PATTERNS OF DEMAND FOR WATER IN ENGLAND AND WALES: 1989-1999

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PURPOSE OF THIS PAPER

This report is an update of Ofwat's 1994 publication *Future levels of demand and supply for water* and the 1996 *Report on recent patterns of demand for water in England and Wales*. These focused on expected trends in demand from 1992-93 levels. This paper provides an analysis of patterns of actual demand for water in England and Wales between 1992-93 and 1999-2000. In particular this paper examines:

- how demand has evolved since 1992-93 including comparisons with the high peak demands in the hot, dry summer of 1995;
- companies' average weekly distribution input data regarding water put into supply since privatisation; and
- how trends in distribution input vary across different regions in England and Wales and possible reasons that lie behind such variations.

This paper goes on to discuss the impact of Ofwat's and companies' policies on the levels of water put into supply over the past five years.

OVERVIEW

The main points that can be drawn are:

- Reductions in leakage since 1994 have had a direct effect on distribution input, which has fallen by almost 10% (1500 Ml/d) for the industry.
- Water delivered, as a whole, has also fallen, particularly to non-households. Water delivered to households has risen, but at less than half the rate originally forecast by companies in their 1994 Strategic Business Plans (SBPs).
- At the industry level, while estimates of per capita consumption have increased since 1992-93, they have remained relatively stable since 1995-96. However, on average, demand per household in 1999-2000 appears to be no higher than in 1992-93.
- Climate has a clear effect on annual demand and demand patterns during the year. Most companies experienced record levels of peak demand during the hot, dry summer of 1995, with the highest peaks matching the most severe weather conditions.
- There is considerable evidence that selective metering can significantly reduce household peak demands.
- Leakage reductions, more widespread metering and security of supply investment, mean that companies are currently much better positioned to cope with dry years than in either 1989 or 1995.

RECENT TRENDS IN INDUSTRY DEMAND

As part of their 1994 Strategic Business Plans submitted in March 1994, all water (and sewerage) companies were required to provide estimates of the quantities of water that would be required to be supplied during the period over which the Director set price limits and beyond.

Table 1 below sets out the industry level components of demand, as forecast by the water companies in their SBPs which were submitted to Ofwat in March 1994.

Table 1: Changes in components of demand forecast in 1994 SBPs

Component	Forecast 1994-95	Forecast 1999-00	Forecast Change 1994-95 to 1999-00 (Ml/d)	%'age Change 1994-95 to 1999-00
Water delivered to households	7,858	8,111	253	3.2%
Water delivered to non-households	4,069	3,874	-195	-4.8%
Distribution losses	3,454	3,107	-348	-10.1%
Distribution Input	15,517	15,225	-292	-1.9%

As set out in Table 1, the 1994 forecasts predicted only a small fall in distribution input in the period 1994-95 to 1999-00. At the industry level, companies projected falls in both the level of water delivered to non-households and distribution losses. However, companies predicted that these reductions would be off-set to some extent by an increase in the level of water delivered to households.

Table 2 below shows the actual movement in demand at the water industry level, as submitted in the companies' annual July Returns.

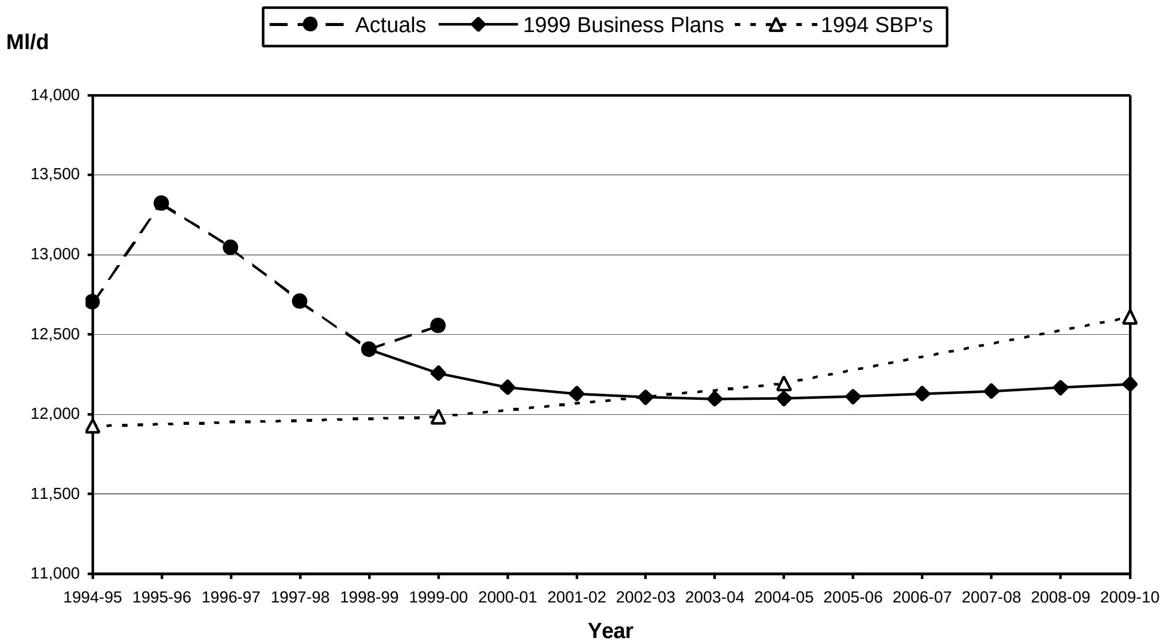
Table 2: Changes in components of demand reported in July Returns

Component	Actual 1994-95	Actual 1999-00	Actual Change 1994-95 to 1999-00 (Ml/d)	%'age Change 1994-95 to 1999-00
Water delivered to households	8,313	8,431	118	1.4%
Water delivered to non-households	4,217	3,939	-279	-6.6%
Distribution losses	3,866	2,431	-1,435	-37.1%
Distribution Input	16,590	15,058	-1,532	-9.2%

Table 2 shows that actual 1994-95 levels of demand and leakage were significantly higher than predicted by the companies at the beginning of that year (Table 1). This difference is partly accounted for by inaccuracies in companies' 1994 estimates of unmeasured supply pipe leakage. For example Thames Water's SBP forecast 1994-95 unmeasured household supply pipe leakage at 96 Ml/d, which compared to a reported actual figure for that year of 266 Ml/d.

Secondly, from 1994-95, distribution input actually fell by over 9% by 1999-00 compared to the 2% reduction that had been expected in companies' SBPs. The main driver behind this fall in demand is the reduction in the levels of leakage experienced by water companies, with distribution losses falling by over 37% in the period 1994-95 to 1999-00. Both household and non-household demand also recorded less growth than companies had originally expected in their 1994 SBPs.

Fig 1: Total water delivered to customers



In April 1999, all companies submitted a new Business Plan, which contained their latest projections of the quantities of water that would be required to be supplied over the next ten years.

Figure 1 demonstrates the extent to which companies' expectations about demand have changed since 1994. Instead of an inexorable increase in consumption, the industry is expecting a fairly flat path, showing only a modest increase after 2005. However, it should be noted that the 1999-00 actual figure for total water delivered, as reported in the 2000 June Returns, shows an unexpected increase compared to the previous year's figure. This is largely attributable to Thames Water's recalculation of their water balance in 1999-00, which led to the company revising upwards its estimate of water delivered to households, compared to the previous year.

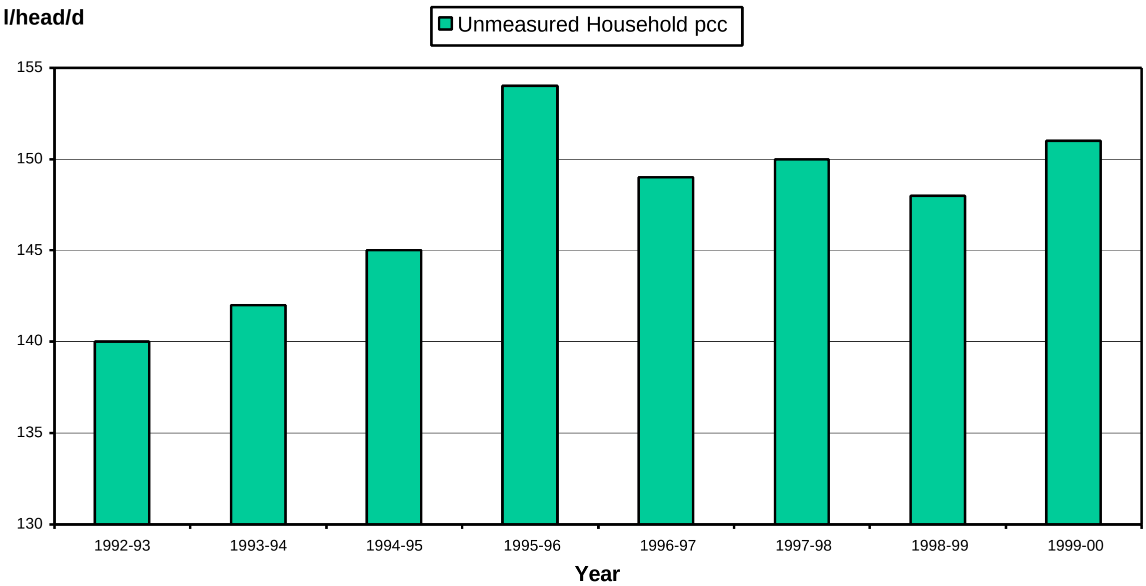
TRENDS IN PER CAPITA AND HOUSEHOLD DEMAND

Per capita demand

As part of the Department of the Environment's 1996 report entitled *Climate Change and the Demand for Water*, Paul Herrington made a number of projections for per capita consumption (pcc) growth between 1991 and 2021. In the 1999 Business Plans, many companies continued to forecast year on year increases in future levels of pcc, both for measured and unmeasured households. The companies also argued that trends towards smaller household occupancy size would tend to increase per capita consumption.

