Residential care / retirement home
Health centre
Nursing home
Childrens' home
Vet surgery
Ambulance station / fire station

Restaurant
Fast food outlets
Hotel / Inn
Hostel
Guest House (bed & breakfast)
Public House / Bar
Café
Campsite

Museum
Art gallery
Exhibition centre
Conference centre
Sports ground
Stadium
Leisure centre
Swimming pool
Health clubs / fitness centres
Dance halls/ nightclubs
Theatre / concert hall
Ice rink
Cinema
Historic building / stately home
Shops
Garden centres

Hairdresser beauty salon
Prison / detention centre
Community centre
Police station
Barracks

Houses
Offices (low rise and high rise)
Factories
Production centres
Workshops
Apartment blocks (low rise and high rise)

Public toilets
Airports
Railway stations
Bus / coach stations
Sea port terminals
Places of worship

UNREFERENCED PROBLEMS WITH BUILDING WATER SUPPLIES

1 Foul taste in hotel water supply

Feather eiderdown used as insulation for roof tank. Wooden tank lid rotted, eiderdown slipped into water and rotted.

2 House – intermittent stale water

Warm stale water only in the mornings on sunny days. New service pipe laid previous autumn, new patio laid at same time. Patio faces south and receives the morning sun. cause of problem was the new service pipe laid in the sand for bedding of new patio at a depth of depth 100mm to 150mm instead of the required standard of between 750mm and 1350mm.

3 House - petrol / oil taste in water

Car oil change / petrol tank leak on driveway permeated plastic service pipe.

4 House - "swimming pool" taste and odour problem

Intermittent problem that has been occurring for some time. Cold water supply is warm but only at the kitchen tap. Cause of problem was localized heating of cold water feed to kitchen because it runs alongside hot water pipes. Therefore, poor design, lack of insulation. Remedy was to lag pipes and investigate alternative routing for hot water pipes.

5 House – phenolic taste and odour problem

Very bad in boiled water. Problem only occurs at kitchen tap. No recent plumbing changes but new washing machine fitted recently. Cause of problem was back siphonage of 'contaminated' water from flexible filling hose to washing machine. Chlorine reacts with 'contaminants' to form range of compounds described under the general term phenolic. Remedy was to fit non-return valve to washing machine hose connection.

6 Similar phenolic taste and odour problems due to:

dishwashers;
flexible hoses to drink dispensers (generally replacements and not those supplied as standard;
kettles and tea urns (particularly the rubber sealing washer for the element and in the case of tea urns and soft water, metallic taste due to internal corrosion);
tap washers; and
garden hoses where non-return valve not fitted.

7 High rise apartment block - complaint of 'strange' taste

Only a problem since local authority owner had refurbished header tank. GC - MS analysis shows the presence of bisphenol A and tert-butyl phenol. The cause was found to be a different epoxy resin lining used to that specified and although an approved material the contractor did not follow the preparation and curing instructions. Compounds leached from the un-cured coating. Remedy was to strip and re-line tank.

8 Factory (wine bottler) - vinegar odour to mains water used for washing tanks.

Only occurred after high water usage. Swabs showed the presence of *Acetobacter* in tanks after washing, not detected on swabs taken before washing. The cause was poor design leading to stagnation of surface water in storage tank. Alcohol fumes and bacteria in the air contaminate tank water. *Acetobacter* converted alcohol to acetic acid – vinegar. Remedy was to re-plumb mains feed to tank and improve ventilation.

9 Other known problems but no specific examples

(i) Taste due to microbial growth in point of entry treatment devices (softeners).
(ii) Excess sodium in softened water from point of entry devices.
(iii) Corrosion from mixed metals.
(iv) Cross contamination from private and non-potable supplies.
(v) DIY plumbing.
(vi) Storage tanks – access by birds, bats, mice, rats.
(vii) Storage tanks – vandalism.
(viii) Storage tanks – stale water due to lack of turnover.
(ix) Lack of records of water supply system in large buildings.
(x) Lack of technical knowledge in staff responsible for water supply systems in large buildings.

Note: section 0 and 1 introduce the coming sections

Section 2 - Roles and responsibilities
Leader David CUNLIFFE

Introduction

There are a large number of stakeholders who can influence the safety of water systems within buildings. Stakeholders can be involved in the planning, design, construction and renovation of buildings as well as development of water safety plans and ongoing maintenance and operation of water systems. The specific titles of stakeholders and divisions of responsibilities will vary between different countries and jurisdictions but the broad range of tasks will remain fairly consistent. An example of technical guidance describing responsibilities and expertise required for management and maintenance of water systems is provided in ...(Not sure where we are placing Figures 1-3 – as indicated in comment BS23 it was agreed that these should be regarded as case study) .

Stakeholders can include:

- Building commissioners who are involved before construction of new buildings or renovation of existing buildings such as,
  - developers, planning officers, architects, design engineers, builders, plumbers, manufacturers and suppliers
- Building operators such as,
  - building managers and owners, occupiers and employers
- Employees, occupiers and users of buildings
- Service providers and specialist consultants who provide technical assistance such as,
  - plumbers, maintenance contractors, risk assessors, water treatment specialists, risk assesors, auditors
- Professional bodies who develop guidance and training for members
- Infection control personnel in dental and medical facilities and infection control teams in hospitals and health care facilities
- Regulators responsible for oversight of,
  - building and plumbing codes, public health requirements and occupational health and safety
- Public health and environmental health officials
- Standard setting bodies and certification agencies
- Training providers

Building commissioners

A range of stakeholders can be involved in the commission design and modification of buildings and installation of water systems. All stakeholders should be aware of regulations and codes applying to buildings as well as associated requirements relating to water systems. In many countries there are codes and design standards that apply to a range of water systems and devices, including cold and hot water systems, cooling towers, ice machines, swimming pools and spas. In some cases requirements are incorporated within building and plumbing codes while in others codes and standards have been issued for specific components such as cooling towers hot/warm water systems. For further discussion see Section 4.

