

<b>Nexus ID</b> 58540462	<b>Custodian</b> Manager - Operations Support, Water Quality Business Unit
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## 1. Purpose

This procedure describes the disinfection process and requirements for the successful disinfection of water mains following construction, maintenance and repair works.

This procedure will assist with maintaining safe drinking water supplies and ensure the water main is suitable from a drinking water quality perspective to be put into service after successful completion of the disinfection process.

The disinfection process is based on addressing the potential risk of pathogenic contamination of the water main or drinking water as well as any other high chlorine demand occurring in the water main from construction, maintenance and repair works. This procedure includes the requirements to verify the effectiveness of the disinfection process in addressing the contamination risk.

The disinfection process meets the following requirements for contamination barriers and pathogen disinfection of water mains as specified in the [Criteria for Drinking Water Supply](#):

- *Disinfect all new distribution mains, reticulation mains and farmland mains when the mains are placed into service with a concentrated chlorine solution to satisfy any high chlorine demand created in the main during construction;*
- *Maintain and repair mains using procedures that minimise contamination during the work;*
- *Evaluate the risk of contamination on all water main maintenance and repair work; and*
- *Disinfect the repaired section of water main in high risk cases before the main is placed back into service by using a concentrated chlorine solution.*

*Caution: Filling a pipe with treated water containing a disinfectant residual is not adequate to disinfect a pipe after repair in cases where contamination is found.*

## 2. Scope

This procedure applies to all water mains of an internal diameter (i.d.)  $\geq 250$ mm including all new and existing water mains and for conveyance of raw and treated drinking water. This procedure shall be applied following construction of water mains and where necessary following maintenance and repair works (hereafter referred to as 'works') to water mains. Water mains include trunk mains, supply mains, distribution mains, reticulation mains and farmland mains (hereafter referred to as 'water mains').

All new mains must be disinfected before they are placed in service. Any existing water main taken out of service for maintenance, repairs or other activities that may lead to contamination of the water main or drinking water shall be disinfected before being returned to service.

Piping with i.d.  $< 250$ mm shall be disinfected in accordance with the requirements detailed in [DS60 Water Supply Distribution Standard - Pipelines Other Than Reticulation](#) and [DS63 Water Reticulation Pipelines DN 250 and Smaller](#).

## 3. Definitions

- Contact time     The time chlorine, of a concentration of at least C mg/L, is in contact with the water. C is measured at the end of the contact time.
- C.t                 A measure of the effectiveness of the disinfection process. C.t (mg.min/L) = free chlorine residual concentration (C; mg/L) x contact time (t; mins) where the free chlorine residual is the minimum concentration measured at the end of the specified contact time.

## 4. References

AWWA Standard for Disinfecting Water Mains - Jun 1, 2005 - Ansi/AWWA C651-05

Water Supply Code of Australia - WSA 03-2011-3.1

[Criteria for Drinking Water Supply](#)

Design Standard: [DS60 Water Supply Distribution Standard - Pipelines Other Than Reticulation](#) (Nexus ID 58560175)

[DS63 Water Reticulation Pipelines DN 250 and Smaller](#) (Nexus ID 58562451)

Manual : [Drinking Water Sampling Procedures](#) (Nexus ID 58546405)

Procedure [Approval of Chemicals and Materials in Contact with Drinking Water](#) (Nexus ID 58560425)

Guideline: [Disposal of Highly Chlorinated Disinfection and Alkaline Water](#) (Nexus ID 58612626)

## 5. Preventive measures

All works will be undertaken to minimise the risk of contamination of water mains.

Where contamination has been observed to occur or has potentially occurred, the water main shall be cleaned as described below in Section 5.1.2 prior to undertaking disinfection described in Section 6.

All materials and products used shall have prior approval for contact with drinking water as per the procedure [Approval of Chemicals and Materials in Contact with Drinking Water](#).

### 5.1.1 Contamination preventive measures

Contamination can occur by the direct or indirect introduction of any foreign materials into the water main including, but not limited to, soil, dirt, dust and debris, rainwater/runoff, construction water and groundwater, and from other sources such as animal/vermin and human activities.

