

State of Ohio Class A Drinking Water Operator Certification Program

**Session Three:
Water Storage; Maintenance; Line Problems; Pumping
Water through the Distribution System &
Contamination of the Water Supply**

This course includes content developed by the Ohio Environmental Protection Agency, the Pennsylvania Department of Environmental Protection, the Indiana Department of Environmental Management, California State University at Sacramento and 360water, Inc.

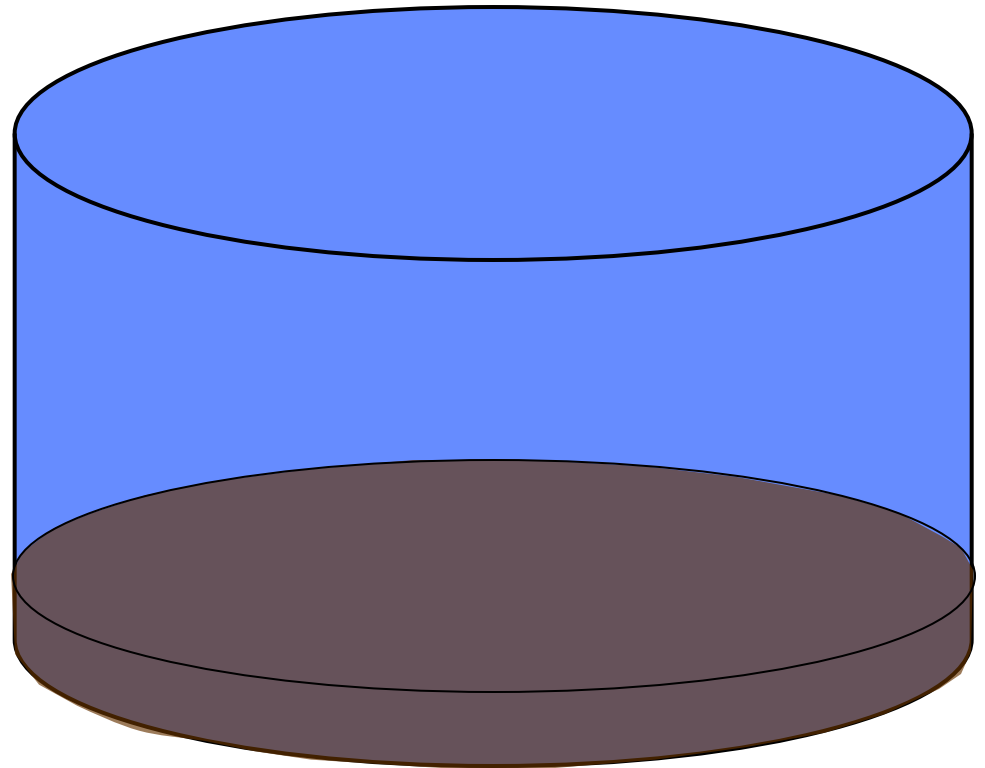
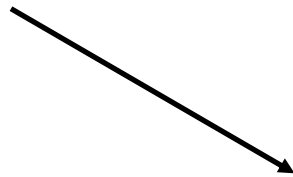
Project funded by the USEPA.

Storage of Treated Water

- Storage tanks should be cleaned out on a yearly basis
- Flush out Hydrants
- Safety Precautions
 1. Locks
 2. Fence
 3. Lights