Developers

Developers have responsibility for oversight of the entire process of construction and

installation. Developers need to be mindful of general responsibilities relating to construction of water systems and installation of associated fittings. This includes ensuring that appropriate design requirements and necessary approvals are obtained. Most countries have building and plumbing codes that include accreditation and approval requirements. However, these codes may not provide sufficient detail for the design of complex systems (e.g. regarding the calculation of hot water return pipes). Specific requirements for preventing the growth of microorganisms (notably avoiding long periods of stagnation of tepid water) may also not be included in these codes. In some cases provisions may be included within separate legislation and standards that apply to specific components of water systems (e.g. water cooling devices, swimming pools, spa pools). Where codes and standards do not provide sufficient detail expert advice will need to be sought.

Where buildings are intended for specific purposes, particular requirements associated with the uses should be determined through consultation with the end user and with relevant legislation such as building codes and plumbing codes. Architects, engineers and plumbers selected to design, construct or renovate buildings and associated water systems should be familiar with the requirements associated with the end-use.

Planning officers

Planning officers can play a role relating to appropriate design of buildings and the design and installation of water systems. Planners need to be aware of requirements relating to water systems. It is good practice for planning or development applications to be referred to health agencies for assessment of potential public health risks prior to approval being issued.

Architects

Architects are responsible for the overall design of buildings and need to have an understanding of the operation and requirements associated with services including water suplies and with devices that use water such as cooling towers. Architects work in partnership with engineers and other professionals who are responsible for construction details, service installation and often final certification. Designs need to take into account requirements associated with specific end uses such as:

- residential health care
- hospitals
- dental surgeries
- medical surgeries
- renal dialysis clinics
- schools
- food retailers
- hotels and guest accommodation (including specialist accommodation such as ski stations, etc.)

In the case of renovation or modification of existing and occupied facilities, architects should consult with users of the building. The extent of consultation will be influenced by the complexity of the project, however, it should include all those involved in management and maintenance of water systems. In the case of hospitals and health care facilities it should involve consultation with infection control teams. Issues that need to be addressed include establishing a risk management plan to minimise risks to users of the building. This should include dealing with potential problems and disruptions to services as well as ensuring compliance with technical standards and regulations.

Engineers

Engineers are responsible for implementation of building design, ensuring structural integrity, material selection, compliance with building standards and plumbing standards. In

many countries standards have been established for products used in plumbing installations. Where standards have been established engineers should ensure that they use products that have been certified as complying with the appropriate standard.

Engineers are often responsible for final certification of satisfactory completion of building, construction and installation of water systems. In the case of renovations or modification of existing structures engineers provide a key role in establishing risk management plans to minimise risks to existing users of buildings. Risk management plans should include education of maintenance and construction workers.

Plumbers

Protection of water quality and proper operation of water systems relies on the actions of plumbers. It is important that plumbers are appropriately qualified and have the competence and knowledge to design, install and maintain plumbing systems. Plumbers need to ensure compliance with applicable standards and codes of practice such as building and plumbing codes. However, the work of a plumber goes beyond the provision of plumbing systems. Most importantly, they play a key role in managing risks associated with plumbing installations. Finally, plumbers and other plumbing professionals play a vital role in water conservation.

A competent plumber should be able to:

- design, install, and maintain water supply and waste removal systems
- consider and manage the health and financial risks associated with plumbing
- install systems that conserve limited supplies of clean water

Good design of plumbing systems is necessary to ensure that the installations are efficient and safe. Good design will also ensure that the installations are appropriate for the different circumstances they serve. The design of a good plumbing service must be based on an understanding of the technical requirements and relevant regulatory restrictions. Where industry based risk management strategies and procedures have been established they should be applied.
Plumbers have to ensure that water systems are intact and that intrusion of microbial and chemical contaminants is minimised. Protection against cross-connections has to be ensured and where necessary backflow prevention has to be provided. Only approved materials and devices should be used or installed.

Plumbing systems have to comply with building plans.

Designers, manufacturers, suppliers and installers

Anyone involved in the design, manufacture, supply and installation of water systems should ensure that they are designed and constructed so that they are safe when used for their designated purpose. Systems should be designed, constructed and installed in compliance with existing codes and design standards. Systems need to be constructed from materials that are appropriate for the function of the water system and device. In addition systems should be designed to enable ease of operation, cleaning, inspection and maintenance.

Building Operators

Building managers, owners and employers

Building management and operation can be undertaken by a range of different stakeholders with specific responsibilities influenced by ownership and tenancy agreements. Legislative requirements may also assign responsibilities to specific parties.

Building management can be the responsibility of a building owner, leasing agency, building manager, an occupier of a building, employers or combinations of these parties. In some cases building owners maintain control over infrastructure including water systems but in other cases this task might be undertaken by a leasing or building management agency. Alternatively occupiers and tenants may install and manage water devices. Regulations and codes of practice often identify responsibilities for a number of parties. For example, the Victorian Health *Legionella* Regulations (2001) identify responsibilities for:

- owners of land to register certain types of water devices and to take all reasonable steps to ensure that a risk management plan is prepared, reviewed and audited on an annual basis
- owners/occupiers of buildings to prevent conditions that may represent a risk to public health
- owners, managers or controllers of water devices to undertake appropriate levels of maintenance
- employers to maintain a safe workplace

In other jurisdictions the responsibilities may vary but the tasks remain generally consistent. The tasks and individual responsibilities should be described in a water safety plan. Whoever takes the lead role in building management needs to be responsible for the design and implementation of the water safety plan. A WSP coordinator needs to be identified. This should either be the building manager or a competent person delegated to this task by the manager. The WSP coordinator needs to have a good knowledge of the technical facilities in the building and the principles associated with development and implementation of WSPs. The coordinator needs to form a team of experts with the range of expertise required to undertake a thorough analysis of the building water system. This will include hazard identification, risk assessment, identification and monitoring of control measures and development of incident protocols. The team will include employees with relevant specialist expertise as well as key users of drinking water systems. Development of WSPs could also involve consultation with specialist contractors.

