Control of legionella risk – technical guidance

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0.1	Development of document	Draft	Michael Orr, H&S Manger (Estates), EHSS	

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1. INTRODUCTION

1.1. This document supplements the Control of Legionella Risk in Water Systems **Policy and Management Arrangements** document by providing technical guidance detailing how the risks from legionella bacteria are to be managed in water systems across University Estate.

1.2. All parties having a role to play in the management of water safety across the University must follow the requirements and prohibitions contained herein.

1.3. Legionella bacteria are a family of pathogenic gram-negative[1] bacteria, ubiquitous in natural water sources and can enter water systems of buildings as a result of breaks in the water supply pipework or construction or maintenance works introducing contamination to the system.

1.4. In low numbers these generally do not give rise to ill health, however under suitable conditions the bacterial can proliferate and in high numbers they can give rise to respiratory illnesses including fatalities in vulnerable populations.

1.5. Legionella bacteria are primarily a risk when entering the respiratory system, predominantly through inhalation of airborne water droplets contaminated with the bacteria. Duty holders must therefore consider water systems capable of forming an inhalable aerosol.

1.6. The University of St Andrews (hereafter "the University") has over 187 buildings / structures with water systems that need to be managed. Many of these are older buildings with complex systems to store, heat and distribute water around the buildings, as well as being constructed from materials that pre-date current legislation and may no longer be acceptable.

1.7. The risk to the University is that, should a system be colonised, the numbers of persons potentially exposed could be large. In the absence of knowledge about the state of health of the people who access the buildings, the law requires the University presume any person could be vulnerable and manage the water systems accordingly.

1 Gram-negative bacteria are bacteria that do not retain the crystal violet stain used in the Gram staining method of bacterial differentiation. They are characterized by their cell envelopes, which are composed of a thin peptidoglycan cell wall sandwiched between an inner cytoplasmic cell membrane and a bacteria membrane.

Gram-negative bacteria represent a medical challenge as their outer membrane protects them from many antibiotics The outer membrane also compromises a complex lipopolysaccharide, part of which can cause a toxic reaction when the bacteria are lysed by immune cells resulting in fever, increased respiratory rate and low blood pressure - a life threatening condition known as septic shock.

1.8. The controls required for the management of legionella bacteria in hot and cold-water systems can simplistically be summarised as:

- keep the hot-water hot;
- keep the cold-water cold;
- only store as much water as can be fully used in 24 hours;
- keep the storage and distribution system clean;
- flush regularly.

2. LEGIONELLA BACTERIA AND ILLNESSES

2.1. Background information

2.2. Legionella acquired its name following a mysterious illness affecting some 221 people who has attended a convention of the American Legion in the Bellevue-Stratford hotel in 1976. Of those, 29 people, many veteran soldiers, died of the illness. The investigation undertaken by the U.S. Centre for Disease Control identified a previously unknown bacteria which was eventually traced back to a cooling tower for the hotel's air conditioning system.

Figure 1

The Bellevue-Stratford Hotel in 1976. The hotel's reputation never recovered from the outbreak

2.2.1. Following the identification of the legionella bacteria a number of prior mysterious illnesses resulting in fatalities were reviewed and identified dating to 1956 including one at the Bellevue-Stratford hotel in 1974 resulting 3 further deaths.

2.3. **Legionellosis** is the common term used for illness resulting from infection by legionella bacteria. A pneumonic form, termed Legionnaires Disease and a milder non-pneumonic form sub-divided into Pontiac Fever and Lochgoilhead Fever.

2.3.1. Legionella bacteria have been found in pathology samples taken from patients with pneumonia where Legionnaires Disease has not been diagnosed.

2.3.2. Legionella bacteria have also been detected in extra-pulmonary infections with clinical consequences.

2.4. Legionellosis are statistically grouped by the method of acquisition. There are 3 terms used at governmental levels: <u>community acquired</u> (includes residual, workplace and urban settings); <u>nosocomial</u> (includes all forms of healthcare although hospitals remain the highest contributor); and <u>travel associated</u> (exposure abroad with symptoms developing upon return to the country of residence).

2.4.1. For the University all instances of illness would fall under the heading of <u>community acquired</u>.

2.4.2. Thereafter classification falls by type of disease and source of disease (airborne - for example drift from a cooling tower capable of affecting a wide area, or direct – for example a hot or cold domestic water system capable of affecting a specific group of service users).

2.5. For legionella bacteria to pose a risk of infection in a human, the bacteria must enter via the respiratory system, whether by inhalation or aspiration. There are no known cases of person to person transmission.

2.6. Reporting obligations and RIDDOR 2013

2.7. The legal definition of a legionella outbreak is where 3 or more cases are diagnoses and reported relating to the same geographical region.

2.8. Cases of legionella infections may be diagnosed at GP or hospital level, however given the changes in how people live and the increased ranges they will travel on a daily basis – whether for home or work purposes, the ability of single GP or hospital to detect localised incidence of an outbreak becomes far more difficult.

2.8.1. For example, people working in St Andrews and infected there may live in Edinburgh, Glasgow, Perth or Dundee, and if infected at work, there is low likelihood their GP or local hospital would be able to correlate their infection to St Andrews.

2.9. A national reporting approach is required to collate information about cases of legionella infection and establish whether there are common factors to consider a common source.

2.9.1. In Scotland this is accomplished via the National Enhanced Legionella Surveillance Scotland – managed by Health Protection Scotland. There is a duty placed on all NHS health professionals to report any case using a standardised form.

2.9.2. Health Protection Scotland publishes a biannual report on the incidence of legionellosis in Scotland. The last publication dated 2017 relates to the period 2015/2016.

2.10. There is also an obligation on the University to report any case of legionellosis in an employee who has worked on a cooling tower or how and cold water systems that are likely to be contaminated with legionella bacteria under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013. This is because legionella bacteria are defined as a biological agent under the Control of Substances Hazardous to Health Regulations 2002 (as amended) (Schedule 3). The Approved List of Biological Agents, HSE's publication to the Advisory Committee on Dangerous Pathogens have classified legionella bacteria as HUMAN HAZARD GROUP 2 "can cause human disease and may be a hazard to employees; it is unlikely to spread to the community and there is usually effective prophylaxis or treatment available”.

2.11. Instances of legionella outbreaks are investigated by a team formed of Health Protection Scotland, HSE and the NHS. Investigators may enter any premises at any time to undertake the investigation.

2.11.1. In the event of a Regulator (HSE) attending any University premises in relation to an investigation of legionella, the Responsible Person and Head of EHSS (or their Depute) must be informed immediately.

2.11.2. As a duty holder the University must be able to produce such records as to demonstrate that the water systems are under a suitable programme of management and that the water system constructed and maintained in a safe condition.

2.11.3. The Regulators may instruct that any water system be turned off in order to permit an inspection of the equipment to happen. This will normally be in relation to cooling tower / evaporative condenser or air conditioning systems where there is an immediate risk to service and inspection personnel, and where such equipment exists, contact must be make with the Building Manager to ensure this action does not result in danger within the building (e.g. the loss of a cooling mechanism resulting in a run-away exothermic reaction). This will not affect the normal domestic hot and cold water systems.

2.11.4. Investigators from HPS may take samples from water systems for culture and analysis in order to identify the source of an outbreak.

2.11.5. Investigators from HSE will not take samples of water systems and the University need not be determined to be the source of an outbreak for the regulator to take enforcement action against the University. The regulator need only establish 3 facts, a failure under any of which could lead to immediate enforcement action:

- There is a water system
- It is capable of forming an aerosol
- It is not adequately under control

2.12. Classification of legionella

> **SEROGROUP – a group of bacteria containing a common ANTIGEN, sometimes including more than one serotype, species or genus**

Domain : *Bacteria*

Phylum: *Proteobacteria*

Class: *Gammaproteobacteria*

Order: *Legionellales*

Family: *Legionellaceace*

Genus: *Legionella*

Species: Over 50 Species identified to date, compromising 70 distinct Serogroups. These continue to increase as they are discovered. There are 15 Serogroups of *Legionella Pneumophila*, the representative species because it was the first species to be described.

2.13. Risk factors

2.14. There are a number of important factors that provide an environment for legionella bacteria to multiply. These include: a suitable temperature, the presence of nutrients, the presence of a biofilm, water stagnation and the materials used in the construction of the water system.

2.14.1. **Water Temperature** Legionella bacteria have a known temperature related growth range. The bacteria are almost dormant at temperatures below 20°C, becoming active above that temperature and have their highest growth rate temperatures between 37°C and 45°C. Above those temperatures the growth rate drops off and at temperatures above 60°C the bacteria begin to be killed off depending on temperature and exposure times (at 60°C the contact time is 1 hour with higher temperatures sterilising quicker).

2.14.2. **Biofilms**. These are thin slimes that can form on surfaces in contact with water. These include the inside walls of water storage tanks, pipes, air conditioners, cooling towers, shower heads, taps and humidifiers. Legionella bacteria can persist intracellular within a biofilm or be absorbed into various protozoa species that exist on and form the biofilm. This provides the legionella bacteria with some protection from temperature extremes disinfectants. The biofilm itself can also be a nutrient source for the legionella bacteria.

Figure 2 Biofilm (biological growth) from a length of dead leg removed from St Salvators' Hall by Estates Trades Nov 2020 – the amount of biofilm shown is sufficient to seed a whole system

2.14.2.1. Figure 3 below illustrates the cycle of colonisation of biofilm with legionella bacterial within a water system

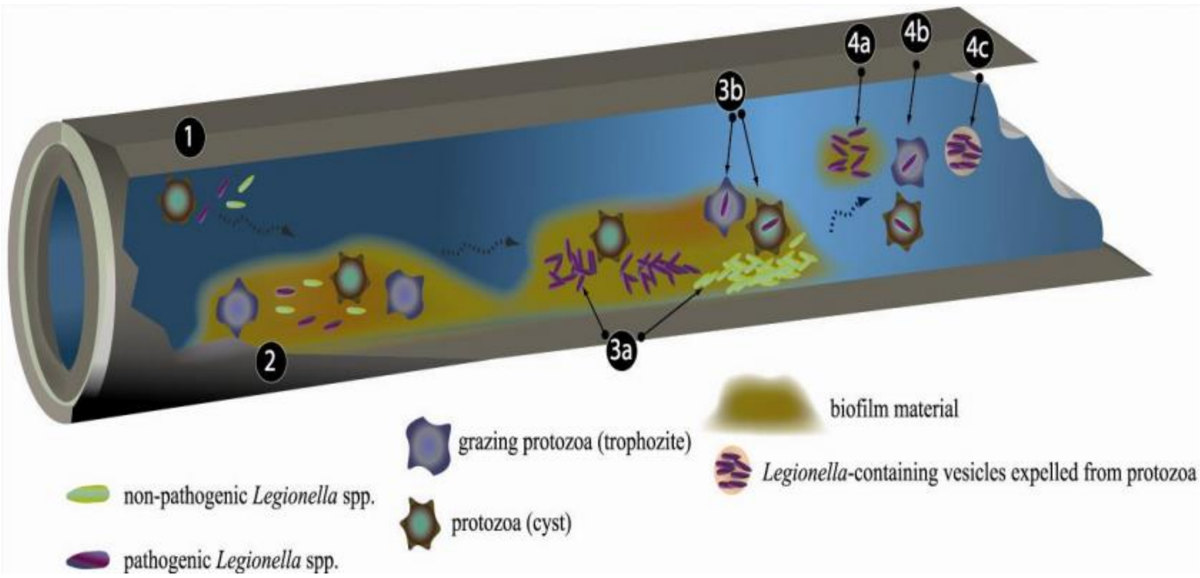

Figure 3 From Lau and Ashbolt The role of biofilm and protozoa in Legionella pathogenesis : implications for drinking water. Journal of Applied Microbiology (2009) vol 107.2

1. *Biological contaminants enter the water system.*
2. *Absorption into biofilms.*
3. *Legionella either colonise (3a) or are ingested by grazing protozoa (3b) where they multiply.*
4. *Legionella are released from biofilm into moving water through sloughing off. They can colonise biofilm further downstream or pass out of the water system potentially infecting persons.*

2.14.2.2. Once legionella bacteria have colonised a water system, complete eradication is very difficult to achieve due to the presence of biofilm and host protozoa, and long-term management processes are required to control the growth of legionella bacteria to ensure it does not reach hazardous levels.

2.14.3. **Non-organic foreign materials**. Scale, corrosion and sediment within a water system can also provide protection from temperature extremes and disinfectants but can also provide a nutrient source for legionella bacteria growth. These conditions also promote the formation of biofilm.

2.14.4. **Stagnation**. When water is stagnant for extended period of time, including instances of low flow through the system, hot water cools and cold water warms up. Examples of this include storage of excessive amounts of water that is not used, little used or unoccupied buildings or the presence of redundant pipework (called dead legs). These favour biofilm growth and allow legionella bacteria to thrive until they reach dangerous levels.

2.14.4.1. The above represents the official position in the UK as set by HSE and the Water Regulatory industry and echoed by the WHO. It is noted there are a number of studies into the effect of turbulent / laminar and stagnant water [2][3]which have concluded that turbulent and laminar flow water systems promote greater and faster biofilm growth with the attendant release of legionella bactereia into drinking water supplies.

2.14.5. **Construction materials**. The material the water system is constructed of may actively promote the growth of biofilm and legionella bacteria. All parts of the water system must comply with the requirements of the Water Supply (Water Fittings) (Scotland) Byelaws 2014.

2.14.6. Seasonal variations. Legionellosis has been shown to have seasonal patterns showing a peak in summer. A cause of this is the prevalence in the UK for water storage tanks to be located in attic spaces that are poorly insulated or ventilated resulting in a rise in the stored water above 20°C. A similar rise in the prevalence of legionella bacteria in natural water systems is also noted.

2 Turbulence accelerates the growth of drinking water biofilms – E. Tsagkari & W.T. Sloan 2018

3 Effect of flow regimes on the presence of Legionella within the biofilm of a model plumbing system – Z. Liu, Y.E. Lin, J.E. Stout, C.C. Hwang, R.D. Vidic, V.L.Yu 2006

2.15. Vulnerable population

2.16. Although legionellosis can affect anyone, not all persons exposed to legionella bacteria will become ill and develop symptoms. The guidance identifies as susceptible persons with the following characteristics:

2.16.1. Older age is a risk factor. HSE identifies people aged 45 and over as at risk, with (for legionnaires disease) a higher rate of mortality as age increases.

2.16.2. Smokers are at heightened risk as a consequence of damage to the lung resulting in increased bacterial adhesion to surface cells, increasing rates of colonisation and infection.

2.16.3. Heavy drinkers are at heightened risk. The exact mechanism is poorly understood. Alcohol intake may cause alterations in neutrophil and macrophage function and abnormalities in ciliary and surfactant functioning in the lung as one risk factor. Alcohol overuse may also increase the risk of aspiration and suppress the normal cough reflex.

2.16.4. Persons with pre-existing conditions such as diabetes, lung or heart disease. Persons with diabetes have increased risk of aspiration, hyperglycaemia, decreased immunity, impaired lung function, pulmonary microangiopathy, and coexisting morbidity.

2.16.5. Persons with an impaired immune system.

2.17. Legionnaires disease

2.18. Legionnaires disease is most commonly (but not exclusively) linked to infection with *Legionella pneumophila*[4] Serogroup 1 although other Serogroup and other legionella species have been linked with the disease.

2.19. The disease has is very difficult to detect / diagnose without sampling due to the range of symptoms, which may or may not present together, and may often be treated as a human pneumonia without legionnaires disease itself being diagnosed.

2.20. The disease has a moderately low attack rate – about 5% of normal population and 15% of vulnerable persons.

4 *Lit* – lung loving

2.20.1. The risk of infection is related to means of exposure (tap, shower, spa, other..), dose (time / bacterial loading) of exposure, and susceptibility of persons.

2.21. This disease typically has an incubation period of 2-10 days before onset of symptoms, although in rare cases it may be up to 20 days.

2.21.1. Initial symptoms frequently include:

- anorexia;
- lethargy;
- headache;
- muscle aches;
- high fever;
- chills.

2.21.2. By the second or 3rd day post onset of symptoms and over the subsequent days, additional signs or symptoms may include:

- a cough, this may be generally non-productive, but in cases may bring up a pus-forming mucus sputum and sometimes blood may be present in the sputum or from the cough;
- shortness of breath;
- chest pain;
- gastrointestinal symptoms such as nausea, vomiting and diarrhoea;
- confusion or other mental changes (delirium, depression, disorientation and hallucinations);
- fine or course tremors of the extremities;
- hyperactive reflexes;
- renal failure.

2.22. Diagnosis is by lab analysis of urine for legionella antigens followed by cultured analysis of sputum or lung tissue samples to determine species and genome.

2.23. Legionnaires disease is treated with specialised antibiotics for gram-negative bacteria. In many cases, treatment will require hospitalisation. In affected persons, the disease can take weeks to bring under control with extended recovery periods thereafter.

2.24. Legionnaires disease is potentially fatal depending on susceptibility. This can be between 40-80% for vulnerable and hospitalised persons. If left undiagnosed and untreated the risk of fatal outcome increases largely due to respiratory failure, shock and multi-organ failure.

2.25. Pontiac Fever and Lochgoilhead Fever

2.26. Pontiac Fever takes its name following an outbreak in 1968, in Pontiac Michigan, where several department of health workers became ill with a non-pneumonia, mild flue like illness with fever. Samples taken from affected workers were re-analysed following the 1976 Legionnaires outbreak in Philadelphia and l*egionella pneumophilia* was identified as the causative bacteria.

2.26.1. Other causative species of Pontiac Fever include *L. longbeachae, L feeleii (sg1), L, Micdadei* and *L. anisa*.

2.27. Lochgoilhead Fever was identified following an outbreak in 1988 at a hotel and leisure complex in Lochgoilhead a village in Argyll, where 170 persons were affected . *Legionella micdadei* was identified as the causative bacteria in that outbreak.

2.28. Both diseases present as non-pneumonia influenza-like illness characterised by:

- High fever;
- Chills;
- Dry cough;
- Dyspnoea (difficulty breathing)
- Headache;
- Fatigue;
- Arthralgia (joint pain)
- Myalgia (muscle pain)
- Asthenia (Loss of strength)
- Diarrhoea;
- Nausea / vomiting (in a small portion of persons)

2.29. Both diseases are difficult to detect due to their close resemblance to acute influenza. Both will self-resolve without medical treatment in most cases, although some are associated with more severe cases.

2.29.1. No deaths have been associated with the direct effects of either disease to date, however Pontiac fever has associated with the production of endotoxins (a toxin present in gram-negative bacteria cells released when the cell us lysed) that can result in fever, shock and in cases death.

2.30. Very few cases are presented to medical professionals for diagnosis and therefore the occurrence of either disease is significantly under reported. Diagnosis is by urine or blood test for legionella antigens.

2.31. The diseases has a very high attack rate – about 95% of normal population exposed to legionella bacteria are at risk of contracting Pontiac Fever.

2.32. This disease typically has an incubation period of between 5 hours and 3 days, although symptom onset most commonly occurs within 24-48 hours.

2.33. Extrapulmonary infections

2.34. Since early 1990, legionella bacteria have been found to be cause of extrapulmonary infections, believed to have spread from the respiratory system to other organs.

2.34.1. The heart is the most commonly infected organ but legionella have also been detected in spleen, liver, kidneys bone marrow joints and lymph nodes.

2.34.2. Legionella bacteria have also been isolated in cutaneous and sub-cutaneous wounds.

2.35. L. pneumophilia is most commonly identified from patient samples.

2.36. Symptoms include but are not limited to:

- Low-grade fever;
- Night sweats;
- Weight loss;
- Congestive heart failure.