Tank Sedimentation

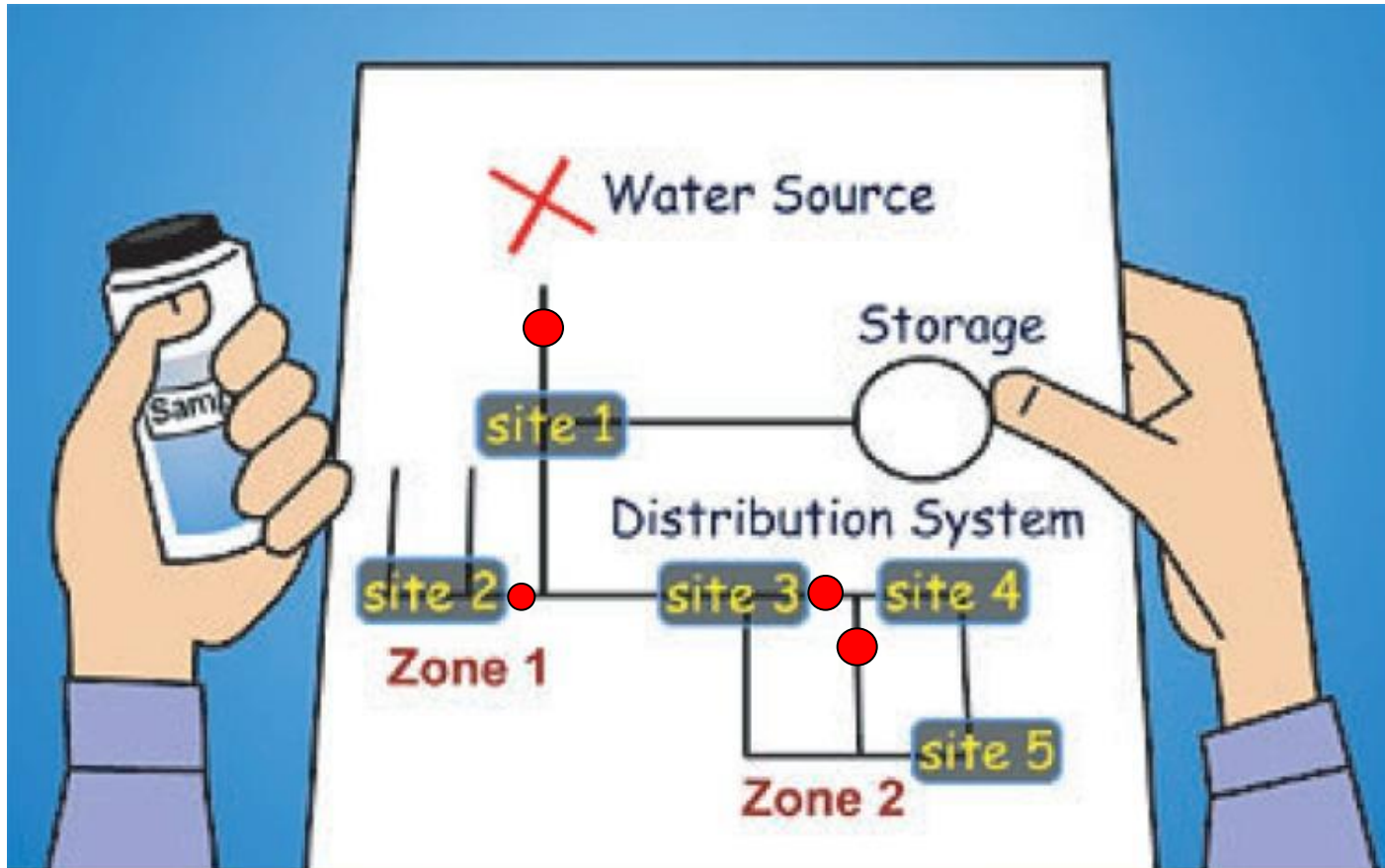
On a periodic basis, the bottom of the tanks should be checked for excess sedimentation and flushed if needed.



Maintenance of the System

- Know where main valve boxes are if in the ground. Be sure the boxes are cleaned out and the valves are accessible
- Exercise valves – open and close slowly to prevent water hammer
- Flush out the system—especially dead-end lines
- Know the location of the valves (see next slide)

