

Water Safety Guidance

Scottish Health Technical Memorandum

Part A - Design, installation and testing of domestic water and above ground drainage systems

SHTM 04-01 part A

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Disclaimer

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Executive Summary

Scottish Health Technical Memorandum (SHTM) 04-01 “Water Safety Guidance” is published in seven parts:

- part A: Design, installation, and commissioning
- part B: Operational management
- part C: Microbiological testing
- part D: Disinfection of domestic water systems
- part E: Alternative materials and filtration
- part F: Chloramination of water supplies
- part G: Operational procedures and Exemplar Water Safety Plan

The documents give comprehensive advice and guidance on the legal requirements, design implications, maintenance, and operation of safe water systems in healthcare premises. The use of these premises is very intense, the occupancy level high and the patients may be particularly susceptible to waterborne infection risks. Their condition may also require close control of the clinical and built environment.

This 2026 SHTM suite draws together developments and updates from the previous guidance, including recommendations for the safe management of water systems, via the integration of the principle of Water Safety Groups (WSGs) and Water Safety Plans (WSPs) and how to manage and minimise the risks to health from various aspects, ranging from clinical risks, microbial and chemical contamination, changes to the water system, resilience of the water supply and so on. It also introduces a stronger emphasis on staff competencies and the implementation of water hygiene awareness training.

There has been increasing evidence that the interaction of water supply and above ground drainage can each give rise to problems where the design and/ or operation is poorly configured. Therefore, a brief section on above ground drainage design has been included in this version.

Information regarding the mechanisms for compliance with the Scottish Water Byelaws are also discussed.

This 2026 version of SHTM 04-01 supersedes all previous versions of SHTM 04-01 “Water Safety for Healthcare Premises”.

Guidance in this SHTM applies to all healthcare facilities containing domestic water and above ground drainage systems.



Language used in technical guidance

In SHTMs verbs such as “must”, “should” and “may” are used to convey notions of obligation, recommendation or permission. The choice of modal verb will reflect the level of obligation needed to be compliant.

The following describes the implications and use of these modal verbs in SHTMs (readers should note that these meanings may differ from those of industry standards and legal documents):

- A.** “Must” is used when indicating compliance with the law
- B.** “Should” is used to indicate a recommendation (not mandatory/ obligatory), for example among several possibilities or methods, one is recommended as being particularly suitable - without excluding other possibilities or methods
- C.** “May” is used for permission, for example to indicate a course of action permissible within the limits of the SHTM
- D.** “Shall”, in the obligatory sense of the word, is never used in current SHTMs

Typical usage examples

- A.** “All water fittings used in the construction of systems referred to in this SHTM must comply with the requirements of the Water Supply (Water Fittings) (Scotland) Byelaws 2014.” [obligation]
- B.** “Waterborne bacteria should be considered during the design, construction, installation, commissioning and maintenance of the hot and cold water systems and above ground drainage system in the healthcare-built environment,” [recommendation]
- C.** “There are also other waterborne bacteria acknowledged to be in the water systems that may require further supplementary management practices to control)” [permission]

Project derogations from the Technical Guidance

Healthcare facilities built for the NHS are expected to support the provision of high-quality healthcare and ensure the NHS Constitution right to a clean, safe and secure environment. It is therefore critical that they are designed and constructed in accordance with appropriate technical standards and guidance. This applies to all new and refurbishment projects, regardless of procurement model.

Note 1: The healthcare organisation, and their project teams, should ensure that they have a fully documented list of technical standards and guidance that are applicable to the specific project.

It is recommended that the starting point for all projects should be one of full adherence to the SHTM guidance or better if that can be demonstrated. While it is recognised that derogations may be required in some cases, these must all be risk-assessed and documented in order that they may be considered within a structured derogation review and approval process. In all instances derogations must not compromise the health and safety or operational resilience of the healthcare facility. Healthcare organisations should ensure that any derogations do not impact on their legal or statutory obligations.

Derogations must be properly authorised by the project's senior responsible officer and informed and supported by appropriate technical advice including that of the WSG, irrespective of a project's internal or external approval processes.

A schedule of derogations should be created for any project, including details of approvals, risk assessment and identified mitigations.

Note 2: This guidance does not alter the healthcare organisations legal or statutory obligations.

NHS Scotland Sustainable Development Policy Drivers

Responding to the global climate emergency is one of the Scottish Government's highest priorities. Sustainable development, the concept that the needs of the present must be met "without compromising the ability of future generations to meet their own needs" is integral to the Scottish Government's overall purpose. The Scottish Government's National Performance Framework (NPF) shares the same aims as the United Nations' Sustainable Development Goals. It highlights the need for a 'whole system approach' to successfully deliver the NPF's national outcomes for Health and recognises the important role that NHS Scotland has in helping to achieve this.

Over recent years the current and future impact of climate change has been well documented, with risks to human health and to health and social care delivery highlighted within Scotland's summary report of the UK Climate Risk Independent Assessment*. NHS Scotland is committed to the delivery of a high quality, environmentally and socially sustainable health service that is resilient to the locked-in impacts of climate change. Director Letter (DL) (2021) 38 'A Policy for NHS Scotland on the Climate Emergency and Sustainable Development' provides the framework for this aim to become a reality, and to maximise NHS Scotland's contribution to mitigating and limiting the effect of the global climate emergency.

* NHS Scotland Climate Change Risk Assessments and Adaptation Plans: A Summary Report on the National Services Scotland (NSS) website.

Who should read this guidance?

This document is aimed at specifiers, designers, suppliers, installers, commissioners, WSGs, estates and facilities managers and operations, and Infection Prevention and Control Teams (IPCT). Elements of the document will also be relevant to managers concerned with the day-to-day management of healthcare facilities and senior healthcare management. Infection prevention specialists who are involved with monitoring water quality and managing infections and outbreaks potentially linked to water supplies will also find it helpful to be familiar with this guidance.

Main changes since the 2014 suite

- This 2026 edition of SHTM 04-01 provides comprehensive guidance on measures to control waterborne pathogens.
- This edition has been updated to align with the Health and Safety Executive's (HSE's) revised Approved Code of Practice (ACOP) for Legionella (L8) and its associated Health and Safety Guidance (HSG) 274 guidance documents.
- A new chapter on above ground drainage has been added to SHTM 04-01 Part A.
- New guidance has been included in SHTM 04-01 Part A on the hygienic storing and installation of fittings and components and on the competency of installers/ plumbers working on healthcare water systems. The guidance also outlines that any person working on water distribution systems or cleaning water outlets needs to have completed a water hygiene awareness training course.
- Information is discussed in relation to compliance with the Scottish Water Byelaws in SHTM 04-01 Part A.
- SHTM 04-01 Part A and Part E now outlines requests for pipework manufacturers data sheets regarding the product limitations.
- Part B of the SHTM 04-01 now includes updated guidance on the remit and aims of the WSG.
- SHTM 04-01 Part B now includes information on Nontuberculous mycobacteria (NTM).
- Guidance on sampling techniques for, testing for, and the microbiological examination of *pseudomonas aeruginosa* samples - originally in the Health Technical Memorandum (HTM) 04-01 Addendum - is now included in SHTM Part C to complement the Total Viable Count (TVC) guidance.
- Whilst SHTM 04-01 Part G provides updated guidance on the WSP and in addition to the 2014 sample templates includes several more.

While some guidance on other water-service applications is included, it is not intended to cover them fully. For example:

- process waters used for laundries, see HTM 01-04 - 'Decontamination of linen in health and social care'
- endoscopy units, see HTM 01-06 - 'Decontamination of flexible endoscopes'
- primary care dental premises, see HTM 01-05 Decontamination in primary care dental facilities
- renal units, see Health Building Note (HBN) 07-01 and HBN 07-02, the Renal Association's guidelines and ISO 13959 and 11663
- sterile services departments, see Scottish Health Planning Note (SHPN) 13 - Part 1 Decontamination Facilities: Central Decontamination Unit
- hydrotherapy pools, see the Pool Water Treatment Advisory Group's (PWTAG's) 'Swimming pool water: treatment and quality standards for pools and spas'
- spa pools, the control of legionella and other infectious agents in spa-pool systems HSG282
- birthing pools, see HBN 21 - 'Maternity' and PWTAG's 'Swimming pool water: treatment and quality standards for pools and spas'



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NHS Scotland Assure acknowledge contributions from those individuals and organisations involved in the development and publication of previous versions of the SHTM 04-01 suite.

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1. Introduction

The needs of the building occupants

- 1.1. The development, construction, installation, commissioning, and maintenance of hot and cold water supply systems are vital for patient and public safety which must remain as a primary focus throughout. Healthcare premises are dependent upon water to maintain hygiene and a safe and a comfortable environment for patients and staff, and for treatment and diagnostic purposes.
- 1.2. Interruptions in water supply can disrupt healthcare activities. The design of systems should ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems. Water safety must be the primary aim.
- 1.3. This Scottish Health Technical Memorandum (SHTM) gives comprehensive advice and guidance to healthcare management, design engineers, estate managers, Infection Prevention and Control Teams (IPCTs), operations managers, contractors and the supply chain on the legal requirements, design applications, maintenance and operation of hot and cold water supply, storage and distribution systems in all types of healthcare premises. It is equally applicable to both new and existing sites.

Aims of this guidance

- 1.4. The current review and update of SHTM 04-01 is intended to move users of the document towards a holistic management of water systems via Water Safety Groups (WSGs), Water Safety Plans (WSPs) and other initiatives. This is especially important when we consider the additional risks of delayed handovers and poor installation techniques.
- 1.5. Outbreaks and pseudo-outbreaks of waterborne infections, including those caused by Nontuberculous mycobacteria (NTM), have been associated with water in distribution systems, wastewater systems and associated equipment. Patients at increased risk of NTM infections (see at-risk patient groups) need spaces which are designed, managed and operated to prevent exposure as much as possible, taking into account all possible modes of transmission including ingestion, inhalation, aspiration and contact (both direct and indirect).

- 1.6. This guidance has been written to promote good practice for those responsible for the design, specification, installation, commissioning, operation, and maintenance of water services in healthcare premises, by:
- highlighting the need for robust governance and management
 - outlining the remit of the WSG and how this relates to the provision of safe water in healthcare premises
 - outlining key criteria and system arrangements to help stop the ingress, colonisation and growth of opportunistic microbial waterborne pathogens, emerging human pathogens including NTM, and the ingress of chemical contaminants
 - identifying temperature regimes for water systems
 - ensuring the safe delivery of hot water
 - outlining how the correct selection of system components and correct use by occupants can help preserve the quality and hygiene of water supplies
 - providing a point of reference to legislation, standards and other guidance pertaining to water systems
 - providing a basic overview of possible potential waterborne pathogens
 - giving an overview of some of the different water systems (including components) and their safe installation, commissioning and operation and maintenance
 - providing typical system layouts and individual component location
 - providing information on thermostatic mixing valve (TMV) configurations, appropriate usage, and maintenance requirements
 - identifying key commissioning, testing and maintenance requirements for referral by designers, installers, commissioners, IPCT, operators, and management

Waterborne pathogens

- 1.7. This guidance provides measures to control waterborne pathogens. Legionella colonisation and growth, in the main, is associated with poor engineering configuration, operation and maintenance, with limited evidence of patient--to-patient or patient-to-outlet transfer. However, *pseudomonas aeruginosa* can colonise skin of healthy individuals without causing infection. *Pseudomonas aeruginosa* may be transferred from person-to-person, person to and from outlets and from splash contamination of the surrounding environment from both patients and staff. Suspected *pseudomonas aeruginosa* waterborne infections require clinical surveillance and additional investigations to determine the source and interventions as agreed by the WSG with input from infection control specialists, microbiologists and estates. Whilst temperature control is the traditional strategy to minimise the risk from Legionella, managing the risk from *pseudomonas aeruginosa* requires a multifactorial approach that will require temperature and other strategies.

There are also other waterborne bacteria acknowledged to be in water systems that may require further or supplementary management practices to control.

- 1.8. As with all control measures, temperatures should be monitored at regular intervals to verify effective control.
- 1.9. Because of the complexity of hot and cold water distribution systems and the difficulty of maintaining a temperature control regime in some healthcare facilities, this guidance suggests that additional chemical, physical and other water control methods that have been shown to be capable of controlling microbial colonisation and growth may also be considered.
- 1.10. NTM (also known as environmental mycobacteria) are a group of bacteria found in soil, water, dust, as well as within constructed water systems and associated equipment such as those installed within healthcare premises. NTM are not contaminants but part of the natural background microbial population entering the incoming supply and can colonise and grow within biofilms attached to water system infrastructure where conditions allow. They are responsible for opportunistic infections that affect both immunocompromised and immunocompetent patients, immunocompromised patients are the most susceptible. *pseudomonas aeruginosa* is a gram-negative organism which is ever-present in the environment being most commonly found in soil and water but can also be part of the normal gut flora and selected out by antibiotics which are not active against it. It is often termed an opportunistic pathogen, thus, there can be infection from a patient's own flora as well as from environmental sources. Legionella are also opportunistic pathogens of humans and normally inhabit warm, moist or aquatic environments. Their predilection for warm water means that they are capable of colonising artificial water systems and equipment containing water. Legionnaires' disease is not contagious from person to person but is of environmental origin and usually contracted by inhaling the organism in an aerosol produced from water containing the organism. Aspiration of water (where water droplets are drawn into the lungs whilst breathing) containing Legionella can also cause infection.
- 1.11. All waterborne bacteria should be considered during the design, construction, installation, commissioning and maintenance of the hot and cold-water system and above ground drainage system in the healthcare-built environment.
- 1.12. Healthcare water and drainage systems are often large and potentially complex which if not designed and managed adequately can lead to growth of organisms.

- 1.13. The management of the water system, including minimising the risk of NTM, should be part of the organisations WSP. The WSP should be developed by the multidisciplinary WSG. The WSG should meet regularly to review the WSP as well as water quality and potential issues. Designers should also inform the water management strategy from the early stages of concept design through to completion, which should include a designer's risk assessment and commissioning brief.
- 1.14. This guidance suite has included information from the relevant British Standards (BS) and Health and Safety Executive (HSE) documentation regarding the management of water systems in relation to Legionella, *pseudomonas aeruginosa* and the current (at the time of writing) information on other waterborne bacteria. It is noted that research is ongoing with respect to the identification and risk reduction techniques for NTM, together with development of a specific British Standard specifically on NTM. It is acknowledged that, at the time of writing, there is limited information available for NTM in healthcare water systems, regarding bacterial survival temperature ranges, material selection and disinfection resistance.
- 1.15. Whilst this guidance is focused on new build and major refurbishment projects, the information provided will be helpful for use in existing buildings where the infrastructure allows, to protect patients at high risk of water and wastewater infections, following risk assessment by those with the competencies, skills and experience to carry out such an assessment and agreed by the WSG/ PWSG.

High risk patient groups

- 1.16. The non-exhaustive list below is intended to be used by key clinical colleagues and the Healthcare Organisations WSGs, to assess the specific patient risk groups who occupy spaces with the healthcare buildings and who may require additional control measures. The findings from these reviews must be documented along with any changes that will need to be made to the WSPs and other initiatives. The completion of these additional control measures should be reported at each Healthcare Organisations WSG meeting.
- 1.17. Potential "high risk" patient groups:
- haematology
 - oncology
 - Cardiac surgery
 - Bone marrow and stem cell transplant
 - Neonatal, paediatric and adult intensive care unit (ICU)
 - Solid organ transplant
 - burns
 - cystic fibrosis

- any patient with a long line (such as central venous catheter) in situ
- any other patients that are severely immunocompromised through disease or treatment

Antimicrobial resistance

- 1.18. Antimicrobial Resistance (AMR) is one of the greatest threats to public health. Often termed the silent pandemic, it is predicted to cause up to 10 million deaths annually and incur a global economic cost of approximately \$100 trillion (AMR Review, 2016). Within UK hospitals, gram-negative organisms resistant to all known antibiotics have now been identified. Even where a small number of restricted antibiotics remain effective, infections caused by these highly resistant organisms are associated with high mortality, largely due to delays in implementing effective therapy (ECDC, 2025).
- 1.19. The healthcare facility wastewater systems have become a major breeding ground for antimicrobial-resistant organisms and are the dominant contributor—by orders of magnitude—to the AMR burden in urban wastewater systems. Several factors underpin this risk. Highly resistant organisms frequently colonise the human gastrointestinal tract and inevitably enter wastewater systems. In addition, pharmacokinetic data demonstrate that many antibiotics are excreted in biologically active forms, with some classes showing over 90% recovery of active compound in urine (Levison et al, 2009 and healthcare without harm, 2021). This creates strong selective pressure within wastewater microbiomes, promoting the persistence and predominance of multidrug-resistant organisms (MDROs).
- 1.20. While healthcare wastewater systems act as a conduit for AMR into municipal wastewater, they also function as a highly efficient internal distribution network within healthcare buildings (Breathnach et al, 2012). Wastewater systems provide multiple pathways and exit points through which organisms can be transmitted back to patients. Risk does not arise solely from patient-facing water or wastewater services; it may originate anywhere in a facility, including non-clinical areas such as hospital kitchens. Routine activities—for example, filling water jugs or patient wash bowls—can result in transmission when receptacles contact drains. Transmission routes include splashing (documented up to 2 metres), direct and indirect contact, and potentially aerosolisation.

- 1.21. Traditional infection prevention measures have limited effectiveness in preventing transmission of water and wastewater associated organisms (Scharer et al, 2023 and Hopman et al, 2017). In response to otherwise intractable outbreaks caused by MDROs, some clinical units have chosen to remove water and wastewater services entirely. These reduced water care (these have been termed water-free, water lite or water safe care by various organisations) models have successfully terminated outbreaks and, in cases, reduced transmission of other Gram-negative organisms. Initially implemented in adult critical care units and later in neonatal intensive care units, these approaches are now extending into other hospital settings in response to the continued spread of AMR (Meda et al, 2025 and Low et al, 2023).
- 1.22. The risks can be more accurately described across three domains (Weinbren et al, 2025):
- A. the main body of the water system** - currently the most developed area in terms of understanding, regulation, and control measures
 - B. the wastewater system** - increasingly recognised as a critical factor in the emergence and spread of AMR, requiring explicit consideration in system design, operation, and maintenance
 - C. the periphery of the water and wastewater system** - a rapidly evolving area requiring close collaboration between IPCTs and clinical services. This includes decisions on whether water and wastewater services are required at all, where they should be located, and what mitigations are necessary when they are retained
- 1.23. Each domain demands a distinct technical knowledge base and skill set, supported by multidisciplinary collaboration, to protect patients, staff, and other building occupants.
- 1.24. Historically, National AMR Action Plans (NAPs) for healthcare facilities have focused primarily on antimicrobial stewardship, and the development of new antibiotics. However, no new classes of antibiotics have been introduced since 1986, and this strategy has failed to halt—and may be accelerating—the spread of AMR. In the 2024–2029 NAP, the built environment has, for the first time, been recognised as an area where substantial gains can be made in preventing the transmission of AMR.
- 1.25. The design, construction, installation, commissioning, and maintenance of healthcare buildings and services play a critical role in infection transmission once facilities are occupied. Poorly designed or maintained water and wastewater systems significantly increase the risk of patient exposure to resistant organisms. In particular, any blockage or failure within a wastewater system markedly elevates transmission risk (Aranega-Bou et al, 2019). These realities necessitate a shift in both language and governance: the risks associated with wastewater must be explicitly recognised, and the traditional ‘water safety group’ should be considered as a “water and wastewater safety group” to reflect the full scope of risk and responsibility.

2. Policy and regulatory overview: water safety and the healthcare estate

Introduction

- 2.1. NHS Scotland has a corporate responsibility to account for the stewardship of its publicly funded assets. This includes the provision, management and operation of an efficient, safe estate that supports clinical services and strategy.
- 2.2. This corporate responsibility is carried by all accountable officers, directors with responsibility for estates and facilities and their equivalents, chairs, chief executive officers and non-executive board members. Together they have a responsibility to enact the principles set out in this document, provide leadership and work together to implement the necessary changes to provide a safe, efficient high-quality healthcare estate.
- 2.3. To achieve this, quality and fitness-for- purpose of the healthcare estate is vital. Scottish Health Technical Memorandum (SHTM) 04-01 seeks to set out the quality of, and standards for, water safety in the healthcare estate.
- 2.4. A healthcare organisation's Water Safety Group (WSG) (see SHTM 04-01 Part B) is pivotal in ensuring that decisions affecting the safety and integrity of the water systems and associated equipment do not go ahead without being agreed by them. This includes consultations relating to decisions on the procurement, design, installation and commissioning of water services, equipment, and associated treatment processes.
- 2.5. The quality and fitness-for-purpose of the estate are assessed against a set of legal requirements and governance standards. Adhering to the guidelines outlined in this SHTM will be taken into account as evidence towards compliance and governance standards.

Compliance of the healthcare estate

- 2.6. Principles related to the safety of healthcare estates and facilities are enshrined in Patient Rights Scotland) Act 2011(11) and The Charter of Patient Rights and Responsibilities (Health and cleanliness standards). There will be an expectation that the NHS facilities are clean, safe, suitable and fit for purpose, this includes water safety.

Note 3: There are numerous other statutes and legal requirements that NHS Scotland organisations, supporting professionals, contractors and suppliers must comply with. These are covered in the respective Health Building Notes (HBNs), Health Technical Memoranda (HTMs), Scottish Health Planning Notes (SHPNs), SHTMs, Scottish Health Facilities Notes (SHFNs), Statutory Compliance Audit and Risk Tool (SCART), Health and Safety Executive (HSE) requirements and the Property and Asset Management Strategy (PAMS).

- 2.7. In the UK, water safety falls within the requirements of the Health and Safety at Work etc. Act 1974. This Act also places duties on design teams, suppliers, and installers to ensure that articles or substances for use at work are safe and without risks to health and that any information related to the article or substance is provided. The Management of Health and Safety at Work Regulations 1999 provide a broad framework for controlling health and safety at work. The Control of Substances Hazardous to Health 2002 (COSHH) provide a framework of actions designed to assess, prevent, or control the risk from bacteria like Legionella and take suitable precautions.
- 2.8. The HSE's (2013) Approved Code of Practice (ACOP) 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)' and (2024) Technical Guidance Health and Safety Guidance (HSG) 274 'Part 2: The control of legionella bacteria in hot and cold water systems' contain practical guidance on how to manage and control the risks in water systems. Much of this information is also relevant to other pathogens, although additional measures will be required.
- 2.9. The HSE has published complementary technical guidance in HSG274, which is split into three specific areas:
- part 1 - evaporative cooling systems
 - part 2 - hot and cold water systems
 - part 3 - other risk systems
- 2.10. In addition, under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), there is a duty for employers to report any cases of legionellosis in an employee who has worked on hot and cold water systems that are likely to be contaminated with Legionella. Cases of legionellosis are reportable under RIDDOR if:
- A.** a doctor notifies the employer
 - B.** the employee's current job involves work on or near cooling systems that are located in the workplace and use water; or work on water-service systems located in the workplace which are likely to be a source of contamination

Healthcare associated infections (HAIs) should also be reported to Antimicrobial Resistance and Healthcare Associated Infection Scotland (ARHAI) in line with the National Infection Prevention and Control Manual (NIPCM) Chapter 3.

- 2.11. Regarding enforcement responsibilities, the HSE will take the lead regarding incidents involving Legionella. See the 'Memorandum of understanding Between HSE and Healthcare Improvement Scotland and the Working Arrangements Protocol between the HSE, Local Authorities in Scotland and Social Care and Social Work Improvements Scotland (Care Inspectorate).

Water regulations

- 2.12. As well as complying with the recommendations outlined in this document, the design and installation of the hot and cold water services, new or extended, in any healthcare premises should also comply with:
- the Water Supply (Water Fittings) (Scotland) Byelaws
 - the Drinking Water Quality Regulator (DWQR) Guidance
 - recommendations of the water suppliers in the Water Regulations Advisory Scheme (WRAS)/ WaterRegsUK
 - any other requirements of the local water undertaker

The Water Supply (Water Fittings) (Scotland) Byelaws

- 2.13. These Byelaws set legal requirements for the design, installation, operation and maintenance of plumbing systems, water fittings and water-using appliances. They have a specific purpose to prevent misuse, waste, undue consumption or erroneous measurement of water and, most importantly, to prevent contamination of drinking water.
- 2.14. These Byelaws apply in all types of premises supplied, or to be supplied, with water from a water undertaker. They apply from the point where water enters the property's underground pipe, to where the water is used in plumbing systems, water fittings and water using appliances. However, they do not apply in premises that have no provision of water from the public mains supply.

The Public Water Supplies (Scotland) Regulations 2014 (as amended 2017)

- 2.15. These Regulations cover the quality of water supplied by water undertakers for public distribution which is intended for domestic purposes; these purposes include drinking, cooking, food preparation, washing and sanitation. Water supplied meeting these quality requirements is referred to as wholesome water.

The Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (as amended 2017)

- 2.16. These Regulations cover private sources of water intended for human consumption including drinking, cooking, food preparation or other domestic purposes, such as boreholes and wells. Water meeting these quality requirements is referred to as wholesome water. These Regulations also place duties for monitoring and control of the quality of public water supplies where these are then further distributed to other users on separate premises by the water company's bill payer (this arrangement is often referred to as onward).

Draft for Consultation

3. Introduction to SHTM 04-01

Introduction

- 3.1. This edition of Scottish Health Technical Memorandum (SHTM) 04-01 - 'Water safety guidance' supersedes SHTM 04-01 Water safety for healthcare premises 2014.
- 3.2. This guidance has been revised to take account of Health and Safety Executive's (HSE's) Approved Code of Practice (ACOP) and guidance on regulations 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)' and its complementary technical guidance Health and Safety Guidance (HSG)274.
- 3.3. This SHTM gives comprehensive advice and guidance to healthcare management, design engineers, Water Safety Groups (WSGs), estates managers and operations managers on the legal requirements, design applications, maintenance and operation of hot and cold water supply, storage and distribution systems in all types of healthcare premises. It is equally applicable to both new and existing sites.
- 3.4. The document comprises seven parts. This part (Part A) outlines the principles involved in the design, installation, testing and commissioning of the hot and cold water supply, storage and distribution systems for healthcare premises. Some variation may be necessary to meet the differing requirements for the various water undertakers.

General

- 3.5. Current statutory legislation requires both "management" and "staff" to be aware of their individual and collective responsibility for the provision of wholesome, safe hot and cold water supplies, and storage and distribution systems in healthcare premises.
- 3.6. Healthcare premises are dependent upon water to maintain hygiene and a safe/ comfortable environment for patients and staff, and for clinical and surgical care.
- 3.7. The safe development, specification, construction, installation, commissioning and maintenance of hot and cold water supply systems and associated systems and equipment are vital for public health.
- 3.8. Interruptions in water supply can increase the risk of microbial ingress especially if these result in depressurisation of the supply pipework. The design of systems should ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems.

- 3.9. Whilst handwashing is a traditional and important measure to control the spread of microorganisms in healthcare premises, the increase in the use of antimicrobial hand-rubs resulted in a significant reduction in the use of wash hand basins which should be taken into account in calculations of water usage. Under-use of taps encourages colonisation and growth with *pseudomonas aeruginosa*, Legionella and other waterborne organisms. The design team should be aware of this and, accordingly, consider how local infection policies regarding hand hygiene and the use of antimicrobial hand-rubs might impact on the frequency of use of wash hand basins and the volume of water being distributed (see also SHTM 04-01 Part B on the extent of utilisation). The placement of clinical wash-hand basins (CWHB) should be agreed by the WSG and informed by a multidisciplinary approach, to mitigate the risk of spray/ splashing that may lead to transmission of water/ waste waterborne organisms and hazards associated with over-provision. Please refer to the National Infection Prevention and Control Manual (NIPCM) Chapter 4 for details on the wash hand basin, also see SHTM 64, the WSG should agree the details of the wash hand station arrangement, including (but not limited to) the soap dispenser and hand towel locations.
- 3.10. Depending on the intended uses and susceptibility of the users, a clinical risk assessment may indicate the need to protect high risk patients of waterborne pathogen (such as *pseudomonas aeruginosa*, Nontuberculous mycobacteria (NTM) and so on) infections by eliminating the potential for exposure to water and associated drainage. For example, the risk assessment should determine the appropriate location of wash-hand basins for patients and staff. Where risk assessment allows, these basins should be situated outside the patient area (such as in a lobby or en-suite) rather than within the patient's bedroom. This placement helps avoid exposure to sprays and aerosols from the outlet and associated drainage. Hand-gel dispensers should be provided inside the room for convenient access.
- 3.11. Wash-hand basins and clinical sinks should not be fitted in high-risk patient rooms where the risk assessment indicates there is too high a risk of infection from outlets and associated drainage. The number, location and specification for showers, basins, sinks, sluices, and specialist equipment should be agreed by the PWSG.
- 3.12. Where the clinical risk assessment determines wash-hand basins/ showers/ or sinks are appropriate in the patient spaces, they should be designed so that:
- water distribution systems are designed to ensure good and balanced flow to all outlets and to achieve target hot and cold temperatures with no potential for stagnation
 - there is appropriate provision and positioning of sinks, CWHBs and drinking water sources whilst minimising the risk of waterborne infection from outlets and drains as well as spray and splash contamination to patients and within the patient care spaces
 - wastewater drainage systems are designed so there is no potential for standing water or backflow onto shower trays/ floors and basins and sinks

- all outlets and sanitary fittings are designed and fitted to minimise the risk, as far as possible, from splashing whilst maintaining sufficient flow for effective hand-washing and showering (for example, using safe distance (>2m) splash screens)
- there is no space within the splash zone for storage of personal or clinical items; sloping the back of the sink will prevent storage by patients
- there are sufficient storage areas within patient bathrooms, dirty utilities, kitchens, clean utilities to avoid cross-contamination from splashing
- there is sufficient space to enable the safe set-down of contaminated articles (for example, bedpans), and separation of dirty equipment (such as wheelchairs, commodes, drip stands, and so on) before cleaning and for storage of clean equipment in separate areas
- there is effective ventilation (see Scottish Health Technical Memorandum (SHTM) 03-01 - 'Specialised ventilation for healthcare premises')
- they drain freely so that there is no backflow from the drain to contaminate the basin
- fittings designed to minimise splashing are robust and not subject to misalignment
- outlets, sinks and wastewater drains should be designed to minimise the risk of colonisation and transmission of NTM and other waterborne pathogens and should not have inserts which increase the risk of biofilm formation
- sanitary fittings are of a suitable size and depth to facilitate adequate activity space without the need to touch the outlets and drain when washing hands. They should be designed and fitted so that they comply with the Water Supply (Water Fittings) Regulations, including when fitted with a point-of-use (POU) filter.

Legislation, standards, and guidance

- 3.13. As well as the recommendations outlined in this document, the design and installation of the hot and cold water services, new or extended, in any healthcare premises should also comply with:
- A. the Water Supply (Water Fittings) (Scotland) Byelaws 2014; Drinking Water Quality Regulator (DWQR) guidance and the recommendations of the water suppliers in the Water Regulations Advisory Scheme's (WRAS)/ WaterRegsUK, and any other requirements of the local water undertaker;
 - B. the HSE's ACOP and guidance on regulations 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)', which requires that sources of risk are identified and assessed, and a written scheme of control is put in place in respect of controlling Legionella in water systems.

