

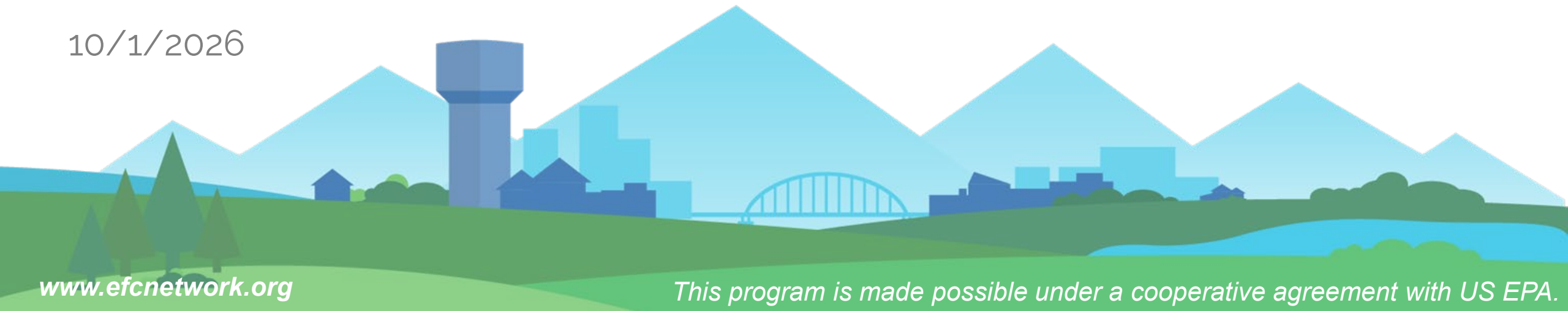


SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

US Territories Water Operator Training Series

Session 21: Distribution O&M

10/1/2026



Your trainers for today



Matt Ziegler
Program Director



Shā Lager
Water Utility Trainer &
Support Specialist



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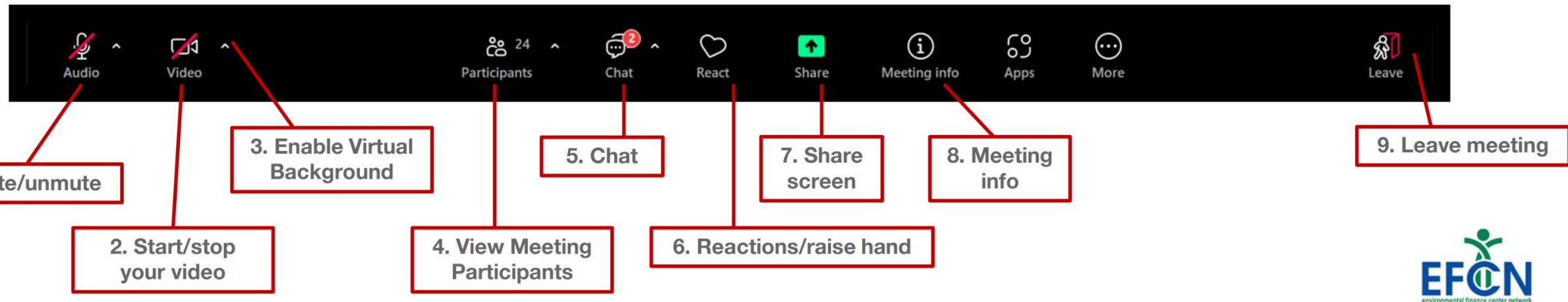
SCHOOL OF
ENGINEERING



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. fluoridation, ion exchange, 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
11/12/26	Sampling & Lab Procedures/Analysis/Interpretation
12/3/26	Management Overview (including organization, communication, PR & record keeping)
12/17/26	Drinking Water Practice Exam and Review

Links to recordings and material are available on our website at <https://swefc.unm.edu/home/op-cert-trainings/>

Pacific Island Territories Operator Certification Trainings

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



**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"

Distribution O&M Agenda

- Water Quality Monitoring
- Valves – Operation, Maintenance, & Exercising
- Flushing
- Pressure Monitoring
- Water Main Disinfection



Distribution Goals

- Maintain water quality from point of entry to point of use
- Maintain adequate pressure and flow to satisfy
 - Customer demand (average & peak)
 - Emergency demand

**Does your water system
set goals for the
distribution system?**

The background image is a faded, semi-transparent photograph of a water treatment or monitoring station. It features a white water tap on the left with a red handle, a black digital meter with a screen and buttons in the center, and three small glass vials with black caps and pink liquid inside. The vials are labeled '10 mL'. In the background, there's a large blue pipe and a blue denim jacket hanging on a rack.

