

# **Guidelines for Drinking Water Safety Plans for Buildings in Hong Kong**



**Water Supplies Department**

**Hong Kong Special Administrative Region Government**

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## Acronyms

<b>Term</b>	<b>Definition</b>
<b>ACWS</b>	Advisory Committee on Water Supplies
<b>AG</b>	Aesthetic Guidelines
<b>DH</b>	Department of Health
<b>DP</b>	Designated Person
<b>DWSU</b>	Drinking Water Safety Unit
<b>HBT</b>	Health-based Targets
<b>HK</b>	Hong Kong
<b>HKDWS</b>	Hong Kong Drinking Water Standards
<b>LP</b>	Licensed Plumber
<b>PMO</b>	Property Management Officer
<b>QP</b>	Qualified Person
<b>RCHE</b>	Residential Care Homes for the Elderly
<b>TGWSB</b>	Task Group on Water Safety in Buildings
<b>WHO</b>	World Health Organization
<b>WSD</b>	Water Supplies Department
<b>WSP</b>	Water Safety Plan
<b>WSPB</b>	Water Safety Plan for Buildings

## 1. Introduction

1.1 When the World Health Organization (WHO) published the third edition of its Guidelines for Drinking-water Quality (WHO Guidelines) in 2004, in addition to a general information update and addition of new guideline values for individual chemicals, the WHO Guidelines introduced a preventive risk management framework to ensure the sustainable supply of safe drinking water (Figure 1).

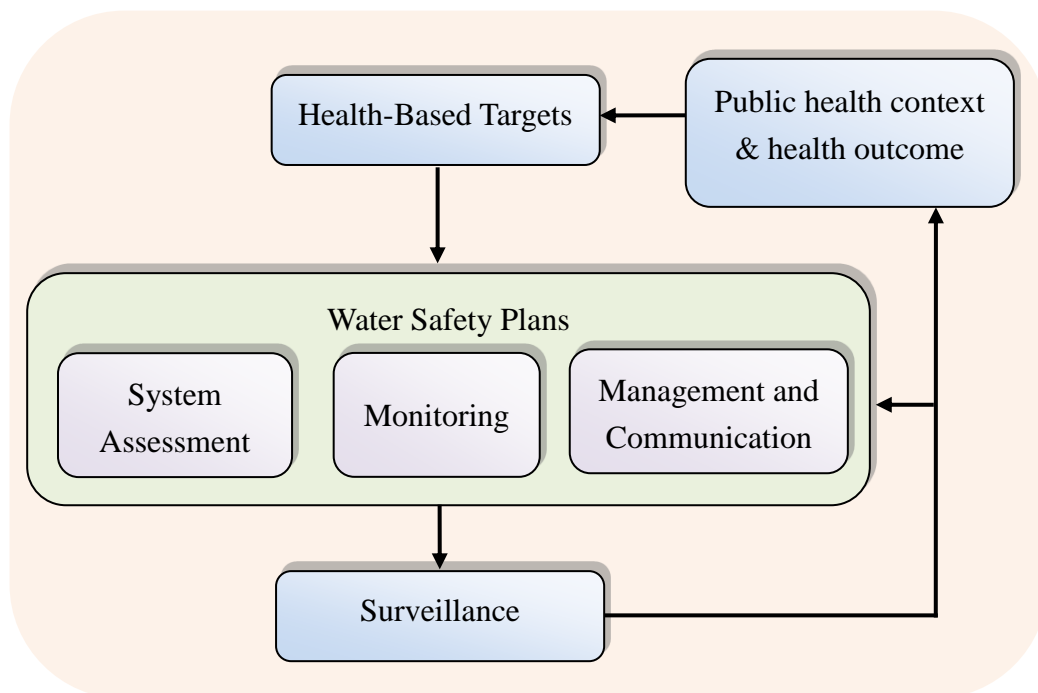


Figure 1 Framework for safe drinking water

- 1.2 The framework for safe drinking water comprises three key components:
- (i) Health-based Targets (HBT) based on an evaluation of health risks.
  - (ii) Water Safety Plans (WSP) comprising system assessment, monitoring of control measures and management and communication plans.
  - (iii) A system of independent surveillance that verifies that the above are operating properly.
- 1.3 The central component of the framework for safe drinking water is the WSP, which is guided by the HBT and overseen through the drinking water quality surveillance. Based on a risk-based and multi-barrier approach, a WSP is used to guide the process of:

- (i) identifying potential hazards and hazardous events associated with a specific water supply system;
  - (ii) assessing the risks associated with those hazards and hazardous events; and
  - (iii) implementing control measures to reduce risks to acceptable levels.
- 1.4 Water quality may deteriorate within buildings due to, for instance, water stagnation, use of inappropriate plumbing materials or ingress of foreign materials. In this context, the Task Group on Water Safety in Buildings (TGWSB) was established in 2016 under the Advisory Committee on Water Supplies (ACWS)<sup>1</sup> to advise Water Supplies Department (WSD) on aspects of water safety in buildings including development of Water Safety Plans for Buildings (WSPB) in HK.
- 1.5 The TGWSB was composed of stakeholders in the areas of water supply, building services, property management, plumbing supplies, public health, architecture, academia and the general public. Since 2018, the duties of TGWSB have been absorbed by the Working Group on Operational Matters and Working Group on Government Network and Inside Service under ACWS. This guideline document is compiled based on the advice offered by the members of TGWSB and the two working groups and endorsed by ACWS.

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<sup>1</sup> ACWS is an independent body comprising members from the public including academics, green advocates, professionals, trades and officials from related government departments and bureau. The committee aims at promoting transparency and encouraging public participation in monitoring the matters relating to water supplies particularly on water resources, quality of water supplies and network management in Hong Kong.

## **2. Scope and Objective**

- 2.1 The primary objective of WSPB is the prevention of chemical or microbial contamination during transfer and storage of drinking water within the inside services between the connection points and the points of consumption.
- 2.2 This document provides an outline of the framework for WSPB (Section 4) and a WSP template for general buildings (Annex I) which covers common requirements applicable to general buildings, such as residential and office buildings, to enhance the drinking water safety. For specific developments with special plumbing layouts, vulnerable users and/or unique drinking patterns (including schools, residential care homes for the elderly (RCHEs) and hospitals), specific templates have been prepared to assist management agents/owners to develop and implement WSPs for these types of buildings (Annex II).
- 2.3 This document will be reviewed at regular intervals by WSD to update information and incorporate lessons learnt from local and overseas experiences.

### **3. Health-Based Targets**

- 3.1 Health-based targets (HBT) for water supplies are established to define the risk that is considered tolerable or acceptable from waterborne hazards by considering the overall public health situation and the contribution of drinking water quality to disease via waterborne hazards.
- 3.2 WSD assures provision of safe and wholesome water supply at all connection points to buildings in compliance with the Hong Kong Drinking Water Standards (HKDWS) and the Aesthetic Guidelines (AG). While water quality may be affected by internal plumbing, implementation of WSPB can reduce deterioration and maintain the water quality to be in line with the water supply up to the point of consumption.
- 3.3 In addition, more stringent water quality requirements may apply in specific buildings which require water of appropriate quality taking into account high risk groups due to their type of exposure and potential vulnerabilities.



#### 4. Framework for Water Safety Plans for Buildings

4.1 The WSP approach has proven to be an effective water quality management tool to maintain drinking water safety through:

- (i) identification of hazards and hazardous events (i.e. contaminants and the circumstances leading to contamination of water);
- (ii) derivation of control measures (i.e. steps to prevent or mitigate the occurrence and consequence of a hazard);
- (iii) implementation of operational monitoring (i.e. procedures to check that the control measures are working properly); and
- (iv) planning of corrective actions (i.e. actions taken in response to adverse findings from operational monitoring).