Note 4: The Water Regulations Guide is the successor to the popular Water Supply Byelaws Guide and includes the full text of the Scottish Water Byelaws, the DETR (Department of Environment, Transport and the Regions) & DEFRA (Department for Environment, Food and Rural Affairs) guidance clauses and water industry recommendations and interpretations.

Note 5: Special measures may have to be introduced to remove biocides from mains water supplied to renal dialysis units. See guidance produced by the Renal Association and SHTM 04-01 Part D and SHTM 04-Part E.

General requirements

- 3.14. Where new healthcare premises are planned or existing premises are to be altered or refurbished, the healthcare organisations WSG should be consulted at the earliest possible opportunity to ensure the safe delivery and use of water which always reflects the patient's requirements. Where deemed appropriate a multidisciplinary Project Water Safety Group (PWSG) should be established, reporting to the healthcare organisations WSG, who will be responsible for the creation of the Project Water Safety Plan (WSP). This will enable the total water hygiene requirements to be assessed in the planning stages, and appropriate action taken, including ensuring that any pressure testing, flushing and cleaning does not lead to stagnation or contamination before being placed into service. Risk assessments should be completed at each stage of the project and be signed off by the WSG prior to moving to the next stage. To inform this risk assessment it is importance to ensure that all those involved before the tender specification stage understand the need that the specification and procurement of materials. This includes understanding the adverse effects on water safety as a result of incompatible materials, including the potential for galvanic corrosion, the leaching of nutrients from plastic products, the incorrect use of jointing compounds and the effects of water treatment chemicals resulting in corrosion of metals and deterioration of plastics used for pipework and components.
- 3.15. At all stages of the design, installation, and commissioning of new or extended water systems, the design team should liaise and consult with the local WSG and soft landings champion in a timely manner, giving consideration to incorporating all operational managements requirement contained in the SHTM suite of documents into their design. Each stage of the process, from concept to handover and beyond, should be risk assessed by taking account of the susceptibility of the patient group. The hazard analysis and critical control point (HACCP) principles of risk assessment should be used, and effective barriers put in place to prevent harm.

- 3.16. A staged process, following Royal Institute of British Architects (RIBA)/ Building Services Research and Information Association (BSRIA) guidance, should be adopted and as each project progresses the PWSG should review the project risk assessment in order to validate and monitor the effectiveness and performance of control the measures. Where necessary, the Project WSP should be updated to ensure the barriers and controls remain effective to prevent harm before progression to the next stage. This will ensure the focus remains on patient safety as the primary aim throughout the project, thereby avoiding expensive downstream costs and patient harm, before progression to the next stage.
- 3.17. Design teams and installers of hot and cold water distribution systems are required by the Water Supply (Water Fittings) (Scotland) Byelaws 2014 to notify the water undertaker of any proposed installation of water fittings and to have the water undertakers' consent before installation commences. It is a criminal offence to install or use water fittings without their prior consent. Liaison with the local water undertaker is strongly recommended at an early stage to avoid problems of compliance in the design.
- 3.18. All water fittings used in the construction of systems referred to in this SHTM must comply with the requirements of the Water Supply (Water Fittings) (Scotland) Byelaws 2014 "4. Requirements for water fittings" and if required be in accordance with relevant British Standards (BSs) and codes of practice appropriate to their use.
- 3.19. The Healthcare Organisation and their supply chain must ensure that the competence of all parties is considered at the point of their introduction and on an ongoing basis. The philosophies that are included in the HSE Industry guidance leaflet INDG368 (current revision), "Using Contractors" should be adopted. In addition, the outputs from the "Setting the Bar" report should be adopted as they are introduced through legislation. Evidence that the recommendations of "Setting the Bar" are being implemented in advance of the legislation would be considered to be good practice, particularly for high-risk buildings. BSI Flex 8670 "Built environment. Core criteria for building safety in competence frameworks. Code of practice" should also form part of the project planning.

- 3.20. Where water is required to be wholesome, all non-metallic materials in contact with water should comply with the requirements of BS 6920. Many of the materials satisfactorily tested against this standard are listed by WRAS in the 'Water Fittings and Materials Directory' or by the Drinking Water Inspectorate (DWI) in their published 'List of Approved Products'. Some of these approval schemes also validate compliance against the mechanical performance requirements and where appropriate installation requirements set out in the Water Supply (Water Fittings) (Scotland) Byelaws 2014. These fittings are considered compliant provided they are installed according to any conditions given with the approval. Additionally, fittings approved by BuildCert, NSF-WRc, Kiwa Watertec (UK) and WRAS, unless they specifically state they are not approved for use under the Water Supply (Water Fittings) (Scotland) Byelaws 2014 are deemed to meet these requirements. Currently no criteria exist to verify metallic materials. Only materials and fittings shown to comply with these regulations should be used (for example, registered in one of the approval lists given above).

Note 6: Organic materials increase the risk of microbial colonisation; materials should be chosen to minimise the risk where possible (see Chapter 3). See also Safety Action Notice - SAN(SC)09/03 Flexible water supply hoses.

- 3.21. The provision of wholesome water to premises is governed by the Water (Scotland) Act 1980 and either the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (as amended 2017) or the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) depending on how the water is supplied. Preserving water quality within premises is governed by the Water Supply (Water Fittings) (Scotland) Byelaws 2014 (where water is supplied by a water undertaker), building regulations, approved codes of practice and technical standards intended to safeguard quality.
- 3.22. Only installers/ fitters with the appropriate qualifications, regulatory knowledge and competence should be used to install and maintain water installations. There are seven Approved Contractors' Schemes authorised through the Water Supply (Water Fittings) (Scotland) Byelaws 2014. All seven schemes require appropriate qualifications and knowledge of the regulations as part of their membership criteria. The seven schemes are:
- the Association of Plumbing and Heating Contractors (APHC)
 - the Chartered Institute of Plumbing and Heating Engineering (CIPHE)
 - the Scottish and Northern Ireland Plumbing Employers' Federation (SNIPEF)
 - Thames Water Approved Plumbing Scheme (TAPS)
 - WaterMark
 - the Water Industry Approved Plumbers' Scheme (WIAPS)

- 3.23. In addition to plumbing installers, four schemes (APLUS, TAPS, WaterMark and WIAPS) operate sector memberships for specialist areas of work covering external water services (below ground pipework and so on), catering equipment and POU (chilled water) equipment. If installing water coolers, consider using contractors who are members of the Water Dispenser and Hydration Association (WCA).
- 3.24. The WaterSafe register holds details from all seven Approved Contractors' Schemes for businesses who have registered and qualified plumbing installers.
- 3.25. A recognised benefit to using an Approved Contractor (including sector installers) is they can carry out some work without the need to provide advanced notification to the water undertaker, and their work will be certified upon completion. A "work completed" certificate issued by a WaterSafe recognised plumber provides a defence for property owners who are challenged by a water undertaker enforcing the Water Supply (Water Fittings) (Scotland) Byelaws 2014 or during legal proceedings.
- 3.26. Installers, (estates or contractors) should adopt practices, supported by document risk assessment and agreed method statements, which reduce the likelihood of cross-contamination from tools, clothing, or the environment. Separate clothing and tools used for other non- wholesome services such as sewerage and drainage systems should be kept separate and not used when working on hot and cold water systems. The cleaning of tools should be in-line with manufacturers recommendations (when possible) and in line with the PWSP/ WSP. Only components (fittings, pipework and other items of the water system) supplied with certification to confirm they will not affect the water hygiene quality or safety and that they have not been pressure or leak tested by the manufacturer with water (pneumatic testing is the preference, if not, sterile grade water testing of component can take place and products must have been suitably dried) should be used, as noted in BS 8680. Alternative safety measures are being explored by manufacturers. Healthcare organisations should discuss what options may be available for WSG discussions.
- 3.27. Good working practices should be developed and monitored:
- to ensure that flushing and disinfection processes remain effective
 - to reduce the risk of seeding a system with anything that could lead to physical, chemical, or microbiological contamination
 - to reduce any damaging effects of the disinfection process through the need for multiple disinfection treatments
 - pressure testing with gases

- 3.28. Only components and sub-assemblies that have been hygienically stored (for example, wrapped in bags and or original packaging) should be used. All components and sub-assemblies should be inspected before installation to ensure they are clean and free of defect. Efforts should be made to ensure debris and or contamination do not enter the hot and cold systems during construction and maintenance works.
- 3.29. Where contamination is suspected, measures should be undertaken to neutralise their effects (for example, flushing and disinfecting). Any components where contamination is confirmed should be rejected prior to installation and removed from site in agreement with the PWSG/ WSG.

Storage

- 3.30. Items and components intended for installation into or to be used to aid the installation of hot and cold water systems should arrive in sealed bags or in the instance of pipework arrive with the ends capped, these should subsequently be stored in clean, dry locations. Pipework, valves and fittings etc should be stored on suitable racking and not on the floor. Larger items of plant that may have to be offloaded from delivery vehicles and delivered directly to their final location should be appropriately covered and protected from damage.

Mobile Facilities

- 3.31. Mobile medical units are used to provide a range of portable services including dental treatment, delivery of vaccination programmes, magnetic resonance imaging (MRI) and computerized tomography (CT) diagnostics, endoscopy services and decontamination. Mobile units equipped with water services can present a significant risk to some of the patient groups using the facilities. It is important that the providers of mobile medical units have considered the specific risks associated with water systems which may be infrequently used. Staff managing the water systems should also understand the risks associated with filling, draining and when necessary, disinfection of the water systems between applications. The healthcare organisation should undertake their own risk assessment of the water systems to identify any potential issues and to understand what maintenance and monitoring is required, details of which should be added to the written scheme of control with updates given at WSG meetings.
- 3.32. Hoses used for filling of remote equipment or mobile units should be of materials suitable for use with wholesome water systems and should be drained, dried and capped between uses and stored in cool dry conditions. They should be disinfected before use in a method agreed by the Healthcare Organisations WSG.

- 3.33. A suitable device should be used to prevent backflow from the mobile unit and shall be appropriate to the highest applicable fluid category to which the fitting is subject downstream before the next such device.

Modular healthcare buildings (constructed offsite)

- 3.34. Healthcare organisations should seek documented assurance from principal contractors that modular building water services and above ground drainage installations are fully compliant with all technical memorandum, British Standards and Health and Safety guidance. The healthcare organisations should ensure that modular component designers and installers are competent to work on healthcare buildings. If modules are tested prior to delivery to site, the principal contractor should provide details of the methodology used for testing, and evidence (factory acceptance test (FAT)) that those conducting the tests are competent to do so.
- 3.35. An FAT from the manufacturer will verify that the modular building components fulfil both their design requirements and operational specifications before they reach the healthcare construction site. Wet testing should not be undertaken prior to the filling of the system on site to avoid the potential of introducing pathogens to the system. Sections/ components should be sealed to avoid contamination. The same training requirements for water safety apply to those in a factory assembling modular components.

Water hygiene training

- 3.36. It is important that any person who works on hot and cold water systems or who is responsible for cleaning water outlets should have completed a water hygiene training course, so they understand:
- the need for good hygiene when working with water distribution systems and water outlets
 - how they can prevent contamination of the water supply and outlets

Note 7: For new builds and refurbishments, it will be the contractor's responsibility to ensure that all operatives intending to work on the water system have completed water hygiene training covering associated risks of working practices and local requirements.

- 3.37. To ensure the delivery of safe wholesome water at all outlets and prevent contamination which may lead to a healthcare-associated infection, it is recommended that healthcare organisations implement a water hygiene training scheme which utilises local content where possible and the information is appropriate for the target audience.

- 3.38. Consideration should also be given to integrating a health screening element into the training to help ensure those undergoing the training are not carriers of any waterborne diseases on the date of training and are aware of the risks from those carrying waterborne diseases and their responsibilities towards the water supply. It is important that individuals are aware of their duty to protect the health of patients, staff and visitors and that they are responsible for ensuring they inform their line manager if they come into contact with any disease that has the potential to cause harm.
- 3.39. As an example, the course should encompass the following topics (not exhaustive):
- organisational governance arrangements in relation to water hygiene and safety
 - familiarisation with local policies/ procedures in relation to the management and provision of water hygiene and safety
 - information on prominent waterborne pathogens and their consequences
 - the ways in which water distribution systems and water outlets can become contaminated
 - the responsibilities of individuals to prevent the contamination of the water distribution system and water outlets and assisting in ensuring control measures in place are effective
 - how the safety of water can be maintained by good hygiene practices
 - system design
 - components/ accessories (such as taps, Thermostatic Mixing Valves (TMVs))
 - disinfection and cleaning equipment/ materials
 - how to store and handle pipes
 - organisation-specific control measures
 - the impact of getting it wrong
 - role of persons being trained
 - personal hygiene along with dealing with clothing, footwear, cleaning equipment/ materials, tools and storage when considering water hygiene (as applicable to each role)

Areas this SHTM does not cover

- 3.40. Although many of this SHTM's recommendations will be applicable, it does not set out to cover water supply for fire-fighting services nor water supply for industrial or other specialist purposes, other than to indicate precautions that should be taken when these are used in association with domestic water services. The point at which a domestic activity becomes an industrial process has not been defined, and the applicability will need to be considered in each case by the Healthcare Organisations WSG.

- 3.41. This SHTM does not cover wet cooling systems such as cooling towers. Guidance on these systems is given in HSE's ACOP and guidance 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)' and HSG274 technical guidance Part 1.

Draft for Consultation

4. Source of supply

General

- 4.1. The source of water supply to healthcare premises is by one or more service-pipe connections from the mains of a water undertaker. If the quantity and rate of flow is inadequate, or if the cost of providing the service connection appears to be uneconomical, alternative sources of supply such as boreholes or wells may be investigated, or other water undertakers may be contacted.
- 4.2. The healthcare building needs could be met by using a private supply (see the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (as amended 2017) as an additional source to the water undertaker's supply provided the risk to health is fully assessed and the supply deemed acceptable for its intended purpose. In such cases, the water undertaker's supply should be the priority supply for drinking, culinary and special hygienic services. Supplies from a private supply should convey water through an entirely separate pipework system that is clearly labelled. Outlets served by the supply system should also be appropriately labelled.

Note 8: With regard to private water supplies, further guidance is given on the Drinking Water Quality Regulator (DWQR) website.

- 4.3. Provision should be included for alternative water supply arrangements to meet an emergency, regardless of the source or sources of supply finally adopted (see Scottish Health Planning Note (SHPN) 00-07: Resilience planning for the healthcare estate).
- 4.4. Alternative arrangements would include a second service connection from the water undertaker or a private supply. In either case the alternative supply should not be vulnerable to the cause of loss of the original supply. Direct physical interconnection of pipework and valves of a water undertaker's supply with any private supply without adequate backflow protection is prohibited by the Water Supply (Water Fittings) (Scotland) Byelaws 2014.
- 4.5. It is essential that the water quality requirements applicable to the main supply are applied also to any alternative supplies.
- 4.6. The water undertaker and local authority must be advised if it is proposed to use any private supply as well as the water undertaker's supply, and advice should be sought on the limitations imposed in respect of break cisterns/ reduced pressure zone (RPZ) valves and interconnections thereafter as required by the Water Supply (Water Fittings) (Scotland) Byelaws 2014.

- 4.7. In Scotland all water intended for human consumption is required by legislation to comply with the quality standards laid down in the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) and the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017. These regulations apply to water sampled at the point where the water is available for use and embrace not just drinking water and water used for washing, but also water used in the preparation of food and beverages.
- 4.8. The responsibility for enforcing the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) rests primarily with the DWQR and for private supplies it rests with the local authority. In respect of public water supplies, the water undertaker has a duty to provide water that is wholesome at the point of supply to premises and to demonstrate - by monitoring - that the supplies meet the above standards. Water undertakers are also required to carry out risk assessments of each of its treatment works and connected supply in order to establish whether there is a significant risk of supplying water that would constitute a risk to human health. Using a risk-based approach, local authorities have a duty to monitor public health and in particular where affected by water supplies.

Supplies from a water undertaker

- 4.9. The following factors should be taken into consideration in the initial stages of the design:
- A.** the water undertaker's requirements
 - B.** water supply quality variations
 - C.** the pH of the supply water
 - D.** the type of disinfectant residual and the variability in its concentration
 - E.** maintaining water supplies in an emergency (see paragraph 2.16)
 - F.** the estimated daily consumption, and the maximum and average flows required, together with the estimated time of peak flow
 - G.** the location of the available supply
 - H.** the quality, quantity and pressure required
 - I.** the cold-water storage capacity required; the likelihood of ground subsidence due to mining activities or any other reason
 - J.** the likelihood of there being any contaminated land on site
 - K.** the proposed method of storage and probable number and purpose of direct connections to pressure mains
 - L.** the minimum and maximum pressures available at the service connection
 - M.** details of the physical, chemical (including radionuclides) and microbiological characteristics of the water supply and scope of any possible variations in such characteristics
 - N.** the possibility of an alternative service connection from some other part of the water undertaker's network, including pressure details

- O. the water undertaker's contingency plans, which may result in disruptions to the quality or quantity of water supplied (such as water bowser to top up tank and bottled drinking water)
- P. the proximity of the supply pipework to wastewater pipes and the materials used for the supply pipework (plastic pipework is permeable to oil-based leaks such as diesels)

Note 9: Regulations require notification to the water undertaker of any proposed changes and additions to the water supply system in the premises. Prior to making any changes, a risk assessment should be carried out and audited as detailed in Part B. Further details can be found on the WaterRegsUK website.

- 4.10. These initial water source design feasibility studies should normally reveal the need for any further treatment, pressurisation, and storage of the water undertaker's supply to meet healthcare building requirements and enable an estimate of costs to be made.
- 4.11. British Standards (BS) EN 805, BS EN 806-1-5 and BS 8558 give further guidance on the procedures that should be followed when carrying out preliminary investigations in relation to new water supplies.
- 4.12. During the design stage, close collaboration with the water undertaker should be maintained, and consent must be sought on the final arrangements before proceeding with the installation. These arrangements should include:
 - siting of service connections, access chambers, metering, bypassing, flushing out, physical security of service connections, installation and provisions for the fire-and-rescue service and proximity to wastewater pipework
 - compliance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014. To ensure that compliance will be achieved, notification shall formally be lodged in accordance with byelaw 5 and a Water Byelaw compliance check should be carried out on the design. It is recommended that the design compliance check is carried out by a Licensed Plumber (registered under the "WaterSafe" scheme)

Water supply quality variations

- 4.13. At different times of year or if an emergency affects a regular source of supply, water suppliers may use different sources of water to maintain supplies to an area, either separately or in combination by blending. While all the supplies will be wholesome and will meet the water quality standards set out in the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017), the chemical composition of the water may vary.

- 4.14. One of the more common variations is in the hardness of the water, which is determined by the geology of the area from which the supply originates. By altering the source of the supply to an area, it is possible for the water to change from soft (for example total hardness of 50 milligrams per litre (mg/L) as calcium carbonate (CaCO₃)) to hard (greater than 200 mg/L) or vice versa, causing users to notice differences with scaling in heating appliances, central heating, and steam-raising plant, and with soap or detergent usage.
- 4.15. Water undertakers often access a variety of sources, which means that other possible changes may include temperature, taste or odour where the source changes between surface waters (such as rivers or reservoirs) and underground waters (such as borehole supplies).
- 4.16. Differences may arise in dissolved iron, manganese or aluminium concentration and in the chlorine, residual maintained in different supplies.
- 4.17. Healthcare organisations should liaise with their water supplier to find out whether it is likely that the quality of the water supplied may vary, either due to planned operational changes to the water sources used at different times of year, or in the event of an emergency that prevents the use of the regular source of supply (see SHPN 00-07 - 'Resilience Planning for the healthcare estate'). Where changes in the nature of supplies may be expected regularly, provision of water treatment facilities may be required within the healthcare facility to prevent complications occurring, such as scaling in central heating equipment, interference with sensitive medical equipment or adverse reaction from users.
- 4.18. Healthcare organisations should be aware of the type of disinfectant residual in the supply to their premises as it can have implications for choice of additional treatment. Under certain conditions, some water companies may also alternate the residual levels and type of disinfectant used (for example, chlorine and chloramine) between winter and summer. It is recommended that the healthcare organisation makes enquiries regarding the type of disinfectant currently used in the water supply, including details of any residual disinfectant levels and variations in concentration within the supply.

Maintaining water supplies in an emergency

- 4.19. Scottish Water supplies every Healthcare Organisation with a hospital water emergency plan. This plan should be developed to ensure that essential supplies of water are maintained in the event of loss of water supplies.

The **purpose** of this emergency plan is to:

- ensure that a framework is provided to secure communications and provide a co-ordinated response to minimise disruption to the hospital in the event of the normal water supply becoming restricted or non-operational for whatever reasons
- outline the actions to be taken quickly to establish temporary water supplies

- highlight the Roles and Responsibilities of participating agencies
- identify the notification procedures of participating agencies
- describe the plans relationship with departmental arrangements
- ensure that all sources of supply are considered (for example where independent supplies are provided for dialysis)

The **aims** of the plan are to:

- ensure temporary water supplies when required are provided in accordance with the relevant guidance/ legislation such as emergency measures
- ensure a timeous and effective response to mitigate the emergency scenario and allow the hospital to function

4.20. As part of the design process the requirements of contingency planning should be an integral part of the design and discussed between the design team/ estates team and clinical team as to the proposed resilience method.

These should include:

- the routine provision of public water supplies to the site from more than one water main, preferably using mains that are fed from different water supply zones. Where mains are fed from different zones, particular care should be taken within the site to prevent direct interconnection and backflow between plumbing systems fed from the different supply zones

Note 10: any arrangements designed-in should ensure there are no areas where water can stagnate (for example, dead-legs).

- adequate storage cistern capacity and distribution arrangements within the healthcare facility to provide minimum volumes of water at the outset of a major incident to maintain hygiene and health for an initial period until other temporary arrangements can be introduced
- the provision of facilities to connect to, and distribute water from, temporary storage cisterns at key locations within the site. Ground-level storage cisterns will require provision of booster pumps to either lift the water to existing storage cisterns or to distribute it directly through existing or temporary-site water mains
- the provision of connection points to existing storage cisterns at suitable locations for delivery of emergency supplies of water, for example from tankers. The emergency fill pipe valve arrangement should comply with the local water undertakers design requirements. Consideration should be given to how the emergency fill pipe is maintained so as not to create a water hygiene concern when used

- suitable distribution points for bottled water should be considered in the design process. This should work in conjunction with plans for the supply and distribution of bottled water for drinking to vulnerable patients and those unable to collect supplies from distribution points within the healthcare facility

Note 11: Planning of the scheme must consider the relationship of the parking space for a tanker to the emergency fill point (a maximum distance will apply). As part of the contingency planning meeting with the supplier, the limitations of tanker-based water delivery will be highlighted, and suitable alternative arrangements will be discussed and agreed upon. It must also consider the arrangements, which are required to disinfect any emergency fill pipework prior to use.

Private supplies

- 4.21. Private supplies independent of the statutory water authority are also governed by the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) and the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (as amended 2017).
- 4.22. A license is required from the Scottish Environment Protection Agency (SEPA) before embarking on any private water supply scheme. If, for any reasons of back-up or security of supply, there is a connection to the public supply (regardless of whether, or how often, it is used), the installations must comply with Water Supply (Water Fittings) (Scotland) Byelaws 2014. Private supplies should be registered with the statutory water authority that has the responsibility to monitor the wholesomeness of the supplies where these are used for domestic or food production purposes.
- 4.23. The standards for private water supply quality are very similar to those for public supplies. Reference should also be made to the Standing Committee of Analysts' (2002) 'The microbiology of drinking water'.
- 4.24. SEPA keeps records and maps of all known sources of private water supply together with details of the geological strata and water-bearing characteristics of the area under its control.
- 4.25. The feasibility of such a private supply should be decided by comparing the capital costs (of the construction of works, including mains, pumping plant and treatment plant) and revenue costs (of electricity for pumping, water treatment chemicals, direct and indirect maintenance and associated management costs, including regular water analysis tests) with the long-term cost of water supply from the water authority over the predicted life-cycle of the installation. Due consideration should be given to the long-term costs of a private supply, and account should be taken of potential deterioration in water quality and/ or capacity of the private supply source.

- 4.26. Where consideration is being given to the use of a private supply, specialist assistance should be sought to:
- confirm the long-term availability of water in sufficient quantity, which is either of proper quality or suitable for treatment
 - confirm the long-term quality of water and define requirements for water treatment
 - design and specify the works needed

Other sources of supply

- 4.27. Greywater and rainwater should not be collected for use on, or in, healthcare premises, Scottish Health Technical Memorandum (SHTM) 04-02 Part A to C have now been archived.

5. Materials of construction

Introduction

- 5.1. Any materials that come into contact with the water in a hot and cold water installation must comply with the requirements of the Water Supply (Water Fittings) (Scotland) Byelaws 2014. To demonstrate compliance with these regulations, all non-metallic materials in contact with water should comply with the requirements of British Standard (BS) 6920. A number of lists exist for products and materials that have been assessed for compliance with the requirements and regulations. Further information on the selection of materials can be found in BS EN 805, BS EN 806-2, BS 8558 and BS 6920-1.
- 5.2. Materials of construction should be selected to take account of water quality and its potential corrosive properties. The water undertaker should be asked to provide details of any specific requirements and variability from standard conditions.

Note 12: Consideration needs to be given to substances that may be present in many rubber compounds and are also occasionally associated with non-metallic materials such as plasticised (softened) plastics, which can provide nutrients for *pseudomonas aeruginosa* growth. Most non-metallic materials meeting the full requirements of BS 6920-1 should not enhance microbial growth. Where oxidising chemicals are used, they may exacerbate leaching.

- 5.3. Water supplied by the water undertaker, although remaining wholesome, will nevertheless differ chemically. Some water supplies are slightly acidic while others are slightly alkaline, and this affects the choice of materials for pipes, fittings, and cisterns. The water undertaker also blends water and, accordingly, the character of the water supply may vary from time-to-time. It will therefore be necessary to consult the water undertaker for advice on what materials should be avoided.
- 5.4. The choice of materials for piping and fittings should also consider the nature of the soil in which the piping is to be laid. The materials selected should, where necessary, resist possible corrosion both inside and outside. The extent, if any, of anti-corrosion treatment of the outside of the piping will depend on the analysis of the soil. The advice of the water undertaker should be sought on the protective measures usually adopted in the area. Reference to the results of a site investigation report may also assist.

- 5.5. Corrosion (or erosion) can be caused by the motion of water when it is in a turbulent state and thus subject to rapid changes in pressure. At moments of low pressure, minute vapour or gas bubbles may be released which collapse with implosive force the moment the pressure is increased. The collapse of such bubbles on a metallic or concrete surface will quickly cause deep pitting or erosion of that surface. The design team should therefore avoid high velocities, the sudden increase of pressures or pulsating pressures.

Note 13: An example of this being where one or more delayed action ball valves may open to fill a tank.

- 5.6. Metallic piping should not be installed in contact with corrosive building products and materials.
- 5.7. If not advised by the Estates team, the design team as part of their duties should visit any existing site for refurbishment or extension works to ascertain the pipework materials for connection into, this will ensure galvanic action will be unlikely to occur during the lifespan of these works. Corrosion may result from galvanic action where dissimilar metals are connected. Dissimilar metals should therefore be avoided as far as practicable, but if that is not possible, it should be determined that deterioration through galvanic action is unlikely to occur, or effective measures should be taken to avoid deterioration.
- 5.8. The materials generally used for the conveyance of water in healthcare premises are copper, stainless steel and plastics (see Scottish Health Technical Memorandum (SHTM) 04-01 Part E for further information). Lead is no longer allowed under the Water Supply (Water Fittings) (Scotland) Byelaws for pipework or solders. Lead-free solders only should be used.
- 5.9. Substances leached from materials of construction of pipes, cisterns or other water fittings in contact with water must not adversely affect the quality of water stored or drawn for domestic or food-production purposes (the Water Supply (Water Fittings) (Scotland) Byelaws 2014).
- 5.10. Direct gas-fired water heaters are particularly prone to corrosion and scale formation, and the inside of these heaters should be provided with suitable linings to limit these effects.

Steel pipes and fittings

- 5.11. Where steel is used for bolts, nuts and slip-on couplings, adequate protection from corrosion should be provided. This usually takes the form of bitumen coating, but bitumen is not permitted in contact with water required to be wholesome (that is, to be used for normal domestic or food-production purposes).

Note 14: Any existing premises with steel (including low carbon steel or thin wall carbon steel), whether galvanised or not, pipework shall have this scheduled for early replacement.

Stainless Steel

- 5.12. Stainless steel is being increasingly used in hot and cold water service systems. Reference should be made to SHTM 04-01 Part E - Alternative materials and filtration, also the British Stainless Steel Association's (2002) 'Operational guidelines and code of practice for stainless steel products in drinking water supply'.

Copper pipes and copper/ copper alloy fittings

- 5.13. Copper in general is resistant to corrosion. Unless resistant to dezincification, brass fittings should not be used where water conveyed is capable of dissolving undue amounts of zinc from the fitting. External protection from corrosion for buried pipework may be obtained by using copper tube with a factory-applied polythene sheath. Dezincification-resistant material should be used for fittings that are concealed or inaccessible, for backflow prevention devices, and for temperature and pressure-relief devices on heating systems. Copper piping should conform to BS EN 1057 as appropriate for underground or above-ground installations. Copper is only used in exceptional circumstances such as, an extension to existing premises with short life expectancy, or very small stand-alone premises, a materials risk assessment will help inform the appropriate materials to be used.
- 5.14. Fittings should comply with the requirements of BS EN 1254-1-6. Copper piping may be joined by means of compression joints or capillary joints or push-to-connect fittings made from copper or copper alloys. Effective capillary joints in copper pipes can be achieved if care is taken in their construction. For underground use, when using fully annealed copper piping, the fittings should be a manipulative joint.
- 5.15. Lead-free materials should be used in the formation of all wholesome water pipe capillary joints.

Solder and flux

- 5.16. When soldering copper tube and fittings, refer to Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-02 – 'Solder and fluxes' (see also paragraph 7.2 on the prohibition of lead solder). If wax-based soldering flux is used, it should be used sparingly and be compliant with BS 6920. It poses a risk of bacterial contamination to the system, which can be difficult to eradicate.

Plastics

- 5.17. Most water systems operate at modest pressures and at a maximum temperature of 70°C. Such operating conditions are within the specified performance of plastics being produced in a range of sizes and costs suitable for healthcare premises. Most ranges of plastic pipework are not suitable for renal dialysis applications, where water at a temperature of 95°C is regularly circulated for sanitation and there is an incompatibility with reverse osmosis (RO) - treated water used in renal dialysis.
- 5.18. Advantages of plastic include corrosion resistance, lightness of weight, ease of handling and fully weldable systems.
- 5.19. Disadvantages include poorer mechanical strengths than metals, greater thermal expansion (about seven times that of copper), low temperature and shorter distances between pipe supports. The latter can be alleviated by employing the manufacturer's longitudinal tray that extends the distance between supports. Plastic pipework may leach plasticisers which can support microbial growth including of *pseudomonas aeruginosa*. It can also be adversely affected by biocide use resulting in hardening and cracking. The compatibility of the supply water disinfectant - including its concentration range, final disinfection parameters, and contact time - should be confirmed with the manufacturer, along with any planned use of secondary disinfection methods.
- 5.20. Materials in common use for plastic pipework are medium-density and high-density polyethylene, the latter being stronger. Unplasticised polyvinyl chloride (uPVC) pipework has mainly been replaced by the stronger chlorinated polyvinyl chloride (PVC-C). Polyvinyl chloride (PVC) pipes to BS 3505, BS EN 1452 (parts 1–5) and BS 3506 are of a rigid material that has a greater tensile strength than polyethylene but is less resistant to fracture. These materials are less susceptible to frost damage than metal pipes. Although freezing is unlikely to damage the pipe, it will result in interruption of supply, and subsequent leakage from joints may occur.
- 5.21. Polyethylene pipes are generally not susceptible to corrosion from either the water or the ground in which they are laid. However, they are not recommended in any soils contaminated with organic materials likely to permeate the plastics and taint the water such as coal gas, methane, oils, petrol, or other organic solvents. However, plastics pipes incorporating a protective barrier (barrier pipes) may be used if tested to Water Industry Specification (WIS) 4-32-19 - 'Polyethylene pressure pipe systems with an aluminium barrier layer for potable water supply in contaminated land'.

