BNWAT27: Domestic external water use: An overview

Version 1.0

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

1 Summary

This Briefing Note considers the relative importance of external water use in the domestic sector. Activities contributing to domestic external water use are summarised and an analysis of the social and temporal patterns of external water use is provided. Potential water-saving techniques that apply to external water use are considered in relation to the activities they may influence.

For the purpose of this document, domestic external water use refers to any potable water that is consumed outside of the domestic dwelling after being drawn from the mains distribution system. External use of rainwater or greywater is not included in the definition of external water use because this does not require any further water to be drawn from the distribution system and therefore does not add to the domestic level of water demand. However, it is recognised that in periods of peak demand of external water, rainwater and greywater might require mains-fed top ups, either for the external use or to support other appliances which use this recycled water such as WCs.

External water use is related to season, Peak days[1], socio-economic class[2] and time of day. The proportion of domestic water use that is consumed by external usage is heavily influenced by these factors, as is the total volume of external water consumed. The influence of seasonal and climatic factors upon external water use means that there is a likelihood of high external water demand occurring during periods of water stress and shortage. Reducing the quantity of water consumed externally could help to minimise the impact of such shortages and decrease the overall level of domestic water consumption.

2 Activities contributing to external water use

There are several different activities that contribute to total domestic external water use. The major contributors are summarised below.

[1] Peak days are defined and explained in section 3.2
[2] ACORN classes are defined and explained in section 3.1

2.1 Garden Watering

Garden watering is the largest component of domestic water use in domestic gardens. Watering can be done manually (by hose or by watering-can) or through sprinklers which can be operated automatically. Hoses and garden sprinklers can be very wasteful of water and a sprinkler can use the same quantity of water in an hour as an average family of four would use in a day[3]. The exact quantity of water used by a hose or a sprinkler will depend on the pressure and flow rate of the tap it is connected to and the duration of the activity. Hoses can use upwards of 540 litres of water per hour depending on the pressure and hose size[4]. Sprinklers typically use 540 to 1000 litres per hour[5,6]. Watering cans come in a variety of volumes, typically between 7 and 13 litres[7].

Automatic watering systems will water the plants in the garden at defined intervals or in response to certain conditions (eg low soil moisture). Micro-drippers (2 to 4 litres per hour[8,9]) and soaker hoses will supply small quantities of water to plants frequently. Sprinklers can also be connected to automatic watering systems.

2.2 Vehicle Washing

The cleaning of private vehicles is another common external use of water. Car washing is either done either with a hose, or with a bucket and sponge, which generally uses less water.

2.3 Ponds and water features

Many gardens in the United Kingdom contain a pond or other water-feature. Garden ponds can be either built using a pond-liner or purchased as preformed pools. Ponds can be many different shapes and sizes. This is particularly the case for liner-ponds since these are built to fit the installer's specifications. Preformed ponds also vary in volume, with typical examples ranging from 150 to 4500 litres[10]. The use of a filter (or a complete eco-system) ensures that pond water does not need replacing. This means that a pond, once filled, will require only small quantities of water to top up any evaporation or water loss through splashing that occurs. This topping-up may occur naturally through rainfall. A pond should only need emptying and refilling in the event of a leak, but some are routinely emptied for cleaning.

Separate water-features (eg pebble pools, hollow rocks) recycle the water used however water would be lost via evaporation which would need to be replaced. The volume of water they require is dependent upon the size of the feature and the related sump (water reservoir). A typical sump for a larger water feature may have a

[3] http://www.environment-agency.gov.uk – Accessed 18/12/07
[4] http://www.3valleys.co.uk – Accessed 18/12/07
[5] SNIFFER, 2004, Valuing water use in Scotland and Northern Ireland for WFD implementation purposes
[6] http://www.communitywatergrants.gov.au fact sheet – Accessed 18/12/07
[7] http://www.diy.com – Accessed 18/12/2007
[8] http://www.diy.com – Accessed 18/12/07
[9] http://www.hozelock.com – Accessed 18/12/07
[10] http://www.worldofwater.com – Accessed 18/12/07

volume of 150 litres, though larger sumps do exist[11]. Since ponds and water features recycle water, they can be viewed as single-event consumers of water. They consume a large volume of water when first installed but should require minimal or no further water consumption after installation.

