# WATER USE EFFICIENCY AND SAFETY IN BUILDINGS
## Volume 2: Guidelines for development of a Water Safety and Security Plan for Buildings

*AH Laher, M Damons, T Manxodidi, M Masango, P Budeli*

WATER RESEARCH COMMISSION

TT 917/23

WATER USE EFFICIENCY AND SAFETY IN BUILDINGS

# Volume 2: Guidelines for development of a Water Safety and Security Plan for Buildings

Report to the

**Water Research Commission**

by


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The publication of this report emanates from a project entitled: *Supporting the Development of Standards for Water Use Efficiency and Water Safety in Buildings* (WRC Project No. C2020/2021-00441).

This report forms part of a set of two reports. The other report is *Water Use Efficiency and Water Safety in Buildings. Volume 1: Technical Support Document for Water Use Efficiency and Water Safety in Buildings* (WRC Project No. 3080/1/23)

*EXECUTIVE SUMMARY*


Worldwide, as in South Africa, national legislation is in place for provision of water services to the public by Government or public Water Services Providers. Once the water enters a private dwelling, the onus is on the property owner to effectively utilise the water, ensure there is no additional contamination from external sources, and safety dispose of any wastewater that cannot be disposed into municipal system. While regulatory authorities provide oversight of public water supplies with regards to water use efficiency and water safety, this is more challenging with thousands of independently owned buildings who are responsible for their internal water services and are not subject to regulations.

The project aims are listed below:

1. To identify gaps in the current legislative framework governing water use efficiency, water supply and water safety in various building types.
2. To assess water use efficiency, water supply and water safety in various building types throughout South Africa.

To generate data sets, benchmarks, and guidelines that will lead to subsequent development of national standards for water use efficiency and water safety in buildings.

Volume 1 reports on aims 1, 2 and 3 by providing an overview of the legislative framework and status quo of water use efficiency, water supply and water safety in buildings. This includes findings from online survey and stakeholder engagement sessions.

Volume 2 provides guidelines for water use efficiency and water safety that will lead to subsequent development of national standards in the future.

There are numerous guidelines for implementing water use efficiency in homes, buildings, industries and agriculture. With regards to buildings, water use efficiency guidelines and benchmarks vary due to several factors such as type of building or industry, size of building, operating hours, occupancy rates, occupancy density, climate, heating/cooling methods, irrigation area and methods, water usage, etc. Water use efficiency benchmarks are therefore complex calculations which apply to specific building types or industries.

Building owners are advised to develop a site-specific water conservation and demand management strategy with realistic internal targets for reducing water consumption. The key components for developing such a plan are summarised below:

- Develop a water balance for the facility,
- Identify Key Performance Indicators (KPIs),
- Determination of Baseline Water Use,
- Identification and Quantification of water conservation opportunities, and
- Setting Water Use Targets.

Over time, however, it does become more and more difficult to continue to improve without significant capital investment. This is the law of diminishing returns as applied to water conservation. When the costs of implementing water conservation exceed the potential economic, social and environmental benefits to be gained, the focus should shift to the maintenance of efficient performance as opposed to the pursuit.

Based on the literature review and status quo assessment, the importance of the risk management approach embodied in the World Health Organisation (WHO) Water Safety Planning (WSP) methodology was highlighted as a method to effectively manage water-related risks in buildings.

The WSP methodology offers a holistic approach to manage water risks in buildings. The use of risk-based methodology in the WSP makes it easy to understand by building owners as risk management is a universal business concept used by all sectors to identify, assess, and control risks.

In addition, the systematic approach of the WSP can be modified to cover all aspects of water services and can be extended to address issues of water scarcity such as water losses in network, climate change, population growth and ageing infrastructure: this extended WSP plan is called a "Water Safety and Security Plan" (WSSP).

The project team has developed a Water Safety and Security Plan (WSSP) Tool for buildings aligned with the WHO WSP methodology and applicable to water quality and water supply risks.

This tool is designed for use by building owners and facilities managers who have technical skills on design and operations of water supply systems but have limited knowledge of water quality and risk management procedures.

The tool is excel-based, easy to understand and has various resources to assist building owners to identify typical risks and associated mitigating measures, determine monitoring requirements, and implement corrective action in the event of failures. The Tool is supported by a number of resource documents that provide information on water quality monitoring, water quality incident management and guidelines for ensuring safe water in buildings after prolonged shutdown or reduced operations.

Through the cycle of continuous risk management, building owners are able to identify and manage new and emerging risks on an ongoing basis. In the absence of legislation and national standards which cover water safety in buildings, the use of the risk-based approach may provide an opportunity for building owners to self-regulate water services in their buildings. Awareness of potential risks may prove to be an effective mechanism to improve water use efficiency and water safety in building.

Planned workshops with building owners and certification bodies will ensure that the WSSP tool is shared with building owners who will adopt this tool as part of risk management practices.

At municipal level, engagement with SALGA is required to highlight the benefits of the WSSP Tool at municipal level. This can be introduced into local by-laws in various ways such as forming part of the WSI agreement for alternative water sources. Local municipalities can learn from the Hong Kong Municipality by implementing Incentive-based programs to ensure private buildings owners are proactive in managing water safety in their buildings and can include the WSSP Tool as a resource to manage risks in water supply systems in buildings. (https://www.wsd.gov.hk/en/water-safety/index.html ).

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# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| CDC | Centre for Disease Control |
| CLASP | Collaborative Labelling and Appliance Standards Program |
| COC | Certification of Compliance |
| DPW | Department of Public Works |
| DWS | Department of Water and Sanitation |
| EO | Executive Order |
| GBCSA | Green Buildings Council of South Africa |
| IOPSA | South African Institute of Plumbers |
| IRIS | Integrated Regulatory Information System |
| IWA | International Water Association |
| kpa | kilopascal |
| NBR and BS Act | National Building Regulations and Building Standards Act |
| NIOH | National Institute of Health |
| NRCS | National Regulator for Compulsory Specifications |
| NWA | National Water Act |
| NWRS2 | National Water Resources Strategy 2 |
| PIRB | Plumbing Industry Regulation Board |
| POE | Point of Entry |
| POU | Point of Use |
| SA | South Africa |
| SABS | South African Bureau of Standards |
| SALGA | South African Local Government Association |
| SANS | South African Nation Standards |
| SANEDI | South African National Energy Development Institute |
| SAPOA | South African Property Owners Association |
| SDG | Sustainable Development Goals |
| SWPN | Strategic Water Partnership Network |
| US EPA | United States Environmental Protection Agency |
| VIPs | Ventilated Improved Pits |
| WRC | Water Research Commission |
| WHO | World Health Organization |
| WSIs | Water Services Institutions |
| WSPs | Water Safety Plans |
| WSSP | Water Safety and Security Plan |

# INTRODUCTION

Worldwide, as in South Africa, national legislation is in place for provision of water services to the public by Government or public Water Services Providers. Once the water enters a private dwelling, the onus is on the property owner to effectively utilise the water, ensure there is no additional contamination from external sources, and safely dispose of any wastewater that cannot be disposed into municipal system.

This report is Part Two of the WRC publication titled: Supporting the Development of Standards for Water Use Efficiency and Water Safety in Buildings. The aims of this project are summarised below:

1. To identify gaps in the current legislative framework governing water use efficiency, water supply and water safety in various building types.
2. To assess water use efficiency, water supply and water safety in various building types throughout South Africa.
3. To generate data sets, benchmarks, and guidelines that will lead to subsequent development of national standards for water use efficiency and water safety in buildings.

Volume One covers Aim 1 and 2 as well as some parts of Aim 3, i.e. generate data sets. This report addresses Aim 3: development of guidelines for water use efficiency and water safety in buildings.

# GUIDANCE ON WATER USE EFFICIENCY IN BUILDINGS

## INTRODUCTION

There are currently no compulsory standards for water use efficiency in the National Building Regulations and Building Standards Act (NBR and BS Act). However proposed amendments to Part X of SANS 10400 (originally SANS 0400-1978) - Code of Practice for Buildings will address issues of water use efficiency:

Part XA informs energy efficiency and states that hot water supply must be regulated, where no more than 50% of the annual volumetric requirement of domestic hot water may be supplied by means of electrical resistance heating. The rest could be heated by any means of water heating.

Part XB will cover water efficiency but it is still under approval. To be approved, Part XB must be integrated into the National Building Regulations (NBRs) under the Department of Trade and Industry. The expected timeline is 2020-2021.28 Part XB will be based on SANS 308829, which provides maximum flow rates for different types of fixtures and fittings to ensure water use efficiency.

The current DWS model by-law includes “labelling of termination fittings” in clause 47. This states that “all terminal water fittings and appliances using or discharging water shall be marked, or have included within the packaging of the item, the following information: (a) the range of pressure in kilopascal (kpa) over which the water fitting or appliance is designed to operate; (b) the flow rates, in litres per minute.” Additionally, the 2018 Amendment to the 2013 Cape Town Water By-law limits showerhead flow rates to 7 litres per minute (L/min), and bathroom faucet flow rates to 6 L/min. However, only certain municipalities adopted this by-law to enforce water use efficiency (CLASP, 2022).

There are numerous guidelines for implementing water use efficiency in homes, buildings, industries and agriculture. With regards to buildings, water use efficiency guidelines and benchmarks vary due to several factors such as type of building or industry, size of building, operating hours, occupancy rates, occupancy density, climate, heating/cooling methods, irrigation area and methods, water usage, etc. Water use efficiency benchmarks are therefore complex calculations which apply to specific building types or industries.

The Green Building Councils Energy Water Performance Tool is an operational performance measurement tool which rates the performance of a whole office building, by comparing the energy and water usage figures against a national “average” benchmark that is adjusted for the following factors: Climate; number of computers; number of occupants; annual vacancies, and operating hours. The building is then positioned on a 10-level scale based on its performance relative to the national benchmark. This can be a valuable tool to building owners to benchmark their water use initiatives against similar facilities.

However, this does not take into consideration differences between parameters such as building technology, quality, level of service, etc. Detailed water use benchmark tools form part of voluntary certification programs which building owners can join to evaluate their water use efficiency.

## DEVELOPING A WATER BALANCE FOR THE FACILITY

A water balance for the facility requires identification of all water sources, water users, and water discharge. The water balance can be illustrated in a simple diagram with supporting information:

- Qualitative: description of infrastructure, nature of material (pipes/valves, heat exchangers) and basic operational procedures,
- Quantitative information: flow and pressure at each critical point (inflow, point of use, discharge).

Building owners are advised to develop a site-specific water conservation and demand management strategy with realistic internal targets for reducing water consumption. The key components for developing such a plan are summarised below:

## IDENTIFY KEY PERFORMANCE INDICATORS (KPIS)

KPI's can be established at a number of levels, for example to measure the performance of an entire site or to measure the performance of an individual process within a site. Examples of KPI's are:

- **The absolute volume of water** used over a defined time period, which is an indicator of the demand that a site places on freshwater resources.

  ***Absolute Water Use = potable water use / annum + raw water use / annum + harvested rainwater / annum + usable effluent / annum***
- **Water Intensity** for commercial buildings relates water use over a defined time period to the square meters of building space served. Note that this is not the area of the entire site, but the floor area of the buildings on the site. In multi-storey buildings, the area of each floor must be accounted for.

  ***Water Use Intensity = Absolute Water Use / Building Floor Area***

## DETERMINATION OF BASELINE WATER USE

Determination of the baseline is the process of establishing the status of absolute water use and water intensity for a commercial site at a defined point in time. This should preferably be done before the implementation of a water conservation programme. When this baseline has been established, it serves as a benchmark against which water use performance improvements may be judged.

## IDENTIFICATION AND QUANTIFICATION OF WATER CONSERVATION OPPORTUNITIES

In order to determine water use targets, it is necessary to first identify each of the water-saving opportunities on the site, and to quantify the amount of water that could be saved. The first step in doing this is to determine how much water is used in various areas of the site. This allows users to identify which areas require the most focus in terms of water conservation. Specific projects can then be pursued within these areas of focus.

A water conservation opportunity may be defined as a viable intervention which, when implemented, results in a reduced consumption of water relative to baseline water use. The viability of individual water conservation interventions should be ascertained using the standard methodologies used by individual organisations when justifying any project.

## SETTING WATER USE TARGETS

Water use targets should be reviewed at least annually, with a target determined for each year over a five-year time horizon. Continuous improvement is one of the drivers of target setting and performance monitoring, and hence the target for each year should demonstrate a progressive planned reduction in water intensity, i.e. a progressive improvement in water use efficiency.

Over time however, it does become more and more difficult to continue to improve without significant capital investment. This is the law of diminishing returns as applied to water conservation. When the costs of implementing water conservation exceed the potential economic, social and environmental benefits to be gained, the focus should shift to the maintenance of efficient performance as opposed to the pursuit of increased efficiency levels.

# GUIDELINES FOR WATER SAFETY IN BUILDINGS

## INTRODUCTION

While there are many excellent guidelines available for managing the various components of water systems in buildings; there is a lack of standards and guidelines for water quality in buildings. The Corona Virus pandemic has highlighted the issues of water Safety in buildings due to prolonged closure of buildings during periods of lockdown resulting in stagnant water which presents potential health risk to consumers. The recent publication of the 2022 Blue Drop Report by DWS states 60% of water supply systems in the country do not comply with microbiological determinants and 77% of water supply systems do not comply with chemical determinants. The poor performance of the majority of municipal supply systems indicates serious health risk to consumers of municipal water and building owners need to take responsibility of their internal water services networks to address risks related to safe drinking water and sufficient water supply.

Based on the literature review and status quo assessment, the importance of the risk management approach embodied in the WHO Water Safety Planning methodology was highlighted as a method to effectively manage water-related risks in buildings.

In 2004, the World Health Organisation (WHO) and the IWA Bonn Charter for Safe Drinking Water introduced the concept of risk-management in drinking water systems called Water Safety Plans (WSP). This was described as” The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.

Since then, more than 93 countries from around the world have adopted or implemented the Water Safety concept and nearly 70 countries have policies or regulations pertaining to WSP in place or under development.

In SA, the WSP approach is adopted into the National Drinking Water Quality standard, SANS 24: 2015 which requires each supply system to:

- Development of a Water Safety Plan,
- Undertake an annual risk assessment of water supply systems (from catchment to tap) to identify, mitigate and manage current and potential risks,
- Develop risk-based monitoring programs, and
- Develop a Water Quality Incident protocol to manage water quality failures

The WSP is a requirement for DWS Blue and Green Drop Incentive-Based Regulation Program requiring a Water Services Institution (WSI) to develop and implement risk management procedures as outlined in the WHO Water Safety Planning manual.

The objective of a Water Safety Plan (WSP) is to consistently ensure the safety of the drinking water system, and includes three key components:

- System assessment to determine whether the drinking water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets.

- Identifying control measures in a drinking water system that will collectively control identified risks and ensure that health-based targets are met. For each control measure identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from the required performance is rapidly detected in a timely manner.

- Management plans describing actions taken during normal operation or incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

The third edition of the WHO Guidelines for drinking-water quality (GDWQ) (WHO, 2008) introduced the concept of WSPs within a Framework for safe drinking-water with focus on effective preventive management and thereby disease prevention. The GDWQ include specific reference to issues associated with large buildings, such as health care facilities, schools and day-care centres and recommend that these buildings have their own WSPs to ensure the maintenance of safe water supplies. The intention is that such building plans should complement the WSPs of water suppliers.

The WSP methodology offers a holistic approach to manage water risks in buildings. The use of risk-based methodology in the WSP makes it easy to understand by building owners as risk management is a universal business concept used by all sectors to identify, assess, and control risks. In addition, the systematic approach of the WSP can be modified to cover all aspects of water services and can be extended to address issues of water scarcity such as water losses in network, climate change, population growth, and ageing infrastructure: this extended WSP plan is called a "Water Safety and Security Plan" (WSSP).

An added benefit of the WSP approach is the cycle of continuous risk management that will ensure new and emerging risks are identified and managed on an ongoing basis. In conclusion, self-regulation by building owners through awareness of potential risks may prove to be an effective mechanism to improve water use efficiency and water safety in buildings.

## TOOL FOR DEVELOPING A WATER SAFETY AND SECURITY PLAN FOR BUILDINGS

The project team has developed a Water Safety and Security Plan (WSSP) Tool for buildings aligned with the WHO WSP methodology and applicable to water quality and water supply risks. This tool can be accessed here: Water Safety and Security Plan (WSSP) Tool for buildings.

This tool is designed for use by building owners and facilities managers who have technical skills on design and operations of water supply systems but have limited knowledge of water quality and risk management procedures. The tool is excel-based, easy to understand and has various resources to assist building owners to identify typical risks and associated mitigating measures, determine monitoring requirements, and implement corrective action in the event of failures. Information and supporting resources are based on National standards (SABS standards) and International/National best practise principles where there are no standards in place. The WHO guidelines serve as the primary input for water quality standards, water quality monitoring and implementation of risk management procedures for water supply systems. Additional sources of information include the Centres for Disease Control and Prevention (https://www.cdc.gov/about/index.html ) and the United States Environmental Protection Agency response to the Corona Virus pandemic (https://www.epa.gov/coronavirus/information-maintaining-or-restoring-water-quality-buildings-low-or-no-use.

## METHODOLOGY FOR DEVELOPING WSSP

The methodology for developing the WSSP as per WHO methodology is displayed in Figure 1 below and discussed in detail.

Tab 1: WSSP Methodology

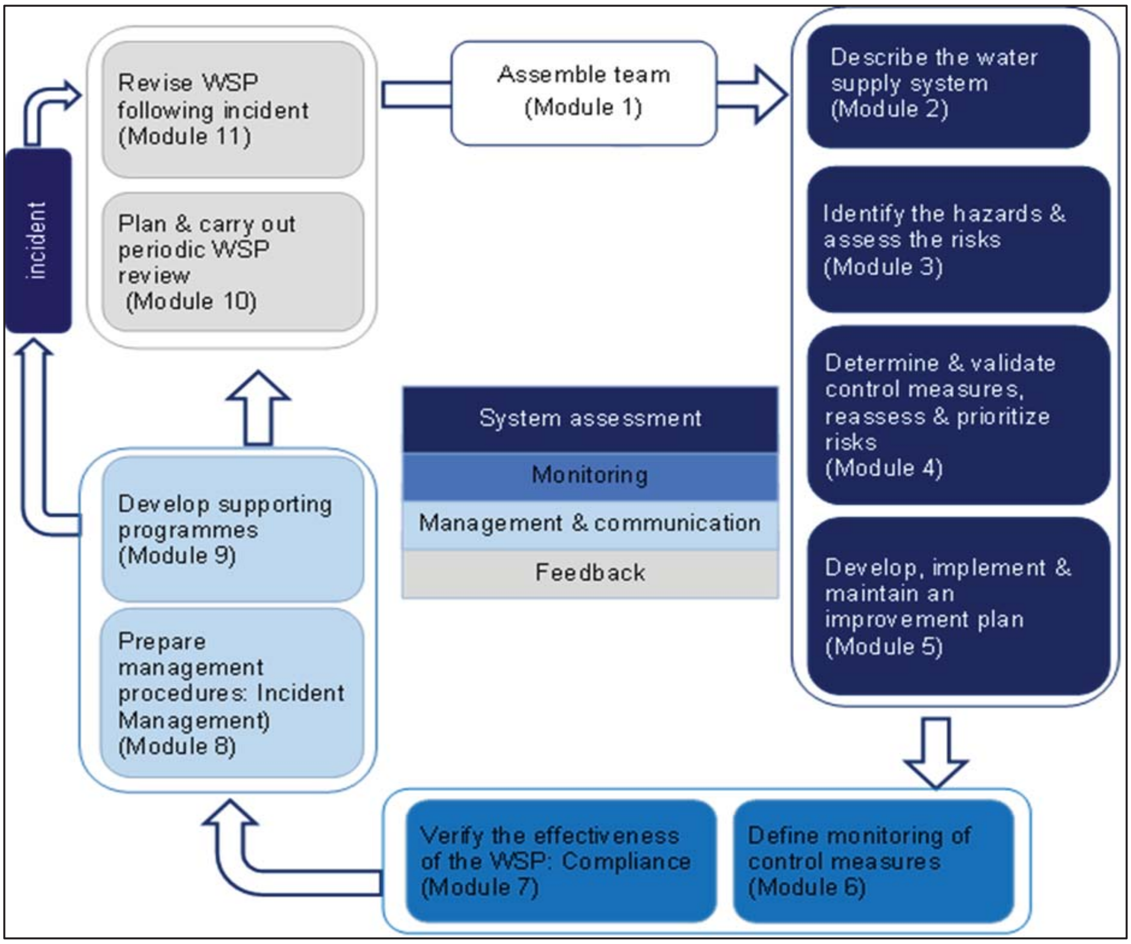



FIGURE 1: WATER SAFETY PLANNING METHODOLOGY AS PER WHO WSP MANUAL, 2007

## MODULE 1: ASSEMBLE A TEAM

Tab 2: WSSP Team

The prerequisite for WSSP is a qualified, dedicated, multi-disciplinary WSSP Team that has the required knowledge and expertise to manage water services risks in the building. The team is responsible for developing, implementing, and maintaining the WSSP and team members should include the range of expertise needed for a thorough analysis of the building's water system, i.e.

