

Water Storage Facility Disinfection Procedure

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Preface

This *Water Storage Facility Disinfection Procedure* (“this procedure”) is a supporting document for Ontario legislation and regulations related to *Drinking Water*. Schedule B, Condition 2.3 of the Drinking Water Works Permit adopts this procedure by reference. Where this procedure refers to ANSI/AWWA *Standard C652* - “Standard for Disinfection of Water-Storage Facilities”, the current version of the standard shall be used. The section numbers in this procedure match the section numbers of the 2019 version of AWWA C652. When an updated version of the standard is released, its corresponding section(s) and amended wording will supersede the requirements of the previous version.

Definitions listed in [Appendix D](#) are capitalized and italicized throughout this procedure.

Table A (below) shows the applicable *Disinfection* procedure for each *Component* by location. Determine the proper *Disinfection* procedure for a particular *Component* by selecting its location from the “Location” column of Table A. Find the specific *Component* to be *Disinfected* within the rows for the selected location. Use the procedure named in the column heading above the selected *Component* to *Disinfect* that *Component*. Sampling and documentation shall be completed as per the identified procedure, unless otherwise indicated in Section 5 of this procedure.

Table A: Applicable *Disinfection* Procedures by Location and *Component*¹

Location	<i>Water Treatment Plant Disinfection Procedure</i>	<i>Water Storage Facility Disinfection Procedure</i>	<i>Watermain Disinfection Procedure</i>
Water Treatment Plant	Filters, Filter basins and contents	<i>Raw Water Tanks</i> ^{2,3,4}	<i>Raw Water Piping and Appurtenances</i> ^{2,3,4}
Water Treatment Plant	<i>Process Water Pumps</i> and UV Units	<i>Process Water Tanks and Drinking Water Tanks</i> ⁴	<i>Process Water Piping and Appurtenances</i> ⁴
Water Treatment Plant	<i>Drinking Water Pumps</i>	<i>Raw</i> ^{2,3} , <i>Process</i> , and <i>Drinking Water Pressure Vessels</i> ^{4,5}	<i>Drinking Water Piping and Appurtenances</i> ⁴
Distribution System	<i>Drinking Water Pumps</i>	<i>Drinking Water Storage Facilities</i> ^{4,5}	<i>Drinking Water Piping and Appurtenances</i> ⁴

Footnotes associated with Table A:

1. Any water used for the purposes of, but not limited to, flushing, cleaning, and *Disinfection* shall be *Drinking Water*. In a water treatment plant, if *Drinking Water* is not available, water that has received the highest level of treatment available may be used.
2. *Raw Water of Drinking Water Systems* that use chlorination prior to filtration as part of their *Log Removal/Inactivation Credit* calculations is not considered *Raw Water* for this procedure. It is considered *Process Water*. *Operating Authorities* who want this water considered as *Raw Water* for this procedure may seek approval from the *Director* for a deviation.
3. *Raw Water Piping/Tanks*:
 - For systems using a well as a *Raw Water* source, *Raw Water Piping* only includes the *Piping* from the well to the water treatment plant. *Piping* within the well is to be *Disinfected* as per the *Municipal Drinking Water Well Disinfection Procedure*.
 - *Raw Water Piping* and *Appurtenances* that convey the following shall be cleaned as per the *Watermain Disinfection Procedure*:
 - surface water
 - “Groundwater Under Direct Influence of Surface Water (GUDI) without adequate insitu filtration”No *Disinfection* is required for these *Raw Water Piping* and *Appurtenances*.
 - *Raw Water Tanks* that contain surface water or “GUDI without adequate insitu filtration” shall be cleaned as per this procedure. No *Disinfection* is required.
 - *Raw Water Piping* and *Appurtenances* that convey non-GUDI groundwater or “GUDI with adequate insitu filtration” shall be cleaned, *Disinfected*, and sampled as per the following sections of the *Watermain Disinfection Procedure*:
 - Section 1 for addition, modification, replacement, extension, and planned maintenance. If applicable, *Microbiological Sampling* as per Section 1.1.3 of the *Watermain Disinfection Procedure* is required.
 - *Microbiological Sampling of Drinking Water* as per Section 1.1.4 of the *Watermain Disinfection Procedure* is not required. The *Operating Authority* may request additional *Treated Water Microbiological Samples* to verify that the *Piping* and *Appurtenances* have been adequately *Disinfected*. Samples should be collected from a *Treated Water* sampling point once water from the *Disinfected Piping* and *Appurtenances* is believed to have achieved “primary disinfection”.
 - Section 2 for emergency repairs of existing *Piping* and *Appurtenances*. *Microbiological Sampling* as per Section 2.4.3 of the *Watermain Disinfection Procedure* is optional.
 - *Raw Water Tanks* that contain non-GUDI groundwater or “GUDI with adequate insitu filtration” shall be cleaned, *Disinfected*, and sampled as per this procedure.

4. *Disinfection* as per this procedure is required for the *Isolated* portions of the *Storage Facility* inlet, outlet, washdown, recirculation and drain *Pipes*. Refer to [Appendix A](#) for figure for visual explanation.
5. For *Disinfection of Pressure Vessels* that cannot withstand high chlorine concentrations, use one of the following methods:
 - chlorination method 1 of this procedure with 6 hours retention period even if chlorine was hand poured
 - chlorination method 2 of this procedure

Operating Authorities shall use *Certified Operators* for activities that must be performed by a *Certified Operator*. *Water Quality Analysts* may perform sampling and testing if permitted through regulation. *Storage Facilities* may only be *Isolated* and placed into service by *Certified Operators*. Activities performed on *Isolated Storage Facilities* are not required to be performed by *Certified Operators*, unless specified otherwise in this procedure. These activities, including taking *Microbiological Samples* and performing chlorine residual concentration testing, may be performed by any person authorized by the *Operating Authority*.

Operating Authorities may use best management practices that exceed the minimum requirements in this procedure.

Deviations from the requirements of this procedure shall be requested and approved in advance by the *Director*.

1. Modifications to Section 1 of AWWA C652 – General

Operating Authorities shall ensure that the requirements of AWWA C652, as modified by this procedure, are followed. For clarity, where this procedure states no *Disinfection* is required for a *Storage Facility*, the sampling required after its *Disinfection* is also not required.

No *Disinfection* is required when a *Storage Facility* is emptied and no maintenance is performed, provided the *Operating Authority* is satisfied that sanitary practices were used. Examples of sanitary practices are:

- cleaning observation hatches (or covers as applicable) and immediate area of loose dirt and debris prior to opening
- cleaning boots and spraying with a minimum 1% chlorine solution immediately prior to entering the *Storage Facility*

If a *Storage Facility* is filled after being left empty for more than 5 days, the *Operating Authority* shall:

- Obtain one set of *Microbiological Samples* as per Section 5 of this procedure.
- Wait for *Satisfactory Microbiological Sample* results prior to placing the *Storage Facility* into service. Section 5.1.2 of this procedure, “Exception – Placing *Storage Facility* into Service Prior to Receiving *Microbiological Sample* Results” does not apply.

Where an *Operating Authority* believes that *Contaminated* or improperly *Disinfected* water was directed to users, the reporting requirements from Schedule 16-4 of [Ontario Regulation 170/03](#) shall apply. The applicable corrective actions outlined in Schedules 17 or 18 of [O. Reg. 170/03](#) shall also apply.

2. Modifications to Section 2 of AWWA C652 – References

In addition to the standards referred to in Section 2 of AWWA C652, this procedure refers to these three *Ministry’s* procedures:

- *Watermain Disinfection Procedure*
- *Water Treatment Plant Disinfection Procedure*
- *Municipal Drinking Water Well Disinfection Procedure*

In their latest editions, these three documents form a part of this procedure to the extent specified within this procedure.

3. Modifications to Section 3 of AWWA C652 – Definitions

[Appendix D](#) of this procedure includes additional definitions, beyond those in Section 3 of AWWA C652. In case of conflict, the definitions from this procedure will supersede the definitions of AWWA C652.

Where AWWA C652 refers to *Potable Water*, the definition of *Drinking Water* in [Appendix D](#) shall be used.

4. Modifications to Section 4 of AWWA C652 – Requirements

At concentrations over 10 mg/L, measurements of total chlorine and free chlorine shall be deemed equivalent.

4.1 Materials and Cleaning

In Section 4.1.2 of AWWA C652:

- “Operating facilities” refers to ancillary *Appurtenances*, structures, and *Pipes* that meet these two criteria:
 - come into contact with water during *Storage Facility* operation
 - may be exposed to *Contaminants* during the work activities
- Drain *Piping* (as shown in [Appendix A](#)) shall be cleaned or flushed with a minimum of two *Pipe* volumes of water.
- All surfaces within the interior of a *Storage Facility* shall be cleaned as per Section 4.1.2 of AWWA C652.
- All surfaces within the interior of a *Storage Facility* that may come in contact with water during normal operation shall be *Disinfected*.
- Any surfaces inside a *Storage Facility* that do not come in contact with water during normal operation may be *Disinfected* at the *Operating Authority’s* discretion.

In addition, any *Component* of chemical feed systems at a *Storage Facility* shall be cleaned and rinsed prior to it being placed into service. Rinsing shall be performed with solution at a minimum 200 mg/L chlorine concentration. *Operating Authorities* may require a retention time after the chlorine solution is applied. Spraying or swabbing are acceptable alternatives to rinsing.

