GUIDANCE FOR

# PROVIDING SAFE DRINKING WATER IN AREAS OF FEDERAL JURISDICTION

Health Canada Santé Canada

Canada

**Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health.** Health Canada is committed to improving the lives of all of Canada's people and to making this country's population among the healthiest in the world as measured by longevity, lifestyle and effective use of the public health care system.

Également disponible en français sous le titre :
Conseils pour un approvisionnement en eau potable salubre dans les secteurs de compétence fédérale

To obtain additional information, please contact:

Health Canada
Address Locator 0900C2
Ottawa, ON  K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: hc.publications-publications.sc@canada.ca



Publication date: December 2021



Cat.: H144-94/2021E-PDF
ISBN: 978-0-660-41262-7
Pub.: 210485

This document may be cited as follows:

Health Canada (2021). Guidance for providing safe drinking water in areas of federal jurisdiction. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario (Catalogue N° H144-94/2021E-PDF).

The document was prepared by the Interdepartmental Working Group on Drinking Water.

Water and Air Quality Bureau
Healthy Environments and Consumer Safety Branch
Health Canada
269 Laurier Avenue West, Address Locator 4903D
Ottawa, Ontario
Canada K1A 0K9

Tel.: 1-833-223-1014 (toll free)
Fax: 613-952-2574
E-mail: hc.water-eau.sc@canada.ca

Other documents concerning Canadian drinking water quality can be found on the following website:
www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.html

# TABLE OF CONTENTS

BOXES



# PREFACE

**Most drinking water supplies in Canada are under provincial or territorial jurisdiction and have regulations, policies and/or standard operating procedures to follow. Federal departments are responsible for the safety of drinking water provided to consumers in areas of federal jurisdiction. Federal legislation establishes the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) as the prescribed standards but does not provide guidance on their implementation.**

The Interdepartmental Working Group on Drinking Water (IWGDW) was created in 2002 to develop health-based guidance for federal drinking water providers. It comprises federal representatives from departments that have responsibilities for producing and/or providing safe and reliable drinking water in areas of federal jurisdiction. Health Canada provides the technical secretariat for the working group and leads the development of this document.

This document is intended to provide technical guidance to assist federal departments meet their legislative obligations. It takes into consideration the unique circumstances faced by many departments in order to best protect human health. While fully achieving the guidance in this document is the end goal, the focus should remain on the achievement of incremental improvements over time as an indicator of success.

This updated document builds on the progress observed and comments received since it was first published in 2005. Earlier versions primarily focused on providing key information for departments that produce their own drinking water. The 2021 document also provides expanded information relating to other types of systems under the responsibility of federal departments, namely those receiving municipally treated drinking water, providing drinking water to employees on board ships, or receiving trucked (hauled) water that may then be stored into cisterns. This document is expected to be updated periodically to remain up to date with evolving needs, policies and legislation.

Collaboration between departments is key to developing consistent approaches across the federal government. The development of this document has been led by Health Canada, with the input of the current and former members of the IWGDW. The IWGDW includes representatives from the following federal departments and agencies that have or share responsibilities for providing safe and reliable drinking water to consumers.

- Agriculture and Agri-Food Canada
- Canada Border Services Agency
- Canadian Coast Guard
- Correctional Service Canada
- Environment and Climate Change Canada
- Fisheries and Oceans Canada
- Global Affairs Canada
- Health Canada
- Indigenous Services Canada
- Innovation, Science and Economic Development Canada
- National Defence
- National Research Council of Canada
- Natural Resources Canada
- Parks Canada
- Public Health Agency of Canada
- Public Services and Procurement Canada
- Royal Canadian Mounted Police
- Transport Canada
- Treasury Board of Canada Secretariat

# INTRODUCTION

In Canada, the responsibility for providing clean, safe and reliable drinking water to the public generally lies with the provincial and territorial governments. Health Canada plays a key role by leading the development of the *Guidelines for Canadian Drinking Water Quality* (GCDWQ) and by providing scientific and technical expertise to the provinces and territories through the Federal-Provincial-Territorial Committee on Drinking Water (CDW) and to federal departments through the Interdepartmental Working Group on Drinking Water (IWGDW).

The federal government has or shares responsibility for ensuring the safety of drinking water supplies on federal lands, in federal facilities, and in First Nations communities. While most supplies and facilities are located on Canadian soil, others such as military vessels and Canadian diplomatic missions may lie outside of Canada's physical borders. Specific requirements are established in federal statutes and regulations (see Section 2.0). First Nations are the owners and operators of community infrastructure on reserve. As such, this Guidance document may be used to inform other federal guidance that is specific to the provision of safe drinking water in First Nations communities.

Some departments have responsibilities for drinking water right from the source through to the tap, whereas others are only responsible for the quality of drinking water after it enters a federal building or facility and until it reaches the consumer. Departments demonstrate the safety and reliability of their supplies through their monitoring programs. Departments responsible for treating their own water will need to develop more comprehensive water quality management programs than those receiving drinking water from a reliable outside agency (e.g., municipality). In locations where the quality of distributed water is unreliable or where tap water is not safe for consumption, a department or responsible authority may choose to provide additional localised treatment by using point-of-entry or point-of-use devices, or by providing an alternative to consumers, such as bottled water.

For all systems, a proactive, preventive approach is essential for providing safe drinking water. This approach means establishing priorities for managing risks and protecting public health based on site-specific considerations. An overall plan should be established to prioritize the order in which to address risks to best protect public health and to establish timelines for achieving these improvements. Following such a plan will ensure steady progress toward achieving all of the health-based benchmarks in this document. It will also allow departments to maximize the use of limited resources and capacity to address the greatest risks to public health.

This document recognizes that federal government drinking water purveyors face a number of challenges that may prevent them from meeting all the guidance contained in this document in a timely manner. These may include:

**Size and location of drinking water systems:** Most federal drinking water systems are very small, serving 500 or fewer people. In addition, many of these systems may be located in remote areas, in countries where water supplies may be unreliable, or on board airplanes and ships, including Coast Guard and military vessels. In some of these locations, drinking water may need to be hauled by truck and stored on-site. In other cases, the only practical drinking water supply may be bottled water.

**Jurisdiction(s) responsible for water:** In most situations, the water source falls under the jurisdiction of a provincial government and/or the drinking water treatment plant is operated by a public or municipal utility. In some cases, the lines of responsibility may not be clear. For government buildings supplied potable water by a municipality, the treatment and distribution systems usually fall under provincial/territorial jurisdiction, while the quality of water at the tap must meet potentially different federal requirements.

**Cost of infrastructure:** Because the number of people served by the federal government in each location is often very small, the cost of installing, operating and maintaining the necessary infrastructure per capita may be extremely high. This cost increases further with remote locations.

**Cost of water quality monitoring:** The costs associated with water quality monitoring are based on the number of samples and the type and frequency of tests conducted, rather than on the number of people served by a water system. Because of the number of federal systems and the relatively small number of people served by each one, the relative costs associated with water quality monitoring are high.

**Funding:** In order to ensure that federal drinking water systems are properly designed, constructed, operated and maintained, departments need to have adequate funds and program management controls in place. On-going funding is also required to cover employee training and infrastructure maintenance and upgrades. For the majority of departments for whom the provision of drinking water is not part of their core mandate, funding may be considered as part of their department's overhead and more difficult to obtain.

# PURPOSE OF THIS DOCUMENT

The purpose of this document is to give clear, consistent guidance on how to implement the GCDWQ to protect human health. Guidance is directed to federal civil servants and other responsible authorities whose jobs relate, either directly or indirectly, to ensuring the safety of drinking water on federal lands and in federal facilities. It is written for employees who make decisions at the policy and management levels, as well as for those who run drinking water systems on a day-to-day basis, such as treatment plant operators.

Detailed information is provided to assist federal departments and responsible authorities to meet the GCDWQ and drinking water-related regulations. Meeting these requirements will ensure a more consistent approach to managing drinking water systems across areas of federal jurisdiction. For issues or concerns specific to a given contaminant, the appropriate guideline technical documents should be consulted. These are available at www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.html.

All affected departments and authorities are encouraged to strive to meet the guidance set out in this document in order to protect the health of the people who consume the water provided. In some cases, it may be preferable for a department to meet more stringent objectives than those detailed in this document. This decision is under the authority of each department or responsible authority.

It is recognized that departments operating unique facilities, such as those in remote locations or in locations beyond Canadian borders, may face challenges that prevent them from meeting all the guidance contained in this document. In such cases, these departments are encouraged to strive to meet the guidance to the best of their ability and to focus on a continuous improvement process.

# SCOPE OF THE DOCUMENT

This document relates to the management of drinking water supplies on federal lands and in federal government facilities. These supplies include those serving:

- Federal government employees working in Canada, as well as Canadian Coast Guard, Canadian Forces personnel, and federal government Canadian diplomatic mission staff working abroad;
- Inmates, staff, and visitors to federal correctional facilities; and
- Visitors to federal lands and facilities;
- Individuals living in government quarters; and
- Neighbouring communities supplied by a federal department (e.g. a town near a military base)

The guidance in this document applies to facilities owned by or leased to the federal government. It outlines considerations regarding the design, operation and maintenance of treatment and distribution systems. It also describes the requirements for conducting assessments and for setting up, running, and evaluating monitoring programs. Departments may have, or wish to develop, more detailed protocols for their staff which address their department's unique circumstances or requirements. The guidance in this document is meant to provide a framework and to complement any existing departmental guidance.

Given that the majority of federal facilities producing their own drinking water provide drinking water to 500 or fewer people, the guidance contained in this document relates primarily to very small drinking water systems and micro-systems. While this document recognizes the importance of managing drinking water from source to tap, source water issues are only briefly discussed. The focus is on drinking water quality from intake to tap. Wastewater issues are considered to be beyond the scope of this document.

# HOW TO USE THIS DOCUMENT

## Part 1: Context

Chapters 1 through 4 outline the key concepts and principles that apply to all federal drinking water systems, and set the stage for each of the types of systems addressed in Part 2.

*Chapter 1: Setting the stage* provides details about the multi-barrier approach to safe drinking water and key jurisdictional issues related to drinking water in Canada. The multi-barrier approach is the overarching concept which ties together each of the individual commitments and tasks outlined in the subsequent chapters.

*Chapter 2: Federal legislation and policies* outlines the federal government's legislated and policy-based responsibilities as a purveyor of drinking water on federal lands and in facilities owned or leased by the federal government.

*Chapter 3: Water quality management* provides key information that applies to all drinking water systems in areas of federal jurisdiction, regardless of whether or not they produce their own water or have specific circumstances to address. It includes operational planning, training and certification, record-keeping, incident and emergency response planning, and compliance verification and reporting.

*Chapter 4: Plumbing and distribution system considerations* focuses on issues that can affect drinking water quality after it leaves the treatment plant, including corrosion control, cross connections and disinfectant residuals.

*Chapter 5: Specific issues* provides some overarching information on specific issues and contaminants that are relevant to all types of drinking water systems, including drinking water advisories, lead and alternative sources of drinking water.

## Part 2: System-specific information

Building upon the general principles outlined in Part 1, each of chapters 6 to 9 explores a different type of drinking water system under federal jurisdiction. Each chapter outlines the actions to be taken by the responsible department, focused on the specific type of system.

*Chapter 6: Facilities receiving municipally-supplied drinking water* focuses on the needs of departments and facilities that receive drinking water treated to the requirements of a different jurisdiction, with particular attention on the contaminants that could originate from the building's own plumbing system.

*Chapter 7: Facilities/departments producing their own drinking water* provides guidance from source to tap, including considerations in choosing a source water, treating and distributing drinking water, conducting basic assessments, and developing/conducting a monitoring program.

*Chapter 8: Drinking water on-board ships* provides guidance on the specific issues that are relevant on-board ships, including source water considerations, mixing of disinfected drinking water, monitoring and storage.

*Chapter 9: Hauled water and cisterns* provides guidance relevant to locations that are remote or without straightforward access to a reliable source of drinking water.

## Part 3: Resources

*Part 3* provides other existing resources available to federal departments, excerpts from relevant legislation, a list of acronyms used in this document, as well as a glossary and references.

# Part 1: Context and General Principles

# 1.0 SETTING THE STAGE

### 1.1 From source to tap

Drinking water systems can be broken down into four main components: the water source, the treatment system, the distribution system and the plumbing system. In each of these areas, steps can be taken to reduce the likelihood of contamination before it occurs. Instead of focusing strictly on compliance monitoring, this risk management concept recognizes the need to take preventive action throughout drinking water systems, from source to tap.

Variability in source water locations and composition, types of source waters (surface water, groundwater, groundwater under the direct influence of surface water), and range of water treatment processes available make it unlikely that a single solution can be applied to correct every exceedance or upset event. For this reason, health risks are more effectively reduced through planning, designing, and managing the entire drinking water system from source to tap, including implementing barriers at critical points throughout the system. This is the multi-barrier approach, an integrated system of procedures, processes and tools to collectively prevent or reduce the contamination of drinking water, from source to tap.

In addition to the physical barriers which relate to the three main system components, a number of procedures, processes and tools need to be in place. These include stakeholder commitments to develop legislative and/or policy frameworks; guidelines, standards and objectives; research, science and technology solutions; and consumer awareness and involvement.

The application of the source to tap approach will vary from department to department and from site to site. For instance, in cases where the drinking water for a specific facility is supplied by a municipality, a department will need to implement barriers within the building; in cases where a department collects water at the source and then treats and distributes it to consumers, many more barriers will need to be implemented. As a general rule, drinking water provided in areas of federal jurisdiction should meet the quality benchmarks set out in the GCDWQ.

## 1.2 Jurisdictional issues

In Canada, the responsibility for water quality is shared by various levels of government, and involves multi-jurisdictional and cross-disciplinary collaboration. Major stakeholders include federal, provincial, and territorial government departments, municipal and local governments, First Nations, non-governmental organizations, and the public.

Although drinking water quality is generally an area of provincial jurisdiction, the federal government has some responsibilities for drinking water quality, including on federal lands. In some instances (e.g., for federal employees), clear legislative obligations are in place to help ensure the safety of drinking water supplies. For example, federal departments have an obligation under the *Canada Labour Code* and its occupational health and safety regulations to provide potable water to their employees. In other cases (e.g., visitors to federal lands), ensuring the safety of drinking water supplies is more a matter of due diligence than a statutory obligation. In general, there are no requirements in the provincial and municipal regulations for private building owners to complete potable water monitoring within their buildings.

### 1.2.1 Leased properties

In the case of facilities located on federal land but leased to a third party, the federal government's responsibilities and liabilities are determined on a case-by-case basis. In such cases, responsibilities for drinking water should be clearly laid out and understood before the lease or agreement is signed. Appropriate clauses should be written into the lease agreement.

When the federal government leases buildings or office space from, or is provided accommodation and/or a legislated installation by a third party, the *Canada Labour Code* requires the government, as the employer, to provide potable water to its employees. *More detailed information can be found in section 2.2.*

The federal government's responsibilities regarding leased properties apply to existing leases as well as new ones.

# 2.0 FEDERAL LEGISLATION AND POLICIES

This chapter provides an overview of the legislation and policies guiding the provision of safe drinking water in areas of federal jurisdiction. This information is included for convenience only; the original documents should be consulted for exact wording regarding federal obligations.

## 2.1 Guidelines for Canadian Drinking Water Quality

Recognizing that safe drinking water is a core public health issue, Health Canada works in close collaboration with the provincial and territorial governments through the Federal-Provincial-Territorial Committee on Drinking Water to develop the GCDWQ. Using the priorities established in collaboration with the CDW, Health Canada leads the development of the health risk assessments for drinking water contaminants. These assessments are the basis for establishing the GCDWQ.

The GCDWQ set out the basic parameters that every water system should strive to achieve in order to provide the cleanest, safest and most reliable drinking water possible. They are used by every jurisdiction in Canada as the basis for establishing their own requirements for drinking water quality, thereby ensuring national consistency. The GCDWQ apply at the consumer's cold water tap, where water is expected to be used for drinking and/or food preparation. Hot tap water may contain higher levels of contaminants, such as metals and microorganisms, and should not be used for drinking or food preparation.

The most important drinking water quality guidelines deal with microbiological quality, to ensure there is minimal risk of exposure to disease-causing organisms in drinking water. These include bacteriological indicators (e.g., *E. coli*, total coliforms), enteric viruses and protozoa. Turbidity and natural organic matter (NOM), while not microbiological parameters per se, are important considerations for microbiological quality. Spikes in turbidity may be associated with contamination and may interfere with disinfection. Changes in NOM can have a significant impact on drinking water treatment processes, leading to a deterioration in water quality and safety.

Health-based maximum acceptable concentrations (MACs) have also been developed for a number of chemical and radiological substances found in drinking water supplies across Canada. While some of these substances are expected to be found in most (or all) drinking water supplies (e.g., disinfection by-products (DBPs)), many others are likely to be a concern in a more limited number of drinking water supplies. Non health-based guidelines (e.g., aesthetic objectives, operational guidance values) have also been developed. These address parameters which may affect consumer acceptance of the water even though the substance in question is found at concentrations below those at which health effects can appear. These parameters affect general characteristics such as taste, odour and colour. Some operational guidance parameters can be important to ensure that health-based guidelines are achieved. Some guideline technical documents do not establish a guideline. This is the case for chlorine and chloramine, as these chemicals are important in drinking water treatment and used broadly but do not pose a health risk at concentrations found in drinking water. Any health effect associated with these disinfectants would be from their DBPs.

Although various editions of the GCDWQ have been referenced in regulations and/or policies, it is recommended to use the most up-to-date version, which considers the most recent developments in science. General information on water quality can be found on the Government of Canada's drinking water quality website at www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water.html. This site also includes a link to subscribe to Health Canada's listserv, which notifies subscribers of changes to its website. Current documents, including the summary table, are posted at www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.htm.

## 2.2 Canada Labour Code

The federal government's legal obligations to its employees as a purveyor of drinking water are described in the *Canada Labour Code* and its related regulations (the Canada Occupational Health and Safety Regulations, the Aviation Occupational Health and Safety Regulations, the Maritime Occupational Health and Safety Regulations, the On Board Trains Occupational Health and Safety Regulations, and the Oil and Gas Occupational Safety and Health Regulations).

All federal employers must comply with the requirements of the *Canada Labour Code* and its regulations. Section 125 (1) (j) in Part II requires federal employers to provide potable water to employees in accordance with prescribed standards. The Occupational Health and Safety Regulations prescribe a specific version of the GCDWQ as those standards. In addition to the requirement to provide potable water to employees, Section 125 (1) (z.11) of the *Canada Labour Code* states that the employer must provide a copy of any report on hazards in the work place, including an assessment of those hazards, to a policy committee, the work place health and safety committee, or to the health and safety representative.

*The relevant excerpts from the Code and its regulations can be found in Chapter 11.*

## 2.3 Other related federal legislation

Two other pieces of federal legislation that may be relevant to purveyor departments deal directly or indirectly with drinking water issues:

- The *Food and Drugs Act*; and
- The *National Defence Act*

### 2.3.1 Food and Drugs Act

Bottled water, which includes all pre-packaged water and ice, is considered to be a food under Canadian law. All bottled water sold in Canada is regulated under the *Food and Drugs Act*. The regulations for bottled water are set out in Division 12 of Part B of the Food and Drug Regulations.

As with all foods, bottled water must comply with Section 4 of the *Food and Drugs Act* which prohibits the sale of foods containing poisonous or harmful substances. It is recommended that when the safety of a particular bottled water is brought into question, the GCDWQ provide the basis for establishing the safety of substances for which no limits are specified in the regulations.

### 2.3.2 National Defence Act

The *National Defence Act* gives the Chief of the Defence Staff certain powers of command, responsibilities and discretion regarding the health protection of members of the Canadian Forces with respect to operational imperatives. Some of these responsibilities are laid out in various directives, policies and standards applicable to drinking water.

## 2.4 Occupational Health and Safety Directive

The National Joint Council Occupational Health and Safety Directive (NJC, 2011) was co-developed by participating bargaining agents and public service employers, and is hosted by the National Joint Council. The Directive contains enhancements to Part II of the *Canada Labour Code* and should be read together with the appropriate sections of the Code and its applicable regulations. The Directive is deemed to be part of collective agreements between the parties to the NJC and as such applies to federal employees. Where employees occupy buildings not owned by the federal government, the Directive applies to the maximum extent that is reasonably practicable.

Part IX of the directive focuses on sanitation, which includes matters related to drinking water. Paragraph 9.4.1 states: "The employer will adhere, as a minimum, to the Guidelines for Canadian Drinking Water Quality, or to any other federally, provincially or territorially appropriate standards and any existing guidelines that provide the higher level of protection to workers."