Figure 2 below shows estimated average unmeasured household consumption for the industry as a whole from 1992-93 to 1999-00[1].

Fig 2: Average Industry unmeasured household consumption



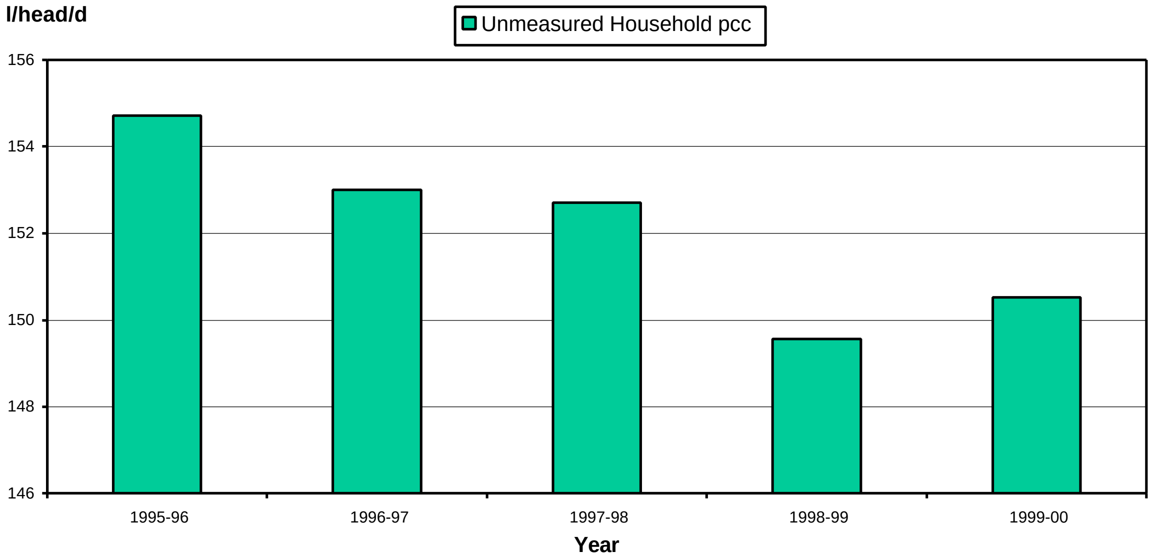
The graph shows that, on average, unmeasured household pcc rose to a peak in 1995-96, and has since remained at a fairly stable level below this peak at 150 l/head/day.

Anglian Water has had in place for a number of years a detailed household consumption monitor upon which the company bases its estimates of unmeasured household pcc. Figure 3 below illustrates the results of this monitor from 1995-96 to 1999-00. It shows that, for Anglian Water, unmeasured household pcc has fallen fairly steadily since 1995-96.

[1] Data taken from *1999-00 Report on leakage and water efficiency*, Office of Water Services, September 2000

Accordingly, the evidence from both the industry generally and the example of Anglian Water suggests that over the last 5 years unmeasured household pcc has not risen. Furthermore, the pattern for the last 5 years does not support the general assumptions being made by companies, that unmeasured household pcc will continue to increase year on year.

Fig 3: Anglian unmeasured household per capita consumption



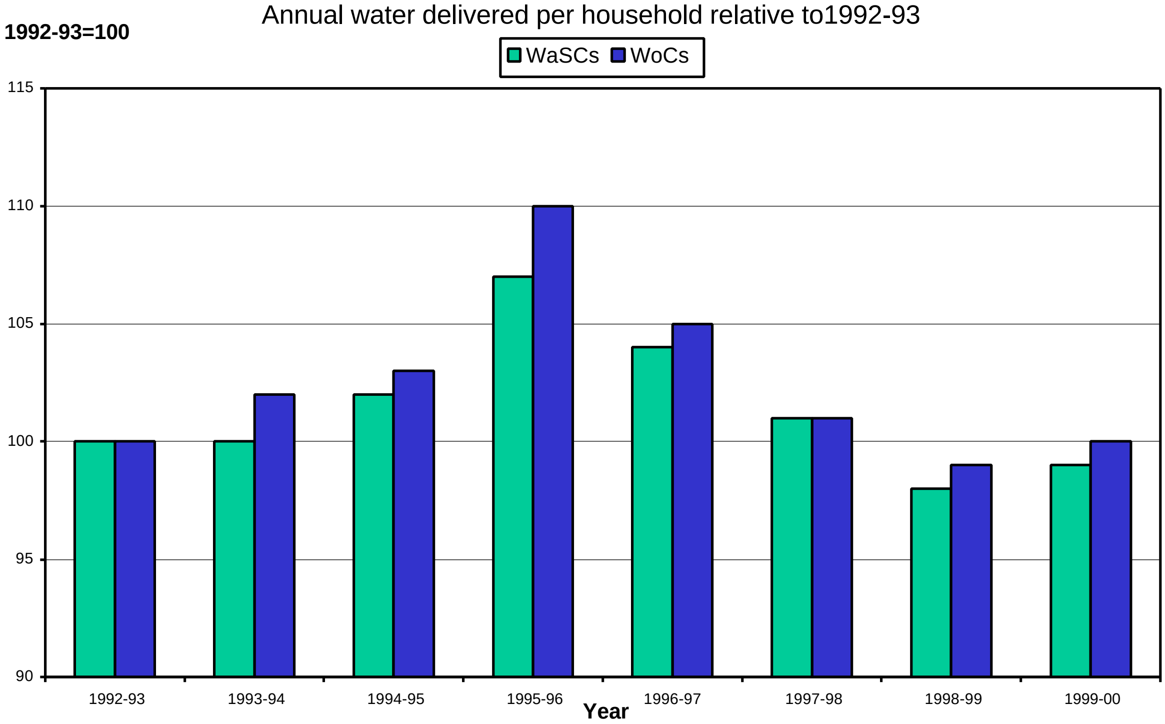
Per household demand

Water companies collect revenue on a per household basis rather than from individuals. From the point of view of meeting any costs of growth in demand, therefore, trends in demand per household are important.

Figure 4 below shows the trend in water delivered per household (both measured and unmeasured) from 1992-93 to 1999-00. It shows water and sewerage companies and water only companies separately using the 1992-93 figure as a baseline. Unlike the pcc measure, water delivered to households includes estimated supply pipe leakage.

The graph shows that water delivered per household increased from 1992-93 to a peak in 1995-96 for both water and sewerage companies and water only companies. However, since the dry year of 1995-96, water delivered per household has actually steadily fallen. Indeed, the 1998-99 level is below that recorded in 1992-93. Furthermore, a number of companies have stated that household demand in 1998-99 was less than they had expected because weather conditions that year were wetter than average. A minor increase in water delivered per household in 1999-00 is attributed to the fact that this year could be regarded as experiencing more 'normal' weather patterns compared to the relatively 'wet year' of 1998-99.

Fig 4: Water delivered per household 1992-93 to 1999-00



Note: The 1992-93 level of water delivered per household is 402 l/prop/d for the WaSCs and 437 l/prop/d for the WoCs.

Demand at the household level will be affected, to an extent, by any reductions in consumption resulting from the customer switching to a metered supply. Also, an element of the fall in water delivered per household is due to companies' efforts to reduce supply pipe leakage[2]. Figure 4, therefore, may not be reflective of any underlying growth in consumption in the same way as Herrington's work. However, it does demonstrate that a targeted metering policy, along with reductions in supply pipe leakage, may contribute to household demand management. The issue of the impact of metering on demand is considered later in this report.

