HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - OCTOBER 1990

Data for this review have been provided principally by the regional divisions of the National Rivers Authority (NRA) in England and Wales, the River Purification Boards in Scotland (RPBs) and by the Meteorological Office. The recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a significant proportion of the river flow data may be subject to review.

For a fuller appreciation of the water resources implications, this hydrological review should be considered alongside assessments of the current reservoir storage and water demand situations in each region.

A map is provided (Figure 4) to assist in the location of monitoring sites.

Summary

The unsettled conditions which began around the third week of September continued throughout much of October which, overall, was a mild and wet month. For England and Wales, the monthly rainfall total was easily the highest since February. In percentage terms (relative to the 1941-70 average) rainfall was particularly abundant in some eastern districts. This resulted in an amelioration of the meteorological drought in most - but not all - districts where the 1990 drought had achieved its greatest severity. Exceptions included parts of the Thames Valley and East Anglia - in these regions droughts of a very considerable magnitude may still be identified.

In western and northern Britain, significant recoveries were registered in runoff rates - some flooding was reported in central and southern Scotland - and healthy replenishment of reservoirs occurred during October. Elsewhere, the exceptional early-autumn soil moisture deficits robbed the rainfall of much of its hydrological effectiveness and produced only modest runoff responses in lowland rivers. For a few, mostly eastern, rivers dependent principally on baseflow, flows continued to decline; in some catchments the notably low October runoff reflects the limited rainfall over at least the last two years. Generally in the east and south runoff rates for October were well below average - often comparable with 1989 - but appreciably above historical minima.

The moderating influence of very dry soil conditions was most evident in relation to groundwater levels. Notwithstanding the above average rainfall throughout most major aquifers, water-table recoveries were confined to a few localities (generally in shallow aquifers where recharge is mostly via fissures). Most water-tables continued a gentle recession and groundwater levels along the eastern seaboard, and in some inland districts, are close to or below historical minima.

The water resources outlook is rather more encouraging than in September but the long term rainfall deficiencies and still significant SMDs serve to emphasise the fragile nature of the water resources outlook in eastern, and parts of central and southern, England. There is a continuing need for above average rainfall, especially in the English lowlands, to produce a further increase in runoff rates and, crucially, generate a sustainable upturn in groundwater levels.

Rainfall

Following the decay of an anticyclone over France early in the month, a sequence of low pressure systems brought rainfall to all areas. Thundery activity was relatively common and spatial variations in rainfall amounts were large. An especially active warm front produced very heavy rainfall on and around the 6th; Edinburgh registered its wettest October day on record (63 mm on the 6th). The associated flooding caused considerable transport disruption throughout large parts of Scotland.

October rainfall was well above average in most regions with monthly totals exceeding 150% of the 1941-70 mean in north-eastern coastal areas, the southern Pennines, parts of Sussex and Kent and a few restricted western districts. The above average rainfall was particularly welcome along the eastern seaboard but the patchy nature of rainfall throughout much of October resulted in monthly totals a little below average in some areas - notably the Thames Valley and parts of Lincolnshire and Norfolk.

Rainfall over the last 6-8 weeks has changed the complexion of the meteorological drought somewhat and rainfall deficiencies for the last five months are modest except in parts of central and eastern England. Over the March-October period however relatively severe droughts may still be recognised (see Table 2). The provisional England and Wales rainfall total for the eight months ending in October is marginally below 400 mm - there are only two drier March-October periods in the general rainfall series which begins in 1766 (those of 1803 and 1921). March to October rainfall totals for the NRA regions are less than 65% of the 1941-70 average in the Anglian, Thames, Southern and Wessex regions. The shortfalls represent severe droughts in the first two areas and notable deficiencies in the latter two. For the Thames Valley the 1921 drought provides the only lower eight-month accumulation (beginning in March) in a 108-year catchment rainfall record.

Extending the timeframe to include the abundant rainfall in January and February 1990 produces a sharp decline in the intensity of the meteorological droughts and over the last 12 months rainfall totals are within about ten per cent of the mean in all regions apart from East Anglia. Longer term rainfall deficiencies especially over the 24-30 month timespan still characterise large tracts of eastern Britain - these are of particular significance in relation to the current groundwater situation (see below).

In Scotland, the October rainfall distribution provided little or no evidence of the rain-shadow effects which have been a persistent feature over the 1989/90 period. Rainfall was well above average in almost all areas especially in the east where the accumulated rainfall totals point to a brisk decline in drought intensity during October along the coastal lowlands. Over the year thus far, the Scottish rainfall total is remarkable. The provisional January-October accumulation is a little above 1600 mm - almost 200 mm greater than the previous highest (that for 1903) in a record from 1869; the corresponding totals for 1988 and 1989 also figure among the five wettest on record.

Evaporation and Soil Moisture Deficits (SMDs)

October was another notably warm month - it seems likely that the annual temperature records established last year will be eclipsed - and evaporation rates were well above average. Potential Evaporation (PE) totals (based on MORECS data for grass) were the highest on record in lowland England and notable elsewhere. Actual Evaporation (AE) losses were high also except in the east and south where they were constrained by the continuing dry soil conditions (see below). The October evaporation pattern is consistent with that for the year as a whole. PE totals for the first 10-months of 1990 widely superseded, especially in central England, the record totals established last year. Conversely, in lowland England the mitigating influence of persistently high SMDs has resulted in accumulated AE totals amongst the lowest on record, but typically above 1976.

Soil moisture deficits declined smartly through the month with particularly large reductions over the first week. By month-end field capacity had been reached, or closely approached, throughout northern and western Britain. To the south and east a relatively sharp transition to substantial deficits occurs with large areas of the English lowlands having SMDs 30-40 mm above the long term average. Spatial variation was also considerable with a particularly notable contrast between the continuing large deficits in the Thames Valley and the modest SMDs in parts of Kent and along the south coast.

The elimination of the remaining significant SMDs will be an important factor determining the timing of the upturn in groundwater levels over the 1990/91 winter.

Runoff

Above average rainfall allied to declining evaporative losses resulted, generally, in an increase in river flows during October. In western and northern Britain the increase in runoff rates constituted a substantial seasonal recovery. Elsewhere, runoff patterns provided a clear demonstration of the importance of soil moisture and catchment geology in influencing the response of individual rivers to rainfall.

With the exception of a significant proportion of eastern and some southern catchments river flows for October were within the normal range throughout much of Britain. Runoff in October exceeded the average in a number of mostly, westward-draining catchments in England and Wales and, more generally, in Scotland. Particularly dramatic recoveries in discharge rates were reported in the central lowlands and the Borders; a new maximum instantaneous flow was recorded early in October on the Whiteadder - a tributary of the Tweed which has experienced a particularly severe drought throughout much of 1989/90.

