Welcome!

Steve Notch
Town of Gilbert
Distribution System Operations and the Impacts on Water Quality

Water Quality

Flushing Program

Developed by AWWA in partnership with RCAP and funded by USEPA, Published 2015
Learning Objectives

• Be able to describe the importance of flushing
• Prepare a simple checklist for flushing a hydrant
• Identify the components in developing a flushing program
Flushing

• Generally established as a corrective measure

• Can be implemented as a proactive method to maintain high quality water

• Flushing is considered a Best Management Practice (AWWA)
Why flush?

• Respond to customer complaints
• Expel contaminants from backflow episode
• Remove sediment and loose deposits
• Scouring
• Decreasing water age in dead end mains
• Restore chlorine residuals
• Prevent or respond to nitrification
Question: Flushing Programs

• How many people have an active flushing program?

• What are your triggers for flushing?
Flushing- A Four Step Program

- Step 1 – Determining the appropriateness of flushing as part of a utility maintenance program
- Step 2 – Planning and managing a flushing program
- Step 3 – Implementing a flushing program and data collection
- Step 4 – Evaluating and revising a flushing program

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Flush – Step 1

Questions to determine the appropriateness of a flushing program

– Do you utilize unfiltered surface water?
– Do you utilize an undisinfected groundwater supply?
– Do you utilize a source of supply with elevated iron and/or manganese?
– Do you experience positive coliform or elevated levels of HPCs?
– Do you use chloramination?
– Have you implemented a treatment change that could affect water quality?

>>>>>> there’s more>>>>>>
Flushing – Step 1 (continued)

– Do you experience frequent customer complaints?
– Do you have difficulty maintaining a disinfectant residual in parts of the distribution system?
– Does your system lack an aggressive valve/hydrant/tank exercise program?
– Is the water entering the distribution system considered to be corrosive?
– Does sediment accumulate in your storage facilities?

• If you answered “yes” to any of the questions, then a flushing program will provide water quality improvements
• If you did not answer yes to any of the questions, other maintenance procedures may be more advantageous for your system
Flushung – Step 2

• Determine flushing plan objectives
  – Planning is critical for obtaining water quality objectives and minimizing costs
  – Need to consider both WQ considerations and hydraulic/maintenance considerations

• Determine flushing approach
  – Unidirectional
  – Conventional
  – Continuous blow-off
Conventional Flushing

• Most commonly used technique
• Implemented with minimal pre-design
• Consists of opening hydrants in the DS until specific criteria are met
  – Disinfectant residual
  – Reduction of color
  – Turbidity reduction
• **Consider hydrant location** to assure you don’t pull poor quality water into otherwise good quality areas… especially if flushing for nitrification remediation.
• Since isolation valves are not used, *flushing velocities are not maximized*
Conventional Flushing (Reactive)

• Primary water quality improvements
  – Restoration of disinfectant residual
  – Expulsion of some of the poor water quality in specified areas of DS

• Conventional flushing drawbacks
  – Customer complaints during and immediately after flushing events
  – Wasted water
  – Minimal improvements to overall water quality
  – Short lived WQ benefits
  – Potential for increased Coliform occurrences
  – Disposal of chlorinated water into watercourse
Unidirectional Flushing

• Performed by isolated sections of the DS
• Can be implemented system wide or on a “where-needed” basis
• Velocity dependent
  • \( > 3 \text{ ft/sec} \) - remove silt, sediment, and reduce disinfectant demand
  • \( > 5 \text{ ft/sec} \) – promote scouring, remove biofilm, loosen deposits and reduce disinfectant demand
  • \( \sim 12 \text{ ft/sec} \) - remove sand from inverted siphons

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## Pipe Size, Flow and Velocity

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<th>Pipe size</th>
<th>velocity fps</th>
<th>Flow gpm</th>
<th>Hydrants at 400 gpm</th>
<th>@1000 gpm</th>
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</table>

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Unidirectional Flushing (Proactive)

