

## **Chapter 2 - Water Needs: The Demand for Water**

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### **Recommendations**

- The RSC in partnership with other key organisations should ensure that water engineers and scientists collaborate with materials scientists in order to specify and develop optimal materials for leakage prevention and water quality maintenance.
- Developers should be required to incorporate water efficiency measures in all new properties.
- Government, regulators and water companies should:
  - examine a potential system that would provide the minimum daily allowance of water for public health needs at low or no cost and where additional water would cost a premium. The system should be implemented alongside smart water meters that report on water use habits and additionally there should be a programme of stakeholder education. This system should encourage roof capture of water and grey water re-use.
  - interpret the WFD as a driver for action on leaks because water quality is affected by volume.
  - examine a holistic approach to water demand management encompassing conservation, new water resources, the possibility of using treated water resources and inter-regional support between companies.

### **Executive Summary**

Water is a precious resource in short supply and is predicted, globally, to triple in price in the next few decades. Water demand is met by non-potable and potable water.

Non-potable water is primarily for industrial (15%) and agricultural (70%) use and represents 85% of water demand globally. To feed the predicted additional 3 billion people in 2050 will require an 80% rise in irrigation water requirements. This analysis primarily concerns potable waters, which are used for human consumption and domestic living. Ready access to clean, reliable water supplies is not a given for one billion people worldwide.

The definition of water demand has switched from the amount required by the supply distribution from the treatment works to the amount of water required by the customer. The water resources required to satisfy consumer demand are substantially higher than the consumer demand itself. Leakage before and after water treatment is a key element; around 22% of water does not meet the end user because of leakage in the UK<sup>1</sup>.

Household water demand is a function of three factors: individual supplying facilities such as taps, showers, hoses, etc: frequency of use; and volume per use. However, the measure is complicated because devices, such as hoses, can be used for different functions. Water demand fluctuates in the day, but broadly speaking has a peak in the morning, after school and a less intense peak in the evening. This cycle varies at the weekend and during the different seasons, typically peaking during winter and summer. Water supply infrastructure is based on peak demand.

Only 29% of UK households are metered and this figure varies dramatically between different regions. Metered customers have lower water demands, however, in the most part these households volunteered to be metered and may not be representative of the general populace. The cost of water is low and therefore demand is inelastic to price increases; in fact, price increases may only affect the poorest families. A potential system could provide the minimum daily allowance of

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<sup>1</sup> Ofwat Security of Supply, Leakage and Water Efficiency Report 2005-06

water at low or no cost with additional water costing a premium. Such a system would best be implemented alongside smart water meters that report on water use habits and a programme of education. It is possible that such a system could encourage roof capture of water and grey water re-use.

In the UK, 3,576 million litres of water are lost daily from the distribution system through leakage. Beyond physical methods of detecting leaks, the best way to estimate leakage is to measure water demand during night time and subtract legitimate water use. Finding and fixing leaks is expensive; if the company calculates that the cost of repairing the leak exceeds the cost of the water saved then the leak is not fixed. The Water Framework Directive (WFD) may provide a driver for action on leaks as the quality of water is affected by volume. If water is lost in transit, then less will be returned to the source and the volume, and hence water quality, is reduced.

UK water demand is expected to increase in the future and several factors are important. Household size is decreasing, the southeast is also expected to become more population dense through internal and external migration and climate change is expected to make the southeast drier and prone to drought. To address this rise in demand will require a holistic approach, encompassing conservation, new water resources, the possibility of using treated water resources and inter-regional support between companies. In the UK source water may come from a different catchment area to effluent discharged water *i.e.* source water in Wales, may discharge into the river Trent.

## **Introduction**

For a billion people, a figure little changed in many decades, ready access to clean reliable water supply is *not* a given. More and more, water is recognised as a precious resource in short supply and predicted, globally, to triple in cost in the next few decades. Water as a resource is of two types: (i) potable, which is fit for human consumption, and (ii) non potable. Non potable waters are abstracted for industrial and agricultural use primarily. Globally the demand for non potable water for agricultural irrigation is one of the greatest sources of water demand exerting more than 70% of the world current water demand. The International Water Management Institute argues that the irrigation water needed to improve food supplies to the existing population and provide for the additional three billion population by 2050 will force a further 80% rise in irrigation water requirements. In the UK the demand for industrial, non potable water has declined over the last 30 years as heavy manufacturing and extractive industry has declined. Industry is being encouraged to switch from potable water supplies to raw water abstraction. In contrast the agricultural demand for water for irrigation has grown. This will continue if the forecasts of warmer drier growing seasons in the arable dominated areas of the UK prove accurate. This analysis primarily concerns potable waters.