Conclusions

Overall, there is some evidence of an upward trend in unmeasured per capita consumption since 1992-93 although the data in years before 1995-96 is less reliable. However, trends to smaller household occupancy size, meter switching and reductions in supply pipe leakage have meant that this increase has not been translated into an increase in total demand per household. Continuing use of more water efficient "white goods" and selective metering of garden sprinkler users should serve to prevent increases in unmeasured demand.

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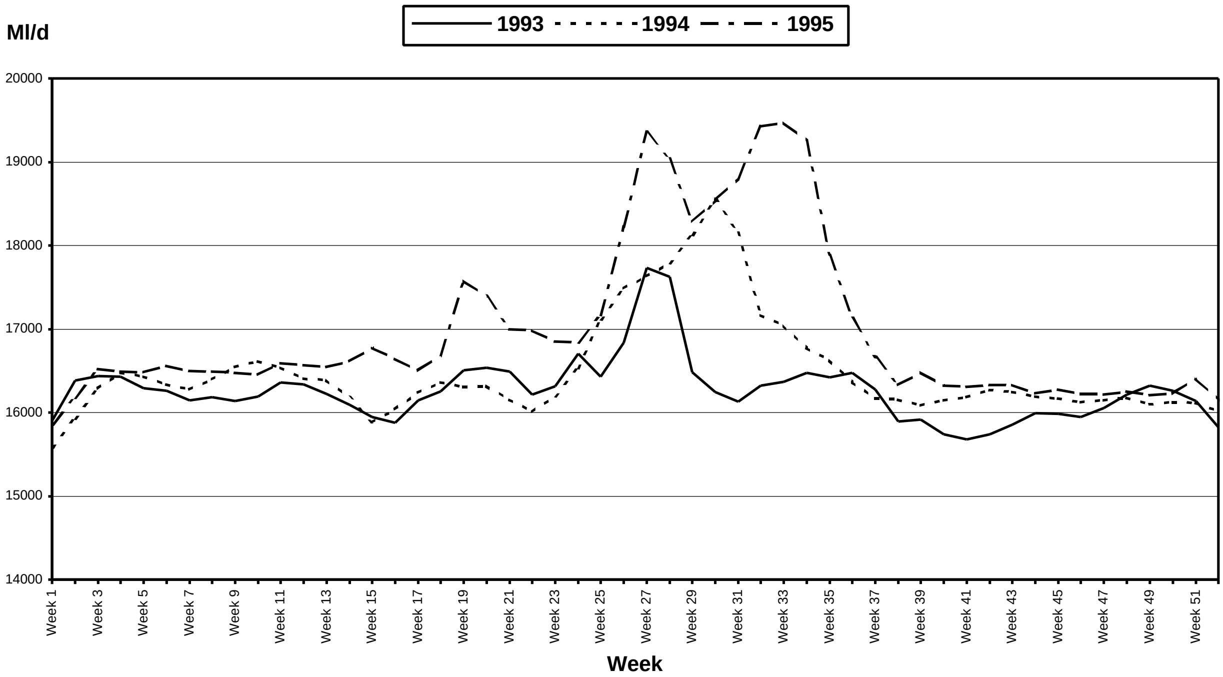
[2] 1999-00 *Report on leakage and water efficiency*, Office of Water Services, September 2000.

PATTERNS OF DEMAND SINCE 1992-93

The weekly demand for water in England and Wales between 1993 and 1995, as measured by distribution input, is shown in Figure 5 below.

Fig 5: 1993 to 1995 Distribution input in England and Wales

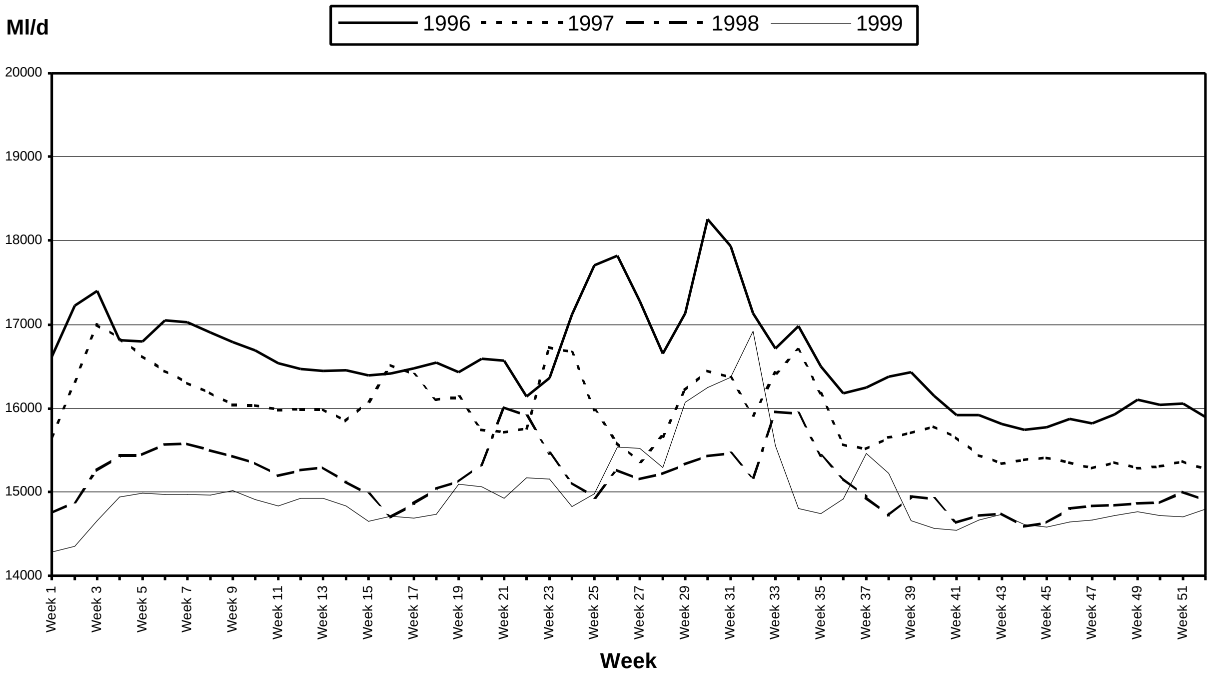


As set out in Figure 5, peak demand in 1994 for England and Wales was much higher than in 1993. However, peak demand in the hot, dry summer of 1995 was greater still and lasted for a longer period of time than in both the previous two years.

The graph also shows that the base levels of demand crept up in the period 1993 to 1995. Changes in the base level of demand usually provide a good indicator as to changing patterns in the level of leakage, and it would therefore appear from Figure 5 that leakage was slightly higher in 1995 than in the previous two years.

Figure 6 shows the weekly demand for water in England and Wales, as measured by distribution input, between 1996 and 1999. The graph shows that in the four years after 1995, peak demand fell year on year, with 1998 experiencing the lowest level of peak demand. It should be noted however, that 1998 was considered by many companies to be a ‘wet year’, which may explain why the level of peak demand is slightly higher in 1999 which experienced more ‘normal’ weather patterns.

Fig 6: 1996 to 1999 Distribution input in England and Wales



The graph shows clearly that base levels of demand fell steadily in the years following 1995, indicating that substantial reductions in leakage levels were being achieved. It is interesting to note that the quantities of water put into supply at peak times during 1998 (approximately 16,000 Ml/d) were comparable to the quantities of winter base distribution input recorded in 1995. This gives some indication of the quantities of water that were leaking in 1995.

LEVELS OF PEAK DEMAND

The summer of 1995 is recognised as being significantly hotter and drier than the long term average[3], 1989 was also a dry year. In the 2000 June Returns, a number of companies reported that they considered the summer of 1999 to also have been hotter and drier then average. Therefore, it is worth making a comparison of the demand patterns seen in these three summers.

Tables 3 to 5 show the average weekly distribution input for both the peak summer period and the base winter period within a year for each company during 1989, 1995 and 1999.

Table 3: 1989 Peak period to base period ratio

Company	Peak Period Average[4] (Ml/d)	Base Period Average[5] (Ml/d)	Peak to Base Ratio
Anglian	1,271	1,174	1.08
Welsh	1,014	1,013	1.00
North West	2,473	2,474	1.00
Northumbrian	780	775	1.01
Severn Trent	2,074	2,013	1.03
South West	502	463	1.09
Southern	767	696	1.10
Thames	na	na	na
Wessex	450	403	1.12
Yorkshire	1,414	1,387	1.02
Bournemouth & West Hants	185	149	1.24
Bristol	342	310	1.10
Cambridge	82	77	1.07
Dee Valley	74	74	1.01
Essex & Suffolk	523	485	1.08
Folkestone	57	55	1.05
Mid Kent	164	154	1.07
North Surrey	140	131	1.07
Portsmouth	na	na	na
South East	412	374	1.10
South Staffs	364	354	1.03
Sutton & East Surrey[6]	71	65	1.09
Tendring Hundred	37	30	1.24
Three Valleys	755	735	1.03
York	47	46	1.02
Total	**13,998**	**13,437**	**1.04**

[3] *The 1995 drought – a water resources perspective,* T.J. Marsh and P.S. Turton
[4] Peak Period refers to weeks 26 to 35 of the year shown.
[5] Base Period refers to weeks 40 to 49 of the year shown.
[6] Data for Sutton area only.