Further advice is available from the report by UK Water Industry Research (UKWIR) "Guidance for the selection of water supply pipes to be used in brownfield sites"

- 5.22. It is essential to consider the locality of exposed plastic pipes to ensure that there is no likelihood of mechanical damage and effects of ultraviolet (UV) light; otherwise, suitable protection around the pipe will be necessary. Plastic piping should be adequately supported and incorporate adequate means of accommodating expansion, bearing in mind that plastic pipes have a much greater coefficient of thermal expansion than metal pipes.
- 5.23. Methods of jointing employed include compression joints with insert liners, flanged, screwed and fusion-welded joints, as well as joints of the spigot and socket type. The method of jointing employed is dependent on the bore of the pipe and the applied internal pressure and should be in accordance with the manufacturer's recommendations. A competent fitter who has been trained under an approved scheme should make joints.
- 5.24. Manufacturers tailor plastics used in pipes and fittings for specific applications and factors such as pressure, temperature, and life-cycle analysis, which consider specific water qualities inclusive of oxidation levels.
- 5.25. Manufacturers recommendations should be strictly followed when selecting appropriate pipes and fittings for a particular application. Assumptions should not be made that a pipe/ fitting suitable for one application can be used in any application. Pipework materials may have limitations. For example, pressure requirements or the suitability for cold water use may not mean it has been designed and tested for hot water use; equally suitability for one high temperature application may not be suitable for another high temperature application. Incorrect selection may not be covered by the manufacturer's warranties and may result in shortened service life. Additional information can be found in SHTM 04-01 Part E Alternative Materials and Filtration.

Multi-layer pipes

- 5.26. Multi-layer pipes are becoming more available and may consist of plastics or metal layers, for example aluminium pipe with an external and internal sheath of plastic. BS EN ISO 21003 should be used to demonstrate the performance of such pipes and fittings before considering their selection.

Iron pipes and fittings

- 5.27. Ductile iron is little used nowadays, but it may be encountered during a refurbishment project or in areas of hostile soil conditions. Cast-iron has good resistance to corrosion, and this is further enhanced if the casting skin on the metal is still intact. Although ductile iron pipes are thinner than grey iron pipes, their resistance to corrosion is at least as good, and there is evidence that they tend to be more resistant. In assessing the life expectancy of ductile iron pipelines, account should be taken of any intended higher operating pressures that may be used or permitted.

- 5.28. In made ground containing ashes and clinker, or in certain natural soils such as aggressive waterlogged clays, and saline and peat marshes, additional external protection may be required. Where iron pipes are encountered and are to remain in use, the internal surfaces must be carefully examined to confirm the presence and integrity of protective linings. This may be provided using protective coatings such as bitumen or coal-tar sheathing, by protective tapes, by loose polythene sleeving or, in certain circumstances, by concrete. Water undertakers are using more composite materials in pipework to overcome the risks.

Lead

- 5.29. The Water Supply (Water Fittings) (Scotland) Byelaws 2014 prohibits the use of lead in wholesome and domestic water systems. No new lead piping or lead solder should be installed or used in any building. In the unlikely event of any lead pipework being discovered in existing healthcare premises, it should be removed as soon as practicable.

Concrete

- 5.30. Protection of concrete pipes may be required against sulphate and acid attack. The minimum size available in concrete pipework is 150 mm diameter, and therefore its practical use for healthcare premises is very limited.
- 5.31. Standard concrete pipes may be used when not subjected to internal pressure. Pre-stressed concrete pipes are available as pressure pipes, but only in larger sizes.

Asbestos cement pipes and fittings

- 5.32. Asbestos cement (AC) pipes were used extensively for water supply and wastewater networks from the 1920s to the 1980s. The use of new AC pipes has been banned in the UK since 2000, because of the risks associated with asbestos.
- 5.33. There may be AC pipes within healthcare sites when AC pipes are identified as part of a refurbishment they should be replaced. The pipework that is removed shall be treated as a special waste. Specialist advice should be sought if work on materials containing, or suspected of containing, asbestos is to be carried out. The Control of Asbestos Regulations 2012 will apply.

Flexible water supply hoses

- 5.34. Flexible hoses (also known as tails) have become a convenient method of connection between hard pipework and sanitary fittings and/ or equipment. They typically comprise a steel-braided outer sheath with a synthetic lining.

- 5.35. There have been reports of high counts of *Pseudomonas* and *Legionella* in water samples taken from outlets fed by flexible lined hoses due to colonisation of the lining. Materials such as ethylene propylene diene monomer (EPDM) rubber may be susceptible to microbial colonisation. Such flexible connections should therefore only be used in healthcare premises where an installation must move during operation or is subject to vibration, otherwise rigid pipe connections shall be made.
- 5.36. Where the installation does have to move during operation or there are vibration issues alternative linings should be considered (not EPDM). New lining materials are now available such as polyethylene (PE), cross-linked polyethylene (PEX), linear low-density polyethylene (LLDPE) and post-chlorinated PVC (PVC-C), polytetrafluoroethylene (PTFE) and should be compliant with BS 6920.
- 5.37. Flexible hoses should be used only for the following applications:
- to allow for vibration of equipment
 - to accommodate vertical displacement of high and low baths and sinks
 - to facilitate essential maintenance and access of bespoke equipment when no alternative is available

Note 15: Where fitted, flexible hoses should be kept as short as possible, smooth bore and be kink-free so as to not affect flow. Flexible hoses details, including locations and outlets served should be included in the water safety risk register, or other location as agreed by the Healthcare Organisations Water Safety Groups (WSG). The condition of each flexible hose should be regularly checked and replaced if necessary.

- 5.38. When specifying the pipework materials, consideration should be given to the products limitations. Requests should be made to the manufacturer, or the reference made to the manufacturer's literature regarding (not an exhaustive list): pressure, temperature limitations, disinfection types and volumes for constant and shock dosing or temperature limitations with disinfection.

Cleanliness and hygiene

- 5.39. All pipes, fittings, valves, sub-assemblies, calorifiers, cisterns etc intended to form part of the hot and cold water service installation should be supplied to site cleaned, free from waterborne pathogens, particulate matter, and other residues. All items should be identified as intended for water supply services. Wet testing should not be undertaken as it may support the colonisation of waterborne pathogens (*pseudomonas aeruginosa*, Nontuberculous mycobacteria (NTM) and so on). It is important that transport and storage conditions ensure that system materials and components, including where systems are constructed off-site, are protected from ingress of water, nutrients and contamination. Poor

management, before and during installation, can lead to systemic colonisation which can remain a risk for the life cycle of the system and have the potential to cause serious infections in high-risk patient.

- 5.40. Pipes should be capped at both ends and wrapped in bundles and stored above ground level. Pipe joint fittings should be suitably bagged or capped and boxed. Larger items of plant such as pumps and calorifiers should have connections blanked with plugs or flanges.
- 5.41. As agreed by the WSG/ Project Water Safety Group (PWSG), leak-testing should be carried out using nitrogen or medical quality compressed air or oil-free dry compressed air, the pumps used should be clean and free from contamination. Assurance should be sought from the hiring company, where applicable, that the pumps will not cause a microbial risk of contamination to the water system. This must be carried out by competent personnel (see Health and Safety Executive's (HSE's) GS4 - 'Safety requirements for pressure testing'). Where water is used for test purposes, it should be supplied, as far as reasonably practicable, using potable water (especially in areas intended for augmented care/ high risk) through a Point Of Entry (POE) (0.2 micron) filtration to minimise the risk of microbial ingress during the filling process (no quick fill via fire systems or bypasses of POE control systems). For pre- assembled items such as bathroom pods, all moisture should be removed before being delivered to site and be packaged in such a way as to prevent contamination from waterborne pathogens during transport and storage.
- 5.42. Only components (fittings, pipework, and other items of the water system) supplied with certification should be used (see BS 8680). This certification will confirm they will not affect the water hygiene quality or safety and that have not been pressure or leak tested by the manufacturers with water (unless sterile water has been used).

6. Water treatment and control programmes for hot and cold water systems

General

- 6.1. Temperature is the preferred method of control for waterborne pathogens in hospital settings. When control of the microbiological safety of water systems cannot be achieved throughout the system by maintaining temperatures, additional control strategies should be considered to reduce microbiological contamination and the risk of waterborne infection. Commonly used strategies include the use of filtration, pasteurisation, or the use of biocides. Any biocide added to a water system should be dosed at the lowest concentration required to protect patient safety and ensure no undue exposure of individuals to harmful concentrations (refer to the Control of Substances Hazardous to Health (COSHH) Regulations 2002). Refer to Scottish Health Technical Memorandum (SHTM) Part D for further guidance on disinfection.
- 6.2. Some biocides require the system to be taken off-line before treatment; in these cases, users should take great care to ensure water cannot be drawn for bathing, food preparation or drinking until the treatment chemical has been completely flushed from the system. The Water Safety Groups (WSG) should ensure that measures are taken to protect vulnerable patients such as those in renal dialysis units.

Note 16: When building a new haemodialysis unit, a separate mains water supply should be considered so that other areas of the healthcare facility may be dosed without affecting the reverse osmosis (RO) plants. If this cannot be achieved and biocides are required, appropriately monitored control systems need to be in place.

- 6.3. A biocidal product for this purpose is defined as one which controls harmful or unwanted organisms within water systems. The Health and Safety Executive (HSE) regulates and approves the use of biocidal products that have been proven to be safe and effective for their intended uses. Within the EU, suppliers of active substances must be registered and as such there is a list of registered products and suppliers (Article 95 list). Within the UK, the HSE is the designated authority for overseeing [implementation of biocides](#).

- 6.4. The European Drinking Water Directive (98/83/EC), which is translated into the Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) and the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017 (as amended 2017) sets out additional separate requirements for products and substances that may affect water intended for human consumption. This ensures that treatment chemicals suitable for use in the preparation and distribution of drinking water have no adverse effects on the quality of water intended for human consumption. The Drinking Water Inspectorate (DWI) publishes a list of products approved for treatment of drinking water supplies.
- 6.5. The WSG should be satisfied that the design, specification and commissioning will enable the water treatment systems to achieve the required biocide concentrations throughout the system at all times to minimise microbial risk.
- 6.6. The impact of treated water on the materials and components of the existing system should be considered along with advice from the necessary suppliers and installers. Within a healthcare facility, the detrimental effects of biocidal treatment, such as corrosion of metal components and deterioration of plastics and elastomers, should be taken into consideration as biocide use may shorten the lifespan of particular components.
- 6.7. Where treatment systems produce a discharge as part of the process, an appropriate air break to the drain must be installed such as a type AA air gap or an air- break-to-drain device in accordance with British Standards (BS) EN 1717 clause 9.

Biocidal treatment

Note 17: Any biocidal treatment system should not adversely affect the materials of construction.

- 6.8. In addition to maintaining a temperature control regime, there may be occasions where additional biocidal treatment is required for the effective control of Legionella and other opportunistic waterborne pathogens. However, the selection of suitable treatment is complex and depends on a number of parameters, and the chosen biocide should be properly managed. This is particularly the case with cold water services compared with hot water services where, with the benefit of circulation, water is returned to the calorifier/water heater and is then pasteurised. However, it should be taken into consideration that effective concentrations of some biocides are difficult to achieve in hot water systems due to gassing off. For water intended for consumption, the biocide concentrations must not exceed prescribed concentrations for drinking water.

- 6.9. Where biocides are used to control microbial growth in water systems, as with the temperature regimen, meticulous control and monitoring programmes should be in place if they are to be effective. However, careful consideration should be given to any equipment that is connected to the water system that may be affected by the application of a biocide (for example, renal departments, haemodialysis units and neonatal units).
- 6.10. To meet legislative requirements, biocides used for water treatment must:
- contain an active substance approved for that use (subject to product-type) under the Biocidal Products Regulations (or be under review for the relevant product-type) and the biocidal product consisting of or containing that substance must be authorised for the product-type (subject to the transitional arrangements while the active substance review is ongoing)
 - be suitable for drinking-water use
- 6.11. The WSG should be actively involved in the decision-making process and should involve consultation with the water undertaker to ensure the suitability of biocidal products for their intended application.
- 6.12. There is no single water treatment regimen that is effective and appropriate in every case, and each system has both merits and limitations. The implementation of a biocide regimen together with maintaining temperature control requires constant vigilance to ensure the safety of particularly vulnerable patients in healthcare premises. For example, dedicated treatment and supply arrangements may be required for renal and haemodialysis units or for making up infant feeds where concentrations of biocides in the water would be harmful to patients.
- 6.13. Each water treatment system should be validated and monitored to demonstrate that the correct biocide concentration is being achieved for controlling microbial growth and does not exceed prescribed or guideline values under differing flow rates and water demands.
- 6.14. The frequency of biocide monitoring and verification, in addition to temperature monitoring, will depend on the treatment regimen selected. Each treatment system should have a failsafe mechanism to prevent overdosing while also ensuring that effective concentrations are maintained throughout the system. When a water system is being purged and is initially dosed, checks should be made at various system outlets to ensure that satisfactory concentrations of treatment chemicals are being achieved throughout the system. Automatic leak detection of the biocidal treatment system is also recommended for hazardous substances.
- 6.15. The effective concentrations of biocides used to treat water systems in highly colonised systems or during commissioning of new installations in healthcare domestic water systems may initially need to exceed the safe concentrations for human consumption as stated in water legislation and may make the water unwholesome. The biocidal treatment systems

used should be selected with care and must comply with the requirements of the Public Water Supplies (Scotland) Regulations 2014 and COSHH Regulations. Where there has been a requirement to provide biocides at concentrations above those permitted for drinking water approval, agreement should be sought from the WSG. In such circumstances the water system should be off-line and drinking-water outlets should be clearly labelled as unsuitable for ingestion (this includes the making up of neonatal feeds).

Chlorine dioxide

- 6.16. Chlorine dioxide is an oxidising biocide that can react with a wide range of organic substances and has been shown to be effective in the control of organisms in water systems. The safe in situ generation of chlorine dioxide as a chemical for drinking water treatment is subject to BS EN 12671. Chlorine- dioxide-generating equipment should be selected to ensure product efficacy of greater than 90% to provide the optimum performance for the minimisation of total oxidants.
- 6.17. The use of chlorine dioxide as a control measure will depend on the design of the systems in use and, in an existing system, its operational history. Where dosing units are installed, other Health & Safety concerns (such as the potential for gas escaping into plant areas) will need to be addressed. In practice this may incorporate the use of gas monitors with visual and audible alarms outside the plant area warning that access may not be safe without other controls. See also Health and Safety Guidance (HSG)274 Part 2. Monitoring of chlorine dioxide and chlorite levels should be considered by an alarm when levels are outside the allowed tolerances. Chlorine dioxide introduces an additional oxidising agent into water that has already been treated by the water undertaker - typically using oxidants such as sodium hypochlorite or monochloramine. While a concentration of 0.5 milligrams per litre (mg/L) of chlorine dioxide might be appropriate in cases where the source water is untreated (such as borehole supply), applying this dose to a hospital supply could result in the cumulative total oxidant concentration exceeding the DWI or Drinking Water Quality Regulator (DWQR) limit of 0.5 mg/L (of total oxidants).

Copper/ silver ionization

- 6.18. Ionisation is the term given to the continuous release, by electrolytic action, of copper and silver ions into water.
- 6.19. The Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) set a standard for copper of 2 mg/L, and this must not be exceeded.

Note 18: Currently the Drinking Water Directive does not include a prescribed concentration for silver, as there is insufficient toxicological data. The World Health Organization (WHO) (2011) states: “there is no adequate data with which to derive a health-based guideline value for silver in drinking water”. It continues: “special situations exist where silver may be used to maintain the bacteriological quality of drinking water [and] higher concentrations of up to 0.1 mg/L ... could be tolerated in such cases without risk to health”.

- 6.20. Copper/ silver ionisation requires soft water to prevent scaling of the electrodes, as maintaining adequate silver ion concentrations in hard water systems can be difficult because of scale build-up on the silver electrodes, potentially leading to the obstruction of copper and silver ion release. In addition, there have been cases of staining to sanitary ware in hard water areas. See also HSG274 Part 2.

Ozone and ultraviolet treatment

- 6.21. Whereas biocides dosed into the water are intended to be dispersive and will result in a biocide agent within the water system, ozone and ultraviolet (UV) (with appropriate pre-filtration) are intended to be effective close to the point of application. UV will only be active in waters of low turbidity and at the point where the water passes through the UV lamp housing. Ozone will only be effective very close to the point of application. Ozone and ultraviolet treatment will not ensure system control downstream in the hot and cold water service systems.

Other water treatments

- 6.22. A range of biocidal treatment systems are available, further advice on their use is given in HSG274 Part 2 and SHTM 04-01 Part D.

Point-of-use filtration

- 6.23. For pathogenic waterborne organisms including multi-drug-resistant strains, and in accordance with the organisation’s water safety plan (WSP), a documented risk assessment should be produced in order to determine whether sterilising-grade point-of-use (POU) filters should be installed or whether taps need to be changed (see American Standard Test Method (ASTM) F838-20 - ‘Determining bacteria retention of membrane filters utilised for liquid filtration’). Refer to National Infection Prevention and Control Manual (NIPCM) Chapter 4 for further guidance.
- 6.24. During design and installation, it is necessary to ensure that:
- POU filters comply with all appropriate regulations and meet EU legislation on the preparation of foodstuffs for infants and young children

- verification that the filter retains Nontuberculous mycobacteria (NTM) and other waterborne pathogens (0.2 µm absolute sterilising-grade filtration) over the claimed installation life of the product
- tap outlets have appropriate fittings for attachment of filters
- suitable filter retaining clips, or similar, are installed to prevent the unauthorised removal of the POU filter
- sufficient activity space between the filter outlet and the basin is provided so that an effective backflow prevention air gap (AUK3) is maintained, and hands can be comfortably washed without contaminating the body of the filter
- there are processes for comparisons of on-filter performance which take into account water quality effects: adverse impacts on water flow and therefore lifecycle where there is a risk of scale and particulates compatibility with water treatment regimens (for example all materials in the water flow pathway should be compatible with relevant biocides at both continuous and shock dosage levels and for the duration of installation filter life
- there is sufficient flow once a filter has been fitted to enable effective hand- washing but not produce excessive splashing
- the filters are changed at the intervals specified by the manufacturer with strict aseptic techniques being agreed by the Healthcare Organisations WSG for the changeover process to reduce the likelihood of cross contamination
- visual checks should be made when fitted to ensure there are no leaks from the connection
- the filter housings are inspected for cracks before fitting
- filter housings are cleaned following manufacturers protocols and the healthcare organisations agreed, documented, processes
- the WSG will evaluate the validation data for POU filters
- filters will not be refitted once removed, as per manufacturers guidelines

6.25. In systems with high particulates, a prefilter may be necessary to prevent shortened lifespan due to filters clogging.

7. Metal contamination

Introduction

- 7.1. If plumbing systems were installed before 1987 (in which lead pipes or lead-based solders are likely to have been used), it may be necessary to consult the water undertaker.
- 7.2. The Public Water Supplies (Scotland) Regulations 2014 (as amended 2017) set an upper concentration for lead in drinking water of 10 microgram per litre ($\mu\text{g/L}$). This value is likely to be exceeded if lead pipes are present or if copper pipes have been joined with solder containing lead. If drinking water contains more than 10 $\mu\text{g/L}$ of lead, remedial action should be taken. The use of lead solder is prohibited on all plumbing installations where water is required to be wholesome.
- 7.3. Copper concentrations above 1 milligram per litre (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 drinking water is 2 mg/L , most supplies will give a concentration at the tap of less than 1 mg/L .
- 7.4. Water supplies to certain specialist units such as maternity, neonatal paediatric, general paediatric and renal dialysis units (see the Renal Association guidelines) should be monitored to ensure that water quality is within acceptable limits (hydrogen peroxide disinfectants should not be used in dialysis units). The design team should seek toxicological advice to ascertain the exact water quality requirements for specialist units. Clinical leads should be consulted before disinfection of specialist service areas.
- 7.5. Where the water supply is known to have dissolved metals (for example, water with very low total dissolved solids (TDS)), regular sampling to determine the condition of the system should be carried out. Strategic sampling points should be selected to ascertain that the level of metal contamination (for example, the dissolution of lead solder in capillary joints) in the water distribution does not result in limits above the stated safe levels.
- 7.6. Elevated concentrations of copper can occur in copper pipework systems with:
- naturally acidic (low TDS) water supplies
 - base-exchange softening
 - poor control of oxidising biocides
 - poor control of copper/ silver ionisation
 - localised stagnation
- 7.7. In some areas with known aggressive water issues, it is normal to specify corrosion-resistant pipework materials such as stainless steel or plastic. These materials may also need to be considered for demineralised, fully deionised, and high purity water.

8. Water softening

Introduction

- 8.1. Hard waters are unsuitable for many industrial and domestic purposes. Treatment may therefore be necessary to remove or alter the constituents to render the water suitable for particular purposes and increase the effectiveness of control measures.
- 8.2. Hardness is due to calcium and magnesium salts in the water and is expressed in terms of milligrams per litre as calcium carbonate (CaCO₃). Temporary (carbonate) hardness is related to the bicarbonate salts of calcium and magnesium. Permanent (non-carbonate) hardness is related to the other salts of calcium and magnesium - chlorides, sulphates, nitrates and so on. The generally accepted classification of waters is shown in Table 8.1.

Table 8.1 - Classification of water hardness

Description	Milligrams per litre (mg/L as CaCO ₃)
Soft	0 to 50
Moderately soft	50 to 100
Slightly hard	100 to 150
Hard	200 to 300
Very Hard	Over 300

- 8.3. When the temperature of water is raised, the hardness will be reduced by some of the bicarbonate dissolved salts (temporary hardness) coming out of solution and forming solids in suspension, some of which will be deposited on heating surfaces to form an adherent limescale, thus reducing the heat-transfer rate. The tendency to form scale, and the morphology of that scale, is not just dependent on the hardness but also on the other chemical constituents of the water.

For this reason, scaling indexes such as Ryznar and Langelier combine various additional factors to assess the likelihood of scaling.

Note 19: Primary heating circuits that are filled/ topped up by water supplied directly from the water mains should be treated with a chemical corrosion inhibitor. Specialist advice is given in Building Services Research and Information Association's (BSRIA's) BG50 - 'Water treatment for closed systems. In exceptionally hard water areas, additional measures may be required.

- 8.4. The extent of treatment required to prevent scale formation will depend on the process for which the water is being heated; it may therefore be necessary to achieve one of the following conditions:
- A. replacement of calcium and magnesium salts by their more soluble sodium equivalents
 - B. removal of all salts (demineralisation)
 - C. where water of enhanced purity is required for specialised uses, it can be produced from softened water by reverse osmosis (RO) or by demineralisation
- 8.5. The most common water-softening process used for the protection of hot water calorifiers is base-exchange softening. This process removes permanent and temporary hardness from water. The technique uses an ion-exchange process in which the calcium and magnesium ions in solution are removed and replaced by sodium ions.
- Note 20: All water softeners must be installed with an appropriate backflow prevention device in accordance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014.

Where softeners discharge to a drain, they must have an appropriate air break to the drain installed such as a type AA or an air-break-to-drain device in accordance with British Standards (BS) EN 1717 clause 9.
- 8.6. Epidemiological studies have shown that the incidence of cardiovascular disease tends to be higher in areas with soft water supplies than in areas with hard water supplies. The association is clearest where the soft water supplies contain hardness below about 150 (as CaCO₃). The explanation is not known, but it is considered prudent, where possible, not to drink water that has been artificially softened to concentrations lower than this. Softened water may also tend to dissolve metals from pipes.
- 8.7. Water softeners containing ion-exchange resins may be subject to bacterial contamination if not adequately maintained in accordance with the manufacturer's instructions (these may also require periodic disinfection). Softeners using salt-regenerated ion-exchange resins increase the sodium content of the water during softening, and this may be undesirable for young children and infants (including the making up of babies' bottles) and anyone on strict salt restricted diets. These concerns can be avoided if water intended for drinking and cooking is not softened. Sample points before and after softeners can be used to indicate deterioration of water quality post softener.
- 8.8. Waters having a hardness of up to 400 mg/L have been used for public supplies without preliminary softening. While it is accepted that supplies for domestic purposes need not be softened, some water undertakers carry out partial softening.

- 8.9. The need for softened water in healthcare facilities for domestic purposes other than drinking and cooking should be considered on the merits of each case; if treatment is considered essential, the extent of softening should be the minimum to achieve an acceptable level. A generally acceptable range is between 80 and 150 mg/L, and not less than 60 mg/L, but this should not be taken as a requirement for healthcare facilities as it may be impracticable to achieve. The cost and difficulties of treatment may be prohibitive for certain waters if the hardness value is particularly high, and the content of magnesium is appreciable.
- 8.10. Scale deposition is a significant problem in pipework, reducing flow, efficiency and increasing the surface area for biofilm formation. In hard water areas, softening may well be needed to reduce risk. Generally, within healthcare premises, softening of a hard water supply may be required on feeds to the following:
- A.** steam boilers - to prevent sludge and limescale building up (see BS 2486)
 - B.** hot water services where outlets (particularly showers) are affected by limescale
 - C.** laundries - high maintenance costs and the uneconomic uses of soap or detergents are caused by the presence of hardness
- 8.11. Other water-softening methods include physical water conditioning and magnetic water conditioning.

9. Filtration

Introduction

- 9.1. Scottish Hospital Technical Note (SHTN) 2 (second edition) was published in December 1999, SHTN 2 then became Part E (2015) and revised as part of this 2024 Scottish Health Technical Memorandum (SHTM) suite. Its guidance reflected examinations at the time of domestic water systems in Scottish Hospitals where water had been supplied by the water supply authorities who used chlorine as a disinfecting agent. It also dealt with the adverse impact on copper tube installations in many parts of the country and listed suitable alternatives.
- 9.2. These examinations revealed significant deposits of sediment and debris in pipework that could provide an environment conducive to the development of bacteria through, for instance, the generation of biofilms. Filtration was recommended to:
- ensure that the domestic water supply and associated pipework was maintained at a high standard of cleanliness throughout the system
 - reduce the accumulation of sediments that may promote the growth of water-borne organisms
- 9.3. Filtration need not be provided for cold water for non-domestic use, for example, firefighting, boiler-feed or other chemically treated or dosed systems unless there is a significant and regular suspended solid carry over from the public water supply.
- 9.4. Anecdotal evidence suggests that there has been some improvement in water quality following examinations of domestic water systems in a number of Scottish healthcare premises with reduced deposits of sediment and debris in pipework and storage tanks. It should be stated, however, that organic matter is a significant source of solids and, as this is a seasonal issue, the evidence currently available should be treated with caution as it may have been derived during periods of low organic contamination.
- 9.5. On-site filtration has been regarded by some as an optional provision despite its inclusion being mandatory since 1999. It is stressed that opting out of installing such plant should not be the default situation. Any decision to exclude filtration would be dependent on careful consideration of the following issues. This list is not exhaustive:
- whether a project comprises an additional building (or buildings) on an existing site without filtration plant
 - a documented risk assessment taking into account the type of accommodation served
 - a documented risk assessment based on the type and vulnerability of patients served

- an assessment of the practicality of introducing filtration for the likes of a ward refurbishment project that involved extending or upgrading part of an existing (unfiltered) system
- analysis of samples of incoming water supplies

The last issue is particularly important. In existing premises, an examination of maintenance records would determine whether strainers were routinely becoming clogged as an indicator of a history of suspended solids being present in the water authority's incoming supplies.

9.6. Before the installation and maintenance of on-site filtration plant is dismissed as an unaffordable burden, the following benefits and associated savings must be balanced against capital and revenue costs of filtration plant.

- the requirement for periodic removal of sediment from storage tanks is reduced along with the precautions associated with working in confined spaces
- the need for a separate or divided storage tank to allow supplies to be maintained during sediment removal is reduced
- the amount of suspended solids carried into the piping network would be virtually eliminated as they would be retained within the filtration plant so that strainers could be omitted from thermostatic mixing valve (TMV) assemblies. In these situations, removal of strainers would also remove a catchment for biofilm and bacteria build-up

Description

9.7. Where it has been determined to install on-site filtration plant, the following guidance will apply.

9.8. Where filtration is provided, it is normally used to prevent ingress of suspended solids into plant and pipework, and as such may be defined as the process of separating solids from liquids using a porous medium. The medium can consist of granular materials (sand, clay, carbon) assisted by chemical and/ or bacterial activity, woven meshes and screens made of metals, fabrics, ceramics, and polymeric membranes.

9.9. Filtration plant is usually specified by various criteria including minimum particle size retained, expressed in microns (μm). 'Absolute filtration' of a given size indicates that the plant can remove 99.9% of all particles above a given size. 'Nominal filtration' is normally taken to mean that 95% of all particles above a specified size will be removed.

9.10. As a guide, suspended materials are normally classified according to Table 9.1.

Table 9.1 - Particle Size

Material	Particle diameter (mm)	Particle diameter (μm)
Pebbles	> 10	-
Gravel	10 - 2	-
Very coarse sand	2 - 1	-
Coarse sand	1 - 0.5	1000 - 500
Medium sand	0.50 - 0.25	500 - 250
Fine sand	0.25 - 0.10	250 - 100
Silt	0.10 - 0.01	100 - 10
Clay	<0.01	<10
Colloid	10 ⁻⁴ - 10 ⁻⁶	0.1 - 0.001

9.11. In practice, water will contain a range of sizes of suspended particulates. The rate of blockage by suspended solids for any given filter will depend on a number of factors such as:

- throughput
- concentration of suspended solids and other fouling debris
- size distribution
- shape of particles

9.12. Particles less than 0.1 μm are invisible microscopically. The smallest visible macroparticle is approximately 40 μm . Particles less than 0.001 μm are considered dissolved and in solution.

Capacity

9.13. To accommodate the variation in flow, and to allow for filter changes etc, the equipment should be installed with redundancy built in. To allow for maintenance it is recommended that n+1 filters are installed to ensure continuous supply of filtered water. Where no redundancy is built in, consideration should be given to how maintenance will be undertaken to the filtration unit whilst maintaining water to the system.

Design features

9.14. The level of filtration should be 0.5 micron absolute. However, where a higher level of protection (0.2 micron absolute for instance) is required due to the patient cohort, this should be agreed by the Water Safety Group (WSG)/ Project Water Safety Group (PWSG) as applicable.

