Managing and minimising water use

In a nutshell

SUMMARY

It is best practice to implement water management according to the principles of the 'plan, do, check, act' cycle in offices owned or managed by the public administration by:

- collecting frequently or monitoring constantly water use data; data can be collected at building level, per relevant building area where water is used (e.g. lobby, offices, canteen/bar), and per end-use category (e.g. restrooms, kitchens);
- analysing the data, setting targets, identifying benchmarks and using them for comparison with actual water use;
- defining a strategy and action plan for the reduction of water use (e.g. installing water efficient taps, showers and pressure reducing valves, regularly maintaining them, installing rainwater harvesting systems)

Target group

Public administrations having office-based operations

Applicability

This best practice is broadly applicable to office buildings owned or managed by public administrations, provided that costs for installation and maintenance of systems for monitoring and collecting water use data are paid back by the expected water savings achievable. In rented buildings, actions that may arise from implementing this best practice may be more limited.

Environmental performance indicators

- Total annual water use per full time equivalent (FTE) employee (m3/FTE/year), split into (if relevant):

- mains water use (m^3/FTE/year)
- harvested rainwater use (m^3/FTE/year)
- recycled greywater use (m^3/FTE/year)

- Total annual water use per internal floor space (m^3/m^2/year), split into (if relevant):

- mains water use (m^3/m^2/year)
- harvested rainwater use (m^3/m^2/year)
- recycled greywater use (m^3/m^2/year)

Bencharks of excellence

Total water use in office buildings is lower than 6.4 m^3/full time equivalent employee/year

Description

There are two key mechanisms for reducing potable water use in offices – becoming more efficient (reducing consumption) and supplementing mains water with harvested rainwater and/or recycled greywater. Reductions in office water use can be mainly achieved through the following activities:

- Technical solutions (e.g. low flow taps, rainwater harvesting)
- Measurement and monitoring of water use
- Occupant behaviour change

The above should be implemented by means of a water management approach following the principles of PDCA (Plan, Do, Check, Act) (IEMA, 2014), as do environmental management systems more broadly e.g. EMAS and ISO 14001. This sequence facilitates continuous improvement and allows those responsible to be proactive.

The rest of this section sets out methodologies for setting water use targets and strategy, based on water monitoring, as well as practical guidance on technical and behavioural solutions to save water.

Management aspects and setting targets

An effective management approach is essential for effectively minimising water consumption. There should be a nominated person who has responsibility for managing water consumption, such as a facilities manager, building manager or sustainability manager.

Water management involves a cycle of monitoring and measuring consumption, comparing with expected consumption, setting targets and creating strategies for reduction in consumption.

In order to help set targets, many data are available in literature. Some of these are presented in Table 1.

Table 1: Examples of benchmarks for office water use. Note that the daily figures in this case assume 253 days per business year

Note	**m3/ employee/ year**	**m3/m2 internal floorspace**	**Litres/employee/day**	**Litres/m2/day**	**Notes**
Office	4	0.6	15.8	2.4	Total employee nu rather than full equivalents are require
Office	9.3				
Office	1.5				
Office	2	0.4	7.9	1.6	Total employee nu rather than full equivalents are require

Office	6.4				
Small office	4.4				Small office defined a than 1000m2
Small office with catering	5.9				Small office defined a than 1000m2
Larger offices	6.8				Larger office define over 1000m2
Larger offices with catering	8.3				Larger office define over 1000m2

Targets for total water consumption can be established by multiplying values achieved by frontrunners by the number of employees to give a total best practice figure:

Water use if best practice achieved (m^3/year) = best practice benchmark (m^3 / employee / year) x number of employees

Water use per person in litres per day is also a useful metric that is easily grasped by building occupants. It can be calculated as follows:

Water use(litres/employee/day) = water use (m^3) / (number of working days per year x 1000 x number of employees)

The number of working days per year varies in different European countries – with annual leave and bank holidays ranging from 27 to 40 days per year (Eiroline, 2011).

Potential savings can be calculated as follows:

Possible savings (m^3/year) = current annual water use (m^3/year)–water use if best practice achieved (m^3/year)

The resulting figure will enable an estimate of financial savings based on the cost of water per m^3. This can help estimate payback times for any capital investments or behaviour change campaigns.