2.37. In most cases hospitalisation is required.

2.38. Sources of Transmission of legionella bacteria

2.39. The primary route for legionella transmission is by inhalation of aerosols with contaminated with legionella bacteria. Aerosols of less than 10 μm are needed for alveolar deposition[5].

[5] An in-premise model for *Legionella* exposure during showering events Mary E. Schoen & Nicholas J. Ashbolt (Elsevier Water Research, Vol 45. Issue 18, 15 Nov 2011)

2.40. The highest risk form of water system capable of forming such aerosols are cooling towers and wet variations on these including evaporative condensers. In the UK, these equipment have been responsible for the largest recorded public outbreaks including the infamous [Barrow-in-Furness incident in 2002](). The management requirements associated with such plant are detailed in HSE guidance [Legionnaires 'disease: Technical guidance Part 1: The control of legionella bacteria in evaporative cooling systems](). Given the risk profile of such equipment and the complex management arrangements required to control them, and the fact that other less hazardous means of achieving cooling exist, it is University Policy that such equipment will not be installed or operated on the University Estate (see [Control of Legionella Risk in Water Systems]() Section 1.6).

2.41. Within the built University estate, domestic hot and cold water systems represent the highest risk factor for formation of aerosol capable of transmitting legionella bacteria.

2.41.1. Showers represent the highest risk outlets on any such systems.

2.41.2. Water outlets (taps) represent risk factors depending on factors including

- Height of the outlet. For example, tall swan neck outlets used in kitchens or cleaners cupboards locate the spout closer to the respiratory zone, and the activities carried out encourage persons to lean into closer to the sinks, thus potentially increasing exposure.

- Water pressure and flow rate (a focus over the past 20 years on reducing water usage for cost and environmental BREAM points in the design of buildings has seen flow restrictor devices installed in outlets. These reduce the amount of water flowing out of the outlet and increase the aeration of the water flow resulting in increased spray and aerosol formation.

2.42. Drinking water from water systems may also be a source of transmission via aspiration of fluids. This can happen under normal circumstances in very low numbers and should not pose a significant risk, however if can also occur in more significant number when physiological barriers (gag reflex or epiglottis) fail to prevent fluid from the mouth or stomach entering the lungs. More common in hospital circumstances with recumbent patients, but in the University may be present if, for example students are ill and remain in bed for a number of days – such as during the COVID-19 pandemic.

2.43. Air Conditioning Systems Ventilation and air conditioning systems represent a potential source or transmission for legionella. These shall be designed so that water, whether from the supply or from other sources such as condensation, cannot accumulate in ductwork or plant, which is subject to an air stream. All condensate drains shall incorporate an air break as near to the ventilation or air conditioning system as possible, to prevent potentially contaminated water from being drawn back into the system. No domestic type air humidifiers, or any similar equipment which may compromise air quality, shall be put into use on the University.

2.44. Transmission of rarer forms of legionellosis can occur during direct skin contact, however this is rare and is predominantly associated with hospital treatment of immune-suppressed patients or from exposure during medical operations. This route of infection is highly unlikely to be present in the University environment.

2.45. Other water systems may exist across the University estate, some of which may not be part of the as-built fabric of the buildings, but rather equipment sourced by Schools associated with their research or teaching. HSE publication Legionnaires' disease: Technical guidance Part 3: the control of legionella bacterial in other risk systems identifies a range of other potential water systems, including:

- ultrasonic humidifiers/foggers;
- spray humidifiers;
- air washers, wet scrubbers, particle and trivial gas scrubbers;
- water softeners;
- emergency showers, eyebaths and face wash fountains;
- sprinkler and hose reel systems;
- spa pools;
- whirlpool baths;
- horticultural misting systems;
- vehicle washers;
- powered dental equipment;
- fountains and decorative water features;
- non-disposable nebulisers used for respiratory therapy;
- industrial effluent treatment plants;

- irrigation systems;
- fire, dust and odour suppression systems;
- paint spray preparation equipment;

3. MANAGEMENT ARRANGEMENTS

3.1. This section covers the arrangements that must be put into place at an institutional level to ensure the risks from legionella are managed.

3.1.1. It details how the management system should work.

3.1.2. It allocates responsibilities to the various roles and establishes a chain of command in-line with the requirements set out by the Government.

3.1.3. It details the requirements for surveys to be undertaken to ensure all relevant parts of the water system are identified and that mechanisms are in place to undertake risk assessments of the water system.

3.1.4. It establishes design standards for key components of the water systems, providing details on the "state to be achieved" and minimum requirements for managing plant that does not currently meet these standards, until such time as necessary improvements can be made.

3.2. MANAGEMENT SYSTEM

3.3. The University has legal obligations control the risk from exposure to legionella bacteria. It also has obligations to implement a management system to ensure the risks are suitable controlled.

3.4. The purpose of a management system is to ensure that mechanisms are in place to ensure controls are complete and effective, that they are not missed, lapse or fail.

3.5. An effective management system should cover the following elements:

3.5.1. There should be a policy document which sets forwards the intent to control the risk, demonstrates the organisation's commitment to said control and establishes the authority under which all subsequent arrangements are made. In terms of legionella risk, this is contained in the Control of legionella risk in water systems policy document.

3.5.2. The management arrangements should make clear who has roles to play provide full details of the responsibilities are assigned to each role.

3.5.3. The management arrangements should detail how information will be held and communicated – the form of the communication and who should receive the various types of information.

3.6. It also ensures arrangements exist that will manage emergency situations, through the initial crisis and back to a controlled condition without putting persons at risk.

3.7. There are a number of models management systems can follow. HSE promotes a **PLAN-DO-CHECK-ACT** Deming cycle, details of which are in the HSE publication Managing for Safety

HSG65. This is also the management system the University has adopted for the management of all health and safety matters. The arrangements for managing water safety are set against this model – this is illustrated in Appendix 1.

3.8. ROLES AND RESPONSIBILITIES

3.9. Management of legionella bacteria risk within the University estate falls under 3 organisational lines

3.9.1. Authority – those roles with direct or delegated authority to make decisions and instruct works to comply with the legal obligations.

3.9.2. Operations – those roles with direct responsibility to implement the controls measures necessary to manage the risk from legionella bacteria.

3.9.3. Governance and Assurance – those roles with responsibility to set standards to be achieved and to verify that the operational roles are effectively discharging their duties.

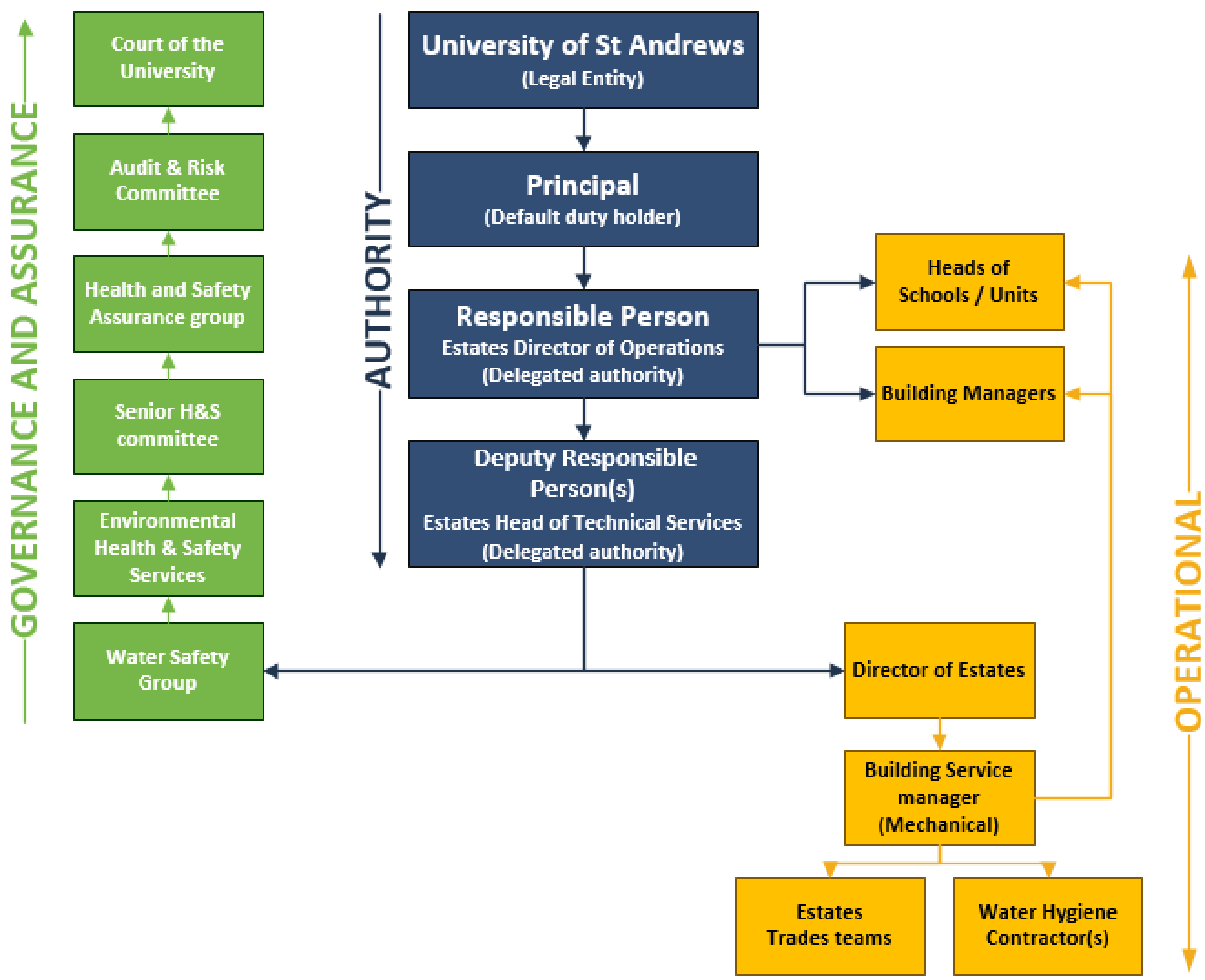

Figure 4 Organisation responsibilities for managing Legionella Risk across University Estate

3.10. Role of the Principal

3.11. The ultimate responsibility for water management systems within the University sit with the Principal as the senior-most identifiable role.

3.11.1. As a minimum, the Principal must have an understanding of the risks of legionella bacteria in water systems and the basic control measures required to manage the risk. Additionally the Principal must understand and approve of the chain of command for the management of legionella risks. This should be achieved by the Principal reading the Control of Legionella Risk in Water Systems **Policy and Management Arrangements** document.

3.12. Role of the Responsible Person

3.13. The *Responsible Person* has overall delegated authority and duties direct from the Principal and this appointment is in writing, and is solely responsible for decisions to be taken in the event of a legionella incident. The *Responsible Person* must accept the appointment in writing. Copies of the template letters for the appointment and acceptance are Schedule 1 and 2 of the Control of Legionella Risk in Water Systems policy document. Once signed a copy of each should be sent to Head of EHSS for retention.

3.13.1. In practice, this means that for the duration of a legionella incident, the *Responsible Person* will make decisions on actions to be taken to make immediately safe and to return the situation to normal.

3.13.2. Such decisions may include actions to cut off the water supply in a building, thermally or chemically disinfect a water system or even close a building.

3.13.3. The scale of the authority is such that **no person** in the University may over-ride the decision of the *Responsible Person*. Reviews of the decisions taken and the impact of those decisions can be undertaken after the legionella incident has been returned to normal.

3.14. The Approved Code of Practice places a duty on the *Responsible Person* is to ensure that requirements and prohibitions set out in the Control of Substances Hazardous to Health Regulations 2002 (as amended) are complied with in respect of the risks from legionella bacteria. These duties are detailed as follows:

3.14.1. COSHH Reg. 6 requires the duty holder to ensure where there is a risk to human health, that a suitable and sufficient assessment is made for the purposes of determining the required control measures.

3.14.1.1. The *Responsible Person* is responsible for ensuring that a risk assessment has been carried out for each building in which there is a water supply, and these are reviewed on a regular basis, and are maintained up to date. As a minimum, the risk assessment must be undertaken to the standards set out in BS8580:2019 Water quality – risk assessments for legionella control – Code of practice[6].

3.14.2. COSHH Reg. 7 requires every employer to ensure that the exposure of his employees[7] to substances hazardous to health is either prevented or, where that is not reasonably practicable, adequately controlled. The regulation further requires the controls to be implemented to be consistent with the findings of the risk assessment, and to give priority to controls in accordance with the hierarchy of control[8].

3.14.2.1. The University estate consists of 187 buildings dated from 1412 to present with a range of water systems consisting of designs construction and materials spanning at least over the last 150 years. The *Responsible Person* is responsible for ensuring there is a legionella strategic management plan (hereafter **The Plan**) to bring and maintain the University estate to a state of compliance with the regulations and standards. This plan must be:

- Have clear actions set against compliance objectives (legislative and guidance based);
- Include suitable and effective interim measures to deal with immediate risk;
- Be prioritised based on clear risk factors;
- Be time bound;
- Be realistic;
- Be supported by clearly identified resources, including personnel and budget.

3.14.2.2. Management of the information and records will require a suitable IT system. The *Responsible Person* is responsible for ensuring that such a system has been identified and implemented.

3.14.2.3. The *Responsible Person* is responsible for ensuring that the recommendations of the risk assessment are reviewed and implemented in a timely manner.

3.14.2.4. The *Responsible Person* is responsible for ensuring that there is a Written Scheme developed from each risk assessment that details the detailing how each building will be managed.

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6 British Standard Documents are located in Estates Shared drive /general/legionella_info folder. They are licensed for University use only and cannot be shared with Contractors. The hyperlinks in this document have been disabled.

7 And by virtue of HSWA 1974, Section 3 and COSHH Reg 3 all other persons who may be exposed.

8 The hierarchy of control requires the duty holder to consider forms of control in descending order to the extent each is possible. Elimination; substitution of less hazardous; engineering controls including safe design, materials and equipment which should control the risk at source; safe systems of work and organisational controls; information, instruction, training and supervision. Where adequate control cannot be achieved through these measures, the provision of personal protective equipment.

3.14.3. COSHH Reg. 8 requires every employer who provides a control measure (in compliance with Reg. 7), to take all reasonable steps to ensure the controls are properly used.

3.14.3.1. The *Responsible Person* is responsible for ensuring that there are suitable arrangements in place (including information, equipment and personnel) to ensure the day-to-day management of the risks identified in the risk assessment for each building in accordance with the Written Schemes for each building and **The Plan**.

3.14.4. COSHH Reg. 9 requires employers to ensure that control measures provided are maintained, including inspected and examined as necessary to ensure they remain in an efficient state, efficient working order, good repair and in a clean condition.

3.14.4.1. The *Responsible Person* is responsible for ensuring that there are suitable arrangements in place (including information, equipment and personnel) to ensure all parts of the water system required to ensure the health of persons are under a relevant programme of inspection and maintenance. Where defects or conditions liable to cause harm or ill health are found, these should be remedied immediately or suitable steps taken to make safe[9].

3.14.5. COSHH Reg. 12 requires every employer who undertakes work liable to expose persons to substances hazardous to health to ensure that the employees are provided with suitable and sufficient information, instruction and training. This extends to ensuring that any person (whether an employee or not) who carries out work in connection with the employer's duties has suitable and sufficient information, instruction and training.

3.14.5.1. The *Responsible Person* is responsible for ensuring that all persons who have a role in the management of legionella or the implementation of the control measures identified in the risk assessment, written scheme or overarching strategic management plan, are competent to do so.

3.14.5.2. For employees of the University this duty extends to ensuring all persons who have a function within the water management system are identified and have clear descriptions of the associated role, responsibility, information and training required to discharge the duties.

3.14.5.3. The *Responsible Person* is responsible for ensuring that University employees who are identified as requiring training to discharge their duties in respect of water management are provided with this training before undertaking the role, and are provided with refresher training at suitable intervals. The *Responsible Person* will be assisted in this by the Training and Development Coordinator (Estates) and the Training Coordinator (RBS)

9 This duty is also imposed by virtue of the Workplace (Health, Safety and Welfare) Regulations 1992, Regulation 5, and the Provision and Use of Work Equipment Regulations 1998, Regulation 5, 6 and 13.

who should provide reports as requested or on a six monthly basis minimum.

3.14.5.4. For contractors providing a service to the University, the *Responsible Person* must establish the competence of the contractor as an organisation.

- For water hygiene services (including risk assessment, inspection, monitoring cleaning and disinfecting services) the contractor must have membership of the Legionella Control Association [LCA] with relevant area of specialism.

- The *Responsible Person* must request confirmation that the contractor has no prior history of enforcement action or prosecutions for health and safety breaches by the regulator in the last 10 year period.

  - Where enforcement action has been taken by the Regulator, this must be explained and evidence provided to demonstrate the steps taken to ensure the root causes have been addressed.

- The *Responsible Person* must request copies of the last 3 audits undertaken for the contractor. This is to demonstrate the contractor is under a programme of audit and that any findings of the audits are being actioned.

- The *Responsible Person* must request a portfolio of references demonstrating the contractor has sufficient experience in the relevant field.

- The *Responsible Person* must request records of qualifications, training and CPD matrix for the employees who will be attending site and those who will be involved in planning work or supervising the workers to ensure they are competent for the works undertaken.

3.14.5.5. The *Responsible Person* must ensure there is a programme of inspection and verification to ensure the performance of the University employees and contractors remains competent and to the standards required by the University. This can be a mix of internal and external inspections.

3.14.6. COSHH Reg. 10 requires every employer to have arrangements in place to monitor exposure of employees (or others) to substances hazardous to health, subject to a risk assessment.

3.14.6.1. Legionella Bacteria are a biological agent (see section on RIDDOR and HSE report on human hazard grouping). In domestic hot and cold water systems biological monitoring is not normally required **if** the system is under an adequate programme of control **and** all relevant information required to manage the water system is known. Where there is cause to doubt the efficiency of the system, and following instances of loss of control, biological is required to ensure the appropriate remedial actions are taken. The *Responsible Person* is responsible for ensuring there is an appropriate regime for biological monitoring (see Control Measures – Biological monitoring) and that it is effectively implemented.

3.14.7. COSHH Reg. 12 (2)(d) requires employers to inform their employees (and other relevant persons) information about the results of any monitoring of exposure in particular where there are occupational exposure levels which have been exceeded.

3.14.7.1. Biological agents do not have occupational exposure limits.

3.14.7.2. Where the biological monitoring shows the presence of legionella bacteria to be present in water systems in concentrations liable to cause harm to human health (i.e. above 100 cfu/l in a system capable of forming an aerosol), the *Responsible Person* is responsible for ensuring all employees or persons who may have been exposed have been informed of this exposure in a timely manner. The *Responsible Person*, together with Heads of Schools or Units, will identify the most appropriate person to impart the information to exposed persons.

3.14.8. COSHH Reg. 13 requires every employer to protect the health of his employees form an accident, incident or emergency related to the presence of a substance hazardous to health in the workplace through the provision of information, warnings and procedures to mitigate the effects of than event, restore the situation to normal and inform those of his employees (or others) who may have been affected.

3.14.8.1. The *Responsible Person* is responsible for ensuring that suitable arrangements are in place to manage the following Out of Specification reports:

3.14.8.1.1. **Out of Specification Report 1**. Where the University has cause to believe a domestic hot water system within a building is out-with the normal operating parameters i.e. failing to reach and maintain required temperatures for thermal control of hot water (min 60°C stored and 50°C at any outlet within 1 minute).

3.14.8.1.2. **Out of Specification Report 2**. Where the University has cause to believe domestic hot water held in calorifier(s) within a building is failing to be fully turned over resulting in the potential for a thermocline to develop, with water under the thermocline not being heated to 60°C.