The requirements from Section 4.2 of this procedure applies to this chlorine solution and associated equipment. When dealing with chemicals that are not compatible with chlorine, *Operating Authorities* shall consider rinsing with *Drinking Water* following the chlorine rinse.

4.2 Forms of Chlorine for *Disinfection* and Rinsing

Chemicals used for *Disinfection* shall meet the requirements of both of these standards:

- American Water Works Association ("AWWA")
- American National Standards Institute ("ANSI") safety criteria standard [NSF/ANSI/CAN 60](#)

The same requirements apply for the chlorine solution used for rinsing as per Section 4.1 of this procedure. The equipment used to apply the chlorine solution is not required to meet the requirements of [NSF/ANSI/CAN 61](#). It shall, however, only be used for chlorine solution applications. Deviations allowing the use of alternate *Disinfection* chemicals (for example, hydrogen peroxide) shall be requested and approved in advance by the *Director*.

4.3 Methods of Chlorination

Operating Authorities may use a combination of the 3 chlorination methods outlined in this section. For example, an *Operating Authority* may use the following combination:

- chlorination method 1 to normal operating levels
- chlorination method 2 for space between operating levels and the overflow point

For clarification, a reference to filling to the overflow level in chlorination methods 1 and 3 means filling until overflow of water is confirmed. Filling to the overflow level is not required if an overflow point does not exist. *Operating Authorities* shall, however, ensure that the *Storage Facility* is filled to the maximum fill level.

Operating Authorities shall ensure that a *Chlorine Meter* is used to test the chlorine concentrations for compliance with Tables 1, 2 and 3. The *Ministry* does not allow the use of test strips to measure the chlorine concentrations recorded to demonstrate compliance with this procedure.

For washdown *Pipes* within *Storage Facilities*:

- If *Contamination* is suspected, the requirements for Category 2 Watermain Breaks from the *Watermain Disinfection Procedure* shall be followed for repair, sampling, and documentation.
- If no *Contamination* is suspected, *Disinfection* is not required. *Operating Authorities* shall perform high velocity flushing after maintenance to clean out the *Pipes*, unless this was achieved during *Storage Facility* cleaning.

Handling of Water Discharges to the Natural Environment

Operating Authorities shall take steps to ensure that discharges of water to the natural environment comply with Condition 10.0 of Schedule B of the Municipal Drinking Water Licence. This includes following the applicable requirements of Section 4.3 of AWWA C652 for dechlorination. Follow ANSI/AWWA C655: Field Dechlorination, until the total chlorine residual concentration is no more than 0.02 mg/L in any of the following situations:

- for any water that is directly discharged into surface water
- if the discharge into the natural environment is likely to cause an adverse effect

If the dechlorinated discharged water meets the criteria of Condition 5.5 of Schedule C of the Municipal Drinking Water Licence, the discharge is deemed to be a Class I spill. Class I spills are defined in [Ontario Regulation 675/98](#) made under the [Environmental Protection Act](#).

Operating Authorities may allow the use of hydrogen peroxide in addition to the dechlorination chemicals mentioned in Section 4.2.3 of ANSI/AWWA C655: Field Dechlorination. Deviations allowing the use of other alternate dechlorination chemicals shall be requested and approved in advance by the *Director*.

4.3.1 Chlorination Method 1

Where a *Storage Facility* is *Disinfected* using chlorination method 1 as per Section 4.3.1 of AWWA C652, *Operating Authorities* shall use Table 1 for the:

- minimum retention periods
- minimum chlorine concentrations required after the retention periods

Table 1: Chlorine Concentrations and Retention periods for Chlorination Method 1

Chlorine Addition Method	Minimum Retention Period	Minimum Chlorine Concentration Required After Retention Period
Liquid-chlorine (gas) or sodium hypochlorite using chemical-feed pump.	1.5 hours	40 mg/L
	3 hours	20 mg/L
	6 hours	10 mg/L
	12 hours	5 mg/L ¹
Hand poured Sodium hypochlorite or calcium hypochlorite.	24 hours ²	10 mg/L
	48 hours	5 mg/L ¹

Footnotes Associated with Table 1:

1. Chlorine concentrations less than or equal to 10 mg/L shall be free chlorine residual.
2. *Disinfection of Pressure Vessels* may use as little as 6 hours retention period even if chlorine was hand poured.

Operating Authorities shall ensure that drain *Piping* is purged of *Contaminants*.

Operating Authorities may require intermediate chlorine concentration tests in addition to the chlorine concentration test(s) after the minimum retention period as per Table 1.

4.3.2 Chlorination Method 2

Where a *Storage Facility* is *Disinfected* using chlorination method 2 as per Section 4.3.2 of AWWA C652, *Operating Authorities* shall use Table 2 for the:

- minimum retention period
- initial chlorine concentration

Chlorine concentration used in chlorination method 2 shall be tested on the day of application.

Table 2: Chlorine Concentration and Retention Period for Chlorination Method 2

Chlorine Application Method	Minimum Retention Period	Initial Chlorine Concentration
Application with suitable brushes or spray equipment.	30 minutes	≥ 200 mg/L

The interior surfaces of all *Pipes* that convey water into or out of the *Storage Facility*, except washdown *Pipes*, require *Disinfection*. Examples of *Pipes* requiring *Disinfection* are inlet, outlet, recirculation and drain *Piping*. If brushing or spraying a 200 mg/L chlorine solution on all *Pipe* surfaces is impractical, use one of the following *Disinfection* methods:

- fill the *Pipes* with a chlorine solution of not less than 200 mg/L, which shall be retained for at least 30 minutes
- *Disinfect* the *Pipes* using chlorination method 1

When chlorine concentration samples cannot practically be taken after the *Piping* is filled, the *Operating Authority* may use calculations to determine the initial chlorine concentration.

For the purpose of Section 4.3.2.1 of AWWA C652, only the portion of the drain *Piping* between the *Storage Facility* and the drain valve needs to be *Disinfected*.

Drain *Piping* downstream of the drain valve does not require *Disinfection*. [Appendix A](#) includes a diagram showing which *Pipes* require *Disinfection*.

Section 4.3.2.2 of AWWA C652 requires to purge the drain *Piping* of the highly chlorinated water after starting to re-fill the *Storage Facility*. *Operating Authorities* may instead choose to purge the drain *Piping* content prior to admitting *Drinking Water* into the *Storage Facility*.

Section 4.3.2.2 of AWWA C652 states that the *Storage Facility* be filled to its overflow level. *Operating Authorities* may instead choose to fill the *Storage Facility* to its maximum operating level without actually overflowing.

Operating Authorities shall endeavour to place *Storage Facilities* into service as soon as possible after *Satisfactory Microbiological Sample* results are received. *Operating Authorities* shall ensure that sanitary and security practices are followed after *Disinfection* until the *Storage Facility* is placed into service. If filling is not started within 5 days, the *Operating Authority* shall wait for *Satisfactory Microbiological Sample* results prior to placing the *Storage Facility* into service. Section 5.1.2 of this procedure, “Exception – Placing *Storage Facility* into Service Prior to Receiving *Microbiological Sample* Results” does not apply.

4.3.3 Chlorination Method 3

Where a *Storage Facility* is *Disinfected* using chlorination method 3 as per Section 4.3.3 of AWWA C652, *Operating Authorities* shall use Table 3 for the:

- minimum initial chlorine concentrations
- minimum retention periods

When initial chlorine concentration samples cannot practically be taken from the *Storage Facility*, the *Operating Authority* may use calculations to determine the initial chlorine concentration.

Table 3: Chlorine Concentrations and Retention Periods for Chlorination Method 3

Initial Chlorine Concentration	Minimum Retention Period at 5% Volume	Minimum Retention Period When <i>Storage Facility</i> Filled to Overflow Level
≥ 25 mg/L	12 hours	24 hours
≥ 50 mg/L	6 hours	24 hours

In Section 4.3.3.1 of AWWA C652, sodium hypochlorite solution may be poured into the *Storage Facility* prior to water depth reaching 5% of total storage volume required by Section 4.3.1.2.2 of AWWA C652. This allows for adequate distribution and mixing of the chlorine solution.

Operating Authorities shall ensure that drain *Piping* is purged of *Contaminants*.

4.4 Disinfection Procedures When Conducting Underwater Inspection and/or Cleaning of *Storage Facilities*

In Section 4.4.5.1.6 of AWWA C652, divers or Remotely Operated Vehicles (ROVs) are prohibited from disturbing the sediment inside the *Storage Facility* in any way. This restriction applies unless the *Operating Authority* explicitly approves the activity. Examples of such situations would be intentional removal of sediment or moving sediment to confirm floor condition. Where disturbing sediment is expected, observed, or suspected, *Operating Authorities* shall take measures to ensure that disturbed sediments are not directed to users. This may include *Isolating the Storage Facility*.

The requirements of Section 4.4.5.2.3 of AWWA C652 related to the dive team personnel health do not apply as their personal medical information does not need to be disclosed.

