DRINKING WATER SUPPLY

CODE OF PRACTICE FOR DISINFECTION OF WATER SYSTEMS

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More information

If you have further queries, please contact the Watercare Quality Science team at wqdisinfection@water.co.nz

DOCUMENT CONTROL

Document owner Water Quality Compliance and Science Manager

Review Head of Service Delivery

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Approvers / Reviewers

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Summary of Changes

Version	Section	Description of revision
5	General	This review reflects industry best practice and requirements under the Taumata Arowai Drinking Water Quality Assurance Rules. Key changes include the following sections (s):
	2.8	Clarity that charging a watermain must stop if field tests do not meet requirements, with escalation to Transmission or Network representative for further instructions.
	8	Disinfection requirements for the replacement of watermains in a reactive scenario and for in-service watermains left empty for > 8 hours due to a reactive issue.

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Glossary

Abbreviation /Terminology	Description
BPD	Backflow Protection Device
BSP	Bulk Supply Point
CCTV	Closed Circuit Television
Charging [the watermain]	Filling the watermain with potable water from Watercare's supply network or registered water tanker.
Chlorination	Increasing the concentration of free available chlorine to achieve disinfection over a 24-hour period. Concentration range of 5-10 mg/L
DWQAR	Drinking Water Quality Assurance Rules 2022
DWSNZ	Drinking Water Standards for New Zealand 2022
ESF	Engineering Standards Framework
FAC	Free Available Chlorine or Chlorine Residual
kPa	Kilo Pascal
L or l	Litre
l/s	Litres per second
M	Metre
mg/L	Milligrams per litre (equivalent to parts per million - ppm)
mL	Millilitres
MPN	Most Probable Number
Network	The reticulated distribution system from the transmission system to the point of supply to the customer (the water meter), less than 300mm in diameter
Potable water	Water from the existing water network, with target chlorine of 0.5-1 mg/L
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
Superchlorination	Increasing the concentration of free available chlorine (FAC) to achieve disinfection over a 1-hour period during high risk or one-off approved scenarios. Concentration of FAC will be at 80-100 mg/L
Transmission	The bulk distribution system from water treatment plants to reservoir storage and/or bulk supply points. Transmission mains can be differentiated from networks mains in that customer connections are generally only on networks mains, and they are >300mm in diameter. There may be some exceptions, in which case Watercare should be contacted for clarification.
Water Supply System	The combined transmission and local network potable water supply system
WTPs	Water Treatment Plants

1. Overview

1.1 Introduction

Watercare monitors water quality throughout Auckland daily to ensure a minimum chlorine residual / free available chlorine (FAC) is maintained and compliance with the Drinking Water Quality Assurance Rules 2022 (DWQAR) and Drinking Water Standards for New Zealand 2022 (DWSNZ) is achieved. A minimum FAC level of 0.5 mg/L is required to act as a barrier to contamination and meet the requirements of the regulations.

Potable water is supplied from the water treatment plants (WTPs), however in some location's chlorine levels are boosted within the network.

Works carried out on the water supply network shall follow best practises as outlined in this Code of Practice to maintain water quality and safeguard the water system against contamination, both chemical and microbiological.

1.2 Objectives

Water supply authorities are required by law to ensure that the water supply system is free from conditions that may be hazardous to public health. The Water Services Act 2021 requires that drinking water suppliers ensure they provide an adequate supply of drinking water that complies with the DWSNZ. The DWQAR specifies water suppliers have disinfection procedures:
The objectives of this Code of Practice are to:

- Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of new assets such as watermains and reservoirs.
- Prevent contamination of the water supply system by defining the minimum requirements for the disinfection of existing assets such as watermains, fittings and reservoirs following planned or reactive maintenance.
- Prevent contamination of the water supply system by defining required best practises for workers and materials that come in contact with water.
- Comply with regulatory requirements under:
    - Water Services Act 2021
    - Drinking Water Standards for New Zealand 2022
    - Drinking Water Quality Assurance Rules 2022
    - Health and Safety at Work Act 2015
    - Resource Management Act 1991
- Follow best practice through the Guidelines for Drinking Water Quality Management for New Zealand 2005 (the Guidelines).

Please note: The intent of the Disinfection Code of Practice is to provide information to show how disinfection criteria can be achieved. This Code of Practice is to be used in conjunction with other Engineering Standards. Staff must ensure all other requirements have also been met - e.g. pressure testing requirements - prior to connecting any watermains or reservoirs to the live supply network.

1.3 Areas of application

Areas of application of this Code of Practice include, but are not limited to:

- Installation of new mains and connections
- Reticulation repairs/maintenance
- Valve and hydrant inspections/repairs
- Reticulation inspections involving cutting of live mains
- Service connections and meters
- Emergency supply lines
- Repair work or modification work on pipeline or connected facilities
- Water pump stations
- Reservoirs
- Transmission pipeline specific requirements
- Treated water tanks at water treatment facilities including contact tanks

2. Guidelines

2.1 Reporting and notifications

All disinfection test results, the disinfection method used, and the sample locations are to be emailed to Watercare's Water Quality Disinfection email (wqdisinfection@water.co.nz) for assessment and water quality approval before connection work can progress. This inbox is monitored Monday – Friday 8am-5pm. Watercare reserves the right to exercise discretion when passing or failing disinfection jobs based on timeframes, test results, site specific configurations as noted on maps, and other supporting data.

Any microbiological transgression of the DWSNZ identified during testing will be investigated by Watercare.

2.2 Assessment of risk level

Disinfection is important in preventing contamination of the water supply during maintenance and repair works but it is not a substitute for incorrect procedures and poor work practises.

The procedure for works and the testing requirement depend upon the level of risk of contamination to the water supply system.

The risk level must be assessed for all work carried out on the water supply system. When working on the network, staff shall assess the risk of contamination on a case-by-case basis as per Table 1. Staff must then then follow the corresponding disinfection procedure outlined in sections 8.1 to 8.3. The risk review must be recorded on EAM or IPS and can be audited at any time. Comments must record the risk level and the reasoning why applied.

Table 1: Risk assessment

Risk Description	Level of Risk Required	E.coli Testing Required
Suspected contamination during repair (sewage, chemical, hydrocarbons etc.)	High	Yes. Return to service only after results approved
Pipe submerged during repair	Medium	Yes, but can return to service after flushing and FAC over 0.5 mg/L
E.coli testing is not required for works while the watermain remains pressurised		
Pressure in watermain maintained during works e.g. under pressure tapping or dewatered below pipe repair	Low	No

2.3 Disinfection solution preparation

Tools, equipment, materials and fittings used when working on the water supply network must be disinfected using a sodium hypochlorite solution with a concentration of at least 1%. The manufacturers specifications for storage and shelf life must be followed.

Solutions prepared by staff must be labelled with the date of preparation and must be discarded after seven days to ensure tools and fittings are always disinfected with an effective solution. Solutions must have a pH between 7 and 8.

Chemical neutralising of chlorine solution (dechlorination) should only be carried out using the chemicals listed in Appendix C.

2.4 Approval of results and connection timeframe

Each new section of water asset must be disinfected, laboratory tested, and results approved by the Water Quality Science team before being placed into service within 10 calendar days after the last laboratory result is received. Documentation (and approved results) must be submitted a minimum two working days prior to the proposed cut-in to the Watercare Transmission or Network representative for approval.

NOTE: all samples must meet the acceptable values as outlined in Table 2 and Table 3.

If the newly chlorinated water asset has not been connected to the existing reticulation network within 10 calendar days of the last sample result but connection would be within 3 days (i.e.by day 13); leniency can be requested from the Networks and Water Quality Science teams to collect handheld FAC and turbidity samples for review and approval for cut-in to the network. If handheld results do not meet the acceptable values outlined in Table 2, the disinfection procedure and laboratory sampling must be re-started.

If the newly chlorinated water asset has not been connected to the existing network within 13 calendar days of the last sample result, or sample results fail, the disinfection procedure and laboratory sampling must be restarted.

Example:

If the watermain is charged and filled with potable water on September 7 with samples collected and sampled results received at 10am on September 9, the watermain can be connected to the reticulated network upon satisfactory results up to 10am on September 19. If the connection cannot be completed in this timeframe or by 22 September at the latest the watermain must remain isolated and the disinfection and sampling process must be repeated.

2.5 Deviation from standard procedures

Where there are deviations from the standard procedures given in this document, for example during emergency works, these works shall be fully documented with supporting information showing the alternative disinfection procedures utilised and the reasons for deviations from the standard procedures. Any deviation from a standard procedure needs to be approved by the appropriate Watercare Transmission or Network Area Manager and Water Quality Science team prior to the disinfection being undertaken.

2.6 Disposal of chlorinated and superchlorinated water

Discharge of chlorinated water to the environment is not permitted. Plans for the disposal of chlorinated water must be submitted to the project team and confirm that:

- Dechlorination of water will be completed.
- The discharge will not enter any water supply catchment, Wetland, Natural Water or Natural Stream Management Area
- The discharge will not cause erosion or scouring, with plans to mitigate this.
- Discharge will be free of oil, grease film, scum, or foam.

