

BNWAT22: Domestic water consumption in domestic and non-domestic properties

Version 1.1

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

The contribution that any particular product type makes to total domestic water consumption needs to be quantified to target efforts through the Market Transformation Programme (MTP) with respect to water efficient design. A reliable figure for total domestic water consumption is required to assess this contribution.

Total domestic water use comprises (a) water use in households and (b) domestic water use in buildings other than dwellings. OFWAT provides estimates for total water use in all of these buildings but does not separate domestic water use and water used in commercial processes for buildings other than dwellings.

The objective of this Briefing Note is to discuss a methodology to estimate the domestic water use component within buildings other than dwellings.

The estimated domestic water consumption from buildings other than dwellings, added to the measured consumption from households (MTP), provides a value for the total domestic water consumption for England and Wales. Using a bottom-up approach, the percentage that each product type contributes to total domestic water consumption can also be estimated. The true effect of policies proposed through the MTP can be established against this baseline. There is a complete audit trail of the data used, and the assumptions made, to establish these values.

It is important to understand the contribution that any particular product type makes to total domestic water consumption in order to target efforts with respect to encouraging water efficient design.

The domestic water consumption from non-domestic buildings has been estimated as 681 Megalitres/day for England and Wales (or, assuming the figure may be scaled by the resident population ratio, 768 Megalitres/day for the UK). The total estimated domestic water consumption from households (based on measured data from a

sample of households) is 8,553 Megalitres/day for England and Wales (9,645 Megalitres/day for the UK, assuming the same population scale factor as above).

The percentage contribution of each product type has been established.

	Percentage of total <u>domestic</u> water consumption (households and commercial/industrial properties)	Water consumption per day from households (MI)	Water consumption per day from non-domestic buildings (MI)
WCs	27	2,103	415
Urinals	<1		74
Basin taps	21	1,818	116
Bath/showers	24	2,151	32
Kitchen taps	13	1,191	44
Domestic washing machines	9	841	<1
Domestic dishwashers	1	95	0
Outdoor use	4	354	0

The reliability of water consumption data for each product type has also been assessed and can be found in Briefing Note BNWAT23.

2 Total water consumption

2.1 Total water balance – England and Wales

The total volume of water into distribution for England and Wales is 15,356 Megalitres/day (Ofwat, 2006).

This consists of water into supply for measured and unmeasured households, measured and unmeasured non-households, water taken unbilled, distribution operational use and distribution losses.

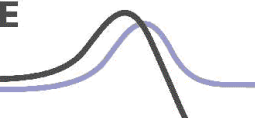
2.2 Total water balance – United Kingdom

The total volume of water into distribution for the UK is 18,328 Megalitres/day (Ofwat, 2006; WIC, 2006; Defra, 2006).

This is made up of water put into supply including domestic consumption, commercial industrial consumption, leakage and other.

2.3 Domestic consumption – England and Wales

The total domestic consumption from metered and unmeasured households is 8,700 Megalitres/day (Ofwat, 2006).



The population of England and Wales (2001 census) is 52,041,916 (www.statistics.gov.uk/census).

2.4 Domestic consumption – United Kingdom

The total domestic consumption for the UK can be estimated assuming that the figure for England and Wales may be scaled by the population ratio:

$$\text{UK domestic consumption} = \frac{\text{Domestic consumption in England and Wales} \times \text{UK population}}{\text{England and Wales population}}$$

The population of the UK (2001 census) is 58,789,194 (www.statistics.gov.uk/census).

The domestic consumption of UK households is estimated to be 9,828 Megalitres/day.

Note 1: Published domestic consumption for Scotland 2005/6 Annual return, Table A2 is 852 Megalitres/day. There are no published data for Northern Ireland but previous work by WRc estimated this to be 212 Megalitres/day (2003). Total 1,064 Megalitres/day compared to 1,128 Megalitres/day based on population ratio method.

Note 2: Total domestic consumption from households can be factored up to the UK simply by using the population ratio. It is not possible to do the same for non-domestic buildings as data on the actual number of buildings of each type would be required.

3 Domestic water consumption in commercial and industrial properties – England and Wales

3.1 Methodology

To calculate the domestic water consumption in non-domestic buildings (drinking, washing, toilet flushing and domestic appliances), it is proposed that all property types are identified. For each, the types of fittings, the number of users and the frequency of use is established from base data where possible and assumptions where necessary.

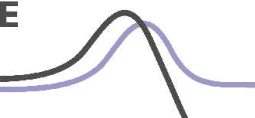
The water consumption per property type is calculated from (volume per use) x (ownership) x (frequency of use).