Part IX also includes broad guidance for sanitary facilities, and for ensuring that sanitary conditions are met for drinking water storage containers and drinking water fountains. In addition, it requires contingency procedures to be developed to address issues such as an interrupted water supply. These procedures are to be developed with the advice of a qualified person and in consultation with the appropriate health and safety committee. *Applicable sections of the National Joint Council Occupational Health and Safety Directive can be found in section 11.2.7.*

## 2.5 Roles and responsibilities in the federal jurisdiction

No single federal department has overall authority for drinking water quality on federal lands. Health Canada provides leadership, as well as guidance upon request, but has no mandate to ensure safe drinking water in the federal house. Each department or responsible authority is in charge of implementing a drinking water program in areas within its mandate and is accountable for carrying out its duties. Each department should define who is responsible for drinking water management in their facilities; each person involved with drinking water programs needs to know what is expected of them and their level of responsibility. Departments should make sure all required tasks have been assigned to specific, qualified staff.

**Note:** While the duties to be performed can be contracted to a third party, the accountability and responsibility for meeting drinking water program objectives remains with the department.

## 2.6 Due diligence

In addition to meeting regulatory requirements, federal departments, drinking water system operators and other responsible authorities are expected to be able to demonstrate due diligence in carrying out their duties (whether these duties are regulated or not).

Demonstrating due diligence means taking every precaution reasonable in the given circumstances to avoid harm. This would likely include following the most recent version of the GCDWQ instead of the version listed in regulations.

Due diligence also means having mechanisms in place to deal with non-compliance and for holding employees accountable for their decisions and actions. The following programs are examples of what may constitute a proper application of due diligence:

- Employer leadership/employee input;
- Hazard identification/assessment (vulnerabilities assessment);
- Hazard elimination/control;
- Training;
- Monitoring;
- Enforcement;
- Documentation; and
- Communication.

# 3.0 WATER QUALITY MANAGEMENT

A risk management approach such as the multi-barrier approach incorporates the principle of sound quality management. A framework can help in coordinating existing or new operational activities, setting priorities and making decisions. It can provide a mechanism to identify and manage risks, apply and introduce measures for prevention, and achieve continuous improvement.

Federal departments have the responsibility to ensure treatment systems are designed and maintained to perform consistently and reliably, and that they are operated by appropriately trained and qualified personnel.

## 3.1 Understanding your system

In a comprehensive review and approval process for new or upgraded water systems, all project proposals are reviewed at various stages of development to ensure that relevant standards and requirements are met. Departments and agencies are responsible for determining what to include in the process, and may wish to consult equivalent provincial and territorial processes for additional guidance. An effective and coordinated review and evaluation of project proposals will result in the overall reduction of potential health hazards in the new or upgraded water system.

Every drinking water system is unique, with different characteristics and needs. The first step to providing safe drinking water is to understand the water system. This will allow the responsible manager to identify potential concerns or hazards, assess their significance and identify corrective measures. The following processes are key to understanding your system and will be further discussed in Part 2 of this document.

Each of these processes should be conducted when a drinking water system is first put into place and repeated every five years. There are exceptions to this guidance, as described in the appropriate chapter in Part 2. In cases where significant changes are made to a system, it may be necessary to conduct one or more of these processes more frequently. For example, an Engineering Evaluation Report (EER), such as those required by many provinces and territories can provide the basis for approval of new or existing facilities requiring modifications or changes.

### 3.1.1 Vulnerabilities assessment

This is a comprehensive assessment of the vulnerability of the source water in the environment. It includes three elements:

» Delineation of watersheds, aquifers and their protection areas;

» Identification of hazards, including contaminants of concern and their sources (where possible to determine); and

» Assessment of susceptibility to contamination and ranking of the hazards.

The vulnerability assessment may not be relevant for all types of systems included in this document. However, it is a critical tool for facilities/departments that produce their own water. Those facilities/departments that produce their own water should, to the extent possible, prepare a source water protection plan; for more information on such plans, see U.S. Environmental Protection Agency (US EPA, 2021) and Conservation Ontario (2021). *More detailed information can be found in Part 2 of this document (section 7.4.1).*

### 3.1.2 Sanitary survey

The World Health Organization (WHO, 2017) defines a sanitary survey as a comprehensive understanding of the system, the range and magnitude of hazards and hazardous events that may affect the system and the ability of existing processes and infrastructure to manage actual or potential risks. In the federal context, source water considerations are assessed through the vulnerabilities assessment (section 3.1.1), and the concept of sanitary survey is limited to intake to tap. It is defined as an on-site review, from intake to tap, of the specific raw water quality, facilities, equipment, operations, and maintenance records for the purpose of evaluating the system's ability to adequately treat source water in order to produce and deliver safe drinking water. The elements of a sanitary survey are outlined in Box 1; however, not all will be relevant for all types of systems discussed in this document (see Part 2). Departments should identify the elements that apply to each of their systems.

Box 1. Elements of a sanitary survey

| Element | | Description |
|---|---|---|
| 1 | System plans | To characterize the capability of the overall system and identify areas requiring improvement and/or corrective actions (intake, filters, pumps, etc.) |
| 2 | Monitoring, reporting, and data verification | Review paperwork and plans to verify and report compliance with applicable requirements |
| 3 | System management and operation | Review paperwork and plans to demonstrate that maintenance and operations can maintain compliance (e.g., cross connection control, emergency plan, operations and maintenance plan, personnel training) |
| 4 | Treatment system | Evaluate treatment processes (e.g., chemical addition, filtration), facilities, components, and techniques |
| 5 | Distribution/ plumbing system | Evaluate its adequacy, reliability and safety |
| 6 | Finished water storage | Evaluate its adequacy, reliability and safety |

Sanitary surveys are intended to provide a range of information and to locate potential problems. The data obtained may identify failures, anomalies, operator errors, and any deviations from normal conditions that may affect the production and distribution of safe drinking water. When conducting a sanitary survey of a water system, it is important to include cross-connection control (see Section 4.2) to ensure that the risks of contaminants entering the water system through backflow are identified.

Sanitary surveys are a useful tool in most drinking water systems, although not all elements described above will be relevant in all types of systems. General information for facilities producing their own water is available in Part 2 of this document (section 7.4.2). However, detailed information on conducting sanitary surveys for different types of systems is beyond the scope of this document.

### 3.1.3 Baseline chemical analysis

The GCDWQ lists many chemical and physical parameters relevant for Canadian drinking water supplies. Many of these may only be a concern in certain parts of the country due either to site-specific geology or to industrial or agricultural activities. For this reason, it is recommended that a baseline chemical analysis of all drinking water supplies be conducted to determine which substances should be monitored as part of the monitoring program.

A baseline chemical analysis is an analysis of all chemical parameters with MACs in the GCDWQ. Where relevant, it would also include monitoring for chemical parameters with other types of guidelines (e.g., operational guidance values, aesthetic objectives) and/or screening for radiological parameters.

A baseline chemical analysis is not required for facilities receiving treated water and that have access to the relevant data from the authority providing the treated water or a reliable third party (e.g., municipality, accredited laboratory). A baseline chemical analysis should be conducted for all other facilities. This is applicable to all types of drinking water systems, as described in Part 2 of this document.

For facilities that require a baseline chemical analysis, it should be conducted every five years, unless a sanitary survey or vulnerabilities assessment indicates that this type of analysis should be done more or less frequently (e.g., based on site-specific considerations). If particular substances are consistently absent from a water system, the frequency of sampling for those substances can be reduced.

## 3.2 Training and certification

All staff or personnel involved in drinking water quality management must be adequately trained for their role and function(s). This includes personnel whose duties relate only to distribution systems, including premise plumbing. Training should be planned, executed, and documented on a continuous basis and must be directly applicable and appropriate to the person's specific responsibilities. The appropriateness and effectiveness of the training should be evaluated using specific mechanisms developed for this purpose. Management should support initial and on-going training and provide a training budget.

### 3.2.1 Operators

Operators of federal drinking water treatment facilities must be trained to the appropriate level based on the type of facility being operated or managed (e.g., classification, size of population served, complexity of operation, water source). Training is essential, regardless of whether an operator is certified. Federal departments should provide opportunities for their operators to participate in approved training. Many well-recognized training programs are available for drinking water treatment operators. Training sessions can range in rigour from educational seminars to certification courses with written examinations.

Where relevant and appropriate, it is recommended that federal departments follow the Association of Boards of Certification (ABC) system for classification of facilities and certification of operators, used by most other Canadian jurisdictions. ABC has developed a designation for very small systems (defined by ABC as serving a maximum population of 500) which may be applicable to many federal facilities. More information on the ABC system can be found at www.abccert.org. Certification information for the province of Quebec can be found at https://www.emploiquebec.gouv.qc.ca/citoyens/developper-et-faire-reconnaitre-vos-competences/qualification-professionnelle/qualification-obligatoire/liste-des-certificats/certifications-dans-le-domaine-de-leau-potable/ (in French).

All operators are encouraged to participate in on-going training in an organized, continuing education setting by qualified instructors. This training may include formal classroom training, conferences, online and interactive presentations, seminars or hands-on workshops or training sessions. It can include training on new or revised operating procedures, reviews of existing operating processes, safety training, computer training and/or training in related environmental or technical areas.

In the case of less complex treatment systems (i.e., a liquid chlorinator with no further treatment), as well as for some complex treatment systems, operators may participate in system-specific training which would provide a site-specific equivalent to a certification for this role only. Such a certificate would not be recognized as valid at other facilities. It is especially important for operators of very small systems to meet one another and develop network contacts amongst their peers. These relationships can facilitate the use of best practices and encourage continuous improvement.

Initially, operator certification should be encouraged on a voluntary basis. As resources permit, certification should become a mandatory requirement, to ensure that operator training is appropriate and kept up to date. This may not be possible in some situations such as in Canadian diplomatic missions overseas. For departments with an "equivalent to certified" program, mandatory certification may not be required, but operators should aim to have an equivalent level of training as their certified counterparts.

## 3.3 Operational plans

The purpose of an operational plan is to characterize the capability of the system to provide safe drinking water, identify areas requiring improvement, and to allow the implementation of corrective actions where necessary. The detailed operational plan forms the foundation for the quality management of the drinking water system.

Operational plans should be specific to each individual drinking water system, and prepared for each drinking water system or facility. Generic plans could be developed at a departmental level for office buildings serviced by municipal water. For leased buildings and/or office space, the department would need to negotiate with the other party to determine who is responsible for developing the plan. This responsibility should be clearly laid out in the lease. The operational plan for each facility should be developed in consultation with the system designer and should include:

- Detailed guidance or instructions related to monitoring, reporting and record-keeping;
- A system assessment showing where barriers are or should be in place;
- The identification of all activities and processes essential to the control of water quality (critical control points), including a list of preventive maintenance activities; and
- The identification of operational controls for each critical control point as well as the monitoring methods for these controls, in order to ensure proper performance and to trigger any required corrective actions in a timely fashion.

The operational planning process should include management and operational staff in order to develop and document specific and realistic operational procedures. The operational plan should be revisited through audit, inspection, or self-assessment cycles in order to continuously improve the system over time. The operational plan is intended to be revised as technologies, methods, and/or risks change.

## 3.4 Monitoring

Monitoring programs should be developed based on site-specific considerations from the relevant assessments described in section 3.1 and updated as needed, typically every five years, or when there are significant changes to the system. There are two types of monitoring.

Operational monitoring is conducted to ensure that the treatment system is operating effectively. This monitoring is carried out by departments/facilities producing their own water. Operational monitoring is also conducted in the distribution system to ensure microbial integrity is being maintained. This monitoring is conducted by departments/facilities producing their own water as well as by facilities receiving municipally supplied water. *Operational monitoring is included as part of the system-specific information in chapters 6 to 9.*

Compliance monitoring verifies that the treated water meets the established requirements, typically the GCDWQ. Parameters and frequency of monitoring are dependent on many contributing factors including water source, historical results, population served, building factors, and local conditions. Routine monitoring should be conducted to maintain an overall understanding of drinking water quality, protect consumers, and increase acceptance and confidence in the water supply. Routine monitoring results can also serve as background data and can be used to compare water quality from one year to the next. Many federal departments have their own documents and/or directives that provide guidance on monitoring frequency and related monitoring issues.

In addition to making sure water entering federal facilities is of acceptable quality, federal staff are responsible for ensuring water does not become contaminated once it enters the facility (e.g., through leaching of metals from pipes, bacterial regrowth). Any significant change in water quality within the facility should be investigated and remedial actions taken as appropriate.

The collection and preservation of samples should follow the procedures (collection, preservation, storage and shipment) recommended by the accredited laboratory analysing the samples.

More comprehensive monitoring programs are needed for federal facilities that supply and treat their own drinking water than for those receiving municipally treated drinking water. Sampling at various points in the distribution/plumbing system identifies issues that may arise within the distribution or plumbing system. Systems that are municipally supplied and have their own distribution system, such as campuses or bases, should also sample at various points in the distribution/plumbing system to identify issues that may arise within these systems. *Specific guidance regarding monitoring frequencies, locations, and the interpretation of results is included as part of the system-specific information in chapters 6 to 9.*

## 3.5 Laboratory accreditation

Accreditation is the best mechanism to provide assurance to customers on the quality and competence of the laboratory. When testing and analysing water samples (with the possible exception of *E. coli* and total coliforms under the conditions outlined below), federal departments should use a laboratory accredited by one of the following: Canadian Association for Laboratory Accreditation (CALA), the Standards Council of Canada (SCC) or, in Quebec, the Centre d'expertise en analyse environnementale du Québec (CEAEQ). It's important to note that laboratories are accredited to perform specific tests.

Canadian diplomatic missions in other countries should use laboratory services accredited as meeting the International Organization for Standardization Standard ISO/IEC 17025. Accredited laboratories in other countries can be found through ILAC, the international organization for accreditation bodies, at www.ilac.org.

In the case of compliance monitoring for *E. coli* and total coliforms, managers and/or operators of facilities may allow trained personnel to use on-site commercial test kits rather than an accredited laboratory. A list of standardized methods, including commercially-available test kits, is included in Guidelines for Canadian drinking water quality: Guideline technical document—*Escherichia coli* (Health Canada, 2020b). The test kits listed have been shown to provide accurate and sensitive results when analysis is performed according to the manufacturer's instructions. Generally, when using test kits for monitoring purposes, the operator must ensure instruments are calibrated and reagents are not past their due date and that the kit is capable of providing the accuracy and precision needed for the analysis. To ensure reliable results, a quality assurance (QA) program, which incorporates quality control (QC) practices, should be in place.

## 3.6 Records and record-keeping

Maintaining a system of documentation is essential to quality management. Monitoring all operational and compliance aspects of a drinking water system establishes on-going verification that the water is safe to drink and the operational plan is being followed. A departmental database to track water quality over time is also useful for determining changes or as an indicator of potential issues.

Documentation is equally important to verify that training activities are taking place and that corrective actions have been taken as required. It also helps track the continuous improvement of operations and/or policies. Comprehensive documentation is a fundamental requirement in the event that any operator or manager should be required to demonstrate due diligence. The use of digital record keeping tools (digitized manual records, spreadsheets, geographic information system -based data systems, supervisory control and data acquisition (SCADA) is encouraged, where possible.

Finally, well-maintained documentation facilitates a more effective and meaningful audit process, which in turn leads to continuous improvement of the managerial and operational strategies to provide safe drinking water. Depending on the type of system, records may include, but are not limited to:

» Reports from the municipality on the quality of drinking water from the municipal system (if municipally supplied water);

» Results of all bacterial and chemical analyses;

» All recorded chlorine residual and turbidity levels;

» A table summary of analytical results obtained during the year;

» Reports of in-house operational procedures or tests;

» Relevant correspondence;

» Communications protocols;

» Maintenance reports and schedule;

» Assessment reports;

» Operational and maintenance manuals and "as-built" design drawings, including "life history cards" (which contain data about each piece of equipment in the water system, including the date and conditions of installation, types of material, record of service problems/performance, and costs of operation and maintenance);

» Manufacturer's information for each piece of equipment;

» Reports of any incidents and remedial or emergency measures (e.g., boil water advisories, shock chlorination);

» Auditor's reports;

» A record of corrective actions taken as part of operational controls, or in the event of non-compliant finished water;

» Training records, including test results, relevance of training, and validation of the source of training; and

» Relevant financial records.

All records must be retained for a minimum period. For example, records related to policy and procedures should be retained for a minimum of five years, whereas other "routine" records should be maintained for at least two years. Some records, including "as built" construction records, should be kept indefinitely.

## 3.7 Incident and emergency response plans

Federal purveyors of drinking water should be prepared for events occurring outside of normal operating conditions. Written emergency and incident response plans/protocols, including a list of potential events, should be developed and maintained for each facility and type of event. Events to consider include extreme or unusual weather events, natural disasters, pandemics, unplanned human activities, line breaks, valve replacements, back-flow events and extended electrical power outages.

To address cases of a suspected/confirmed event of microbiological contamination, the plan should include the possibility that a boil water advisory may need to be issued. For extreme events where a significant chemical/radiological contamination has or is expected to occur, drinking water avoidance advisories may be issued. *Details about advisories are found in Section 5.2.*

Incident response protocols should be established with the understanding that notification and reporting integrate with relevant provincial or territorial approaches. Relationships required for such protocols should be in place well in advance and maintained, as they are fundamental to public health protection and due diligence. This type of integrated information-sharing keeps all agencies properly informed, whether the incident originates at a federal facility or municipal supply, and is often the trigger for implementing appropriate responses. The establishment of web-based and other information sharing protocols to report all incidents is important for timely notifications.

One of the tools available to drinking water purveyors is the drinking water module of the Canadian Network of Public Health Intelligence (CNPHI). This is a secure, real time, web-based alert and reporting system, which was developed collaboratively by Health Canada and the Public Health Agency of Canada. It provides a means of real-time notification and information sharing regarding drinking water advisories. It is available for use by drinking water agencies across Canada at no cost.

## 3.8 Compliance verification and reporting

Compliance verification and reporting activities are an essential part of any quality management approach. They provide an opportunity to evaluate performance related to each component of the federal framework identified in this document. They can also serve to identify issues and to determine appropriate corrective measures in a timely fashion. These activities should be conducted on a regular basis, to help ensure the on-going safety of the drinking water and to be able to report on any progress or concerns.

In addition to routine compliance verification and reporting activities, internal or external audits should be undertaken at regular intervals (e.g., every five years) to ensure the following:

- Policies and procedures are current and being implemented as intended;
- A process for continuous improvement supports drinking water activities; and
- Responsible authorities can demonstrate at the headquarters, regional or site level how they meet the requirements and expectations outlined in this document.

An audit or verification is normally completed in three phases:

1. **Planning:** The planning step is used to define the scope of the audit and identify the specific activities to be conducted. It should include a file review to generate a list of items to be verified and a list of questions or lines of inquiry. It may include a combination of interviews with managers or operational personnel and a review of documents such as engineering studies, monitoring records, policies or procedures.
2. **Conducting the audit/verification:** This process should be collaborative, transparent and non-adversarial, explain the scope and goals, provide an opportunity to raise questions and concerns, and allow reasonable flexibility in terms of timelines. It should follow the established scope and lines of inquiry to verify that observed operational activities and procedures are consistent with written policies and procedures, and identify inconsistencies as a deficiency. These should be brought to the attention of the appropriate personnel, together with a discussion of suggested corrective measures, prior to writing the final report.
3. **Final reporting:** The final report should include the timelines of the process, the scope, verification goals and lines of inquiry, the names and titles of participants, the findings of the process. It should also recommend corrective measures and timelines to address the deficiencies identified.

### 3.8.1 Site level compliance verification

This level of audit activity aims to verify that operations and procedures at a given site are implemented as intended by the responsible authority. Site level verification goals will generally seek to confirm that the drinking water system is managed and operated in a manner consistent with the site operational plan and that issues have been documented and resolved with appropriate and timely corrective measures. This verification should confirm that aspects of drinking water management described throughout this document are being maintained in a manner appropriate to site characteristics.

Section 3.6 on records and record-keeping provides an overview of the types of documentation that should be maintained at the site. Auditors will want to confirm that site records are present and accurately reflect operations. This can be facilitated by making observations on-site, or by interviewing site personnel, for example.

As a general guide, lines of inquiry for the site level compliance verification may seek to confirm the following, as relevant to the site:

- The operational plan is accessible and kept up-to-date.
- An appropriate vulnerabilities assessment has been carried out and is sufficiently current.
- The drinking water system design remains relevant and offers acceptable performance.
- Sanitary surveys have been completed with appropriate frequency and related preventive maintenance has been carried out.
- Monitoring activities and related corrective measures are carried out as required.
- An incident and emergency response plan is accessible and properly maintained.
- Site personnel have received training appropriate to their roles.
- Recommendations from previous compliance verifications have been addressed appropriately.

#### 3.8.2 Corporate roll up

Findings and recommendations developed at the site levels should be rolled up at the corporate level. This allows departments to maintain a global understanding of the state of their drinking water systems and related priorities. It also helps inform decision-making to prioritize improvements in areas of greatest benefits, either to a specific site or to address departmental-wide gaps or issues (e.g., training, equipment upgrades).