Valve Locations



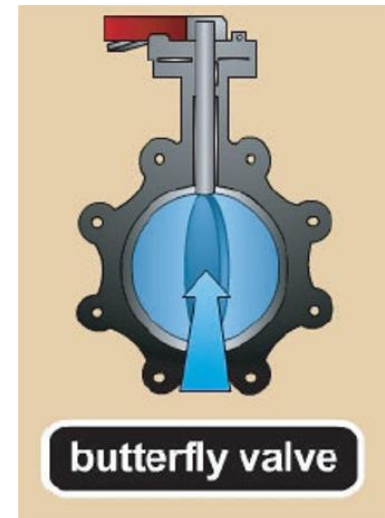
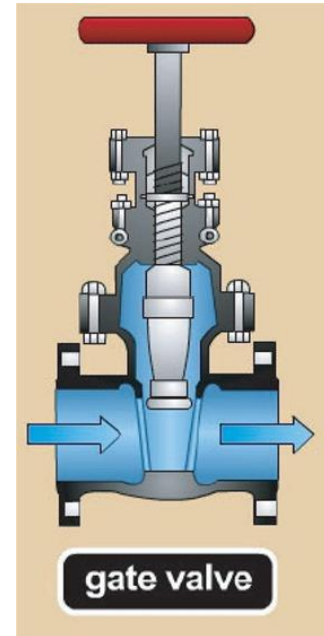
Valves

Valves are extremely important throughout all aspects of the water supply system. Some of their essential functions include:

- Regulating the flow of water
- Reducing pressure in the line
- Providing air or vacuum relief
- Draining water
- Preventing Backflow

When opening or closing any kind of valve, it should be done slowly because **Water Hammer** could develop.

Water Hammer is a strong wave that develops in the pipe that can cause extensive damage—even a pipe blowout!



Line Breaks and Line Depressurizations

- The pressure in the system must be at least 20 PSI. If it is below 20 PSI, there could be a backflow problem
- Notify Ohio EPA as soon as possible about a line break/depressurization (see the Emergency Contact magnet)

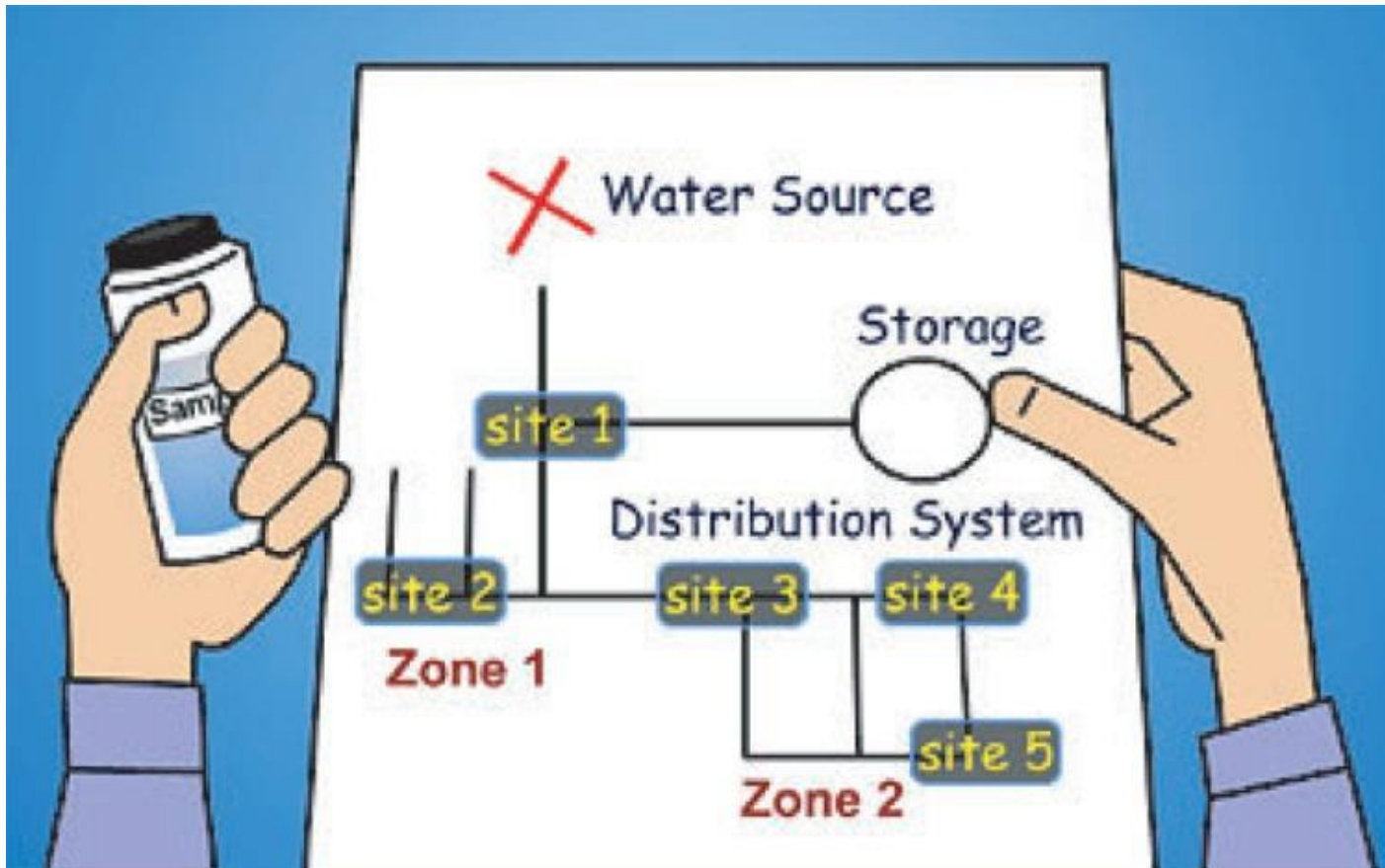
Line Breaks and Line Depressurizations, *continued...*