- 9.15. For small establishments (such as health centres and clinics), it will normally be appropriate to use filters with cartridge or membrane elements. This form of filtration may also be appropriate for larger premises but would be a function of water quality, user demand and patient category.
- 9.16. In larger establishments and those with high water usage, the filtration equipment plant should be fully automatic in operation and include self - cleaning and back-washing modes so that the filter medium does not become a reservoir for organisms capable of contaminating the service pipework. Consideration should be given to the periodic (frequency based on a risk assessment including historic site sampling and inspection data and manufacturers recommendations) treatment of the back flush water to water filtration units to combat a build-up of pathogens.
- 9.17. Point of entry filtration plant should be of the 3 stage step down or back washable patterns and should be capable of achieving sterilising grade performance (typically 0.2 - 0.5 micron, absolute filtration depending on the patient cohort).
- 9.18. All items in contact with water must be of materials that comply with the Scottish Water Byelaws 2014 (for example, materials approved by the Water Regulations Advisory Scheme (WRAS) and listed in the WRAS 'Water Fittings and Materials Directory', having been assessed and shown not to have adverse effects on water quality).
- 9.19. Parameters essential for the continued performance of the plant should be automatically monitored, for example downstream pressures and automatic cycling of back-washing facilities. These should be relayed to a building management system (BMS).

Note 21: Point-of-use (POU) filtration is covered elsewhere in this publication.

10. Water storage

Introduction

Note 22: Refer also to Health and Safety Guidance (HSG)274 Part 2.

- 10.1. Water is stored in healthcare premises for the following reasons:
- A.** to provide backflow protection
 - B.** to provide a reserve supply during disruption of the incoming cold-water supply and to prevent depressurisation if the supply fails (this encompasses water quality as well as water quantity issues)
 - C.** to reduce the maximum demand on the cold-water supply and increase resilience during periods of peak demand
 - D.** to reduce or increase the pressure from that of the supply system

Note 23: Separate arrangements are required to provide accommodation for the expansion of any water subjected to heat, that is, hot water and heating services.

- 10.2. The purpose for which the storage is used can vary but has only a minor effect on its design. The following generally covers a typical range of uses:
- A.** cold water services, domestic and so on
 - B.** cold water feed to hot water services
 - C.** pathology
 - D.** endoscopy units
 - E.** dental premises
 - F.** treated cold water for laundries heating and so on when local supplies are unsuitable
 - G.** to comply with the water regulations and prevent back contamination from water designated at a higher fluid category
 - H.** firefighting
 - I.** balance tanks for pools
 - J.** to ensure availability of water of a defined water quality for a specific purpose such as Reverse osmosis (RO) water

Note 24: Feed and expansion cisterns for heating services, chilled water are excluded.

- 10.3. All water storage tanks should meet drinking-water quality requirements.

Note 25: Separate drinking water systems are not recommended for new buildings.

Water supplies

- 10.4. Where there is private supply in addition to the water undertaker's, it needs to be introduced separately into the healthcare facility's water storage system. See WaterRegsUK for further guidance.

Note 26: It is best practice to include the operation of valves in a regular maintenance and operation schedule to ensure they do not become seized. The flushing of the supply could be integrated into this programme to aid the prevention of stagnation of water at dead-ends. Additionally, advice from the water undertaker on an appropriate time period to undertake flushing cycles on supplies should be sought.

Extent of storage

- 10.5. Storage should be designed to minimise residence time in the cistern and maximise turnover of water to avoid stagnation and deterioration of water quality. Storage volume should be calculated based on peak demand and the rate of make-up from source of supply. There may be more than one peak period during each day. The interval between peak periods is important as it affects the storage capacity based on the make-up flow. It also determines the available time for maintenance if twin cisterns are not installed. Unless the water supply is particularly vulnerable to disruption and subject to risk assessment (balancing the microbiological risk and contingency supplies), a nominal 12 hours' on-site storage is recommended (this would represent the total storage serving one water pipe network, therefore would be the sum of the unfiltered and filtered water storage which can be drawn from the tanks into that pipe network). Automatic self-adjusting tank volumes controlled by the Building Management System (BMS) should be considered, therefore allowing the nominal 12hr storage for that day regardless of the water consumption.
- 10.6. There is currently a lack of real data analysis to inform industry guidance for sizing an accurate water storage tank capacity. Design teams should therefore liaise with the commissioning Healthcare Organisation to ascertain their recent records on the quantity of water used over the previous five years, (this may have been assessed from regular drop tests over a period of time or from water meters and sub-meters). Provision of sub-meters in the new design should be agreed (particularly for high-risk areas) to assist with future information and to highlight operational problems. There is evidence that the historical values given for district general teaching hospitals that amounted to 900 L per day per bed are in excess of actual usage. If the proposed healthcare building development includes significant changes in function that introduce greater specialisms and more intensive treatment programmes, then the design team is advised to seek guidance from other healthcare organisations that are responsible for buildings of a similar nature.

Note 27: water figures are also available at NHS board/ site level from their energy and water monitoring, data collecting and analysing tool

- 10.7. The design team should ensure that the local water supplier is involved in proposals for planning the water storage values. Chartered Institution of Building Services Engineers (CIBSE's) Guide G - 'Public health engineering' gives further guidance on sizing cold water storage.
- 10.8. A summation of the average daily consumption for each ward unit contained in a building should be made. From the requirements of each building, the policy of water storage for the whole complex should be decided. It does not always follow that peak demands for each building will coincide, and therefore there may be scope for applying a diversity factor to the whole site.
- 10.9. Where the water requirement is to be met from a private supply, the summation for each building may require assessment on the basis of storing and using water according to the minimum treatment of the water for each particular use. Likewise, where the water is hard enough to require softening for certain domestic and/ or laundry purposes, separate storage will be required, and this should be considered when assessing the total stored water.
- 10.10. Staff quarters and industrial areas may be remote from the main building and supporting departments. The laundry may serve a number of healthcare buildings as well as the premises at which it is located. The storage requirement for such accommodation should therefore be calculated separately and integrated with the accommodation whenever this is practical.
- 10.11. Where new healthcare premises are to be built in separate phases, the water storage, supply, and distribution service for the whole premises should, as far as possible, be planned, risk assessed and agreed by the Project Water Safety Groups (PWSG) at the design stage. This will enable the total water supply requirement to be assessed in the planning stages, and appropriate areas of accommodation) to be allocated. It is important that, where it is anticipated that a building will be occupied in phases, the storage levels can be raised as required. Commissioning should be carried out also as a planned process related to occupation following a documented risk assessment (see British Standard (BS) 8580). The design should facilitate compartmentalisation.

Location and form of storage

- 10.12. The location of storage will depend on the total volume required, the topography and layout of the site proposed for development, and the sources and adequacy of the water supply. A limited site footprint may call for much higher buildings to achieve the required accommodation. Depending on the supply water pressure, it may be necessary to install pressurisation equipment to boost the incoming supply. The cost of the supporting structure

will have an important bearing on the solution adopted. Discussions with the water authority should be undertaken to establish any future reduction in pressure which they may instigate in their mains water supply. This will ensure that the system in the building should still function if/when they make the change in pressure.

- 10.13. Where storage is located in individual buildings and an adequate supply is available from the water undertaker, a connection in accordance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 to each point of storage may be the most economical arrangement. In such cases, interconnections between selected points of storage should be provided to deal with emergency and maintenance requirements, always providing that such interconnections do not contravene the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and do not result in water stagnating or gaining heat within the storage or distribution system.
- 10.14. Cisterns should not be located where there is any likelihood of flooding, excessive heat gain or any other factor that could affect the contents of the cisterns. They should not be installed in any location where access for general inspection or maintenance and replacement of cisterns is restricted. Where refurbishment is undertaken, an assessment is carried out to ensure no adverse impacts occur on the temperature and quality of the water stored. As part of this assessment, climate change mitigation measures should be considered. The cleanliness of the plant/ tank rooms should be included in the WSP and should highlight the importance that dirt/ dust/ other contamination should not accumulate on or around the tanks or cisterns. Staff that have access to the plant rooms to work or clean should have been trained as per the Water Safety Groups (WSG) training plan, so they understand contamination risks.
- 10.15. Separate systems are required to segregate domestic services (WC, hand- washing) from high-risk applications and equipment within such facilities as laboratory, pathology and mortuary departments. Refer to Water Byelaws/ Regulations for further guidance. The Healthcare Organisations WSG should risk assess the need for separate water systems along with the project team at the initial design stages. The WSG should also risk assess the provision of separate small systems, with independent filtered supplies and above ground drainage systems for augmented care units with patients susceptible to invasive disease from environmental and opportunistic pathogens. Consideration should be given to water turnover, flowrate and usage pattern.

- 10.16. An assessment of atmospheric and environmental (including feral wildlife such as birds) risks should be undertaken to ensure they do not affect the temperature or quality of stored water. If concrete water cisterns are to be considered, they should be designed to form an integral part of the building structure. The materials of construction, however, must comply the Water Supply (Water Fittings) (Scotland) Byelaws 2014. As in the case of external storage, cisterns should be installed in positions where they can be readily inspected and maintained and where they will not be affected by frost or high temperatures.
- 10.17. To determine access requirements to cisterns, it is essential that a suitable and sufficiently comprehensive assessment of the risks for all work associated with cisterns is carried out to determine what measures and parameters are required under Regulation 3 of the Management of Health and Safety at Work Regulations 1999. For work in confined spaces this means identifying the hazards present, assessing the risks and determining what precautions to take, (for example additional side access panels to storage tanks would provide a safer working environment where tanks need to have full personnel access for internal works or cleaning).
- 10.18. Roof spaces in which cisterns are to be installed should have adequate safe means of access, the area around the cisterns should be suitably floored and adequate lighting to facilitate inspection and maintenance.
- 10.19. Where storage is in ground, as distinct from being housed within a building, it is essential to ensure that there is no risk of contamination. Investigations of such risk require careful consideration of site conditions and should include such aspects as:
- flooding
 - subsidence
 - the location of sewers and drains and other buried services
 - the maximum and minimum height of the water table in the area
 - the natural drainage of surface water
 - ingress of contaminants such as dust, debris
 - in the event of storage below a car- parking area or roads, the danger of oil/ fuel seepage

The future development of the healthcare building and probable extensions should also be considered in this respect (such as for space to include increased storage capacity).

Accessibility should be limited to those who need access.

- 10.20. Storage below ground should be adopted only as a last resort, and cisterns should be installed within a watertight bund allowing sufficient space all around and beneath the storage vessel to permit inspection and maintenance. Any underground construction arrangement, concrete or otherwise, not directly against earth will reduce the risk of contamination. The tank chamber should include provision for a sump to collect drainage water and any piping necessary to pump out tanks to the site drainage. The Water Supply (Water Fittings) (Scotland) Byelaws 2014 require any buried concrete reservoir to be designed, constructed, and tested in accordance with BS EN 1992-3.

Note 28: Refer also to the Health and Safety Executive's (HSE's) guidance on confined spaces.

Construction of cisterns

- 10.21. All storage cisterns:
- should be constructed in accordance with manufacturers' recommendations and should comply the Water Supply (Water Fittings) (Scotland) Byelaws 2014
 - should have been assessed and shown they are appropriate (for example, suitable approvals) for the intended purpose
 - should comply with BS EN 805, BS EN 806 (Part 1 to 5) and BS 8558. Glass-reinforced plastic (GRP) cisterns should comply with BS EN 13280
- 10.22. The Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-04 - 'Cold water storage systems - design recommendation for mains supply inlets' provides useful advice regarding the design of the inlet arrangements to ensure compliance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014. Of particular importance is the need to ensure cistern roof supports and hollow ladders are of a type that do not retain water within the support, cause pockets of stagnation, or prevent the free flow of water throughout the cistern, as these have been shown to cause degradation of the stored water quality (see also Estates and Facilities Alert EFA/2013/004 - 'Cold water storage tanks'). Any other internal structures should be designed so as not to retain water, cause pockets of stagnation, or prevent the free flow of water throughout the cistern.
- 10.23. Depending on size and/ or capacity, water storage should be divided into convenient compartments suitably interconnected and valved to facilitate cleaning, disinfection, repair, modification, and inspection, without seriously disturbing the cold-water service. Cistern strengthening should be by means of stainless-steel tie bars and not baffle plates. Where multiple cisterns are provided, they should be connected in such a way that there is equal flow to prevent stagnation (in parallel). Pipework connections should also be arranged to ensure crossflow across the cistern. A water meter should be considered at each inlet pipe verify equal volumes are being used.

- 10.24. Separate cisterns should also be provided for storage of different water supplies, for example central-heating header cisterns, cold water storage, softened water, fire-fighting water, haemodialysis/renal and high-risk areas (for example, laboratories, pathology, and mortuary). Precautions should be taken to ensure that mixing does not take place between such supplies, and it should be noted that isolation by means of shut-off valves between them is not acceptable.
- 10.25. The materials used for storage cisterns serving healthcare should be appropriate for the intended use. The material selected should comply fully with the Water Supply (Water Fittings) (Scotland) Byelaws 2014. Pre-insulated sections are recommended where practicable.
- 10.26. Sectional cisterns fabricated from GRP or pressed steel provide a convenient means of bulk storage of water at atmospheric pressure. The components can be readily transported to site and, subject to unit multiples, they can be erected to give varying proportions of length to breadth and height. It is also possible to make provision for future extension in capacity by an increase in available base area or, within limits, depth. If sectional cisterns are selected, designs with external assembly flanges and self-draining profiles should be used, since this arrangement facilitates easy cleaning of internal surfaces of the cisterns. In particular internally flanged bases should be avoided.
- 10.27. The Water Supply (Water Fittings) (Scotland) Byelaws 2014 laid down the minimum requirements for wholesome water storage cisterns. Recommendations to comply with these are given on the WaterRegsUK website.

Note 29: Cisterns should be sited away from heat sources and be protected from heat gains by insulation. Adequate and safe access should be provided for inspection and maintenance (both internally and externally). Equipment which emits heat should not be sited in the water storage tank room.

Figure 10.1 - General filtered potable water storage cistern arrangements

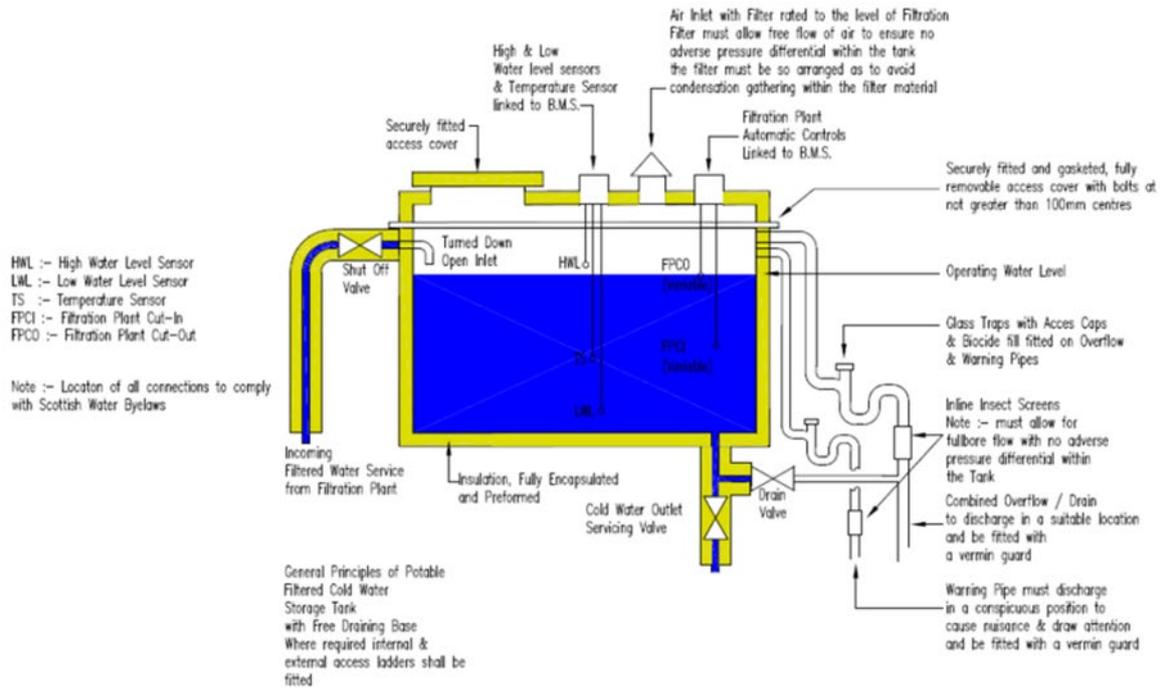
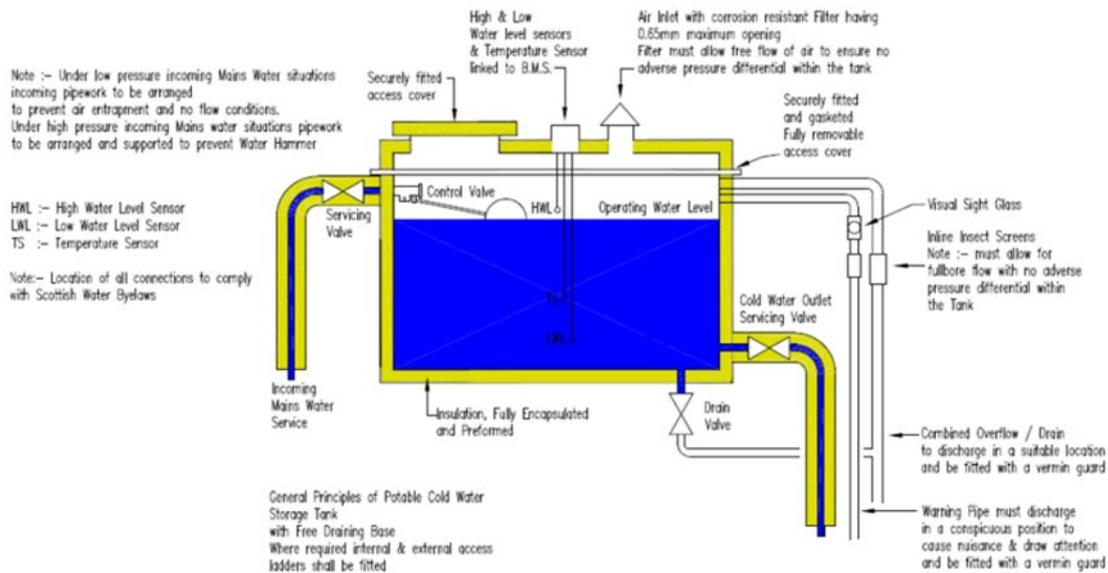


Figure 10.2 - General unfiltered potable water storage cistern arrangements



- 10.28. Each storage cistern or its compartment should also be provided with the following:
- A.** internal and external access ladders as necessary to comply with current health and safety requirements
 - B.** a full-way servicing valve at each inlet and outlet connection, except for cisterns providing water to primary circuits or heating circuits, overflow pipes and warning pipes (including the necessary rodent screens with a mesh size of no greater than 0.65mm). Where practicable, all outlets should be taken from the base of the system and be sited opposite to the inlet

- C. a suitably sized drain connection complete with isolating valve. The invert of the drain connection should be positioned to provide maximum drainage of the cistern
- D. a means of locking the lid

- 10.29. Cisterns in roof spaces should be adequately supported on bearers placed under the longitudinal or lateral cistern section joints. Final siting should be in accordance with the manufacturers' recommendations. New cisterns should not be located into roof spaces unless all other locations have proved to be impracticable and only after a documented risk assessment has been signed off by the WSG.
- 10.30. The design may incorporate a watertight drip tray or watertight bund under the cistern to contain condensed water or leakage to avoid damage to accommodation below.
- The necessity of a drip tray or watertight bund with drainage will depend on individual case requirements. The floor of the drip tray or bund should be graded to a drainage sump complete with drainpipe. A single pipe should drain off any overflow water from the sump and lead to a discharge point at ground level where any water flow would be readily noticed.
- If it is not possible to terminate the discharge pipe from the sump so that any discharge of water can be seen, an audible alarm should be installed to warn of overflow conditions. Cistern support levels should be constructed to keep the valves clear of the water level in the drip tray or bund in the event of cistern leakage. Special requirements apply to the supporting of GRP sectional cisterns on bearers, and manufacturers' recommendations should be observed. The cistern should be provided with a warning pipe or a no less effective device to indicate leakage through the inlet control valve if this should occur.
- 10.31. On no account should a sectional cistern be installed on a concrete plinth that is protected by an asphalt membrane (directly or on steel beams). Subsequent irregular settlement into the asphalt may lead to cistern distortion and leakage.
- 10.32. Another consideration in deciding cistern shape and layout is the location of the services duct. Whereas the cistern room may be positioned aesthetically in relation to the building elevation, the services duct serving it will be located to suit the internal layout. The pipe route from the system to the service duct will require access for inspection and protection from frost and heat gain.

Note 30: Care must be taken in the ventilation of water tank rooms to avoid condensation and mould growth. This requires particular attention in basement tank rooms where colder building surfaces can coincide with high specific air moisture content.

If due consideration is not given to the need for ventilation there is a risk that the water tank rooms may not be fit for their intended use. See Scottish Health Technical Memorandum (SHTM) 03-01 for further guidance.

- 10.33. Piping and valve arrangements for dual-cistern should be arranged to facilitate good through-flow and turnover of stored water without stagnation.
- 10.34. General space lighting should be provided in cistern rooms together with suitable power points for low voltage small tools and inspection lamps.
- 10.35. The contents and capacity of all cisterns should be clearly labelled as per the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and should include the fluid category, and the operational water level should be indicated. A tank reference number should also be clearly labelled in letters not less than 100mm high on a white background.

Ancillary pipework, valves, and fittings

- 10.36. The arrangement of the cisterns in the room should be such that the pipework runs are as short as possible, but accessibility and walkway clearances are ensured. Flanges on parallel runs should be staggered.
- 10.37. All cistern-room pipework and valves should be insulated and clearly labelled to identify their purpose and the direction of flow.
- 10.38. The use of delayed-action float-operated valves on water storage cisterns should be considered since these help avoid stagnation of water in the cistern. Where multiple tanks are installed in parallel the float valves must be synchronised to ensure they operate in unison. They may not be suitable when the supply is pumped. Water consumption onsite can be lower than the design intention, due to design guide figures and interpretation of occupancy levels, therefore leading to low turnover of stored water and possibly creating water hygiene issues. The water volumes should be discussed between the designers and WSG (including Infection Prevention and Control Team (IPCT) representation) and whether the initial water levels are set below the actual capacity of the sized cisterns and then adjusted to suit by the estates team for actual turnover during the building being in-use.
- 10.39. Strainers should be fitted within the water pipework system if not supplied integral to thermostatic valves etc and are used to protect vulnerable valves and fittings against ingress of particulate matter. The installation of these fittings should allow adequate access for maintenance/ replacement, and they should be provided with means of upstream and downstream isolation as appropriate. Strainers can be a source of Legionella bacteria and should be included in routine cleaning, maintenance, and disinfection procedures (see Part B).

- 10.40. Service isolation valves should be fitted to all pipework at pipe branches preceding sanitary tapware, showers and WCs for servicing, repair, or replacement. Drain-valve provision may also be appropriate for certain installations, for example, service pipework to en-suite facilities. Suitable backflow prevention devices or arrangements should be provided appropriate to the fluid risk category (see the Water Supply (Water Fittings) (Scotland) Byelaws 2014).

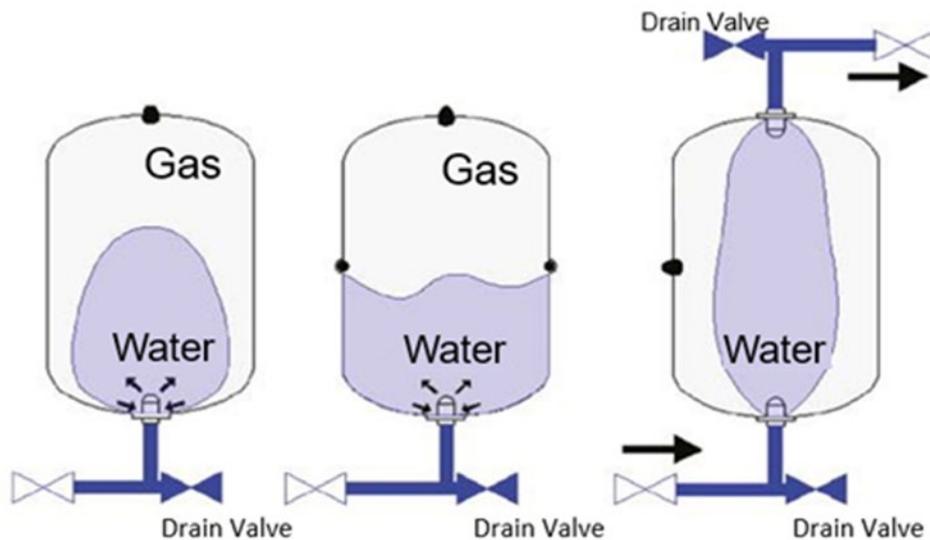
Expansion vessels

- 10.41. Expansion vessels (see Figure 10.3) should be vertical in orientation and have a bladder or diaphragm either with nitrogen or with air fill in the upper space. They introduce a potential problem of microbial colonisation, including Legionella, as plantroom temperatures usually exceed that of the incoming water.
- 10.42. Such vessels should be appropriately sized, installed and operated in a manner that prevents the accumulation of debris, pockets of stagnating water and increases in temperature within the vessels. They should preferably be of a design in which water passes through the vessel entering at low level and exiting at high level. For smaller vessels it may be appropriate to utilise specialist valves which promote the flow of water within the vessels or allow sufficient pressure movement so that water is changed over during normal operation. Any non-flow through vessels should be fitted in a vertical position in such a way as to allow gravity to help reduce any accumulations within the vessel itself. When larger vessels are installed, adequate flushing and drain-down connections should be provided at the top and bottom of flow-through vessels or at the bottom only of diaphragm or bladder types. Replacement of bladders should be possible.
- 10.43. All materials in contact with water should have been assessed and shown they are appropriate (for example, suitable approvals) for the intended purpose. It is important that the expansion vessel is located on the cold feed rather than on the hot water side of the system.
- 10.44. Pipework connections should be kept to a minimum, and the vessel should be sited and insulated to minimise heat gain. Where diaphragm or bladder-type vessels are used, they should be designed to ensure an adequate turnover of water within the vessel.

Note 31: Vessels where the diaphragm or bladder is designed to be replaceable may be considered as they will facilitate routine checking and/ or replacement when contaminated.

There are several types of vessels available including diaphragm or bladder type, with fixed and interchangeable (replaceable) bladders, as shown below. These internal bladders are often made of synthetic rubber such as ethylene propylene diene monomer (EPDM) and may support the growth of microorganisms including Legionella, so check to see if these are approved against BS 6920. Vessels with a 'flow through' design should provide less opportunity for water to stagnate and become contaminated (as in the latter design).

Figure 10.3 - Expansion vessel. Left to right, Bladder, Diaphragm and Flow through



Water meters

- 10.45. BS EN 806-2 Section 11 gives guidance on the design and installation of water meters.
- 10.46. Revenue meters are normally supplied and installed by the water undertaker to their specification, whereas the consumer may install sub-meters within their system.
- 10.47. Adequate sub-metering of water supplies should be provided so that supplies can be monitored for individual heavy-use departments. Such monitoring will assist in the detection of leaks or abnormal water demands. Water meters can be connected to an automatic monitoring system such as a BMS, which can identify anomalous consumption and lead to the early detection of leaks.
- 10.48. Only where downstream applications are considered critical and in need of a continuous supply of water should bypass arrangements be considered for consumer sub-meters. Where this is the case, sub-meters should have an upstream and downstream isolation valve. In case of servicing or replacement of the water meter, a replacement pipework insert should be stored capped, in clean conditions adjacent to the meter and should be disinfected before use.

- 10.49. Meters should also be installed on the cold supplies to cisterns and hot water storage vessels where multiple units are installed supplying the same system. This will allow equal usage and turnover to be verified.
- 10.50. A group of illustrations follow (Figure 10.4 to Figure 10.7) which indicate relative storage and pipe arrangements across different scenarios. These are not fully comprehensive, in terms of other valves (for example required to comply with Water Byelaws, for pressure control). In Figure 10.4 to Figure 10.7, there may also be other arrangements that are relevant (for example cold water circulation loops, local circulation loops powered by venturi tees, cooling heat exchangers or automatic water flow valves). The requirement for any such measure must be determined through a risk assessment of the potential for stagnant water or the digression from the desired water temperature range. This risk assessment undertaken by the designers should be presented early in the design stage for the client to understand and be part of the design process. This risk assessment must include the measures to combat these conditions through passive design (for example routing of cold pipes remote from heat gains or hot pipes from excessive heat losses, locating cold-water tanks in cool spaces, configuration of the pipe network to locate frequently used outlets at the end of all branch lines). TMVs are indicated however thermostatic mixing taps (TMTs) can be used, in either scenario an RA should be undertaken as to whether these are required.