Verification goals at the corporate level may seek to confirm that organizational drinking water policies and procedures are being implemented consistently across their sites and that progress on addressing broader organizational priorities can be demonstrated and evaluated.

#### 3.8.3 Core federal reporting on drinking water management

Core reporting is important to ensure transparency at the federal level, and to allow departments to respond consistently to requests for compliance information from central agencies, the Commissioner of the Environment and Sustainable Development (CESD, Office of the Auditor General of Canada), senior management or the Canadian public.

Core reporting will allow the federal government to demonstrate due diligence at the jurisdictional level, characterize priority areas and contribute to federal, provincial and territorial drinking water protection initiatives. The most important outcome of federal core reporting will be an improved understanding of key risks and vulnerabilities across all areas of federal responsibility, which in turn will help central agencies make informed decisions around funding and other resource priorities.

Based on Chapter 4 of the 2005 CESD Report, Safety of Drinking Water: Federal Responsibilities, core federal reporting should reflect how drinking water-related risks are assessed and managed. Reporting should incorporate the following information:

- Water source (municipally supplied, surface or groundwater);
- Size and location of water treatment systems (accessible or remote);
- Water treatment system design and performance (disinfection, filtration);
- Distribution system design and status (age, condition, complexity); and
- Operational requirements (monitoring, testing, maintenance and training).

# 4.0 DISTRIBUTION AND PLUMBING SYSTEMS CONSIDERATIONS

Drinking water distribution systems are made up of components that connect the water treatment plant to buildings, such as treated water reservoirs, water mains (distribution system pipes), service lines to individual buildings, backflow preventers, valves, hydrants, and, if required, pipe insulation and heating cables.

In general, the distribution system does not include premise plumbing, point-of-entry or point-of-use treatment devices. However, in some situations, such as non-residential buildings and staff quarters, the plumbing may be considered part of the distribution system.

A routine maintenance schedule for plumbing systems should include the following elements: inspecting the building's plumbing for cross-connections, pressure testing, flushing water lines (when warranted) and hydrants, regular disinfection of bottled water coolers and drinking fountains, and monitoring water quality. Depending on the facility, a management program to control *Legionella* bacteria may also be necessary (PWGSC, 2016).

In order to keep track of the infrastructure as it was built and changes made over time, it is important to keep up-to-date drawings on hand. These drawings should include notes describing all work and observations over time.

## 4.1 Corrosion control

If not properly maintained, many water distribution system components (including plumbing) can deteriorate, potentially leading to contamination of the water supply. Corrosion is a key issue, and can cause deterioration of water distribution systems in the following ways:

**Internal corrosion:**

- Impaired/poor water quality due to internal corrosion of unlined metallic components, biofilm build-up and/or poor maintenance practices.
- Reduced hydraulic capacity due to internal corrosion of unlined metallic components or calcium carbonate precipitation (i.e., scaling).

**External corrosion:**

- High leakage rate due to external corrosion of the infrastructure, through holes in pipe walls and/or deteriorating joints.
- Frequent breaks due to external corrosion, material degradation, poor installation practices, manufacturing defects and operating conditions (NRC, 2006).

Health Canada and the CDW have developed guidance on corrosion control in drinking water systems that addresses internal corrosion (Health Canada, 2009a), which should be consulted for further information.

## 4.2 Cross-connection control

A cross-connection is any direct connection in the distribution or plumbing system to a source of pollution or contamination that could allow contaminants to enter the treated water supply. This can include direct connections to irrigation systems, storm sewer lines, septic system lines, or even a garden hose left sitting in a bucket of water, a pond or puddle. The potential for inadvertent cross-connections between drinking water systems and non-potable water systems (e.g., independent fire systems) increases in relation to the size and complexity of buildings (WHO, 2011). A flow of contaminated water into the drinking water supply is called a backflow event. Water typically flows within a drinking water system in one direction. If the water within the system begins to flow in the opposite direction as a result of back pressure (pressure greater than water supply pressure) or back-siphonage (caused by negative pressure within a water system), there is a possibility of contamination (Ontario Ministry of the Environment, Conservation and Parks, 2019).

Cross-connection control measures are needed to prevent backflow events. The National Plumbing Code (NPC) (NRCC, 2015) is the over-riding code for cross-connection control and backflow prevention requirements. It stipulates the need to comply with the most recent version of the CAN/CSA Standard B64. Most jurisdictions have adopted the NPC. Purveyors may also have to meet additional requirements for their jurisdiction. The NPC applies from the property line into the facility. When a municipality is responsible for meters, valves, or other fittings within the property line, municipal codes or other by-laws may also apply.

Cross-connection control programs should be in place in order to prevent contamination. Such programs may include the following elements (U.S. EPA, 2003; AWWA, 2014; Ontario Ministry of the Environment, Conservation and Parks, 2019):

- Reviewing standards and regulations (including relevant provincial/territorial/municipal standards and regulations);
- Establishing program requirements, including roles and responsibilities of the drinking water system owner and building owners;
- Establishing a budget and sources of funding and resources;
- Reviewing records to identify hazards, then assessing and classifying them;
- Setting out the qualifications required for a person to be allowed to perform a building's cross-connection control survey;
- Training and educating staff;
- Surveying existing buildings to rank the connections based on the degree of hazard that they present to the water supply;
- Preparing a list of all testable backflow devices in buildings' water systems;
- Assessing new construction plans for cross-connection hazards;
- Installing proper backflow preventers;
- Instituting a tamper policy;
- Testing, inspecting, and maintaining devices; and
- Establishing protocols for notifying the building owner or responsible party to test devices.

A cross-connection control survey, as well as testing backflow prevention or cross-connection control devices, should be conducted by a certified cross-connection control specialist or other qualified professional who has expertise in this area. Devices used in the prevention of cross-connections and backflow may also deteriorate over time without regular maintenance and inspection, potentially allowing contaminants to enter the water system. Consequently, testing, inspecting, and maintaining cross-connection control devices must be done following manufacturers' instructions with guidance from CAN/CSA Standard B64. Additional guidance on cross-connection control is available from American Water and Wastewater Association (AWWA) (2015a, 2015b). You may also wish to consult your local Canadian section of AWWA for additional information relevant to the Canadian situation, as well as the relevant provincial or territorial building code.

## 4.3 Dead ends and loops

Dead ends and loops within plumbing and distribution systems result in water remaining in pipes for an extended period of time. As the water stagnates, metal concentrations may increase as a result of the pipes leaching metals into the water. Bacteriological growth in stagnant areas is also a concern.

Problems may also arise as a result of low water use or water sitting in pipes overnight (or on weekends) when no one is at the facility. As it is not possible to eliminate these times of low use, it is advisable to allow the water to run for several minutes (or an appropriate length of time for the site) after periods of low usage in order to flush the pipes. Automatic flushing hydrants are available to improve water quality at the end of lines. The appropriate flushing frequency may be determined through a sanitary survey/vulnerabilities assessment process.

As part of a sanitary survey/vulnerabilities assessment process, facility managers should work to identify any dead ends or loops in the plumbing system and measure chlorine residual. They should give special attention to dead ends and loops in flushing and monitoring schedules. Similarly, in cases where a department is responsible for the distribution system, identification of dead ends or loops and the measurement of chlorine residual should be undertaken. Again, special attention should be given to dead ends and loops in flushing and monitoring schedules. Regular maintenance of distribution systems should include uni-directional flushing and swabbing. In northern areas, it is necessary to have looped water networks designed to ensure the continuous flow of water as a means of anti-freeze protection. When undertaking maintenance activities such as unidirectional flushing and/or swabbing, best practices include creating a written plan, outlining valve-opening and closing sequences, and recording turbidity levels and flow volumes and rates.

## 4.4 Flushing of the plumbing system

Routine maintenance should include flushing water lines within a building. A minimum flushing regimen should be put into place, with flushing frequency based on the sanitary survey and vulnerabilities assessment. Water should be flushed regularly through the lines in all inactive areas of the plumbing system (e.g., water fountains that are used infrequently, areas with dead ends or loops). The entire system should be flushed once a year, regardless of use pattern. The sanitary survey and vulnerabilities assessment may identify site-specific problems that require more, or less, frequent attention.

### 4.4.1 Flushing after periods of reduced occupancy

Long-term reduced building occupancy from a specific crisis or situation, such as a natural disaster or a pandemic, may increase risks associated with water systems and the use of the potable water system for the returning and/or remaining employees. The resulting water stagnation may increase the leaching of metals such as lead, reduce the disinfectant residual and increase the risk of bacterial growth (e.g., *Legionella*). General information and considerations when planning and preparing for the return of staff/employees under these conditions is available (CSA, 2020). Some more detailed documents have been developed to address such risks (RBQ, 2020; Government of Ontario, 2020). The most relevant document for use by federal departments was developed by Public Services and Procurement Canada in early 2020 and is included as Appendix A.

## 4.5 Low pressure

The distribution system should be pressure-tested on a regular basis to ensure that flow pressure conforms to section 6.3 of the most recent version of the NPC (NRCC, 2015). Low-pressure complaints should be recorded. Low and negative transient pressures can occur as a result of distribution system operation, maintenance, power outages or watermain breaks. Low and negative transient pressures also allow contamination to enter the distribution system and should be reported and investigated to identify and address the problem. After repairing or replacing a watermain, it should be disinfected according to the AWWA C-651-14 Standard before returning it to service. If the number of low pressure complaints increases over time, it may suggest the hydraulic capacity of the system is deteriorating. A conditions assessment of the watermains can help indicate the degree of flow restriction from corrosion. This can include steps such as visual inspection of the water main interior or of the water when a watermain or hydrant is flushed (NRC, 2006).

A complete cross-connection control program includes training and education for staff. Employees who will administer the program need to be competent in the use of backflow testers, surveys, and device repair (NRCC, 2015). Each department's training plan should address these needs.

## 4.6 Water quality complaints

A preliminary assessment of the water quality in a distribution system can be completed using routine water quality monitoring data, complemented by water quality complaint records. Complaints can provide insight into areas in need of attention before they become significant problems. Departments should establish an appropriate mechanism for reporting water quality complaints (including taste, colour, high turbidity, etc.). The water quality complaint records should be recorded and tracked in a manner similar to that for low-pressure complaints or breaks. Water quality complaints related to construction and maintenance activities (e.g., flushing, repairs, new construction) should be excluded from the analysis to properly reflect the condition of the system but should be reviewed to determine if operational changes are necessary.

On-going analysis of water quality data will indicate if the water quality is changing through the distribution or plumbing system, both spatially and over time. Low chlorine residuals in some parts of a system, in combination with increased colour, high turbidity, increased iron, increased heterotrophic plate count (HPC), or drops in pressure or flow may demonstrate that the mains in these areas are deteriorating. Low chlorine residuals could also indicate deteriorating water quality (Health Canada, 2009a; AWWA, 2014). Similarly, the concentration of iron in the water may denote the degree of internal corrosion of unlined mains (Health Canada, 2009a). Complaints related to increased colour should not be assumed to be only an aesthetic issue, as they are often associated with the release of other metals such as lead and manganese (Health Canada, 2019a, 2019b). *See section 5.3 for further information.*

## 4.7 Disinfectant residuals

Disinfection in the treatment plant is critical to ensuring the safety of the drinking water supply. In addition to this primary disinfection, free and/or total chlorine is used in residual amounts to ensure continued disinfection throughout the distribution system (secondary disinfection) and to protect the water from re-contamination. Where there is a distribution system, a disinfectant residual (either chlorine or chloramine) should be maintained throughout the system at all times. The chlorine residual is the concentration of chlorine species present in water after the oxidant demand has been satisfied.

Tests of chlorine residuals at the drinking water treatment plant and in the distribution system are needed to determine chlorine dosage levels and to monitor water quality. A disinfectant residual should be detectable at all points in a distribution system. Maintenance of an adequate free chlorine residual will minimize bacterial regrowth in the distribution system and provide a measurable level of chlorine; therefore, a rapid drop in free chlorine concentrations suggesting unexpected changes in water quality can be more quickly detected.

A free chlorine residual of 0.2 mg/L is considered a desirable minimum level throughout the distribution system for control of bacterial regrowth. In the provinces and territories, specific requirements for chlorine residual concentrations are set by the regulatory authority and may vary between jurisdictions. Further information on chlorine residual can be found in the guideline technical documents for chlorine and chloramines (Health Canada, 2009b, 2020a).

In the case of a very small system or micro-system that obtains its water from a groundwater source, and has little or no distribution system, no chlorine residual is needed.

## 4.8 Drinking water materials

Drinking water materials are materials that come into contact with drinking water for its treatment or distribution, from its intake at the source through the treatment plant and the distribution system and all the way to the consumer's tap (and beyond). These materials fall into three general categories: treatment devices (such as filters and reverse osmosis systems and their components), treatment additives (such as alum and chlorine) and system components (such as pipes and faucets). Drinking water quality concerns from these materials are generally related to:

» Leaching of contaminants from the material into the drinking water;

» Treatment devices not meeting manufacturers' claims of efficiency for removing specific contaminants; and

» Treatment chemicals adding contaminants to the treated water.

Health Canada does not recommend specific brands of drinking water treatment devices or additives, but it strongly recommends that consumers look for a mark or label indicating that the product has been certified by an accredited certification body as meeting the appropriate NSF International (NSF)/American National Standards Institute (ANSI) health-based performance standards. These standards have been designed to safeguard drinking water by helping to ensure the material safety and/or performance of products that come into contact with drinking water. Certification organizations provide assurance that a product conforms to applicable standards and must be accredited by the Standards Council of Canada (SCC). An up-to-date list of accredited certification organizations can be obtained from the SCC.

NSF standards are widely accepted in North America, and reference and incorporate other relevant standards and protocols as appropriate. Some of these standards have been accredited by the SCC as a National Standard of Canada and carry the CAN designation. The NSF website (www.nsf.org) has information about both health-based and performance standards related to drinking water treatment devices. Standards exist for most drinking water treatment devices. The two key standards with respect to health effects are: NSF/ANSI/CAN Standard 60: Drinking water treatment chemicals-health effects, which addresses treatment chemicals/additives (NSF, 2019); and NSF/ANSI/CAN Standard 61: Drinking water system components-health effects, which addresses leaching from products that come into contact with drinking water, including pipes, fittings and coatings such as water storage tank liners (NSF, 2020). Additionally, certification to NSF/ANSI Standard 372: Drinking water system components-lead content, which evaluates the lead content of components such as plumbing fittings, is recommended (NSF, 2016). Certification to this standard ensures that components and materials do not contain more than 0.25% lead, as a weighted average.

Plumbing systems (internal building distribution systems) within federal buildings must be designed and constructed to meet the NPC. The NPC currently requires that fittings used in potable water applications meet relevant standards for plumbing fittings (NRCC, 2015). The relevant standards, namely ASME A112.18.1/CSA B125.1 and CSA B125.3, include requirements to comply with both NSF/ANSI/CAN Standard 61 and NSF/ANSI/CAN Standard 372 (CSA, 2018a, 2018b) to ensure that the plumbing components also meet minimum health effects requirements. Meeting the requirements of the NPC may not be possible in places such as Canadian diplomatic missions in other countries. In these situations, minimum sanitary engineering practices should be met.

Any chemicals (additives) used in drinking water treatment processes and/or the distribution system must meet the applicable health-based standards established by NSF, namely NSF/ANSI/CAN Standard 60 (NSF, 2020). This standard requires treatment chemicals meet purity criteria for drinking water applications but does not include product performance requirements. These are currently addressed in standards established by the AWWA. Because these AWWA standards complement NSF/ANSI/CAN Standard 60, regulators generally recommend that products also meet the appropriate requirements specified in the AWWA standards.

Other international standards do exist (e.g., British Standards International) but do not currently address the health-based issues related to materials that come into contact with drinking water and therefore should not be considered equivalent.

# 5.0 SPECIFIC ISSUES

## 5.1 Microbiological quality

Since the most significant health risk from drinking water supplies is the presence of disease-causing microorganisms, priority must be given to ensuring the microbiological quality of drinking water, including by ensuring the presence of an appropriate disinfectant residual throughout the drinking water system. *Specific guidance is included as part of the system-specific information in chapters 6 to 9.*

## 5.2 Drinking water advisories

Drinking water advisories are public announcements to advise the public of an identified or expected risk to their water supply. They fall into 2 separate types, as described below:

- Boil water advisories are issued in the event of a possible or confirmed microbiological contamination of drinking water (including possible failures in the treatment or distribution system).
- Drinking water avoidance advisories are issued in the event of significant contamination by chemical and/or radiological contaminants. Such contamination would not be resolved by boiling the water.

Decisions concerning drinking water advisories are generally made at the provincial, territorial or local level, using a risk management/risk assessment approach based upon site-specific knowledge and conditions. Boil water advisories are used much more commonly than drinking water avoidance advisories.

### 5.2.1 Boil water advisories

Boil water advisories are important tools in public health risk management and are by far the most commonly used type of drinking water advisory (Health Canada, 2015). They are used to advise the public that they should boil their drinking water prior to consumption in order to eliminate any disease-causing microorganisms, usually as a result of a possible or confirmed microbiological contamination. They can be issued either as a precaution against or in response to a waterborne disease outbreak.

A number of factors may prompt further investigation or form the basis for issuing a boil water advisory. These include operational conditions such as local maintenance or emergency repairs in the distribution system; equipment malfunction during treatment or distribution; inadequate disinfection or disinfectant residuals; or situations where operation of the system would compromise public health. They also include water quality conditions such as significant deterioration in the microbiological quality or increased turbidity of the source water; sudden unexpected changes in water quality; unacceptable microbiological quality of treated water; unacceptable turbidity or particle counts of treated water; or where epidemiological evidence indicates that the drinking water is or may be responsible for an outbreak of illness. During a waterborne outbreak, boil water advisories should recommend additional precautions for specific situations such as bathing, showering, handwashing and washing dishes (Health Canada, 2015).

Boil water advisories are intended to be used as short-term, incident-specific public health interventions aimed at protecting consumers from potential health risks while corrective actions are taken.

### 5.2.2 Drinking water avoidance advisories

Drinking water avoidance advisories are typically issued in emergency situations (e.g., chemical spill) to advise the public that they should avoid using their tap water, either completely or for specified uses (Health Canada, 2009c). Drinking water avoidance advisories are much less common than boil water advisories.

Drinking water avoidance advisories would typically be issued following a catastrophic event such as a natural disaster or as a result of accidental or deliberate action, where the drinking water or its source may or has become heavily contaminated (usually by chemicals) and its use could pose a significant public health risk**. Drinking water avoidance advisories are not intended to address short-term minor exceedances over existing MACs**. They rarely, if ever, require a cessation of supply, as the water will most likely be suitable for domestic purposes, such as flushing toilets and washing clothes, and necessary for essential services such as firefighting. There are two types of drinking water avoidance advisories:

» **Do not consume advisories** are used for contaminants that are only of concern through ingestion. In such cases, the water should not be used for drinking, preparing food or beverages (including ice cubes), washing fruits and vegetables, dish-washing and personal hygiene (such as brushing teeth);

» **Do not use advisories** are used for contaminants that may also be a concern from skin contact or inhalation. In such advisories, the water should not be used for any domestic purpose, including all uses identified for a "do not consume" advisory and activities such as showering and bathing.

**Box 2.** Issuing the right drinking water advisory

> Boil water advisories should only be issued to address suspected or confirmed incidents of microbiological contamination.
>
> In cases of chemical or radiological contamination, boiling the water would not improve the safety of drinking water. As MACs for these contaminants generally represent a level of exposure that is acceptable over a lifetime (70 years) without causing an increased risk to health, small exceedances over a short period of time are not sufficient to prompt the issuing of a drinking water avoidance advisory. For water that is heavily contaminated by a chemical or radiological substance (e.g., as a result of a spill), drinking water authorities can issue drinking water avoidance advisories. The type of avoidance advisory will depend on the contaminant or contaminants of concern.
>
> A "do not use" advisory would be issued when the contaminant could be absorbed by inhalation or skin contact. These would be identified in table 2 of the latest Guidelines for Canadian Drinking Water Quality Summary Table, where the last column would state that the MAC "takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing". For other chemical and radiological contaminants, a "do not consume" advisory would be issued.
>
> In some cases, the water quality may be affected by both microbiological contaminants and a significant chemical contamination. While the microbiological safety of drinking water should always be the first priority, boiling the water should be done in a manner that would minimize exposure to volatile chemical contaminants via inhalation, such as making sure that the area is well ventilated.

## 5.3 Metals

The GCDWQ apply at the consumer's cold water tap. While monitoring contaminants at the treatment plant or where the water enters a building is more practical and cost effective than monitoring at the tap, it is not appropriate for all contaminants. This is particularly true of metals that are found in the distribution and plumbing systems, where the exposure may be primarily or entirely due to leaching from system components (e.g., pipes, fittings).