In many lowland catchments the moderating influence on flow recoveries of the substantial autumn SMDs resulted in only modest increases in runoff relative to September. Consequently, runoff rates remained well below the autumn average for the third successive year. In responsive rivers however surface runoff was normally sufficient to produce October runoff totals appreciably greater than those which characterised the dry autumns of the 1970s. Over large parts of southern and eastern England, October runoff totals were broadly similar to (mostly a little above) those of October 1989. In hydrological terms the drought is generally most severe in those eastern catchments where the October runoff fell below the corresponding 1989 figure. These include the Thames for which naturalised flows (at Kingston) were the lowest since 1947 - in the context of the full record (from 1883) the October runoff appears less remarkable. October runoff totals were particularly depressed in rivers dependant principally on baseflow (the Yorkshire Derwent, the Coln and the Mimram being examples) but the associated return periods rarely exceed 25 years.

Accumulated runoff totals are a better guide to drought magnitude than data for a single month. The severity and persistence of the 1989/90 drought may be judged by the low ranking of the accumulated runoff totals - across a range of timeframes - for catchments in the English lowlands and along Britain's eastern seaboard (see Table 3). Over the spril-October period runoff totals are the lowest on record for a significant minority of catchments. For a number of rivers the mean flow over the last seven months falls considerably below the corresponding minimum for the preceding record (in some cases the minimum was established only last year). On the basis of provisional data, the return periods associated with the April-October runoff deficiencies on the Trent, Yorkshire Derwent, the Brue and the Kent Stour fall in the range 25-50 years; rather longer return periods apply to the Taw and the Severn.

As with rainfall, runoff deficiencies generally decrease beyond the eight-month timespan but the twelve-month accumulations provide clear evidence of the regional dimension to the hydrological drought. Rivers draining from the major drainage divide in Scotland (e.g. the Tay and the Clyde) have registered new maximum November-October runoff totals. Conversely, a few eastern English rivers have accumulations amongst the lowest on record.

Groundwater

The recession of groundwater levels has continued through October with little, if any, significant recharge; away from the eastern seaboard, some very limited benefit from the infiltration over the last three or four weeks may however be anticipated.

As a result of the significant lag before water-tables respond to rainfall, drought severity - as indexed by groundwater levels - increased in October. The late September level at the Dalton Holme site in the Chalk of Humberside was already beneath the recorded minimum for that month; by late October not only Dalton Holme but also at the Llanfair site in the Permo-Triassic sandstones, the Fairfields and Ashton Farm sites in the Chalk and the Ampney Crucis site in the Jurassic Oolite, showed levels beneath the pre-1990 monthly minimum; for the latter two boreholes absolute minima were registered. The Limekiln Way site in the Chalk and Upper Greensand aquifer of south-west England shows groundwater levels near the seasonal average, although the reason for this is not fully understood - it is probably a reflection of the very abundant recharge early in 1990. At all other sites, groundwater levels stand below the seasonal means, and generally near to or even below the seasonal minima. Table 4 emphasises the generally depressed nature of water-tables especially in the east. It should also be noted that the observation well at Rockley has gone dry about one month earlier than in 1989 (which was the first occasion since 1976).

In summary, the falling groundwater levels have left the groundwater resources somewhat lower than in September, and approaching the state realised in late September 1976. Levels throughout most major aquifers are exceptionally low but still depart only modestly from those registered in November 1989. Substantial rainfall through the remainder of the winter months will be required to bring groundwater resources to the mean values (as reflected in the groundwater levels); average winter rainfall may be expected to leave levels well below the normal spring maxima in most areas. The temporal distribution of the rainfall will also be important, abundant rainfall before the end of the year will be of less value than a wet spring which would serve to delay the onset of the seasonal decline in groundwater levels. Since many rivers in the United Kingdom normally receive a substantial contribution from baseflow, low groundwater levels would inevitably be reflected in reduced runoff rates through the summer of 1991.

IH/BGS
14/11/90

TABLE 1 1989/90 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Sep 1989	Oct	Nov	Dec	Jan 1990	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
England and	mm	41	98	61	134	133	142	23	38	25	70	35	49	53	102
Wales	%	49	118	63	149	154	219	39	66	37	115	47	54	64	122
NRA REGIONS															
North West	mm	29	145	84	100	197	193	45	52	49	97	55	70	84	168
	%	24	123	69	83	176	238	63	68	60	117	53	55	68	142
Northumbria	mm	20	71	35	75	112	135	32	28	51	68	40	57	53	110
	%	25	95	37	100	140	205	62	51	80	111	52	56	66	146
Severn Trent	mm	38	82	52	135	106	109	18	30	19	62	29	39	49	88
	%	57	126	66	193	154	206	35	58	30	111	44	48	73	135
Yorkshire	mm	20	77	45	98	118	112	23	24	29	83	34	61	42	90
	%	28	112	51	132	153	175	43	43	48	143	48	68	58	130
Anglia	mm	30	41	36	98	52	75	15	36	16	45	22	30	31	53
	%	58	79	58	185	101	179	38	90	34	92	39	47	59	101
Thames	mm	28	65	37	141	92	114	12	35	7	46	15	34	34	60
	%	45	102	51	214	148	242	26	76	13	88	25	49	55	94
Southern	mm	37	79	50	142	121	136	6	43	11	59	12	32	37	102
	%	52	101	53	175	159	237	12	90	20	118	21	45	51	131
Wessex	mm	49	101	58	165	124	158	14	35	13	63	30	42	53	83
	%	62	123	60	183	147	268	24	65	19	117	49	51	67	101
South West	mm	107	148	100	196	195	238	25	47	24	98	58	61	72	129
	%	103	131	75	145	151	264	30	66	29	151	69	60	69	114
Welsh	mm	62	180	109	199	240	215	37	45	33	94	48	62	82	155
	%	50	140	76	137	176	224	43	52	36	115	50	52	66	120
Scotland	mm	96	187	60	96	250	291	247	97	55	124	67	119	143	205
	%	70	126	42	62	182	280	268	108	60	135	60	92	104	138
RIVER PURIFICATION BOARDS															
Highland	mm	118	258	79	109	293	365	409	136	57	137	94	161	230	238
	%	75	139	47	56	179	274	359	119	55	125	74	109	146	128
North-East	mm	57	87	29	54	108	149	87	44	48	108	47	78	85	159
	%	66	90	28	53	119	201	140	72	62	154	51	73	98	164
Tay	mm	83	136	51	86	239	287	178	60	43	122	40	74	67	226
	%	72	111	43	64	203	288	217	80	45	147	39	63	58	185
Forth	mm	69	112	39	79	222	222	142	55	39	119	50	80	65	214
	%	64	106	36	72	224	288	206	81	46	159	51	69	60	202
Tweed	mm	47	68	30	78	167	178	52	31	46	101	54	61	68	149
	%	51	77	29	87	180	258	90	51	61	149	61	54	73	169
Solway	mm	77	145	59	119	254	285	94	71	77	120	76	106	81	213
	%	51	101	41	79	181	306	103	81	84	133	69	82	54	148
Clyde	mm	120	244	73	107	316	341	295	127	58	134	96	149	173	298
	%	69	133	44	58	196	302	281	123	60	130	74	105	99	163

Note: October figures for England and Wales for 1990 are based upon MORECS figures supplied by the Meteorological Office
Scottish RPB data for October 1990 are estimated from the isohyetal map of September rainfall in the MORECS bulletin. The Scottish national value was provided by the London Weather Centre.