- Expertise in design, operation, and management of water network: engineering; plumbing; maintenance.
- Expertise in water quality: can be external service provider – scientist, engineer, laboratory.

The WSSP team must Include both Internal and external stakeholders

- Internal: employees with relevant specialist expertise, as well as representatives of key users of the building water systems: tenants, representative of staff, OHS representative, building management, body corporate
- External: Water service Authority
- Ad hoc members: Chief financial officer, Building owner, and any other key decision makers

The WSSP team is led by the WSSP Coordinator who is a Senior member of the organisation with required authority to secure resources (people and funds), and external support (if required). The WSSP Coordinator is either the building manager or a competent person delegated to this task by the manager. The WSSP Coordinator should have (or acquire) a good knowledge of the technical facilities in the building, and their daily work should be related to the building. Technical knowledge in drinking-water and/or sanitation, while useful, is not necessarily required as this can be obtained from external specialists.

***Instructions:***

- ***The building owner / body corporate must identify individuals who should form part of the WSSP; and the team will choose the Coordinator.***
- ***Open spreadsheet to Tab 2: WSSP Team***
- ***Insert details of building including GPS location.***
- ***Type of building selected from drop down box.***
- ***Version control is important so choose suitable format to reflect annual changes.***

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Name of Building | | Date of Water Safety Plan | | |
| 2 | Address | | Version Number | | |
| 3 | GPS Location | | | | |
| 4 | Type of building | Please select from dropdown | | | |
| 5 | | | | | |
| 6 | | Name | Designation and Organisation | Contact Number | Contact Email |
| 7 | Building owner (if applicable) | | | | |
| 8 | Facility Manager | | | | |
| 9 | WSP Team | | | | |
| 10 | WSP Coordinator | | | | |
| 11 | Team member 1 | | | | |
| 12 | Team member 2 | | | | |
| 13 | Team member 3 | | | | |
| 14 | Team member 4 | | | | |
| 15 | Team member 5 | | | | |
| 16 | Team member 6 | | | | |

FIGURE 2: SCREENSHOT OF TAB 1: WSSP TEAM

## MODULE 2: DESCRIBE THE WATER SUPPLY SYSTEM

Tab 3: System Description

Tab 4: Water Supply Flow Diagram

The next step of the WSSP team is to compile all available information on the design and operation of the water-distribution system in the building. This can be in the form of a high-level flow diagram to capture the various elements of the building water system supported by a library of reference documents that covers all aspects of water in the building.
Guidelines for describing the water supply system are listed below:

- As-built drawings are critical for compiling flow diagrams and latest version must form part of the library. Technical information such as manufacturers specifications, feasibility reports, maintenance records should form part of the reference documents.
- On-site verification is critical to ensure correct information is captured and will highlight gaps in information.
- Flow diagram can contain additional technical information such as flow rates, pressure, size of units, etc. This will depend on the type of building and expertise of the WSSP team.
- The description must address all types of water networks: hot water, cold water, process water and wastewater.
- Water usage patterns should be recorded for all sources of water: drinking, showering, preparing food, cleaning, toilet flushing, irrigation, firefighting, laundries, water-using devices (e.g. cooling towers, swimming pools, water coolers, water fountains) or specific applications (medical: autoclaves, surgery, dialysis, etc.). Usage determines the required volume and flow rate at each Point of Use (PoU) and this will assist in identifying areas of low flow, stagnation, or variability in usage due to occupancy rates.

- Process layout must cover the full value chain of water:
  - Point(s) of entry (PoE) to the building, including possible PoE treatment;
  - Building-specific sources of water and associated treatment (boreholes, rainwater harvesting, water reuse),
  - Water piping systems: hot and cold systems,
  - Storage systems: for potable water, wastewater, other waste streams (process water, cooling tower blowdown water),
  - Connections between potable and non-potable systems, including
    - intended connections (e.g. between drinking water systems and fire systems), and
    - unintended connections (e.g. between drinking-water systems and sewage or recycled-water systems);
  - Devices for heating and supplying hot water (geysers, heat exchangers, boilers, etc.);
  - Equipment installed at PoU (e.g. dishwashers, washing machines, drinking- water fountains,);
  - Water treatment systems at PoU (tap connections, under-counter units, conventional treatment, specialised processes, etc.).

The WSSP and the associated library of reference documents should be stored on a shared drive or on the Cloud where it can be accessed by the WSSP team and updated annually. This will build institutional memory and improve understanding of process operations and management.

***Instructions***

- ***Tab 3: System descriptions to be completed by the team.***
  - ***This is a generic format to capture information: items can be added/removed as per building layout.***
  - ***Additional information related to infrastructure can be added such as nature of pipes material (copper, galvanised steel, HDPE, etc.), description of equipment (model number, make, type, size (volume/length), manufacturer, etc.), and location.***
- ***Tab 4: Water Supply Flow Diagram***
  - ***Two examples provided of typical flow diagrams. The WSSP Team must decide on format and level of details for the flow diagram. This can vary from a simple line diagram (as per examples) to a detailed civil drawing of buildings internal reticulation network.***

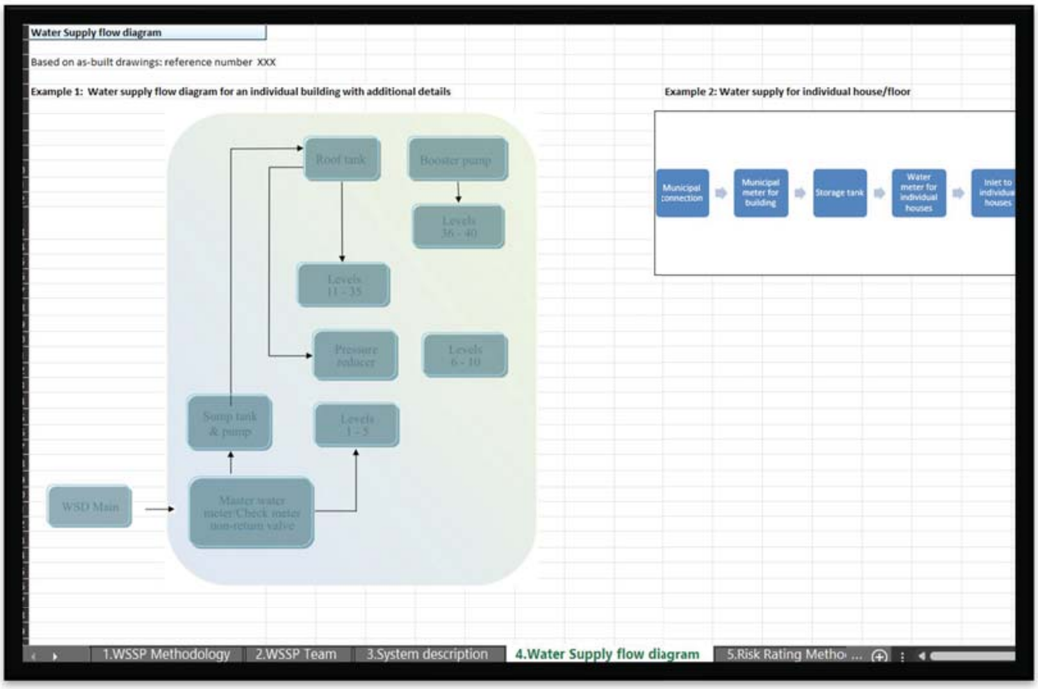



FIGURE 3: SCREENSHOT OF TAB 4 WATER SUPPLY FLOW DIAGRAM

## MODULE 3: IDENTIFY THE HAZARD AND ASSESS THE RISK, AND MODULE 4: DETERMINE AND VALIDATE CONTROL MEASURES, REASSESS AND PRIORITISE RISKS

Modules 3 and 4 form the basis of the risk assessment process where risks are identified, rated, and evaluated to determine if current control measures are sufficient to mitigate the risk. The process of identifying risks and control measure, assigning risk ratings, validating control measures and reassessing risk is illustrated in the figure below and provided in Tab 7 of the Tool for reference.

FIGURE 4: RISK ASSESSMENT PROCESS

#### 1.1.1.1 IDENTIFY THE HAZARD AND ASSOCIATED RISK

Tab 5: Typical risks overview

The risk assessment process begins with identification of hazards and associated risks. This must be conducted by the WSSP Team to ensure all risks are identified and there is consensus on the risk rating and required mitigating measures. The risk identification process involves a physical site inspection of the water services infrastructure and a desk-top assessment of process diagrams, civil drawings, water quality information, maintenance reports, customer complaints and any other supporting documentation.

Effective risk management requires the identification of potential hazards, potential hazardous events, and the associated risk as per definitions given below:

- **A HAZARD** is a biological, chemical, physical or radiological agent that has the potential to cause harm:
  - contaminants in source water,
  - external contaminants (bird droppings, rat faeces, sediment deposit in storage tanks, etc.),
  - internal contaminants (corrosion/scaling of pipes, contamination with wastewater, biofilm formation, Legionella due to temperature fluctuations, etc.)
- **A HAZARDOUS EVENT** is an incident or situation that can lead to the presence of a hazard (what can happen and how). In buildings this can include interruption to supply - scheduled or unscheduled, contamination of the incoming water, temperature changes in hot water systems, equipment failure, incorrect equipment, incorrect operations of treatment units or water use devices, etc.
- **Risk** is the likelihood of identified hazards causing harm in exposed populations in a specified time frame, including the magnitude of that harm and/or the consequences.

When describing hazards and hazardous events the following formula must be applied: X happens (to the water supply) because of Y, where

X = What can happen to the water supply

Y = How it can happen (i.e. cause)

Examples:

- Water in storage tanks becomes contaminated (X) because of open rainwater tanks (i.e. no lid) (Y).
- Water in the pipe network becomes contaminated (X) because of unsanitary pipeline repair practices (Y).
- Water is over- or under-dosed with chlorine (X) because of insufficient operator training (Y).

***Instructions***

- ***Tab 5 provides an infographic to show typical hazards/hazardous events associated with water services in buildings.***
- ***The WSSP Team can use this as a guideline to identify water services risks within their building.***
- ***The list is not exhaustive as there may be site-specific risks which may be unique to a building such as cooling towers, autoclaves, water fountains, saunas, etc.***
- ***The outcome of this exercise is list of water services risks in the building which will be entered into Tab 7: Risk Matrix.***

*Optional: The building owner can compile a similar infographic which can be displayed in the building to sensitise personnel on potential hazards and associated risks.*

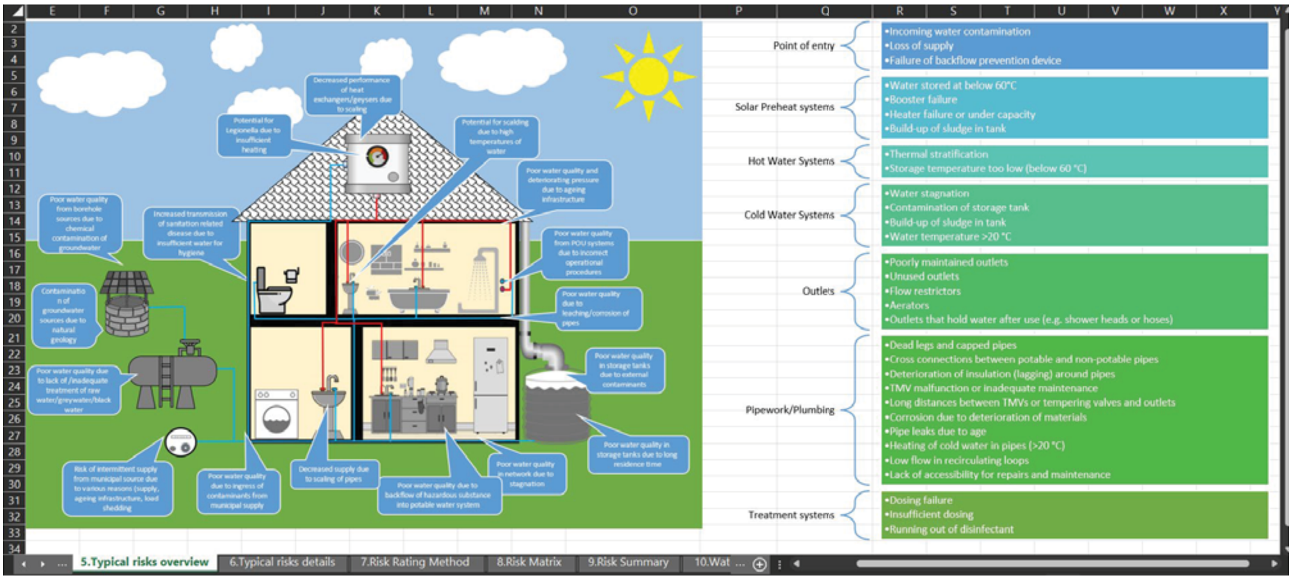



**FIGURE 5: SCREENSHOT OF TAB 5: TYPICAL RISK OVERVIEW**

### 1.1.1.2 CALCULATION OF RISK RATING

As stated above, Risk is the likelihood of identified hazards causing harm in exposed populations in a specified time frame, including the magnitude of that harm and/or the consequences.

***Instructions***

Tab 7: Risk Matrix

- ***The WSSP Team must capture all identified risks into Tab 7; Risk Matrix, Column F with appropriate numbering.***
- ***Risks are categorized according to type of risk as per the risk matrix. The building owner can change the type of risk to meet their buildings individual requirements.***
- ***The next step is to classify the risk type as per dropdown list in Column G***

| | D | E | F | G |
|---|---|---|---|---|
| 11 | Risk Matrix of XXX | | | |
| 12 | Targeted Risks | Risk No. | Identified Risk | Risk type |
| 13 | | | Point of entry | |
| 14 | | 1 | Lack of sufficient supply/pressure | Physical: leakages |
| 15 | | | | Please select from dropdown list |
| 16 | | | | Please select from dropdown list |
| 17 | | | | Please select from dropdown list |
| 18 | | | | Please select from dropdown list |
| 19 | | | | Please select from dropdown list |
| 20 | | | | Please select from dropdown list |
| 21 | | | | Please select from dropdown list |
| 22 | | | Onsite storage | |
| 23 | | | | Please select from dropdown list |
| 24 | | | | Please select from dropdown list |
| 25 | | | | Quantity: limited/no supply |
| 26 | | | | Please select from dropdown list |
| 27 | | | | Please select from dropdown list |
| 28 | | | | Please select from dropdown list |
| 29 | | | | Please select from dropdown list |
| 30 | | | | Please select from dropdown list |

... 5.Typical risks overview | 6.Risk Rating Method | 7.Risk Matrix | 8.Typical risks details | 9.Risk Summary

FIGURE 6: SCREENSHOT TO SHOW CAPTURE OF RISKS AND TYPE OF RISK.

Tab 6: Risk rating Method

- ***The next step is to determine the risk rating for each risk using the following formular.***
  ***Risk = Likelihood X Consequence, where***
  - *Likelihood is determined by "how often' or "how likely" a hazard or a hazardous event occurs. It should consider hazards that have occurred in the past and their likelihood of re-occurrence, as well as for those hazards and hazardous events that have not occurred to date.*
  - *Consequence is the severity of the results of the hazards and hazardous event and the seriousness or intensity of the impact of the hazards. When dealing with impact we are concerned with human health and environmental integrity.*

  ***The definition of likelihood and consequence is given in Tab 6: Risk Rating Method, Table 1 with extended set of definition for consequence for various users:***
  - *Consequence based on water quality failures as per the WHO WSP manual,*
  - *Consequence based on water supply: therefore, WSP can be expanded to a "**Water Safety and Security Plan",***
  - *Consequence to management of the buildings. This definition with improved understanding of consequence by non-technical personnel such as building manager, tenants, etc.*

***For each identified risk, the WSSP Team must assign likelihood and consequence as per definitions in Table 1 as per the risk tool (Figure 7)***.

| Table 1: Risk Rating = Likelihood X Consequence | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Probability/ Likelihood** | | | | **Impact/Severity of Consequence** | | | | |
| **Category** | **Score** | **Definition 1** | **Definition 2** | **Category** | **Score** | **Definition for water quality** | **Definition for water supply/quantity** | **Definition for building** |
| **Almost certain** | **5** | Once per day | Is expected to occur in most circumstances | **Catastrophic** | **5** | Potentially lethal to all people using the building, including vulnerable groups (e.g. immunocompromised patients, infants and the elderly), following acute exposure | No water supply for more than 48 hrs or more than 15 days per year/ flooding in building resulting in damage to building infrastructure and catastrophic ingress (water is unconsumable) | Major impact for whole of facility, complete failure of systems |
| **Likely** | **4** | Once per week | Will probably occur in most circumstances | **Major** | **4** | Potentially harmful to all people using the building following acute exposure | Major interruption in supply for more than 24 hrs due to major leaks/ Damaged building water network leading to major ingress of contaminants | Major impact for part of facility, systems significantly compromised, abnormal (if any) operation, high level of monitoring required (e.g. temporary closure of part of facility requiring extensive disinfection) |
| **Moderately likely** | **3** | Once per month | Might occur or should occur at some time | **Moderate** | **3** | Potentially harmful to vulnerable groups (e.g. immunocompromised patients, infants and the elderly) following chronic exposure | Moderate Interruption in supply (12-24hrs) due to localised leaks / Damaged building water network leading to moderate ingress of contaminants | Minor impact for most of facility, significant but manageable modification to normal operation, increase in operating costs, increased monitoring |
| **Unlikely** | **2** | Once per year | Could occur at some time | **Minor** | **2** | Aesthetic impacts, Potentially harmful to all people using the building following chronic exposure(>1 year) | Minor interruptions in supply (<12hrs) due to small leaks / Damaged building water network leading to minor ingress of contaminants | Minor impact for part of facility, some manageable disruption to normal operation, some increase in operating costs |
| **Rare** | **1** | Once every 5 years | May occur only in exceptional circumstances | **Insignificant** | **1** | No impact or not detectable | No impact / damage or not detectable | Insignificant impact, little disruption to normal operation, low increase in normal operating costs |

FIGURE 7: TABLE 1 WITH DEFINITIONS FOR LIKELIHOOD AND CONSEQUENCE

*This will allow for categorisation of each risk as a low, medium, or high risk as per the risk categorisation matrix as per* ***Table 2****: Risk Rating Categorisation* in the risk tool. *Management can use Table 3 to prioritise implementation of mitigating measures: address high risk first.*

| **Table 2: Risk rating categorisation** | | | **Impact/Severity of Consequence** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Insignificant** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| | | | **1** | **2** | **3** | **4** | **5** |
| **Probability/ Likelihood** | **Almost certain** | **5** | 5 | 10 | 15 | 20 | 25 |
| | **Likely** | **4** | 4 | 8 | 12 | 16 | 20 |
| | **Moderately likely** | **3** | 3 | 6 | 9 | 12 | 15 |
| | **Unlikely** | **2** | 2 | 4 | 6 | 8 | 10 |
| | **Rare** | **1** | 1 | 2 | 3 | 4 | 5 |

| **Table 3: Management Guidelines** | | |
|---|---|---|
| **Risk Rating** | **Range** | **Management actions required** |
| **LOW** | **0-9** | No immediate action required. Keep under review and introduce any simple and |
| **MEDIUM** | **10 - 15** | Evaluate underlying factors, set timescale for putting extra control measures in place. |
| **HIGH** | **> 15** | Immediate substantive action is required to bring the situation under control, and then introduce extra control measures (barrier). |

FIGURE 8: SCREENSHOT OF TAB 6 SHOWING RISK RATING CATEGORIES (TABLE 2) AND MANAGEMENT GUIDELINES (TABLE 3).

