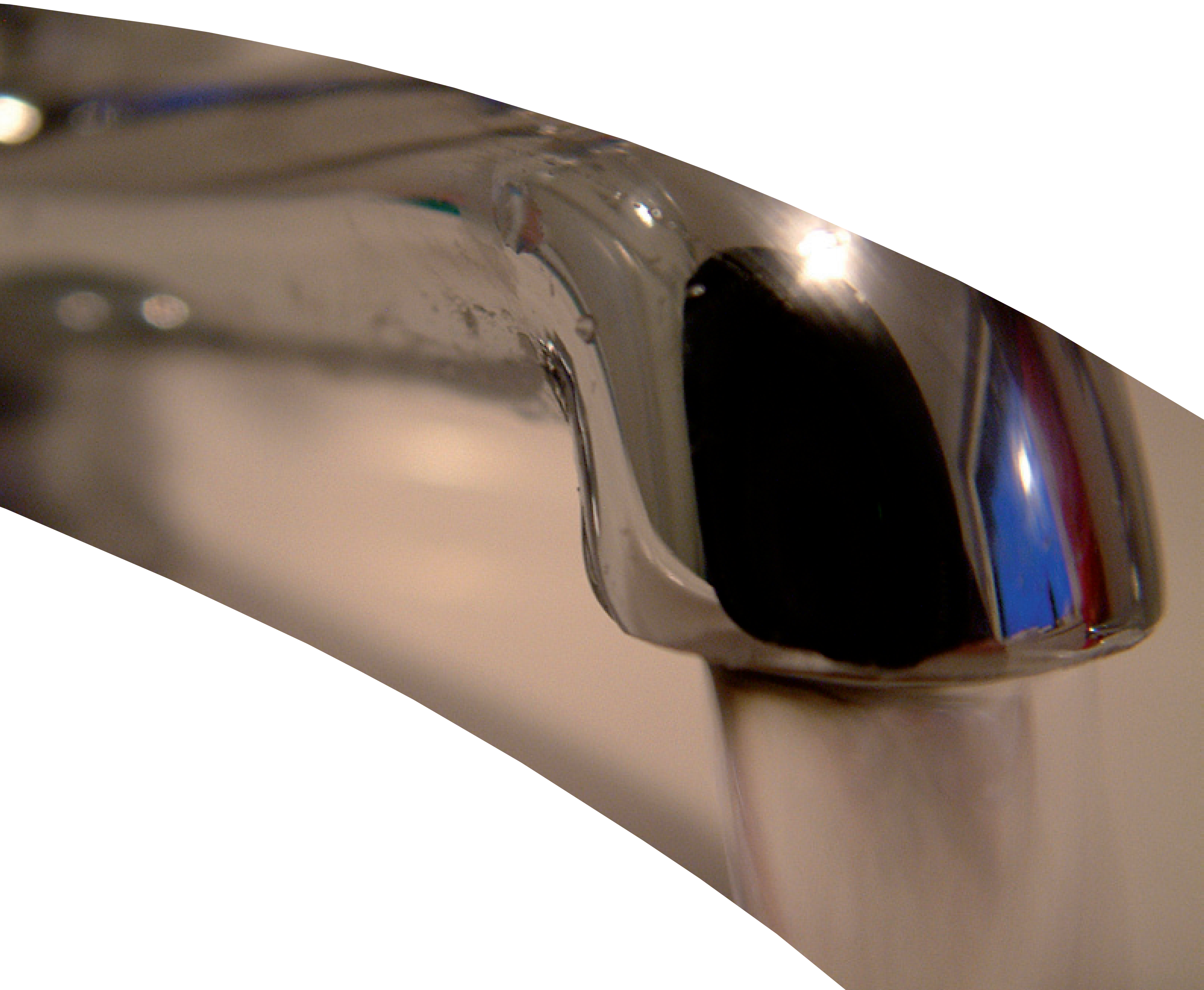
Department of Health

Environment and sustainability
Health Technical Memorandum 07-04: Water management and water efficiency – best practice advice for the healthcare sector



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Health Technical Memorandum 07-04: Water management and water efficiency – best practice advice for the healthcare sector

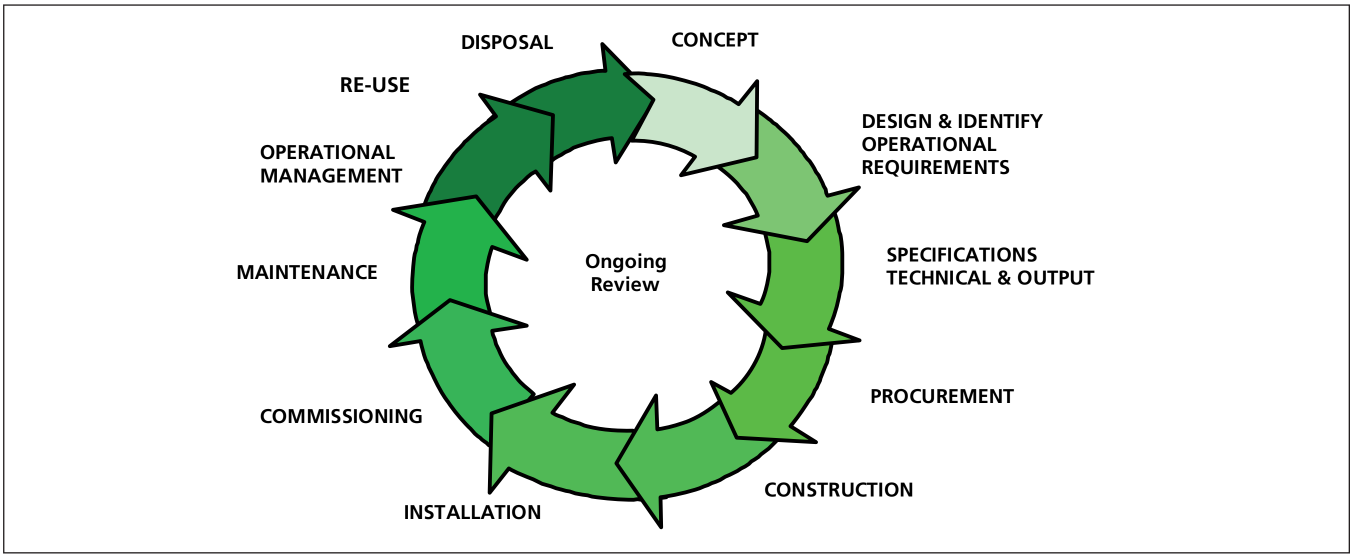
Preface

About Health Technical Memoranda

Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

The focus of Health Technical Memorandum guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

Figure 1 Healthcare building life-cycle



Healthcare providers have a duty of care to ensure that appropriate governance arrangements are in place and are managed effectively. The Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to unnecessarily repeat international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of nine subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering, technology and sustainability;
- provides a structured reference for healthcare engineering.

Structure of the Health Technical Memorandum suite

The series contains a suite of nine core subjects:

Health Technical Memorandum 00
  Policies and principles (applicable to all Health Technical Memoranda in this series)

Health Technical Memorandum 01
  Decontamination

Health Technical Memorandum 02
  Medical gases

Health Technical Memorandum 03
Heating and ventilation systems

Health Technical Memorandum 04
Water systems

Health Technical Memorandum 05
Fire safety

Health Technical Memorandum 06
Electrical services

Health Technical Memorandum 07
Environment and sustainability

Health Technical Memorandum 08
Specialist services

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Health Technical Memorandum 06-02 represents:

Electrical Services – Electrical safety guidance for low voltage systems

In a similar way Health Technical Memorandum 07-02 represents:

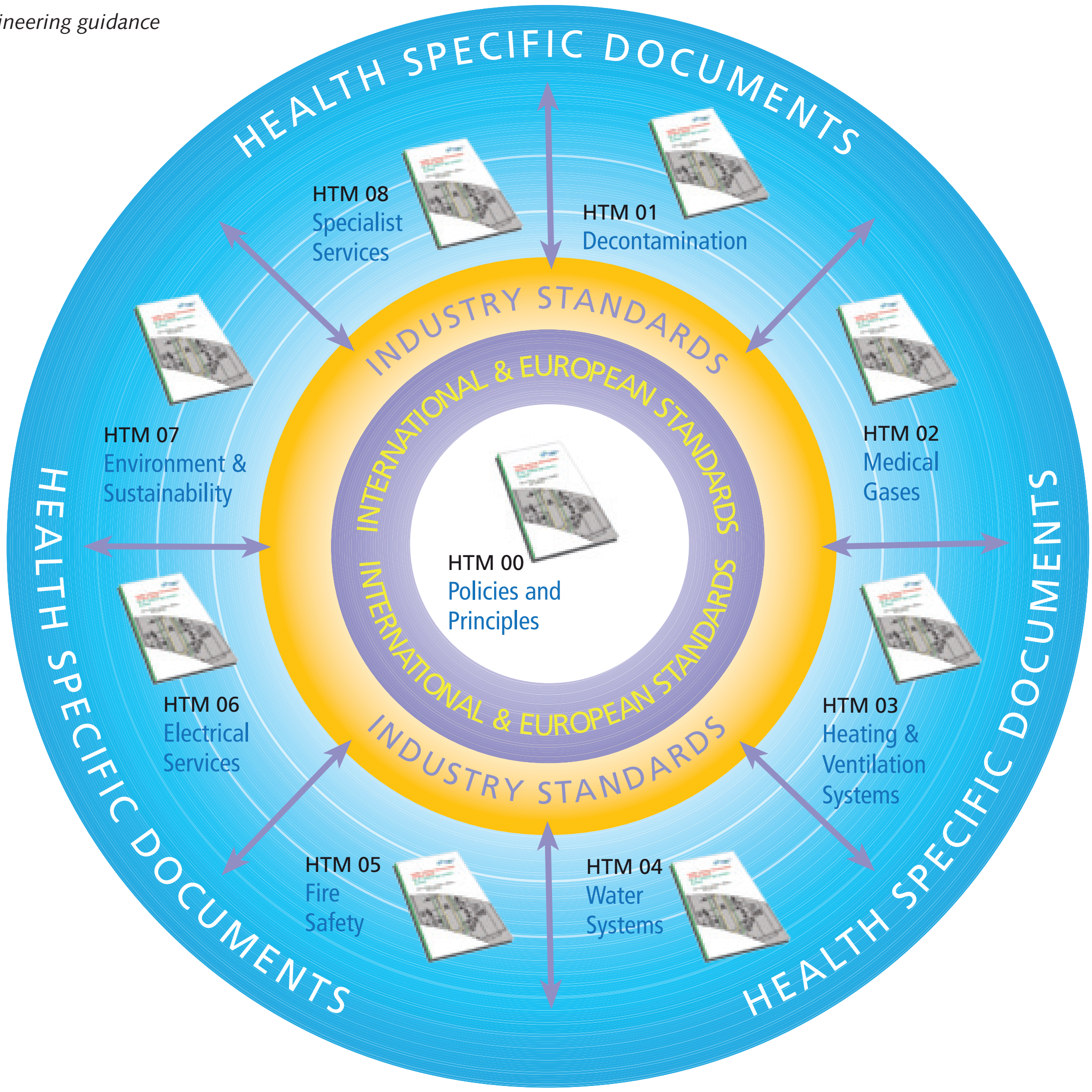
Environment and Sustainability – EnCO$_2$de.

All Health Technical Memoranda are supported by the initial document Health Technical Memorandum 00 which embraces the management and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.

DH Estates and Facilities Division wishes to acknowledge the contribution made by professional bodies, engineering consultants, healthcare specialists and NHS staff who have contributed to the production of this guidance.

Figure 2 Engineering guidance



Executive summary

During 2002/2003, the NHS in England consumed 40.3 million cubic metres of water and produced 34.4 million cubic metres of sewage. This comes at a cost – not just financial, but at a cost to the environment.

Financial savings of up to 20% may be achieved through water-efficiency measures, with little or no cost in investment. This translates to a possible saving of £9.5 million per year.

Much of these savings can be immediately realised through minor repairs to existing infrastructure and through staff behaviour, while others may require an initial capital investment that can be recovered within a specified payback period.

This Health Technical Memorandum encourages investigating these possible savings. Its principal remit is to encourage the efficient management of water and to promote the economic and environmental benefits of doing so. Additionally, it examines water-management decisions in the context of:

- patient health and well-being;
- social and behavioural aspects; and
- available and appropriate technology.

Methods for auditing facilities are outlined, with common areas of high water use discussed and technical solutions proposed. Guidance on establishing necessary social and behavioural aspects such as staff awareness, appropriate use of technology and a clear definition of responsibilities are also outlined.

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Contents

1 Introduction

1.1 This guidance document lays out the steps to developing a water strategy for healthcare facilities. Its principal remit is to encourage the efficient management of water and to promote the economic and environmental benefits of doing so. Additionally, it examines water-management decisions in the context of:

- patient health and well-being;
- social and behavioural aspects; and
- available and appropriate technology.

It is relevant to all healthcare facilities, not just hospitals.

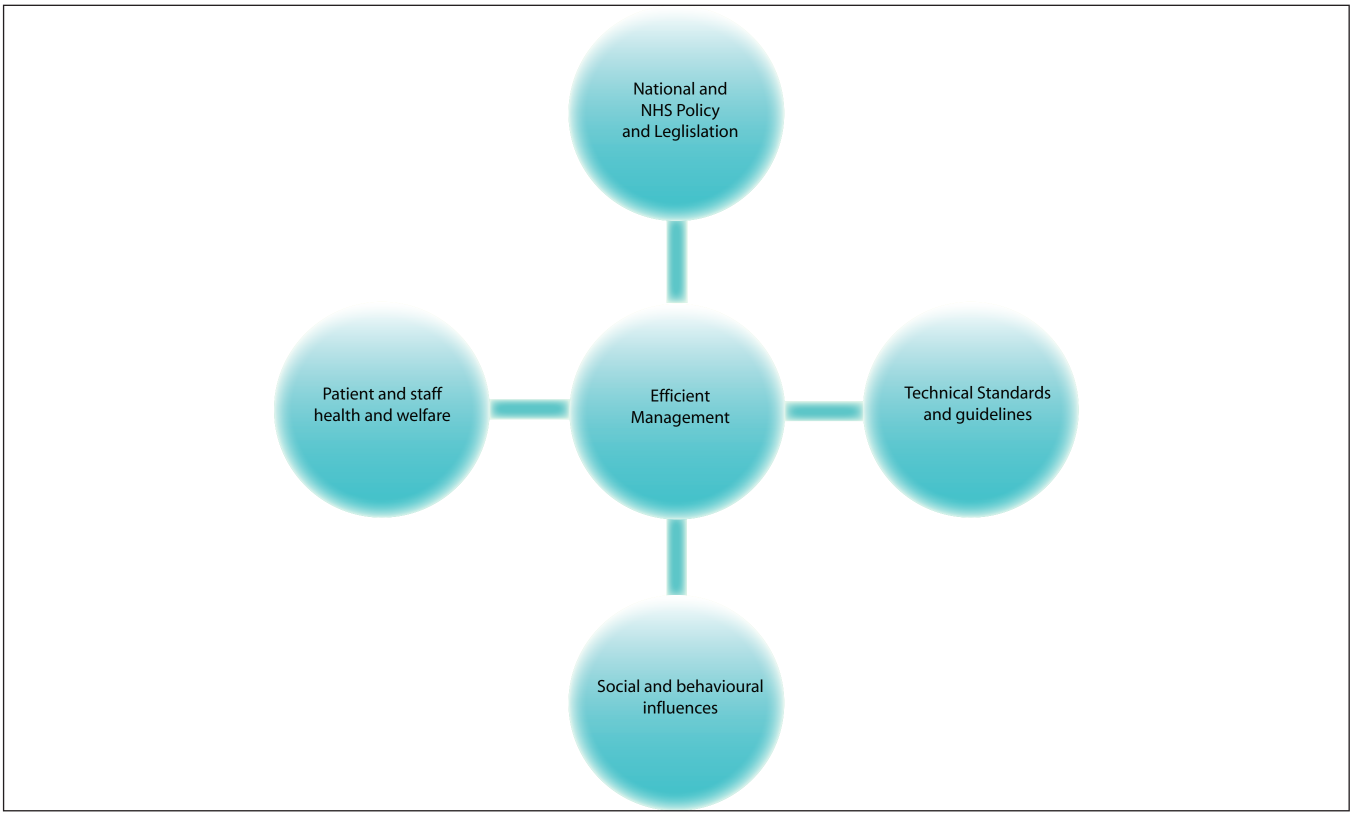
1.2 The document refers to national or NHS policy and guidelines where appropriate, outlining a comprehensive approach to water management (see Figure 1).