Measures shall be taken to the extent practicable to prevent or minimise contamination of the water main including during all phases of the works including materials storage, construction, commissioning, maintenance and repairs.

- All items, equipment and persons shall be free of foreign materials that may cause contamination prior to entering water mains.
  - Any items or equipment needing cleaning shall be cleaned with a hypochlorite solution containing a free chlorine residual of 20-50mg/L using an appropriate application method such as spray, brush, mopping or swabbing etc.
  - All footwear shall be washed upon each entry using a hypochlorite solution containing a free chlorine residual of 200 mg/L;
- Water mains should be capped; and fittings, valves, gaskets, seals and other fittings/appurtenances should be boxed, capped or sealed during storage and transportation;

- Exclusion caps, watertight plugs or blank flanges of approved design should be used to seal all open ends of water mains, fittings and valves, particularly:
  - At the completion of the work day;
  - Where there is risk of rainwater/runoff, construction water, groundwater or any other water entering the water main, the seals shall be watertight;
  - Rodent proof plugs may be used during construction when the Site Manager [or equivalent] determines that watertight plugs are not practicable.

### **5.1.2 Cleaning**

Where contamination has been observed to occur or has potentially occurred, the water main shall be cleaned by complete removal followed by local disinfection (see Section 6.2 Local Disinfection Method) of any gross contamination areas prior to disinfection by the Standard Method or Minimum C.t Method described in Section 6.2.

- The cleaning method shall be acceptable to the Site Manager [or equivalent]. The cleaning method used shall not force foreign materials into the water main interior joint spaces or valving;
- Any gross contamination of the water main such as by soil, dirt or debris, animals/vermin and any faecal contamination of the water main must be removed and cleaned in a way to prevent further contamination prior to local disinfection;
- If any water other than treated drinking water including rainwater/runoff, floodwater, groundwater or construction water enters the water main during construction, the water main shall be fully drained, the extent of the flooding and contamination of the main determined and delineated and cleaned by an acceptable method prior to localised disinfection;
- Following cleaning, the following localised disinfection process shall be implemented, where:
  - The entire contaminated area and its surrounds (2m either side of the contamination, where possible) shall be disinfected using a hypochlorite solution containing a free chlorine residual of 200 mg/L;
  - The disinfectant shall be applied by an acceptable method such as by spray, brush, mopping, swabbing etc to ensure all contaminated surfaces remain in contact with the hypochlorite solution for a minimum of 1 minute;
- Where local disinfection has been undertaken, the water main will still require disinfection by Standard Method or Minimum C.t Method in Section 6.2.

### **5.1.3 Backflow prevention**

Backflow prevention shall be maintained during disinfection, with all activities undertaken to prevent the contamination of any existing drinking water supply system. In addition to minimising contamination of the water main, the water main must also be kept isolated from the existing water system until satisfactory bacteriological results are achieved.

Temporary connections to the water main for the purposes of pressure testing, disinfection and flushing shall be equipped with appropriate backflow prevention at all times and those direct temporary connections shall be disconnected when carrying out pressure testing. Water flow shall be prevented from the pipework under test back into the existing water main system

## **6. Procedure**

The following steps describe the disinfection process:

- Pre-disinfection flush – removal of any contamination prior to disinfection;
- Disinfection – the water main will be filled with water containing chlorine within the specified residual range for a specified time period;

- Flush – the chlorinated water will be flushed from the main – note. dechlorinating the water before disposing may be required to meet environmental requirements;
- Refill and Monitor – the water main will be refilled with fresh drinking water and water quality monitoring undertaken;
- Final commissioning - acceptable water quality results show the water main is ready, from a water quality perspective, to be brought into service.

## 6.1 Pre-disinfection flush

Flushing of water mains is recommended prior to undertaking disinfection as described below. Flushing should also be undertaken particularly where contamination has or potentially has occurred and has been cleaned as per Section 5.1.2.