Although discoloured water events (e.g., red, brown, yellow) are often considered to be only an aesthetic issue, they are likely to be accompanied by the release of accumulated metals, including lead and manganese. This occurs because many metals are adsorbed onto iron deposits in iron pipes and on other pipe materials such as PVC. These metals can subsequently be released when there are changes in water quality or disturbances (e.g., work on the plumbing or distribution system). Therefore, discoloured water events should trigger sampling for metals and possibly distribution system maintenance (Health Canada, 2019a,b).

### 5.3.1 Lead

Because lead has been widely used in drinking water distribution and plumbing systems, it continues to be found in drinking water and must be monitored at the tap where water is used for drinking or food preparation. Scientists have been studying the effects of lead on human health for a long time. Current science has determined that humans should not be exposed to lead, as it can cause adverse health effects even at very low levels. That is why it is important to reduce lead exposure as much as possible.

The most significant source of lead in drinking water is likely to be from a lead service line. Some plumbing parts or fittings, such as solder or faucets or valves, may also contain lead that can leach into drinking water. If there is a lead service line present, the most effective, and permanent, way to reduce lead from your drinking water is to completely remove it. There are also simple temporary measures that can be taken to reduce exposure to lead:

- Only use cold tap water for drinking or cooking, since hot water increases the leaching of lead and other metals from plumbing;
- Flush out your plumbing after water has been sitting in the pipes for a few hours; and/or
- Use a water treatment device certified to remove lead to the appropriate NSF/ANSI Standard for lead removal (e.g., carbon-based filter—NSF 53, reverse osmosis—NSF 58, distillation—NSF 62).
- Note that lead from drinking water is not absorbed through the skin and is not taken in through breathing. As a result, exposure to lead from showering, bathing, dishwashing or cleaning is not a concern.

## 5.4 Disinfection by-products

For systems using chemical disinfection, the GCDWQ recommends monitoring for disinfection by-products (DBPs) every three months. There are MACs for trihalomethanes (THMs) and haloacetic acids (HAAs), which are DBPs linked to the use of chlorine as a disinfectant in the presence of NOM. The MACs for both are a locational running annual average of quarterly samples that is the average concentration for samples collected, at a specific location every 3 months for the previous 12 months. Although every effort should be made to maintain concentrations of DBPs as low as reasonably achievable, the effectiveness of disinfection should never be compromised.

## 5.5 Watermains

The condition of critical watermains should be monitored to minimize failures. Critical mains are typically those which serve as a trunk line to the smaller water lines. It is also important to monitor the condition of non-critical water mains. Failures should be "managed" to minimize operational and maintenance costs (NRC, 2006).

Watermains may need to be replaced, or a structural liner may need to be used, if they fail because of high rates of breakage or excessive leakage. If hydraulic capacity or water quality are a concern, rehabilitation might be more cost-effective than replacement.

**Recording and tracking main breaks**

Federal facilities should record the location and details of watermain breaks. The total number of breaks in a year should be compiled and reviewed to identify any trends (NRC, 2006).

## 5.6 Staff quarters

The need to provide potable water to staff quarters is determined on a department-by-department basis.

## 5.7 Bottled water

In some situations, departments may need or choose to provide bottled water as an alternative source of drinking water. This would include water from water coolers and/or dispensers. Although bottled water may be safe when it is delivered, precautions should be taken to ensure it does not become contaminated at the cooler and/or dispenser. Health Canada recommends that the water cooler or dispenser be cleaned before every bottle change.

Within Canada, bottled water must meet the requirements of the *Food and Drugs Act* and Division 12 of Part B of the *Food and Drug Regulations*. Additional information is available from Health Canada.

Outside of Canada, for example in Canadian diplomatic missions in foreign countries, the bottled water available is not necessarily safe. In foreign jurisdictions where no water quality results are available from the manufacturer, departments should ensure the safety of bottled water by conducting tests as per their own policies. They may also want to select a bottled water supplier that is a member of the International Bottled Water Association (IBWA) and to request routine sample results from the supplier.

## 5.8 Drinking water fountains

Drinking water fountains should be disinfected to ensure contamination does not occur at the spigot. Current industry standards recommend that fountains be disinfected a minimum of once every two months and at an increased frequency if heavily used. They should also be maintained according to the manufacturer's recommendations.

# Part 2: System-specific Information

This document aims to provide relevant information for all departments that have some responsibilities related to the provision of drinking water. However, the extent and nature of federal drinking water programs vary, and so does the guidance that they require. Building on the information provided in Part 1, Part 2 is designed to facilitate the use of this document by providing separate guidance for each of the four possible types of drinking water systems that are relevant in the federal context, as follows:

- Chapter 6: Facilities receiving municipally-supplied drinking water
- Chapter 7: Facilities/departments producing their own drinking water
- Chapter 8: Drinking water on-board ships
- Chapter 9: Trucked water and cisterns

Each chapter will only address the components of the intake-to-tap approach that are relevant to the type of system. For example, a facility located in a large Canadian city and receiving treated water that meets the relevant provincial requirements will need less oversight than a facility producing its own water.

Nevertheless, as federal requirements do exist (e.g., *Occupational Health and Safety Regulations* under the *Canada Labour Code*), some action is still required in each of the types of system identified above.

# 6.0 FACILITIES RECEIVING MUNICIPALLY-SUPPLIED DRINKING WATER

Departments receiving municipally treated drinking water face unique challenges. They must provide their employees with drinking water that meets federal requirements for example, the GCDWQ under the *Canada Labour Code*. Additional federal, provincial and territorial standards and guidelines that offer specific protection to workers under the National Joint Council Occupational Health and Safety Directive may be applicable (*see section 2.0 and 2.4*). However, the municipal water distributed to federal facilities must meet the requirements of the provincial or territorial jurisdiction where they are located, and these requirements may differ from the GCDWQ. Facilities receiving municipal drinking water that does not meet the GCDWQ or other applicable requirements may need to implement additional strategies in order to meet the established federal drinking water requirements.

## 6.1 Municipal water quality

The quality of drinking water distributed within a municipality is the responsibility of the system owner (typically the municipality). However, federal departments and facilities still have a responsibility to verify and maintain the quality of the water received. The extent of this work will depend on the unique situation of each facility as outlined in the following sections.

### 6.1.1 Vulnerabilities assessment

Where a federal department receives municipally-treated drinking water, a vulnerabilities assessment may not be practical or necessary. In order to ensure that the water received is of acceptable quality, water quality managers and/or technical support staff should request drinking water quality data from the municipality, and maintain regular contact with the municipality's drinking water program. This will enable staff to be kept informed of any water quality or quantity issues that could affect the health of consumers.

For facilities that have regular access to municipal drinking water data, a complete assessment of these data can provide the information normally gathered through the vulnerabilities assessment. It is also important to periodically review the municipality's reports describing water sampling results in order to keep informed of the water's changing characteristics and to understand the quality of drinking water entering the facility's distribution system or building plumbing.

Facilities that do not have access to such data are still expected to conduct a vulnerabilities assessment as per sections 3.1.1 and 7.4.1.

### 6.1.2 Sanitary survey

Sanitary surveys should be conducted every five years for all systems. Sanitary surveys are needed to verify a number of factors (described in section 3.1.2), which include the condition of the plumbing, the type of materials, and the state of the connections, including cross-connection control (see section 4.2), within the building. A sanitary survey, focused on the elements that are relevant to the system, should be conducted for each system or facility, as its purpose is to maintain a comprehensive understanding of the drinking water system and any associated risks.

### 6.1.3 Baseline chemical analysis

The department does not have to conduct the baseline chemical analysis if it can access the relevant data from a reliable third party source (e.g., an accredited laboratory or a municipality).

In cases where a department cannot access the required relevant data from a reliable source, the baseline chemical analysis would include an analysis of the water received to determine if there are any concerns with the supply that require further treatment or whether an alternative source should be used. Samples should be collected at the point closest to the intake of municipal water to the building in order to establish a baseline understanding of the quality of the water received from the municipality.

## 6.2 Plumbing systems

When drinking water is provided by a municipality, the municipality's responsibility for the quality of the water generally ends at the curb or at the point where the water enters the building's plumbing system. The beginning of the facility or, in some cases, the community's supply system marks the end of municipal responsibility. However, facilities must still concern themselves with the distribution through the plumbing system within the building. Drinking water quality issues in buildings will vary with the characteristics of the building and water system. Plumbing systems may be poorly documented, particularly in older or renovated buildings. In large buildings, the plumbing/distribution system can be very long and complex, and can include large variations in flow (WHO, 2011).

Regardless of the jurisdiction over the water source, all federal purveyors of drinking water are responsible for monitoring drinking water quality in their facilities. This will enable them to detect any contamination event as soon as possible and to put in place appropriate measures to address the contamination. The department or facility's responsibilities include routine maintenance of the facility's plumbing system and analysis to determine if a change in water quality is occurring within the building. The plumbing systems of federal facilities must meet the NPC (NRCC, 2015).

## 6.3 Water Quality Monitoring

The level of monitoring needed also depends on the facility and the municipality providing its drinking water. Monitoring frequencies should be established by the appropriate department or responsible authority, with proper guidance and due consideration of the factors discussed in the subsections below and any regulatory requirements. In some cases, it may be possible to negotiate to have the federal building designated as a routine municipal water sampling location, which would decrease the need for sampling.

#### 6.3.1 Microbiological quality

Facilities that receive water from a Canadian municipality should be receiving microbiologically safe water that contains an adequate chlorine residual. However, it is the responsibility of the department to have the appropriate documentation (e.g., sanitary survey results, third party reliable data) to verify that the incoming water is microbiologically safe. In facilities that have confirmed they are receiving microbiologically safe water, there is no need to routinely collect *E. coli* or total coliform samples where the distribution system is minimal (i.e., consists of a single building). These facilities do need to determine that the water quality is being maintained inside the building plumbing system. This should include having a cross-connection control program in place (see section 4.2), regular cleaning and maintenance of system components (e.g. faucets, drinking water fountains—see section 5.8), and testing for parameters that can be done onsite. This could include monitoring chlorine residuals, monitoring turbidity, checking for colour/taste/odour issues and checking water temperatures. In addition, some facilities may be required to follow monitoring requirements described in a *Legionella* bacteria management control program. In facilities with more complex distribution systems (e.g. campuses consisting of multiple buildings), total coliform and *E. coli* should be included in monitoring programs to confirm the microbiological quality of the water is being maintained.

Where the quality of the municipally supplied water does not meet the microbiological parameters in the GCDWQ or is uncertain (e.g., no sanitary survey information, absence of third party reliable data, inadequate chlorine residual levels), the system should be considered to be an untreated supply and steps must be taken to ensure public health is protected. The guidance in other parts of this document (e.g., chapters 4, 5, and 6) will help departments fulfill their responsibility to provide safe drinking water to their employees.

Facilities receiving municipal drinking water that require *E. coli*/total coliform monitoring should collect samples at the main or at the point of entry to the building (where applicable), in the building's plumbing system (i.e., dead ends), and in other locations identified in the sanitary survey.

#### 6.3.2 Chemical parameters

Federal facilities that receive water from a municipal source will usually have to monitor chemical parameters that may be affected by the distribution system supplying the facility and the facility's plumbing (e.g., lead, copper and manganese levels). However, it is important to be aware of issues related to the municipal water source and to obtain regular drinking water quality reports from the municipal purveyor. If this is not feasible, drinking water samples may need to be collected for some additional parameters.

# 7.0 FACILITIES/ DEPARTMENTS PRODUCING THEIR OWN DRINKING WATER

The properties of the treated water will be affected by the quality of the source water, treatment components and design, treatment processes and chemicals used, treatment efficiency, and distribution system characteristics.

## 7.1 Selecting a source for drinking water

For new systems, the selection of a source water must take into consideration the results of the vulnerability assessment and baseline chemical survey as well as other factors, including whether:

- The source water is of high enough quality that it can be rendered safe for human consumption.
- The quantity of water available is suitable for the number of people who will be using it over the long term, the types and duration of activities they will use it for, and water demands for other uses (e.g., industrial or recreational).

When selecting a source for drinking water, more than one water source should be evaluated, where practical. Doing so will help determine whether a better source exists or if an alternative source is available that can be used as a back-up in cases where the chosen water supply becomes contaminated or otherwise unsuitable.

## 7.2 Design of drinking water treatment systems

Treatment systems should be designed based on the site-specific raw water quality and quantity and should take into account seasonal variations. Because of the complexity of assessing the level of risk associated with drinking water hazards, as well as the need to properly design a water treatment system, the evaluation of the source water and the design and construction of the treatment facility should be performed by appropriately qualified specialists (e.g., registered professional engineers).

### 7.2.1 Continuous monitoring and automated systems

When considering the construction of a new treatment plant or upgrading an existing plant, it is recommended that the design include an automated, continuous monitoring system that allows an operator to control and monitor processes from a central location. When a plant does not have an operator present 24 hours per day, 7 days per week, such systems are capable of calling a designated location if there is a process failure during silent hours. In addition, the use of some remote monitoring technologies, such as SCADA or similar, allows the operator to make operational adjustments from a remote location. These products should be secure from accidental or deliberate interference.

Automation is advantageous in situations where an operator's duties are shared between different systems or different roles (i.e., not just drinking water) and when it is not possible for the operator to physically check equipment every day (including weekends). It can be used for any size of system; however, the utility of automation in a very small system would have to be assessed in terms of the costs and benefits related to the level of risk the water system represents to the users. The costs associated with the operator's time need to be assessed against the cost of the suggested equipment.

For very small systems, less sophisticated automated notification systems can be used to communicate alarms to an offsite location, such as a pager or phone, when a water quality parameter is out of compliance.

### 7.2.2 Surface water intakes

A surface water source requires an intake structure for drawing water into the water treatment system. The main purpose of the intake structure is to draw in water while preventing leaves and other debris from clogging or damaging pumps, pipes, and other pieces of equipment in the treatment plant. The location of the water intake structure can greatly affect the quality of the water withdrawn. Ideally, the intake would be located upstream of any potential source of contamination or, if that is not possible, sufficiently downstream to minimize impact. It should also be located deep enough under water to ensure that the water around it does not freeze in the winter, thereby ensuring water can be drawn year round, but far enough from the bottom of the water body to avoid sediments and mud. Another consideration for surface water intakes is whether the water body is susceptible to cyanobacterial blooms (blue-green algae) which could produce cyanobacterial toxins such as microcystins (Health Canada, 2017).

Proper design, maintenance, and operation of surface water intakes are essential to prevent partial or complete shut-down of the entire drinking water system. Screens should be cleaned regularly to prevent blockage. Each spring, the lake or river intake pipe and screen should be inspected by divers to ensure no damage has occurred over the winter.

### 7.2.3 Treatment options

The treatment process selected should address all potential hazards identified in the source assessment (Health Canada, 2001). Minimum treatment of all supplies derived from surface water sources and groundwater under the influence of surface waters should include filtration (or technologies providing an equivalent log reduction credit) and disinfection. Treatment of groundwater sources should include a minimum 4 log (99.99%) removal and/or inactivation of enteric viruses, unless the responsible jurisdiction has determined that the risk of enteric viruses is minimal (Health Canada, 2020b).

## 7.3 Distribution systems

### 7.3.1 Design and assessment

Distribution systems, including treated water reservoirs, should be designed to take the following into account: public access, access by wildlife, system capacity, emergency water storage (including fire flow capacity), contact time required for disinfection, the minimization or elimination of dead ends, and cross-connection control. They should also be designed and constructed to comply with all local or provincial by-laws and regulations and take into account best management practices.

Federal facilities that supply their own drinking water have to consider the distribution system from the treatment plant to the building or to the curb stop before the house (this may include water delivered by trucks) and then within the building to consumers. Federal facilities that rely on a municipal supply but also have their own distribution system, such as campuses or bases, need to consider the distribution system from the municipal connection point to the building or to the curb stop of the house.

Portions of the infrastructure that are accessible to the public and/or animals should be secured, where applicable. Treated water reservoirs should be covered, watertight, and secured to prevent contamination.

When assessing the condition of water distribution systems, a two-phase approach is suggested. The first phase involves a preliminary assessment of the structural condition, hydraulic capacity, leakage and water quality on a system-wide basis using existing data. The second phase involves a more detailed investigation of specific problems based on findings of the preliminary assessment.

The most effective way to investigate the condition of a water distribution system is through regular analysis of readily available data. A preliminary assessment of this data should be conducted every three to five years to identify trends and to determine the need for more detailed investigations. If the preliminary assessment indicates that a more detailed investigation is needed, experts in distribution system analysis should do the work.

## 7.4 Developing a monitoring program

The monitoring program for all federal facilities/departments producing their own drinking water should be developed based on the combined findings of a vulnerabilities assessment, a sanitary survey and a baseline chemical analysis, each conducted by a competent expert in the appropriate field.

At minimum, an initial sanitary survey, vulnerabilities assessment, and baseline chemical analysis should be conducted within five years for an existing system and before a new system is put into service. They should continue to be conducted every five years, or when there are significant changes to the treatment system, land use, or other conditions which may adversely affect water quality.

Although the survey/assessment/analysis may only be done every five years, departments should endeavour to be aware on an on-going basis of any changes at a site that could impact water quality. This will help to determine if changes are required to the monitoring program. *See Section 7.4.3 for specific guidance in cases where the frequency of the baseline chemical analysis may be reduced.*

### 7.4.1 Vulnerabilities assessment

The first step in assessing the drinking water supply is to assess the quality and quantity of the source water. The vulnerabilities assessment is a comprehensive assessment of the vulnerability of the source water in the environment. For micro-systems or individual households (where applicable), it may be difficult to conduct a detailed assessment of the vulnerability and a simplified vulnerability assessment (as detailed below) may be sufficient to determine the quality of the source water. The results of the vulnerabilities assessment help determine the extent of treatment or other management actions required.

Drinking water supplies may originate from surface water or subsurface sources. Microbiological risks differ depending on the type of source. Surface water is defined as water open to the atmosphere or subject to surface run-off. It is vulnerable to contamination, including microbiological, and must be treated. Subsurface sources vary in their vulnerability to contamination. Groundwater under the direct influence of surface water (GUDI) carries the same risks to health as surface water and is dealt with in the same way. It is defined as any water beneath the surface of the ground with (i) occurrence of insects or other microorganisms, algae, organic debris, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or (ii) significant fluctuations in water characteristics such as turbidity, temperature, conductivity, or pH which may closely correlate to climatological or surface water conditions.

Most other subsurface sources are vulnerable to fecal contamination, particularly from enteric viruses, but to varying degrees. The vulnerability of the aquifer is typically determined by a hydrogeologist or other well specialist. Enteric viruses have been detected in many different types of aquifers highlighting the importance of assessing the risk of the aquifer to contamination. Wells in thick and protected sand aquifers with deeper water tables may be at lower risk, whereas shallow wells and wells in fractured bedrock (which make up the majority of wells in Canada) are highly vulnerable to contamination from fecal sources.

Vulnerabilities assessment reports for groundwater systems should ideally include a description of the facility and surrounding land use, the direction and rate of groundwater flow, capacities of the selected water source, the radius of influence, hazards associated with the water source, and protection measures that are either in place or needed.

As part of the overall assessment, an evaluation of demands on water quantity is also required.

**Delineation of watersheds and aquifers**

The land area that contributes water and potential contaminants to the water supply should be defined and mapped (delineated) in order for drinking water managers to focus their efforts within a defined area and respond appropriately to incidents or emergencies.

This component of the vulnerabilities assessment should include characterizing the water source, geology, and features of the surrounding area to determine what may be in the water and what could become a concern in the treated drinking water (e.g., bromide in humic acid in the source water could react with chlorine or other chlorinated disinfectants to form brominated disinfection by-products at the tap). Many methods exist to delineate watersheds and aquifers, ranging from simplistic terrain mapping to complex mathematical models requiring significant amounts of field data. The decision about which method is required will depend on source water characteristics and the relative risk of contamination.

For wells serving micro-systems and individual households, vulnerability assessments may be limited to information on well construction, type of aquifer material surrounding the well and the location of the well in relation to sources of fecal contamination (e.g. septic systems, sanitary sewers, animal waste).

**Identifying source water hazards**

The next step is to identify the potential hazards to the water source within the delineated area. Hazards can be identified in a number of ways such as inventories of land uses and contaminant sources, evaluations of watershed and/or aquifer characteristics, and monitoring data related to source water quality and quantity.

The level of effort expended on identifying hazards will depend on available resources. However, the goal should be to collect as much data as feasible on contaminants (including their sources and concentrations), pressures on water quantity, and to fill knowledge gaps with new information from public consultations and/or field studies.