Data collection and analysis

Once targets have been set, meter readings and inventories of water using devices can be used to determine priorities for action. This should be based on areas where the maximum impact can be made and return on investment is best.

Automatic meter reading (AMR) should be installed, ideally linked to the Building Management System. Automatic reading could be set at frequent intervals such as half hourly. There should be submetering points for major water using areas e.g. bathrooms, kitchens, outdoor areas etc.

Where AMR is not present, it is recommended that meters be read weekly but also between times when the building is empty (at night or during weekends) to check for leakages.

Setting a strategy and developing an action plan

The data above combined with information on water using devices and activities will allow breaking down water uses – Table 2. It will help clarify where there is most capacity for improvement based on amount of water consumed, potential for reduction etc.

Table 2: Sample breakdown of water use (EPBV, 2009)

Total annual water use	Area	Volume used (m3)	Description	Intensity of use	Potential for improvement

980 m^3 / year	Bathrooms	898 m^3/ year estimated	8 WCs (dual flush, 4 litres average flush volume) 4 wash basins. Taps have flow limiters but no aeration Mixer shower	Intensive	Adaptations have already been made except for the mixer shower
	Internal cleaning	8 litres x 6 x 50 weeks = 2.4m^3 /year	Mopping indoor areas	Not significant	Potential for improvement
	External cleaning	20 litres / minute x 30 minutes x 50 weeks = 30 m^3/year	Pressure cleaning, 20 litres / minute	Equivalent to 5 buckets of water twice a week	Efficient
	Irrigation of outdoor areas	10 litres / m^2 / hour x 20 minutes x 100m2 x 150 days = 50 m^2 / year	100m^2 shrubs being watered by sprinkler, 10mm / hour	Every week for 30 minutes.	This source of water consumption could be avoided altogether
	Leaks	0 m^3/ year	Two readings taken per day during test phase	Test carried out for 20 minutes per day, May to September	Automatic meter readings preferable.

Minimising water consumption should follow the lines of the waste hierarchy applied to water as illustrated in Figure 1 (WRAP, 2013)

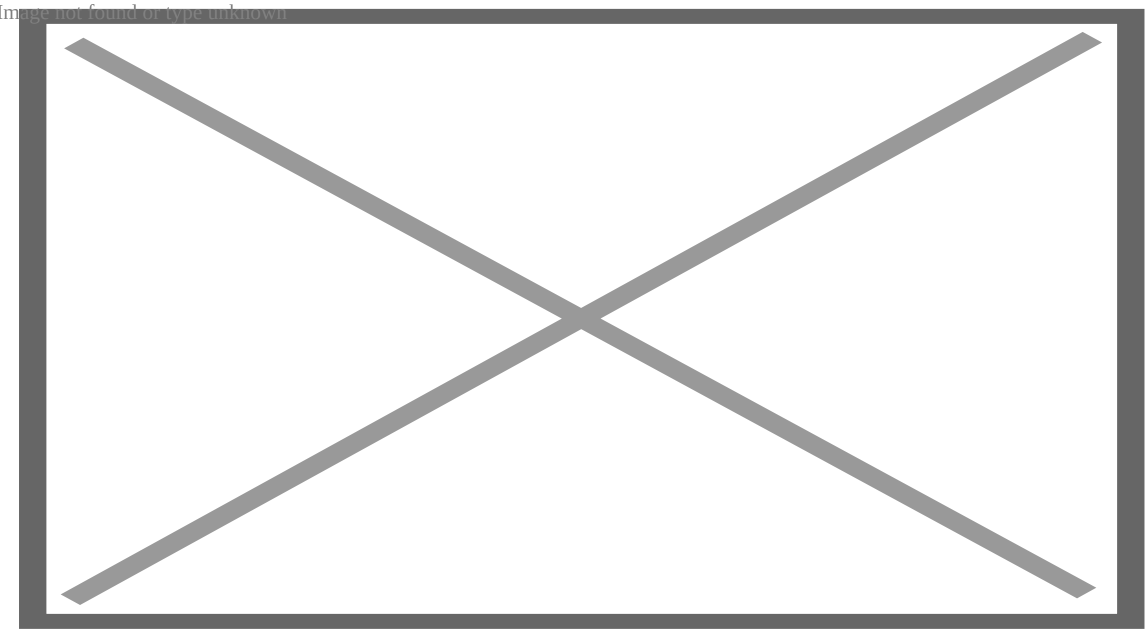

Figure 1: Waste hierarchy applied to water

Technical solutions

Water efficient taps, WCs and showers

Low flow taps and showers can enable significant water consumption reductions. Savings will depend on existing fittings (if retrofitting) and water pressures in the area if flow rates are not capped by the device.