Flushing should be undertaken at a water flow velocity at  $>1$  m/s for effective removal of contamination. Flushing shall be undertaken with raw or treated drinking water. Flushing should be maintained for as long as required to ensure all gross contamination has been removed. Flushing can be undertaken with raw or treated drinking water.

## 6.2 Disinfection of water mains

The disinfection process follows a risk-based approach considering the type of activity undertaken and the risk of contamination. Disinfection is based on filling the water main with water containing chlorine within a specified residual and for a specified period of time.

Disinfection of water mains shall be undertaken using free chlorine in the form of sodium hypochlorite dosed into treated drinking water. Under specific circumstances in chloraminated schemes, disinfection may be undertaken using other alternative disinfectants i.e. monochloramine. Contact the Manager Operations Support, Water Quality Business Unit (WQBU) to determine alternative suitable disinfectants, required disinfectant residuals and contact times. The use of untreated or raw drinking water is not recommended for use as disinfection water. Contact the Manager Operations Support, WQBU if treated drinking water is not available for use as disinfection water.

The reactivity of chlorine and monochloramine is affected by pH. Contact the Manager Operations Support, WQBU if the pH of the disinfection water is outside the pH range of 6.5 – 8.5 or if the disinfection water is to be dosed multiple times with chlorine or used for disinfection of multiple sections of water main.

### 6.2.1 Disinfection methods

Disinfection requires sufficient disinfectant concentration (C) present for a contact time (t) to ensure deactivation of most microbiological pathogens/contaminants. This is represented by a C.t (mg.min/L) value.

There are three methods for disinfection of water mains:

- Standard Method – using a free chlorine residual of 10-15mg/L and a contact time of 10-24 hours (maximum) to exceed the required C.t.
- Minimum C.t Method – using a targeted free chlorine residual and contact time to meet the minimum C.t.
- Local Disinfection – used for smaller disinfection requirements without any contamination and where chlorine can be successfully applied by spray, brush, mopping, swabbing etc.

The use of the disinfection methods shall be as presented in Table 1.

**Table 1: The disinfection methods applicable to activities.**

Activity	Standard Method	Minimum C.t Method	Local Disinfection
Maintenance activity / piece-ins / new water mains construction (≤12m) with NO CONTAMINATION	Yes	Yes	Yes
Maintenance activity / piece-ins / new water mains construction (≤12m) with POSSIBLE / CONFIRMED CONTAMINATION	Yes, clean-up and local disinfection of confirmed contamination is required	Yes, clean-up and local disinfection of confirmed contamination is required	For disinfection after clean-up of contamination only - prior to disinfection by primary method
New water mains construction (>12m)	Yes	Yes	No
Response to failed disinfection process	Yes	Yes	No

### Standard Method

The Standard Method is based on filling the water main with chlorinated water containing an initial free chlorine residual of 10-15mg/L and leaving in the main for a contact time of at least 10 hours to a maximum of 20 hours.

The actual chlorine dose rate into the drinking water should account for any chlorine demand of the water to ensure the initial chlorine residual is achieved.

The contact time will commence at the completion of the water main being entirely filled.

At the completion of the contact time, the free chlorine residual remaining in the water main should not be less than 50% of the initial free chlorine residual. It is recommended that free chlorine residuals are measured either along the length of the water main prior to discharge or at regular intervals at the point of discharge. Contact the Manager Operations Support, WQBU if the remaining free chlorine residual is less than 50% of the target free chlorine residual.

Free chlorine residuals from 5-10mg/L can be measured using HACH Aquatec free chlorine test strips with comparison to the colour chart.

### Minimum C.t Method

The Minimum C.t Method can be used for disinfection of water mains as shown in Table 1. It should not be used where contamination has occurred unless the contamination has been cleaned up followed by localised disinfection.