Figure 10.6 - Schematic layout of a domestic hot and cold water services system with low level storage, booster pumps and filtration plant

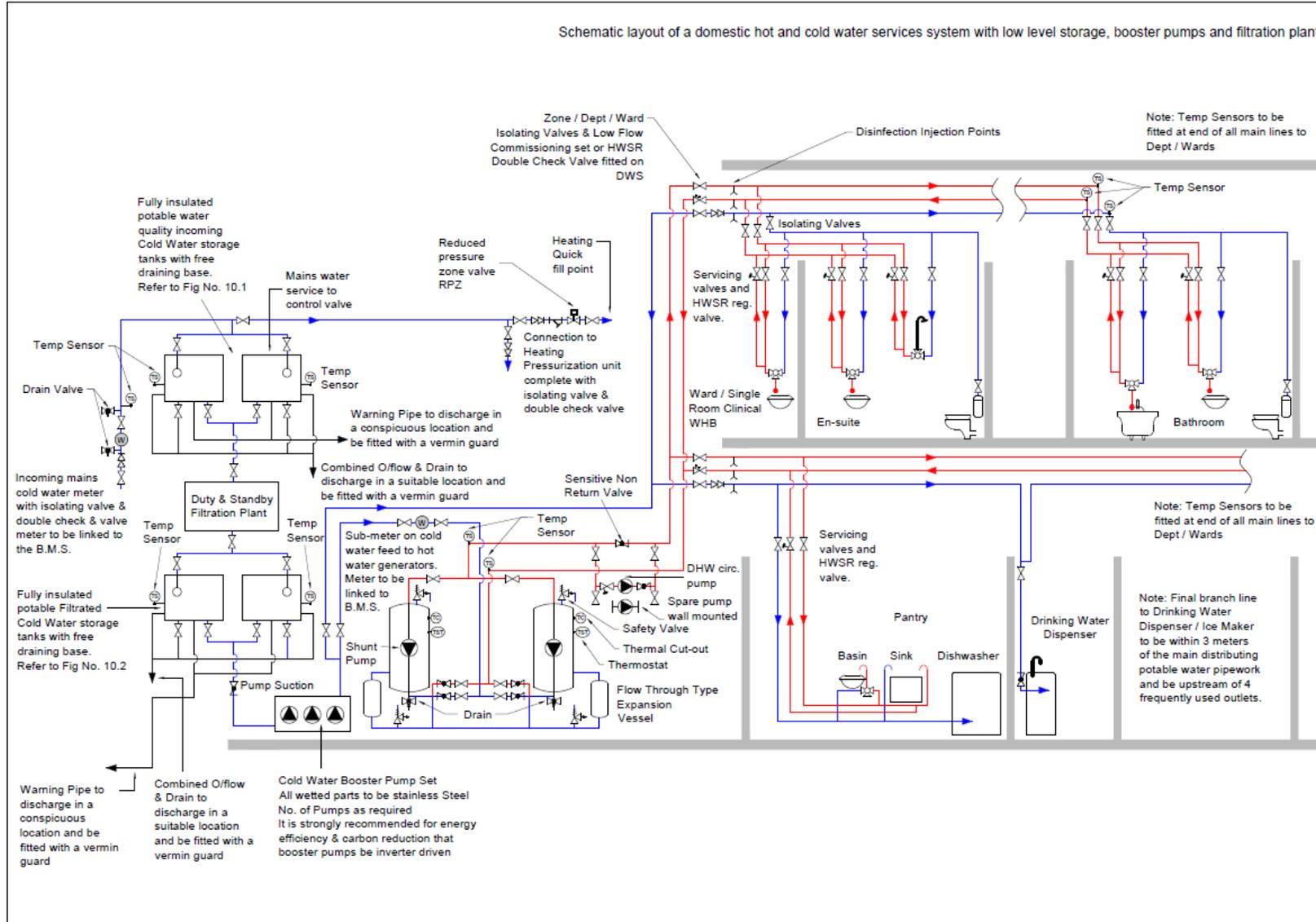
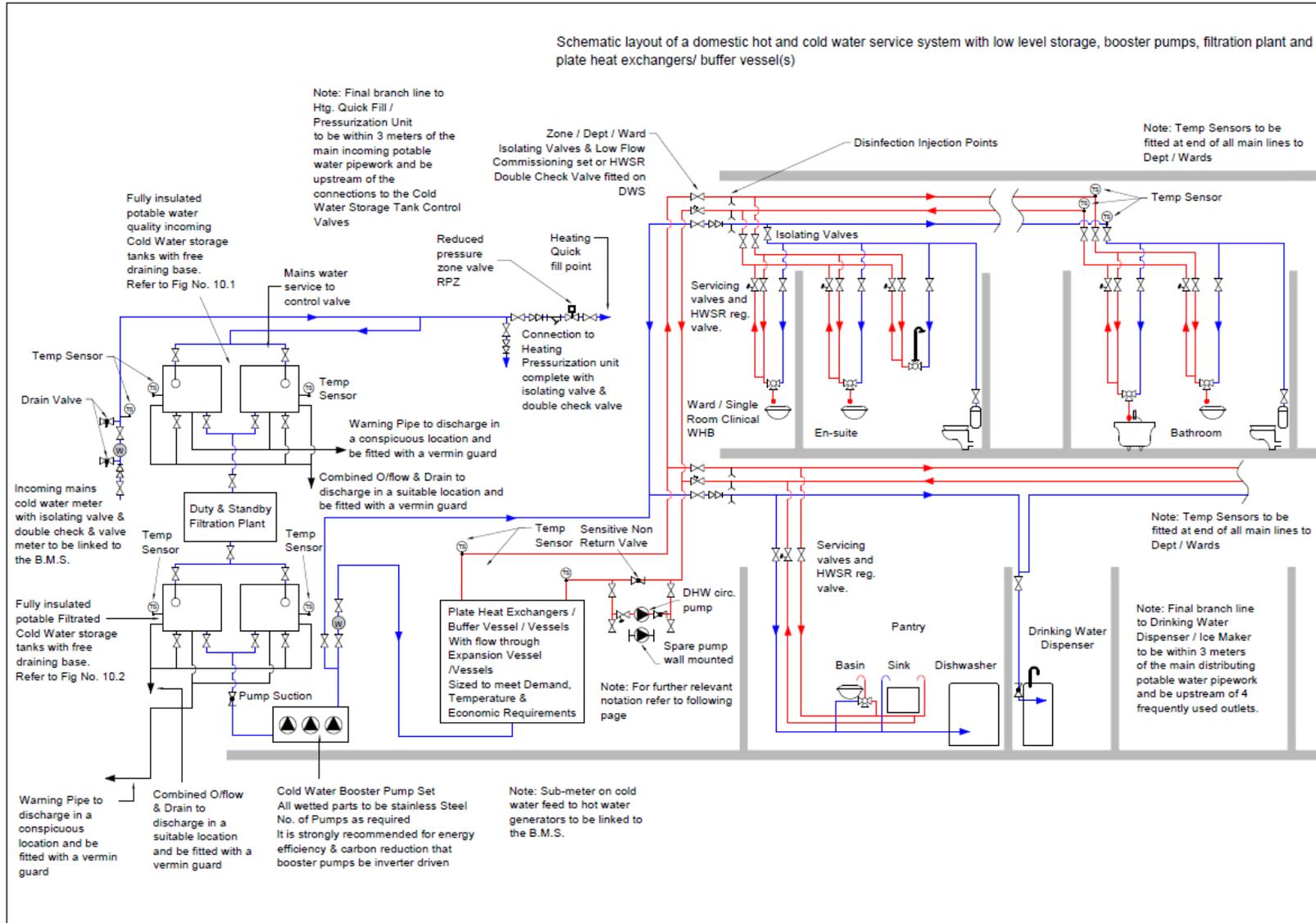


Figure 10.7 - Schematic layout of a domestic hot and cold water service system with low level storage, booster pumps, filtration plant and plate heat exchangers/ buffer vessel(s)



11. Cold water distribution system

Introduction

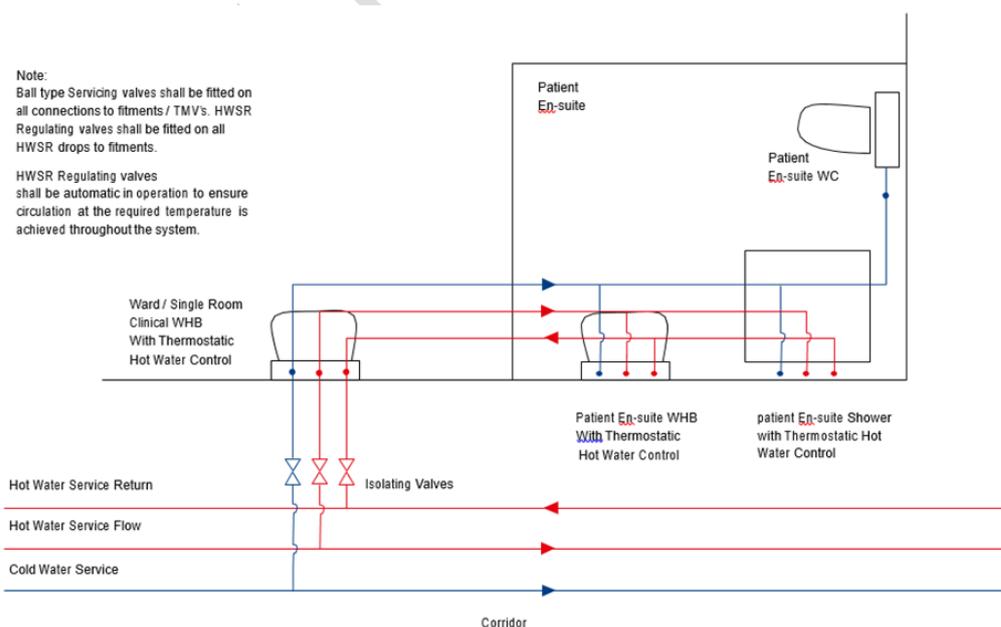
- 11.1. The design and installation of the cold-water distribution system should comply with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and relevant parts of British Standard (BS) EN 806-2 and BS 8558.

Note 32: All pipework should be insulated. All water system drains should discharge to waste via an appropriate air break to the drainage network such as a type AA air gap or an air-break-to-drain device in accordance with BS EN 1717 clause 9.

- 11.2. Cold water pipework runs should be designed and installed to reduce the risk of heat gain and should not be above or near heat sources including ceiling-mounted radiant heating panels. Void thermal modelling should be undertaken to assess potential heat gains to aid in the designers' water system proposals, encompassing a feasibility study pros and cons of heat gain/ water stagnation mitigation options for review by the Water Safety Group (WSG). Cold water service mains, wherever practicable, should be run within a different ceiling space (or zone within the ceiling void), or riser from other heat sources. This also includes keeping away from hot water service distribution system and steam supply. If not possible, the cold-water service and hot water services should be run apart as far as practicable and with the hot water at a higher level than the cold.
- 11.3. All pipework and valves should be insulated, except for any exposed final connections to sanitary appliances. Insulation should be of an optimum performance (relating to thermal values and thickness) to minimise heat gains in order to achieve the temperature regime. The installation of insulated pipe supports, and a vapour seal (for stainless steel pipework) is essential for all areas susceptible to heat gain and/ or condensation. All insulation should be installed in accordance with BS 5970. All pipework should be arranged to eliminate or minimise dead legs. Additional guidance can be found in BS 8558 Tables 6 and 7.
- 11.4. Currently there is no upper limit standard for drinking water temperature in European or domestic legislation. In normal circumstances temperatures should be delivered below 20°C. Every effort should be made to prevent the incoming supply from rising above 20°C (for example ensure adequate cover for underground mains, insulation at point of entry). The design aim should be to ensure that cold water temperature draw-off at outlets complies with Health and Safety Guidance (HSG)274 Part 2 and as far as reasonably practicable cold water temperatures should not exceed 20°C.

- 11.5. Historical data should be sought on incoming cold-water temperatures, especially during the summer and autumn, to allow these factors to be built into the design of the cold-water system. If temperatures exceed 20°C, then further control measures should be implemented based on the designer's risk assessment with input from NHS stakeholders.
- 11.6. The control of water temperature in the cold-water service, however, will essentially rely on placing pipes where heat gain is minimised, good insulation and water turnover. Cold water services should be sized to provide sufficient flow at draw-off points and prevent stagnation. Pipe layouts should be designed to connect outlets, with low/infrequent flow, upstream of outlets with higher/ frequent flow.
- 11.7. Further, cooling of cold water was previously (Scottish Health Technical Memorandum (SHTM) 04-01, 2014) only considered in specialist units where people are deemed as in an "augmented care" setting and for other accommodation, the aim was to promote turnover of cold water by means of the design of the distribution circuitry. Since the previous SHTM edition, the use of cooling water systems with recirculation has become more prevalent out with "specialist units". If consideration is given to the design of such systems, the Project Water Safety Groups (PWSG) should review the design stage appraisals and the designers risk assessment at the very early stages of the design process.
- 11.8. In all areas (particularly those with en-suite facilities), the aim should be to supply sanitary assemblies in series, with the WC connected as the final element to promote regular throughput of cold water. Elsewhere, pipeline routings should be run so that other outlets are connected in such a way that a WC or flushing device (for example, sluice hopper or pantry sink) provides the final element at the distal end of the branch - this may require pipe routing reversal (see Figure 11.1).

Figure 11.1 - Piping arrangements for an en-suite facility



- 11.9. The cold-water distribution system should be designed so that the pressure is the same as that for the hot water service at draw-off points. This may require the inclusion of pressure-reducing valves in the distribution pipework (care should be taken in their selection to avoid cavitation). Where water mixes in the body of the tap, a single check valve is required on each feed pipe to the tap to prevent backflow of water from one to the other.

Drinking water

- 11.10. When separate drinking-water systems have been provided, the practice has been to distribute directly from the mains without storage (nor softening), with stored cold water (down service) being used solely for supplies to WCs, wash-hand basins etc. Providing drinking water without storage may not be appropriate in healthcare premises because of the need to have some security of supply. The advantage of separate drinking and cold-water services chiefly lies in the possibility of treating the latter (softening or other forms of treatment) without compromising the drinking, cooking, and food preparation supplies. The WSG should define a strategy either for separate supplies or for restricting the extent of softening.
- 11.11. Low water flow is often experienced in dedicated drinking water systems leading to stagnation, and the likelihood of temperatures exceeding 20°C. The preferred option may be to decommission dedicated drinking water systems totally. A designer's risk assessment should show the optimum solution for patient safety.
- 11.12. A possible strategy, therefore, is to have a drinking water supplied from the stored domestic water system that also provides a cold feed to all other outlets (WHBs, showers, WCs and so on). The disadvantage of the concept is that the use of WCs, particularly in en-suite facilities, as the mechanism for achieving good utilisation in the cold-water service may compromise water quality if usage is low. Automatic flushing WCs should be considered to assist with maintaining water turnover in cold water systems.

Note 33: Sensor-activated delivery devices that have a duty cycle feature to prevent stagnation should be considered. Flushing devices are now available that will only initiate flushing if an outlet has not been used for a predefined period - this interval can often be set by the user. Some can also be configured to flush only during waking hours and be disabled entirely in cases where the flushing noise may distress patients.

Pumped systems

- 11.13. Where the pressure of the water undertaker's supply is inadequate, it will be necessary to use pressurisation plant. Similarly, pumping or pressurisation may be required for fire-fighting purposes.

- 11.14. Various arrangements of pumping system are indicated in BS EN 806-1 Part 5 and BS 8558. Where booster pumps are to be installed, a break cistern will be required between the mains supply pipe and the pumps. This is required to comply with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 with regard to prevention of backflow and the pumps should be constructed of materials that also comply with the Water Supply (Water Fittings) (Scotland) Byelaws 2014. Any pump delivering more than 12 L/min must be notified to the water undertaker whose consent is required.
- 11.15. Control of the pump(s) should be fully automatic in operation and controlled by pressure sensors for the following reasons:
- A.** to reduce energy consumption
 - B.** to prevent heat gain from the pump to the water, which could become significant if large pumps are used
 - C.** to reduce wear on the pumps and hence reduce maintenance
 - D.** all pump sets should be inverter-controlled, allowing them to modulate performance and maintain the required system design pressure under variable demand conditions
- With properly configured inverter drives, this approach should negate the need for downstream pressure reducing valves (PRVs), as pressure can be controlled dynamically at the source.
- 11.16. Factors to be considered when selecting pumps are:
- A.** quantity and pressure of water to be pumped
 - B.** the number of units required to obtain the necessary output and to provide adequate standby capacity
 - C.** the desirability of speed variation
 - D.** the degree of automatic sequence control required (but with manual override)
 - E.** the characteristics of the system on both the delivery and suction sides, and in pumping efficiency and priming requirements
 - F.** the type of materials used in manufacturing the pumps relative to the chemical analysis of the water to be pumped
 - G.** ferrous materials should not be incorporated into wetted surfaces
- 11.17. Depending on the circumstances, the operation and shutdown of pumps may be controlled by various methods (for example, water-level float switches, pressure switches, flow switches, electrode probes or pneumatic systems). Certain services may also require the pumping equipment to be energised from the emergency electrical service as recommended in SHTM 06-01 - 'Electrical services supply and distribution'.

- 11.18. Where two or more pumps are installed, the pumps should be arranged with automatic cascade controls to prevent stagnation. The pumped units shall have hydraulic accumulator vessels, individually isolatable with lockable isolating valves. The design should ensure that appropriate resilience is considered and automatic switching on a regular basis (daily) is included.
- 11.19. The pumping sets for lifting to higher-level storage should be controlled from the level in the high-level tanks by transmitting sensors, level switches or other suitable devices. A low-level alarm should be arranged to give a warning when the storage volume of water falls to a predetermined low level.
- 11.20. The plantroom should be constructed with a waterproof and non-dusting floor, and non-dusting walls and ceiling. The floor should be constructed with a slight fall to a drainage trench that should terminate in a trapped gully. The trapped gully should incorporate provisions to either avoid or replenish any trap water seal loss. The plantroom will require adequate lighting, ventilation, and heating (to prevent freezing or condensation),
- 11.21. If heavy plant is to be installed that may need to be removed for testing, maintenance or replacement, fixed lifting beams of suitable capacity and sufficient space should be provided.

Specialist systems

- 11.22. Where water supplies are required for specialist systems such as endoscope cleaning installations, dialysis units etc (see also Health Building Note (HBN) 07-01 - 'Satellite dialysis unit'), the design team should consult the Infection Prevention and Control Team (IPCT) and equipment manufacturer to establish any specific water treatment requirements for the process and that sufficient space is allowed.

The WSG and the manufacturer installation guidance should be followed including for drainage requirements (especially important for macerators and birthing pools).

Additionally, such systems also require backflow prevention arrangements to protect the source water supplies from contamination. The local water undertaker should be consulted:

- to clarify the backflow prevention arrangements or devices
- on any possible variation in the quality of its water supply or possible changes to the source of the supply

Vending, chilled water and ice-making machines

Note 34: These should not be installed in augmented care areas.

11.23. The design, installation, location, and risk assessment of all equipment should be approved by the WSG (see also Scottish Health Facilities Note (SHFN) 30 Part A: Manual Information for Design Teams, Construction Teams, Estates and Facilities and IPCTs)

The risk assessment should consider (not exhaustive):

- carbon filtration in these devices, which are a high nutrient source for bacteria
- cleanability and maintenance of the machine
- location

11.24. The water supply to this equipment should be taken from a wholesome supply via a double-check valve to prevent backflow and be upstream of a regularly used outlet with the minimum of intervening pipe-run, that is, less than 3m. The supply should not be softened. Additionally, it should be established that the usage is sufficient to avoid deterioration in water quality, for example that the inlet water temperature does not exceed 20°C. The equipment should be positioned so that the warm air exhaust does not impinge directly on taps or hoses supplying cold water and to provide access for maintenance.

11.25. Design considerations include for example:

- no drinking fountain or vending machine should be installed at the end of the line (potential dead-leg)
- the pipework should be as short as possible from take-off point (mains water tee)
- the cold-water supply pipework should be copper or stainless steel (to suit the remainder of the metal pipework) and fitted with a local isolation valve and drain valve
- flexible pipe connector should only be included if there was a risk of vibration passing into the pipework. If they are essential their length must be kept as short as possible.

Note 35: Flexible ethylene propylene diene monomer (EPDM) should not be used (see 5.34 to 5.38 flexible water supply hose clause for further details.)

11.26. Reference should also be made to the Food Safety (Temperature Control) Regulations 1995 and Food Safety (General good hygiene) Regulations 1995. The Automatic Vending Association of Britain (AV) 'Guide to good hygiene practice in the vending industry' should be followed regarding hygiene and water quality and hygienic operation of vending machines. Vending machines dispensing carbonated drinks require special materials of construction which should have been assessed and shown to be appropriate (for example, suitable approvals) for the intended.

11.27. Water dispensed from mains-fed water coolers is also defined by legislation as a food product and must be treated as such.

- 11.28. Also, water from mains-fed coolers should not be given to moderately or severely immunocompromised patients. Refer to National Infection Prevention and Control Manual (NIPCM) Chapter 4 for more guidance on the safe use of water for clinical care.
- 11.29. Water coolers under no circumstances should be located in highly immunocompromised units, laboratories, toilets, theatres and should be located away from heat sources, direct sunlight and in areas that could cause an obstruction. Refer to NIPCM Chapter 4 for more guidance on the safe use of water for clinical care.
- 11.30. Vending/ ice machines should not be placed in areas with highly immunocompromised patients as they present a *pseudomonas aeruginosa* risk. Consideration should be given to the risk of poorly maintained ice making units, the WSG should consider these risks and whether alternative options should be explored, such as food grade bagged ice or cooling packs.

Other water uses

- 11.31. The guidance contained in this SHTM is principally concerned with hot and cold water services used for domestic purposes within the interior of the healthcare premises.
- 11.32. This will include vending equipment, as above, and additional devices such as dishwashers and non-industrial clothes washing machines.
- 11.33. The cold-water distribution system may also be used for non-domestic purposes outside the building but within the curtilage of the healthcare premises. This use may introduce potential hazards, and reference should be made to SHTM 04-01 Part B.
- 11.34. A domestic water connection may also be required to top up closed loop systems, appropriate backflow protection to the domestic water systems will be required.
- 11.35. The closed loop system will require detailed knowledge for the system design, commissioning, treatment, monitoring and maintenance, with consideration given to Chartered Institution of Building Services Engineers (CIBSE) and Building Services Research and Information Association (BSRIA) for design, installation, treatment and British Standards 8552 for sampling and monitoring. SHTM 08-08 (pressure systems) should also be considered. Consideration should be given to the added engineering sensitivities of the healthcare setting. Particular care should be taken in the design/ planning of a closed loop system to protect areas with vulnerable patients and sensitive equipment. System decisions maybe required from both the Healthcare Organisations WSG and Ventilation Safety Group (VSG).

12. Hot water services

Introduction

- 12.1. Hot water services should be designed and installed in accordance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and relevant parts of British Standard (BS) EN 805, BS EN 806 (Parts 1-5) and BS 8558. The hot water system may be of either the vented or the unvented type.
- 12.2. The basic components of a hot and cold service system as used within healthcare facilities are shown in Figure 10.4 to Figure 10.7; most installations will have additional features and components. The schematic diagrams indicate traditional hot water return to every outlet, this is for indicative purposes, the designer may also consider, when appropriate, a looped hot water system. This should be discussed and agreed with the Project Water Safety Groups (PWSG).
- 12.3. A vented system usually consists of a cold-water storage cistern situated above the highest outlets, which feeds a hot water storage vessel (for example a calorifier or direct-fired boiler).
- 12.4. An unvented system usually has the hot water storage vessel connected to the mains water supply via a backflow prevention device and a pressure-reducing valve or supplied via a break-tank or booster pump set. For new facilities preference would be given to the use of unvented hot water systems to remove the risk from stagnant open vents. Care should be taken in all systems to match the minimum and maximum pressure requirements for the plant and system.

Note 36: See also Health and Safety Executive's (HSE's): 'Managing the risks from hot water and surfaces'; Chapter 10 on hot water and surfaces in 'Health and safety in care homes'. Health and Safety Guidance (HSG)274 part 2

Hot water temperatures

- 12.5. Hot water is required in healthcare premises at various delivery temperatures for particular needs. The highest outlet temperature is required typically in main kitchens, laundries, dirty utilities, and food preparation areas. Elsewhere the delivery temperature for personal hygiene will depend on individual preference for comfort and safety of patients who require assistance. In circulating hot water systems, the highest temperature, 55°C will be required at all draw-offs on a loop. To achieve this, see note below, the flow from the calorifier/ water heater is required to be at least 60°C at its outlet with a minimum return temperature to it at 50°C.

Notes 37:

- Requirements in the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and Approved Code of Practice (ACOP) L8 are prescribed to ensure efficient use and appropriate control of microbial elements in hot water systems. Guidance to these dual requirements recommends that, to comply, hot water should be delivered to the outlet at 55°C within 1 minute of an outlet being opened.
- The flow temperature of hot water out of the calorifier should be a minimum of 60°C. It should be a minimum of 55°C on flow and returns to all outlets and at the start of each hot water return. It should be a minimum of 50°C at the final connection to the calorifier.
- Water system design should negate the need for trace heating in healthcare premises (unless it is essential for frost protection).

- 12.6. The individual outlets, taps, mixing valves or other outlet devices will be served from the circulating distribution system; this should be designed such that the minimum temperature on all return loops should be 55°C. This will ensure a temperature of 55°C at all outlets within a maximum of 1 minute.

Note 38: Where the hot water return is local to the outlet, a much quicker response should be achieved: less than 30 seconds (typically less than 10-20 seconds). Failure to achieve this may indicate a hot water return fault and should be noted during subordinate loop monitoring.

- 12.7. A small number of localised hot water distribution systems can have advantages over one large centralised system. Balancing water flow rates in the hot water secondary distribution system becomes less of a problem, and distribution losses are reduced. A small localised hot water distribution system may comprise a plate heat exchanger, gas-fired water heater or a storage calorifier. The adoption of localised hot water distribution systems will require the provision of local plantrooms.
- 12.8. With large centralised hot water systems, it is more difficult to maintain secondary distribution temperatures within recommended values; also, water flow rates in large secondary distribution systems can prove difficult to balance. This can be simplified by not overcomplicating the design for circulating systems for example, by installing just one return to low level to accommodate the supply for two wash-hand basins back-to-back. An alternative is the use of automatic temperature activated balancing valves, but these will require ongoing maintenance.

- 12.9. There are also maintenance factors to be considered. With a central hot water system, plant maintenance can be focused in one location, whereas with localised systems there will be a number of plantrooms at remote locations. In order of preference, the localised systems should be considered first.

Hot water heater types

- 12.10. In most healthcare premises, hot water storage vessels include the heating source, which can be steam, high-or medium-temperature hot water (HTHW/ MTHW), low temperature hot water (LTHW) or electric immersion heating elements. The flow to the pipeline distribution system is normally taken from the top of the vessel, as too is the open vent, which may or may not be combined. The cold feed and return pipe should be connected to the vessel at the lowest point. Instantaneous water heaters for distribution systems have similar pipeline connections. They should be designed to have minimum water storage below the elements and should not be run to feed further outlets downstream. All water heaters should have been assessed and shown to be mechanically and materially appropriate (for example, suitable approvals) for the intended purpose.
- 12.11. For open vented systems, traditional design practice is to rely on a cold stored water feed and vent pipe to maintain its safe operation (that is, preventing water exceeding 100°C and maintaining fixed system pressures). Upon heating, expanded water can travel along both the cold feed and open vent pipework.
- 12.12. Means should be taken to prevent thermal circulation of hot water from the water heater to the cold-feed cistern occurring, leading to conditions conducive to microbial colonisation (for example, Legionella). It is common for an anti-thermal cycling loop to be installed on the cold-water feed pipe between the water heater and the vertical cold water feed pipe, such as a U- or S-bend pipe configuration. When this arrangement is used, no heated water should extend upstream of the bend into the vertical cold water feed pipe.
- 12.13. To preserve the quality of stored water within the cistern, the practice of terminating the vent pipe (air vent) over the cistern is no longer permitted. The vent should be arranged to discharge over a separate air-break-to-drain arrangement (in accordance with BS EN 1717) or a visible Type AA air gap and sited at a level that takes account of the hydrostatic head of the system to prevent unwanted discharges, the tundish should discharge to drain.
- 12.14. The vent pipe is critical to the safe operation of vented hot water systems and should be situated in a hygienic, frost-free environment to prevent blockages of the vent. The ingress of small animals, insects, debris or dust should be prevented. Vents should be designed to prevent unnecessary discharges of hot water and should be sized in accordance with relevant standards. Where screens are used on the vent outlet, additional measures should be included to ensure the continuing operation of the vent. Suitable maintenance should be specified to ensure the vent outlet is kept free from the collection of dust or biofilms.

- 12.15. The calorifier or water heater should be provided with a suitable safety valve of appropriate size and vacuum release arrangement.
- 12.16. Most vessels have some means of access for inspection, either via a special panel or by removing the heating coils/ elements. When new calorifiers are required, it should be specified that they have separate and adequately sized access panels.
- 12.17. The combined storage capacity and heater output should be sufficient to ensure that the outflow temperature, at continuous design flow from calorifiers or other heaters, is not less than 60°C under maximum design flow. This applies to both circulating and non-circulating hot water systems. The positioning of the control and high-limit thermostats, cold feed and return water connections should ensure that these temperatures are achieved.
- 12.18. There are three types of water heater:
- A. instantaneous heater
 - B. storage calorifier
 - C. semi-storage calorifier

Instantaneous water heaters

- 12.19. This type of heater can be further subdivided into:
- instantaneous water heaters for single- or multi-point outlets: these devices usually serve one draw-off only and are either electrically or gas-heated. The general principles and limitations of instantaneous water heaters are in essence:
 - the hot water flow rate is limited and is dependent on the heater's power rating
 - the water in instantaneous water heaters is usually heated to about 55°C at its lowest rate, and its temperature will rise and fall inversely to its flow rate. Where constant flow temperature is important, the heater should be fitted with a water governor at its inflow. Close control of temperature is of particular importance for showers. To attain constant temperatures on delivery, water flow and pressure should also be controlled. Variations in pressure can cause flow and temperature problems when the heater is in use and when setting up or adjusting flow controls
 - they are susceptible to scale formation in hard water areas, where they will require frequent maintenance
 - this form of hot water heating should be considered only for smaller premises or where it is not economically viable to run a hot water circulation to a remote outlet
 - for electrical instantaneous point-of-use showering, consideration should be given to selecting an appropriate thermostatically controlled product (for example, those with British Electrotechnical Approvals Board (BEAB) Care Mark approval)

Note 39: Some designs of combination water heater are arranged to have the cold-feed tank above the hot closed water tank. These are not recommended for healthcare premises, but where they are used, careful consideration should be given to managing the risks from these types of systems, and this should be reflected in the risk assessment. See also Scottish Health Technical Memorandum (SHTM) 04-01 Part B.

- instantaneous-type water heaters for distribution systems: these devices, which normally use steam or high- or medium-pressure hot water as the primary heating medium, are designed to heat their rated throughput of water rapidly from cold to the design outlet temperature. They can be used either to feed directly into a hot water distribution system or in conjunction with a separate storage vessel (often referred to as a buffer vessel), which reduces the load on the heater during periods of peak demand. This type of heater includes:
 - hot water generators: these are vertical instantaneous water heaters that contain modular helical primary coils normally served by steam, LTHW, MTHW or HTHW. The unit incorporates a temperature control device, which varies the rate of primary energy input so as to maintain a constant hot water flow temperature over a range of secondary flow rates through the heater
 - plate heat exchangers: plate heat exchangers consist of a number of rectangular plates sandwiched between two flat endplates and held together by tie bolts. The plates have ports in all four corners that allow entry and discharge of the primary and secondary liquids. Primary liquid is directed through alternate pairs of plates while the domestic hot water (DHW) is normally fed in a counter flow direction through the remaining pairs of plates. Each plate is sealed round the edges by a gasketing system, the design of which should ensure that fluids cannot, under normal operating conditions, either leak to atmosphere or mix. This type of heat exchanger can be extended easily, or shortened, to suit changes in hot water demand

Storage calorifiers

- 12.20. Storage calorifiers are usually cylindrical vessels mounted either vertically or horizontally; the base of a vertical calorifier can be concave or convex, with the vessel being supported on feet. The latter design is preferred, as it avoids the annular space where the base joins the cylinder wall. Heater batteries are usually located near the bottom of the cylinder, which can give rise to an area of water beneath the battery significantly below the storage temperature. This “dead” area can provide an ideal breeding ground for bacteria. Galvanised cylinders are particularly susceptible to scale formation, which can also provide a source of nutrition and shelter for bacteria.

Note 40: Galvanised cylinders are not recommended in new healthcare installations or for replacement.

- 12.21. The following points should be considered during the design process:
- A. the entire storage volume should be capable of being heated to at least 60°C without permanent pockets of lukewarm water
 - B. the shell lining should be resistant to bacterial growth
 - C. sufficient access to ensure adequate cleaning of the shell should be provided
 - D. a suitably sized drain should be connected to the base of the calorifier
 - E. allow for sufficient space for safe drainage and silt removal

Semi-storage calorifiers

- 12.22. These calorifiers can either have an independent heating facility such as oil or gas burners or electric elements or use primary water/ steam from a boiler to heat the water via a heat exchanger. The equipment is available in a range of storage capacities and recovery flow rates. This type of equipment is particularly suitable where systems are being decentralised, and water heaters are required close to the point of use (POU).