Discharge of water with chlorine >3 mg/L into the wastewater network requires approval from the Watercare Trade Waste team. The rate of discharge to the wastewater network shall be limited to a maximum of 10 litres per second. Refer to the Environmental Protection Guide for Water to Water and Water to Land Discharges document published on Watercare's Engineering Standards Framework.

If the disposal of chlorinated or superchlorinated water into the wastewater network or to a tanker is not achievable then the water must be de-chlorinated to a maximum FAC of 0.02 mg/L before discharging to ground or a stormwater system. Refer to Appendix C for de-chlorination options. Where Watercare has existing discharge consents the applicable consent conditions must be met, and the disposal plan must be acceptable to Watercare. Queries about dechlorination can be raised with the Environmental Care Team.

Following discharge of chlorinated or superchlorinated water, the watermain shall be flushed until a chlorine concentration in the range between 0.5 to 1 mg/L is achieved. Chlorine testing must be carried out on-site using a handheld meter as per section 2.9.

2.7 Sample location requirements

The length and type of main being disinfected determines the number of sample locations required. For each sample location, all tests required by the relevant disinfection procedure must be taken.

Networks watermains (<300mm in diameter)

- For mains less than 6 metres in length, no sampling is required providing the section of pipe is new, thoroughly cleaned, disinfected, and pigged; and it is not high risk as per table 1.
- For mains that are greater than or equal to 6 metres in length but less than 150 metres in length, samples are required to be taken at the beginning and the end of the length of main being disinfected.
- For mains that are 150 metres or greater in length, samples are required to be taken:
    - at the beginning and the end of the length of main being disinfected, AND
    - at 150 metre intervals, with locations confirmed by the Networks Engineer and Water Quality Scientist

For example, if a 515-metre-long main is disinfected, samples must be taken at:

- 0 metres – the beginning of the main
- 150 metres
- 300 metres
- 450 metres
- 515 metres – the end of the main

Transmission watermains (>300mm in diameter)

Where available, samples will be collected at three points along the watermain, subject to specific design and approval by the Watercare Transmission or Network representative and Water Quality Science team. For pipelines longer than 500m the number of sampling points shall be confirmed by the Watercare Transmission or Network and Water Quality Science teams.

The tests required are outlined in sections 2.8 and 2.9 below. Where field tests are required, all parameters listed in Table 2 must be tested for unless otherwise specified in the disinfection procedure.

Where laboratory tests are required, all parameters listed in Table 3 must be tested for unless otherwise specified in the disinfection procedure. Note that laboratory tests are normally required in addition to field tests.

The sample results shall be in accordance with the acceptable values noted in Table 2 and Table 3 before the disinfection job can be considered satisfactory to put the reservoir or watermain into service. Test results shall be returned to Watercare Quality Science team (wqdisinfection@water.co.nz).

2.8 Field testing requirements and acceptable results

All field sampling and testing must be carried out by trained personnel. Training documentation may be audited at any time. Acceptable sample locations and the number of locations required are outlined in section 2.7.
Field testing requirements for handheld meters are as follows:

- All meters must be externally calibrated as per manufacturer specifications
- All meters must have a digital reading option

- Staff are trained to use these meters
- A register of meters is maintained by the meter owner(s), including service history records and calibrations

Where field tests are required, all parameters listed in Table 2 must be tested for unless otherwise specified in the disinfection procedure. Results must be recorded with supporting photographic evidence of the digital reading. Where field tests are failing during the filling of a watermain or reservoir, cease the activity and escalate to the Transmission or Networks representative at the time of the work for an assessment and further instructions.
The sample results shall be in accordance with the acceptable values noted in Table 2 before the disinfection job can be considered satisfactory to put the reservoir or watermain into service. Test results to be emailed to Watercare's Water Quality Disinfection email (wqdisinfection@water.co.nz).

Table 2: Acceptable field test results

Parameter	Acceptable Value
FAC	Between 0.5 and 1 mg/L
Turbidity	Less than 1 NTU

2.9 Laboratory testing requirements and acceptable results

All sampling and testing must be carried out by an IANZ certified laboratory. Sampling must be completed by authorised laboratory personnel only. Acceptable sample locations and the number of locations required are outlined in section 2.7.

Where laboratory tests are required, all parameters listed in Table 3 must be tested for unless otherwise specified in the disinfection procedure (for example, jobs where only field tests are required).

The sample results shall be in accordance with the acceptable values noted in Table 3 before the disinfection job can be considered satisfactory to put the reservoir or watermain into service. Test results must be emailed to Watercare's Water Quality Disinfection email (wqdisinfection@water.co.nz).

Table 3: Acceptable Laboratory test results

Parameter	Acceptable Value	Processing Time
FAC	Between 0.5 and 1 mg/L	Instant onsite
Turbidity	Less than 1 NTU	24 hours
pH	Between 7.5 and 8.5	24 hours
E. coli	Less than 1 in 100 mL sample (<1 MPN/100mL)	24 hours
Total coliforms	Less than 1 in 100 mL sample (<1 MPN/100mL) (see Note 3)	24 hours

If a different laboratory testing method is used, confirmation from wqdisinfection@water.co.nz is required to ensure that this method is acceptable.

Note 1: For disinfection procedures that allow the return to service prior to the completion of any laboratory analysis, field tests must be approved by appropriate Watercare staff as outlined in the relevant procedure. Confirmation from Watercare staff must be received before any return to service.

Note 2: Should *E. coli* be identified in any sample either prior to or following the return to service of the reservoir or watermain, then the response should be as per the DWSNZ section 4.3.6 and Figure 4.2. This response will be managed by Watercare staff according to the Watercare Incident Management Plan, the Watercare Water Quality Incident Response Plan and the relevant Water Safety Plan.

Note 3: Based on site-specific circumstances and supporting information (including site maps and test results), a total coliform result of up to 10 MPN/100mL may be accepted. This decision is made at the discretion of the Water Quality Science team.

2.10 Additional pH testing for new concrete lined steel pipes

Where concrete lined steel pipes (CLS) are being commissioned, there is risk of elevated pH for an initial period of operation. A risk assessment must be completed for each CLS installation with the Transmission or Network representative and Water Quality Science Team to assess pH risk and potential mitigations required.

3. Water Reticulation Staff

3.1 Roles and Responsibilities

All water supply contractors must adhere to this Code of Practice for all work carried out on the Watercare water supply network.

Supervisors shall spot audit the disinfection practises to ensure the Code is being followed. Records must be kept of audit results.

Contractors shall ensure their workers are fit for purpose and have no medical condition that poses a risk of contaminating the water supply as outlined in section 3.3.

Any problems or transgressions from the outlined procedures must be reported to the appropriate Watercare Transmission or Network Area Manager without delay.

Any confirmed or suspected contamination to the water supply network must be escalated to the appropriate Watercare Transmission or Network Area Manager. The area manager will then manage the incident according to the Watercare Incident Management Plan, the Watercare Water Quality Incident Response Plan and the relevant Water Safety Plan.

The responsibilities of the Watercare Transmission or Network Area Manager and their delegated representatives are to:

- Be satisfied that disinfection of facilities is being undertaken in compliance with written procedures
- Identify any special conditions or restrictions applicable to the disinfection procedure
- Maintain a record of all disinfected facilities in their relevant area of authorisation

3.2 Qualifications

Water supply workers must hold the Civil Trade Certification in Pipeline Construction and Maintenance NZQA qualification to work on the network or work under the supervision of a NZQA qualified Supervisor.

3.3 Hygiene and health

A high standard of personal hygiene shall be maintained by all people employed on the water supply network. Staff employed on the maintenance or repair of existing watermains and the construction of new watermains must be fit for purpose; particularly following any gastrointestinal illness (vomiting, diarrhoea etc.) or overseas travel to countries with endemic waterborne disease.

Water supply staff with running/septic skin infections or wounds shall not work on the water supply network unless cleared by a medical professional.

Watercare may at any time require water supply staff to produce a medical clearance against being carriers of potentially waterborne diseases including *Shigella, Salmonella, Campylobacter, Hepatitis A, E. coli* 0157*, Giardia* and *Cryptosporidium*.

4. Disinfection of Tools, Materials, and Other Equipment

4.1 Vehicles

A high standard of cleanliness shall be maintained in the interiors of all vehicles. Vehicles must be equipped with sanitary wipes or antibacterial liquid for hand sanitation when working on site.

Where possible separate vehicles for water and wastewater activities is preferential. Where not practicable, any tools and equipment used on the wastewater network must be separated from any water equipment or fully disinfected to approved procedures prior to use on the water network. This includes operator PPE and any equipment that may have been in contact with a wastewater operation. All pipes must be capped in transit or when stored.

4.2 Stores

A high standard of cleanliness shall be maintained in the interior of all stores. Water supply and wastewater equipment shall be stored separately. All materials shall be stored and handled to minimise contact with foreign materials. Fittings shall be boxed, capped or sealed with plastic wrapping. All pipes shall be capped.

4.3 PPE, tools and equipment

Where practicable tools and equipment must not be shared between water and wastewater reticulation works. Any tools and equipment used on the wastewater network must be separated from any water equipment or fully disinfected using a minimum 1% sodium hypochlorite solution prior to use. This includes operator PPE and any equipment that may be in contact with a wastewater operation.