4.2 With reference to WHO’s recommendations in the *Water Safety Plan Manual* (2009) and *Water Safety in Buildings* (2011), the approach to develop and implement a WSP is summarised in Figure 2.

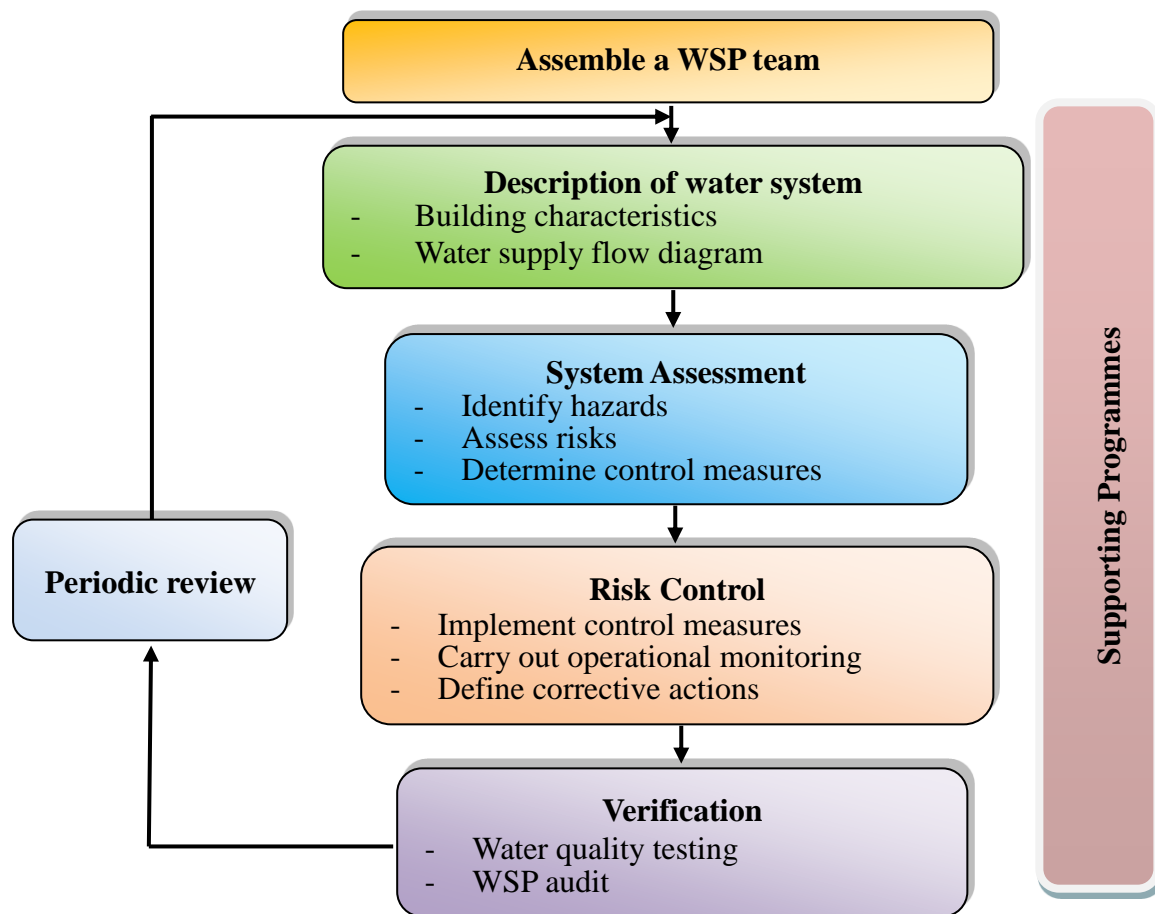


Figure 2 Approach to develop and implement WSP

### The WSP Team

- 4.3 As delineated in Figure 2, a WSP team comprising persons that are familiar with the characteristics, operations and maintenance of a building should be assembled as the first step toward development of a WSPB.
- 4.4 The WSP team is responsible for the development, implementation and review of the WSPB. It is recommended that an individual be designated to oversee the implementation of WSPB. In most cases a property management officer (PMO), school administrative/teaching staff member, RCHE house manager or hospital estate manager may act as the Designated Person (DP) and fulfil that role. Operation and maintenance staff, agents or contractors, plumbers and resident representatives can form part of the team. The WSP team should be able to carry out a thorough analysis of the building's water system and identify possible risks associated with delivering drinking water. For specific developments or buildings with complex internal plumbing systems, the DP may need to gain support from third party contractors or consultants to develop and implement the WSPB, particularly when there is a need to take into account special environments and requirements.

### Description of Water System

- 4.5 The WSP team should study characteristics of the building and provide a general description of the building. Relevant information includes:
- (i) allocating responsibility (e.g. the DP role);
  - (ii) noting the types of water supply present within the building;
  - (iii) identifying the parties responsible for maintenance of internal plumbing;  
and
  - (iv) identifying the parties responsible for specific aspects of the WSPB.
- 4.6 Examples of general descriptions of buildings are given in Part A of Annexes.
- 4.7 In addition to the general description, details of the internal plumbing system of the building should be described using drawings and diagrams or other appropriate means. As-built plumbing line diagrams, or schematic process flow diagrams based on the as-built diagrams or existing plumbing layout, illustrating the principal components of the water supply system may be used in this respect. Examples of schematic process flow diagrams are given in Part

B of Annexes for illustration.

### System Assessment

- 4.8 With the aid of the diagrams, the WSP team should identify the potential hazards and hazardous events, assess the associated risks and determine the corresponding control measures required to reduce risks to acceptable or tolerable levels. In many cases the required control measures are already in place but in some cases some additional control measures may be required to further reduce risks.
