US Territories Water Operator Training Series

Session 22: Distribution O&M: Cross-Connection Control

10/15/2026



This program is made possible under a cooperative agreement with US EPA.

Your trainers for today

SOUTHWEST ENVIRONMENTAL FINANCE CENTER



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Program Director



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Support Specialist



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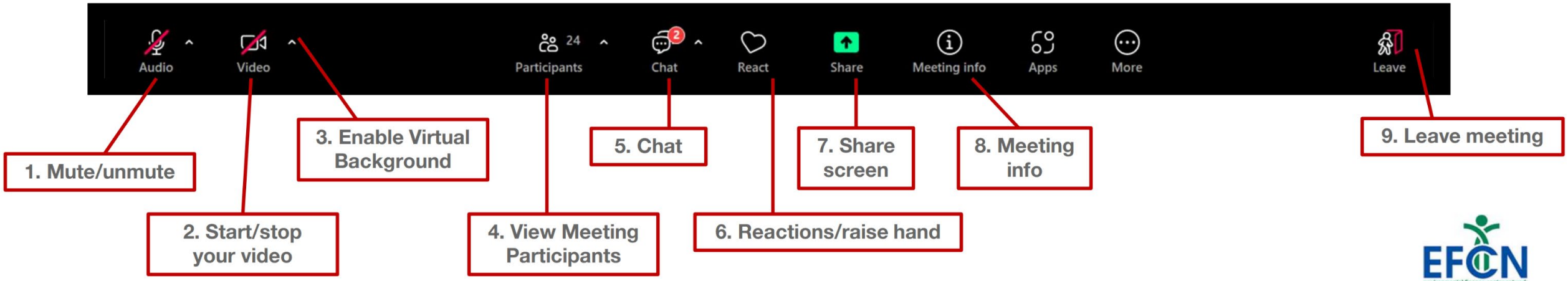
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This training series is funded by the US EPA

Attendee Meeting Controls

- Locate your control bar
- All attendees will see a black horizontal bar on their screen
- If your control bar is not visible, it may be hidden
  - Move your cursor to the screen's bottom (or top) to reveal this control bar.



Schedule for 2026:

Date	Topic
1/22/26	Alternative Treatment Processes (e.g. flouridation, ion exhange, RO…)
2/5/26	Drinking Water Treatment Math & Concept Review
2/19/26	Safety Program Basics (including personal safety, equipment safety, facility safety)
3/5/26	Lead & Copper Rule, Corrosion Control
3/19/26	Distribution Systems 1: Hydraulics, Pipe Types, Selection, Installation, and Water Quality
4/2/26	Distribution Systems 2: Valves, Hydrants, Meters, and Service Connections
9/17/26	Distribution Systems 3: Storage and Booster Pumping
10/1/26	O&M: Pumps, Main, and Appurtenance Maintenance (including pressure monitoring, valve exercising, and flushing)
10/15/26	O&M: Cross Connection Control
10/29/26	O&M: Distribution System Math and Concept Review
11/19/26	Sampling & Lab Procedures/Analysis/Interpretation
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This page is a repository of Wastewater and Drinking Water Operator Certification (Op Cert) Training Webinars offered by the SW EFC for systems in the Pacific Territories. Below you will find the **training webinar schedules (wastewater, then drinking water)** followed by a **training webinar recordings library.**

Jump to Wastewater Trainings

Jump to Drinking Water Trainings

Wastewater Training Schedule

Please note all times are local to CNMI and Guam. The times in American Samoa are one day earlier at 11 am.

Session	Date	Training Topic & Link to Recording (click to view)	Supporting Materials (click to download)
1	6/25/2025	Program Overview, Test Format, Study & Test Tips	PPT slides
2	7/9/2025	Treatment Overview	PPT slides
3	7/23/2025	WW Math Part 1 (Areas & Volumes)	PPT slides
4	8/6/2025	WW Math Part 2 (Flow Rates & Detention Times)	PPT slides
5	8/20/2025	Collection Systems – Gravity systems	PPT Slides

Sign in for **every session** to ensure you **get credit** for attending

SOUTHWEST ENVIRONMENTAL FINANCE CENTER

US Territories Water & Wastewater Operator Certification
Virtual Training Series Group Attendance Sheet

Session Title: _____

Session Date: _____

Training Location: _____

Attendee Name	Attendee Signature	Arrival Time	Departure Time

I hereby certify that the individuals listed above attended the referenced training session.

Name: _____

Signature: _____

Title: _____

Date: _____

Please scan this sheet after each training session and email it to swefc@unm.edu with the subject line: "US Territories Op Cert Attendance Sheet"



Cross-Connection Control

U.S. Territories Water Operator Training Series

Cross-Connections

A cross-connection is an actual or potential physical connection between otherwise separate piping systems one of which contains potable water and the other, water of unknown or questionable safety, or steam, gas, or chemicals whereby these may flow between the two systems.

Why do we really care about cross-connections?



Where can we find cross-connections?

Customer Connections

- Irrigation systems
- Hoses in swimming pools, for chemical application, flushing radiators
- Boilers
- Fire protection systems

Water System Controlled

- Treatment
- Pumping Systems
- Distribution

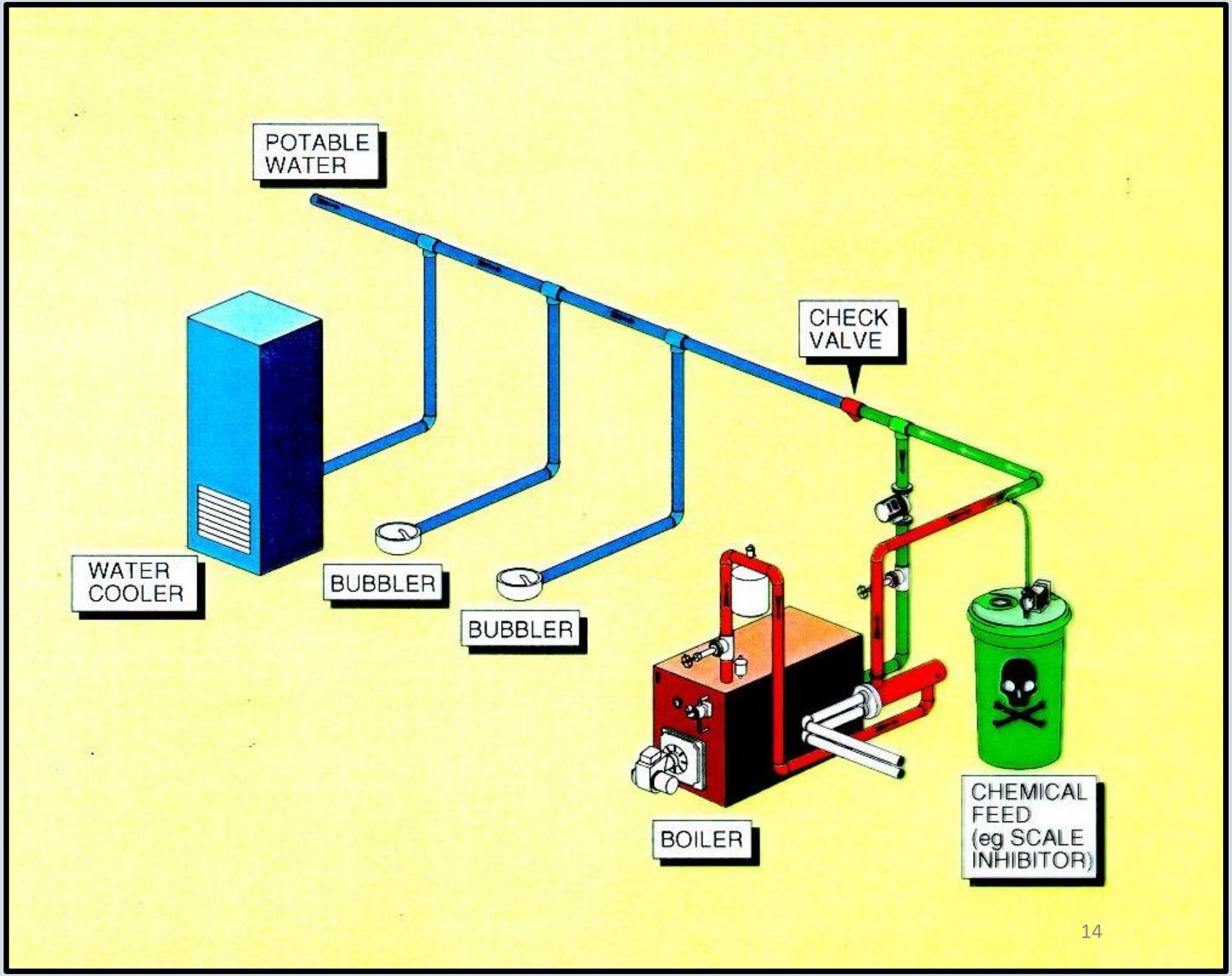
Cross-connections in water systems are a sanitary risk that threaten drinking water quality and public health.