All tools used in the construction or maintenance of the main and fittings that come into contact with the treated water must have been thoroughly disinfected and sprayed or rinsed in a minimum 1% sodium hypochlorite solution prior to use. Larger items of plant and equipment including excavators shall be thoroughly cleaned before use on potable water works if recently used on a wastewater or contaminated site. Disinfected tools must not be placed directly on the ground prior to use. A surface that can be disinfected – such as a tray or piece of plastic -should be used to store the tools while working.

A dedicated water only Closed-Circuit Television (CCTV) camera can only be used in the water network. Refer to section 4.5 for more detail.

4.4 Hydro-excavation

Any use of hydro-excavation and dewatering must be with a water dedicated hose which is securely stored and separate from wastewater activities; with equipment stored in a suitable bag and disinfected prior to use. Operators must clearly demonstrate procedures to have water dedicated PPE and personal hygiene measures applicable for a water site.

Hydro-excavation for watermain repairs must use potable water. Air-vac is an acceptable alternative to hydro-excavation.

4.5 Equipment, CCTV, or manned entry to inspect/maintain a pipeline or reservoir

Any equipment being used to inspect/maintain a pipeline must be thoroughly disinfected using a minimum 1% sodium hypochlorite solution. This includes submersible drones, pumps and cables.

A dedicated water only CCTV camera can only be used in the water network. The camera and fittings/ cabling must be disinfected using a minimum 1% sodium hypochlorite solution before and after each use; and stored in a clean/secure environment during transport and in between jobs.

For manned entry, such as for internal welding; personal must ensure strict hygiene processes are in place; including overalls and footwear that are clean. Divers entering a reservoir must follow approved procedures.

A risk assessment for returning an existing pipeline or reservoir to service following inspections/maintenance must be completed by the Network Engineer and Water Quality Science team. As a minimum, flushing and Laboratory testing must be completed before return to service. Higher risk activities may require full disinfection procedures.

4.6 Materials

All materials used in the construction or maintenance of the main and fittings that come into contact with the treated water must be:

1. Sealed by the manufacturer under hygienic conditions and not uncovered until immediately before use;

   OR

2. If option 1 cannot be met, approval can be sought from the Network Engineer and Water Quality Science team to thoroughly disinfect and spray or rinse in a minimum 1% sodium hypochlorite solution prior to use. Disinfected items must not be placed directly on the ground prior to installation.

All materials used must comply with Watercare's current Material Supply Standard. This standard is available in the Engineering Standards Framework on Watercare's website: https://www.watercare.co.nz/Water-and-wastewater/Building-and-developing/Engineering-standards-framework.

5. Work Practises

Good trade practises shall always be applied during main laying, maintenance, and repair procedures.

In the event of a confirmed or suspected contamination of the water supply system the immediate area shall be isolated, and the job escalated to the appropriate Watercare Transmission or Network Area Manager and the Water Quality Disinfection email (wqdisinfection@water.co.nz).

All connecting valves used to isolate the reticulated water from a main being disinfected shall be tagged and recorded by the site supervisor responsible for the disinfection and signed off at re-commissioning.

5.1 Backflow Prevention Devices

All temporary connections of reticulated water to mains under construction and/or maintenance shall incorporate testable double check Backflow Prevention Devices (BPDs) as a minimum. If connecting directly to the network from the new main, an RPZ is required. This includes water being used for hydrostatic pressure testing, flushing and disinfection.

For permanently installed BPDs refer to the following codes of practice:

- Water New Zealand Boundary Backflow Code of Practice, Part 2
- Watercare Code of Practice for Land Development and Subdivision – Water Drawing Sets WS19-21 and WS23-26

5.2 Standpipes

Use of standpipes is withdrawn unless specific approval is obtained from Watercare, as required by the DWQAR.

5.3 Water tankers for disinfection jobs, recharging the network, filling a reservoir, or providing alternate supply

Water tankers for use on the water network must be dedicated to carry only potable water from a source that complies with the DWSNZ and have a current registration with the Ministry of Health that is prominently displayed on the vehicle.

Where there is not a dedicated filling point at a reservoir, a risk assessment must be undertaken by the Network Engineer and Water Quality Science Team for filling the reservoir. All pipes being used to discharge tanker water into a reservoir must be sprayed with a minimum sodium hypochlorite 1% solution. Handheld FAC and turbidity samples must be collected and recorded from the tank to confirm DWSNZ requirements are met before filling a reservoir.

6. Disinfection Procedure for New Local Network Watermains (<300mm in diameter) or network pump stations

Connecting a new local network watermain or pump station to the existing reticulation network is not permitted until all requirements in the following sections have been successfully completed and commissioning water samples have been approved by a representative from Watercare's Water Quality Science team. All disinfection results are to be emailed to wqdisinfection@water.co.nz for assessment and approval. Note: once disinfection results are approved by the Water Quality Science team, approval of connection into service is still not permitted until final sign off from the Transmission or Network representative.

Refer to Figure A1 in Appendix A for the disinfection process flowchart.

6.1 Cleaning

The cleaning procedure for a new watermain is as follows:

a) Confirm that the new pipe is clear of all foreign matter and clean; and verified by the Engineer Appropriate methods include CCTV survey using dedicated water (disinfected) equipment, pigging or visual inspection
b) Thoroughly clean and disinfect existing connecting pipework/fittings as per section 4.
    i. Any new fittings to be installed shall be kept clear of the surrounding trench material and when unwrapped placed on a clean surface (e.g. impervious plastic sheet) until installed.
    ii. Spray all surfaces of fittings and wipe the interior of open ends of the new and existing watermains with a minimum 1% sodium hypochlorite solution (refer to section 4.3).
c) Flush the new watermain
    i. Potable water must be used - a separate supply such as a water tanker is required
    ii. The volume of flushing water used must be equivalent to at least three pipe volumes
    iii. The isolated watermain shall be thoroughly flushed in sections through installed hydrants or fittings using sufficient flow velocity to remove all foreign matter. See Appendix B for calculations on required flow velocity.
    iv. The flow of water shall be from one direction at a time and, depending on the position of the flushing point(s) used, flushing may be required to alternate between opposite directions to ensure all of the water is completely flushed out of the watermain
    v. Flushing guidelines are provided in Appendix B
d) Proceed with the disinfection procedure as outlined below in section 6.2

6.2 Disinfection by chlorination

The watermain to be disinfected shall be drained completely and then slowly filled with potable water that has been pre-mixed with chlorine in a tanker or other appropriate mixing option such as a mixer/blaster that uses potable/chlorinated/superchlorinated water and is kept clean, disinfected with a minimum 1% sodium hypochlorite solution before use, and is secured safely between jobs.

The water shall be tested for chlorine concentration before use and must contain sufficient FAC to produce a uniform concentration of at least 5 mg/L and not more than 10 mg/L in the pipe. Chlorination of 25-50 mg/L can only be used following approval from the network engineer and Water Quality Science Team on a case-by-case scenario where there is a higher risk.

If pre-mixed chlorinated water is not used the chlorine solution must be dosed at a continuous rate and mixed to ensure a concentration of at least 5 mg/L and not more than 10 mg/L is in contact with every part of the watermain. This can be achieved by dosing chlorine solution or by using mixing ratio approach chlorine dosing while the watermain is being filled with water. Any discharge water must be disposed of as per section 2.6.

The chlorinated water shall be introduced at the lowest point of the section of pipe to be disinfected to ensure that no air is trapped. Chlorine levels shall be tested and recorded along the length of the main at intervals as per section 2.7 to ensure effective distribution of the chlorine. Hydrants may be used to collect these samples. Chlorine levels to be submitted to the Water Quality Science team together with disinfection results.

The use of hypochlorite powder, granules or tablets dumped into the pipe or through hydrants is not acceptable under any circumstance.

Pressure testing can be completed at the same time as disinfection.

6.3 Testing

After 24 hours of contact time the FAC must be tested and at least 4 mg/L. If this is not achieved, the chlorination procedure shall be repeated. Once these requirements are achieved, the chlorinated water shall be drained and disposed of. Refer to section 2.6 for the procedure for disposal of chlorinated water.

The watermain and service connection pipes shall be flushed with potable water from Watercare's supply network. The volume of water used must be equivalent to at least three pipe volumes. The chlorine concentration of the water must be between 0.5 to 1 mg/L. If this is not achieved, flushing shall continue until the chlorine concentration is within this range. Field tests are required as outlined in section 2.8. This data must be included in the test results sent for approval.

Once the chlorine concentration is within the acceptable range, the watermain shall be charged with potable water from the supply network and left isolated for a further 24 hours. At the completion of this period, samples that represent the extent of the disinfection must be taken to ensure that adequate disinfection has been achieved across the extent of the watermain. Sample location requirements are outlined in section 2.7. Sample methods are outlined in sections 2.8 and 2.9. These samples must be tested for all the determinands listed in Table 2 and Table 3.

Acceptable sample results are given in Table 2 and Table 3 and must be achieved before the watermain can be placed into service. If satisfactory results are not achieved, the chlorination process must be repeated and the watermain re-tested until acceptable results are achieved. All sample results must to be emailed to wqdisinfection@water.co.nz for approval by the Water Quality Science team. If any of the repeat samples fail any of the tests, or if approval is not given, the disinfection procedure must be restarted.

