

Assessment of extra demand expected during a dry year

From 1994 to 1997 the company experienced a continuous sequence of three minor single season droughts. However, winter recharge in each of the years was adequate and prevented the situation deteriorating into a more serious two-season drought.

The year 1995/96 was warmer and drier than the other two years and demand for water generated the highest peak in seasonal water demand above the baseline. The company continues to use this year as our benchmark 'dry year' as we have not experienced a more significant event. During that year, it was recognised that the climatic conditions were the driver for the observed increase in water put into supply. Because of this, an effort was made to capture water demand data and understand what components of demand could be attributed to dry/warm weather effects.

Data capture

A sample of residential district meter areas was logged during 1995 summer periods when water demand was high and the daily demand profile exhibited a clear evening peak in demand during a four-hour period from 18:00 to 22:00 (specifically where evening peaks were greater than the morning peaks). This evening peak in demand was assumed to be indicative of significant external water use.

Logged data for the same sample districts was analysed for a baseline demand period in the same year, typically during October and November to be free of both winter leakage and warm weather effects. Diurnal profiles and nightlines were checked to ensure similar values in both periods to eliminate districts impacted by leakage and re-zoning influences.

Analysis

The data from the sample districts was reduced to represent the average of seven days consumption, expressed in terms of l/p/d for the sample of districts for both summer and base demand conditions.

For the sample of districts, the calculation of the average water demand per property during summer when extra discretionary use took place was 790 l/p/d

For the sample of districts, the calculation of the average water demand per property during base demand periods with no discretionary use was 408 l/p/d

To disaggregate the two components of demand, the water consumed during the 4-hour evening peak from 18:00 to 22:00 was compared between the summer and base period demand plots. The average extra volume of water use in the evening period was 260 l over four hours. This volume was assigned initially only to external household use

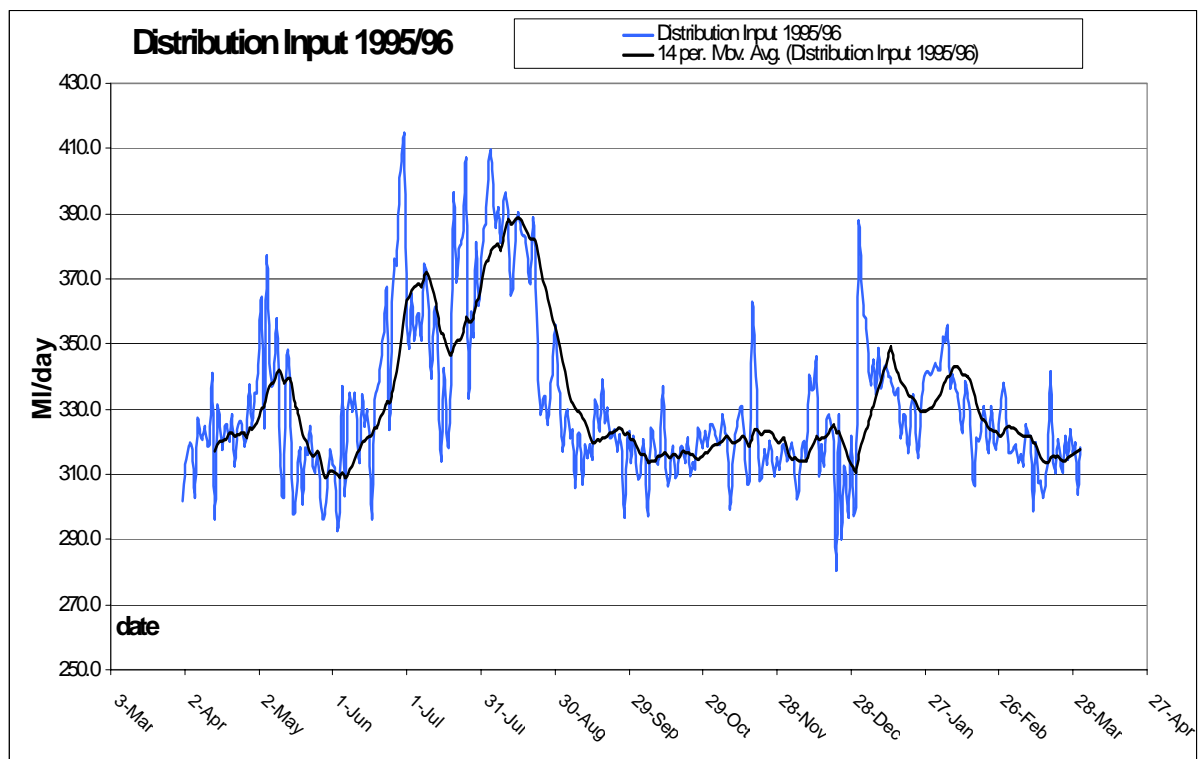
The average difference in total daily demand for 24 hours from base period to summer period was 382 l/p/d (790 l/p/d – 408 l/p/d).