Water Quality Monitoring

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Distribution O&M

Water Quality Monitoring Regulatory – SDWA

- Revised Total Coliform Rule (RTCR)
- Disinfectants and Disinfection Byproducts Rule (D/DBPR)
 - Disinfectant residual – at same point and time as total coliform sampling
 - Disinfection Byproducts
- Lead & Copper Rule (LCR)



WQ Monitoring – When Non-Regulatory

- Source
 - During development
 - After heavy rain or runoff event
 - After well maintenance
- Treatment
 - Process control monitoring to optimize the treatment process
- Distribution
 - New construction
 - After repairs
 - Customer complaints

Maximizing
the Barriers to
Contamination

Beyond
Compliance

**When do you collect
non-regulatory WQ
monitoring samples?**

WQ Monitoring – Types Non-Regulatory

- Total Coliform Bacteria
- Heterotrophic Plate Count (HPC)
- Total & Free Chlorine Residual
- Turbidity
- Pressure

Maximizing
the Barriers to
Contamination

Beyond
Compliance

What types of non-regulatory WQ samples do you take and why?

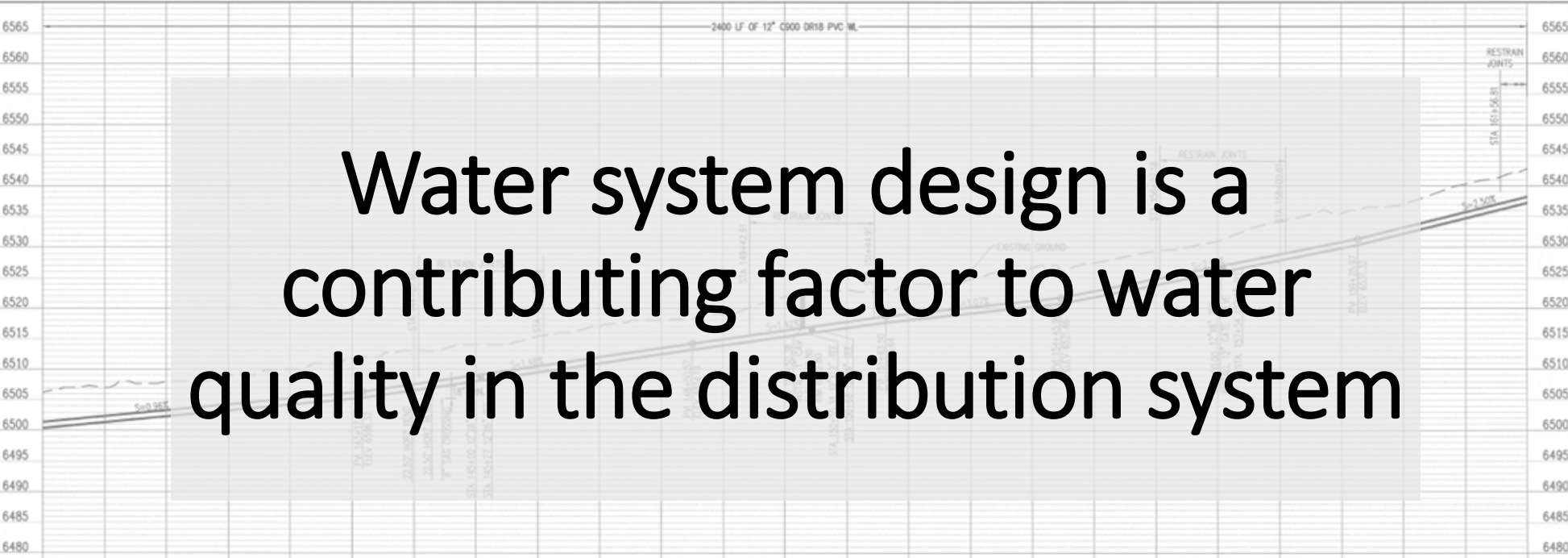
WQ Monitoring – Special Studies

- Help manage the distribution system
- Investigate WQ problems and identify root causes
- Respond to emergencies
- Respond to complaints
- Evaluate alternatives to system improvements

What is one special study that you have done to investigate WQ in your distribution system?



STA 138+00 TO STA 162+00



Water system design is a contributing factor to water quality in the distribution system