2.4 Pressure Washers

Pressure washer systems can be used for cleaning patios and garden furniture, and for similar cleaning tasks in the garden. Pressure washers connect to a water source, such as an external tap, and deliver the water from a nozzle at high pressure. This high pressure increases the cleaning power of the washer and therefore reduces the time taken to perform the cleaning task. Several factors impact upon the cleaning power of a pressure washer:

- The distance from the surface to be cleaned to the nozzle of the pressure washer[12].
- The angle of the jet of water relative to the surface.
- The shape of the spray from the nozzle.
- The ability of the nozzle to rotate.

The shorter duration of cleaning time may reduce the quantity of water used in cleaning compared with a hose. Kärcher UK Ltd, for example, claims that its pressure washer uses, on average, only 40% of the water of a hose. This model can also draw water from a bucket or water-butt[13] [14]. The total water consumption of a pressure washer is dependent on a number of different factors, therefore it is not possible to state whether or not the use of them would result in a decrease in overall water consumption

2.5 Recreational water use

Water is also consumed outdoors for recreational purposes. The most significant of these in terms of volume are swimming pools, hot tubs and paddling pools. Domestic swimming pools can be installed either above or below ground. Below-ground (also termed in-ground) systems are custom-installed, while above-ground pools are often smaller and built from a standard kit. Swimming pools are expensive to install and maintain so are not common in domestic properties. The British Swimming Pool Federation (BSPF) states that the average volume of an in-ground pool is around 75,000 litres[15]. This is a significant quantity of water for domestic use. Once filled, swimming pools lose water through evaporation, splashing and backwashing of filters. Pools do not need refilling (except when repairs are necessary) but do require regular topping-up. The BSPF, in response to Defra's *Consultation on proposed*

[11] http://www.valuewaterfeatures.co.uk – Accessed 18/12/07
[12] http://www.diyfaq.org.uk – Accessed 18/12/07
[13] This is based on a flow rate of 6.6 litres per minute for a pressure washer and 58 litres per minute for a hose however the flow rate suggested for the hose is higher than would be typically delivered in the UK.
[14] Comment from Kärcher Ltd to Defra's *Consultation on proposed changes to powers to restrict non-essential uses of water*
[15] BSPF response to Defra's *Consultation on proposed changes to powers to restrict non-essential uses of water*

changes to powers to restrict non-essential uses of water[16], claims that an average-sized covered pool consumes an average of 66 litres of water per day. This is based upon a 30 litres loss through evaporation (this assumes a covered pool; a pool cover gives 80% heat retention; the average annual rate of evaporation of 3mm per day for an uncovered pool would increase loss through evaporation to 150 litres per day) and a fortnightly backwashing of the filter using 500 litres (averaged over the fortnight to about 36 litres per day)[17]. BSPF (which incorporates the British and Irish Spa and Hot Tub Association (BISHTA)) states in the same response that an average hot tub has a volume of 1500 litres and needs completely refilling every three months. This is an equivalent usage of about 16 litres per day[18]. These figures reflect averages and hot tub volumes can range from 400 to 2500 litres[19]. Manufacturers recommend that hot tub filters should be cleaned every two to four weeks. This is performed using a garden hose or tap and will add to the water consumption attributable to hot tubs[20].

Paddling pools are typically filled each time they are used and emptied afterwards. They can be 500 to 2000 litres in volume[21,22], though the boundary between paddling pools and the larger splasher pools is not well-defined. Splasher pools usually have a pump, filter and cover and thus can be left filled for longer periods of time. Volumes range from 5500 to 23000 litres[23]. Recommendations suggest that small pools (less than 4.6 metres in diameter and less than 93 cm deep) should be drained weekly if there is no pump and filter system[24].