Note: water consumption from commercial fittings (eg commercial dishwashers, washing machines, glass washing machines) is not included as domestic usage.

3.2 Property types and sub-types

The property types included in British Standard BS 6465 (Sanitary installations. Code of practice for the design of sanitary facilities and scales of provision of sanitary and associated appliances) were used to create a list of commercial/industrial properties.

BS 6465 outlines the necessary provision for WCs and basins (and, in some cases, other devices such as showers and baths) in non-domestic buildings and can therefore be used to establish the ownership of product types in any property type.



BS 6465: 1994 was used, although it was republished and updated in 2006, as it was assumed that existing non-domestic buildings would have been constructed prior to 2006.

The property types for which population data (ie resident population or visits per day as appropriate) were available are listed in the left-hand column of Table 1. The right-hand column lists the property sub-types applicable to each property type.

Table 1 Property types and sub-types

Property type	Property sub-type
Accommodation for elderly and sheltered accommodation	NHS Psychiatric NHS Other Local Authority children's home Local authority Other Housing association sheltered accommodation Other children's homes
Residential and nursing homes	Nursing homes Other residential care homes Other establishments Medical and care establishments Other establishments
Staff in offices, shops, factories and other non-domestic premises	Manufacturing Electricity, gas and water supply Wholesale and retail trades, repairs Hotels and restaurants Transport, storage and communications
Financial intermediation	Real estate, renting and business activities Public administration and defence, social security Education Health and social work Other
Facilities in shops and shopping malls	
Schools	Special schools Primary schools Secondary schools Nursery schools Boarding schools Other schools
Buildings used for public entertainment	Cinemas Theatres Town halls Libraries Leisure centres (excluding swimming pools)

Property type	Property sub-type
Hotels	Hotels Guest-houses Farmhouses Bed and Breakfast accommodation Flats/apartments Self catering Hostels Universities/Schools Self-catering holiday camps Catered holiday camps Camping Caravans
Restaurants, cafés, canteens and fast food outlets	-
Pubs and licensed bars	-
Swimming pools	-

3.3 Population for each property type

Total dwelling stock in England and Wales is 23,110,000 (www.communities.gov.uk).

The resident population or visits per day (eg to shops and restaurants) was established from a range of sources (Table 2).

Table 2 Sources of population data by property type

Property type	Property sub-type	Population data source
Accommodation for elderly and sheltered accommodation	All	www.statistics.gov.uk Table KS23
Residential and nursing homes	All	www.statistics.gov.uk Table KS23
Staff in offices, shops, factories and other non-domestic premises, and Financial intermediation	All	www.statistics.gov.uk Table S039
Facilities in shops and shopping malls	All	www.brc.org.uk
Schools	All	
Buildings used for public entertainment	Cinemas	www.esrc.ac.uk
	Theatres and libraries	www.statistics.gov.uk
	Town halls	www.statistics.gov.uk and www.prospects.ac.uk



Property type	Property sub-type	Population data source
	Leisure centres	www.prospects.ac.uk
Hotels	All	www.tourismtrade.org.uk/MarketIntelligenceResearch/
Restaurants, cafés, canteens and fast food outlets	All	J Kearney et al (2001) ' <i>Eating patterns – temporal distribution, converging and diverging foods, meals eaten inside and outside of the home – implications for developing FBDG</i> ' in Public Health Nutrition: 4(2B) 693-698
Pubs and licensed bars	All	www.statistics.gov.uk <i>Commercial and Industrial Floorspace and Rateable Value Statistics 2005 (2005 Revaluation)</i> . J Kearney et al (2001)
Swimming pools	All	www.nationalwatersafety.org.uk/

3.4 Estimating the ownership and frequency of use

3.4.1 Method

The minimum number of each product type was estimated for each property type using BS 6465: 1994 and, therefore, from the population in each property type, the total number of a product type installed could be estimated. For each property type, therefore, the number of WCs, urinals, baths, showers, kitchen taps, domestic washing machines and domestic dishwashers was estimated.

It was assumed that all non-domestic buildings had minimal or no outdoor water use.

3.4.2 Assumptions

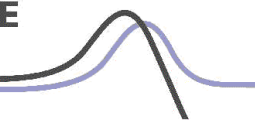
The assumptions made on ownership and frequency of use are listed below. These are based on established sources and experience of product usage. However, it is assumed that these will be reviewed and refined over time.

Accommodation for elderly and sheltered accommodation

- Normal domestic consumption is assumed for residents for WC, basin and bath/shower use.