*To Calculate the baseline risk rating, select the appropriate likelihood and consequence from the drop down in columns H and I. The risk matrix will automatically calculate the risk rating (Column J) as outlined below.*

| | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|
| 11 | Risk Matrix of XXX | | | | Baseline Risk | | |
| 12 | Targeted Risks | Risk No. | Identified Risk | Risk type | Likelihood | Consequence | Risk Rating |
| 13 | | | Point of entry | | | | |
| 14 | | 1 | Lack of sufficient water pressure from municipal supply | Physical: low pressure | 5. Once per day | 2.Minor impact | 10 |
| 15 | | 2 | Risk of poor municipal water quality | Health: microbiological | 5. Once per day | 4.Major impact | 20 |
| 16 | | 3 | Lack of sufficient water supply due to high demand during peak season | Quantity: limited/no supply | 3. Once per month | 3.Moderate impact | 9 |
| 17 | | | | Please select from dropdown list | Please select from dropdown list | Please select from dropdown list | 0 |

FIGURE 9: SCREENSHOT OF TAB 7: TO AUTO- CALCULATION OF RISK RATING

***Note:*** *if additional rows are added to the risk matrix, please check input values for graphs under Tab 8 and update accordingly.*
***Note****: Calculation of risk rating is a team effort, to be conducted by the entire WSSP to ensure consensus on implementation of mitigating measures, in particular allocation of budget to address high risks versus low risks.*

#### 1.1.1.3 IDENTIFY CONTROL MEASURES AND VALIDATE RISK RATING

Tab 8: Typical risks details

The next step in the process is the identification and evaluation of **control measures** which is described as "*Any action or activity that can be used to prevent, eliminate, or reduce the risk of any water safety hazard to an acceptable level".* In this case, the control measure extends to any action or activity that can reduce risk associated with water quality or supply. Typical control measures are treatment processes, water storage facilities, pressure management, routine inspections and maintenance, non-return valves, security, etc.

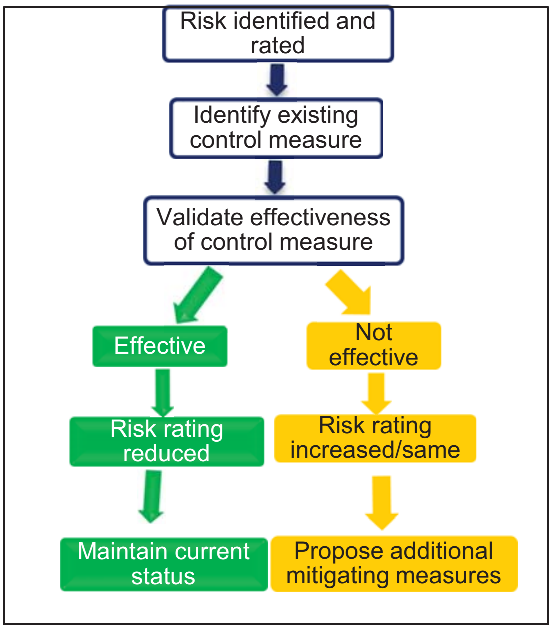
**Tab 8** provides a list of typical control measures and associated mitigating measures for water-related risks in buildings.

Once the control measure is identified, the WSSP Team must verify the efficacy of the current control measures through the process of **validation**: *Validation is the process of identifying the effectiveness of control measures with supporting evidence to prove/disprove the effectiveness of the control measure*. The information required for validation can come from a variety of sources, including:

- Quantitative assessment with actual numbers, i.e. water quality results, flow meters, pumping hours, operating hours of equipment, maintenance records, etc.
- Visual inspection: smell/colour/sound/condition of infrastructure and pipes.
- Records: number of OHS incidents, days without power, number of consumer complaints, number of unresolved incidents.

***Instructions:***

***The WSSP Team must identify existing control measures for all risks which have been identified.***




- ***Complete Columns K:" Control Measure" and Column L: "Monitoring".***
    - Tab 8 provides list of typical control measures and associated monitoring. This will assist to complete columns K:" Control Measure" and Column L: "Monitoring".
    - See Section 3.3.5 for more information on water quality monitoring and how to develop a water quality monitoring plan to the building.
- ***To complete column M: "Tests for efficacy of existing control measures", the WSSP team must validate the efficacy of each control measure using monitoring information.***
    - *If the control measure is effective in reducing the risk, then the "Residual risk" (Column P) may be reduced and no further actions are required.*
    - *If the control measure is not effective in reducing the risk, then the risk either remains the same or increases.*

## MODULE 5: DEVELOP, IMPLEMENT AND MAINTAIN AN IMPROVEMENT PLAN

Tab 7: Risk Matrix

Once residual risk has been determined, the next step is to develop an improvement plan to mitigate all medium and high risks. The implementation plan outlines specific actions to address each uncontrolled or ineffectively controlled risk in a structured manner using risk rating as the basis to allocate resources. Prioritisation is based on risk rating and the implementation plan provides for short, medium, and long-term activities that will maximise effectiveness of resources (budget, personnel).

***Instructions:***

- ***Complete Column Q: "Additional Control Measures to mitigate risks".***
    - *Tab 8 provides typical mitigating measures associated with each risk and this will assist the WSSP team to outline mitigating measures to address all medium and high risks.*
- ***Complete Column R: "Specific actions"*** *- breakdown of actions to implement mitigating measures.*
- ***Complete Column S: "Responsible Person/Department/Organisation"*** *– this is the responsible party for implementing actions.*
- ***Complete Column T: "Total Budget allocation".***
- ***Complete Column U: "Due Date/ Timeline".*** *The WSSP Team can decide which KPI to use. "Due date" is recommended for short term, emergency actions while "Timeline" can be used to track long term projects.*

Below is an example of two risks which have been completed up to implementation phase: first risk is reduced due to efficacy of control measure while the second risk is increased due to health consequence to consumers.

| | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Risk Matrix of XXX | | | | Baseline Risk | | | | | | Residual Risk | | | Implementation plan | | | | |
| 12 | Targeted Risks | Risk No. | Identified Risk | Risk type | Likelihood | Consequence | Risk Rating | Control Measures | Monitoring | Tests for efficacy of existing control measures | Likelihood | Consequence | Residual Risk Rating | Additional Control Measures to mitigate risks | Specific actions | Responsible Person/Department/Organisation | Total Budget allocation | Due Date/ Timeline |
| 13 | | | Point of entry | | | | | | | | | | | | | | | |
| 14 | | 1 | Lack of sufficient water pressure from municipal supply | Physical: low pressure | 5. Once per day | 3.Moderate impact | 15 | Storage tank with booster pump in place. | Monthtly record of average pressure at point of entry and in building | Effective: pressure is mainatined at all points in network with only occasional decrease in pressure when municipal supply has issues | 3. Once per month | 3.Moderate impact | 9 | No actions required, maintain monthly checks of presssure | | | | |
| 15 | | 2 | Risk of poor municipal water quality | Health: microbiological | 5. Once per day | 3.Moderate impact | 15 | On-site treatment taking place: filtation to remove sediments. | Monthly monitoring of Turbidity and microiobloglcal indicators (E.Coli | Not effective: E.Coli failures in final water | 5. Once per day | 5.Catastrophic impact | 25 | 1)Provide alternative supply while failure is resolved<br>2) Install disinfection facility to treat water before it enters network.<br>3) Ensure monthly monitorng to verfiy safety of water | 1)Provide alternative supply while failure is resolved or advise consumers to boil water before consuming.<br>2) contact service provider to discuss options for disinfection, conduct feasbilty with regards to operations and cost.<br>3) Train staff to monitor disinfectant levels and microbiological determinants (ILab Petrifilm) weeekly.<br>4) Ensure monthly monitorng of microbiological parameters by external lab to ensure safety of water | Facility Manager | R150 000 | Item 1: Immediately<br>Item 2: within 1 month<br>Item 3: After installation of disinfection unit |

FIGURE 10: EXAMPLE OF RISK COMPLETED WITH ALL ATTRIBUTES AS PER TAB 7: RISK MATRIX

***Tab 9: "Risk Summary"*** provides graphical representation of all risks with regards to risk rating category, types of risks, and location of risks. This is helpful to visualise where the risks are located and how they should be addressed.

Tab 9: Risk Summary

Implementation is the next phase. To facilitate the process of developing a long-term implementation plan, the WSSP Team can choose to list "Targeted risks" which are high/medium risk which have been allocated budget and will be implemented in the next year. The use of targeted risks provides a specific, time-bound plan to track implementation of high risks over a period of one year and set up long-term targets to mitigate medium and low risks.

***Instructions***

- ***The WSSP Team must review risks and decide which high and medium risks will be targeted in the next financial year, i.e. they will be implemented and mitigated.***
  - *Refer to Table 3 for management guidelines for targeting risks (Figure 8**).***
  - *Prioritisation must be given to the high-risk categories. However, there may be high and medium risks that do **not require funding and can be implemented immediately,***
- ***The WSSP must allocate responsibility, timeframe and budget for implementation of targeted risks.***
  - *Some mitigating measures may be long term projects which will be implemented over more than one year or are ongoing activities.*
- ***The WSSP Team must set up date for annual review of the implementation plan:***
  - *Update risk assessment by adding new/emerging risks*
  - *Use dropdown list in Column D to select "Targeted Risks".*
  - *Complete Columns V: "Progress to date at end of Year 1" and Column W: "Implementation on Schedule".*
  - *If risk has been completed, then WSSP Team must use process of validation to check if risk has been mitigated.*
    - *If risk is mitigated, it will not be included in new risk assessment.*
    - *If risk is not mitigated, it will remain in risk register until root cause is addressed and risk is mitigated.*

## Module 6: Define Monitoring of Control Measures and Module 7: Verify the Effectiveness of the WSSP

Tab 10: Water Quality Monitoring

Tab 11: IRIS Data Sheet

*Module 6* outlines the development of a comprehensive monitoring program that covers all existing and proposed control measures to allow for validating the efficacy of the control measures. Monitoring programs must outline all aspects of monitoring: where will it take place, what is being monitored, how will it be monitored, when will it be monitored (frequency), and who will monitor. In addition, each operational monitoring check should have a critical limit assigned to it; this is the point where a control measure is operating outside of an acceptable limit and a potential risk exists.

Monitoring of water quality is essential to verify the effectiveness of the WSSP to provide safe water. The National Drinking Water Quality guideline, SANS 241 lists the water quality parameters and associated limits which verify the safety of drinking water. Although the SANS 241 does not extend to buildings, the standard outlines key operational water quality parameters for distribution networks and provides guidelines on development of risk-based monitoring programs as per WHO WSP methodology.

Section 9.3 of the SANS 10252-1:2012 (Edition 3) deals with disinfection of building networks and recommends analysis of water quality in terms of SANS 241 to verify the performance of the disinfection process.

***Instructions:***
***For all risks, compile a list of required monitoring parameters which will verify the efficacy of the control measure.***

- *This can be in the form of quantitative and qualitative data which include water quality monitoring.*
- *The monitoring parameter should form part of routine operational monitoring programs which include daily/weekly/monthly/annual inspections of network and equipment, inspection of PoU applications by service providers, maintenance records, flow meter readings, temperature measurements, pressure measurements, water balance for the facility, etc.*

**Annexure A**: Guidelines for Water Quality Monitoring in Buildings

***For water quality parameters, consult Annexure A "Guidelines for Water Quality Monitoring in Buildings".*** *This resource document provides an overview of water quality in buildings and will assist building owners to set up a site-specific water quality program for their building/s. The following components are covered in this resource document:*

- ***Rationale for internal water quality monitoring***

- ***Understanding Water quality***
  - *National Drinking Water Quality Standard provides a description of the SANS 241 National drinking water quality standards to ensure safe water. The table summarises main risk categories of water quality as per the SANS 241 standard. This explains the water quality risk and associated frequency of monitoring for each category.*

*Table 1: list of water quality categories and monitoring frequency as per SANS 241:2015*

| Risk category | Description of risk | Type of determinant | Monitoring frequency |
|---|---|---|---|
| Acute health | Poses an immediate unacceptable health risk if present at concentration values exceeding the numerical limit | Micro: E. Coli, Faecal Coliforms, Protozoan parasites (Cryptosporidium species Giardia species. Chemical: Nitrate, Nitrite, Sulphate, Cyanide. | Weekly |
| Chronic health | Poses an unacceptable health risk if ingested over an extended period. Advise that a water quality notice to be issued for sensitive groups. | Chemical: Heavy metals, THM, Fluoride, Chlorine, Iron, Sodium, Chloride (higher concentrations) | Twice a month |
| Aesthetic | Taints water with respect to taste, odour, or colour and that does not pose an unacceptable health risk. | Physical and aesthetic: Colour TDS, EC, pH, Turbidity, Chemical: phenols, manganese, iron, sodium chloride, ammonia, zinc | Monthly |
| Operational | Essential for assessing the efficient operation of treatment systems and | Micro: Heterotrophic plate count (HPC), Total Coliforms, | Monthly |

FIGURE 11 WATER QUALITY CATEGORIES AS PER SANS 241 (ANNEXURE A)

  - ***Water Quality risks specific to plumbing systems***
  - ***Monitoring of Legionella**: typical sites, legislation, recommendations and tools. Monitoring of Legionella is requirement as per SANS 893 and OHS Act and follows a risk-based approach:*
    - *Conduct a risk assessment done by a competent person (OHS Act and SANS 893)*
    - *Establish a Legionella Risk Management system for continuous control and review (SANS 893 part 1)*
    - *Ensure specific water systems are treated correctly, tested, actioned, and recorded (SANS 893 part 2)*
    - *Ensure temperature settings on calorifiers and PoU temperatures meet SANS 893 requirements*
    - *Train and inform staff on all Legionella-related matters (OHS Act and SANS 893*

- ***Verification of incoming municipal water quality***

- ***Use of IRIS to check municipal water quality:*** *This provides instructions on how to verify the quality of municipal water in your area using the Department of Water and Sanitation (DWS) website (https://ws.dws.gov.za/IRIS/login.aspx)*
- *that provides monthly compliance data. Note this is also included in **Tab 11**: for reference.*
- ***Internal Water Quality Assessment.*** *This section provides a generic monitoring program for facilities with municipal supply which based on the SANS 241 National Drinking Water Quality Standard and World Health Organisation guidelines. This has been included in **Tab 10** for reference*

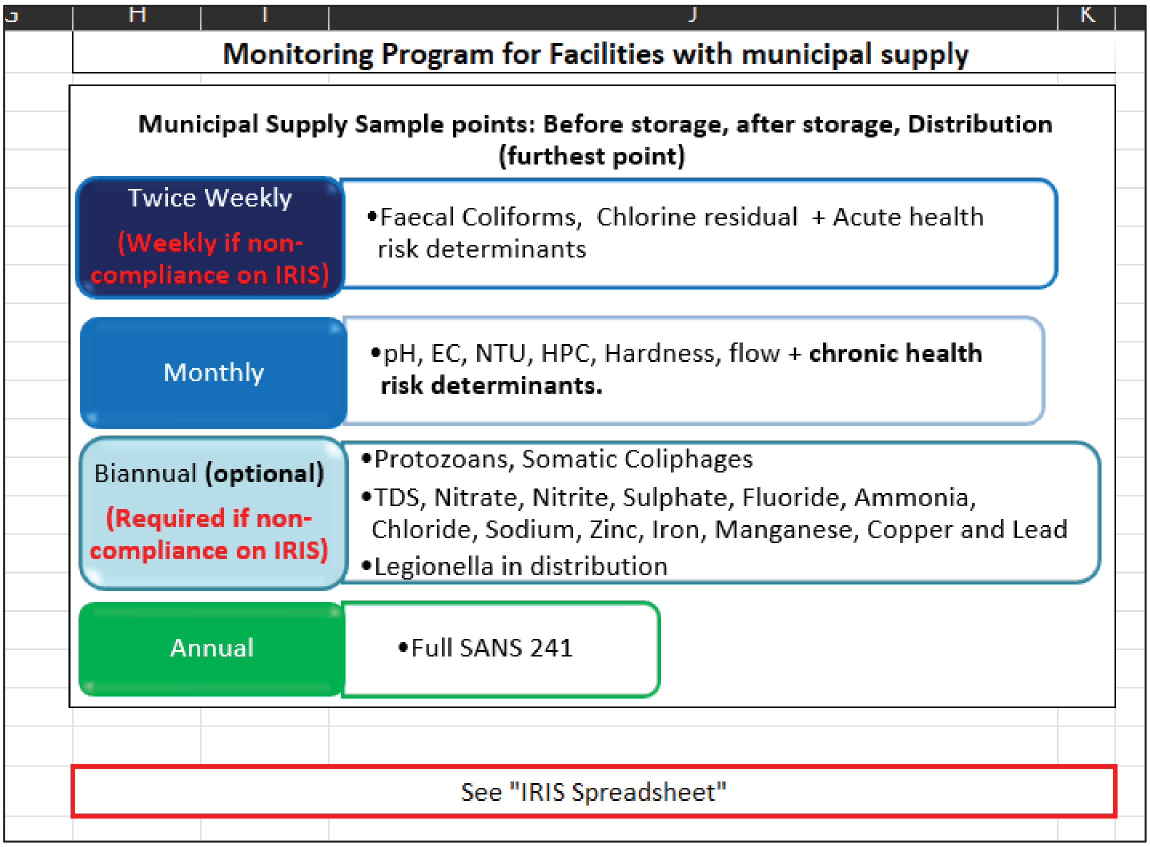



FIGURE 12: GENERIC MONITORING PROGRAM FOR FACILITIES WITH MUNICIPAL SUPPLY (ANNEXURE A)

- ***Monitoring equipment***
- ***Monitoring program for Facilities with On-site Treatment Plants*** *– generic program for water quality monitoring of treatment plants using various sources of water. This has been included in **Tab 10** for reference.*

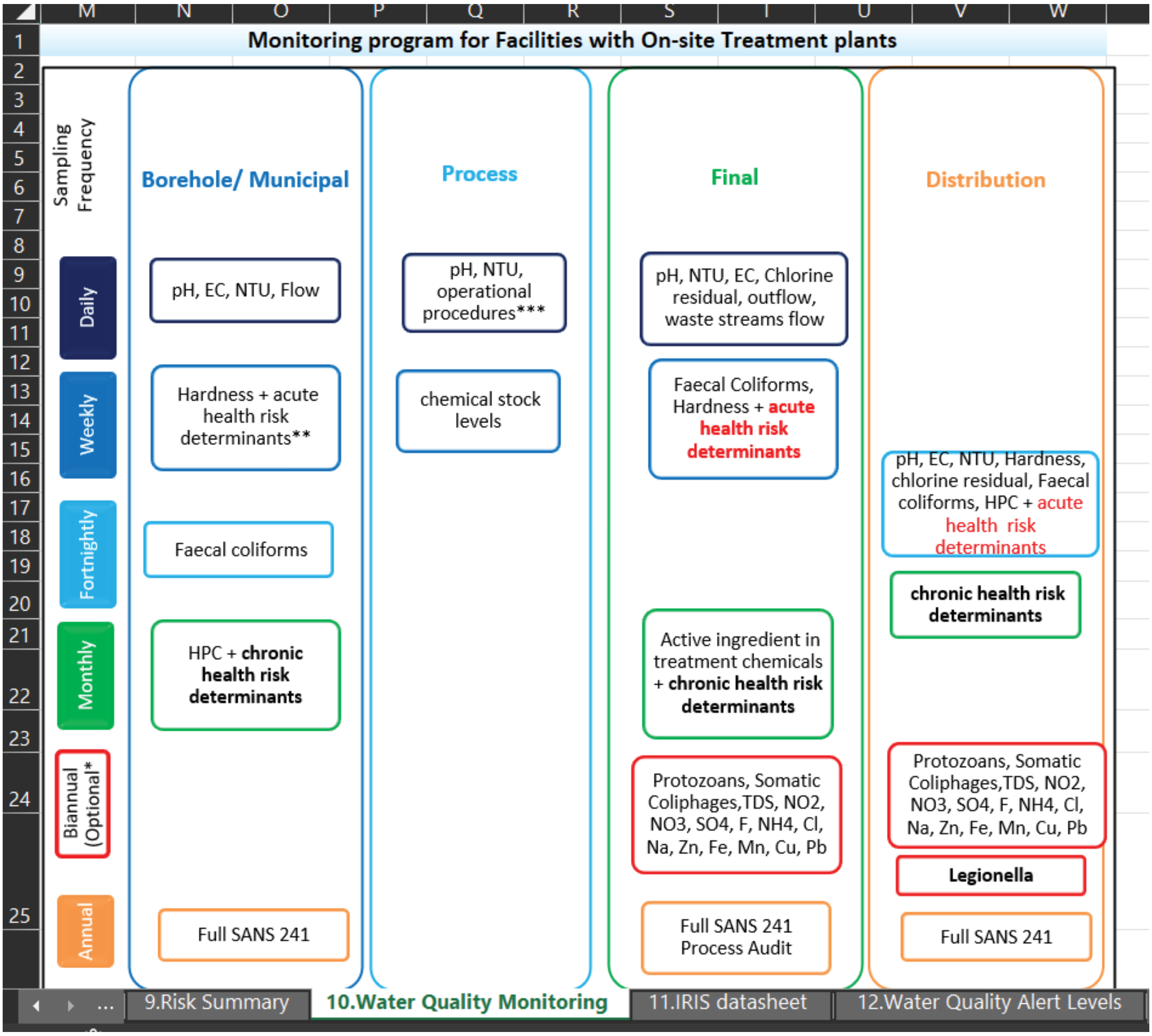



FIGURE 13: GENERIC MONITORING PROGRAM FOR FACILITIES WITH ONSITE TREATMENT (ANNEXURE A)

## MODULE 8: PREPARE MANAGEMENT PROCEDURES AND MODULE 9: DEVELOP SUPPORTING PROGRAMS

Management procedures are the actions to be undertaken during normal operational conditions (SOP's) and in response to specific "incidents" where a loss of control of the system may occur.
Incidents occur when the operational monitoring check exceeds the critical limits assigned to it and a potential risk exists. For example, a critical limit for treated water turbidity in the distribution system may be 5 NTU and immediate corrective actions are required when the limits are exceeded. For operational checks related to water supply, critical limit may be maximum number of hours without supply after which alternative water supply must be secured. A detailed incident protocol will include the following components:

- Alert levels/Critical limits,
- Response times
- Required actions

- Roles & responsibilities
- Communication vehicles/methods,
- Contact details, and
- Incident Register to record and track incidents. Incident registers should include dates, location and description of incident, action/s taken, date of resolution, and outcome of root cause investigation.