Following approval of acceptable results by the Water Quality Science team, the new watermain can be connected to the supply network after final sign off from the Transmission or Network representative

If the newly chlorinated watermain has not been connected to the existing reticulation network within 10 days as outlined in section 2.4, the watermain must remain isolated and the chlorination process and testing must be repeated.

7. Disinfection Procedure for Temporary (i.e. emergency watermain for reactive situations only) Local Network Watermains (<300mm in diameter)

When a reactive situation requires the use of an emergency watermain, all temporary fittings shall be disinfected as per section 4.3 prior to connecting to the existing system.

Refer to Figure A2 in Appendix A for the disinfection process flowchart.

7.1 Cleaning

The cleaning procedure for a temporary watermain is as follows:

a) Excavate trench and dig sump under the section of the existing watermain to allow for the repair. The sump shall be of a depth at least 400mm.
b) Confirm that the temporary watermain is clear of all foreign matter and clean
c) Thoroughly clean and disinfect existing connecting pipework/fittings as per section 4.
    i. Any new fittings to be installed shall be kept clear of the surrounding trench material and when unwrapped placed on a clean surface (e.g. impervious plastic sheet) until installed.
    ii. Spray all surfaces of fittings and wipe the interior of open ends of the new and existing watermains with a minimum 1% sodium hypochlorite solution.
d) Flush the temporary watermain using hydrants downstream from the new connection using potable water
    i. The volume of water used must be equivalent to at least three pipe volumes
    ii. The watermain shall be thoroughly flushed in sections through hydrants using sufficient flow velocity to remove all foreign matter
    iii. The flow of water shall be from one direction at a time and, depending on the position of the flushing point(s) used, flushing may be required to alternate between opposite directions to ensure all of the water is completely flushed out of the watermain
    iv. Flushing guidelines are provided in Appendix B.
e) Proceed with the disinfection procedure as outlined below.

7.2 Disinfection by superchlorination

While isolated, the watermain to be disinfected shall be drained completely and then slowly filled with potable water that has been pre-mixed with chlorine in a tanker. The water shall be tested for chlorine concentration before use and must contain sufficient FAC to produce a uniform concentration approved by the Watercare Transmission or Network representative and water quality science team of between 80 - 100 mg/L in the pipe.

If pre-mixed chlorinated water is not used the chlorine solution must be injected at a continuous rate to ensure a concentration of 80 - 100 mg/L is in contact with every part of the watermain (Refer to Appendix C for chlorine dosage rates). This can be achieved by dosing chlorine solution or by using mixing ratio approach chlorine dosing while the watermain is being filled with water.

The chlorinated water shall be introduced at the lowest point of the section of pipe to be disinfected to ensure that no air is trapped. Chlorine levels shall be tested and recorded along the length of the main at a minimum of 150m intervals to ensure effective distribution of the chlorine.

The use of hypochlorite powder, granules or tablets dumped into the pipe or through hydrants is not acceptable under any circumstance.

The temporary watermain and fittings shall be disinfected with a chlorine dose of 80-100 mg/L for a minimum period of 60 minutes.

7.3 Testing

After the 60-minute contact time the water within the temporary watermain shall be retested and the FAC must not have dropped by more than 20 mg/L. Field tests are acceptable as confirmation of the dosage.

The watermain shall be thoroughly flushed in sections using an alternative potable water source with sufficient velocity of water to remove the superchlorinated water. Disposal of the superchlorinated water shall be in accordance with the guidelines given under section 2.6. The volume of water used must be equivalent to at least three pipe volumes.

Note: when temporary mains are disinfected offsite, prior to connection, this needs approval of the Watercare Transmission or Network Area Manager.

Connect the emergency watermain to the existing watermain and take field samples as outlined in section 2.8. Sample location requirements are outlined in section 2.7.

Following return to service, contractors must contact a Networks Engineer to arrange for precautionary laboratory samples to demonstrate a satisfactory repair. The Networks Engineer will contact the Water Quality Science team to arrange for sampling. The Water Quality Science Team will arrange for the laboratory to collect samples from the nearest compliance sampling point(s). All determinands listed in Table 3 must be tested for. If the results do not meet the acceptable results outlined in Table 3 the Water Quality Science team must immediately escalate this to the Watercare Transmission or Network Area Manager or representative for a bespoke remedial action plan

Sample test results to be emailed to Watercare's Water Quality Disinfection email (wqdisinfection@water.co.nz).

8. Disinfection Procedure for Repairs to the Local Network (<300mm in diameter)

This section applies to local networks only and can be applied to emergency and planned repairs. Repairs to Watercare's network must only be carried out by Watercare's authorised maintenance contractors. All Transmission risk scenarios are bespoke and determined on a case-by-case basis by the Watercare Transmission team. For the replacement of broken watermains in a reactive scenario, a risk assessment must be completed to determine if the works can be completed as a medium or low risk scenario.

Refer to section 2.2 for risk categorisation.

Refer to Figure A3 in Appendix A for the disinfection process flowchart.

8.1 High risk procedure

All high-risk situations (for example confirmed or suspected contamination from sewage, chemicals, hydrocarbons) require microbiological testing (and chemical testing if suspected chemical contamination) must be escalated as an incident to the Watercare Transmission or Network Area Manager. The section of watermain must remain isolated until testing has been approved by the Water Quality Science team. Alternate water will be provided to customers during this time.

All laboratory sampling and analysis for high-risk scenarios is to be done by an IANZ certified laboratory. Sampling must be completed by authorised laboratory personnel only.

The required procedure is:

a) Escalate the incident to the appropriate Watercare Transmission or Network Area Manager.
b) Isolate the watermain to prevent further dispersal of the contaminated water.
c) Isolate all affected service connections.
    i. If a service connection cannot be isolated the customer must be advised not to use water until the watermain has been commissioned.
d) Tag and record all valves used to isolate.
e) Ensure the groundwater remains well below the invert of the open pipe.
f) Isolate and/or remove the contaminant.
g) Thoroughly clean exterior of pipe and fittings to be connected prior to starting the repair.
    i. Wipe the interior of the open ends of the existing pipe and the new pipe with a clean rag or foam plug soaked in a minimum 1% sodium hypochlorite solution. Wipe or spray fittings prior to installation with a minimum 1% sodium hypochlorite solution (refer to section 4.3). Place disinfected materials onto a clean surface e.g. an impervious plastic sheet, not directly onto the ground.
h) Complete the required repair
i) A return to service procedure must be submitted to the Watercare Transmission or Network representative and Water Quality Science team for approval and include how flushing will

be completed. The volume of water used must be equivalent to at least three pipe volumes. Water must not be fed through a valve used to isolate the area.

j) The watermain shall be charged using superchlorinated water to a concentration between 80 - 100 mg/L. When the superchlorinated water is detected at the flushing hydrant, close the charging valve. The sample shall be tested for FAC on site with a handheld meter and the result shall be noted in the job details.

k) Leave the superchlorinated section isolated for 60 minutes. After the 60-minute contact time the water within the temporary watermain shall be retested and the FAC must not have dropped by more than 20 mg/L. Field tests are acceptable as confirmation of the dosage.

l) Disposal of the superchlorinated water shall be in accordance with the guidelines given under section 2.6.

m) Flush the section as per the flushing guidelines in Appendix B.

n) Field tests as per section 2.7 and 2.8 must be taken. Continue flushing if the acceptable values in Table 2 are not met.

o) Following the completion of the repair, contractors must contact a Networks Engineer to arrange for laboratory samples to demonstrate a satisfactory repair. The Networks Engineer will contact the Water Quality Science team to arrange sampling. The Water Quality Science Team will arrange for the laboratory to collect samples from an appropriate location within the repair zone. All determinands listed in Table 2 and Table 3 must be tested for as well as any other determinands required as determined by the water quality science team, relating to the risk of the contamination. A rushed turnaround time for results will be requested of the Laboratory

p) The section of watermain must remain isolated until the results of the testing are received and approved by the Water Quality Science team.

q) The Watercare Transmission or Network Area Manager must approve the re-commissioning of the watermain into service including the opening and flushing of the customers service connections until field tests for all parameters return an acceptable result.

r) All tagged valves must be signed off and reinstated following completion of the work.

s) All actions taken during a high-risk situation must be recorded.

8.2 Medium risk procedure

For medium risk situations (where works are on a depressurised pipe, a pipe is submerged during the repair, or the pipe has been emptied for >8 hrs) following completion of the repair and flushing, the existing watermain may be returned to service prior to the completion of microbiological sampling in order to minimise disruption to customers. Field testing as outlined in section 2.8 is required. Acceptable results are included in Table 2.

Where microbiological sampling is required, the Networks Engineer will contact the Water Quality Science team to arrange for sampling. The Water Quality Science Team will arrange for an IANZ accredited Laboratory to collect samples from the nearest downstream compliance sampling point. All determinands listed in Table 3 must be tested for.