In the vulnerabilities assessment, it is essential to identify hazards since they influence the type of treatment required and any response required in the watershed or aquifer. For instance, a watershed where the primary hazards come from industrial effluent will be managed differently than one where the main threat to water quality is nutrient enrichment.

**Susceptibility to contamination**

Once the hazards have been identified within a delineated area, the vulnerability of the source to the hazards needs to be determined. The potential impact of the hazards on human health also needs to be determined. The results of these assessments influence the treatment required to ensure the water is safe and aesthetically pleasing for human consumption. For subsurface sources that are not considered GUDI, there may be insufficient information available to determine if a well is vulnerable, specifically to viral contamination. In those situations, treatment of the well is a way to reduce risk. The risks associated with contamination of subsurface sources vary with the type of activities on the property, the surrounding land use, soil type, and the type and condition of the wellhead or wellfield. More information on determining groundwater vulnerabilities is available in Health Canada (2019c).

Assessments also guide integrated watershed/aquifer protection efforts by identifying the quantity and quality of the water and its potential vulnerability to degradation. Assessment results may be extremely useful to other agencies and stakeholders who share common interests.

In assessing vulnerability or risk, the data from the identification of hazards needs to be complemented with monitoring data to get an idea of the concentration at which the contaminant is found in the source water and whether this concentration fluctuates over time. Many systems may rely on indicator monitoring results as opposed to monitoring directly for contaminants. Fluctuations in physical parameters should also be noted. These types of data are gathered through long-term monitoring programs. While concentrations can be modelled, it is preferable to obtain real-time, site-specific monitoring data.

The amount of effort and resources expended on assessing a water supply will depend on factors such as its size, use, and location. In the case of subsurface supplies, suitable sealing, capping, filling or removal of abandoned wells is important to ensure the safety of the aquifer and the environment and to protect against future hazards. (Note: Listing relevant guidelines for abandoning wells is beyond the scope of this document.)

More information on wells has been developed by Health Canada. Although it is primarily targeted at private well owners, the information may also be of use to departments for their facilities relying on well water. The Be Well Aware series of documents is available at the following URL: www.canada.ca/en/health-canada/services/publications/healthy-living/water-talk-information-private-well-owners.html

#### 7.4.2 Sanitary survey

The elements of a sanitary survey, outlined in Section 3.1.2 and in Box 1, cover a drinking water system from intake to tap. Sanitary surveys, while they cannot replace water quality analyses, are an essential complement to drinking water quality test results. They allow for an overall appraisal of the many factors associated with a drinking water system.

The sanitary survey for a water supply should include a review of previous sampling results, identify whether further treatment is required, investigate the type of well in place (or proposed), and, in the case of subsurface supplies, lay out requirements for wellhead protection. It should recommend improvements and upgrades where needed, and identify any compliance and enforcement issues. Federal staff will then be able to regularly update records (CDW and CCME, 2004).

Sanitary surveys are intended to provide a range of information and to locate potential problems. The data obtained may identify failures, anomalies, operator errors, and any deviations from normal conditions that may affect the production and distribution of safe drinking water.

All the elements outlined in Box 1 would be relevant for departments/facilities responsible for producing their own drinking water.

#### 7.4.3 Baseline chemical analysis

A baseline chemical analysis is an analysis of all chemical parameters with MACs in the GCDWQ. The analysis includes screening for radiological parameters where testing is feasible or warranted. Departments may also choose to look at parameters with aesthetic and/or operational values. Pesticides are generally tested in a suite. However, there may be no need to test for some pesticides (e.g., those not used in a particular watershed). A water quality professional should make this determination.

As a safeguard, it is recommended that a baseline chemical analysis be conducted every five years, unless a sanitary survey or vulnerabilities assessment indicates that this type of analysis should be done more or less frequently. If particular substances are consistently absent from a water system, the frequency of sampling for those substances can be reduced. As well, where water supplies are obtained from sources that are not likely to be contaminated by industrial and agricultural wastes, a baseline chemical analysis may be needed only to help select new drinking water sources and then only occasionally thereafter.

### 7.5 Operational and compliance monitoring

#### 7.5.1 Operational monitoring

Operational monitoring practices focus on critical control points in the drinking water system to ensure that the system is being operated as required. This type of monitoring allows the operator to detect changes in water quality to allow the operator to take action quickly, including by adjusting the treatment process. It helps ensure that the treatment system is working effectively. In addition, increased monitoring during extreme conditions yields important information on source water quality and on the ability of the treatment to cope, and helps identify required improvements.

Operational monitoring strategies need to be system-specific, based on the characteristics of the system and its source water. They should be part of the operational plan of the water system. Continuous monitoring is recommended for some operational parameters, depending on the water system. For example, where feasible, plants using chlorine-based disinfectants should continuously monitor chlorine and plants with filtration systems should continuously monitor turbidity. Other parameters (e.g., those used to characterize NOM) should have source-specific monitoring plans.

Tests for operational monitoring do not need to go to an accredited lab. However, written operational monitoring records should be kept on-site and a quality assurance program incorporating quality control practices, should be in place.

### 7.5.2 Compliance monitoring

In addition to the baseline chemical analysis, it is recommended that monitoring programs for identified chemical contaminants include, at minimum, annual monitoring for surface water sources, and monitoring every two years for groundwater sources, unless otherwise specified in the GCDWQ. For systems using chemical disinfection, monitoring of DBPs should be conducted every three months, to meet the requirements of the GCDWQ. For example, the MACs for THMs and HAAs, which are DBPs linked to the use of chlorine as a disinfectant, are established as locational running annual averages of quarterly samples.

When treatment is in place for chemical reduction, it is recommended that samples be collected after treatment (prior to distribution). Paired samples of source and treated water should be taken to confirm the efficacy of the treatment.

Since lead is usually found in drinking water as a result of leaching from distribution and plumbing system components, sampling programs for lead should be conducted, collecting water at the tap using the appropriate protocol for the type of building being sampled (Health Canada, 2019a).

## 7.6 Microbiological considerations and monitoring

Since the most significant health risk from drinking water supplies is the presence of disease-causing microorganisms, the most important goal of drinking water treatment is to reduce microbiological risk in the treated water to an acceptable level. The most appropriate type and level of treatment should take into account the potential fluctuations in the source water quality, including short-term water quality degradation, and variability in treatment performance.

For this reason, it is important that federal drinking water quality management systems address any existing and potential microbiological quality concerns at the site (e.g., level of treatment, historical testing results, surface and groundwater vulnerabilities, potential water quality risks, user activities, and local trends), prior to establishing a routine monitoring regimen. Given the sheer number of federal drinking water systems and the wide variety in system size, location, and site-specific concerns, the guidance in this document is designed to be flexible. For the purpose of this document, drinking water systems have been categorized as large, small, very small, and micro-systems depending on the size of the population they were *designed* to serve *(see Section 7.6.1 below for definitions)*. These categories do not include wells serving individual households and therefore separate advice is included in this document where applicable.

Microbiological monitoring programs for all types of systems should include the indicator organisms *E. coli* and total coliforms. Depending on the system, other parameters that can help ensure the microbiological integrity of the water, such as turbidity and chlorine residuals, should be monitored, as well as site-specific monitoring to characterize NOM. System operators may also choose to use a variety of other methods and parameters in order to ensure that there has been minimal change in microbial water quality in the distribution system, a concept referred to as maintaining biological stability. Changes in biological stability can be measured using many of the parameters that are already being monitored. System operators should employ a combination of the most appropriate methods and parameters, based on a system-specific assessment, cost, and ease-of-use, to routinely monitor distribution system water quality and establish baseline conditions, monitor changes and detect potential or actual contamination events.

Generally, minimum treatment of supplies derived from surface water sources or groundwater under the influence of surface water should include adequate filtration (or technologies providing an equivalent log reduction credit) and primary disinfection. Treatment of groundwater sources should include a minimum 4 log (99.99%) removal and/or inactivation of enteric viruses, unless the responsible jurisdiction has determined that the risk of enteric viruses is minimal. Where there is a distribution system, a disinfectant residual (either chlorine or chloramine) should be maintained throughout the distribution system at all times (secondary disinfection). Very small systems or micro-systems where there is little or no distribution system do not require a disinfectant residual. Commonly used disinfectants include chlorine (primary and/or secondary disinfection), chloramine (secondary disinfection), chlorine dioxide (primary disinfection), ultraviolet radiation (UV—primary disinfection) and ozone (primary disinfection).

It is important to note that all chemical disinfectants used in drinking water can be expected to form DBPs, which may affect human health. Current scientific data show that the benefits of disinfecting drinking water (reduced rates of infectious illness) are much greater than any health risks from DBPs. While every effort should be made to reduce concentrations of DBPs, any method of control must not compromise the effectiveness of disinfection.

### 7.6.1 Types of water supplies and systems

For the purpose of this document, the following definitions apply to drinking water systems owned or leased by the federal government. Although the same basic principles apply for all drinking water systems, some guidance has been provided in this document that is specific to a given size and/or type of system.

- **Large systems** are designed to serve more than 5000 people.
- **Small systems** are designed to serve between 501 and 5000 people.
- **Very small systems** are designed to serve between 26 and 500 people.
- **Micro-systems** are designed to serve up to and including 25 people (excluding wells serving individual households).

### 7.6.2 Monitoring frequency

For departments/facilities who produce/treat their own drinking water, the recommended monitoring frequency for microbiological parameters depends on a number of factors, including the size of the population served, the monitoring history, type and quality of the source water, and the presence and type of treatment used.

Some guidance on monitoring frequency is provided in the GCDWQ. Monitoring frequencies at the facility or system level should be established by the appropriate department or responsible authority, with proper guidance and due consideration of the above factors and any regulatory requirements.

Generally, for all systems serving up to and including 5,000 people, bacteriological samples should be collected at a minimum four times per month at regular intervals as shown in Box 3. Sampling could be scheduled to match provincial guidelines or regulations where these are more stringent. It is recommended that chlorine residuals and turbidity be tested when bacteriological samples are taken. Ideally, each monitoring event for *E. coli* and total coliforms should include samples at both the treatment plant and in the distribution system. Wells serving individual households should be sampled as per the provincial recommendations where the wells are located (where applicable).

*Box 3 lists the default monitoring frequencies that should be followed (unless conditions are met for reduced monitoring as per Section 7.6.2, Boxes 4 through 8) by departments and other responsible authorities who produce/treat their own drinking water.*

**Box 3. Default monitoring frequency and locations**

| Systems serving up to and including 5,000 people | | |
|---|---|---|
| **Groundwater** | | |
| *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) |
| Four times per month | Sampled four times per month in conjunction with *E. coli*/ total coliforms | Continuous or daily[1] |

**Sampling locations**

*E. coli*/total coliforms and turbidity:

- At the source
- After treatment
- At representative locations in the distribution system (if applicable)

Chlorine residual (if applicable)

- After treatment
- At representative locations in the distribution system

| Surface water or GUDI | | |
|---|---|---|
| *E. coli*/Total coliforms | Turbidity[1] | Chlorine residual[1] |
| Four times per month | Continuous or daily | Continuous or daily |

**Sampling locations**

*E. coli*/total coliforms and chlorine residual:

- After treatment
- At representative locations in the distribution system (if applicable)

Turbidity:

- At the source, prior to treatment
- In treatment plant after each filter (if applicable)
- At representative locations in the distribution system (if applicable)

[1] Distribution system samples may be at a lower frequency.

See Boxes 4–7 for additional guidance.

For routine sampling, an effort should be made to collect and analyze samples when the risk of contamination is highest and there is a potential public health risk (e.g., spring thaw, heavy rains, dry periods, noticeable deterioration in water quality).

During high risk events (e.g., flooding, extreme/unusual weather events), there may be a need for additional monitoring. Additional monitoring should also be done when alterations are made to treatment, plumbing, or distribution systems. In addition, new or renovated wells should be sampled and analyzed at start-up to confirm acceptable bacteriological quality (Health Canada, 2020b).

Where the finished water is expected to come into contact with a distribution system, a storage tank, or a trucked (hauled) water container, a chlorine residual should be maintained at all times (throughout the distribution system and/or in the storage tank and/or trucked (hauled) water container). If a very small system or micro-system has little or no distribution system, no chlorine residual is required.

Both surface water and GUDI systems require filtration (or technologies providing an equivalent log reduction credit) in addition to disinfection, unless systems are exempt from this requirement by the appropriate authority based on site-specific considerations. The main considerations are outlined in the guideline technical document on turbidity (Health Canada, 2012).

### 7.6.3 Conditions for reducing monitoring frequency

There is no flexibility provided for small systems (i.e., serving 501 to 5000 people) to reduce monitoring frequencies. In some cases, for very small systems and micro-systems, it may be possible to reduce the number of samples taken and analyzed.

Boxes 4 through 8 define the conditions for reduced monitoring frequency, once an acceptable history has been established. **Box 4 must be read together with each of Boxes 5 to 8.** The department must default to four samples per month for systems serving 500 or fewer people if the conditions identified in Box 4 and tables 5 through 8 are not met.

Box 4. Conditions for reduced monitoring frequencies in very small and micro systems

**Conditions for reduced monitoring frequencies**

- For very small systems, the supply should have a vulnerabilities assessment with acceptable results and a history of acceptable bacteriological quality (i.e., monitoring history).
- For very small systems and micro-systems in the "treated—surface water or GUDI" category, departments may choose to reduce monitoring frequency for turbidity and chlorine residuals if they are satisfied that they have adequate strategies to ensure health protection in place.
- For micro-systems, while having both a vulnerabilities assessment and a monitoring history is recommended, this is not always possible. Therefore, for these systems only, the department may choose to accept either a vulnerabilities assessment with acceptable results or a history of acceptable bacteriological quality, to implement a reduced monitoring frequency.

**Box 5.** Reduced monitoring for very small systems—continuous supply

| **Very small systems** (26 to 500 people): Reduced monitoring frequency where conditions are met | | | | | |
|---|---|---|---|---|---|
| Conditions for reduced monitoring:<br>» A vulnerabilities assessment with acceptable results and a monitoring history of acceptable bacteriological quality<br>» Where water is treated, process in place to ensure treatment system operating effectively | | | | | |
| **Reduced monitoring frequency** | | | **Further reductions/conditions** | | |
| *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) | *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) |
| **Groundwater*—Not disinfected** | | | | | |
| Once monthly, at regular intervals | Sampled in conjunction with *E.coli*/ total coliforms | N/A | No further reductions | No further reductions | N/A |
| **Groundwater*—Disinfected** | | | | | |
| Once monthly, at regular intervals | Sampled in conjunction with *E.coli*/ total coliforms | Once weekly | May be reduced to no less than once quarterly, at regular intervals, IF process is in place to ensure treatment system operating effectively and weekly monitoring demonstrates:<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (if applicable). | Sampled in conjunction with *E.coli*/ total coliforms | No further reductions |
| **Treated—Surface water or GUDI** | | | | | |
| Once monthly, at regular intervals if daily monitoring demonstrates:<br>» Turbidity of treated water consistently meeting the GCDWQ turbidity limits<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (where applicable). | Once daily | Once daily | No further reductions | No further reductions (Also see 3rd bullet in Box 4) | No further reductions (Also see 3rd bullet in Box 4) |
| **Sampling locations**<br>*E. coli*/Total coliforms:<br>» At source (for groundwater systems)<br>» After treatment (if applicable)<br>» At representative locations throughout the distribution system (if applicable)<br>Turbidity:<br>» At source, prior to treatment<br>» In treatment plant after each filter (if applicable)<br>» At representative locations throughout the distribution system (if applicable)<br>Chlorine residual (if applicable):<br>» After treatment<br>» At representative locations throughout the distribution system | | | | | |

* applies to subsurface water that is not considered GUDI

**Box 6. Reduced monitoring for very small systems—seasonal supply**

**Very small systems** (26 to 500 people): Reduced monitoring frequency where conditions are met

Conditions for reduced monitoring:

» A vulnerabilities assessment with acceptable results and a monitoring history of acceptable bacteriological quality

» Where water is treated, process in place to ensure treatment system operating effectively

| **Reduced monitoring frequency** | | | **Further reductions/conditions** | | |
|---|---|---|---|---|---|
| *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) | *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) |
| **Groundwater*—Not disinfected** | | | | | |
| At start-up and once monthly, regular intervals, during operating period | Sampled in conjunction with *E.coli*/ total coliforms | N/A | No further reductions | No further reductions | N/A |
| **Groundwater*—Disinfected** | | | | | |
| At start-up and once monthly, regular intervals, during operating period | Sampled in conjunction with *E.coli*/ total coliforms | Once weekly, during operating period | May be reduced to once quarterly, at regular intervals during operating period, IF process is in place to ensure treatment system operating effectively, and weekly monitoring demonstrates:<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (where applicable). | Sampled in conjunction with *E.coli*/ total coliforms | N/A |
| **Treated—Surface water or GUDI** | | | | | |
| At start-up and once monthly, regular intervals, during operating period, if daily monitoring demonstrates:<br>» Turbidity of treated water consistently meeting the GCDWQ turbidity limits<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (where applicable). | Once daily, during operating period | Once daily, during operating period | No further reductions | No further reductions (Also see 3rd bullet in Box 4) | No further reductions (Also see 3rd bullet in Box 4) |

**Sampling locations**

*E. coli*/Total coliforms:

» At source (for groundwater systems)

» After treatment (if applicable)

» At representative locations throughout the distribution system (if applicable)

Turbidity:

» At source, prior to treatment

» In treatment plant after each filter (if applicable)

» At representative locations throughout the distribution system (if applicable)

Chlorine residual (if applicable):

» After treatment

» At representative locations throughout the distribution system

* applies to subsurface water that is not considered GUDI

Box 7. **Reduced monitoring for micro-systems—continuous supply**

**Micro-systems** (1 to 25 people): Reduced monitoring frequency where conditions are met

Conditions for reduced monitoring:

- A vulnerabilities assessment with acceptable results or a monitoring history of acceptable bacteriological quality
- Where water is treated, process in place to ensure treatment system operating effectively

| **Reduced monitoring frequency** | | | **Further reductions/conditions** | | |
|---|---|---|---|---|---|
| *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) | *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) |
| **Groundwater*—Not disinfected** | | | | | |
| 4 samples per year (i.e., once quarterly at regular intervals | N/A | N/A | No further reductions | N/A | N/A |
| **Groundwater*—Disinfected** | | | | | |
| 2 samples per year when risk of contamination highest (spring and fall) | N/A | Once monthly | No further reductions | N/A | No further reductions |
| **Treated—Surface water or GUDI** | | | | | |
| 4 samples per year (i.e., once quarterly at regular intervals) IF daily monitoring demonstrates:<br>» Turbidity of treated water consistently meeting the GCDWQ turbidity limits.<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (where applicable). | Once daily | Once daily | No further reductions | No further reductions (Also see 3rd bullet in Box 4) | No further reductions (Also see 3rd bullet in Box 4) |

**Sampling locations**

*E. coli*/Total coliforms:

- At source (for groundwater systems)
- After treatment (if applicable)
- At representative locations throughout the distribution system (if applicable)

Turbidity:

- At source, prior to treatment
- In treatment plant after each filter (if applicable)
- At representative locations throughout the distribution system (if applicable)

Chlorine residual (if applicable):

- After treatment
- At representative locations throughout the distribution system

* applies to subsurface water that is not considered GUDI

Box 8. Reduced monitoring for micro-systems—seasonal supply

**Micro-systems** (1 to 25 people): Reduced monitoring frequency where conditions are met

Conditions for reduced monitoring:

- A vulnerabilities assessment with acceptable results or a monitoring history of acceptable bacteriological quality
- Where water is treated, process in place to ensure treatment system operating effectively

| **Reduced monitoring frequency** | | | **Further reductions/conditions** | | |
|---|---|---|---|---|---|
| *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) | *E. coli*/Total coliforms | Turbidity | Chlorine residual (if applicable) |
| **Groundwater*—Not disinfected** | | | | | |
| Minimum of 3 samples per period of operation (at least one every three months at regular intervals), including at start-up and mid-season (if possible) | N/A | N/A | No further reductions | N/A | N/A |
| **Groundwater*—Disinfected** | | | | | |
| 2 samples per period of operation, including at start-up | N/A | Once monthly during operating period | No further reductions | N/A | No further reductions |
| **Treated—Surface water or GUDI** | | | | | |
| 2 to 4 samples per period of operation, including at start-up and mid-season, IF daily monitoring demonstrates:<br>» Turbidity of treated water consistently meeting the GCDWQ turbidity limits.<br>» Acceptable chlorine residual leaving treatment plant and in distribution system (where applicable). | Once daily | Once daily | No further reductions | No further reductions (Also see 3rd bullet in Box 4) | No further reductions (Also see 3rd bullet in Box 4) |

**Sampling locations**

*E. coli*/Total coliforms:

- At source (for groundwater systems)
- After treatment (if applicable)
- At representative locations throughout the distribution system (if applicable)

Turbidity:

- At source, prior to treatment
- In treatment plant after each filter (if applicable)
- At representative locations throughout the distribution system (if applicable)

Chlorine residual (if applicable):

- After treatment
- At representative locations throughout the distribution system

* applies to subsurface water that is not considered GUDI

### 7.6.4 Sampling locations

Samples should be taken at the point where the water enters the system (to eliminate the source water as the cause of the adverse water quality), in the treatment plant after each filter (if applicable) and from representative points throughout the network, although not necessarily the same points on each occasion. Samples should also be taken in any other locations identified in the sanitary survey as areas of concern. For **very small systems** where there is little or no distribution system, samples should be taken at the first point where water is taken for drinking.