3 Patterns of external water use

Data have been gathered to analyse the percentage of domestic water use that is external and any patterns within this external use. The proportion of domestic water use that is external was compared for five different sources. WRc (2005), Waterwise and the Environment Agency give similar values (7.3%, 7% and 6% respectively) while the two older sources (data from 1991 and 1998) show lower values (4.9% and 4% respectively)[25,26,27,28,29]. This variation may be due to either a difference in the measured datasets or an increase in the importance of external water use in the last decade. The WRc (2005) dataset provides data for external water use, which can be analysed using a number of different influencing factors that were recorded for each of the measured dwellings. The similarity in the overall percentage of domestic water

[16] Defra, 2007, *Consultation on proposed changes to powers to restrict non-essential uses of water*
[17] BSPF response to Defra's *Consultation on proposed changes to powers to restrict non-essential uses of water*
[18] BSPF response to Defra's *Consultation on proposed changes to powers to restrict non-essential uses of water*
[19] MTP Hot-tubs scoping study (due to be published in March 2008).
[20] http://www.splashspas.co.uk – Accessed 18/12/07
[21] http://www.ukpoolstore.co.uk – Accessed 18/12/07
[22] http://www.toysrus.co.uk – Accessed 19/12/2007
[23] http://www.splasherpools.com – Accessed 19/12/07
[24] http://www.poolstore.co.uk – Accessed 19/12/07
[25] WRc, 2005, *Increasing the value of domestic water use data for demand management*
[26] http://www.waterwise.org.uk – Accessed 19/12/07
[27] http://www.environment-agency.gov.uk – Accessed 19/12/07
[28] Downing, T.E., Butterfield, R.E., Edmonds, B., Knox, J.W., Moss, S., Piper, B.S., Weatherhead, E.K., (and the CCDeW project team), 2003, *Climate change and the demand for water*
[29] POST note 135, 2000, *Water efficiency in the home*

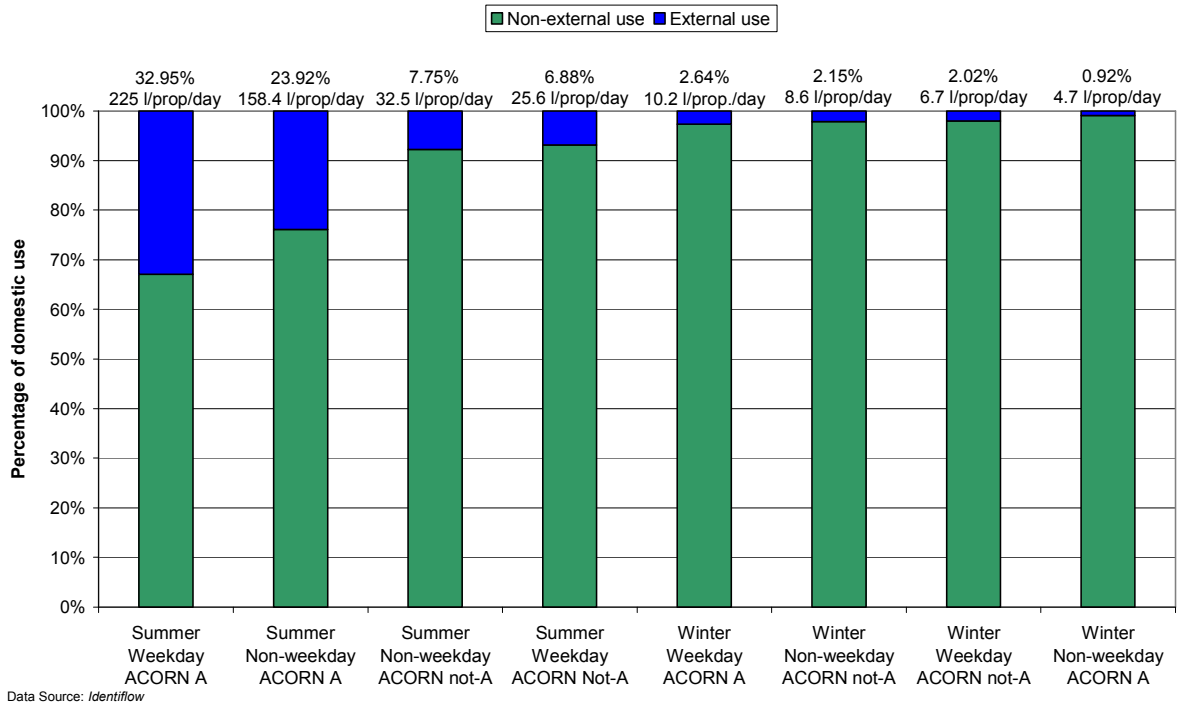
use externally between this dataset and other quoted values suggests that confidence can be placed upon the validity of these data. This dataset was therefore studied in depth for patterns relating to external water use.