The required procedure is:

a) Isolate the affected watermain.

b) Isolate all affected service connections.
    i. If a service connection cannot be isolated the customer may be advised not to use water until the watermain has been commissioned. In this scenario, until the situation is resolved, customer will be provided with bottled water or water carrier type of water supply.
c) Tag and record all valves used to isolate.
d) Ensure the groundwater remains well below the invert of the open pipe.
e) Inspect and thoroughly clean exterior of the pipe and fittings to be connected prior to starting the repair.
f) Wipe the interior of the open ends of the existing pipe and the new pipe with a clean rag or foam plug soaked in a minimum 1% sodium hypochlorite solution. Wipe or spray fittings prior to installation with a 1% sodium hypochlorite solution (refer to section 4.3). Place disinfected materials onto a clean surface e.g. an impervious plastic sheet, not directly onto the ground.
g) Complete the required repair
h) After completion of the repair work the watermain shall be thoroughly flushed from a hydrant within the shutdown area, introduced flushing point or appropriate fitting. The volume of water used must be equivalent to at least three pipe volumes. Inspect the water for contaminants and discolouration and repeat flushing until clear.
i) Field tests as per sections 2.7 and 2.8 must be taken. Continue flushing if the acceptable values in Table 2 are not met.
j) Return the watermain to service after flushing and on-site tests meet the requirements above. Samples should be tested for all determinands in Table 2 after the repair to demonstrate that it was satisfactory.
k) Following return to service, contractors must contact a Networks Engineer to arrange for precautionary laboratory samples to demonstrate a satisfactory repair. The Networks Engineer will contact the Water Quality Science team to arrange for sampling. The Water Quality Science Team will arrange for the laboratory to collect samples from the nearest compliance sampling point(s). All determinands listed in Table 3 must be tested for.
    i. If the results do not meet the acceptable results outlined in Table 3 the Water Quality Science team must immediately escalate this to the Watercare Transmission or Network Area Manager or representative for a bespoke remedial action plan
l) All tagged valves must be signed off and reinstated following completion of the work.

8.3 Low risk procedure

For low-risk situations, following completion of the repair and flushing, the existing watermain is to be returned to service after field testing as outlined in section 2.7 and 2.8 is completed and all results are within the acceptable range as outlined in Table 2.

The required procedure is:

a) Isolate the affected section of the watermain.
b) Ensure the groundwater remains well below the invert of the open pipe.

c) Thoroughly clean exterior of pipe and fittings to be connected prior to starting the repair.
    i. Wipe the interior of the open ends of the existing pipe and the new pipe with a clean rag or foam plug soaked in a minimum 1% sodium hypochlorite solution. Wipe or spray fittings prior to installation with a minimum 1% sodium hypochlorite solution (refer to section 4.3). Place disinfected materials onto a clean surface e.g. an impervious plastic sheet, not directly onto the ground.
d) Complete the required repair.
e) Connect the watermain to the supply network.
f) After completion of the repair work the watermain shall be thoroughly flushed using water from the supply network. The volume of water used must be equivalent to at least three pipe volumes.
g) Field tests as per section 2.8 must be taken. Continue flushing if the acceptable values in Table 3 are not met.

9. Disinfection Procedure for Reservoirs

All transmission reservoirs will be filled and chlorinated by Watercare. Contractors are not authorised to operate valves on the transmission network. Network reservoirs shall only be filled and chlorinated by a Watercare authorised contractor and under the guidance of Watercare Operations staff in accordance with an approved work methodology that includes isolation and disinfection procedures.

Additional guidance for reservoir disinfection is provided in AWWA Standard ANSI/AWWA C652-02 for "Disinfection of Water-storage Facilities". This document is available from the Watercare Services upon request from the Asset Information Team.

Where a reservoir has been isolated and kept full for less than 10 days, a handheld FAC sample must first be completed to ensure FAC meets the requirements outlined in Table 2. If this is not met, rechlorination must be arranged.

Where a reservoir has been isolated for more than 10 days (full, or empty), rechlorination and sampling must be completed by the Laboratory before approval by the Water Quality Science and Transmission or Network teams for to return to service.

A risk assessment for returning an existing reservoir to service following inspections/maintenance must be completed by the Transmission or Network representative and Water Quality Science team. As a minimum, Laboratory testing must be completed before return to service. Higher risk activities may require full disinfection procedures.

Refer to Figure A4 in Appendix A for the disinfection process flowchart

9.1 Cleaning

A method statement for cleaning a reservoir must be provided for approval, using methods such as water blasting and internal spraying of walls. The reservoir shall be thoroughly cleaned and then inspected by an authorised Watercare Transmission or Network representative. Disinfection shall not commence until Watercare’s approval to proceed is given.

All equipment used in the disinfection of reservoirs, including air compressors for stirring the reservoirs, must be oil-free. Maintenance records for the equipment must be provided. It is not acceptable to use hired equipment for disinfecting reservoirs.
Use of divers and robotic equipment is subject to specific approval from the Watercare Transmission or Network representative.

9.2 Reservoir filling and disinfection by chlorination

The reservoir shall be partially filled with potable water to a volume of 20% of the reservoir’s capacity. The extent and sequencing of the fill needs to be confirmed with the Watercare Transmission or Network representative. All inlet and outlet valves on the reservoir shall then be isolated, and if practical locked, prior to disinfection starting.

Chlorine shall be added to the volume of the fill to result in a FAC of 2.0 mg/L. Field testing using a potable handheld meter must confirm the FAC is achieved. The water is then left to stand for a minimum of 24 hours.

9.3 Testing

The FAC concentration shall be measured at the end of the initial 24-hour standing period If FAC has dropped to less than 1 mg/L, escalate to the Transmission or Network representative to undertake a risk assessment and if further disinfection is required. If satisfactory, fill reservoir to 100% (or top operating level) and if required add chlorine to achieve a final chlorine concentration of 0.6 to 1.0 mg/L. The acceptable final concentration for the reservoir must be agreed upon with the Watercare Transmission or Network Area Manager. The reservoir shall be filled in such a way that the water is well mixed as per contractor standard operating procedure.

Field testing of the chlorine concentration shall be carried out using a handheld meter with samples taken from representative sample points to confirm the actual FAC concentration. If the reservoir has top and bottom sample points, both points must be sampled. If the concentration is less than the required minimum, further chlorination and mixing shall be undertaken until this concentration is achieved.

Having achieved the required chlorine concentration from both sample points, the reservoir shall be left to stand for a further 24 hours. After this period the reservoir shall be sampled as early as practicable by an IANZ certified laboratory. Sampling must be completed by authorised laboratory personnel only. The required tests are listed in sections 2.8 and 2.9.

All sample results must to be emailed to wqdisinfection@water.co.nz for approval by the Water Quality Science team.

Acceptable sample results are given in Table 2 and Table 3 and must be achieved before the reservoir is placed into service. If the results are not satisfactory, the reservoir shall be re-chlorinated and tested until acceptable results are achieved. The reservoir can only be returned to service following final approval by the Transmission or Network representative.

10. Disinfection Procedure for New Transmission Watermains (>300mm diameter), Bulk Supply Points or pump stations

All transmission watermains will be filled and chlorinated by Watercare. Contractors are not authorised to operate valves on the transmission network. All Transmission risk scenarios are bespoke and determined on a case-by-case basis by the Watercare Transmission or Network team. Disinfection should not be done up to a live valve. This section can also be applied to new transmission Bulk Supply Points and pump stations.

Refer to Figure A5 in Appendix A for the disinfection process flowchart.

10.1 Cleaning

The new watermain shall be cleaned and inspected, with method issued for review. Spray all surfaces of fittings and wipe the interior of open ends of the new and existing watermains with a minimum 1% sodium hypochlorite solution. A CCTV inspection shall be carried out before chlorination using dedicated water (disinfected) equipment.

10.2 Disinfection by chlorination

The watermain shall be filled with potable water and sufficient chlorine added to provide a FAC of at least 5 mg/L and not more than 10 mg/L when the watermain is full. Note: Disinfection is not to be done up to a live valve.

The pipe shall be filled from the lowest point and air released to prevent pockets with no contact. The method of filling shall be such that the chlorine concentration is consistent when measured at a minimum of three of points along the watermain, subject to specific design and approval by the Watercare Transmission or Network representative and Water Quality Science team. For pipelines longer than 500m the number of sampling points shall be confirmed by the Watercare Transmission or Network team.

Once filled, the watermain shall be isolated to prevent any water loss and left to stand for 24 hours. At the end of this period the chlorine concentration shall be taken on-site using a handheld meter and must have a minimum concentration of 4 mg/L at each end of the section being disinfected. Further chlorination and mixing shall be undertaken until the minimum FAC concentration is met. Seek advice from the Watercare Transmission or Network team for other remedial steps if further chlorination is unsuccessful.

The watermain shall be emptied and the ingress of any contaminants prevented. Refer to section 2.6 for guidelines on the disposal of chlorinated water. The watermain is then refilled with potable water and flushed until the chlorine levels are at the same level as the incoming water. The flushing is to ensure that pockets of highly chlorinated water in the watermain are flushed prior to samples being taken. Once filled with mains water, the watermain shall remain isolated and left to stand for a further 24 hours prior to laboratory samples being taken.