If the water supply is obtained from more than one source, the location of sampling points in the distribution system should ensure that water from each source is periodically sampled. The majority of samples should be taken in potential problem areas: low-pressure zones, reservoirs, dead ends, areas at the periphery of the system farthest from the treatment plant and areas with a poor previous record.

### 7.6.5 Interpreting indicator organisms results

As part of a "source to tap" approach, testing for *E. coli* and total coliforms should be used to verify the microbiological quality of the water. The GCDWQ have separate guideline technical documents for each of these parameters. *Information regarding sample analysis and laboratory accreditation can be found in Section.3.5.*

***E. coli***

*E. coli* is a member of the total coliform group that is naturally found in the intestinal system of humans and animals. It is present in feces in high numbers and can be easily measured in water, which makes it a useful indicator of fecal contamination for drinking water providers. The GCDWQ state that the MAC of *E. coli* in a drinking water system is none detectable per 100 mL. The presence of *E. coli* indicates recent fecal contamination and the possible presence of enteric pathogens that may adversely affect human health. If *E. coli* is detected, the appropriate agencies should be notified, and corrective actions taken, including re-sampling. A boil water advisory should be issued when the presence of *E. coli* is either detected or confirmed.

**Total coliforms**

Total coliforms are an indicator of the general microbiological quality of the water. Although they are not a reliable indicator of fecal contamination, they are considered to be a good indicator of recent fecal contamination. Members of the total coliform group are found naturally in water, soil and vegetation, as well as in faeces. The GCDWQ establish a MAC for total coliforms of none detectable per 100 mL in water leaving a treatment plant or in groundwater leaving the well. They also state that total coliforms should be monitored in distribution systems. For municipal scale systems, the detection of total coliforms from consecutive samples from the same site in the distribution system or from more than 10% of the samples collected in a given sampling period indicates changes in water quality and should be investigated.

As total coliforms are easily destroyed during disinfection, their presence in water leaving a treatment plant indicates that treatment has been inadequate and that additional actions need to be taken (e.g., notification, investigation, possible issuance of a boil water advisory).

The presence of total coliforms in the distribution and storage system, when water tested immediately post-treatment is free of total coliforms, indicates water quality degradation, possibly via bacterial regrowth or post-treatment contamination. It does not necessarily mean a boil water advisory must immediately be issued; however, the source of the problem should be determined and corrective actions taken (Health Canada, 2020c).

In well water, the presence of total coliform bacteria in the absence of *E. coli* indicates the well may be prone to surface water infiltration and is therefore at risk of fecal contamination, or may indicate the presence of biofilm in the well or plumbing system (Health Canada, 2020c). A biofilm is a community of microorganisms attached to a solid surface in an aquatic environment, for example the inside wall of a pipe. Even though the biofilm itself is not a health concern, it could harbor pathogens and/or interfere with analytical testing. Also, it could eventually impede water flow, potentially leading to the deterioration of aesthetic water quality and ultimately to taste and odour problems.

If total coliforms are found in the absence of *E. coli* in a non-disinfected groundwater system, necessary action will vary depending on the source of the total coliforms and the size and history of the system. For very small systems and micro-systems, it is recommended that boil water advisories be issued—or an alternative safe source of drinking water used—if the presence of total coliforms has been confirmed in the groundwater system. Regardless of whether a boil water advisory was issued, corrective actions should be implemented.

Corrective actions could include shock chlorination (the addition of a strong solution of liquid chlorine into a drinking water system to reduce the presence of microbiological contaminants) and flushing of the well and/or distribution system.

A recommended approach to shock chlorinating wells can be found in Health Canada's Water Talk series: Be Well Aware—Protect and Clean Your Well at www.canada.ca/en/health-canada/services/publications/healthy-living/water-talk-protect-clean-well.html.

If a boil water advisory is issued, it is recommended that it be used only as a temporary measure while problems are being identified and remediated. In certain circumstances, boil water advisories may be in place for a longer period of time. *More information on issuing and rescinding boil water advisories is provided in section 5.2.1.*

### 7.6.6 Interpreting heterotrophic plate count and background colonies

Heterotrophic plate count bacteria are not a suitable indicator of the microbiological safety of water, but can provide an indication of the general bacteriological quality. For example, increases in HPC bacteria above normal baseline levels can indicate changes in raw water quality, problems such as bacterial regrowth in the distribution system or plumbing, or problems with drinking water treatment.

Effective treatment can reduce concentrations of HPC bacteria to fewer than ten colony forming units per 100 mL of water. These counts can be used for quality control in water treatment plants and as a measure of quality deterioration in wells, distribution lines, and reservoirs.

Background colonies are the non-coliform colonies that may grow on the coliform growth media when using membrane filtration methods. These non-coliform colonies can interfere with coliform detection if they are present in high enough numbers. For accurate enumeration when using membrane filtration methods, the membrane-filter surface should have $<$ 200 colonies present (including coliform and non-coliform colonies).

A sudden rise of HPC or background colonies in drinking water collected from a site that has traditionally had low counts should give rise to concern. If a sample contains greater than usual levels of HPC or background colonies, the site should be re-sampled and the chlorine residual verified (if applicable). If the repeat sample still indicates an elevated HPC, the system should be inspected to determine the cause, and if necessary, remedial action should be taken.

It is increasingly recognized that there are limitations to HPC, including the fact that they significantly underestimate the concentration and diversity of bacteria present. As such, HPC results should be interpreted together with results from other monitoring methods and parameters, in order to assess changes in the biological stability of distributed water.

The document, Guidance on monitoring the biological stability of drinking water in distribution systems, incorporates the content of the former guidance document on HPC and provides information on many other available monitoring tools (Health Canada, 2022).

### 7.6.7 Interpreting turbidity results

Turbidity as it is a strong indicator of water quality, particularly of the effectiveness of water treatment processes such as filtration in the removal of potential microbial pathogens. It is also an important indicator of treatment efficiency and filter performance in particular (Health Canada, 2012).

Generally, minimum treatment of supplies derived from surface water and GUDI sources should include adequate filtration (or technologies providing an equivalent log reduction credit) and disinfection. Filtration is an important barrier for removing particles that cause turbidity. Microorganisms, in addition to being particles themselves, can become attached to soil and waste particles in the environment and can aggregate or attach to inorganic or other particles during treatment. Effective removal of microbial pathogens is best achieved when water of low turbidity is produced and effective inactivation of microbial pathogens is best achieved when low-turbidity water is disinfected.

The most important consideration when dealing with turbidity is the need to reduce it to a level as low as reasonably achievable and to minimize fluctuation. Optimizing treatment performance for turbidity reduction and particle removal also generally optimizes pathogen removal and subsequent disinfection while reducing the potential formation of undesirable disinfection by-products.

Health-based treatment limits (HBTL) for turbidity have been established for the different filtration technologies to help ensure that systems are meeting the minimum levels of pathogen removal (log removal credits) provided in the enteric protozoa guideline technical document. The HBTL are achievable by most filtration systems. However, filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 Nephelometric Turbidity Units (NTU). Turbidity should be measured at each individual filter, and can be measured by online turbidity meters, a laboratory, or by using a test kit.

Where filtration is not required to meet pathogen removal goals, it is best practice to keep turbidity levels below 1.0 NTU to minimize the potential for interference with disinfection. In addition, to minimize particulate loading and effectively operate the distribution system, it is also good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU.

Turbidity monitoring is also recommended for systems using subsurface sources that zare not considered GUDI (with the exception of those serving 25 people or less, i.e., micro-systems and households). In these systems, turbidity values of 1.0 NTU or less are recommended to maintain the effectiveness of disinfection and for good operation of the distribution system (if applicable). Turbidity levels in groundwater should be relatively constant. Changes in turbidity outside the normal range for a groundwater system indicate changes in groundwater quality or changes in the integrity of the well that need to be investigated.

Turbidity sampling should take place in accordance with Boxes 3 through 8. The daily source water turbidity level can be based on either a single grab sample measurement or the arithmetic average of all the source water turbidity measurements taken in one calendar day. In systems where turbidity monitoring is not continuous, turbidity samples should be taken during times of poorest source water quality, such as after heavy rains, and during spring run-off (when possible) and carried out in conjunction with *E. coli* and total coliform monitoring.

### 7.6.8 Natural organic matter

The importance of natural organic matter (NOM) in drinking water treatment and quality is being increasingly recognized. NOM is a complex mixture of organic compounds that is found in all sources of drinking water. Its impact on health is indirect, as it affects the efficacy of treatment processes and the ability to produce water of an acceptable quality (Health Canada, 2020d). It is recommended that facilities consider including NOM characterization in their site-specific drinking water management plans.

### 7.6.9 Disinfection targets

Barring system-specific exemptions (as described below), all drinking water supplies should be disinfected to ensure the safety of the drinking water leaving the treatment plant. The effectiveness of disinfection can be predicted based on a knowledge of the residual concentration of disinfectant, temperature, pH (for chlorine), and the time between the moment the disinfectant is added to the water and the moment the water arrives to the first customer. This relationship is commonly referred to as the "contact time" or "CT" concept. CT is the product of C (the residual concentration of disinfectant, measured in mg/L) and T (the disinfectant contact time, measured in minutes). For UV disinfection, the product of light intensity "I" (measured in $mW/cm^2$ or $W/m^2$) and time "T" (measured in seconds) results in a computed dose (fluence) in $mJ/cm^2$ for a specific microorganism. This relationship is referred to as the IT concept. These calculations are used by drinking water systems as tools for ensuring adequate inactivation of organisms during disinfection (Health Canada, 2020b, 2020c).

In general, a minimum 4 log removal and/or inactivation of enteric viruses is recommended for all water sources, including groundwater sources. However, very small systems and micro-systems that have confirmed that the risk of enteric virus presence in the groundwater supply is minimal, may decide that primary disinfection is not necessary. In such cases, it is important that a sanitary survey and a vulnerabilities assessment be conducted annually to ensure that the source is not subject to fecal contamination, that conditions have not changed, and that routine monitoring and appropriate system maintenance are in place. A vulnerabilities assessment may not be required for micro-systems if the conditions described in Box 4 are met. In addition, if a comprehensive sanitary survey is conducted following the elements described in Box 1, the responsible authority may choose to reduce its frequency to once every three to five years, as appropriate.

Where disinfection is practised, a residual of an acceptable disinfectant, typically chlorine, should be present at all times in the distribution system (*see section 4.7 for further information on chlorine residuals*). Free and/or total chlorine residuals should be tested when bacteriological samples are taken, as identified above, as well as independently. Chlorine residuals can be verified by a laboratory or by using an acceptable test kit (*addressed in section 3.5*). Additional testing of chlorine residuals could also be done to routinely monitor the integrity of the distribution system.

**Note:** Even in cases where a sanitary survey or vulnerabilities assessment suggests that disinfection is not required, periodic disinfection may become necessary in situations where the microbiological quality of the water deteriorates. For this reason, it is recommended that disinfection equipment and supplies, or an equivalent incident response mechanism (such as an alternative source or boil water advisory), be available to deal with potential occurrences. Should an incident result in a need for disinfection to be applied, it is recommended that the sanitary survey and/or vulnerabilities assessment be revisited.

#### 7.6.10 Operation of groundwater systems

Operating a groundwater system consists mainly of taking necessary measurements, maintaining yield, and preventing contamination. In general, wells should be pumped within specific pumping rates. When there is more than one well, they should be operated in rotation, if possible, to equalize wear on pumping equipment. If specified pumping rates are exceeded, sand and silt may pack in and around the well screen and clog it or may fill the voids in gravel-wall wells, reducing yield. Frequent starting and stopping of a well pump causes agitation in the aquifer around the well and may wash out sand or gravel, causing clogging or cave-ins that will reduce the yield. Any requirement for altering pump operation methods can be determined from well performance records and the quality of water produced.

It is good practice to monitor the quantity of water produced from a well over time to verify that the pump is working properly and the well yield is not dropping. Some of these activities can be completed by installing a water meter at the wellhead and routinely reading it. Static and operating water levels should be measured and plotted to determine if a trend exists over time.

# 8.0 DRINKING WATER ON-BOARD SHIPS

No single federal department has overall authority for drinking water quality on regulated ships and boats. The actual management and operation of drinking water systems are the responsibility of the implicated department (e.g., Department of National Defence, Canadian Coast Guard. Potable water systems on board ships should be designed and sized to meet the expected potable water demand (for drinking, food preparation, sanitation and hygiene activities) and required water pressure at each tap to minimize the potential for contamination. Potable water system requirements on board ships will vary by size, crew number, capacity and usage. Ships and boats operating around the clock will have different requirements to accommodate for the expanded usage pattern.

## 8.1 Sources of drinking water

Potable water from shore supplies should be from a source that meets the GCDWQ. Disinfectant and pH levels should be measured prior to intake, and the water should have a detectable disinfectant residual. All hoses, fittings, water filters, buckets, equipment and tools used for the bunkering of potable water should be handled and stored in a sanitary manner, and only used for this purpose. Alternatively, water can be produced on board ships and boats using either distillation plants or reverse osmosis.

## 8.2 Treatment

All shipboard potable water, whether bulk purchased, taken onboard from Canadian ports or produced on board, should be chemically disinfected. Chlorination and bromination can be used as a drinking water disinfectant on board ships. Chloramine, although only used as a secondary drinking water disinfectant by municipalities and not used on board ships, might be encountered by crew members when water is bulk purchased from a Canadian port that chloraminates its water.

Disinfection target levels in shipboard water are the same as in municipal systems. A free chlorine residual or total bromine residual of 0.2 mg/L is considered a desirable minimum level throughout the distribution system for control of bacterial regrowth. A total chlorine concentration of 1.0 mg/L is considered a desirable minimum level in chloraminated water taken onboard.

## 8.3 Mixing of different types of disinfected drinking water

Mixing of different types of disinfected drinking water is an acceptable practice on board ships. For example, mixing of water produced on board (chlorinated or brominated water), with chlorinated or chloraminated drinking water taken on board from Canadian ports happens frequently. Water disinfection residuals cannot be accurately measured in mixed water. This limitation will persist up until the water tank is completely replenished and only one type of disinfectant is present.

When chlorinated or brominated water is mixed with chloraminated water, there will be no disinfectant in that water until (1) enough chlorine or bromine is added to convert the disinfection process from chloramination to chlorination or to bromination (reaching breakpoint); or (2) the water tank is completely renewed with chlorinated or brominated water. Until this happens, the water may be considered safe for drinking, provided that monitoring for *E. coli* and total coliforms is conducted on a daily basis to verify the on-going safety of the water.

## 8.4 Monitoring

**Disinfectant:** Shipboard water disinfection levels should be tested daily. Tests should be conducted at the tank, and at a minimum, two other downstream locations: one location should be selected at random; and one should be on the longest run of pipe.

**Bacteriological:** Shipboard potable water should meet the GCDWQ's MAC for *E. coli* of none detectable per 100 mL. A minimum of four samples per month (preferably weekly) should be collected and analyzed for the presence of *E. coli*. Samples should be collected from the forward, aft, upper, and lower decks of the ships. If possible, sample sites should be changed each month to ensure that the potable water distribution system is effectively monitored.

**Salinity:** Ocean going ships produce fresh water from salt water utilizing the process of desalination. Salinity can be evaluated by measuring the total dissolved solids (TDS). The treatment objective of desalinated water is less than 500 mg/L TDS in the fresh water produced. Note: For the purposes of palatability, a level of TDS of 250 mg/L or less is considered optimal.

## 8.5 Storage

Potable water tanks should not share a common wall with the hull of the ships and boats or with tanks or piping containing non-potable water or other liquids. They should be identified with a number and the words "potable water" in letters at least 13 millimeters (0.5 inch) high.

All drinking water storage tanks should be constructed with materials that meet NSF/ANSI Standard 61, be watertight, have an access hatch with a watertight lid, a fill pipe and a vent pipe and be installed in accordance with the manufacturer's instructions. All pertinent codes, legislation and acts (public health protection, construction, plumbing, environmental considerations, etc.) should also be followed.

On small ships, drinking water tanks are not integrated into the structure and are usually made of stainless steel or plastic. The design principles are to use ready-made off-the-shelf products, and to ensure easy access, maintenance and/or replacement of each element of the drinking water system.

### 8.5.1 Tank coatings

Many potable water tanks on-board ships (e.g., tanks made of steel, concrete) must be coated to protect water quality. Both the coatings used in potable water tanks and their application (e.g., curing) must meet standards to prevent adverse effect on water quality. The testing and certification of coatings should be completed in accordance with NSF/ANSI/CAN Standard 61.

The selected epoxy coating should hold a valid NSF/ANSI/CAN Standard 61 certification for the intended use, including tank volume, throughout the duration of the coating work period.

On large ships, drinking water tanks are an integral part of the hull's structure and are therefore usually made of the same metal as the hull. In such cases, they should be coated with solvent-free lining or sealing material that is appropriate for storage of drinking water, such as 100% solids epoxy paint. ANSI/AWWA Standard D102-17 (Coating Steel Water-Storage Tanks) provides information on the minimum requirements for coating, including materials, coating systems, surface preparation, application, inspection, and testing. ANSI/AWWA Standard D103-09 (Factory-Coated Bolted Steel Tanks for Water Storage) provides the minimum requirements for the design, construction, inspection, and testing of new cylindrical, factory coated, bolted carbon-steel tanks for the storage of water. Some ships may use stainless steel tanks; in these cases, no coating or liner is required.

Equipment that was cleaned using thinners or solvents should not be used during the coating application process. Equipment should not come in to contact with the coating at any stage prior to, during, and after the coating is applied.

The contractor must provide written proof of a valid certification to NSF/ANSI/CAN Standard 61 for the coating applied. All new equipment should be used for the application of the coating, including pumps, hoses, spray guns and brushes. The re-use of pumps, but not hoses, may be permitted if the contractor demonstrates that they have been cleaned and/or flushed with a product that is NSF/ANSI/CAN Standard 61 certified for use in potable water tanks, and the product does not contain any solvents. As a quality assurance/quality control measure, the levels of volatile organic compounds (VOC) in 100% solids epoxy coatings should be measured once the application of the coating is completed. Analysis should be done using an established analytical method for VOCs such as EPA Method 524.

# 9.0 HAULED WATER AND CISTERNS

Remote locations, or those that do not have easy access to a reliable drinking water source, may have to rely on drinking water that is hauled to the location and stored on-site. Hauled water quality may be affected by the quality of the water supply, contact with transportation equipment, transfer into a storage container (cistern) and storage in the cistern. Care must be taken to avoid contamination throughout this process. Although no federal regulations address hauled potable water, federal departments are still responsible to provide safe water as mandated by the relevant legislation. The guidance in this section is based in part on relevant documents from provinces and/or territories. A comparison of practices recommended by various North American organizations is available from Region of Peel (2015).

## 9.1 Source of the hauled water

Hauled water to be used as a drinking water supply must meet the GCDWQ. Departments should verify the conformity of the supply to the requirements established under the relevant legislation (e.g., Canada Labour Code). In addition, there should be an appropriate disinfectant residual (e.g., ≥ 0.2 mg/L free chlorine) in the hauled treated water.

## 9.2 Transportation equipment

Appropriate measures should be taken to protect the water and its source, the storage tank, and all other equipment from contamination during filling, storage, transportation and delivery (Manitoba Health, 2013). The sanitary condition of the transportation equipment is very important. The tank or container used to carry potable water and pumps, hoses, and other equipment used in the supply or delivery of the potable water should be kept in a clean and sanitary condition that is unlikely to contaminate the water during transportation or transfer. It should not have been used to transport substances that are unfit for human consumption. If used to transport materials other than water (but fit for human consumption), the tank, pumps, pipes and other equipment should be cleaned and disinfected before transporting drinking water (Ministère du Développement durable, de l'Environnement et des Parcs du Québec, 2019). The container should be constructed of materials that meet NSF/ANSI/CAN Standard 61 (NSF, 2020), allow easy access for cleaning and be disinfected at least weekly. Precautions to prevent backflow are needed when the container is being filled or emptied.