Management has a responsibility to ensure all management procedures are updated regularly, are accessible to all relevant personnel and provide staff with adequate resources to implement corrective actions.

**Annexure B:** Water Quality Incident Protocol for Buildings

***Annexure B: Water Quality Incident Protocol for Buildings*** *is a resource that will assist buildings to develop their own-site specific Incident Protocol that will cover all water services risks in their building. The resource document contains the following sections*:

- ***Alert Levels:*** *Three alert levels given with associated time frame for response/s linked to severity of the consequence. This will assist building owners to prioritise actions for risks at alert levels two and three while alert levels one actions form part of routine operational monitoring.*

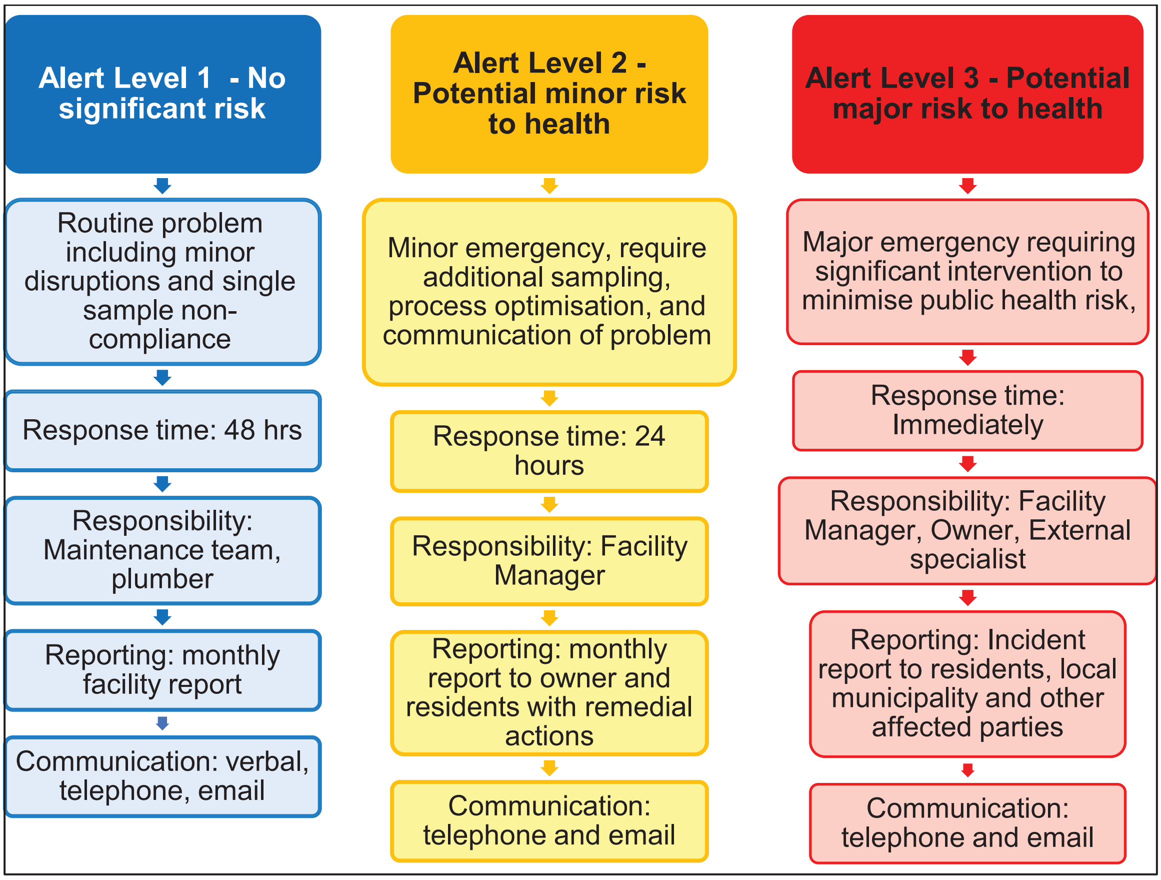



FIGURE 14: GENERIC ALERT LEVELS IN ANNEXURE B: WATER QUALITY INCIDENT PROTOCOL FOR BUILDINGS

- ***Protocol for water quality failures:*** *Is a flow diagram to show water quality testing, reporting and resampling linked to alert levels. The WSSP Team must develop such a protocol that covers their building network and ensure all possible sources of contamination are monitored.*

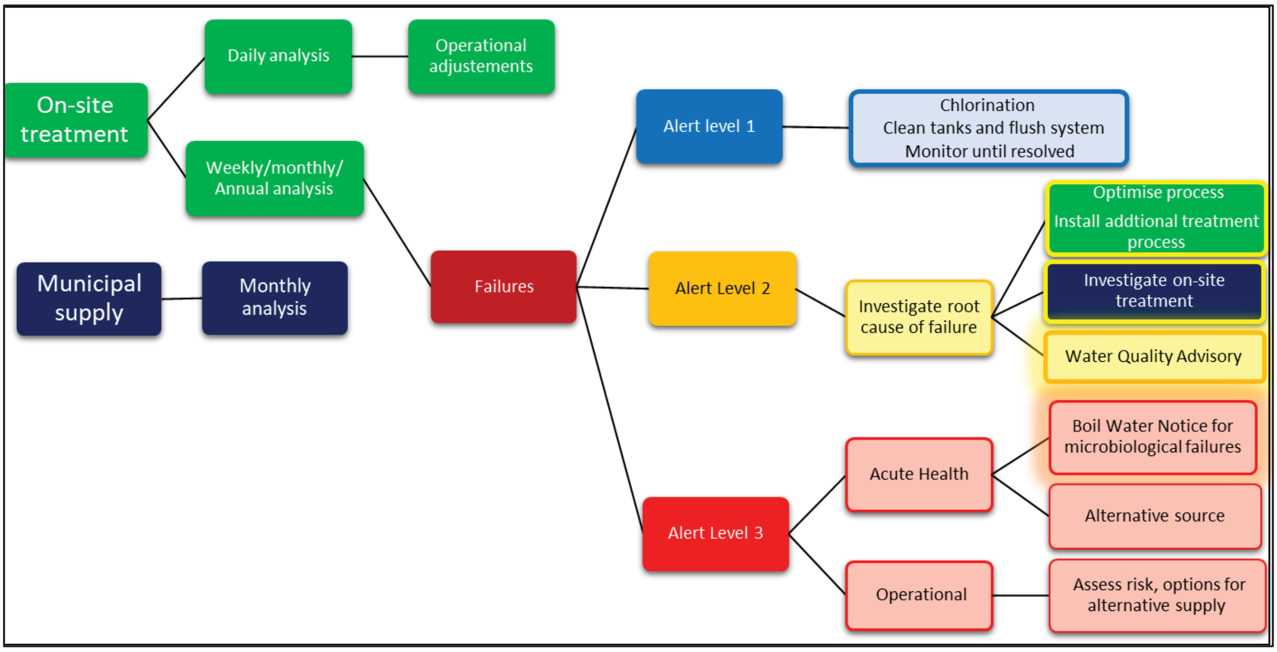



FIGURE 15: GENERIC PROTOCOL FOR WATER QUALITY FAILURES IN ANNEXURE B

- ***Remedial actions for water quality and quantity determinants:*** *specific water quality values linked to alert levels and details actions for each failure.*
- ***Contact list templates and Incident Register templates.***

***Annexure C: Guideline for Ensuring Safe Water in Building After Prolonged Shutdown or Reduced Operations***

**Annexure C:** Guideline for Ensuring Safe Water in Building After Prolonged Shutdown or Reduced Operations

- ***Procedure for reopening buildings.*** *This is based on the UP EPA guideline titled: Maintaining or restoring water quality in buildings with low or no use: [https://www.epa.gov/sites/production/files/2020-05/documents/final_maintaining_building_water_quality_5.6.20-v2.pdf](https://www.epa.gov/sites/production/files/2020-05/documents/final_maintaining_building_water_quality_5.6.20-v2.pdf)*
- ***Guidance to manage Legionella in Buildings with no or reduced occupancy.*** *This section is taken directly from the National Health Laboratory Services which compiled this guideline in response to a request from the plumbing industry for advice on flushing pipes impacted by water stagnation during the COVID-19 lockdown*
- ***Guideline for disinfection with chlorine***
- ***Procedure to disinfect reticulation system:*** *This procedure is from section 9.3 of the SANS 10252-1 (2012): Water supply and drainage for buildings Part 1: Water supply installations for buildings*
- ***Building Inspection Checklist:*** *Generic checklist that will assist Building management to action all items required to ensure building is safe after periods of prolonged shutdown or reduced operations*

Supporting programmes are activities that support the development of skills and knowledge, commitment to the WSSP approach, and capacity to effectively manage the water supply system to always deliver a reliable supply of safe water. Programs relate to training, research and development, and management practises. Typical supporting programs include public awareness on hygiene/water savings, skills development program, organisational realignment, document storage and control, communication protocols.

## Module 10: Plan and carry out periodic review of WSSP and Module 11: Review the WSSP after an Incident

Risk management is a continuous process of identify, assess, control and review risks. Therefore, the WSSP must be periodically reviewed to ensure current risks have been mitigated, control measures are effective, new procedures have been implemented and emerging risks are identified and managed.

***The WSSP Team must decide on the frequency of review:***

- ***the Blue Drop guidelines and WHO / IWA water Safety Plan guideline recommends at least an annual review to ensure all new and emerging risks are identified.***
- ***However, this is at the discretion of the WSSP team with less frequent review required when there are few risks (small systems) and good operations and management practises.***

WSSP review is required after the following incidents or events:

- Near misses: aesthetic water quality issues, frequent interruptions.
- Major events: water quality failures, extended periods of no supply,
- Significant changes in network: upgrade/refurbish/new infrastructure,
- New procedures.

The WSSP review process must be comprehensive and transparent detailing why the incident occurred and report on adequacy of response to reduce the risk. Key components of the review process are summarised below:

- Update risk assessment: report on 'targeted risks' reassess risks based on implementation of mitigating measures, identify new risks and update implementation plan for the new year.
- Critically assess the methodology, technical adequacy, and effectiveness of the WSSP to support implementation.
- Conduct quality assurance of results: laboratory accreditation, legal requirements, calibration certificates
- Evaluate management responses:
  - Implementation of mitigating measures: Reasons for poor implementation, KPI to measure performance of personnel, budget/organisational constraints.
  - Incident management: is it working, are there "near misses", is it logical/achievable?
- Communication of documents: record keeping, accessibility, version control
- Who is responsible for review? Are they qualified and independent?
- When/how often must you conduct review?
- Incorporation of lessons learned into WSSP documents and procedures to ensure continuous improvement in the WSSP process.

## Additional Tools and Guidelines

Additional reference materials which can assist building owners to effectively manage water services within buildings is listed in the table below.

TABLE 1: LIST OF ADDITIONAL GUIDELINES AND TOOLS FOR WATER SERVICES IN BUILDINGS.

| Name | Details |
|---|---|
| **CDC Water Management Program and Toolkit**<br>https://www.cdc.gov/legionella/wmp/overview.html | The Centre for Disease Control and Prevention is the leading science-based, data-driven, service organization that protects public's health in the USA. The Water management program outlines procedures to develop water management plans with several toolkits/templates for various types of facilities (hospitals, hotels, cruise ships, hot tubs, etc.), and Legionella monitoring. |
| **Guideline for Greywater use and management in South Africa.**<br>Water Research Commission Report TT 746-17. March 2018 | This is a strategic document providing context for inclusion of greywater as a viable alternative source of non-potable water in South Africa. The guidelines are based on existing knowledge and expert opinion and targeted to households and managed facilities. |
| **Guidelines for the Installation of Alternative Water Systems.**<br>City of Cape Town. http://www.capetown.gov.za/thinkwater | These guidelines have been developed to show how to safely install and use alternative water systems and safety connect them into buildings. Although these guidelines are not legislated, they provide best practise principles for use of alternative water sources in buildings. |
| **Introduction to Operation and Maintenance of Water Distribution Systems.**<br>JE Van Zyl. Water research commission report TT 600/14. July 204 | The book focuses on water distribution system including description of pipes, pumps, valves, storage reservoirs, meters and other fittings. The book outlines issues related to operation and maintenance, physical and hydraulic integrity, water quality, water losses and pressure management. Although the s focus is on municipal systems, the information also applies to building supply systems. |
| **The Illustrated guide to hot and cold-water services.**<br>Building Services Research and Information Association (BSRIA) BSRIA. November 2014. BSRIA BG 33/2014.<br>https://www.bsria.com/uk/ | This guideline explains the principles and technology used in hot and cold-water services in all types of buildings. It also includes sections on drainage, installation, commissioning of plumbing services and covers wide variety of topics including water quality, leak detections, corrosion, and greywater reuse. Although the document refers to British standards, the document is easy to read and provides practical advice on O&M of water use devices. |

# CONCLUSIONS AND RECOMMENDATIONS

Based on the literature review and status quo assessment, the importance of the risk management approach embodied in the WHO Water Safety Planning methodology was highlighted as a method to effectively manage water-related risks in buildings. The WSP methodology offers a holistic approach to manage water risks in buildings. The use of risk-based methodology in the WSP makes it easy to be understood by building owners as risk management is a universal business concept used by all sectors to identify, assess, and control risks.

In addition, the systematic approach of the WSP can be modified to cover all aspects of water services and can be extended to address issues of water scarcity such water losses in network, climate change, population growth, and ageing infrastructure: this extended WSP plan is called a "Water Safety and Security Plan" (WSSP).

The project team has developed a Water Safety and Security Plan (WSSP) Tool for buildings aligned with the WHO WSP methodology and applicable to water quality and water supply risks.

This tool is designed for use by building owners and facilities managers who have technical skills on design and operations of water supply systems but have limited knowledge of water quality and risk management procedures. The tool is excel-based, easy to understand and has various resources to assist building owners to identify typical risks and associated mitigating measures, determine monitoring requirements, and implement corrective action in the event of failures. The Tool is supported by a number of resource documents that provide information on water quality monitoring, water quality incident management and guidelines for ensuring safe water in building after prolonged shutdown or reduced operations.

Through the cycle of continuous risk management, building owners are able to identify and manage new and emerging risks on an ongoing basis. In the absence of legislation and national standards which cover water safety in buildings, the use of the risk-based approach may provide an opportunity for building owners to self-regulate water services in their buildings. Awareness of potential risks may prove to be an effective mechanism to improve water use efficiency and water safety in buildings.

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# ANNEXURE A: GUIDELINES FOR WATER QUALITY MONITORING

## A. RATIONALE FOR INTERNAL WATER QUALITY MONITORING

As per the Constitution of South Africa, the Water Service Authority (WSA) are responsible for water services provision. While most buildings receive potable water directly from the municipality, several facilities act as Water Services Intermediaries as they treat borehole water to potable standard to augment municipal supply. The WSA is required to conduct monthly compliance monitoring of final water to ensure delivery of safe water which meets the standards outlined in the National Drinking Water Quality Standard SANS 241:2015 or amended. This information is uploaded to the IRIS (Integrated Regulatory Information System) website of the Department of Water and Sanitation (DWS). This information allows DWS to regulate potable water quality thereby ensuring provision of safe drinking water. The monthly compliance results are available to the public to promote awareness on water and effluent quality.

The 2022 Blue Drop Progress report [1] which was released by the Minister of Water and Sanitation, Mr Senzo Mchunu in May 2022, states that 60% of water supply systems in the country do not comply with microbiological determinants and 77% of water supply systems do not comply with chemical determinants. In addition, 66% have insufficient number of samples to verify microbiological quality and 77% have insufficient number of samples to verify chemical water quality as per the SANS 241 requirements. The poor performance of most supply systems indicates serious health risk to consumers of municipal water supply due to water quality failures or insufficient information to verify the safety of municipal water supply.

Building owners therefore can no longer assume municipal water entering their buildings is safe for human consumption. The lack of credible monitoring information and sustained water quality failures, necessitate the need for internal water quality monitoring to verify the quality of the incoming municipal source.

For facilities that have on-site treatment plants, monitoring is a legal requirement to evaluate the performance of the treatment facility and confirm safety of the final water.

In addition, buildings with on-site storage and extensive internal reticulation networks may experience a decrease in water quality in the reticulation network due to various reasons such as:

- Long residence time leading to reduced disinfection residual and promoting growth of pathogenic organisms in storage tanks and in the network,
- Leachate from old pipes leading to iron/manganese/lead deposits in the water,
- Sediment build-up in storage tanks which can lead to unacceptable / tainted colour, unacceptable / tainted odour, bacterial contamination in the reticulation network,

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[1] 2022 Blue Drop Progress Report, DWS. Pretoria. https://ws.dws.gov.za/IRIS/latestresults.aspx

- Increased deposits of calcium and magnesium deposits in tanks which can reduce performance of geysers, heat exchanges and autoclaves,
- Cross contamination with rainwater/grey/blackwater systems.

Water quality analysis is the best method of identifying associated risk within the reticulation network as visual inspection of pipes cannot be undertaken. Therefore, internal water quality verification is required to ensure delivery of safe drinking water in buildings.

A site-specific risk-based monitoring program is required for each site due to various factors such as location, source of water and internal reticulation network.

## B. UNDERSTANDING WATER QUALITY

### I. NATIONAL DRINKING WATER QUALITY STANDARD.

As per the National Drinking Water Quality standard SANS 241:2015, water must comply with specific limits outlined in the standard. The water quality determinants are categorised based on the consequence to human health as illustrated below in Table 2.

