love every drop
anglianwater

PR24
Assessment of the impact of Covid-19 on per capita consumption

Anglian Water

October 2023

Assessment of the impact of Covid-19 restrictions on per capita consumption in the first three years of the 2020-25 price control period[1]

1.0 Introduction

We have an AMP7 performance commitment designed to incentivise the reduction in household use of water, measured by per capita consumption (PCC). Under the performance commitment we are liable for out- and under-performance payments, depending on how we perform in relation to the performance commitment levels, which are assessed on a three-year average basis. Table 1 below shows:

- The actual PCC in the three years to 2019-20, which set the base year PCC
- The base year PCC on a three-year average (3YA) basis
- The performance commitment level (PCL), expressed as a percentage reduction from the base year
- The performance commitment level, expressed as PCC, on a three-year average basis
- Our actual performance on PCC in 2020-21, 2021-22 and 2022-23
- The consequences of this actual performance under the AMP7 performance framework determined by the CMA at PR19.

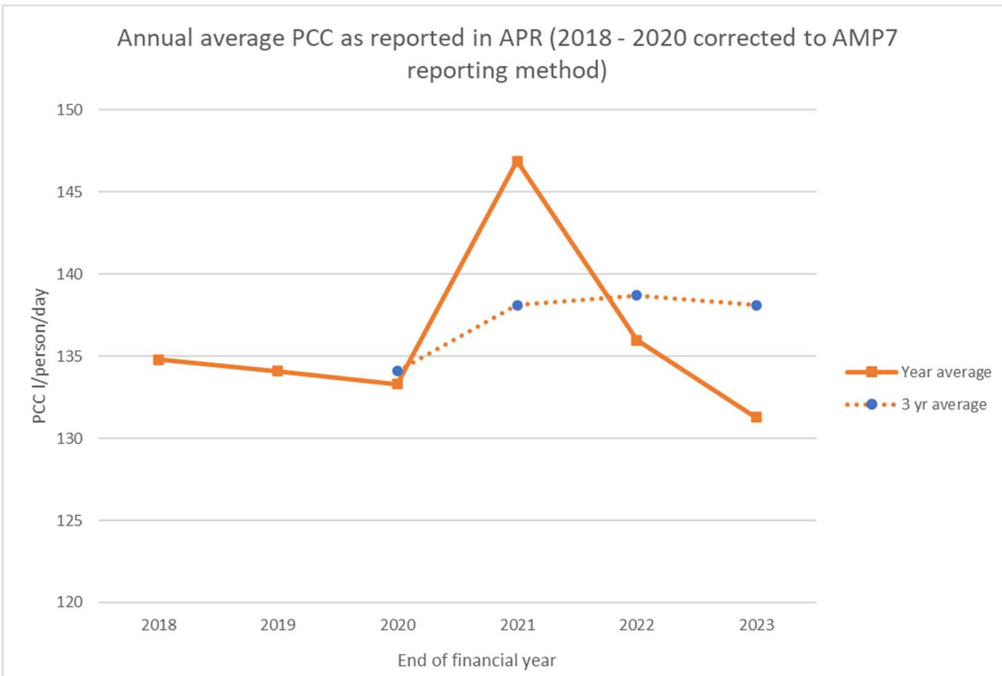
Table 1

		17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
AMP6 PCC (in year)	l/hd/d	134.8	134.1	133.3					
AMP6 PCC (3YA) – base year	l/hd/d			134.1					
Performance commitment level - Percentage reduction from 19-20 base	%				0.8	2.0	3.2	4.5	5.6
Performance commitment level – 3YA PCC	l/hd/d				133.0	131.4	129.8	128.0	126.6
AMP7 PCC (in year), actual	l/hd/d				146.9	136.0	131.3		
AMP7 PCC (3YA), actual	l/hd/d				138.1	138.7	138.1		
Variance to Performance commitment level	l/hd/d				5.1	7.3	8.3		
Penalty @ £0.374m per l/hd/d	£m				1.9	2.7	3.1		