Sizing of hot water storage vessels

- 12.23. Storage should be calculated on the requirements of peak demand and the rate of heat input. There may be more than one peak period in each 24 hours. The interval between peak periods is important, as it affects the recovery time. See Chartered Institution of Building Services Engineers (CIBSE) Guide G: 'Public health engineering', which gives guidance on sizing hot water storage.
- 12.24. Where storage calorifiers are used, the hot water storage capacity should be sufficient to meet the consumption for up to two hours; this must include the period of maximum draw-off. The installed hot water capacity should be sized for current needs and should not be designed with built-in capacity for future extensions.
- 12.25. Some devices are optimistically rated so that, at a continuous demand equal to their design rating, the flow temperature can fall below 60°C. Semi-storage or high-efficiency minimum storage calorifiers and instantaneous heaters are especially prone to this if under- sized.

Stratification in storage vessels, calorifiers, water heaters and associated buffer vessels

- 12.26. Stratification will occur in any storage calorifier, heater or associated buffer vessel; the temperature gradient will depend on the rate of draw-off and heat input. In some calorifier designs, stratification is significantly more pronounced and is a feature of their design.

Note 41: Stratification: in a storage calorifier, the upper level above the heating element will be at operating temperature (60°C) during normal periods of demand. Below this level there will be a volume of water at a temperature between that of the return feed water and the operating temperature. A higher return temperature is preferable to ensure all water in the calorifier can be stored above 60°C. This level will vary as draw-off takes place according to the thermal input and rate of demand.

- 12.27. Storage and semi-storage calorifiers should be provided with independently pumped circulation from the top to the base of the calorifier; this is referred to as a “shunt pump”. The pump should be run for long enough to ensure that the entire contents of the calorifier are raised to 60°C for an hour a day, often performed during periods of minimum demand. During periods of low draw-off (usually in the early hours of the morning), the temperature will readily achieve 60°C to effect disinfection. Control should be by a timing device that can be adjusted when the profile of demand has been established.
- 12.28. Some semi-storage/ high efficiency calorifiers are supplied with an integral pump that circulates water in the calorifier; in this case a second shunt pump is not required. A similar arrangement is included in some plate heat exchanger/ storage vessel packaged systems where there is primary DHW circulation which provides pasteurisation without the requirement of a further shunt pump on the vessel.

Unvented hot water systems

- 12.29. Hot water storage systems have traditionally been provided with an open vent pipe that relieves any steam generated in the event of failure of temperature controls. The open vent pipe also protects against rupture of the cylinder by expansion of water.
- 12.30. The use of unvented heating systems is covered in Section 6 in the non-domestic Scottish technical handbook which covers installation, specification, and discharge.
- 12.31. Where an unvented hot water system is connected directly to the water mains, no back-up will exist in the event of a water supply failure. Such an arrangement may also be unacceptable to the local water undertaker since they will be required to meet the maximum demand at any time over a 24-hour period.
- 12.32. The design and installation of unvented hot water systems should comply fully with the Building Regulations and the Water Supply (Water Fittings) (Scotland) Byelaws 2014.
- 12.33. The key requirements are that the temperature of stored water should be prevented at any time from exceeding 100°C and that discharges from safety devices should be conveyed to a safe and visible place and protected to prevent blockage and the ingress of birds and rodents.

- 12.34. The discharge pipes from the temperature-relief valve and expansion valve should be carefully located so that they are readily visible - but do not present a risk to people - and protected to prevent blockage and the ingress of birds and rodents.
- 12.35. Where the hot water is heated directly, for example by a steam or LTHW primary coil, a non-self-resetting thermal cut-out wired to a motorised valve on the primary coil should be provided for control of excessive temperature. This should further be protected by a direct-acting protection device.

Connection arrangements for calorifiers and water heaters

- 12.36. Where more than one calorifier or heating device is used, they should be connected in parallel, taking care to ensure that the flow can be balanced so that the water temperature from all the calorifiers always exceeds 60°C.
- 12.37. Installations should not include for series operation of calorifiers/ heaters.

Provisions for maintenance

- 12.38. There should be adequate access to calorifiers for inspection and cleaning, removal and replacement of tube bundles and removal and replacement of the entire calorifier.
- 12.39. All calorifiers and water heaters should be fitted with a drain valve located in an accessible position at the lowest point on the vessel so that accumulated sludge may be removed safely and effectively from the lowest point. The drain should be of sufficient size to empty the vessel in a reasonable time.
- 12.40. Drain valves should be of the ball type to avoid clogging, and a drainage gully should be provided of sufficient size to accommodate the flow from the calorifier drain.

Sealed expansion tanks for unvented hot water systems

- 12.41. It is essential that the expansion vessel is located on the cold feed rather than on the hot water side of the system in an area not subject to heat gain. Where flow through expansion vessels have not been installed there should be a means of isolation and drain provision to allow periodic flushing.
- 12.42. These vessels should be appropriately sized to take account of the thermal expansion of the hot water service system. Otherwise, they should comply with the recommendations in previous paragraphs of this SHTM.

Hot water distribution system

- 12.43. To achieve the required circulating temperatures, it will be necessary to provide some form of regulation to balance the flow to individual pipe branches serving groups of draw-off points, for example each washroom/ toilet and en-suite facility.
- 12.44. The means of balancing the hot water circulation can be achieved by either manual or thermostatic regulating valves installed in the return loops to outlets. There should be means of isolation, both upstream and downstream. Adequate access for servicing is also essential. Lock-shield valves should not be used for balancing.
- 12.45. In in-patient accommodation where en-suite facilities are provided, it is recommended that the hot water circulation be extended to TMVs/ thermostatic mixing taps (TMTs) in series; for example, the supply to a TMV/ TMT serving each basin, bath and/or shower should be run as one circuit.
- 12.46. The operating pressures for both hot and cold water at draw-off points should be the same.
- 12.47. The DHW system should not be used for heating purposes. This includes all radiators, towel rails, heated bedpan racks and so on, whatever the pipework configuration.
- 12.48. Particular attention should be given to ensuring that pipework containing blended water should be kept to a minimum. Generally, the downstream supply from the mixing device should not exceed 2m.

Note 42: The same restriction applies to communal blending, that is, where more than one outlet is served by one device. Central blending systems should not be used, where the length of distribution pipework would exceed this maximum permissible length.

Hot water circulating pump

- 12.49. Hot water circulating pumps have traditionally been installed on either the flow or return. When installed on the flow, the arrangement comprises a full-bore non-return valve into which the pump is installed (a non-return valve is also required in the return at the calorifier/ water heater); appropriate valves and drain points are also required for servicing. The size of flow pipe is selected, with larger bores to begin with to ensure the maximum diversified simultaneous flow demand is achieved.
- 12.50. When installed in the return, the installation will require a downstream non- return valve, upstream and downstream isolation valves and drain valve. Installing the circulating pump in the return simplifies the valving arrangements and may improve circulation when draw-off is taking place. (During high demands, the flow from the calorifier may exceed that of the circulating pump in the flow resulting in the non-return valve at the calorifier closing).

- 12.51. Duplex pumps should not be installed. A spare secondary pump shall be provided that is clean and dry, with both ends capped during storage and be ready-for-service in the event of failure of the service pump. The pump and any replacement pipework and fittings should be disinfected before being installed onto the live system.

Note 43: If a permanently installed standby pump is considered to be essential, the control system should automatically change over operation every 3 hours.

- 12.52. The electrical connection should be by means of a lockable socket outlet for either single- or three-phase as required.

In-line strainers

- 12.53. Where not integral to the fitting, in-line strainers should be fitted within the water pipework system to protect vulnerable valves and fittings (pressure-reducing, safety-relief and stop valves, terminal fittings including thermostats and solenoid valves and so on) against ingress of particulate matter. The installation of these fittings should allow adequate access for maintenance/ replacement, and they should be provided with means of upstream (and downstream where appropriate) isolation. Strainers can be a source of microbial contamination including *Legionella* and *pseudomonas aeruginosa* and should be removed after commissioning has been satisfactorily completed. The PWSG should consider whether these additional in-line strainers are needed at all where Point of Entry Filtration (POEF) is installed.

Cold-feed cisterns

- 12.54. When separate cold-feed cisterns are provided for hot water service installations, they should comply with the requirements for cold water systems.

Note 44: Hot water cylinders with an integral feed and expansion tank should not be used.

- 12.55. Some instantaneous water heaters include a flow-limiting device to ensure that the rate of draw-off does not exceed the capacity of the heater to achieve the required temperature. Such devices are not recommended for larger systems as air can be introduced into the circulating system if taps are opened on upper floors during excess draw-off.

Service isolation valves

- 12.56. Service isolation valves should be fitted to all pipework preceding sanitary tapware and WCs for servicing, repair, and replacement. These valves must not be used for balancing the hot water system. The design needs to ensure that there are enough isolation valves for maintenance and repair to allow essential services to continue (for example, on all riser connections and pipework entries to specific areas).

Water temperatures, delivery devices and splash risk

- 12.57. With the move towards improving the patient environment and minimising the risk of healthcare-associated infections, there has been an increase in the provision of single-bed rooms with en-suite facilities. Additionally, to promote good hand hygiene, wash-hand basin provision has increased significantly in all clinical areas. Effective handwashing is best performed under running water at a safe, stable and comfortable temperature over basins/sinks (for clarification and design specifications, see SHTM 64 - 'Sanitary assemblies' and - Scottish Health Facilities Note (SHFN) 30 Part A: Manual Information for Design Teams, Construction Teams, Estates and Facilities and Infection Prevention and Control Teams (IPCTs).

Note 45: The Water Supply (Water Fittings) (Scotland) Byelaws 2014 place limits on the flow of water to draw-offs where plugs are not provided. Spray-type mixer taps are not recommended in healthcare premises; therefore, the type of tap should be carefully selected to minimise the formation of water droplets and aerosols. Water flow profile should be compatible with the shape of the wash-hand basin to avoid splashing (no inserts or flow regulators to be fitted). The fitting and basin combination should be such that the water stream never discharges directly into the basin's waste outlet (see SHTM 64 - 'Sanitary assemblies').

- 12.58. Components should be selected for their ability to minimise the accumulation of debris and splashing (including devices that deliver a smooth non-splashing/ spraying flow), to allow for the fitting of POU filters and to facilitate disinfection. Note when selecting new taps, SHFN 30 advises against using aerators, strainers, and flow restrictors at the point of discharge. In augmented care demountable taps fittings which can be autoclaved may be preferred and should be discussed with the Water Safety Groups (WSG).
- 12.59. The use of filtered water using a sterilising-grade POU filter has been shown to reduce the incidence of Nontuberculous mycobacteria (NTM) infections. Where outlets are considered to be safe for these patients (for example, when progressing through their recovery pathway), these outlets should be removable for effective disinfection and be fitted with sterilising-grade POU filters (see POU filters).

- 12.60. Wash hand basin bowl types should be assessed as the most suitable when considering splash to surrounding spaces. The WSG and the Healthcare Organisations IPCT should be involved throughout the sanitary ware selection process.
- 12.61. Splashing from sink and drain outlets has been shown to travel up to 2 m. A 2 m zone around outlets should therefore be kept clear to avoid the risk of transmission of NTM and other waterborne pathogens by splashing originating either from water or wastewater. To clearly demarcate this splash zone, it is recommended that contrasting colours on the walls and floors extending 2 m from the outlets should be used. This visual cue will help to ensure that trolleys, patient beds, equipment and other items are not parked or placed within the splash zone, even temporarily. If a 2 m zone is not possible, the use of splash screens should be considered.
- 12.62. The risk of scalding for vulnerable patients (young children and older people, disabled people and those with neuropathy) is of particular concern in healthcare premises caring for such individuals, and therefore thermostatic mixing devices could be needed for hot water outlets. A risk assessment for scalding risk versus the risk of infection from waterborne pathogens should be completed and signed off by the WSG. TMV and TMTs can be complex with small internal components. Without appropriate servicing they can provide an ideal environment for bacterial growth. It is important to ensure that TMVs are not overused as this can add additional risk from pathogens and unnecessary maintenance burden on estates teams.

Table 12.1 - Recommended Devices and outlets

Activity/ area - areas where TMV type 3 valves should be fitted	Maximum recommended set delivery temperature (°C)	Type of device
Shower and hair wash facilities	41°C	Type 3 thermostatic
Unassisted bath	44°C	Type 3 thermostatic
Bath for assisted bathing	46°C - to allow for the cold mass of the bath. NB - prior to patient immersion, water should be checked with a thermometer.	Type 3 thermostatic
Bidet	38°C	Type 3 thermostatic

Activity/ area - areas where TMV type 3 valves should be fitted	Maximum recommended set delivery temperature (°C)	Type of device
Staff bases, ward and consulting rooms etc basins, In-patient, out-patient hand wash basins	See note 46 below	See note 46 below
Office, staff-only access areas hand wash basins	43°C	Type 1
All sinks, kitchens, pantries, slop sinks and so on	55°C - minimum required for food hygiene and decontamination purposes	Separate hot and cold taps or combination tap assembly. Type 1; no preceding thermostatic device

* Scalding risk assessments should be undertaken to determine whether a TMV is required for the space.

Note 46: Bath fill temperatures of more than 44°C should only be considered in exceptional circumstances where there are difficulties in achieving an adequate bathing temperature. If a temperature of more than 44°C is to be used, then a safe means of preventing access to the hot water should be devised to protect vulnerable patients.

Wash-hand basins and sinks - Wherever wash-hand basins are installed, a risk assessment should be undertaken, which is overseen by the WSG undertaken by the project team, that considers the needs of patients and service-users to determine whether there is a scalding risk and whether additional protection is required (such as a type 1 with temperature stop, type 2 or type 3 mixing valve - see options below). The preference should be that there are direct hot and cold water supplies to the wash-hand basins such as no TMV/ TMT fitted. Hazard warning signs for scalding risk should be displayed if appropriate.

For outlets not intended for handwashing (such as sinks in kitchens, dirty utilities or cleaners' rooms), TMVs should not be installed. All installations require a hot water hazard warning sign (the temperature could equate to the maximum temperature available from the calorifier).

Note 47: Microbiological risks should also be considered for all installations.

Options:

1. Separate hot and cold taps.
2. Mixed temperature outlet:
 - Type 1 - a mechanical mixing valve with or without temperature stop (i.e. manually blended)
 - Type 2 - a thermostatic mixing valve (TMV): BS EN 1111 and or BS EN 1287
 - Type 3 - a TMV with enhanced performance: SHTM 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'. Type 3 TMVs should have undergone third-party testing and certification to the requirements of Health Technical Memorandum (HTM) 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'.

Note 48: Where installed, it is preferable that thermostatic mixing devices are fitted directly to the mixed temperature outlet or be integral with it, and be the method of temperature and flow control, for instance the mixing device should not be separate nor supply water via a second tap or manual mixer since there will be many cases where draw-off of cold water will not occur. If a separate thermostatic device is used, it should be fitted as close to the outlet as possible, which should be a flow-only control. Where "T" type mixing valves are installed, they should be readily accessible for maintenance.

In the case of bidets with ascending sprays or a handle douche, which may be accidentally immersed, the water supply should be independently fed from storage with no draw-offs at a lower level (for instance a break-tank arrangement). Appropriate backflow protection must be provided.

Automatic taps (timed flow) can be considered as a result of a risk assessment and should be specified as appropriate for the conditions of use, either type 2 or 3. If the temperature is non-user adjustable, they should be supplied via a type 2 or 3 TMV set to 39-40°C. The sensors should include a timer that can be adjusted to take account of the optimum washing time: this is particularly for scrub sinks. Sensors should be offset or positioned such as to reduce the risk of accidental contamination of the outlet and be positioned so that POU filters can be used. Facilities for overriding the sensors will be necessary. When a duty cycle setting exists, it should be activated to avoid stagnation. (If there is more than one tap/ outlet, for example in the case of scrub sinks, then all should deliver water to avoid stagnation).

In the case of dual-function delivery devices, such as bath/ shower diverter, type 3 valves should deliver the temperature appropriate to each outlet for example bath max 44°C or 46°C, shower 41°C. (Refer also to the commissioning procedure section in HTM 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'.) Taps, components, and fittings should be removable and easily dismantled for cleaning and disinfection.

Where manual mixing devices with a temperature stop are installed, it is important to ensure that the normal maximum delivery temperature is controlled to safe limits. Installation, commissioning, and maintenance should take account of the system's dynamic pressure and temperature changes, and the seasonal changes in incoming cold-water temperatures. Mechanical sensor mixers (that do not have thermostats), may be considered when an appropriate risk assessment has been undertaken.

This table does not cover birthing pools. (See "Areas this SHTM does not cover" in Chapter 1).

Direct fed hot water outlets provided for food hygiene and decontamination purposes should be provided with a notice 'caution - very hot water'.

- 12.63. Design risk assessments should be carried out by the multidisciplinary PWSG with input from clinical leads and Infection Prevention and Control (IPC) teams to consider the appropriateness of installing (or not installing) showers. WC's and clinical wash hand basins in high-risk patient care areas. The risk assessment will inform whether these outlets are required in areas designated as high-risk patient areas. The WSG with specific input from Infection control, the consultant microbiologist and clinical leads are responsible for identifying high risk areas within healthcare premises. The risk assessment should consider susceptibility of individual exposed, exposure risks, the potential for amplification, the possible waterborne pathogens and associated transmission pathways.
- 12.64. The risk assessments and risk assessment reviews should be documented, kept up-to-date and available to all who need access to them.

Showers

- 12.65. Showers with fixed heads are preferred for prevention of and minimisation of contamination. The ability of the shower fitting to accept a POU Filter should have a bearing on the selection made. Where flexible hoses and moveable shower outlets are provided, the outlet should have a retaining ring and not be capable of being accidentally immersed into a drain, WC or other potential source of contamination. Shower heads must be capable of being dismantled to facilitate ease of cleaning, descaling, and disinfection. Selection of these fittings should prioritise ease of maintenance. Clinical staff and domestic staff should be aware of the need to not remove the retaining ring and to rehang the shower head if removed from the holder when used.
- 12.66. The flow of some showerheads can be adjusted by selecting different sets of nozzles (fine spray and pulsating flow); as this will exacerbate possible stagnation problems, they should not be installed in healthcare premises.
- 12.67. TMVs should be easily accessible in such a way as to prevent damage to the shower installation, the supply pipework, or the removable panels themselves in wet areas. Access for safe inspection and removal should be given high priority. Where anti ligature fittings or other remote access requirements for maintenance in high risk (in radiotherapy/ ablations rooms for example and mental health areas are required, this should form an early part of the space planning strategy. The cleaning of shower areas should follow the national cleaning specification/ local policy. Whilst estates maintenance etc is provided in SHTM 04-01 Part B.
- 12.68. Risks from all potential opportunistic waterborne pathogens can be mitigated by designing out all potential sources of exposure to water, sprays and aerosols derived from water. In critical care areas, Hopman et al. (2017) have shown the beneficial effects from removing tap water resulting in an overall reduction in the incidence of Gram-negative infections.

13. Above ground drainage

Introduction

- 13.1. Drainage systems should be designed to British Standard (BS) EN 12056-2:2000 but should also consider the added sensitivities of the healthcare setting.
- 13.2. Care should be taken in the design/ planning of the drainage to protect areas with vulnerable patients and sensitive equipment such as cold water storage tanks. In areas where there is a risk of condensation, insulation will be required to prevent moisture accumulation and potential microbiological growth.
- 13.3. Regardless of the venting arrangements, a designer above ground drainage risk assessment should be provided and discussed with the Water Safety Groups (WSG). This should highlight the pros and cons, maintenance requirements, locations of venting, other building openings to prevent smells re-entering, whether radioactive (or similar) effluent will be discharged and possible Healthcare Associated Infection (HAI) issues. The NHS boards Infection Prevention and Control Team (IPCT) should be fully engaged during each project stage.

Layout planning

- 13.4. Where practicable, the planning of the pipe routing should avoid main drainage stacks being routed inside of spaces where treatments, procedures, operations or imaging of patients may take place (without being enclosed in an accessible service enclosure). Wherever practicable, this service enclosure should be accessed from an adjacent, non-clinical area. Consideration should be given to the planning of pipework on outside walls where possible, a suitable risk assessment should also be undertaken, covering access at height for example.
- 13.5. The least desirable situation would find non-vertical drainage pipe routes, in the ceiling void above critical patient rooms or above spaces which contain sensitive equipment. Preference must be given to the use of sufficient vertical stacks which then removes the need for this scenario. If the project team (including the WSG) establishes that horizontal pipework in sensitive spaces is the only option, drip trays with Building Management System (BMS) leak detection should be considered. This should be appropriately risk assessed by the project team and WSG.
- 13.6. Locations for rodding/ access points should be in accordance with the BS EN 12056-2:2000. In addition, the design should, wherever practicable, plan to locate these away from patient areas. They should be at heights/ locations where overspill/ fouling is unlikely or can be contained and cleaned.

- 13.7. Coordinated space planning for building services must acknowledge the correct gradients for pipework to ensure that inadequate gradients are not enforced through poor planning.

Drainage outlets

- 13.8. Locations for drainage outlets in sanitary ware should avoid direct water discharge onto the drainage outlet, under normal operation. Bends at outlets must be no more abrupt than slow radius and must meet the manufacturer's requirements.
- 13.9. Shower drains should be positioned so that patients do not stand directly over them particularly in augmented care settings, to reduce the risk of splash-back and environmental contamination. Additionally, outlets in shower trays must be located away from the direct projected flow of water from the showerhead to minimise aerosol generation and surface pooling.
- 13.10. Clinical basins will have an outlet, which is not in the direct line of water flow. It is important, however, that the design and installation does not encourage ponding of water. This should involve discussion with the manufacturer and care in the methods of sealing drain outlets. The drain outlet should be seen to drain freely from the wash hand basin, and the water is not backing up as this can lead to splashing and contamination to surrounding areas. Refer to the National Infection Prevention and Control Manual (NIPCM) for further guidance.
- 13.11. Where a method of retaining water in the sanitary ware is included (such as in a bath) it must not be lower than the internal surface of the sanitary ware to ensure that the drain does not form part of the retained water surface. Isolation to retain the water from a point along the drain, will give rise to cleaning difficulties for the section of the surfaces which retain the water between the isolation device and the internal surface of the sanitary ware.

Materials

- 13.12. The pipework system and fittings must be from the same product range to ensure successfully sealed joints. Manufacturers guidance should be followed for drain design and only sealants approved by them used and installed by those trained by the manufacturer.
- 13.13. The materials should be selected to suit the application, considering the topics of longevity, resistance to damage, chemical resistance, acoustic performance, and fire performance.
- 13.14. Drainage stacks and WC discharges may be manufactured from cast iron (internal coating), ductile iron (internal coating), polyvinyl chloride (PVC), high density polyethylene (HDPE), or polypropylene. Vulcathene may be required depending on the patient group as identified via the clinical/boards brief. The project team should liaise closely with the Healthcare Organisations project team to ascertain material requirements.

- 13.15. Drainage runs which connect sanitary ware to the stacks may be Modified Unplasticized Polyvinyl Chloride (MuPVC), polypropylene, ABS, or copper (for high temperatures).
- 13.16. Joints shall in the main, be jointed using solvent joints. Mechanical joints shall be used where regular dismantling will be required. In addition, expansion joints may be required.
- 13.17. Traps shall be selected to meet the specific needs of the drain. Traps for ventilation and cooling system drains are covered in Scottish Health Technical Memorandum (SHTM) 03-01 Part A. Drains for sinks, basins and showers are covered in SHTM 64. Traps on the overflow and warning pipes from filtered water storage tanks should be tubular manufactured from borosilicate glass. Traps for specialist applications (for example laboratories and plantroom floor drains) should be selected for the specific purpose.
- 13.18. Support systems shall all be in accordance with the manufacturers guidance.
- 13.19. Where drains run in patient areas, the acoustic standards may require insulation to be applied around the pipework to comply.
- 13.20. Insulation will be required on cold water drainage pipes, such as rainwater and condensate drains where there is a risk of condensation.
- 13.21. Expansion facilities must be in accordance with the manufacturer's requirements.
- 13.22. Fire stopping standards must be met in terms of the Scottish Technical Standards and of the NHS Firecode.
- 13.23. During installation, pipe ends and outlets should be temporarily sealed with purpose made caps to prevent site debris entering. A clearly identifiable set of separate tools should be used for the above ground drainage system installation. A separate set of tools will also be required by those who maintain the above ground drainage system. Cleaning of the tools should be undertaken, and records kept of this.

Venting

- 13.24. The system venting arrangements must comply with BS EN 12056-2:2000 and local building standards. Preference should be given to using open ended vent pipes, which terminate external to the building in preference to air admittance valves.
- 13.25. Open vents can be combined once they are above the wet sections of the system, before exiting to outside and terminate with an appropriate guard or cage or durable material.

Testing and commissioning

- 13.26. Similar to the domestic water services process, the designers should provide a commissioning brief for the contractor's commissioning engineer. This brief should specify fully and clearly the extent of the commissioning and maintenance and the objectives which must be achieved, and should include:
- any plant and equipment data
 - drawing and schematics
 - list of test certificates to be provided
- 13.27. Testing and commissioning should generally follow BS EN 12056. With pre-commissioning checks including general inspections (undertaken by the projects team and the Healthcare Organisations WSG) as the work progresses onsite to ensure pipework is clear of obstructions and debris before being concealed. In addition to this before handover:
- visual checks of pipe joints should be undertaken when wetted
 - all traps installed should be checked for debris
 - an intrusive CCTV survey should be undertaken. This is to identify any site debris and the quality of the installer's workmanship of the joint. This will highlight whether jointing materials project into the pipe free area. The scale of survey should be proposed by the project team and agreed with the Healthcare Organisations WSG
 - all stacks should be suitably labelled for cross referencing to drawings
- 13.28. If any existing outlet(s) are deemed not necessary, a drainage risk assessment should be considered as the removal may affect the interconnected drainage systems performance. If the outlet is decommissioned and removed, the drainage pipe should be cut back to the branch and capped appropriately.
- 13.29. The Healthcare Organisation should have in place a permit to work scheme for the above ground drainage system. The permits will be issued by the Authorised Person (Water) - see SHTM 04-01 Part B for more details on the duties - for installation, commissioning and ongoing maintenance as required.
- 13.30. The Healthcare Organisation should consider a proactive approach to checking potential trap seal loss of floor drains. This may occur due to improperly sized branch pipes causing self-siphonage or infrequent use which can lead to evaporation.
- 13.31. The WSP should outline the following for the above ground drainage system (not exhaustive):

13.32. The procedures for unblocking drains,

- procedures for decontaminating equipment used in unblocking drains
- process for reviewing any patterns of blockages
- agreed time limits deemed acceptable by the WSG when drainage outlets become blocked, as the domestic water feed could become stagnant as the drainage outlets are waiting to be fixed
- planned preventative maintenance should also be considered for the installation, based on the complexity of the system

Draft for Consultation

14. Building management systems

Introduction

14.1. The continued safe operation of domestic hot and cold water systems requires a number of routine checks to be made by physical means using separate thermometric equipment. A number of the control parameters can, however, be continuously monitored by building management systems (BMS) even though routine checks will still be required for calibration purposes. Parameters that should be monitored are as follows:

- A. incoming mains temperature (at the water meter), inlet, outlet, and surface water temperatures of cisterns and cold-water feed tanks for hot water calorifiers
- B. temperatures for calorifier flow and returns
- C. hot water service return temperatures on all primary and subordinate loops

Note 49: In non-recirculating hot and cold systems, at least two points, including the furthest from the entry of the pipe into the department, should be monitored. In other departments, monitoring should be provided on a similar basis.

- D. cold water service at furthest point and in a location that demonstrates general temperature representation within the ward/ department (this may be in a ceiling void or behind an IPS panel)
- E. consideration should be given to the frequency, timing, and monitoring of taps and so on with automatic flushing devices
- F. consideration towards BMS monitoring of constant dosing/ disinfection systems and water filtration systems

14.2. In addition to temperature, the BMS should monitor pressurisation and circulating pumps and water treatment systems for fault conditions or change of status likely to result in a fault. There should be a documented procedure for regularly checking the BMS for such alarms. Where water treatment systems go into fault/ alarm due to a chemical gas alarm, consideration should be given to an audible alarm and beacon, so that the persons entering that area are not put at risk by any chemical gases. Additional local extract systems may be required for chemical gases, refer to Scottish Health Technical Memorandum (SHTM) 03-01 Part A and manufacturers recommendations for details.

- 14.3. Remote temperature, usage patterns and flow rate monitoring can also be completed by using systems which are not integrated with the BMS system but that the Healthcare Organisation can access and monitor alongside the service provider. Where remote monitoring is proposed the parameters should be set so that areas of non-compliance can be easily identified and appropriate actions taken. Such systems proposed should be agreed by the project team and the Healthcare Organisation Water Safety Groups (WSG). A biofilm monitoring device(s) should also be considered and agreed with the Healthcare Organisation WSG.
- 14.4. As part of data collection and water management, The Healthcare Organisation should consider implementing software systems/ electronic logbooks which can interface with monitoring tools, Barcode readers, temperature recorders and Personal Digital Assistants (PDAs) These can automate the collection of data, provide dashboards, compliance reports, assist in the collection of data and aid in Water Management compliance.
- 14.5. Where a BMS is used, it will be essential to ensure that regular calibration and physical tests are performed in accordance with the manufacturer's instructions. The designer as part of their designer's risk assessment should have noted maintenance/ calibration requirements, cost and possible time out of service.

15. Pipework installations

Introduction

- 15.1. All hot and cold water pipework should be designed and installed in full accordance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and relevant parts of British Standard (BS) EN 805, BS EN 806-2 and BS 8558. When specifying pipework materials, requests should be made to the manufacturer for data sheets of pipework limitations, this includes [but is not limited to]:
- operational temperatures (cold and hot)
 - disinfection types and volumes for constant and shock dosing
 - thermal disinfection temperatures and durations
- 15.2. Within the system, it is essential to include facilities for measuring, regulating, isolating, venting, draining, and controlling the flow of water. Regulating valves with built-in pressure tapping's or orifice plates with manometer tapping's will be required for the measurement of pressure drop, which enables the volume rates of flow to be determined. Care should be taken to ensure that regulating valves or orifice plates are sited well away from bends or fittings.

Sizing

- 15.3. Pipes should be capable of a rate of flow to satisfy the combined maximum demand of all the services to be supplied. All the maximum demands of the separate services may not occur simultaneously, and the actual combined maximum demand may be a proportion of the sum of the separate maximum demands, which will be determined by the number and character of the services.
- 15.4. Hot and cold water pipework should be sized using the procedure outlined in Chartered Institution of Building Services Engineers (CIBSE's) Guide G - 'Public health engineering' and BS EN 806 Part 3.

Pipe branching

- 15.5. Pipe branches should be designed with the aim of avoiding stagnation. As far as practical, the maximum length of any pipework between a terminal device and a recirculating system or a cold-water distribution main should be kept to a minimum; generally, the complete length of the spur should not exceed 3m. The length is measured from the centre line of the circulation pipework to the point of discharge along the centre line of the pipework. These pipes should be insulated.

Routing of pipework

- 15.6. Pipework in buildings should be designed and routed:
- so that minimal heat transfer will occur between hot and cold or the surrounding environment
 - in a manner that will promote good turnover of water, particularly in cold water service systems
- 15.7. All pipework should be accessible for inspection, maintenance and repair as far as is practicable. Ducts, trenches and chases containing pipework should be large enough to facilitate repairs.