The mechanisms by which tasks are undertaken can vary. In some cases the tasks could be undertaken by an owner, manager or employer but they could also be delegated or assigned to competent individuals employed within a building or business or to specialist contractors. When tasks are either delegated or contracted the owner, manager or employer retains the responsibility to ensure that those charged with performing designated functions are competent and that required tasks identified in the water safety plan are completed and documented appropriately.

Competence should be supported by training. Owners, managers or employers should ensure that those who are assigned to undertake specific tasks are provided with appropriate levels of training. In some countries certification programmes have been established to provide evidence of training. Where such programmes have been established owners, managers or employers should ensure that work is undertaken by employees or contractors with relevant certificates.

Building managers and employers should communicate with occupiers of buildings and employees in relation to

- potential risks associated with water systems,
- management plans developed for these systems, and
- provide notification and information relating to any incidents that give rise to potential or perceived risks to public health. Such incidents should also be reported to the appropriate regulatory agency(ies).

Occupational Health and Safety Management

Employers have a duty to protect the health and safety of workers and this is often subject to regulation and legislation. Occupational health and safety regulations can be administered by specific departments or agencies within government. In some jurisdictions these regulations are the primary legislative mechanism applied to water systems while in others they support or supplement public health legislation.

Administration of occupational health and safety requirements should be coordinated with other functions and regulations designed to provide protection of public health from water systems. Administration may include either random or routine inspections of workplaces and occupational health and safety inspectors should be aware of other requirements developed to control risks associated with water systems.

Employees, occupiers and users of buildings

Employees and occupiers are often the first to detect change or faults in water systems. These could be detected due to changes in temperature or appearance, odour, taste, reduced flow or leaks. Reporting of changes and faults should be encouraged and mechanisms should be established to support reporting. Feedback should be provided on the outcome of investigations and any remedial action.

Employees and occupiers have responsibilities to operate and use water systems as intended and not to introduce modifications. For example point-of-use devices should not be installed without permission from building managers. Devices and controls such as thermostats should not be altered without permission.

Service providers and specialist consultants

Technical contractors, water treatment contractors, maintenance contractors, plumbers

It is common practice to use service providers to undertake a wide range of technical services associated with water systems from installation to management and maintenance. Service providers may install water treatment devices and plumbing fittings and provide routine and emergency maintenance. Service providers need to be able to demonstrate competence in undertaking tasks for which they contract. In some cases certification programmes have been established. In other cases levels of service or training may be specified by industry associations.

Service providers should ensure that they or their employees have received appropriate training and that, where available, appropriate certificates have been obtained. Requirements established by industry associations should be identified and implemented. Service providers should be able to provide evidence of compliance with training systems.

Service providers should provide evidence in the form of formal reports or certificates of completion to demonstrate that tasks have been completed in accord with requirements.

Risk assessors

Building owners, managers and occupiers may use specialist consultants to undertake risk assessments of water systems and to develop or assist in the development of water safety plans. Risk assessors need to have the expertise, knowledge and resources to undertake the task competently. Risk assessors should have expertise in:

- local legislative requirements, standards and codes of practice

- development of water safety plans,
- identification of hazards and potential sources of these hazards,
- determination of risk,
- identification and assessment of appropriate control measures
- operational monitoring procedures to ensure that the control measures remain effective
- verification procedures.

Risk assessors need to comply with formal requirements including certification and approval conditions established by regulatory agencies. If unacceptable risks are identified they should be reported immediately to whoever commissioned the assessment. If a serious and potentially immediate risk to public health is identified then notification of the regulatory authority will be required.

Independent auditors

Some jurisdictions use and certify independent auditors to determine the effectiveness of water safety plans and compliance with occupational health and safety requirements. Levels of knowledge and expertise as well as the need to comply with formal requirements are similar to those described for risk assessors. Auditors should also have expertise in assessing documentation and reporting mechanisms. Auditors may be required to submit reports of their findings to the regulatory agency.

Professional bodies

Professional bodies (e.g.for dentists, medical practitioners, hospital engineers, nurses) can perform a number of functions including:

- development and advocacy of policies and codes of practice relating to water systems,
- establishment of practice guidelines to support implementation of water safety plans,
- training for members and their employees,
- identification of practical issues associated with implementation,
- a mechanism for gathering information relating to incidence of infection that may be related to water systems,
- reporting notifiable diseases and unusual or elevated incidence of disease to public health agencies, and
- a mechanism for gathering information on successful management approaches

Infection control

Infection control coordinators

In small facilities, clinics or surgeries infection control coordinators should be appointed to manage established control programmes. The coordinator could be the head of the facility or could be an employee trained to undertake the task. The head of the facility is responsible for establishing the program, ensuring that it is implemented and that the coordinator has or receives appropriate training.

Infection control teams

Hospitals and other health care centres use infection control committees and teams to prevent nosocomial infections including those arising from water systems. The committees should include representatives from all relevant sections including management, nursing, physicians, hospital engineers, maintenance, cleaning and microbiology

Management

Management is responsible for:

- establishing and supporting the infection control team,
- ensuring that a water safety plan has been developed and implemented,
- ensuring that staff involved in this process are appropriately trained and competent, and
- internal review of the water safety plan, including periodic review of nosocomial infections as an assessment of effectiveness of the plan.