TABLE 2: LIST OF WATER QUALITY CATEGORIES AND MONITORING FREQUENCY AS PER SANS 241:2015

| Risk category | Description of risk | Type of determinant | Monitoring frequency |
|---|---|---|---|
| Acute health | Poses an immediate unacceptable health risk if present at concentration values exceeding the numerical limit | Micro: *E. Coli*, Faecal Coliforms, Protozoan parasites (Cryptosporidium species Giardia species.<br>Chemical:  Nitrate, Nitrite, Sulphate, Cyanide. | Weekly |
| Chronic health | Poses an unacceptable health risk if ingested over an extended period.<br>Advise that a water quality notice to be issued for sensitive groups. | Chemical: Heavy metals, THM, Fluoride, Chlorine, Iron, Sodium, Chloride (higher concentrations) | Twice a month |
| Aesthetic | Taints water with respect to taste, odour, or colour and that does not pose an unacceptable health risk. | Physical and aesthetic: Colour TDS, EC, pH, Turbidity,<br>Chemical: phenols, manganese, iron, sodium chloride, ammonia, zinc | Monthly |
| Operational | Essential for assessing the efficient operation of treatment systems and risks to infrastructure. | Micro: Heterotrophic plate count (HPC), Total Coliforms,<br>Physical and aesthetic: Turbidity, pH, and Langelier Index | Monthly |

Depending on which limits are exceeded, the water can be consumed with minimal treatment (filtration + disinfection) or may require additional advanced treatment options to produce potable water.

The various water treatment and water use options to deal with specific categories of water quality are outlined in Figure 16 below.

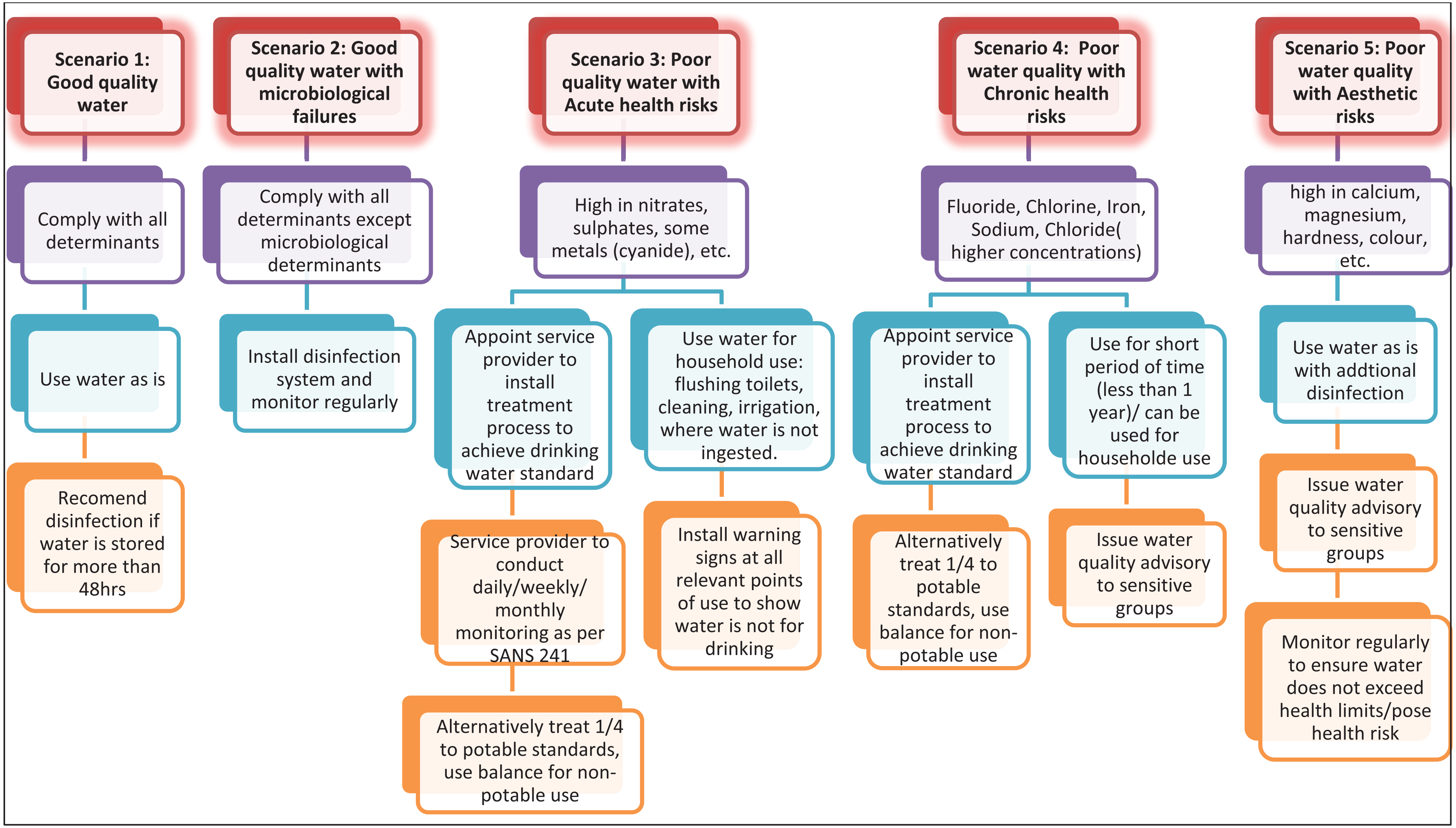



FIGURE 16: SCENARIOS FOR USING WATER WITH DIFFERENT WATER QUALITY RESULTS

The Scenarios are briefly discussed below:

- **Scenario 1**: this applies when borehole has good quality water and required no treatment. The Institution must ensure equipment is operating well and undertake routine housekeeping. If water is stored, then disinfection is required – this does not require skilled personnel and can be undertaken by the Institution.
- **Scenario 2:** Disinfection is critical to ensure the water is safe as microbiological failures present an acute health risk to everyone and can result in serious illness in vulnerable groups, particularly infants younger than 2 years. Effective disinfection can be easily achieved with installation of chlorination equipment and daily checking of chlorine residuals.
- **Scenario 3**: The water presents a serious health risk and unless it is treated, the water can only be used for household activities where water is not ingested. Note this water should not be used for cooking or bathing either. Treatment may be an expensive option requiring skilled personnel to operate the system.
- **Scenario 4**: The water can only be used as potable source for limited period of time before it presents a health risk. In some instances, the water can be used for household activities. As for Scenario 3, there is an option to treat a small portion of the water to potable standards but this will depend on cost of treatment.
- **Scenario 5**: The water is safe to drink but may have objectionable colour, taste, or odour. Communication with consumers is essential to explain that aesthetic water quality failures do not present a health risk. Consumers must be advised of additional problems related to scaling of kettles and geyser or staining of toilets and basins (iron) as outlined in Figure 17. Additional treatment may be installed to improve quality.

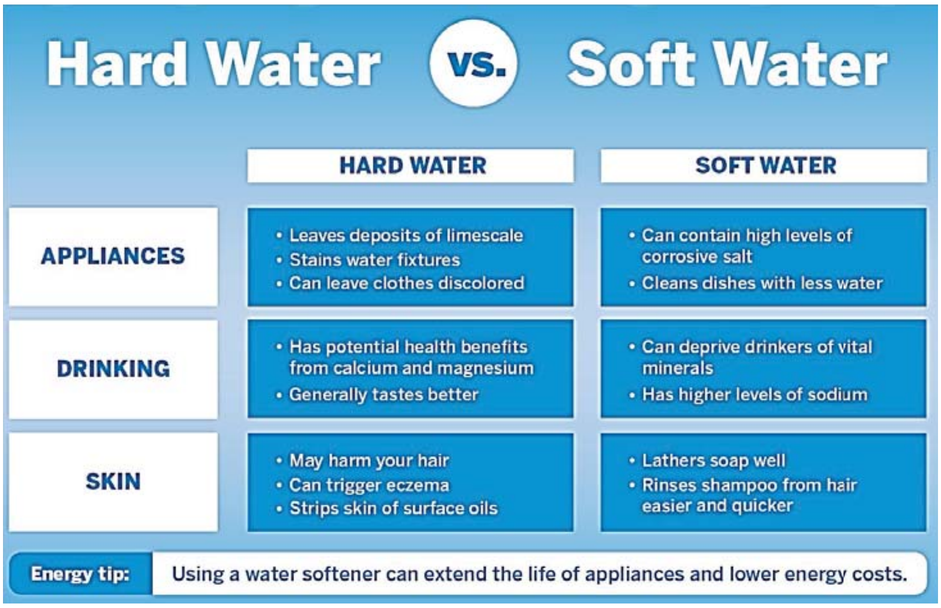



FIGURE 17: INFORMATION ON EFFECTS OF HARD WATER (HTTPS://BLOG.CONSTELLATION.COM/2019/12/02/HARD-WATER-VERSUS-SOFT-WATER-DIFFERENCES)

**Note 1**: The SANS 241 standard further outlines the requirements for a comprehensive Water Safety Plan as per the World Health Organisation (WHO) Guidelines[2]. This risk-based methodology includes an annual risk assessment of the supply system, development of a risk-based monitoring program, and development of a water quality incident protocol to deal with failures.

**Note 2**: A Water Safety and Security Plan Tool for Buildings has been developed to assist building owners in understanding and implementing this risk-management approach to always ensure the delivery of safe water.

## II. WATER QUALITY RISKS SPECIFIC TO PLUMBING SYSTEMS

The full SANS 241 covers all possible determinants that may be present in the water supply regardless of source and therefore includes many determinants which are found in nature.

The table below summarises the main six metals which can occur in plumbing systems due to corrosion or leaching of plumbing materials thereby presenting possible source and risk of contamination.

TABLE 3: LIST OF SIX METALS FROM PLUMBING MATERIAL WHICH CAN POSE RISK (WATER SUPPLIES DEPARTMENT, 2017. WATER SAFETY IN BUILDINGS. WATER SUPPLIES DEPARTMENT. [ONLINE]. AVAILABLE AT: HTTPS://WWW.WSD.GOV.HK/EN/WATER-SAFETY/INDEX.HTML

| Determinant | Possible Sources | Risk of Contamination |
|---|---|---|
| Antimony (Sb) = 0.02 mg/l | Antimony is a possible replacement for lead in solders. | Solder materials using antimony are not commonly available in the market: check with suppliers to confirm if antimony is used for soldering.<br>The risk of exceedance for oral exposure to antimony from drinking water is known to be low. |
| Cadmium (Cd) =0.03 mg/l | Cadmium is a possible impurity in the zinc of galvanised steel pipes, silver brazing materials, fittings, water heaters, water coolers and taps. | The use of unlined galvanised steel pipes can lead to cadmium leaching. The lining in the lined galvanised steel pipes guards against possible leaching of zinc.<br>Silver brazing materials with excess levels of cadmium are not commonly available in the market.<br>The risk of exceedance for oral exposure to cadmium from drinking water is known to be low. |
| Chromium (Cr) = 0.05 mg/l | Due to defects during the electroplating process, chromium may seep into the wetted surfaces of taps leading to possible dissolution of chromium into drinking water. | As taps hold very small amount of water (less than 150 mL) under stagnant condition, the leached chromium from water taps, if any, could be flushed away within one to two seconds after turning on the taps. |

[2] World Health Organisation. Water Safety Planning manual. 2009.

| Determinant | Possible Sources | Risk of Contamination |
|---|---|---|
| | | The risk of exceedance for oral exposure to chromium from drinking water is known to be low. |
| Copper (Cu) = 2000 mg/l | Copper may come from internal corrosion of copper pipe in water of pH below 6.5. | The risk of copper corrosion is pH dependant. Recommendation is slightly alkaline water (pH 8.2 to 8.8) to prevent copper corrosion from the pipe. |
| Lead (Pb) = 0.01 mg/l | Lead may come from leaded solders and copper alloy fittings especially new copper alloy fittings. | Leaded solders are prohibited for use in inside services in some countries. Check with suppliers to confirm if lead is used for soldering<br><br>Recommend systematic flushing protocol for newly installed systems to reduce the leaching of lead from new internal plumbing systems. |
| Nickel (Ni) =0.07 mg/L | Due to defects during the electroplating process, nickel may seep into the wetted surfaces of taps leading to possible dissolution of nickel into drinking water. | As taps hold very small amount of water (less than 150 mL) under stagnant condition, the leached nickel from water taps, if any, could be flushed away within one to two seconds after turning on the taps. |

## III. MONITORING OF LEGIONELLA

There are over 40 species of Legionella of which Legionella pheumophila serogroup 1 is responsible for most of the Legionnaire's disease which is a progressive pneumonia type illness that has a fatality rate of 12,5% in the general population and a much higher fatality rate if contracted in hospital/frail care facilities. It has an incubation period of 2 – 10 days and is treatable with antibiotics.[3]

Legionella bacteria can be found in small amounts in natural water systems such as lakes, rivers, hot water springs and soil. Internal plumbing systems can present favourable growth conditions that will allow the bacteria to proliferate:

- Temperature optimal growth range of 20 – 45◦C,
- Stagnant / low flow water areas with no disinfectant residual,
- Systems that have corrosion, deposition of iron or other nutrients, biological growth, biofilms

If people are then exposed to this water - the potential for them to be infected escalates depending on their susceptibility. The most common form of transmission is by inhalation of fine aerosols from contaminated water systems, aspiration of contaminated water or ice, particularly in hospital patients. The most common water systems where Legionella can occur are:

- Cooling towers / Evaporative Condensers/Process was sprayers
- Spas / Jacuzzis / Saunas / Hot tubs
- Ornamental fountains
- Showers and taps (hot and cold-water systems)
- Misters / sprinkling systems

[3] https://www.wwinc.co.za/wp-content/uploads/2017/03/WWinc-Legionella-in-South-Africa-QA.pdf

- Water storage tanks
- Ice machines
- Dental sprays
- Vehicle wash systems – especially those that recycle water, Vehicle window wash water
- Compost, potting soil
- Other systems

Legionella is currently legislated as follows in South Africa.[4]

- Legionella falls under the auspices of the Occupational Health and Safety (OHS)Act, No. 85 of 1993
- A component of the OHS Act is the Regulations for Hazardous Biological Agents (HBA)
- The HBA Regulations apply to every employer or self-employed person at a workplace whether the HBA's are deliberately or not deliberately produced, processed, used, handled, stored or transported.
- The HBA Regulations are all encompassing, and determine the need for: Risk Assessment, Adequate Training and Information, Monitoring and Record Keeping
- HBA's are ranked based on their perceived potential to inflict harm to humans. Legionella is normally identified as a Group 2 HBA, however, should there be a known presence of immune compromised individuals (e.g. in hospitals), Legionella becomes classified as a Group 3 HBA.
- In addition, Legionnaires Disease is recognized as a "Notifiable Disease" within South Africa, this in turn requires any medical practitioner or individual which positively identifies a case of Legionnaires Disease being forced to notify / report the case to the appropriate local authority
- SABS Voluntary standards:
  - **SANS 893-1, Legionnaires' disease Part 1 : Risk management.** Provides guidelines for the risk management of Legionella bacteria in any undertaking involving a work activity and to premises regulated in connection with a trade, business or other undertaking where water is used or stored and where there is a means of creating and transmitting water droplets which may be inhaled thereby causing a reasonably foreseeable risk of exposure to Legionella bacteria.
  - **SANS 893-2, Legionnaires' disease Part 2: The control of Legionella in water systems.** Provides requirements for the design and management of cooling towers, evaporative condensers, hot and cold-water systems, or any water system where water is used or stored and where there is a means of creating and transmitting water droplets which might be inhaled, so as to control the risk of exposure to Legionella bacteria that cause Legionnaires' disease.

The main requirements set out in the OHS Act and the SANS 893 standards are summarised below:

- Risk assessment conducted by a competent person (OHS Act and SANS 893)
- Establish a Legionella Risk Management system for continuous control and review (SANS 893 part 1)
- Ensure specific water systems are treated correctly, tested, actioned and recorded (SANS 893 part 2)

[4] http://ecosafe.co.za/3743-2

- Ensure temperature settings on calorifiers and point of use temperatures meet SANS 893 requirements.
- Train and inform staff on all Legionella-related matters (OHS Act and SANS 893)

In summary, control of Legionella follows the risk assessment methodology of the Water Safety Plan to identify potential sources of contamination, implement mitigating measures and conduct regular monitoring to verify the safety of the water supply system.  Below are some guidelines for monitoring of Legionella:

- Monitoring of Legionella is expensive and must be conducted by an accredited laboratory.
- Monitoring program will be determined by the risk assessment of the system.
- Both frequency and number of samples will depend on several factors including size and complexity of the building, type of water use systems, design of water systems, number of occupants, occupancy rates, type of establishment (higher risk in hospitals), etc.
- Routine (monthly) monitoring of operational parameters can serve as indicators for possible growth of Legionella.
    - Temperature: at geysers, heat sources, taps
    - Free Chlorine residual in storage tanks, network, taps, dead ends. Insufficient residual may lead to bacterial growth and consequently growth of Legionella. Required levels of free chlorine at point of consumption as per SANS 241 is >0, and <0,2 mg/l.
    - Heterotrophic Plant count (HPC) provides information on treatment efficacy, growth in reticulation and sufficiency of disinfectant. SANS 241 limit is <1000 counts/1 ml.

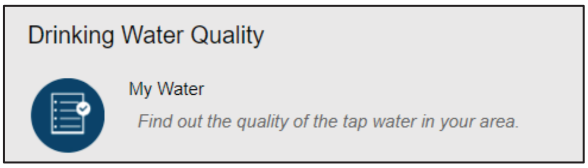
The Health and Safety Executive in Britain has produced a technical guidance document for control of Legionella in hot and cold-water systems.[5] This document provides detailed description of design, operations, monitoring, disinfection, and risk assessment of hot and cold-water systems to control Legionella.

## C. VERIFICATION OF INCOMING MUNICIPAL WATER QUALITY

### I. USE OF IRIS TO CHECK MUNICIPAL WATER QUALITY

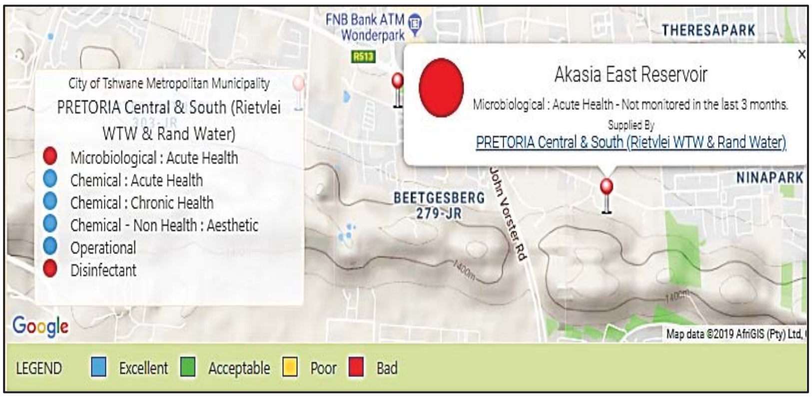
To ensure safe drinking water in the building, the first step is to verify the quality of water entering the building.  As mentioned, the monthly compliance monitoring conducted by the municipality is uploaded on the DWS IRIS website and this information is accessible to the public.

- Click on My Water: http://ws.dwa.gov.za/IRIS/mywater.aspx
- On the "Dashboard" Tab, select "My Water"
- Type in the name of your town/suburb in the search button.
- Under system area, select "View All".
- This will bring up a google map with all the monitoring points in the area.




[5] Legionnaire's Disease. Technical Guidance HSG 274. Part Two: the control of Legionella in hot and cold-water systems. Health and Safety Executive, Britain. https://www.hse.gov.uk/index.htm

- Select a sample point closest to your building and click on the point to view current status of water quality at the point.
- Results are categorised as per water quality categories and monitoring compliance (this indicates if sufficient sample points have been analysed as required in SANS 241:2015 – based on population served)




- The water quality compliance is indicated in the Legend below: Blue indicates excellent compliance for the various categories of water.
- Record readings to track repeated failures.

**NOTE 1:** Water is safe to drink if Acute Health categories are ‘Excellent’ or ‘Acceptable’. If not, then water presents a potential health risk and additional treatment processes are required to ensure the water is safe.

**NOTE 2:** if there is no data on IRIS or “sample point not monitored in past three months” then the safety of water cannot be guaranteed due to lack of monitoring information.