In Tables 3, 4 and 5, the peak period refers to a 10-week period from mid-June to mid-August, which was chosen on the basis of trends in the distribution input data across the industry. The base period consists of 10 weeks from late-September to late-November rather than the winter months in order to avoid any distortions in the data that may be due to burst pipes caused by freezing conditions.

Table 4: 1995 Peak period to base period ratio

Company	Peak Period Average[7] (Ml/d)	Base Period Average[8] (Ml/d)	Peak to Base Ratio
Anglian	1,332	1,111	1.20
Welsh	1,165	1,087	1.07
North West	2,534	2,270	1.12
Northumbrian	828	782	1.06
Severn Trent	2,437	2,122	1.15
South West	570	477	1.20
Southern	773	600	1.29
Thames	3,098	2,753	1.13
Wessex	503	411	1.22
Yorkshire	1,521	1,377	1.10
Bournemouth & West Hants	216	156	1.39
Bristol	367	319	1.15
Cambridge	88	73	1.21
Dee Valley	82	74	1.11
Essex & Suffolk	585	479	1.22
Folkestone	60	50	1.19
Mid Kent	199	160	1.24
North Surrey	186	132	1.41
Portsmouth	231	170	1.35
South East	476	383	1.24
South Staffs	396	339	1.17
Sutton & East Surrey	213	146	1.46
Tendring Hundred	44	31	1.42
Three Valleys	837	688	1.22
York	56	46	1.22
Total	**18,797**	**16,236**	**1.16**

It should be noted that the total figures for 1989 in Table 3 do not include Thames, Portsmouth or East Surrey as the relevant data was not made available by these companies. If we remove the peak period and base period figures for these companies from the 1995 total in Table 4, it becomes clear that peak period average weekly distribution input in 1989 was lower than in 1995. This was true of all companies. There is a much more varied picture for average weekly distribution input for the base period in 1989 as compared to 1995 with the overall total approximately the same.

[7] Peak Period refers to weeks 26 to 35 of the year shown.
[8] Base Period refers to weeks 40 to 49 of the year shown.

1995 Totals excluding Thames, Portsmouth and East Surrey

Total	**15,342**	**13,228**	**1.16**

Tables 4 and 5 show that the average weekly distribution input for the peak period of 1995 was higher for all companies than in 1999. However, the same also applies to the base period average weekly distribution input. Only Portsmouth report a higher winter base figure in 1999 as compared to 1995.

Table 5: 1999 Peak period to base period ratio

Company	Peak Period Average[9] (Ml/d)	Base Period Average[10] (Ml/d)	Peak to Base Ratio
Anglian	1,167	1,076	1.08
Welsh	1,002	921	1.09
North West	2,029	1,936	1.05
Northumbrian	766	748	1.02
Severn Trent	1,956	1,862	1.05
South West	478	423	1.13
Southern	649	571	1.14
Thames	2,543	2,426	1.05
Wessex	413	368	1.12
Yorkshire	1,255	1,207	1.04
Bournemouth & West Hants	177	153	1.16
Bristol	315	284	1.11
Cambridge	72	68	1.06
Dee Valley	75	71	1.06
Essex & Suffolk	519	471	1.10
Folkestone	52	47	1.10
Mid Kent	176	156	1.13
North Surrey	152	126	1.20
Portsmouth	200	174	1.15
South East	383	343	1.12
South Staffs	349	326	1.07
Sutton & East Surrey	173	146	1.19
Tendring Hundred	34	28	1.21
Three Valleys	723	677	1.07
York	50	46	1.09
Total	**15,708**	**14,654**	**1.07**

Industry wide, as well as experiencing lower levels of peak distribution input, all companies except Welsh Water recorded much lower peak to base ratios in 1999 than in 1995. However, for a number of companies, the peak to base ratios in 1999 are broadly similar to those recorded during 1989.

[9] Peak Period refers to weeks 26 to 35 of the year shown.
[10] Base Period refers to weeks 40 to 49 of the year shown.

Conclusions

It can be concluded from the above analysis that the peak to base ratios experienced by water companies are highest under hot and dry weather conditions. On average, the highest peak to base demand ratios were recorded by companies in 1995. The next section considers the impact of weather conditions on demand in more detail.

FACTORS AFFECTING DEMAND

The impact of weather conditions on demand

As previously stated, the level of peak demand in 1995 was higher than that experienced in previous years and in any year since. The weather conditions of the summer of 1995 were the key factor in driving demand to such levels. To demonstrate this relationship we compare the weather conditions, in terms of rainfall and maximum temperature, recorded in Southampton[11], with the level of average weekly distribution input experienced by Southern Water for the years 1989, 1995, and 1999.

It should be noted that the distribution input is shown for the whole of the Southern Water region, while the Southampton climatic data is site specific. However, the Southampton data does provide a useful guide to the climatic conditions that prevailed generally for the South of England in those years.

Figures 7 and 8 show that the pattern of demand for Southern Water in 1989 roughly correlates to the maximum level of temperature experienced in Southampton for the same year. In addition, when rainfall in Southampton was at its lowest in 1989, Southern Water experienced its highest level of distribution input for that year. This point also marked the beginning of the summer peak distribution input period. Conversely, the level of demand for Southern in the later weeks of 1989 was at its lowest level for the year, at the same time as Southampton experienced its highest level of rainfall (around 160mm in December 1989).

[11] This information was taken from the Met. Office's web-site.

Fig 7: Southampton 1989 weather patterns

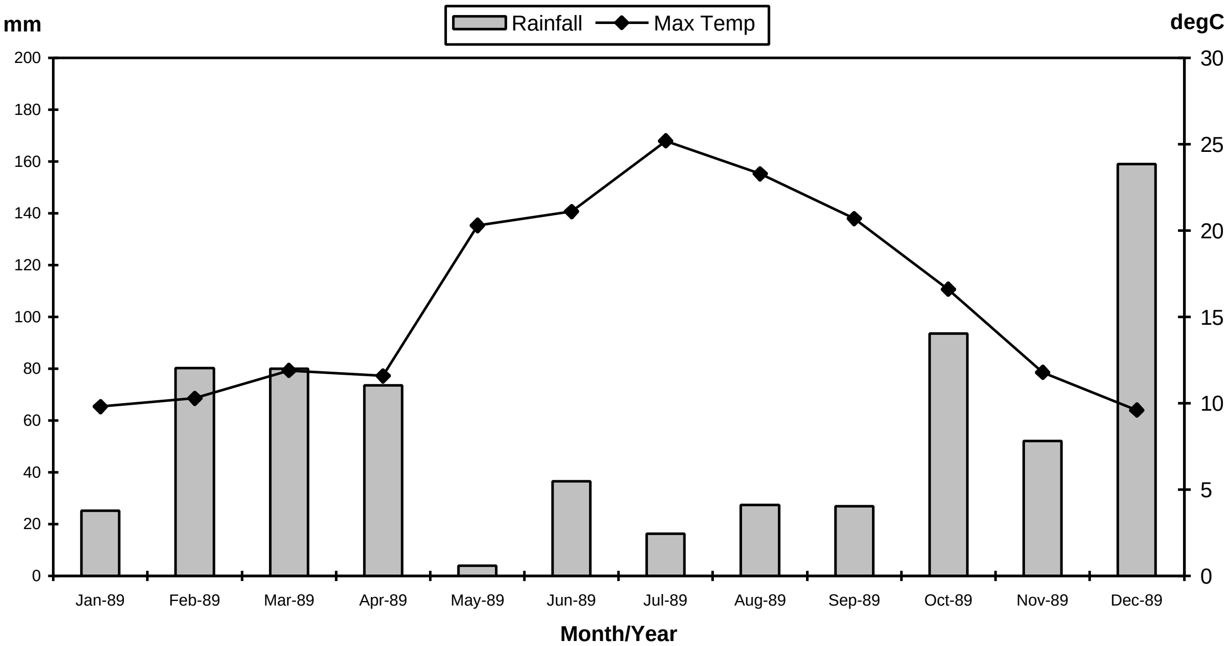
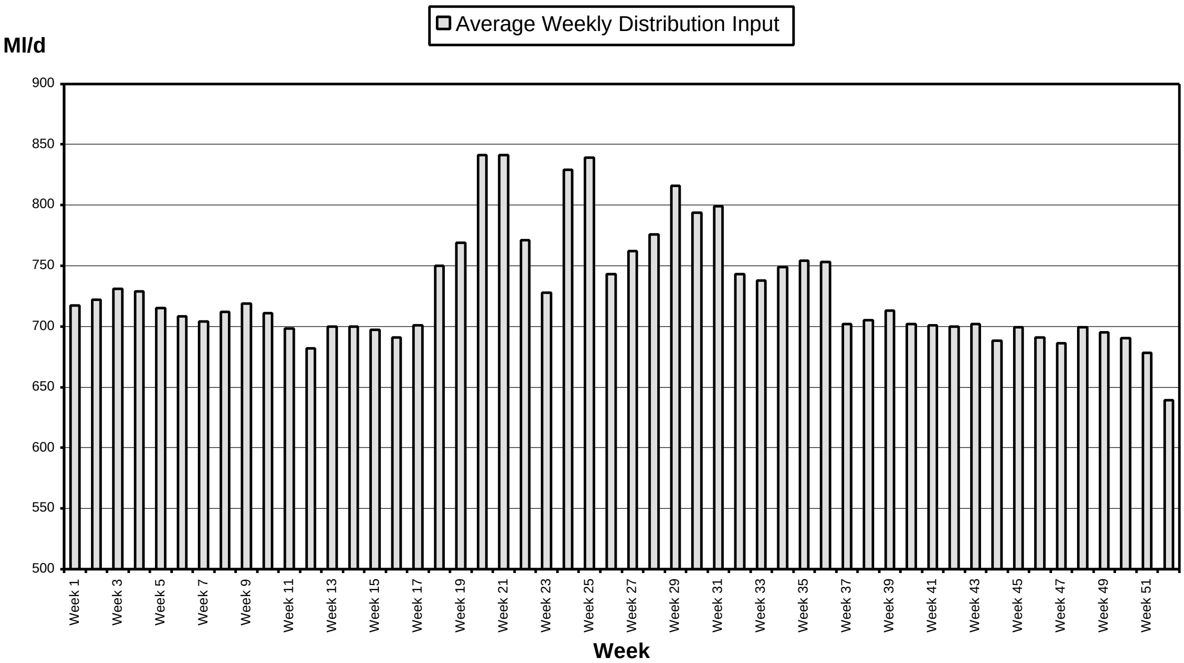