1.3 Methods for auditing facilities are outlined, with common areas of high water use discussed and technical solutions proposed. Guidance on establishing necessary social and behavioural aspects such as staff awareness, appropriate use of technology and a clear definition of responsibilities are also outlined.

Action checklist

1.4 The following table is a summary of actions and their associated savings in terms of water and costs. It is not an exclusive list, but rather represents a first glimpse of how water savings can be accomplished. These items are discussed in more detail in Chapter 6.

Figure 1 Efficient water management in context



Item	Typical percentage of total healthcare consumption	Typical consumption rate	Potential actions
WCs	24	6–9 L flush	• Install a cistern displacement device – saving approximately 1 L per flush • Retrofit to a dual flush or lower flush system – giving the option for a half flush. (Note: Where dual-flush toilets are specified, they should have guidance or symbols instructing the user on the appropriate operation of the flushing device) • Replace old WCs with those that give a flush volume of up to 6 L (maximum)
Urinals	5	500–900 L per day	• Controlled flushing through foot triggers or motion sensors can reduce consumption by 120–200 L per day • Waterless urinals
Taps	13	400 L per day	• Flow restrictors, non-concussive self-closing taps and sensor[a] taps can reduce consumption by up to 50% (Note: the choice of tap should be appropriate for the intended use)
Leak detection	15–30	Small leak: 6 L per hour Large leak: 400–800 L per hour	Inspect all fixtures and fittings, graph monthly bills, or conduct internal monitoring through submetering to identify possible leaks
Boiler	Variable	Intense energy consumption means costs are much higher than water alone	• Adjust boiler blowdown amount and frequency to reduce waste and to control total dissolved solids (TDS) • Collect and reuse steam condensate • Control steam losses

See Health Technical Memorandum 00 for guidance on recommended sanitary assemblies in healthcare facilities.

Also refer to the compliance criteria in BREEAM Healthcare.

[a] Automatic or sensor taps will only be effective when properly maintained and kept in good working order.

2 Managing water wisely in healthcare facilities

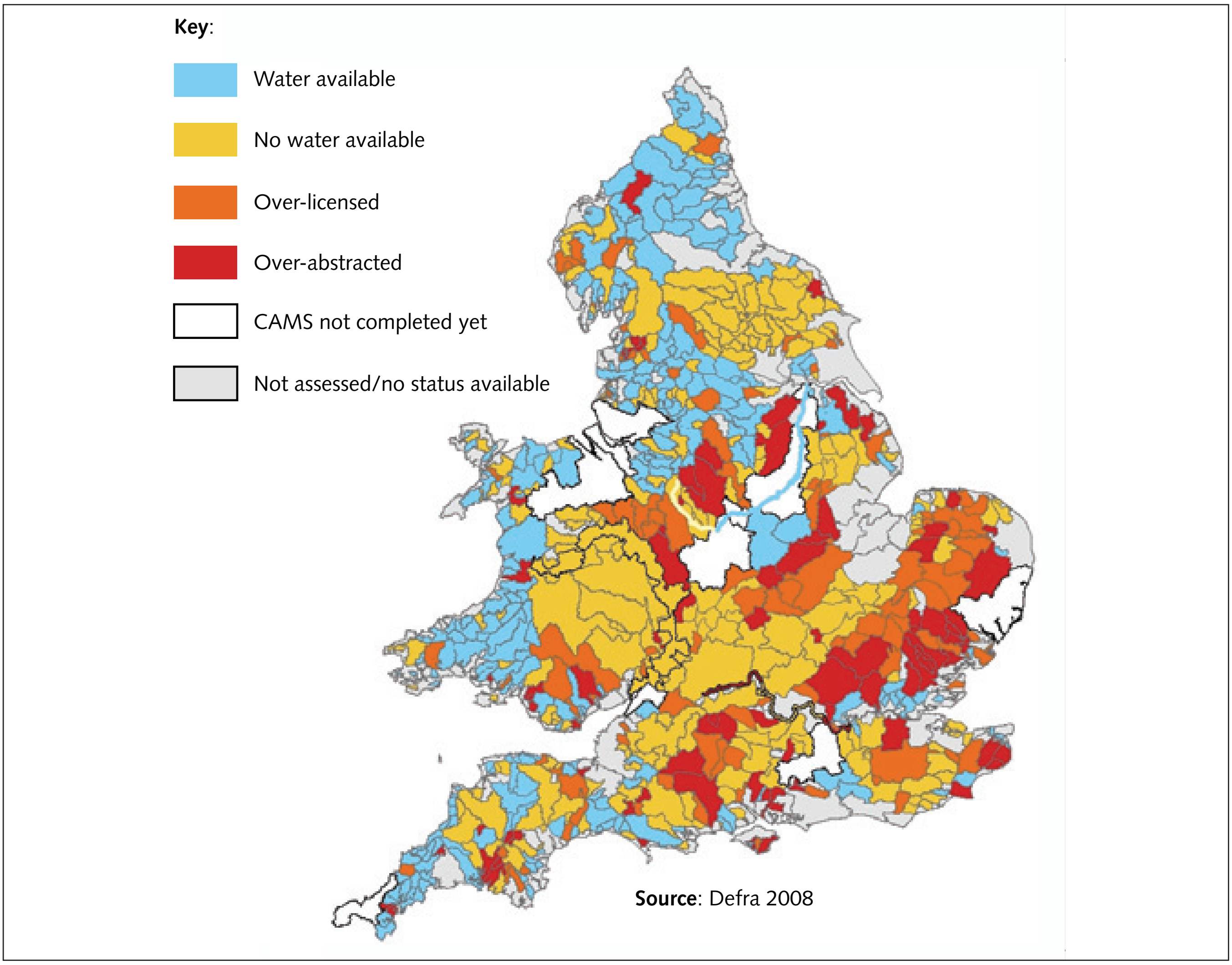
Water resources in the UK

2.1 The UK's water resources are coming under increasing pressure. There is a risk that demand might exceed the total amount of water that can be abstracted from rivers and underground supplies, a situation that could lead to environmental damage and degradation. The Environment Agency has estimated that many aquifers are already over-abstracted. (Figure 2 summarises the water resource availability for each catchment in England and Wales.)

2.2 In highly urbanised regions such as southern England, the natural environment is now seriously under threat from water abstraction. For some areas of the South East, the availability of water per head has grown sufficiently serious to be comparable with that of some Middle-Eastern countries. There is a need, therefore, to relieve pressure by implementing better and more informed water-management strategies.

2.3 In addition to growing pressures on water resources from housing and commercial development,

Figure 2 Water resource availability for England and Wales



climate change will significantly alter the way the UK uses its water resources, as well as the nature of water resources themselves. Summers are projected to become hotter and drier, and winters wetter. Accompanying this change in seasons will be an increased incidence and intensity of droughts and floods. Water will therefore be a crucial aspect of climate-change adaptation.

2.4 Furthermore, water use has a direct association with climate-change mitigation. Significant amounts of energy are used in the supply and treatment of water. Water UK (2007) estimates place the carbon costs of water supply at around 0.271 grams of CO_2 per litre, a figure likely to be much higher if the water is heated. Therefore, a more efficient use of water in healthcare facilities could result in a significant reduction of their carbon footprint.

2.5 In the context of increased development, climate change and limited water resources, the Department for Environment, Food and Rural Affairs (Defra) has observed that maintaining a reliable supply of water is no longer uniquely the remit of water suppliers. Measures need to be taken on the part of those using water to improve efficiency (Defra, 2007).

Social responsibility and sustainable development

2.6 The NHS has the largest and most complex estate portfolio in Europe. These estates will have an impact on their surroundings, be it in terms of culture, economy or the environment.

2.7 Managing water efficiently across the healthcare estate will require a wide range of approaches and will ultimately have a large impact on the healthcare sector's environmental footprint.

2.8 A clear and ambitious water strategy (see Chapter 5) will not only help to mitigate the environmental impacts of healthcare facilities, but will also serve to promote the sustainability of those facilities to those who use them and to the wider public.

Refer also to:

- BREEAM Healthcare;
- The Good Corporate Citizenship model.

3 Legislative and policy-related responsibilities

3.1 In addition to Defra's broad twin-track policy on water resources (Defra, 2008), a mounting volume of national and international policy and legislation specifically calls for actions to be taken to improve water efficiency and management.

European policy and legislation

3.2 The European Commission's communication on drought and water scarcity (COM (2007) 414 final) estimates that 20% of all water consumed in the EU is wasted and states that:

"Water saving must become the priority and all possibilities to improve water efficiency must therefore be explored."

3.3 The Water Framework Directive (2000/60/EC) sets out requirements and measures to improve water efficiency.

3.4 The Integrated Pollution Prevention and Control (PPC) Directive (96/61/EC) has now been transposed into law by the Pollution Prevention and Control Act 1999 and the Pollution Prevention and Control (England and Wales) Regulations 2000 (as amended).

National policy and legislation

Water Act 2003

3.5 The Water Act 2003 established that it is the responsibility of all public bodies to conserve water.

3.6 The Act also:

- introduced time limits for all new abstraction licences;
- introduced the facility to revoke abstraction licences that cause serious environmental damage;
- introduced greater flexibility to raise or lower licensing thresholds;
- deregulated small and environmentally insignificant abstractions;
- extended licensing to abstractors of significant quantities presently outside the licensing system.

3.7 The Environment Agency is developing catchment abstraction management strategies (CAMS) that aim to provide a structured approach to local water resources management, recognising the reasonable needs of abstractors and the needs of the environment. This fits in with the needs of the Water Framework Directive (2000/60/EC) mentioned in paragraph 3.3. The Environment Agency assesses any new application for a licence against the CAMS.

In Scotland, the Scottish Building Standards Agency has issued guidance on water use and efficiency.

In Northern Ireland, under the Water Act (Northern Ireland) 1972, the Environment and Heritage Service (EHS) is required to promote the conservation of the water resources of Northern Ireland and to promote the cleanliness of water in waterways and underground strata.

Water Supply (Water Fittings) Regulations 1999

3.8 All water fittings are covered by the Water Supply (Water Fittings) Regulations 1999 for England and Wales. This legislation includes information on the water use of individual appliances.

3.9 Implementation of the Regulations is overseen by the Water Regulations Advisory Scheme (WRAS).

Note

In England and Wales, the Water Supply (Water Fittings) Regulations and the Building Regulations are to be updated to include greater emphasis on water efficiency.

In Scotland, water fittings are covered by the Water Byelaws (2004).

In Northern Ireland, water fittings are governed by the Water Regulations (Northern Ireland) 1991. The Water and Sewerage Services (Miscellaneous Provisions) (Northern Ireland) Order 2006 introduces provisions relating to information sharing in connection with water and sewerage charges and introduces controls on the abstraction and impounding of water.

Water strategy

3.10 The Government has set a target of a 25% reduction in water use in its office and non-office estates by 2020, relative to 2004/2005 levels (Defra, 1999).

3.11 Defra's (2008) current water strategy cites water efficiency as playing a prominent role in achieving a sustainable supply–demand balance, and encourages industrial and commercial sectors to lead by example through initiatives such as voluntary agreements.

Code for Sustainable Homes

3.12 All new public-building developments are subject to obligatory water efficiency benchmarks as defined in the 2006 Code for Sustainable Homes. It is likely that a non-domestic version of the Code will be produced in the next two years.

A list of regulators and other independent bodies involved in water management is given in Chapter 9.

4 Economic benefits

4.1 It is likely that the trend of emerging policy and legislation with regard to water efficiency and management will continue, as will increases in water prices. In highly stressed areas, restrictions on water use may be enforced more frequently during drought periods. Acting sooner rather than later will establish standards of water management and reporting, which pre-empt these changes and limit the associated risks to healthcare services.

4.2 During 2002/2003, the NHS in England consumed 40.3 million cubic metres of water and produced 34.4 million cubic metres of sewage. Healthcare estates are likely to be classified as non-domestic and charged through a combined flat rate and a volumetric rate, the flat-rate portion being determined by the size of the supply pipe and/or meter entering the property. This Health Technical Memorandum encourages investigating the possible savings that can be achieved not only through a reduction in the volume of water consumed, but possibly through a downsizing of supply pipes and/or meters in order to match the reduced consumption.

Note

The Water Services Regulation Authority (Ofwat) has published proposals to change the water supply licensing (WSL) regime to extend competition in the water and sewerage industry. The aim is to deliver economic as well as environmental benefits. Visit Ofwat's website for more information.

Potential savings

4.3 Water UK (2003) estimated that, in total, financial savings of up to 20% may be achieved through water-efficiency measures in healthcare estates, with little or no cost in investment. This translates to a possible saving of £9.5 million per year (at 2001 prices).

4.4 Much of these savings can be immediately realised through minor repairs to existing infrastructure and through staff behaviour, while others may require an initial capital investment that can be recovered within a specified payback period.

4.5 Some types of water-efficiency activity will also incur savings in energy costs, as less water is required to be heated.

Reducing water waste and its associated savings

4.6 The following examples show the types of measure – and their associated savings – that can be taken to reduce water consumption. They are examples of practical actions that have been used in the healthcare sector.

4.7 Examples 1 and 2 show how large savings can be made with very little capital expenditure and no actual or perceived impact on hygiene. Examples 3 and 4 show that large savings can be made with payback periods of a couple of years, if more money is invested. In addition, example 4 shows that action can be taken in clinical areas without compromising hygiene.

Note

Other actions to save water may be more appropriate for different estates, and a choice of the best action to take can only be made after a preliminary audit.

Example 1: identifying leaks

It was estimated that 15–30% of hospital consumption could be attributed to leakage. A small leak was potentially found to lose around 6 L per hour, leading to the loss of 53 m^3 per year. More significant leaks were found to potentially lose up to 3500–7000 m^3 per year, costing approximately £6400 a year. After identifying and repairing two major leaks, one NHS hospital reported savings of £100,000 a year (source: Water UK, 2003).