In Section 4.4.6 of AWWA C652, in lieu of using Section 4.3.2 of AWWA C652 for *Disinfection* of equipment and personnel, *Operating Authorities* shall use Table 4 for the:

- minimum chlorine concentrations
- minimum retention periods

When the chlorine concentration to meet the Table 4 requirements cannot practically be measured, the *Operating Authority* may allow the concentration to be calculated.

Table 4: Chlorine Concentrations and Retention Periods for *Disinfection* of Equipment or Personnel

Minimum Chlorine Concentration	Minimum Retention Period
200 mg/L	30 minutes
300 mg/L	15 minutes
1% (10,000 mg/L)	Immediate

Unless the *Storage Facility* is *Isolated*, the *Operating Authority* shall ensure that all the following criteria are met:

- a *Certified Operator* is present
- the *Certified Operator* witnesses and confirms that the sanitary practices and *Disinfection* requirements listed in this section are followed

In Section 4.4.7 of AWWA C652, for clarity,

- for ROV inspections, *Microbiological Samples* are not required unless sediment disturbance is expected, observed, or suspected
- after underwater inspection and/or cleaning activities using divers, *Microbiological Samples* are required whether the *Storage Facility* was kept in service or *Isolated*
- if the *Storage Facility* was kept in service, the *Microbiological Samples* and associated chlorine residual concentration tests shall be taken by a *Certified Operator* or *Water Quality Analyst*

5. Modifications to Section 5 of AWWA C652 – Verification

5.1 Water Quality Sampling and Testing

Section 5.1 of this procedure provides the requirements for sampling and testing after a *Storage Facility* has been *Disinfected* as per this procedure.

5.1.1 Microbiological Sampling Requirements

All *Microbiological Samples* shall be taken and handled as per the *Ministry's Practices for the Collection and Handling of Drinking Water Samples* document (as amended).

Operating Authorities shall endeavour to take a set of *Microbiological Samples* that are representative of the contents of the *Storage Facility*. For example, a representative set of *Microbiological Samples* could include one of the following:

- samples from at least two locations
- two samples from the same location, taken at least 30 minutes apart, with water flowing between samples
- two samples from the same location, at least 16 hours apart, with or without water flowing
- any other sampling strategy approved by the *Director*

Suggested locations may include the following (but are not limited to):

- each cell of a *Storage Facility*
- each inlet and/or outlet *Pipe* of a *Storage Facility*

When *Microbiological Samples* are taken from an *Isolated Storage Facility*, additional samples shall be taken at the same time from the same location. These samples shall be tested immediately for one of these parameters below:

- free chlorine residual concentration if the system provides chlorination and does not provide chloramination
- combined chlorine residual concentration if the system provides chloramination

Any person authorized by the *Operating Authority* may take *Microbiological Samples* from *Isolated Storage Facilities* and perform the associated chlorine residual concentration tests.

5.1.1.1 Result of Testing

In Section 5.1.1.1 of *AWWA C652*, where the situation shall be evaluated by qualified personnel, “qualified personnel” means *Operating Authority* or any employee thereof.

In Section 5.1.1.1 of *AWWA C652*, repeat *Microbiological Samples* shall be taken from every location where the initial samples were taken. These samples shall be

taken at least 30 minutes from the previous samples. If repeat *Microbiological Samples* are taken from a tap, the *Operating Authority* shall endeavour to have water flow continuously from the sample point between samples.

Microbiological Samples results obtained from *Isolated Storage Facilities* shall be uploaded to the *Ministry's* database by the laboratory. Non-Satisfactory results from these samples are not reportable under Schedule 16 of [O. Reg. 170/03](#).

5.1.1.2 Care in Sampling

If samples are taken from a *Storage Facility* hatch, care shall be taken to ensure *Contamination* is not introduced when the hatch is open. For example, the area may be covered with a tent during inclement weather.

5.1.1.3 and 5.1.1.4 Additional and Optional Sampling

The “recommended additional samples” per Section 5.1.1.3 of AWWA C652 and the “optional sampling and testing” per Section 5.1.1.4 of AWWA C652 shall be considered as optional and at the discretion of the *Operating Authority*. Determinations of acceptable values for these parameters shall be at the discretion of the *Operating Authority*.

5.1.1.5 Placing the *Storage Facility* into Service

Operating Authorities shall endeavour to place *Disinfected Storage Facilities* into service as soon as possible after *Satisfactory Microbiological Sample* results are received. Additionally, chlorine residual concentration shall be tested at all the following locations immediately before placing in service an *Isolated Storage Facility* that will direct *Drinking Water* to users:

- at each inlet/outlet *Pipe*
- at all locations where *Microbiological Samples* were taken
- at any other location required by the *Operating Authority*

Determinations of acceptable chlorine residual concentrations and any other water quality parameters shall be at the discretion of the *Operating Authority*. One of the following minimum chlorine residual concentrations shall however be achieved:

- at least 0.20 mg/L free chlorine residual concentration in a chlorinated system

- at least 1.0 mg/L combined chlorine residual concentration in a chloraminated system

If these concentrations cannot be achieved, the *Operating Authority* shall develop and implement a re-commissioning plan. The plan shall reflect the duration of *Isolation* and the associated risks. The plan may include the implementation of Section 4 of this procedure. As a minimum, the plan shall include the following two items:

- Steps to raise the chlorine residual concentrations to the minimum values mentioned above.
- Taking at least two consecutive sets of *Microbiological Samples* as per Section 5.1.1 of this procedure at each sampling point after chlorine residual concentration has been raised. The *Operating Authority* shall wait for *Satisfactory* results to place the *Isolated Storage Facility* into service.

5.1.2 Exception – Placing *Storage Facility* into Service Prior to Receiving *Microbiological Sample* Results

The intent of this procedure is for *Operating Authorities* to keep the *Disinfected Storage Facilities* requiring *Microbiological Sampling Isolated* until *Satisfactory Microbiological Sample* results are received.

There are circumstances where it may be impractical to wait for the *Microbiological Sample* results before placing the *Disinfected Storage Facility* into service (meaning, water directed to users). The following are examples of acceptable circumstances:

- when the ability to meet *Drinking Water* demand may be compromised
- when stored *Drinking Water* levels may fall below acceptable limits

In these circumstances, the *Operating Authority* may place an *Isolated Storage Facility* into service prior to receiving *Satisfactory Microbiological Sample* results.

Any *Drinking Water Microbiological Samples* and their associated chlorine residual concentration tests shall be deemed *Drinking Water* samples within the meaning of [O. Reg. 170/03](#):

- These samples and tests shall be taken by a *Certified Operator* or a *Water Quality Analyst*.
- *Microbiological Sample* results shall be uploaded to the *Ministry's* database by the laboratory.

- The following shall apply to adverse *Microbiological Sample* and/or chlorine residual concentration test results:
 - the reporting requirements outlined in Schedule 16-3 of O. Reg. 170/03
 - the applicable corrective actions outlined in Schedules 17 or 18 of O. Reg. 170/03

For *Disinfected Raw or Process Water Storage Facilities*, the *Operating Authority* shall arrange to take all the following samples:

- The *Microbiological Samples* obtained on the *Isolated Storage Facility* as per Section 5.1.1 of this procedure.
- Additional *Microbiological Samples* and chlorine concentration tests from the *Treated Water* sampling point. These shall be taken at an estimated point in time when both of the following criteria are met:
 - the water from the *Disinfected Storage Facility* is believed to have achieved “primary disinfection”
 - the water has reached the *Treated Water* sampling point

A. After Disinfection is Performed as Per Section 4.3 of this Procedure

After *Disinfection* is performed, the *Operating Authority* may place the *Storage Facility* into service prior to receiving all *Satisfactory Microbiological Sample* results if all the following criteria are met:

- The *Operating Authority* provides written notice of its intention to use this exception to the local *Ministry* office and Medical Officer of Health in advance. If not possible, the written notices shall be provided as soon as reasonably possible. The written notice shall include the following two items at a minimum:
 - the *Operating Authority's* reason for using this exception rather than waiting for *Satisfactory Microbiological Sample* results prior to placing the *Storage Facility* into service
 - a description of the work performed and the *Disinfection* method to be used
- The *Operating Authority* shall document and follow any direction from the local *Ministry* office and/or the local Medical Officer of Health. The *Operating Authority* shall document if the following occurs:
 - no additional direction was provided
 - direction was not provided in time to be incorporated into the work performed

- An *Operator-in-Charge* verifies that the cleaning and *Disinfection* of the *Storage Facility* meet the requirements of this procedure.

B. After Underwater Inspection and/or Cleaning is Performed as Per Section 4.4 of this Procedure

When *Microbiological Samples* are required to be taken from *Isolated Storage Facilities*, *Operating Authorities* may return the *Storage Facility* to service prior to receiving all *Satisfactory Microbiological Sample* results if all the following criteria are met:

- a *Certified Operator* verifies that the sanitary practices and *Disinfection* requirements of Section 4.4 of this procedure are followed
- a *Certified Operator* states that there is no observed or suspected disturbance of sediment or that measures are taken to ensure that disturbed sediments are not directed to users
- if applicable, the chlorine residual concentration test result is acceptable to the *Operating Authority*

5.2 Record of Compliance (Documentation)

When using this procedure, *Operating Authorities* shall maintain records of the following information as a minimum. The information shall be retained as per the record-keeping requirements of Section 27 of [O. Reg. 128/04](#) and Condition 13.0 of Schedule B of the Municipal Drinking Water Licence. This section does not require that all the information be recorded on a single form.