Fig 8: Southern Water 1989 distribution input



Figures 9 and 10 below show the temperature, rainfall and demand patterns for 1995.

Fig 9: Southampton 1995 weather patterns

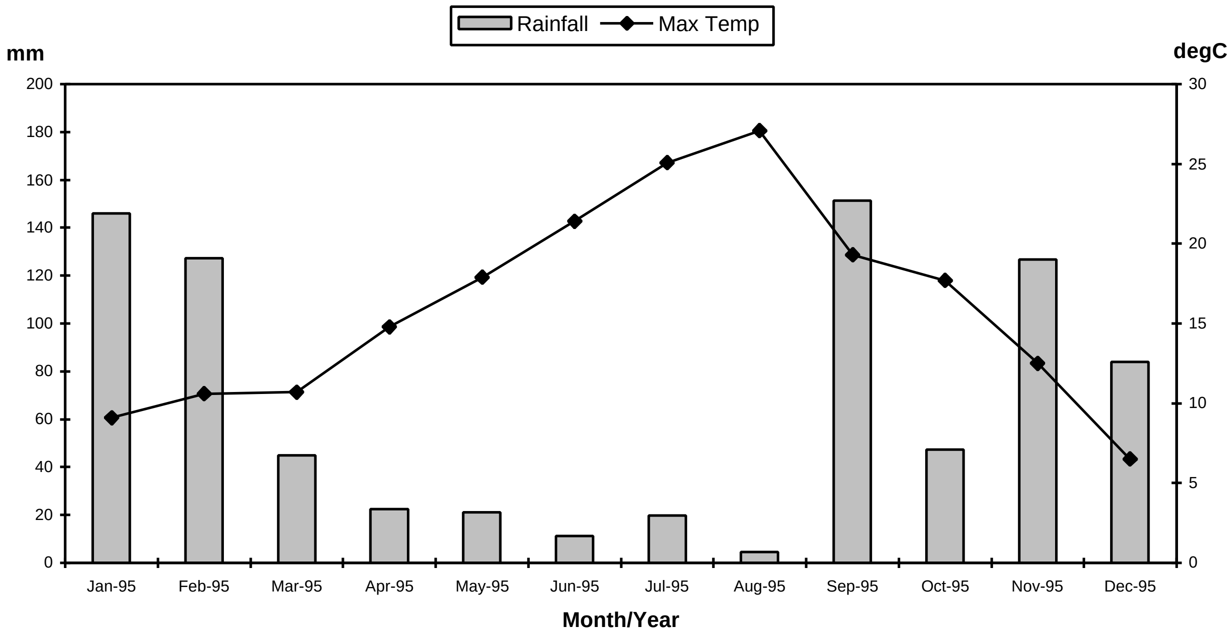
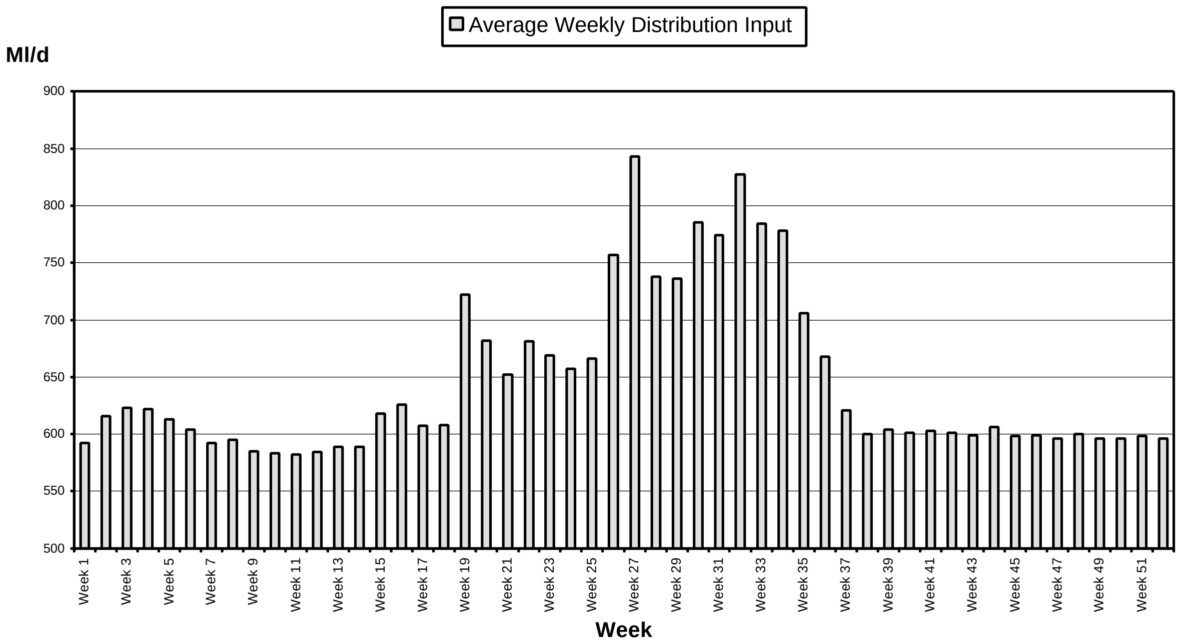


Fig 10: Southern Water 1995 distribution input



Comparing the weather patterns for Southampton in Figure 9 to that in Figure 7, shows that the spring and summer months of 1995 experienced a lower level of cumulative rainfall, compared to 1989. However, in 1989 the spring was characterised by a May period which had much lower rainfall and higher average maximum temperatures than in 1995. It was this May dry period that marked the beginning of the 1989 peak in distribution input.

Despite the apparently more severe weather conditions experienced during the spring and summer of 1995 compared to 1989, Figure 10 shows that the absolute peak quantities of water into supply in the Southern Water area were no higher than those which occurred in 1989. However, when comparing demand patterns for Southern Water in Figure 8 to those shown in Figure 10, it can quite clearly be seen that the base levels of demand in 1995 were much lower (around 600 Ml/d) than those in 1989 (around 700 Ml/d). This indicates that leakage levels were lower for the company in 1995 than in 1989. Therefore, although peak demand in 1995 was comparable to that in 1989, it actually had a lower base level from which to increase, hence a peak to base ratio of 1.29 in 1995 compared to 1.10 in 1989. The pressures on meeting peak demand in the summer of 1995, therefore, were greater than those experienced in 1989.