- 4.9 The WSP team can assess risks based on the professional judgment and experience of its members. Risks can be qualitatively rated simply as high, medium and low. Alternatively, the risks can be evaluated using a semi-quantitative approach based on the likelihood of occurrence and severity of consequences of the hazards and hazardous events. An example of such a semi-quantitative risk assessment method is provided as Attachment A.
- 4.10 As part of the risk assessment process, control measures and the associated supporting or operational monitoring procedures should be identified for each hazard and hazardous event. The main hazards and hazardous events should include, but not be limited to, the following items:
- (i) water stagnation due to low turnover of water;
  - (ii) growth of opportunistic pathogens due to storing and supplying water at temperatures between 20°C and 46°C to vulnerable persons, such as immunocompromised or immunosuppressed people;
  - (iii) leaching or transfer of hazardous chemicals from inappropriate plumbing materials;
  - (iv) cross-connections leading to non-potable water flowing into the drinking water system;
  - (v) ingress of contaminants due to pipe breaks, leakages or plumbing modifications;
  - (vi) backflow of hazardous substance into drinking water system;
  - (vii) entry of hazardous substance into drinking water storage tanks (sump tanks or roof tanks);
  - (viii) inappropriate alterations to plumbing installation leading to the use of unsuitable materials or conducting the work in an unsanitary manner;
- and

- (ix) inappropriate installation, operation or maintenance of point-of-use (POU) devices such as water filters.

4.11 A risk assessment summary table should be prepared to briefly describe the hazards and summarise the risk assessment results. Examples of risk summary table with identified hazards and recommended control measures are provided in Part C of Annexes.

### Risk Control

4.12 Operational monitoring procedures should be implemented to monitor the effectiveness of the control measures identified in the risk assessment. To facilitate implementation, a routine water safety checklist summarising checking items for each plumbing component or general activities should be prepared.

4.13 The water safety checklist should be explicit and detailed and include information such as:

- (i) what needs to be checked;
- (ii) the target that needs to be achieved;
- (iii) the party responsible for the checking;
- (iv) the frequency of checking; and
- (v) the corrective actions to be taken if the target is not met, including reporting, rectification and review of the causes to prevent a recurrence.