Example 2: urinal flushing

Public urinals in one hospital were set to flush automatically every 20 minutes and retrofitted with water-saving devices, which limit unnecessary flushes. Each fitting cost £120 per unit, saving £234 of water each year, resulting in a six-month payback period (source: Water UK, 2003).

Example 3: steam traps

South Manchester Hospital Trust installed a low-maintenance steam-trap system to conserve water. The cost of the project was £24,000, saving £1750 a year on water costs and £8600 on energy costs. The payback period was around 28 months (source: Carbon Trust, 2000).

Example 4: wastewater recycling

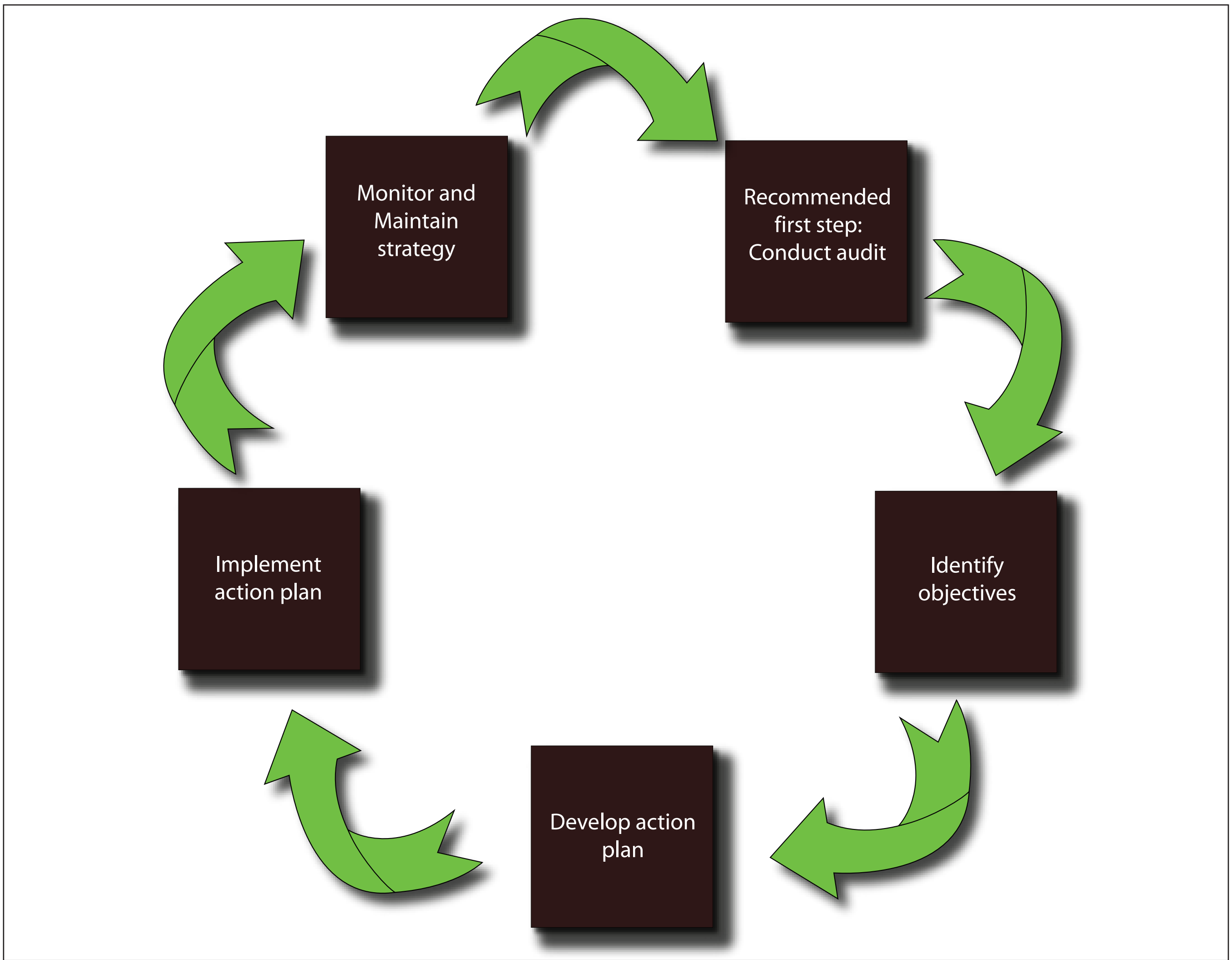
East Kent and Canterbury Trust made huge savings in its renal unit. A significant amount of wastewater was produced by the hospital's reverse osmosis plant. The project installed holding tanks and pipework that allowed the wastewater to be reused for urinal and WC flushing in the main operating theatres and the emergency care department, topped up with mains water when needed. The project reduced mains water consumption by 33%, saving £7000 a year. This allowed for project costs to be recovered in less than three years (source: Environment Agency, 2005).

5 Developing a water strategy

5.1 The best way to approach water management within any site or building is to develop a strategic plan. One of the main aspects of a water strategy is water efficiency, but it should be much wider than that, encompassing all water issues. The strategy should cover everything from flooding to hygiene – even if specific sections just state that the issue is covered elsewhere. The aim is to act as a central reference for all water issues.

5.2 A water strategy will not be static; rather it will be a continuous process of monitoring, adaptation and implementation, which feeds into a live document (see Figure 3). The process can be entered at any stage, depending on where the site/building is with regard to water management. However, it is recommended that the first step is an audit.

Figure 3 The water strategy process



Establishing and maintaining a framework of management

5.3 In developing a water strategy, stakeholders from various organisational levels should be involved (see Figure 4).

Senior management

5.4 In preparation for developing a water strategy, the issue of water management should be raised at a senior management level and support secured. Senior management should also discuss the possibility of integrating water-efficiency goals into key performance indicators.

Water champions

5.5 Senior management should designate a water champion and provide the necessary resources and powers to conduct a water audit and coordinate the water strategy. Champions will act as coordinators for implementation, sources of information and a channel for reporting to senior management.

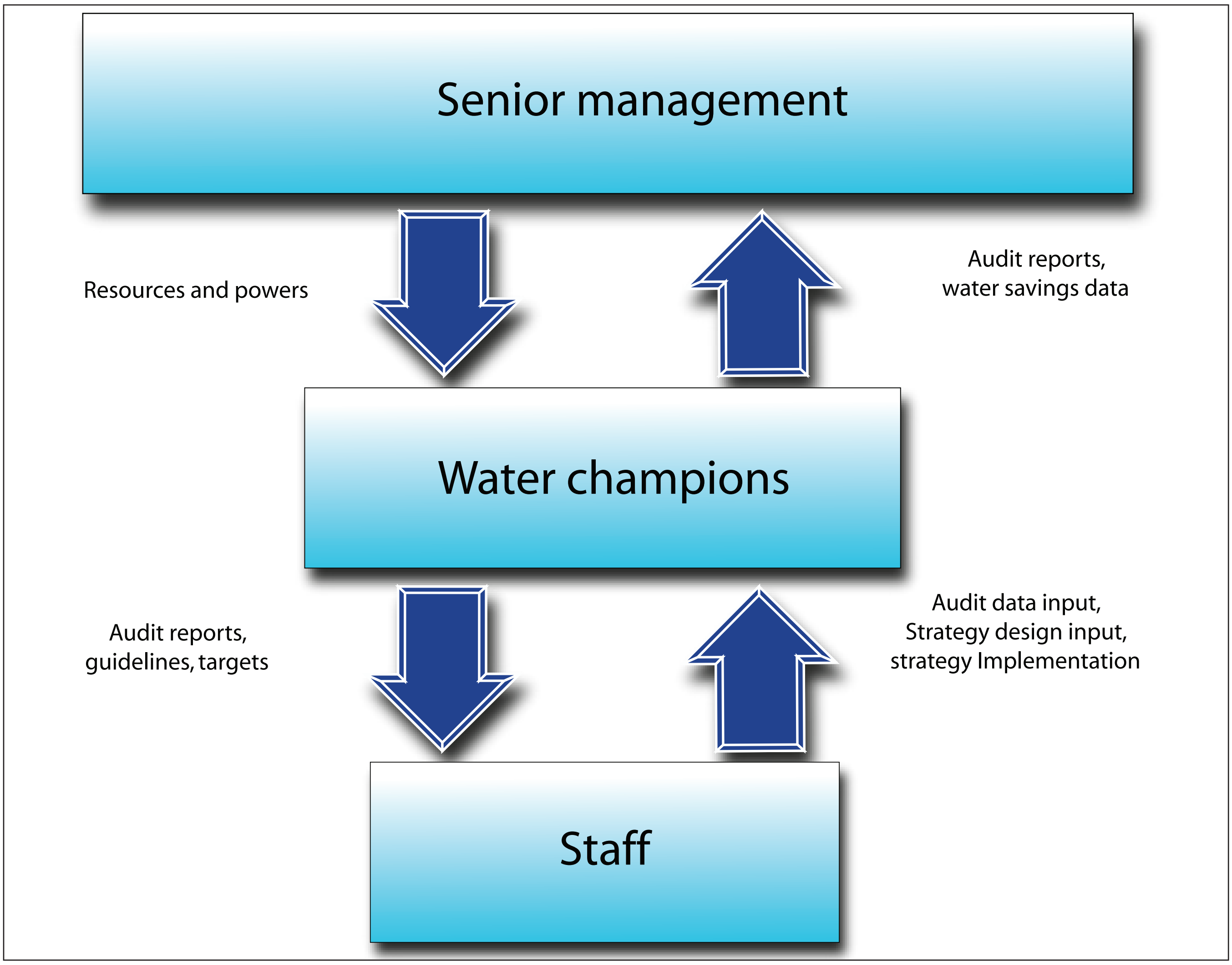
Staff involvement

5.6 Water is often misconceived as effectively limitless and costless. Efficient management is hampered by a lack of staff awareness, leading to potential savings in water bills and increased environmental integrity being overlooked in the past.

5.7 The development of a water strategy should be seen as an opportunity to raise staff awareness as well as to gather input.

5.8 Water use is an emotive issue, and staff should be informed of the project to develop a water strategy and be given regular information during the process.

Figure 4 Framework of responsibilities for water management



5.9 The development of the strategy should also, where possible, be an interactive process with adequate provision for staff to comment or contribute to the strategy. All staff will have a view on water, but the strategy should particularly involve those who use water in their duties or would be affected by the strategy.

5.10 Daily routines should be investigated to identify patterns of water use.

5.11 Finally, it may be of particular significance to discuss changes in water management with medical, nursing and infection-control staff in order to ensure that all parties are satisfied that there is no compromise to clinical care, hygiene or infection control.

Building management systems

5.12 A building management system (BMS) is a computer-based centralised procedure that helps to manage, control and monitor certain engineering services within a building or a group of buildings. If used appropriately, such a system ensures efficiency and cost-effectiveness in terms of labour and energy costs, and provides a safe and more comfortable environment for the building's occupants.

5.13 A BMS is operated from a central station, usually a personal computer, from which the user is able to analyse updated monitor values received from outstation sensors, actuators and stand-alone controllers.

5.14 With the installation of water submeters, temperature sensors and reporting procedures at key points in a building, a BMS may support water management through the following:

- monitoring of water consumption and the identification of leaks or excessive consumption (see paragraphs 5.27–5.39);
- monitoring of water temperature for health and safety reasons (see paragraphs 5.25–5.26 and paragraphs 7.22–7.30);
- management of boilerhouses and cooling-tower cycles and maintenance (see paragraphs 6.1–6.14);
- scheduling of maintenance events.

5.15 Water champions should be assigned responsibility to cooperate with BMS managers in integrating water management into the BMS.

5.16 Further information on BMS installation and operation can be found in Health Technical Memorandum 2005 – 'Building management systems'.

Metering and submetering

Metering

5.17 Information from water meters can be used by both water and sewerage service providers to carry out assessments for charging purposes and to aid water management within a facility.

5.18 Beyond the main service meter, additional submeters may be installed at floor, section or appliance level to provide data on internal rates of consumption. In all cases, it is important that the meter be appropriately sized according to average flow rate measured.

5.19 Main service meters that measure water entering from the supply network should be appropriately sized, as there is often a component of service charges which is based on meter size. Sizes may need to be reviewed after efficiency measures have been made inside the building, as flow rates may decrease.

5.20 Water meters should be properly installed, maintained and used according to the manufacturer's instructions. The meter supplier should calibrate the meter and check its accuracy.

Submetering

5.21 Submeters allow for management to measure consumption according to sections of the system. These can be especially useful for conducting water audits, by which areas of high use can be more precisely detected.

5.22 For monitoring purposes, submetering will also show area-specific rises in water consumption, indicating possible leakage.

5.23 The possibility of integrating submeters into building management systems should be considered.

5.24 For a case study of the use of meters in water management, see Chapter 13.

Water quality, infection control, staff and patient welfare

5.25 While this document's principal focus is on water efficiency in healthcare facilities, many decisions regarding water management will be affected by priority areas of water quality, infection control, and patient and staff welfare.

5.26 Where standards in water efficiency overlap with those in infection control and patient and staff welfare, existing guidance is referred to and should be consulted before management decisions are made (see Table 1). Further discussion of water quality issues can be found in paragraphs 7.22–7.30.

Conducting an audit

5.27 A water audit is similar to a financial audit and can be as simple or as detailed as appropriate to meet circumstances and needs. In short, the audit looks at the amount of water entering the site, the amount leaving the site and the amount consumed. This basic calculation should provide an overview of costs, potential savings and areas of wastage. It will also highlight discrepancies, which will indicate leakage or other losses. The initial audit should

Table 1 Key health concerns and relevant documents

Key quality and health concerns	Relevant document
The control of water-borne infections, in particular legionellosis	• Health Technical Memorandum 04-01 – 'The control of Legionella, hygiene, "safe" hot water, cold water and drinking water systems' • Health Facilities Note 30 – 'Infection control in the built environment'
The control of infection transmission pathways through appropriate choice of technology and through staff training on cleaning and personal washing	• Health Facilities Note 30 • Health Building Note 00-10 Part C • NHS Healthcare Cleaning Manual
The needs of vulnerable patients, such as vulnerability to scalding, ergonomic design and accessibility	• Health Technical Memorandum 04-01 • Health Building Note 00-02 – 'Sanitary spaces' • Health Technical Memorandum 00
Providing adequate points of access for drinking water and promoting the health benefits of hydration within the NHS estate and in the wider community.	Water UK has established the Water for Health Alliance, an industry initiative to promote the health benefits of hydration. The initiative includes guidelines for hospitals, available at www.wateratwork.org.uk/?page_id=13

Note
Planning teams should note the contents of 'The Health Act 2006: Code of practice for the prevention and control of healthcare associated infections' (Department of Health, January 2008). This code of practice sets out criteria by which managers of healthcare organisations are to ensure that patients are cared for in a clean environment and where the risk of healthcare-associated infections is kept as low as possible. The document contains a comprehensive list of the Department's guidance on the prevention of healthcare-associated infection.

