By Bret Beye, Technical Assistant

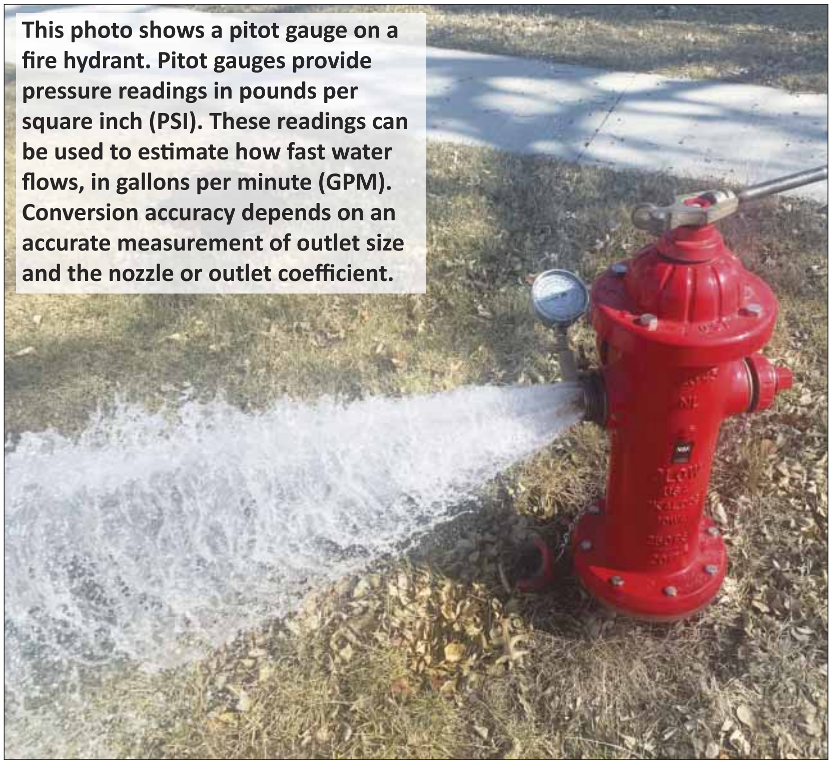
# Proper Methods of Flushing a Water System

This diffuser diverts water in two directions, reducing damage to streets, lawns, and other landscaping.

Flushing a water system can be very beneficial. There are several reasons to flush at least annually. Not only should a system keep records on the condition of hydrants used for flushing, but also the type and size of hydrants and flow rates should be recorded. If the flow rate continually drops over time or a significant drop is noticed that could be an alert that a valve is not fully open or that there is a blockage somewhere.

The objectives of a good flushing plan are to reduce customer complaints such as colored water, taste and odor, and debris in the water and in general, to improve water quality. If a system is properly flushed the system can expect to remove sediment and debris, scour lines to remove deposits (both chemical and biological), improve chlorine residuals, and operate system valves and hydrants.

A good flushing program should not be just a "response" to customer complaints. Always be proactive; develop a planned flushing program to reduce those complaints. Timing and scheduling of flushing are key elements to a successful flushing program.



This photo shows a pitot gauge on a fire hydrant. Pitot gauges provide pressure readings in pounds per square inch (PSI). These readings can be used to estimate how fast water flows, in gallons per minute (GPM). Conversion accuracy depends on an accurate measurement of outlet size and the nozzle or outlet coefficient.

Try not to flush when the water demand is high and when it might cause issues because of cold weather. Flushing should always be performed system-wide. Notify customers well in advance of the procedure. The process will stir up the water in the system. During the process, customers might experience lower water pressure, colored water and taste and odor issues if they attempt to use the water. Water systems must avoid any threat to public health. Late at night is the opportune time to flush. Water systems that purchase from another system should notify the seller that the water usage will increase during the flushing.

It may be necessary to use unidirectional flushing. Looped systems are great but to get the best out of the flushing program it might be best to close a valve bringing all the water from one direction and then open that valve and close the other end. In this way, all the water is forced to go in one direction. Another benefit is that the system will have a chance to find out if the valves are working properly.