[1] *Note – all financial reward and penalty figures in this document are in 17/18 prices, consistent with our PR19 final determination*

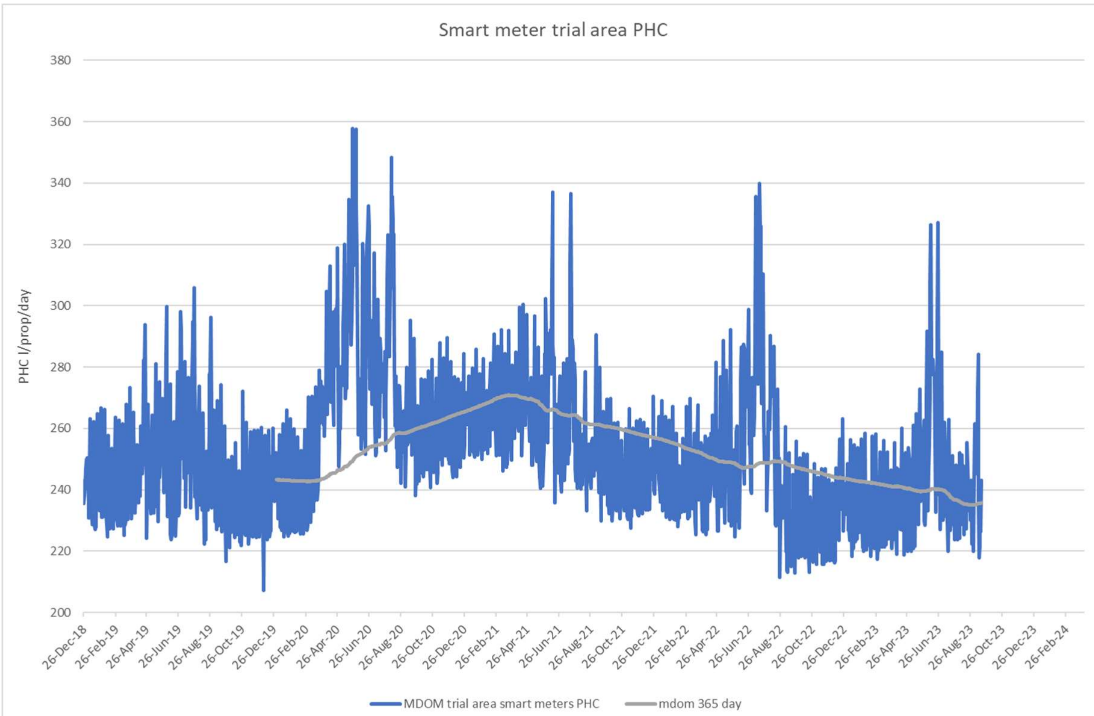
The table shows that our reported PCC rose significantly in 2020-21 from typical levels seen in prior years. While it partially recovered in 2021-22, it was not until year 3 of the period, 2022-23, that it returned to below our base year figure. However, because PCC is assessed on a three-year average basis, the high PCC values for 2020-21 and 2021-22 contribute to our reported figures for the respective following two years. Accordingly, even though PCC in 2022-23 fell below our base year figure we still missed our performance commitment level because of the contribution from those earlier years. The total financial impact of the 2020-21 and 2021-22 PCC performance will therefore be apparent in the most years of the price control period. To the end of year 3, our unadjusted financial penalty from PCC performance is £7.8m.

The chart below illustrates this point. It also shows that the in-year performance for 2022-23 has returned to the previous trajectory of reductions seen prior to the pandemic.



Our PCC in 2020-21 and, to a lesser extent, 2021-22 was adversely impacted by the restrictions on movement imposed by the government in response to the Covid-19 pandemic. For lengthy periods in both years, customers were asked to remain at home. Beyond these mandatory lockdowns were substantial periods of time when people continued to work from home because their employers required it, they were anxious about mixing, they preferred home working or other reasons. A substantial proportion of their normal water use was therefore diverted from their usual places of work or education, where it would have been recorded as non-household demand, to their homes, where it contributed to PCC. In addition, particularly in the first national lockdown (March – June 2020, which coincided with a period of warm, sunny weather) many customers made the best of being confined to home (while being furloughed and/or needing to occupy children unable to attend school) by pursuing activities which consumed water, such as filling paddling pools and pressure washing patios. At the peak of lockdown, we recorded domestic consumption across our region to be over 50 per cent higher than typical levels.