Case study: combining water efficiency and infection control and patient welfare

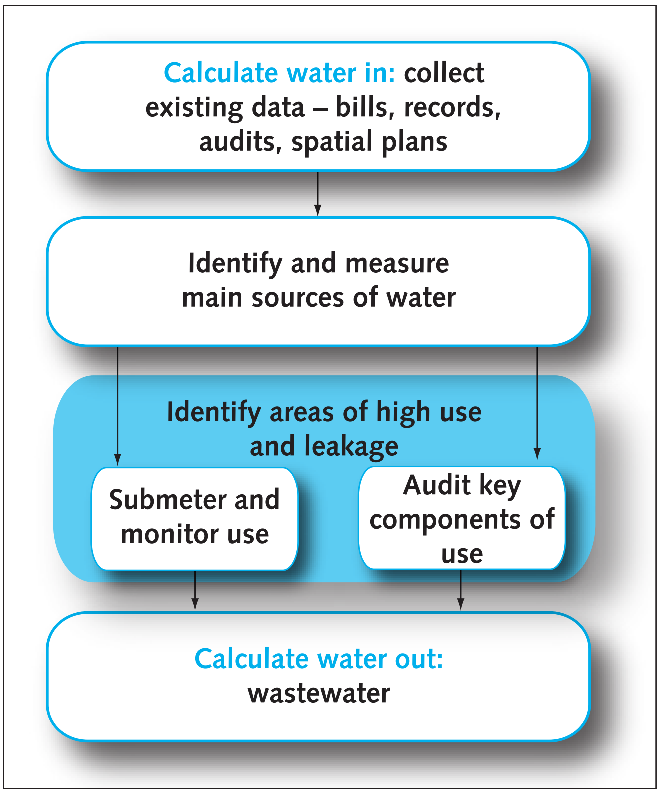
Dorset County Hospital, Dorchester, has embarked on a programme to change all of its WC flush valves and taps to non-touch types. This is partly due to the water efficiency achieved, but mainly because there is mounting evidence that non-touch products offer significant benefits to improving hand hygiene.

The same hospital had an outbreak of *Clostridium difficile*. There were no cases of the disease in areas where non-touch taps were used. While it may be coincidental to some extent, it demonstrated the potential of hand hygiene and the benefits of non-touch taps.

Non-touch products not only offer water-saving and infection control benefits, but also convenience and ease of use for children and people with disabilities.

also aim to establish a framework for ongoing monitoring of water consumption inside the building or site (see Figure 5).

Figure 5 The water auditing process



5.28 In seeking support for conducting an audit, healthcare organisations should designate a key accounts manager to liaise with the local water company. Some water companies are able to offer water audits to high-consumption customers (see also Chapter 11).

Calculating water coming in

5.29 Existing data (such as bills, records and spatial plans of the site) should be collated, and also any other previous audits or reports on water. These should then be used to identify the main sources of water in the building or site, which may consist of private water supplies (for example boreholes), mains supply, bottled water, rainwater harvesting or water recycled within the building.

5.30 Plotting monthly water bills against time on a graph can help to analyse trends in water use and identify a departure from normal consumption levels. A gradual increase in monthly consumption may indicate a leak.

5.31 The possibility of downgrading to a smaller supply-pipe meter should be investigated, based on the data gathered, as this will reduce standing charges for water and sewerage services.

> **Note**
>
> In the analysis of water bills, account needs to be taken of any price increases, any appliances installed or removed, and significant changes in usage such as any ward closures etc.

Identifying areas of high use and leaks

5.32 Once the net use of water for a building has been estimated, areas of high use should be identified, as these provide the largest potential for savings. In some cases, a simple paper audit listing water-consuming fixtures and fittings within the facility, as well as their condition, will be a sufficient preliminary audit. Reference to Chapter 6 should be made when considering which components to include in the audit.

5.33 In larger facilities, submeters provide a means of mapping water flows and analysing consumption according to different sections of the building. For more detailed audits, it may be worth installing submeters for audit and monitoring purposes. Gathering data on water use in different sections of the building may also identify leaks that are not immediately visible in monthly building-wide water consumption.

5.34 Identifying and repairing leaks is relevant to both efficiency and health in facilities. Metered charges will be reduced, as will the risk of contamination of the water supply. Engineering work that exposes pipework and/or produces a large amount of dust should be screened for infection risk (see Health Facilities Note 30).

5.35 Measuring flows during periods of low use (typically at night-time) can reveal unusually high base flows, which can indicate a leak in the area supplied. This may not be the case for buildings such as hospitals, in which daily patterns of water use are erratic and do not drop sufficiently at night-time. In such cases, metering may only be able to identify major long-term leaks (see Figure 7).

5.36 Figure 6 is a hypothetical example, showing baseline consumption standing at 30 L per hour during night hours, possibly indicating a leak. Figure 7 is an actual example of a hospital's monthly consumption, illustrating a major leak that occurred in March 2000.

5.37 The healthcare facility's local water company should be able to assist in identifying leaks and anomalously high use. Almost all companies will offer free advice and some will offer free hands-on support.

5.38 They will also be able to advise on which types of meter to install and whether advanced metering technology would be useful.

In Scotland and Northern Ireland, Scottish Water and Northern Ireland Water, respectively, are the single providers of water. (With regard to commercial customers in Scotland, 1 April 2008 saw the introduction of competition in water services. Therefore, service providers are likely to vary.)

Welsh customers are mostly served by Dŵr Cymru (Welsh Water), with small portions served by Dee Valley Water and Severn Trent Water.

Calculating water coming out

5.39 As water services are charged according to separate water and sewerage charges, the amount of wastewater discharged into sewerage pipes should be calculated. Often this is more difficult than calculating the water coming in, as it tends not to be metered. It is advisable to check the following:

- the location of sewer outflows;
- where rainwater drainage goes;
- whether there are any septic tanks or soakaways;
- whether any water is taken off site;
- steam losses.

Identifying objectives and developing an action plan

5.40 Having conducted a water audit, it should be possible to identify key objectives. These may be focused on identified leaks or may involve changing the management of water in those sections of the building with high water use.

5.41 In developing an action plan, both behavioural and technological options for management should be considered. As mentioned above, staff involvement in the design as well as the implementation of an action plan is essential. The initial results of the

Figure 6 Hypothetical daily consumption

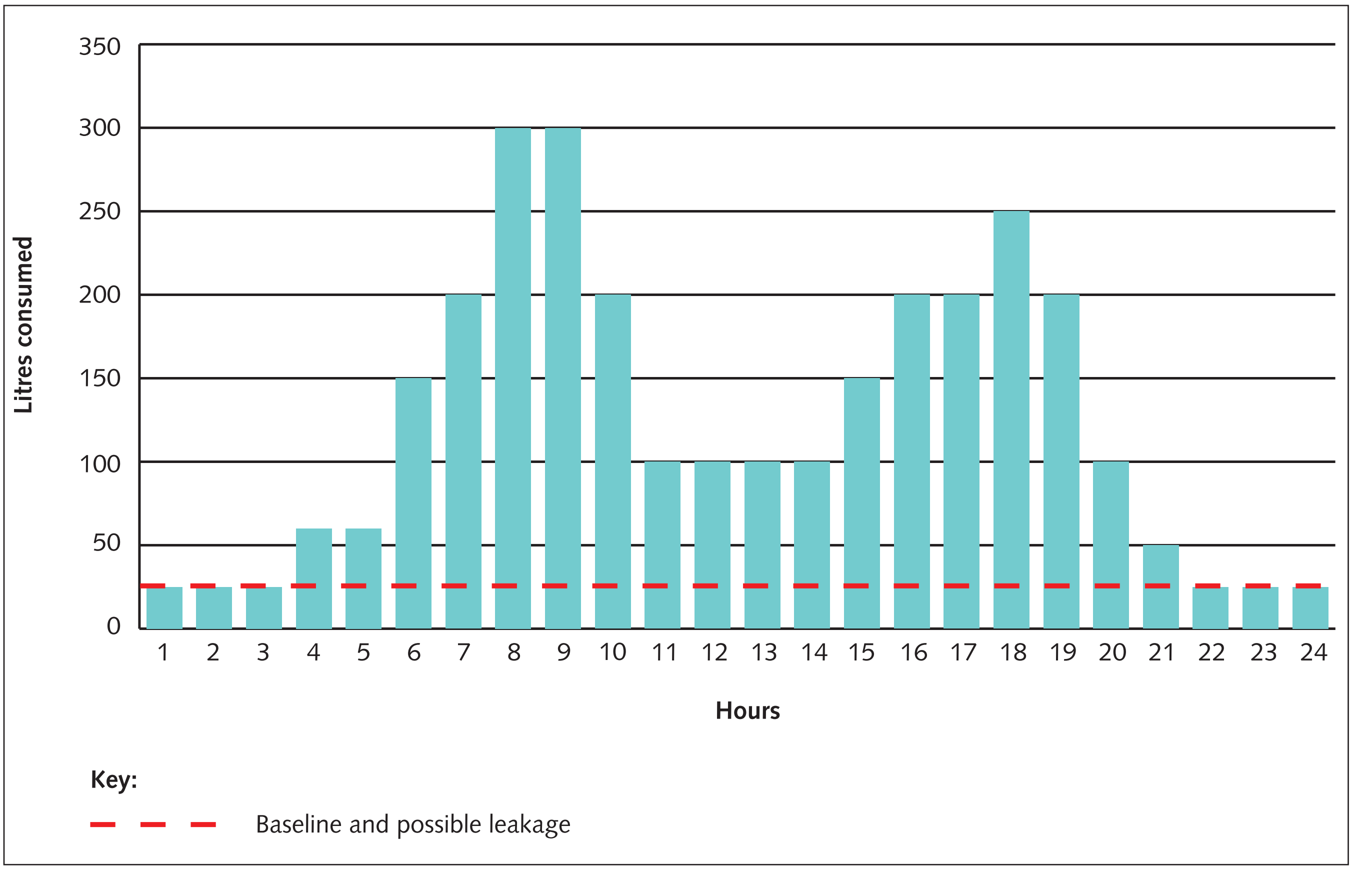
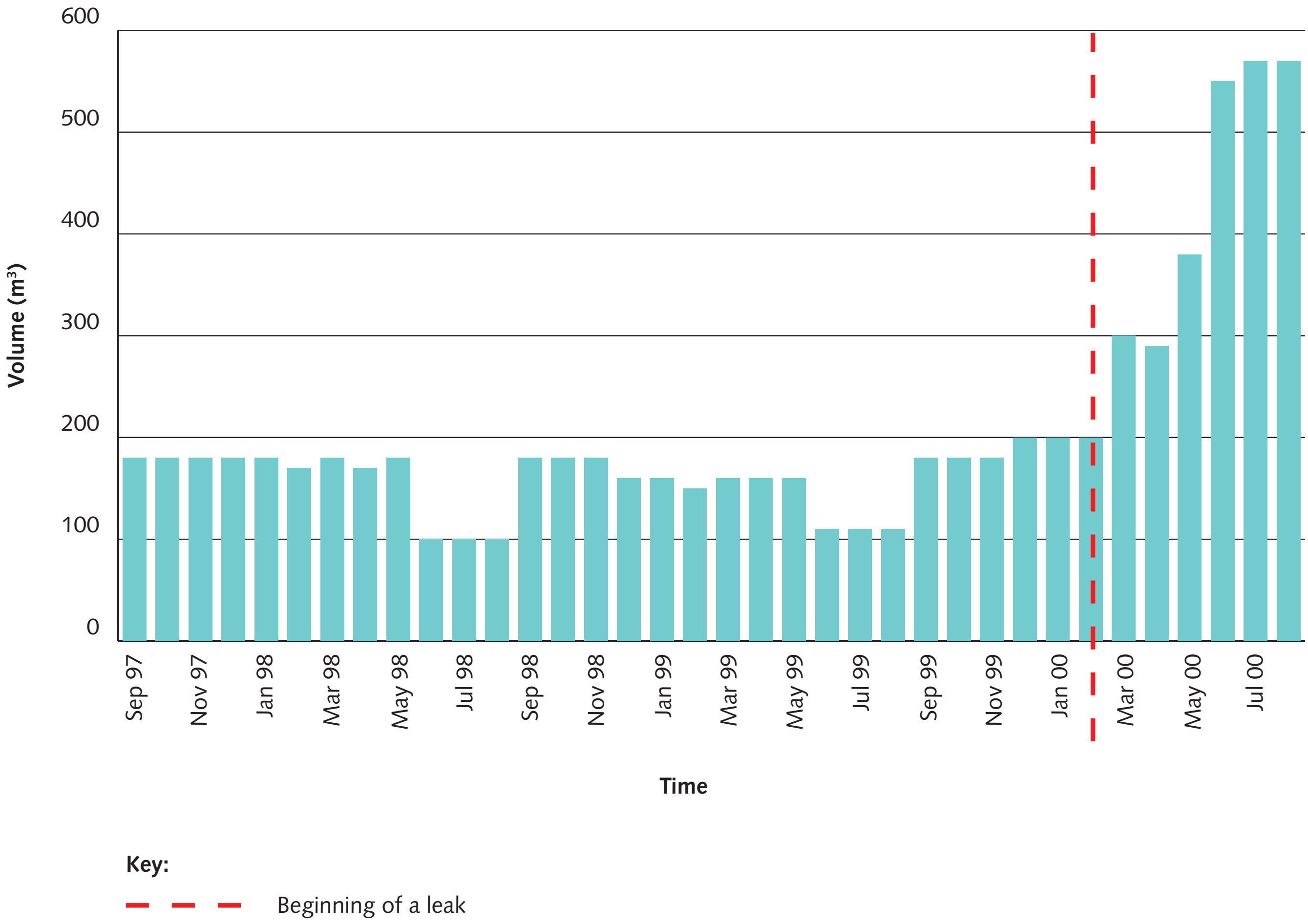


Figure 7 Example of annual consumption for a hospital



water audit should be circulated to staff, and an opportunity to discuss the most appropriate actions provided.

5.42 Once a picture of water use and wastage emerges, the costs of each type of water should be calculated; this will indicate potential volumes and cost savings associated with water-efficiency options (outlined in Chapter 6).

5.43 The next action is to assess the capital costs of implementing changes to reduce wastage. Capital costs can then be compared against operational savings; this should provide a hierarchy of water-saving actions based on whole-lifecycle costs.

5.44 In making final decisions on water conservation actions, other factors should be taken into account, such as infection control, health and safety, staff acceptability, environmental costs and benefits, the implications for sewerage, and any energy savings or costs associated with the water-saving measures. When choosing the appropriate technology, it is important to consult with staff and the control of infection team in order to identify any health risks or patients' needs that may be relevant.

5.45 A plan should consist of a clear, measurable set of key objectives that can be easily monitored and updated.

Note

The formulation of an action plan is considered best practice. It is not mandatory.

Implementation

Outreach

5.46 Once an audit is produced or a strategy is in place, it should be disseminated. A strategy should seek to empower and engage staff and patients, as half of all water savings can be generated through behaviour change, which can be free if the right atmosphere is created. Some suggestions for outreach are:

- an information pack or other communication that highlights the importance and value of efficient water use both in and out of the workplace;
- management rewards and ring-fencing of water savings;
- signs and notices on appropriate use next to water-using appliances; and
- informing local media (via a healthcare organisation's communications manager) of the new plan to raise the profile of water efficiency and local environmental policy.

Procurement and installation

5.47 Information on water-efficient devices is included in Chapter 10. When corresponding with contractors and consultants, water efficiency should be stressed as a priority.