## Pipe Flow Velocity Chart

| GPM | 3/4" | 1" | 1.25" | 1.5" | 2" | 2.5" | 3" | 4" | 5" | 6" | 8" | 10" | 12" | 16" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.72 | 0.41 | 0.26 | 0.18 | 0.10 | 0.07 | | | | | | | | |
| 2 | 1.40 | 0.82 | 0.52 | 0.36 | 0.20 | 0.13 | 0.09 | | | | | | | |
| 3 | 2.20 | 1.20 | 0.78 | 0.55 | 0.31 | 0.19 | 0.14 | 0.08 | | | | | | |
| 4 | 2.90 | 1.60 | 1.04 | 0.73 | 0.41 | 0.26 | 0.18 | 0.11 | | | | | | |
| 5 | 3.60 | 2.00 | 1.30 | 0.90 | 0.51 | 0.32 | 0.23 | 0.13 | 0.08 | | | | | |
| 6 | 4.30 | 2.40 | 1.56 | 1.10 | 0.61 | 0.39 | 0.27 | 0.16 | 0.10 | | | | | |
| 7 | 5.10 | 2.90 | 1.82 | 1.25 | 0.71 | 0.45 | 0.32 | 0.18 | 0.12 | 0.08 | | | | |
| 8 | 5.80 | 3.30 | 2.10 | 1.45 | 0.82 | 0.52 | 0.36 | 0.21 | 0.13 | 0.09 | | | | |
| 10 | 7.20 | 4.10 | 2.60 | 1.80 | 1.00 | 0.65 | 0.45 | 0.25 | 0.16 | 0.11 | | | | |
| 12 | | 4.90 | 3.10 | 2.20 | 1.20 | 0.78 | 0.50 | 0.31 | 0.20 | 0.13 | 0.08 | | | |
| 14 | | 5.70 | 3.60 | 2.50 | 1.40 | 0.90 | 0.60 | 0.36 | 0.23 | 0.16 | 0.09 | | | |
| 16 | | 6.50 | 4.20 | 2.90 | 1.60 | 1.00 | 0.70 | 0.40 | 0.26 | 0.18 | 0.10 | | | |
| 18 | | 7.30 | 4.70 | 3.30 | 1.80 | 1.20 | 0.80 | 0.45 | 0.29 | 0.20 | 0.11 | | | |
| 20 | | 8.20 | 5.20 | 3.60 | 2.00 | 1.30 | 0.90 | 0.51 | 0.33 | 0.23 | 0.13 | 0.08 | | |
| 25 | | | 6.50 | 4.60 | 2.50 | 1.65 | 1.15 | 0.64 | 0.41 | 0.28 | 0.16 | 0.10 | | |
| 30 | | | 7.80 | 5.40 | 3.10 | 1.90 | 1.40 | 0.77 | 0.48 | 0.34 | 0.19 | 0.12 | 0.08 | |
| 35 | | | 9.10 | 6.30 | 3.60 | 2.30 | 1.60 | 0.90 | 0.56 | 0.40 | 0.22 | 0.14 | 0.10 | |
| 40 | | | 10.40 | 7.20 | 4.10 | 2.60 | 1.80 | 1.03 | 0.64 | 0.45 | 0.26 | 0.16 | 0.11 | |
| 45 | | | | 8.20 | 4.60 | 2.90 | 2.00 | 1.16 | 0.73 | 0.50 | 0.29 | 0.18 | 0.12 | |
| 50 | | | | 9.10 | 5.10 | 3.30 | 2.30 | 1.30 | 0.83 | 0.55 | 0.32 | 0.20 | 0.14 | 0.08 |
| 55 | | | | 10.00 | 5.60 | 3.60 | 2.50 | 1.43 | 0.92 | 0.62 | 0.35 | 0.22 | 0.16 | 0.88 |
| 60 | | | | 10.90 | 6.10 | 3.90 | 2.70 | 1.56 | 1.00 | 0.68 | 0.38 | 0.24 | 0.17 | 0.96 |
| 70 | | | | 12.70 | 7.10 | 4.60 | 3.20 | 1.81 | 1.15 | 0.79 | 0.45 | 0.29 | 0.20 | 0.11 |
| 75 | | | | | 7.70 | 4.90 | 3.40 | 1.93 | 1.22 | 0.85 | 0.48 | 0.31 | 0.21 | 0.12 |
| 80 | | | | | 8.20 | 5.20 | 3.60 | 2.06 | 1.30 | 0.91 | 0.51 | 0.33 | 0.23 | 0.13 |
| 90 | | | | | 9.20 | 5.90 | 4.10 | 2.31 | 1.48 | 1.00 | 0.58 | 0.37 | 0.26 | 0.14 |
| 100 | | | | | 10.20 | 6.50 | 4.50 | 2.50 | 1.62 | 1.10 | 0.65 | 0.41 | 0.28 | 0.16 |
| 125 | | | | | 12.70 | 8.10 | 5.70 | 3.20 | 2.02 | 1.40 | 0.81 | 0.51 | 0.35 | 0.20 |
| 150 | | | | | | 9.80 | 6.90 | 3.80 | 2.43 | 1.70 | 0.97 | 0.61 | 0.42 | 0.24 |
| 175 | | | | | | 11.40 | 7.90 | 4.50 | 2.83 | 2.00 | 1.14 | 0.71 | 0.49 | 0.28 |
| 200 | | | | | | 13.10 | 9.00 | 5.10 | 3.28 | 2.30 | 1.30 | 0.82 | 0.57 | 0.32 |
| 225 | | | | | | | 10.10 | 5.75 | 3.66 | 2.55 | 1.45 | 0.91 | 0.64 | 0.36 |
| 250 | | | | | | | 11.30 | 6.40 | 4.04 | 2.80 | 1.60 | 1.01 | 0.71 | 0.40 |
| 300 | | | | | | | 13.60 | 7.70 | 4.96 | 3.40 | 1.90 | 1.20 | 0.85 | 0.48 |
| 350 | | | | | | | | 9.00 | 5.70 | 4.00 | 2.20 | 1.40 | 0.98 | 0.56 |
| 400 | | | | | | | | 10.20 | 6.40 | 4.50 | 2.60 | 1.60 | 1.10 | 0.65 |
| 450 | | | | | | | | 11.50 | 7.20 | 5.10 | 2.90 | 1.80 | 1.25 | 0.73 |
| 500 | | | | | | | | 12.80 | 8.00 | 5.70 | 3.30 | 2.00 | 1.40 | 0.80 |
| 600 | | | | | | | | | 9.60 | 6.80 | 3.80 | 2.40 | 1.70 | 0.96 |
| 700 | | | | | | | | | 11.60 | 7.90 | 4.50 | 2.90 | 2.00 | 1.10 |
| 800 | | | | | | | | | 13.20 | 9.10 | 5.10 | 3.30 | 2.30 | 1.30 |
| 900 | | | | | | | | | | 10.20 | 5.80 | 3.70 | 2.60 | 1.40 |
| 1000 | | | | | | | | | | 11.40 | 6.40 | 4.10 | 2.80 | 1.60 |
| 1100 | | | | | | | | | | 12.40 | 7.00 | 4.50 | 3.10 | 1.80 |
| 1200 | | | | | | | | | | 13.60 | 7.60 | 4.90 | 3.40 | 1.90 |
| 1400 | | | | | | | | | | | 9.00 | 5.70 | 4.00 | 2.20 |
| 1600 | | | | | | | | | | | 10.20 | 6.60 | 4.50 | 2.60 |
| 1800 | | | | | | | | | | | 11.40 | 7.20 | 5.10 | 2.90 |
| 2000 | | | | | | | | | | | 13.00 | 8.20 | 5.70 | 3.20 |
| 2500 | | | | | | | | | | | | 10.10 | 7.10 | 4.00 |
| 3000 | | | | | | | | | | | | 12.00 | 8.50 | 4.80 |
| 3500 | | | | | | | | | | | | | 9.80 | 5.60 |