## II. INTERNAL WATER QUALITY ASSESSMENT

The actual water entering the building must be verified as this may differ from results on IRIS (or if there is no data on IRIS). In addition, once the water enters the building, there may be additional water quality risks in the reticulation network which may negatively impact water quality. To address this, a water quality assessment is recommended:

- Conduct water quality analysis for all determinants listed in the SANS 241 standards at the following points:
  - Municipal intake/before storage,
  - After storage (if applicable),
  - Distribution point/s (include furthest point in distribution network and dead ends).

  There may be more than one distribution point depending on the size and complexity of the reticulation network.
- This must be conducted by an accredited laboratory: the laboratory report will state which determinants are out of range, i.e. “problem determinants”.
- These problem determinants indicate water quality failures which may present health risk to consumers.
- A comprehensive risk assessment must be conducted as per the Water Safety Plan Methodology to identify the root cause of the failure and implement remedial actions to reduce the risk.
- A site-specific risk-based monitoring program should be adopted which provides information on key operational and health determinants. Figure 18 below outlines a basic monitoring program for buildings receiving municipal water supply. This is aligned with operational requirements for distribution network outlined in SANS 241 + addition of problem determinants identified in the water quality risk assessment.

**Municipal Supply Sample points: Before storage, after storage, Distribution (furthest point)**

| Frequency | Determinants |
|---|---|
| Twice Monthly **(Weekly if non-compliance on IRIS*)** | •Faecal Coliforms, Chlorine residual + Acute health risk determinants |
| Monthly | •pH, NTU, HPC, Hardness, flow, pressure + **chronic health risk determinants.** |

FIGURE 18: MONITORING PROGRAM FOR FACILITIES WITH MUNICIPAL SUPPLY

*** Required if there is no data on IRIS/not monitored in past three months/less than 99% acute**

**Note 1**: The frequency of sampling for problem determinants is based on their categorisation as outlined in Table 1.

**Note 2**: Measurement of flow and pressure at various points in the network is recommended to verify consumption and ensure sufficient pressure at all points in the building.

**Note 3**: Table 4 provides overview of the operational monitoring determinants and limits.

TABLE 4: DETAILS OF OPERATIONAL MONITORING DETERMINANTS FOR BUILDINGS

| Determinant | Description | Category | Limit as per SANS 241:2015 |
|---|---|---|---|
| Turbidity (NTU) | Indicative of suspended particles in water which may negatively impact on safety of water depending on nature of particles | Operational/ Aesthetic | <1 NTU |
| Chlorine residual (mg/l) | Insufficient residual may lead to bacterial growth.<br>Excess chlorine leads to taste/odour complaints and increase in disinfection by-products (chronic health determinants) | Operational/ Aesthetic | Point of consumption:<br>>0, and ≤0,2 mg/l.<br>Max 2 mg/l at final water dosage - taste threshold |
| *E. Coli*/Faecal Coliforms | Indicator of faecal contamination in water, risk of infection to consumers | Acute health risk | 0 count/100 ml |
| HPC: Heterotrophic Plant count | Process indicator that provides information on treatment efficacy, growth in reticulation and sufficiency of disinfectant | Operational | <1000 counts/1 ml |

| | | | |
|---|---|---|---|
| Hardness | Measure of acid-neutralising capacity of water. High alkalinity leads to calcium build-up, low alkalinity leads to corrosion of pipes. | Operational | 80 - 150 mg/l $CaCO_3$: Ideal range<br><80 mg/l: reasonably soft, may be corrosive<br>>150 mg/l: reasonably hard, can cause scale formation |

## III. MONITORING EQUIPMENT

The ILab Water Testing kit can be used to monitor *E. Coli* and check chlorine residual in buildings. The test kit allows for rapid testing of 14 water quality determinants including microbiological determinants (*E. Coli*) based on standard, accredited procedures. The ILab kits comes with online Dashboard that allows you to capture all results of the tests on this electronic platform and then gives you report that will indicate if the water is safe/ not safe for drinking.

Kit is easy to use with instruction video on website: http://www.ilabwater.co.za/ and can be ordered from tech2@iwatersolutions.co.za.

Cost for *E. Coli* test is only R 40 per sample, compared to R 350 per sample if conducted by a laboratory and therefore provides cost-effective option to verify safety of water in buildings.

An accredited laboratory must be appointed for other tests including the annual SANS 241 analysis. The requirements for an accredited lab are either SANAS accredited laboratory, or laboratory that participates in a Proficiency Testing Scheme with acceptable Z scores for the past year. Check that the laboratory participates in the following proficiency testing schemes: LA proficiency testing for microbiological determinants, and SABS proficiency testing: Group 1: Heavy metals, and Group 3: Major constituents in water.

## IV. MONITORING PROGRAM FOR FACILITIES WITH ON-SITE TREATMENT PLANTS

If a water treatment system is required to treat the water to potable standards in buildings, this water treatment system must comply with the Blue Drop Certification requirements of DWS. These are legislative requirements for operating and managing a water treatment plant and address a wide score including plant registration, required staff skills, monitoring requirements, risk management (Water safety Plan), asset management, incident reporting, process audits, etc. The Blue Drop requirements are attached under Annexure A for reference.

As per SANS 241:2015 and Blue Drop requirements, water treatment plants require daily monitoring of key operational parameters. The treatment plant should have detailed operational procedures which are dependent on the type of unit process and usually form part of the O&M Manual provided by the supplier of the treatment plant. All operational parameters and procedures must be recorded in daily log sheets and used to optimize the treatment process.

It is recommended that each facility purchase handheld meters for measuring operational water quality determinants such as pH, Turbidity and Chlorine residual. The supplies of the monitoring equipment should provide training, consumables, and regular calibration of equipment. Although in-line monitors coupled with central PLC are preferred over hand-held monitors, this may be an expensive option.

Weekly/twice monthly monitoring of *E. Coli* can be conducted by the ILab Test kit. However, monthly analysis of the final water for all required determinants must be conducted by an accredited laboratory to ensure delivery of safe water.

A generic monitoring program for treatment plants is outlined in the Figure 19 below. This must be amended to monitor all process units that form part of the treatment plant as well as 'problem determinants' identified during a full water quality assessment of raw, final and distribution network as outlined above.

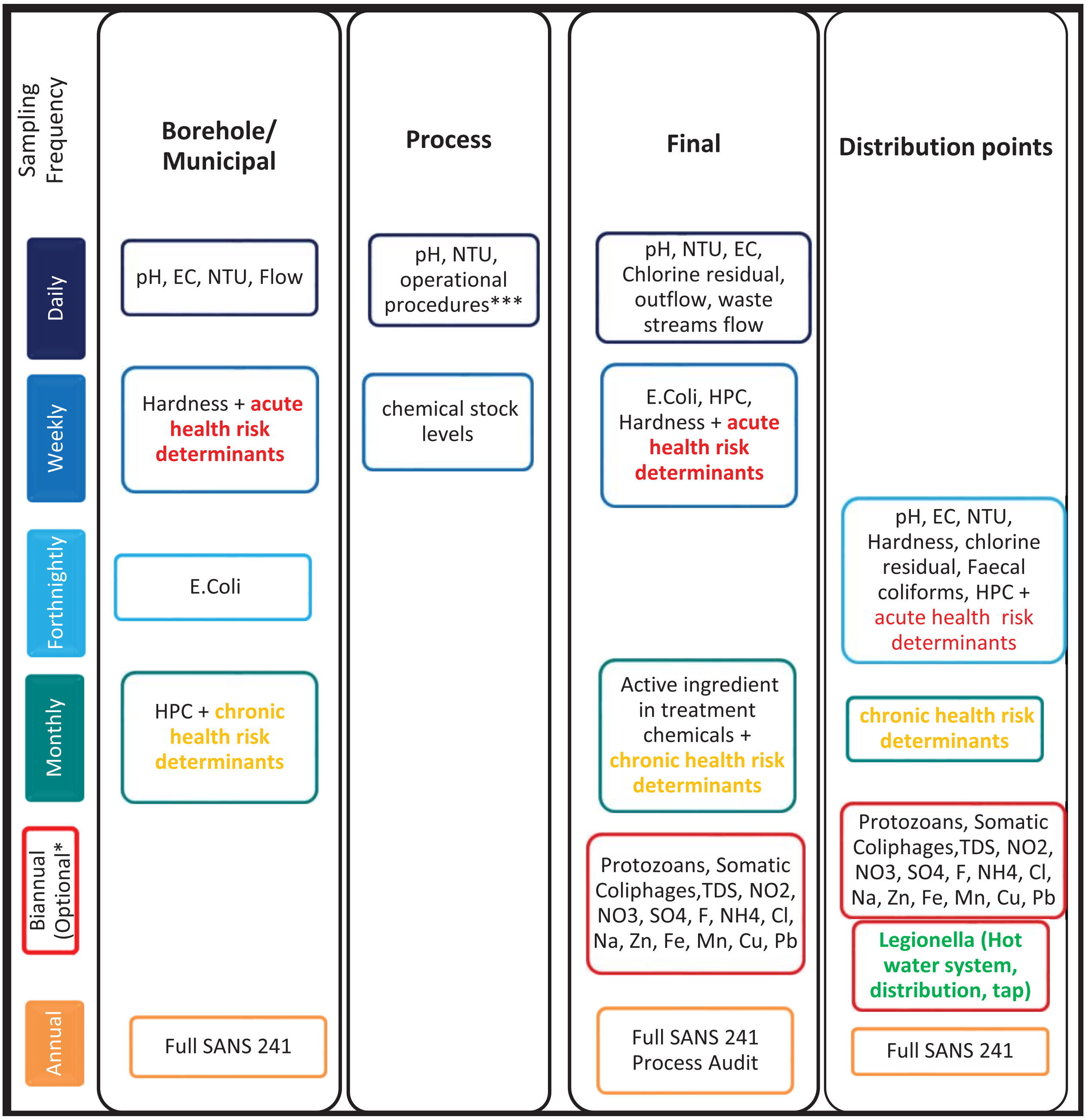



FIGURE 19: MONITORING PROGRAM FOR FACILITIES WITH ON-SITE TREATMENT PLANTS

**Note 1:** Active ingredient in treatment chemicals refers to any chemical that is added in the treatment process, e.g.

- Coagulant: Ferric Chloride – measure Iron and Chloride
- Lime for pH adjustment – measure calcium, magnesium, and alkalinity
- CIP wash chemicals – consult MSDS sheet for active ingredient
- Disinfections – measure Combined Trihalomethanes

**Note 2**: A Process audit is an annual assessment conducted by a water treatment specialist to evaluate the performance of treatment plant against design and identify any performance-limiting factors. The performance-limiting factors may include additional monitoring points, improving operational procedures or implementing additional treatment processes. The findings of the process audit form the basis of the Water Safety plan by identifying process-related risks.

**Note 3**: the Operational arrangements for the treatment plant are site-specific.

If the building owner appoints a service provider to operate and maintain the treatment plant, Blue Drop requirements must form part of the service level agreement to always ensure delivery of safe water and effective management of assets. The service provider will also be responsible for monthly water quality monitoring and reporting to verify the quality of the treated water.

If there are limited treatment processes required (filtration/disinfection), the daily operations of these processes can be undertaken by a designated person employed by the Institution. The Institution must however ensure the supplier of the treatment systems provides the following resources upon commissioning:

- On-site training to explain the treatment process, function of all equipment and demonstration of daily operational procedures, monitoring and data interpretation,
- Comprehensive O&M manual with routine maintenance schedule, daily log sheets, troubleshooting guide, SOP for all activities, and
- Ongoing support as and when required – in the event of major failures.

## REFERENCES FOR ANNEXURE A


- [1] 2022 Blue Drop Progress Report, DWS. Pretoria. https://ws.dws.gov.za/IRIS/latestresults.aspx
- [2] World Health Organisation. Water Safety Planning manual. 2009.
- [3] https://www.wwinc.co.za/wp-content/uploads/2017/03/WWinc-Legionella-in-South-Africa-QA.pdf
- [4] http://ecosafe.co.za/3743-2
- 5 Legionnaire's Disease. Technical Guidance HSG 274. Part Two: the control of Legionella in hot and cold-water systems. Health and Safety Executive, Britain. https://www.hse.gov.uk/index.htm
- SOUTH AFRICAN NATIONAL STANDARD. 2015. Drinking water (SANS 241). [Online]. Available at: https://www.mwa.co.th/download/prd01/iDW_standard/South_African_Water_Standard_SANS_241-2015.pdf [Accessed: 27 July 2021]
- Information on effects of hard water. https://blog.constellation.com/2019/12/02/hard-water-versus-soft-water-differences [Accessed 13 August 2022]
- Water Safety in Buildings. Water Supplies Department. [Online]. Available at: https://www.wsd.gov.hk/en/water-safety/index.html

# ANNEXURE B: WATER QUALITY INCIDENT PROTOCOL FOR BUILDINGS

An Incident Management Protocol (IMP) is a documented plan to guide the Water Services Institution's (WSI) response to resolution and communication of drinking water quality failures as defined by National Drinking Water Quality Standard SANS 241:2015 or as amended. This is in accordance with the Water Services Act (No. 108 of 1997) which states that in emergency situations, WSI must take reasonable steps to address incidents to minimise the health risks to consumers.

The IMP must be aligned to the communication requirements stipulated in the Compulsory National standards for the Quality of Potable Water under Section 9 of the Water Services Act, i.e.

- Drinking water Quality Advisory issued when results indicate a health risk
- Boil Water Notice issued when the risk can be adequately addressed by boiling water
- Do Not use Water Notice issued when there is a risk which cannot be mitigated by current treatment.

As per the SANS 241, any deviation in drinking quality from the prescribed limits set out in SANS 241 is described as an incident and must be addressed in a water quality Incident Management Protocol (IMP) This protocol will outline the following:

- What are the possible incidents?
- How they will be communicated and resolved?
- Who are the responsible parties, and the interested and affected parties?

The focus of the IMP is on water quality incidents which can considered acute, chronic, or aesthetic depending on the risk and/or concentration of the determinant and therefore require different management approaches. Supply of water can also be addressed in such a protocol as it is linked to water quality and vital for continuous operation of all buildings.

Incidents may occur under normal conditions, are predictable incidents or may be due to emergency conditions.  The nature of the incident will dictate required action, communication protocol and response time.

This generic protocol contains the following components and can be used by building owners and building maintenance team to develop a comprehensive IMP for their buildings.

1. Alert Levels
2. Protocol for water quality failures
3. Remedial actions for water quality and quantity determinants
4. Contact list templates
5. Requirements for incident register

## A. ALERT LEVELS

The Figure below outlines the three alert levels with associated time frame for response linked to severity of consequence.

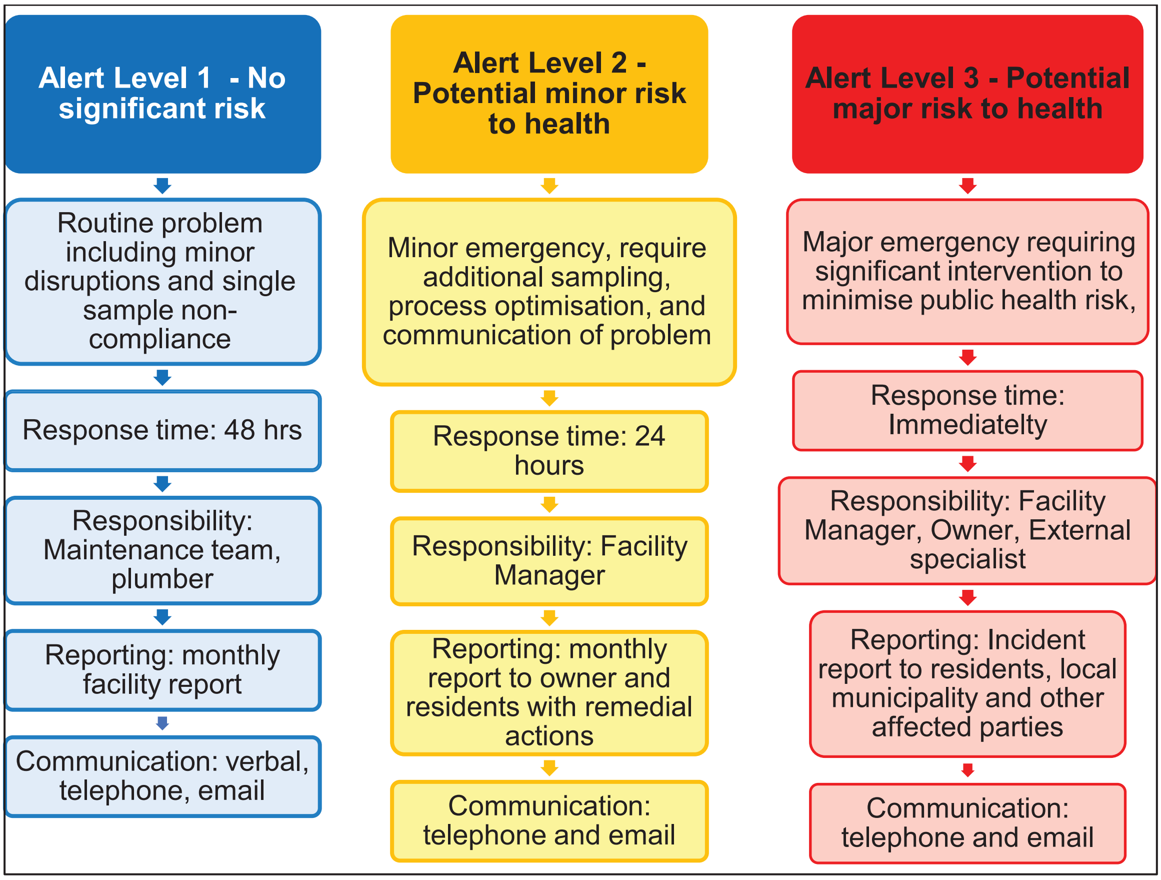



FIGURE 20: ALERT LEVELS FOR WATER QUALITY FAILURES

## B. PROTOCOL FOR WATER QUALITY FAILURES

This protocol addresses buildings with municipal supply and on-site treatment. The protocol must be read in conjunction with Table 5 (incidents and required actions) and Figure  (Alert Levels).

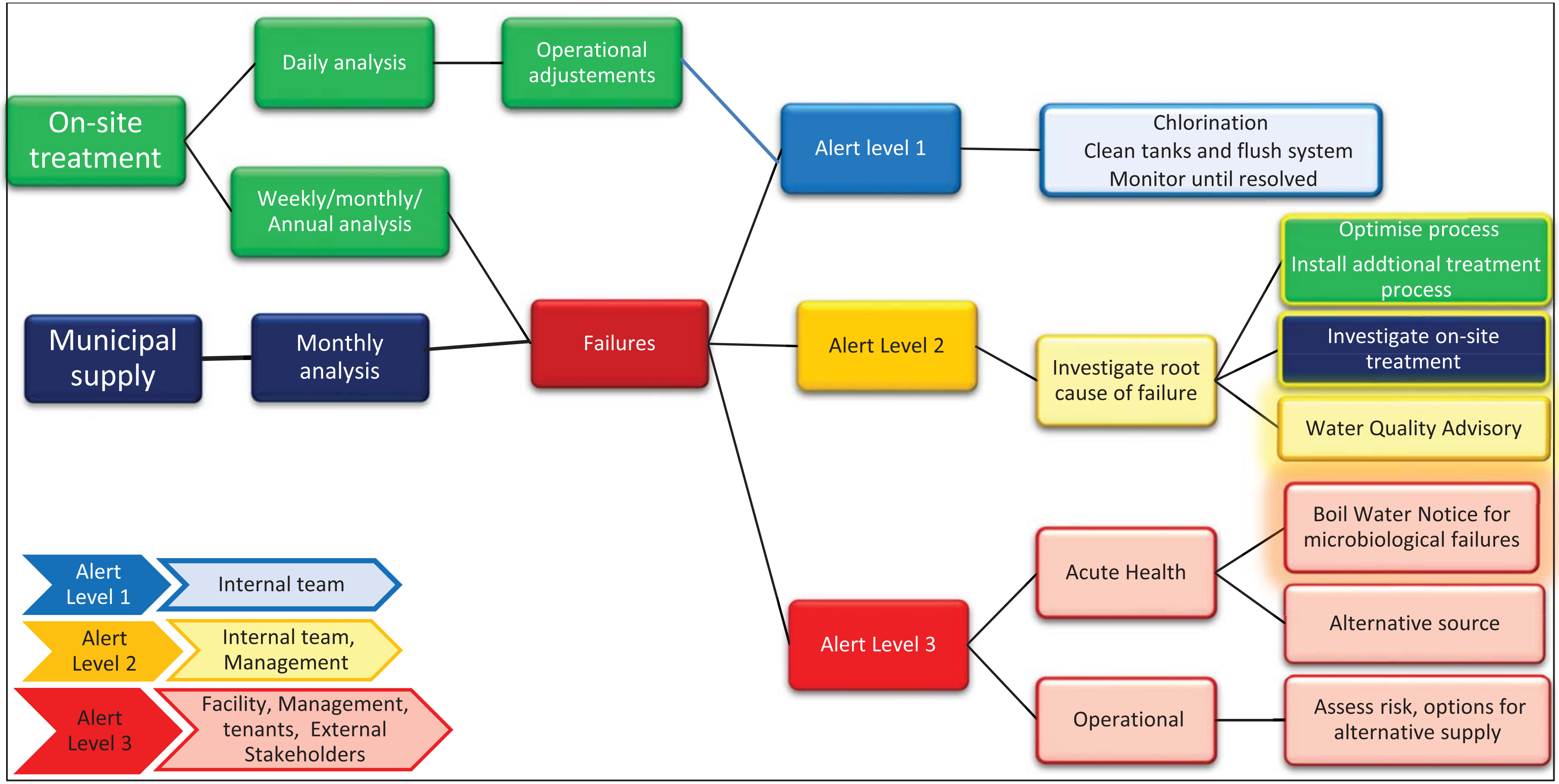



FIGURE 21: PROTOCOL FOR WATER QUALITY FAILURES

## C. REMEDIAL ACTIONS FOR WATER QUALITY AND QUANTITY DETERMINANTS

The Table below outlines remedial actions for specific water quality and quantity incidents with alert levels related to specific limits for each determinant.