3.14.8.1.3. **Out of Specification Report 3**. Where the University has cause to believe a domestic cold water system within a building is out-with normal operating parameters i.e. stored and / or delivered cold water is above 20°C.

3.14.8.1.4. **Out of Specification Report 4**. Where the University has cause to believe a domestic cold water system within a building has significant build up of sediment or biofilm within a storage tank.

3.14.8.1.5. **Out of Specification Report 5**. Where, as a result of biological sampling, the University has cause to believe the presence of micro-organisms (including legionella bacteria) may be present in the water systems (including domestic hot and cold water systems or other water systems) in a building in harmful quantities.

3.14.8.1.6. **Out of Specification Report 6**. Where, as a result of one or more reports of legionellosis amongst the University population (employees or students) the University has cause to believe the presence of legionella bacteria may be present in water systems somewhere across the University Estate.

3.14.8.2. The arrangements must ensure that where an *Out of Specification* scenario arises, the *Responsible Person* is informed and instructs the actions to be taken in accordance with the established procedures.

3.14.9. COSHH Reg's. 6, 9, 10 and 12 require the employer to ensure suitable records of risk assessments, control measures, inspection and testing of the control measures, and the results of any monitoring are kept for a minimum of 5 years or until superseded and for any records pertaining to the health of an identifiable individual for 40 years.

3.14.9.1. The *Responsible Person* is responsible for ensuring that there is a suitable and effective system for keeping and retrieving the necessary records (see Control Measures – Information Management and Record Keeping).

3.15. The minimum training requirement for the *Responsible Person* is the 2-day City and Guilds Legionella: Role of the Responsible Person/Duty Holder/Landlord training course WS1. This training is valid for a period of 3 years or until the current legislative and HSE guidance significantly changes (whichever happens soonest). Thereafter the post holder must undertake a 1 day refresher course.

3.15.1. It is recommended that the Responsible Person undertake the 2 day City and Guilds Management of Legionella Bacteria in Hot and Cold Water Systems training course WS2 and the 1 day City and Guilds Disinfection of Water Supplies in Buildings training course WS3.

3.16. Role of the Deputy Responsible Person

3.17. The *Responsible Person* is aided in the day to day discharge of their duties by the *Deputy Responsible Person(s)* who may also take the authoritative decisions of in the *Responsible Person* is absent and unable to make said decisions. The *Deputy Responsible Person* must be appointed in writing and accept the appointment in writing. Copies of the template letters the for the appointment and acceptance are Schedule 3 and 4 of the Control of Legionella Risk in Water Systems policy document. Once signed a copy of each should be sent to Head of EHSS for retention.

3.17.1. The minimum training requirement for the *Deputy Responsible Person* are the same as for the *Responsible Person*.

3.18. Role of the Director Estates

3.19. The Director of Estates has overall responsibility for the delivery and maintenance of the fabric of the University built estate. This responsibility is delegated from the Office of the Principal to the Estates Department.

3.20. The Director of Estates is responsible for ensuring that all parts of a water system with any University building can be:

3.20.1. Safely accessed. That they are without a risk to health (for example from the presence of asbestos or other respiratory contaminants) and that they are without a risk to safety (for example from fall from height or as a result of spaces being confined spaces as defined).

3.20.2. Properly designed. That the design of all parts of the system are suitable for the functional intent, and that the design takes cognisance of all operations the equipment is required to fulfil. The design must not introduce hazards to the operations (for example access hatches located below ceilings with clearances so small as to render access dangerous or impossible, or functional components obstructed by fixed installations for other services).

3.20.3. Constructed of suitable materials to prevent the growth of biological organisms (including legionella bacteria). All parts of water systems should be free from materials liable to degrade and form a harbour for biofilm or legionella bacteria, or to degrade and form a nutrient source for them. All materials used should conform to the WRAS Products and Materials Directory.

3.20.4. Maintained (including cleaned as appropriate) in an efficient state, in efficient working order and in good repair. This obligation comes from Regulation 5(1) of the Workplace (Health, Safety and Welfare) Regulations 1992.

3.21. The Director of Estates is responsible for ensuring that suitable arrangements and sufficient appointments are made within the Estates Department to enable the operational activities to be delivered, and that these are aligned with **The Plan**.

3.22. The training requirements for the Director Estates as a minimum consist of reading the Control of Legionella Risk in Water Systems Policy and Management Arrangements document, and this technical guidance document, and confirming in writing to VP Governance receipt of instruction, understanding and acknowledgement of the responsibilities. If required this can be supplemented by in-house briefing sessions.

3.23. Role of the Water Safety Group

3.24. The Water Safety Group forms part of the legionella control through being a formal part of the communication strategy for ensuring that relevant stakeholders across the University are actively involved in the management of legionella risk.

3.25. The Water Safety Group is to:

3.25.1. Meet on a regular basis – minimum recommended frequency is quarterly.

3.25.2. The group should also meet in the event of a legionella incident, at a frequency determined by the Responsible Person upon evaluation of the risk.

3.25.3. Ensure the Responsible Person has produced **The Plan** for bringing the University Estate into compliance with the requirements and prohibitions imposed by legislation, HSE guidance and the University Policy and supporting documents.

3.25.3.1. Reviewing **The Plan** to ensure it is time bound, prioritised and realistic. Will deliver against the objectives and is supported by an adequate resources including budget.

3.25.3.2. Reviewing progress against **The Plan**.

3.25.3.3. Identify any weaknesses or threats (including delays) to the plan, and agree modifications and timescales to address these.

3.25.3.4. Review details of any hot or cold water out of specification reports. Ensure a suitable and sufficient investigation has been carried out and that immediate, underlying and root causes have been identified. Ensure suitable actions have been identified to address the causes and that these are implemented in a timely manner.

3.25.4. Following each meeting of the Water Safety Group, a report to be prepared for submission to EHSS and the Health and Safety Assurance Group and corporate risk register to be updated as appropriate.

3.26. The Water Safety Group is also a critical route for ensuring relevant information about the management of water systems in buildings is shared with stakeholders. This includes securing the active cooperation of Schools and Units in provision of information to service users as well as ensuring access for Estates Trades staff and Contractors to buildings and the necessary parts of the water systems in a timely manner to discharge their duties.

3.27. Role of the Environmental Health and Safety Service (EHSS)

3.28. EHSS is part of the University Governance system and is responsible for identifying and setting the standards to be achieved to manage the risks of legionella in water systems in the University.

3.29. EHSS is responsible for undertaking checks, inspections and audits to be able to report to the Health and Safety Assurance Group, Audit and Risk Committee and VP Governance, that the risks of legionella in the water systems are adequately being managed.

3.29.1. EHSS will undertake annual internal audits. Such audits will be based upon the Control of legionella in water systems audit template.

3.29.2. EHSS will identify an external auditor to conduct a full audit of the University's control of legionella risk on a 3 yearly basis. The appointed auditor will be fully independent of any contracting water hygiene company appointed by Estates to supply any service in relation to legionella.

3.30. EHSS, together with the *Responsible Person*, is responsible for leading investigations into instances of positive legionella samples and reports of legionellosis on the University estate.

3.31. RISK ASSESSMENTS

3.32. As requirement by COSHH (2002) Reg 5 and the Management of Health and Safety at Work (1999) Reg 3, risk assessments will be carried out for the risk of legionella bacteria.

3.32.1. Although the Regulations do not specify whether this requires one risk assessment for the whole University estate, or one risk assessment for each building containing a water system, or for each water system within a building, the Approved Code of Practice require risk assessments to be carried out for each premises, considering the whole system and not parts in isolation.

3.32.2. Risk assessments will be undertaken for each building containing a water system.

3.32.3. A register will be created of Schools and Units having water systems associated with specific equipment or experiments and these will be subject to specific risk assessments.

3.32.4. Based on these, an overarching risk assessment will be produced for the University as a whole. This will inform the development of **The Plan** and be used to inform and update the Corporate Risk Register.

3.33. The risk assessment will be carried out as a minimum in accordance with BS8580-1:2019 Water Quality – Risk assessments for legionella control – Code of Practice.

3.34. Survey to fully identify all parts of the water system

3.35. Each building in which a water system is present will have a survey undertaken as part of the risk assessment to ensure all components which form part of the water system have been identified.

3.35.1. Before undertaking any survey, the appointed surveyors must undertake a desktop review of any and all existing plans and records of the water system for a building to establish what is known about the building.

3.35.1.1. This information is to be provided by the Building Services Manager (Mechanical), and a written record retailed detailing what records were found and provided OR that no records were found to exist.

3.35.1.2. Before undertaking any on-site surveying, the Building Services Manager (Mech) and the appointed surveyors must identify where within a building access will be required.

3.35.1.2.1. For all surveys to be undertaken, the Building Services Manager (Mech) will coordinate with the relevant Building Manager or Head of School/Unit to ensure full access can be achieved.

3.35.1.3. Any part of a building or water system that has not or cannot be properly surveyed and inspected must be clearly marked on the survey with the reasons given.

3.35.1.4. The planning of a survey will need to include consideration of environmental hazards. These include;

- The possible presence of asbestos (see Environmental Hazards - Asbestos)
- The risks from work at height (see Environmental Hazards - Work at Height)
- Fire safety (see Environmental Hazards - Fire Safety)
- Lighting (see Environmental Hazards - Lighting)

3.35.1.5. Before any survey can be accepted as completed the Building Services Manager (Mechanical) must resolve the access issues and the surveyors must have surveyed and inspected the parts where access was previously restricted.

3.35.2. The survey will identify all parts of the water system within each building. Where the University holds full details about the presence, location and route of all parts of the water system through O&M documentation this may be used to form the basis of the schematic. Where this information is not fully documented, a full track and trace survey will be required.

3.35.2.1. The outcome of the survey is to be recorded on a CAD editable drawing, to be held by the Estates CAD Technician. This set of drawings for each building will be the **Schematic** for the building and contain full details of all relevant components of the system, including showing any limitations on access due to size, space or environmental hazards.

3.35.2.2. As a minimum, the CAD drawings provided must be in AutoCAD V2018 in DWG format. All features must be recorded on separate layers within the file. The contractor carrying out the survey must review with the Estates CAD Technician before creating the CAD drawing to ensure file formats remain current and any specific requirements or anomalies are agreed up front.

3.35.2.2.1. All subsequent alterations to the water system, whether by contractors or Estates Tradespersons, MUST be recorded on the CAD drawing. It is the responsibility of the Building Services Manager (Mechanical) and the Estates Trades Manager to ensure this is done to ensure the records remain up to date.

3.35.3. This survey will consider each functional part of the water system to identify individual parts of the system that require to be registered as individual asset which requires inspection, testing or maintenance such that it can be recorded an asset register (see section on Asset Register).

3.35.4. The survey will also identify any equipment or apparatus connected to the domestic water system or independent of the domestic water system, including scientific or catering equipment as these risk systems must also be assessed and managed.

3.35.4.1. In preparation for this, a survey questionnaire will be circulated to Schools and units requiring them to identify any equipment with water systems.

3.35.5. Where there are multiple water systems within one building, the survey will clearly identify which outlets are associated with which water system.

3.35.6. Specific to showers, the survey will identify the type of shower fitted (Make, model, form of spray head – fixed or hose and rosette, and temperature settings).

3.35.7. The survey should clearly identify where thermostatic mixing valves (TMV) are present. In particular, for each it should identify:

3.35.7.1. The location and accessibility of the TMV;

3.35.7.2. The type of TMV (make, model, class, date, temperature set point). Note that some older designs of TMV lack backflow protection devices and can result in hot water blending with the cold water behind the TMV encouraging legionella or biofilm growth.

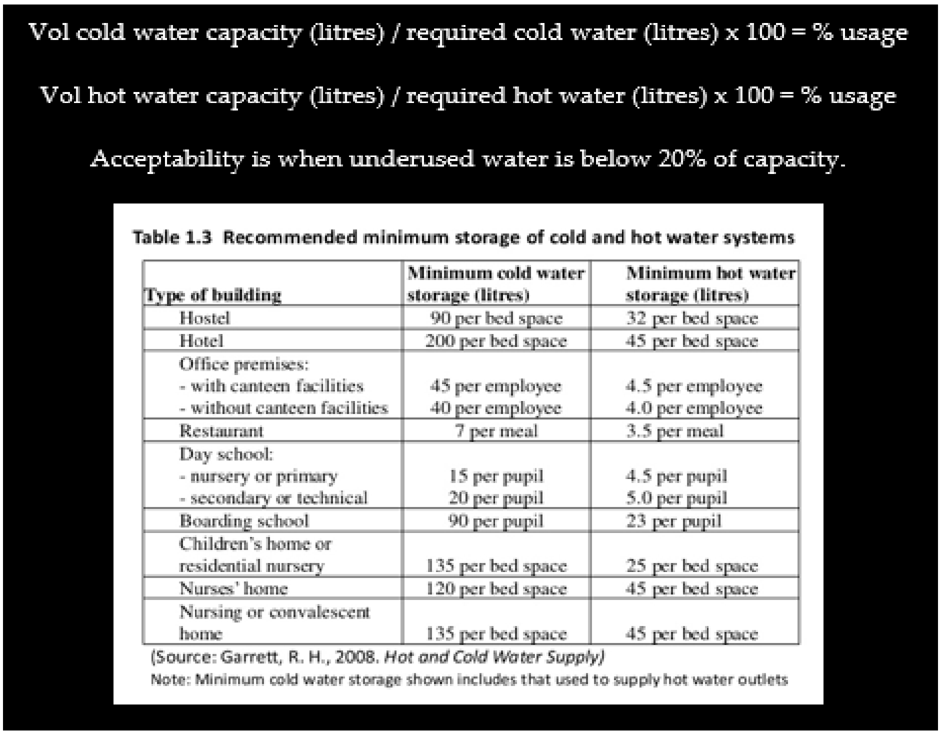
3.35.7.3. The number of outlets served by the TMV;

3.35.7.4. The distance between the TMV and the outlet served (this may be a maximum of 2m by law, but University standard should ensure this is less than 50cm).

3.35.8. Specific to mains water supply, the survey should clearly identify the location where the mains enters the building, the location and means of access for stop-cock systems, and the location for any mains injections that may be required for any clean and disinfection of the water system.

3.35.9. Specific to cold water storage tanks and cold water cisterns the survey should identify whether or not a **calculation of acceptability of design** has been carried out.

3.35.9.1. The *calculation of acceptability of design* is the accepted method of determining the required water storage requirements for any building.[10]



Vol cold water capacity (litres) / required cold water (litres) x 100 = % usage

Vol hot water capacity (litres) / required hot water (litres) x 100 = % usage

Acceptability is when underused water is below 20% of capacity.

Table 1.3 Recommended minimum storage of cold and hot water systems

Type of building	Minimum cold water storage (litres)	Minimum hot water storage (litres)
Hostel	90 per bed space	32 per bed space
Hotel	200 per bed space	45 per bed space
Office premises:		
- with canteen facilities	45 per employee	4.5 per employee
- without canteen facilities	40 per employee	4.0 per employee
Restaurant	7 per meal	3.5 per meal
Day school:		
- nursery or primary	15 per pupil	4.5 per pupil
- secondary or technical	20 per pupil	5.0 per pupil
Boarding school	90 per pupil	23 per pupil
Children's home or residential nursery	135 per bed space	25 per bed space
Nurses' home	120 per bed space	45 per bed space
Nursing or convalescent home	135 per bed space	45 per bed space

(Source: Garrett, R. H., 2008. *Hot and Cold Water Supply)*

Note: Minimum cold water storage shown includes that used to supply hot water outlets

Figure 5 Calculation of acceptability of design

3.35.9.2. Preventing water from stagnating is a key control measure to reduce the potential for legionella bacterial from developing. This is achieved by ensuring that excess water is not stored, and that the water this is stored in the system is fully used or turned over within any 24 hours period.

3.35.10. Specific to the cold water storage tanks, the survey should identify if automated release solenoids have been fitted to the drainage outlets.

3.35.11. Specific to the cold water storage tanks and cold water cisterns, the survey must identify whether the installation of these has left sufficient space above the water tank to permit a person to safely gain access and undertake an inspection (see Design requirements - cold water storage tanks).

[10] Note – this table is also referenced in BS EN 806-2:2005 Specification for installations inside buildings conveying water for human consumption Part 2:Design (para 19.1.4 and Table 6)

3.35.12. Specific to expansion vessels on the system, the survey must identify if these are effective dead-legs on the system and need to be included in regular flushing activities (see Design requirements - expansion vessels).

3.35.13. Specific to calorifiers, the survey must identify the type (make, model and age) of the calorifier, the presence of an inspection hatch and the size of the inspection hatch, the presence or absence of a de-stratification pump to ensure a thermocline cannot develop. The presence of flow and return sensors.

3.35.14. The survey will identify for the cold water storage tanks, cold water storage cisterns and calorifiers, the whether there is adequate provision to drain the stored water.

3.35.14.1. Drain valves on the storage tanks will be accessible without an operator being at risk from exposure to an aerosol being formed whilst the storage tank is being drained or from drowning. There should be continuous drainage pipes leading to the drains built into the building.

3.35.14.2. Drain valves on calorifiers should be capable of accepting an appropriately rated hose and be within 10 meters of a designated drain. This is to allow periodic water samples to be taken from the base of the calorifier.

3.35.14.3. The drain built into the building must be adequately located must have the capacity to accept the full flow rate from the connected drain to prevent a water escaping and creating a slip risk in plant rooms.

3.35.15. The survey will identify where water pipe runs are installed in close proximity to each other whether hot water pipes are installed over or under cold water pipe runs.

3.35.15.1. Cold water supply can be subject to thermal gain whilst in distribution pipes, if the hot water pipes are installed underneath them due to thermal convection.

3.35.16. The survey will identify where thermal insulation is sub-standard (e.g. non-conforming material or thickness), damaged or missing from the water system.

3.35.17. The survey should identify the presence of lead pipework anywhere on the system. This has been a recognised issue on mains supply pipes in historic parts of the town, and therefore particular attention must be given to the incoming mains.

3.36. Asset Register

3.37. All functional or mechanical parts of the water system must be registered as assets with unique identifier references on the Estates Department software system.

3.37.1. The register of assets must go to a granular level of detail. Individual check valves, sensors, TMV’s and water outlets should be registered as well as larger components such as calorifiers, water tanks and expansion vessels as all of these require maintenance.

3.37.2. Each asset will be fitted with a label on the asset (or if this is not possible, immediately adjacent to it) showing its unique identifier reference and a bar code / QR reader. Human error due to incorrect identification of parts will be reduced or eliminated.

3.37.3. Each asset identified must be assessed to determine the type and frequency of operational, maintenance and cleaning requirements associated with it and this to be recorded on the Estates Department computer aided facilities management system as appropriate, and to be included into the Written Schemes.

3.38. Limitation on connections to domestic water system

3.39. All appliances connected to the domestic water system must be compatible with the purposes of the water system in terms of material, construction and function.

3.40. No appliance may be connected to the domestic water system that risks causing deterioration of the quality of the water being circulated.

3.40.1. All appliances connected to outlets liable to affect the quality of the water must be fitted with suitable backflow prevention devices and comply with the Water Supply (Water Fittings) (Scotland) Byelaws 2014.

3.40.2. Any person wishing to connect an appliance to the domestic water that does not draw water off the system to an outlet, but rather intends to return the water to the system must provide a suitable and sufficient risk assessment which demonstrates how this complies with 3.39 above and obtain written authorisation from the *Responsible Person* **before** any such connection is make.

3.40.3. Any such connections must be registered on the asset register and included in the Written Scheme for the building.

3.41. Any modification to the water system including connections to appliances will trigger a review of the risk assessment for the building.

3.42. Design Requirements - Cold water storage tank

3.43. All cold water storage tanks should comply with the requirements of the relevant legislation and guidance. Where the guidance is ambiguous or permit varying standards the following standards are applicable across the University Estate. Any proposed variation will only be permitted following full assessment and must be agreed in writing with EHSS and the *Responsible Person*.