## **Perspectives and Definitions**

There are two rather different perspectives on water demand which result in two definitions. The older perspective is that of the water engineer operating at a time of resource plenty and with no metered customers. The definition of water demand by this group was the amount of water that was required to be put into supply distribution from the treatment works. As more customers became metered, as water was recognised as a scarce resource and consequently as the economics of water allocation became more prominent, the demand for water by customers rose in importance. The definition today then is the amount of water required by a customer (strictly at a specified price). There is a big physical water requirement difference

between these two perspectives and definitions. The difference is the water needed for leakage, operational and other requirements (see elements of demand below). Reported demand varies between companies and, by a surprising amount, from year to year (Table 1). In 04-05, Thames Water reported a per capita consumption of 160.57l d<sup>-1</sup> for unmetered customers although that has proven to be a low water use year for that company.

**Table 16 Company estimates of average household consumption (l/head/d)<sup>1</sup>**

	2001-02	2002-03	2003-04	2004-05	2005-06
<b>Water and sewerage companies</b>					
Anglian	137	143	146	143	144
Dŵr Cymru	150	150	149	151	150
Northumbrian – North East	147	145	150	146	148
Northumbrian – Essex & Suffolk	161	155	164	158	160
Severn Trent	139	130	136	132	132
South West	151	153	160	161	154
Southern	161	159	162	157	153
Thames	159	162	162	159	164
United Utilities	142	146	148	142	142
Wessex	143	142	151	146	151
Yorkshire	147	144	147	145	145
<b>WaSC average</b>	<b>147</b>	<b>147</b>	<b>150</b>	<b>147</b>	<b>148</b>

*Table 1: Average household demand of water and sewerage companies 2001 – 2006 as self estimated and reported to OFWAT (see OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report Table 16)*

## The Elements of Demand

The water resources required to satisfy consumer demand are substantially higher than the consumer demand itself. The consideration of why this is the case can be subdivided into two elements (i) a non potable element prior to the treatment works and a potable element after treatment. After treatment water is required for the functions listed in table 2. Most of the elements other than household demand, are frequently gathered in the collective term ‘unaccounted for water’ (UFW). However in the OFWAT table this term is not used. Of interest is the unbilled component which is broken down to a legal and illegal component. For several companies the illegal

stolen water exceeds that used by the company as operational waters (for mains flushing, bearing lubrication etc.) Some companies have set up specific task forces and call numbers to report illegal use of water.

	T10 L17	T10 L18	T10 L19	T10 L20	T10 L16	T10 L24	T10 L25	T10 L25
	Water taken=unbilled			Water delivered and input				
	Legally M/d	Illegally M/d	Total M/d	Water delivered M/d	Operational use M/d	Distribution losses M/d	Distribution input M/d	Total leakage M/d
<b>Water and sewerage companies</b>								
Anglian	14.1	2.5	16.6	991.6	19.0	152.9	1,163.5	213.6
Dŵr Cymru	7.4	1.0	8.3	666.1	7.0	192.9	866.0	224.2
Northumbrian – North East	5.3	5.0	10.3	598.6	13.3	109.7	721.6	157.1
Northumbrian – Essex & Suffolk	3.1	3.8	6.9	422.9	1.6	43.5	468.0	66.6
Severn Trent	13.9	14.2	28.1	1,616.5	4.6	325.3	1,946.4	542.0
South West	8.9	6.2	15.1	381.7	6.4	61.8	449.9	84.3
Southern	5.2	3.5	8.7	504.3	1.1	76.2	581.6	92.8
Thames	25.4	17.0	42.4	2,168.4	8.7	623.5	2,800.6	862.4
United Utilities	25.1	10.4	35.5	1,527.4	5.8	406.5	1,939.7	477.4
Wessex	3.7	1.1	4.8	311.0	6.2	53.5	370.7	73.2
Yorkshire	32.1	12.3	44.4	1,057.1	9.5	228.0	1,294.6	296.7
<b>WaSC total/average</b>	<b>144.2</b>	<b>76.9</b>	<b>221.1</b>	<b>10,245.4</b>	<b>83.3</b>	<b>2,274.0</b>	<b>12,602.5</b>	<b>3,090.5</b>