Figures 11 and 12 show the weather and demand patterns for 1999 respectively. It should be noted that weather data is currently only available for Southampton up to and including September 1999.

As shown in Figure 11, the summer months of June and August were far wetter in 1999 than the same months in 1989 and 1995. Indeed, despite the fact that the maximum temperature levels follow a similar pattern in the summers of 1989 and 1999, it can quite clearly be seen in Figure 12 that the peak level of demand is between 125 Ml/d and 150 Ml/d below the peak level experienced in 1989. This is partly attributable to around a 100 Ml/d fall in the base levels of demand in 1999 as compared to 1989, due to reductions in leakage. However, the remaining difference is most likely due to weather conditions.

Fig 11: Southampton 1999 weather patterns

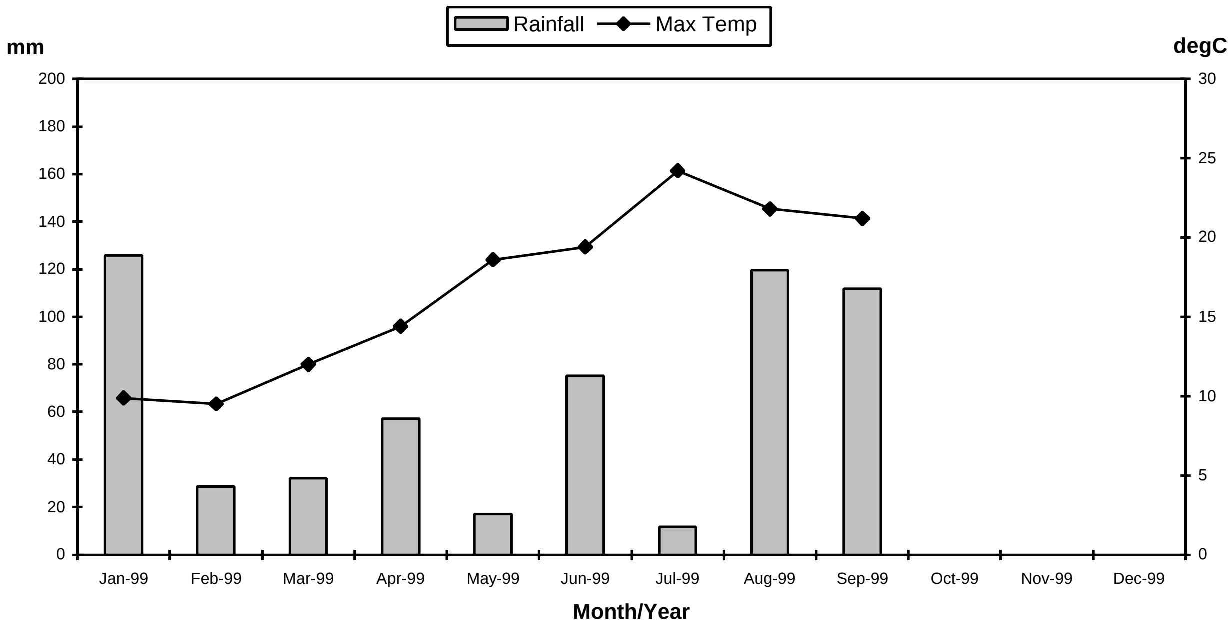
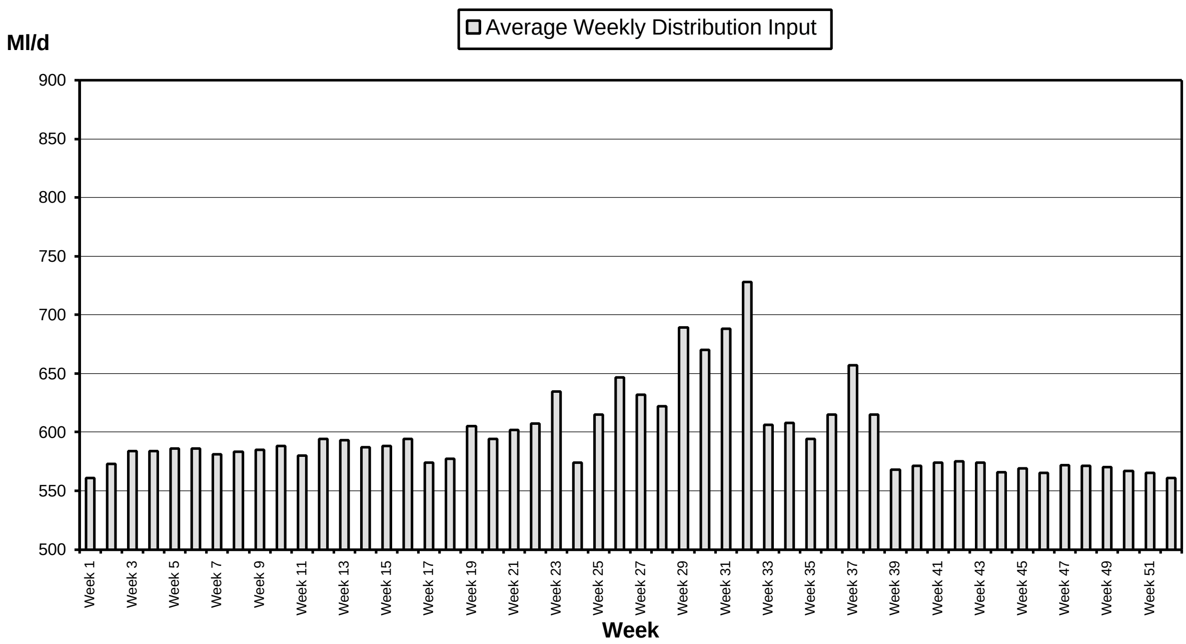


Fig 12: Southern Water 1999 distribution input



Monthly rainfall in 1995 barely exceeded 20mm from April through to August. This contrasts with the comparably wet summer experienced in 1999, with rainfall in June and August reaching around 75mm and 120mm respectively.

Conclusions

The above analysis examines the extent to which prolonged periods of hot and dry weather can put large pressures on companies' efforts to meet the peak level of demand, as experienced in 1995. However, it should also be noted that substantial reductions in leakage levels have been achieved since 1995. These reductions in leakage should greatly help to offset any increases in the level of distribution input caused by extreme weather conditions, and should increase security of supply.

The distribution input graphs for all water companies along with the temperature and rainfall data for seven different representative areas in England and Wales can be seen in Annexes 1 and 2 respectively.

Although factors such as weather conditions tend to lead to an increase in demand, companies may be able to use metering and tariff structures to manage customer demand. The following section provides an analysis of the effect of metering on the demand for water.

The effect of metering on demand

The level of demand is, to a certain extent, within companies' control. Metering and tariff structures can be used to help manage the level of demand. In order to assess the effect of metering on the level of demand, this section will provide a comparison between two distinct neighbouring regions in Southern Water, the Isle of Wight and Hampshire. The information used in this analysis is taken from *Water Consumption on the Isle of Wight 1988-1997* prepared by Southern Water Services in December 1997.

The National Water Metering Trials ran from April 1989 to March 1993 and were set up to assess the practicalities of large scale metering. By 1993 the results of this trial had shown that the average reduction in domestic consumption associated with compulsory metering was found to be 11% nationally. The trials also suggested that compulsory metering had very marked effects on peak demand with a 30% reduction being recorded in peak month, week, day and hour demand in years with hot, dry summers[12].

As part of these trials meters were installed in approximately 48,000 properties on the Isle of Wight. In contrast, the neighbouring Hampshire region did not form part of the metering trial, and so the properties remained largely unmetered. It is for these reasons that the Isle of Wight and Hampshire regions have been considered in the past to provide good comparisons for the levels of measured and unmeasured demand under similar climatic conditions.

During the period 1988 to 1992, a reduction of 22% in distribution input for the Isle of Wight occurred following the introduction of metering. Of this reduction, 44% was attributed to leakage control, 44% attributed to decreased net domestic demand due to metering, 15% to decreased net domestic demand due to factors other than metering, and increased non domestic demand contributed a rise of 3%.

The average distribution input and peak demands for both the Isle of Wight and Hampshire have been shown to have fallen over the period from 1989 to 1994, as shown in Tables 6 and 7.

[12] *The Effects of Metered Charging on Customer Demand for Water from 1 April 1989 to 31 March 1993*, WRc, January 1994.