3.43.1. Cold water storage tanks should be designed (including insulation as appropriate – see BS 5422:2009 *Method for specifying thermal insulating materials for pipes, tanks, vessels,* *ductwork and equipment operating range -40°C to + 700°C*) and located to ensure that the contents are not exposed to conditions liable to raise the temperature above 20°C.

3.43.2. To avoid stagnation, where multiple cold water storage tanks are fitted, they must not be connected in sequence and may only be installed and connected to ensure each tank fills uniformly and water is drawn off uniformly through each of the tanks.

3.43.3. Inlet and outlet pipes should be located at opposite ends of the tank at differing heights to ensure regular movement of the water within the tank and avoid stagnation

3.43.4. The location and environment of the installation must have sufficient space to accommodate not only the water system but also to allow for the safe access by persons and equipment required to maintain the system.

3.43.5. Existing cold water storage tanks across the University vary in size, how most have the following features in common that require management. These are illustrated in Figure 6 below.

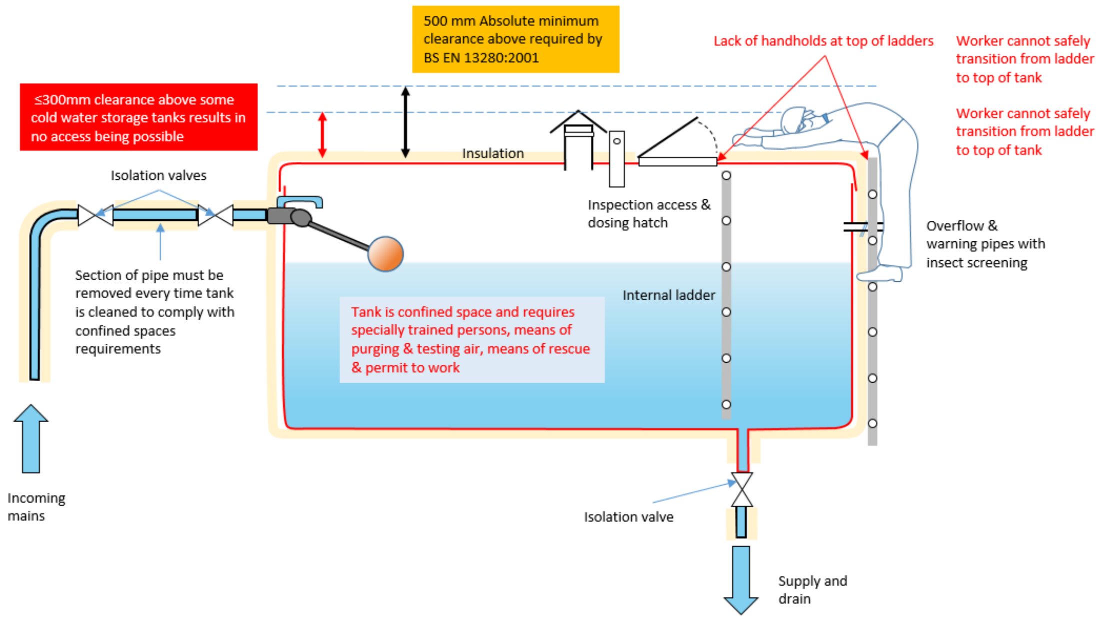


Figure 6 Illustration of typical cold water storage tank across University estate.

3.43.6. Access to existing tanks is mostly via fixed vertical ladders. These do not reach above the top of the tank, and there are no suitable handholds to assist a person to transition from the ladder to the top of the tank. This fails to comply with the requirements of the Work at Height Regulations 2005 Regulation 8(e) and Schedule 6(6).

3.43.7. Space above the water tank should ideally be sufficient to allow a person to stand upright, as this is required to safely transition between an access ladder and the roof of cold water storage tank. Recommended height is 2100 mm. However, where this is not possible, an absolute minimum height of 1250[11] mm must be provided to enable a stooped or squatting person to undertake operations.

3.43.7.1. Where possible existing fixed ladders should be replaced with ladders extending a minimum of 1m (3 rungs) above the top of the tank.

3.43.7.2. Where this is not possible, suitable hand-holds to be installed on the top of the tank to allow a person to safely grip these whilst transitioning between the tank and the ladder.

3.43.7.3. Where neither of the above solutions are available, suitably erected and braced alloy mobile towers must be used to provide a safe working platform from which persons can access the top of the tank. These should be positioned as close as possible to the access hatch and provide edge protection against the risk of a fall from height.

3.43.7.4. Where it is not possible to get physically reach or open the inspection hatch at all due to lack of clearance above the tank, then remote inspection equipment such as a borescope should be used to inspect the tank.

3.43.7.5. If a cold water storage tank cannot be visually inspected it must be taken out of use and urgent engineering works undertaken.

3.43.8. Cold water storage tanks meet the legal definition of a confined space under the Confined Spaces Regulations 1997 due to having the potential for several of the specified risks to be present. These include the risk of low oxygen levels; risk of flooding or drowning in the event of a mains isolation valve failing; and the risk of rise in bodily temperature resulting in loss of consciousness.

3.43.8.1. Because the tank becomes a confined space as defined, work within the tank can only be carried out under a Permit to Work for Confined Spaces. The Regulations require there to be a means of rescue in the event a person is overcome whilst in the confined space. For top accessed confined spaces, this requires a rescue winch to be deployed above the hatch that the Top man can use to winch the inside man to safety if required. These rescue winches are typically attached to a tripod which will require greater than 2m headroom clearance and will require wooden supports on the top of the water tank to prevent the feet from damaging / penetrating the roof. Where appropriate Estates Department should consider fitting suitably designed anchor eyelets above hatches to attach the rescue winch to. **IF** there is not space available above the tank to deploy means of rescue, **then no person**

11 The Work at Height Regulations 2005 require a ladder used for access purposes to extend 1m (3 rungs) past the landing platform. This assume arms held level with shoulders to ensure an ergonomic posture is adopted and reduce the likelihood of a mis-step or fall. The 1250 mm represents this requirement, plus an allowance for headroom. BS EN 13280:2001 *Specification for glass fibre reinforced cisterns of one-piece and sectional construction, for the storage above ground, of cold water* sets a lower minimum clearance above the inspection hatch of 500mm. The University as a client must comply with the higher H&S and legal requirements.

may enter the tank whilst it is a confined space as defined and the approach detailed in 3.41.8.2 or 3.41.8.3 below **must be followed.**

3.43.8.2. In the immediate and short term, to clean such tanks, once the tank has been drained down, low level panels will have to be removed to provide a safe means of access and egress. **This action is effectively dismantling a part of the tank, and it will require recommissioning prior to being put back into use.**

3.43.8.3. In the longer term to clean such tanks, manway low level side access hatches should be installed to at least 2 sides of the tank to form access and through movement of air, thereby eliminating the tank as a confined space.

3.43.9. The specification for cold water storage tanks in all new builds or refurbishment works as illustrated in Figure 7 below should as a minimum include:

- Sufficient clearance over the tank to allow access;
- Suitable means of access to the top of the tank. Ideally a designed staircase, but as a minimum a fixed ladder with at least 3 rungs above the step off landing;
- Suitable edge protection extending to all areas where a person foreseeably has to access for inspection, maintenance or repair purposes;

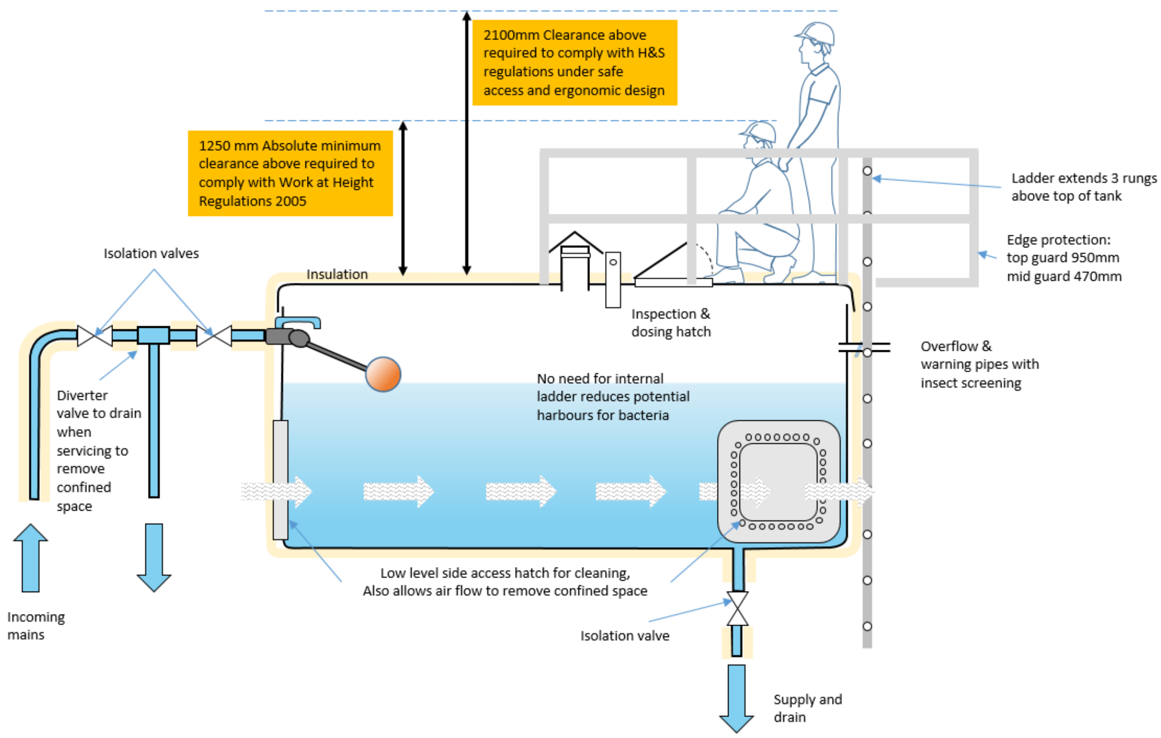


Figure 7 Specification for Cold Water Storage Tanks in New builds or Refurbishments

- Double isolation valves and a diverter valve on the incoming mains, such that in the event of a failure of an isolation valve the water is diverted to a drain and cannot enter the cold water storage tank or cause a flooding / slip problem on the plant room floor;

- The installation of at least 2 manway side hatches at low level which allow for access of a person and equipment in an ergonomically manner, eliminates work at height, and ensures the through-flow of air, thus removing the risk of low oxygen;

- The isolation valve on the drainage downpipe to be fitted with a controlling solenoid connected to the BEMS system (see Control Measures – Temperature control). In the event of loss of thermal control this can automatically be instructed to empty the contents of the tank. This can also be a part of the planned control measure for ensuring the contents of the water tank are turned over within 24 hours (in periods of low occupancy this can be opened for a specified period of time every day, draining a determined quantity of water that would otherwise be used by occupants, avoiding stagnating water). This will still require access for regular inspections and maintenance and so the space requirements under the tank remain.

3.44. Design Requirements - Expansion vessels

3.45. Expansion vessels on a system may have long periods without exchanging any water and thus become effective dead-legs on the system allowing for stagnation and aiding biological growth.

3.45.1. Across the University estate there are a variety of types of expansion vessels (see Figure 8 below), however most are of the diaphragm or bladder style.

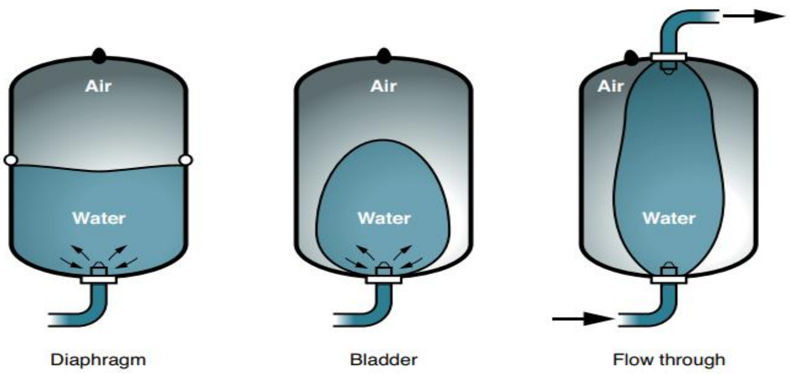


Figure 8 Expansion vessels design types (from HSG 274)

3.45.2. To reduce the risk of biological growth associated with expansion vessels, design and installation should be verified to ensure the internal diaphragm or bladder is of an approved material (BS 6920:2014 *Suitability of non-metallic materials and products for use in contact with water interned for human consumption with regards to their effect on the quality of water*).

3.45.3. They should be mounted vertically on pipework to reduce the potential for debris to be trapped within them

3.45.4. They should be fitted with an isolation and drain valve to aid with flushing and sampling and, where identified within the risk assessment, should be part of a PPM flushing regime.

3.45.5. All new expansion vessels installed during construction, refurbishment or maintenance work should be of a "Flow Through" design to further reduce the risk of stagnation.

3.45.6. Bladders should be capable of being accessed for replacement – frequency of this should be identified by the manufacturer's guidelines or by risk assessment. Labels indicating the frequency of the change and the date of the last change should be on the outside of the expansion vessel.

3.45.7. Where critical information is unknown for the University to manage expansion vessels as assets, they must be replaced with modern units.

3.46. Design Requirements - Calorifiers

3.47. All calorifiers should comply with the requirements of the relevant legislation and guidance. Where the guidance is ambiguous or permit varying standards the following standards are applicable across the University Estate, any proposed variation will only be permitted following full assessment and must be agreed in writing with EHSS and the *Responsible Person*.

3.48. There are wide variation in the types and designs of Calorifiers and hot water cylinders, this section details the key components required for health and safety purposes:

3.48.1. The primary control requirement for calorifiers within the University are that the hot water is stored at least at 60°C.

3.48.2. For recirculating hot water systems, any associated circulation pumps must be suitably sized and the system balanced to ensure the water reaches a temperature of 55°C at outlets within 1 minute, and a minimum of 50°C at the return to the calorifier.

3.48.3. For indirect heated calorifier with an internal heating coil, a de-stratification pump or charging pump must be fitted to ensure a thermocline does not form within the calorifier (the pump should be set to run for a minimum of 1 hour / day), or the internal boiler heating coil must rise the full height of the calorifier. These arrangements are required to prevent conditions whereby biological growth is encouraged within the calorifier.

3.48.4. Calorifiers attached to solar heating systems are not acceptable on the University estate.

3.48.5. Where more than one calorifier is fitted to a water system, they must be connected in parallel and balanced to ensure water is constantly delivered between them at a temperature of at least 60°C.

3.48.6. Calorifiers shall have a means of drain down located at the lowest point to allow sediment or debris to be removed from the system.

3.48.7. Calorifiers shall have a suitably sized inspection hatch to permit the periodic visual inspection of the condition of the calorifier and for cleaning to be safely carried out as necessary. The location and design of the calorifier and other pipework shall not obstruct access to the inspection hatch.

3.48.8. Where the calorifier is a vented system, the overflow vent must not empty into the cold water storage tank as this can heat the stored cold water resulting in conditions liable to encourage biological growth. It should vent externally in an appropriate location to provide a safe and visible warning of a fault condition.

3.48.9. Calorifiers should be fitted with temperature sensors linked to the BEMS system. These temperature sensors must provide information on the temperature of the water leaving the calorifier, the temperature of the stored water at the base of the calorifier, and the temperature of the water returning to the calorifier.

3.48.10. Calorifiers should be suitably insulated ensure they remain within temperature ranges (BS 5422:2009 *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating range -40°C to + 700°C*). The thermal insulation must be considered as part of periodic inspections and maintained.

3.49. Design Requirements – Pipework and drains

3.50. All hot and cold water pipework should be suitably insulated (BS 5422:2009 *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating range -40°C to + 700°C*) to prevent thermal gain.

3.51. When installed there should be sufficient separation between the domestic hot and cold water pipework, and on horizontal runs the hot water pipework should never be installed underneath the cold water. This is to eliminate the risk of thermal transfer through convection from the hot water pipework to the cold water pipework, that could result in temperature conditions favourable to biological growth within the pipework.

3.52. All lengths of pipework forming a dead leg or blind end in which water can stagnate must be removed.

3.52.1. Where possible the pipework shall be disconnected from the system and the entire redundant length should be removed from the building.

3.52.2. Where this is not possible (e.g. due to presence of asbestos) the pipework shall be disconnected from the system and the redundant lengths drained down. The redundant pipework shall be labelled as disconnected from the system and the date of the disconnection at suitable points of access for future information.

3.52.3. Where pipework has been removed from the system, the "T joint" shall be removed entirely from the remaining distribution pipework, and replaced with an appropriate fitting. No pocket however small may remain to act as a harbour or effective dead leg on the system.

3.52.4. Where pipework has been removed from the system the CAD plans for the building shall be updated to reflect this and details held of the date of disconnection, a digital photograph shall be provided of the point of disconnection showing the T joint removed, and information of whether the redundant pipework was fully removed from the building or not, will be recorded on the CAD plans. The building specific Written Scheme shall also be updated with this information.

3.53. In attic spaces a fixed means of drainage must be provided. Connecting hoses to the drainage outlets and pushing the hoses out of windows/skylights or dangling them from the edges of building are not permitted as these create a number of significant uncontrolled risks including:

- Manual handling injury associated with the handling of the extensive lengths of hosepipe;
- The falling water may well be contaminated with legionella bacteria and the activity is creating an aerosol in a public area which can drift and expose many people;
- Risk of a person falling a distance from a roof edge;
- Risk of the hosepipe itself coming lose, falling from height and striking a person;
- Risk of dislodging part of the building (loose stonework or tiles) which can fall and strike a person;
- Risk of material damage to the property through mechanical damage or water ingress.

3.53.1. It is acceptable in attic spaces for fixed connections to be formed that join the drain valve on the cold water storage tank to the external rainwater downpipe. The drain valve must be so sized that the volume of water discharged from the cold water storage tank cannot over-whelm the capability of the rainwater downpipe resulting in danger or damage.

3.53.2. In plant rooms drainage must be located and sized to ensure that water discharged from calorifiers and cold water storage tanks are wholly contained and do not create wet floors liable to give rise to slip or a fall.

3.53.2.1. For Calorifiers in particular, the drainage provided must ensure it is still possible to collate discharge water calorifiers for analysis, or on older calorifiers lacking inspection hatches, that borescopes can be inserted for inspection purposes.

3.54. Design Requirements – Thermostatic Mixing Valves (TMVs)

3.55. Storing and circulating hot water at temperatures in excess of 50°C to control legionella bacteria can introduce a risk of scalding. A scalding injury to an employee is a specified injury under RIDDOR. Most scalding injuries (resulting in partial or full thickness burns) require hospital treatment and frequently require admission which would also qualify for RIDDOR reporting.

3.56. HSE and the NHS indicate that the minimum temperature that can result in a scald or burn for a finite time is 44°C with partial-thickness burns (also known as second degree burns) occurring at 45°C. At temperatures above these, the level of damage and increases significantly at decreasing exposure times.

3.56.1. Partial thickness burns are more serious as they penetrate further into the skin, with longer lasting effects and higher subsequent risks of infection. Where exposure exceeds 10% of the body area there are secondary risks of shock which can (in extreme cases) result in death.

3.56.2. The University has a great many outlets supplied with hot water, however it is only showers and baths where there is a foreseeable risk of a person having an exposure of greater than 10% of their body area.