This is illustrated by the chart below, which shows per household consumption (PHC) data from our smart metering trial areas in Newmarket and Norwich. The chart shows that summer peaks are typical of all years but the one in April and May 2020 was both higher and broader than any other year. The grey line shows how rolling annual average consumption rose from that time and only returned to the pre-pandemic level at the end of 2022-23.



Our experience is entirely consistent with the findings of the research conducted by Artesia Consulting into the impact of the Covid-19 restrictions on demand in the early months of the pandemic across England and Wales.[2] Artesia found that the impacts from Covid-19 policies and measures in the period February to October 2020 included an increase in total household consumption of 9% - 13%.

While 2020-21 and 2021-22 were undoubtedly the peak years for the pandemic, the impact of Covid-19 on society and individuals' behaviour continued into 2022-23. In an ONS survey of working adults in April 2022[3], 38% of respondents said they were working from home all or some of the time. Of those that had not worked from home prior to the pandemic, 42% said that they expected to work mostly from home in the future, 24% said they would split their time evenly between home and their workplace and 6% said they would continue to work exclusively from home. Most respondents expressed high levels of satisfaction with home working, supporting the view that home or hybrid working was likely to become an established norm for millions of UK workers. We therefore expected an impact on domestic water use in 2022-23 and, potentially, beyond.

[2] *Collaborative report: The impact of COVID-19 on water consumption during February to October 2020 – Final report*, Artesia Consulting, April 2021

[3] *Is hybrid working here to stay?*, ONS, May 2023

The demand forecasts we have included in our Water Resources Management Plan (WRMP24) published in August 2023 include uplift factors for Covid-19. For our draft WRMP we estimated uplifts in household consumption on the prior year (after accounting for weather-related changes) of 10.2% for 2020-21 and 2.56% for 2022-23 and subsequent years. These factors were carried forward into the revised draft WRMP, after adjusting for movement of the base-line year to 2021-22. The WRMP envisages Covid-19 impacts on demand persisting to 2023.

Ofwat has said that it will listen to arguments about how far the company's underperformance was attributable to Covid-19 and consider the case for reducing our penalty. The purposes of this note are to:

- Set out our assessment of how far the PCC performance in the price control period has been affected by the Covid-19
- Estimate what our PCC performance would have been in the absence of Covid-19
- Demonstrate what the company's performance payment/penalty for the first three years of the price control period would have been in the absence of Covid-19.

2.0 Our approach to assessing the impact of Covid-19 on PCC

There are a number of factors which drive PCC. For example, as already stated, the main lockdown period of April and May 2020 (when PCC increased significantly) coincided with warm and sunny weather. We would have expected PCC to rise in any year in these circumstances. Our challenge is to separate the impact of Covid-19 from the impact of other factors such as these.

We cannot measure directly the impact of Covid-19 on PCC. Our approach therefore is to

- Identify the factors which have driven material differences in PCC since base year ('drivers of PCC')
- Quantify the impact on PCC of those factors
- Attribute the residual, unexplained difference to Covid-19.

3.0 Drivers of PCC

As previously stated, there are a number of factors which drive household PCC. In the short term the key factor is the **weather** and its impact on customer behaviour. In short, when the weather is hot and dry customers use substantially greater volumes of water in their gardens; in particular, watering plants and lawns and filling paddling pools. Shower use may also rise. Because of differences in weather the input of water into the distribution system can vary by 50% from one week to the next. We make an estimate of the impact on PCC of the weather in AMP7 (section 4.1).