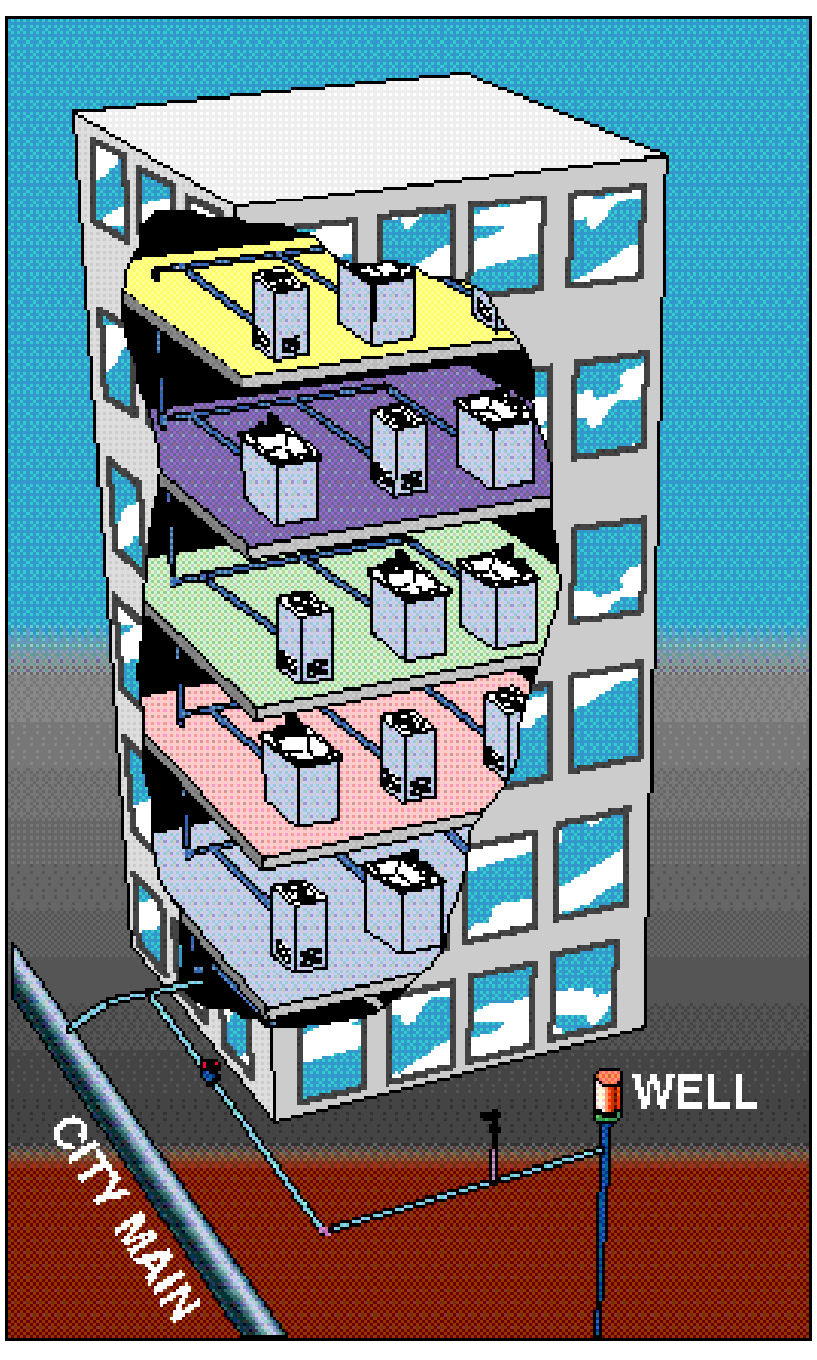
Cross-Connections & Backflow

- Contaminants can enter the potable supply when the pressure in the non-potable system is greater than the pressure in the potable system
- This pressure differential causes 2 types of **BACKFLOW**
  - **Backpressure** – User's supply > than potable system pressure
  - **Backsiphonage** – Vacuum in the potable system from high demand causes non-potable water to be siphoned into the potable system

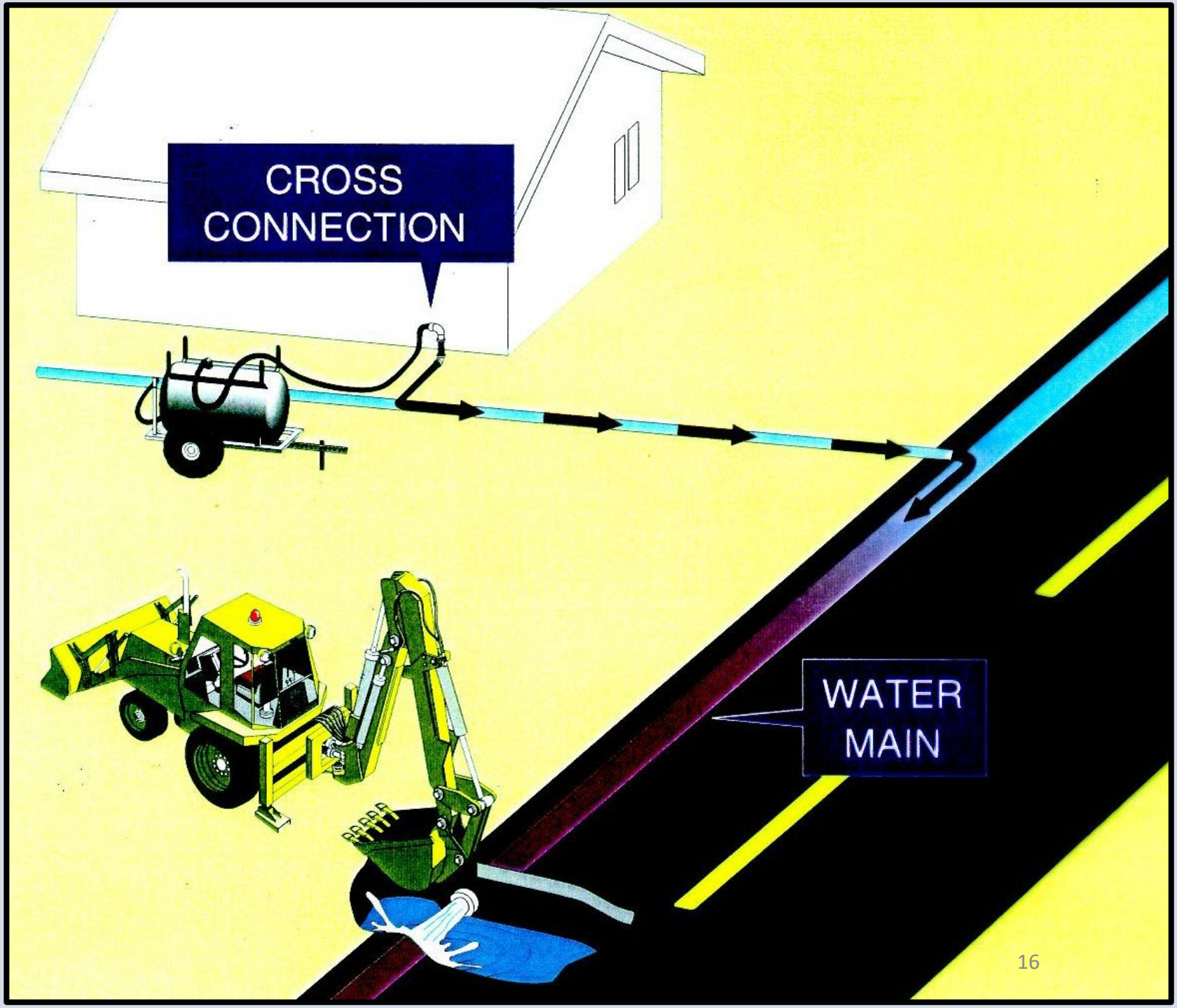
Backflow from Backpressure



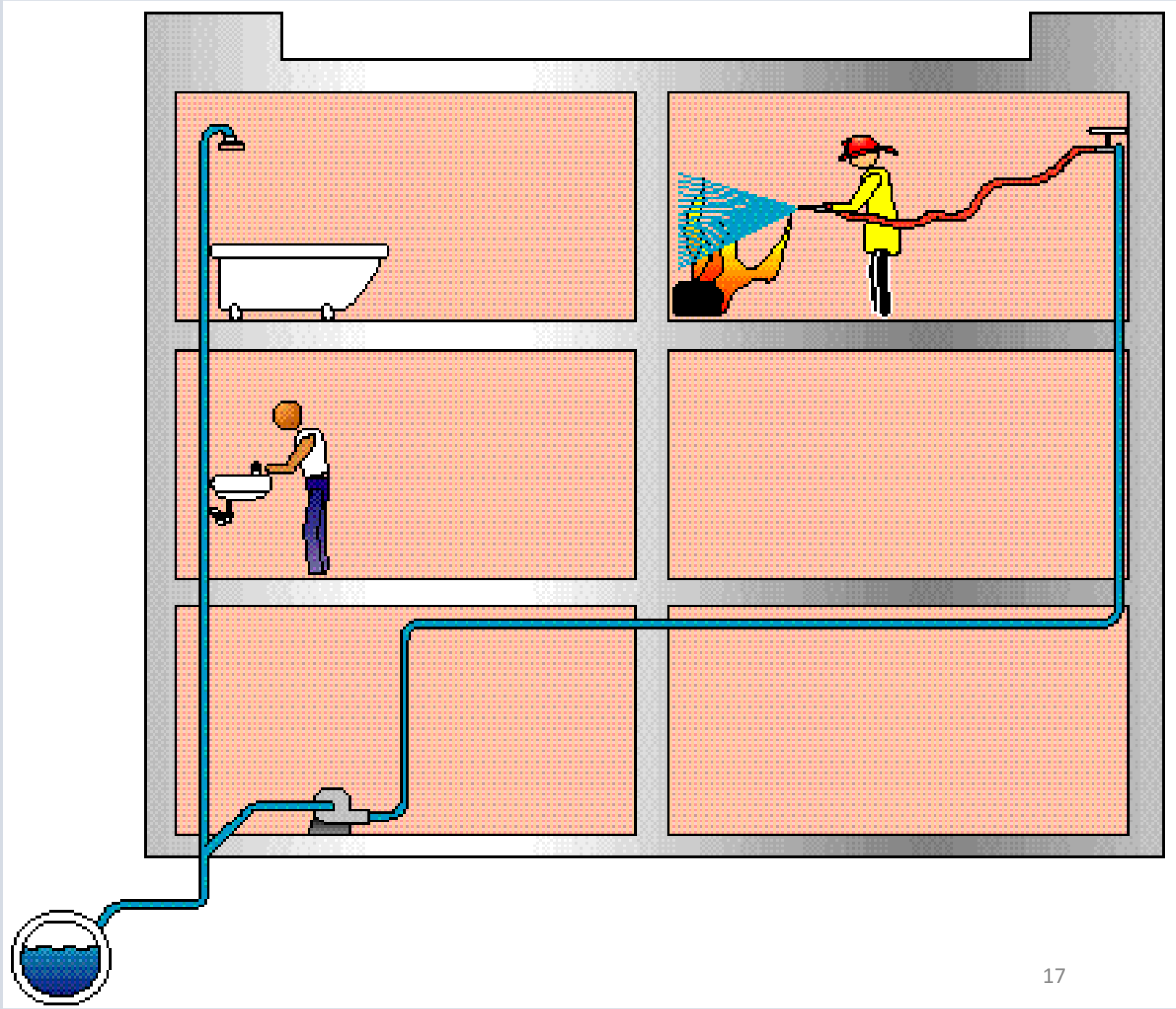
Backflow from Backpressure Hydraulic Head