Dual/variable flush or siphon mechanisms for WCs can save 4 litres per flush (WRAP 2013).

For individual water using devices such as taps, showers and WCs, the performance of products bearing the EU Ecolabel [1] can be considered best practice. In terms of maximum available water flow rates, the criteria that EU Ecolabelled tapware products must fulfil are (European Commission, 2014a):

- Kitchen taps (without flow limiting device) shall not exceed 6,0 l/min, with flow limiting device[1] shall not exceed 8,0 l/min
- Basin taps (without flow limiting device) shall not exceed 6,0 l/min, with flow limiting device[1] shall not exceed 8,0 l/min
- Showerheads and showers – shall not exceed 8,0 l/min. Showerheads and showers with more than one spray pattern shall fulfil the requirement for the setting with the highest water flow.

1The flow limiting device must allow for setting the default water flow rate (water-saving setting) at the value of max of 6 l/min. The maximum available water flow rate shall not exceed 8 l/min.

As for flushing toilets and urinals, EU Ecolabelled products must respect the following (European Commission, 2014b):

- The full flush volume shall not exceed 6 l/flush for flushing toilet equipment or 1 l/flush for flushing urinal equipment.
- A water saving device should be added to toilet suites with a full flush volume of more than 4,0 litres and to toilet flushing systems. When placed on the market, the reduced flush volume shall not exceed 3,0 l/flush.

Another source of information on water efficiency of taps, showers and WCs is the Water Label European Industry Scheme, which provides a water efficiency grading system. A best practice benchmark for water using devices could be taken as the most efficient band within this system:

- Taps and showers – maximum flow rate of 6 litres per minute or less (tested at a pressure of 3 bar)[2]
- Dual flush WCs – average flush volume[3] of 3.5 litres or less

The best practice in BREEAM[4] sustainable building standard are lower, as follows:

- Taps – maximum flow rate of 3 litres per minute.
- Showers – 3.5 litres per minute.
- Urinals – waterless urinals
- WCs – average flush volume of 3.5 litres or less (BRE, 2012,p241)).

There are additional technical “hardware” solutions, for example (WRAP, 2013):

- Installing push button showers or ball valves
- Fitting older 9 litre cisterns with Hippos / Save-A-Flushes (these devices reduce the flush volume by up to 3 litres by displacing this with their own volume)
- Fitting electronic taps with infrared hand sensors or self-closing taps.

Once water efficient devices have been installed, it is also important to maintain them regularly. Limescale and soap can cause jamming of mechanisms leading to dripping (WRAP 2013).

Pressure reducing valves

Pressure reducing valves (PRVs) may be necessary if mains pressure is causing excessive flows at taps. For example, tap flow rates of 60 litres per minute can occur if there is a gravity fed system in a 14 storey building. PRVs can be located in various locations e.g. at the incoming mains, or at each floor (WRAP, 2013 b).

Rainwater harvesting systems

Rainwater collection capacity can broadly be calculated using the following equation:

Rainfall harvest (litres) = rainfall (mm/year) x area (m^2) x runoff coefficient

The runoff coefficient takes account of the fact that not all water reaches the collection tank – some may evaporate once it stops raining. The runoff coefficient is typically 0.8 but varies depending on the roof surface, e.g. (Khoury-Nolde, no date; p. 5):

- Plastic / metal surfaces - 0.8 – 0.9
- Cement – 0.75
- Clay tiles – 0.5

Table 3: Typical volumes of rainwater collected for different roof sizes and rainfall (Envirowise, 2008)

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Identifying leaks

There should be regular monitoring of the building when vacant. If meters are showing water use above zero, this highlights a leak somewhere in the building.