Monitoring and maintaining standards

Benchmarking: hospital water consumption

5.48 Benchmarking helps to inform a manager about appropriate parameters for water efficiency.

5.49 As the size, design and use of healthcare facilities will vary considerably, a means of normalising water consumption across buildings is necessary. Normalisation may be achieved by calculating water consumed:

- per square metre of floor space (Table 2);
- per bed day (Table 3); or
- by person type (Table 4).

5.50 In each case, it may also be necessary to distinguish between building types in order to achieve a more realistic benchmark. It is recommended that benchmarking be used as a guideline for management rather than a stringent target.

Table 2 Hospital water use (expressed in cubic metres per square metre of floor area per year)

Type of hospital	Typical use	Best practice benchmarks
Small acute or long-stay hospitals without personal laundry	1.17	0.90
Small acute or long-stay hospitals with personal laundry	1.56	1.24
Large acute/teaching hospital	1.66	1.38

Source: Water UK (2003)

Recommended benchmarks

5.51 Table 2 reflects the findings of a Water UK study conducted in 2003, in which cubic metres of water per square metre of floor space per year was found to most accurately reflect data analysis. It was also found that the only activity within hospitals which significantly influenced consumption was laundry washing.

Table 3 Hospital water use (by patient bed days)

Type of hospital	Water per patient bed-day (m^3)			
	Very poor	Poor	Average	Good
Acute (>100 beds)	1.138	0.711–1.137	0.531–0.710	<0.530
Long-stay (>25,000 patient days per year)	0.690	0.412–0.689	0.331–0.411	<0.330
Long-stay (<25,000 patient days per year)	0.380	0.298–0.379	0.218–0.297	<0.217

Source: Audit Commission (1993)

Table 4 Hospital water use (expressed in litres per person per day)

Person type	Litres per person per day
Employee (full-time without canteen)	25–50
Employee (full-time with canteen)	40–90
Resident employee	180
Hospital patient (in-patient)	450

Source: Audit Commission (1993)

Other benchmarks

5.52 The benchmarks in Tables 3 and 4 are provided for information purposes only. However, if data necessary for calculating water consumption according to Table 2 (for instance total floor space) is not available, they may be used as guidance for water management.

Benchmarking: water consumption in healthcare facilities other than hospitals

5.53 The benchmarks given in Tables 2–4 may not be appropriate for other types of healthcare facility. Where the facilities are largely used for office work, it is advisable that building managers use the current government performance target of 4 m^3 per employee per year (CIRIA, 2006).

5.54 In other instances, data for water consumption per square metre of floor space (collected through a recent Estates Return Information Collection (ERIC) survey) may help to indicate an appropriate consumption level.

Northern Ireland and Scotland have similar data-gathering systems.

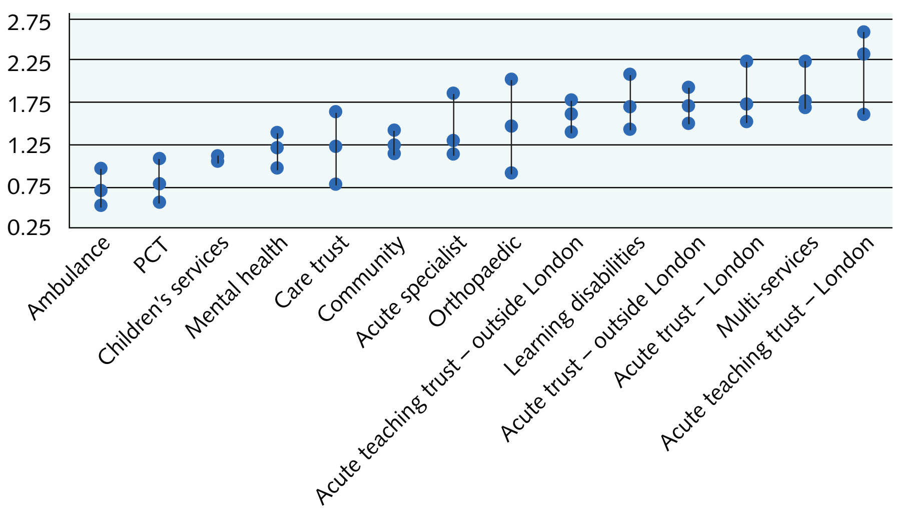
5.55 Table 5 and Figure 8 provide figures for a number of healthcare facilities. Data is given according to upper and lower quartiles and median values. These values should be taken as indicators only.

Table 5 Annual water consumption (litres per occupied floor area)

Building type	Consumption (m^3 per m^2 per year)		
	Q1	Median	Q2
Ambulance	0.969	0.716	0.535
PCT	1.092	0.798	0.567
Children's services	1.116	1.088	1.053
Mental health	1.39	1.222	0.973
Care trust	1.636	1.227	0.776
Community	1.412	1.248	1.135
Acute specialist	1.844	1.29	1.128
Orthopaedic	2.018	1.458	0.902
Acute teaching – outside London	1.771	1.596	1.39
Learning disabilities	2.072	1.682	1.422
Acute – outside London	1.906	1.7	1.499
Multi-service	2.219	1.702	1.492
Acute teaching – London	2.213	1.74	1.656
Acute – London	2.554	2.298	1.591

Source: Estates Return Information Collection (ERIC) (2005/2006)

Figure 8 Annual water consumption (litres per occupied floor area)



Source: Estates Return Information Collection (ERIC) (2005/2006)

6 Suggested components of a water strategy

Boilerhouses

6.1 Optimising boiler performance and maintaining the system can save large amounts of water. This can be very cost-effective and will have a significant impact on reducing a facility's carbon footprint, since hot water and steam have a great deal of embedded energy.

6.2 When making any changes to boiler management or alterations to design, suitably trained personnel or companies must be employed.

6.3 In addition to manufacturers' instructions, the Health and Safety Executive's (HSE) Guidance Note PM5 – 'Automatically controlled steam and hot water boilers' should be consulted prior to any action.

Boiler feed-water pre-treatment

6.4 Feed-water entering the boiler will frequently need to be demineralised in order to reduce solid deposits in the system. This process often involves the use of ion-exchange beds. These beds require frequent regeneration, typically through the use of hydrochloric acid or caustic soda. Water is used to flush the regeneration agents from the beds and is then considered effluent.

6.5 Water may be conserved by conducting the regeneration process only when needed, rather than at regular daily intervals. Trigger levels for regeneration can be defined either by volume of water treated or by monitored conductivity breakthrough of the bed.

Boiler blowdown

6.6 Throughout operation, boiler units gradually build up concentrations of total dissolved solids (TDS). At sufficient concentrations, these TDS precipitate from the water and form solid material in the boiler unit, impairing efficiency and heat transfer. In order to avoid the water reaching high concentration of TDS, water should occasionally be dumped from the boiler; this is called "blowdown".

6.7 Older models of boiler may continuously remove water from the top of the water tank or they may flush the system out at predetermined intervals. A blowdown system that is activated only when TDS concentration exceeds a certain threshold may provide significant energy and water savings. Calculations and decisions should be made by a competent person.

Steam losses, leaks and condensate recovery

6.8 As steam travels through the outlet pipes of a boiler, its temperature decreases and water condenses in the pipes. This condensate can be collected and recycled into the boiler system, reducing energy and water consumption as well as slowing the build-up of TDS (as the condensed water tends to have a much lower TDS content).

6.9 The energy required to produce steam is extremely high. Approximately 80% of the energy used in a boiler is used in providing the necessary latent heat to produce steam, with only 20% attributed to raising water to boiling point; care should be taken to prevent steam losses from the system and to ensure that the necessary safety precautions are in place.

6.10 Installing heat exchangers (sealed thermal units) should be considered, as this will reclaim otherwise lost heat and will help to curb the risk of *Legionella* growth.

Cooling towers

6.11 Cooling towers are used to transport heat from processes within the building to the roof. The process involves pumping water to holding tanks on the roof where water is allowed to evaporate – cooling the remaining water. In a similar manner to boilers, as water is lost through evaporation, the concentration of TDS grows. In order to prevent the build-up of solid materials in the tower, water must occasionally be bled from the system and make-up water introduced.

6.12 Alternatives to using cooling towers for temperature control are outlined in the Building Research Energy Conservation Support Unit's (BRESCU) General Information Report 85 (GIR085) – 'New ways of cooling: information for building designers'. (See also the Health and Safety Executive's (2000) 'Approved Code of Practice: Legionnaires' disease – the control of legionella bacteria in water systems'.)

Cycles of concentration

6.13 The rate at which water is replaced in cooling towers is determined by the "cycles of concentration" (CoC) value. This value describes the acceptable ratio between the TDS bled from the cooling tower system and those introduced. Systems at lower CoC will use more water to maintain the required TDS value. Calculations and decisions should be made by a competent person.

Additional losses

6.14 Losses due to factors other than evaporation and bleed water can be calculated using the following equation:

$$\left(\frac{\text{Make-up water}}{\text{Cycles of concentration (CoC)}}\right) \times \text{Bleed water}$$

Catering department

6.15 The catering department constitutes a significant portion of total water consumption in healthcare facilities, and may benefit from being submetered for monitoring purposes. Reducing water waste in this department requires a combination of behavioural change in staff and appropriate changes to technology. Suggestions for informing staff on how to conserve water are outlined below, followed by technical advice.

Washing and preparing food

6.16 Staff awareness concerning efficient use of water in food preparation should be raised on the following points:

- **Taps:** A running tap can typically consume 12 L/min. An effort not to leave unused taps running should be made – signs next to taps may be effective. Technology such as flow restrictors and automatic shut-off mechanisms will also reduce waste.
- **Defrosting:** Defrosting food under running hot water should be avoided when possible. Changing management of frozen foods to avoid using hot water for defrosting will save water and may be more energy-efficient.

Waste disposal

- **Recycling:** When preparing packaging for recycling, the recycling authority should be consulted on whether it is necessary to wash/rinse packaging.
- **Automatic potato peelers:** Peelers often require a water supply to flush out potato peelings. Flows should be set at the minimum amount required. A flow-restricting valve can be used to achieve this.
- **Food waste disposal channels:** Larger kitchens occasionally use channels of water running through the facility to transport organic waste to a macerator, which is then released into the sewers. If an alternative method of collecting food waste cannot be implemented, channels should be managed with the following in mind:
  – channels should only flow when the kitchen is in use and there is a need for them;
  – the number of channels should be kept to a minimum;
  – flow rates in the channel should be regulated and kept to a minimum.
- **Reducing waste:** Where the amount of waste entering the sewerage system is significant, water companies may charge an additional "trade effluent" charge. Reducing the amount of waste entering the sewerage system will help to reduce or remove such charges where present.

Washing

- **Dishwashing and laundry:** Daily uses should be evaluated for dishwashers and washing machines, and a washing routine which ensures that machines are completely full before turning them on should be established. When replacing machines, water-efficient models should be selected. In larger facilities, industrial-standard machines will be required, and procurement should be based on the most efficient model, taking into account whole-life costings.

In the case of smaller estates where domestic (as opposed to industrial) washers are used, a database of domestic dishwashers and their efficiency ratings is available from the Waterwise website.

- **Washing food-preparation areas:** In larger kitchens, surfaces and equipment are often washed down using a hose. If hoses are used, there is a need to reduce the risk of aerosol formation.

Sanitary appliances

6.17 Non-process uses of water are commonly referred to as "domestic". Domestic appliances consist of WCs, urinals, taps, baths and showers. It is likely that domestic uses will be the most cost-effective area for water efficiency as they constitute a large portion of water consumption in hospitals and other healthcare facilities. This section outlines options for upgrading technology and changing staff behaviour and the resulting water savings.

6.18 The use of water-efficient fittings and appliances may not be appropriate to the needs of the patient and may adversely affect the incidence and propagation of infections (see Health Technical Memorandum 00 and Health Building Note 00-02 for further guidance). Managers are also advised to refer to the control of infection team before any measures are taken (see also Health Technical Memorandum 04-01).

WCs

6.19 Water consumption per flush for WCs will depend on the age of the model, as will options for upgrading or retrofitting. Often WCs are the first choice for water efficiency, as they constitute a large portion of domestic use. Older models may use as much as 12 L per flush, whereas newer models consume around 4–6 L. The Water Supply (Water Fittings) Regulations 1999 (Water Byelaws in Scotland; Water Regulations in Northern Ireland) require any new WC installations to use a maximum of 6 L per flush (7.5 L in Northern Ireland) (see Health Technical Memorandum 00 and Health Building Note 00-02 for further guidance).

Cistern displacement devices (CDDs)

6.20 A cistern displacement device (CDD) may be used to displace a set volume of water inside the WC cistern, saving water on each flush. CDDs typically save around 1 L of water per flush.

6.21 Care should be taken to install a CDD appropriate for the WC model and that still provides an adequate flush volume. CDDs offer a simple low-cost method of reducing WC flush volumes; however, consideration should be given as to whether it is better to use CDDs or to upgrade WCs to low-flush models, which may also be easier to maintain and ergonomically better to use.

6.22 Generally, CDDs may be useful for clinics and WCs in GP surgeries, but large-scale use of CDDs in a hospital may indicate the need to refurbish the WCs.

Retrofitting flush mechanisms

6.23 As mentioned in paragraph 6.19, WCs manufactured after 2001 are subject to regulations enforcing a maximum flush of 6 L. Older WCs that consume as much as 12 L per flush can be retrofitted with flushing mechanisms that allow the user to vary the flush volume. Depending on the age of the WC, water savings of up to 5 L per flush are possible. Users control the flush either through a choice between a full and a half-flush (dual flush) or through releasing the flush handle to cut the flow of water (variable flush). If such a device is installed, clear instructions on its use should be displayed near the WC.

Installing new water-efficient WCs

6.24 When installing a new WC, it should be confirmed that the model has been approved by WRAS. WRAS-approved WCs consume as little as 4 L per flush and 2.6 L per reduced flush. When upgrading WCs, a dual-flush water-efficient model should be considered (see Health Technical Memorandum 00). Drainage facilities for new sanitary equipment should be designed to cope with the maximum expected production of waste.

Urinals

6.25 Urinals are often controlled through an automatic flush system which is triggered at regular intervals. A typical system will flush volumes of approximately 7.5–12 L of water at 20-minute intervals. This can amount to as much as 197 m^3 per year per urinal, resulting in unnecessary water and sewerage charges. Installing passive infrared detectors in urinals typically reduces water consumption by 60%. Costs stand at £120–£150, but payback is rapid. Further options include installing more water-efficient models when upgrading, or considering waterless urinals for certain areas; however, the infection control team should be consulted before installing waterless urinals (see Health Technical Memorandum 00 and Health Building Note 00-02 for further guidance).

> **Note**
>
> With regard to waterless urinals, there may be issues over perception and maintenance, as cleaning staff may not be familiar with these types of urinal. It is recommended that the use of waterless urinals is discussed with medical and cleaning staff before a decision on installation is made. There are also ultra-low-flush urinals available that may overcome any perceived hygiene issues.
>
> Some waterless urinals use disposable cartridges or other devices, which need changing routinely. The system also needs to be flushed occasionally to remove any debris. Both of these tasks will need to be accounted for in an agreed maintenance contract, which must then be evaluated in terms of additional costs introduced versus the water savings, as well as the appropriate levels of maintenance necessary to ensure good hygiene.