- Statement that all surfaces requiring cleaning were cleaned as per Section 4.1 of this procedure.
- If applicable, statement that any chemical system *Components* at a *Storage Facility* requiring cleaning and rinsing, as per Section 4.1 of this procedure, were:
 - rinsed (or alternatively sprayed or swabbed) with a solution at a minimum 200 mg/L chlorine concentration
 - rinsed with *Drinking Water* afterwards if necessary
- Type of water used for cleaning and/or *Disinfection* (*Raw, Process or Drinking Water*).
- Statement that all screens (such as vent, overflow) were checked after cleaning.
- For the chemical used for *Disinfection*, include all the following items:

- name and form of chemical
- concentrations as required
- statement that it meets the requirements of both the AWWA and NSF/ANSI/CAN 60 Standards
- **Disinfection Procedure:**
 - **For all *Disinfection* methods in this procedure:**
 - Method of *Disinfection* used.
 - Date and time *Disinfection* started and ended with calculation of retention period(s) in minutes or hours (two retention periods in chlorination method 3).
 - Statement that drain *Piping* was purged.
 - Statement whether a *Chlorine Meter* was used to measure chlorine residual concentrations used for *Disinfection*. If the concentrations were calculated, reason why it was impractical to use a *Chlorine Meter*.
 - If water was discharged to the natural environment:
 - description of handling of *Disinfection* water
 - if dechlorination was required, total chlorine residual concentration of water discharged after dechlorination, and name of chemical used for dechlorination
 - statement whether discharge met the requirements of Condition 5.5 of Schedule B of the Municipal Drinking Water Licence, including which sub-clause of Condition 5.5 was met
 - **Chlorination Method 1:**
 - If sodium hypochlorite was used, include if added with chemical-feed pump or hand-poured.
 - Statement that water was filled to overflow level and overflow was confirmed. If an overflow point does not exist, a statement that water was filled to maximum fill level.
 - Chlorine concentration test result at end of retention period at each sampling point.
 - **Chlorination Method 2:**
 - Method of application (brush or spray).
 - Test result or calculated value of chlorine concentration sprayed or brushed.

- Statement that all surfaces up to the overflow point, including outside of *Pipes*, were thoroughly coated.
 - If impractical to coat inside of a *Pipe* - initial chlorine concentration (tested or calculated) and retention period.
- **Chlorination Method 3:**
 - Test result or calculated value of initial chlorine concentration.
 - Approximate measurement and percentage of volume filled initially.
 - Statement that water was filled to overflow level for second portion of *Disinfection* and overflow was confirmed. If an overflow point does not exist, a statement that water was filled to maximum fill level.
- **Underwater Inspection and/or Cleaning:**
 - Type of inspection: ROV or divers.
 - Statement whether *Storage Facility* was kept in service at the time or *Isolated*. If *Isolated*, date and time *Storage Facility* was *Isolated*.
 - Statement whether there was observed or suspected disturbance of sediment. If applicable, description of measures taken to ensure that disturbed sediments were not directed to user.
 - Statement that access hatches and immediate area were cleaned of loose dirt or debris prior to opening.
 - Initial water quality – chlorine residual concentration test results at representative locations.
 - If the *Storage Facility* was kept in service at the time, daily *Microbiological Sample* and associated chlorine residual concentration test results.
 - Statement that equipment and personnel were *Disinfected*, chlorine concentration used for *Disinfection*, and retention period if applicable.
 - Name of *Certified Operator* present (if required).
 - Post inspection *Microbiological Sample* and chlorine residual concentration test results (if required).
- **Microbiological Sampling:**
 - Date, time, and location of *Microbiological Samples*.

- *Microbiological Sample* and applicable chlorine residual concentration test results.
- If applicable, name of *Certified Operator* or *Water Quality Analyst* who took the *Microbiological Samples* and associated chlorine concentration residual tests.
- **Placing into Service:**
 - Date and time of placing into service (if applicable).
 - Statement that sanitary practices were maintained following *Disinfection* until the *Storage Facility* was placed into service.
 - If applicable, the day a *Storage Facility* was placed into service:
 - chlorine residual concentration test result(s)
 - date, time and location of the test(s)
 - plan and associated records if any chlorine residual concentration test result was too low
 - **Exception as per Section 5.1.2:** If a *Disinfected Storage Facility* was placed into service prior to receiving *Microbiological Sample* test results:
 - Description of the circumstances requiring the placing into service prior to receiving *Microbiological Sample* test results.
 - **After *Disinfection*:**
 - Copy of written notice sent to the local *Ministry* office and the local Medical Officer of Health.
 - Response to any direction received. Document if no additional direction was provided or direction was not provided on time.
 - Name of *Operator-in-Charge* who verified that the cleaning and *Disinfection* of the *Storage Facility* met the requirements of this procedure.
 - **After underwater inspection and/or cleaning:**
 - name of *Certified Operator* who verified that the sanitary practices and *Disinfection* of the *Storage Facility* met the requirements of this procedure

6. Delivery

No modification to this section.

Appendix A - Pipes That Require Disinfection using the Water Storage Facility Disinfection Procedure

Figure 1 - Example of Storage Facility and its Associated Piping

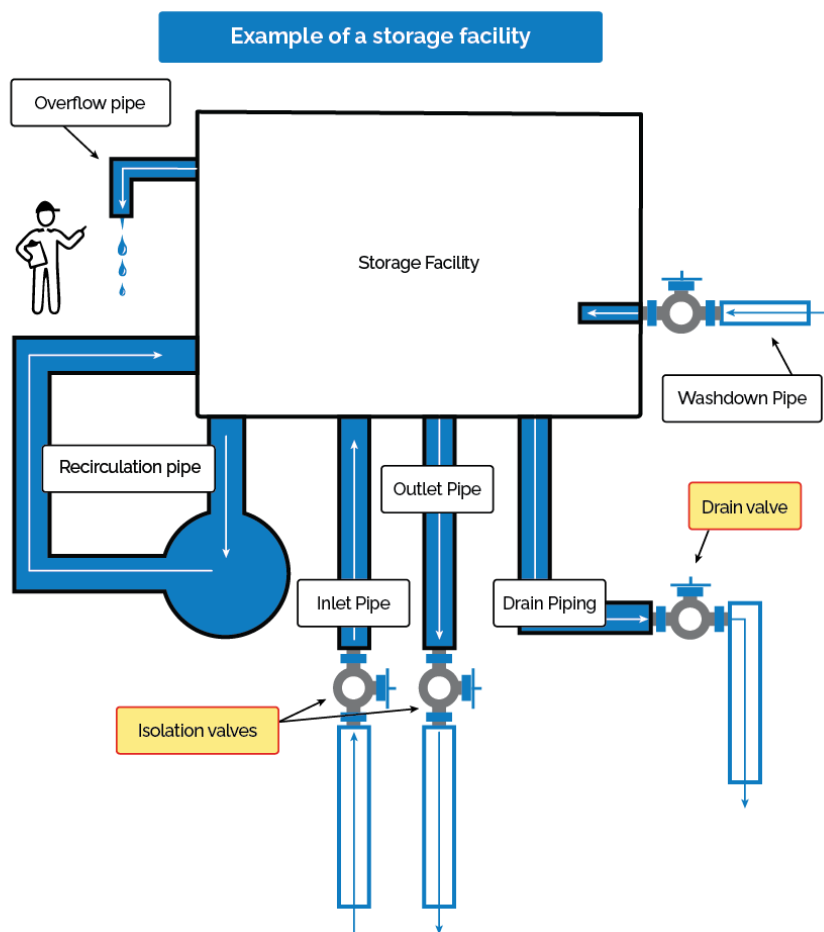


Figure 1 is an example of a *Storage Facility* and its associated *Piping*. *Disinfection* as per the *Water Storage Facility Disinfection Procedure* is required for the portions of the inlet, outlet, washdown, recirculation and drain *Pipes* that connect to the *Storage Facility* up to their *Isolation valves*. These portions are shown in blue in the figure.

The portions of the inlet, outlet, washdown and drain *Pipes* after their *Isolation valves*, shown in white in the figure, do not require *Disinfection*. *Overflow Pipe* from *Storage Facility* do not require *Disinfection*.

For chlorination methods 1 and 3, overflow of water must be confirmed. If an overflow point does not exist, water shall be filled to maximum fill level.

Appendix B - Flowcharts - Section 4 – Requirements (Disinfection of Storage Facility)

Section 4 of this procedure provides steps required to *Disinfect a Storage Facility*.

- When *Disinfecting a Storage Facility* and its associated sampling, section 4 of AWWA C652 must be followed as modified by this procedure.
- Section numbers in **bold** refer to AWWA C652. Section numbers in normal font refer to this procedure.
- No *Disinfection* is required if a *Storage Facility* is emptied, no maintenance is performed and the *Operating Authority* is satisfied that sanitary practices were used.
- At concentrations > 10 mg/L, measurements of total chlorine and free chlorine shall be deemed equivalent.