The second major factor affecting PCC is **metering**. 84% of our customers pay measured charges compared to an industry average of less than 60%. Because metered customers enjoy the financial savings from optimising their water use, their per capita consumption is shown to be lower than customers paying unmeasured bills. During the current price control period customers have continued to switch from unmeasured to measured payment. In total, 37,000 of our customers switched in the first three years. We assume a reduction in consumption of 15 per cent for customers who switch from unmeasured to measured charges with a visual read meter.

In 2020-21 we embarked on a ten-year programme of replacing all our visual read meters with smart meters. Smart meters provide an additional consumption benefit because whereas customers with visual read meters receive an annual consumption value, customers with smart meters can track their water use in real time and take immediate steps to eliminate waste. We assume that transferring a customer from a visual read meter to a smart meter enables a further three per cent reduction in consumption. Figures in table 6D of our Annual Performance Reports (APRs) show that we have replaced over 500,000 visual read meters with smart meters in the first three years of the price control period. Our target is to fit over a million smart meters by the end of the period. We make an estimate of the impact on PCC of metering in AMP7 (section 4.2). This includes the impact of both switching customers to measured charges for the first time and replacing visual read meters with smart meters.

As a water company, we take steps to encourage lower water use by our customers. These include the following:

- Informing customers via press, radio, social media and marketing activity about the financial and environmental costs of water use and appealing to their sense of social and environmental responsibility through a communications campaign to use water efficiently
- Supplying or fitting devices which can assist reduced water use – such as cistern displacement devices, tap inserts or shower timers. These make up our water saving home kits.

We have pursued our **water efficiency programme** during the price control period, though have had to modify the activities at times to reflect Covid-19 restrictions. We set out the detail of our water efficiency campaign in our commentary to table 3A of our APRs. We make an estimate of the impact on PCC of these activities in AMP7 (section 4.3).

In the long-term other factors affect PCC on a more gradual, incremental basis. For example, smaller households use proportionally greater volumes of water and as mean household size in the UK decreases PCC will tend to rise.

In the long-term customer behaviours also change. These serve to both increase and reduce average PCC. Examples of relevant factors include the following:

- The general trend from baths to showers
- Ownership of domestic appliances, such as washing machines and dishwashers
- The water efficiency of domestic appliances
- Ownership of paddling pools and hot-tubs, and the size of those
- Adoption of rain- and grey-water reuse systems
- Attitudes towards the environment and the appetite to eliminate wasteful water use.

For the purposes of this analysis we have not quantified the impact of these. As set out above, these demographic and behavioural impacts are long-term and incremental. Since we are comparing PCC in just three years with performance in the base year, only one year previously, we have assumed the impact of them to be negligible.

4.0 Impact of drivers on PCC

4.1 Impact of weather

In 2005 we commissioned Atkins to create a model to define the relationship between demand for water and the drivers of demand. The inputs to the model were the data which we had gathered from our consumption monitor, SODCON, over the previous decade.

The model takes into account a variety of demographic, social and meteorological factors. Since from one year to the next demographic and social factors remain stable, the main thing it measures is the impact of the weather and the interaction of weather characteristics with the day of the week[4].

By comparing the demand which the model forecast for any given day with the actual observed demand, we could see that the model was accurate to within 2%. Accordingly, we find that it forms a reliable basis for the prediction of demand and PCC. For the purposes of this analysis, we have used it to estimate the impact of weather factors on the change in PCC since 2019-20, the base year.

We describe our predictive model in more detail in the appendix.

The step-wise process we used to assess the impact of weather characteristics on our PCC in comparison to the base year, 2019-20, is set out below:

- Use the predictive model to predict the PCC we should have expected in 2019-20 ($Modelled_{20}$) and the three subsequent years ($Modelled_t$) on the basis of the weather parameters in each year
- Calculate the percentage variances between $Modelled_{20}$ and $Modelled_t$ due to differences in the weather characteristics of the respective years
- Apply these percentage variances to the actual PCC in 2019-20 ($Actual_{20}$). This gives us the PCC we would have expected in the three years as a result of the differences in the weather compared to the weather in 2019-20, all else equal. We call this $Forecast_t$
- Subtract the $Actual_{20}$ from $Forecast_t$ to calculate the impact of the weather characteristics in the three years compared to the weather in 19-20 in l/h/d.