The Minimum C.t Method is based on achieving the minimum C.t required for disinfection. C.t is calculated from the minimum free chlorine residual (C) (mg/L) measured at the end of the contact time (t) (minutes) multiplied by the contact time (t):

$$C.t \text{ (mg.min/L)} = \text{free chlorine residual (C)(mg/L)} \times \text{contact time (t)(minutes)}$$

$$\text{i.e. } C.t = 5 \text{ mg/L} \times 60 \text{ minutes} = 300 \text{ mg.min/L}$$

^ (C) is measured at the end of the contact time (t)

^^ (t) the contact time the disinfection water has remained in the water main

Table 2 presents the minimum free chlorine residual and contact time to achieve a C.t of 30 or 300 mg.min/L. Note. for effective disinfection, the minimum free chlorine residual measured at the end of the contact time is 1.5 mg/L for activities requiring C.t 300 mg.min/L and 0.5 mg/L for activities requiring C.t 30 mg.min/L. Contact the Manager Operations Support, WQBU for advice on the minimum monochloramine residuals for the specified C.t values.

**Table 2: Lowest free chlorine residual (C) and minimum contact time (t) and to achieve C.t.**

Minimum C.t (refer Table 3)	Free chlorine residual (C) mg/L measured at contact time (t)	Contact time (t) minutes
300 mg.min/L	5 mg/L or higher	60 mins
	4 mg/L	75 mins
	3 mg/L	100 mins
	2 mg/L minimum	150 mins
	1.5 mg/L (Note 1)	200 mins
30 mg.min/L	3 mg/L or higher	10 mins
	2 mg/L	15 mins
	1 mg/L	30mins
	0.5 mg/L minimum (Note 1)	60 mins

Note 1. the free chlorine residual measured at the end of contact time should not be less than 1.5 mg/L for effective disinfection for activities requiring C.t 300 mg.min/L or less than 0.5 mg/L for activities requiring C.t 30 mg.min/L.

The minimum C.t values for various activities considering the associated risk of microbiological contamination are presented in Table 3.

**Table 3: C.t values required for disinfection of water mains based on activity and level of contamination.**

Activity	Minimum C.t
Maintenance activity / piece-ins / new water mains construction ( $\leq 12m$ ) with NO CONTAMINATION	Free chlorine 300 mg.min/L
	Monochloramine / chloramination 600 mg.min/L
Maintenance activity / piece-ins / new water mains construction ( $\leq 12m$ ) with POSSIBLE / CONFIRMED CONTAMINATION	Free chlorine 300 mg.min/L
New water mains construction ( $> 12m$ )	Free chlorine 300 mg.min/L
	Monochloramine / chloramination 6000 mg.min/L – not suitable for possible / confirmed contamination
Response to failed disinfection process	Free chlorine 300 mg.min/L

The Minimum C.t Method is based on filling the water main with chlorinated water containing an initial free chlorine residual and leaving in the main for the required contact time as per Table 2 to ensure the C.t has been achieved as required in Table 3. Note: Table 2 only applies to the use of free chlorine and C.t of 30 and 300 mg.min/L. Monochloramine/chloramination requires larger C.t values which need to be accounted for when using these for disinfection.

The actual chlorine dose rate into the drinking water should account for any chlorine demand of the water to ensure the initial chlorine residual is achieved.

The contact time will commence at the completion of the water main being entirely filled.

Once the water main has been filled with chlorinated water, the free chlorine residual shall be measured at 15-30 minute intervals during the disinfection process along the length of the water main. If the free chlorine residual has decreased below 30% of the initial free chlorine residual within 15 - 30 minutes of completing the filling, consider flushing the chlorinated water from the water main and refilling with fresh chlorinated water.

As the free chlorine residual will decrease with time, the contact time shall be extended as required until the minimum C.t value is achieved. The free chlorine residual shall be measured at the end of the contact time to confirm that the minimum C.t has been achieved. If the free chlorine residual is less than planned, the contact time shall be extended until the minimum C.t is achieved.

At the completion of the contact time, the free chlorine residual remaining in the water main should not be less than 50% of the initial free chlorine residual. It is recommended that free chlorine residuals are measured either along the length of the water main prior to discharge or at regular intervals at the point of discharge. Contact the Manager Operations Support, WQBU if the remaining free chlorine residual is less than 50% of the target free chlorine residual.