2. FIELD VERIFY LOCATION AND ELEVATION OF EXISTING FIBER OPTIC PRIOR TO EXCAVATION OF BORE PITS. CONTACT CENTURY LINK FOR REQUIREMENTS.
3. 10' MINIMUM HORIZONTAL SEPERATION REQUIRED BETWEEN SEWER AND WATER.
- KEYED NOTES:**
- (1) 12" WL PER SECTION 801
 - (2) 12" GATE VALVE, BOX AND COVER PER STD DWG 2326
 - (3) 12" X 6" TEE, 6" GATE VALVE AND 6" CAP
 - (4) FIRE HYDRANT PER STD DWG 2340
 - (5) BID ALTERNATE #1, (2) JACK AND BORES PER DWG. 10-ST-02
 - (7) 12"x6" TEE WITH 6" GATE VALVE, 6" CAP, BOX AND COVER PER STD. DWG. 2326
 - (8) NOT USED
 - (9) 8" WL PER SECTION 801
 - (10) 8" GATE VALVE, BOX AND COVER PER STD DWG 2326
 - (11) 12"x8" TEE
 - (12) 8"x6" TEE
 - (13) STUB AND CAP FOR FUTURE CONNECTION
 - (14) 12"x12" TEE, CAP AFTER VALVE, FOR BID ALTERNATE #1, EXTEND 12" WL TO END OF BORE PLUS 5 FEET AND CAP.
 - (15) CAV PER STD. DWG. 2350
- LEGEND**
- ⊕ REGISTERED ARCHAEOLOGICAL SITES
 - × ISOLATED OCCURENCE
 - SEE POINT TABLE DWG # 01-G-03

ENGINEER'S SEAL		AS-BUILT INFORMATION	
CONTRACTOR	DATE	DATE	DATE
DRAWN BY	DATE	DATE	DATE
CHECKED BY	DATE	DATE	DATE
DESIGNED BY	DATE	DATE	DATE
DATE 04/2015	DATE 04/2015	DATE 04/2015	DATE 04/2015
NO.	DATE	REMARKS	BY
		REVISIONS	
		DESIGN	

Water Quality and System Design

Bad Design

- Mains sized for fire flow
- Dead ends
- Inadequate valving

OG system added
to over time

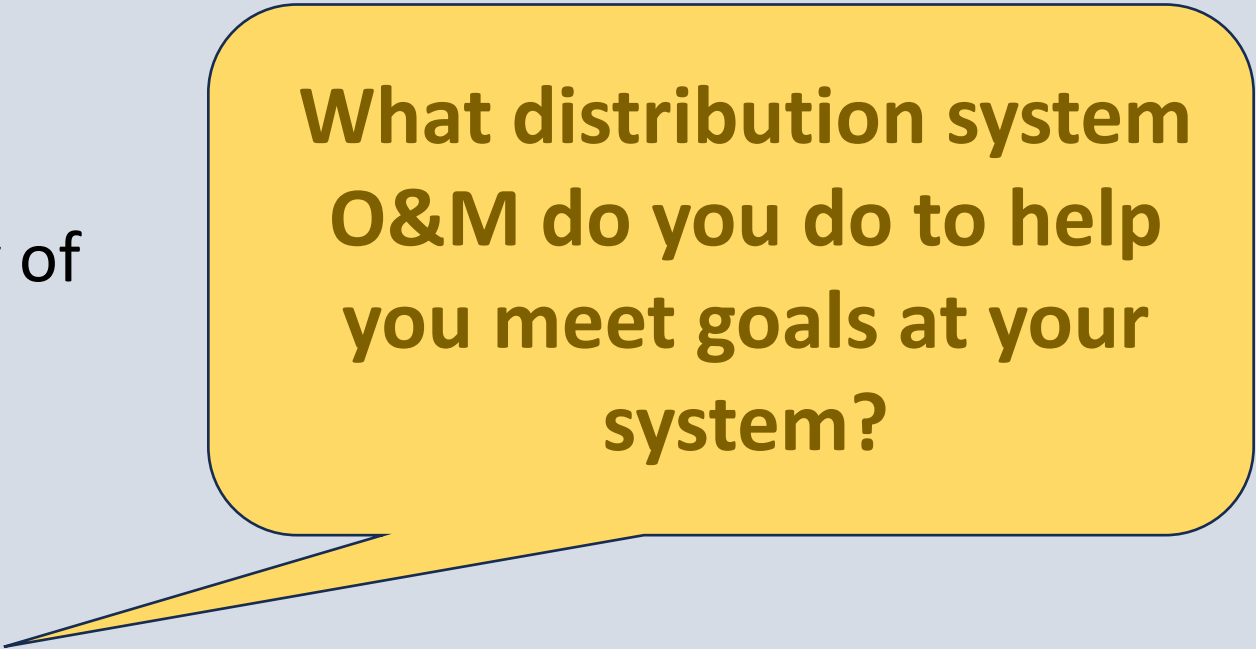
Good Design

- Looping
- Reduce areas of low pressure
- Adequate valving

Computer
Modeling

Water Quality Goals and System O&M

- Minimize detention time
- Maintain a consistent disinfectant residual
- Maintain positive pressure
- Control the direction and velocity of bulk water
- Remove contaminants



What distribution system O&M do you do to help you meet goals at your system?

The background image shows a trench with several large, light blue pipes. Red metal valves and flanges are visible, connected to the pipes. The ground around the pipes is sandy and uneven.