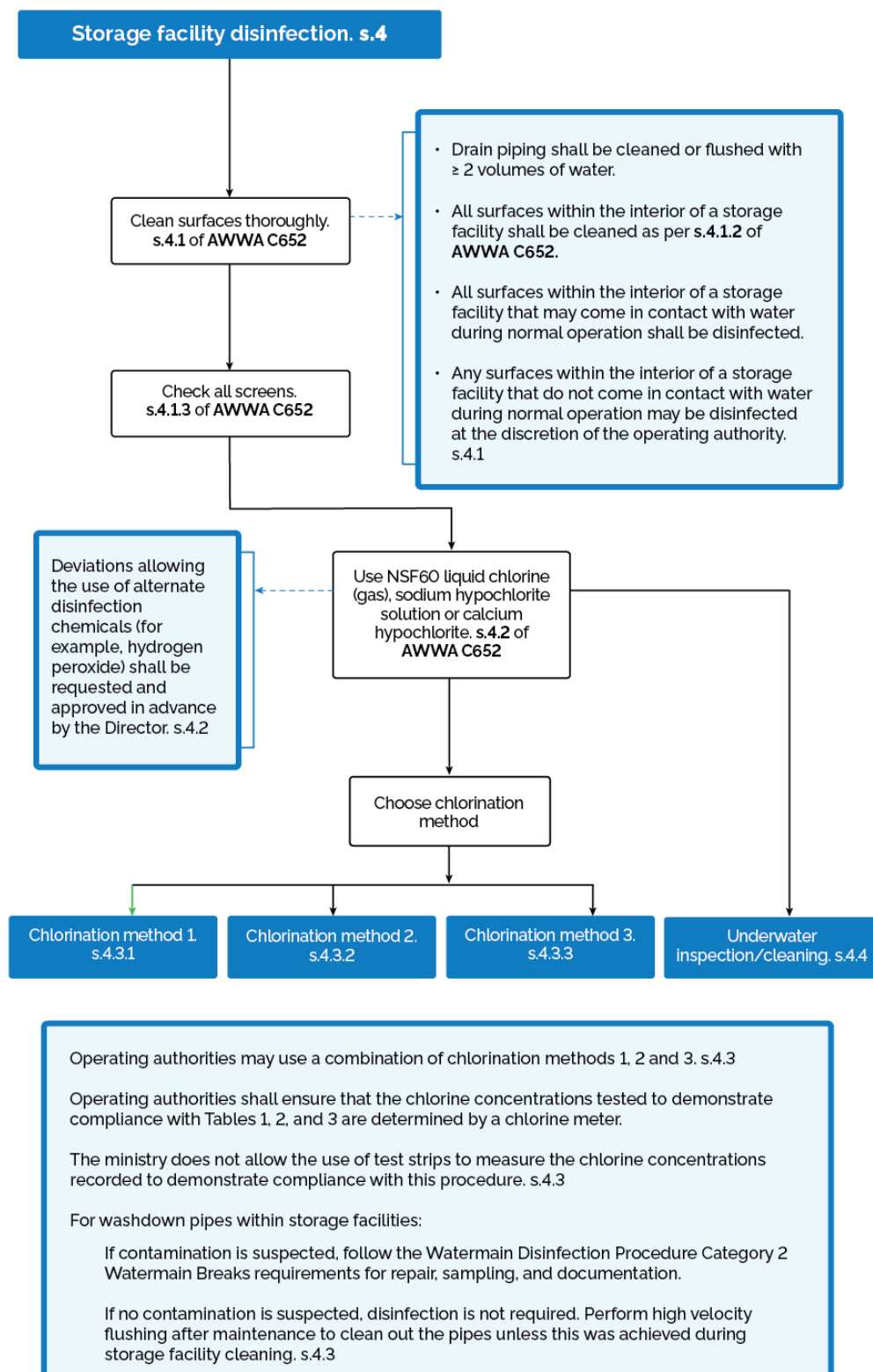
Figure 2 - Section 4 Requirements – Disinfection of Storage Facility