10.3 Testing

After the second 24-hour period, samples are to be taken at a minimum three locations within the watermain or as outlined in sections 2.7 by an IANZ certified laboratory. Sampling must be completed by authorised laboratory personnel only as early as practicable. Samples are to be tested for all determinands listed in sections 2.8 and 2.9.

While the samples are being tested, the watermain must remain isolated and charged to prevent contamination of the network.
Acceptable sample results are given in Table 2 and Table 3 and must be achieved before the watermain can be placed into service. If satisfactory results are not achieved, the chlorination process must be repeated and the watermain tested until acceptable results are achieved.

All sample results must to be emailed to wqdisinfection@water.co.nz for approval by the Water Quality Science team, with final sign off then required from the Transmission or Network representative

If the newly chlorinated watermain has not been connected to the existing reticulation network within 10 days of chlorination as outlined in section 2.4, the watermain shall be retested for all of the determinands listed in sections 2.8 and 2.9 as per the initial testing. Results must be sent for approval to the Water Quality Science team. If any of the new samples fail any of the tests, or if approval is not given, the disinfection procedure must be repeated.

11. Disinfection Procedure for Existing Transmission Watermains (>300mm diameter)

All transmission watermains will be filled and chlorinated by Watercare. Contractors are not authorised to operate valves on the transmission network. All Transmission risk scenarios are bespoke and determined on a case-by-case basis by the Watercare Transmission or Network team. Disinfection should not be done carried out against a live valve.

Refer to Figure A6 in Appendix A for the disinfection process flowchart.

11.1 Cleaning

The watermain shall be cleaned, flushed and then inspected, with method issued for review. CCTV inspection shall be carried out before chlorination using dedicated water (disinfected) equipment. The areas of the watermain that have been worked on shall be swabbed with a 1% sodium hypochlorite solution.

11.2 Disinfection by chlorination

Following swabbing, the watermain shall be filled with potable water with sufficient chlorine added to result in a final chlorine concentration along the watermain within the range of 0.5 to 1 mg/L. The chlorine concentration must be taken on site using a handheld meter. The results must be submitted to the Watercare Transmission or Network Area Manager and Water Quality Science team for verification and approval.

After chlorination the watermain may be returned to service upon satisfactory testing and approval by the Transmission or Network representative and Water Quality Science team. Field sampling as outlined in section 2.8 must be completed at the nearest bulk supply points. This sampling must be completed immediately following the return to service. The results must be submitted to the Watercare Transmission or Network Area Manager and Water Quality Science team for verification and approval.

11.3 Testing

Following the return to service of the watermain, the Watercare Transmission or Network Team must arrange for a sample to be taken at the first meter supply point adjacent to the works section by an IANZ certified laboratory. Sampling must be completed by authorised laboratory personnel only as early as practicable following the return to service of the watermain. Samples are to be tested for all determinands listed in section 2.9.

Sample results must be sent to wqdisinfection@water.co.nz for approval by the Water Quality Science team.

Acceptable sample results are given in Table 3. If satisfactory results are not achieved, the Water Quality Science team must immediately escalate this to the Watercare Transmission or Network Area Manager for a bespoke remedial action plan.

12. Disinfection Procedure for watermains to be capped and put into service in the future

All network and transmission watermains that will be capped until put into service in the future must follow the full disinfection procedures outlined above, including sampling. Following approval of the water quality sampling results the watermain can then be refilled with chlorinated water and capped. Laboratory sampling is not required for the final chlorinated water that will remain sitting in the pipe.

Full disinfection and sampling procedures must then be completed again prior to going into service in the future.

Appendix A: Local Networks Disinfection Procedure Flow Charts

Figure A1: Disinfection procedure flowchart for new local network watermain

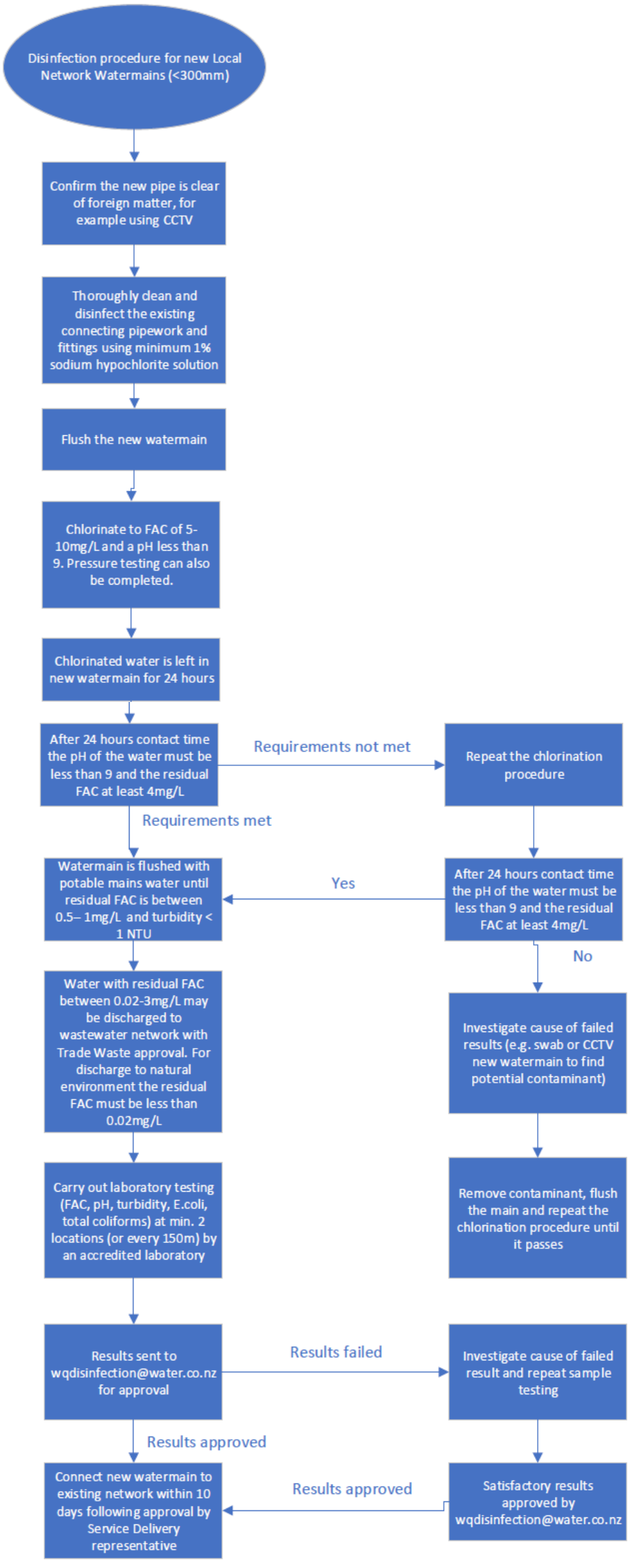


Figure A2: Disinfection procedure flowchart for temporary local network watermain (i.e. emergency watermain for reactive situations only)

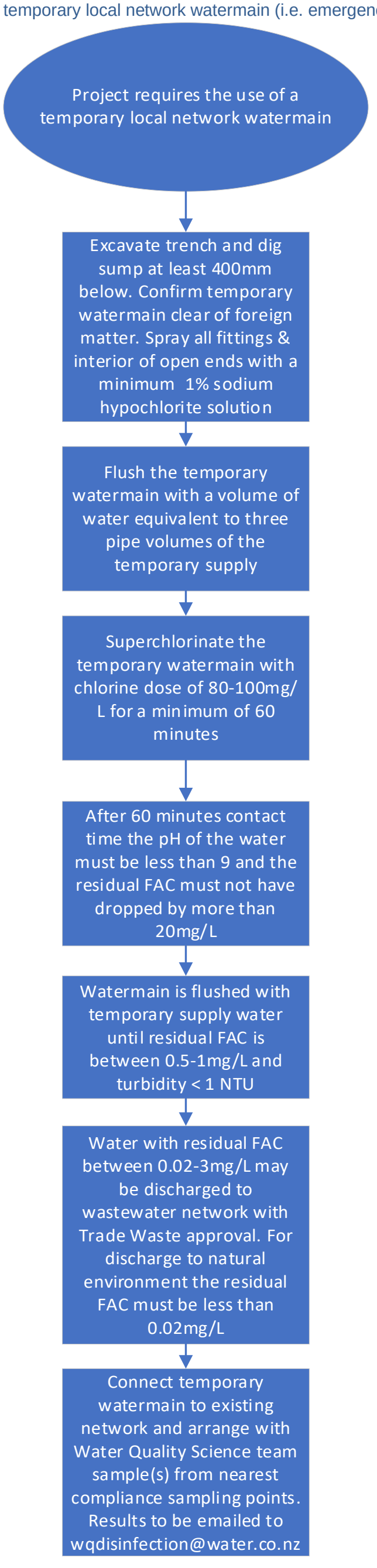


Figure A3: Disinfection procedure flowchart for network emergency and planned repairs