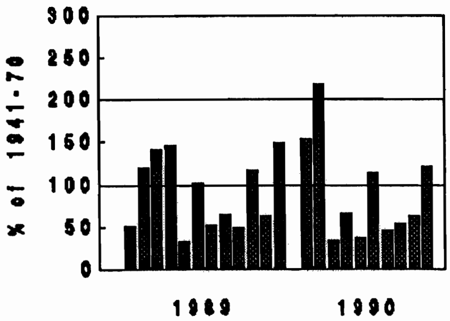
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		MAR - OCT 90	Est Return Period, years	JAN - OCT 90	Est Return Period, years	MAY 89 - OCT 90	Est Return Period, years	NOV 88 - OCT 90	Est Return Period, years
England and Wales	mm	394		669		1174		1580	
	% LTA	69	40-50	92	2-5	86	10	87	10-15
NRA REGIONS									
North West	mm	619		1009		1635		2269	
	% LTA	79	10	103	2-5	88	5-10	93	2-5
Northumbrian	mm	438		685		1055		1419	
	% LTA	78	10-15	97	2-5	79	30-40	81	30-50
Severn Trent	mm	333		549		1017		1347	
	% LTA	66	40-50	88	2-5	87	5-10	87	10
Yorkshire	mm	386		616		1028		1383	
	% LTA	73	15-25	92	2-5	82	15-20	83	15-25
Anglia	mm	248		375		726		973	
	% LTA	62	90-110	76	15-20	78	40-50	80	40-60
Thames	mm	243		449		854		1138	
	% LTA	53	180-200	79	10	80	15-20	81	15-25
Southern	mm	302		559		970		1277	
	% LTA	62	40-60	90	2-5	82	10-20	80	30-40
Wessex	mm	333		615		1121		1480	
	% LTA	62	40-60	90	2-5	86	5-10	85	5-10
South West	mm	514		947		1643		2182	
	% LTA	73	15-20	102	2-5	94	2-5	91	5
Welsh	mm	556		1011		1792		2435	
	% LTA	68	30-40	97	2-5	91	2-5	91	5-10
Scotland	mm	1073		1671		2419		3363	
	% LTA	120	10-20	143	>>200	113	10-20	117	60-80
RIVER PURIFICATION BOARDS									
Highland	mm	1462		2120		3129		4441	
	% LTA	138	150-200	156	>>200	123	100-120	129	>>200
North-East	mm	656		913		1363		1782	
	% LTA	100	<2	112	5	88	10	87	10-15
Tay	mm	810		1336		1962		2711	
	% LTA	102	2-5	133	60-80	104	2-5	108	5
Forth	mm	764		1208		1778		2422	
	% LTA	106	2-5	134	100-150	104	2-5	108	5
Tweed	mm	562		907		1360		1807	
	% LTA	87	2-5	112	5	89	5-10	90	5-10
Solway	mm	838		1377		2101		2901	
	% LTA	94	2-5	122	15-20	98	2-5	102	2-5
Clyde	mm	1330		1987		2982		4093	
	% LTA	128	40-50	151	>>200	120	30-40	123	>200

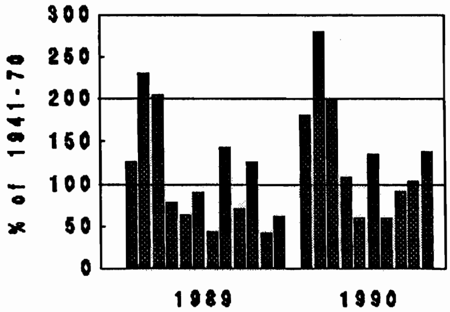
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

* Tabony, R C, 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

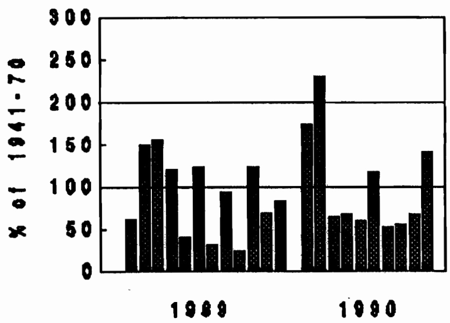
FIGURE 1. MONTHLY RAINFALL FOR 1989-1990 AS A PERCENTAGE OF THE 1941-1970 AVERAGE FOR ENGLAND AND WALES, SCOTLAND, AND THE NRA REGIONS



England and Wales



Scotland



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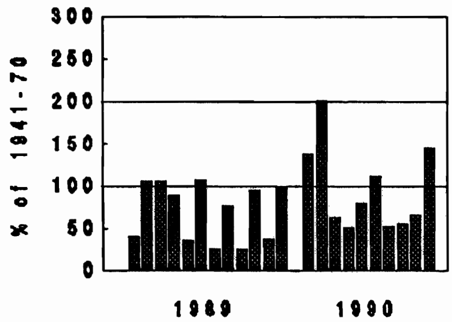

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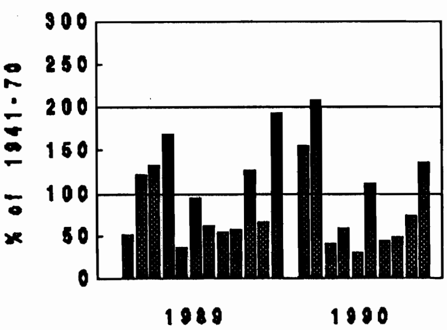
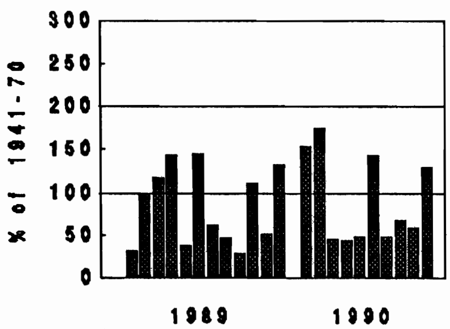
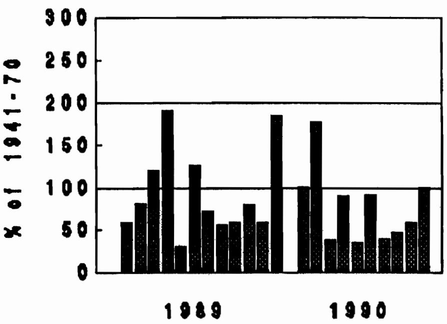