Free chlorine residuals from 5-10mg/L can be measured using HACH Aquachek free chlorine test strips with comparison to the colour chart.

### **Local Disinfection Method**

Local Disinfection can be used for smaller disinfection requirements where no contamination has occurred or has the potential to have occurred as described in Table 1. Smaller disinfection requirements include new water mains construction less than 12m in length (<12m), piece-ins, repair of mains break / bursts and installation of fittings etc. This method can also be used for disinfection following cleaning of contamination events prior to disinfection by one of the primary disinfection methods described above.

The internal surfaces of water mains, piece-ins and fittings to be installed as well as the areas either side of the water main joints i.e. 1 metre either side shall be sprayed with a sodium hypochlorite solution containing free chlorine residual of 200 mg/L just prior to installation and close up.



## 6.2.2 Introducing chlorine into a water main

There are two methods to introduce chlorine into a water main as shown in Table 4 and described below.

**Table 4: Methods to introduce chlorine and applicable activities.**

Activity	Continuous Dosing - Sodium Hypochlorite	Drinking Water Residuals
Maintenance activity / piece-ins / new water mains construction ( $\leq 12\text{m}$ ) with NO CONTAMINATION	Yes	Yes
Maintenance activity / piece-ins / new water mains construction ( $\leq 12\text{m}$ ) with POSSIBLE / CONFIRMED CONTAMINATION	Yes	No
New water mains construction ( $> 12\text{m}$ )	Yes	Yes – only if no possible / confirmed contamination
Response to failed disinfection process	Yes	No

The water main shall be completely filled with chlorinated water via a suitable filling point located at the start (within 3 meters where possible) of the water main to be disinfected. The water main shall be filled with the chlorinated water and the chlorinated water simultaneously discharged from the distal end of the water main via a suitable discharge point until the free chlorine residual in the discharge water is comparable to the free chlorine residual at the filling point.

All fittings, i.e. valves, scours and hydrants etc and main extensions shall be opened to ensure complete filling and disinfection of all fittings and water main extensions/branches.

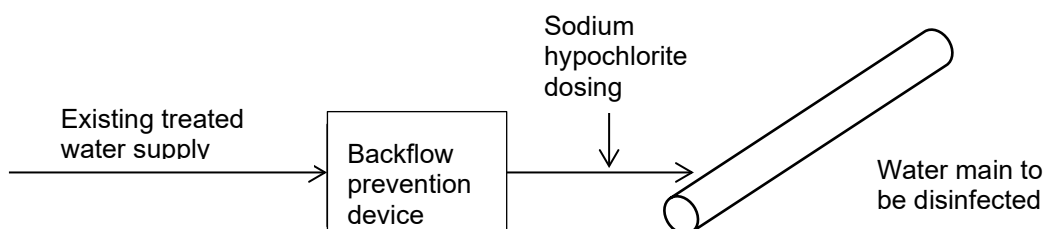
### Continuous sodium hypochlorite dosing

This method applies to both the Standard Method and Minimum C.t Method for disinfection.

All water mains shall be disinfected using chlorine in the form of sodium hypochlorite dosed into treated drinking water.

Sodium hypochlorite dosing shall be controlled to continually achieve the initial free chlorine residual prior to the chlorinated water entering the water main. This will ensure the target free chlorine residual is achieved uniformly throughout the entire water main. It is recommended that free chlorine residuals should be measured at regular time intervals during the filling of the water main to confirm.

The dose rate of sodium hypochlorite will depend on the flowrate of treated drinking water, the target free chlorine residual for the disinfection water, the existing free chlorine residual and the chlorine demand of the water, and the contact time for disinfection. Appendix 1 shows the amount of sodium hypochlorite required for dosing into water for every 100 metres of water main to be disinfected. Note. the existing free chlorine residual and the chlorine demand of the water has not been factored into the required amounts of sodium hypochlorite in Appendix 1.