Figure 3 - Chlorination Method 1 Requirements

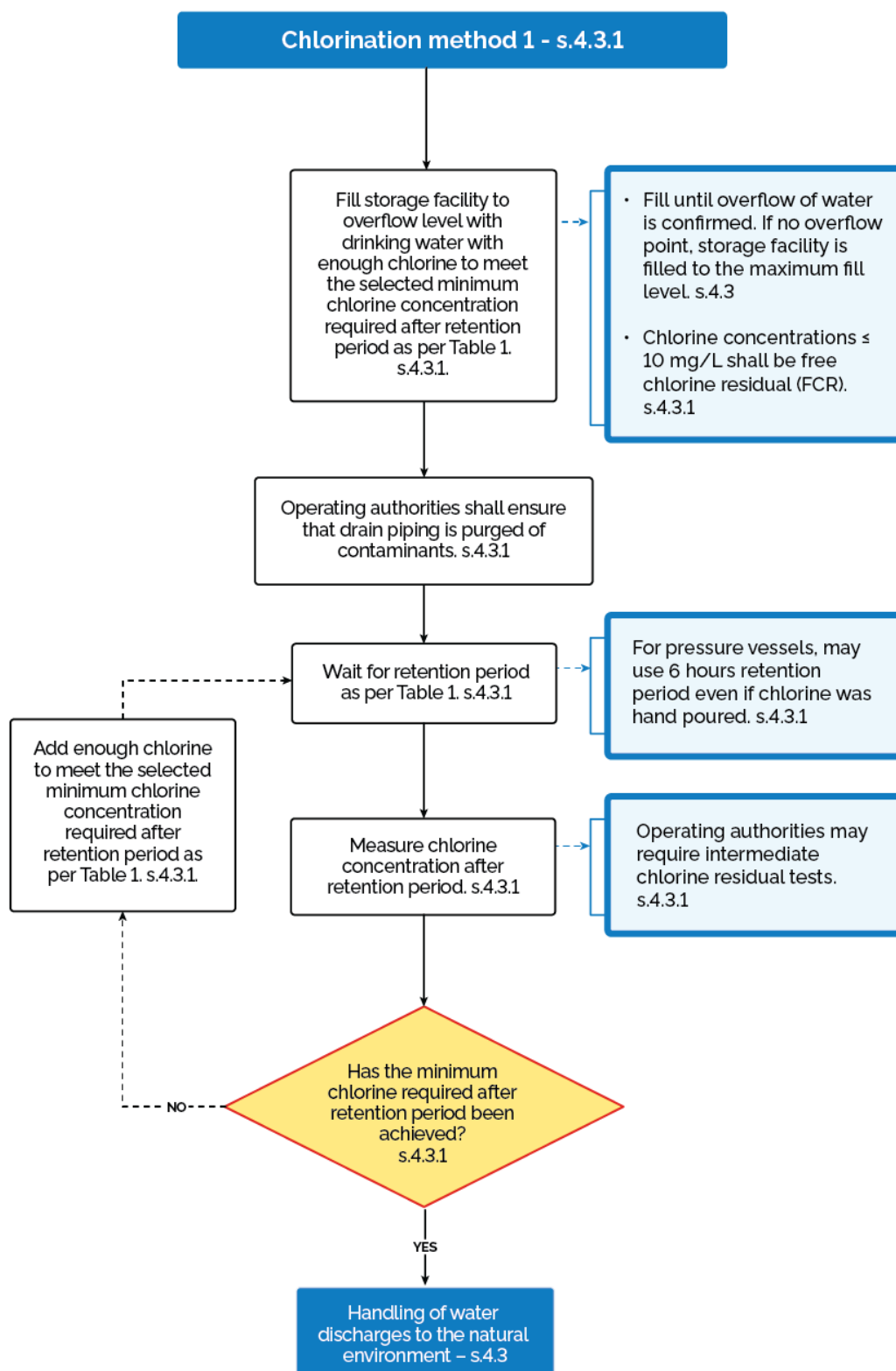


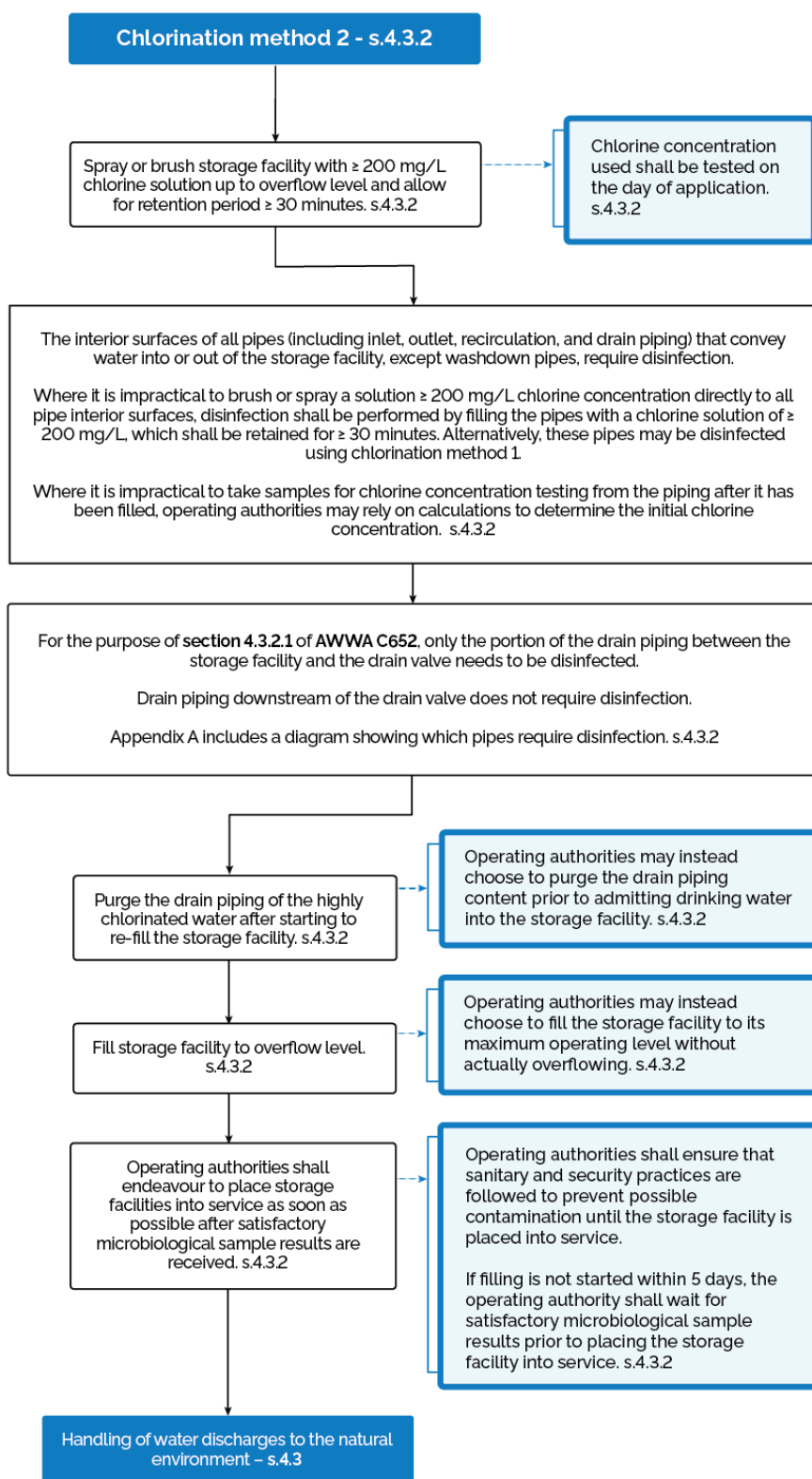
Figure 4 - Chlorination Method 2 Requirements

Figure 5 - Chlorination Method 3 Requirements

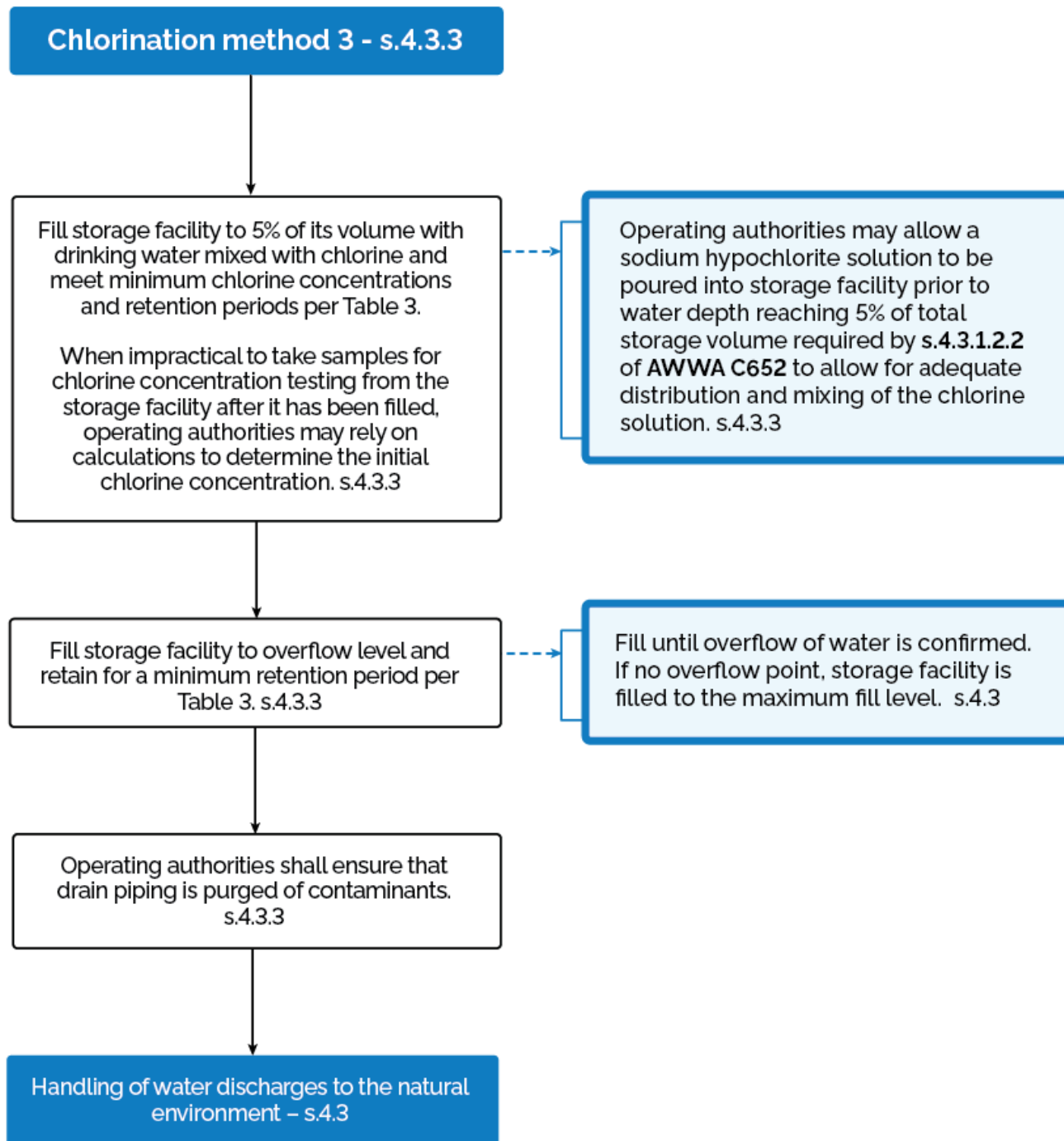


Figure 6 - Requirements for Handling of Water Discharges to the Natural Environment