Nursing

The nursing administrator is responsible for ensuring that staff:

- are aware of how water systems are to be used,
- how they should operate, and
- report faults immediately

Maintenance/hospital engineers

Maintenance and hospital engineers are responsible for operational monitoring and maintenance of water systems to ensure that they function as required at all times. Whenever faults are detected they should be rectified immediately and reported to the infection control team.

Physicians

Physicians are responsible for investigating potential cases of nosocomial infection and identifying the nature of the infection. All cases should be notified to the infection control committee

Microbiologists

Microbiologists are responsible for:

- establishment of methods for collection, transport and handling of samples
- development and application of appropriate methods for sample analysis
- use of serological or genetic typing where necessary
- timely communication of results

Regulators

There are a numbers of activities and requirements that can be subject to regulation. These include compliance with building and plumbing codes, occupational health and safety requirements and codes applying to operation of devices such as water cooled air conditioning plants, swimming pools, spa pools. Regulation of each of these requirements will typically reside in different agencies or responsibilities. It is important that there is a shared understanding of the function of each set of regulations to ensure consistency of purpose is maiantained.

In developed countries the "regulator" figure may not be an institutional body but can be a public officer from an agency or authority (e.g. government agency, local health authorities). The regulator will have the responsibility for dealing with specific technical issues covered by regulations. The regulator may operate through multilateral committees and expert consultation.

In most countries the primary agency involved in public health surveillance of water systems is the ministry of health and its regional or departmental offices. In some countries surveillance can be undertaken by an environmental health section within an environment protection agency. Environmental health departments of local government may also play a role.

The lead public health agency may act in a number of areas, including surveillance and auditing as well as involvement in the setting of standards and codes, detection and

investigation of disease, and monitoring of disease trends.

Surveillance

Independent surveillance of water supplies is an important element of quality assurance. Surveillance of water systems in buildings will include similar features to those applied to drinking water supplies but may also incorporate additional elements such as requirements associated with specific uses of the water and with occupational health and safety needs. These requirements could broaden the range of auditors involved in surveillance.

Surveillance and auditing should include processes for approving water safety plans as well as processes for assessing that water safety plans are being implemented appropriately and are effective in protecting public health.

Surveillance and auditing may be undertaken directly by public health regulators or may be undertaken by contractors or registered auditors in a manner prescribed by regulators. In some cases programmes undertaken by registered auditors may be supplemented by random inspections by regulators.

Disease surveillance

The role of public health agencies normally includes detection and investigation of disease and monitoring of disease trends. Detection of clusters of disease or in some cases single cases of diseases such as water borne legionellosis can prompt investigations of potential sources of the cause. Public health authorities need to establish criteria that would initiate an investigation, procedures on how such investigations will be performed and who will be involved. The public health agency may undertake such investigations directly or in conjunction with local environmental health officers. Other personnel may be involved depending on the potential sources of disease. For example, in hospitals infection control teams may be enlisted to assist in the investigation.

Detection of outbreaks may require implementation of immediate action to prevent further cases. This could include decontamination and/or decommissioning of water systems. In the case of such investigations public health agencies should consult with building managers and users of buildings. Advice and warnings may need to be issued to occupants and employees of buildings as well as the general public. This should be done in a timely manner to reduce or contain public health impacts and to provide appropriate information about the level of risk, responses and about triggers for seeking medical attention.

Information from disease investigations should be used to assess the suitability of risk management approaches, standards and codes of practice.

Monitoring of disease trends can provide evidence of the need to improve management of water systems or following implementation of new strategies could provide evidence of the impact of these strategies.

Public health agencies should establish networks with professional bodies to assist in detection of disease and also as a mechanism for disseminating public health information. These could include networks with dentists, medical practitioners, nurses and pharmacists.

Public health and environmental health officials

Public health and environmental health officials are responsible for ensuring maintenance of public health standards. They are responsible for ensuring compliance with regulations designed to protect public health and with the implementation of actions required by

regulations or by codes of practice developed by regulatory authorities. This can include regulations and codes applied to specific devices such as water cooled air conditioning plants, swimming pools, spa pools. Required actions can include development of WSPs.

In the event of known or suspected disease outbreaks public health and environmental health officials are responsible for investigations including inspections of buildings, auditing of water safety plans and collection of water samples.

Public health and environmental health officials are also responsible for issuing directions relating to remedial action and where required issuing of public notifications.

Standard setting and certification bodies

Devices and materials used in water systems need to meet quality requirements and comply with applicable standards and codes of practice. Some countries have established standard setting bodies and certification systems to provide assurance that, when used in accord with design specifications, devices and materials will perform as required and be safe. Standards can apply to the design, installation, maintenance and operation of devices such as water cooling towers, swimming pools, spa pools, hot water systems and plumbing devices. Standards can also apply to materials used in plumbing systems including pipework. Material standards can deal with physical attributes as well as ensuring that products do not give rise to unacceptable contamination of water or support microbial growth. Standards should include criteria for achieving and measuring compliance.

Certification is used to validate that devices and materials used in water systems meet standards or alternative criteria. Certification can be undertaken by government agencies or private organisations. Certification agencies may assess data and information provided by manufacturers, undertake specific testing or conduct inspections and audits. Certification may be issued subject to application of defined conditions. These could identify specific applications and uses of certified products (e.g. where devices can and cannot be used).