Several factors were found to contribute to the relative importance of external water use following the analysis of WRc (2005) data. These factors were: season of the year; peak days and non-peak days; weekdays and non-weekdays; socio-economic classification; and time of day.

3.1 Socio-economic class

The ACORN (A Classification Of Residential Neighbourhoods) classification is a demographic system developed by CACI Ltd that classifies all postcodes in the UK into 'types', 'groups' and 'categories' based upon lifestyle variables and demographic statistics. Analysis of the data shows that domestic water use patterns are influenced by whether or not the dwelling is in ACORN group A (Wealthy Executives). Therefore, dwellings were classed as ACORN-A or Non-ACORN-A for the comparisons between patterns of external water use. The ACORN-A group comprises about 8.6% of the UK population[30]. Different patterns of water use have also been identified for weekdays and non-weekdays (weekends and holidays).

Figure 3.1 Comparison of external water use by season, day and ACORN-classification[31]



Data Source: *Identiflow*

Figure 3.1 shows external water use as a percentage of total domestic use for different seasons, days and ACORN types. It can be seen from the chart that external water use is a greater proportion of domestic water use in summer than in winter. This is expected since the warmer temperatures and drier weather

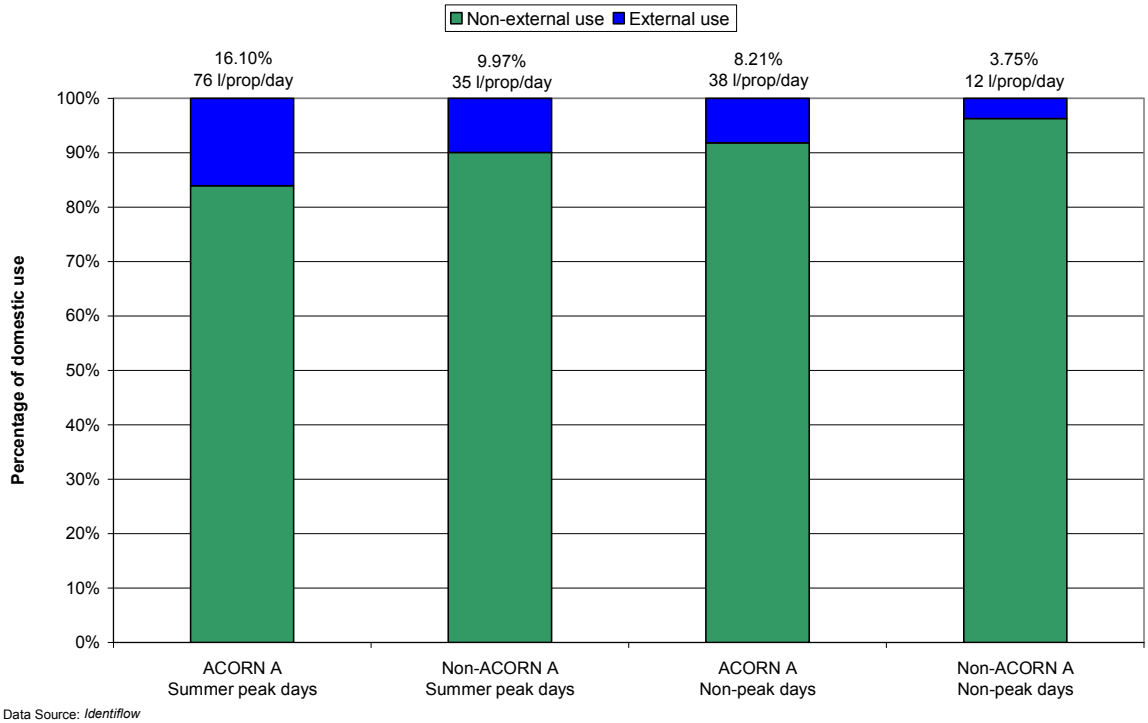
[30] CACI Ltd, 2004, *ACORN user guide*
[31] WRc, 2005, *Increasing the value of domestic water use data for demand management*