Occupant behaviour

One of the easiest and cheapest ways of reducing water consumption is through encouraging behaviour change. All staff should be aware that the organisation is working to save water and that they are a crucial part of this effort. Campaigns can be run that include:

- Posters / stickers next to water using devices in bathrooms / kitchens
- Accessible information on how to report dripping taps and other water issues
- A water champion who can be a point of call and help promote water awareness and saving

Outdoor areas

Outdoor areas should be designed to require minimal / no irrigation. This can be achieved by choosing drought-resistant plants and trying to conserve water in the soil e.g. by using mulches.

Examples of drought tolerant plants can be found using online directories, for example *Drought Resistant Plants* (Royal Horticultural Society, 2014) or *Repertoire des Plantes a ne Jamais Arroser* (Saint Jean, 2014). Drought tolerant plant lists must be regionally relevant as clearly suitable plants vary with climate.

[1] Further information on the EU Ecolabels for sanitary tapware and flushing toilets and urinals is available at: http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html

[2] It should be noted that electric showers can be relatively carbon intense despite low flow rates depending on the energy mix of the country-specific national grid, hence these would not necessarily be recommended.

[3] The average flush volume for dual flush WC Suites and Cisterns is calculated as $(a + (3 \times b)) \div 4$, where a is the full flush value and b is the low flush value.

[4] BREEAM (Building Research Establishment Environmental Assessment Methodology) was first published by the Building Research Establishment (BRE - UK) in 1990. Globally, it is the most widely used method of assessing, rating, and certifying the sustainability of buildings.

Environmental benefits

The main environmental benefit to implementing this best practice is saving potable water, a very valuable resource. This is particularly true taking into account the high environmental burden of transporting from far away and/or treating the water to reach the quality needed for drinking and treating the waste water (grey and black water) before these are being returned to the natural water cycle, which is energy and carbon intensive. For instance, the embodied carbon of a litre of potable tap water in the UK is 0.79 gCO_2/litre (Water UK, 2011, quoted in Bull, 2014). Reductions in hot water use will also save energy, again leading to reduced carbon emissions.

Side effects

There are no cross media effects from the implementation of this best practice.

Applicability

The technique described in this best practice is applicable to all office buildings. It has environmental and economic benefits whether the building is rented or owned even though there may be more restricted actions possible in rented buildings.

This best practice is particularly relevant to areas prone to water stress due to their geographical location e.g. Southern Europe. Figure 4 comprises a water stress map of Europe showing regions with low, medium and severe water stress. However, even in an area of apparent low water stress, this best practice applies as it can be a function of the geology and climate of an individual river catchment, as well as the varying weather patterns. Also, there is always an environmental benefit with saving water because of the avoided energy / carbon / environmental cost to supplying potable water and treating waste water.