### Where to begin . . .

Always start at the beginning and flush to the dead ends. The beginning of the system might include pump stations, master meters, wells, or storage tanks. The required velocity to remove sediment and debris a minimum flow velocity of 2.5 fps (feet per second). To scour pipes to remove chemical and biological buildup, a minimum velocity of 5.0 fps is required.

Public water systems are required to always maintain a minimum of 20 psi operating pressure. Test the chlorine residual to make certain that the residual has returned to the proper guidelines. A good time to flush is while when doing a free chlorine burnout. Flushing then will help move the free chlorine throughout the system more thoroughly and the system might be able to return to total chlorine more quickly.

A city or RWD might want to budget for flushing. The extra time and water will need to be accounted for. Try to keep accurate records of how much water was used in the process. Flushed water should not be tabulated as unaccounted-for water. The city that I worked for involved the fire department. The fire department kept records for the city's Insurance Service Organization (ISO) ratings. The flow was measured with a pitot gauge and then recorded by the fire department personnel.

If KRWA can be of any help feel free to contact me at bret@krwa.net or call me at 785-258-0642. KRWA is pleased to be of help to any system interested in developing a flushing program or to help with any other water or wastewater utility operation and maintenance issue.

*Bret Beye joined the KRWA staff in March 2017. He previously worked for 30 years at the city of Herington where he was Water Distribution and Sewer Collection Foreman. A Class III water operator and certified as a backflow device technician, Bret also served on the USD 487 Board of Education from 2003 to April 2017 where he was board president and vice-president.*