Table 6 – Isle of Wight – Distribution input data

Year	Average (Ml/d)	Peak Demand (Ml/d)	7 day Peak Demand (Ml/d)	Peak to Average factor	Leakage (Ml/d)
1989-90	39.9	57.7	51.4	1.29	10.8
1990-91	36.3	55.2	46.2	1.27	7.1
1991-92	34.5	47.4	42.0	1.22	7.4
1992-93	31.2	43.2	39.2	1.26	6.1
1993-94	29.9	41.6	36.7	1.23	5.0
1994-95	31.7	42.8	41.3	1.30	4.2
1995-96	33.1	46.5	44.0	1.33	4.1
1996-97	32.2	42.8	40.8	1.27	4.5

Southern Water observes that the rate of decline in distribution input for the Isle of Wight is substantially greater than for the Hampshire area. Following the period of the metering trial, which ran from April 1989 to March 1993, the quantities of water put into supply in both areas increased at similar rates. Southern Water has suggested that the effect of metering, with supply pipe repairs, led to a step reduction in the amount of water put into supply. The three years of data following the completion of the metering trial show average distribution input remaining broadly static.

Table 7 – Hampshire – Distribution input data

Year	Average (Ml/d)	Peak Demand (Ml/d)	7 day Peak Demand (Ml/d)	Peak to Average factor	Leakage (Ml/d)
1989-90	210.3	283.8	278.2	1.35	55.9
1990-91	203.1	276.2	268.1	1.36	52.9
1991-92	189.8	243.7	220.8	1.28	46.1
1992-93	182.9	231.9	222.7	1.27	46.7
1993-94	188.3	228.4	221.5	1.21	40.2
1994-95	196.9	284.2	273.5	1.44	36.1
1995-96	205.9	290.0	280.2	1.41	37.0
1996-97	196.3	261.9	251.3	1.28	30.5

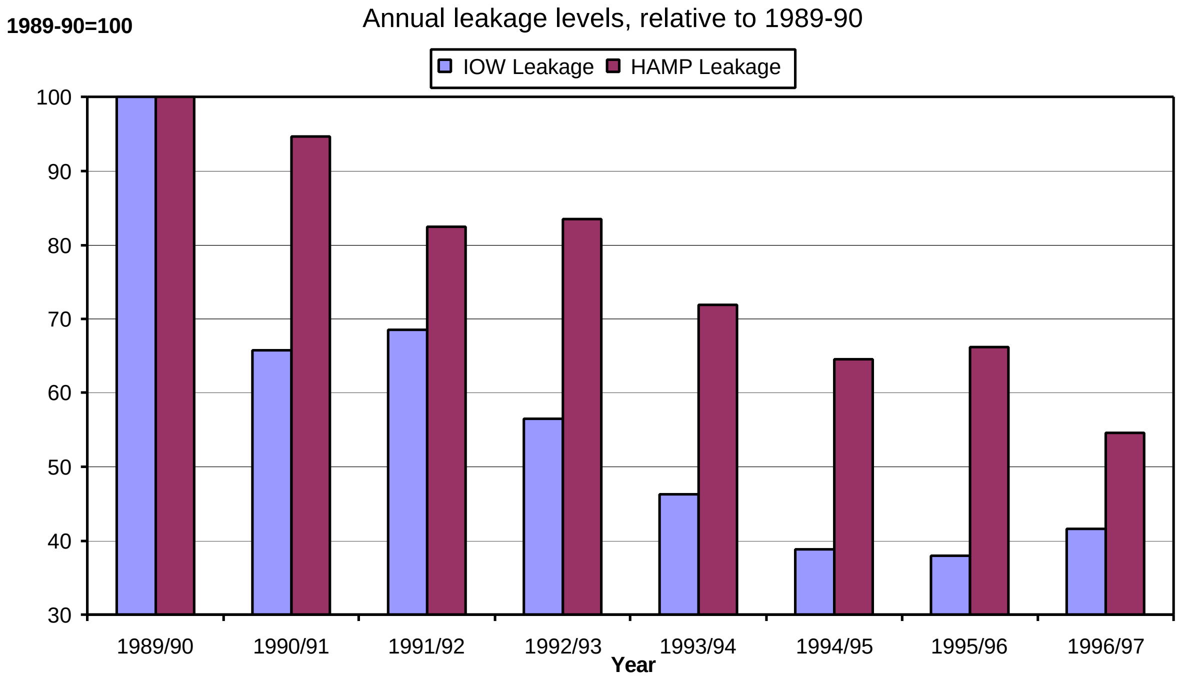
From Tables 6 and 7, it can be seen that following the introduction of compulsory meters in 1989-90 peak week distribution input for the Isle of Wight steadily fell until 1993-94. This was followed by a rise in peak demand with the greatest peak in 1995-96. This increase can be attributed to the weather conditions in the summer of 1995 previously mentioned. However, it should be noted that the peak demand figure in 1995-96 is much lower, by about 14%, than in the hot summer of 1989-90 when households remained largely unmetered. In comparison Hampshire’s peak demand, despite falling after 1991-92, experienced a large increase in 1994-95, with the 1995-96 peak demand figure 1% above that recorded in 1989-90.

These results would appear to indicate that the introduction of meters through the National Water Metering Trials had the long-term effect of reducing demand in the Isle of Wight area. In particular, widespread metering on the Isle of Wight appears to have prevented the increase in peak demands between 1989 and 1995 that were experienced in neighbouring Hampshire. Tables 6 and 7 also indicate a sustained reduction in the levels of leakage for both areas throughout the period, with the Isle of Wight experiencing a small increase of 0.4 Ml/d in 1996-97 and Hampshire showing minor increases in 1992-93 and 1995-96.

It is considered by Southern Water that a substantial part of these leakage reductions can be attributed to the identification and repair of leaking stopcocks, communication pipes and supply pipes at the time of meter installation. Southern Water argues that once the effect of leakage has been removed from the distribution input figures, the reductions experienced in demand levels shown in the above tables are less significant.

Southern Water also stresses the importance of the introduction of continuous night line monitoring on the Isle of Wight in 1988-89, which has been seen as a critical part in improving leakage detection rates. A comparison of the leakage levels for Hampshire and the Isle of Wight can be seen in Figure 13 below.

Fig 13: Changes in zonal leakage levels

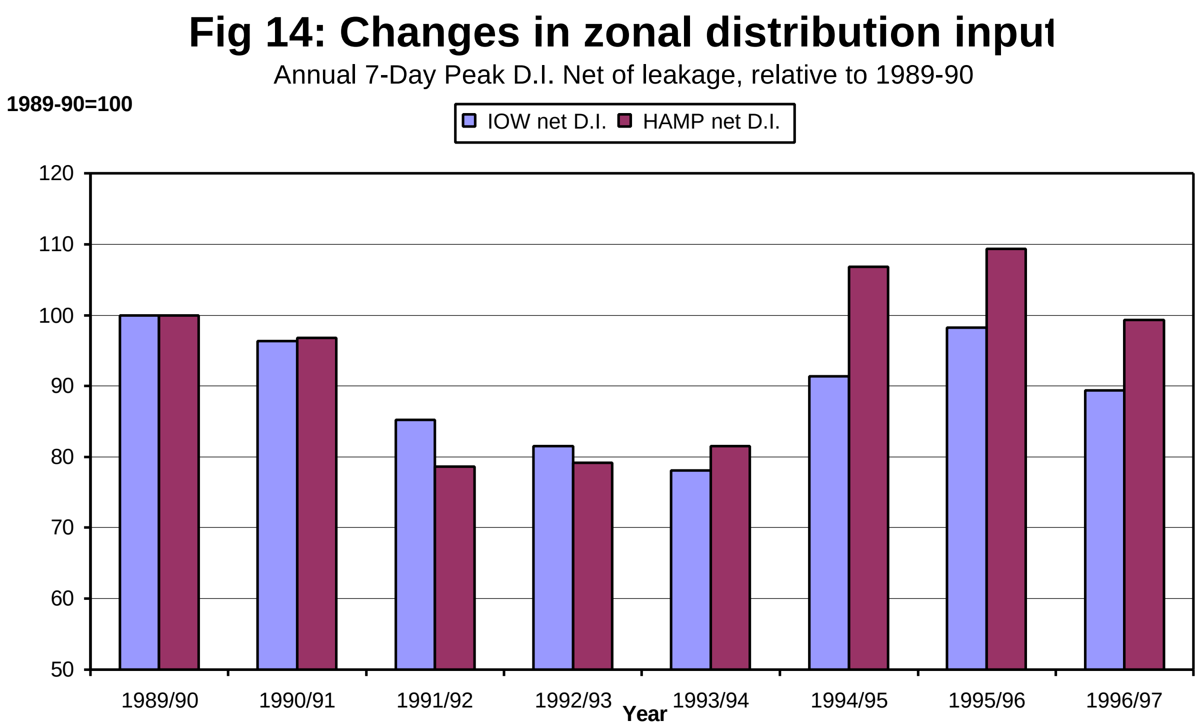


Note: The 1989/90 level of leakage is 10.8 Ml/d for IOW and 55.9 Ml/d for HAMP.