Valves Operation, Maintenance, & Exercising

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Distribution O&M

Valves in Distribution Systems

- At intersections, hydrants, and placed strategically throughout system
- Used to isolate parts of the distribution system
- Used to stop the flow of water in a distribution system



Valve Operation Customer Notification

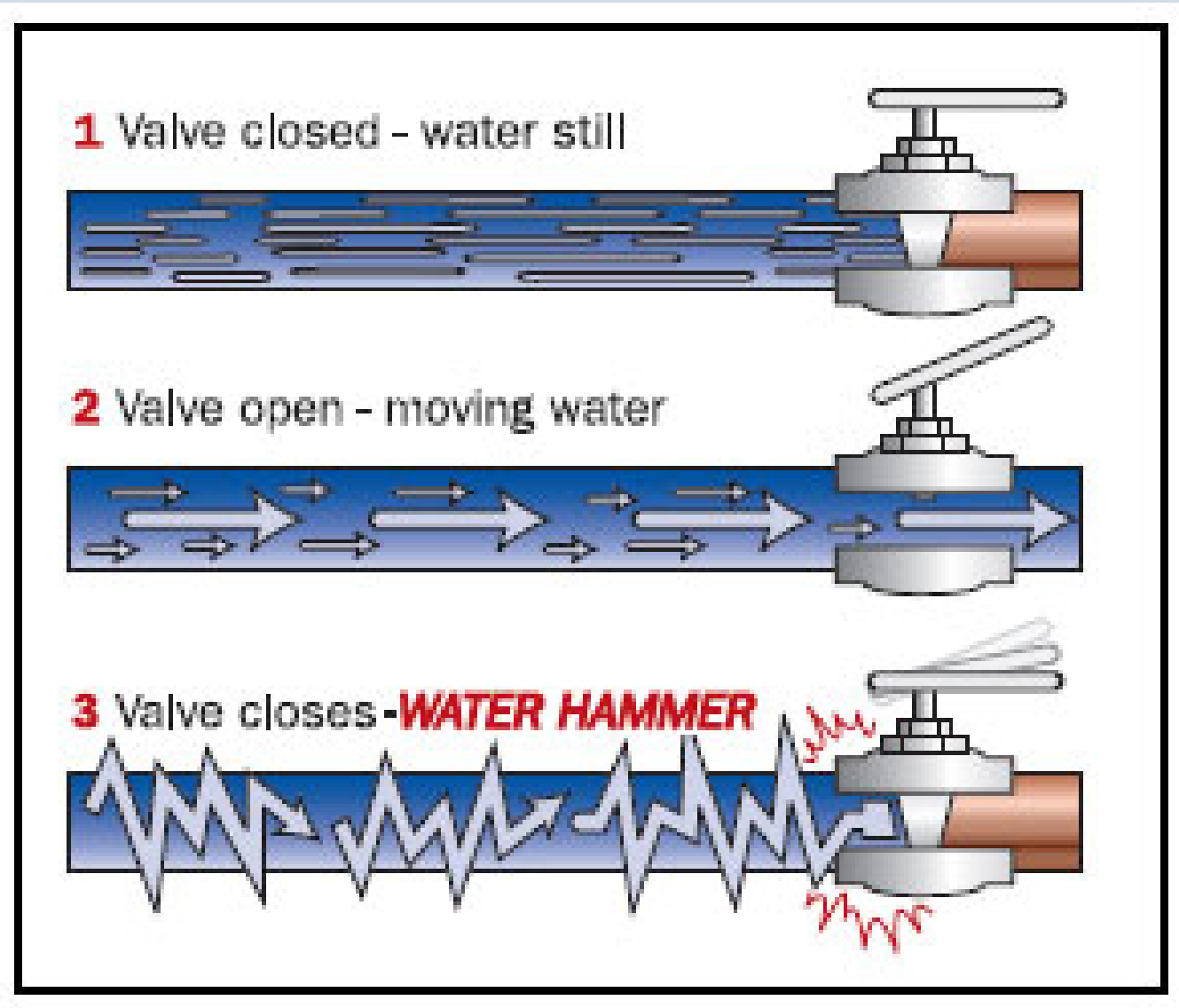
- Notify customers affected by closed valve
 - Mail
 - Phone
 - Door hangers
 - Direct contact



Valve Operation

Water Hammer

- A pressure wave in a pipe caused when closing or opening valves
- Occurs when opening or closing valves too quickly



Valve Operation

Water Hammer

- Sounds like hammering on the pipe and can cause damage
- Can reduce water hammer by slowly opening the valve and letting the pipe fill before opening it all of the way





Valve Operation

Water Hammer

$$\mathbf{dp = 0.070vl/t}$$

dp = increase in pressure (psi)

v = water velocity (ft/s)

t = valve closing time (s)

l = upstream pipe length (ft)



Valve Operations

Water Hammer Examples

$$dp = 0.070vl/t$$



Example 1 – What is the pressure increase if the solenoid valve closes in 0.1 seconds?

$$dp = 0.070(6 \text{ ft/s})(100 \text{ ft})/0.1 \text{ s} = 420 \text{ psi}$$

Example 2 – What is the pressure increase if the solenoid valve has a damper and closes in 1 seconds?

$$dp = 0.070(6 \text{ ft/s})(100 \text{ ft})/1 \text{ s} = 42 \text{ psi}$$

Valve Operation Exercising Program

- Routine annual maintenance
- Operate the valve from open to closed and back to open again to ensure operation
- Identifies and targets faulty valves for repair or replacement.