These figures are set out below. They show that the impact of weather differences in all three years on PCC were relatively small. Cumulatively across all three years they amounted to -0.2 l/hd/d.

Table 2

		19-20	20-21	21-22	22-23		Calc.
Actual PCC (in year)	l/hd/d	133.3				a	Input
Modelled PC (in year)	l/hd/d	132.6	133.0	131.1	133.5	b	Input
Modelled PC - Variance to prior year	%	-	0.31%	-1.11%	0.68%	c	$(b_t-b_{20})/100$
Forecast PCC based on 2019-20 PCC plus the impact of weather differences	l/hd/d		133.7	131.8	134.2	d	a x (1+c)
PCC uplift attributable to weather	l/hd/d	-	0.4	-1.5	0.9		d-a

[4] Hot weather will have greater impact on demand on a bank holiday than if the same weather falls on a working Tuesday

4.2 Impact of our metering programme

Table 3 below shows our estimate of the impact on total water demand of our metering activities on PCC in the first three years of the price control period. These data are sourced from table 6D of our APRs.

Table 3

		20-21	21-22	22-23	Total	Source	Calc.
Supply-demand benefit from switching from unmeasured to measured	Ml/d	0.15	0.24	0.25	0.64	APR21 6D.11	a
Supply-demand benefit from switching from basic meter to smart meter	Ml/d	1.36	1.15	1.79	4.30	APR21 6D.13	b
Total supply-demand benefit from metering	Ml/d	1.51	1.39	2.04	4.94		a+b
Total resident population	No.	4,837,755	4,909,539	4,972,797		APR21 4R.26	c
Total supply-demand benefit to PCC	l/hd/d	0.3	0.3	0.4	1.0		(a+b)/c x 1,000,000

4.3 Impact of Anglian's water efficiency activities

We measure the reach of the various media which make up our communication campaign but we have no reliable way of assessing the water savings which result from our messaging and hence the impact on PCC. We conservatively assume zero.

We are able to assess the water savings which result directly from the use of devices which we issue to customers. This calculation depends on the number of devices we have issued and assumptions on the average saving per each use of the device and the number of uses made by the household each day. Savings assumptions for each device are those claimed by the manufacturers. Table 4 shows the total savings attributable to our water efficiency programme in 2020-21.

Table 4

Device	Assumed saving per device	Assumed uses per household per day	Daily saving per household	No. devices issued	Total daily saving
	Litre per use	**No.**	**Litre per household**	**No.**	**l/d**
	a	*b*	*c (= a x b)*	*d*	*e (= c x d)*
Save-a-flush	1.6	11.5	18.4	97	1,785

Hippo	1.6	11.5	18.4	25	460
Shower timer	5	2.3	11.5	28	667
Shower save regulator	6	2.3	13.8	29	400
Eco-beta	47	11.5	540.5	6	3,243
Digital shower timer	5	2.3	11.5	50	575
Hose gun	2	0.5	1	185	185
Shower head	30	2.3	69	75	5,175
Bath buoy	15	1	15	156	2,340
Garden kit	0.5	0.5	0.5	331	166
Water saving kit	5	2.3	11.5	1,728	19,872
Baby dam	56	1	56	11	616
Bathroom kit	5	2.3	11.5	13,105	150,708
TOTAL					**186,191**

We assume that the savings made in the year that we issue a device persists into subsequent years. We have also assumed that the savings from 2021-22 and 2022-23 were similar to those we have calculated for 20-21. Table 5 shows the overall impact on per capita consumption as a result of these activities.