Severn-Trent NRA Region

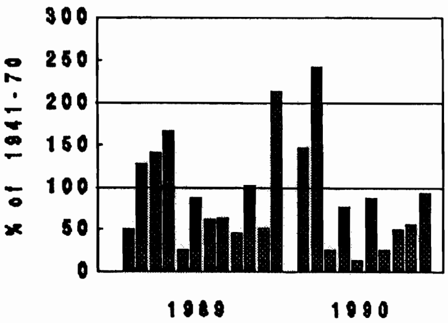


Yorkshire NRA Region

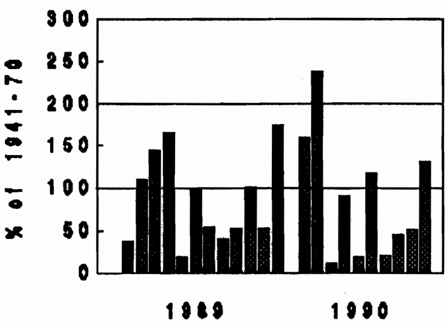
FIGURE 1 (continued)



Anglian NRA Region



Thames NRA Region



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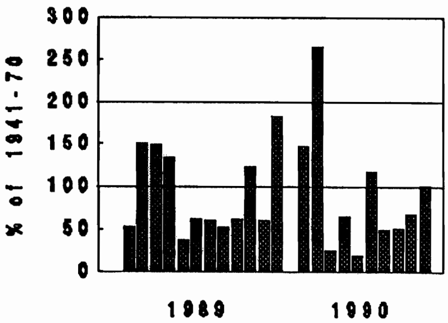
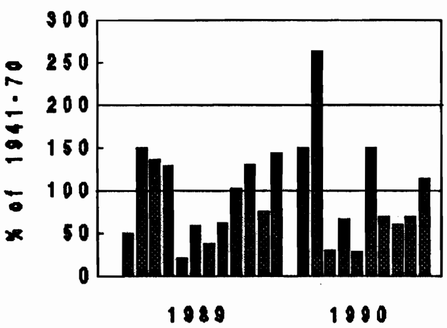
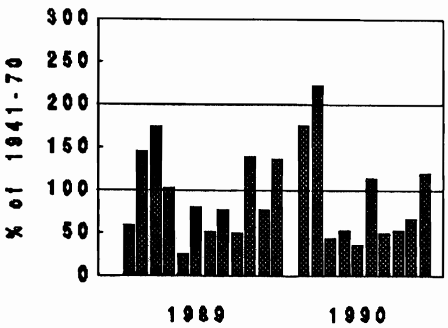


Wessex NRA Region

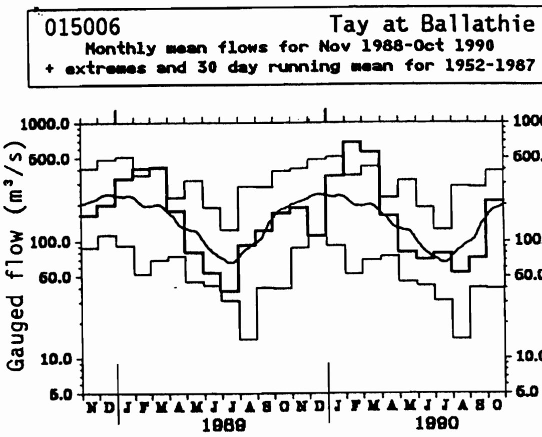


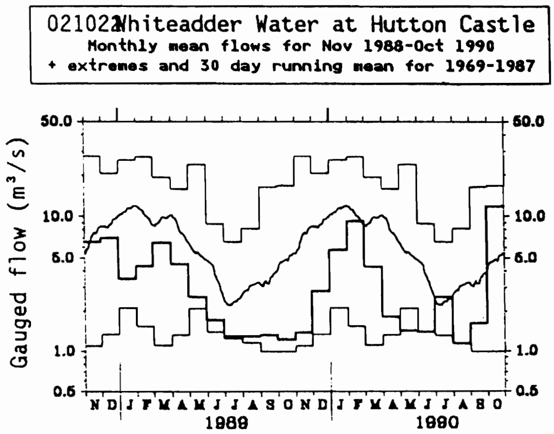
South West NRA Region

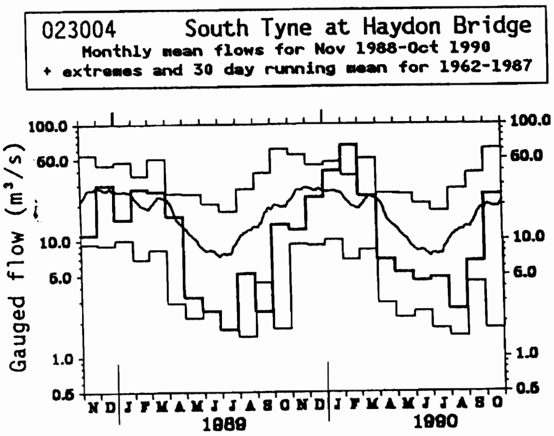


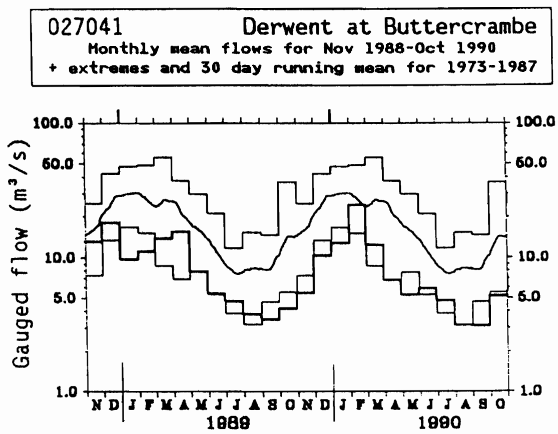
Welsh NRA Region

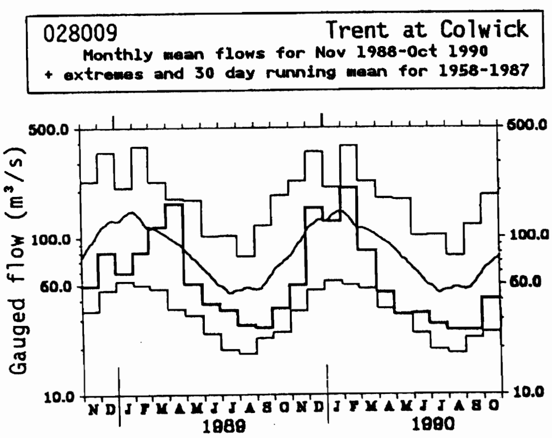
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

