American Water Works Association

Dedicated to the World's Most Important Resource™

RCAP

Flushing Program

Workshop developed by RCAP/AWWA and funded by the USEPA

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

Flushing – 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?

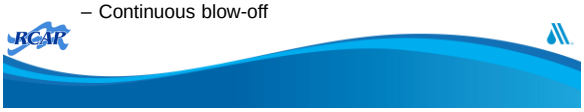
Flushing – Step 1 *(continued)*

- 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

Flushing – 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 ft/sec - remove silt, sediment, and reduce disinfectant demand
  - ≥ 5 ft/sec – promote scouring, remove biofilm, loosen deposits and reduce disinfectant demand
  - ~ 12 ft/sec- remove sand from inverted siphons

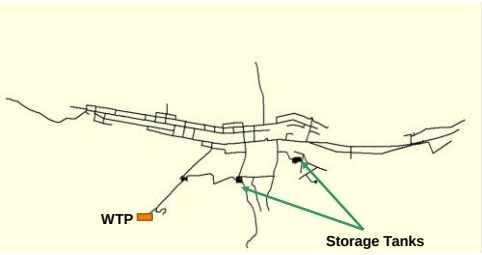
Pipe Size, Flow and Velocity

Pipe size	velocity fps	Flow gpm	Hydrants at 400 gpm	@1000 gpm
4	6	250	1	
6	6	550	1	
8	6	950	2	
12	6	2100	5	2
24	6	8300		8
36	6	20000		20

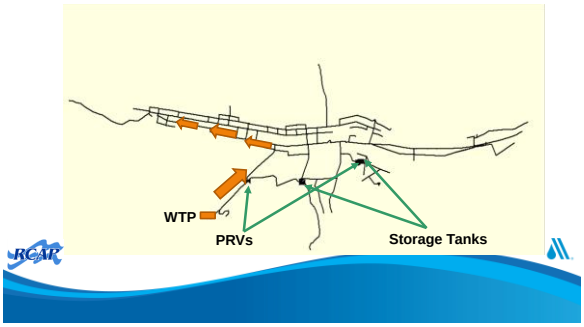
Unidirectional Flushing (Proactive)

- 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



Unidirectional Flushing



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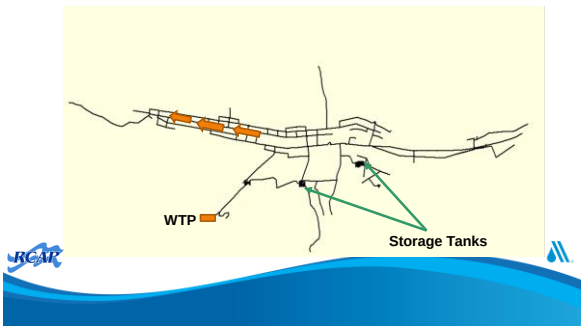

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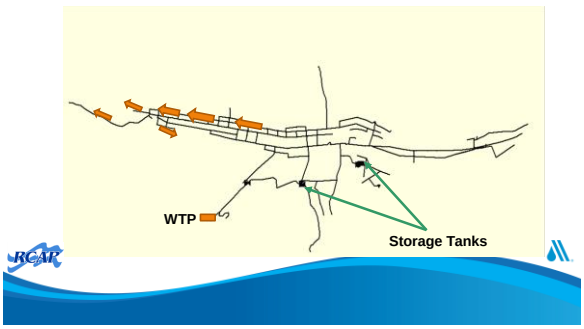

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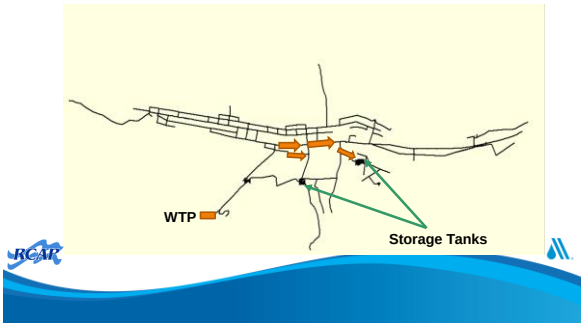

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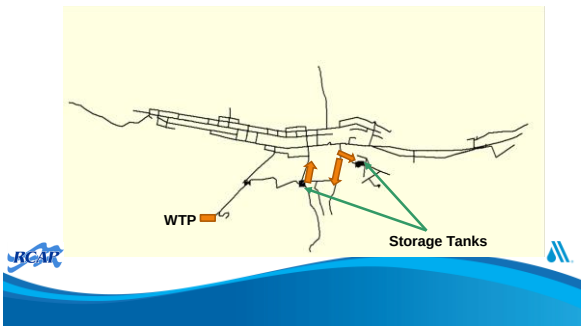

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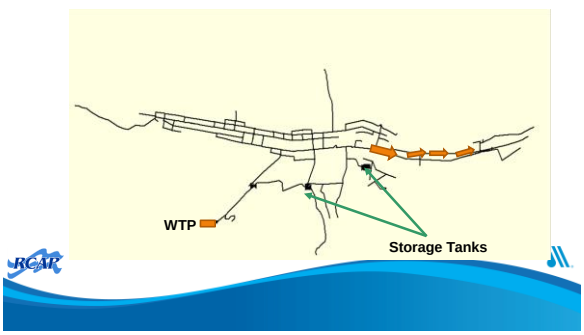

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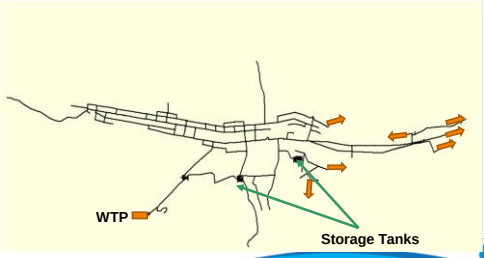


Unidirectional Flushing Guidelines

- 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

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

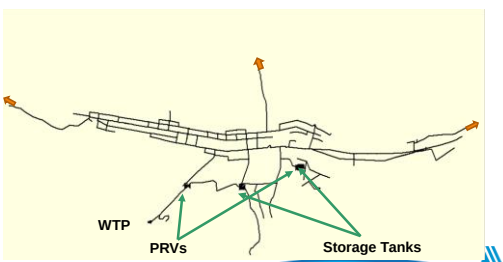
Unidirectional Flushing Optimization

- 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?

How to Flush a Hydrant – Opening and Closing

- Open and close hydrants (and valves) ***SLOWLY*** to prevent surges
  - For a velocity change of 1 ft/sec, a 50 to 60 psi pressure rise can be expected
- Open hydrant valves completely to prevent water from discharging through the barrel drain
  - This could undermine the hydrant support
  - This will also impact WQ if sampling from a partially open hydrant

How to Flush a Hydrant – Opening and Closing

- Restrain flow dissipaters to limit damage to property
- Discharge water directly to sewer when possible to prevent flooding
  - If not possible redirect traffic and use signage as necessary
- 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

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.

Resources

- AWWA Video – Unidirectional Flushing
  - http://www.awwa.org/store/productdetail.aspx?productid=7076
- AWWA Water Distribution Operator Training Handbook
  - http://www.awwa.org/store/productdetail.aspx?productid=36142344
- AWWA Water Distribution Systems Handbook
  - http://www.awwa.org/store/productdetail.aspx?productid=6435
- WRF Report: Guidance Manual for Maintaining Distribution System Water Quality
  - http://www.waterrf.org/Pages/Projects.aspx?PID=357

Questions?