Taps

Leakage

6.26 Taps are prone to leakage. It is estimated that a dripping tap may consume around 15 L per day. Staff should be informed of the importance of reporting leakage and a reporting system should be put in place.

Design

- The uses of taps should be considered before reducing flow rates. In some cases, reducing flow rates may be inappropriate. For instance, where taps are used to fill containers, reducing flow rates will only increase the time taken and will have little effect on efficiency. In other cases, where the risk of spread of infection is particularly high (for example surgical scrubbing), sensor-, lever- or foot-operated taps may be most appropriate.
- Taps typically use about 9 L of water per minute, but may use as much as 18 L per minute. Staff should be informed of the importance of using taps appropriately.
- Sensor (non-touch) taps may in some cases be ideal, as they both conserve water and reduce the risk of infections spreading.
- The fitting of non-concussive self-closing taps can also reduce unnecessary flow.
- Flow regulators may also be fitted to taps, as appropriate.

> See Health Technical Memorandum 00 for guidance on the appropriate types of tap for use in healthcare facilities.

Baths and showers

6.27 Baths typically use around 80 L per event and showers around 9 L per minute. Where possible, showers should be favoured over baths; however, the care needs of patients must take priority. Reducing the water used for showers and baths may also potentially reduce energy bills due to a reduction in hot water used.

Shower technology

- Flow restrictors may be used to reduce the flow rate of water in showers.
- Shower location and design can significantly reduce the amount of water wasted due to waiting for showers to reach the desired temperature. In addition, in healthcare facilities there is a risk of scalding for vulnerable patients, the very young, older people and patients with mental-health illnesses. Upgrading to thermostatic mixing valves will minimise this risk (see Health Technical Memorandum 04-01 and Health Technical Memorandum 00).
- Fitting water-efficient showerheads may reduce water consumption significantly.
- There should be efficient ventilation to control aerosol dispersion.

Medical activities

Surgical scrubbing

6.28 The NHS carries out about 7 million operations a day; each one will require a minimum of two staff to scrub. Scrub taps are generally lever- or sensor-operated. This is an essential area of water use;

reduced flow taps should not be used (see also Health Technical Memorandum 00).

Dialysis unit

6.29 In a renal unit, water quality should meet the recommendations specified by the European Renal Association-European Dialysis and Transplant Association's (ERA-EDTA) 'European best practice guidelines for haemodialysis'. To ensure purity, water is passed through a reverse osmosis (RO) unit. This means that water can be reused (for WC flushing, for instance) as the RO unit can remove almost any level of contamination (see also "Example 4" after paragraph 4.7).

Patient care

6.30 Patient bathing, WC use, washing and drinking can use a large amount of water. However, the best way to reduce waste is by ensuring all the appliances used by patients are efficient. Indeed, patients should be encouraged to use more water through good hydration and personal washing. All hospitals should provide easy access to drinking water for patients, and the promotion of good hydration should be stated in any water management plan.

Laser cooling

6.31 Medical lasers are generally water-cooled. Owing to the cost and sensitivity of the equipment, water efficiency should be a secondary consideration after ensuring water purity (to prevent corrosion) and cooling efficiency. Depending on the type of laser, it may be possible to use thermoelectric cooling or air cooling, but water efficiency should not be a driving factor in choosing cooling systems.

Hydrotherapy pools and swimming pools

6.32 Hydrotherapy is a therapeutic whole-body treatment that involves moving and exercising in water – physiotherapy in a pool. Hydrotherapy pools are usually different from ordinary pools – the temperature and movement of water is controlled and changed according to who is using the pool and why. Pool covers can reduce evaporation losses. Filtration units can be used to recirculate water. This is common on modern pools, but is expensive to retrofit; however, the Health Protection Agency's (1999) 'Hygiene for hydrotherapy pools' states that most pools should have a filter.

Birthing pools

6.33 Birthing pools can use around 500 L of water per use. For hygiene reasons, the water cannot be reused without extensive treatment. The only way to increase water efficiency is through the shape of the pools; however, medical and comfort considerations should take priority over water efficiency. If considering installing birthing pools, there are three points to take into account:

1. They will use a great deal of water.
2. They are very heavy – therefore, the structural integrity of the building should be considered if a number of pools are situated in the same area of a floor.
3. They require a great deal of cleaning, which will use much water.

6.34 Some hospitals may also have mobile birthing pools.

Decontamination

Endoscopy

6.35 This is an area where water efficiency is unlikely to be acceptable from a clinical perspective and where water reuse may pose an infection threat. For further guidance on decontamination in endoscopy, see Health Technical Memorandum 01-06 – 'Decontamination of flexible endoscopes'.

Sterile services departments

6.36 It is very difficult to improve water efficiency in essential support services such as sterile services. While trying to promote water-efficiency measures, it is important to remember that the decontamination process should not be compromised in any way.

6.37 However, it is recommended that:

- all decontamination equipment (washer-disinfectors and sterilizers) operates with full loads;
- wash cycles are evaluated for water-use efficiency.

Outdoor use

6.38 Few healthcare facilities have considered the amount or type of water used for outside watering, or the selection of plants. Given that a single water sprinkler may consume as much as 900 L of water an hour, the costs of outdoor use are potentially large. Consider the following solutions to reducing outdoor use:

- **Rainwater harvesting:** this may be ideal for plant watering, as the collected water requires little or no treatment (see paragraphs 7.9–7.11).
- **Plant choice:** consideration should be given to installing drought-resistant or perennial plants in estate grounds; these will need little water and will add diversity.
- **Sprinkler timings:** sprinkler timings should be adjusted such that they are active in the early morning or late afternoon; this will reduce water loss due to evaporation.
- **Mulching:** mulch and bark should be used in flower and tree beds: this will reduce the loss of water through evaporation by up to 70%.

7 Whole building concerns

7.1 Achieving good water management in healthcare facilities will demand that decisions about issues such as security of supply, water quality and flood risk are assessed in terms of impacts on the entire building (see also Health Technical Memorandum 00 and Health Technical Memorandum 04-01 for further guidance).

Alternative supply sources

Boreholes/private supplies

7.2 The use of water abstracted from private sources may be feasible in some circumstances.

7.3 Where water quality is not required to be at a potable standard (for instance in cooling equipment or flushing urinals and WCs), it may be possible to use water directly abstracted from a borehole.

7.4 Where water is to be used for human consumption or cleaning, filtration and/or further treatment may be necessary to comply with the Private Supplies Regulations 1991 and Water Industry Act 1999.

In Northern Ireland, this is covered by the Water and Sewerage Services Order 2006, and in Scotland by the Water Supply (Water Quality) Regulations 2001.

7.5 Boreholes are drilled through underground strata that contain water (known as aquifers). Water is then abstracted through a submersible pump at depths varying from 20 to 200 m. The water is then stored in a holding tank on the surface.

7.6 In each case, feasibility of abstraction will depend on the availability and quality of groundwater, which can be established through a preliminary survey. Once this has been verified, abstraction will require a licence.

In England and Wales, licences are managed by the Environment Agency and often depend on the density of abstractors in the area, managed through local CAMS. In the case of Scotland, abstraction licences are provided by the Scottish Environment Protection Agency, and in Northern Ireland by the Department of Environment.

7.7 There are potentially large financial savings to be made through private abstraction; however, the long-term costs of water supply from water companies must be balanced against the following:

- the capital costs of the construction of works, mains, plumbing, treatment plant etc;
- the operational costs of electricity for pumping, water treatment chemicals, direct and indirect maintenance, and associated management costs.

7.8 Once all factors are taken into account, a decision to develop a private water supply can be made. Figure 9 is an example of a decision tree outlining the key factors.

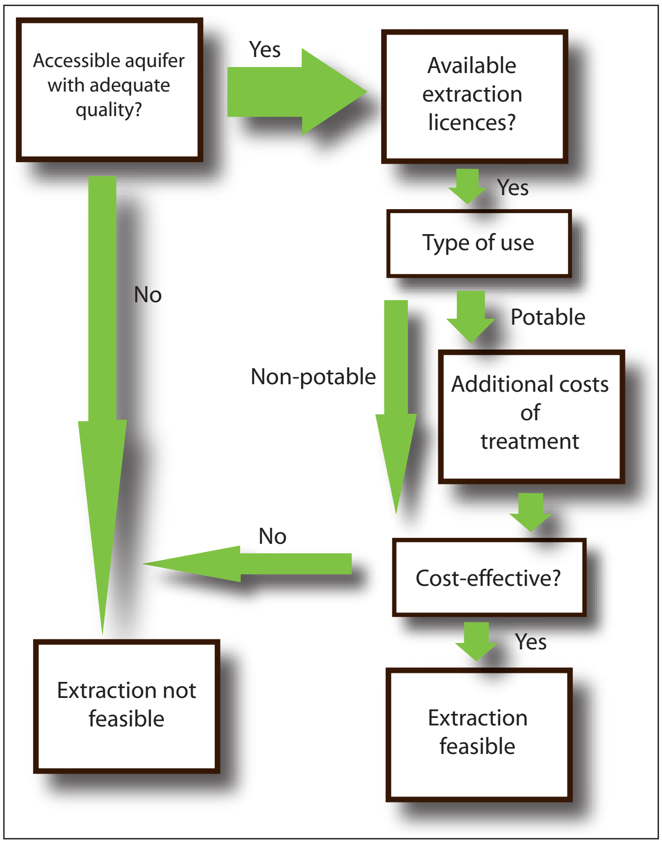
Rainwater harvesting

7.9 Harvesting rainwater that falls on property roofs may be economically feasible for larger buildings. Water collected from roofs may be used for low-quality purposes such as laundries and WC/urinal flushing. The payback period will vary depending on the size of the roof and annual rainfall values.

7.10 Systems supplied should have an alternative automatic supply (for instance where rainfall is insufficient).

7.11 Depending on where the water is harvested from, there may be issues with water quality (bird droppings and pesticide deposits are commonly present on roofs). It should always be presumed that rainwater is non-potable, and it should not be used where ingestion is a possibility.

Figure 9 Decision tree for establishing a private water supply



At the time of writing this guidance, industry standards for rainwater and greywater harvesting have not yet been developed, but a British Standard is in preparation.

Visit the UK Rainwater Harvesting Association's website for further information.

Greywater reuse

7.12 Greywater and rainwater are often discussed together. Greywater is water that has been previously used and is almost certainly contaminated.

7.13 Greywater should not be used in healthcare premises. However, there may be circumstances where its use may be acceptable on a case-by-case basis. Where greywater is to be considered, a risk assessment should be undertaken that considers all the potential microbiological risks that may result from such a change of use. This assessment should involve a microbiologist and infection-control staff.

7.14 Technology for greywater reuse is advancing very quickly and there may be certain circumstances where the type of greywater or the certainty of the technology can allow greywater reuse. Each case should be judged on its merits, balancing risks and benefits, and should be discussed fully with staff before implementation. Any implementation should also ensure that all pipes and equipment carrying or using greywater are clearly labelled.

Water security

7.15 To guard against an interruption in supply, Health Technical Memorandum 04-01 stipulates that at least 12 hours' supply of cold water should be stored on site. Guidelines also state that a maximum of 24 hours' supply of water should be stored in order to avoid stagnation of water in supply tanks and the resulting risk of *Legionella* growth and transmission.

7.16 Where actions are taken to reduce water consumption in existing buildings, the amount of water required to supply the building for 12 hours will reduce, as will the turnover rate of water in the storage tank. Where it is calculated that a building has significantly reduced the amount of water used per day, the possibility of reducing storage tank sizes should be investigated.

7.17 The required storage volume should be calculated for a 12-hour demand scenario, including peak periods of demand. Similar calculations should be made if there is a reduction in turnover times for wall-mounted calorifiers, with a maximum of two hours' storage time available, including peak demand.

7.18 In addition, the turnover rate of water in all pipes within the building should be considered. The risk of water remaining stagnant in the distribution pipes will rise – particularly in deadlegs.

7.19 Where fixtures are rarely used, the possibility of removing the fixture and any deadlegs supplying it should be considered.

7.20 A water management strategy should consider the logistics of ensuring water supply. The following questions should be addressed:

- In the case of a "boil water" notice from the local water company, how will water be boiled and distributed around the site?
- In the case of interruption to the supply, where are the connection points for water supplied by a tanker?

7.21 It may be necessary to have arrangements for bringing in drinking water to ensure patients do not dehydrate (see also Health Building Note 00-07 – 'Resilience planning for the healthcare estate').

Water quality

7.22 In all circumstances, water efficiency should not compromise water quality and safety requirements. Issues relating to these requirements are discussed below.

Legionella and internal hot and cold distribution networks

7.23 Related to the issue of security of supply is the overall risk of *Legionella* growth. High-risk scenarios of *Legionella* growth include those where water remains stagnant in tanks and distribution pipes for extended periods of time, particularly under favourable temperatures. For cold water supplies, water temperature should not exceed 20°C and should aim to be no more than 2°C warmer than the temperature recorded at the main supply pipe. For hot water supplies, flow temperatures should be set to 60°C, and a minimum of 55°C should be maintained at all points in the network (see Health Technical Memorandum 04-01 for further guidance).

Water hardness

7.24 Water hardness is expressed in terms of milligrams per litre of calcium carbonate ($CaCO_3$). The hardness of water supplies will depend largely on the region in which the water is abstracted.

For a map of hardness, see the report 'Water hardness in the British Isles' on the Waterwise website.

7.25 Higher hardness levels may adversely affect equipment – as water is heated, its capacity to carry dissolved salts decreases, leading to calcium deposits on pipe walls and heating elements, thus decreasing efficiency. It may therefore be appropriate in some cases to install water softeners for certain uses. Possible uses that may benefit from softening are:

- boilers and hot-water supply systems – to prevent sludge and limescale build-up;
- mixing devices and blending valves – to avoid clogging of control ports and showerheads by limescale;
- laundries – water hardness leads to high maintenance costs and the uneconomic use of soap detergents.

7.26 In the case of drinking water, epidemiological studies have shown that the incidence of cardiovascular disease tends to be higher in areas of soft-water supplies than in areas with hard water. The association is clearest in supplies which contain less than 150 mg/L. The explanation is not known, but it is advised that where water is used for drinking supplies, it should not be softened.

Metal contamination

Water softness and monitoring

7.27 Where water is acidic and particularly soft, its capacity to dissolve metals is higher. In such cases, regular sampling through the building should be conducted to identify possible contamination from the original source or the internal distribution network.

Lead

7.28 The Water Supply (Water Quality) Regulations 2000 stipulate an upper limit of 0.01 mg/L to be achieved in all supply by 2013; this value is likely to be exceeded if lead pipework or solder containing lead has been used in building plumbing systems. Should a value higher than 0.01mg/L be detected, remedial action should be taken.

Copper

7.29 Copper concentrations above 1 mg/L may cause staining of laundry and sanitaryware and increase the corrosion of galvanised iron and steel fittings. While the maximum allowable copper concentration in water supply is 2 mg/L, a typical supply will be below 1 mg/L.

Specialist units

7.30 In general, the supply of water to certain specialist units such as maternity departments, neo-natal units, children's units and renal dialysis areas should be monitored to ensure that water quality is within acceptable limits. Epidemiological advice should be sought concerning the exact water quality requirements for each specialist unit.