Backflow from Backsiphonage



Backflow from Backsiphonage

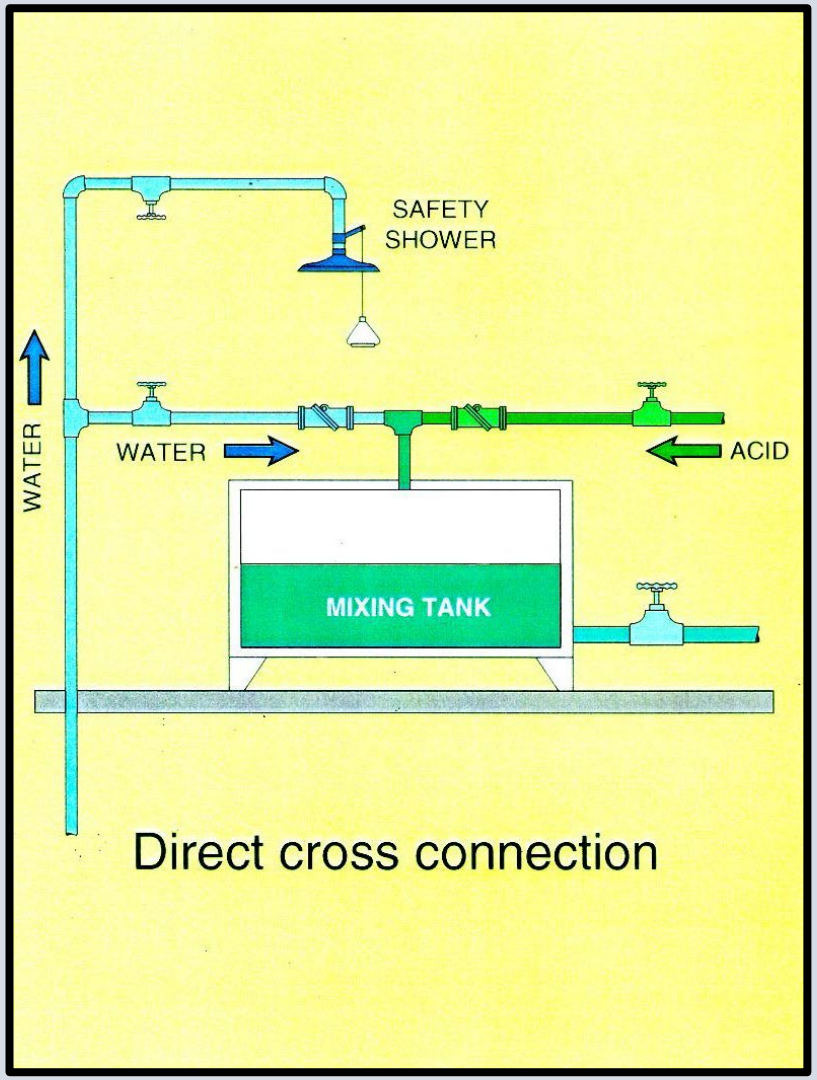


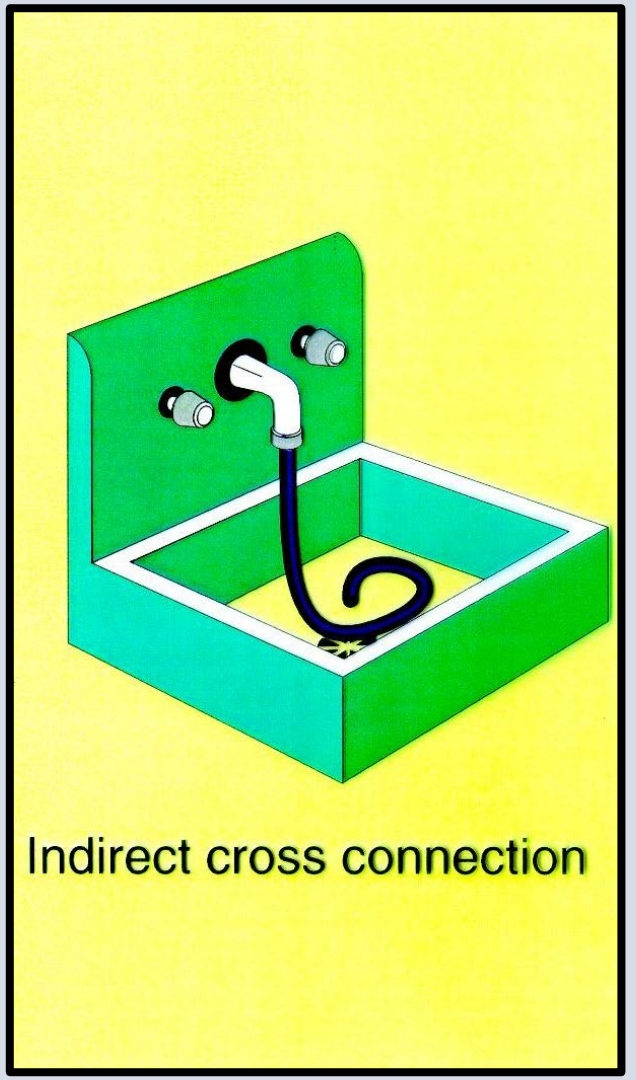
Preventing Backflow

- Sever service connection
- Require air gap
- Install an appropriate cross-connection control device
- Implement a cross-connection control program

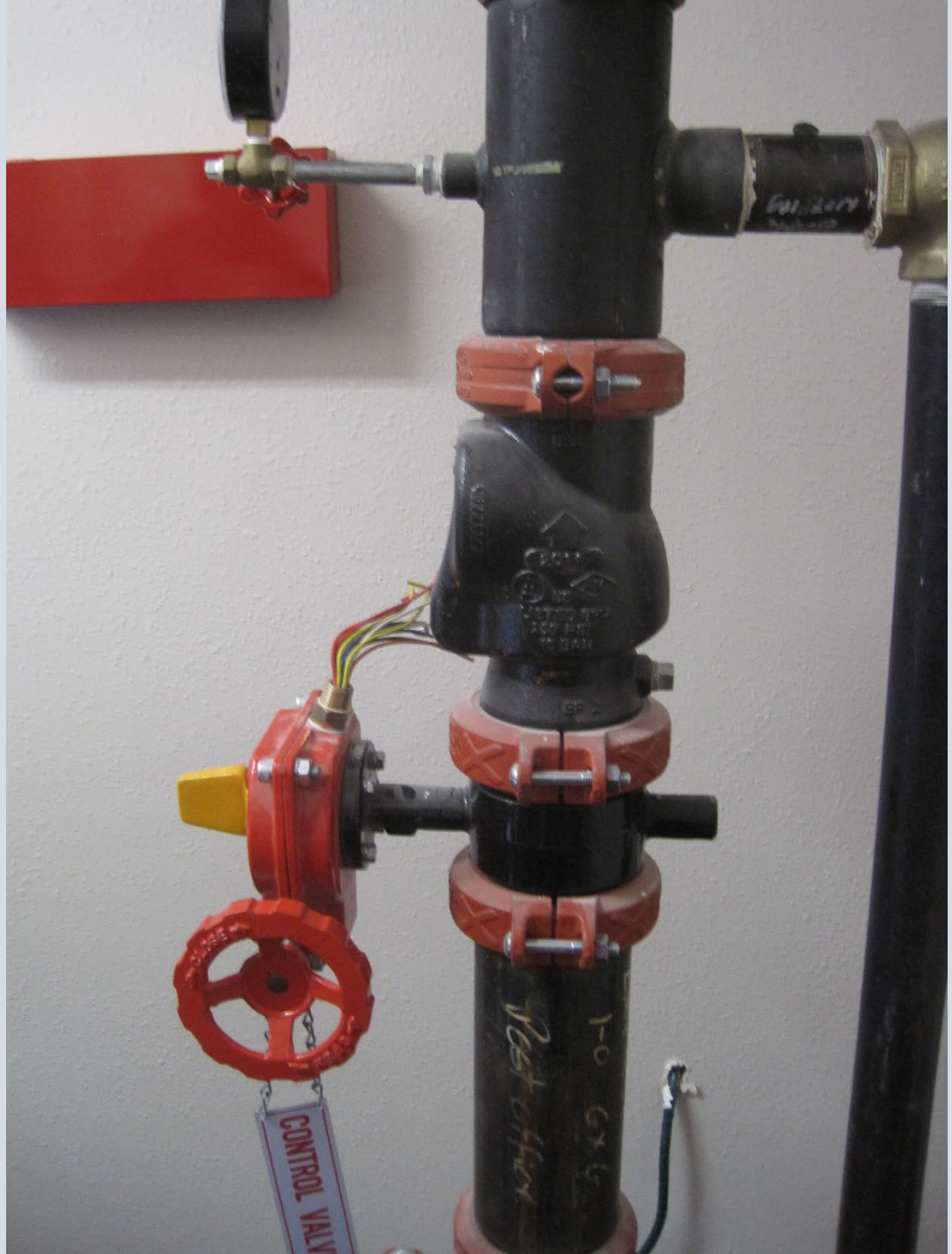


Direct vs. Indirect Cross-Connections

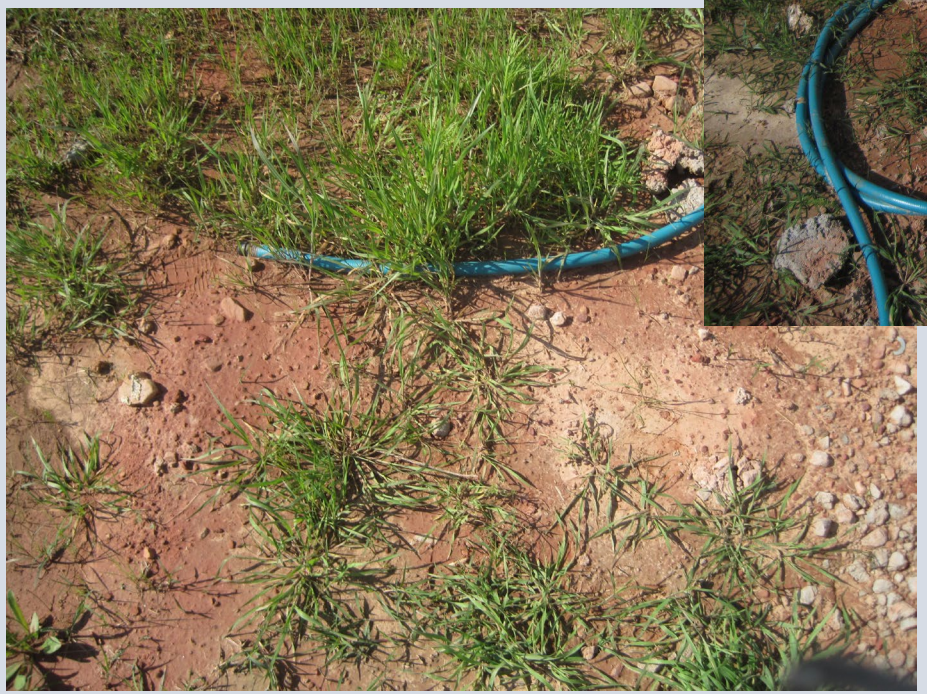




Direct Cross-Connections



Indirect Cross-Connections







Indirect Cross-Connections



Water System Controlled Cross-Connections

Cross connections controlled by the water system that could have a significant impact on water quality if a backflow event should occur.