encourages people to spend more time in the garden and to use more water outside. The chart also highlights the higher level of external water use by ACORN-A properties. This is particularly noticeable in summer, when ACORN-A properties use around 199 litres more per property on a weekday than Non-ACORN-A properties and around 126 litres more on non-weekdays. This trend is not obvious in winter. On winter weekdays, ACORN-A properties use slightly more water than others, whilst on winter non-weekdays ACORN-A properties use slightly less water than others for external use, as percentages.

3.2 Peak and non-Peak days

The ACORN groups were also studied for Peak summer days compared with the rest of the year. For the study being analysed, a Peak day was defined as a day when the maximum temperature equals or exceeds 18°C and the daily rainfall is less than 2mm on the day and the two previous days. The pattern of daily usage is shown in Figure 3.2 for properties with two occupants on non-weekdays. The chart shows that for both Peak and non-Peak days the proportion of water used externally is higher for ACORN-A properties. External water use also accounts for a larger percentage of domestic demand on Peak days for both groups, as is expected.

Figure 3.2 Comparison of ACORN-classification by Peak and non-Peak days for two occupant properties, non-weekdays[32]



Data Source: *Identiflow*

Alternative sources record that external usage can account for over 50%, and even as high as 70%, of domestic demand on peak days[33,34]. Although such a high percentage was not found from the WRc (2005) data; this is probably due to the data

[32] WRc, 2005, Increasing the value of domestic water use data for demand management
[33] http://www.waterwise.org.uk – Accessed 19/12/07
[34] http://www.rhs.org.uk – Accessed 19/12/07

recording the average external water use per property over all Peak days rather than the maximum percentage of total demand used externally on any given day. External water use is the main driver of higher total domestic water use levels on Peak days. It accounts for 65% of the difference between Peak day and non-Peak day water use volumes on weekdays and 84% of the difference on non-weekdays.

The impact of Peak days on external water use suggests that regional differences in climate will produce different patterns and volumes of external water consumption. The average percentage of daily domestic water use that is external was calculated from WRc (2005) data for South-East and North-West England based on the number of Peak and non-Peak days each region experienced in a year. The higher number of Peak days in South-East England suggests that external water use is a more important component of total domestic water use (6.8%) than it is in North-East England (5.1%).

