Key Distribution System Infrastructure and the Impacts on Water Quality

Module 5
Learning Objectives

• Be able to describe components of the DS, and how they can impact water quality

• Be able to describe potential areas of water quality concern in your system, and consider ways to improve these
Components we will discuss

- Distribution piping systems
- Valves
- Cross connections
- Storage tanks
- Hydrants
Pipe systems

• Different aspects of pipe networks can have impacts on water quality
  – Dead ends
  – Cross connections
  – Main breaks
Pipe systems - dead ends

• Effect on water quality
  – Extended water age
    • Decay of chlorine residual
    • Increased DBPs
    • Increased microorganisms

If there is a failure – some customers will not have water service
- As such, try to prevent a failure event as best you can!
Solutions to dead ends

• Pipe loops
• Flushing valves
• Flushing program
Dead end solutions - pipe loops

• Pipe loops make the distribution system more robust
• Allow more than 1 way for water to get to different points of distribution system
• Effect on water quality
  – Decrease water age
  – Help maintain disinfectant residual
  – Potentially reduce DBP and microbiological concentrations
Dead end solutions – flushing

- Flushing valves
- Flushing programs
Activity

• Has anyone addressed a dead end in your system?

• What did you do?
Valves

• Most commonly operated and widely dispersed components of distribution systems

• Types of valves
  – Flushing
  – Pressure regulating
  – Flow control
  – Isolation
  – Backflow prevention
  – Air release
  – Buried-under-the-pavement valves
Valves - Uses

• Isolate parts of the distribution system in case of leaks, maintenance, or water quality emergencies
• Control flow and/or pressure
• Release air that can accumulate in high points of the distribution system
Valves - Effect on Water Quality

• Closed valves create dead ends in the distribution system
  – Stagnation
  – Increased water age
  – Biofilm development
  – Sediment built up

• If opened or closed rapidly, water hammer can develop
Valves - Solutions

What can be done to limit water quality impacts?
- Survey valves to be sure they are open
- Exercise valves
- Open and close valves slowly
Cross Connections

• Any point in a water distribution system where chemical, biological, or other contaminants may come into contact with potable water

• These contaminants can be drawn or pushed back into the water distribution system during a backflow event
What is the Cross Connection?
Storage Tanks

Purpose
• Improve system hydraulics
• Peak flow/fire flow
• Balance treatment needs
Factors that Impact Water Quality in Storage

- Stratification vs mixing
- Inlet/outlet configuration
- External contamination
- Increased water age
- Loss of chlorine residual
- Formation of DBPs
- Microscopic critters in the water
- BIG critters in the water
What can be done to maintain or improve water quality in storage?

- Reduce water age
- Booster chlorination
- Inspection and maintenance
Some common storage tank problems

- Finished water storage not properly covered
- Cracks in the walls or storage cover
- Accesses and vents not protected with proper screen or other approved devices
- Storage facility not structurally sound
- Lack of normal maintenance and inspection schedule for storage tanks
Loss of integrity of storage facilities

Knot hole in a spring box

Hole in storage tank wall

Courtesy Robert Clement, USEPA
At least 3 bloated mice

At least 7 snakes

Inside the spring box with a knot hole

Courtesy Robert Clement, USEPA
Hydrants

• Fire protection
• Flushing
  – To improve water quality
• Caution – water hammer
Hydrant Impacts on Water Quality

• Flushing, scouring and cleaning (planned/unplanned)
• Cross connection potential
• Poor sampling points
  – Water can be trapped in the barrel of the hydrant when closed, resulting in unrepresentative samples
EPANet Demonstration

Identify vulnerable aspects of the distribution system, dead ends, pipe loops, storage etc.

http://www.epa.gov/nrmrl/wswrd/dw/epanet.html
Activity: Where would you expect to find water with the greatest age?
Where would you expect to find water with the greatest age?
Questions?