Water System Controlled Cross-Connections
Water Treatment Plants

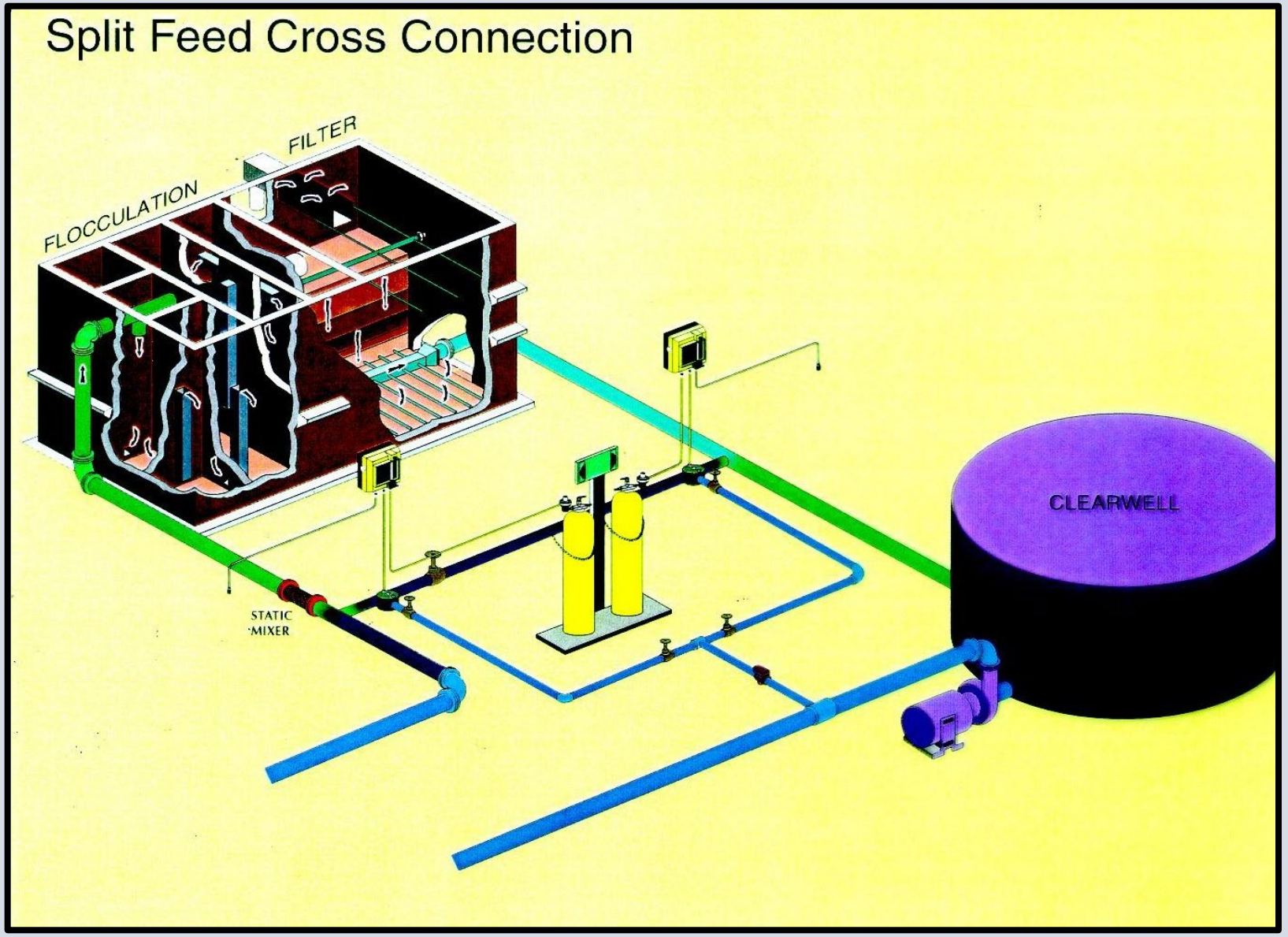
- Submerged inlets or water piped directly to chemical feed tanks
- No antisiphon valves on chemical feeders
- Hose bibbs with no vacuum breaker
- Laboratory aspirators
- Split chemical feeds to raw or partially treated water and finished water. Examples are pre and post chlorination or pre and post caustic addition for pH control

Water System Controlled Cross-Connections
Water Treatment Plants

- Surface wash on filters
- Filter to waste piped directly to a drain
- Drain or sewer traps with direct water injection
- Floor drains that allow water to be returned to the process stream
- Lack of legends and color coding on pipes
- Bypasses around backflow preventers
- Feed water to boilers with chemical injection
- Water loading stations for bulk water sales

Treatment

Water System Controlled Cross-Connections



Treatment

Water System Controlled Cross-Connections



Submerged inlets or water piped directly to chemical feed tanks

Treatment

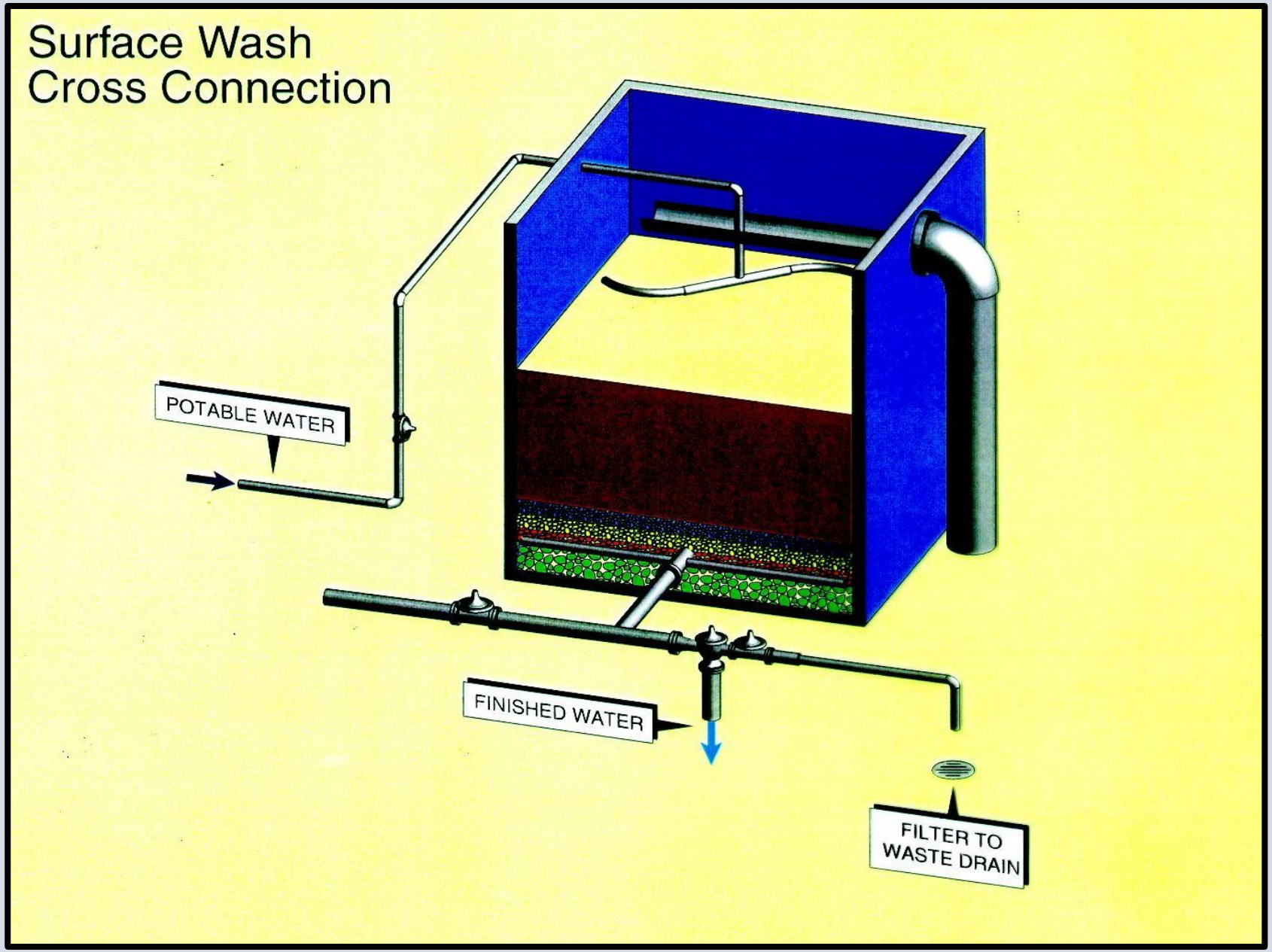
Water System Controlled Cross-Connections