Temp	Adult 3dr degree burn	Adult 2nd degree burn	Child 3rd degree burn	Child 2nd degree burn
45°C	>60m (e)	>60m (e)	>50m (e)	>30m (e)
50°C	300s	165s	105s	45s
55°C	28s	15s	8s	3.2s
60°C	5.4s	2.8s	1.5s	0.7s
65°C	2.0s	1.0s	0.52s	0.27s
70°C	1.0s	0.5s	0.27s	0.14s
75°C	0.7s	0.36s	0.18s	<0.1s
80°C	0.6s (e)	0.3s	0.1s (e)	<0.1s (e)

Time of exposure
e = estimated
m = minutes
s = seconds

Figure 9 Illustration of scalding risk at increasing temperatures

3.57. To address the risks from scalding, the use of devices to prevent scalding by controlling the maximum temperature at point of discharge has been introduced into law by:

- Building Standards technical Handbook 2017: non-domestic buildings (guidance on the Building (Scotland) Regulations 2004)
- Workplace (Health, Safety and Welfare) Regulations 1992, Regulation 21, (in ACoP, P 38, para 195);

3.58. Thermostatic mixing valves (hereafter TMVs) are designed to blend the hot and cold water to a single stream to provide a controlled temperature output at point of use.

3.59. Should the cold-water supply reduce or fail for any reason the TMV must reduce or cut off the hot water flow to ensure that scalding cannot take place – this is known as the fail-to-safe or *failsafe* design.

3.60. TMVs are sensitive to the flow and temperature of the building in which they are installed. A TMV may lose functionality if the hot water temperature supplied to it is below design intent, or if the flow of the hot water supply is below design pressure range (this varies depending on the Type and manufacturer/model). The hot water temperature and flow is therefore very important detail to establish when the technical specification of the shower or bath is being determined as this affects the choice of the TMV to be installed. Changing these variables (for example the change over to the District Heating System) can affect the operation of the TMV.

3.61. TMV in the UK are designed and manufactured to one of 2 technical compliance standards referred to as either TMV 2 (BS EN 1111:2017 *Sanitary tapware. Thermostatic mixing valves (P10). General technical specification* and BS EN 1287:2017 *Sanitary tapware. Low pressure thermostatic mixing valves. General specification*) or TMV 3 (Designed by NHS Estates for healthcare settings due to higher vulnerability population). The TMV 3 design can provide a more immediate failsafe function and improved performance with temperature or pressure variations in a building.

3.62. Most TMVs installed across the University campus are Type 2. This is the minimum standard for a TMV in the University.

3.63. The preferred standard for a TMV in showers and baths will be TMV Type 3 and all new installations / refurbishments should comply with this.

3.64. The Scottish Building Standards technical handbook sets a maximum limit for hot water discharge at showers, baths and bidets at 48°C. It is however for the duty holder to determine through risk assessment whether this temperature is suitable or if a lower temperature is suitable.

3.65. HSE published guidance indicates that where vulnerable users are identified, TMV should be are used with a maximum temperature for hot water in showers of 41°C in showers and 43°C in baths.

3.65.1. In a bath, the temperature is set at a higher temperature because the body of water has been delivered and immediately begins losing heat in exchange with the environment, the bath and any person in it, therefore as time passes the temperature drops, thus the higher temperature of , thus the higher temperature of 43°C.

3.65.2. In showers there is a continually renewed supply of hot water at constant temperature and no drop of temperature over time, thus the lower temperature of 41°C.

3.65.3. The definition of a vulnerable person in context of scald risk from HSE includes:

- Elderly persons or young persons by virtue of their skin being thinner;

- Persons who are unable to self-rescue (get out of the bath or shower on their own)
- Persons who for medical (including sensory or judgement impairment) reasons are unable to sense the temperature of the water and therefore may inadvertently burn themselves.

3.65.4. The University has no knowledge of the medical status of most of its student population, staff or visitors who may use showers or baths.

3.65.5. Many of the residential premises are rented out to members of the public during the holiday periods, and many of these paying guests have young children.

3.65.6. The University is unable to customise the service, offering higher temperature showers / baths to some and lower temperature showers and baths.

3.65.7. The University will therefore ensure the showers and baths are only capable of delivering hot water to 41°C in showers and 43°C in baths.

3.65.8. Temperatures at dedicated wash hand basins will be controlled via TMVs to a maximum temperature of 41°C.

3.65.8.1. Outlets in kitchens, kitchenettes and laboratories require higher temperatures, and in those locations, the optimal temperature will be 46°C with a maximum temperature of 48°C – all such outlets **must** be fitted with signage indicating the risk.

Figure 10 Sample of scald risk signage for kitchens

3.66. Group installations for TMV's is not permitted across the University estate, each TMV will service only one outlet.

3.67. TMV's will be fitted as close to possible to the outlet they serve and in all circumstances be no more distant than a maximum of 50cm from the outlet.

3.68. TMV's must either be supplied with integral backflow prevention devices to or these must be provided as separate items to prevent water passing from hot to cold or vice versa, and potentially resulting conditions liable to encourage biological growth.

3.68.1. Where TMV type 1 mixer taps are provided, these must be checked to ensure they have integral backflow prevention devices to prevent biological growth. Where this is missing the mixing tap should be replaced with a suitable tap that integrates this control.

3.69. TMV's are a part of the water system where biological growth can happen and must be under a relevant programme of cleaning and maintenance in accordance with the manufacturer's recommendations.

3.70. Any TMV fitted must be easily accessible for the operational and maintenance purposes. All access hatches must be suitably positioned and sized to allow such activities to be undertaken in a safe and ergonomically sound manner.

3.71. Functional checks of TMV's must be drawn from the manufacturer's guidance, but as a minimum all functional checks must include the following steps:

3.71.1. Temperature check of the hot water at the outlet using a UKAS calibrated digital thermometer.

3.71.2. A cold-water failsafe shut-off test by isolating the cold-water supply to the TMV. Wait for five seconds the hot water at the outlet should have shut off. If the water is still flowing, check that the temperature is 41°C (showers) or 43°C (baths) or below. Continue this check for 3 minutes. A report of this should be generated and checked against manufacture's operating guidelines. This may be an indication of a fault developing.

3.71.3. If there is no significant change to the set outlet temperature, and the failsafe shut-off is functioning, the TMV is working correctly.

3.71.4. If the outlet water temperature has drifted up from its set point or if the failsafe function does not work, a full service and recommissioning of the TMV is required. The outlet should be isolated until this has been carried out.

3.72. Further guidance on the installation and operation of TMV's is available from:

- Thermostatic Mixing Valve Manufacturer's Association Recommended Code of practice for Safe Water Temperatures;
- The Bathroom Academy Thermostatic Mixing Valves.

3.73. Environmental hazards - Asbestos

3.74. For buildings constructed **before the year 2000** asbestos clearance must be obtained from the Estates Department Compliance Team, OR arrangements must be made for an asbestos surveyor to accompany the any person undertaking work and provide on-site clearance to access.

3.75. Where the compliance team or asbestos surveyor identifies an area where access is not possible due to the presence or suspected presence of asbestos, arrangements must be made to return when safe access can be granted that complies with the Control of Asbestos Regulations 2012.

3.75.1. Where the requirement for access is for the purposes of surveying alone, alternative survey methods can be used to complete the survey, including use of in-pipe borescopes, or the use of asbestos licensed contractors to access the area under suitable controls and provide video and photographic evidence of parts and condition of the equipment located within the space.

3.75.2. Ultimately however, where water services exist that require routine access for inspection and operational and maintenance purposes, any asbestos present must be safely remediated.

3.75.3. Asbestos can be present in on the water systems associated with:

- Thermal insulation on cold water tanks and calorifiers;
- Asbestos paper undercoat present under foam insulation on hot and cold water pipes
- Gaskets to inspection hatches and on flanges between sections of pipework;
- Textiles such as asbestos rope used as sealants on pipework and flanges.

3.76. Where access to an area is prohibited or restricted due to asbestos presence or removal/remediation works. Coordination must occur between the Compliance Team and the Building Services Manager (Mechanical) to ensure that legionella control arrangements (such as routine flushing or inspections) are maintained.

3.76.1. These may be carried out by the asbestos contractor – for example routine flushing of outlets, or by the appointment of water hygiene contractors who are suitable trained and authorised for entry into asbestos environments, and do so under the control of the Compliance Team.

3.77. Environmental hazards – Work at height

3.78. All parts of the water system located in places of height requiring access for survey, inspection, operation or maintenance must be provided with safe means of access in compliance with the Work at Height Regulations 2005.

3.78.1. Plant such as cold water storage tanks or pipe runs are frequently located within attic spaces. Some of these spaces lack a load bearing floor and only have joists present and these present a risk of a fall from height through a fragile surface.

3.78.1.1. The preferred standard is that the whole attic space is fitted with a load bearing floor.

3.78.1.2. Where this is not currently provided, a load bearing walkway of min 1 meter width must be provided to the plant and pipe runs. This must be fitted with guardrails of a suitable strength and rigidity. The top guardrail must be a minimum of 950 mm height from the walkway and a mid guardrail fitted with a maximum gap below the top guardrail of 470 mm.

3.78.1.3. Where no such flooring has been provided and access is required for surveying or inspection purposes alone, the use of temporary expandable flooring may be used. The University recommends the use of the Oxford 240V expanding safety mats, a number of which are held in Estates Stores. These are a GRP product providing insulation against electrical shock risks, and are capable of providing a structurally sound flooring to enable persons to form a walkway or flooring around plant requiring survey or, inspection or light maintenance works.

Figure 11 Oxford 240V expanding floor mats

3.78.2. Water tanks and services which are above floor level and require persons to climb to access them should be provided with a fixed safe means of access consisting of steps, a working platform and guardrails of suitable of suitable strength, stability and rigidity, with the top guardrail at 950 mm above the working platform and the gap between the mid-guard and the top guardrail being no more than 470 mm.

3.78.2.1. **Climbing upon struts, pipes or ventilation ducts is not permitted.** This has a significant fall risk and the risk of causing damage. Where access to parts of the system are required but cannot be achieved without the need to climb upon such structures, engineering works will be required to either provide a suitable and safe means of access or to relocate the part of the water system requiring access.

3.79. Access to attic and roof spaces across the University is a high risk activity and is by Permit to Work only. **Lone working in such spaces is not permitted**.

3.80. Environmental hazards – Fire safety

3.81. For fire safety purposes it is important that there is a safe means of access and egress, and that in the event of a fire alarm sounding and requiring persons to leave the building, that all persons can do so with relative ease and without undue delay – such as having to crawl on belly under pipework or in under-crofts in order to reach an exit point.

3.82. Where access is required to such areas for survey or inspection purposes only, consideration should be given to the use of remote operated vehicles with cameras for accessing such areas, thereby avoiding human access unless absolutely necessary.

3.83. Where routine access to such areas is required for inspection, operation and maintenance purposes, then either the plant must be relocated or new safer means of access will have to be created.

3.84. All spaces where persons have to carry out work, must be fitted with a means of detection and audible alarm which is connected to the fire monitoring system.

3.85. All attic spaces where persons have to carry must have suitable illuminated signage indicating emergency escape routes.

3.86. Fire detection sensors must not be covered for water management normal operations.

3.87. Environmental hazards – Lighting

3.88. All spaces containing key components of water systems should be provided with sufficient fixed lighting providing a minimum of 200 lux which as a minimum must cover the plant to be worked and access routes to / from the plant.

3.89. Emergency lighting should also be provided as appropriate to the space. In un-floored attic spaces, with dedicated walkways, as a minimum the emergency lighting should illuminate the walkway to the escape route.

4. OPERATIONAL ARRANGEMENTS

4.1. This section covers the activities that will be carried out in order to manage the risk of legionella on a day to day operational basis.

4.1.1. It establishes the Control Measures to be implemented and details minimum standards for these.

4.2. Written Schemes

4.3. The written scheme contains the information required to manage the risks identified and assessed with the risk assessments for managing, preventing and controlling legionella in water systems.

4.4. Written schemes can exist at an organisational level and at an individual building level.

4.4.1. For the University of St Andrews, at an organisational level the written scheme consists of the Policy document and this Technical Document as these set out the arrangements for managing the risks from legionella as a top-line approach and includes the University legionella incident response plans as shown in the Out of Specification reports.

4.4.2. Supporting the top-line Written Scheme, HSE published guidance HSG274 provides an indicative checklist for the frequency of inspection and monitoring regimes in hot and cold water systems, a copy of this is in Appendix 2 to this document. The University will adhere to these recommendations as a minimum. The University will go beyond the frequency of the inspections or actions in this checklist, based upon the results and recommendations of individual building risk assessments.

4.4.3. Underpinning these top line arrangements, a written scheme must be prepared and implemented for each building having a water system.

4.4.4. The written scheme must be an electronically held document – the golden source to be held centrally via Estates Unit with a linked access available within the relevant building.

4.4.4.1. At an individual building level the written scheme must as a minimum contain the following information:

- Purpose of the document;
- the risk assessment for the building.
- identification of the management structure with responsibilities for the individual building and information showing how this relates to the top level management system;
    - communication pathways;

- allocation of specific responsibilities for the building;
- details of training requirements to discharge responsibilities for building;

- details of the building, description of the water system and locations of the key components of the water system;
- up-to date schematic for the building with clearly marked key components including piping routes, storage and header tanks, calorifiers and relevant items of plant such as water softeners, filters, strainers, pumps, all water outlets, sentinel taps and isolation points;
- details of the management operations and checks to be carried out on the system, indicating which will be undertaken **on site** (where and how), and those which are undertaken via **remote monitoring (via the BEMS system**);
- details of analytical testing (including biological monitoring) and other operational checks, inspections and calibrations to be carried out, their frequency and records of any findings and corrective actions;
- details of any remedial action to be taken in the event the existing controls prove are shown not to be effective, including clear records of any modifications to the system (see Out of Specification Reports);
- details on the safe storage, handling, use and disposal of any chemicals used for the treatment or testing of the water system, including their neutralisation post use and / or environmental consents for discharge required;
- details of an incident management plan covering major plant failure (see Out of Specification Reports).

4.5. Control Measures – Temperature control

4.6. Thermal controls are a **primary** operational control measures for the control of legionella bacteria in the hot and cold water systems.

4.7. Cold water shall be stored and distributed at no greater than 20°C.

4.7.1. For cold water storage tanks, as a minimum, temperature sensors shall be installed to monitor the incoming mains temperature and the core temperature of the water within the tank. These shall be connected to the University BEMS system.

4.7.1.1. Where capability does not currently exist to connect these to the BEMS system, the checks will be manually performed on site at the same time as the monthly Sentinel tap checks.

4.7.2. For water in pipework, the temperature of water at Sentinel Taps (those nearest and furthest from the cold water storage tank, but also those identified in the building Risk Assessment, for example at end of line or with low pressure) and 5% of other outlets on a random basis shall be checked on a monthly basis in each building.

4.7.2.1. The water at the outlet should be below 20°C within 2 minutes of turning it on.

4.7.3. Where water in the cold water storage tank is recorded as above 20°C the contents of the tank must be drained and the tank refilled with mains water and the temperature checked again.

4.7.4. Hot water systems operating on a direct fired water heater or indirect fired calorifier shall be fitted with temperature sensors at on the flow and return pipework and at the base of the cylinder. These shall be connected to the University BEMS system.

4.7.5. For water in pipework the temperature of water at Sentinel Taps (those nearest and furthest from the water heater or calorifier, but also those identified in the building Risk Assessment, for example at end of line or with low pressure) and 5% of other outlets on a random basis shall be checked on a monthly basis in each building.

4.7.5.1. The water at the outlet should not be below 55°C within 1 minute of turning it on.

4.7.5.2. Where TMVs are fitted on hot water outlets, 2 temperature checks must be carried out.

4.7.5.2.1. The temperature within the hot water pipework before the TMV should be checked first. The recorded temperature must not be below 55°C within 1 minute of turning it on.

4.7.5.2.2. The water at the outlet post TMV should be checked second and must not be above 41°C to control scald risk (except kitchens which must not be above 48°C).

4.7.5.2.3. In addition to 4.7.5.2.1 above, for showers the spray nature of the showerhead results in false readings. The delivered water must be collected in a small container as close to the point of discharge as possible. Allow up to 2 minutes for the system to stabilise before immersing the probe into this collected water. Do not allow the probe to contact the container as this will give a false reading.

4.7.6. UKAS calibrated digital thermometers should be used to checks water temperature. For the elimination of human error during data entry, these should be Wi-Fi or Bluetooth enabled.

4.7.6.1. An immersion probe is required for all wet testing. The probe is placed in the running water flow for the appropriate time.

4.7.6.2. A surface contact probe is required for testing of pre-TMV pipework. The probe is placed in contact with the pipework whilst the outlet is running for the appropriate time.

4.7.6.3. Before undertaking any checks with the digital thermometer, the calibration certificate must be checked to ensure it is in date.

4.7.6.4. When recording the results of all temperature checks the serial number of the digital thermometer must be noted and related back to the calibration certificate.

4.8. The results of all temperature monitoring should be recorded and analysed to identify systemic or localised issues and any loss of control to be escalated in line with the Out of Specification reports.

4.9. Use of temperature controls on the hot water system can be used as a thermal disinfection method (see Control Measures – Cleaning and disinfecting) in the case loss of thermal control or localised low levels of biological growth discovered through the biological monitoring (see Control Measures – Biological monitoring).

4.10. Control Measures – Routine flushing

4.11. Prevention of stagnation of water is a **primary** control measure. Regular movement of water within a system does not eliminate the presence of legionella bacteria from a system but ensures if present that the numbers remain so low as to not form a risk. The hot and cold water is routinely draw off and replaced, or in the case of the hot water , if not used it is returned to the calorifier and thermally disinfected.

4.12. The risk exists that outlets on a length of distribution pipework are not used of a period of time can result in stagnant water in which biological growth can take place. From there it can either re-seed the whole water system or pose a high risk to persons when the outlet returns to use.

4.13. Where outlets are identified as redundant, then the outlet and all associated pipework leading back to the distribution pipework must be disconnected from the system (see Design Requirements – Pipework and Drains)

4.14. Under used outlets can become effective dead-legs. HSE defines an under-used outlet as one which has not been used within 8 days.

4.15. The University has a programme of flushing of underused outlets to ensure these do not become dead-legs.

4.16. In the absence of any measures to confirm which outlets are underused and which outlets are routinely used, the University has adopted an approach of flushing all outlets.

4.16.1. This approach is resource intensive and costly.

4.16.2. Sensors capable of identifying water flow should be installed on the supply pipework of outlets and connected to the BEMS system. This would give the University the capability of identifying the underused outlets by exception and allow targeted flushing where required instead of flushing everything.

4.16.3. In student residences, Residential Business Service cleaning staff have responsibility for ensuring all outlets in publically accessible areas are flushed on a weekly basis.

4.16.4. In student residences where outlets are within the student's rooms, the student themselves is responsible for ensuring the outlet is flushed on a weekly basis.

4.16.4.1. In student residences where outlets are within the student's room and the student is absent for any period of time of 1 week or more, Residential Business Service cleaning staff have responsibility for flushing the outlet on a weekly basis.

4.16.5. In buildings having laundry or catering appliances connected to the water supply, these should be operated once a week by the relevant responsible unit (or Student Association) to ensure they do not become dead legs.

4.16.6. In support and science buildings, Estates staff have responsibility for ensuring outlets are flushed on a weekly basis.

4.16.6.1. In laboratories of science buildings, lab personnel have responsibility for ensuring all other outlets within laboratory spaces and associated stores are flushed on a weekly basis.

4.17. To flush an outlet, the water must be flowing and allowed to come to temperature (flowing cold to touch for cold water outlets and hot to touch for hot water outlets) and then be allowed to flow continuously for a 5 minutes.

4.17.1. When turning on variable flow taps (twist the control knob or lever to cause the water to flow) the operator should do so slowly to ensure the water does not spurt and splash creating a respirable spray.