Residential and nursing homes

- Normal domestic consumption is assumed for bath/shower and basin tap use. Two extra WC uses above the normal domestic consumption is assumed, except for those in the 'other' categories.
- Drinking water use of 4 litres per person per day is allowed (note: this has been separated from cooking and dishwashing which may be carried out using commercial equipment).



Staff in offices, shops, factories and other non-domestic premises

- The categories have been selected as they are most likely to be based in buildings as opposed to remote or site work where temporary facilities (eg chemical 'portaloos') would be provided.
- Number of working days in year assumed to be 220.
- Occupancy assumed to be 50% female and 50% male.
- Four female WC uses per day.
- One male WC use and three urinal uses. Urinals assumed to be on timed flush once every 30 minutes, flushing 1.5 litres.
- Four basin tap uses of 0.5 litres per person per day assumed.
- Average office size is 66 persons (number of offices from www.communities.gov.uk).

Facilities in shops and shopping malls

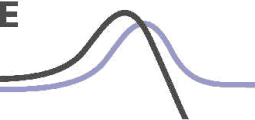
- Only shops with an area of over 1,000 m² are required to provide toilets, and therefore the majority of facilities are covered by the 2,150 major outlets.
- Based on BS 6465, the ratio of WCs:urinals installed is double that of offices. Therefore, we assume the ratio of use is also doubled, so one WC use to six urinal uses for men. (Note: BS 6465 has been developed from the needs identified for individual buildings and therefore installation is assumed to equal usage.)
- Visits assumed to be 35% male and 65% female (from BS 6465).
- One WC/urinal use per visit assumed.

Schools

- Occupancy assumed to be 50% male pupils and 50% female.
- Number of days in school year assumed to be 195 for day pupils and 252 for boarding pupils.
- Ratio of WC to urinal use suggested in BS 6465 is 2:1, therefore the ratio of use, in the same way as for shopping malls, will be assumed to be one WC use to six urinal uses for men.
- Assume two uses per day of facilities, and seven uses for boarding pupils (ie equal to WC usage in households).
- No shower usage is assumed for day pupils as there are no accurate data on this subject.
- One bathing event per day is assumed for boarding pupils, with a ratio of 25% baths to 75% showers following recommendations for installation in BS 6465. The average volume per use is 42 litres based on MTP data.
- Two litres per day pupil for drinking water is allowed and 4 litres per boarding pupil per day.

Buildings used for public entertainment

- Visits are assumed to be 50% male and 50% female.
- One visit to WC/urinal assumed per visit, except for libraries where 1 in 100 visitors is assumed.



- The same ratio of WC to urinal use is assumed for men as in shopping centres.

Hotels

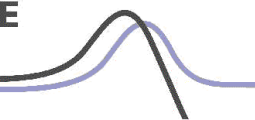
- All hotel rooms have been assumed to have an occupancy of two persons per room and to be en-suite. Four WC uses per person per night (ie equal to WC usage in households where individuals are at work), and one shower/bath use per night is assumed. Kitchen tap consumption is assumed to be zero. Normal domestic basin tap consumption is assumed.
- All guest-houses, farmhouses and bed and breakfast accommodation are assumed to have shared facilities and occupancy of two persons per room. Four WC uses per person per night (see above) and one shower/bath use per night is assumed. Kitchen tap consumption is assumed to be half of normal domestic use. Normal domestic basin tap consumption is assumed.
- For hostels, an occupancy of two persons per room is assumed. Four WC uses per person per night (see above) and normal domestic use of shower/bath are assumed. Kitchen tap consumption is assumed to be half of normal domestic use. Normal domestic basin tap consumption is assumed.
- For university accommodation, four WC uses per person per night (see above) and normal shower/bath consumption are assumed. Kitchen tap consumption is assumed to be half of normal domestic use. Normal domestic basin tap consumption is assumed.
- Self-catering accommodation, flats/apartments and holiday camps have an assumed occupancy of two persons per apartment. Normal domestic use of WCs, bath/shower and basin taps is assumed. Catered holiday camps have no domestic kitchen tap usage, and self-catering accommodation has normal domestic consumption. Self-catering accommodation is also assumed to have half of normal domestic washing machine consumption.
- Normal domestic use of WC and shower/bath is assumed for camping and caravans. No kitchen tap usage is assumed for camping, whilst normal domestic consumption is assumed for caravans. Normal domestic basin tap consumption is assumed.
- Two out of three male WCs are replaced with urinals for camping and caravanning following BS 6465, with the same ratio of use as for shopping centres (ie one WC use to six urinal uses).