## 9.3 Cisterns

Receiving tanks or cisterns should be maintained in a clean and sanitary condition and not be used for any other purpose. They must be cleaned and disinfected before they are put into use and when the system or any of its parts are dismantled for repair, maintenance or replacement. All water, even high quality treated potable water, may deteriorate in water storage tanks and cisterns. CSA Standard B126 Series on water cisterns (CSA, 2013) addresses cisterns that are connected to the plumbing system but that are not part of a municipal water system. It consists of the following standards:

- CSA B126.0, General requirements and methods of testing for water cisterns;
- CSA B126.1, Installation of water cisterns;
- CSA B126.2, Commissioning and field inspection of water cisterns;
- CSA B126.3, Operation and maintenance of water cisterns;
- CSA B126.4, Decommissioning of water cisterns; and
- CSA B126.5, Mobile water cisterns.

## 9.4 Disinfection

A disinfectant residual of at least 1.0 mg/L of total chlorine or 0.2 mg/L free chlorine should be present in the water at the time of delivery. The free chlorine residual in the truck should be measured once per day, in a water sample collected at the outlet of the tank. All data should be recorded in a register containing the data and results of the measurements and the name of the person who took them (Ministère du Développement durable, de l'Environnement et des Parcs du Québec, 2019).

## 9.5 Monitoring

Chlorine residual levels should be measured frequently to ensure the microbiological quality of the water is maintained. In addition, it is recommended that received water be monitored for microbiological indicators on a quarterly basis (Health Canada, 2007). Although sampling for most chemical and radiological parameter is not needed, annual lead sampling should be conducted at each of the drinking water fountains or cold water taps where water is used for drinking or food preparation.

# Part 3: Resources

# 10.0 INFORMATION AND RESOURCES

A number of federal programs and documents exist to support departments in carrying out their duties related to drinking water issues.

## 10.1 Health Canada

**CDW and GCDWQ**

Health Canada plays a key role in the safety of drinking water by working with the provinces and territories, through the CDW, to establish the GCDWQ. The GCDWQ are used by every jurisdiction in Canada as the basis for their own enforceable drinking water quality requirements.

Health Canada provides scientific expertise and leadership to the development of the GCDWQ. Following the priorities established collaboratively with the CDW, it leads the development of health risk assessments for drinking water contaminants. These assessments can be presented either as guideline technical documents or as guidance documents. All these documents undergo public consultations.

All current documents, including the guideline summary table, guideline technical documents and guidance documents are available at the following address: www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.html

**Guideline technical documents**

Guideline technical documents present the scientific and technical information that forms the basis for the establishment of a numerical guideline. They are developed for contaminants that meet all of the following criteria:

» Exposure to the contaminant could lead to adverse health effects;

» The contaminant is frequently detected or could be expected to be found in a large number of drinking water supplies throughout Canada; and

» The contaminant is detected, or could be expected to be detected, at a level that is of possible health significance.

The process remains flexible. Guideline technical documents may be developed for some parameters which do not meet all criteria (e.g., chlorine, ammonia), where appropriate.

**Guidance documents**

Guidance documents provide advice and guidance on issues related to drinking water quality for parameters that are of national interest but for which a formal drinking water guideline cannot be developed or is not required.

The CDW may choose to develop guidance documents in two instances. The first would be to provide operational or management guidance related to specific drinking water related issues (e.g., boil water advisories, corrosion control), in which case the documents would provide only limited scientific information or health risk assessment. The second instance would be for a contaminant of interest does not meet all the criteria for developing a guideline technical document (e.g., chloral hydrate, potassium), to make their risk assessment information available.

Guidance documents undergo a similar development process to guideline technical documents, including public consultations through the Health Canada website. They are offered as information for drinking water authorities and, in some cases, to help provide guidance in spill or other emergency situations.

**Drinking water screening values**

Health Canada can develop drinking water screening values (DWSV) at the request of a federal department, a province, or territory, usually as a result of a spill or unexpected contamination. It is not based on thorough research of all existing studies; rather, it is developed for use within the department or government that has made the request. A DWSV is based on the scientific information available at the time of the request.

DWSVs are not subject to a review as detailed as the GCDWQ, which undergo internal peer review and public consultation before being endorsed by the CDW.

**Water Talks and other resources**

Health Canada also publishes the Water Talk series, which are plain language summaries on drinking water contaminants and issues, generally posted simultaneously with the final GCDWQ. It also includes "Be Well Aware", information for private well owners which may be relevant for some departments, and an infographic on lead in drinking water. These documents are available at: www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality.html#wtfs.

**Federal role**

Health Canada also plays an advisory role at the federal level, to foster a consistent federal approach to drinking water quality. It provides the secretariat function and scientific expertise to the IWGDW, coordinating the update and publication of this federal guidance document. Health Canada does not regulate drinking water federally.

**Other activities**

In order to help ensure the quality of drinking water nationally, and thereby protecting public health, Health Canada:

» Shares expertise and scientific advice with other government departments and organizations interested in drinking water issues, and with the public;

» Conducts scientific health assessments related to the GCDWQ;

» Participates in the development of standards for materials that come into contact with drinking water;

» Provides advice and assists in emergencies such as chemical spills, on request; and

» works in collaboration with the Public Health Agency of Canada on the development and use of the Canadian Network of Public Health Intelligence's drinking water application (CNPHI DWA), to identify threats to the safety of drinking water.

## 10.2 Federal training tools

Training tools aimed at very small and micro-systems have been developed through the IWGDW, filling a documented gap in resources and tools. This has been possible through the amalgamation of resources and expertise from all members. The following documents and videos are all available in English, French and Spanish:

» Safe Drinking Water—Your Responsibility
» Water Sampling in Federal Facilities
» Ultraviolet & Reverse Osmosis for Micro-Systems
» Drinking Water Storage Tanks
» Bottled Water: Selection & Application in Federal Facilities
» Water Wells for Micro-Systems
» Water Filtration and Ion Exchange for Micro-Systems
» Disinfection for Micro-Systems
» Advice for the Operation of Potable Water Field Test Equipment
» Water Quality 101: Potable Water Micro-System Fundamentals (a course consisting of 10 modules and a supporting workbook, which may count toward continuing education credits in some certification programs).

The training materials from the Training Board are publically available through the Walkerton Clean Water Centre, at: www.waterqualitytraining.ca/docsAndInfo_e.php

## 10.3 Third party standards

The following standards will be useful tools for federal departments in order to meet their obligations related to the provision of safe drinking water.

**American Water Works Association:**

» ANSI/AWWA Standard C510-17: Double Check-Valve Backflow Prevention Assembly
» ANSI/AWWA Standard C511-17: Reduced-Pressure Principle Backflow Prevention Assembly
» ANSI/AWWA Standard C651-14: Disinfecting Water Mains
» ANSI/AWWA Standard D102-17: Coating Steel Water-Storage Tanks
» ANSI/AWWA Standard D103-09: Factory-Coated Bolted Steel Tanks for Water Storage

**NSF International:**

» NSF/ANSI Standard 53: Drinking Water Treatment Units—Health Effects
» NSF/ANSI Standard 55: Ultraviolet Microbiological Water Treatment Systems
» NSF/ANSI Standard 58: Reverse Osmosis Drinking Water Treatment Systems
» NSF/ANSI/CAN Standard 60: Drinking Water Treatment Chemicals—Health Effects
» NSF/ANSI/CAN Standard 61: Drinking Water System Components—Health Effects
» NSF/ANSI Standard 62: Drinking Water Distillation Systems
» NSF/ANSI Standard 372: Drinking Water System Components—Lead Content

**Canadian Standards Association:**

» CAN/CSA-B64 Series-17: Backflow Preventers and Vacuum Breakers
» CAN/CSA-B126 Series-13 (R2018): Water Cisterns
» CAN/CSA-B483.1-07 (R2017): Drinking Water Treatment Systems

**International Organization for Standardization:**

» ISO/IEC 17025: Testing and Calibration Laboratories

# 11.0 OCCUPATIONAL HEALTH AND SAFETY LEGISLATION AND DIRECTIVE

## 11.1 Titles

*Canada Labour Code*. R.S. 1985, c. L-2. Part II: Occupational Health and Safety, ss. 125(1)(j) and 125(1)(z.11). Available at: https://laws.justice.gc.ca/eng/acts/L-2/index.html

- *Canada Occupational Health and Safety Regulations*. SOR/86-304, Part IX—Sanitation. s. 9.24—9.29. Available at: https://laws.justice.gc.ca/eng/regulations/SOR-86-304/index.html
- *Aviation Occupational Safety and Health Regulations*. SOR/2011-87, Part IV—Sanitation. s.4.9—4.12. Available at: https://laws.justice.gc.ca/eng/regulations/SOR-2011-87/index.html
- *Maritime Occupational Health and Safety Regulations*. SOR/2010-120, Part 4—Sanitation. s.73-79. Available at: https://laws.justice.gc.ca/eng/regulations/SOR-2010-120/index.html
- *Oil and Gas Occupational Safety and Health Regulations*. SOR/87-612. Part X—Sanitation. s. 10.19. Available at: https://laws.justice.gc.ca/eng/regulations/SOR-87-612/index.html
- *On-Board Trains Occupational Safety and Health Regulations*. SOR/95-105, Part VI—Sanitation. ss. 6.9—6.24. Available at: https://laws.justice.gc.ca/eng/regulations/SOR-87-184/index.html

*National Joint Council—Occupational Health and Safety Directive*

- Part IX—Sanitation, which enhances part IX of the *Canada Occupational Health and Safety Regulations* and should be read in that context. Available at: www.njc-cnm.gc.ca/directive/d7/en

## 11.2 Excerpts

Excerpts of relevant texts are provided below, for information. It is important to note that these excerpts are included for information only and that the reader should refer to the official version.

### 11.2.1 Canada Labour Code

Part II—Occupational Health and Safety

125. (1) Without restricting the generality of section 124, every employer shall, in respect of every work place controlled by the employer and, in respect of every work activity carried out by an employee in a work place that is not controlled by the employer, to the extent that the employer controls the activity,

(j) provide, in accordance with prescribed standards, potable water;

(z.11) provide to the policy committee, if any, and to the work place committee or the health and safety representative, a copy of any report on hazards in the work place, including an assessment of those hazards;

### 11.2.2 Canada Occupational Health and Safety Regulations (SOR/86-304)

9.24 Every employer shall provide potable water for drinking, personal washing and food preparation that meets the standards set out in the Guidelines for Canadian Drinking Water Quality 1978, published by authority of the Minister of National Health and Welfare.

9.25 Where it is necessary to transport water for drinking, personal washing or food preparation, only sanitary portable water containers shall be used.

9.26 Where a portable storage container for drinking water is used,

(a) the container shall be securely covered and closed;

(b) the container shall be used only for the purpose of storing potable water;

(c) the container shall not be stored in a toilet room; and

(d) the water shall be drawn from the container by

(i) a tap,

(ii) a ladle used only for the purpose of drawing water from the container, or

(iii) any other means that precludes the contamination of the water.

9.27 Except where drinking water is supplied by a drinking fountain, sanitary single-use drinking cups shall be provided.

9.28 Any ice that is added to drinking water or used for the contact refrigeration of foodstuffs shall

(a) be made from potable water; and

(b) be so stored and handled as to prevent contamination.

9.29 Where drinking water is supplied by a drinking fountain, the fountain shall meet the standards set out in ARI Standard 1010-82, *Standard for Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers*, dated 1982.

### 11.2.3 Aviation Occupational Safety and Health Regulations (SOR/2011-87)

4.10 (1) Every employer shall ensure that employees are provided with potable water in sufficient quantity for drinking, personal washing and food preparation.

(2) The potable water shall meet the microbiological quality guidelines set out in the Guidelines for Canadian Drinking Water Quality, prepared by the Federal-Provincial-Territorial Committee on Drinking Water and published by the Department of Health.

4.11 If a portable storage container for potable water is used,

(a) the container shall be equipped with an airtight cover that can be securely closed;

(b) the container shall be used only for the purpose of storing potable water;

(c) the container shall not be stored in a washroom; and

(d) the water shall be drawn from the container by a tap, a ladle used only for the purpose of drawing water from the container or any other means that precludes the contamination of the water.

4.12 If potable water is not supplied by a drinking fountain the employer shall provide sanitary single-use drinking cups or bottled water.

4.13 Any ice that is added to potable water or used for the contact refrigeration of foodstuffs shall be

(a) made from potable water; and

(b) stored and handled in a manner that prevents contamination.

### 11.2.4 Maritime Occupational Health and Safety Regulations (SOR/2010-120)

73. (1) Every employer must ensure that employees are provided with potable water for drinking, personal washing and food preparation.

(2) The potable water must

(a) be in sufficient quantity to meet the purposes set out in subsection (1); and

(b) meet the quality guidelines set out in the most recent edition of Guidelines for Canadian Drinking Water Quality, prepared by the Federal-Provincial-Territorial Committee on Drinking Water and published by the Department of Health.

(3) Potable water for drinking must be available at all times for the use of every employee working on the vessel.

74. (1) Every employer must develop a potable water management program that sets out the testing procedures and frequency and the measures to be taken to prevent contamination.

(2) The potable water management program must be made readily available for inspection.

75. (1) Every vessel of 300 gross tonnage or more that is not a day vessel must have on board a supply of water that is available for all wash basins, tubs and showers and is sufficient to provide at least 68 l of water for each employee on the vessel for each day that the employee spends on that vessel.

(2) A day vessel must have on board at least 22.7 l of water for each employee on the vessel for each day that the employee spends on that vessel.

76. If it is necessary to transport water for drinking, personal washing or food preparation, only sanitary portable water containers must be used.

77. If a portable storage container for drinking water is used,

(a) the container must be securely closed;

(b) the container must be used only for storing potable water;

(c) the container must not be stored in a sanitary facility; and

(d) the water must be drawn from the container by

(i) a tap,

(ii) a ladle used only for the purpose of drawing water from the container, or

(iii) any other means that precludes the contamination of the water.

78. Any ice that is added to drinking water or used for the contact refrigeration of foodstuffs must be made from potable water, and stored and handled so as to prevent contamination.

79. If drinking water is supplied by a drinking fountain,

(a) the fountain must meet the standards set out in the Air-Conditioning and Refrigeration Institute (ARI) of the United States ARI 1010-2002, Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers; and

(b) the fountain must not be installed in a sanitary facility.

### 11.2.5 Oil and Gas Occupational Safety and Health Regulations (SOR/87-612)

10.19 Every employer shall provide potable water for drinking, personal washing and food preparation that meets the standards set out in the *Guidelines for Canadian Drinking Water Quality, 1978*, published by authority of the Minister of National Health and Welfare.

10.20 Where water is transported for drinking, personal washing or food preparation, only sanitary water containers shall be used.

10.21 Where a storage container for drinking water is used,

(a) the container shall be securely covered and labelled that it contains potable water;

(b) the container shall be used only for the purpose of storing potable water; and

(c) the water shall be drawn from the container by

(i) a tap,

(ii) a ladle used only for the purpose of drawing water from the container, or

(iii) any other means that precludes the contamination of the water.

10.22 Except where drinking water is supplied by a drinking fountain, sanitary single-use drinking cups shall be provided.

10.23 Any ice that is added to drinking water or used for the contact refrigeration of foodstuffs shall

(a) be made from potable water; and

(b) be so stored and handled as to prevent contamination.

10.24 Where drinking water is supplied by a drinking fountain, the fountain shall meet the standards set out in ARI Standard 1010-82, *Standard for Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers*, dated 1982.

### 11.2.6 On Board Trains Occupational Safety and Health Regulations (SOR/87-184)

6.19 (1) Subject to subsection (2), every employer shall provide employees with potable water for drinking, personal washing and food preparation that meets the standards set out in the publication entitled *Guidelines for Canadian Drinking Water Quality, 1978*, as amended in March 1990, published under the authority of the Minister of National Health and Welfare.

(2) An employer is not required to provide potable water for personal washing if waterless hand cleaning supplies are provided.

6.20 Where it is necessary to transport water for drinking, personal washing or food preparation, only sanitary portable water containers shall be used.

6.21 Where a portable storage container for drinking water is used,

(a) the container shall be securely covered and closed;

(b) the container shall be used only for the purpose of storing potable water;

(c) the container shall not be stored in a toilet room; and

(d) where the container is not a single-use storage container, water shall be drawn from it by

(i) a tap,

(ii) a ladle used only for the purpose of drawing water from the container, or

(iii) any other means that precludes the contamination of the water.

6.22 Except where drinking water is supplied by a drinking fountain or a single-use portable storage container, sanitary single-use drinking cups shall be provided.

6.23 Any ice that is added to drinking water or used for the contact refrigeration of foodstuffs shall be

(a) made from potable water; and

(b) stored and handled in a manner that prevents contamination.

6.24 Where drinking water is supplied by a drinking fountain, the fountain shall meet the standards set out in ARI Standard 1010-82, *Standard for Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers*, dated 1982.

### 11.2.7 Occupational Health and Safety Directive

This directive, hosted by the National Joint Council, was co-developed by participating bargaining agents and public service employers.

Part IX—Sanitation of the Directive enhances and supplements Part IX (Sanitation) of the *Canada Occupational Health and Safety Regulations* (SOR/86-304) and should be read in that context.

**Scope:** This part applies in all government-owned buildings. However, where employees occupy buildings not owned by the federal government, this part shall apply to the maximum extent that is reasonably practicable.

9.2 Care of Premises

9.2.3 With the advice of a qualified person and in consultation with the appropriate health and safety committee, departments shall establish contingency procedures for cases in which there is a temporary interruption in the supply of drinking water or to the water used to remove water-borne waste.

9.4 Water Quality

9.4.1 The employer will adhere, as a minimum, to the *Guidelines for Canadian Drinking Water Quality*, or to any other federally, provincially or territorially appropriate standards and any existing guidelines that provide the higher level of protection to workers.

9.4.2 Any storage container for drinking water shall be disinfected in a manner approved by a qualified person at least once a week while in use, and before the container is used following storage.

9.4.3 A fountain supplying drinking water shall not be installed in a personal service room containing a toilet.

# 12.0 ACRONYMS

| | |
|---|---|
| **ABC** | Association of Boards of Certification |
| **ANSI** | American National Standards Institute |
| **AO** | aesthetic objective |
| **ARI** | Air-Conditioning and Refrigeration Institute |
| **AWWA** | American Water Works Association |
| **CALA** | Canadian Association for Laboratory Accreditation |
| **CCME** | Canadian Council of Ministers of the Environment |
| **CDW** | Federal-Provincial-Territorial Committee on Drinking Water |
| **CEAEQ** | Centre d'expertise en analyse environnementale du Québec(C |
| **CESD** | Commissioner of the Environment and Sustainable Development |
| **CSA** | CSA Group (formerly called Canadian Standards Association) |
| **DBP** | disinfection by-product |
| **DWSV** | drinking water screening value |
| **EER** | Engineering Evaluation Report |
| **GCDWQ** | Guidelines for Canadian Drinking Water Quality |
| **GUDI** | groundwater under the direct influence of surface water |
| **HAA** | haloacetic acid |
| **HBTL** | health-based treatment limit |
| **HPC** | heterotrophic plate count |
| **IBWA** | International Bottled Water Association |
| **IWGDW** | Interdepartmental Working Group on Drinking Water |
| **LBCMP** | Legionella Bacteria Control Management Program |
| **MAC** | maximum acceptable concentration |
| **NOM** | natural organic matter |
| **NSF** | NSF International Standard |
| **NTU** | Nephelometric Turbidity Units |
| **NJC** | National Joint Council |
| **NPC** | National Plumbing Code |
| **NSF** | NSF International |
| **PPE** | Personal Protective Equipment |
| **PSPC** | Public Services and Procurement Canada |
| **QA** | quality assurance |
| **QC** | quality control |
| **SCADA** | Supervisory Control And Data Acquisition |
| **SCC** | Standards Council of Canada |
| **TDS** | total dissolved solids |
| **THM** | trihalomethane |
| **US EPA** | United States Environmental Protection Agency |
| **UV** | ultraviolet |
| **VOC** | volatile organic compounds |
| **WHO** | Word Health Organization |

# 13.0 GLOSSARY

**Drinking water system**

All aspects from the point of collection of water to the consumer (can include intakes, treatment systems, service reservoirs, distribution and plumbing systems, storage reservoirs and supply systems).

For the purpose of this document, federal drinking water systems have been broken down into the following categories:

- **Large systems:** designed to serve more than 5000 people.
- **Small systems:** designed to serve between 501 and 5000 people.
- **Very small systems:** designed to serve between 26 and 500 people.
- **Micro-systems:** designed to serve up to and including 25 people.

**Due diligence**

Taking every precaution reasonable, in the circumstances, to avoid harm or loss. In the context of drinking water, taking every reasonable precaution means implementing the multi-barrier approach to safe drinking water (GOC, 2009).

**Federal facility**

Any federal government infrastructure that provides access to a drinking water supply, including, but not limited to, federal buildings and hand pumps designed to provide drinking water, whether freestanding or not.