## **Drinking water residuals**

The use of drinking water containing residuals of free chlorine or monochloramine for disinfection of water mains is only intended for activities as specified in Table 4 where there is no contamination.

The water main to be disinfected shall be completely filled with treated water containing sufficient disinfectant residuals to achieve the required C.t as per Table 2 with at least a minimum free chlorine residual measured at the end of contact time of not less than 1.5 mg/L free chlorine (or 2.5 mg/L for monochloramine) for effective disinfection for activities requiring C.t 300 mg.min/L or not less than 0.5 mg/L (or 1.5 mg/L for monochloramine) for activities requiring C.t 30 mg.min/L.

### **6.2.3 Disinfection records**

The following information shall be recorded:

- 1) Method of disinfection;
- 2) Method to introduce chlorine into water main;
- 3) Volume and type (treated or raw) of drinking water required for disinfection, kL;
- 4) Volume of sodium hypochlorite (if required for dosing), L;
- 5) Free chlorine residuals in the disinfection water during filling of water main, mg/L;
- 6) Free chlorine residuals measured along the length of the water main at the required time intervals during the required contact time, mg/L;
- 7) Contact time, minutes;
- 8) Free chlorine residual at the end of the contact time along the length of the water main or measurements of the free chlorine residual in the disinfection water during discharge of water main, mg/L;

## **6.3 Flushing – Post-disinfection**

### **6.3.1 Clearing the main of highly chlorinated water**

After the appropriate contact time, the water main should be flushed to remove heavily chlorinated water i.e. where the water contains free chlorine residuals higher than 2 mg/L. Highly chlorinated water should not remain in prolonged contact with the main for more than 20 hours maximum to prevent damage to the lining or corrosion to the main itself.

The highly chlorinated water shall be flushed from the water main until the chlorine residual in the main is no higher than the chlorine residuals in the existing drinking water system.

Note: This highly chlorinated water can be used for disinfection of multiple sections of water main provided that the existing free chlorine residual is higher than the minimum free chlorine residual and will be maintained for the duration of the required contact time without the requirement for further dosing. The disinfectant water shall not be used if it needs to be re-dosed unless the pH is corrected as necessary (if it is outside the pH range of 6.5 – 8.5). Contact the Manager Operations Support, WQBU if the disinfection water is to be dosed multiple times with chlorine or used for disinfection of multiple sections of water main.

### **6.3.2 Discharge of highly chlorinated water**

The environment into which the chlorinated water is to be discharged shall be thoroughly inspected and risk assessed. If there is any risk of damage to the environment as a result of that discharge e.g. natural water course or water body, then a neutralising agent shall be applied to the water to be discharged to completely neutralise the chlorine residual remaining in the water. Refer to Guideline: [Disposal of Highly Chlorinated / Alkaline Disinfection Water](#).

## 6.4 Refilling

After disinfection and flushing of post-disinfection water, the water main shall be completely refilled with treated drinking water containing free chlorine (or monochloramine) residuals in accordance with the specified residual levels for the existing water supply. The water main shall be completely filled and allowed to stand for 2 hours prior to undertaking water monitoring.

## 6.5 Water Quality monitoring

After disinfection, flushing the chlorinated water from the water main and completely refilling the water main with treated drinking water and leaving the water to stand for at least 2 hours, the water quality within the water main shall be monitored and assessed to verify the effectiveness of the disinfection process. Water quality monitoring will involve sampling for laboratory analyses and field measurements.

The water main should not be connected to the existing water supply and put into service until all required sampling and measurements have been undertaken and satisfactory water quality results have been obtained.

All sampling shall be managed in accordance with the Manual: [Drinking Water Sampling Procedures](#).

### 6.5.1 Microbiological sampling

Bacteriological samples should be collected following disinfection of all water mains and shall be tested for total coliforms, thermotolerant coliforms, *Escherichia coli* (*E. coli*) and background counts. Amoeba (*Naegleria*) sampling should be included for schemes which have a high risk for *Naegleria*.