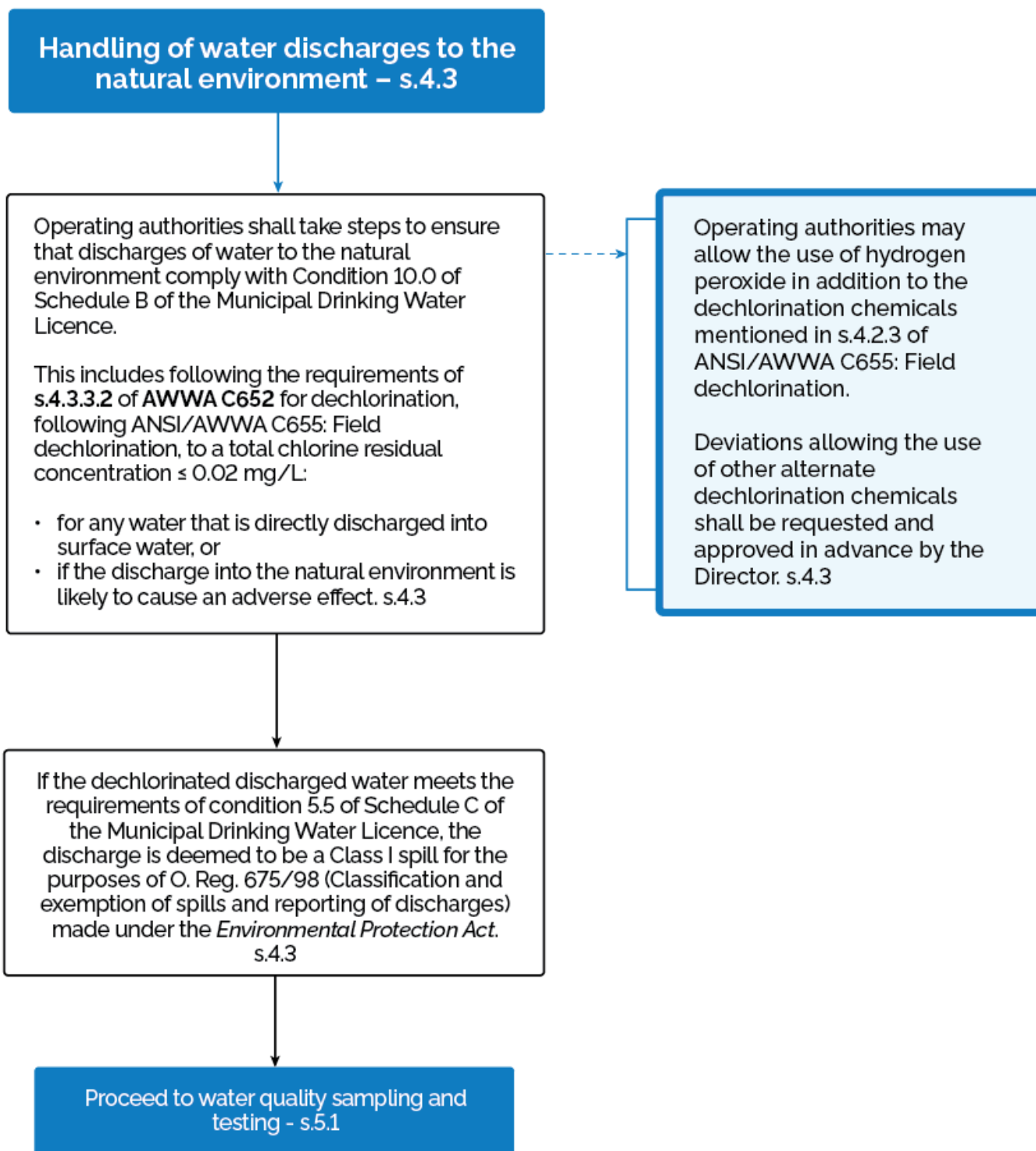
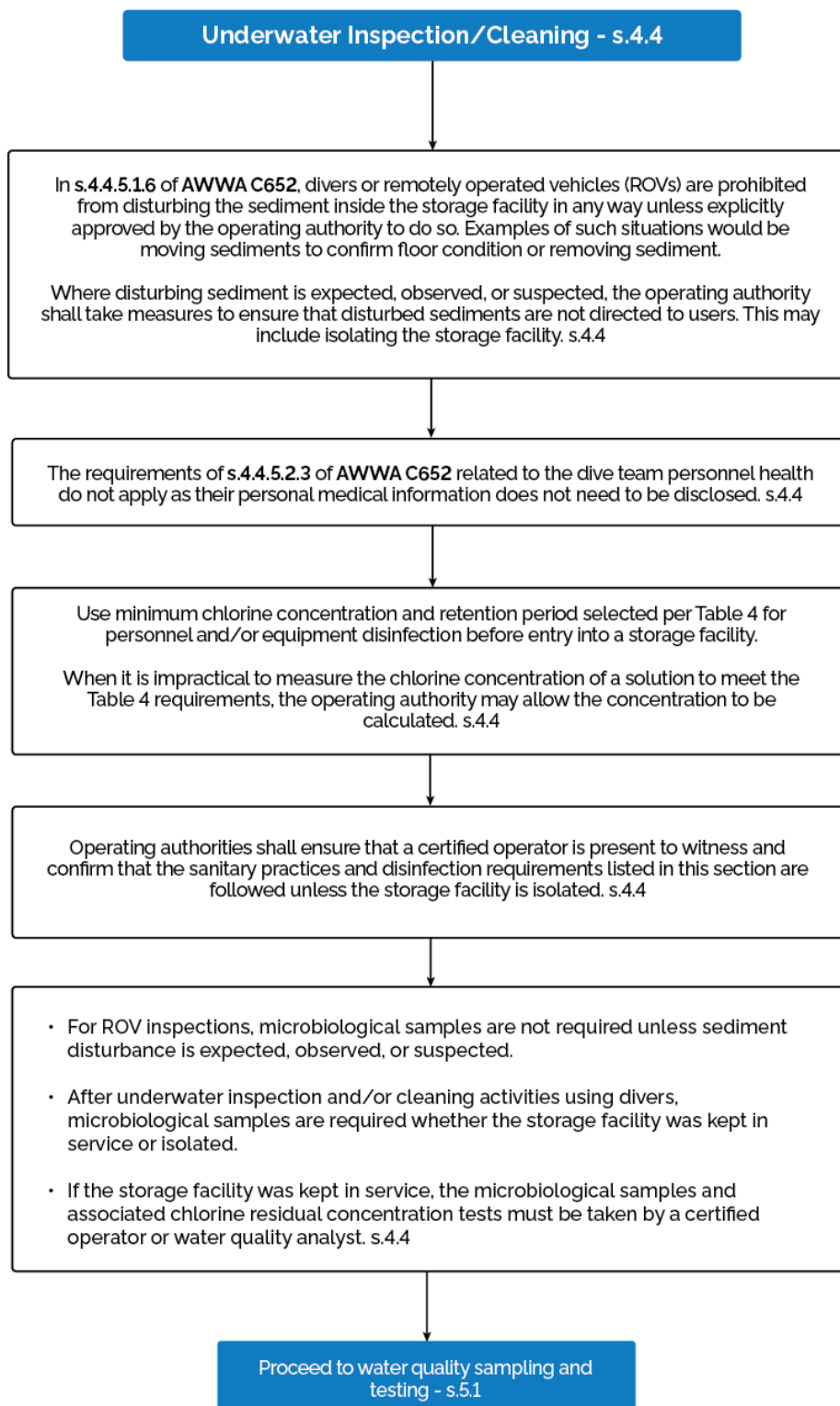


Figure 7 - Requirements for Disinfection after Underwater Inspection or Cleaning of a Storage Facility

Appendix C - Flowchart - Section 5.1 – Water Quality Sampling and Testing

Section 5.1 of this procedure provides the requirements for sampling and testing after a *Storage Facility* has been *Disinfected* as per this procedure.

The following are general notes related to this section:

- When sampling and testing after *Disinfection* a *Storage Facility*, section 5 of AWWA C652 must be followed as modified by this procedure.
- All section numbers in Figure 8 refer to this procedure.
- All microbiological samples shall be taken and handled as per the ministry's [Practices for Collection and Handling of Drinking Water Samples](#) document (as amended).
- Any person authorized by the *Operating Authority* may take *Microbiological Samples* from *Isolated Storage Facility* and perform the associated chlorine residual concentration tests.
- If samples are taken from a *Storage Facility* hatch, care must be taken to ensure contamination is not introduced when the hatch is open. For example, the area may be covered with a tent during inclement weather.
- The “recommended additional samples” under sections 5.1.1.3 and the “optional sampling and testing” under section 5.1.1.4 of AWWA C652 are considered as optional and at the discretion of the *Operating Authority*. Determinations of acceptable values for these parameters shall be at the discretion of the *Operating Authority*.

Figure 8 - Part 1 - Section 5.1 – Water Quality Sampling and Testing after a Storage Facility has been Disinfected

