80	82	81	86	86	54	1996
	DerwentValley	• 39525	90	80	72	73	79	100	10	1996
Yorkshire	Washburn	• 22035	87	77	72	60	73	98	23	1996
	Bradford supply	• 41407	87	76	76	72	85	99	22	1996
Anglian	Grafham	58707	66	59	46	44	47	57	57	**1998**
	Rutland	130061	78	76	72	71	75	88	60	1991
Thames	London	• 206399	77	67	53	51	68	72	60	1991
	Farmoor	• 13843	98	99	96	97	92	96	71	1991
Southern	Bewl	28170	74	65	58	56	76	98	38	1991
	Ardingly	4685	93	86	68	68	100	100	61	1990
Wessex	Clatworthy	5364	91	91	85	85	100	100	59	1989
	BristolWW	• (38666)	(74)	(72)	(67)	(62)	(71)	(97)	(40)	1991
SouthWest	Colliford	28540	47	43	43	44	53	62	46	1996
	Roadford	34500	57	56	56	56	65	78	20	1990
	Wimbleball	21320	81	84	79	80	91	100	46	1996
	Stithians	5205	66	70	70	68	84	100	37	1992
Welsh	Celyn and Brenig	• 131155	93	83	83	82	86	99	54	1996
	Brianne	62140	93	92	94	97	100	100	76	1996
	Big Five	• 69762	74	71	68	69	87	98	67	1996
	Elan Valley	• 99106	89	84	87	92	100	100	56	1996
East of Scotland	Edinburgh/Mid	• 97639	90	71	66	62	67	74	72	1990
	East Lothian	• 10206	94	80	71	62	63	100	48	1990
West of Scotland	Loch Katrine	• 111363	68	56	72	76	86	100	80	1996
	Daer	22412	74	60	73	70	87	100	83	1996
	LochThom	• 11840	69	58	69	74	82	93	93	**1998**

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 area; this can be particularly important during droughts.
The minimum storage figures relate to the 1988-1997 period only. In some gravity-fed reservoirs (eg. Clywedog) stocks are kept below capacity during the winter to provide scope for flood alleviation.

Location map . . . Location map

Where the information comes from

The National Hydrological Monitoring Programme was instigated in 1988 and is undertaken jointly by the Institute of Hydrology (IH) and the British Geological Survey (BGS). Financial support for the production of the monthly Hydrological Summaries is provided by the Department of the Environment, Transport and the Regions, the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA) and the Office of Water Services (OFWAT).

River flow and groundwater levels

The National River Flow Archive (maintained by IH) and the National Groundwater Level Archive (maintained by BGS) provide the historical perspective within which to examine contemporary hydrological conditions.

River flow and groundwater level data are provided by the regional divisions of the EA (England and Wales) and SEPA (Scotland). In all cases the data are subject to revision following validation (flood and drought data in particular may be subject to significant revision).

Reservoirs

Reservoir level information is provided by the Water Service Companies, the EA and, in Scotland, the West of Scotland and East of Scotland Water Authorities.

Rainfall

Most rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data are presented for the regional divisions of the precursor organisations of the EA and SEPA. The recent rainfall estimates for the Scottish regions are derived by IH in collaboration with the SEPA regions. In England and Wales the recent rainfall figures derive from MORECS. MORECS is the generic name for the Meteorological Office services involving the routine calculation of evaporation and soil moisture throughout Great Britain. The provisional regional rainfall figures are regularly updated using figures derived from a much denser rainguage network. Further details of Met. Office services can be obtained from:

The Meteorological Office
Sutton House
London Road
Bracknell
RG12 2SY.
Tel. 01344 856858; 01344 854024.

The cooperation of all data suppliers is gratefully acknowledged.

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