3.3 Daily and diurnal variation

The pattern of external water use as a percentage of domestic demand during the week was also considered and it was seen to be similar between weekdays and non-weekdays for both Peak (15.2% non-weekday, 14.0% weekday) and non-Peak (4.5% non-weekday, 3.5% weekday) days. The quantity of water used externally is higher on non-weekdays (17.5 litres/property/day on non-Peak days and 68.1 litres/property/day on Peak days) than on weekdays (11.8 litres/property/day on non-Peak days and 56.4 litres/property/day on Peak days). This increase matches the increase in non-external water use and thus the *percentage* of external water use is similar throughout the entire week.

The pattern of external water use shows most diurnal variation on summer Peak days. Figures 3.3 and 3.4 show the pattern of use throughout such days. These charts are based on the entire properties dataset and represent the average consumption across all of the houses[35].]

[35] Note, the unit of volume consumed is based on rolling hours, i.e. if the rate of water consumption in any given 15 minute period was sustained for 24 hours, the total volume consumed would be as per the bar.

Figure 3.3 Diurnal profile for rolling hourly water consumption on summer Peak weekdays[36]

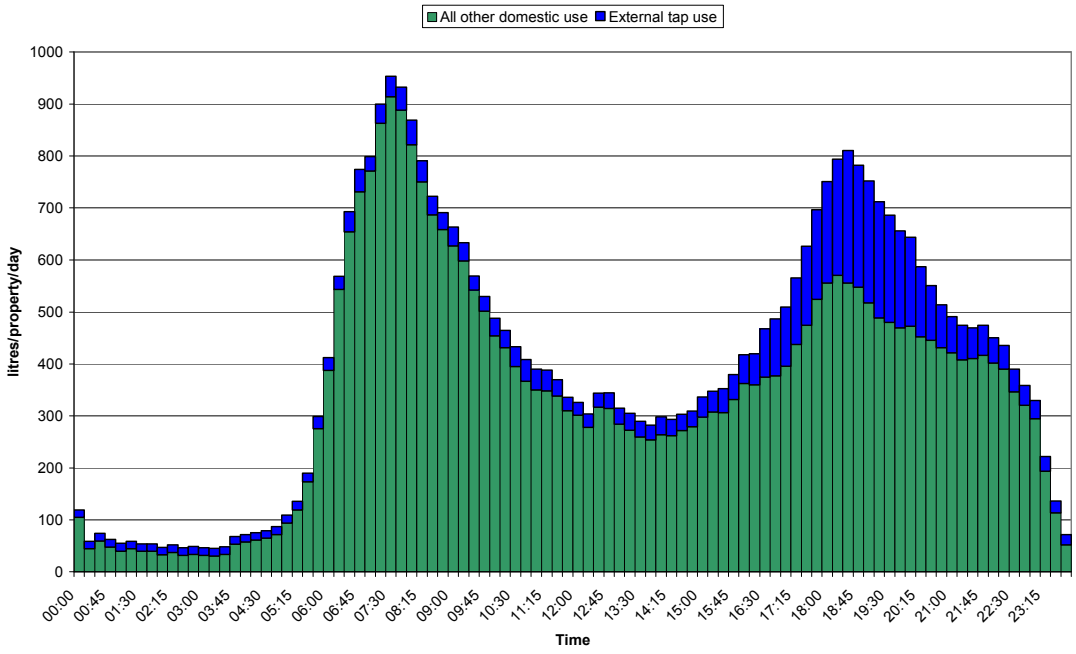
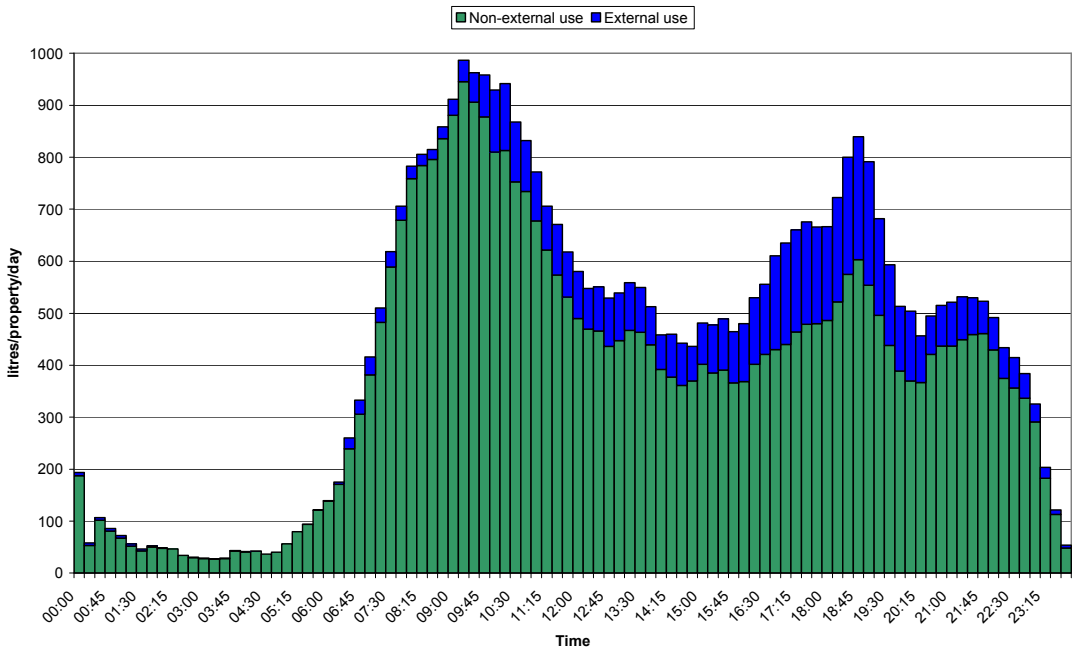