4.17.2. When flushing non-concussive taps, the operator will have to hold the tap down against its return to ensure a continuous flow of water for the required flushing time.

4.17.3. When flushing infrared timed flow taps, the operator will have to ensure the sensor is triggered sufficiently to ensure the continual flow of water for the required flushing time.

4.17.4. When flushing showers, if possible lower the shower head and angle away from the operator's respiratory zone.

4.17.4.1. On a well-managed system the risk from legionella exposure during routine flushing should no more than the risk to persons using the shower for personal washing.

4.17.4.2. Emergency drench showers in laboratories must also be included in the flushing regime.

4.17.4.2.1. Suitable equipment should be provided to contain the water from normal or emergency showers to prevent staff performing the flushing from becoming wet or resulting wet floors and introducing slip risks.

Figure 12 Example of hand held shower bag (shown with bucket and emergency drench shower

4.17.4.3. Plumbed emergency eye washes in lab spaces must also be included in the flushing regime.

4.18. Records must be kept of the flushing activities for each building and provided to Estates Department in a timely manner (see Control Measures – Information Management and Record Keeping).

4.19. Control Measures – Visual Inspections

4.20. Visual inspections are a secondary control measure. An inspection of the inside condition of the cold water storage tank should be undertaken on a routine basis. HSE guidance indicates a minimum of an annual be undertaken.

4.21. The University standard is that this should be visually inspected annually by contracted water hygiene professionals, and should be visually inspected quarterly by University Competent Persons from the Estates Trades staff. All visual inspections must include digital photographic record of the as found condition to be held against the individual building Written Scheme.

4.22. Figure 13 below gives a colour coded indication of the condition of the tanks.

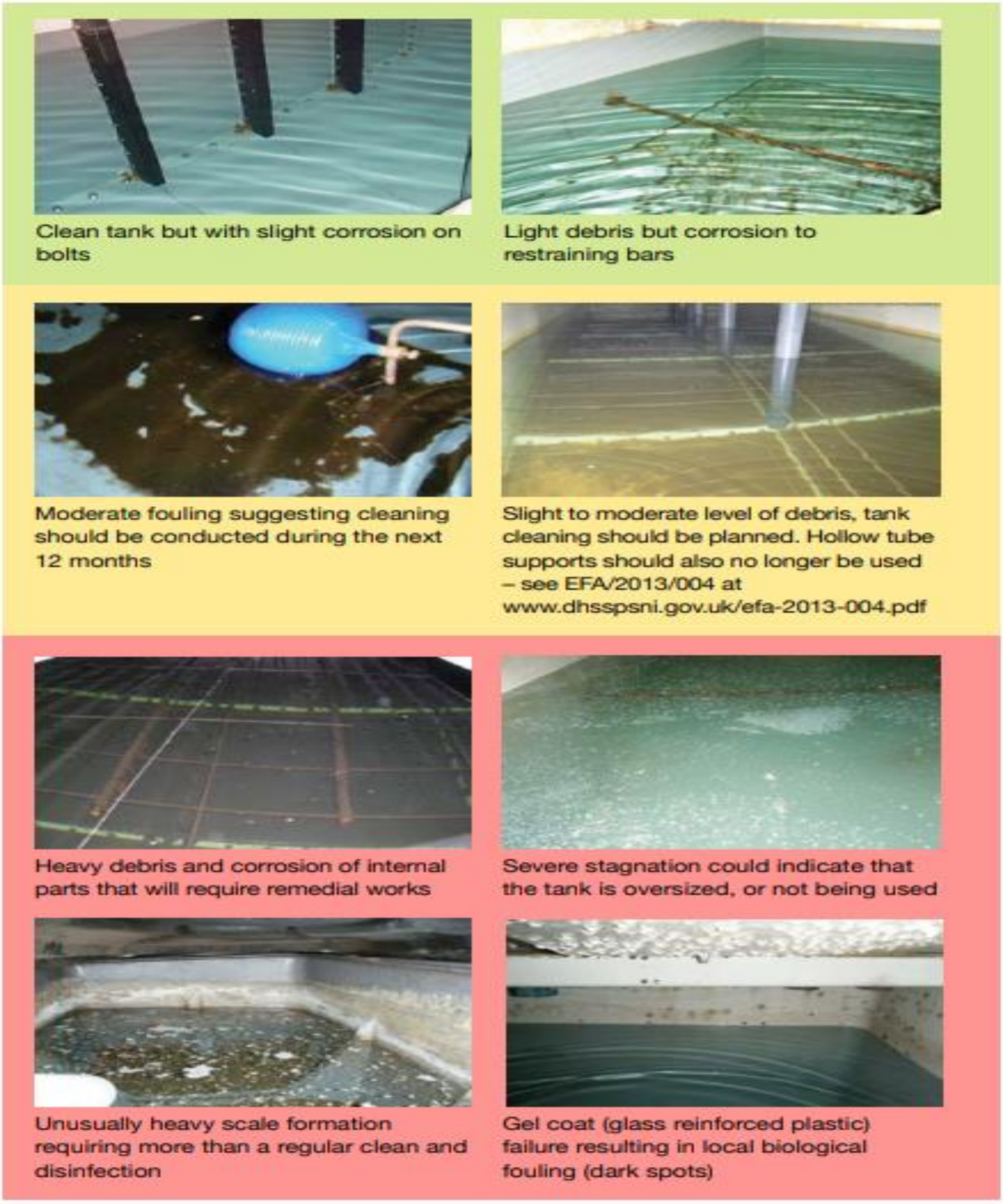


Figure 13 Illustration of cold water storage tanks in various conditions set against traffic light colour coding.

Source HSE publication HSG 274 Part 2.

4.23. Visual inspection of water heaters and calorifiers is a two stage approach:

4.23.1. The water heater / calorifier a small amount of water (1-5 ltr) is drawn from the drain valve into a clean white container (for colour contrast). The water is visually assessed for colour, particles, sediment and smell as indicators of the quality of the water. A photographic record is to be taken after 1 minute settling time.

4.23.1.1. This water is very hot min 60°C. There is a risk of scalding associated with this task, and safety gloves to EN 407 with Contact Heat rating of level 1 which are of a gauntlet style offering hand wrist and base of the forearm protection must be worn.

4.23.1.2. The container should be positioned below the drain valve. Where this is not possible a length of clean flexible hose should be connected to the drain valve to feed into the container and held or secured to ensure it does not move. The drain valve should be opened slowly.

4.23.2. Where the drain water is of poor quality – interior inspection may be appropriate. The water heater / calorifier must be isolated and drained. Where inspection hatches exist these should be opened and the interior visually inspected with photographic records taken. Where no inspection hatch exists, a borescope should be used, inserted via the drain valve.

4.24. Control Measures – Biological monitoring

4.25. Biological monitoring is a secondary control measure. It is not normally required for domestic hot and cold-water distribution systems where the management arrangements are mature, the design is proven, and the system is well maintained as demonstrated by trend analysis of the water temperatures.

4.25.1. HSE requires biological monitoring in hot and cold-water systems to be used as a short-term tool following corrective action where a system has been out of normal operating parameters, to confirm the actions taken have been effective, or where the management arrangements for the control of legionella have been found to be ineffective.

4.25.2. Biological monitoring should be carried out in accordance with BS 7592:2022 *Sampling for Legionella organisms in water and related materials*. See Appendix 3 for flow chart summarising general requirements and protocol for complying with the standard in the University.

4.25.3. The University's water management system is at present still in development and the use of biological monitoring will be a core part of the management system.

4.25.4. The University will undertake biological monitoring for 2 reasons:

- To provide routine reassurance that the control measures are working as designed and the University is not exposing persons to harmful levels of legionella bacteria from its water systems.
  - Non-science academic buildings and support buildings, will be subject to biological monitoring on a yearly basis.
  - Science academic buildings will be subject to biological monitoring on a twice yearly basis.
  - Residential buildings and Sports Centre will be subject to biological monitoring on a quarterly basis.
  - This regime will continue for a period of 3 years to form a baseline after which time a review will be undertaken and a new regime for biological monitoring will be identified as appropriate.
- Following incidents of loss of control as a means of quantifying the risk at the time of loss of control and as confirmation that corrective actions have been effective.

4.25.5. The University will operate a 3-stage approach to biological sampling:

4.25.5.1. **Field sampling kits**. These make use of a lateral flow test to sample the water within a building for the presence of *Legionella Pneumophila Serogroup 1* antigen (the bacteria most associated with Legionnaire's disease).

- This test provides an initial indication within 25 minutes on the presence of the legionella bacteria up to 100 cfu's (colony forming units – this refers to viable bacteria cells capable of multiplying via binary fission in the system).
- This test does not provide information on the presence of any other legionella bacteria or biological growth.
- Suitably trained University personnel (including plumbers and maintenance support) can carry out this test.
- The field sampling kit is suitable for a routine reassurance testing regime and is used to inform the University's immediate response to potential threats to the water supply from the most harmful form of legionella bacteria.
- This test is not independently certified and must be used in conjunction with the dip slide testing.
- Any positive results must be confirmed immediately by a second test and a water sample taken for Dip-slide testing.

4.25.5.2. **Dip-slide testing** – this test samples for the presence of the all biological activity.

- Water samples are collected on site and returned to the Estates office where they are incubated over 48 hours and growth is compared to a reference chart to provide an indication of levels of growth.
- This test is not independently certified and is an early indication of biological activity within the water system. It is used to inform initial response actions by the University.
- Where positive results are obtained, samples must also be taken and sent for full biological analysis.

4.25.5.3. **Full biological analysis** – these are samples taken on site and analysed by a UKAS accredited laboratory. Results will indicate the presence / absence legionella bacteria, the Serogroup/species of bacterial present and quantify the number of viable cfu's present. In accordance with BS EN ISO 11731:2017 *Enumeration of legionella in water samples*.

- Samples are collected on site and delivered to laboratories to commence processing within 24 hours. Certified results are available from day 10 of the commencement of processing.

4.26. Where water samples are taken to confirm disinfection, they must be taken between 2 and 7 days after the system is treated. Samples taken immediately after a disinfection are at high risk of providing a false negative result.

4.27. HSE guidance HSG274 Part 2 sets the following outcomes from the results of biological monitoring, as illustrated below, and the University will use this guidance as a minimum set of actions as appropriate, although additional actions are identified in the Out of Specification Reports.

Legionella bacteria (cfu/l)	**Recommended actions**
> 100 cfu/l and up to 1000	Either: • if the minority of samples are positive, the system should be re-sampled. If similar results are found again, a review of the control measures and risk assessment should be carried out to identify any remedial actions necessary or • if the majority of samples are positive, the system may be colonised, albeit at a low level. An immediate review of the control measures and risk assessment should be carried out to identify any other

	remedial action required. Disinfection of the system should be considered
> 1000 cfu/l	The system should be re-sampled, and an immediate review of the control measures and risk assessment carried out to identify any remedial actions, including possible disinfection of the system. Retesting should take place a few days after disinfection and at frequent intervals afterwards until a satisfactory level of control is achieved.

4.28. Control Measures – Cleaning and disinfecting (general)

4.29. A programme of cleaning and disinfecting of the water system is a secondary control measure. It involves a mix of mechanical, chemical and thermal approaches to remove or destroy contaminants (including biofilm, nutrient materials, inert materials that act as a harbour to protect biofilm) from the system. This section contains an indication of the minimum actions required as set against BSi Published Document 855468:2015, *Guide to the flushing and disinfection of services supplying water for domestic use within buildings and their curtilages*.

4.29.1. Chemical disinfection is a means of disinfecting the whole system (both hot and cold-water systems) by the addition of biocidal chemicals such as bromide, chlorine, chlorine dioxide or stabilised silver hydrogen peroxide solution to the water systems, and maintaining it in the system for a suitable contact time (not less than 1 hour).

4.30. The choice between the chorine-based biocide and silver hydrogen peroxide based one will be influenced by the materials present in the system as chlorine products cause corrosion in stainless steel fittings.

4.31. Planned cleaning and disinfection of the system in residential buildings and high risk academic and support buildings should be carried out based on:

- completion of a new water installation or refurbishment of a hot and cold water system;
- installation of new components, especially those that have been pressure tested using water by the manufacturer;
- if part of the system has been substantially altered or entered for maintenance purposes that may introduce contamination;
- loss of control through controls not being implemented in required timeframes, presence of legionella at levels liable to be harmful identified through biological monitoring, of visual inspections indicating this action is appropriate;
- Any instance of known or suspected legionellosis linked to the system;
- Where indicated by a risk assessment.

4.32. Reactive clean and disinfection actions will be determined following the indications of the Out of Specification reports.

4.33. The hot and cold water domestic systems within a building are not available for use by the normal building users whilst system wide cleaning and disinfection activities are being undertaken. Buildings (or parts thereof) must be decanted for the duration of the works as the cleaning activities can introduce a risk of harm to the service users.

4.33.1. To avoid the generation of toxic fumes, not other chemicals may be added to the system at any other point in the system (e.g. toilet or sink cleaners).

4.33.2. Signage to Figure 14 below must be posted at every entrance to the building.

Figure 14 Illustration of warning signage to be displayed.

4.33.2.1. Where for any reason the building has not been fully decanted, **all** accessible outlets must also be signed.

4.34. Risk assessments, COSHH assessments and written method statements must be produced by the contractor undertaking the clean and disinfect. Appendix 4 is a sample template of the minimum considerations that must feature in a risk assessment.

4.35. Clean and disinfect of the hot and cold water system as a minimum will involve the following steps:

4.35.1. Ensure any system boosters, circulating pumps etc. are electrically isolated keeping a written list of what has been isolated and where it was isolated.

4.35.2. Ensure any hot water systems have been isolated and allowed to cool to a max of 25°C for the safety of the operatives.

4.35.3. Before any clean or disinfection of a cold water storage tank / cistern or water heater / calorifier is undertaken, a digital photographic record must be taken of the BEFORE condition.

4.35.3.1. Water heaters / calorifiers should be isolated from flow and return, drained down and inspected via the inspection hatch.

4.35.4. Where a visual inspection identifies the presence of biofilm, sediment or corrosion sufficient to warrant mechanical cleaning (see Control Measures – Visual Inspections), the tank should be drained down to and mechanically scrubbed to dislodge and remove the contaminant. Equipment such as wet or dry vacs should be used to help remove sediments and as much of the dislodged deposits as possible.

4.35.4.1. The method of mechanical cleaning should not damage any cured coatings.

4.35.4.2. Consideration should be given to access and confined space requirements detailed in Design Requirements – Cold water storage tank.

4.35.4.3. Mechanical cleaning of a calorifier should be achieve via the inspection hatch making use of long handled tools. Operatives should not be "entering" these as they are confined spaces and not capable of being made safe for entry.

4.35.5. Following the mechanical clean the cold water storage tank / cistern, should be refilled to maximum capacity (up to the overflow outlet) and the flushed to remove dislodged material.

4.35.5.1. Following any mechanical scrubbing / blasting of the inside of a calorifier, disturbed deposits / sediments should be drained out via the bottom drain valve or removed by wet / dry vacuum. The inspection hatch should be re-sealed and the calorifier re-charged. Allow a standing time and then water should be drawn off via the drain valve until it runs clear.

4.35.6. The cold water storage tank should then be refilled to maximum capacity. The designated biocide disinfectant added to the requisite dose whilst refilling it taking place to ensure the disinfectant is evenly distributed and not localised. Some chemicals will require the dose to be adjusted to reflect pH effects.

4.35.7. Once the cold water storage tank / cistern is filled, the incoming water supply should be isolated to prevent further dilution or overflowing occurring and drawing off any disinfectant.

4.35.8. Using a quantitative test verify the concentration of disinfectant in the cold water storage tank / cistern.

4.35.9. Reinstate any system boosters or pumps isolated at the start of the process (including calorifier and hot water pumps against the written list taken.

4.35.10. The disinfectant water solution must then be drawn through all pipework to the farthest sentinels on both hot and cold water supply until the disinfectant is detected at the target concentration using a quantitative test.

4.35.11. Working progressively backwards from the furthest sentinel towards the cold water storage tank / cistern and the calorifiers until the disinfectant is detected at all outlets using a fast and simple test for the presence or absence of the disinfectant.

4.35.12. Top off the cold water storage tank / cistern is topped up maximum capacity, using a qualitative test check the concentration of the disinfectant present and dose as required to bring the concentration back to target levels.

4.35.13. Leave the system for the designated contact time appropriate to the pH level and disinfectant type and concentration.

4.35.14. Quantitative tests should be carried out of the concentration levels of the cold water storage tank / cistern and sentinel outlets every 15 minutes with the results recorded. If the disinfectant concentration levels drop these should be topped up as appropriate.

4.35.14.1. If the disinfectant concentration levels fall below the minimum residual disinfectant levels, this must be recorded and the process must be restarted.

4.35.15. At the conclusion of the contact time, conduct a final quantitative test of the cold water storage tank / cistern and sentinel outlets to ensure the disinfectant is above the minimum residual disinfectant level and record results.

4.35.16. Add neutralising agent to the cold water storage tank / cistern to the required concentration and check to ensure no disinfectant remains before drawing through to the water heaters / calorifiers.

4.35.17. Draw neutralised water through to all outlets, performing fast simple test for absence of disinfectant.

4.35.18. Refill the cold water storage tank / cistern with fresh mains water and flush free of neutralising agent, drawing down to all outlets.

4.35.19. Ensure how water system returns to required temperatures.

4.35.20. Remove signage.

4.36. Chemicals used for clean and disinfection will be identified based on site specific requirements and any restrictions recorded in the written scheme for the building.

4.37. Chemicals from the cleaning and disinfection process are by definition harmful to the organic life and environment. Where these are discharged into foul water, the University may have to apply to the water authority (Scottish Water) for a Consent to Discharge under the Sewerage (Scotland) Act 1968 (as amended 2002).(See Written Schemes).

4.38. **Thermal disinfection** involves raising temperature of the hot water system to a temperature where legionella will not survive, drawing it through to every outlet and flushing at a slow flush rate to expose all pipework and outlets to high temperature for the required contact time (normally min 1 hour at 60°C at the outlet or TMV).

4.38.1. Thermal disinfection is less effective than chemical disinfection, it is limited to the hot water system only, and only for pipework up to TMV, thus outlets are not disinfected by this process. It is highly dependent on the system being able to maintain the temperature for the duration of the process. The use of thermal disinfection as a process will be subject to a case-by-case basis and risk assessment.

4.38.2. There is also a scalding risk for service users and operatives associated with this activity.

4.39. Control Measures – Cleaning and disinfecting (Showerhead and spray taps)

4.40. Shower heads generate high levels of aerosol in the respiratory zone. Due to the manner of construction and lower temperatures post TMV, these are hot-spot for bacterial growth and thus are a high risk item. For this reason they are required to be under a quarterly programme of cleaning and disinfection.

4.41. Three different types of shower fittings exist within the University buildings.

Figure 15 - Hose and shower head

Figure 16 - Outlet pipe and fixed or articulating head

Figure 17 - Anti-ligature showerhead

4.42. The hose and shower head and outlet pipe with articulating head shower fittings should be dismounted from the wall to be disinfected.

4.42.1. These should be completely dis-assembled, mechanically scrubbed to dislodge any deposits and submersed in container of disinfectant solution for an appropriate contact time, after which they should be thoroughly rinsed with clean water, reassembled and reattached.

4.43. The anti-ligature shower heads cannot be routinely dismounted from the walls.

4.43.1. The rosette of the showerhead should be removed using key or tool, mechanically scrubbed to dislodge any deposits and submerged in a container of disinfectant solution for an appropriate contact time after which it should be thoroughly rinsed with clean water in preparation for reattachment.

4.43.2. The body of the shower head should be mechanically scrubbed using a disinfectant gel and bristled brush to reach as far into the housing as possible. After the required contact time the housing is flushed with clean water and the cleaned rosette reattached.