Standards are typically developed in cooperation with manufacturers, technical experts, regulatory agencies, certifying agencies and consumers. Public health agencies should participate in developing or approving parts of standards that are intended to protect public health.

Standards can:

- represent technical provisions and norms to be adopted on a voluntary basis as good practice
- be adopted as requirements by government or local government authorities
- be adopted by reference in regulations.

Training Providers

Design, installation and management of water systems can involve a range of personnel. All need to be competent to undertake assigned or required tasks. Training providers can provide courses to support competence. Training should be consistent with existing regulations, standards, codes of practice and requirements of regulatory authorities.

Training can be provided by water companies, professional associations (e.g. building, plumbing, engineers, environmental health institutes, dental and medical associations etc) and specialist technical colleges and institutes. In some countries training programmes are subject to certification programmes. Training providers should ensure that they comply with the requirements of such programmes.

Training providers should regularly review the content of their courses and should consult with regulators as well as those seeking training to ensure that their needs are being met.

Competent Individuals

A competent person is an individual who has sufficient expertise and training to undertake specific tasks. However, measuring the level of competence can sometimes be challenging. Where tailor-made courses and certification programmes are available it can be straightforward but where competence is based on degrees of experience there can be difficulties. A flexible approach may need to be adopted to assessing competence while ensuring that tasks are only performed by those who have sufficient expertise and knowledge. Codes and legislation that include reference to "competent persons" need to identify criteria for establishing competence including qualifications and training requirements.

Figure 1: Roles and responsibilities for new projects / significant modifications