Figure 3.4 Diurnal profile for rolling hourly water consumption on summer Peak non-weekdays[37]



The two charts show that external use increases both in volume and as a percentage of total domestic use in the late afternoon and evening. This variation is most pronounced on weekdays when many water users will be away from the home until the late afternoon.

[36] WRc, 2005, *Increasing the value of domestic water use data for demand management*
[37] WRc, 2005, *Increasing the value of domestic water use data for demand management*

3.4 Context of data by region

The data analysed in section 3.3 covers only England and not Scotland, Northern Ireland or Wales. The pattern of external water consumption is assumed to be similar across the UK, differing slightly owing to spatial climatic variability (ie number of Peak days). Assumptions of external use made in the Water Resource Strategy 2002-2030 for Northern Ireland are summarised in Table 3.1

Table 3.1 Estimated external water use for Northern Ireland[38]

Property type	External use (litres/property/day)	External use as percentage of daily domestic use
Detached	29.1	6.4%
Semi-detached	19.7	4.6%
Terraced	5.7	1.7%
Apartment	1.3	0.6%

4 Methods of reducing external water consumption

Water use in the garden is thought to have increased significantly over the last three decades and is predicted to rise further in the future[39]. Reducing the consumption of potable water consumed externally is an important component of reducing overall domestic water demand. External water saving can be achieved through efficient technologies, including rainwater harvesting and greywater resuse, and user behaviour.

4.1 User behaviour

The volume of water used by an external tap is determined, in the main, by the user. A person can have the tap running for any length of time. Education is therefore important to encourage the conservation of water. Technology can aid this reduction, but can only be successful in tandem with behavioural change and water metering.

4.2 Garden watering

Garden watering has increased substantially in the last decade and is expected to increase in the future partly driven by climate change[40]. There are many methods by which the volume of water required in the garden can be reduced, by making the process of watering more efficient. These include ideas such as watering at the optimum time of day and in the correct location[41].