4.14 If appropriate, the water safety checklist may be integrated into the routine maintenance schedule of building management. DP may perform more general checking duties such as inspection of water tanks, while qualified persons (QP)<sup>2</sup> should be engaged to conduct more specific checking such as performance of water pumps. Illustrative examples based on the components of checking are provided in Part D of Annexes. In order to facilitate delineation of responsibilities of the DP and LP, illustrative examples with a different format based on the persons responsible for conducting checking are also provided in Part E of Annexes.

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<sup>2</sup> QPs refer to those professionals such as licensed plumbers, building services engineers, building surveyors, etc. who are conversant with internal plumbing systems and competent to carry out the checking duties.

### Verification

- 4.15 Effectiveness of the WSPB may be verified by water quality testing and/or a periodic WSP audit.
- 4.16 Based on WHO's *Water Safety in Buildings* (2011), in general there will be no requirements for independent verification by water quality testing in buildings. However, water quality testing may be helpful to verify water quality in some cases, e.g. if there are concerns that need to be addressed, investigations that need to be undertaken, or following unusual circumstances or activities that could adversely impact water quality, such as modification or repair to plumbing systems, or the introduction of new water supplies such as roof-harvested rain water. For instance, in some cases, residents of the building may want testing undertaken to provide them with confidence of water safety and the DP may consider such testing worthwhile. In other cases, there may be adverse water quality identified for which the cause cannot be readily explained and some testing may assist in the DP or QP to identify and fix the problem.
- 4.17 Should water quality testing be carried out, it is not necessary to test for all the parameters specified in the HKDWS and AG. DP should focus on water quality parameters that might change within the building, i.e. between the point of water supply by WSD at the building interface and the point of use of the water.
- 4.18 It is recommended that water quality testing be arranged for some specific buildings that include more vulnerable persons, such as hospitals, on a regular basis to help verify the effectiveness of the WSP. Such assessment may need to assess additional parameters taking into account the specific environment, functional requirements of the building and the vulnerabilities of the water users.
- 4.19 It is recommended that a WSPB audit be conducted on a regular basis to demonstrate the effectiveness of the WSPB and identify areas for improvement. The audit frequency should not be lower than once every two years. The audit should normally focus on the implementation of the WSPB, including the following aspects:

- (i) correct description of the water supply system within the building;
- (ii) identification of significant hazards, hazardous events and control measures;
- (iii) implementation of operational monitoring and achievement of the associated targets;
- (iv) implementation of corrective actions in response to adverse findings from the operational monitoring;
- (v) good condition of a sample of components of the water supply system within the building that can be readily inspected;
- (vi) compliance with appropriate regulations, codes and practices;
- (vii) the adequacy of the training and competency of the persons responsible for managing water quality within the buildings;
- (viii) implementation of supporting programmes;
- (ix) completion of relevant verification, if applicable; and
- (x) implementation of documentation and records control.

4.20 The WSP audit may be carried out by independent parties, such as professional external auditors, peer review by persons involved in water safety management in similar buildings, or by internal parties involved in building and property management for the same property management company or entity, or even working in related roles within the same building. Preferably such auditors would have been trained in conducting internal audits, such as auditing quality management systems. Auditors should not be directly involved in the implementation of the WSPB that is being audited.

4.21 An improvement programme should be prepared to document all the improvements identified during risk assessment, audits and periodic reviews, and that programme should document the parties responsible and time schedule for those actions.

#### Review and update

4.22 It is important for the WSP team to conduct periodic reviews of the WSP at least once every two years, in order to update information and procedures, incorporate lessons learnt and monitor progress of the improvements identified.

4.23 In addition to a routine periodic review, an additional *ad hoc* review, including a root cause analysis, should be conducted following the occurrence of water

quality incidents or following major modifications of the plumbing systems.

- 4.24 All reviews should aim to identify means to protect water quality, prevent adverse water quality events occurring and be properly documented.