Valve Operation Exercising Program Record Keeping

- Unique ID# for each valve
- Installation Date
- Size
- Type
- # of turns to open and close
- Last time it was operated and # of turns exercised
- Condition notes





Valve Exercising

**Does your water system
have a valve exercising
program?**

Flushing

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Distribution O&M



Why Flush?

- Because water quality changes in the distribution system
- Solids settle out
 - May harbor biofilm and bacterial growth
 - May decrease carrying capacity of mains and flow rate
- Flushing can correct and prevent water quality issues

Drought and manpower
constraints can impact
ability to flush

Why Flush?

Remove Solids

Improve
Disinfectant
Residual/Water
Age

Respond to
Complaints

Remove Attached
Growth (biofilm)

Test Hydrants

Cleanup After
Contamination

Flushing Commonalities

- Flush with clean water
- Plan before you flush
- Don't open too many hydrants at once that could cause low pressures and backflow
- Notify affected residents as well as emergency services
- Open & close hydrants fully at a steady rate
- Use a diffuser in areas as needed
- Dechlorinate
- Only flush as long as necessary
- Document pressures, flows, and quality
- Consider safety



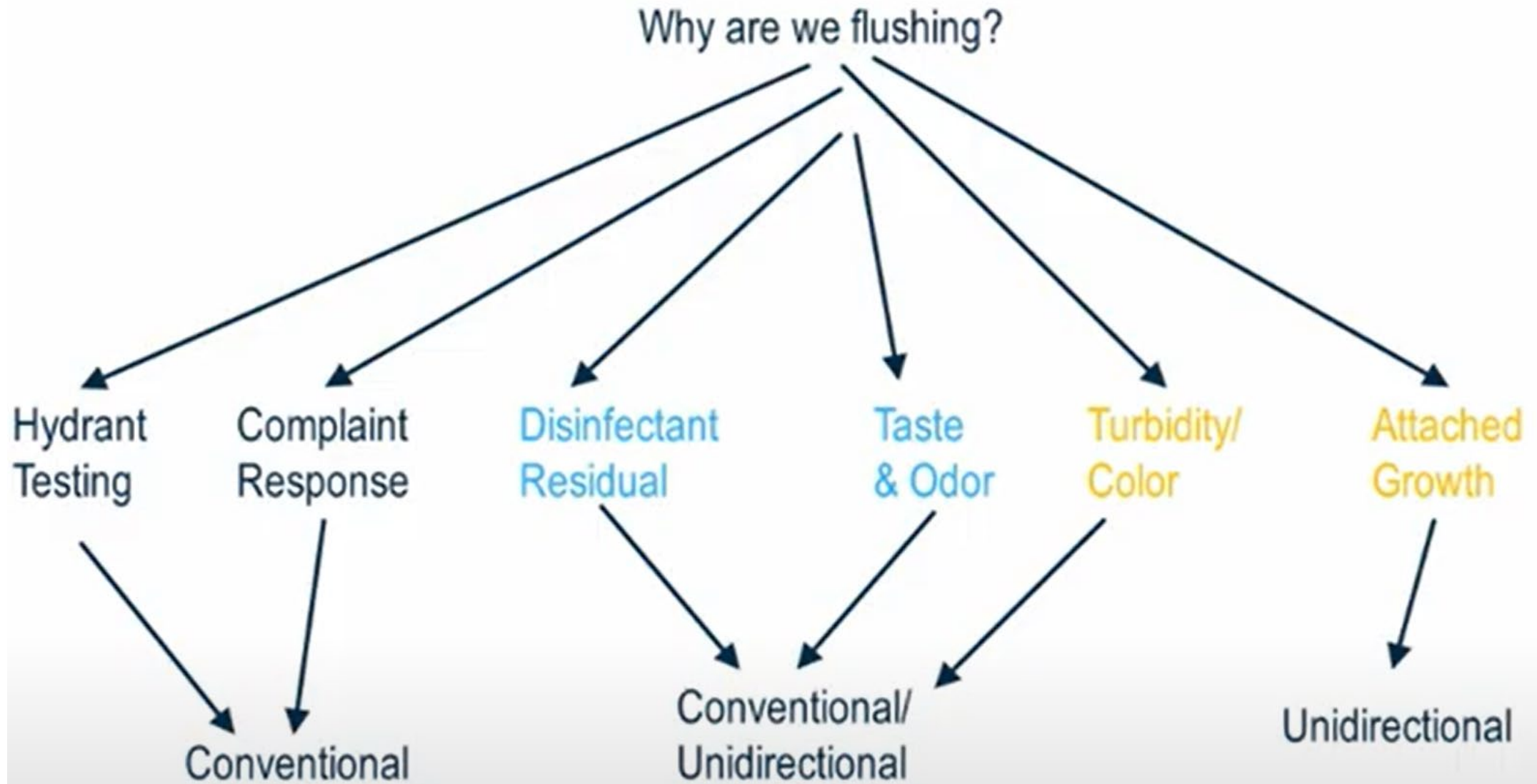
Flushing Types

- Conventional

- Easy to implement
- Achieves high velocity
- Must understand flow direction

- Unidirectional

- Create a plan and follow it
- Achieves higher velocity than conventional
- Uses less water



Flushing Methodologies – Conventional

Isolation

- Good for customer complaints of taste, color, odor
- Isolate part of the system
- Identify valves & hydrants
- Create flushing pattern
- Flush until clear

Continuous Blow Off

- Great for systems with lots of dead ends
- Automated with timer
- Helps restore disinfectant residuals and decrease water age
- Doesn't scour to remove sediment and biofilm growth

Directional