*Table 2: The elements of demand by company, operational use, unbilled usage, and losses breakdown. Data synthesised from table 18a of OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report*

Before water reaches the treatment works it may travel considerable distances from reservoir, rivers and boreholes and further water is lost in transmission. This 'leakage' is usually not counted within the normal 'leakage' reporting (as in OFWATs table above) as this is a less costly (untreated) water element. Many of the elements in Table 2 can be further subdivided. The leakage for example can be reported by location (as service reservoir, mains, company service pipe or customer connection pipe) or by time (night or day – which reflects pressures operating).

## Drivers of Demand

The drivers of demand are listed in Table 3 below. At the most fundamental level the sole driver of demand is people. Houses, and the water using facilities (taps, sinks, pools, toilets sprinklers washing machines etc - collectively known as the micro-components of demand) - that they contain do not use water. Importantly however, the way the population is assembled into households has an influence on demand and the water use by individuals (the per capita demand reported to OFWAT and others) is never measured since the individual is not the customer. The customer is the household albeit that in a single person household the household is the individual who is the consumer. Per capita consumption then is a **derived** measure of rather questionable value.

Driver	Influencing Factors
Population	Growth, Migration, Development
Household structure	Ethnicity, Housing, Planning
Household Affluence	
Cost of water	Tariffs, metering
Water using facilities	Consumer regulations
House Type	Building Regulations
Garden	Size, House type
Knowledge	Education
Information	Affluence, - proactive supply company

*Table 3: Drivers of demand and some influencing factors*

Table 4 below shows the latest publicly available figures for the demand for water across the water and sewerage companies (capturing many but not all the large water companies) of England. There is a broad north south divide with united Utilites, Yorkshire and Northumbrian reporting average demand in the 140 - 150 l per person

per day range and the ‘southern’ group of South West, Thames, Essex and Suffolk, Southern and Wessex reporting 150 – 160 l per person per day. Interestingly Severn Trent seems to be out of trend reporting a much lower demand than any other company. The table shows the demand by metered and unmetered customers. The difference is clear but surprisingly variable between companies.

	<b>2005/06 Overall PCC (Litre/head/day)</b>	<b>2005/06 Unmetered PCC (Litre/head/day)</b>	<b>2005/06 Metered PCC (Litre/head/day)</b>
<b>Anglian</b>	144	160	128
<b>Dwr Cymru</b>	150	154	129
<b>Northumbrian Nth</b>	148	148	143
<b>Essex &amp; Suffolk</b>	160	163	151
<b>Severn Trent</b>	132	137	118
<b>South West</b>	154	165	139
<b>Southern</b>	153	157	139
<b>Thames</b>	164	167	154
<b>United Utilities</b>	142	144	132
<b>Wessex</b>	151	157	136
<b>Yorkshire</b>	145	148	134
<b>Weighted Average</b>	<b>148</b>	<b>152</b>	<b>134</b>

*Table 4: Water & Sewerage Company Per Capita Consumption 2005/06 showing both metered and unmetered demand populations. Data from tables 14, 15 and 16 of OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report*

To some extent the difference might be due to the pressures used to promote metering or to the degree of meter penetration. In companies with many metered customers, less water efficient customers may be joining the metered cohort. However, Table 5 which shows the extent of meter penetration by company appears not to support such a presumption. Indeed it is clear that the higher penetration appears to be inducing significant difference between metered and unmetered customers. Strong encouragement towards a universal metering policy perhaps (although the economic rationale will depend on who pays for the meter).

	<b>2005/06 Metering %</b>
<b>Anglian</b>	55
<b>Dwr Cymru</b>	23
<b>Northumbrian Nth</b>	13
<b>Essex &amp; Suffolk</b>	37
<b>Severn Trent</b>	26
<b>South West</b>	51
<b>Southern</b>	29
<b>Thames</b>	21
<b>United Utilities</b>	19
<b>Wessex</b>	35
<b>Yorkshire</b>	29
<b>Average</b>	<b>28%</b>

Table 5: Water & Sewerage Company Meter Penetration of Billed Properties 2005/06  
 Data calculated from table 18b of OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report

The direct use of water is through the water using or supplying facilities of the home such as taps, showers, washing machines etc. These are known as micro-components of demand. Just owning such a facility however does not mean it can be used to determine the additional water use of that household. After all the purchase of a second toilet will not double the natural functions for which the facility caters. Instead it is necessary to determine three factors (collectively known as OVF values) relating to each micro component within a population namely (i) the ownership, (ii) frequency of use and (iii) volume per use (which itself may be a function of rate and duration of use per 'usage'). Since such a facility may be used for different functions (an outside tap for example may be used for car washing – say 10 minutes use, or for garden watering, say 3 hours if connected to a sprinkler system) the use of micro components contains some significant challenges. The dynamics of many of the micro-components is related to the household size through the frequency of use. However not all components display such a relation. Some are attributes of the property. Garden watering will depend more on whether the property is a flat or a house with a large garden than whether there are one or two persons in the household.

Table 6 below lists micro components and suggests OVF values. However even this level of disaggregation leaves questions. For example the maximum flow rate of a tap appears quite different from the average flow rates, which is the appropriate value to use? Manufacturers claimed volume per use of the appliance may vary from the actual and the appliance may have several different programmes which use different amounts of water. Thus decisions relating to OVF both regarding current and future use will contain variations based on the assumptions used. The water industry uses ratings of the confidence that they have in the data to indicate the extent of the possible variance.

Micro component	Measure used	Volume or flow rate per use	Ownership (Max = 100)	Frequency of Use (# of uses/prop/day)
WC	Actual Flush Volume	9	100%	11.5
Basin Taps	Max Flow rate (l/min)	6	100%	17
	Avg Flow rate (l/min)	3.1		
Kitchen Sink Taps	Flow rate (l/min)	13/5	100%	24
	Effective Flow rate (l/min)	3.1		
Outside Taps	Nominal Value (l/min)	18	60%	0.9
Non power shower	Water use per visit (l)	25	80%	1.5
Power Shower	Water use per visit (l)	67	20%	1.5
Bath	Bath Volume (l)	225	100%	0.9
	Water use per visit	73		
Washing Machine	Manufacturers estimate (l)	60 <	100%	0.8
	Volume per use (l)	65		
Dishwasher	Manufacturers estimate (l)	20 <	40%	0.7
	Volume per use (l)	20		

*Table 6: The micro-components of demand and associated OVF values*

## **Peak and Average Demand**

Like energy requirements, the demand for water is far from constant. The demand for water is the interaction of three cycles plus some semi random perturbations. The first cycle is the daily cycle of our lives. There is fairly short intense morning peak associated with washing and cooking followed by a trough which ends on the return from school, work and the activities of the evening which appear as another longer somewhat less intense peak demand which dies off almost completely overnight before starting again the following day. The second element is a weekly fluctuation that shows the differences in demand between the weekend and the working week. This is a cycle that is variable between supply areas depending on whether the supply area is predominantly commercial or domestic. The final cycle is annual and relates to higher winter and summer demands resulting from garden irrigation requirements and increased leakage resulting from freezing or ground drying. Periods of exceptionally good or poor weather will influence water demand (although this appears to be a surprisingly weak driver) as will statutory hosepipe bans and requests for water conservation.

A significant proportion of investment is targeted towards the continuity of supply in the face of peak demand. Pumping capacity, the size of service reservoirs, pipes etc are all based on peak demand. So cutting average demand by a small amount will have little effect on investment requirement if peak demand is not also reliably reduced. Indeed if all customers were metered water company income, in such circumstances, would decline by a greater amount than the decline in investment required. This could have complex outcomes. In the longer term universal smart metering and associated tariffs may be an important direction to take if water is to be conserved.

## Metering and Tariffs

The UK is near unique in the developed world in having a water system that is not measured at the point of delivery and charged accordingly. Only about 26% of the households in the UK are metered. The majority are unmetered. This statistic is regionally highly variable. In Thames Water (04 – 05) about 20% of customers were metered (2,551,693 households were billed unmetered and 654,478 were billed metered.) In the southwest and in Anglian region the figure is approaching 50%. This unusual situation arose because the UK was the earliest developers of a national domestic piped water supply system (as a response to major public health problems in the rapidly expanding cities and town of the industrial revolution). The situation however exists and it is essentially an economic (political and ethical) choice as to whether all customers should be metered. Most customers who are metered have chosen to opt for a meter. They are a highly-biased; self-selected sample and do not represent, *at all*, the levels of water demand that would arise if all the population were to be compulsorily metered. On aggregate metered customers use significantly less water than unmetered customers (for Thames Water 152.86 and 160.57 l d<sup>-1</sup> respectively) and so the seductive simplistic and highly erroneous conclusion is that if all customers were metered there would be a significant (5 to 6%) lowering of demand. Yet conversely this is the level of demand reduction found in the national metering trials on the Isle of White when no self selection was involved. However such a highly publicised trial and the 'selected status' of the experimental subject raises concerns about applicability to a more general population.

It was once said that water was 'dirt cheap' – it's much cheaper than that! One could not get a cubic meter of dirt delivered to the door for the £2 – 3 currently charged for that volume of water. The result is that at the tariffs currently available our demand for water is inelastic to price. That is the price moves but the demand does not. We will not modify our water using habits unless there is a *major* change in the price of water at which point there may be logic in metering. However a major change in water

prices may impact upon the poorest families and may have consequences for public health. As a result of such public health possibilities water companies are not allowed to cut off supplies in the same way that other utility companies can. The result of this is that the numbers of people who simply refuse to pay their water bills is significant in the water industry as there is no final sanction. The House of Lords Report on Water Management was particularly concerned about this 'loophole'. Such issues are not irresolvable. The maintenance of public health can be achieved by the provision of a modest amount of water. This minimum daily allowance could be provided free or at very low cost with increases in price for additional water. Such additional waters could be purchased in advance where there was a history of bad debt. This could be achieved for example through smart metering and automated daily cut-off which would ensure the required minimum for hygiene, washing and cooking but cut out the extravagant use of unpaid water.

Meters are a relatively crude instrument. They record only the gross amount of water passing through that meter in the reading interval. However recent national research initiatives have started to examine 'smart' meters which record the amount of water used at different times of the day or the rate at which water is used. This information allied to changed tariff structures might be used (i) to control peak water demand and (ii) to alleviate the hazard of high tariffs to water poor households. For example to tackle the former issue the price of water at peak times (say summer) could be substantially increased to encourage roof water capture and water reuse. Evening peak use might be encouraged to reduce or delay the use of garden sprinklers. To address the second issue, customers could be provided with a basic quota of water at a low (or even zero) price and further water could be priced at rapidly rising unit rates in a system analogous to that discussed above to counteract the potential of water poverty if no payment is addressed. Clearly there is an element of education that would be required to a public that has been trained over generations to believe that water is cost free. In addition to education, information on water use is required in a customer friendly format in (or near) real time in the home.

## Measuring Demand

If most of the customer base is unmeasured just how do we measure demand? There are two approaches (i) through domestic consumption monitors and (ii) through area meters. Domestic consumption monitors (DCMs) are operated by about half the large UK water services companies. A DCM is a large panel of water users who have their supply passing through a meter and logger but who pay on a rateable value tariff. The panel **must** be independent, random, representative and unbiased. This may sound straightforward but is in fact difficult to achieve. When DCMs were first being created some companies 'triallyd' their development by encouraging their own staff to join and these individuals often remained in the sample despite being clearly unrepresentative. Some local councils, at the time of the privatisation of the water industry a time at which DCMs were being developed, refused, presumably for largely political reasons, to allow their tenants to take part. The new water companies did not wish to contest whether the councils had any such right and accepted this refusal replacing the missing households not with other council tenants, but with more random selections from their billing lists which were a mix of owner occupiers, private tenants and public tenants. Done in good faith this resulted in a lower number of council tenants than would be expected.

These and other structural biases are minor however when compared to the financial and Hawthorn biases. Households entering the DCM were typically offered a small financial reward for taking part but more importantly they were to be informed of the amount of water they used and the relative advantages of their current vs. a metered tariff. If they chose to opt for a metered tariff there would be no charge for the meter. Not surprisingly large numbers are likely to have opted for the DCM because they saw themselves as likely to be low water users, could test this assumption and then gain a 'free' meter. Thus in some water companies the rate of opting for a metered tariff in the DCM cohort was triple the rate that existed in the whole population. The

Hawthorne effect is a well documented effect whereby a sample population will try to deliver the behaviour that they perceive the 'experiment' seek. Since the DCM managers specifically told the sample why the work was being done, reported to them annually on their performance and (if they had an internal meter and logger) reminded them every 12 weeks by downloading the logger, there is little wonder that the Hawthorne effect is present.

The significance of the demand by house hold size is seen in Figure 1 below

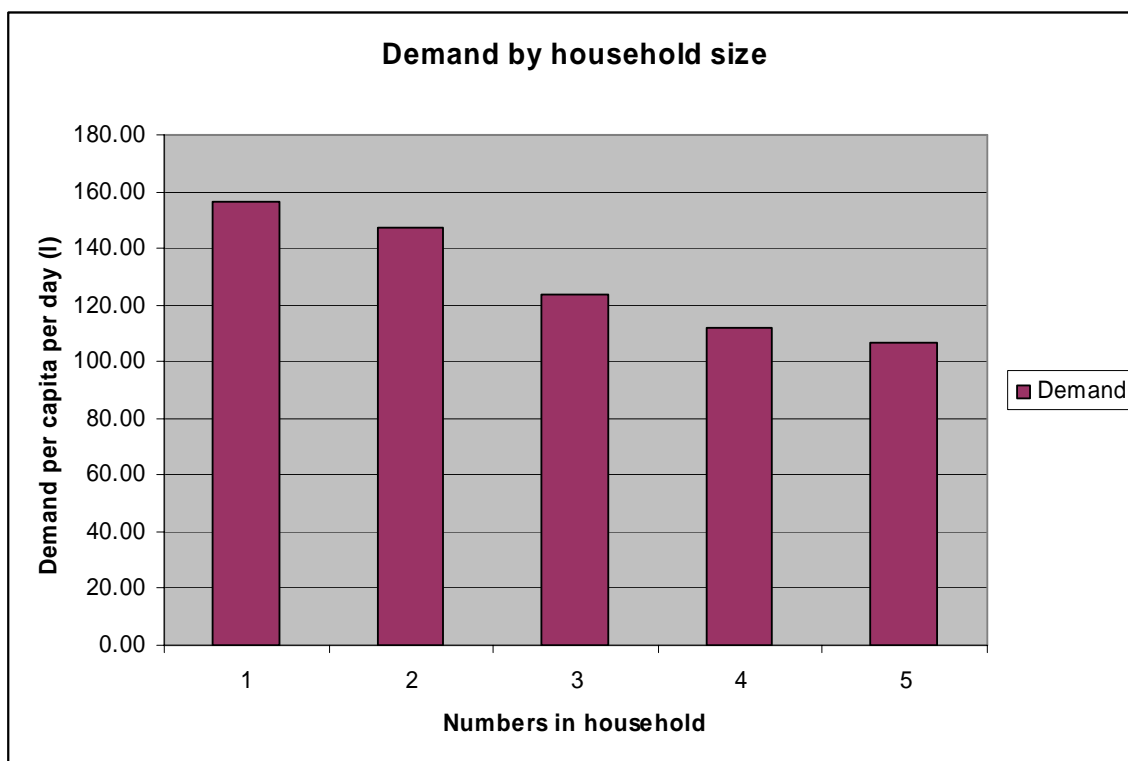


Figure 1: Demand per capita derived from DCM data for a large water company.

In an effort to respond to this effect one water company monitored a large sample of households by using meters placed in water company boundary boxes. Clearly this sample could not involve flats and there may have been some concerns relating to multiple uses in terraced housing but the outcome appears to indicate that the real use of water is substantially more than was previously thought from DCMs. DCMs

need to record also the attributes of the household which change due to births, deaths, separation, partnership and migration as well as more complex social dynamics and today these are updated annually. Interestingly, when the population that was observed independently, were (i) asked for and provided household attributes (ii) (from the remainder) were paid for the information and (iii) would not provide any information; the lowest water users in the three groups were those who provided information, those that were paid for the information were higher water users and those that refused were the highest water users. An indication perhaps of the more sophisticated perception of water use in a household than is the normally accepted.

Area meters, the second approach to demand measurement, work by measuring the flow into a defined area. Commercial use and estimated leakage is subtracted from the figure and an average household and per capita use is derived. The accuracy of this method depends on how representative the area is and on the estimation of leakage. Sample areas are usually chosen because of the presence of a reliable area meter, a stable area (unchanged by valve operation) and a relatively simple well documented population. The result is that the sites chosen are often 'cul de sacs' and similar sites likely to have new housing and a particular population subset.

## **Leakage**

Leakage is an important loss of water resources. Table 7 below shows the leakage by company and the trends in leakage. The data show a highly variable picture both between companies and between years. The differences between companies is driven by the populations to be supplied and by the built style of the housing which together govern the length of pipe from which leaks arise. This is further confounded by the ages of the piping, by the pressures involved (a function of topography) and by the ground stability (a function of drought and freezing, soil type and urban conditions).

However the fundamental message remains that some 3,000 million litres of water are lost daily through leaks.

	2001-02	2002-03	2003-04	2004-05	2005-06
Anglian	224	192	216	214	214
Dwr Cymru	245	234	231	226	224
Northumbrian – North East	161	153	160	155	157
Northumbrian – Essex & Suffolk	73	67	70	67	67
Severn Trent	340	514	512	502	542
South West	83	84	84	83	84
Southern	92	92	92	92	93
Thames	865	943	946	915	862
United Utilities	452	465	479	500	477
Wessex	79	75	75	73	73
Yorkshire	297	296	295	293	297
<b>WaSC total</b>	<b>2,913</b>	<b>3,114</b>	<b>3,160</b>	<b>3,118</b>	<b>3,090</b>

*Table 7: Water & Sewerage Company estimates of total leakage (Ml/d)*

*Data from table 9 of OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report*

There is no perfect comparative measure of leakage performance. Table 8 shows the leakage by company per property and per km of pipe to reduce effects of rurality and dispersion/concentration. However this does not address the question of topographic differences or freezing/drought. Recognising these deficiencies, Thames appears to have the highest leakage rates both per property and per unit pipe length. The ranking of the remaining companies varies with the measure used. The best performing companies per unit of pipe length are Anglian, Wessex and South West but measured per property the best performers are Southern and Essex and Suffolk. Returning to Thames Water, the high leakage value leads one to question whether gross demand can ever properly reflect the population attributes of such a dynamic city in which a partially unknown weekly and seasonal tidal flow of people will arise. Further a DCM aligned to national guidelines will be a smaller sample than that in other companies.

	<b>Leakage per Property per day</b>	<b>Total leakage (m<sup>3</sup>/km/day)</b>
Anglian	108	6
Dwr Cymru	167	8
Northumbrian – North East	136	9
Northumbrian – Essex & Suffolk	86	8
Severn Trent	163	12
South West	113	6
Southern	90	7
Thames	244	28
United Utilities	152	11
Wessex	132	6
Yorkshire	138	9
<b>WaSC Average</b>	157	11

*Table 8: Water & Sewerage Company estimates of per property and per pipe length leakage (Ml/d). Data from tables 10 & 11 of OFWAT Security of Supply, Leakage and Water Efficiency 2005-06 Report*

Leakage is only a direct part of this analysis if the 'ex-treatment works' definition of leakage is accepted. However, since leakage is determined through demand there is an indirect need to consider leakage. Large leaks are detected by (i) the sound of the escaping water (using listening sticks or microphones and correlators, (ii) changing geophysical properties detecting using for example ground penetrating radar and (iii) changing surface characteristics detected from for example infrared scanners (or visually!). However the detection and quantification of insidious leakage is derived from the lowest night-time water use (the nightline) from which an allowance for legitimate water use is removed (currently this figure is 1.75l/pp/hr). The residue is deemed leakage. This is sometimes further reduced by recognising formally that the higher night-time water pressure increases leakage or informally by calculating a day leakage rate by multiplying by a 20 hour day.

Finding and fixing leaks is expensive. There is clearly a calculation that determines whether it is economic to repair a leak or not. If the cost of repairs or renewal exceeds the cost of the water saved then it is not economic to continue with the intervention. The full portfolio of costs needs to be considered including the public perception of the efficiency of the company if visible leaks are untreated and the disruption to traffic while repairs are implemented. The degree of risk involved is also a part of the overall assessment. If a significant leak would mean that a company failed to achieve standards of service then this risk might cause action to be taken. If however the price of water were raised to promote conservation based on new tariff arrangements, it is very likely that the cost of the water would be raised (with raw water being purchased from the EA for example) and so the whole leak repair economics would be moved to a different plain. Why might this happen? The Water Framework Directive requires that a programme of measures is specified and enacted to a timetable to deliver every river reach in Europe to good ecological status. This requires investment and where some water has been removed from the channel to supply the water lost through leaks, that investment is likely to be higher as there is less water to dilute effluents and a greater likelihood of damaging low flows. Thus there is a good case for more expensive raw waters.

### **Water Conservation**

Water conservation seeks to reduce the demand on water resources by either influencing habits and lifestyle to alter the fundamental demand for water, by the use of more water efficient devices or by substituting some of the demand by locally gathered water. Thus water conservation may be at the discretion of the customer or may be involuntary. Involuntary or non-discretionary conservation will arise when more efficient, water saving fixtures are required as part of the building standards. Voluntary conservation (the adoption of water saving devices and habits) will be driven by information, ethics and, fundamentally, by price. There is a limit however to the reduction in water demand that can be achieved whilst still maintaining the

lifestyle to which we have become accustomed. An alternative is to displace demand by capturing roof water or by reusing some household water (gray water). Extending the range of use to which such waters can be put and increasing the safety of such adaptations may well depend on the extent to which technology can economically monitor and, if required, 'purify' such water locally. There is little evidence from other, more mature conservation markets, such as the energy market, that uptake of water conservation will be successful. Water demand continues to grow at some 1 - 2% per year despite the water saving publicity associated with the severe droughts of the last 30 years.

An alternative then being raised in several influential places (Code for Sustainable Housing, House of Lords report, RSC Water Management Report) is to hard wire conservation into the housing through the building regulations, building standards and the planning system. DCLG and DEFRA have made a strong start by developing a set of proposals aimed at the new housing market. These proposals have been offered for consultation, a process that has now ended. They are seeking to drive down per capita consumption to 120 -135 l per day from the existing value of around 160 l per day. They have offered two approaches. The first sets a water standard for the house as a whole. Designers may still use water hungry devices but will have to compensate with highly water efficient devices to arrive at a planned consumption. The second approach limits the availability of water using devices only to those which are inherently more water efficient. This latter approach is thus more aggressive and reduces choice. The former more liberal approach will suffice if renewals broadly refit with water efficient devices and if a similar plan is evolved to tackle water use in the much bigger 'existing' properties market. However this will be much more problematic possibly tying efficient water use certification to house sales or to a condition of the planning approval for house change that involves and plumbing work. If the more aggressive approach, which limits availability in the market to only more water efficient facilities, is implemented there will be a slow transformation of the housing stock to more water efficiency without draconian legislation. Further

renewals to both new and existing housing will only be made with efficient fixtures. The conservation performance of the energy industry has identified several failures and anomalies which has held back energy saving for decades. Now the incandescent light bulb is to be removed from the market and only energy efficient bulbs will be available. Given a choice consumers opted for the cheap, well known but inefficient. This perhaps indicates that a similar approach to market availability will be required in the more challenging water conservation market.

### **Future Water Demand**

How will the demand for water grow in the future? All of the demand drivers appear to be promoting further demand for water. The UK is the focus of substantial immigration from the enlarged European Community. Household size is declining and by 2030 the single person household is likely to be the norm. This alone will drive up demand. The forecasts for climate change for the populous south east suggest drier, more drought like conditions. This will have a further effect on water demand. The growth will be spatially varied. The south east is expected to require substantial new housing and both internal and external migration may be focussed on that region. Transient populations of commuters for example will be hidden from the normal measures of drivers of water demand and so this growth will be hard to predict, understand and plan for which, given the long gestation time of water resource development projects, is a serious concern.

To supply this demand will require the holistic approach long advocated but of limited application. Conservation will have a place driven by lifestyle influencing, regulation and fiscal incentives but it will never be the panacea sometimes suggested. New water resources will be required and the acceptability of using treated waters will have to be influenced. Standards of service may have to be relaxed but the benefits of such relaxation on infrastructure and resource requirements will have to be clearly displayed. Finally the place of inter-regional support (and here a national grid

providing all water resource requirements is **not** advocated.) between companies will have to be considered. Stand alone resource companies are a costly independence in out more drought prone world.