For additional problem determinants which are identified, the response time and required actions will be similar for determinants with same risk category, e.g.

- If nitrates are present in raw water, they will follow similar alert levels to *E. Coli* as they are both acute health determinants – monitor weekly, issue water quality notice and use alternative supply.
- If iron is present, one will follow the protocol for HPC as they are both operational/aesthetic determinants- monitor monthly, issue water quality advisory, and evaluate risk associated with current supply.

**TABLE 5: LIST OF INCIDENTS AND REQUIRED ACTIONS.**

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| 1. | Turbidity (NTU) | Indicative of suspended particles in water, which may negatively impact on water safety depending on nature of particles | Operational/ Aesthetic WQ | <1 NTU | Alert Level 1 48 hrs | ≥1 NTU, ≤ 5NTU | 1) Clean storage tank and flush system.<br>2) Increase monitoring of NTU until issue is resolved. | 1) Check NTU at each unit process to identify root cause.<br>2) Follow troubleshooting guide to improve turbidity, i.e. increase frequency of backwashing/desludging/adjust coagulant dosage.<br>3) Resample to check if issue is resolved. |
| | | | | | Alert Level 2 24 hours | >5 NTU | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory to staff and patients.<br>3) Appoint water treatment specialist to identify root cause and provide options for on-site treatment, e.g. installation of sand filters<br>4) Increase monitoring of NTU and Faecal Coliforms until issue is resolved. | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory to staff and patients.<br>3) Appoint water treatment specialist to investigate root cause and optimise treatment process.<br>4) Increase monitoring of NTU and Faecal Coliforms until issue is resolved. |

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| 2. | Chlorine residual (mg/l) | Insufficient residual may lead to bacterial growth. Excess chlorine leads to taste/odour complaints and increase in disinfection by-products (chronic health determinants) | Operational /Aesthetic | Point of consumption:<br>>0 and ≤ 0.2<br>Max 2 mg/l at final water dosage - taste threshold | Alert Level 1 48 hrs | > 0 and ≤ 0.2 mg/l at point of consumption | 1) If residual is less than 0 mg/l at furthest point, add chlorine tablets in storage tank to obtain desired residual at furthest point.<br>2) If problem persists, investigate option of permanent chlorine dosage or alternative disinfection process.<br>3) Increase monitoring of Faecal Coliforms at all points until issue is resolved. | 1) if residual is less than 0 mg/l, increase chlorine dosage to ensure sufficient residual at furthest point.<br>2) if residual is too high, decrease chlorine dosage to obtain optimal dosage. |
| 3. | *E. Coli* | Indicator of faecal contamination in water, risk of infection to consumers | Acute health risk | 0 count/100 ml | Alert Level 1 48 hrs | 1 count/100 ml | 1) Check if municipal water is source of contamination. If yes, add chlorine tablets in storage tank and increase frequency of monitoring until the issue is resolved.<br>2) If source of contamination is in reticulation, escalate to Alert level 2 | 1) Increase chlorine dosage and resample.<br>2) Increase monitoring of chlorine and Faecal coliforms until issue is resolved |
| | | | | | Alert Level 2 24 hrs | 2 counts/100 ml | 1) Inform Alert Level 2 Group of failure.<br>2) Clean storage tanks and flush system<br>3) Issue Water Quality advisory<br>4) Appoint water treatment specialist to investigate root cause and provide options for on-site treatment, e.g. chlorination/UV light/Ozone.<br>5) Increase monitoring of Faecal Coliforms until failure is resolved. | 1) Inform Alert Level 2 Group of failure.<br>2) Clean all storage tanks, flush treatment plant and system with chlorinated water.<br>3) Issue Water Quality advisory.<br>4) Appoint water treatment specialist to investigate root cause and optimise treatment process.<br>5) Increase monitoring of Faecal Coliforms until issue is resolved. |

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| | | | | | Alert Level 3 Immediately | > 2 counts/100 ml | 1) Inform Alert Level 3 Group<br>2) Issue Boil Water Notice to personnel<br>3) Provide alternative source of water until failure is resolved.<br>4) Inform local municipality and DWS offices if failure is from municipal source. | 1) Inform Alert Level 3 Group.<br>2) Issue Boil Water Notice to personnel.<br>3) Provide alternative source of water until failure is resolved. |
| 4. | Protozoans: *Giardia and Cryptosporidium* species | Present immediate health risk to consumers | Acute health risk | 0 counts/10L | Alert Level 2 24 hrs | 1 count /10L | 1) Clean storage tank/s and flush the system.<br>2) Add chlorine tablets to increase residual at all points.<br>3) Inform Alert Level 2 Group of failure.<br>4) Issue Water Quality advisory to staff and patients.<br>5) Appoint water treatment specialist to investigate root cause and provide options for on-site treatment, e.g. chlorination/UV light/Ozone.<br>6) Increase monitoring of Protozoan species until failure is resolved. | 1) Increase chlorination dosage and/or contact time.<br>2) Clean all storage tanks flush treatment plant and system with chlorinated water.<br>3) Inform Alert Level 2 Group of failure.<br>4) Issue Water Quality advisory to staff and patients.<br>5) Appoint water treatment specialist to investigate root cause and optimise treatment process.<br>6) Increase monitoring of Protozoan species until issue is resolved. |
| | | | | | Alert Level 3 Immediately | >1 count /10L | 1) Inform Alert Level 3 Group<br>2) Provide alternative source of water until failure is resolved.<br>3) Inform local municipality and DWS offices if failure is from municipal source. | 1) Inform Alert Level 3 Group<br>2) Provide alternative source of water until failure is resolved. |

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| 5. | HPC: Heterotrophic Plant count | Process indicator that provides information on treatment efficacy, growth in reticulation and sufficiency of disinfectant | Operational | <1000 counts/1 ml | Alert Level 1 48 hrs | 1000 counts/1 ml | 1) Clean storage tank and flush system.<br>2) Add chlorine tablets to increase residual.<br>3) Increase monitoring of NTU, Chlorine residual and HPC until failure is resolved | 1) Increase chlorine dosage and resample.<br>2) Clean all storage tanks flush treatment plant and system with chlorinated water.<br>3) Increase monitoring of NTU, Chlorine residual and HPC until failure is resolved. |
| | | | | | Alert Level 2 24 hrs | >1000 counts /ml | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory for sensitive groups.<br>3) Appoint water treatment specialist to investigate root cause and provide options for on-site treatment, e.g. chlorination/UV light/Ozone.<br>4) Increase monitoring of NTU, Chlorine residual and HPC until failure is resolved. | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory for sensitive groups.<br>3) Appoint water treatment specialist to investigate root cause and optimise treatment process.<br>6) Increase monitoring of NTU, Chlorine residual and HPC until failure is resolved. |
| 6. | Coliphages | Indicative of viral infection, may present health risk to sensitive groups | Operational | 0 counts/10 ml | Alert Level 1 48 hrs | 1 to 10 count/10 ml | 1) Clean storage tank and flush system.<br>2) Add chlorine tablets to increase residual.<br>3) Increase monitoring of Chlorine residual and Coliphages until failure is resolved | 1) Increase chlorine dosage and resample.<br>2) Clean all storage tanks flush treatment plant and system with chlorinated water.<br>3) Increase monitoring of chlorine and Coliphages until issue is resolved |

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| | | | | | Alert Level 2 24 hrs | 10 - 100 counts/10 ml | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory for sensitive groups.<br>3) Appoint water treatment specialist to investigate root cause and provide options for on-site treatment, e.g. chlorination/UV light/Ozone.<br>4) Increase monitoring of Chlorine residual and Coliphages until failure is resolved | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory for sensitive groups.<br>3) Appoint water treatment specialist to investigate root cause and optimise treatment process.<br>4) Increase monitoring of Chlorine residual and Coliphages until failure is resolved |
| | | | | | Alert Level 3 Immediately | > 100 counts/10 ml | 1) Inform Alert Level 3 Group<br>2) Assess risk and investigate options for alternative supply until failure is resolved.<br>3) Inform local municipality and DWS offices if failure is from municipal source. | 1) Inform Alert Level 3 Group<br>2) Assess risk and investigate options for alternative supply until failure is resolved. |
| 7. | Hardness | Measure of acid-neutralising capacity of water. High alkalinity leads to calcium build-up, low alkalinity leads to corrosion of pipes. | Operational | 80 - 150 mg/l $CaCO_3$: Ideal range<br><80 mg/l: reasonably soft, may be corrosive<br>>150 mg/l: reasonably hard, can cause scale formation | Alert Level 1 48 hrs | Increase/ decrease in average Hardness by 30% | 1) If water is hard: investigate option for water softener<br>2) if water is soft: investigate option to add lime. | 1) If water is hard: investigate option for water softener<br>2) if water is soft: investigate option to add lime. |
| 8. | Water Supply | Supply of water from either municipal source or on-site treatment | Supply | Uninterrupted supply (no reference) | Alert Level 1 48 hrs | < 8 hours interruption | No action required | No action required |

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| | | | | | Alert Level 2 24 hrs | 1–2-day interruption | 1) Inform Alert Level 2 Group<br>2) Issue advisory to reduce consumption<br>3) Contact municipality to determine duration of interruption | 1) Reduce backwashing/desludging frequency: ensure final water quality is not compromised.<br>2) Inform Alert Level 2 Group<br>3) Issue advisory to reduce consumption |
| | | | | | Alert Level 3 Immediately | >2-day interruption | 1) Inform Alert Level 3 Group<br>2) Provide alternative source until interruption is resolved.<br>3) Investigate long-term plans for alternative water sources: borehole, grey water re-use, rainwater harvesting, etc. | 1) Inform Alert Level 3 Group<br>2) Provide alternative source until interruption is resolved.<br>3) Investigate long-term plans for alternate water sources: borehole, grey water re-use, rainwater harvesting, etc. |
| 9. | Legionella | Present immediate health risk to consumers | Acute health risk | 1 CFU/mL (1,000 CFU/L) (AIHA (American Industrial Hygiene Association). Recognition, evaluation and control of Legionella in building water systems. Falls Church, VA: AIHA; 2015) | Alert Level 2 24 hrs | >100 cfu/l and up to 1000 | Either: [6]<br>I1) of the minority of samples are positive; the system should be resampled. 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<br>2) 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 | 1) Inform Alert Level 2 Group of failure.<br>2) Issue Water Quality advisory for sensitive groups.<br>3) Appoint specialist to investigate root cause and optimise treatment process.<br>4) Increase monitoring of Chlorine residual and Coliphages until failure is resolved |

[6] [6] Legionnaire's Disease. Technical Guidance HSG 274

| # | Risk Parameter | Description | Categorisation of risk | Target Limit for final water (SANS 241 unless stated otherwise) | Alert Level and response time | Alert Limit | Municipal supply | On-site treatment |
|---|---|---|---|---|---|---|---|---|
| | | | | | Alert Level 3 Immediately | >1000 cfu/l | The system should be resampled 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. | 1) Inform Alert Level 3 Group<br>2) Provide alternative source until interruption is resolved. |

## D. CONTACT LIST TEMPLATES

The Table below provides an example of emergency contact lists for all personnel and external stakeholders per Alert Levels. Building owners must customize this list to align with buildings organisational arrangement and personnel compliment. This list must be updated regularly, shared with all stakeholders, and displayed together with Alert Levels in technical department.

TABLE 6: CONTACT DETAILS FOR WATER QUALITY INCIDENTS

| | Department/Organisation | Name | Designation | Email | Tel/Cell |
|---|---|---|---|---|---|
| Alert Level 3 | Municipality: Water Quality compliance | | | | |
| | DWS Water Quality Regulations | | | | |
| | Tenants' association | | | | |
| | OHS representative | | | | |
| Alert Level 2 | | | | | |
| | Maintenance manager | | | | |
| | Water Technical specialist | | | | |
| | Building Owner | | | | |
| Alert Level 1 | Facilities Manager | | | | |
| | Artisan/Technician responsible for daily operations/monitoring | | | | |
| | Maintenance technician | | | | |
| | OHS officer | | | | |

## E. INCIDENT REGISTER

Building owners are advised to develop an incident register to record all incidents related to water quality and supply:

- Water quality failures from operational and compliance monitoring.
- Water quality complaints received from the hospitals
- Maintenance issues on the treatment plant and network
- Interruptions in supply

The incident register must include at least the following components: date of incident, description, actions taken, outcome and date of resolution. An example of a simplified incident register is given below in

Table 7.

In the event of Alert Level 2 and Alert level 3 incidents, root cause analysis must be undertaken with clear implementation plant to mitigate the risk.

The register can form part of normal incident reporting procedures for all other infrastructure-related incidents at the facility and must be maintained by the Technical Services Manager of the building.

TABLE 7: GENERIC INCIDENT REGISTER

| INCIDENT REGISTER | | | |
|---|---|---|---|
| **Incident Number** | | | |
| **Date of Incident:** | | | |
| **Location of Incident:** | | | |
| **Division / Section:** | | | |
| **Description of Incident** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Name of person registering the Incident | | Telephone No. | |
| Date | | | |
| **Corrective Actions taken:** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Facility manager | | Telephone No. | |
| Date | | | |
| **Details of Investigation and further preventative actions required to eliminate root cause** | | | |
| | | | |
| | | | |
| | | | |
| Facility manager | | Telephone No. | |
| Date | | | |

# ANNEXURE C: GUIDELINE FOR ENSURING SAFE WATER IN BUILDING AFTER PROLONGED SHUTDOWN OR REDUCED OPERATIONS

Buildings can face reduced occupancy or closure for prolonged periods of time due to variety of reasons such as seasonal occupancy, disaster regulations and financial constraints but to name a few. This will result in reduced water usage within these buildings, potentially leading to stagnant water within the reticulation network. Stagnant water poses a health risk and renders water unsafe for domestic or commercial purposes for several reasons:

A. Stagnant water can lead to a decrease in hot water temperatures, thereby providing opportunity for Legionella growth.
B. Stagnant water can lead to low or undetectable levels of disinfectant (chlorine) thereby promoting growth of pathogenic organisms such as bacteria, mould, viruses, parasitic protozoans, within storage tanks as well as the reticulation network.
C. Stagnant water can promote corrosion of pipes due to lack of sufficient calcium carbonate in the water to maintain biofilms. Corrosion may cause leaching of metals such as copper and lead into the drinking water supply, while low calcium carbonate levels may result in release of biofilms which may contain pathogenic organisms, mould, and metals.

Prolonged periods of closure can also promote growth of mould on building materials where there is moisture produced from leaks or condensation from roofs, windows, pipes, or from a flood.

For *Legionella*, a "prolonged period" may be **weeks** or **months** depending on plumbing-specific factors, disinfectant residuals, water heater temperature set points, water usage patterns, and pre-existing *Legionella* colonization.

For mould, a "prolonged period" may be **days**, **weeks**, or **months** depending upon building-specific factors, season, and weather variables.

For lead and copper, a "prolonged period" may be **hours**, **days**, **weeks**, or **months** depending on plumbing and water-specific factors, the amount of time the water remains stagnant inside the pipes, whether there are protective scales or coatings present inside pipes that prevent metals from leaching into water, and the materials used to build the plumbing

## 1. PROCEDURE FOR REOPENING BUILDINGS

This is based on the UP EPA guideline titled: Maintaining or restoring water quality in buildings with low or no use:https://www.epa.gov/sites/production/files/2020-05/documents/final_maintaining_building_water_quality_5.6.20-v2.pdf.

The following steps are recommended to prepare the buildings water system for returning to normal operation after extend period of closure (>2 weeks). These steps must be performed prior to the building reopening including verification of water quality.

## A. INSPECT THE RETICULATION NETWORK TO ENSURE IT IS FUNCTIONAL AND IN GOOD CONDITION.

Conduct a visual inspection of pipes, storage tanks, valves, water use devices, drains, etc. to check functioning, structural integrity, and condition of all infrastructure. Check maintenance schedule for repeated failures and replace any broken/poor performing infrastructure.

## B. FLUSH THE RETICULATION NETWORK AND ASSOCIATED WATER INFRASTRUCTURE

Flushing involves opening all the taps to let the stagnant water run out and replace with 'fresh water' from the municipal or treated onsite water supply thereby removing contaminants and biofilms that accumulated during periods of low water usage.

- Drain and clean water storage tanks including fire water.
- Drain and clean water hot water heaters as per manufacturer's instructions.
- Flush cold and hot water systems at all water points of use (taps, showers, toilets) and water using devices (dishwasher, washing machines, ice machines, water fountains, hot tubs, cooling towers, autoclaves, etc.).
- Flushing may need to take place by sections (floors) depending on plumbing configuration, size, and variations in pressure.
- Flushing should proceed in one direction and zone-by zone, starting from the point of entry going progressively to the distal points of the plumbing system
- Cold water must be flushed before hot water.
- Special consideration must be given to looped systems and onsite storage to ensure they are adequately flushed.
- Consider removing some plumbing components (aerators, showerheads, filters) that restrict flow rates but remember to clean and disinfect bypassed components.
- Flushing time will vary depending on plumbing configuration and size of the reticulation network. Consult plumbers or suitably qualified professional to understand plumbing configurations and flushing volumes
- Continue flushing until a constant cold-water temperature is maintained.
- Repeated flushing may be required to bring the building water system back to baseline conditions.
- Flush hot water systems until they reach the correct temperature as per manufacturer's specifications or relevant standards to control Legionella. SANS 10252-1:2012 Edition 3, 7.1.2 states the following:
    - in a hot water installation, there shall be no zones where water is stored at temperatures of between 25 °C and 45 °C,
    - the stored hot water shall be maintained at a temperature of at least 55 °C,
    - Check all taps to ensure water temperature does not present risk of scalding to users. If there is a risk of scalding, ensure installation of thermo-regulatory mixers before taps to reduce risk of scalding.
    - Conduct testing for Legionella prior to re-opening building to verify safety of the system.

## C. MAINTAIN ALL NON-POTABLE WATER SUPPLIES AND DEVICES AS PER MANUFACTURER'S SPECIFICATIONS.

- Emergency devices such as eye wash stations, safety showers, sprinkler systems, firewater storage.
- Decorative fountains, water features, spa's, hot tubs, pools, and cooling towers.