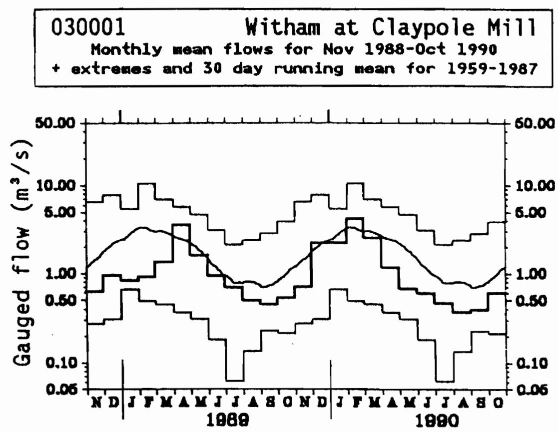


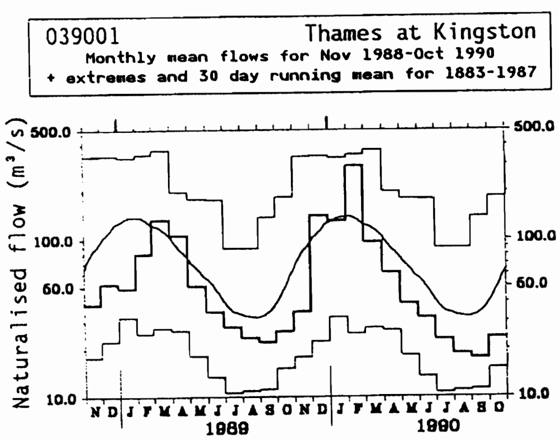


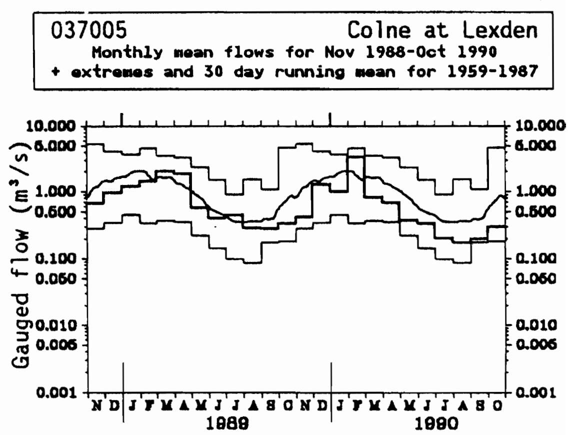




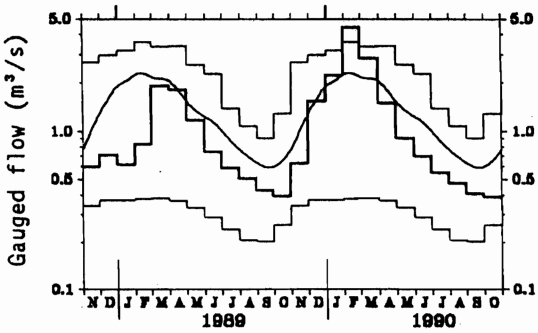




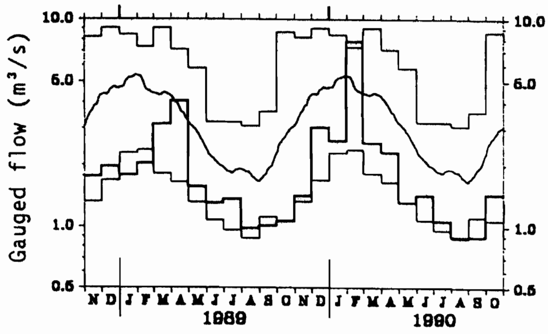




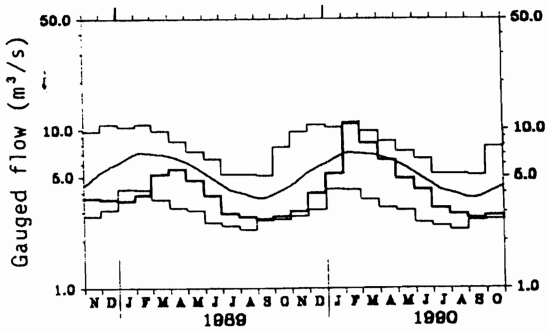
039020 Coln at Bibury
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1963-1987



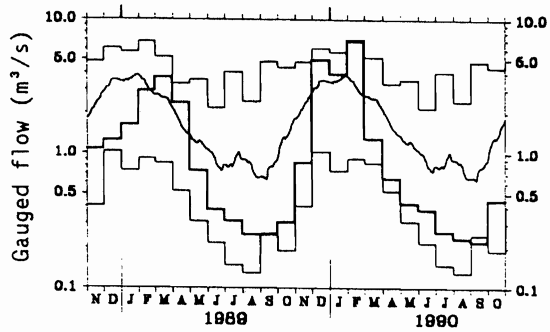
040011 Great Stour at Horton
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1964-1987



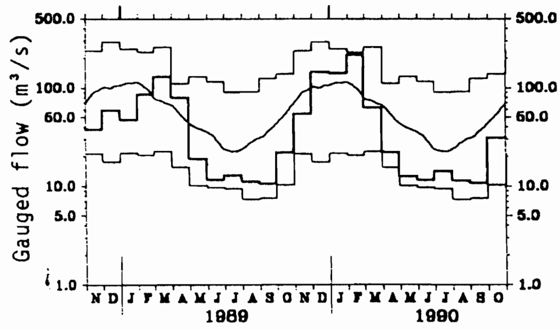
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1958-1987



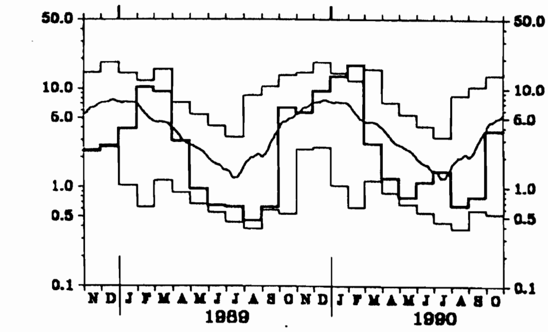
052010 Brue at Lovington
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1964-1987