Do not dispatch any samples to the laboratory that are discoloured or contain particulate matter. In this instance, flush the sampling point and water main as necessary until samples are not discoloured and are clear of particulate matter.

Depending on the length and design of the water main, bacteriological samples may be collected from the beginning, middle and discharge end of the main. The following shall be applied for sampling requirements:

- For treated drinking water mains up to 12m in length, raw water and farmlands conveyance water mains, no bacteriological sampling is required.
- For treated drinking water mains longer than 12m and less than 250m in length, one sample should be taken, preferably from or as close as possible to the discharge end of the main.
- For water mains longer than 250m and up to 1000m in length, two samples should be taken, from the middle and discharge end.
- For water mains greater than 1000m and up to 5000m, three samples shall be collected, from the beginning, middle and discharge end, with an additional sample taken for every additional 5000m length of water main.

It is recommended that a bacteriological sample is collected from the existing water supply used to refill the water main. The sample should be collected as close to the water main filling connection as possible at the same time as the water main is sampled. This will enable comparison of results from the water supply with those from within the disinfected water main.

Contact the Manager Operations Support, WQBU as required for sampling requirements including if the design of the water main includes a number of branches/extensions and/or dead-ends.

### 6.5.2 Field measurements

The free chlorine (or monochloramine) residuals and temperature in the water main shall be measured in the field after refilling the water main with treated drinking water to confirm that they are comparable along the length of the water main and with the existing water supply system. Free chlorine residuals and temperature will be measured as part of the requirements for bacteriological sampling.

The pH in the water main shall be measured in the field (or a water sample taken) if there is reason to believe the pH level may be higher than 8.5. If the pH is measured in the water main, it is recommended that it is also measured in the existing water supply. pH up to 9.2 is acceptable if the bacteriological results are satisfactory and the main will be put into service immediately.

### 6.5.3 Sampling and field measurement locations

The location of all sampling and measurement points shall be recorded.

Appropriate sample location reference(s) describing sampling locations shall also be provided to the testing laboratory (using laboratory analysis request forms (LARF)).

## 6.6 Acceptance of water quality results

The water quality results shall be considered acceptable if they are within the limits for all parameters specified in Table 5.

**Table 5: Acceptable water quality results for monitoring within disinfected water mains.**

Parameter	Existing Water Supply	Water Main	Comment
pH	≥6.5 and ≤8.5	≥6.5 and ≤8.5	pH up to 9.2 is acceptable if the bacteriological results and chlorine residuals are satisfactory and the main is put into service immediately.
Free chlorine (or monochloramine) residuals	Within specified residual levels	Within existing water supply specified residual levels ±0.2 mg/L	Free chlorine residual should be no less than 0.2 mg/L (1.5 mg/L monochloramine) for the water main to be put into service.
Total coliforms	<1 cfu/100mL	<1 cfu/100mL	The bacteriological results should be clear. Contact Manager Operations Support, WQBU for any positive detections.
Thermotolerant coliforms	<1 cfu/100mL	<1 cfu/100mL	
<i>Escherichia coli</i> ( <i>E. coli</i> )	<1 cfu/100mL	<1 cfu/100mL	
Bacteriological samples - background count	up to two plus signs ‘++’	up to two plus signs ‘++’	The bacteriological background in the water main should be comparable to but not higher than the background for the existing water supply. Plus signs increase the possibility of coliforms being masked/undetected.
Amoeba	None detected	None detected	

## 6.7 Water Quality Non-compliance

For water quality results outside of the limits specified in Section 6.6, contact the Manager Operations Support, WQBU. Additional samples, sampling locations and/or parameters for re-sampling as well as other actions may be requested. Non-compliant water quality results may also result in the requirements to repeat the disinfection process if the non-compliance indicates the disinfection process has not been successful.

Where additional sampling is undertaken following water quality non-compliance, the same water quality acceptance criteria in Table 5 will apply.