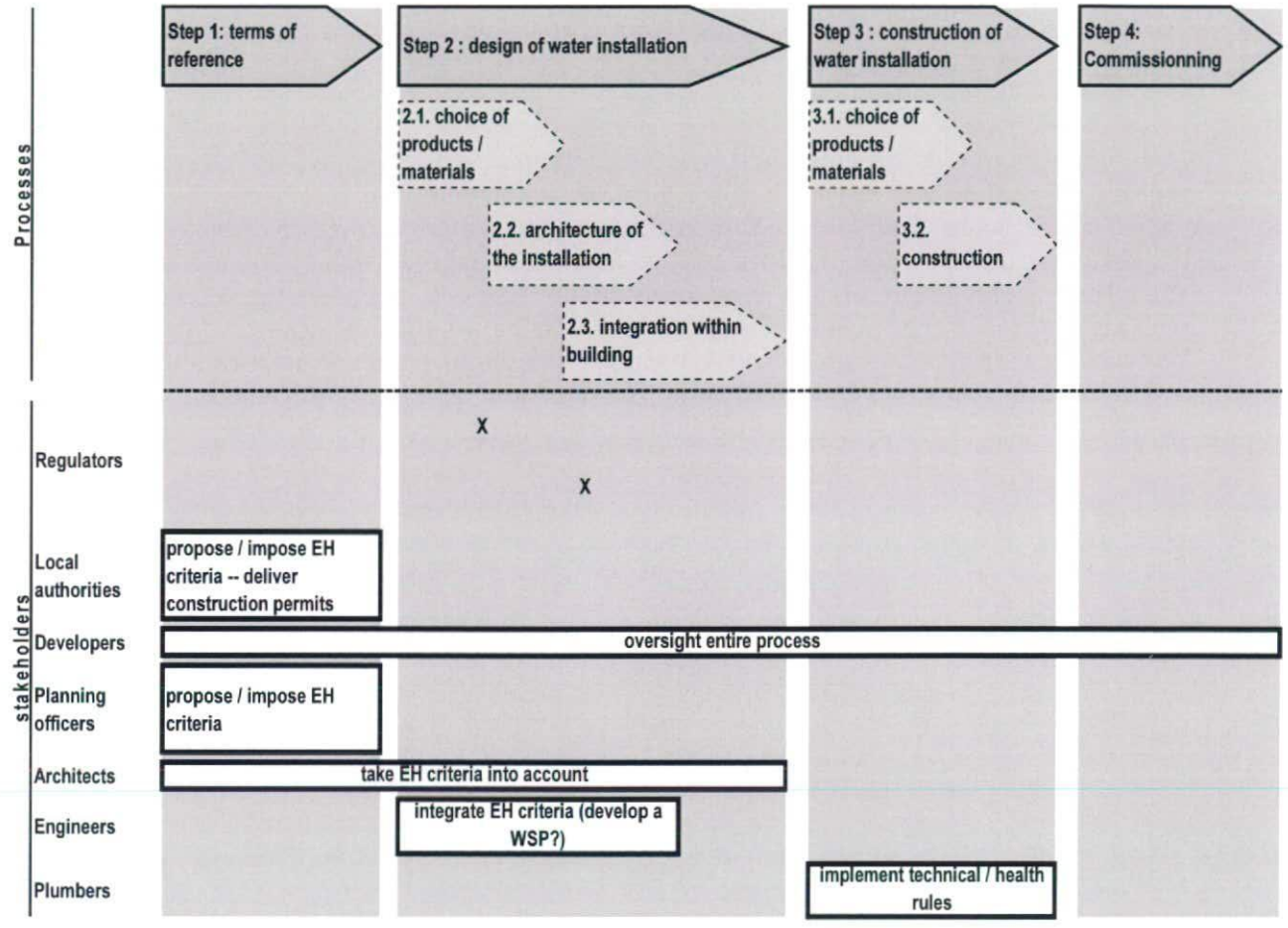


Figure 2: Roles and responsibilities for existing installations

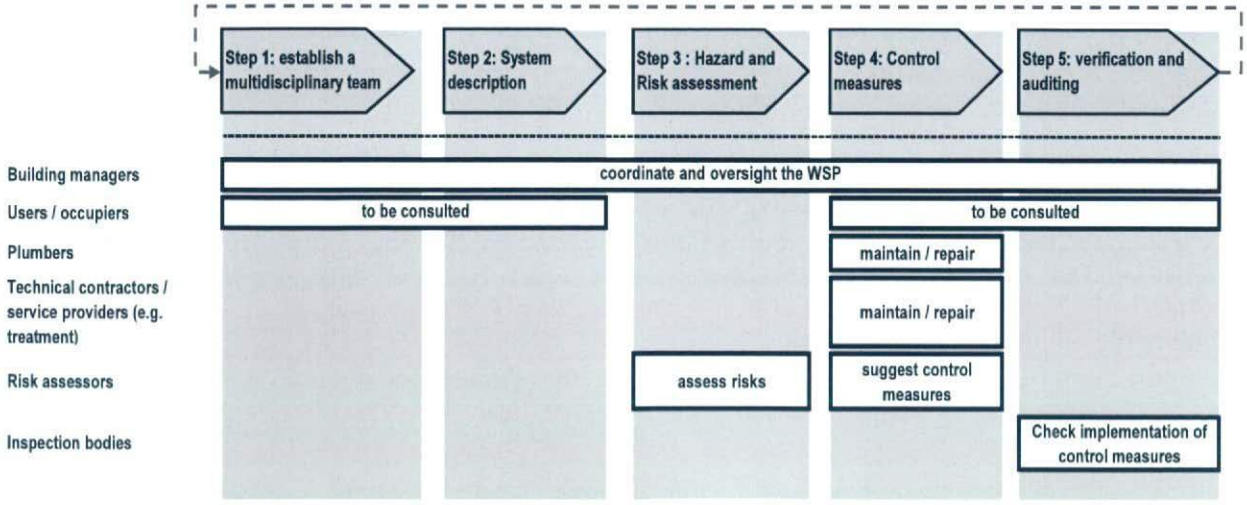
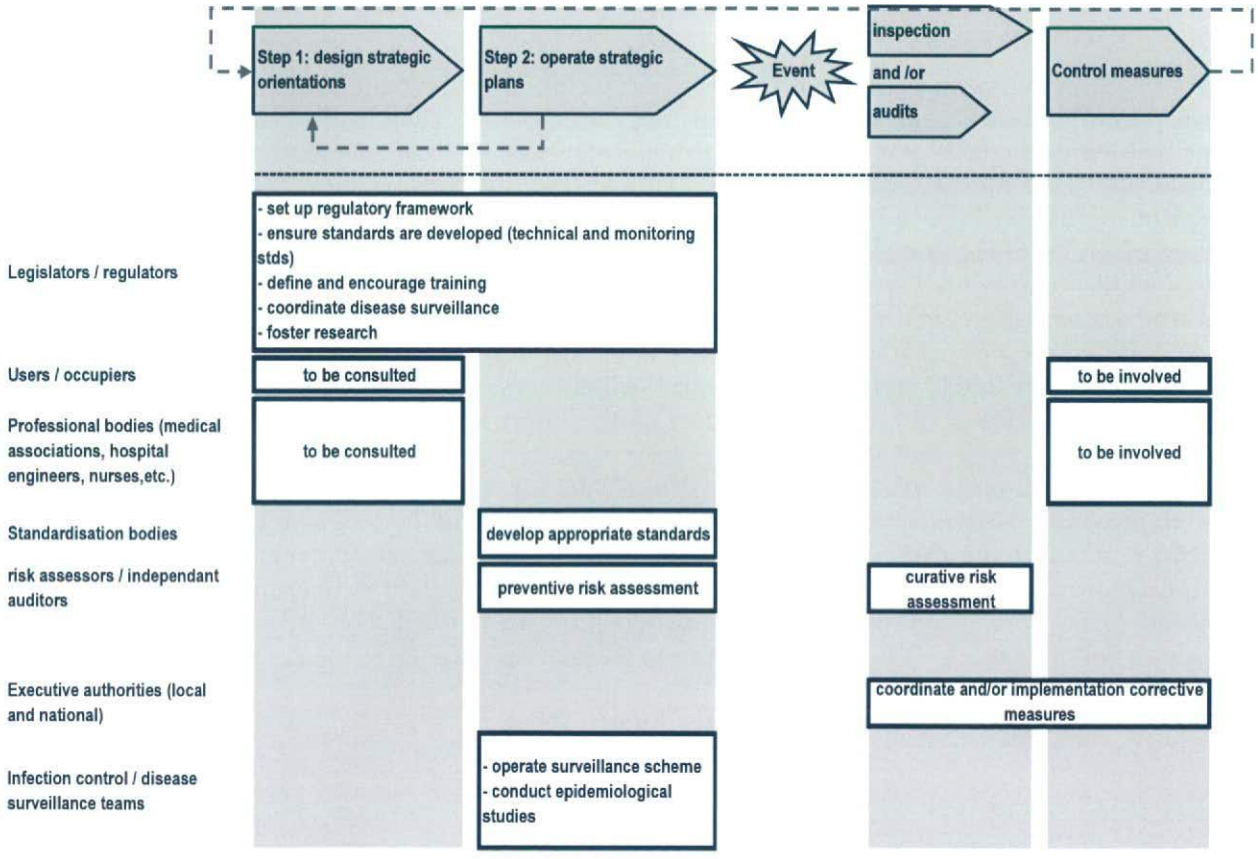


Figure 3: Roles and responsibilities for surveillance and supporting requirements



Section 3 - Water Safety Plan
Section leader - Benedikt SCHAEFER
Contributors: Emmanuel Briand, Thomas Rapp, Oliver Schmoll

Introduction

The continuous delivery of safe drinking water requires effective management and operation throughout the drinking-water supply chain from the catchment to the point of consumption. The WHO's *Guidelines for Drinking-water Quality* (GDWQ) suggest that this is most effectively achieved by establishing a Water Safety Framework that encompasses the following elements (WHO, 2004):

- Establishing of health-based targets for drinking-water as a "benchmark" for evaluation of the adequacy of existing installations and policies (see Chapter 3 of the GDWQ).
- Developing a management system to meet these targets that is termed Water Safety Plan (WSP) (chapter 4 of the GDWQ).
- Establishing a system of independent surveillance that verifies that WSP are working effectively and that health-based targets are met (see Chapter 5 of the GDWQ).