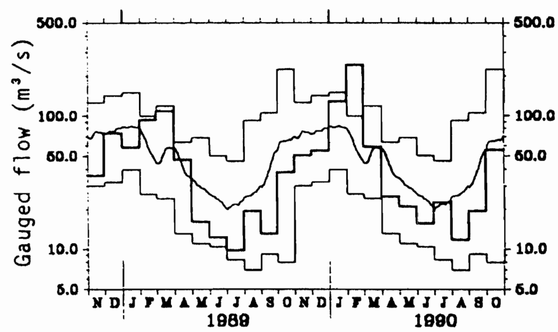
054001 Severn at Bewdley
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1921-1987



057004 Cynon at Abercynon
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1957-1987



076007 Eden at Sheepmount
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1967-1987



084013 Clyde at Daldowie
Monthly mean flows for Nov 1988-Oct 1990
+ extremes and 30 day running mean for 1963-1987

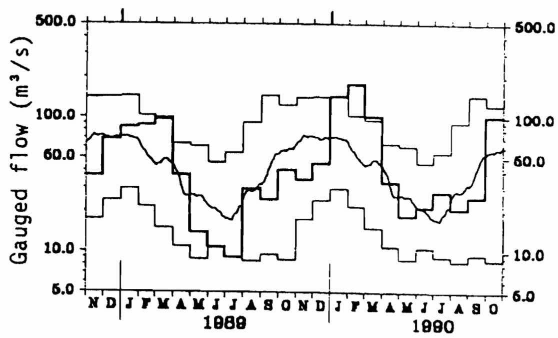


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

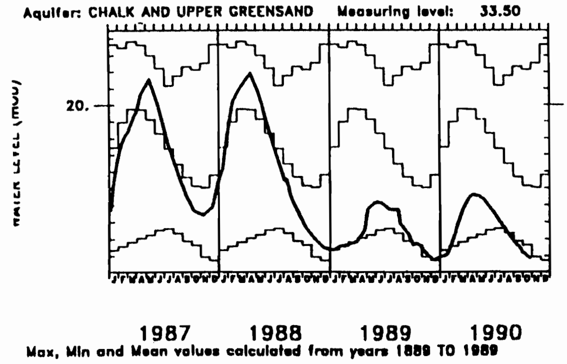
River/ Station name	May 1990	Jun	Jul	Aug	Sep	Oct 1990		4/90 to 10/90		1/90 to 10/90		11/89 to 10/90		11/88 to 10/90	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at	24	28	37	18	23	78	13	242	4	589	7	669	4	1242	2
Park	37	75	134	55	54	97	/18	67	/18	96	/18	86	/18	78	/17
Tay at	47	40	46	31	41	124	27	420	11	1301	38	1471	38	2744	37
Ballathie	67	89	116	60	58	111	/39	89	/38	152	/38	132	/38	123	/37
Whiteadder Water at	8	7	14	6	8	62	20	114	7	212	4	234	3	450	3
Hutton Castle	28	39	109	37	50	235	/22	74	/21	68	/21	59	/21	57	/20
South Tyne as	19	16	17	9	23	88	23	195	3	628	20	754	13	1289	4
Haydon Bridge	52	58	58	22	44	127	/29	63	/27	112	/27	100	/27	85	/25
Derwent at	9	10	8	5	5	9	2	57	1	137	2	163	1	345	1
Buttercrambe	35	59	60	36	38	39	/18	42	/17	51	/17	49	/17	51	/16
Trent at	11	11	10	9	9	14	12	81	1	222	5	294	5	560	2
Colwick	43	57	62	53	53	59	/33	54	/32	78	/32	82	/32	78	/31
Dove at	15	15	13	10	11	22	9	110	3	296	3	383	2	771	3
Marston on Dove	42	57	57	43	45	66	/30	53	/28	77	/28	77	/28	77	/26
Lud at	11	11	9	8	8	8	7	69	3	123	4	139	3	290	2
Louth	39	53	54	58	70	65	/23	53	/22	53	/22	52	/22	54	/21
Bedford Ouse at	6	5	4	3	3	8	40	38	15	164	27	224	30	416	23
Bedford	45	61	67	58	60	79	/58	56	/58	97	/58	103	/57	95	/56
Colne at	4	4	2	2	2	3	10	25	4	80	5	99	5	213	6
Lexden	45	73	47	49	47	35	/32	52	/31	74	/31	72	/31	77	/30
Mimram at	10	8	7	6	5	5	4	53	5	93	11	109	11	215	6
Panshanger Park	81	73	72	67	62	60	/38	75	/38	87	/38	86	/37	85	/36
Thames at	10	8	6	5	5	6	15	56	16	188	50	235	48	404	28
Kingston (natr.)	57	63	63	57	56	45	/108	61	/108	97	/108	96	/107	82	/106
Blackwater at	14	12	10	9	9	12	16	86	10	231	23	288	23	511	16
Swallowfield	72	81	87	78	68	61	/39	76	/38	111	/38	110	/38	97	/37
Coln at	23	17	14	12	10	10	2	121	4	348	15	402	11	656	6
Bibury	69	63	66	71	70	61	/28	71	/27	105	/27	102	/27	83	/26
Great Stour at	10	11	8	7	7	11	8	71	1	166	4	200	4	367	1
Horton	46	70	56	51	50	53	/27	56	/24	70	/24	67	/23	61	/21
Itchen at	36	30	23	21	20	21	4	198	5	372	10	423	8	753	2
Highbridge+Allbrook	84	86	75	74	76	69	/33	83	/32	96	/32	91	/32	81	/31
Stour at	15	10	6	5	4	8	3	71	2	340	14	430	10	677	4
Throop Mill	63	63	53	47	33	37	/18	56	/18	113	/18	108	/17	85	/16
Exe at	13	11	20	10	10	44	15	127	1	529	8	742	11	1293	3
Thorverton	34	46	97	35	25	58	/35	46	/34	88	/34	90	/34	78	/33
Brue at	8	7	5	5	4	9	10	51	1	278	8	393	7	685	2
Lovington	34	46	30	32	26	32	/27	36	/26	86	/26	90	/26	78	/25
Severn at	8	7	9	7	6	19	24	70	1	316	28	437	30	755	10
Bewdley	33	40	63	40	27	56	/70	44	/70	94	/69	97	/69	83	/68
Teme at	12	10	9	7	7	9	8	71	3	316	13	432	19	640	4
Knightsford Bridge	56	70	109	80	83	44	/21	62	/21	110	/20	115	/20	86	/19
Wye at	26	68	105	88	121	252	28	747	7	1560	21	2020	14	3789	6
Cefn Brwyn	27	80	96	61	73	121	/38	81	/34	103	/33	99	/33	92	/28
Cynon at	20	28	37	16	19	94	16	244	4	1038	22	1415	20	2415	14
Abercynon	33	69	109	32	28	77	/33	54	/31	116	/31	115	/31	98	/29
Dee at	23	50	59	36	66	222	14	530	4	1353	12	1749	10	3219	6
New Inn	33	85	87	38	48	111	/22	72	/21	102	/21	96	/21	88	/20
Lune at	28	15	68	12	36	142	20	343	6	985	22	1174	15	2156	10
Caton	56	37	132	17	41	116	/28	70	/28	117	/28	104	/26	95	/24
Eden at	24	17	26	14	22	65	10	197	5	668	19	789	14	1387	9
Sheepmount	73	66	95	45	50	87	/21	73	/20	129	/20	116	/19	103	/17
Clyde at	26	29	39	29	35	143	27	345	20	913	27	1023	27	1765	24
Daldowie	74	110	146	71	60	177	/28	111	/27	161	/27	135	/27	117	/26

