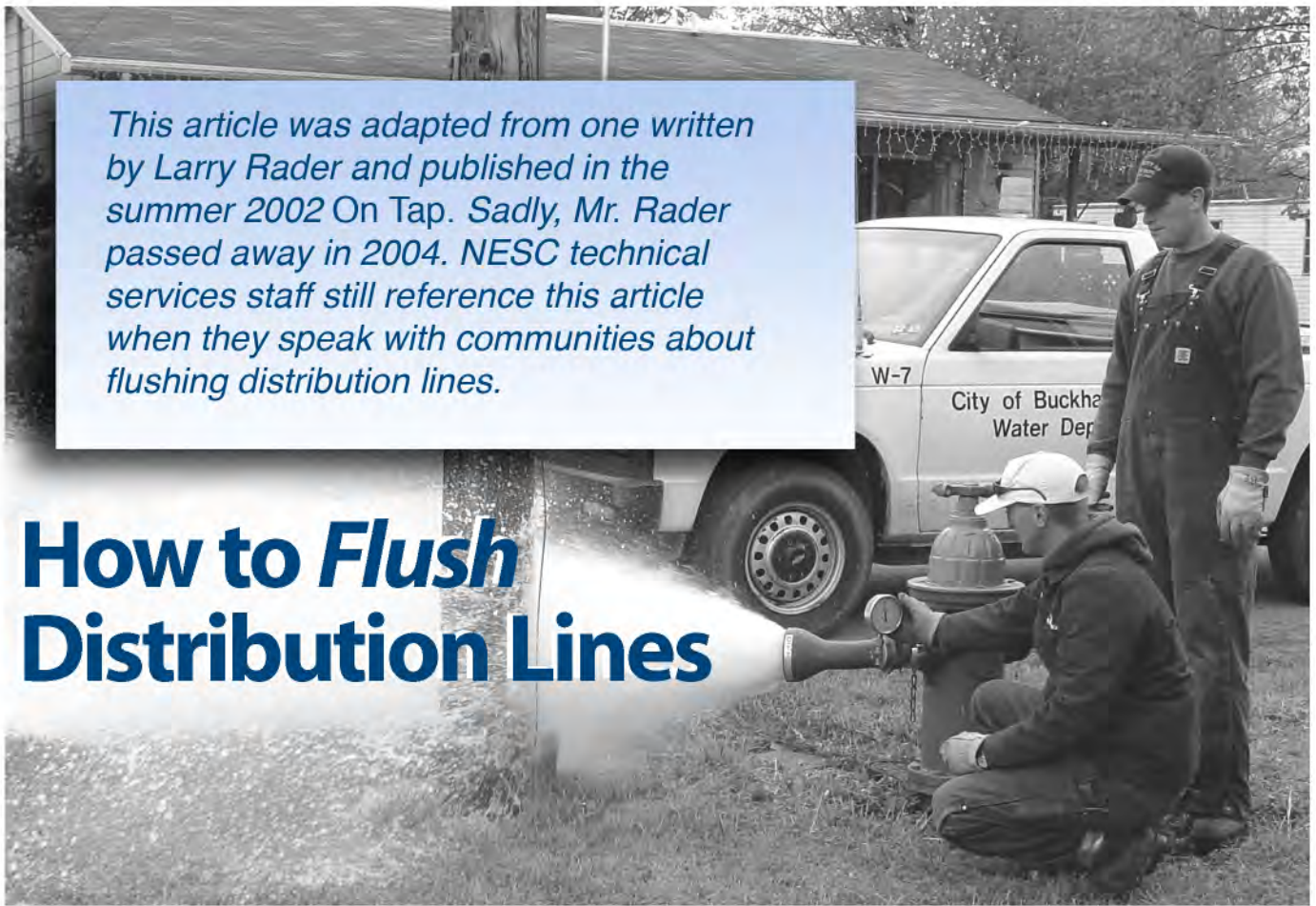


This article was adapted from one written by Larry Rader and published in the summer 2002 On Tap. Sadly, Mr. Rader passed away in 2004. NESC technical services staff still reference this article when they speak with communities about flushing distribution lines.