Buried pipelines

- 15.8. Pipelines made of plastics are susceptible to hydrocarbons such as fuels and oils. These chemicals can travel through plastic pipes if they are nearby and contaminate the water supply, and it may take days, weeks or even months before a noticeable taste can be detected in the water supply. Whenever spills are reported, an assessment of services within the area should be undertaken (see Water Industry Specification (WIS) 4-32-19 and UK Water Industry Research (UKWIR's) '[Guidance for the selection of water supply pipes to be used in brownfield sites](#)').
- 15.9. Pipework distribution networks should be divided into sections by the provision of isolating valves in accessible locations to facilitate isolation for repairs, maintenance, and flushing.
- 15.10. Underground mains need not be laid at unvarying gradients but may follow the general contour of the ground. As far as possible, however, they should fall continuously towards drain points and rise continuously towards the air vent. They should not rise above the hydraulic gradient; that is, there should always be a positive pressure, greater than atmospheric, at every point under working conditions. The gradient between air release and drainage valves should be not less than 1:500 rising in the direction of flow and not less than 1:200 falling in the direction of flow.
- 15.11. Underground pipes entering a building should do so with a cover of not less than 0.75 m below the external ground surface and should pass through the wall within a watertight built-in sleeve. The sleeve should be filled in around the pipe with a suitable material (hydrophilic or similar) for a minimum length of 152 mm at both ends to prevent the ingress of water or vermin. External underground pipes should be at a depth, or otherwise sufficiently protected, to prevent damage by traffic and any consequent vibrations. A minimum depth under roadways of 1 m measured from the top of the pipe to the surface of the roadway is necessary. In other underground locations the depth should not be less than 0.75 m, subject to this depth being sufficient protection against frost (frost penetration

depends on the nature of the subsoil and the ground surface). Freezing can occur at depths of up to 1.1 m, local information on the prevalence of frost should be sought.

- 15.12. Marker tapes should be laid over the whole length of all underground water services pipework (see also the requirements in BS 1710). The tapes should be clearly marked with the description of the service and should be coloured blue for potable water and red for fire mains.

Vents and drains

- 15.13. Air-release valves should be provided at high points and drainage valves at low points between peaks unless adequate provision is made for the discharge of air and water by the presence of service connections. Large-orifice air valves will discharge displaced air when mains are being charged with water. When air is liable to collect at summits under ordinary conditions of flow, small orifice air valves, which discharge air under pressure, may be required. "Double-acting" air valves having both large and small orifices should be provided where necessary. Air-valve chambers should be adequately drained to avoid the possibility of contamination.
- 15.14. Automatic air-release valves should be installed where accessible for maintenance. Installation in ceiling voids is not recommended.
- 15.15. Drain points should not discharge directly into a drain or sewer or into a manhole or chamber connected thereto without an appropriate air gap between the water system and the drain. This can be achieved with a Type AA air gap or an air-break-to-drain device in accordance with BS EN 1717 clause 9. Where a wash-out discharges into a natural watercourse, the discharge should always be well above the highest possible water level in the watercourse. Consent for this discharge may be required from the Environment Agency. In some cases, it may be necessary for the wash-out to discharge into a watertight sump, which must be emptied while in use by portable pumping equipment.
- 15.16. In order to minimise quantities of water that may collect in stub pipes at drain points, the length of such stub pipes should be kept to an absolute minimum. This relates to drains from hot water calorifiers, storage cisterns and distribution pipework.

Valves

- 15.17. A clear indication should be given on all valves of the direction of rotation needed to close the valve. Normal practice is to have clockwise closing when looking down on the valve.

- 15.18. Where blending valves have been installed at the end of a run of hot water pipework, consideration should be given to the inclusion of a drain valve adjacent to the mixer. This should be located upstream of the mixing valve to facilitate flushing out and routine temperature testing of the hot water without having to dismantle the blending valve.

Backflow protection and the prevention of contamination

- 15.19. Healthcare buildings and medical premises have been identified as involving Fluid Category 5 backflow risks (see Schedule 1 “Fluid Categories” the Water Supply (Water Fittings) (Scotland) Byelaws 2014, which are defined as points of use or delivery of water where backflow is likely to involve fluids contaminated with human waste or pathogens. Within healthcare facilities, water usage covers a wide range of applications, from domestic use by patients and staff to specialised use in operating departments and pathology laboratories, and with equipment such as bedpan washers and haemodialysis machines. Even within high-risk specialist areas such as pathology laboratories, further separation of water supplies may be required to protect water used for domestic uses from those high-risk applications. In addition, many apparently “commercial” usages may be classed as high-risk because they are for healthcare purposes (such as centralised laundries).
- 15.20. In all cold-water installations, it is important that adequate protection be provided to all supplies against backflow. In a healthcare facility, there should be a high degree of protection not only to the water in the undertaker’s mains, but also within the facility’s installations to protect the patients and staff. Instances of water use in healthcare facilities where backflow is likely to be harmful to health include bidets, macerators, bedpan washers, dental spittoons and equipment, mortuary equipment, and water outlets located in laboratories.
- 15.21. In addition to backflow protection at all points of use, the whole installation protection should be provided as required by the Water Supply (Water Fittings) (Scotland) Byelaws 2014. A plumber who is a member of the “Water Safe” scheme should be used to ensure compliance of the design and later of the installation.
- 15.22. Where any doubt exists regarding the level of protection required against water supply contamination, reference should be made to the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and guidance contained on the WaterRegsUK website or to the water undertaker.

- 15.23. The Water Supply (Water Fittings) (Scotland) Byelaws 2014 require the identification, by colour-coding or labelling, of all pipework carrying fluids other than wholesome water. This includes plumbed-in equipment used for diagnostic and treatment purposes (see BS 1710). Systems which carry specialist water systems or private water supplies, must clearly identify this on the pipework or equipment.
- 15.24. New systems should not include legs of pipework for potential future extensions to the system as these will create stagnant legs. Any alterations to existing systems – or where redundant pipework is found - should be cut back to the connection point; this includes replacing the branch 'T' with a straight coupling.
- 15.25. Certain departments such as pathology laboratories present particular risks of water contamination. Refer to the WaterRegsUK website on supplementing point-of-use (POU) protection by zone protection, where the pipes supplying a high-risk area can be given additional protection by installation of a secondary backflow protection device.

Frost protection

- 15.26. The Water Supply (Water Fittings) (Scotland) Byelaws 2014 require that all cold-water pipework and fittings be adequately protected against damage from freezing.
- 15.27. In the case of external pipework that is run underground, the Regulations require that consent be sought from the water supplier if pipes are to be run at depths of less than 0.75m or greater than 1.35m. Permission from the water undertaker should be sought if any deviation is required.
- 15.28. Care is required when routing pipework externally above ground or through unheated areas within buildings. The WaterRegsUK website gives guidance on the minimum thickness of thermal insulating materials that should be applied in such cases.
- 15.29. Adequate provisions for isolating and draining sections of cold-water distribution pipework will ensure that disruption caused by frost damage can be minimised.
- 15.30. For further guidance on frost protection, refer to the WaterRegsUK website.

Maintenance cleanliness and hygiene

- 15.31. To prevent the risk of seeding the water system during construction and installation, care should be taken to prevent the ingress of contaminants and particulate matter into pipework, fittings, and cylinders and so on. Blanking flanges, plugs and caps should not be removed until connections need to be made. Open ends of pipes should be recapped when work ceases. Particular attention should be taken when pipes are passed through partitions etc and when transporting items from storage to installation locations.

- 15.32. The Contractor is responsible for handing over a pathogen free system as far as reasonably practicable, has shown they have followed guidance and industry good practice, at each point of use. Contractors should come up with a documented plan at the tender stage as to how they will do this.

Draft for Consultation

16. Noise and vibration

Pump noise

- 16.1. Noise generated by centrifugal pumps will not cause problems if water velocity in the pipes and the speed of the pumps are low, for example about 1 m/s and 960 rpm respectively.
- 16.2. Care should be taken in locating water-boosting pumps within healthcare buildings to ensure that they will not cause interference to in-patient accommodation and other quiet zones.
- 16.3. Such interference may result from break-out noise from the boosting equipment, or noise transmitted through the pipework system or through the building structure. Pump noise may also result from cavitation caused by low suction head.
- 16.4. Where pumps are located close to sensitive areas, provision for noise and vibration reduction should be incorporated in the design. Such provision will include selection of quiet-running motors, vibration isolation of boosting equipment from pipework and structure and, if required, acoustic lining to the booster plant enclosure.
- 16.5. Guidance on recommended noise levels for various locations is given in Chartered Institution of Building Services Engineers (CIBSE's) Guide A - 'Environmental design' See also Scottish Health Technical Memorandum (SHTM) 08-01: Specialist services Acoustics.

Other forms of system noise

- 16.6. Other forms of nuisance noise that may be generated by hot and cold water distribution systems are listed below:
 - A. noise from pipework due to excessive water velocity
 - B. water hammer caused by rapid closure of valves or taps
 - C. oscillation of the float of a float-operated valve
 - D. tap washer oscillation
 - E. noise caused by water discharging from float-operated valves into cisterns
 - F. noise caused by thermal movement of pipes
 - G. noise due to trapping of air within pipework, particularly on hot water systems
- 16.7. Further details on the above sources of noise, including guidance on avoiding such noise problems, are given on the WaterRegsUK website.

17. Water economy and energy conservation

Water

- 17.1. Hot and cold water distribution systems for healthcare buildings should be designed to ensure water poses no risk to users and for all uses, this should be the primary design objective, the building water systems and any ancillary equipment should be designed, specified, constructed/ installed, commissioned so it is pathogen free at handover and remains so during normal operation and maintenance. The cold-water distribution systems should incorporate an adequate number of water meters to allow for close monitoring of water consumption. Where practicable, consideration should be given to linking water meters to a building management system (BMS) or an automatic metering system. Saving water in healthcare environments, while maintaining water quality is a careful balancing act. The most effective way to conserve water is simply to avoid unnecessary outlets being installed which may lead to unnecessary flushing regimes. This should be combined with avoiding excessive volumes of stored water and sizing distribution pipework which encourages suitable water flow rates.
- 17.2. Measures to optimise water consumption and yet avoid risk of stagnation - that should be considered at design stage include:
- provision of automatic systems to control flushing of urinals
 - use of showers rather than baths wherever practicable
 - WC pans and flushing cisterns that use more than 6 L per flush are prohibited by the Water Supply (Water Fittings) (Scotland) Byelaws 2014, Building Standards Non-technical handbook refers to the use of 4.5 L per flush
 - control of water pressure to a level that is not excessive for the purpose required
 - use of self-closing or non-concussive taps in appropriate circumstances (only if agreed by the Water Safety Groups (WSG))
 - locating warning pipes from cisterns and discharge pipes from relief valves in such a way that any discharge can be readily observed, and/ or fitting alarms on such pipes
- 17.3. Further guidance on the prevention of wastage of water is given on the WaterRegsUK website.

Energy

- 17.4. Where water-boosting pumps are used, the pump motors should be selected to operate at maximum efficiency at the required duty.

- 17.5. The practice of pre-heating of the cold feed to calorifiers should not be carried out. The only time it is acceptable is when under all flow/demand conditions a temperature greater than 45°C can be guaranteed at the entry to the calorifier. Any pre-heater should have a low water capacity. Heat recovery/systems for pre-heating water for domestic purposes should not be installed in healthcare premises unless there are adequate fail-safe measures in place to ensure that the hot water distribution system is not compromised.
- 17.6. Further guidance on energy conservation in relation to hot and cold water systems is given in Scottish Health Technical Memorandum (SHTM) 07-02 - 'Encode' (see also the [Carbon Trust website](#)).
- 17.7. SHTN 02-01, Sustainable Design and Construction (SDaC) Guide has been developed to support healthcare organisations in making informed decisions that enhance their role in mitigating and reducing the effects of the global climate emergency. It provides a framework for developing an environmentally and socially sustainable health service that is resilient to the impacts of climate change.
- 17.8. It is a requirement that all healthcare organisations adopt and follow this guidance to help deliver sustainable outcomes when undertaking any works that impact the physical built environment, for example new build, refurbishment, minor works or any other preplanned work across the estate, throughout the lifecycle of an asset.
- 17.9. In making final decisions on water conservation actions, other factors should be considered, 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 the WSG to identify any health risks or patients' needs that may be relevant.

18. Installation, testing and commissioning

Introduction

Note 50: See also Health Technical Memorandum (HTM) 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'.

- 18.1. While testing and commissioning is regarded as a discrete activity, continuous monitoring is required throughout the installation to ensure that:
- A.** materials and equipment installed comply with the Water Supply (Water Fittings) (Scotland) Byelaws 2014 and other British Standards (BS) and are not otherwise unsuitable. For example, equipment has been assessed and shown mechanically and materially to be appropriate (for example, suitable approvals) for the intended purpose) and has been installed in accordance with any relevant conditions
 - B.** the work is done entirely within the specification for the scheme
 - C.** all the requirements of current legislation are met, both during construction of the installation and when it is completed, particularly regarding the Health and Safety at Work etc. Act 1974
 - D.** the hygienic nature of the installation of the system components is fully understood and that preventative measures have been put in place, for example the separation of tools used on potable and non-potable systems, cleaning of tools, health screening and surveillance

Installation check

- 18.2. The system should be regularly checked during installation to ensure that open pipes, valve ends, and cylinder connections are sealed to prevent the ingress of dust/ debris that could cause problems during commissioning and subsequent operation. Checks should also be made to ensure that lead solders are not being used.

Inspection of joints

- 18.3. Before pressure testing, a number of fittings should be identified that will be cut out for examination to establish whether the quality of the finished joint meets the specification. The exact number to be cut out will vary according to the size of the installation, but as a guide, a ratio of one fitting per 400 installations should be cut out. In any event, a minimum of two, and not normally more than five, fittings should be cut out for examination for each pipe fitter involved in the installation. During the installation the initials of the fitter should be written on the pipework beside each joint and records kept indicating clearly who worked on each part of the system.

- 18.4. The fittings cut out should be cut open (quartered longitudinally) and examined by the manufacturer or an agreed competent independent individual out with the project with a resulting report identifying (not an exhaustive list) of insertion depth, deburring of the pipe end, o-rings intact and if the fitting has been correctly pressed. In order to maintain a full record of the inspected joints, consideration should be given to photographing the fittings before removal, recording the pipeline section the fitting was removed from and photographing the 'made good' fittings. If unacceptable joints are found, adjacent fittings should be cut out until the extent of any faulty workmanship has been established.
- 18.5. New joints will be installed, and all pipelines should be made good.
- 18.6. The tube and fitting should be internally clean and free from particulate matter. Some oxidation will be evident when hot 'joints' are made on copper piping.
- 18.7. When copper pipe and capillary fittings are used, because of the viscosity of the brazing filler, full penetration may not be achieved.
- 18.8. The minimum penetration at any point must be three times the wall thickness of the tube or 3mm, whichever is the greater.

System filling

- 18.9. Prior to the system being filled, consideration should have been given as to when PPMs and monitoring should commence, this should form part of the PWSP. Supervised filling of the system should follow the project WSP should only be carried out as late as possible and should minimise the risk of microbial growth as far as reasonably practicable using potable water (especially in areas intended for augmented care/ high risk) through a Point Of Entry (POE) (0.2-0.5 micron) filtration to minimise the risk of microbial ingress during the filling process (no quick fill via fire systems or bypasses of POE control systems).
- 18.10. Filling should be supervised by the competent operational estates/ soft landings champion/ Client project assurance team. No equipment to be used which has been filled previously with water unless certificated to say it will not pose a risk to the system from microbial ingress. Connections into the new system only via an appropriate in line 0.2-0.5 micron filter (even if testing with dry air to prevent unnecessary microbial ingress). Only filled by those with Watersafe/ Water Industry Approved Plumbers' Scheme (WIAPS) or equivalent certification. Refer to Scottish Health Technical Memorandum (SHTM) 04-01 Part D and E for further guidance.

- 18.11. Once filled the system should be flushed (this may include leachate flushing as prescribed in SHTM 04-01 Part E) refilled and disinfected with an oxidising biocide following the manufacturers protocols (concentration/ contact time/ target parameters (pH/ biocide levels) with tests at all furthest points and taking account of the materials. Cisterns/ tanks should have bypasses (which do not constitute a dead leg so the system can be filled and used without filling the water storage cisterns/ tanks and allow for draining and maintenance). Once filled the system should be managed as in normal operation with regular flushing and biocide tests to ensure target residual levels and temperatures are maintained.
- 18.12. A flushing regimen should include every associated system and item of plumbed in equipment. A plan for ongoing verification should have been Water Safety Groups (WSG) pre-approved together with the sampling plan and criteria for accepting the handover and actions to take if positive outlets are found. Each outlet identified by the Healthcare Organisations WSG to be sampled shall be carried out and tested independently by a client approved sampling and testing contractor. Refer to SHTM Part C for further guidance.

Commissioning

- 18.13. Correct commissioning is vitally important for the satisfactory operation and long-term control of hot and cold-water systems. It is important to stress that the commissioning is undertaken prior to the facility being occupied. Where buildings are to be occupied in stages, the systems should be commissioned in stages as occupation is anticipated. The commissioning brief should have been prepared at the design stage, risk assessed and agreed by the Project Water Safety Groups (PWSG), soft landings champion and from specialist external advisers if necessary. The design team should prepare this commissioning brief for use by the contractor's commissioning engineer.
- 18.14. It is important that any commissioning plant used on the water system should not bring with it a possible risk to contaminate the system. Verification shall be provided and checked by the PWSG, that the equipment does not pose a risk of microbial contamination (such as because it had been filled with water/ used on other sites prior to this commissioning).
- 18.15. Method statements and associated task risk assessments should be prepared by the design team and contractors, and this should be agreed by the WSG before commissioning begins and should form part of the project Water Safety Plan (WSP). As commissioning correctly is such an important step in ensuring the safety of the building for the rest of its life cycle, estates departments should ensure competent staff are available for witnessing key stages. All isolation valves to be left fully open to allow for system balancing during commissioning to take place. Isolation valves should not be used to balance systems.

- 18.16. The project WSP should also include details (not an exhaustive list, refer to British Standard BS 8680 and Chartered Institution of Building Services Engineers (CIBSE) Commissioning Code M):
- clearly defined roles and responsibilities
 - risk assessments
 - agreed programme of work
 - sampling plan
 - competence of individuals carrying out commissioning activities have been reviewed, and this has been documented
 - a Healthcare Organisation's representative will witness commissioning activities
 - escalation plans if sampling results give non-compliant outcomes
- 18.17. The water system should be filled as late in the commissioning process as possible. Due to the scale and complexity of some pipework installations, consideration could be given to a phased fill, this would require suitable risk assessments and planned control measures as agreed by the PWSG and the healthcare organisations main WSG before commencing. The design team should consider using dry inert filtered gas or air (introducing moisture can encourage microbial growth and corrosion) for pressure-testing when possible. The system should be flushed to remove all flux and debris before being filled with water as soon as possible to prevent biofilm development and corrosion. Refer to previous paragraph 18.9 for system filling. Treated water should be available as necessary during the commissioning process. All strainers should be cleaned after flushing and before final filling.
- 18.18. After water has been introduced into the system, the flushing regime agreed by the PWSG, should be introduced immediately to maintain the wholesomeness of the water content, this should be agreed by the PWSG and should take into account the system design and anticipated water usage. The flushing regime should not be delayed until building occupation. Consider filling with a disinfectant residual (after the first flush) and ensuring that residual and temperature targets are maintained throughout the system (documentation to be audited independently by the project assurance team/ soft landings champion). An elevated biocide level may be considered in unoccupied buildings, this should be discussed and agreed with the PWSG before commencing.
- 18.19. It is essential that the results of all checks and measurements are recorded in writing at the time they are made, by the person undertaking the task, and be available to the Healthcare Organisation before leaving site. Breaks in the continuity of commissioning operations are likely, and proper records will show the state of progress at any stage. It is most important that commissioning records are provided as part of the handover information.

- 18.20. The handover of a phased system should only occur when the water system is delivering safe water as defined by the healthcare organisation and their original design brief. The handover documents should include for any details relevant to any phased ongoing works, and assurances and plans to ensure the portion of the system not complete will meet the water hygiene standards.
- 18.21. Where there is a delay between commissioning of the water systems and the building being occupied and taken into use, the system should be considered and operated as a live system. It is essential to put control measures in place to ensure that system temperatures are maintained and routine flushing is carried out. All interim control measures should be reviewed and agreed with the healthcare organisations WSG. Any planned maintenance activities, such as TMV/ thermostatic mixing taps (TMT) checks and servicing as identified by the healthcare organisation that fall within the time delay to handover should be undertaken. Records should be retained of all control measures and servicing. All records and testing results should be shared with the healthcare organisations Authorised Person (Water) and WSG for review.
- 18.22. The commissioning brief should specify fully and clearly the extent of the commissioning, the competencies of the personnel to be carrying out the process and the objectives which should be achieved, and should include:
- full design data on temperatures, water flow rates and pressures
 - plant and equipment data
 - number of commissioning procedures for thermostatic mixing valves (TMVs) in accordance with HTM 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'
 - drawings and schematics
 - a list of test certificates to be provided
- 18.23. The design team's attention is drawn to CIBSE's Commissioning Code W - 'Water distribution', which provides guidance on information that will be required by the commissioning engineers.
- 18.24. In the preparation of commissioning instructions for domestic hot and cold-water services, design teams should ensure that their work is in accordance with up-to-date guidance.
- 18.25. The design team should prepare for inclusion in the contract documents a list of tests and measurements that are to be taken by the contractor and recorded. These should be witnessed by the contract supervising officer or project engineer on their behalf and if approved, will circulate the results, in accordance with the client's instructions.
- 18.26. The installation, on completion, should be operated by the contractor as a whole, and subjected to functional or performance tests.

- 18.27. The commissioning manual should be prepared by the contractor and submitted to the client's commissioning adviser and the WSG/ PWSG (with support from their specialist adviser if required) for review before being issued in final form.
- 18.28. Schedules of checks and performance tests should be included in the commissioning manual together with record sheets. These should be amended and supplemented as the design team considers necessary.
- 18.29. On completion of all commissioning activities as defined in the commissioning plan, with witnessing undertaking as deemed appropriate by the WSG/ PWSG, and once the client's commissioning adviser is satisfied that the system meets the design intent, the final accordance record sheets should be completed. If performance is not acceptable, the matter should be dealt with in accordance with the contract requirements.
- 18.30. The supervising officer or project engineer, who should countersign any relevant test record documents, should witness commissioning and testing as deemed appropriate by the WSG/ PWSG.
- 18.31. "As installed" record drawings, schematic diagrams, and operating and maintenance instructions should be supplied at the time of handover. The as installed drawings should be checked to see they reflect the installation. Certified records of pressure-testing and disinfection should also be made available.
- 18.32. The whole commissioning procedure should be carried out under the guidance of a single authority, appointed by the PWSG, this is to avoid multiple organisations taking responsibility for only their own small part and no-one overseeing the full process to ensure there are no gaps. The involvement of specialists or manufacturers may be required for specific items of plant.
- 18.33. Valid calibration certificates should be submitted and checked for all measuring equipment to be used by the commissioning engineers before the start of the commissioning phase. Alternatively, calibration certificates should be checked on the date of witnessing, a witness should record this.
- 18.34. The commissioning should be carried out in a logical and methodical manner.
- 18.35. The installation, on completion, should be operated by the contractor as a whole, and subjected to specified functional or performance tests. The full system should be running in a steady state system for a period of time as identified in the contract and PWSP before handover to the healthcare organisation
- 18.36. Once the system meets the design intent, the final completion record sheet(s) should be completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract requirements.

- 18.37. Before handover, systems should run at normal operational levels for at least eight weeks to verify they are safe for occupation. This process involves flushing the designed volume of water each day, seven days per week, at every outlet and plumbed-in equipment until the building is in full use. During this period, the results of post-commissioning biological checks can be reviewed by the PWSG.

Commissioning and testing checklist

- 18.38. The following is a summary of the key activities associated with pre-commissioning and commissioning of hot and cold-water storage and distribution systems. The list is not intended to be comprehensive.

Note 51: Before water is introduced into any part of the system, checks should be carried out to determine that appropriate backflow prevention measures have been implemented.

Cold-water installations

- 18.39. Pre-commissioning checks can be carried out on completion of the system installation, filling and pressure-testing.
- 18.40. Pre-commissioning checks and tests to be applied are as follows. Check that:
- A.** systems have been provided and installed in accordance with specification and drawings, and that the systems are charged with water (with sufficient disinfectant residual to prevent microbial colonisation and growth), vented and free from leaks
 - B.** water storage cisterns are free from distortion and leaks, are properly supported and secured, are provided with correctly fitting covers, and are in accordance with the Water Supply (Water Fittings) (Scotland) Byelaws 2014
 - C.** distribution pipework is rigidly supported, insulated, and incorporates adequate provisions for venting, draining, expansion, isolation and measurement of flow, temperature and pressure
 - D.** pipework systems have been pressure- tested

Note 52: Except where otherwise specified, testing of underground pipelines should be carried out in accordance with the requirements of the Water Supply (Water Fittings) (Scotland) Byelaws 2014.

- E.** pipework systems and storage/break- tanks are correctly identified and marked
- F.** regulating valves and flow control devices operate freely
- G.** water meter(s) is/ are fitted correctly
- H.** electrical isolation, cross-bonding and wiring of system components are installed in accordance with the current edition of BS 7671

Hot water installations

- 18.41. Pre-commissioning checks can be carried out upon completion of system installation, filling, and pressure-testing.

Note 53: Before water is introduced into any part of the system, checks should be carried out to determine that appropriate backflow prevention measures have been implemented.

- 18.42. Pre-commissioning checks and tests to be applied are as follows. Check that:
- A.** systems have been provided and installed in accordance with the specification and drawings
 - B.** the system is charged with cold water (with sufficient disinfectant residual to prevent microbial colonisation and growth), vented, and free from leaks
 - C.** hot water storage vessels are free from leaks and are properly supported and secured
 - D.** distribution pipework is rigidly supported, insulated, and incorporates adequate provision for venting, drainage, expansion, isolation, no metallic ties (which cross from hot to cold allowing heat transfer), measurement of flow, temperature and pressure, no inserts are fitted to outlets and no dead legs/ blind ends
 - E.** pipework systems and storage cylinders have been pressure-tested
 - F.** pipework systems, calorifiers and cisterns are correctly identified and marked (all pipework labelled including with flow), outlets and sentinels barcoded
 - G.** regulating valves and flow control devices operate freely
 - H.** all control and regulating valves are labelled or marked to correspond with reference numbers on contract drawings
 - I.** electrical isolation, cross-bonding and wiring of system components is installed in accordance with the current edition of BS 7671
 - J.** up-to-date system schematics are displayed in a frame in the relevant plantroom and additional schematics are available for update

Commissioning checks of hot and cold-water systems

- 18.43. Upon satisfactory completion of the pre-commissioning checks, the systems should be cleaned, disinfected, and flushed before refilling. Advice on cleaning and disinfection is given in Health and Safety Guidance (HSG)274 Part 2 and SHTM 04-1 Part D.
- 18.44. Commissioning checks and tests to be applied are as follows. Check that:
- A.** drain-down points flow when released and are free from leaks when shut, that air vents and release valves open correctly and are airtight when shut off, and that overflows run freely, and discharged water does not cause flooding or damage

- B.** wastewater system is freely flowing and there is no debris/ rubble in the system or backflow resulting in contamination of sinks, basins, shower floors and shower trays
- C.** float-operated valves function satisfactorily and are adjusted to achieve the correct water level
- D.** all temperature and other controls are adjusted and calibrated to agreed design limits of system performance
- E.** all electrical circuits are tested, and the pump motor direction of rotation is correct, and that electrical controls and alarms function correctly, equipment readouts calibrated and independently verified
- F.** operation of any safety or anti-flood device is satisfactory
- G.** circulating and pressurisation pumps are free from excessive noise, vibration and leaks and that pressurisation vessels are filled to the correct water level, automatic pump switching operates as intended
- H.** expansion vessels where installed are filled to the correct water level, they shall be fitted vertically, are easy to drain, are sited away from any source of heat gain and can be accessed for sampling/draining bladder change
- I.** control valves operate correctly, and shut-off valves close tightly
- J.** heat exchangers operate satisfactorily
- K.** primary heating circuits are adjusted and regulated, and thermostatic settings are correct; and that bypass circuits and automatic control valves operate correctly
- L.** remote and automatic control of pumps (if appropriate) is satisfactory, and there are no leaks at joints under maximum flow conditions
- M.** the cold water and hot water circulating, and distribution systems are vented and regulated
- N.** thermostatic mixing devices and regulating valves are adjusted and set to desired values (TMVs require hot and cold water for testing and commissioning, and should be commissioned in accordance with HTM 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)')
- O.** all taps, mixers and outlets operate satisfactorily and that all strainers and shower outlets have been cleaned and are free from contamination, outlets where intended can be operated handsfree and automatic sensors are offset so that the outlet does not get contaminated
- P.** water flow quantities at all plant items, regulating valves and flow-measuring valves are recorded
- Q.** mass flow rates from taps, main and other outlets in positions shown on contract drawings are satisfactory
- R.** pressure drop at heat exchangers at full design demand flow is tested and recorded
- S.** hydraulic balancing of hot water (or cold) secondary circulation system is carried out to ensure that minimum temperatures are achieved in all parts of the circuit
- T.** full load current of components does not exceed the recommended values

- U. the running current of components does not exceed the recommended values
- V. pump thermal overload trips are set
- W. microbiological sampling results are within range

Temperature testing

- 18.45. These tests should be performed and validated, in a normal operational simulated environment, prior to contractual handover and bringing the system into use and when in occupation. It is important to demonstrate that appropriate temperatures are achieved in normal operation. Separate thermostatic measuring and recording equipment should be used, that is, independent of any building management system (BMS), which will be suitably calibrated at the time the tests are undertaken. It will be necessary to have systems fully operational and to simulate typical draw-off of water.
- 18.46. Tests should include:
- A. measuring the incoming water temperature at the main water meter
 - B. testing the inlet, outlet and stored water temperatures of all cisterns and cold-water feed/ header tanks for the hot water calorifiers and water heaters. The temperature should be close to the water temperature of the incoming water
 - C. testing the flow and return temperatures at connections to all calorifiers and water heaters. These should not be less than 60°C and 50°C respectively
 - D. testing the temperature in branches of hot water circulating systems installed in all departments to ensure that the system has been balanced, and that under no draw-off conditions, the circulating system will achieve and maintain 55 °C at all return legs throughout the system
 - E. testing all single cold-water outlets and the cold-water inlet to mixing valves to ensure temperature equilibrium below 20°C as achieved within 2 minutes
 - F. testing all non-mixed hot water outlets to ensure that 55°C can be achieved within 1 minute of opening the outlet

Sampling

- 18.47. The WSG should discuss and agree a sampling regime and appropriate parameters (physical, chemical, and microbiological) depending on the intended use of the system and vulnerability of the patients, the sampling should confirm the efficacy of the system control measures. This should be agreed prior to tender. As a minimum testing should be undertaken at all outlets for Total Viable Counts (TVC's), *E. coli*, *pseudomonas aeruginosa* and *Legionella* spp. Local documented risk assessments should be carried out to determine if there are additional testing requirements. For guidance see SHTM 04-01 Part C, National Infection Prevention and Control Manual (NIPCM) and BS 8580-1.