**Legislated installation**

Term applied to "port of entry" installations (i.e., the land itself, physical infrastructure, operations, and all supporting services) provided at no cost to Her Majesty by third party owners and/or operators, as required by law (e.g., *Customs Act*).

**Monitoring program**

A plan that identifies the parameters that should be routinely monitored, and related details (e.g., frequency). A monitoring program is developed using information provided by the vulnerabilities assessment, sanitary survey and baseline chemical analysis.

**Plumbing system**

A plumbing system (plumbing) is a building's internal piping system, starting at the curb stop. It includes water supply pipes, fixtures and other devices; drainage and vent systems and connections within and adjacent to the building.

# 14.0 REFERENCES


AWWA (2014). Water Quality Complaint Investigator's Guide. Second edition. American Water Works Association, Denver, Colorado. Available from: www.awwa.org/Store/Product-Details/productId/39485836

AWWA (2015a). Backflow prevention and cross-connection control: Recommended practices. Manual of water supply practices M14. Fourth edition. American Water Works Association, Denver, Colorado. Available from: www.awwa.org/Store/Product-Details/productId/46494412.

AWWA (2015b). Distribution valves: Selection, installation, field testing, and maintenance. Manual of water supply practices M44. Third edition. American Water Works Association, Denver, Colorado. Available from: www.awwa.org/Store/ ProductDetail/51319025.

CDW and CCME (2004). From source to tap: Guidance on the multi-barrier approach to safe drinking water. Produced jointly by the Federal-Provincial-Territorial Committee on Drinking Water and the Canadian Council of Ministers of the Environment. Available at: www.ccme.ca/files/Resources/water/source_tap/mba_guidance_doc_e.pdf

Conservation Ontario (2021). Drinking water source protection—protecting drinking water sources in Ontario. Available from: https://conservationontario.ca/conservation-authorities/source-water-protection.

CSA (2013). CAN/CSA Standard B126 Series. Water cisterns. Reaffirmed in 2018. Available from: https://store.csagroup.org.

CSA (2017). CSA Standard B64.10-17/B64.10.1-17. Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers. Available from: https://store.csagroup.org.

CSA (2018a). Standard ASME A112.18.1-2018/CSA B125.1-18, Plumbing supply fittings. prepared by the ASME/CSA Joint Harmonization Task Group on Plumbing Fittings and the CSA Technical Committee on Plumbing Fittings. Available from: https://store.csagroup.org.

CSA (2018b). CSA Standard B125.3, Plumbing fittings. Available from: https://store.csagroup.org.

CSA (2020). Workplaces and COVID-19: Occupational health and safety considerations for reopening and operating during the pandemic. Available at: www.csagroup.org/article/research/workplaces-and-covid-19-occupational-health-and-safety-considerations-for-reopening-and-operating-during-the-pandemic/

Government of Ontario (2020). Guide for maintaining building plumbing after an extended vacancy. Available at: www.ontario.ca/page/guide-maintaining-building-plumbing-after-extended-vacancy.

Health Canada (2001). Guidance for safe drinking water in Canada: From intake to tap. Federal-Provincial-Territorial Committee on Drinking Water. Available at: www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidance-safe-drinking-water-canada-intake-health-canada-2001.html.

Health Canada (2009a). Guidance on controlling corrosion in drinking water distribution systems. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H128-1/09-595E). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-controlling-corrosion-drinking-water-distribution-systems.html.

Health Canada (2009b). Guidelines for Canadian drinking water quality: Guideline technical document—Chlorine. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H128-1/09-588E). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-chlorine-guideline-technical-document.html.

Health Canada (2009c). Guidance for issuing and rescinding drinking water avoidance advisories in emergency situations. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H128-1/09-579E). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-issuing-rescinding-drinking-water-avoidance-advisories-emergency-situations.html.

Health Canada (2012). Guidelines for Canadian drinking water quality: Guideline technical document—Turbidity. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-9/2013E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-turbidity.html.

Health Canada (2015). Guidance for issuing and rescinding boil water advisories in Canadian drinking water supplies. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H128-1/09-578-1E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-issuing-rescinding-boil-water-advisories-canadian-drinking-water-supplies.html.

Health Canada (2017). Guidelines for Canadian drinking water quality: Guideline technical document—Cyanobacterial toxins. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-38/2017E-PDF). Available at : www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-cyanobacterial-toxins.html.

Health Canada (2019a). Guidelines for Canadian drinking water quality: Guideline technical document—Lead. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No H144-13/11-2018E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-lead/guidance-document.html.

Health Canada (2019b). Guidelines for Canadian drinking water quality: Guideline technical document—Manganese. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-39/2017E-PDF). Available at: https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-manganese/pub-manganese-0212-2019-eng.pdf

Health Canada (2019c). Guidelines for Canadian Drinking Water Quality: Guideline Technical Document—Enteric Viruses. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H129-6/2019E-PDF). Available at: https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-enteric-viruses.html.

Health Canada (2020a). Guidelines for Canadian drinking water quality: Guideline technical document—Chloramines. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-13/15-2019E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-chloramines.html.

Health Canada (2020b). Guidelines for Canadian drinking water quality: Guideline technical document—*Escherichia coli*. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H129-27/2020E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-escherichia-coli.html.

Health Canada (2020c). Guidelines for Canadian drinking water quality: Guideline technical document—Total coliforms. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-8/2020E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-total-coliforms.html.

Health Canada (2020d). Guidance on natural organic matter in drinking water. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No. H144-67/2020E-PDF). Available at: www.canada.ca/en/health-canada/services/publications/healthy-living/guidance-natural-organic-matter-drinking-water.html

Health Canada (2022). Guidance on monitoring the biological stability of drinking water in distribution systems. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No.). Available at: www.canada.ca/en/services/health/publications/healthy-living.html#a2.6

Manitoba Health (2013). Bulk water hauling guidelines. Health Protection Unit, Manitoba Health. February. Available at: www.gov.mb.ca/health/publichealth/environmentalhealth/protection/docs/bulkwater.pdf

Ministère du Développement durable, de l'Environnement et des Parcs du Québec (2019). Regulation respecting the quality of drinking water. Available at: http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,%20r.%2040

NJC (2011). Occupational health and safety directive. National Joint Council. Available at: www.njc-cnm.gc.ca/directive/oshd-dsst/index-eng.php.

NRC (2006). Drinking water distribution systems: Assessing and reducing risks. National Research Council. The National Academies Press, Washington, DC. Available from: https://doi.org/10.17226/11728.

NRCC (2015). National Plumbing Code of Canada 2015. National Research Council of Canada, Ottawa, Ontario. Available from: https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-plumbing-code-canada-2015.

NSF (2016). NSF/ANSI Standard 372—Drinking water system components—Lead content. Available from: www.techstreet.com/nsf/?

NSF (2019). NSF/ANSI/CAN Standard 60—Drinking water treatment chemicals—health effects. Available from: www.techstreet.com/nsf/?

NSF (2020). NSF/ANSI/CAN Standard 61—Drinking water system components—health effects. Available from: www.techstreet.com/nsf/?

Ontario Ministry of the Environment, Conservation and Parks (2019). A guide for drinking water system owners seeking to undertake a backflow prevention program. May. Available at: www.ontario.ca/page/guide-drinking-water-system-owners-seeking-undertake-backflow-prevention-program.

PWGSC (2016). Control of *Legionella* in Mechanical Systems. Standard for Building Owners, Design Professionals, and Maintenance Personnel. Public Works and Government Services Canada. Gatineau, Quebec. MD 15161—2013. Available at: www.tpsgc-pwgsc.gc.ca/biens-property/legionella/index-eng.htm.

RBQ (2020). Reopening buildings—Recommendations for restoring service to water distribution systems. Régie du bâtiment du Québec. Available at: www.rbq.gouv.qc.ca/en/areas-of-intervention/plumbing/quality-and-safety-requirements/reopening-buildings-recommendations-for-restoring-service-to-water-distribution-systems.html.

Region of Peel (2015). Measures to mitigate risk of contaminated hauled water: A focused practice question. Environmental Health, Region of Peel Public Health. June. Available at: www.peelregion.ca/health/library/pdf/measures-mitigate-contaminated-hauled-water-FPQ.pdf

U.S. EPA (2003). Cross-connection control manual. Office of Water, U.S. Environmental Protection Agency (EPA-816-R-03-002). Available from: https://nepis.epa.gov/

U.S. EPA (2021). Source Water Protection. Accessed July 2021. Available from: https://www.epa.gov/sourcewaterprotection.

WHO (2011). Water safety in buildings. World Health Organization, Geneva, Switzerland. Available at: www.who.int/water_sanitation_health/publications/2011/9789241548106/en/

WHO (2017). Guidelines for drinking-water quality: Fourth edition incorporating the first addendum. World Health Organization, Geneva, Switzerland. Available at: www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4-including-1st-addendum/en/

# APPENDIX A:
# BUILDING WATER SYSTEMS MINIMUM REQUIREMENTS—COVID-19

Public Services and Procurement Canada (PSPC)
April 6, 2020, *updated June 26 2020*

In response to COVID-19, many client departments have reduced the number of employees who are present in the office. The resulting reduced building occupancy may increase risks associated with water systems and the use of the potable water system for the remaining employees. While Health Canada guidance at this time is that it is highly unlikely that drinking water is a route of transmission for COVID-19 (the disease) or SARS-CoV-2 (the virus), there are other issues to be considered.

As fewer people use the building water systems, there is increased potential for water stagnation. Stagnant water conditions increase the risk for bacterial growth including *Legionella*. In potable water systems, stagnant water conditions can also cause a loss of disinfectant residual and increase risks for the presence of lead. This document establishes minimum requirements. Site specific conditions may require additional measures.

The following requirements have been established by Technical Services Service Line and the Property Facility Management Service Line part of PSPC Real Property Services in consultation with Health Canada to address risks to building water systems. These requirements, which apply to PSPC crown-owned buildings will be reviewed and updated as required. For leases, it is required to have a discussion with the landlord to ensure that similar measures are being implemented prior to re-occupancy of leased spaces.

**Communications Requirements**

Note that in order for PSPC to successfully complete the required actions and testing to meet the minimum requirements prior to re-occupancy and to assist clients in their employer role; it is important that client departments provide sufficient advance notice of their intention to re-occupy a space that they have vacated. The amount of advance notice required will depend on a variety of factors (e.g., regional capacity, localized demand, and remoteness of buildings). Communication is key to the success of re-occupancy; it is therefore important that clients be informed ahead of time of the planned actions and testing. It is equally important that the client departments be informed of actions completed and of the testing results.

**A. Minimum requirements for potable (cold) water systems and building hot water systems**

*A1. Buildings affected:*

Buildings with reduced occupancy or unoccupied due to COVID-19. This occupancy condition is likely to last for the medium term as occupancy levels will be limited by physical distancing requirements in the workspace.

*A2. Existing operational requirements for hot water:*

Ensure that storage temperatures are maintained and that stagnant water conditions are avoided in accordance with the PSPC building's Legionella Bacteria Control Management Program (LBCMP).

*A3. Periodic flushing:*

During periods of reduced occupancy or no occupancy related to COVID-19, it is required to do a periodic flush in accordance with the following steps:

1. Remove aerators before flushing. Thoroughly clean aerator before re-installation.
2. A flush of at least thirty (30) minutes is to be conducted at least every three (3) days for each of the hot and cold water risers or main distribution pipes in the building. The flush is to be conducted from the point(s) of consumption (e.g. a kitchen faucet) furthest from the water entry on the top floor of the building (or the longest run furthest from the water entry for single storey sites) until:
   a. the flushing time is completed and;
   b. the measured temperature is stable for one minute (hot flush) and the presence of residual disinfectant is measured at the fixture (cold flush).

3. Flush (zone by zone) for at least two (2) minutes on a weekly basis all water fixtures that are directly connected to the building water system starting at the water fixture closest to the water entry. Examples include, kitchen faucets (cold then hot), drinking fountains, washroom faucets (cold then hot), showers (cold then hot) and equipment that is directly connected to the building water system, such as ice machines, coffee machines and eyewash stations.
4. It is important to open outlets slowly to avoid splashing and the creation of aerosols. Appropriate Personal Protective Equipment (PPE) should be worn. Consult your employer for requirements.
5. It is required to maintain a log of the flushing that is completed, to be kept at the building level and available upon request. A template for this log is available from PSPC.

If the building is not on a municipally feed system, ensure that the flushing program implemented does not exceed the capacity of your water source.

**Daycare requirements:** For buildings with an operating daycare, it is required to have a discussion with the daycare operator to recommend that daily flushes (5 minutes) be performed by the daycare operator at each of the points of consumption prior to the children's arrival.

**Signage:** It is recommended that the following notice be installed at each point of consumption in the building (e.g., at each drinking fountain and kitchen faucets):

"PSPC has implemented additional flushing during this period of reduced occupancy to ensure the continued safety of the potable water system in the building.

How you can help:

- Let the water run for two (2) minutes before consuming it.
- When washing your hands (min twenty (20) sec), let the water run to help with flushing the system."

### B. Additional water system considerations

**Trap Seals:** Trap seals may not be maintained if water system use has been reduced. Ensure that trap seals are maintained to keep sewer gases from entering the building. Pour water into floor drains and flush each sanitary fixture (i.e., toilet, urinal) once a week to maintain trap seals.

If regular maintenance activities are reduced, drain building water systems that are not being used (e.g., landscape irrigation, water reuse, decorative water features) to avoid stagnant water conditions. Ensure that the requirements of the building's LBCMP are followed. Follow start-up procedures, manufacturer recommendations and requirements of LBCMP when re-starting systems.

### C. Sampling programs

The annual potable water sampling program and the Legionella testing requirements established in the facilities LBCMP are to be conducted this year and should be coordinated with re-occupancy plans. Testing should be done as soon as possible for buildings that have implemented periodic flushing detailed in section A above. Test results, despite partial occupancy of the buildings, will allow us to assess the water quality and evaluate the effectiveness of the periodic flushing. Test results will inform the need to adjust the building's periodic flushing program or implement additional corrective measures. Consult your regional technical center of expertise for assistance flushing program requirements, interpreting testing results, and implementing correctives measures.

The annual potable water sampling program must include the following minimum parameters:

- microbiological (*E. coli*, TC)
- metals (e.g., lead)
- residual disinfectant (e.g., chlorinated or chloraminated system)
- any site-specific parameters

### D. Return to occupancy

The lack of occupancy of certain space(s) may last for the medium term. Before unoccupied space(s) can be re-occupied, the following steps must be completed for the space(s) that are being re- occupied.

Prior to re-occupancy of a space the property facility manager must complete the Building Water Systems Return to Occupancy Checklist in section G. This checklist is to be kept at the building level and available upon request.

Please consult with your regional technical centre of expertise for support in implementing these requirements.

*D1. For buildings that have implemented the periodic flushing detailed in Section A for at least a month prior to occupancy*

1. Remove aerators before flushing. Thoroughly clean aerator before re-installation.
2. Remove filter before flushing (where possible, i.e. not on fixture that would not function without the filter) and install new filters after flushing.
3. Following the periodic flush at the top of the water risers or end of the main distribution pipes detailed in Section A, flush (zone by zone) for at least five (5) minutes all water fixtures, in the space(s) to be re-occupied, that are directly connected to the building water system starting at the water fixture closest to the water entry. Examples include, kitchen faucets (cold then hot), drinking fountains, washroom faucets (cold then hot), showers (cold then hot) and equipment that is directly connected to the building water system, such as ice machines, coffee machines and eyewash stations.
4. It is important to open outlets slowly to avoid splashing and the creation of aerosols. Appropriate personal protective equipment (PPE) should be worn. Consult your employer for requirements.
5. Following the re-occupancy of a space(s) within the building, maintain the periodic flushing detailed in Section A for the building.

*D2. For buildings that have NOT implemented the periodic flushing detailed in section A for at least a month prior to occupancy*

For buildings that have NOT implemented periodic flushing detailed in section A for at least a month, additional measures must be taken prior to occupancy to minimize the risk from water stagnation in the building systems.

Before unoccupied space(s) can be re-occupied, the following steps must be completed:

1. Remove aerators before flushing. Thoroughly clean and disinfect aerator before re- installation.
2. Remove filter before flushing (where possible, i.e. not on fixture that would not function without the filter) and install new filters after flushing.
3. A flush of at least thirty (30) minutes is to be conducted for each of the hot and cold water risers or main distribution pipes in the building. The flush is to be conducted from the point(s) of consumption (e.g. a kitchen faucet) furthest from the water entry on the top floor of the building (or the longest run furthest from the water entry for single storey sites) until:
   a. the flushing time is completed and;
   b. the measured temperature is stable for one minute (hot flush) and the presence of residual disinfectant is measured at the fixture (cold flush).
4. Following the flush at the top of the water risers or end of the main distribution pipes, flush (zone by zone) for at least five (5) minutes, all water fixtures in the building that are directly connected to the building water system starting at the water fixture closest to the water entry. Examples include, kitchen faucets (cold then hot), drinking fountains, washroom faucets (cold then hot), showers (cold then hot), eyewash stations, and equipment that is directly connected to the building water system, such as coffee machines, water coolers and ice machines.
5. It is important to open outlets slowly to avoid splashing and the creation of aerosols. Appropriate Personal Protective Equipment (PPE) should be worn. Consult your employer for requirements.
6. Sample and analyze the potable water in accordance with the requirements of section C above.
7. Provide an alternative source of drinking water until sampling results demonstrate that the drinking water quality meets the GCDWQ.
8. In the event of non-compliant testing results, the following actions are required in the space(s) that is being re-occupied:
   a. Evaluate the need for space-specific measures (e.g., fixture replacement, filters for lead, disinfection—See section E)
   b. Re-testing for the non-compliant parameters
9. Following the re-occupancy of a space(s) within the building, the periodic flushing detailed in section A must be implemented for the building.
10. Additional re-occupancy of other spaces in a building are to follow requirements of section D1.

Note that it may takes several days for testing results. Check with your laboratory for expected delays in obtaining results, as the COVID-19 situation could delay laboratory operations.

*D3. Third party tenants (e.g., commercials tenants)*

For third party tenants, it is required to have a discussion with the tenant to remind them to follow recommendations from their jurisdiction related to water quality and to recommend that the tenant flush (cold then hot) all their water fixtures for at least 5 minutes prior to re-occupancy. The PSPC flushing program is designed to support the provision of water that meets federal requirements up the entry to the third party tenant space.

### E. Disinfection of water system

Disinfection of a portion of the building's water system may become necessary depending on site conditions. Implementing periodic flushing reduces the risk of bacterial growth. The results of the annual potable sampling program or Legionella testing may demonstrate a need to disinfect a portion of the building water system to address water quality issues.

If disinfection is required, a site-specific procedure must be developed and implemented. The procedure shall be:

1. Developed by a qualified professional
2. Meet applicable federal, provincial/territorial or municipal regulatory requirements (e.g., wastewater)
3. Consider the characteristics of the building's water system such as:
   a. type of disinfectant (e.g., chlorinated or chloraminated) used by the municipality,
   b. materials of piping, fittings and fixtures
   c. age and condition of the system

Following the disinfection of the building's water system:

1. Flush the system until residual disinfectant levels are at an acceptable level and do not exceed the maximum acceptable concentrations established in the GCDWQ.
2. Complete re-sampling and analysis for the non-compliant testing parameters.
3. Provide alternate sources of drinking water until testing results indicate that the quality of the drinking water meets the GCDWQ.

### F. Key Contacts

Please consult with your regional technical center of expertise for support implementing these requirements.

Technical enquiries related to this document should be directed to Senior Director Environment, Health and Safety, Technical Services Service Line, Real Property Services.

Facility Management enquiries related to this document should be directed to Senior Director Property and Facility Management Services Directorate, Property Facility Management Service Line, Real Property Services.

### G. Building water systems return to occupancy checklist

| | | | | |
|---|---|---|---|---|
| **Building Name:** | | | | |
| **Building Address:** | | | | |
| **Area Being re-occupied:** | | | | |
| **Date Completed:** | | | | |
| **Checklist completed by:** | | | | |
| **Name:** | | | | |
| **Email:** | | | | |
| **Telephone:** | | | | |
| Element | | Yes | No | Comments |
| 1 | Periodic flushing completed and log available (Ref: section A3) | | | |
| 2 | Signage posted at each point of consumption (Ref: section A3) | | | |
| 3 | Trap seals maintained (Ref: section B) | | | |
| 4 | Sampling programs (Ref: section C) | | | |
| 5 | Return to occupancy for buildings that have implemented the periodic flushing procedure completed (Ref: section D) | | | |
| 6 | Return to occupancy for buildings that have NOT implemented the periodic flushing procedure completed (Ref: section D) | | | |
| 7 | Alternate source of drinking water provided (if applicable) (Ref: section D) | | | |
| 8 | Disinfection of water system completed (if applicable) (Refer to section E) | | | |