4.43.3. Disinfectants used can damage decorative chrome and all surfaces should be wiped with clean water to remove any traces of the disinfectant.

4.43.4. The use of antimicrobial showerheads where biocidal materials are used in the manufacturing of the unit are a new technology that will limit the risk of legionella in showers. These make use of interchangeable spray rosettes which can be colour coded. Where these are used the clean and disinfection of the showerhead can be limited to mechanical brushing of the inner housing and replacement of the spray rosette.

4.44. Spray taps represent similar legionella risks to showerheads and must be cleaned on a quarterly basis.

4.44.1. The spout, hose (if present) and head arrangements should be detached from body of the tap, disassembled mechanically scrubbed to dislodge any deposits and submersed in container of disinfectant solution for an appropriate contact time, after which they should be thoroughly rinsed with clean water, reassembled and reattached.

4.45. Control Measures – Cleaning and disinfecting (Maintenance or alteration activities)

4.46. Any significant extension or alteration to an existing water system will require the whole system to be commissioned, cleaned and disinfected as per a new installation.

4.47. When fitting new joints, couplings or fittings for localised pipework, these must be suitably disinfected these must be immersed in a disinfectant solution of 200 mg/l free chlorine for 15 minutes.

4.48. Control Measures – Point of use filters

4.49. Point of use filters are a tertiary control measure. They consist of a cartridge filter fitted onto an outlet such as a tap or showerhead which incorporates layers of 0.2 micron sterilizing grade membranes with a high efficiency are removal of bacteria including legionella.

4.50. Attachment of the point of use filters to outlets requires modification of the outlet.

4.51. Where point of use filters are installed to basins or sinks, there should be sufficient "activity space" to wash hands or fill drinking water bottles/receptacles without contact with the drain or any surfaces. The installation should also ensure the air gap is maintained so there is no potential for backflow contaminating the supply.

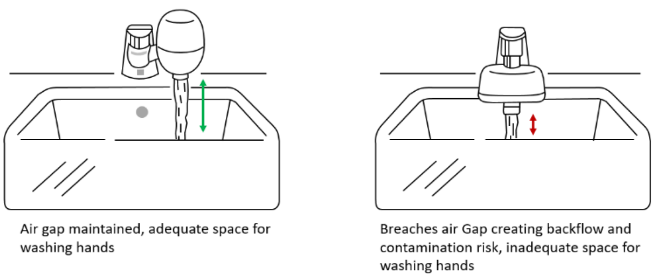


Figure 18 - Installation of Point of Use filters on sinks

4.52. Point of use filters cannot be dismantled or cleaned and must be replaced on a frequency as stipulated by the manufacturer. The date of installation and replacement date should be clearly marked on each filter.

4.53. Point of use filters should be temporary control measure for buildings experiencing sustained low levels of biological growth, where investigations have identified longer term engineering solutions such as plant / pipework replacement are required.

4.54. Where point of use filters are used as a control measure, the requirement for quarterly clean and disinfection of the showerhead is superseded by the act of the replacement of the point of use filter as this achieves the same aim.

4.55. Control Measures - Commissioning new buildings / major refurbishments

4.56. Water systems in new buildings or in major refurbishments where a new water system has been installed or where the water system has been significantly altered, must be designed and installed to the standards of the relevant British Standards and to the specifications of this Technical Guidance document as a minimum.

4.57. Where a water system has been newly installed, significantly altered or been out of use for a period of time, it must be managed in line with the requirement of PD 855468:2015 *Guide to the flushing and disinfection of services supplying water for domestic use within buildings and their curtilages*. It is the responsibility of the contractor to:

4.57.1. Put arrangements into place to comply with the requirements;

4.57.2. Maintain suitable records to demonstrate how the requirements have been met;

4.57.3. Before handover / hand back of the building to the University ensure a full clean and disinfection has been carried out to the standards with photographic records as detailed within this Technical Guidance document;

4.57.4. Before handover / handback, meet with the Building Services Manager (Mechanical) and demonstrate with the relevant documents and visual inspections as appropriate the cleanliness of the water system.

4.58. The *Responsible Person* will confirm in writing that they the water system can be adopted onto the University water management system once they are satisfied the water system is:

- installed and maintainable in line with the minimum standards in the British Standards and in this Technical Guidance document;
- that the system has been suitably cleaned as required;
- that all paperwork pertaining to the design, maintenance and cleanliness of the system have been received.

4.59. Control Measures - Mothballing buildings

4.60. Except for the period pre-demolition of a building the University will not fully mothball a building. Water management controls will be maintained throughout the period the building is not available for use. These will include:

4.60.1. The water system will be dosed with a higher concentration of disinfectant and drawn through to all outlets

4.60.1.1. A quantitative test will be carried out at the furthest sentinel to ensure the disinfectant is present at the correct concentration, and then all other outlets will be opened to draw water through working progressively back from the furthest sentinel towards the cold water storage tank / cistern.

4.60.1.2. High presence of disinfectant for extended periods of time can risk deterioration of elements of the water system and water hygiene professionals should be consulted to identify the correct chemical and concentration for each building based upon the installed water system and materials. Once identified, this should be documented within the Written Scheme for the building.

4.60.2. All outlets will be flushed on a weekly basis to ensure water does not stagnate, cold water storage tank / cistern will be topped up and additional disinfectant added to maintain the required concentration.

4.60.3. Suitable signage will be posted at all entrance doors and at the doors to every building indicating that the water system is not to be used for any purpose other than flushing.

4.60.3.1. During mothball, standard cleaning product **must not** be deployed in the building as they may react with the disinfectant and generate toxic gases.

4.60.4. At the completion of mothballing process, before the building can be brought back into operation, the system must undergo a full disinfection regime and biological monitoring using UKAS full water analysis.

4.60.4.1. Suitable plans must be made in preparation for bringing a building out of mothballing. Until the results of the biological monitoring have been certified as free from legionella water system remains a risk, and signage prohibiting its use must remain in place. Other activities such as checks for fire, gas, and electrical safety may be undertaken, however welfare provisions for operatives undertaking these tasks must be provided elsewhere. Only cleaning activities that do not involve the use of soured from the affected building water may be undertaken.

4.61. Buildings that are occupied but at very low usage (e.g. during the 2020-2021 COVID pandemic buildings housing critical research where all other normal activities have been

suspended) cannot be considered to be mothballed. The full range of normal controls must be implemented, and a monthly programme of biological monitoring is required.

4.62. Control Measures – Information Management and Record Keeping

4.63. The University will have the means of holding and analysing information relevant to the management of legionella risk in water systems, that is effective and efficient.

4.63.1. To meet the criteria of effective and efficient the information must:

- be digital in nature to eliminate paper records and human error associated with poorly printed or illegible writing, scanning and filing;
- be capable of receiving data from various input mechanisms (digital thermometers for temperature monitoring, scans of QR/Bar codes on assets, digital photographs, documents, data from forms and emails);
- be accessible by all persons requiring access to the level of authority required;
- link in with other University systems as required (for training records, or asset maintenance records);

4.64. At a **Strategic University level** it will hold the Strategic Plan created by the Responsible Person which will be maintained current and used to report to the Water Safety Group and the University Governance mechanism.

4.64.1. Hold details of all persons with responsibility for water management activities across the University estate, including their roles, specific responsibilities and the training / qualification requirements to discharge those responsibilities.

4.64.1.1. It must link with existing University record systems to confirm all persons who have responsibilities have received the training required and that this remains valid.

4.64.2. Hold target details (action, frequency, due date, person/company performing activity) for scheduled works to control legionella risk across the University estate.

4.64.3. Hold the single source of the Out of Specification reports developed by the Responsible Person and identifying the actions to be taken at University level in the event of loss of control of any sort.

4.64.4. As a minimum it will set and report on key performance indicators for the following items:

- Number of outstanding items requiring remedial action from risk assessments set against (plan / target %);

- Number of recorded underused outlets flushed set against number of missed flushes;
- Number of successful disinfections of systems carried out.
- Number of positive legionella incidents where legionella bacteria detected in systems;
- Number and types of biological sampling carried out across estate per quarter, set against minimum target number;
- Number of loss of control incidents where legionella growth could have occurred;

4.65. At an individual building level it should hold the following information:

4.65.1. Hold the Written scheme for each building, to include but not limited to;

4.65.1.1. The Risk Assessment for each building. This to contain the following items:

- The list of outstanding items requiring corrective action with a link to the Estates Department integrated workplace management system as appropriate to ensure the corrective actions are undertaken and the Risk Assessment items marked as actioned as appropriate.
- Schematics of the water system within the building, this should be a link to the CAD Technician's single source documents.
- The asset register for the building detailing both relevant plant requiring maintenance, all outlets and the locations of these.

4.65.1.2. Details of persons within the building with responsibilities for water management actions, with full details of the responsibilities for each role, the activities and the training / qualification requirements to discharge those responsibilities.

4.65.1.3. It must link with existing University record systems to confirm all persons who have responsibilities have received the training required and that this remains valid.

4.65.1.4. A schedule of activities required, the frequency of those activities and the person(s) or companies responsible for discharging each. This should include as a minimum:

- Flushing of underused outlets;

- Temperature monitoring;
- Installation / changing out of point of use filters;
- Undertaking visual inspections;
- Biological monitoring;
- TMV servicing;
- Expansion vessel bladder flushing / replacing;
- Visual inspections of cold water storage tanks / cisterns, water heaters / calorifiers;
- Clean and disinfection of water systems.
- Showerhead cleans as required.

4.66. It should automatically prompt the scheduled activity when it is required, have a means of confirming that the activity has been carried out and a means of escalation if the activity is not carried out within the assigned timeframe.

4.67. It should have a means of analysing data input to identify trends that may indicate loss of control in terms of temperature at supply, storage, distribution or return (for hot water) to enable rapid intervention and prevent significant loss of control.

4.68. It should have a means of analysing data input to identify trends that may indicate loss of control in terms of biological growth that may be present either localised or system wide to enable rapid intervention and prevent significant loss of control.

4.69. It should have a means of analysing data input to identify build up of sediment / fouling or scaling to enable suitably targeted clean and disinfection to be properly planned in a timely manner.

4.70. All data generated at building level should be accessible at the University level for KPI monitoring and reporting.

4.71. It should be capable of retaining data generated for a period of 5 year, and any data relating to exposure of persons to legionella for a period of 40 years.

End of document.. Appendices and Schedules follow>

Appendix 1 – Water safety management system aligned to HSE guidance HSG65

Setting out the management arrangements detailing how the risks from legionella will be managed across the whole estate. Who will do what to deliver daily operations. How will these be communicated. How will incidents be investigated and returned to normal and safe conditions. Decide on how building users will be kept safe whilst non-compliant matters are resolved. **Critically a Responsible Person must be appointed.**

Takes a close look at the estate as a whole and each building. Determines which parts of the system are the greatest risks and the highest priorities.

Prepare the written plan, detailing what needs done in every building, the frequency of the activities and exactly who will do what. Ensure each person involved has clear instructions of what is expected of them and is trained to deliver it. Ensure the lines of communication are known to all and are working. Ensure emergency arrangements as detailed in the management arrangement are in place and work (conduct drills as appropriate).

Sets out the intent of the university to ensure no persons are exposed to risks from legionella bacteria, and a commitment to identify the risk, develop management arrangements to control the risk and provide adequate resources to deliver against these.

Carry out the tasks identified. Ensure adequate records of the work undertaken are kept

Consider the outcomes of inspections, audits and incident investigations. Have all actions been closed out. What lessons can be learnt for continual improvement of the as built estate, future builds.

Proactively monitor the condition of the water system through visual inspections, temperature & flow monitoring, and where appropriate biological monitoring. Check to ensure that persons assigned tasks are carrying these out in accordance with protocols and standards. This will be by periodic inspection and by audit.

Undertake a review of the system to ensure the intent of the Policy is capable of being met with the existing management arrangements. Review risk assessments as appropriate to ensure they remain valid and ensure they are being used to drive written schemes and improvements. Keep pace with new techology developments on the market AND changes to Regulations or Guidance.

Investigate incidents fully to determine the root causes. These include failures to follow procedures, equipment / plant failures, loss of thermal control, the presence of legionella bacteria in a water system or reports of legionellosis. NOTE that instances of Legionellosis are RIDDOR reportable. Actions identified must be set against an action plan and undertaken in a timely manner.

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Appendix 2 – HSG274 Part 2 – Checklist for hot and cold water systems

Service	Action to take	Frequency
Calorifiers	Inspect calorifier internally by removing the inspection hatch or using a borescope and clean by draining the vessel. The frequency of inspection and cleaning should be subject to the findings and increased or decreased based on conditions recorded	Annually, or as indicated by the rate of fouling
	Where there is no inspection hatch, purge any debris in the base of the calorifier to a suitable drain Collect the initial flush from the base of hot water heaters to inspect clarity, quantity of debris, and temperature	Annually, but may be increased as indicated by the risk assessment or result of inspection findings
	Check calorifier flow temperatures (thermostat settings should modulate as close to 60 °C as practicable without going below 60 °C) Check calorifier return temperatures (not below 50 °C).	Monthly
Hot water services	For non-circulating systems: take temperatures at sentinel points (nearest outlet, furthest outlet and long branches to outlets) to confirm they are at a minimum of 55 °C within one minute (University standard)	Monthly
	For circulating systems: take temperatures at return legs of principal loops (sentinel points) to confirm they are at a minimum of 55 °C (University standard). Temperature measurements may be taken on the surface of metallic pipework	Monthly
	All HWS systems: take temperatures at a representative selection of other points (intermediate outlets of single pipe systems and tertiary loops in circulating systems) to confirm they are at a minimum of 55 °C (University standard) to create a temperature profile of the whole system over a defined time period	Quarterly (ideally on a rolling monthly rota)
	All HWS systems: take temperatures at a representative selection of other points (intermediate outlets of single pipe systems and tertiary loops in circulating systems) to confirm they are at a minimum of 55 °C (University standard) to create a temperature profile of the whole system over a defined time period	Representative selection of other sentinel outlets considered on a rotational basis to ensure the whole system is reaching satisfactory temperatures for legionella control
POU water heaters (no greater than 15 litres)	Check water temperatures to confirm the heater operates at 50–60 °C (55 °C is University standard) or check the installation has a high turnover	Monthly to six monthly, or as indicated by the risk assessment
Combination water heaters	Inspect the integral cold water header tanks as part of the cold water storage tank inspection regime, clean and disinfect as necessary. If evidence shows that the unit regularly overflows hot water into the integral cold water header tank, instigate a temperature monitoring regime to determine the frequency and take precautionary measures as determined by the findings of this monitoring regime	Annually
	Check water temperatures at an outlet to confirm the heater operates at 50–60 °C (55°C University standard)	Monthly

Service	Action to take	Frequency
Cold water tanks	Inspect cold water storage tanks and carry out remedial work where necessary	Annually
	Check the tank water temperature remote from the ball valve and the incoming mains temperature. Record the maximum temperatures of the stored and supply water recorded by fixed maximum/minimum thermometers where fitted	Annually (Summer) or as indicated by the temperature profiling
Cold water services	Check temperatures at sentinel taps (typically those nearest to and furthest from the cold tank, but may also include other key locations on long branches to zones or floor levels). These outlets should be below 20 °C within two minutes of running the cold tap. To identify any local heat gain, which might not be apparent after one minute, observe the thermometer reading during flushing	Monthly
	Take temperatures at a representative selection of other points to confirm they are below 20 °C to create a temperature profile of the whole system over a defined time period. Peak temperatures or any temperatures that are slow to fall should be an indicator of a localised problem	Representative selection of other sentinel outlets considered on a rotational basis to ensure the whole system is reaching satisfactory temperatures for legionella control
	Check thermal insulation to ensure it is intact and consider weatherproofing where components are exposed to the outdoor environment	Annually
Showers and spray taps	Dismantle, clean and descale removable parts, heads, inserts and hoses where fitted	Quarterly or as indicated by the rate of fouling or other risk factors
POU filters	Record the service start date and lifespan or end date and replace filters as recommended by the manufacturer (0.2 µm membrane POU filters should be used primarily as a temporary control measure while a permanent safe engineering solution is developed, although long-term use of such filters may be needed in some healthcare situations)	According to manufacturer's guidelines
Base exchange softeners	Visually check the salt levels and top up salt, if required. Undertake a hardness check to confirm operation of the softener	Weekly, but depends on the size of the vessel and the rate of salt consumption
	Service and disinfect	Annually, or according to manufacturer's guidelines
Multiple use filters	Backwash and regenerate as specified by the manufacturer	According to manufacturer's guidelines
TMVs	Risk assess whether the TMV fitting is required, and if not, remove Where needed, inspect, clean, descale and disinfect any strainers or filters associated with TMVs To maintain protection against scald risk, TMVs require regular routine maintenance carried out by competent persons in accordance with the manufacturer's instructions.	Annually or on a frequency defined by the risk assessment, taking account of any manufacturer's recommendation
Expansion vessels	Where practical, flush through and purge to drain. Bladders should be changed according to the manufacturer's guidelines or as indicated by the risk assessment	Monthly to six monthly, as indicated by the risk assessment

Service	Action to take	Frequency
Infrequently used outlets	Consideration should be given to removing infrequently used showers, taps and any associated equipment that uses water. If removed, any redundant supply pipework should be cut back as far as possible to a common supply (e.g. to the recirculating pipework or the pipework supplying a more frequently used upstream fitting) but preferably by removing the feeding 'T' Infrequently used equipment within a water system (i.e. not used for a period equal to or greater than seven days) should be included on the flushing regime Flush the outlets until the temperature at the outlet stabilises and is comparable to supply water and purge to drain Regularly use the outlets to minimise the risk from microbial growth in the peripheral parts of the water system, sustain and log this procedure once started For high risk populations, e.g. healthcare and care homes, more frequent flushing may be required as indicated by the risk assessment	Weekly, or as indicated by the risk assessment

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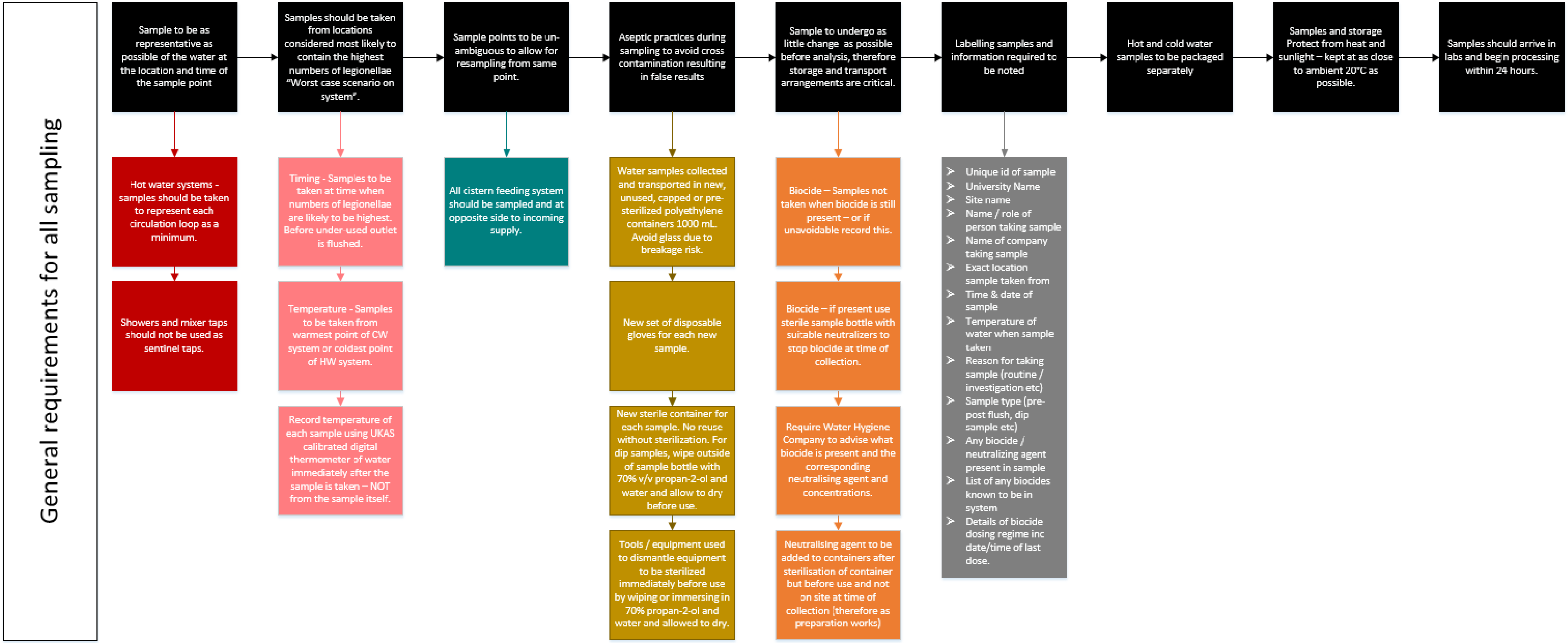
Appendix 3 – Sampling requirements in accordance with BS7592:2022

For full size image click here.