Wastewater and sewage

Sewage

7.31 Sewage accounts for over 50% of water and sewage costs to the NHS. Unlike water, which is metered, sewage bills are normally based on water use.

7.32 Standing charges for sewage depend on the size of the incoming water meters and the volume of water consumed.

7.33 It is possible to negotiate an allowance with water or sewerage companies for water that is not returned to the sewer. For clinics and GP surgeries, where water use is domestic, sewage rates are based on 95% return, but hospitals have higher evaporation losses, and returns to sewer could be as low as 70%.

7.34 Once an audit has been carried out or the water balance has been assessed, a rebate with the water or sewerage company should be negotiated. In some areas, water and sewerage are provided by a single company; in others, there may be two separate companies.

7.35 Water and sewerage companies classify effluent discharges as either domestic or trade. Most healthcare facilities' wastewater is classified as domestic. However, parts of certain sites, such as laundries or laboratories, could possibly be classified as trade. The classification varies between water companies.

7.36 Charges for trade effluent depend on the toxicity of the wastewater. If a healthcare facility has a trade tariff, it should contact its local water or sewerage provider about how to reduce toxicity and thus reduce charges.

7.37 The volume flow of effluent is the most important factor in determining the bill. However, it is very common for trade effluent flows not to be measured. In such circumstances, the volume of effluent is assumed to be the same as the volume of water purchased, as recorded on the site's incoming water meter. This figure may be used as it stands or after some modification for losses as steam or in product use.

7.38 In general, what is going into the drains at the facility should be assessed. Increasing water efficiency will reduce sewage bills as well as water bills, and it will also highlight areas where wastewater can be reused. As the level of wastewater reuse increases, consideration should be given to opportunities to renegotiate the sewage return rate.

7.39 It is therefore very important to take all steps to reduce water consumption and, where practical, to measure or make a reliable estimate of the flow of effluent that enters the sewer. The flow of water and effluent through the premises should be mapped and analysed; all opportunities for reducing water use should be noted. It should be determined whether any cooling water or rainwater that flows to sewer would be sufficiently clean for direct discharge to a ditch; this may require discharge consent from the Environment Agency (England and Wales).

In Northern Ireland, discharge consent is given by the Department of Environment, and in Scotland by the Scottish Environment Protection Agency.

7.40 It is also worth monitoring the contents of wastewater; this will enable a reduction of the contaminants in sewage and will enable optimised chemical use in certain processes. A reduction in contaminants may also reduce trade effluent charges.

Sustainable urban drainage systems (SUDS)

7.41 Discharge of clean wastewater or drainage water to a soakaway, swale or infiltration area is often classified as a sustainable urban drainage system (SUDS). This method can reduce sewage or drainage bills, but may require discharge consent from the Environment Agency.

In Northern Ireland, discharge consent is given by the Department of Environment, and in Scotland by the Scottish Environment Protection Agency.

7.42 When designing new buildings, re-landscaping or adding car parking, a SUDS should always be considered. Well-designed drainage systems can reduce landscape watering requirements, add biodiversity through the creation of wetland areas, reduce drainage charges, and – if the water is captured in rainwater tanks – provide water for irrigation, WC flushing and fire-fighting. However, water quality should be assessed before using rainwater or greywater inside any healthcare facility (see also paragraphs 7.9–7.14).

Hospital sources of sewage pollution

7.43 Freshwater quality in healthcare facilities is paramount; however, the contamination of wastewater should not be overlooked. Reducing contaminants released into the sewerage system will significantly contribute to improving the natural environment, into which the contaminants could otherwise be released (see Table 6).

Discharges to sewers: red list chemicals

7.44 The chemicals shown in Table 7 must not be discharged to sewer.

Water pressure

Effects of high pressure

7.45 Excessive water pressure can contribute to waste in the following ways:

- It places additional and unnecessary wear and tear on the distribution system.
- It can cause or exacerbate leakage.
- It causes a higher flow-rate of water through appliances.

Calculating changes in flow rate due to water pressure

7.46 In general, the following approximation for change in flow rates due to a change in pressure can be used to determine the effects on taps, showers, hoses etc.

$$\text{New flow rate} = \text{Old flow rate} \times \sqrt{\left(\frac{\text{New pressure}}{\text{Old pressure}}\right)}$$

Equation (1)

See also Figure 10, which shows an example calculation for a tap with a base flow of 8 L per minute at 1 bar pressure.

Table 6 Possible contaminants to the sewerage system from hospital sources

Source	Main contaminants	Officer responsible
X-ray	Photographic fixer	Superintendent/senior radiographer
Nuclear medicine	Aqueous radioactive isotopes	Medical physicist
Pathology laboratories	• Aqueous radioactive isotopes • Solvents • Heavy-metal compounds • Tissues: human/animal	Laboratory manager
Dental departments	Mercury	Chief dental technician
Dispensing pharmacy	Drugs	Chief pharmacist
Manufacturing pharmacy	Batch failures of products	Chief pharmacist
Medical illustration	• Photographic fixer • Photographic developer	Chief technician
Laundry	• Detergents • Contaminants on laundry	Laundry manager
Sterile services department, endoscopy unit	• Detergents • Disinfectants • Microbial contaminants	Unit manager
Catering	• Cleaning agents • Macerated food	Catering manager
Incinerators	Ash	Estates manager
Domestic maintenance	Cleaning agents	Domestic services manager
Vehicle maintenance	Spent oil	Transport manager
Grounds maintenance	• Pesticides • Nitrate fertilisers	Grounds manager
Blood transfusion centre	• Aqueous radioactive isotopes • Crushed glass	Unit manager

Table 7 Red list chemicals

All flammable and water-immiscible substances
1,2-Dichloroethane
Aldrin
Atrazine
Azinphos-methyl
Cadmium and its compounds
Dichlorodiphenyltrichloroethane (DDT)
Dichlorvos
Dieldrin
Endosulfan
Endrin
Fenitrothion
Gamma-hexachlorocyclohexane
Hexachlorobenzene
Hexachlorobutadiene
Malathion
Mercury and its compounds
Pentachlorophenol and its compounds
Polychlorinated biphenyls
Simazine
Tributyltin compounds
Trichlorobenzene
Trifluralin
Triphenyltin compounds

Sources of high pressure

7.47 Water is supplied according to minimum flow and pressure regulations, typically at around 2–4 bar; however, maximum pressure would not typically exceed 10 bar. High pressure supplies may occur where buildings are located down-gradient from storage reservoirs (for example when a reservoir is located on top of a hill and the building is in a neighbouring valley).

7.48 High pressures may also occur due to building design. Lower floors of multi-storey buildings in which water is supplied under gravity from a break tank in the roof may experience high pressures. High pressure may also occur when water is delivered via booster pumps inside the building.

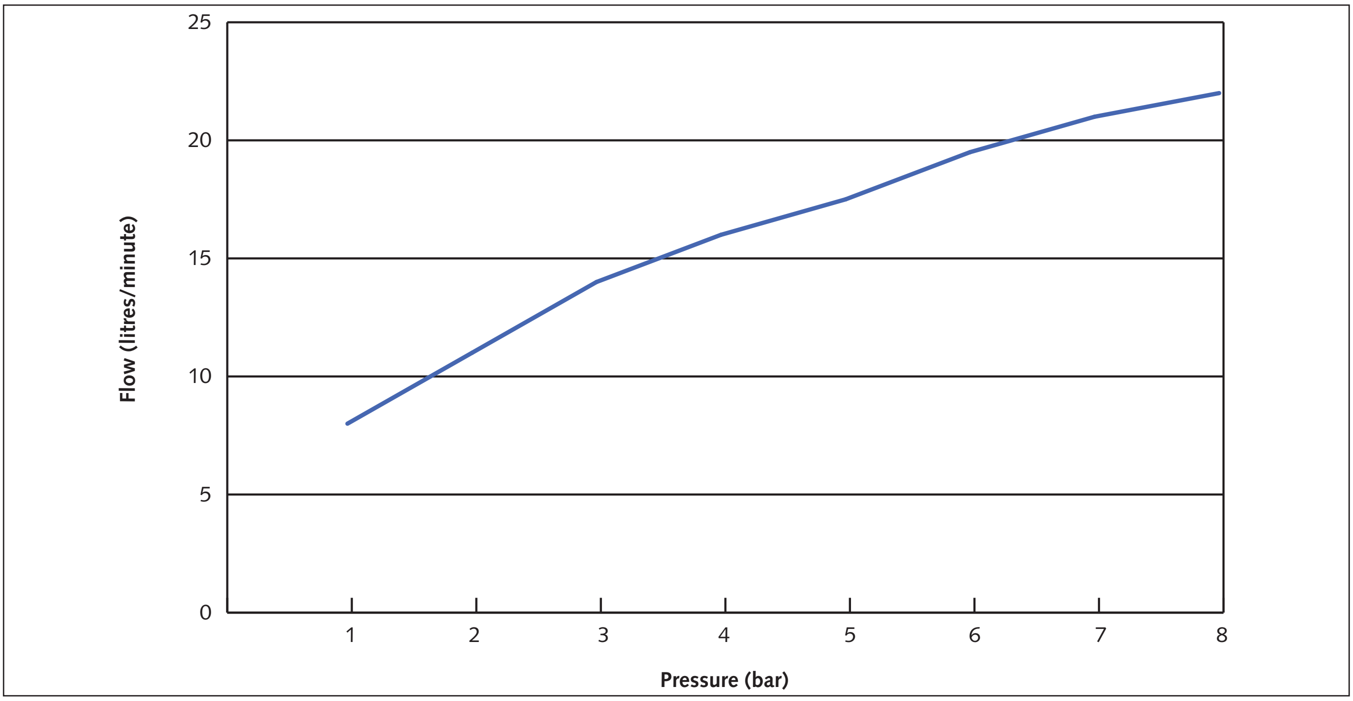
Managing water pressure

7.49 Pressure-reducing valves (PRVs) can act as pre-set or adjustable pressure controls. Typically a valve can accept up to 25 bar pressure, and control this to a delivered 1.5–6 bar.

7.50 Valves can be installed in incoming mains pipes and are also commonly used to regulate supply pressure on each floor of a building in gravity-fed or pumped systems.

7.51 When selecting the size and setting of PRV, input and output pressures should be taken into consideration. The valve should be suited to the

Figure 10 An example calculation for a tap with base flow of 8 L per minute at 1 bar pressure (with further flow rates calculated using Equation (1))



level of incoming pressure and should ensure an adequate flow rate for all appliances it supplies. This is particularly the case for mixer taps and showers (see Health Technical Memorandum 04-01).

Water temperature

7.52 Owing to the risk of *Legionella* growth, hot and cold water supply temperatures should be closely monitored and maintained (see paragraph 7.23). Insulating distribution pipes will help to maintain stable temperatures and will reduce waste by decreasing the waiting time for water to reach the desired temperature in taps and showers.

7.53 When designing new buildings, efforts should be made to reduce the length of hot-water supply pipes to fixtures, as this will reduce the time allowed for heat to dissipate through pipes. Point-of-source heating may be appropriate where there is a particularly large lag-time in water temperatures (see Health Technical Memorandum 04-01).

8 Flood risk

8.1 The water strategy should contain contingencies for flooding. Flooding can be coastal flooding, river flooding, localised flooding due to high rainfall, or groundwater flooding where water seeps up from below.

8.2 In addition to the immediate threat of flood waters, flooding may disrupt water supplies through contamination of the mains supply or damage to pumping stations. Contamination of water within the building's own system is also a risk.

8.3 Guidelines on developing new build and extending existing building in the context of flood risk are provided in the Department for Communities and Local Government's Planning Policy Statement 25 – 'Development and flood risk'.

In Northern Ireland, guidance is provided in Planning Policy Statement 15 – 'Planning and flood risk'.

Mitigating flood risk

8.4 When designing new buildings or extensions to existing buildings, the following should be taken into account.

- **Consult the flood risk maps:** flood risk maps are available from the Environment Agency (England and Wales), Department of Environment (Northern Ireland), or the Scottish Environment Protection Agency, and will provide initial guidance on appropriate construction sites for new build. These maps can be found at:
  – www.environment-agency.gov.uk/homeandleisure/37837.aspx (England and Wales).
- **Design to reduce risk:** both new buildings and refurbishments will alter surface shape and permeability, affecting the dynamics of flood risk in terms of timing, volume and areas of accumulation. Designs should adhere to the principles of SUDS, in which the principal aim is to mimic as closely as possible the natural drainage dynamics of an area in order to reduce the risk of flooding to buildings nearby. Approaches include improving drainage through semi-permeable surfaces in areas such as car parks and channelling flood paths away from high-risk areas into "sacrificial land", in which water is allowed to collect and drain away.
- **Direct flood defence:** bunding walls can be installed to redirect flood waters. This is a more traditional approach; however, efforts to reduce risk should be made before conventional flood defences are installed.

8.5 However, in mitigating flood risk to one site, it should not be passed on to create flood risk at another vulnerable site (see Health Technical Memorandum 07-07 – 'Sustainable health and social care buildings').

Responding to flooding

8.6 Contingency plans for flooding should be drawn up and should include the following:

- options for securing alternative supplies for essential water uses;
- screening back-up-generator power supplies for resilience to flooding;
- a full citing of patients, equipment, power lines and communications cables that are at risk from flooding;
- options for evacuation of patients and staff, including routes, assembly points and responsibilities;
- accessibility for services to get to the site.

See also the Department of Health's "preparedness for floods" website.

9 Responsible bodies in water management

Consumer councils

Consumer Council for Water (CCWater)

The Consumer Council for Water (CCWater) is the industry watchdog, set up to represent customers of water and sewerage companies in England and Wales, and provides a national voice for consumers.
www.ccwater.org.uk/

Department for Environment, Food and Rural Affairs (Defra)

The Department for Environment, Food and Rural Affairs (Defra) is a governmental organisation responsible for water supply and resources, regulatory systems for the water industry and environmental protection.
www.defra.gov.uk/

Drinking water regulators

Drinking Water Inspectorate (DWI)

The Drinking Water Inspectorate (DWI) is responsible for ensuring that water companies and suppliers in England and Wales meet their statutory duties in relation to drinking water quality. The Inspectorate does this through a programme of technical audit to ensure that water companies are taking appropriate actions to safeguard drinking water quality. The Inspectorate can call on powers of enforcement and (where appropriate) prosecution to legally enforce the requirements of the legislation.
www.dwi.gov.uk/

Economic regulators

Water Services Regulation Authority (Ofwat)

The Water Services Regulation Authority (Ofwat) is the government-appointed economic regulator of the private water industry in England and Wales. Its remit is to protect the interests of water-company customers while ensuring water companies are able to properly finance and carry out their functions. It determines prices through periodic reviews of water-company expenditures and future plans.
www.ofwat.gov.uk/

UK environmental regulatory authorities

Environment Agency

The Environment Agency is responsible for the protection and preservation of the natural environment in England and Wales. Its role in the water industry is to ensure that water-company operations do not adversely affect the water environment and are sustainable in the long term. As well as reviewing water-company plans, it regulates abstraction licences and is responsible for flood risk management.
www.environment-agency.gov.uk/default.aspx

Water UK

Water UK represents the private water industry in the UK. It actively seeks to develop policy and improve understanding in areas that involve the industry, its customers and stakeholders.
www.water.org.uk/

10 How to find water-efficient products

Bathroom Manufacturers Association

The Bathroom Manufacturers Association (BMA) is the lead trade association for manufacturers of bathroom products in the UK and has launched a "water-efficient product" labelling scheme. The scheme acts as a guide to selecting products for use in bathrooms.
http://water-efficiencylabel.org.uk/default.asp

Enhanced Capital Allowances Scheme: the Water Technology List

The Enhanced Capital Allowance (ECA) Scheme enables businesses to claim 100% first-year capital allowances on investments in technologies and products that encourage sustainable water use. Businesses are now able to write off the whole cost of their investment against their taxable profits for the period during which they make the investment. As part of this scheme, a list of water-efficient technologies that qualify can be found on the ECA water technology list website.
www.eca-water.gov.uk/

Water Regulations Advisory Scheme (WRAS)

The Water Regulations Advisory Scheme (WRAS) is the UK water industries' scheme to promote knowledge of UK water regulations and byelaws and approve fittings and appliances that comply with these. It encourages consistent interpretation and enforcement for the prevention of waste, undue consumption, misuse, erroneous measurement or contamination of water.