As the external household component was assessed as 260 l/p/d, the remainder of the increased demand over the day was attributed to increased personal consumption and was calculated to be 122 l/p/d (382 l/p/d – 260 l/p/d).

This district-based analysis is of a biased sample, but is only used to estimate the proportion of component consumption for those customers exhibiting significant extra discretionary use during dry periods. From this we initially concluded that the:

- Proportion of the extra dry weather demand due to external household consumption was 68% (260/382)
- Proportion of the extra dry weather demand due to internal personal consumption was 32% (122/382)

The analysis does not provide information regarding the actual use of these customers in sampled districts over a complete year. For this we used the recorded daily distribution input (DI) data for 1995/96, as set out below.



The average daily distribution input for the period April to September was calculated and taken to represent the summer period of climate induced discretionary demand.

The average daily distribution input for the period October and November was calculated and taken to represent the baseline period when there would be minimal climate induced discretionary demand or increased leakage.

For the purposes of the analysis, leakage and non-household demand is assumed to be constant for the two periods (we have not identified any significant seasonal or climatic variation in non household demand, however leakage can increase significantly during December and January in a cold winter).

The baseline average daily DI of 318 Mld was subtracted from the summer period average daily DI of 343 Mld and multiplied by the 153 summer days to give the total extra consumption attributed to summer 'dry weather' (approximately 3770 MI).

The summer period total consumption was converted back to Mld averaged over the year and divided by the number of domestic households for 1995/97 to give a value of approximately 25 l/p/d additional demand due to dry weather.

This value of 25 l/p/d reconciled with the recorded increase in per capita consumption in 1995/96 of approximately 10 l/c/d overall compared to the reference 'normal climatic' years of 1993/94 and 1997/98.

Using the proportions calculated for external and personal water consumption from the zonal analysis detailed above, the extra component demands expressed per property were:

- Extra dry weather consumption external use 17 l/p/d as a daily average over the year
- Extra dry weather consumption personal use 8 l/p/d as a daily average over the year

It was subsequently considered that the attributing all of the water consumed during the period 18:00 to 22:00 hours to external use only was probably an over-estimate. Some of the water consumed during this period would be likely to have been used for other purposes. To avoid overestimating external discretionary water use, the values were simplified to give:

- Extra dry weather consumption external use 15 l/p/d as a daily average over the year
- Extra dry weather consumption personal use 10 l/p/d as a daily average over the year

The simplification is not unreasonable given the range of uncertainties. The key point is that the total of 25 l/p/d remains consistent with the overall increase in demand due to dry weather identified from the distribution input.