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Appendix 4 – Sample risk assessment for clean and disinfect of water system.

Part 1 Details of Risk Assessment			
Primary purpose of those being assessed	Provide a minimum generic risk assessment template indicative of elements to be considered and controlled for the cleaning and disinfection of domestic hot and cold water systems across the University	**Date**	03/03/2021
School/Unit/Department	Environmental Health and Safety Services	**Assessor Name**	Michael Orr, Health and Safety Manager
Line Manager / Supervisor Name	**Hugh Graham, Head of Health and Safety**	**Primary site/location**	Whole site, University of St Andrews
Task/activity	• Mechanically/manually cleaning cisterns, calorifiers, shower heads and outlets • Chemically disinfecting water system • Thermally disinfecting hot water system • Flushing water system		
Brief details/comments	This risk assessment is a guide for contractors of the minimum hazards and controls to be applied to ensure no harm results from the activities associated with the statutory requirement to clean and disinfect the domestic hot and cold water system		
Universal Controls	• All works must comply with the requirements set out in the Control of legionella risk policy document and the Control of legionella risk – Technical guidance document. • All works must be suitably planned • The competence of the company / persons undertaking the works must be demonstrated before appointment can be confirmed. • The plan must involve all relevant stakeholders – the Responsible Person Legionella, the Estates Officer in charge of the works, the school or unit as a service user for the building, the contractors undertaking the work, the estates Trades Manager and the Small Works Manager as a minimum. • Effective lines of communication must be made. • Should there be any cause for deviation from the plan – this must be reviewed and agreed with the Estates Officer in charge of the works and the Responsible Person legionella BEFORE the changed works progress. • Suitable records of all actions must be provided in digital format to the Estates Officer in charge of the works in a timely manner		
Additional Notes (if required)	➢ Separate COSHH assessments will be required for the chemicals used during the disinfection process. ➢ The contractor is responsible for the provision of suitable PPE as identified in their risk assessment. ➢ Contractors attention is drawn to the University requirement to ensure PPE suppliers are registered with the British Safety Industry Federation Registered Safety Supplier Scheme as set out in the standard Terms and Conditions. ➢ During the 2020-2021 SARS-Cov-2 pandemic (also known as COVID-19) attention is drawn to the requirement for a suitable and sufficient risk assessment to control the risk of exposure and transmission of the virus. The risk assessment should reflect any Scottish Government Regulations and University requirements and guidance in force at the time.		

Part 2 Identification of Hazard Section										
Hazard	**Persons at Risk**	**Potential Consequences**	**Existing Risk L+I+S**			**Existing Control measures (use the risk hierarchy)**	**Residual Risk L+I+S**			**Further controls (use the risk hierarchy)**
			Likelihood	**Impact**	**Score**		**Likelihood**	**Impact**	**Score**	
Risk of inhaling bacteria including legionella bacterial that may be present in the water system, and may become aerosolised as a result of the operation of the system or from the cleaning activity.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Inhalation of critical load of bacteria can result in number of respiratory disorders. Susceptible individuals exposed to Legionella bacteria in particular can give rise to Pontiac Fever or Lochgoilhead Fever – both being non fatal respiratory illnesses; or Legionnaire's Disease which is a potentially fatal form of pneumonia in susceptible persons.	**3**	**5**	**15**	1. Pre-work assessment to identify persons involved in the work who may be at increased risk and thus require additional controls or should simply not be assigned work of this nature. This should be carried out by Contractor for their staff and University via Occ Health. There are GDPR issues associated with this that must be recognised and managed. 2. All works should be carried out in such a manner that the formation of aerosols is eliminated or minimised. Critical elements are such controls as cleaning and flushing of showers. 3. Where residual risk of aerosol exists this is to be controlled by the use of suitable respiratory protective equipment for which a face fit test has been successfully undertaken.	**1**	**5**	**5**	
Risk of exposure to asbestos present as insulation material on storage tanks, cisterns, calorifiers, distribution pipework; as gaskets between flanges; as textile at connections; or associated with the fabric of the building.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Asbestos is classified as a class 1 human carcinogen. Asbestos that becomes disturbed and inhaled can result in a number of long latency diseases that can be debilitating or fatal.	**3**	**5**	**15**	1. All works must be planned and written asbestos clearance sought from the University Estates Compliance team. 2. Where information about the presence of asbestos is not available the works will have to be delayed whilst a suitable survey for the presence of asbestos is undertaken. 3. Where the presence of asbestos has been identified the work must be reassessed to determine if access to the space is actually required and if so by a human person or if other suitable controls are possible, such as remote CCVT etc. all such control measures should be verified with the University Estates Compliance team. 4. Where the presence of asbestos is identified AND human access is required, the works may not proceed until and unless a) the works are not liable to disturb the asbestos by virtue of separation distance or encapsulation or b) remedial action has been undertaken by licensed asbestos companies to encapsulate or remove the asbestos and a suitable clearance certificate has been obtained.	**1**	**5**	**5**	

Hazard	Persons at Risk	Potential Consequences	Existing Risk L+I+S			Existing Control measures (use the risk hierarchy)	Residual Risk L+I+S			Further controls (use the risk hierarchy)
			Likelihood	Impact	Score		Likelihood	Impact	Score	
Risk of poor access / egress to parts of water system requiring access, such as tight narrow spaces by virtue of physical space available or presence of other plant or pipe runs obstructing access.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Risk of musculoskeletal injuries arising from poor ergonomic posture. Risk of striking head / elbows / knees as transiting through such areas. Risk of laceration or injury to eyes from sharp edges of plant / pipework / fixings. Risk of delayed evacuation in event of emergency or fire.	3	5	15	1. All access routes to be assessed before making access. 2. Where access cannot be safely managed this must be escalated to Estates Officer and new plan for access determined – may include need to isolate and move obstructing pipework to provide safe access. 3. Cut resistant gloves, bump caps and safety eye protection should be worn for such activities.	2	5	10	
Risk of burning or scalding from contact with very hot water or contact with hot surfaces of machinery / plant.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Hot water and surfaces in excess of 45°C can result in scalding or burning of the skin. The amount of the body exposed to the hot temperatures, the duration of the exposure will determine the extent of damage caused. At low levels this can result in burns to hands which can be painful and depending on the extent of damage may result in permanent loss of function or disfigurement of the skin. In cases where the over 10% of the human skin is exposed to hot water in excess of 50°C, damage there are secondary risks of shock which may result in death.	3	3	9	1. Hot water systems are isolated from heat sources. 2. For Calorifiers stored hot water will be around 60-65°C. All operatives should be aware of this and exercise care in all activities. 3. Calorifiers and water heaters should be drained via drain valves to dedicated drains, where necessary suitably temperature rated rubber hoses should form a connection between the drain valve and the drain. 4. Hot surfaces should be cooled before operatives are required to work with them, either by allowing cooling time or by contact with cooling water. 5. All hot surfaces should be suitably insulated and protected from contact. Where this is not the case this must be escalated to the Estates Officer in charge of the works. 6. Safety gloves to EN 407 with Contact Heat rating of level 1 which are of a gauntlet style offering hand wrist and base of the forearm protection must be worn 7. Water proof footwear to EN 13287 SRC should be worn if there is a risk of feet becoming wet.	1	3	3	

Hazard	Persons at Risk	Potential Consequences	Existing Risk L+I+S			Existing Control measures (use the risk hierarchy)	Residual Risk L+I+S			Further controls (use the risk hierarchy)
			Likelihood	Impact	Score		Likelihood	Impact	Score	
Work in confined spaces.	Contractor undertaking the works.	Risk of being overcome by lack of oxygen, toxic fumes, drowning or sudden rise in bodily temperatures leading to unconsciousness or death.	4	5	20	1. Work within cold water storage tanks as confined spaces is prohibited – refer to Control of legionella risk – Appendix 1 – Technical guidance document section on Design Requirements for Cold Water Storage Tanks for controls that must be followed. 2. Work in calorifiers should be achieved from outside of the calorifier with tool and limbs only being inside via the inspection hatch. 3. Any other access that has the potential of being confined space access may only be undertaken pursuant to University Permit to Work system for Confined Spaces, for which a separate Risk Assessment, Plan of Work / rescue and Training requirements must be demonstrated.	1	5	5	
Manual handling of equipment and materials.	Contractor undertaking the works.	Poorly assessed and controlled manual handling activities can result in musculoskeletal injuries.	3	3	9	1. All elements of the activities undertaken by the contractor should be subject to a manual handling assessment. a. Where possible loads should be less than 20kg when held close to the body. b. Equipment should be selected based on the risk associated with the weight, the gripping points, the stability of the load. Equipment that is larger or heavier should be capable of being broken down into smaller parts for ease of handling. c. Transit routes should be viewed and assessed before equipment and materials are handled. d. All persons involved in manual handling should have suitable training and not be asked to handle items that exceed their individual capabilities.	1	3	3	

Hazard	Persons at Risk	Potential Consequences	Existing Risk L+I+S			Existing Control measures (use the risk hierarchy)	Residual Risk L+I+S			Further controls (use the risk hierarchy)
			Likelihood	Impact	Score		Likelihood	Impact	Score	
Work at height.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Risk of a fall from height liable to cause serious personal injury whilst accessing cold water storage tanks / cisterns, draining said services from roof tops, or from falling through un-floored attic floors Falls from height are almost always serious with life altering or fatal consequences.	**4**	**5**	**20**	1. No work at height is permitted where there is a risk of a fall from an unprotected edge. Refer to Control of legionella risk – Appendix 1 – Technical guidance document section on Design Requirements for Cold Water Storage Tanks for controls that must be followed. 2. All work in attic spaces or on roofs will require a Permit to Work to be issued by the Estates officer in charge of the works. 3. Walking the joists in un-floored attics, using pipework, or any equipment not specifically designed to be climbed upon is prohibited refer to refer to Control of legionella risk – Appendix 1 – Technical guidance document section on Environmental Controls – Work at height for controls that must be followed. 4. Any other work at height issues that are not otherwise controlled through actions identified above must be escalated to the Estates Officer in charge of the works.	**1**	**5**	**5**	
Slips, trips and falls on a level.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Slips trips and falls on a level can result in musculoskeletal and neurological injuries with lasting effects.	**3**	**3**	**9**	1. Slips are caused by stepping on surfaces contaminated with substances that the surface below cannot penetrate to provide a gripping surface. a. Largely the work is in a wet environment, but water movement should be controlled and limited to drains. Flooding of walking floors must not happen and the work should be planned to ensure this does not happen. b. Spills should be cleaned as they happen with suitable equipment and absorbent materials. c. All persons should be provided with suitable slip resistant footwear. 2. Trips are largely the result of poor housekeeping of materials and trailing cables. Ensure all traffic routes are free from such items.	**1**	**3**	**3**	

						a. Where these cannot be moved they should be highlighted.				

Hazard	Persons at Risk	Potential Consequences	Existing Risk L+I+S			Existing Control measures (use the risk hierarchy)	Residual Risk L+I+S			Further controls (use the risk hierarchy)
			Likelihood	Impact	Score		Likelihood	Impact	Score	
Electrical equipment for use on site.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Much of the work involved in the activities is in a wet environment. Water is a conductive medium for electricity and incorrectly rated or poorly maintained equipment can result in an electrical shock (burn) or fibrillation (disruption of the heart beat) which can be fatal.	**3**	**5**	**15**	1. All equipment to be brought to site for the works must be of a standard designed, protected and rated for the work. 2. Equipment brought to site should ideally be capable of operating at 110V. The contractor shall provide suitable transformer for the equipment. 3. Equipment must be under a programme of inspection by a competent person so it remains in good condition and efficient working order. 4. Equipment to be used on site must be visually checked by the operator before use as a last-minute check to ensure it is safe and has not sustained damage in transit. 5. All persons using electrical equipment must be trained and authorised in their use.	**1**	**5**	**5**	
Chemicals used for the disinfection or neutralisation of the water system.	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Exposure to differing chemicals can have various effects on the human body in the neat or diluted state. These can range from minor skin ailments, to serious organ damage if inhaled, ingested or entering the eyes.	**3**	**3**	**9**	1. Contractors must provide a full COSHH assessment for each chemical brought to site. This must consider how it is stored, transported, measured out, mixed / diluted as appropriate and if necessary neutralised. 2. All chemicals brought to site must conform with the requirements of the Classification, Packaging and Labelling Regulations, the GB Biocidal Products Regulations and the Approved products and processes for use in the public water supply list. 3. Chemicals used must be suitable for the task and only as concentrated or aggressive as required for the activity. 4. Chemicals used must be compatible with the materials of the water system so as not to cause damage or deterioration.	**1**	**3**	**3**	

						5. Chemicals should be brought to site, used as appropriate and then removed from site as the work completes. Chemicals must not be stored on site. Where necessary un-used chemicals may be stored with Estates Stores upon agreement with the Estates Officer in charge of the works.				
Hazard	**Persons at Risk**	**Potential Consequences**	**Existing Risk L+I+S**			**Existing Control measures (use the risk hierarchy)**	**Residual Risk L+I+S**			**Further controls (use the risk hierarchy)**
			Likelihood	**Impact**	**Score**		**Likelihood**	**Impact**	**Score**	
Machinery / plant giving rise to risks of harmful levels of noise or vibration	Contractor undertaking the works. University Estates personnel involved in inspection or supervision of the works.	Exposure to harmful levels of noise can result in noise induced hearing loss. Factors that should be taken into account are the sound pressure and the duration of exposure. All plant rooms should be considered to be above the lower exposure action value of 80dB(A). Few may be at or above the upper exposure action value of 85dB(A). None are currently known to be at or above the exposure limit value of 87dB(A).	**3**	**3**	**9**	1. All plant rooms should be considered to be above the lower exposure action value of 80dB(A). a. Few may be at or above the upper exposure action value of 85dB(A). b. None are currently known to be at or above the exposure limit value of 87dB(A). c. Hearing protection should be provided and recommended for use whilst working in such areas. 2. No work should be undertaken on live plant liable to cause part or whole body vibration. Any such plant must be isolated for the duration of the works. 3. Contractors bringing equipment to site that evolves vibration such as wet/dry vacuums should assess the vibration risk from these.	**1**	**3**	**3**	

Part 3 Risk Assessment Approval

Declaration by responsible manager: I confirm that this is a suitable & sufficient risk assessment for the activities identified above and that all residual risks can be reduced to as low as is reasonably practicable (green).					
Signed		**Print name**		**Date**	
Declaration by School/Unit/Department senior manager: I approve this assessment and accept the risks identified.					
Signed		**Print name**		**Date**	
Declaration by Head of School/Unit/Department: I approve this assessment and accept the risks identified.					
Signed		**Print name**		**Date**	

Part 4 Risk Assessment Review Details

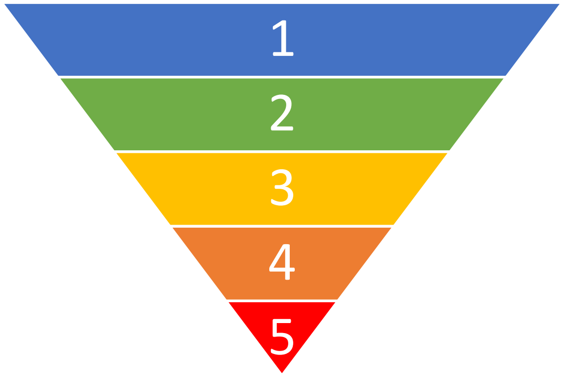
Date		**Name of reviewer**		**Frequency of review**	
Date		**Name of reviewer**		**Frequency of review**	
Date		**Name of reviewer**		**Frequency of review**	

Process owners should review their risk assessments and risk management practices once every year for low risk activities, once every 6 months for high risk activities, or:

- Whenever there are any significant changes to workplace processes or design.
- Whenever new machinery, substances or procedures are introduced.
- Whenever there is an injury or incident as a result of hazard exposure.

Assessment guide

1. Eliminate	Remove the hazard wherever possible which negates the need for further controls	If this is not possible then explain why	
2. Substitute	Replace the hazard with one less hazardous	If not possible then explain why	
3. Physical controls	Examples: enclosure, fume cupboard, glove box	Likely to still require admin controls as well	
4. Admin controls	Examples: training, supervision, signage		
5. Personal protection	Examples: respirators, safety specs, gloves	Last resort as it only protects the individual	



Risk process

1. Identify the impact and likelihood using the tables above.
2. Identify the risk rating by multiplying the Impact by the likelihood using the coloured matrix.
3. If the risk is amber or red – identify control measures to reduce the risk to as low as is reasonably practicable.
4. If the residual risk is green, additional controls are not necessary.
5. If the residual risk is amber the activity can continue but you must identify and implement further controls to reduce the risk to as low as reasonably practicable.
6. If the residual risk is red <u>do not continue with the activity</u> until additional controls have been implemented and the risk is reduced.
7. Control measures should follow the risk hierarchy, where appropriate as per the pyramid above.
8. The cost of implementing control measures can be taken into account but should be proportional to the risk i.e. a control to reduce low risk may not need to be carried out if the cost is high but a control to manage high risk means that even at high cost the control would be necessary.

LIKELIHOOD					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5

IMPACT

Likelihood	
1	Rare
2	Unlikely
3	Possible
4	Likely
5	Very Likely

Impact		
1	Trivial – insignificant	Very minor injuries e.g. slight bruising.
2	Minor	Injuries or illness, e.g. small cut or abrasion which require basic first aid treatment even if self administered.
3	Moderate	Injuries or illness, e.g. strain or sprain requiring first aid or medical support.
4	Major	Injuries or illness, e.g. broken bone requiring medical support >24 hours and time off work >4 weeks.
5	Severe - extremely significant	Fatality or multiple serious injuries or illness, requiring hospital admission or significant time off work

Consequences		
20 - 25	Very High	Activity must be stopped immediately and cannot be restarted until controls have been agreed with EHSS and fully implemented
15 – 19	High	Activity muse be stopped immediately and cannot be restarted until controls have been fully implemented and activity re-assessed.
10 – 14	Substantial	Activity must be urgently reviewed and additional controls identified and implemented.
5 – 9	Moderate	Review the risk assessment for activity before carrying on
3 - 4	Low	Activity is low risk and can safely be carried out with suitable levels of training and supervision - risk assessment should be reviewed on periodic basis
1 – 2	Negligible	Activity is notionally safe to undertake under normal conditions – risk assessment should be reviewed on periodic basis.

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Version number	Purpose / changes	Document status	Author of changes, role and school / unit	Date