

Distribution System Water Quality

Protecting Water Quality Through Distribution System Flushing



Flushing can be an important maintenance technique to remove stagnant water, restore disinfectant residual, remove loose deposits, and scour pipe surfaces. Flushing can reduce water age and address water quality complaints. Flushing involves opening a distribution system connection and allowing water to discharge from the system. Depending on public water system (PWS) needs, flushing is performed on a scheduled or unscheduled basis. This fact sheet is part of EPA's Distribution System Toolbox developed to summarize best management practices that PWSs, particularly small systems, can use to maintain distribution system water quality and protect public health.

Examples of Utility Actions

A PWS in the western U.S. serving nearly one million people conducting monitoring under the Revised Total Coliform Rule observed positive coliform sampling results. In response, they first conducted spot flushing near the coliform sampling sites to remove water with low disinfectant residual, and then increased the chloramine dosage and implemented unidirectional and conventional flushing to increase and maintain the disinfectant residual. The coliform results were corrected in about five weeks.

A PWS in the eastern U.S. serving 6,000 people struggled to maintain a disinfectant residual >0.1 mg/L at far reaches of the distribution system. The PWS implemented a spot flushing program with automatic flushing units in three problem areas and free chlorine residual increased to >0.2 mg/L in those areas.



Spot Flushing Application

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Water Quality and Flushing

- Flushing may be performed as part of a regular maintenance program to scour pipe surfaces and remove loose sediment, biofilm, and scale.
- Flushing may also be performed in response to low disinfectant residual, positive coliform results, evidence of nitrification, or customer water quality complaints about turbidity or other aesthetic issues.
- Benefits of flushing can include removal of stagnant water, reduced distribution system water age, increase disinfectant residual, lower heterotrophic bacterial counts, and lower concentrations of disinfection byproducts.
- Depending on the technique used, flushing might only result in an exchange of bulk water and not removal of sediment, biofilm, or scale.
- Depending on flushing velocity and method, flushing can loosen and mobilize sediment in the pipe without fully removing it.

Flushing Programs and Techniques

- Flushing programs can be categorized as scheduled or unscheduled; comprehensive or targeted; and conventional or unidirectional.
- Scheduled flushing is a component of a routine preventive maintenance program, whereas unscheduled flushing is often conducted in response to customer complaints or water quality changes.
- A comprehensive flushing program covers the whole distribution system, while a targeted program focuses on select areas of the system.
- Conventional flushing involves fully opening one or more hydrants and using the available flow rate. Care needs to be taken about disturbing sediment, or else it can spread to nearby customers.
- Unidirectional flushing is a planned, organized, sequential technique that begins from a clean starting point. It involves closing isolation valves to direct flow to the flushing hydrant. This minimizes the spread of sediment to other parts of the system and produces a higher velocity of flow.
- Spot flushing is used to remove stagnant water from low water use areas such as dead-end water mains. Spot flushing can be performed on a regular schedule at areas with known problems (e.g., a history of customer complaints) or can be performed when needed (e.g., based on water quality parameters).

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Planning a Flushing Program

- ✓ Review state and local regulations for flushing and water discharge requirements.
- ✓ Establish specific water quality goals to be achieved by flushing.
- ✓ Review flushing techniques and policies to identify ways to reduce costs and increase benefits.
- ✓ Review operational records and verify that the system has sufficient hydraulic capacity to support flushing.
- ✓ Consider whether the flushing program can be coordinated with a valve exercising program and/or hydrant testing program.
- ✓ Update flushing procedures and maps as needed.
- ✓ Prepare and distribute customer notifications about flushing activities.

High Velocity Unidirectional Flushing to Remove Hydraulically Mobile Contaminants



Image Source: Confluence Engineering Group. Used with permission.

Table 1: Resources and Guidelines for Distribution System Flushing

Resource Title and URL	Relevance to Distribution System Flushing
ASDWA. 2020. State Drinking Water Distribution System Survey. https://www.asdwa.org/	Summarizes survey responses from states; topics include requirements and recommendations for distribution system flushing protocols and programs.
Hill et al. 2018. Use of Flushing as a Corrective Action Under the Revised Total Coliform Rule. Project #4653. https://www.waterrf.org/ . Note: There may be a fee associated with obtaining this resource.	Reports research findings and guidance on the effectiveness of flushing in keeping the distribution system clean.
AWWA. 2014. M28 Rehabilitation of Water Mains. https://www.awwa.org/ . Note: There may be a fee associated with obtaining this resource.	Provides guidance on selecting water-main rehabilitation techniques, including cleaning techniques such as flushing.
WHO. 2004. Safe Piped Water, Managing Microbial Water Quality in Piped Distribution Systems. https://www.who.int/	Provides guidance on water main maintenance and planning, including flushing.