- Operate valves
  - Allows for simultaneous implementation of preventative maintenance procedures of valves and hydrants
- Uses less water than conventional flushing
- Provides performance baseline for comparison with future events
- Reduces trouble-shooting efforts
Unidirectional Flushing

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Unidirectional Flushing

Diagram showing the relationship between WTP, PRVs, and Storage Tanks.
Unidirectional Flushing
Unidirectional Flushing
Unidirectional Flushing

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Unidirectional Flushing
Unidirectional Flushing

[Diagram showing the flow of water from WTP to Storage Tanks]
Unidirectional Flushing
Unidirectional Flushing Guidelines

• Notify customers ahead of time
  – Pay special attention high need customers (hospitals, dialysis patients, restaurants, etc.)
• When possible perform late at night to avoid service disruptions
• Use diffusers and hoses to avoid property damage
• Water should originate from areas that have already been flushed
  – Start from the source and work outward

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Unidirectional Flushing Guidelines

• A larger main should not be flushed from a smaller main due to flow and velocity restrictions
• Keep pipe lengths as short as possible to maximize velocity- use valve where appropriate
• If gate valves are used for isolation- they should be reopened prior to closing the hydrant.
  – This will remove slugs of water that are trapped behind the valve
• Maintain pressure above 20 psi
Unidirectional Flushing Optimization

• The keys to optimizing flushing programs
  – Plan ahead using as much information as is available
  – Collect and analyze data during flushing and use it to improve the plan during the next flushing event
Continuous Blow-Off

- Used in parts of distribution system that have known stagnation or circulation issues
- Typically velocities are $\leq 1$ ft/sec
- Can help restore or maintain disinfection residuals and reduce water age
- Can result in significant water loss
- Does not address source of water quality issues
Continuous Blow-Offs
Step 3 – Implementing a Flushing Program and Data Collection

- Identify loops - Flushing should be conducted from the source to the periphery of the DS and from larger pipes to smaller. A loop should be able to be flushed during one work shift.
- Determine flushing velocities - For thorough scouring, pipe velocities should be targeted @ 6 ft/sec
- Develop step-by-step procedures - Include detailed instruction for sequencing of valve and hydrant opening and closing
Step 3 – Implementing a Flushing Program and Data Collection

• Complete a trial run
  – Verify the crew is prepared and can respond to unforeseen challenges

• Conduct flushing program
  – Ideally program is conducted during off-peak hours to minimize service disruptions
  – Have safety protocol in place

• Data collection
  – Baseline
  – During flushing
  – Post flushing
Step 4 – Evaluating and Revising Program

Ask the following questions after flushing is complete

- Were water quality objectives met?
- What are the estimated costs/savings of the program?
- Were there any positive secondary impacts of the program?
- Were there any negative secondary impacts of the flushing program?
Flush through a Hydrant

- Discharge water directly to sewer when possible
- When is dechlorination appropriate?
How long to flush?

• Depends on the objective of flushing
• Sample water frequently until the objective is reached
  – Turbidity reduction
  – Color reduction
  – Chlorine residual increase
• Record the time of flushing to estimate the amount of water used
Hydrant Safety

• Use caution
  – Force of water
  – Objects may be in pipes (rocks, bolts ...)
  – Make sure all attachments are on tight
  – Don’t stand in front of the attachments

• Be wary of traffic concerns

• If diverting to sewer with a hose, watch out for a cross connection

• Water hammer

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Public Notification

• Notify the public for any flushing event
• Coordinate with Fire Department … two birds with one flush!
  – Flushing is seen by some as a waste of water
  – Important to let the public know why flushing is conducted
    • Improve water quality
    • Part of distribution system maintenance
    • Decrease reliance on chemical treatment and chemical use within the distribution system
    • Improve system hydraulics
    • Etc.
Flushing Alternative
Resources

- AWWA Video – Unidirectional Flushing
- AWWA Water Distribution Operator Training Handbook
- AWWA Water Distribution Systems Handbook
  - [http://www.waterrf.org/Pages/Projects.aspx?PID=357](http://www.waterrf.org/Pages/Projects.aspx?PID=357)
Questions?