Restaurants, cafés, canteens and fast food outlets

- Visits are assumed to be 50% male and 50% female.
- Overall, 57 meals per person per year are assumed to be bought and eaten in these locations.
- One visit to facilities per visit is assumed.
- Following BS 6465, one WC use to six urinal uses is assumed for men.

Pubs and licensed bars

- Visits are assumed to be 50% male and 50% female.



- Two visits to facilities per visit to public house/bar are assumed.
- Based on BS 6465, one WC use to six urinal uses is assumed for men.
- No figures are available on domestic kitchen tap consumption in bars and restaurants, although it is recognised that many premises do have domestic taps behind bars.

Swimming pools

- Visitors are assumed to be 50% male and 50% female.
- One visit to facilities per visit to a swimming pool is assumed.
- Two showers per visitor are assumed. One 'one-push' shower pre-swimming, and one 'two-push' shower post-swimming (one shower of 30 seconds (push control), 8 litre/minute flow rate; one shower of one minute (two pushes), 8 litre/minute flow rate = 12 litres/person/visit).
- The same ratio of WC to urinal uses is assumed as the ratio for provision in BS 6465 (ie one WC use to five urinal uses for men).

3.5 Assessing water consumption estimates

3.5.1 Method

To check that the assumptions applied to individual property types were plausible, and that the estimates for domestic water consumption in industrial/commercial properties did not exceed the total (measured) water consumption for those property types, the property types from BS 6465: 1994 were paired up with industry categories from the REWARD (1999) report¹.

The REWARD report gives the water consumption for various industrial and commercial sectors by SIC code in 1999. The SIC codes from REWARD 1999 and the property types in BS 6465 (Table 1) were matched as closely as possible to produce the following list of industries for which domestic consumption could be estimated using the assumptions in section 3.4

- Food and drink industry (SIC code 15).
- Retail industry (SIC code 52).
- Hotels (SIC code 55).
- Education (SIC code 80).
- Health and social work (SIC code 85).
- Recreation, culture and sport (SIC code 92).
- Public administration and defence (SIC code 75).
- All other (all other SIC codes).

¹ REWARD (1999) *Regional and Welsh Appraisal of Resource Productivity and Development: Key Industrial Environmental Pressures – Water Use report*.
www.environment-agency.gov.uk.

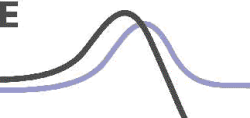
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Table 3 Total measured and estimated domestic water consumption by industry type

SIC code	Industry	Total water supply (REWARD report) / Volume /Ml/day	Total domestic consumption (bottom-up calculation)		Domestic water use by product (bottom-up calculation)					
			Volume /Ml/day	% of total water supply	WC	Urinal	Basin tap	Shower/bath	Kitchen tap	Washing machine
15	Food and drink	715.87	94.47	13.20	75.41	9.05	9.33		0.68	
52	Retail	485.87	81.23	16.72	53.90	12.38	10.16		4.79	
55	Hotels	348.70	92.39	26.50	27.56	1.56	24.77	29.68	8.07	0.77
80	Education	317.07	113.29	35.73	72.49	16.11	9.81	2.03	12.85	
85	Health and social work	81.38	45.47	55.88	30.47	5.76	6.16		3.08	
92	Recreation, culture and sport	18.41	14.32	77.81	11.05	2.54	0.74			
75	Public admin and defence	30.06	21.15	70.36	16.09	2.95	0.48		1.63	
All other	All other	3783.00	218.98	5.79	128.3	23.49	54.18		12.98	



3.5.2 Assumptions and simplifications

SIC codes 01.1 (Agriculture Arable), 01.2 (Agriculture Livestock) and 45 (Construction) were excluded as they are deemed to have little or no domestic water consumption owing to the high proportion of remote and site work undertaken in these industries.

The BS 6465 property type 'Hotels and restaurants' has been assumed to be 50% hotels and 50% restaurants for division into the appropriate SIC codes (SIC codes 55 and 15).

BS 6465 property types relating to accommodation for the elderly, sheltered accommodation, and residential and nursing homes have been placed in a separate category for residential (non-housing water consumption).

The REWARD report (see section 3.5.1) dates from 1999 and therefore the figures for total water consumed by industry could be regarded as out of date. It has not been possible to obtain more up-to-date figures at the time of writing. The water into supply data have been very similar between 1999 and 2007, therefore it is assumed that breakdown in the REWARD report can still be used to compare with the figures from the bottom-up approach (December 2006).