- 18.48. Sampling should be carried out prior to any construction/refurbishment works. Samples should be taken no sooner than five days and no later than seven days after a full disinfection process has been completed and a further set of samples should be taken immediately prior to handover, after the system has been fully commissioned and in a steady state condition. The healthcare organisation should define the percentage failure rate for sampling in the contract and PWSP for acceptance/ handover of the facility. It is recommended that sampling is undertaken by an accredited organisation independent of the contractor. This should form part of the project WSP. The contract and PWSP should allow for a set of resamples to be undertaken, if a predetermined time between the initial sampling and handover is exceeded.
- 18.49. If any of the target organisms are identified (*legionella*, *pseudomonas aeruginosa*, *E.coli*, coliforms and so on) or are above agreed threshold limits (TVCs, selective Nontuberculous mycobacteria (NTMs) and so on) within the samples collected, then the guidance in the PWSP and SHTM 04-01 Part C should help inform the PWSGs decision on the steps to be taken. Pre and post flush samples may help identify if this is a local or systemic problem.

Discharge of wastewater used during disinfection procedures within buildings

- 18.50. Contaminated water from disinfection procedures that is run to waste, be it to a natural watercourse or sewer, can potentially result in a pollution hazard or affect the efficacy of a sewage treatment plant. It is therefore important that the appropriate consent to discharge is obtained prior to disposing of the contaminated water. It may be necessary to neutralize any disinfectants as per the manufacturers recommendations (which should be independently witnessed) and the system flushed.
- 18.51. Where water from disinfection procedures is to be discharged into a watercourse or into a drain leading to a watercourse, consent to discharge should be obtained from the appropriate authority (the Scottish Environmental Protection Agency (SEPA)).
- 18.52. Water from disinfection procedures may be classed as trade effluent and, prior to any discharge into a sewer or sewerage system, consent to discharge should be sought from the local water company that provides the sewage and trade effluent services to the site (sewerage undertaker). Notification to the wastewater undertakers should be undertaken for the discharge of chemically treated water, prior to the works being undertaken.

Note 54: Dependent on the geographical location of the site with respect to the operational boundaries of water companies, two different companies may provide the duties of the water undertaker and sewerage undertaker.

19. Documentation

Introduction

- 19.1. It is essential that a full report of all commissioning and testing activities is compiled and handed over to be incorporated within the operation and maintenance manuals.
- 19.2. These commissioning and testing records will be required so that subsequent maintenance and periodic checks can be made to ensure that the installation continues to operate as intended. Such information will include:
- results of temperature checks on the cold-water supply
 - results of temperature checks on hot water circulating systems and trace- heated hot water installations
 - commissioning and in-service test data for type 3 and type 2 TMVs (see Health Technical Memorandum (HTM) 04-01: Supplement - 'Performance specification D 08: thermostatic mixing valves (healthcare premises)')
- 19.3. The information should also include identification of, and test results for, sentinel taps (nearest and furthest outlets on all non re-circulation system as well as other points on long branches as agreed by the Water Safety Groups (WSG) and points for all Principal, Subordinate and Tertiary loops.
- 19.4. Where continuous water treatment is installed, the commissioning records should include details of settings of the equipment, dosing rates, concentrations found at the sentinels and other test points and requirements for testing.
- 19.5. Operation and maintenance manuals should be in accordance with Building Services Research and Information Association's (BSRIA's) Building Applications Guide BG79/2020 - 'Handover information and O&M manuals.
- 19.6. As a minimum, for new installations or major refurbishment, the contract should require the following documents and drawings to be supplied:
- A.** full manufacturing details, including batch numbers of all pipes and fittings
 - B.** (in accordance with British Standards (BS) 8580-1) a risk assessment for the control of Legionella and where applicable *pseudomonas aeruginosa* and other waterborne pathogens in accordance with BS 8580-2
 - C.** full records and certificates of pressure tests for all sections of pipework
 - D.** settings of all balancing valves, with readings of flow rates where applicable
 - E.** full details of each item of plant, including arrangement drawings and appropriate test certificates

- F.** as-fitted drawings, including schematics, clearly showing the location of balancing valves, flows and settings, isolation valves, drain valves. All Principal, Subordinate, and Tertiary loops must be annotated accordingly, on floor plans with flow directions and colour coding in line with the conventions set out in Health and Safety Guidance (HSG)274 Part 2, Appendices 2.4 and 2.5
- G.** schematic drawings for installation in plantrooms showing all valves and plant items
- H.** full details of water treatment parameters and operating modes and settings
- I.** full details of maintenance requirements based on the assets installed and the recommended frequency of the maintenance/ monitoring/ inspection of each
- J.** detailed confirmation of disinfection procedures to BS EN 806 series (parts 1–5), PD 855468 and BS 8558 and results of post- disinfection microbiological analysis
- K.** full records confirming that all materials and fittings are compliant with the Water Byelaws, via Water Regulations Advisory Scheme (WRAS) or equally approved other certifications
- L.** expected operational conditions of the water system (that is, expected pressures, expected temperatures, expected flow rate throughout the system as pressure drops will occur)

Appendix A Impact of water consumption on care pathways

- A.1 Within NHS Scotland, NHS boards utilise an energy monitoring, data collecting and analysing tool. This tool gathers energy and water data for NHS sites and produces consumptions based on automated meter readings on an hourly, 24 hourly, weekly and an annual basis. This information is available at NHS board/ Site level and can be accessed by contacting the relevant Energy/ Estates Officer for the information required.
- A.2 Water consumption figures are also available from NHS England, Estates Return Information Collection (ERIC) data on total water consumption (litres per day per floor area). The 2017/ 18 data for each type of healthcare organisation can be found at the [Digital NHS England website](#).
- A.3 For other historic data go to the [Digital NHS England website](#) and search on Estates.

Appendix B Water consumption

B.1 The consumption data shown here is for reference only, the healthcare organisation should refer to other similar facilities for live data as well as other industry standards to help inform the design process.

Ward unit

B.2 For the purposes of this study, a ward unit is defined as a combination of all the rooms which make up the working area for patient care, that is, patients' bedrooms, day spaces, treatment, utility and test rooms, bathrooms, showers, WCs, pantry, staff rooms, cleaners' room and circulation spaces. Figure B.1 shows the average daily consumption of stored water and Figure B.2 shows the rate of supply of mains water to cistern. Designers should consider the impact on water consumption of such specialist departments such as Renal Dialysis and the dumping of water as part of the filtration processes.

Figure B.1 - Average daily consumption of total stored water

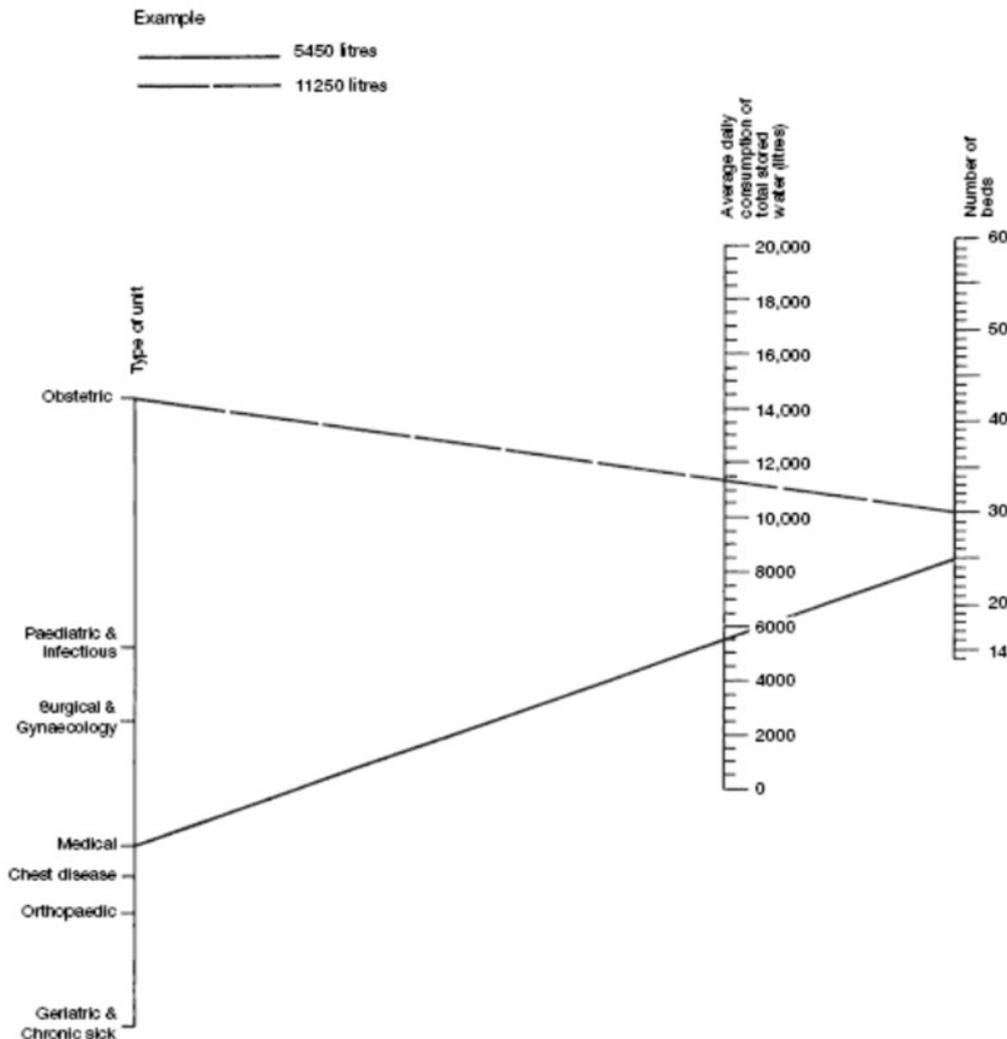
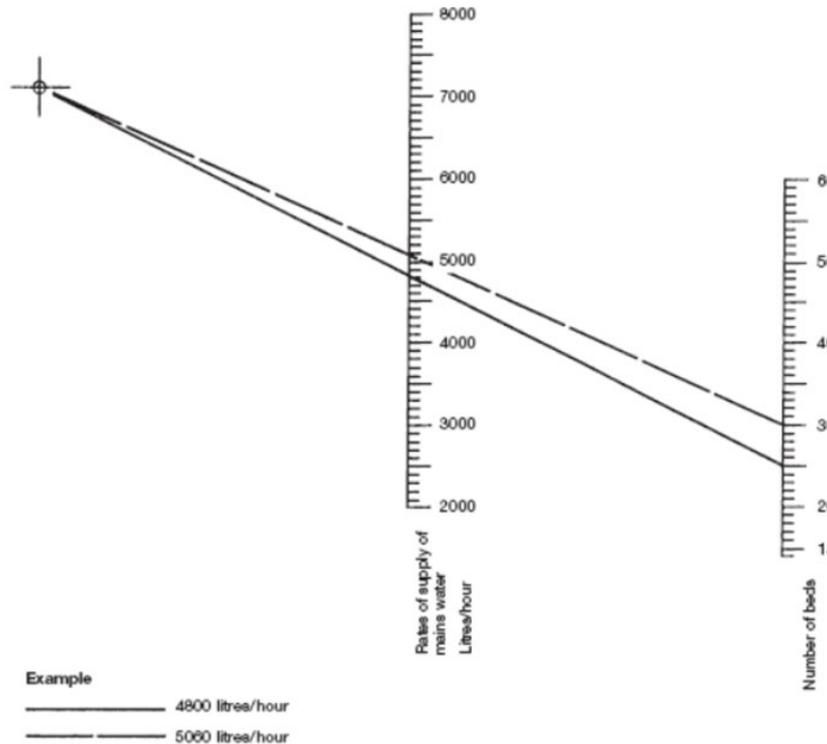


Figure B.2 - Rate of supply of mains water to cistern

Use of nomogram
Project line from point \oplus to number of beds. The intersection on 8000 scale gives rate of supply of mains water in litres/hour. The result obtained relates to one ward unit. For a given number of ward units, multiply by the number.



Average water consumption by type and size of hospital

- B.3 Table B.1 (the results of a survey of NHS hospitals by the Department of Health and Social Security in 1974) provides basic data for design guidance on the estimation of water storage and consumption for whole hospitals. The definitions that have been used for the classification of hospitals are shown in Table B.8. 'Excluded departments' are those for psychiatry (mental illness), psychiatry (mental handicap), diseases of the chest, chronic sick, geriatrics and convalescence (including rehabilitation, but not pre-convalescence).

Relative intensity of water consumption

- B.4 Whilst water consumption per bed content is a convenient estimating and planning yardstick, it does not show the widely differing floor areas which are provided per bed in hospitals of different sizes and type. To illustrate the relative rates of consumption as seen against a basis of comparable patient density and showing the amount of water consumed - not only directly by the patient but also in the supporting treatment departments - a graphical presentation of the figures given in Table B.1 to Table B.7 is presented on a per bed and per floor area basis in Figures A.3 and A.4.

Table B.1 - Average water consumption by type and size of hospital - Acute (Types 1, 2, 3 and 17)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m ³ per annum	Average consumption litres/bed/day
0-50	150	4,208	28	458,900	299
51-100	58	4,151	72	602,909	398
101-200	70	9,946	142	1,708,700	490
201-400	62	18,167	293	3,914,351	590
401-600	23	10,741	467	2,348,682	599
Over 600	3	2,023	674	721,887	978

Table B.2 - Average water consumption by type and size of hospital - Specialist acute (Types 11, 14, 15, 16 and 18)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m ³ per annum	Average consumption litres/bed/day
0-25	53	931	18	108,336	319
26-50	18	651	36	82,455	347
51-100	38	2,664	70	352,133	362
101-200	16	1,952	122	341,004	479
Over 200	7	1,633	233	316,874	531

Table B.3 - Average water consumption by type and size of hospital - Long stay (Types 4 and 5)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m ³ per annum	Average consumption litres/bed/day
0-50	30	1,126	38	74,009	180
51-100	45	3,463	77	339,791	569
101-200	44	6,222	141	560,731	247

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m3 per annum	Average consumption litres/bed/day
201-300	10	2,300	230	182,617	217
Over 300	3	1,121	374	25,247	306

Table B.4 - Average water consumption by type and size of hospital - Recovery and convalescent

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m3 per annum	Average consumption litres/bed/day
0-25	6	126	21	9,965	216
26-50	35	1,339	38	100,721	206
51-100	19	1,357	71	91,847	185
Over 100	3	449	150	29,663	181

Table B.5 - Average water consumption by type and size of hospital - Geriatric and chronic sick (Type 19)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m3 per annum	Average consumption litres/bed/day
0-50	18	573	32	51,520	246
51-100	20	1,460	73	108,163	203
101-200	6	788	131	46,987	164
Over 200	2	512	256	23,748	127

Table B.6 - Average water consumption by type and size of hospital - Psychiatric (Types 12 and 13)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m3 per annum	Average consumption litres/bed/day
0-100	46	2,186	48	166,588	209
101-200	12	1,773	148	156,814	242
201-400	13	3,782	291	976,559	273
400-600	10	4,884	488	443,662	249
601-1,000	7	5,112	730	654,024	350
Over 1,000	5	6,098	1,220	747,676	336

Table B.7 - Average water consumption by type and size of hospital - London teaching (all types)

Sire band (no of beds)	No of hospital in sample	Total no of beds in sample	Average size of hospital (no of beds)	Total consumption m3 per annum	Average consumption litres/bed/day
0-100	20	1,161	58	789,422	680
101-200	15	1,896	126	1,642,106	866
201-300	10	2,580	258	2,141,166	830
301-500	8	3,161	395	2,859,434	904
Over 500	4	2,611	652	3,207,658	1,228

Table B.8 - Definition of types of hospital

Type of hospital	Type number	Definition
Acute	1	Hospital with not more than 15 per cent of their beds allocated to the "excluded departments"
Mainly Acute	2	Hospitals with more than 15 per cent and up to 40 per cent of their beds allocated to the "excluded departments"
Partly Acute	3	Hospitals with more than 40 per cent and up to 60 per cent of their beds allocated to the "excluded departments"

Type of hospital	Type number	Definition
Mainly Long-stay	4	Hospitals with more than 60 per cent and up to 85 per cent of their beds allocated to the “excluded departments”
Long-stay	5	Hospital with more than 85 per cent of their beds allocated to the “excluded departments”
Pre-convalescent	7	Hospitals with 90 per cent or more of their beds allocated to patients who have already received elsewhere the most intensive part of their treatment, but who still require active nursing care and medical oversight.
Convalescent	8	Hospitals with 90 per cent or more of their beds allocated to patients recovering from a disability who no longer require active medical supervision or nursing care in bed though they may need such simple nursing procedures as renewal of dressings or the administration of medicines.
Rehabilitation	9	Hospitals with 9% or more of their beds allocated to patients who no longer require nursing care in bed and who, with or without the aid of appliances, can get about and attend to their own needs with occasional assistance but who require remedial and re-educative treatment with a view to attaining the maximum degree of use of functions.
Maternity	11	Hospitals (including General Practice maternity Hospitals) with 90 per cent or more of their neds allocated to obstetrics.
Psychiatric (Mental Illness)	12	Hospitals with 90% or more of their beds allocated to mental disorder and 50% or more of the psychiatric beds allocated to mental illness.
Psychiatric (Mental Handicap)	13	Hospitals with 90% or more of their beds allocated to mental disorder and more than 50% of psychiatric beds allocated to handicapped and/ or severely handicapped patients.
Orthopaedic	14	Hospitals with 90% of their beds or more of their beds allocated to traumatic and orthopaedic surgery, including bon ad joint tuberculosis.
Tuberculosis and Chest	15	Hospitals with 90% of their beds allocated to tuberculosis (both respiratory and non-respiratory) or diseases of the chest (including thoracic surgery) or both.

Type of hospital	Type number	Definition
Tuberculosis and Chest Isolation	16	Hospitals with 90% of their beds allocated to tuberculosis (both respiratory and non-respiratory) or diseases of the chest (including thoracic surgery) or both and infectious diseases.
Children's (Acute)	17	Hospitals with 90% or more of their beds allocated as in Type 1 but for children only.
Eye	18	Hospitals with 90% or more of their beds allocated to that one function.
Other hospitals	19	<p>These Dental and Ears, Nose and Throat (ENT) hospitals and also:</p> <p>All hospitals with 90% or more of their beds allocated to a single department not specifically named above unless that department is "General Medicine", "General Surgery" or "General Practice (medical)", in which event that hospital would be classified as "Acute" (Type 1) Type 19 will include Geriatric and Chronic Sick Hospitals.</p>

Figure B.3 - Average water consumption by type and size of hospital (litres per floor area)

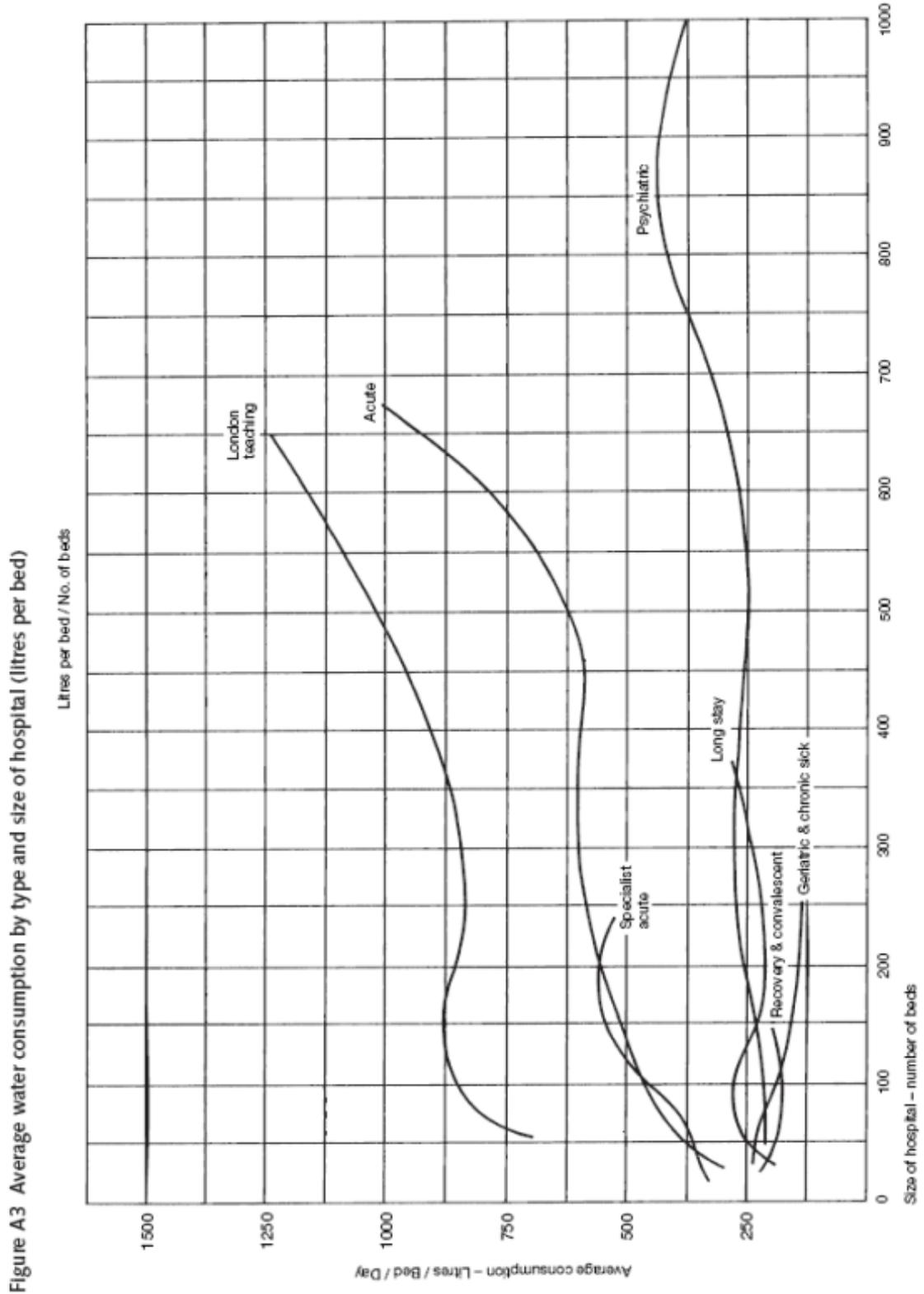


Figure A3 Average water consumption by type and size of hospital (litres per bed)

Table B.9 - Example of water consumption by nursing staff in residential accommodation - Data

Type of accommodation	Number of residents	Allocations of fittings	Total fittings
A - Student nurses	150	1 Lavatory Basin (LB) per person 1 Bath per 5 persons 1 WC per 5 persons 1 Sink per 5 persons 1 Laundry per 50 persons	150 LBs 30 Baths 30 WCs 30 Sinks 3 Laundries
B - Staff nurses	50	1 LB per person 1 Bath per 4 persons 1 WC per 4 persons 1 Sink per 4 persons	50 LBs 12 Baths 12 WCs 12 Sinks
C-F - Deputy matrons	50 Plus 50 family residents	1 LB per flat 1 Bath per flat 1 WC per flat 1 Sink per flat	50 LBs 50 Baths 50 WCs 50 Sinks
Totals	300	-	250 LBs 92 Baths 92 WCs 92 Sinks 3 Laundries

Table B.10 - Example of water consumption by nursing staff in residential accommodation - Daily usage per fitting

Type of fitting	Accommodation A	Accommodation B	Accommodation C
LB	3	3	6
Bath	2.5	2	1
WC	20	16	8
Sink	5	4	6
Washing Machine	8	-	-

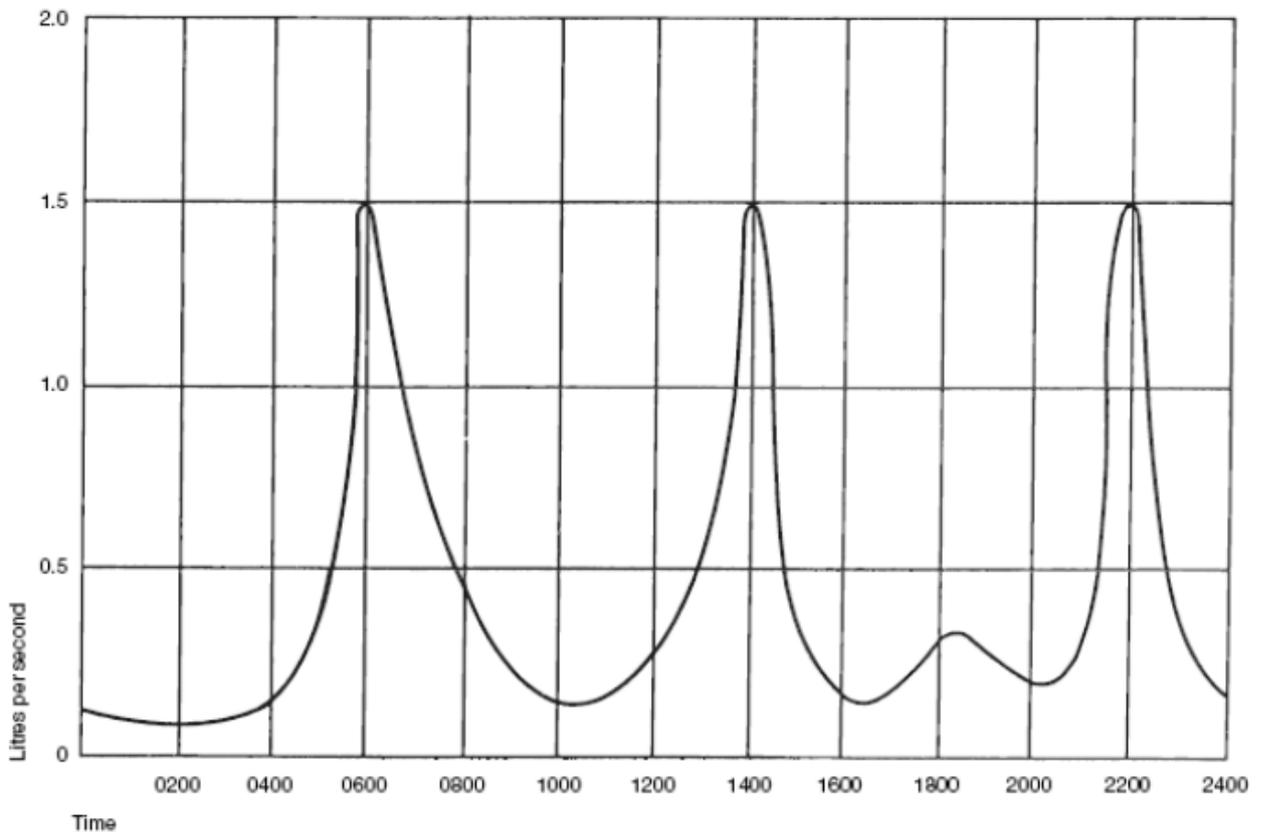
Table B.11 - Example of water consumption by nursing staff in residential accommodation - Consumption per use

Type of fitting	Accommodation A	Accommodation B	Accommodation C
LB	4.5 litres	Not known	Not known
Bath	72 litres	Not known	Not known
WC	6 litres	Not known	Not known
Sink	6 litres	Not known	Not known
Washing Machine	114 litres	Not known	Not known

Note 55: Estimated daily consumption 34,090 litres - Daily consumption per person - 114 litres.

Note 56: Peak demands - If two-thirds of resident staff work three shifts commencing at 6am, 2pm and 10pm, peak demands will occur from 5am to 7am, 1pm to 3pm and 9pm to 11pm. Peak demand may reach 1.5 litres per sec, with an average demand of 1.06 litres per sec over three periods.

Figure B.4 - Water consumption profile for residential accommodation of nursing staff



Demand Incidence for 200 nursing staff & 100 senior staff flats

Draft for C

Abbreviations

AC:	Asbestos Cement
ACOP:	Approved Code of Practice
APHC:	Association of Plumbing and Heating Contractors
AP(W):	Authorised Person (Water)
AMR:	Anti-Microbial Resistance
ARHAI:	Antimicrobial Resistance and Healthcare Associated Infection
ASTM:	American Standard Test Method
BEAB:	British Electrotechnical Approvals Board
BS:	British Standards
BMS:	Building Management System
BSRIA:	Building Services Research and Information Association
CaCO:	Calcium Carbonate
CIBSE:	Chartered Institution of Building Services Engineers
COSHH:	Control of Substances Hazardous to Health [Regulations]
CT:	Computerized Tomography
CWHB:	Clinical Wash-hand Basins
DHW:	Domestic Hot Water
DL:	Director Letter
DWI:	Drinking Water Inspectorate
DWQR:	Drinking Water Quality Regulator
ENT:	Ears, Nose and Throat
EPDM:	Ethylene propylene diene monomer
ERIC:	Estates Return Information Collection
FAT:	Factory Acceptance Test
GRP:	Glass-reinforced plastic
HACCP:	Hazard Analysis and Critical Control Point

HAI:	Healthcare Associated Infection
HBN:	Health Building Note
HDPE:	High Density Polyethylene
HSE:	Health and Safety Executive
HSG:	Health and Safety Guidance
HTHW:	High Temperature Hot Water
HTM:	Health Technical Memorandum
ICU:	Intensive Care Unit
IPCT:	Infection Prevention and Control Team
LB:	Lavatory Basin
LLDPE:	Linear low-density polyethylene
LTHW:	Low Temperature Hot Water
µg/L:	microgram per litre
MDRO:	Multi Drug-Resistant Organisms
mg/L:	milligrams per litre
MRI:	Magnetic Resonance Imaging
MTHW:	Medium Temperature Hot Water
MuPCV:	Modified Unplasticized Polyvinyl Chloride
NAP:	National AMR Action Plan
NIPCM:	National Infection Prevention and Control Manual
NPF:	National Performance Framework
NSS:	National Services Scotland
NTM:	Nontuberculous mycobacteria
NWSAG:	National Water Services Advisory Group
PAMS:	Property and Asset Management Strategy
PDA:	Personal Digital Assistant
PEX:	Cross-linked polyethylene
POE:	Point Of Entry

POEF:	Point Of Entry Filtration
POU:	Point-of-use
PRV:	Pressure Reducing Valves
PTFE:	Polytetrafluoroethylene
PWSP:	Project Water Safety Plan
PVC:	Polyvinyl chloride
PVC-C:	Chlorinated polyvinyl chloride
PWTAG:	Pool Water Treatment Advisory Group
RIBA:	Royal Institute of British Architects
RIDDOR:	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RO:	Reverse Osmosis
RPZ:	Reduced Pressure Zone
SAN:	Safety Action Notice
SCART:	Statutory Compliance Audit Reporting Tool
SDaC:	Sustainable Design and Construction
SEPA:	Scottish Environment Protection Agency
SETAG:	Scottish Engineering and Technology Advisory Group
SHFN:	Scottish Health Facility Note
SHPN:	Scottish Health Planning Note
SHTM:	Scottish Health Technical Memorandum
SNIEF:	Scottish and Northern Ireland Plumbing Employers' Federation
TAPS:	Thames Water Approved Plumbing Scheme
TDS:	Total Dissolved Solids
TMT:	Thermostatic Mixing Tap
TMV:	Thermostatic Mixing Valve
TVC:	Total Viable Count
UKWIR:	UK Water Industry Research
uPVC:	Unplasticised polyvinyl chloride

UV:	ultraviolet
VSG:	Ventilation Safety Group
WCA:	Water Dispenser and Hydration Association
WHO:	World Health Organization
WIAPS:	Water Industry Approved Plumbers' Scheme
WIS:	Water Industry Specification
WRAS:	Water Regulations Advisory Scheme
WSG:	Water Safety Group
WSP:	Water Safety Plan

Draft for Consultation



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