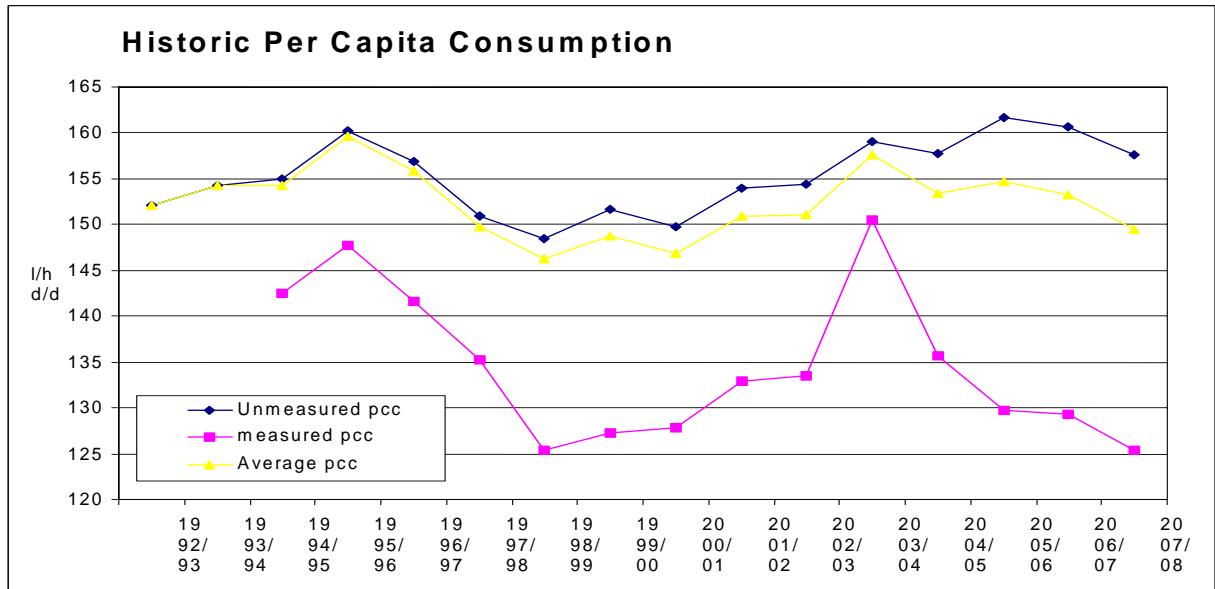
In 1995/97, the average occupancy was very close to 2.5 persons per property, so dividing 10 l/p/d by 2.5 results in the per person discretionary consumption due to dry weather of 4 l/c/d, so that:

- Extra dry weather consumption external use 15 l/p/d as a daily average over the year
- Extra dry weather consumption personal use 4 l/c/d as a daily average over the year

Behaviour of measured household customers

Since 1995 we have applied this factor to both measured and unmeasured households to estimate the extra demand due to dry weather. In 2003/04 we experienced a relatively dry year including a hot summer (but nowhere near as extreme in its effect as 1995/96).

During 2003, the company began running a low level campaign to encourage customers to ‘use water wisely’. However, on analysis of the consumption data for the year, unmeasured consumption expressed as per capita consumption displayed a small increase compared to other years. However, the measured per capita consumption increased quite significantly, as illustrated below.



This effect had been observed in 1995/96, however it was considered at the time that the number of metered household customers may not have been sufficient for the result to be reliable (due to timing of readings and level of estimated readings). As the effect has occurred twice during the two warmer than average summers, we should now take this effect into consideration as being indicative of the way metered household customers expect to use water.

The current baseline per capita consumption during ‘average’ climatic years for measured household customers approximates to 130 l/c/d. In 2003/04, the measured PCC increased to 150 l/c/d. If measured households behaved in the same manner as the unmeasured households, we may have expected the PCC to increase to approximately 140 l/c/d (equivalent to an extra 20 l/p/d, a reasonable figure given that 2003/04 was not as dry as 1995/96). The extra 10 l/c/d increase above 140 l/c/d implies that metered customers may have a propensity to consume twice the amount of discretionary water use per property in response to dry conditions, or 50 l/p/d.

If this were the case, the extra dry weather consumption for measures households would be:

- Extra dry weather consumption external use 30 l/p/d as a daily average over the year
- Extra dry weather consumption personal use 10 l/c/d as a daily average over the year

The data supports the fact that metered customers make use of more water when they consider conditions require. In addition, the 30 l/p/d of external water use represents a total of 11m³ of water. If this takes place over 25 weeks, it would only amount to a weekly average of less than 0.5 of a cubic metre of water at a cost of £0.50 per week.

It is probable that bi-annual meter readings may give rise to some lag effects such as demand being transferred to following years etc. In order to allow for these effects, we assume only half of the observed increase in measured consumption above that of unmeasured customers as a planning allowance until we have better information.

Therefore, our plan now assumes that in response to dry weather, measured customers demand will increase by an extra 12 l/p/d above that of unmeasured customers to 37 l/p/d (25 l/p/d plus 12 l/p/d, instead of 25 l/p/d plus the observed extra 25 l/p/d).

Based on the current average occupancy of two, for measured households, this consumption is apportioned in the following manner:

- Extra dry weather consumption external use 20 l/p/d as a daily average over the year
- Extra dry weather consumption personal use 8 l/c/d as a daily average over the year

We have adopted a reduced external consumption to allow for the fact that many new, metered properties may have less opportunity for significant external water due to the relaxation of planning controls on maximum housing density.