Notes (i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1;
(iii) %LT means percentage of long term average from the start of the record to 1989. For the long periods (at the right of this table), the end date for the long term is 1990.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

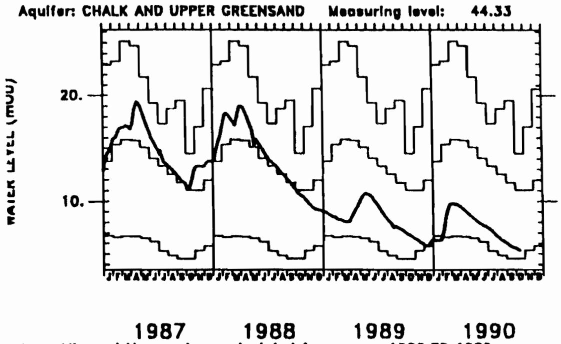
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

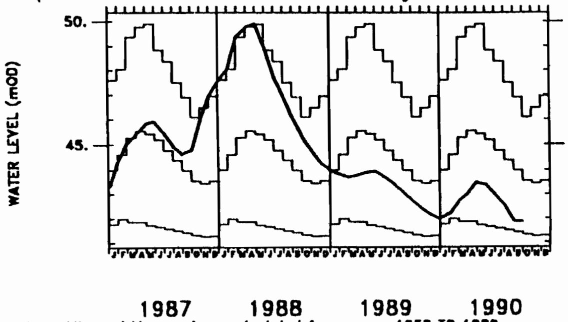
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 44.33



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

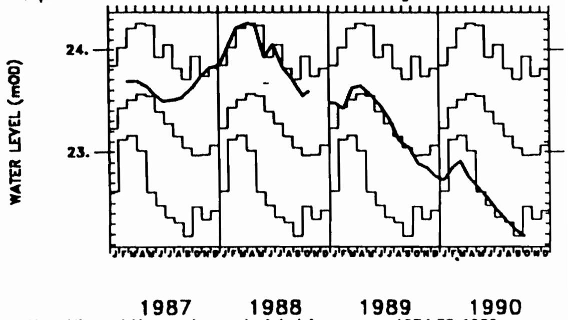
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: FAIRFIELDS

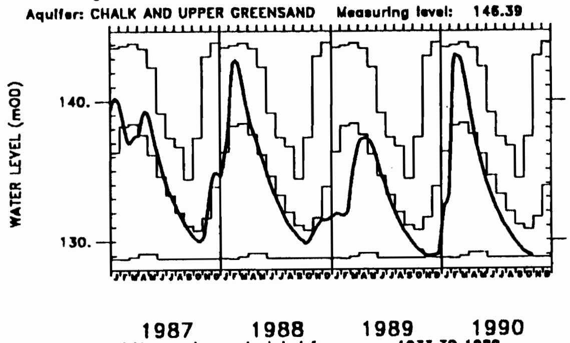
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



Max, Min and Mean values calculated from years 1974 TO 1989

Site name: ROCKLEY

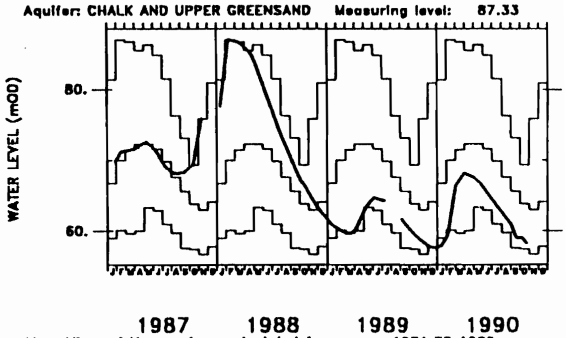
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

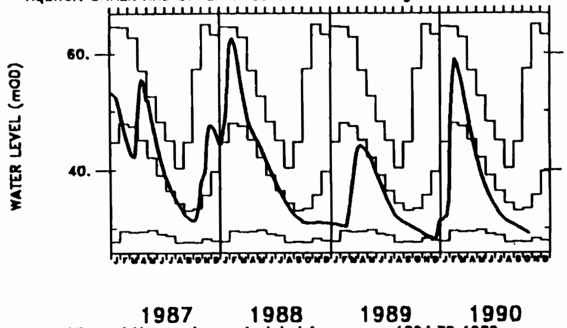
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

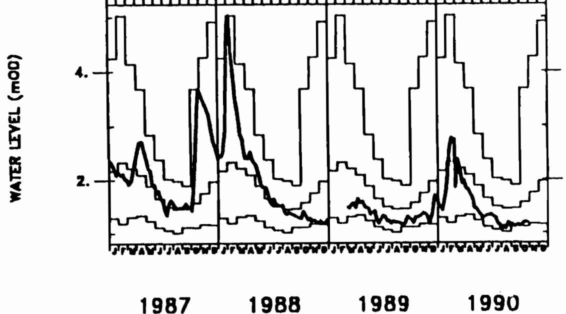
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST DEAN NO.3

