**1.0 Purpose**

 The purpose of this procedure is to detail all steps in flushing, disinfecting and testing of water mains during routine flushing or inspections and repairs.

**2.0 Background**

New sections of water mains and water mains taken out of service for inspection, repair, or other activities, must be flushed, disinfected and tested for bacteriological quality prior to being reinstated for use by the customer. The primary function of water main flushing is to initially remove contamination left in the pipe after installation, and as a routine maintenance, to remove dirt and debris that settles out of the water over time. Routine water main flushing is to be performed at a minimum frequency of once per year. Where flushing is not effective in removing dirt and debris from water mains, swabbing shall be performed at the same minimum frequency.

**3.0 Flushing Procedure**

Provide a flushing velocity of at least 0.76 m/s (2.5 ft/s) to 1.5 m/s (5.0 ft/s). This velocity may be obtained by using more than one hydrant (see table below). Maintain this flow rate until there has been two or three complete changes of water in the pipe, and the water leaving the hydrant is visibly clean.

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| --- | --- | --- |
| **Pipe Diameter** | **Minimum Required Flow Rate** | **No. of Hydrants Required Open** |
|  | Based on 0.76 m/s at 280 kPa (2.5 ft/s at 40 psi) | Based on a hydrant with one63 mm (2 1/2”) outlet. |
| 100 mm (4”) | 100 GPM (6 L/s) | 1 |
| 150 mm (6”) | 200 GPM (13 L/s) | 1 |
| 200 mm (8”) | 400 GPM (25 L/s) | 1 |
| 250 mm (10”) | 600 GPM (38 L/s) | 1 |
| 300 mm (12”) | 900 GPM (57 L/s) | 2 |
| 400 mm (16”) | 1600 GPM (100 L/s) | 2 |

The free chlorine residuals at the end of flushing is to be recorded on the Form HM1 – Hydrant Maintenance Report, to ensure that they are at the 0.2 mg/L range with the minimum being 0.05 mg/L.

Routine water main flushing is to be performed ONCE A YEAR, except at any locations where problems with debris and dirt are more prevalent.

* Pre-plan and entire day’s flushing using available system maps. Consider flushing between midnight and 5:00 a.m. To avoid competing for water.
* Determine the sections of main that are to be flushed at one time, the valves to be used and the order in which the pipelines will be flushed.
* Start at or near a source and work outward into the distribution system, progressing from large to small mains.
* Ensure that an adequate amount of flushing water is available (reservoir is full) and a minimum flushing velocity is used (0.76 m/s (2.5 ft/s) minimum, 1.5 m/s (5.0 ft/s) preferred).
* Prior to flushing the mains, notify all customers who will be affected, of the dates and times of the flushing through billing, newspapers, and local radio and TV announcements. Individually notify people who might be on dialysis machines and also hospitals, restaurants, laundromats, etc.
* Isolate the section to be flushed from the rest of the system, closing the valves slowly to prevent water hammer.
* Open the fire hydrant or blowoff valve slowly.
* Direct flushing water away from traffic, pedestrians and private lots.
* Open hydrants fully or a period long enough to stir up the deposits inside the water main (5 to 10 minutes).
* Ensure that the system pressure in nearby areas does not drop below 138 kPa (20 psi).
* Record all pertinent data (valve and hydrant condition, description of appearance and odour of water being flushed).
* Collect two water samples from each flowing hydrant, one about 2 to 3 minutes after the hydrant was opened, and the second just before closing the hydrant, for water quality testing (iron, chlorine residual, turbidity).
* When the flushing water runs clear, slowly close the hydrant or blowoff valve.
* Where the flushing water does not run clear, the operator should use judgement as to relative colour and turbidity and decide when to shut down.
* Mark closed valves on a map or flushing sheet when they are closed and erase marks after they are reopened.
* After one section of pipe has been flushed, move onto the next section to be flushed and repeat the same procedure.

**3.1 Mechanical Cleaning**

* Isolate the line to be cleaned, ensure that customers requiring temporary service have enough water.
* Verify that all valves in the section to be cleaned are fully opened.
* Turn on the water and verify the direction of flow.
* Run a full-sized bare swab through the main to prove the direction of flow.
* Run a swab unit through the main, and measure the diameter of the unit upon exiting and introduce a crisscross type unit into the main that will just fit the true opening. Run a full-sized bare swab behind the crisscross unit to ensure a tight seal. Continue this process until a unit is discharged from the main in reusable condition.
* Increase the size of the crisscross pigs in one inch increments until the units that measure the same as the pipe inside diameter are being used. For pipes with a build-up of hard scale, such as carbonates, crisscross wire pigs can be used on the final pass.
* Run a full-sized bare swab to sweep out any loose debris.
* Flush thoroughly after each pig run.
* Avoid applying more than two wire-brush pigs on the final pass, to prevent over-cleaning.
* Launch the pigs from fire hydrants for mains of 200 mm (8”) or smaller, or from concentric reducers, pipe couplings, spools, eccentric reducers, in-line launchers or by hand.
* Have an operator with experience in proper main cleaning procedures help you the first time you attempt to clean a main.
* After the cleaning operation is completed, flush and disinfect (chlorinate) the main. When the main is reactivated, flush service lines and remove any temporary services.

**4.0 Water Disinfection**

One of the following procedures is to be followed to disinfect all new water mains and parts prior to being put to use.