Submerged inlets or water piped directly to chemical feed tanks

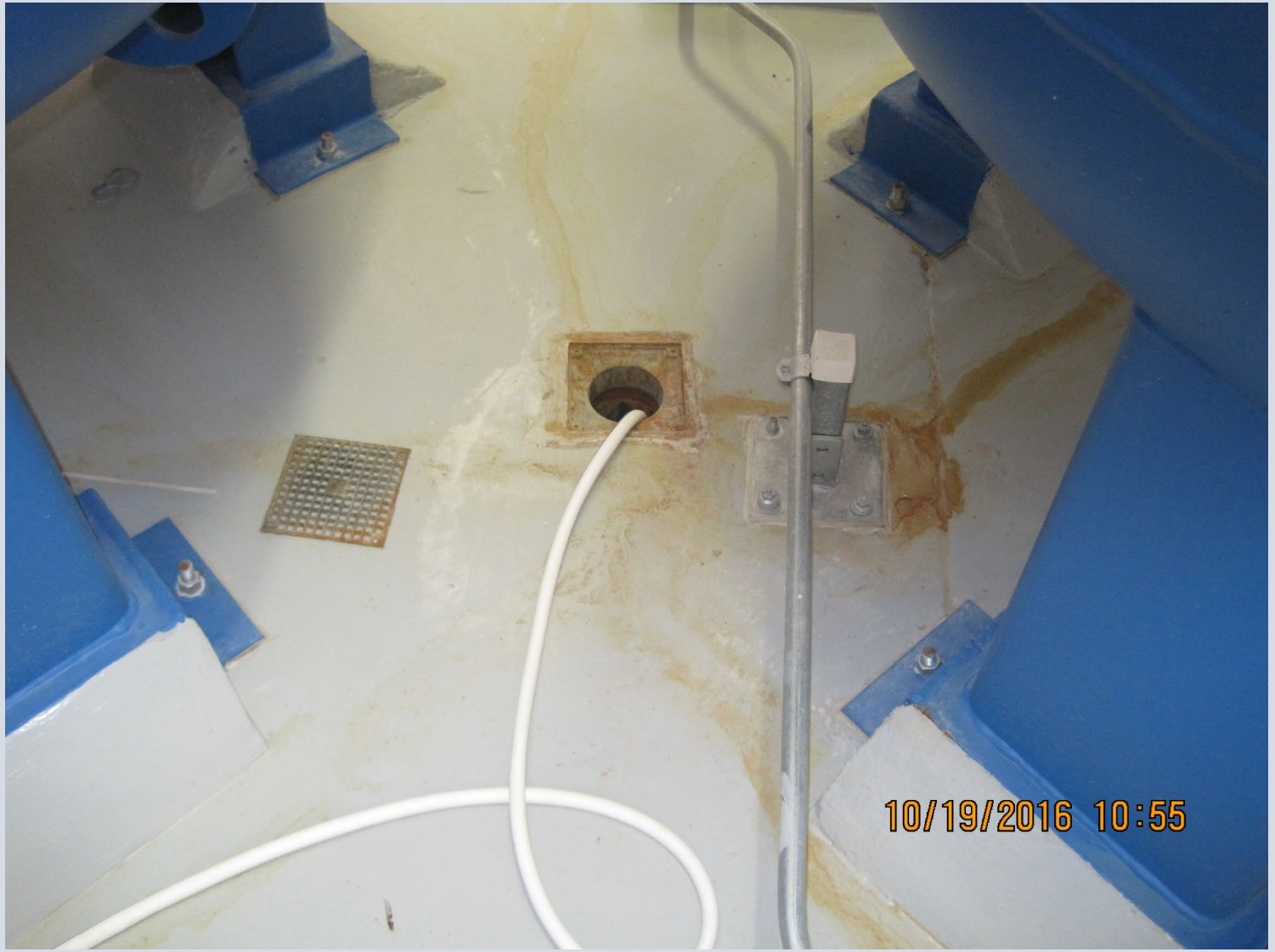
Treatment

Water System Controlled Cross-Connections



Treatment

Water System Controlled Cross-Connections



Treatment Backwash Piped Directly to Drain

Water System Controlled Cross-Connections
Pumping Stations

- Priming of raw water pumps with finished water
- Air relief valves piped directly to a drain
- Cooling water for an emergency generator submerged in a drain or returned to the potable supply

Water System Controlled Cross-Connections

Pumping Stations



Bypasses Around Backflow Preventers

Water System Controlled Cross-Connections

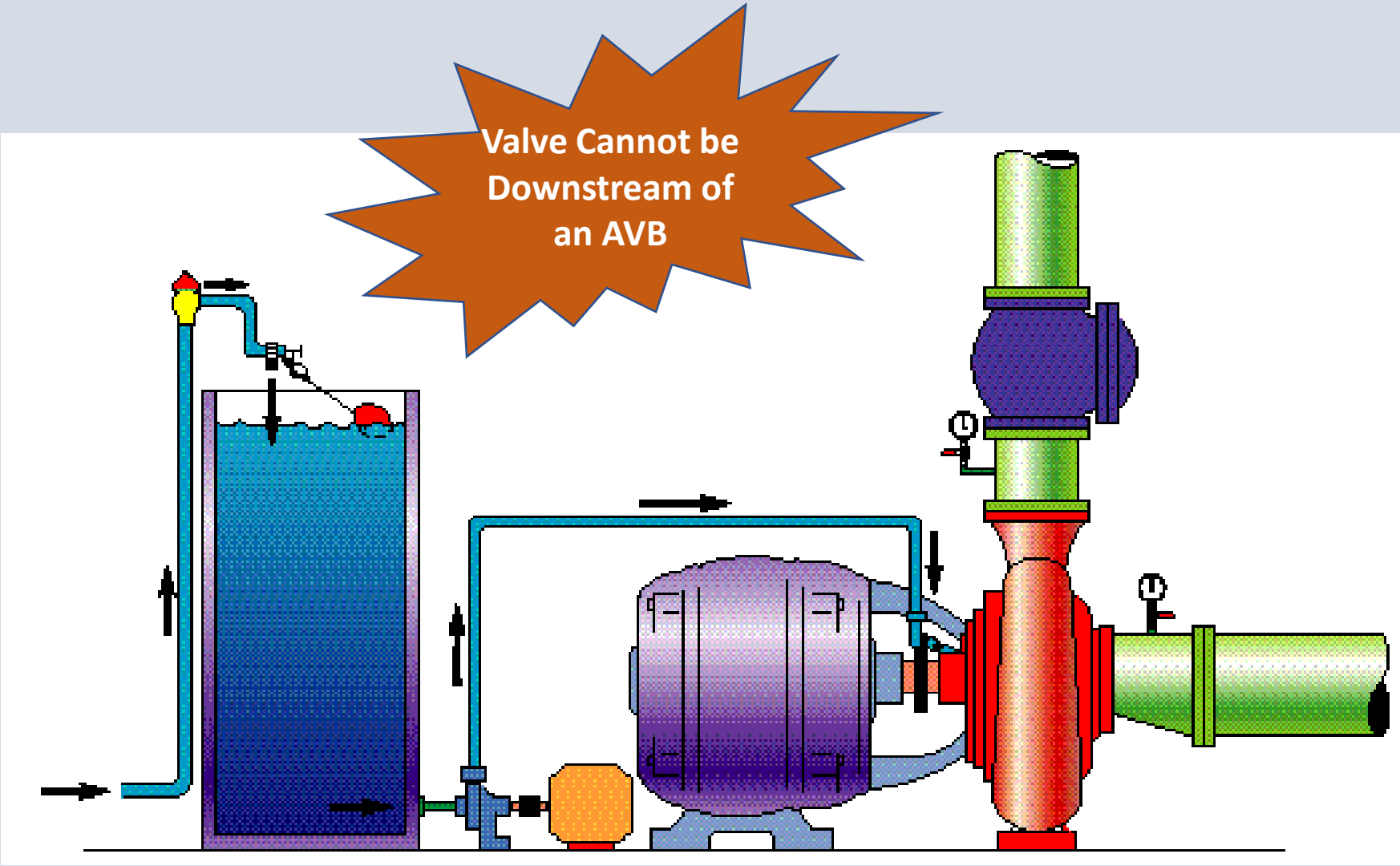
Pumping Stations



Air Relief Valve Piped Directly to a Drain

Water System Controlled Cross-Connections

Pumping Stations



Improper Use of Atmospheric Vacuum Breakers

Water System Controlled Cross-Connections
Distribution Systems

- Submerged inlets in water meter testing equipment
- Uncontrolled use of fire hydrants
- Filling of newly installed mains from fire hydrants for flushing and disinfection
- Air relief valves in pits with the potential of the open end to be submerged
- Relief ports from pressure reducing valves submerged
- Overflows from storage tanks piped directly to storm drains or sewers

Distribution

Water System Controlled Cross-Connections



Water Loading Stations for Bulk Water Sales

Distribution

Water System Controlled Cross-Connections

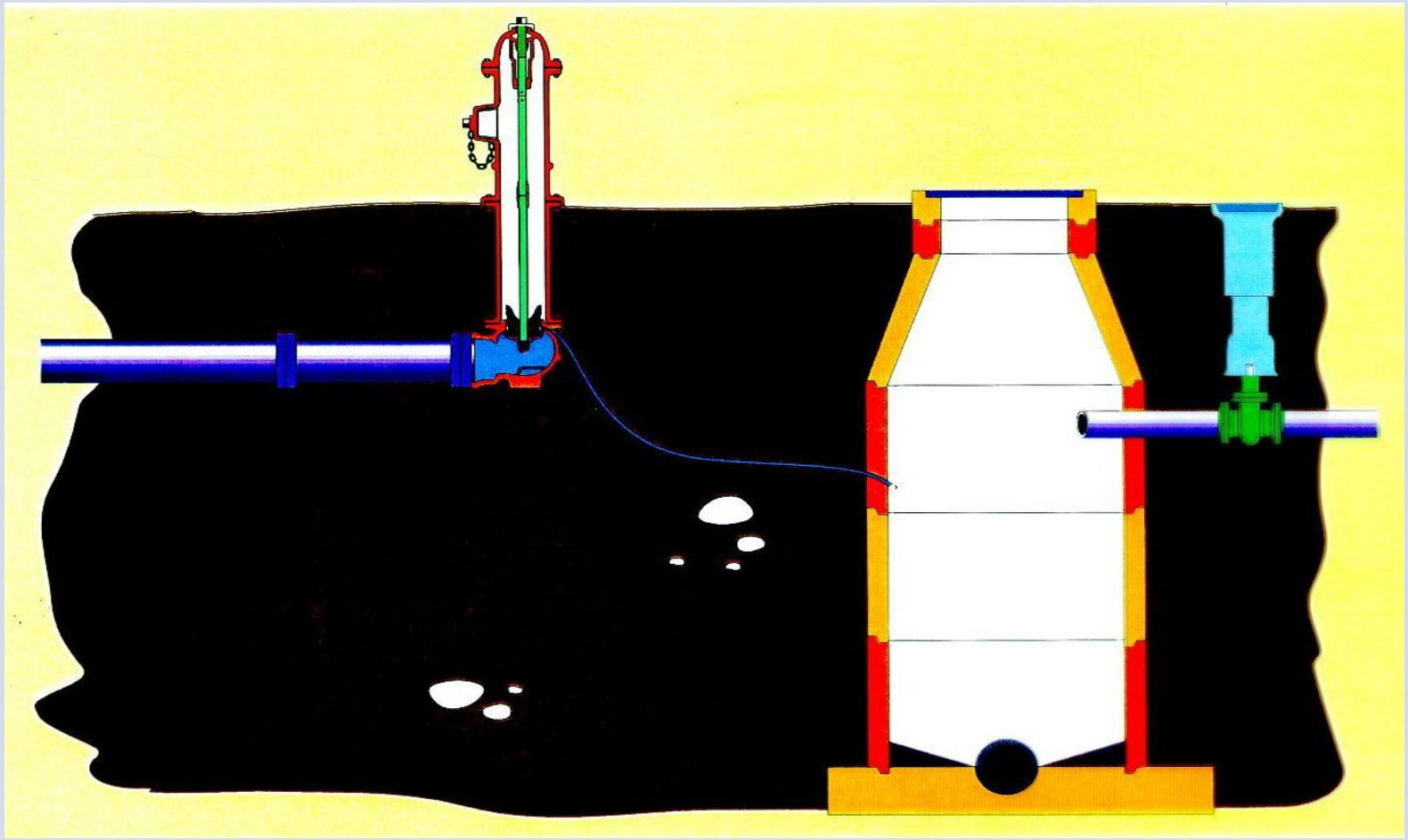


Water Loading Stations for Bulk Water Sales

Distribution

Water System Controlled Cross-Connections

Direct Connections to Sewers for Flushing Either the Water Main or Sewer



Hydrants with Drain Lines to Sewer

Distribution

Water System Controlled Cross-Connections



Overflow from Storage Tank Piped Directly to Storm Drains or Sewers

Distribution

Water System Controlled Cross-Connections



Air Relief Valves In Pits with the Potential of the Open End to be Submerged

Can we prevent all cross-connections?