- Follows an established path through system
- Leaves cleaned mains behind and unflushed mains ahead
- Achieves velocities of at least 2.5 ft/sec in a 6" main
- Flush until clear

Flushing Methodologies



Unidirectional

- Starts at water source or at tank and move in the direction of flow
- Uses 40% less water
- Monitor water quality to know when to stop
- Maintains strict velocity control
- ≥ 3 ft/sec removes silt, sediment, and reduces disinfectant demand
- ≥ 5 ft/sec to promote scouring, remove biofilm, loosens deposits, and reduces disinfectant demand

Water Quality Monitoring During Flushing

- Disinfectant residual (total & free)
- Turbidity
- Color
- Alkalinity/pH
- Coliform
- Iron/Manganese
- Heterotrophic Plate Count (HPC)
- Ammonia
- Nitrate
- Nitrite



Flushing

**If your water system
practices distribution
system flushing, what types
of flushing do you do?**



Pressure Monitoring

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Distribution O&M



Pressure Monitoring

- Distribution system pressures should be monitored, and records kept
- High pressures can increase water leakage and breaks and decreases life of system components
- Low pressures can allow contaminants to enter the system
 - 20 psi is the absolute minimum (need to issue boil water advisory if drops below)

Pressure Monitoring

**Does your water system
routinely monitor
distribution pressures?**

A photograph of a water main disinfection operation. A large, powerful jet of water is being sprayed upwards from a trench, creating a massive cloud of mist and spray that fills the upper half of the frame. The scene is set outdoors with trees in the background and a road in the foreground. A red and white striped construction barrier is visible in the trench area. A speed limit sign for 40 is on the right side of the road.

Water Main Disinfection

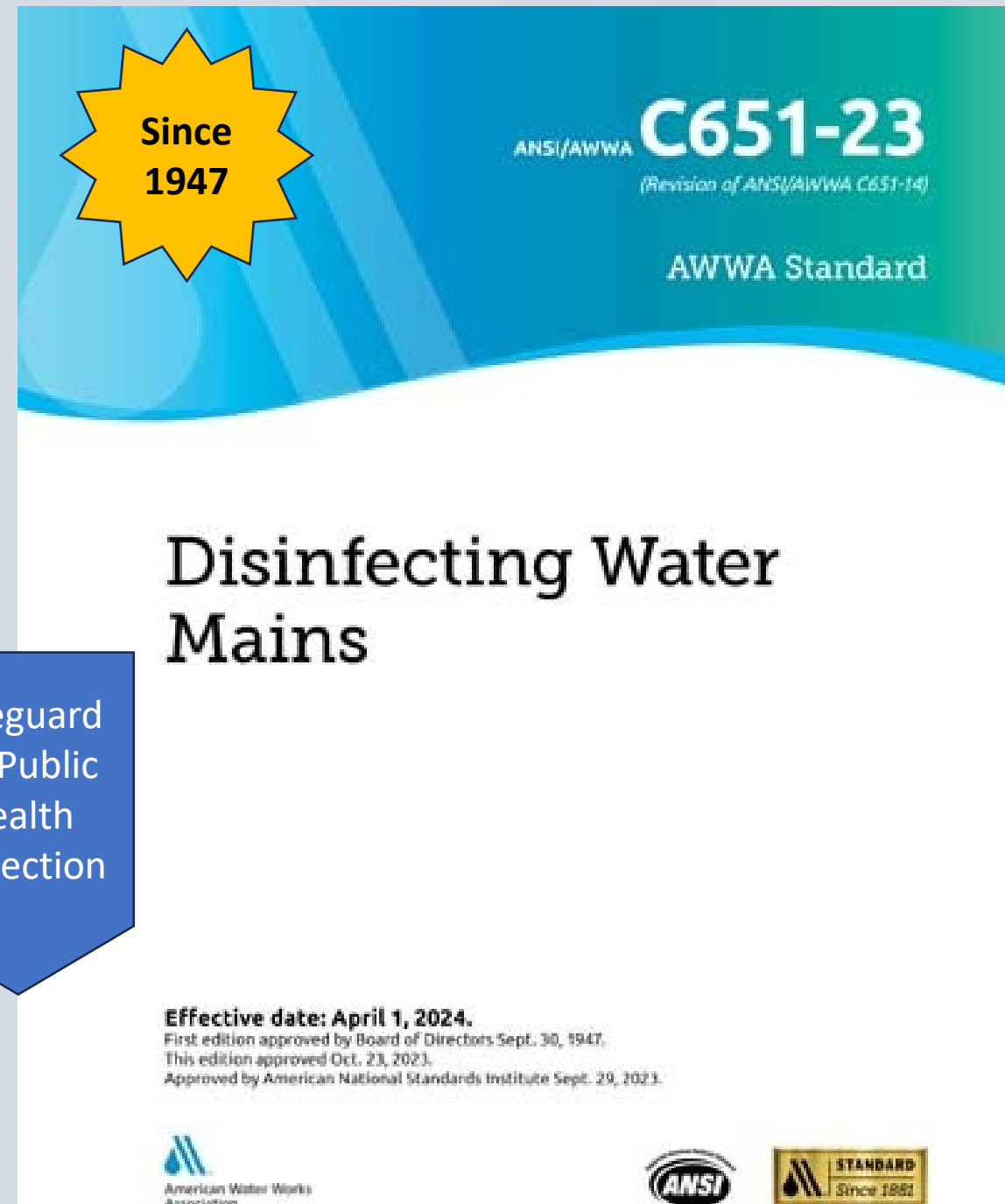
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Distribution O&M