A simple way to reduce water use is to use a watering can rather than a hosepipe. However, reduction in water wastage by hosepipes can be achieved by attaching a

[38] SNIFFER, 2004, *Valuing water use in Scotland and Northern Ireland for WFD implantation purposes*
[39] http://www.guardian.co.uk, *Turning the tide in the Thames Gateway, 2007* – Accessed 19/12/07
[40] Downing, T.E., Butterfield, R.E., Edmonds, B., Knox, J.W., Moss, S., Piper, B.S., Weatherhead, E.K., (and the CCDeW project team), 2003, *Climate change and the demand for water*
[41] More information on efficient garden watering can be found at Environment Agency (2007) *Conserving Water in Buildings – A practical guide*

trigger nozzle to ensure the hosepipe is switched on only when it is needed. Adjustable flow rates and spray patterns reduce water run-off as well as the water consumed.

Installing a water butt to collect rainwater run-off, from the house roof via a downpipe will provide rainwater for garden watering (via an attachable hose or watering can). However, this might have little impact on water use during a prolonged dry spell as the water-butt will be rapidly emptied. More research into the frequency of refilling of water butts during normal and dry weather is needed to assess the potential of the water butts to deliver a reliable source of water for garden watering.

Greywater from baths and showers can be used to water ornamental plants in the garden. Greywater should not be stored for later use and should not be used on edible plants[42].

Water timers or sensors (for rainwater or soil moisture) can be placed on irrigation systems so that automatic watering only occurs only when necessary. Drip irrigation systems can be used for larger gardens reducing runoff and evaporation. Gel crystals can also be used to reduce water loss. These are buried in the soil and expand when they come into contact with water, retaining the moisture in the soil. Weed-controlling fabrics can be used for new plants; these prevent evaporation and prevent the growth of weeds, ensuring water is not wasted on unwanted plants (removal of weeds will also decrease unwanted water use). A further method of reducing water consumption in gardens is to use drought tolerant plants..

4.3 Other water uses

The volume of water used to wash a car at home can be reduced by using a bucket and sponge rather than a hosepipe. Two average-sized buckets contain approximately 14 litres of water, whereas a hosepipe could use up to 15 litres per minute (a trigger hose nozzle could reduce this). There are also some products available to wash cars that do not require any water.

Ponds can be allowed to fill and top up naturally via rainfall. Evaporation of swimming pool water can be reduced by a cover which can also reduce heat loss. Backwashing of filters should be reduced in times of droughts or disposable filters should be used. The Drought Direction 1991 allows the banning of filling or refilling of pools during a drought[43].

Power washers, if used correctly to clean patios and garden furniture, have the potential to use less water when compared with using a hosepipe. However the cleaning efficiency and the volume of water used vary between different models. A comparison has not been carried out between using a pressure washer and a dry brush or bucket and sponge.

[42] Environment Agency (2007) *Conserving Water in Buildings – A practical guide*
[43] Drought Direction, 1991 available at http://www.defra.gov.uk/environment/water/resources/drought/pdf/droughtdirection1991.pdf

5 Conclusions

External water use normally accounts for around 7% of total domestic water use although this figure is highly variable. External water use is heavily influenced by the season, Peak days, ACORN class and the time of day. More water is used externally in summer and particularly on Peak days, when the temperature is high and rainfall is low. Decreasing external water use may help to reduce water supply interruptions during prolonged dry summer periods or during peak days when network capacity is stretched.

Water users in the ACORN-A group use a higher percentage and volume of external water during the summer than other water users. This difference is not noticeable in winter. External water use also varies significantly during the day on Peak days, with the highest volume used in the late afternoon and early evening. Therefore, there are social and behavioural factors influencing external water use as well as climatic factors.

A variety if methods can be used to reduce the quantity of water used externally. These involve the use of water-efficient and water-reducing products, and the influencing of user behaviour to make more efficient use of external water. Good advice and information for consumers will enable them to reduce water usage using these methods.

Related MTP information

Briefing Note BNWAT19: Alternative sources of water – greywater and rainwater reuse: Innovation Briefing Note

Version

This is the first version of this briefing note

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email **info@mtprog.com** quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

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