NO

Cross-connections are required for many reasons and are unavoidable!

So…. What do we do instead?

Cross-Connection Control Program





If we can't prevent, the best we can do is plan, eliminate, control, and enforce.

Cross-Connection Control Program **Responsibilities**

Water Supplier	Water User	Local or State Health Agency
• **Prevent contamination by backflow** • Create and enforce laws, rules, regulations, policies • Deny service to premises with unprotected cross-connections	• **Keep contaminants our of potable water on their side** • Pay for installation, testing, maintenance of approved control devices • Prevent cross-connections when modifying plumbing	• **Issue and enforce laws, rules, regulations, and policies** • Ensure maintenance of cross-connection control programs

Cross Connection-Control Program
Water Supplier Responsibilities

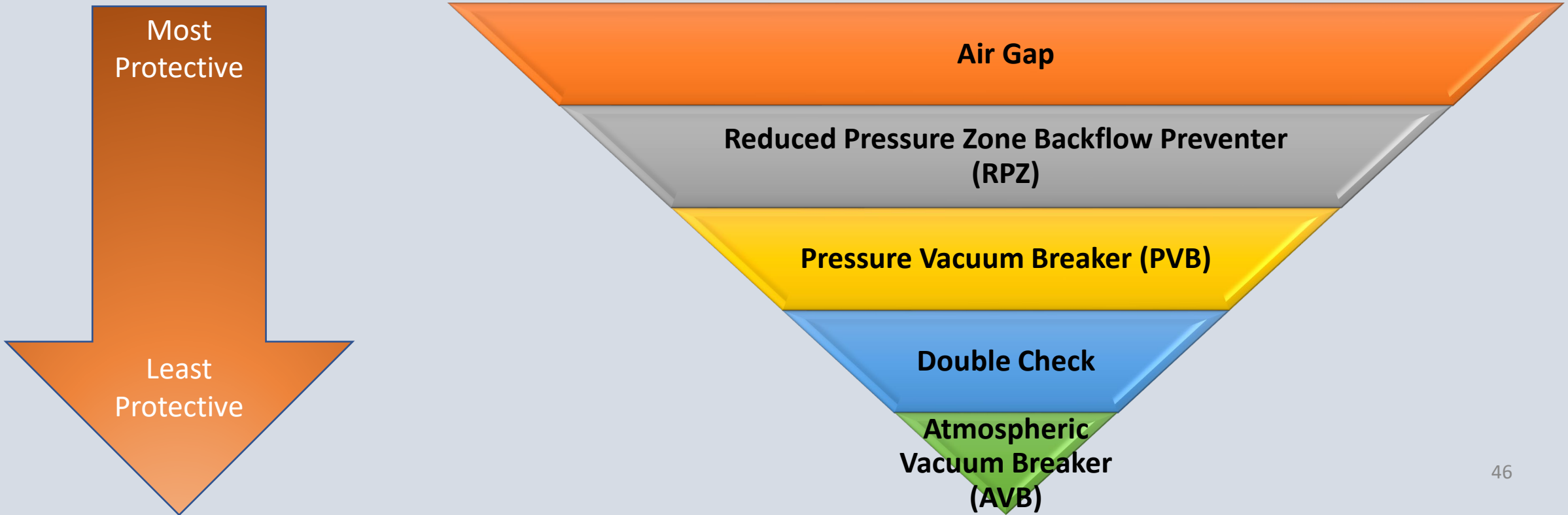
- Enact enforceable ordinance
- Train personnel on causes, hazards, and procedures
- Priority inspection program of facilities with cross-connections
- Review existing and screen new service applications to determine backflow protection requirements
- Develop/obtain list of approved backflow prevention devices and certified testers
- Determine acceptable installation requirements for backflow prevention devices
- Require routine testing of installed backflow prevention devices (when new, repaired, minimum once a year)
- Maintain records of device installation, inspection, and testing
- Notify water users when devices must be tested
- Maintain adequate distribution pressures to protect from unknown cross-connections

Customer Connections with Cross-Connection Potential

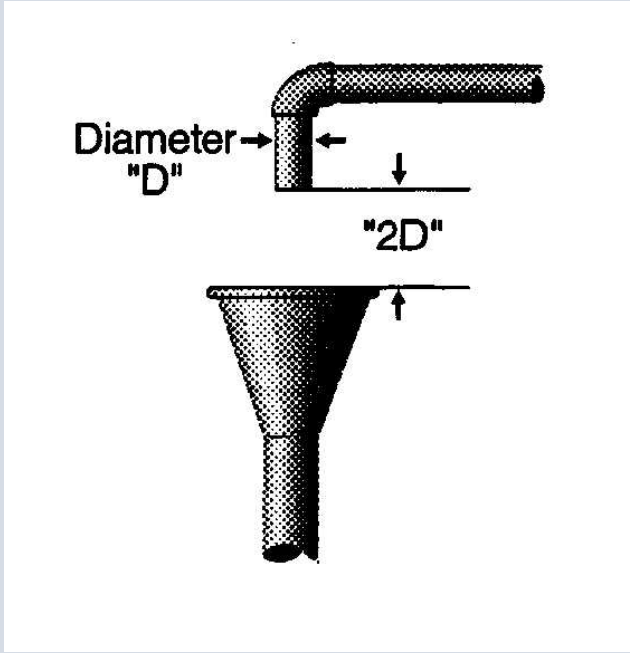
- Auxiliary Water Systems
- Beverage Bottling & Breweries
- Canneries & Packing Houses
- Chemical Plants
- Dairies & Cold Storage Plants
- Film Laboratories
- Hospitals, Medical Facilities, Morgues
- Laundries & Dye Works
- Marine Facilities
- Metal Manufacturing, Cleaning, Processing
- Multistoried Buildings
- Oil & Gas Production, Storage, Transimission
- Paper & Paper Product Plants
- Radioactive Handling Facilities
- Restricted, Classified, or Closed Facilities
- Solar Domestic Hot Water Systems
- Water Hauling Equipment

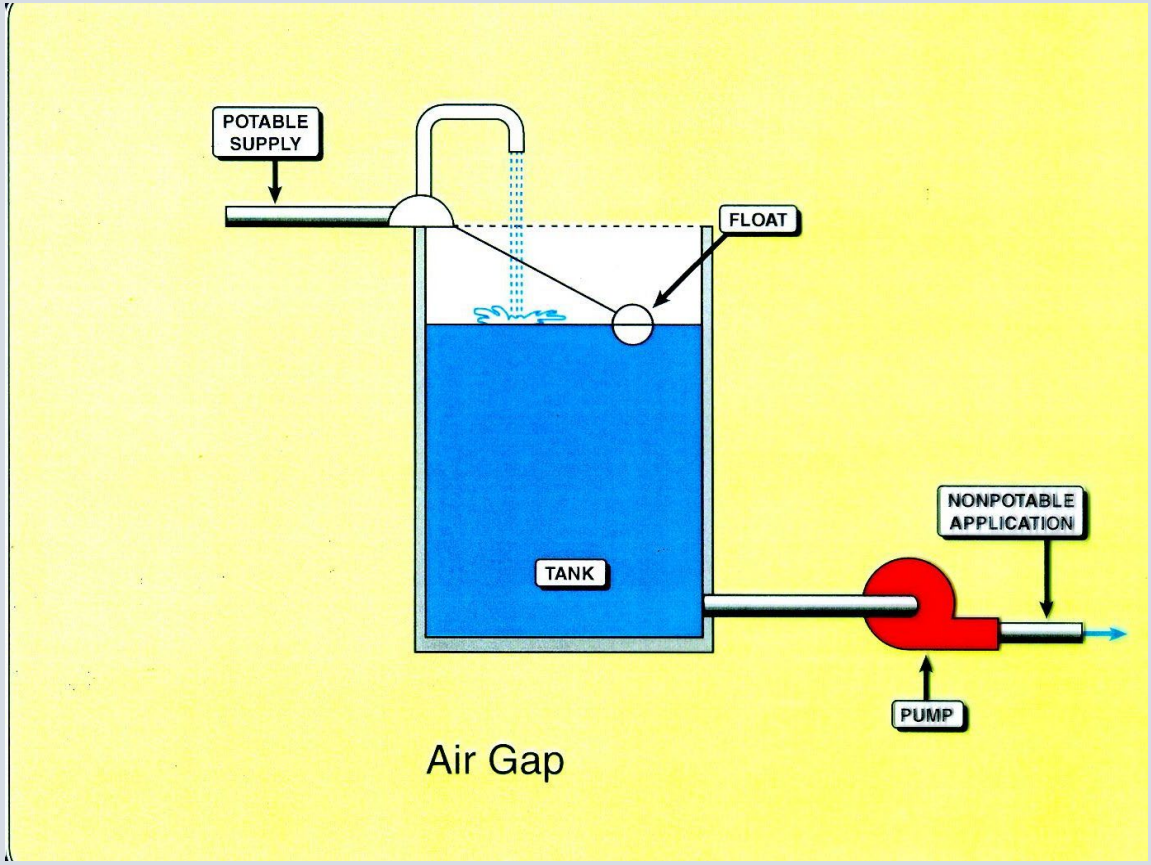
Cross Connection Control Devices

Device used should be based on the potential hazard presented by the cross connection