## 6.7.1 Re-flushing

If the initial disinfection fails to produce satisfactory bacteriological results including where the results confirm the presence of coliform organisms up to 5 cfu/100mL (but no presence of thermotolerant coliforms and E.coli i.e. <1 cfu/100mL) or the background level is two plus signs (++) higher than the background level for the existing water supply at more than one sampling location within the water main, then the water main may require re-flushing with treated drinking water.

After re-flushing and achieving a free chlorine residual of  $\geq 0.5$  mg/L for at least 12 hours, collect response samples from the monitoring points where the original detection occurred by re-sampling in accordance with Section 6.5. If none of the samples are discoloured or contain particulate matter, dispatch the samples to the laboratory.

If the pH level is higher than 9.2 but the bacteriological results and free chlorine residuals are satisfactory, then the water main shall be immediately put into service otherwise it should be re-flushed with treated drinking water or actions implemented to increase the free chlorine residual and/or decrease the pH.

If the re-sampling after re-flushing fails to produce satisfactory bacteriological results, then the water main may require re-disinfecting which shall be via the full disinfection process with response samples collected from all sampling points by re-sampling in accordance with Section 6.5 until satisfactory bacteriological results are achieved.

## 6.7.2 Re-disinfection

If the initial disinfection fails to produce satisfactory bacteriological results including where the results confirm the presence of E. coli  $\geq 1$  cfu/100mL, thermotolerant coliforms  $\geq 1$  cfu/100mL, or total coliform organisms  $> 5$  cfu/100mL or where the background level is three plus signs (+++) higher than the existing water supply including at more than one sampling location within the water main, the water main shall be re-disinfected via the full disinfection process and response samples collected from all sampling points by re-sampling in accordance with Section 6.5 until satisfactory bacteriological results are achieved.

If the re-disinfection fails to produce satisfactory bacteriological results, then the water main shall be disinfected again via the full disinfection process and response samples collected from all sampling points by re-sampling in accordance with Section 6.5 until satisfactory bacteriological results are achieved. Contact Manager Operations Support, WQBU to determine any additional actions prior to commencing the repeat disinfection.

## 6.8 Records

The disinfection records described in Section 6.2.3 and sampling and field measurement location records described in Section 6.5 as well as the water quality monitoring results shall be provided to the Region Water Quality Technical Advisor within one day of the completion of each activity. The Water Quality Technical Advisor will store these records in Nexus.

Document Revision History (see Nexus ID 48531424 for word version)	
21/3/2002	First version available
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Apr 2009	Reviewed – some minor changes. New CorDocs template (source Doc # 1637747)
June 2012	Review – addition of pH info in section 5.3
April 2015	Routine review – Replaced Operations Support Manager with Distribution and Systems Manager.
July 2015	Doc numbers added to hyperlinks in references. Distribution and Systems Manager DWQB changed to Operations Support Manager, WQB
May 2021	Clarified disinfection process, modification to disinfection method including inclusion of second disinfection method (Minimum C.t Method), modification to methods to introduce chlorine into water mains, clarified sampling requirements, acceptance criteria and non-compliance activities.

## Appendix 1

**Table 6: Required volume of Sodium hypochlorite per 100 metres of water main**  
 (Sodium Hypochlorite 12% available Cl<sub>2</sub>).

Nominal diameter (mm)	Volume in pipe ML of water per 100 m of pipe length	Dose at 5 mg/L	Dose at 10 mg/L	Dose at 20 mg/L
		No of litres per 100 m of pipe length (L)	No of litres per 100 m of pipe length (L)	No of litres per 100 m of pipe length (L)
300	0.007	0.3	0.6	1.2
400	0.011	0.5	1.0	2.0
500	0.018	0.75	1.5	3.0
600	0.026	1.1	2.3	4.5
700	0.036	1.5	3.0	6.0
800	0.046	1.9	4.0	8.0
900	0.059	2.5	5.0	10.0
1000	0.073	3.1	6.0	12.0
1200	0.106	4.4	9.0	18.0
1400	0.144	6	12.0	24.0
1600	0.187	7.8	16.0	32.0