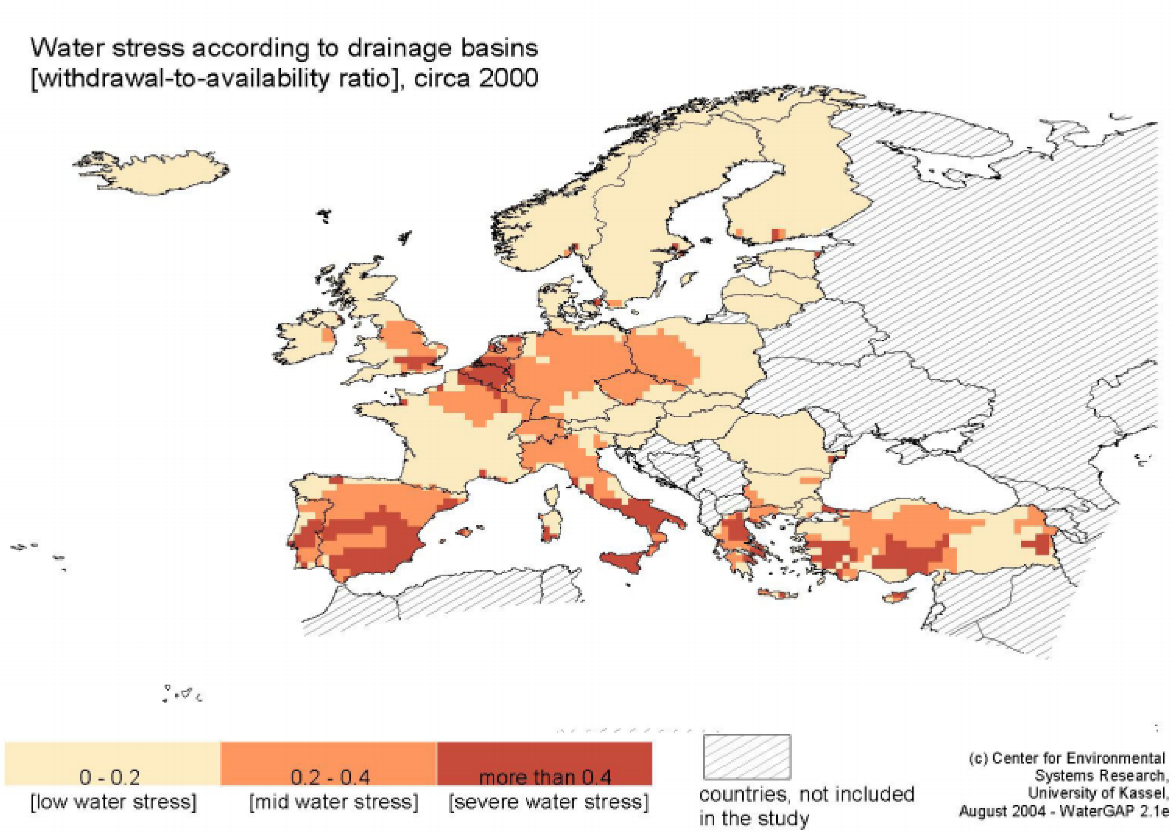

Figure 4: Water stress in Europe (Floerke and Alcamo, 2004, p50)

Economics

Minimising water consumption in offices can deliver financial savings equivalent to an estimated 30% of reduced water bills (figure applies to businesses, WRAP, 2011). In Europe, water costs on average €3.25 per m3 (EPBV, 2009). A 5mm stream of water flowing from a tap can use 528,000 litres ($528m^3$) of water/year, costing about €1,300 for cold water, but up to €5,100 if the water has been heated. A dripping tap wastes at least 5,500 litres of water / year (WRAP UK, 2013). Below are some examples of possible savings through water management and investments:

- Tap aerators and flow restrictors are low-cost solutions which can reduce water use of basin taps by up to 70% (WRAP, 2013).
- Replacement of an 11 litre single flush WC with a low flush 4 litre or 4.5/3 litre dual flush WC, water savings of 170 litres per day can be achieved (assumes relatively high utilisation rate of 50 flushes per day). It is usually expensive to replace old WCs, except as part of a whole building upgrade / major refurbishment, due to the low cost of water (WRAP, 2013).
- There is an estimated 10-20 year payback on rainwater harvesting system installations. Variables affecting payback include climate and building characteristics (Khoury-Nolde, no date).

As well as saving directly on water and effluent charges, there are possibilities for savings elsewhere in the value chain, including cost of energy to heat water and cost of wasted energy (e.g. heating system pumps).

Driving forces for implementation

Public Administrations are implementing water savings measures to reduce water costs as well as energy costs and carbon taxes payable, if applicable. They help ensure business continuity (security of supply) and enhance reputation. The implementation of energy management can also be dictated by environmental consciousness and/or the need to deliver water resource and carbon savings according to political targets. When an effective water management system is implemented specifically for public administration offices, it can play the additional role of demonstrating best practice. For example the water policy, water consumption data, key performance indicators and actions can be made public.

Reference organisations

Liborne Town Hall, France

Cost benefits of installing flow regulators at town hall taps

UN City Complex, Copenhagen, Denmark

Demonstrates rainwater harvesting and water management at state of the art UN Building

The Hive, Worcestershire Council, UK

Demonstrates water management at the building level, including rainwater and mains water.

Bristol City Council, UK

Demonstrates reductions in water use through water management and reducing water demand in outdoor areas.

Hannover City Council, Germany

Outlines an incentive scheme for reducing energy and water use in Hannover's municipal office buildings, with a case study of Hannover Town Hall and water efficiency retrofits implemented.

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