Note that the total water consumed reported in the REWARD report includes domestic water use and water for commercial processes (catering, laundry, cleaning, swimming pool filling etc).

3.6 Water consumption by product type

3.6.1 Calculation method

The water consumption per property per day is calculated from (volume per use) x (ownership) x (frequency of use of fitting per property per day).

Ownership and stock

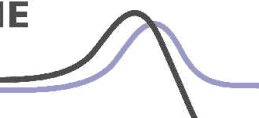
The ownership or number of products in use for each property type was derived from the estimates reported in section 3.4 above.

Volume per use

The volume per use was taken from the Market Transformation Programme Annual Report SP06, for WCs, showers (excluding showers used in swimming pools which was derived from volume per use, number of users and an assumption of frequency of use by an individual), baths, washing machines and dishwashers.

The volume per use for urinals was calculated from the period of operation and an assumed flow rate per minute (ie urinals assumed to be on timed flush once every 30 minutes, flushing 1.5 litres).

The volume per use for taps (median tap volume use to be 0.55 litres) was taken from the WRc report, *Increasing the value of domestic water use data for demand management* (WRc, 2005).



Frequency of use

The frequency of use of each product type was taken from the Market Transformation Programme Annual Report SP06 (MTP, 2006).

3.6.2 Results

Using the above calculation method, the water consumption for each product type could be established for non-domestic buildings for England and Wales (see Table 4).

Table 3 Total estimated domestic water consumption in non-domestic buildings (England and Wales) by product type

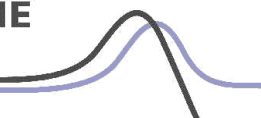
Product type	Total domestic water consumption per day / MI
WCs	415
Urinals	74
Basin taps	116
Baths/showers	32
Kitchen taps	44
Domestic washing machines	<1
Domestic dishwashers	0
Outdoor use	0

From values for domestic water usage in households (MTP, 2006), the water consumption for each product type in England and Wales for households can be estimated (see Table 5).

Table 4 Total estimated water consumption in domestic buildings (England and Wales) by product type

Product type	Total ownership (stock) / 10 ³	Total water consumption per year / MI	Total water consumption per day / MI
WCs	35,816	767,666	2,103
Urinals	-	-	-
Basin taps	34,169	663,597	1,818
Baths/showers	39,004	785,068	2,151
Kitchen taps	25,072	434,572	1,191
Domestic washing machines	17,689.9	306,910	841
Domestic dishwashers	6,021.3	34,787	95
Outdoor use	-	129,100	354

The total domestic water consumption in all buildings can therefore be estimated from the information in Tables 4 and 5.



In addition, using the total volume of water supplied (reported in section 2.1), the proportion of all water supplied which is consumed by domestic products can be estimated for each product type (see Table 6).

Table 5 Total estimated domestic water consumption (all buildings in England and Wales)

Product type	Total domestic water consumption per day / MI*	Percentage of total domestic water consumption in all buildings*	Percentage of total water supplied*
WCs	2,518	27	16
Urinals	74	< 1	< 1
Basin taps	1,934	21	13
Baths/showers	2,183	24	14
Kitchen taps	1,236	13	8
Domestic washing machines	841	9	5
Domestic dishwashers	95	1	< 1
Outdoor use	354	4	2
TOTAL	9,235	100	60

* Column entries may not sum to their column totals owing to rounding errors.

3.7 Concluding remarks

The total volume of water consumed for domestic purposes (in households and other buildings) has been estimated from a 'bottom-up' approach.

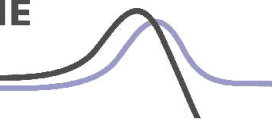
The total volume of water consumed by product type for domestic purposes has been estimated.

From the information in Table 6:

- The total volume of water consumed for domestic purposes accounts for 60% of water supplied (England and Wales).
- The use of WCs, baths and showers accounts for 51% of water consumed for domestic purposes. (Note: This is equivalent to 30% of all water supplied.)

The current MTP Briefing Notes and Policy Briefs cover baths, showers and WCs. To impact on products that account for more than 50% of all water supplied, taps (which account for 25% of all water supplied) would need to be included.

In addition, it is important to assess the reliability of data and test methods available to establish the water efficiency of products. This is reported in Briefing Note BNPAT23.



Related MTP information

BNWAT23 – Reliability of information on water consumption of appliances.

Changes from version 1.0

Bath/shower consumption figure for non-domestic buildings figure corrected from 41 MI/day to 32 MI/day.

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.

For further information on related issues visit www.mtprog.com