## D. CHECK SEWER NETWORK AND OTHER DRAINAGE SYSTEMS FOR BLOCKAGES.

## E. CONDUCT WATER QUALITY TEST TO VERIFY THE SAFETY OF THE WATER.

- Conduct water quality test to verify that there is sufficient disinfection residual: ensure that is >0 mg/l free chlorine detected at furthest point in the network. The Drinking Water quality Standards SANS 241: 2015 states the recommend range for free chlorine residual at point of consumption is >0 to ≤ 0.2 mg/l.
- Conduct water quality test to verify the safety of the final water. Limits outlined in Drinking Water Standard SANS 241: 2015 is:
  - *E. Coli* = 0 count/100 ml or not detected,
  - Total Coliforms <10 count/100 ml, and
  - HPC <1000 count/1 ml.

Refer to **Annexure B: Water Quality Incident Protocol**

- If water does not meet water quality requirements: Undertake disinfection of systems as per SANS 10252 outlined below.

## F. FOLLOW ALL APPROPRIATE REGULATIONS AND POLICIES FOR WORKERS HEALTH AND SAFETY DURING THE PROCEDURES.

- Workers have adequate PPE to protect their face, hands, arms, legs, and torso
- Workers have the right equipment to perform checks, maintenance, and repairs without endangering themselves
- Workers have been successfully trained to use maintenance, repair, and emergency equipment and understand safe handling of chemicals (such as Chlorine gas)
- Workers have been trained when water-related emergencies arise such as issue a notice to occupants, evacuate building when an incident occurs, provide alternative water sources to occupants

## G. COMMUNICATE WITH OCCUPANTS OF THE BUILDING

- Consider notifying building occupants on the status of the buildings water system and implementation measures to ensure safety of water.
- Consider whether limiting access to the building or use of water is an appropriated precautionary measure prior to returning to normal use of the building.
- Notify occupants of planned maintenance on the reticulation network which include the date, time, and duration

## H. CONSIDER DEVELOPING A WATER MANAGEMENT PROGRAM TO ALWAYS ENSURE THE DELIVERY OF RELIABLE SUPPLY OF SAFE WATER.

- The programme must include relevant contact information of building managers and maintenance teams
- The programme must include emergency management procedures in case there is an incident

## 2. GUIDANCE TO MANAGE LEGIONELLA RISKS IN BUILDING WATER SYSTEMS WITH NO OR REDUCED OCCUPANCY

This section is taken directly from the National Health Laboratory Services which compiled this guideline in response to a request from the plumbing industry for advice on flushing pipes impacted by water stagnation during the COVID-19 lockdown. At that time, this guideline was widely shared both nationally and internationally to assist building owners to reduce risk to Legionella infections in buildings. The contact details for the Nation Health Laboratory Services are given below:

National Institute for Occupational Health
Immunology and Microbiology Department
PO Box 4788, Johannesburg, 2000, RSA
Office: +27 (0) 11 712 6404
Email: NoncyG@nioh.ac.za | Website: http://www.nhls.ac.za; http://www.nioh.ac.za

***Guidance to managing Legionella risks in building water systems with no or reduced occupancy during COVID-19 lockdown***

*In compliance to the government COVID-19 lockdown regulations, many buildings including offices, retail outlets, restaurants, hotels, factories, schools, gyms, community centres among others were left unused or sub-operational with no or low occupancy for a significant amount of time. This leads to potential water stagnation in water pipes, fixtures, and storage tanks as water usage was reduced significantly or brought to a halt in some instances. Another possible consequence of the lockdown is the inability to monitor and maintain cold or hot water systems as required. These conditions can create hazards due to deterioration of water quality with possible adverse health risks to returning occupants.*

***Building water quality concerns during lockdown***

*As the government begins to ease lockdown restrictions and more companies prepare to re-open, it is important that building owners and operators are aware of concerns that could threaten the quality and safety of the water in their premises. An unintended health risk that could result from the fight against COVID-19 is legionellosis. Legionella infections can cause Legionnaires' disease (a severe type of pneumonia) and Pontiac fever (a mild form), collectively known as legionellosis. Persons with compromised immune systems are at risk of contracting the disease, similar to COVID-19.*

*A conducive environment for Legionella growth*

- *A stagnant water system provides the 'right' conditions and a potential breeding ground for bacteria such as Legionella to proliferate due to several reasons.*
- *Hot and cold-water temperatures can stabilise into a range that favours Legionella growth (25–40°C)*
- *The chlorine disinfectant added to the water supplied to a building can drop to ineffective levels*
- *Stagnation can promote biofilms to develop in pipes and fixtures*
- *Once established in a building's plumbing, Legionella can be dispersed by aerosol generating activities, potentially exposing individuals through inhalation of aerosols*

***Building water systems and devices impacted by stagnation***

*Systems and devices that are prone to water stagnation during a lockdown include:*

- *Toilets and showers*
- *Sink faucets*
- *Eye wash stations*
- *Emergency showers*
- *Irrigation and fire hoses*
- *Cooling towers*
- *Evaporative condensers*
- *Decorative fountains*
- *Hot tubs and spas*
- *Misters, atomisers, and humidifiers*

***Recommendations to safe re-opening of buildings during or after the risk-adjusted easing of COVID-19 lockdown***

*Building owners and operators must take all reasonably practicable precautions to control any water hygiene-related risks that may have arisen during the lockdown such as Legionella growth. Professional assistance is recommended to evaluate these factors so that appropriate measures can be taken. Given the variability and complexity of plumbing, generalizations are not possible. The main concern is whether the water poses unacceptable health risks to building occupants, which can differ drastically in terms of building size and complexity, length of shutdown, likely integrity of the system, vulnerability of occupants, and water uses. All procedures implemented should be documented.*

***Risk assessment***

***Purpose:*** *Risk assessments are done to check system integrity and should inform measures to be followed to restore water quality to pre-COVID conditions.*

***Considerations***

- REVIEW WATER HYGIENE AND LEGIONELLA RISK ASSESSMENT TO REFLECT CURRENT USAGE AND CONSIDER WHETHER THERE IS A HEIGHTENED RISK OF LEGIONELLA AS A RESULT OF THE LOCKDOWN.
- RISK ASSESSMENT SHOULD BE CARRIED OUT BY A TRAINED AND COMPETENT PERSON.
- WHERE RISK IS IDENTIFIED, APPROPRIATE STEPS (SUCH AS INTERIM CONTROL MEASURES SUCH AS FLUSHING OR WATER TESTING AND/OR TREATMENTS) SHOULD BE DETERMINED AND ACTIONED IN A TIMELY MANNER.

***Flushing***

***Purpose:*** *Flushing replaces low quality water with high quality 'fresh water' from the municipal supply thereby removing contaminants and biofilms that accumulated during stagnation. Repeated flushing maybe required to bring the building water system back to baseline conditions*

***Considerations***

- CONSIDER FLUSHING THE ENTIRE BUILDING WATER SYSTEM INCLUDING HOT AND COLD WATER THROUGH ALL POINTS OF USE (SHOWERS, FAUCETS, ETC.)
- IT MAY NEED TO OCCUR IN SEGMENTS DUE TO FACILITY SIZE AND WATER PRESSURE ISSUES
- FLUSHING ORDER ALSO MATTERS AND PROFESSIONAL ASSISTANTS MIGHT BE REQUIRED TO HELP UNDERSTAND PLUMBING CONFIGURATIONS AND FLUSHING VOLUMES
- FLUSHING SHOULD PROCEED IN ONE DIRECTION AND ZONE-BY ZONE, STARTING FROM THE POINT OF ENTRY GOING PROGRESSIVELY TO THE DISTAL POINTS OF THE PLUMBING SYSTEM
- IT IS ADVISABLE TO FLUSH COLD WATER FIRST FOLLOWED BY HOT WATER
- CONSIDER REMOVING SOME PLUMBING COMPONENTS (AERATORS, SHOWERHEADS, FILTERS) THAT RESTRICT FLOW RATES BUT REMEMBER TO CLEAN AND DISINFECT BYPASSED COMPONENTS
- FLUSHING REQUIREMENTS ARE SITE-SPECIFIC BUT RUN THE WATER UNTIL A CONSTANT COLD-WATER TEMPERATURE IS MAINTAINED AND DISINFECTANT IS DETECTED

***Clean and disinfect fixtures***

***Purpose:*** *Some components of the water system need additional measures because they can generate aerosols. Cleaning of fixtures removes contaminants and biofilms from the complex internal structures at the point of discharge.*

***Considerations:*** Remove aerators, faucets, shower heads, etc. and clean and disinfect with bleach before returning to service

***Shock disinfection***

***Purpose:*** *Disinfection is particularly important when the facility serves a vulnerable population, such as immune-compromised individuals or the building is a large system with a history of contamination with Legionella or other harmful microorganisms*

***Considerations***

- FACILITY STAFF CAN SEND A HIGH DOSE OF DISINFECTANT SUCH AS CHLORINE THROUGH THE BUILDING OR RAISE TEMPERATURES TO KILL THE MICROBES
- DISINFECTANTS SUCH AS CHLORINE ARE DANGEROUS TO HANDLE AND CAN CAUSE SERIOUS DAMAGE TO PLUMBING SYSTEM COMPONENTS IF NOT PROPERLY USED
- GET PROFESSIONAL ASSISTANCE REGARDING METHODS AND CHEMICALS COMPATIBLE WITH PLUMBING MATERIAL
- THOROUGHLY FLUSH THE SYSTEM BEFORE AND AFTER SHOCK-DISINFECTION TO IMPROVE RESULTS AND REMOVE DISINFECTANTS

**How do you know if your procedure has been effective and water is now safe for use?**

- CONSIDER COLLECTING WATER SAMPLES FOR LEGIONELLA AND PORTABILITY TESTS AT A QUALIFIED AND REPUTABLE LABORATORY
- VERIFY POTABLE WATER DISINFECTANT RESIDUALS
    - CHLORINE RESIDUALS SHOULD BE MONITORED AT THE POINT OF ENTRY TO VERIFY SUFFICIENT DISINFECTANT LEVELS ARE PROVIDED TO THE BUILDING
    - CHLORINE RESIDUALS SHOULD ALSO BE MONITORED AT LOCATIONS THROUGHOUT THE BUILDING TO ENSURE FLUSHING MINIMIZES DEGRADATION OF DISINFECTANT RESIDUALS AT THE POINTS OF USE
    - FREE CHLORINE RESIDUALS SHOULD BE MONITORED IF THE BUILDING IS SUPPLIED WITH CHLORINATED WATER, AND TOTAL CHLORINE RESIDUALS MONITORED IF SUPPLIED WITH CHLORAMINE TREATED WATER

***Worker protection***

*Ensure safety of workers during the flushing, cleaning, and disinfection procedures*

- WORKERS SHOULD BE COMPETENT AND APPROPRIATELY TRAINED FOR THE WORK THEY WILL BE DOING
- APPROPRIATE PPE, E.G. GLOVES, N95 MASKS (FIT-TESTED), AND FACE SHIELDS, SHOULD BE WORN TO PREVENT EXPOSURE FROM DISINFECTION CHEMICALS, AND POTENTIALLY CONTAMINATED SPLASHES AND AEROSOLS
- AVOID SPLASHING AND CREATING AEROSOLS DURING FLUSHING BY USING HOSES TO CONNECT TAPS OR SHOWER HEAD ENDS DIRECTLY TO DRAINS, OR BY OPENING OUTLETS SLOWLY
- PREVENT EXPOSURE OF WORKERS TO CHEMICALS OR HIGH TEMPERATURE WATER BY USING SIGNAGE OR ACCESS CONTROL

- SOCIAL DISTANCING PROTOCOLS SHOULD BE OBSERVED DURING RISK ASSESSMENTS, CLEANING, AND DISINFECTION PROCEDURES

*The information provided here is intended to raise awareness and provide guidance on water quality issues pertinent to stagnation resulting from the COVID-19 lockdowns with specific reference to Legionella risks. The information is based on literature currently available. As more research is done information may change.*

Annexure A: **Water Quality Incident Protocol, Section B iii: Monitoring of Legionella**

## 3. GUIDELINE FOR DISINFECTION WITH CHLORINE

If water is not consumed immediately and stored for more than 48hrs, there is potential for growth of pathogenic organisms which may present a health risk to consumers. These organisms may originate from various sources: air, contaminated storage vessels, biofilm in pipes, leaking pipes, etc.

Disinfection is required to kills bacteria, viruses, and other microorganisms that cause disease and immediate illness. Disinfection is required when:

- water is stored for more than 48 hrs,
- there is a long reticulation network,
- there are additional storage facilities,
- there is a potential for water to remain stagnant.

The best option for disinfection for small systems is the use of granular chlorine which can be dosed directly into the storage tank: this is the same chlorine use for swimming pools. A good alternative is to use floating chlorine tablets in larger tanks as this is easier to manage and are designed to last longer before they must be replaced.

**It is critical to ensure the correct dosage of chlorine is applied because chlorine levels which exceeds 5 mg/l present a chronic health risk and may negatively affect sensitive groups such as infants younger than 2 years and the elderly.**

The following procedures are recommended when chlorinating small systems:

- Dose a small amount of chlorine into storage tank: this depends on volume of tank and may require several attempts before chlorine residual is observed.
- Measure chlorine residual at point of consumption:
    - ILab test strip can be used, or
    - Hand-held chlorine comparator (Lovibond) which is cheap, easy to use and does not require any specialist skills.


FIGURE 22: LOVIBOND CHLORINE COMPARATOR (WWW.LOVIBOND.COM/EN/PW/WATER-TESTING/PRODUCTS/TEST-KITS/CHECKITCOMPARATOR/TEST-KITS-MULTI-PARAMETER/CHECKITCOMPARATOR-2-IN-1-CHLORINE-DPDPH5)

- The level of chlorine must be > 0 and less than or equal to 0.2 mg/l.
- The responsible person will have to do several checks initially to work out how much chlorine is required to maintain a residual of 0.2 mg/l at point of consumption.
- The required dosage depends on the amount of water and quality of water: as turbidity increases, the chlorine demand increases.

- Ideally weekly/twice monthly testing of *E. Coli* should be conducted to determine if the disinfection is sufficient to kill all the bacteria. This is based on the SANS 241:2015 standard for monitoring of distribution points in the reticulation network.
    - The water quality limit of *E. Coli* is zero, i.e. there must be no *E. Coli* in the final water.
    - If there are *E. Coli* in the final water, then increase chlorination and flush tanks.
    - If the problem is not resolved, issue a "Boil water" Notice to consumers until the *E. Coli* is zero.
- Correct storage and handling of chlorine is required as it is corrosive:
    - Use PPE to prevent contact with skin and eyes (overall, gloves, goggles, gas mask), wash hands after handling.
    - Store in a cool, dry, well-ventilated place and out of direct sunlight.
    - Keep containers closed when not in use and protect from water and moisture
    - Refer to Materials Safety Data Sheet for additional safety precautions.

There are several reputable suppliers of larger chlorine dosing systems which either use sodium hypochlorite granules/solution, or gas chlorine. Please ensure all required health and safety procedures are followed for these installations in particular gas chlorine which requires additional safety equipment such as gas masks, leak detectors, and training for chlorine gas handling.

## 4. PROCEDURE TO DISINFECT RETICULATION SYSTEM

In the event of water quality failures which cannot be resolved by flushing the reticulation network, disinfection may be required to remove pathogens. **As per section 9.3 of the SANS 10252-1 (2012): Water supply and drainage for buildings Part 1: Water supply installations for buildings, the procedure for disinfection of water system is as follows:**

***Water installations***

*When any extension or modification has been made to a water installation on any premises separately occupied, or any private dwelling that has its own separate service pipe, then that water installation shall, immediately before being taken into use, be thoroughly flushed with fresh water drawn direct from the mains.*

***Storage tanks***

- *Apply the following disinfection procedure to any storage tank:*

    *a) remove all visible dirt and debris from the inside of the storage tank;*

    *b) fill the storage tank with clean water and then drained until empty;*

    *c) refill the storage tank with clean water and add a solution of sodium hypochlorite to the water until a free residual chlorine level of 50 mg/L in the water is measured;*

    *d) leave the chlorinated water in the tank for not less than 1 h and not more than 3 h, after which (in turn) open each terminal fitting served by the storage tank, starting at the one closest to the tank and working progressively away from the tank, until the water discharged begins to smell of chlorine, then close each terminal again;*

    *e) do not allow the storage tank to become empty during the discharging described in (d); refill and re-chlorinate the tank as in (c), as necessary;*

    *f) when the discharging is conducted on the terminal fitting furthest from the tank and the smell of chlorine becomes evident, measure the level of free residual chlorine in the water discharged. If the concentration of free residual chlorine is less than 30 mg/L, repeat the disinfecting process, starting from (c); and* *g) keep the tank and pipes charged with the chlorinated water for at least 16 h and then thoroughly flush them with clean water until the free residual chlorine level at any terminal fitting does not exceed that present in the clean water from the mains.*

- *In the case of pipework under pressure, apply the following procedure:*

  *a) conduct chlorination treatment through a properly installed injection point, using a chemical pump at the start of the installation until the measured free residual chlorine at the end of the installation is at least 20 mg/L; and*

  *b) leave the chlorinated water in the system for at least 24 h, after which flush the installation with clean water until the free residual chlorine level in the water, measured at the furthest point from the injection point, does not exceed that present in the clean water of the mains.*

**NOTE 1** Disinfection should be compatible with the pipe system manufacturer's specifications.

**NOTE 2** Should the use of alternative disinfection systems be considered, the process should be performed under the supervision of, and the results certified by a suitably qualified specialist personnel as specified by the manufacturer of the materials and equipment.

**NOTE 3** Following the performance of the disinfection process, it is recommended that a water sample be obtained and submitted for quality analysis in terms of the requirements given in SANS 241-1 and SANS 241-2.

## 5. BUILDING INSPECTION CHECKLIST

The checklist below will assist Building management to action all items required to ensure building is safe after periods of prolonged shutdown or reduced operations.

| Inspection element | Response | | |
|---|---|---|---|
| 1. The building reticulation network has been inspected and is functional and in a good condition. | Yes | No | N/A |
| 2. The reticulation network and associated water infrastructure has been flushed. | Yes | No | N/A |
| 3. All non-potable water supplies and devices are maintained as per manufacturer's specifications. | Yes | No | N/A |
| 4. The sewer network and other drainage systems have been checked for blockages, and any blockages have been cleared. | Yes | No | N/A |
| 5. Water quality has been tested and the safety of the water has been verified using the SANS 241. | Yes | No | N/A |
| 5.1 Free Chlorine is within the >0 and ≤ 0.2 mg/l limit as per SANS 241. | Yes | No | N/A |
| 5.2 *E. Coli* in the drinking water supply has a 0 count/100 ml or not detected. | Yes | No | N/A |
| 5.3 Total Coliforms in the drinking water supply has <10 count/100 ml. | Yes | No | N/A |
| 5.4 Heterotrophic Plate Count (HPC) has <1000 count/1 ml. | Yes | No | N/A |

| Inspection element | Response | | |
|---|---|---|---|
| 5.5 Where the above parameters listed in 5.1 to 5.4 are not met, disinfection of the systems was done as per SANS 10252. | Yes | No | N/A |
| 6. Legionella monitoring has been conducted in hot water system and results indicate no Legionella in the system. | Yes | No | N/A |
| 7. All appropriate regulations and policies for workers health and safety were followed during the procedures. | Yes | No | N/A |
| 8. Issues related to the buildings water are communicated to occupants timeously. | Yes | No | N/A |
| 9. A water management is in place to ensure the delivery of reliable supply of safe water, especially after prolonged periods of low / no occupancy. | Yes | No | N/A |

## REFERENCES FOR ANNEXURE C


- *CDC Water Management Program and Toolkit*. https://www.cdc.gov/legionella/wmp/overview.html
- *CDC Guidance for Reponing Buildings After Prolonged Shutdown or Reduced Operations*. https://www.cdc.gov/nceh/ehs/water/legionella/building-water-system.html
- *MAINTAINING OR RESTORING WATER QUALITY IN BUILDINGS WITH LOW OR NO USE*. https://www.epa.gov/sites/production/files/2020-05/documents/final_maintaining_building_water_quality_5.6.20-v2.pdf
- *SANS 10252-1 (2012): Water supply and drainage for buildings. Part 1: Water supply installations for buildings.* SABS Pretoria
- *Guidance to manage Legionella risks in building water systems with no or reduced occupancy during COVID-19 lockdown*. National Health Laboratory Services, Johannesburg. http://www.nioh.ac.za