Table 5

		20-21		**21-22**		**22-23**	
		In-year	Cum. AMP7	In-year	Cum. AMP7	In-year	Cum. AMP7
Total savings from water efficiency programme	Ml/d	0.186	0.186	0.186	0.372	0.186	0.559
Total resident population	‘000	4,837,755		4,909,539		4,972,797	
Total benefit to PCC from water efficiency programme	l/hd/d	-0.038	-0.038	-0.038	-0.076	-0.037	-1.114

The purpose of issuing water efficient tools and devices is to foster a water efficiency mindset which customers then apply to all of their interactions with water. The savings which are generated by this wider behaviour change should be multiple times bigger than the direct savings resulting from the devices alone. However, we have no way of assessing their value. Taking a conservative approach, we assume no further savings from the water efficiency programme from this behavioural change.

5.0 Conclusion: Impact of Covid-19 on PCC

Table 6 brings together the estimates derived in section 4 and, by subtraction, estimates the impact on PCC which can be attributed to the effect of Covid-19.

Table 6

		19-20	**20-21**	**21-22**	**22-23**	
Actual PCC (in year)	l/hd/d	133.3				*a*
Variance from 2019-20 attributable to weather	l/hd/d		0.4	-1.5	0.9	*b*
Variance from 2019-20 attributable to metering	l/hd/d		-0.3	-0.6	-1.0	*c*
Variance from 2019-20 attributable to water efficiency activities	l/hd/d		0	-0.1	-0.1	*d*
Adjusted PCC (in year)	l/hd/d		133.4	131.2	133.1	$a_{20}+b_t+c_t+d_t$
Actual PCC (in year)	l/hd/d		146.9	136.0	131.3	
Variance attributable to Covid-19 (balance)	l/hd/d		13.5	4.8	-1.8	*e* (=a-b-c-d)

The table confirms our hypothesis that there was a substantial variance between expected and observed PCC in 20-21, which persisted at a reduced level into 2021-22. This is consistent with the expected relative impact of Covid-19 restrictions across those two years.

The result for year 3 is less intuitive. We would expect to see a residual Covid-19 impact from the persistence of behavioural changes, particularly home working, that continued into 2022-23. However, observed PCC was actually lower than the expected level (though on trend with the long-term trend of reductions we have observed). We suggest the main reason is that we have significantly understated the benefit to PCC from improved water efficiency measures in the year. In 2022-23 we saw the highest temperatures ever recorded in the UK. There was extensive comment across all media about water shortages and six companies[5] imposed hosepipe bans in at least parts of their regions. We know that a substantial proportion of customers – including those served by companies not imposing hosepipe bans - responded positively to these media stories in terms of their water use. Customers may have been additionally incentivised to reduce water use in 2022-23 by economic factors as interest rates rose and the cost of living challenge intensified.

As a cross-check, we have compared the estimates of Covid-19 impact derived from the analysis in this paper with the uplifts estimated in our draft WRMP[6]. In Table 7 below we uplift our adjusted PCC numbers with the uplift factors quoted in the WRMP and compare them with our actual observed PCC for each year. There is a very close match on year 1 and a relatively good match on year 2. For year 3, the comparison could suggest that the adjustment for Covid-19 set out in this

[5] Thames Water, Yorkshire Water, Welsh Water, South West Water, Southern Water, South East Water

[6] For the revised draft WRMP24 published in August 2023, we moved the forecast base-line to 2021/22 and assumed that the Covid uplift would be reflected in the base-year values

paper is too small. Alternatively, it could support the theory above about the impact of the extraordinary summer weather on customer behaviour.

Table 7

		20-21	21-22	22-23	
PCC in year – adjusted to remove Covid-19 impact	l/hd/d	133.4	131.2	133.2	a
WRMP Covid uplift factor	l/hd/d	10.2%	2.56%	2.56%	b
PCC in year – adjusted for WRMP Covid-19 uplift factor	l/hd/d	147.0	134.6	136.6	= a/(1+b)
PCC in year actual	l/hd/d	146.9	136.0	131.3	

Impact of Covid-19 on performance commitment penalty

Finally, Table 8 is a modified version of Table 1 in which the reported PCC values for 2020-21, 2021-22 and 2022-23 are replaced with the adjusted values calculated as if the pandemic had not happened. It shows that, in the absence of Covid-19, our outturn PCC performance would have been significantly lower than the figure we reported in all three years. After adjusting fully for the effects of Covid-19 the company's total penalty for these years should be 1.720m. This calculation can be readily repeated for the remaining years of the price control period.