Water Main Disinfection

- Mains ensure flow of water to our taps
- Distribution systems are growing and aging
- Risk of bacteriological contamination with construction, replacement, and repair of mains
- Main materials often arrive already contaminated

Safeguard
for Public
Health
Protection



Water Main Disinfection Material Storage & Handling

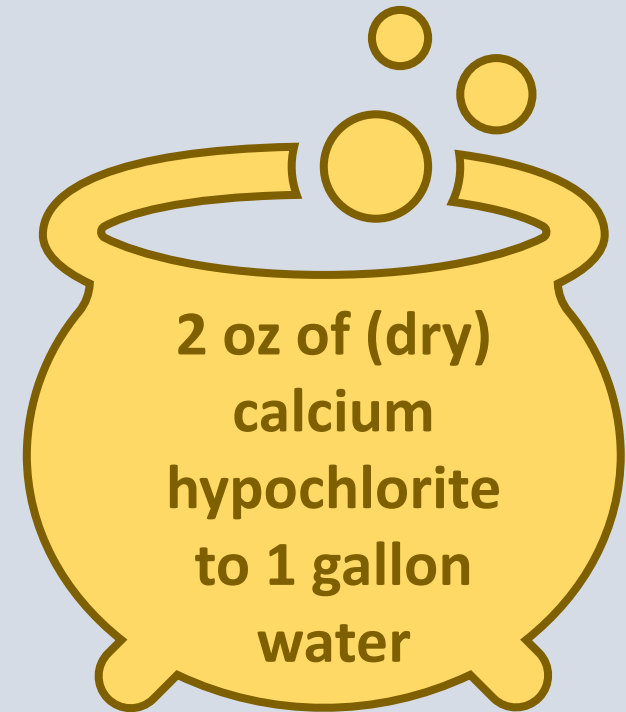
- Use end caps, tarps, shrink wrap, and elevate pipes in storage
- Regularly inspect storage
- At site, stage pipes so they don't sit in soil or runoff
- Consider installation directly from truck instead of stringing
- Inspect inside before installing