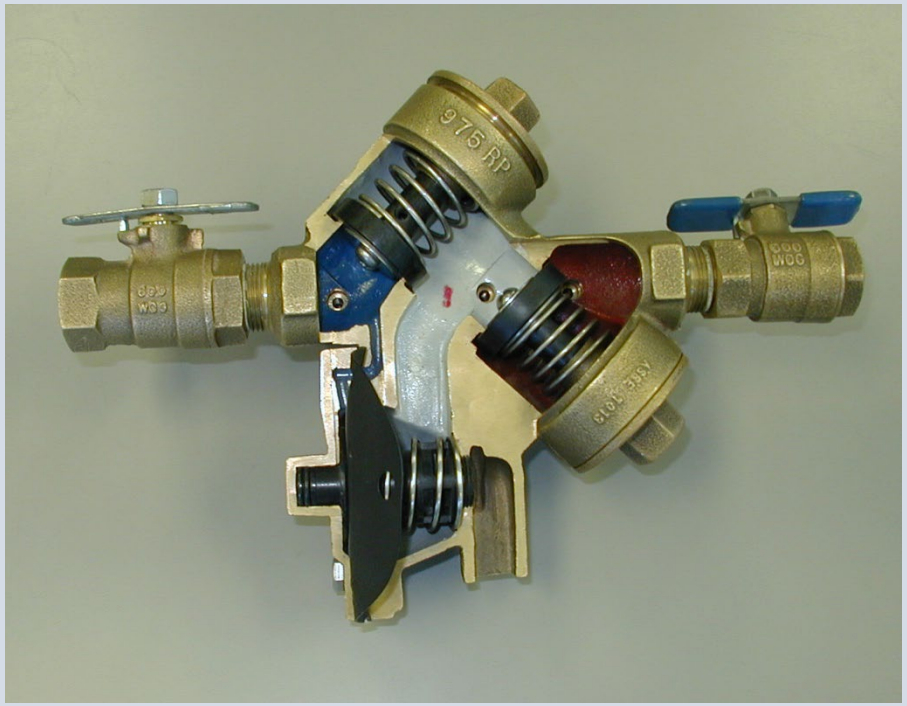


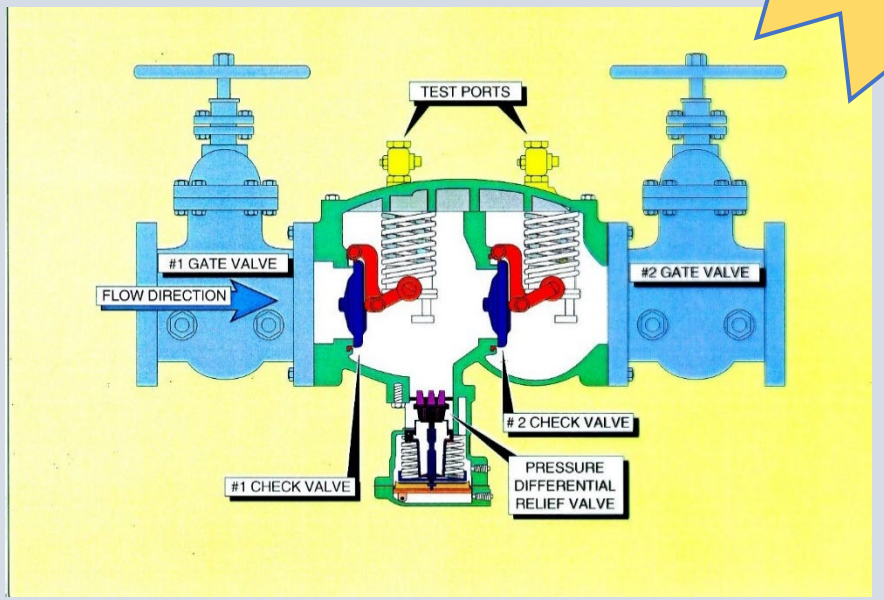
Cross-Connection Control Devices
Air Gap



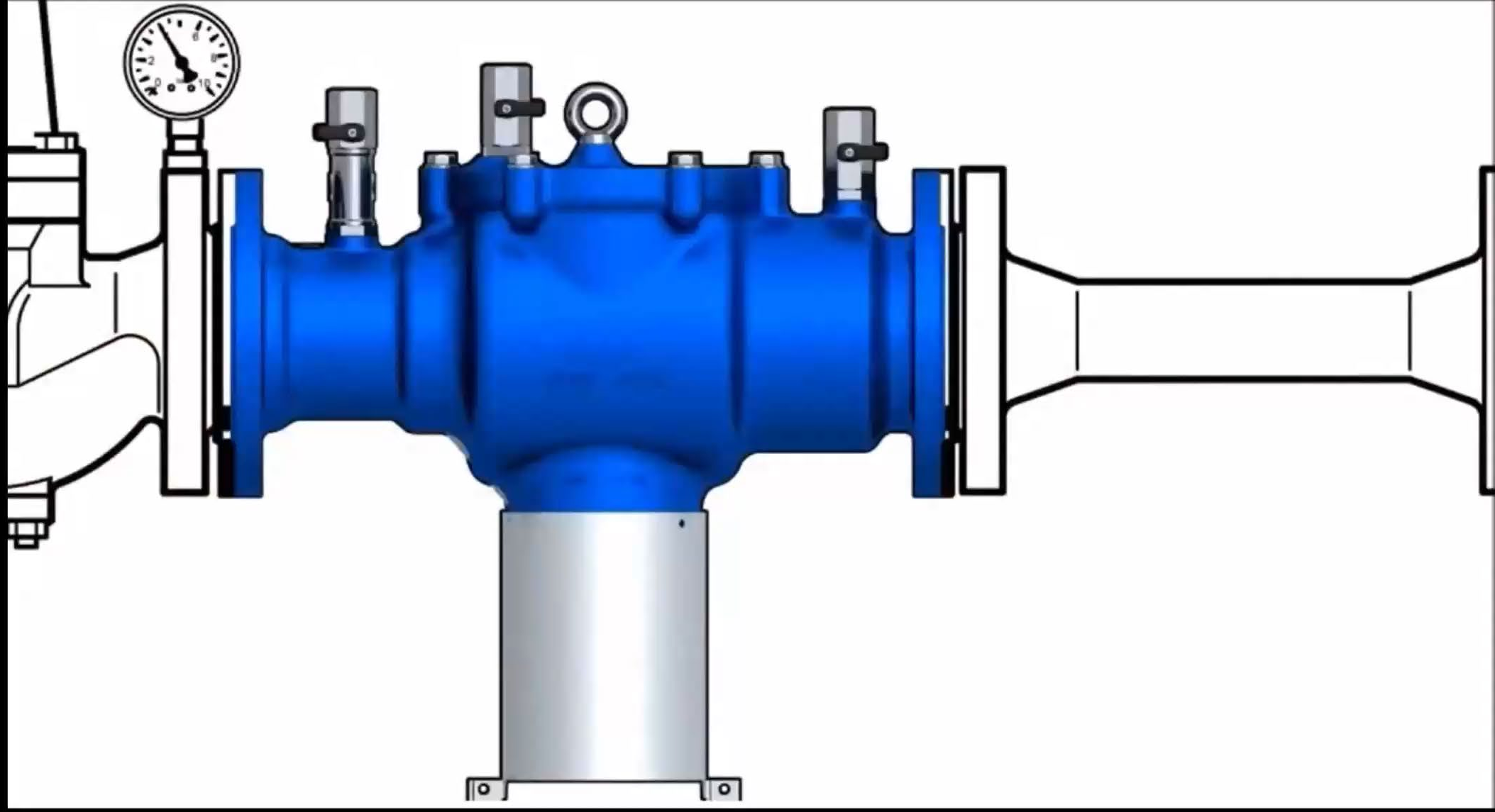


Cross-Connection Control Devices
Reduce Pressure Zone Backflow Preventer (RPZ)





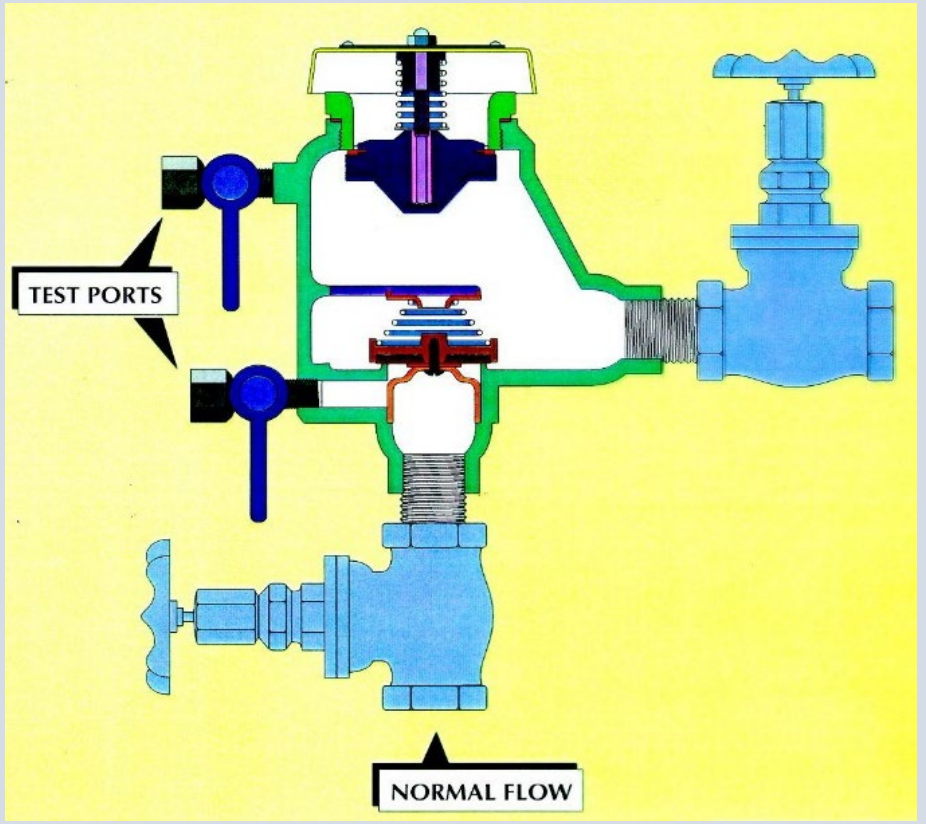
Must be installed at least 12-inches above grade