The graph indicates that leakage levels for the Isle of Wight have been reducing at a greater rate than for Hampshire.

Not only does this point to the success of the night line monitoring introduced into the Isle of Wight, but also appears to support Southern Water's assertion that reductions in leakage levels partly explain falls in distribution input in this area. However, it should be remembered that the introduction of external meters into an area contributes to lower leakage levels by increasing the detection rate. As previously mentioned, Southern Water have pointed to the process of meter installation as the reason for increased detection and subsequent repair of leaking pipes. It can be seen that metering contributes to lower leakage levels, and therefore, the reduction in distribution input can still be linked to the metering programme. It should be noted, however, that companies will have to decide where it is economical to use the installation of external meters to detect supply pipe leakage rather than cheaper internal meters.

If we remove the effect of leakage from the 7-day peak demand figures we arrive at a net consumption figure, and can therefore clearly see the effect of metering on peak demand net of any leakage reductions. This is a more meaningful comparison of demand trends between Hampshire and the Isle of Wight. This is set out in Figure 14 below.



Note: The 1989/90 level of net D.I. is 40.6 Ml/d for IOW and 222.3 Ml/d for HAMP.

The graph shows 7-day peak demand net of leakage as a percentage of the 1989 figure so that the figures for each area can be compared accurately. It can be seen that once the leakage figures have been removed from the Isle of Wight peak demand data, the effect of the introduction meters into the area appears to be less significant than first suggested. The graph shows that although distribution input on the Isle of Wight fell over the period, the peak in

1995-96 is only marginally less (2%) than that experienced in the similarly hot year of 1989-90.

However, a better indicator of the impact of metering is derived if we compare the Isle of Wight with the distribution input pattern for Hampshire shown in Figure 14. The level of peak demand experienced in Hampshire in 1995-96 is much higher (9%) than that in 1989/90, and indeed higher than the 1995-96 figure for the Isle of Wight. This, once again, indicates that demand pressures were much higher in 1995-96 than in 1989-90. In addition, the introduction of metering in the neighbouring Isle of Wight region has had the effect of preventing the significant increase in summer peak demand recorded in Hampshire. Overall the graph shows that metering leads to the level of demand being some 10% lower than would otherwise be the case.

Conclusions

It can be seen that the introduction of meters into the Isle of Wight has indeed had the effect of preventing levels of peak demand increasing in the area. However, it must also be considered that sustained decreases in leakage levels, for both the Isle of Wight and Hampshire, partly explain falling levels of average distribution input.

Following the summer of 1995, most companies adopted policies that required customers using high amounts of water for discretionary purposes, such as garden sprinklers, to pay for water on a measured basis. By adopting such policies, the companies were acknowledging the contribution that compulsory metering can make to managing demand during peak periods. All companies have retained the right to require certain types of discretionary water use to be metered under the Water Industry Act 1999.

The next section considers the incidence and effect of demand restrictions on weekly consumption.

Demand patterns in drought episodes/restrictions

The last 30 years have seen three major incidences of drought conditions that have lead to widespread restrictions on water use. A water company's ability to manage during such conditions are an important aspect of their performance. The Environment Agency requires all companies to draw up and annually review a Drought Contingency Plan[13]. The use of restrictions on customer use forms part of these Drought Contingency Plans.

As we have seen in preceding sections, periods of hot summer weather mean that demand can be up to 40% higher than base conditions in the rest of the year (North Surrey, and Bournemouth and West Hants in 1995). At the same time, less rainfall may mean that less water is available to serve the additional demands. This applies particularly for companies and resource zones that are reliant on direct river abstractions. In contrast, if water supplies are served by the same kind of storage mechanism e.g. a reservoir or groundwater, the effect on the amount of water available is less immediate. However, when rainfall is lower than average over a consistently long period, such sources can also take a longer time to recover.

Increases in demand in dry periods are often the result of garden watering[14]. Companies do not have a statutory obligation to provide for non-domestic use (which includes most garden watering) at all times and hosepipe bans can be imposed to constrain demand. More serious restrictions (e.g. rota cuts and standpipes) are very infrequent; two areas were affected in 1976, South Wales and North Devon. Such restrictions are no longer thought to be acceptable.

Rota cuts and standpipes are no longer regarded as acceptable. This means companies must introduce hosepipe bans soon enough to avoid the need for more serious restrictions later. However, it may not be acceptable for customers to be subject to frequent hosepipe bans for preventative reasons.

It is interesting to consider the nature of the three most recent drought events in 1975-76, 1990-92 and 1995-97 and the actions taken in response. Figure 15 shows the cumulative deviation of England and Wales's average rainfall from the 1960-90 average in the three drought periods; starting from the October preceding the first summer affected. This shows that 1975-76 was a relatively short drought episode in duration, but extremely severe. The two droughts in the 1990s, were longer and more gradual in build up. A number of companies now argue that two successive dry years are needed before restrictions would need to be imposed.

[13] *The Environment Agency's Review of Water Company Drought Plans; A submission to Central Government and the National Assembly for Wales*, Environment Agency, June 2000.
[14] *Report on Recent Patterns of demand for water in England and Wales*, Office of Water Services, May 1996.

The report on the 1976 drought compiled by the National Water Council[15] suggested that hosepipe bans served to give a general message to customers to be careful generally in their use of water as well as refraining from garden watering. The report suggested that the effect of restrictions could have reduced consumption by as much as 20%.

Fig 15: Deviation from average rainfall in England and Wales during drought periods

Evidence from company weekly distribution input data also provides a guide to the effectiveness of restrictions as a demand management tool. Table 8 below considers selected companies which imposed a ban during the 1995-97 drought. It compares the average four week distribution input before and after the hosepipe ban was imposed for 100% of the company area.

[15] *The 1975-76 drought*, National Water Council, April 1977.

Table 8- Demand effect of hosepipe bans 1995-97

Company	Date imposed	%'age population affected	Average DI in 4 weeks before (Ml/d)	Average DI in 4 weeks after (Ml/d)
NWT	17.8.95	100	2,537	2,400
SVT	end 8.95	100	2,379	2,121
YKS	7.7.95	84	1,540	1,540
MKT	end 8.95	100	203	172
SEW	24.8.95	100	215	178
FLK	1.3.96	100	52	52
YKS	29.4.96	100	1,411	1,383
SEW	1.4.96	100	168	172
ESK	12.6.97	100	520	490

Of course this comparison does not take into account the impact of other factors which may have caused a reduction in consumption. These factors include changes in weather, incidence of bank holidays etc. However, the data does suggest that the imposition of a hosepipe ban by the above companies did indeed have some impact. Of all the companies that imposed a hosepipe ban during the 1995-97 drought, only Yorkshire Water (in 1995), Folkestone Water and South East Water (in 1996) did not experience a fall in distribution in the following four weeks. However, it can be argued that for these companies, hosepipe bans were introduced at a time when the following four weeks would have experienced more severe weather conditions than the previous weeks, and so the bans prevented further increases in demand.

For example, Yorkshire Water introduced a hosepipe ban in July of 1995 yet the average level of distribution input over the next 4 weeks did not fall. However, it must be considered that August 1995 was a hotter and dryer month than July of the same year (see the Bradford and Sheffield weather patterns graphs for 1995 in Annex 2). It may also be that the effect of garden watering demand was over estimated by comparison with leakage. It can therefore be argued that the imposition of a hosepipe ban at this time helped to keep demand stable despite the onset of harsher weather conditions.

Similarly, given the date that restrictions were imposed, it can be expected that the previous four weeks for both the Folkestone Water and South East Water 1996 hosepipe bans experienced more favourable weather conditions than the four weeks after the ban was introduced.

It can therefore be concluded that in the absence of a better alternative, timely introduction of customer restrictions on non-essential uses are an effective method of constraining demand at peak times in the most severe conditions.

CONCLUSIONS

Distribution input has steadily fallen since the record peak levels experienced in the dry year of 1995. The industry now forecasts little underlying increase in demand over the 2000-10 period compared to their 1994 expectations.

Industry wide, both unmeasured per capita demand and total demand per household do not appear to have increased since 1995-96. However, the picture varies by company.

Coping with peaks in demand, particularly in dry years, is a key aspect of company performance. Such peaks can often be one-third higher than the level of demand in the rest of the year. Companies can impose restrictions on non-essential use in certain circumstances and these can be shown as having a positive effect. However, if restrictions become commonplace, there would be little in reserve for exceptional years.

Companies have already taken considerable action to improve their ability to cope with drought conditions, particularly by reducing leakage and, to a lesser extent, constraining growth in demand by installing meters and promoting more efficient use of water.

Management of demand will continue to play a major role in ensuring companies can match this position and continue to provide a good security of supply to their customers.