Water Safety Plans provide a preventative risk management approach that build on other risk management and quality assurance principles. They systemize long-established principles and good practices in drinking-water supply covering both water quality and quantity management issues. Their development and implementation is the responsibility of various stakeholders: while WSP for water treatment and distribution is typically the responsibility of the water supplier, WSP for buildings is the responsibility of building owners or facility managers, with support from various other stakeholders such as planners, plumbers or public health professionals. Depending on the size of the building, on the level of risks posed by the installation and on the population exposed to the water system inside the building, water safety plans may be more or less complex. Nevertheless, their development and implementation will always provide a better safety for water users.

This chapter describes the various steps in developing and implementing Water Safety Plans and provides examples on how those key principles can be applied to buildings. A key requirement of the WSP concept is its periodic review, e.g. after every 3-5 years or after significant changes of the supply system. Periodic review ensures regular updates of system assessment and management procedures but also explicitly allow for incremental improvement strategies in system upgrades, for example.

An overview of the WSP concept provides Figure YY.

Figure YY: Summary of WSP steps.

Water Safety Plans are a risk management approach for the operation of the drinking water supply. The design and the construction of the supply system within buildings are of great importance for the supply of safe drinking water. A thorough design and construction should consider the available technical knowledge (e.g. documented in technical rules). Although the design and the construction phase take place before the operation of the system starts, the Water Safety Plan approach should support a thorough design and construction of new installation systems. In the following chapters also information for the design and construction of new installation systems are included, although this is not part of a Water Safety Plan for the operation.

Chapter 1 – Team building

WSP-Team

Building a team is a core preparatory requirement for the development and implementation of a WSP in a building. The team will be in charge for developing and implementing the WSP.

For leading the team, a responsible person (or WSP coordinator) needs to be identified. This person should have (or acquire) a good knowledge of the technical facilities in the building and his/her daily work should be related to the building. Since the coordinator's primary task is to coordinate the process of WSP development and implementation, a special technical knowledge in drinking water and/or sanitation is not necessarily required. A facility manager is probably a good choice for the WSP coordinator.

The WSP coordinator needs to form a team of experts who will support WSP development and who provide access to all relevant information needed. Team members should cover the range of expertise needed for a thorough analysis of the building's water system. A setting of this group would include, for example, an expert for the construction side and one for health issues but may also include public authorities, drinking water suppliers and eventually representative of key users.

Some hazards that may compromise water quality in a building may be obvious to the building management; some others may be more concealed. Therefore, it is essential that the WSP-team is able to deal with all possible risks in respect of delivering drinking water. It may also be helpful to consult persons who have experience from other buildings.

The first step of the WSP-team is to compile available information on the design and the operation of the water distribution system and other water-related installations in the building or associated with it.

Specificities and objectives of different water networks inside buildings

Drinking water networks inside buildings have important differences that need to be considered when analysing potential health hazards. In many buildings, at least two different networks are operated, i.e. the cold water system and the hot water system, whose dynamics, design and objectives differ from each other:.

- Cold water networks are typically designed to deliver water under satisfactory pressure and flow rate at any tap, in particular for those which demand large flow rates (these taps will guide the dimensioning of the network). Another, secondary design objective is to ensure that the life time of water networks is as long as possible (e.g. in terms of protection against corrosion). In addition, cold water networks may be requested to provide water for specific uses incurring specific constraints in terms of water flow-rates (e.g. fire systems) or water quality (e.g. in health care buildings).

- With regard to hot water networks, primary objectives include typically to deliver water that is quickly available at satisfactory temperature, while limiting energy consumption. This may be attained through:
    - storage of hot water near point of use responding to demand peaks
    - for large networks, installation of re-circulation loops in order to make the hot water available as close as possible to the point of use

Beyond these technical objectives, the protection of the health of the user is most often not an integral criterion in the design, construction and operation of water networks inside buildings. The development of WSP in buildings should help improve this situation, particularly by developing a thorough understanding of both water uses and users of the building.

Usages and water use patterns

A good understanding of a water network starts with a good understanding of the purpose of its points of use.

Therefore, it is useful to identify all water usages (planned and actual) for each point of use as well as different user groups in a building. This analysis may be based on a list of different possible uses, e.g. water for drinking, showering, preparation of food, washing, cleaning, toilet flushing, technical uses, watering, fire-fighting or leisure activities.

The water usages determine the water volume and flow rates with which the water has to be provided at each point of use. This understanding is essential for the determination of the stagnation periods of the water within the installation system, for example. It is also important to examine, whether in addition to the drinking water other types of waters (e.g. distilled water, water of the heating system, rain water, water for fire-fighting, grey water, recycled water, ...) are distributed. In these cases special attention has to be drawn on cross-connections of these different systems.

In general it should not be distinguished between different qualities of drinking water within one building. The reason is that the design and maintenance of such a system will be very extensive (back flow prevention, regular check of function of the back flow prevention, ...). This may be different when drinking water is provided for persons with special needs for example in health or care facilities. If the drinking water installation system is connected to a water system delivering non-drinking water (e.g. water for fire fighting) appropriate backflow

prevention is required. A regular check of the function of the backflow prevention is an additional requirement.