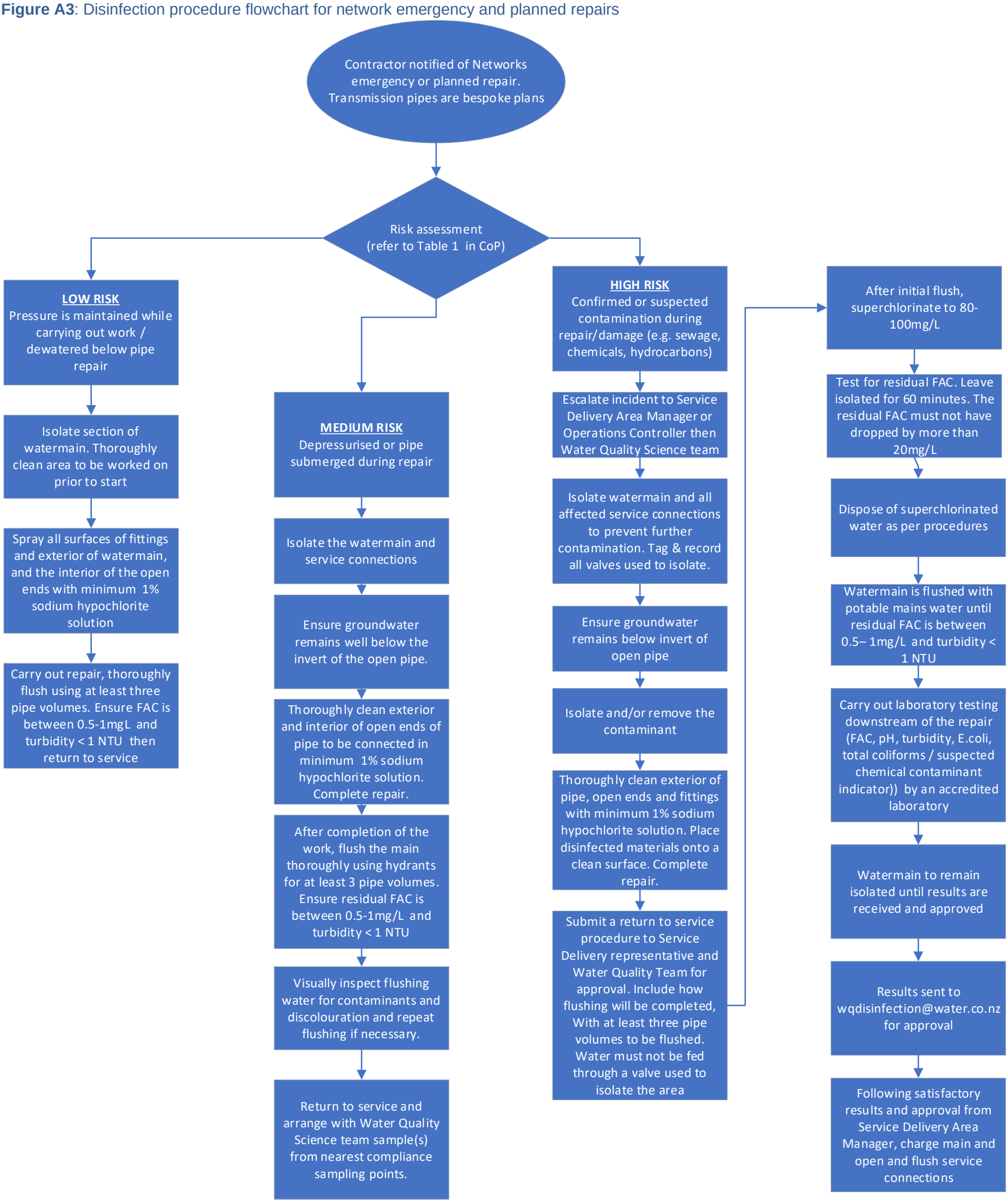


Figure A4: Disinfection procedure flowchart for Reservoirs

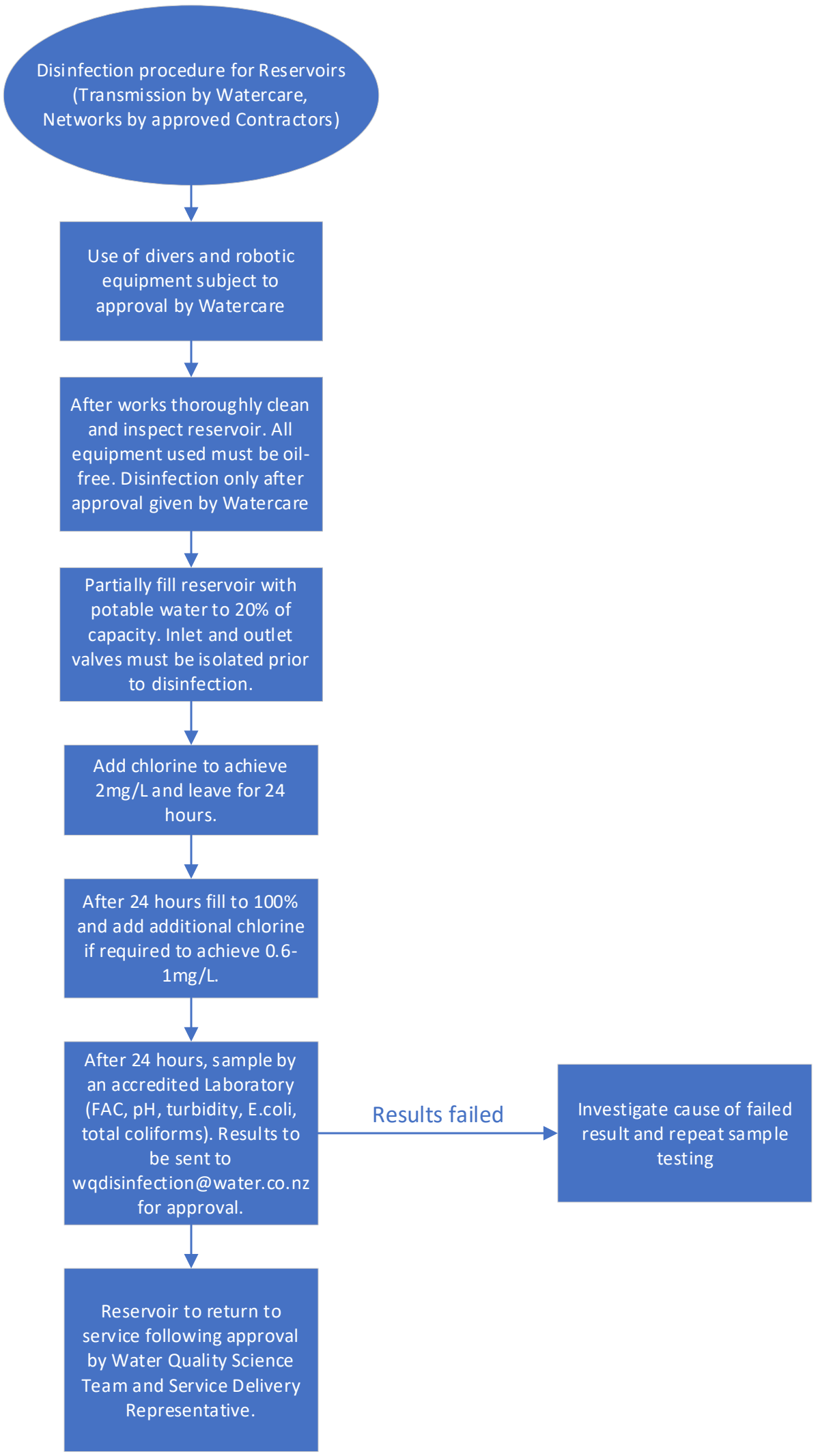


Figure A5: Disinfection procedure flowchart for new transmission watermains

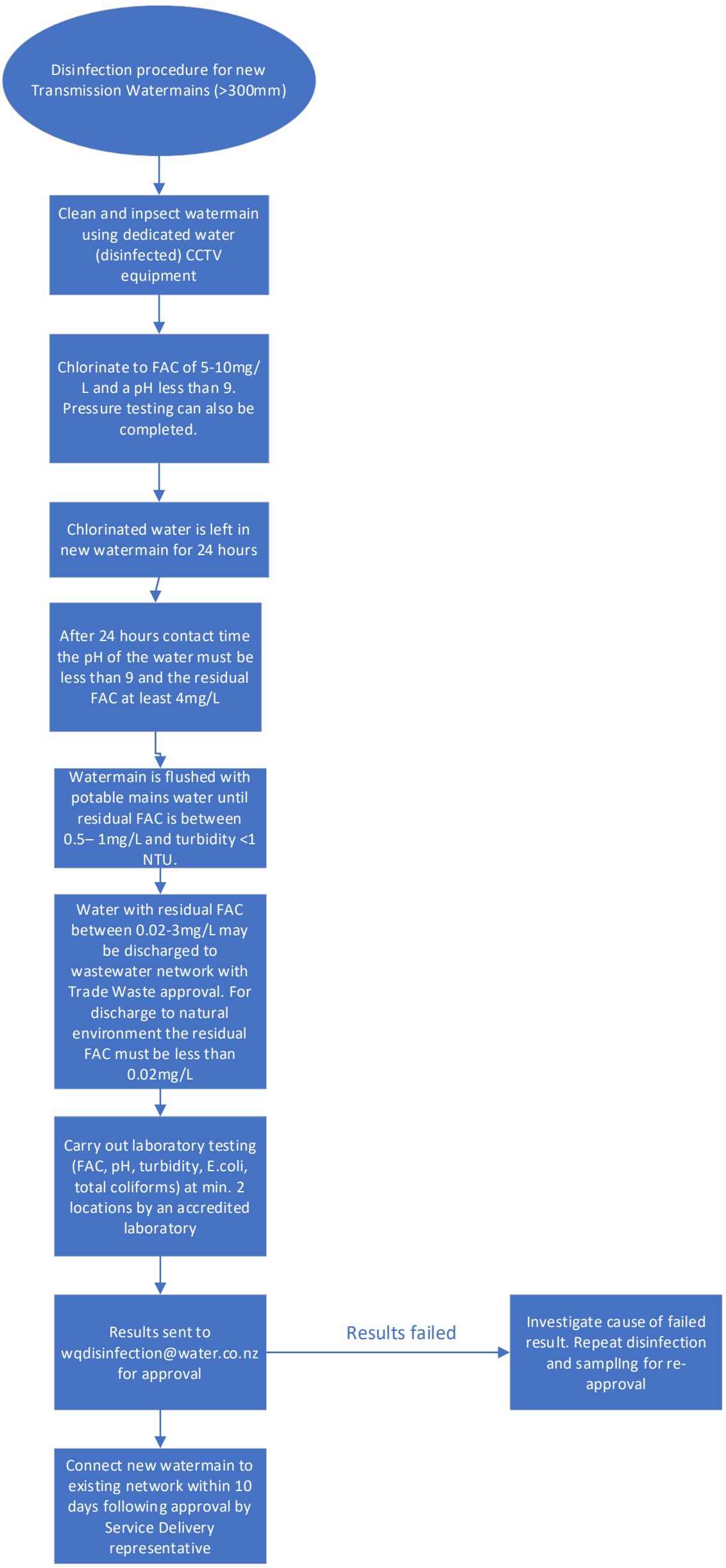
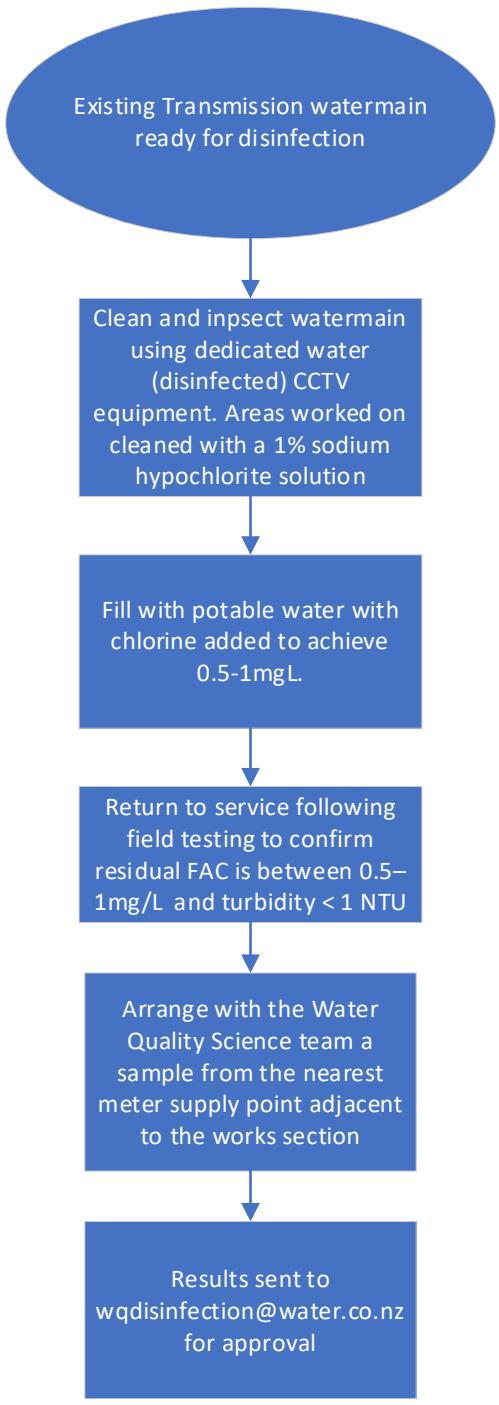


Figure A6: Disinfection procedure flowchart for existing transmission watermains



Appendix B: Flushing Guidelines

Flushing time guidelines in minutes for new works prior to disinfection are outlined in Table B1 below.

Table B1: Time in minutes to flush at 20 L/s

Pipe Diameter (mm)	Number of hydrants to achieve flushing velocity*	Length of Pipe			
		50m	100m	200m	500m
50	-	5	5	5	5
75	-	5	5	5	8
100	1	5	5	5	15
150	3	5	6	5	11
200	4	5	5	6	15
300	9	5	5	6	15
600	35	5	5	7	15
Pipe >600mm	Scour valve – per design	-	-	-	-

*(assumes flow rate through 75mm hydrant of 20l/s)

Note: Flushing rates of 5l/s and 10l/s can be used effectively on 50 and 75mm lines respectively.

Appendix C: Neutralising Chlorine

At the end of the contact time, the chlorine in the water in the new main must be neutralised before the water is discharged to the receiving environment (the street channel or stormwater system). There are three options that can be used to de-chlorinate the water:

1. Chemical Neutralisation dosing;
2. Chemical Neutralisation with dechlorination mats (where dosing at a discharge chamber is not feasible); or
3. Chlorine Dissipation.

C1: Chemical neutralisation

Chemical neutralisation as a method to de-chlorinate water involves dosing to the water as it is being discharged from the main. The most effective and most commonly used chemical to achieve dechlorination is sodium thiosulphate, though there are other alternatives:

Table C1a: Chlorine neutralisation chemicals

Name	Chemical Formula	Solubility
Sodium thiosulphite pentahydrate	$Na_2S_2O_3.5H_20$	200g/l
Anhydrous Sodium sulphite	Na_2SO_3	26.9g in 100g of water at 20^oC
Sodium Sulphite heptahydrate	$Na_2SO_3.7H_2O$	30g/100ml

Chemical SDS sheets must be available at all times.

Procedure: Part (a)

To prepare 15% w/v solution of any of the above three chemicals, the following steps should be taken:

Step 1. Fill the solution tank approximately 2/3 full with water
Step 2. Add the required amount of the neutralising chemical into the tank as specified in Table 17.2
Step 3. Mix the solution until the added chemical has dissolved
Step 4. Add the remainder of water and mix
Step 5. Stir periodically to avoid the solution stratifying