* 1. **Calcium Hypochlorite Tablet Method (HTH)**

**When to Use**

 Primarily used for new installations. The pipe must be kept clean during installation, since the main cannot be flushed before it is disinfected.

**When NOT to Use**
 If the pipe cannot be maintained clean during installation, this method should not be used so the line can be flushed prior to disinfection.

 Should not be used on solvent-welded plastic or on screwed-joint steel pipe due to the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

* Place the HTH tablets in each section of pipe and fire hydrant as the work proceeds, affixed to the top of the pipe with epoxy resin. Tablets are to be placed at each end of each section of pipe. Provide sufficient quantities to produce a chlorine residual of 25 mg/L after the pipes have been completely filled with water. Bleed some water to ensure the chlorinated water has contacted all sections of the pipe.
* The pipe is to be filled at a velocity below 0.3 m/s (1 ft/s) to prevent the tablets from dislodging.
* Record the chlorine residual once the main has been filled.
* See the table below for the number of 5 gram calcium hypochlorite tablets required to produce a chlorine residual of 25 mg/L in 6 m (20 ft) pipe lengths.

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| **Pipe Diameter** | **No. or Tablets per Pipe Length** |
| 100 mm (4”) | 1 |
| 150 mm (6”) | 1 |
| 200 mm (8”) | 2 |
| 250 mm (10”) | 3 |
| 300 mm (12”) | 4 |
| 400 mm (16”) | 7 |

* 1. **Calcium Hypochlorite Granules Method**
* As an alternate to the tablets, granules of calcium hypochlorite may be used. Granules shall be placed at the start of the first section of pipe and at each branch main and at 150 m (500 ft) intervals. See the table below for the amount of granules required for a chlorine residual of 25 mg/L in a 150 m (500 ft) length of pipe, for various sized pipes.

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| **Pipe Diameter** | **Calcium Hypochlorite Granules** |
| 100 mm (4”) | 57 g (1.7 oz) |
| 150 mm (6”) | 113 g (3.8 oz) |
| 200 mm (8”) | 200 g (6.7 oz) |
| 250 mm (10”) | 300 g (10.5 oz) |
| 300 mm (12”) | 430 g (15.1 oz) |
| 350 mm (14”) and larger | D2\*427.9 (D2\*15.1) |

Where D is the diameter of the pipe in feet.

* 1. **Hypochlorite Disinfection**
* Prior to disinfection, flush the system if possible to ensure all contamination and debris has been removed.
* Ensure adequate drainage has been provided during flushing and disinfection.
* Inject a concentrated chlorine solution through a corporation stop that has been installed close to the valve that connects to the existing water system, either as a continuous feed system or using a slug.
* Using a continuous feed method, add water slowly to the pipeline at the same time that the chlorine solution is added, using a chemical feed pump.
* Take the flow of water volume by measuring the water exiting from the fire hydrant at the end of the line, or by metering the flow entering the system.
* Set the chemical feed rate to produce a concentration of about 50 mg/L when mixed with the incoming water.
* Continue to feed water and the chlorine solution until you measure at least a residual of 25 mg/L in the flow at the end of the line (see Calcium Hypochlorite Granules Method above for hypochlorite addition).
* Dechlorinate highly chlorinated water before if enters the surrounding environment.
* Once the chlorine residual in the pipe has reached a minimum of 25 mg/L, stop pumping and allow the pipe to stand for 24 hours. Prior to stopping pumping, exercise all hydrants on the system to ensure that they are all adequately disinfected. After pupmping has stopped, operate all line valves to ensure adequate disinfection.
* Check the chlorine residual after 24 hours. If the residual is less than 10 mg/L, flush and repeat this procedure to ensure the system is free from contamination.
* Using the slug method, move a slug of a concentration of 100 mg/L minimum through the pipe slowly to achieve a contact time of at least three hours as it moves through the system.
* As the slug moves through the system, operate the fire hydrants to ensure they are disinfected.
* Monitor various points to ensure a high residual which will indicate successful disinfection.
* When the slug reaches the end of the line, and the system is being dechlorinated, the line and all hydrants must be flushed to ensure all traces of highly chlorinated water are removed.

**Quantity of HTH required to produce 50 mg/L chlorine residual.**

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| --- | --- |
| **Pipe Diameter** | **Amount of Hypochlorite Granules per 30.5m (100 ft) of pipe** |
| 100 mm (4”) | 0.02 kg (0.04 lbs) |
| 150 mm (6”) | 0.04 kg (0.09 lbs) |
| 200 mm (8”) | 0.08 kg (0.017 lbs) |
| 250 mm (10”) | 0.12 kg (0.26 lbs) |
| 300 mm (12”) | 0.17 kg (0.38 lbs) |
| 350 mm (14”) | 0.23 kg (0.51 lbs) |
| 400 mm (16”) | 0.3 kg (0.67 lbs) |
| 450 mm ( 18”) | 0.39 kg (0.85lbs) |
| 500 mm (20”) | 0.47 kg (1.05 lbs) |

Town Manager/Clerk: Signature: Date:

References

“Small System Operation and Maintenance Practices” Version 1, Federation of Canadian Municipalities and National Research Council, 2005, ISBN 1-897094-94-9.

“From Source to Tap: Guidance on the Multi-Barrier Approach to Safe Drinking Water”, Federal-Provincial-Territorial Committee on Drinking Water and CCME Water Quality Task Group, 2004, ISBN 1-896997-48-1.

“AWWA Standard for Disinfecting Water Mains” American Water Works Association, 1999.