In developing the WSP, both different water uses and different water qualities used in a building should be listed. The use of a clear nomenclature has been proven useful. An example of such nomenclature for health care buildings is provided in Table xxx.

Quality1. Water not submitted to any treatment within the health care building	
	1.1.:water dedicated to drinking and food preparation
	1.2.:water for regular care
Quality 2. Specific Water treated within a health care setting complying with defined criteria in accordance with usages	
	2.1. bacteriologically controlled water
	2.2. Hot Water
	2.3. water from hydrotherapy pools
	2.4. water from hot tubs and shower jets
	2.5. water for haemodialysis
	2.6. Purified water (drug preparation)
	2.7. Highly purified water (for injection)
	2.8. drinking water from fountains
Quality 3. Sterile waters	
	3.1. diluents for injections
	3.2. water for irrigation (pouring water)
	3.3. sterilized drinking water
Quality 4. Water for technical use	
Note : Only Quality1, Quality2. and Quality 3. are produced from the water network, thus have an impact on the expected quality of water delivered by this network	

Table xxx: Nomenclature of waters used in Health Care Buildings in France (adapted from. "L'eau dans les établissements de santé", Ministry of Health)

Understanding and documenting the design of the water system

To effectively assess potential health hazards posed by an installation requires a sound description or documentation of the physical structure of the building's water system (e.g. architecture, materials, location of installations and equipment) and expected conditions of operation. For this purpose, construction plans or any other documentation of the building's infrastructure, if available, are good bases for the system description. The construction of a high level, simple flow diagram helps to capture the various elements of the building's water system in sufficient detail. A flow diagram facilitates the identification of hazards, risks and controls.

The existing documentation and the flow diagram need to be verified by an on-site examination in order to confirm that it is up-to-date and correct. The on-site examination should follow the way of the distributed water from its entrance to the building to all final points of delivery or use.

The main elements to be examined and documented are (see Figure xxx):

- ❶ Point(s) where the water is admitted in the building
- ❷ Possible private resource of the building and treatments applied to raw water before it enters the building water system
- ❸ Water piping and storage systems and cross-connections to non-drinking water systems

❹ Installations for the preparation of hot water
❺ Hot water piping systems
❻ Equipments installed at the points of use
❼ Possible water treatment system (Point of Entry (POE) or Point of Use (POU))

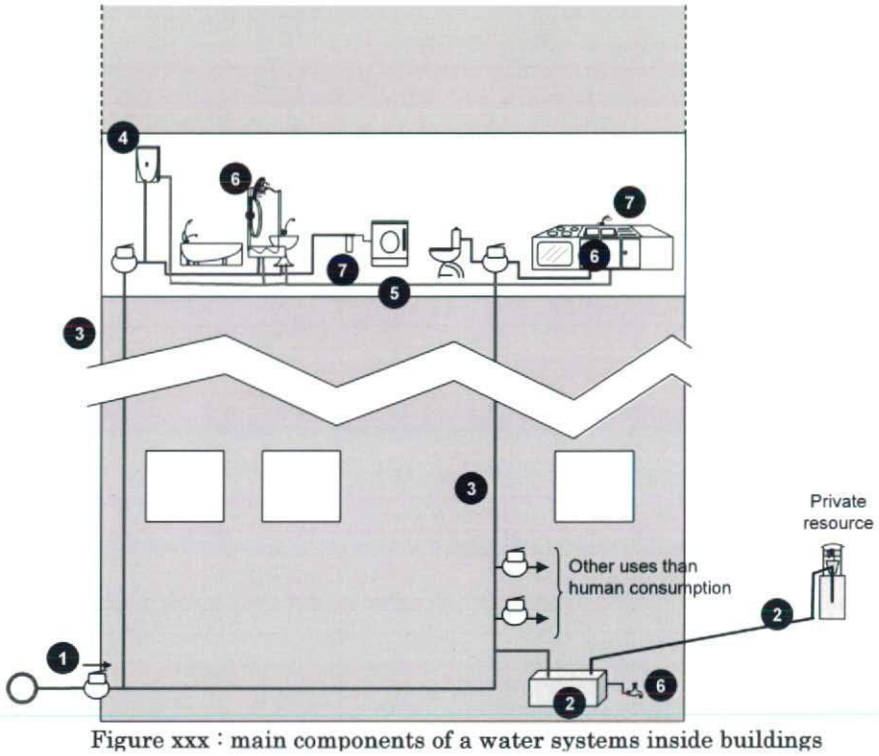


Figure xxx : main components of a water systems inside buildings

❶ Point(s) where the water is admitted in the building

Drinking water is usually delivered to a building via the public water delivering service but can also be supplied thru cisterns, for example. The point of admission of water, often materialised by the water meter, is also the point where responsibilities change to the building owner. Therefore it is a critical point for the management of the quality of drinking water inside the building.

In particular, the following elements should be documented:
- the quality and composition of the delivered water (information given by water supplier)
- continuity and quantity of water supply
- conditions of accessibility of the admission point
- presence of a water meter and of a backflow prevention systems (aiming at avoiding the pollution of the public network by private networks)

In addition, it may be that buildings or groups of buildings be connected to public facilities via several points of admission. There could also be a non-permanent point of supply like for water for fire-fighting. Each of these admission points of water should be identified, as well as their condition of use (permanent, intermittent, backup) and the way they are connected to the inner water system and to other admission points.

Possible health hazards related to this stage include:
- Delivery of microbially or chemically contaminated water
- Corrosion of the piping system if water quality delivered has corrosive characteristics in relation to piping materials installed in the building