How to Flush Distribution Lines



Some systems only flush their lines after they receive a customer complaint—and then only in the problem areas. But like most other things in the drinking water business, a little preventive maintenance is always easier than trying to pacify angry customers after a problem occurs.

Story and photos by **Larry Rader**,
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Distribution lines can accumulate all sorts of things that cause discolored water, taste and odor, or even hydraulic problems. To keep these situations from turning into complaints, distribution lines need to be flushed. Flushing a drinking water distribution system simply means opening fire hydrants in a specific order so fresh water replaces the water standing in the lines.

The operator or system employee assigned to the task regulates the flow rate from the hydrants so that debris, sediment, and biological material are removed from the line. In other words, line flushing is housekeeping for your distribution system that improves water quality and service. Flushing these lines can also keep disinfection by-products down.

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Developing a Program

Like other long-term programs, line flushing requires homework and planning.

How often: Most people agree that flushing lines two times a year, usually spring and fall, is sufficient and do-able for most smaller systems. However, system personnel may need to flush dead ends more often.

Time of day: The best time to flush the system is usually late at night between the hours of 9 p.m. and 5 a.m. Typically, there's less vehicle traffic, and customers usually don't need much water during these hours so there will be fewer complaints.

Customers: Developing a flushing program also requires an advance method of notifying your customers. Newspaper announcements, mass mailings, TV advertisements, or going house to house are all acceptable methods. However, you'll want to make a special effort to notify customers who use dialy-

Line Flushing with a Diffuser

sis units or business customers, such as laundromats, restaurants, and beauty shops that need water to maintain their services.

Temperature: If the outside temperature is near freezing (or below), it is a good to wait for warmer weather. When ice accumulates in the fire hydrant due to cold weather, it can be difficult to close the hydrant once you are done with the flushing. Snow and ice on roads and sidewalks can also make this work dangerous.

Accomplishing Your Goal

After you make the decision to implement a line-flushing program, devise a plan to accomplish your goal.

Water availability: Line flushing uses lots of water. So before you start, be certain you have enough water stored to finish each section.

Tools: In addition to the usual valve and hydrant wrenches, other equipment, such as a pressure and pitot gauges as well as diffusers or diverters, can be very useful. You can monitor residual pressure using a pressure gauge threaded into a hydrant cap. In addition, you can calculate the flow as gallons per minute (gpm) using a pitot gauge held into the water stream flowing from the hydrant. Also, diffusers or diverters should be used to direct the water stream and prevent property damage.

Maps: Take time to study your distribution system's maps. If you plan to flush in sections, you will need to identify those sections and locate the valves that isolate them. Also, identify sections served by smaller diameter lines and flush these separately. In other words, don't pull water through a two-inch line that serves a trailer park when you're flushing a four-inch or six-inch main. Flush the trailer park separately and then continue with the main line.

Direction: Flushing typically follows the direction that the water flows, starting at or near the water plant, well, spring, etc., and moving out into the system toward the periphery.

Safety: Anytime you work along a highway, especially at night, everything and everyone needs to be marked or lighted. Use cones, signs, flashing lights, safety vests, and a flagman. The flushing crew should consist of two people at a minimum, more if the situation requires flaggers.

Property protection: Use diffusers, diverters, or even a length of hose to keep the water being



1. Flushing distribution lines is a two-person job.



2. A diffuser protects property.



3. When finished, make sure to turn the hydrant securely off.



This pitot gauge is showing approximately 50 pounds per square inch (psi) of pressure or approximately 1,190 gallons per minute (gpm) of flow.