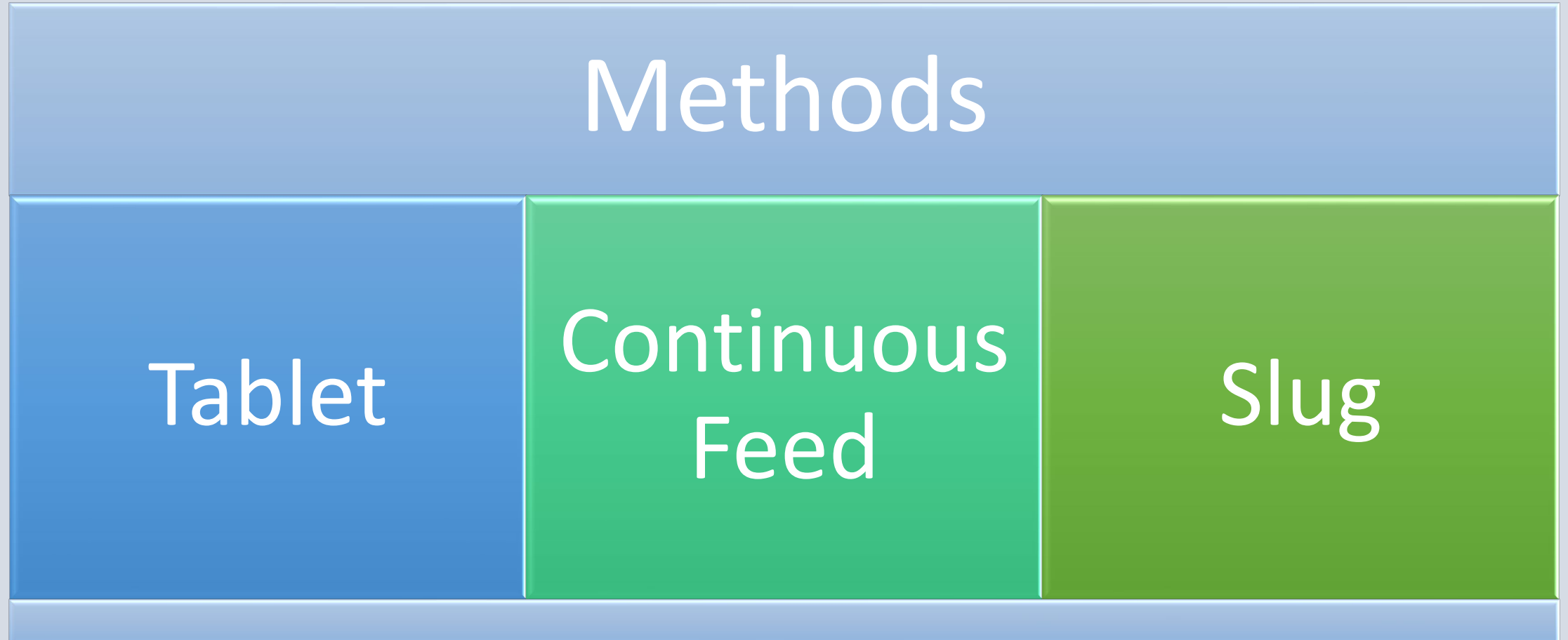
Water Main Disinfection

Material Storage & Handling

- Trenches should have at least 18" of horizontal clearance around mains
- Keep trench dry
- Swab or spray main components and tools with concentrated hypochlorite solution before installation
- Wear PPE!



Water Main Disinfection



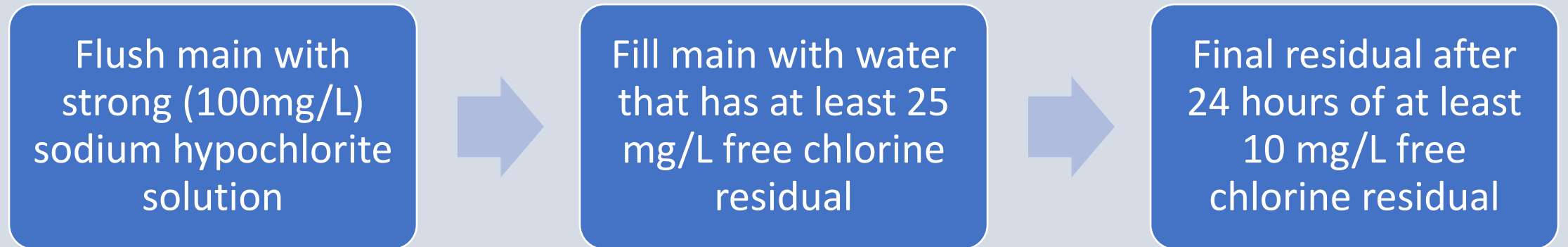
Water Main Disinfection Tablet

Place tablets of
calcium
hypochlorite
around pipe ends



Goal = 25 mg/L of
free chlorine
residual after 24
hours

Water Main Disinfection Continuous Feed



Water Main Disinfection Slug

Slug of 100 mg/L
free chlorine for
3 hours

Or

Slug of 300 mg/L
free chlorine for
less time



Final free chlorine
residual of ≥ 50
mg/L

Water Main Disinfection

After Chlorine Contact Period

- Flush until residual at normal daily operating levels and ~1 pipe volume has been replaced
- Flush to reduce levels of DBPs (THMs)
- Use a chemical dechlorinating agent to protect aquatic life

Sodium
Sulfite

Ascorbic
Acid

Sulfur
Dioxide

- Collect 2 coliform samples from isolated mains at least 24h apart
- Keep new or repaired mains isolated until get bacteriological results

Water Main Disinfection

**If your system/s practices
water main disinfection,
what procedure do you use?**

Next time:

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