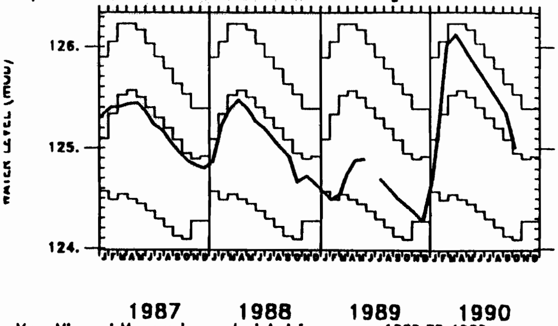
National grid reference: TV 5290 9920 Well number: TV59/7C
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 12.88



Max, Min and Mean values calculated from years 1940 TO 1989

Site name: LIME KILN WAY

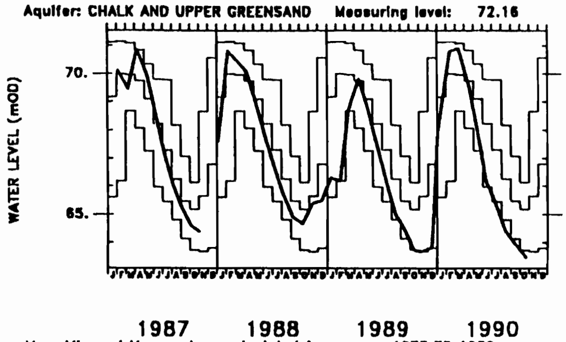
National grid reference: ST 3763 0667 Well number: ST30/7
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 130.19



Max, Min and Mean values calculated from years 1969 TO 1989

Site name: ASHTON FARM

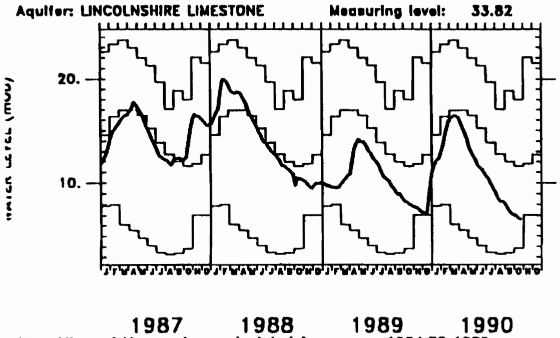
National grid reference: SY 6620 8810 Well number: SY68/34
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 72.16



Max, Min and Mean values calculated from years 1977 TO 1989

Site name: NEW RED LION

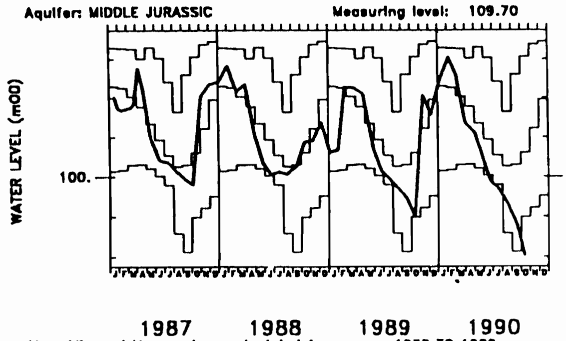
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

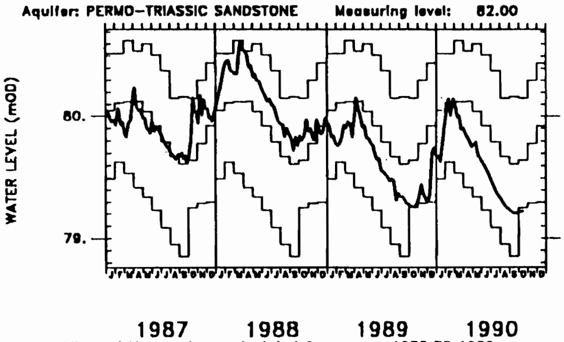
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.70



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

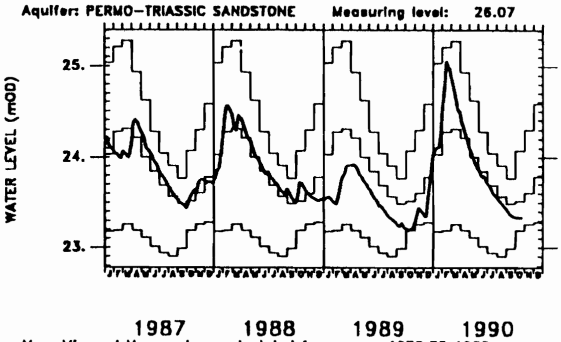
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 82.00



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: BUSSELS NO.7A

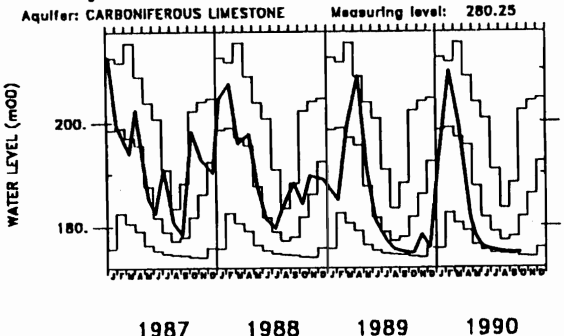
National grid reference: SX 9528 9872 Well number: SX99/379
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.07



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 4 A COMPARISON OF OCTOBER GROUNDWATER LEVELS: 1990 AND 1976

Borehole	Aquifer	First year of record	Av. Oct level	Oct 1976		Oct 1990		No. of years of record with Oct levels <1990
				Day	level	Day	level	
Dalton Holme	C & U.G.	1889	15.12	30	12.62	28	10.86	0
L. Brocklesby	"	1926	11.04	29	4.82	16	5.32	1
Washpit Farm	"	1950	43.54	01	41.50	01	41.83	2
Rockley	"	1933	130.72	-	Dry	-	Dry	4
Compton House	"	1894	33.47	21	28.05	23	29.10	3
L. Bucket Farm	"	1971	63.74	-	57.2E	25	58.29	1
West Dean	"	1940	1.58	22	1.70	26	1.20	4
Limekiln Way	"	1969	124.95	15	124.14	11	125.01	11
Fairfields	"	1974	22.97	29	22.56	09	22.18	0
Ashton Farm	"	1977	65.21	19	64.79	22	63.48	0
Ampney Crucis	M.J.	1958	100.61	22	100.79	15	98.02	0
New Red Lion	L.L.	1964	11.58	29	5.79	22	6.60	1
Llanfair D.C.	PTS	1972	79.64	01	79.28	15	79.22	0
Bussels 7A	"	1972	23.51	26	24.07	23	23.33	6
Alstonfield	C.B.	1974	181.72	21	185.26	08	174.97	5

C & U.G.	Chalk and Upper Greensand;
L.L.	Lincolnshire Limestone
PTS	Permo-Triassic Sandstones
M.J.	Middle Jurassic Limestone
C.B.	Carboniferous Limestone

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS