20th WEDC Conference
Colombo, Sri Lanka, 1994
AFFORDABLE WATER SUPPLY AND SANITATION

# Leakage and demand management

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WATER HAS LONG been thought of in many countries as a plentiful resource. In other countries it has always been scarce but wherever, increasing demands for potable water plus increasing demands from agriculture and industry mean that there is now more competition for existing water resources. Unlimited cheap supplies of clean water are no longer possible in many countries, and significant planning of how resources should be managed to achieve an equitable and economical distribution of the water is required.

As demands for water rise to meet the capacity of existing sources, pressure to exploit the remaining available resources mounts. Many options may arise for meeting demands. These options may include:

- new source works
- transfers from regions with water to regions without
- new storage schemes
- management of demands to reduce the pressure on resources
- conjunctive use of surface and groundwater schemes
- re-designation of planning areas within catchments to allow different qualities of water to be used
- control of leakage
- more unconventional options (such as icebergs)

These options, when considered with the legislation, planning, organisational and economic implications, can form a Strategic Planning of Water Resources study. Such a plan will avoid haphazard and piecemeal development of sources, avoiding lack of control, inefficiency and over utilisation which may result in environmental damage. In one large country in the southern hemisphere, academics have recently come to the conclusion that poor planning of their national water resources is leading to severe restrictions in economic growth.

So how much effort needs to be spent on reducing leakage and on other forms of Demand Management and what is the validity of a Demand Management programme, within a wide ranging Strategic Resource Strategy?

Demand management techniques include water saving technology, economic incentives, regulations and consumer education. They can be split into two categories; intermittent and continuous.

In the intermittent category are those measures which can be introduced when the normal demand / supply relationship goes out of balance. These include:

- Hosepipe and sprinkler bans
- Drought order
- Campaigns for voluntary savings
- Rota cuts
- Use of standpipes

These measures have increasing effectiveness. In the UK, past calls for voluntary savings have obtained reductions in demand of the order of 15%.

The Director General has now made each water company agree a Level of Service Indicator, which sets return periods for these measures. Thus their use is restrained.

Continuous demand management measures include:

- Metering
- Tariff Structures
- Water Using Appliances
- Consumer Education
- Leakage and Waste Prevention
- Pressure Reduction

## Metering

Metering of Domestic Consumption together with an appropriate tariff is an effective way of managing demand, since it imposes an economic incentive on the consumers to reduce wastage, leaks and uneconomic use of water.

The UK National Metering Trials project was set up in April 1989 to provide information on the costs and benefits of widespread domestic metering. The Metering Trials Final Report (Ref. 1), recently published, gives the results from the running of the trials over a three year period covering:-

- Installation Costs
- Operating Costs
- Customer acceptability and effect on bills
- Meter location
- Effect on demand
- Technology

The Trials covered 60,000 households in twelve trial areas in England, one of which, the Isle of Wight, was a large scale trial involving 50,000 properties.

The trials have confirmed that domestic metering can influence the amount of water that customers use. In the small scale trials, the average reduction in use was 11%. In the Isle of Wight trial, a 21% saving in household use was estimated due to metering. At the same time, a 22% drop in water put into supply was noted, indicating significant reductions in leakage. However, other factors will have influenced customer demands such as; housing density and type, location, weather, occupancy, public awareness of conservation, tariff etc, but these are difficult to quantify.

On the basis of these trials, it is reasonable to conclude that the introduction of universal metering in a similar environment could result in household demand savings of 5% to 10%. Savings in leakage can also be expected.

In the UK, the Regulating bodies are promoting the concept of reviewing the possibility of introducing meters on a selective basis to control demand before they are willing to consider applications for new licences, particularly if they are for controversial schemes such as reservoirs or ground water supplies. Some supply companies openly embrace the concept whereas others are less keen suggesting that the effects will be shortlived, representing blips in a steadily rising demand curve, and only postponing the need for new resources by a few years.

Metering will undoubtedly involve significant investment, costing around £200 per household. The tariff will also have a key effect on control of demand; for instance if set too low, it could perhaps increase demand.

There are many other complications such as the question of metering blocks of flats or any other properties sharing supply pipes, and also the cost of maintaining and reading the meters once installed.

The effects on customers' bills and hence their acceptance of metering as a fair system of charging may well be significant in any public debate. Results from the National Metering Trials showed that over 70% of households accepted that it was reasonable to meter water. However, the trials were not wholly representative of the socio-economic distribution nationally. Low rateable value properties do not currently pay a level of charge which is proportionate to their water use, thus the introduction of water meters would mean increasing bills for this group.

In a situation where a significant number of low income households would be paying more for their water, then any public relations exercise would have difficulty in gaining majority acceptance for universal metering.

The effect of metering on demand elsewhere may well be less than experienced in the UK metering trials, particularly if the climate is cooler and wetter than Southern England where most of the trials were located. Less external usage on garden watering etc. will then be evident hence the average per capita demand could be lower.

The economic and environmental benefits of universal metering can outweigh the costs where water resources are scarce, and where development of new sources and infrastructure is more expensive than for an area with adequate resources. For example, Anglian Water have declared their commitment to universal metering, whereas many other UK water companies have not.

## Tariffs

In deciding the costs to be recovered from different customers, companies need to allocate costs in a number of ways:

- between water supply, sewerage and drainage
- between metered and unmetered consumers
- between fixed standing charges and measured charges

Most metered tariff structures in operation throughout the world, fall into four groups:

- Fixed charge plus uniform volume charge
- Fixed charge plus decreasing block volume charge
- Fixed charge plus increasing block volume charge
- Fixed charge plus seasonal / peak / volume charge

Uniform volume charges are simple and easily understood.

Decreasing Block Volume charges is the most common two part tariff and is where the unit volume charge decreases as consumption increases. It is widely used in North America and in some areas in Australia and Western Europe. Declining block tariffs do not encourage water economy and tend to discriminate against small water users.

The use of decreasing blocks has been criticised, particularly in areas where new water sources are expensive to develop. Their use internationally has gradually been reduced during the 1980s.

By contrast, the use of Increasing Block tariffs (where the volume charge per unit increases as consumption rises) has gained in popularity over the last decade. Examples of such tariffs can now be found in Europe and the USA.

Clearly, as the same supply of low priced water is given irrespective of family size, large families are allowed less per head and these may easily move into higher priced consumption blocks.

Increasing block tariffs are used to curb demands and are designed to ensure that customers demanding large volumes of water realise the high costs involved in developing new supply sources. Japanese water undertakings, have adopted this rationale in the design of their tariffs.

The Seasonal Tariff is today gaining in popularity, particularly in the United States. The basic idea is that, since peak summer consumption costs more to meet than winter consumption, then the price should reflect these excess costs.

One scheme is to combine block and seasonal tariffs. Winter use provides the 'block' and only excess consumption in the summer over winter volumes is charged at the higher rate.

Although it is superficially attractive, this tariff does not seem an improvement over the simple season tariff. A cubic metre saved in the summer is of equal value whether saved by someone with high winter consumption or low winter consumption. It discriminates against those who, for whatever reason, use little water in the winter. Indeed, there can be perverse incentives to consume a little more in the winter. This tariff structure is probably of less advantage to large families than appears on casual inspection.

It is argued that customers with meters should have the genuine opportunity to influence their bills, hence fixed charges should be low. But the disadvantage to the companies with this approach is that revenue is more uncertain because seasonal demands and economic recessions become considerable risks.

Some suppression of demand is therefore expected if the sliding scale of tariffs is pitched correctly.

Comprehensive debate (Ref 3) is ongoing in the UK water industry on the subject 'Paying for Growth'. Reference can be made to the related documentation for details and viewpoints including those on charges for measured and unmeasured consumption.

Whatever tariff structure is adopted, it needs to achieve:

- fairness and equity
- sensible incentives to customers and to companies
- simplicity and comprehensibility

## Water using appliances

In the UK, water used in various household activities is typically (litres / head / day):

| | |
|---|---|
| • toilets | 35 |
| • clothes washing | 20 |
| • dishwasher | 11 |
| • baths and showers | 36 |
| • outside | 9 |
| • cooking, cleaning, drinking etc | 35 |
| | 146 |

Toilets and washing therefore currently account for about 70% of average household daily consumption. In any assessment of future demands, changes in the rate of use of water using appliances and the volume per use must be taken into account.

In the UK, it is generally considered that toilet usage will remain static, but that the volume per use will reduce gradually as new houses are built and existing systems are replaced with the lower capacity cisterns now required by the 1991 Water Regulations. An average reduction after 10 years of only about 1 l / hd / day is expected.

Bath and shower use is often forecast to increase due to increased emphasis in personal cleanliness and the likely increase in the number of power showers. Usage in showers and baths is affected primarily by personal habits and preferences. While household supplies are unmeasured, no major constraint on the forecast growth in this component of usage is foreseen.

In the UK, the volume per use of both automatic washing machines and dishwashers is expected to reduce by around 25%. However, increased ownership and usage are expected to offset these reductions.

The size of washing machines and dishwashers is determined by the manufacturers who are more constrained by reducing operating cost, i.e. power, rather than conserving water. European manufacturers may be more affected by 'green' policies and customer support for conservation. If all machines are limited to approximately 85 litres / wash, it may be possible to reduce demand by about 3 l / hd / day over their 10 year life. Until water consumption becomes a significant element in the choice of machine, there is little incentive on manufacturers or consumers to achieve these savings.

Apart from the above, it is generally concluded that there are no real opportunities for further demand management of water using domestic appliances.

## Consumer education

Publicity campaigns give the opportunity for public education in the work of the Water Companies and to make people more aware of the effects of wastage and extravagant usage. In a drought situation they should be used as a preliminary stage prior to the introduction of restrictions.

Advice can be given on how much water is needed on a garden, and perhaps the public can be encouraged more to use native species of plants and water butts to reduce water taken from the distribution system.

In discussions with System Managers, there is often general agreement that publicity campaigns are an important part of public relations, but that they make little difference to the level of demand.

Commercial and industrial customers in both the private and public sectors are usually very aware of the cost of water. In one area of UK, the dual effect of increasing water charges and the introduction of trade effluent charges have resulted in significant effort by major customers to reduce leakage and waste and to increase recycling of process water. The effect of this is expected to reduce industrial and public sector demand over the next 10 years, and thereafter to reduce the rate of growth as new industries have more water efficient processes.

In commercial premises, retrofit devices are now being used to prevent wastage, particularly in toilets.

## Leakage and waste prevention

Considerable effort is now being expended in an attempt to understand what happens to the water after it leaves the Treatment Works.

Terms such as 'unaccounted for water' are being phased out as new terminology such as 'Water Delivered' and 'Distribution Losses' are adopted. Water Delivered is, what it implies, water delivered by the water company to the consumer. It has many sub categories - such as domestic unmeasured, domestic measured, commercial non measured etc.

'Distribution Losses' includes leakage upstream of the 'Point of Delivery' to the customer and is the area where the water company can, by a structured and organised approach, implement system and management policies to save water.

Leakage and waste are significant components of distribution input. Measures which can reduce losses will be of considerable benefit since leakage control has an influence on customer charges, financing of future growth and allocation of water resources. Those factors which can influence leakage are summarised as:

- pressure management
- refurbishment of mains
- replacement of corroding service pipes
- refurbishment of internal plumbing systems
- leakage control programme

In areas of high pressure, reduction in pressure can produce significant savings in leakage and reduce wastage in the house. Reductions in pressure from 70m to 40m can halve leakage levels. Pressure reduction should be a high priority where it is possible.

Refurbishment of mains and replacement of service pipes is more likely to be driven by the requirement of water quality. However, significant proportions (in the region of 75%) of distribution leakage is thought to come from service pipes. Such rehabilitation measures will therefore produce reductions in leakage.

Leaks on customers' properties are not the responsibility of the Water Company. When leaks are detected, notices can be issued instructing the customer to organise repairs. No significant improvement to this system is usually envisaged unless the leak is downstream of the water meter and the customer realises he is paying for wastage.

Improvements in the technology available to monitor and detect leaks will reduce the level of leakage. Continual Night Flow Monitoring is becoming the standard practice. By setting up District Meter areas, and then monitoring the flow into the area each night (either by telemetry or by a locally placed logger downloaded at regular intervals), any change in Net Night Flow can be quickly identified and further investigative work carried out to pinpoint the leak. Recent research work has highlighted that although major bursts lose high rates of water for short periods, more water is lost through smaller leaks running over much longer periods. Hence, it is important to reduce the period over which these leaks are allowed to run. The Industry textbook on leakage is the STC Report 26 (Ref 2). This book, now 15 years old, introduced many concepts, but is becoming obsolete due to technical advances in the industry, and there is currently a National Leakage Initiative (NLI) which is updating Report 26.

The NLI is producing some interesting results, including the need to quote leakage in terms of $m^3$/day/km rather than $m^3$/day, and the impact of distribution pressure on leakage. This very interesting work is ongoing and will be fully reported in the near future.

Summarising, demand management, in particular leakage control, has come to the forefront of the water industry's thinking. It is now a high profile subject and more information is becoming available. What remains undisputed however, is that a successful demand management and leakage control programme will reduce operating costs, enable better use of resources and defer capital expenditure, all to the benefit of the investor.

## References and acknowledgements :

1. The National Metering Trials Working Group: WSA, WCA, OFWAT, WRc, DoE, 1993
2. UK Water Industry National Leakage Control Initiative
3. Paying for Growth : Consultation Paper, Office of Water Services, February 1993 and subsequent support documents.

Acknowledgement is given to Mr CJA Binnie : Managing Director, Mr TEA Askew : Divisional Manager (Water) and Mr JA Downer (Engineer), all of WS Atkins Consultants Ltd, for their support in the preparation of this paper.