Line Flushing is Housekeeping



1. One person should always monitor traffic.



2. Dirty water is better here than in your customers' homes.

flushed out from damaging property. Never use a home-made diverter constructed from solid lengths of pipe with a bend or elbow. Due to leverage, the discharge through this type of solid diverter can generate very high torque on the hydrant. An important point to remember is that if you have a stream of water shooting across a roadway, you need a flagger to stop traffic.

Let's Get Started

From the beginning: Beginning at a hydrant that is at or near the source, remove one of the two-and-a-half inch caps and install a diffuser or diverter; make certain all caps are tight. At another nearby hydrant that's on the same line that you are going to flush, replace one of its two-and-a-half inch caps with a cap that has a pressure gauge installed and securely tighten all caps. The hydrant with the pressure gauge should then be turned on slowly until fully charged and the gauge reads line pressure. This hydrant will be used to monitor residual pressure. Return to the hydrant you are going to flush and open slowly.

Pressures and flow rates: Although there are a wide variety of recommended flow rates, the minimum rate is two-and-a-half feet per second (ft/sec) and goes up to six ft/sec. In older systems, the higher rate can cause problems so you might want to use a lower flow rate, around five ft/sec.

Because flow rates are important, a method to measure them is also important. Hydrant meters work very well, but are expensive. The pitot gauge is much less costly and also works well. Another method is to measure the trajectory of the hydrant discharge and estimate flow. If you do not have any equipment that measures flow, slowly open the hydrant to a full stream and run for five to 10 minutes while checking the residual pressure at a



Residual pressure is very important during line flushing and should never drop below 20 pounds per square inch (psi) to prevent a backflow situation. This gauge is reading a static pressure of 95 psi.



Brian Elmore and Jerry Wamsley of the Buckhannon Water Department in Buckhannon, West Virginia, regularly flush their system's distribution lines.

nearby hydrant using a psi gauge. Residual pressure is very important during line flushing and should never drop below 20 psi to prevent a backflow situation.

Observations and tests: Because you flush lines to remove sediment, iron and manganese deposits, organic material, or anything else that degrades the quality of the water you worked so hard to make clean, a few tests and your visual observations will tell you when you are successful.

Document the water that was flushed. This water should be included in the system water accountability report as water used for maintenance.

Collecting samples two or three minutes into the flush and again at the end—once the water has cleared up—will give you a visual before and after. Also as the water clears and just before the hydrant is turned off, collect another sample in case you want to check chlorine, turbidity, iron, manganese, or anything else that will cause water quality problems.

To help build a history, record any observations or tests for each hydrant. You also should make a record of the complete process from start to finish; it will help next time. Also, if you have measured the flow rates for each hydrant, that information will be very helpful to your fire department.

Line flushing isn't as hard as it looks. However, many systems choose to put it off until cus-

tomers are knocking at their door and then randomly turn on a few hydrants hoping the complaints will stop. Taking the time to develop a comprehensive flushing program will benefit any community.

References

- American Water Works Association. 1962. "Distribution and Maintenance." *Distribution Manual*. Denver: AWWA.
- Antoun, Edward N., John E. Dysen, and David J. Hildebrand. 1999. "Unidirectional Flushing: A Powerful Tool." *Journal AWWA*. Denver: American Water Works Association (AWWA).
- Chadderton, Ronald A., G. Lee Christensen, and Patricia Henry-Unrath. 1993. "Planning a Distribution System Flushing Program." *Journal AWWA*. Denver: AWWA.

Larry Rader has more than 25 years in the water and wastewater industry. He began his career in his hometown, Elizabeth, West Virginia, (population 1,100) operating both the water and wastewater plants. While employed there, he drove the trash truck, read meters, fixed leaks, and wrote parking tickets in his spare time. He has devoted the last 17 plus years to training operators and trouble-shooting treatment problems in small systems, first for the West Virginia Rural Water Association and now in his own consulting business. All of his education came from the School of Hard Work.



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