Table C1b: Amounts of chemicals required for chlorine neutralisation

Solution Volume (L)	Sodium Thiosulphite (kg)	Anhydrous Sodium Sulphite (kg)	Sodium Sulphite Heptahydrate (kg)
100	15.2	15	30
200	30.3	30	60
300	45.5	45	90
400	61.0	60	120
500	76.0	75	150
600	91.3	90	180
700	106.2	105	210
800	121.2	120	240
900	136.0	135	270
1000	151.5	150	300

Procedure: Part (b)

To add the neutralisation chemical to the super-chlorinated water, the following steps should be taken:

Step 1. Calculate the flow rate required to add the neutralising chemical (refer below formula).
Step 2. Use a calibrated dosing pump to achieve the calculated required flow rate by adjusting the speed or stroke setting of a calibration chart.
Step 3. Verify successful neutralisation by testing for FAC. Note that the FAC of the discharged water to the environment must be <0.02 mg/L.

To calculate flow rate:

The following formula shows the rate at which the prepared neutralising chemical needs to be added to the water as it is being discharged from the main:

$$\text{Flow (L/hr)} = \frac{\text{FAC (g/m}^3\text{)} \times 3 \times \text{draining flow rate of chlorinated water (L/min)} \times 60\text{min/hr}}{\text{\% Strength of the neutralising solution} \times 10{,}000}$$

Example:

The FAC of the super-chlorinated water to be neutralised is 20 mg/L (i.e. 20g/m3). The super-chlorinated water is being discharged from the main at a flow rate of 100 L/min. The required flow rate of the 15% neutralising chemical solution is:

$$\text{Flow} = \frac{20\ \text{g/m}^3 \times 3 \times 100\ \text{L/min} \times 60\ \text{min/hr}}{15\% \times 10{,}000}$$

$$= 2.4\ \text{L/hr}$$

C2: Chlorine neutralisation with dechloromats

Dechloromats must be placed such that the channelled water does not flow outside the span of the mat, but still covers the full width. The channelled flow must be long enough to ensure proper mixing with the sodium sulphide tablets. Typical channelled flow height should not be more than 50mm. Samples must be taken 10m downstream of the mat. When tablets reach half their original size the mat should be replaced or have new tablets added.

C3: Chlorine dissipation

This is an alternative method in dealing with superchlorinated water which allows the chlorine to dissipate.

Capture the disinfected water on site prior to the discharge of the chlorinated water (e.g. in a tanker). It is suggested that the water is kept contained on site for a minimum of 2 days until the FAC is reduced to the acceptable level of the receiving environment.