All WRAS-approved products or materials (which will normally bear the "WRAS-Approved Product" or "WRAS-Approved Materials" logos) have been tested and have been found to comply with the Water Supply (Water Fittings) Regulations 1999 (as amended) and the Scottish Water Byelaws 2004.

WRAS approval should be sought on all procured fixtures and fittings.
www.wras.co.uk/

Waterwise

Waterwise is an independent, not-for-profit organisation that receives funding from the UK water industry and from sponsorship and consultancy work. In England, it sits on the Government's Water Saving Group alongside the water industry and regulators. Waterwise's website provides guidance on water-efficient appliances, including a database of water-efficient washing-machines and dishwashers. Waterwise also awards the Waterwise Marque to products which are deemed to save water.
www.waterwise.org.uk/

11 Available support for auditing

Advanced Demand Side Management (ADSM)

OGCbuying.solutions (an executive agency of the Office of Government Commerce (OGC) in the Treasury) has negotiated a framework contract with ADSM.

ADSM can assist with the following:

- Compare a facility's water usage with that of similar organisations.
- Obtain help and advice to reduce consumption.
- Implement water-saving measures.
- Have the facility's entire water system and bills monitored and managed.
- Fast-track savings and meet government environmental targets.

www.adsm.com/

Envirowise

Envirowise delivers a government-funded programme of free, confidential advice to UK businesses. This assistance enables companies to increase profitability and reduce environmental impact.
www.enviro-wise.co.uk/site/uk/content-folder/homepage

National Water Conservation Group

The mission of the NWCG is to stimulate and inform debate about how to achieve the efficient use of water in the UK.
www.waterwise.org.uk/pages/national-water-conservation-group.html

Water UK

Water UK is the representative body for the UK water industry. It can advise on which water and sewerage companies provide local services.
www.water.org.uk/

12 Audit structures

GPs' surgeries and health clinics

In almost all cases, water use in GPs' surgeries and health clinics will be domestic. Normally there will be WCs, basin taps, a kitchen tap and a dishwasher. In some cases, there may also be a shower, a urinal and fittings for outside use (for example, water for a garden).

The following steps should be considered in a water management plan:

> **Note**
>
> These are best practice guidelines only.

- **Choose a designated water champion.** This should be someone with an overview of the building's facilities, someone in charge of financial management or someone who is keen on the subject.
- **Communicate with all staff (including contract cleaners and washroom maintenance contractors).** Communication could be written or ideally face-to-face, and should explain that a water management plan is being established and that all staff will be kept informed and are also welcome to contribute.
- **Gather information.** This should include plans of the building showing plumbing and fixtures, water and sewerage bills, how water is used in the building (who waters the plants, how often is the dishwasher used, does anyone use the shower, where do the cleaners fill their buckets etc), and any alternative sources of water (bottled water for catering, a water cooler in the waiting room, rainwater butt for the garden).
- **Carry out a water audit.**
- **Assess other water issues** such as what the level of flood risk is, how to deal with flooding, and what to do if the water supply is interrupted.
- **Draw up a management plan.** This should include plans of where all water fittings, plumbing and drains are. It should list all appliances and fittings with a guide to their water consumption (WC flush volume, dishwasher usage per wash etc). It should then suggest actions such as fitting cistern displacement devices or sourcing flood-prevention measures, with an outline of potential costs and savings.
- **Discuss the management plan** with all staff and take action where appropriate.
- **Keep the plan up to date.**

Hospitals

- **Choose a designated water champion.** This should be someone with an overview of the building's facilities, someone in charge of financial management or someone who is keen on the subject. This person should have the support of the senior management.
- **Communicate with all staff (including clinicians, contract cleaners and washroom maintenance contractors).** Communication could be written or ideally face-to-face, and should explain that a water management plan is being established and that all staff will be kept informed and are also welcome to contribute.
- **Gather information.** This should include plans of the site showing water meters, plumbing and fixtures, water and sewerage bills, the main areas of water use and drainage. It should include any existing water reports, input from staff who use water, and copies of contracts that specify water use for landscape maintenance or cleaning.
- **Walk the site** to check information and plans against reality.
- **Carry out a water and wastewater audit.**
- **Assess other water issues** such as what the level of flood risk is, how to deal with flooding and what to do if water supply is interrupted.
- **Draw up a management plan.** This should include plans of where all water fittings, plumbing and drains are. It should provide a breakdown of water and wastewater issues for each part of the site, allocating a reference code to each piece of water-using equipment and providing details of its water use, its condition and information on what it does. The plan should

then suggest actions for each area of the site with an outline of potential costs and savings.

- **Discuss the management plan** with all staff and take action where appropriate.
- **Keep the plan up to date.**

13 Case Study 1: Gwent Healthcare NHS Trust: water-leakage detection initiative

The energy team at Gwent Healthcare NHS Trust, South Wales, manages over 70 properties including nine hospitals, among them being the Royal Gwent (600 beds) and Nevill Hall (400 beds). The Trust spends over £4 million per year on electricity, gas and water, which is billed from over 300 meter points.

Managers at County Hospital, Griffithstown, had long suspected there might have been a water leak on the site, as the water bills appeared excessive compared to hospitals of a similar size. As a result, they decided to install a water-leakage detection system. This involved the use of a meter logger and Internet-based water-meter monitoring and analysis, which helped to track water usage.

When the results were analysed using the water-meter-monitoring website, they discovered that there was a very high level of water consumption during the early hours of the morning – a period when water demand should have been low.

It soon became apparent there was a leak of 4 m^3 per hour on the site. Trial holes were excavated at positions where the leak was thought to be. Because of the high number of unrecorded service tees off the site's water main, the leak initially proved difficult to locate. When it was eventually found and repaired, water demand on the site was reduced by a factor of 10.

This initiative has saved the Gwent Healthcare NHS Trust over £66,000 on its annual water bill. It will receive an additional £66,000 in sewerage rebates from its water supplier for the last two years. These savings will be used to invest in additional energy-saving technology.

Internet-based metering services can analyse and identify abnormal utility consumption, correct excessive usage or leakage and provide daily reporting to facilities management. In most cases, the payback period is less than two years. In the case of Griffithstown, payback was less than one month, with immediate positive cash-flow benefit from the second month onwards in reduced water charges.

14 Case study 2: St Thomas' Hospital water audit

Introduction

There are seven strategic health authorities within the Thames Water area and numerous hospitals of differing types and sizes. Thames Water carried out a thorough water review at each of the seven largest London hospitals to understand where water savings could be achieved, estimate how much water these actions could save, and identify the best location and type of water savings devices to be installed.

The following summarises the findings of Thames Water's water audit of St Thomas' Hospital.

St Thomas' Hospital

St Thomas' Hospital is part of the Guy's and St Thomas' NHS Trust. The individual buildings range considerably in age.

Trending

The hospital has put in place some good water management practices (for example the closed-loop cooling of MRI scanners), and St Thomas' water consumption appears to be better than average.

The hospital has lower than average consumption of around 342,500 m^3/year when compared with its expected use of between 247,500 m^3 and 517,500 m^3 of water per annum (based on the benchmarking data given in Tables 2–4 of Chapter 5, and assuming there will be 750,000 patient contacts per year).

Periodic checks of actual normalised consumption against benchmarking data and the previous year's performance are worthwhile completing. Without monitoring and comparing water consumption against historical levels and consumption patterns, it is impossible to know whether current consumption is typical or excessive, or whether the hospital is getting more or less efficient. Trending also allows the unusual to be rapidly identified – particularly leaks or losses.

Guidance on how to trend a site's water consumption is given in 'Steps to sustainable water use'.

Cost

St Thomas' is currently on the Thames Water major-user tariff and is charged with a separate volumetric rate for water supply and wastewater disposal.

Water use at the time of the audit cost the hospital approximately £206,860 and £116,826 for water and wastewater volumetric charges, respectively, and an additional £47,444 in standing charges – a total of £371,130 per annum.

Given the large losses of steam and water from evaporation in the cooling towers (estimated at 30,000 m^3/year and 9000 m^3/year, respectively), the 10% non-return-to-sewer allowance currently assumed appeared low. However, no accurate data existed on which to base any correction. Thames Water recommended that flowmeters be inserted at relevant points so that non-return-to-sewer could be more accurately evaluated.

Water distribution plan

It was recommended that the site's water distribution plan be maintained and developed to show meters, submeters and valve work in order to assist in water management and provide a process-mapping tool to understand water use on site.

Recommendations to reduce water use

Pressure

There is a variable pressure supply throughout one of the buildings – the lower the floor, the greater the water pressure. With an estimated 4 m between floors, the static head from the 13 floors to the ground floor is some 50 m or 5 bar. Several taps were tested (mixer tap, full-bore cold supply) in the building as follows:

- upper floor – 15 L/min;
- lower floor – 40 L/min;
- basement – 60 L/min.

Apart from the flow on the top floor, the flows through other taps are excessive.

Even though taps are not often used fully open, any overpressure results in unnecessary water consumption by taps (and showers).

It was recommended that pressure-reducing valves be fitted to reduce pressure to points of use to the more usual 1.5–2.5 bar. However, because of the pipework configuration, it was acknowledged that this could prove to be difficult. An alternative could be to restrict the maximum flow by adjusting the isolation ball-valves to taps, where they are fitted.

Leakage

As the site is fed by multiple water mains and has a large network of internal and underground pipes, a leakage survey was undertaken. The only significant water leak identified during the water review was estimated at around 120 L per hour (over 1000 m^3/year).

Steam loss

Several significant steam releases were occurring across the site. It was thought that traps or steam-release valves were not seating correctly. Apart from the obvious water loss, the value of this loss is really in the treatment of, and energy in, the steam.

An approximate assessment of its value can be made at £1 per cubic metre for the raw water (including softening and boiler water treatment costs) and approximately £11 in energy costs (assuming 732 kWh to raise 1 m^3 water from 15°C to 100°C, and converting it to steam with useful energy at 1.5p per kWh). This gives a value of approximately £12 per cubic metre of water used for steam generation – the cost of a steam loss is therefore reasonably high.

Evaporation from the hydrotherapy pool

The hydrotherapy pool is approximately 18 m^3. The water temperature is held at 35°C and has a pH value of 7.28 during sessions. It is not equipped with a cover.

Evaporation losses from this pool are typically around 5–10 mm per day – hence, annual evaporation loss may be 22–44 m^3/year. While this may not appear much water, its value is high because of the energy loss. Each litre of water that evaporates wastes 1.3 kWh of energy; assuming useful energy costs at 1.5p per kWh, this represents a loss of £21 per cubic metre.

Fitting a pool cover will virtually eliminate evaporation when the pool is unoccupied, saving water and energy. Assuming this is 16 hours per day, savings will be around £300–£600 per annum.

Baths/showers

It was recommended that, when showers are provided, high-performance low-flow types are used and that, to avoid water running to waste while the correct temperature is obtained (and for safety), thermostatic controls are used. Apart from the savings in water, there are also significant energy savings, as most of the water saved will be hot or warm.

WCs

The volume of water used for flushing can be minimised by adjusting the internal ball-cock to reduce filling volume to a minimum, fitment of a cistern volume adjuster (cistern devices) or replacement of the toilet (new units have a maximum flush of 6 L).

Urinals

It was recommended that the urinals be fitted with a passive infrared (PIR) automatic sensor flush control of the "cumulative" type – that is, it counts the number of people using the facility and flushes after, for example, 25 users. Such a device would eliminate flushing during low use, weekends and at night (except a hygiene flush) such that the amount of water saved will be approximately 1051 m^3 per annum.

Savings can be notable, with payback for each unit generally obtained within 9–12 months.

It was also recommended that all urinals fitted during refurbishment be specified with PIR-type flush controls.

Taps

By far the greatest problem was the excessive flow due to high pressure on lower floors (see above). Tap regulators can be fitted to reduce the flow of water. In the case of hot water taps, energy savings will also result. Regulators can reduce the flow of water by up to 50%.

Break tanks and overflows

Overflows from break tanks and toilet cisterns should be visible so that if an overflow occurs it is easy to detect – a hidden overflow could be running for years without detection. A minor overflow (estimated as a 3 mm stream) will lose approximately 350 m^3 water per year.

Potential savings

There are still several opportunities to reduce water consumption, some of which will also reduce energy consumption, allowing significant financial savings to be made.

Practical actions to achieve water savings have been identified in Table A1.

Table A1 Potential savings

	Opportunity	Action	Potential saving (m^3/annum)	Cost saving[a] (£/annum)	Estimated payback
Immediate low-cost actions	Hydrotherapy pool	Minimise evaporation by fitting simple cover when not in use	33	450	Moderate
	Urinal flush control	Fit sensor-type flush control to existing urinals	2,180	2,137	9–12 months
	Toilet cistern flush	Adjust ball-cock to reduce flush by 250 ml (or more)	500	489	Immediate
	Leaking taps	Repair leaking tap in the sterile services department	1,000	980	Immediate
	Steam losses	Maintain/repair release valves, traps etc	2,242	26,846	Rapid
	Endoscopy RO overflow	Replace two small ball-cock units with one larger one to avoid jamming of floats	1,576	1,544	Immediate
	Condensate losses	Fix leaks (appeared to require simple gland tightening)	30	75	Immediate
	Leaking pipes	Investigate and repair leak	1,000	980	Immediate
	Reduce distribution pressure	Install pressure-reducing valves (PRVs) as appropriate (or adjust isolation/flow regulation valves to taps)	8,076[b]	7,915	Not calculated
Medium-term actions	Still cooling water	Replace once-through softened water with recirculating chiller or cooling-tower feed water. Alternatively, buy in distilled water	585	570	Moderate or intermediate
	Condensate return	Investigate current efficiency and improve collection and return	5,800	14,500	High
	Blowdown cooling	Cool blowdown via a heat exchanger – not simple dilution cooling with fresh water	182	450	Immediate
	Reuse reverse osmosis reject	Investigate scope for collecting reject water from boiler water RO unit (and others), storing it and using for a low-grade use	700	15,386	High but long-term
Total			15,828	72,322	

Notes:
Savings are combined estimations from separate building audits, summarised as net potential savings for the entire hospital.

a. Annualised cost estimated based on current tariffs. Note these are also year-on-year savings.

b. This figure could well be much higher than this

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