Table 8

		17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
PCC (in year)	l/hd/d	134.8	134.1	133.3					
PCC (three year average – base year)	l/hd/d			134.1					
Performance Commitment Level - Percentage reduction from 19-20 base	%				0.8	2.0	3.2	4.5	5.6
Performance Commitment Level - Three-year average PCC	l/hd/d				133.0	131.4	129.8	128.0	126.6
AMP7 PCC (in year), adjusted	l/hd/d				133.4	131.2	133.1		
AMP7 PCC (3YA), adjusted	l/hd/d				133.6	132.6	132.5		
Variance to PCL	l/hd/d				0.6	1.3	2.8		
Penalty @ £0.374m per l/hd/d, £m	£m				0.224	0.449	1.047		

Appendix – The Anglian predictive model

In 2005 Anglian commissioned Atkins to create a model to define the relationship between demand for water and the drivers of demand. The work entailed statistical analysis of the household consumption data that Anglian had obtained from SODCON, the consumption monitor which the company had operated since 1994. This monitor included over 1000 measured and 1000 unmeasured customers. The analysis was supplemented by demographic information Anglian had obtained from the questionnaires it sent to all customers on the SODCON monitor every year from 2001 – 2004. This information included house type and size, garden size, occupancy, factors relating to consumption (such as white good ownership and use of hosepipes) and income factors.

The factors that were available for testing in the model were these:

1. Daily household consumption (from SODCON) in litres per property per day

2. Explanatory ‘household’ factors. These included:

- Occupancy of the household
- Measured/unmeasured status of the household
- Location of the household, both in terms of its Water Resource Zone and Concession (old WRZ)
- ACORN group (new scoring system)
- Rateable value

3. Explanatory ’time variant’ factors. These included:

- Day of the week
- Month
- Year
- Whether the particular day fell on a bank holiday, or was within the Christmas period (24th – 30th December)
- Maximum temperature (°C) on that day, plus the average maximum temperature for the preceding 3, 7 and 30 days
- Sunshine hours on that day, plus the average sunshine hours for the preceding 3, 7 and 30 days
- Rainfall (mm) on the day, plus the average rainfall for the preceding 3, 7 and 30 days
- The current tariff structure for water use in that house

Account was taken of the interaction between variables – for example, that the impact on demand of a dry day within a generally wet period will be different from the impact when the dry day follows many other dry days. Another example is that a hot day will have greater impact on demand when it falls on a bank holiday than when it falls on a working day.

Atkins built 12 separate models, one for each of 6 bands of occupancy rate, split between measured and unmeasured households. The models used per property consumption (PPC) as the dependent variable. Through addition of the outputs of the results of the 12 models forecasts of region-wide PPC – and, hence, PCC - could be obtained.

The model was validated by comparing predicted versus actual values for the SODCON data from 2001 – 2004. Table 1 reproduced from Atkins’ report below gives the validation accuracy of the model for each metered category in each of the years.

Table 1 – Model Validation Results

Year	Predicted Versus Actual Annual Average PCC (l/h/d)				Validation Accuracy (%)	
	Measured Actual	Measured Predicted	Unmeasured Actual	Unmeasured Predicted	Measured	Unmeasured
2002	123.7	121.7	136.1	138	-1.6%	+1.4%
2003	125.9	125.9	139.3	141.1	-0.0%	+1.3%
2004	123.4	121.3	137.4	138.1	-1.6%	+0.5%

Atkins concluded: 'Overall it is considered that the main analysis was able to produce a robust predictive model of the consumption of customers within the SODCON sample. This model should be suitable for use in calculating both yearly average PCCs, and shorter duration events at various scales, although accuracy increases as population and timescales increase.'

A full report on Atkins' work was produced[7].

[7] Statistical Modelling of the Demand for Water in the Anglian Region, WS Atkins, September 2005