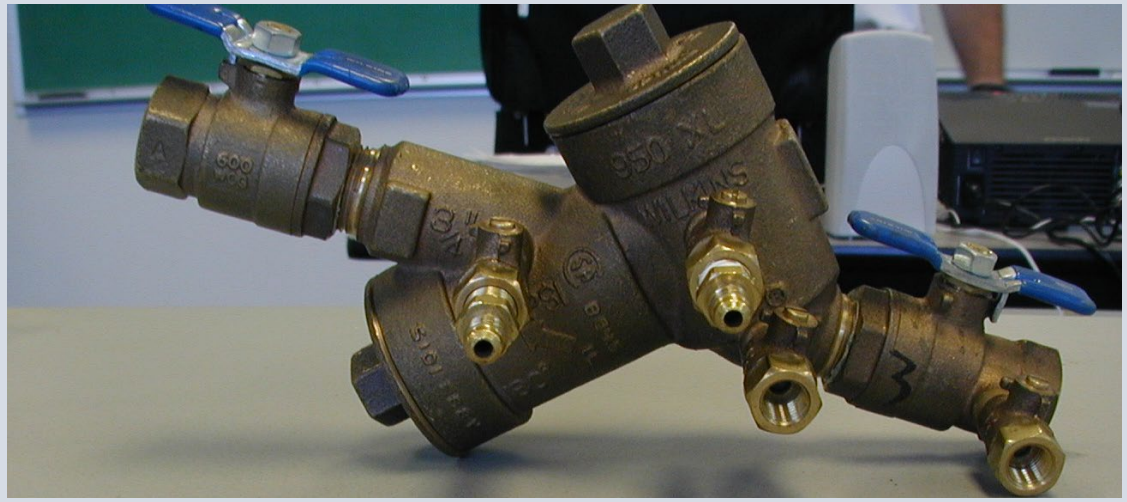
Cross-Connection Control Devices
Pressure Vacuum Breaker (PVB)

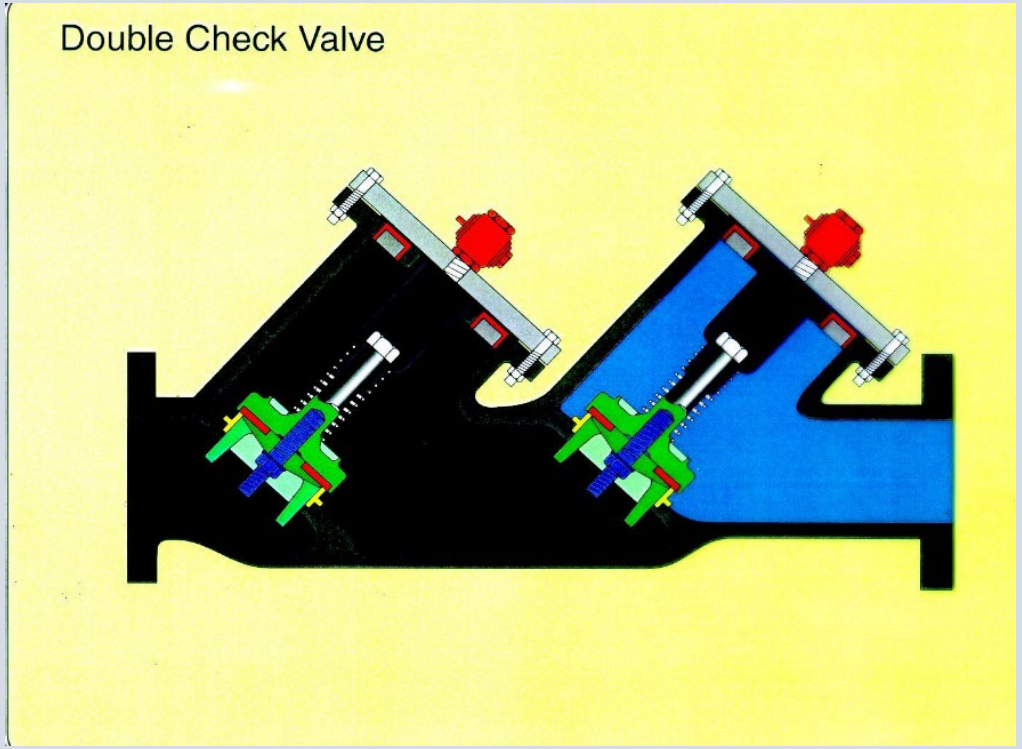






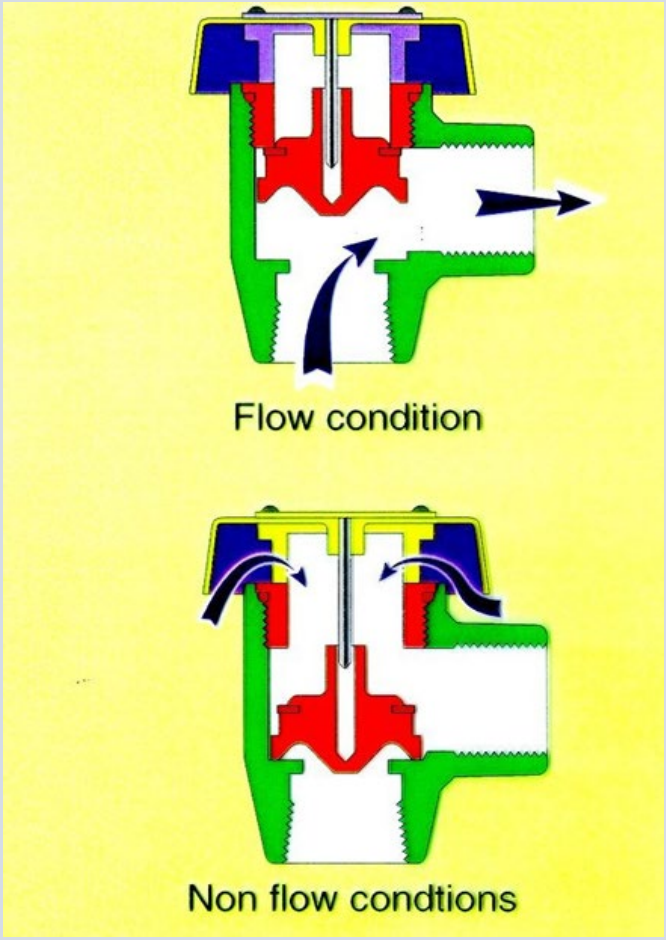
Cross-Connection Control Devices
Double Check Valve





Cross-Connection Control Devices
Atmospheric Vacuum Breaker (AVB)







Cross-Connection Control Devices
Hose Bibb Vacuum Breaker (HBVB)

A type of Atmospheric Vacuum Breaker







Are these cross-connection control devices 100% effective?

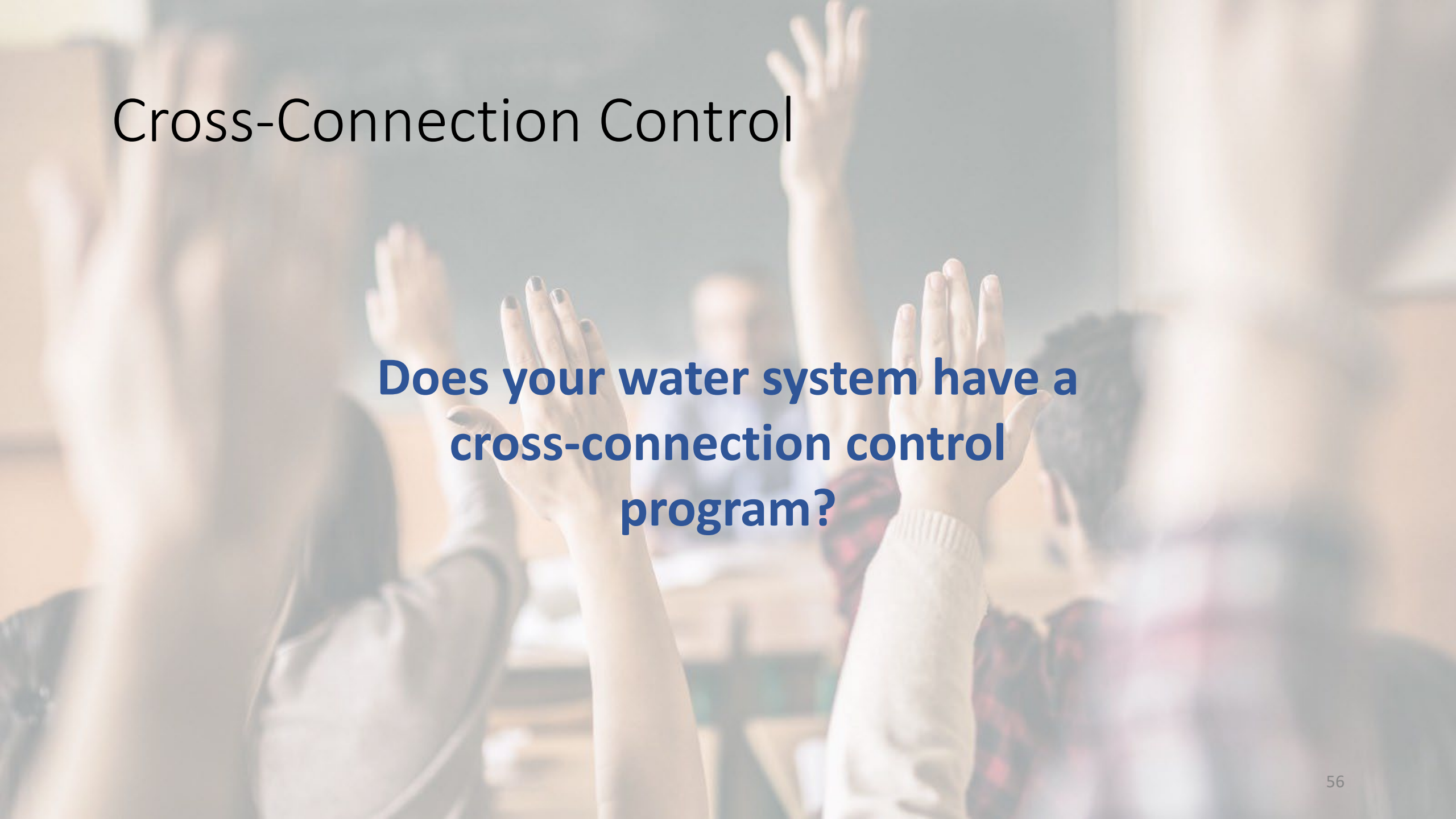
No, they can fail

What is most protective approach?

Cross Connection Control Program

Maintain Distribution System Pressures

Cross-Connection Control



Does your water system have a cross-connection control program?

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CONTACT INFORMATION



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