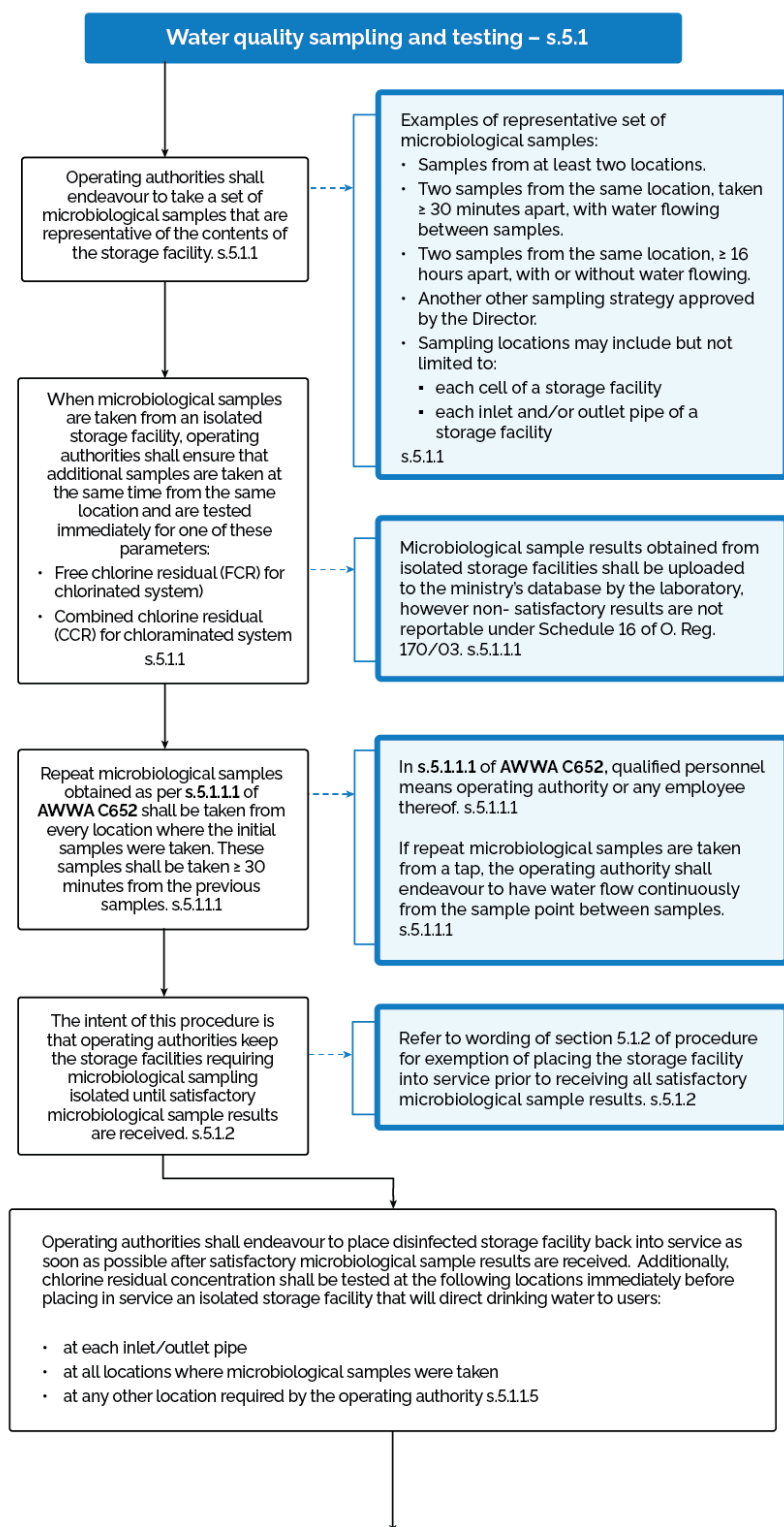
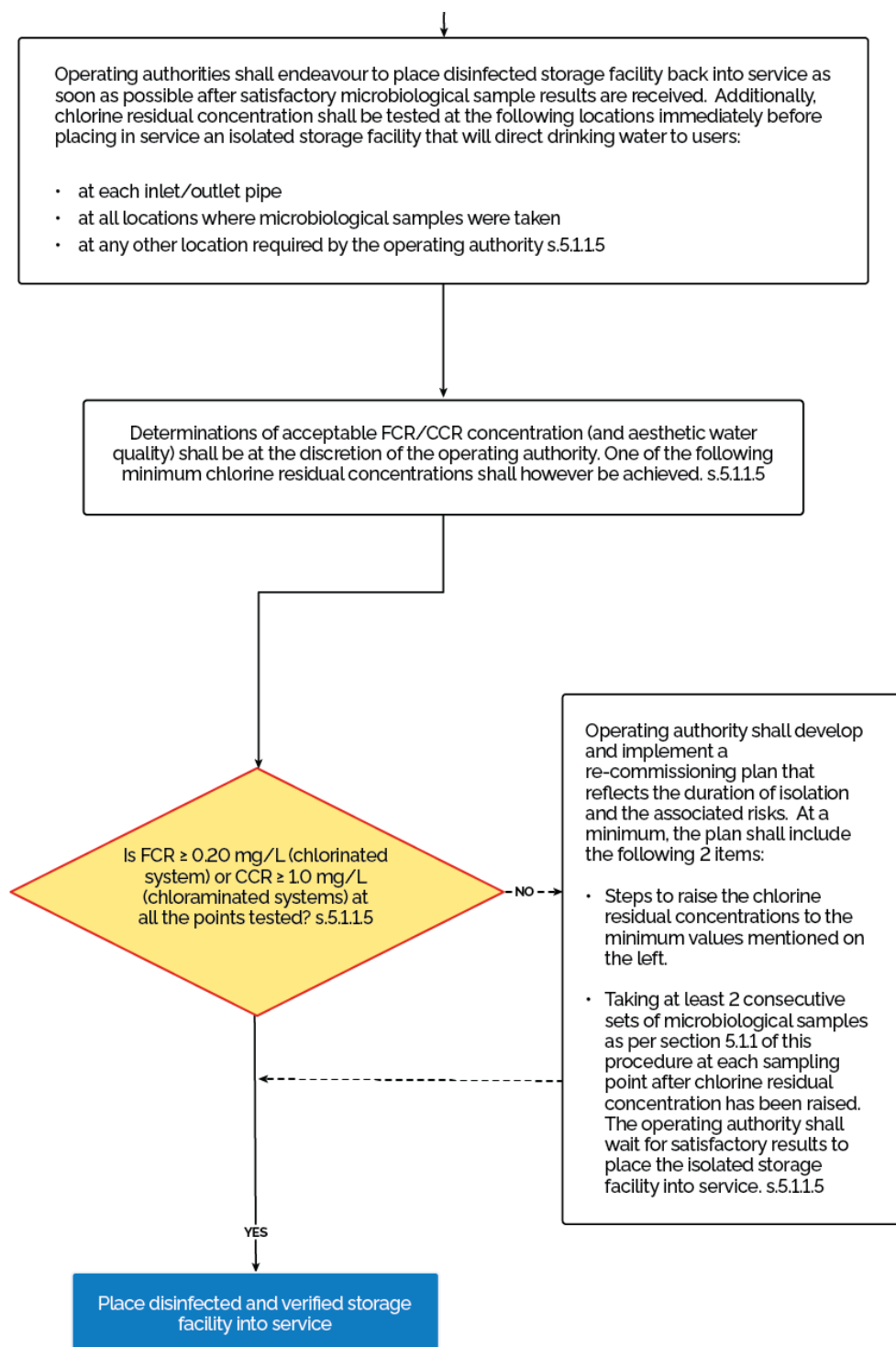


Figure 8 – Part 2 - Section 5.1 – Water Quality Sampling and Testing after a Storage Facility has been Disinfected

Appendix D - Definitions

In this procedure,

Appurtenance

means an appurtenance, within the meaning of [O. Reg. 170/03](#), that is in contact with water.

AWWA C652

means ANSI/AWWA Standard C652 - “Disinfection of Water-Storage Facilities”, Version 2019, as updated.

Certified Operator

means certified operator within the meaning of [O. Reg. 170/03](#).

Chlorine Meter

means a calibrated electronic direct readout colourimetric or amperometric chlorine meter that has a readout that displays to at least two significant figures. Another method may be approved by the *Director*.

Component

means a part of a *Drinking Water System* that is normally in contact with *Raw Water*, *Process Water* or *Drinking Water*.

Contaminant

means foreign matter that is not intended to enter *Drinking Water*.

Contaminated/Contamination

means the presence of a *Contaminant* in *Drinking Water*.

Director

means a Director appointed pursuant to Section 6 of the [Safe Drinking Water Act \(SDWA\)](#) for the purposes of Parts V/VI of the Act.

Disinfected/Disinfection

means a process that inactivates pathogenic microorganisms on the surfaces of system *Components* in contact with water by chemical oxidants or equivalent agents. This definition does not include “primary disinfection” based on *Log Removal/Inactivation Credits*.

Drinking Water

means drinking water within the meaning of the [Safe Drinking Water Act \(SDWA\)](#).

Drinking Water System

means drinking water system within the meaning of the [Safe Drinking Water Act \(SDWA\)](#).

Isolate/Isolation

means operate valves to ensure that there is no flow of water to or from a specific section of a *Storage Facility, Component, and/or its associated Piping*.

Log Removal/Inactivation Credit

means a value assigned to a unit treatment process used to achieve “primary disinfection”, expressed in logarithmic units, for the removal or inactivation of a specific pathogen or group of pathogens, such as viruses, bacteria, and protozoa.

Microbiological Sample

means water sample taken and tested for *Escherichia coli* and Total Coliforms by a licensed and accredited laboratory.

Ministry

means Ontario’s Ministry of the Environment, Conservation and Parks.

Municipal Drinking Water Well Disinfection Procedure

means any future “Municipal Drinking Water Well Disinfection Procedure” published by the *Ministry*, as amended.

Operating Authority

means operating authority within the meaning of the [Safe Drinking Water Act \(SDWA\)](#).

Operator-in-Charge

means an operator-in-charge within the meaning of [O. Reg. 128/04](#).

Pipe/Piping

means any pipe or conduit that conveys water, inside a building or underground.

Potable Water

in AWWA C652 means *Drinking Water*.

Pressure Vessel

means an enclosed vessel containing *Raw, Process or Drinking Water* that is pressurized during normal operation.

Process Water

means water that is in the process of being treated in a water treatment plant. This means, **AFTER** the point where *Log Removal/Inactivation Credit* treatment has started, but **BEFORE** all *Log Removal/Inactivation Credit* treatment has been achieved.

Raw Water

means water **BEFORE** the point where *Log Removal/Inactivation Credit* treatment starts.

Satisfactory

- as related to *Drinking Water*, means *Microbiological Sample* results that are negative for *Escherichia coli* and Total Coliforms
- as related to *Raw or Process Water*, means *Microbiological Sample* results acceptable to the *Operating Authority*

Storage Facility

means any *Tank*, reservoir, elevated tank, standpipe, or *Pressure Vessel* that contains *Raw*, *Process* or *Drinking Water*, other than filter basins.

Tank

means any clearwell and any tank (including any tank within the water treatment plant process and pressure/surge tank that is bladderless). *Tank* DOES NOT include filter basins.

Treated Water

means water inside the Water Treatment Plant **AFTER** the point where *Log Removal/Inactivation Credit* treatment has been completed.

Water Quality Analyst

means a water quality analyst within the meaning of [O. Reg. 128/04](#).

Water Treatment Plant Disinfection Procedure

means any future “Water Treatment Plant Disinfection Procedure” published by the *Ministry*, as amended.

Watermain Disinfection Procedure

means the *Ministry’s* “Watermain Disinfection Procedure”, dated August 1, 2020, as amended.

Appendix E - Version History

Version	Details	Date
1.0	Initial publication of the <i>Water Storage Facility Disinfection Procedure</i>	August 27, 2026
1.1	Section 5.1.2 - Corrected wording: <i>“Microbiological Sample</i> results shall be uploaded to the <i>Ministry’s</i> database by the laboratory”.	September 23, 2026