#### Supporting Programmes

- 4.25 Feedback from property tenants and owners (including complaints, enquiries or opinions) can reflect consumers' satisfaction with water quality as well as serve as an important source of information on performance of the water supply system. Procedures should be set up to handle complaints, enquiries or comments and conduct surveys as appropriate to address consumers' concerns on water quality and assess whether the control measures are operating effectively.
- 4.26 In addition, it is recommended that the following supporting programmes/procedures be prepared as appropriate:
- (i) staff training programme to facilitate building operators to carry out operational monitoring of control measures;
  - (ii) improvement programme for improvement items identified during risk assessment, audits and periodic review;
  - (iii) cleansing/flushing programme before occupancy, and after major plumbing modifications;
  - (iv) routine cleansing/flushing programme of tanks/pipes to prevent water stagnation with particular attention being paid to dead ends, components of the plumbing system with limited use and turnover, or following periods of non-use, such as holiday periods;
  - (v) procedures to inform residents/users of scheduled activities that may affect water quality and supply;
  - (vi) procedures to alert residents/users upon detection of unsatisfactory water quality;
  - (vii) ongoing and regular education of residents and users of the building regarding proper handling of inside services and use of water e.g. flushing after prolonged periods of non-use;
  - (viii) procedures to provide back-up drinking water (e.g. bottled water) to residents/users should that be required as a contingency;
  - (ix) procedures to carry out disinfection of the plumbing system following plumbing modifications or suspected contamination; and/or
  - (x) action plan to respond to the suspected detection of contamination or

water-borne disease.



## **5. Surveillance Arrangements**

- 5.1 Surveillance refers to the continuous and vigilant public health assessment and overview of the safety and acceptability of the drinking water supply.
- 5.2 As part of WSD's water quality monitoring programme, water samples are collected at consumer taps on a random basis and tested for consistency with HKDWS (Section 3). WSD provides summary reports of water monitoring results of drinking water quality to Drinking Water Safety Unit (DWSU) of the Development Bureau and the Department of Health (DH) at regular intervals. WSD will also alert DWSU immediately upon detection of non-compliant water quality testing results.
- 5.3 To complement WSD's water quality monitoring programme, it is recommended that WSP auditing and/or water quality verification testing be conducted as discussed in Sections 4.15 to 4.21.

## 6. References

1. WHO (2004) *Guidelines for Drinking-water Quality*, 3<sup>rd</sup> edition.
2. WHO (2009) *Water Safety Plan Manual: step-by-step risk management for drinking-water suppliers*.
3. WHO (2011) *Guidelines for Drinking-water Quality*, 4<sup>th</sup> edition.
4. WHO (2011) *Water Safety in Buildings*.

**Attachment A**

**Example of Semi-quantitative Risk Assessment Rating Criteria**  
(Based on WHO’s *Water Safety in Buildings* (2011))

	<b>Definition</b>
<b>Likelihood categories (likelihood of the hazardous event occurring)</b>	
Almost certain	Once per day
Likely	Once per week
Moderately likely	Once per month
Unlikely	Once per year
Rare	Once every 5 years
<b>Severity categories (consequence if the hazardous event occurs)</b>	
Catastrophic	Potentially lethal to all people using the building, including vulnerable groups <sup>#</sup> , following acute exposure
Major	Potentially harmful to all people using the building following acute exposure
Moderate	Potentially harmful to vulnerable groups <sup>#</sup> following chronic exposure
Minor	Potentially harmful to all people using the building following chronic exposure
Insignificant	No impact or not detectable

<sup>#</sup> Vulnerable groups refer to immunocompromised patients, infants, the elderly, etc.

Table 1 Likelihoods and severities of hazards

<b>Likelihood</b>	<b>Severity of Consequences</b>				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Moderate	High	Very High	
Likely				Very High	
Moderately likely			High		
Unlikely		Moderate			
Rare		Low			

Table 2 Risk matrix