- Notification of consumers about line break/depressurization with a Boil Advisory

Procedure:

1. Collect 2 Total Coliform Samples in accordance with AWWA standards (contact District office)
2. Analyze the Sample
3. Receive notification from lab
4. If negative, call the Ohio EPA for permission to lift the Boil Advisory

Sample Siting Plan



Maintenance

Procedure when putting a new line in:

1. Flush line
2. Chlorinate and let stand in accordance with AWWA standards (contact District office)
3. Take a bacteria test in accordance with AWWA standards (contact District office) before putting the line into operation
4. Obtain a negative Total Coliform bacteria sample before placing the line into service

Signs of Line Problems



Melting Snow



Water coming up
through the ground



Water damage on ceiling

What is Pressure?

Pressure is the energy that moves water in a pipe

For example,
pressure forces water
to spray out of a
garden hose

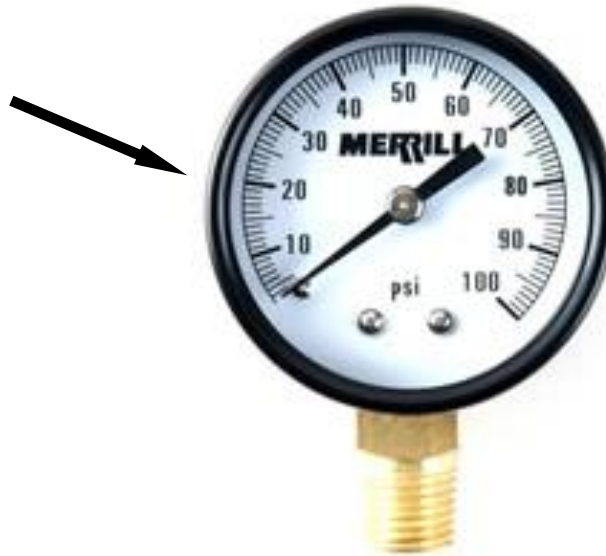


Measurement of Pressure

Pressure is usually stated in terms of PSI, or “Pounds per Square Inch”

$$PSI = \frac{lbs}{in^2}$$

This Pressure Gauge measures in PSI

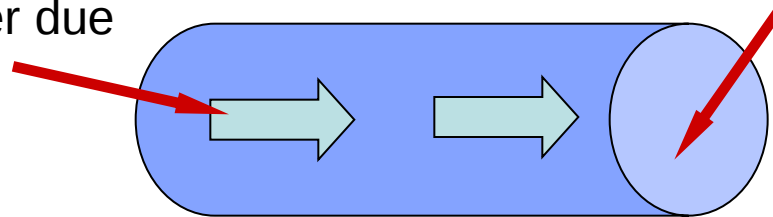


Line Pressure

There are two components that make up the Line Pressure:

- **Static Pressure** is always present
- **Dynamic Pressure** exists if the water is moving

Dynamic Pressure = The pressure of the water due to its flow

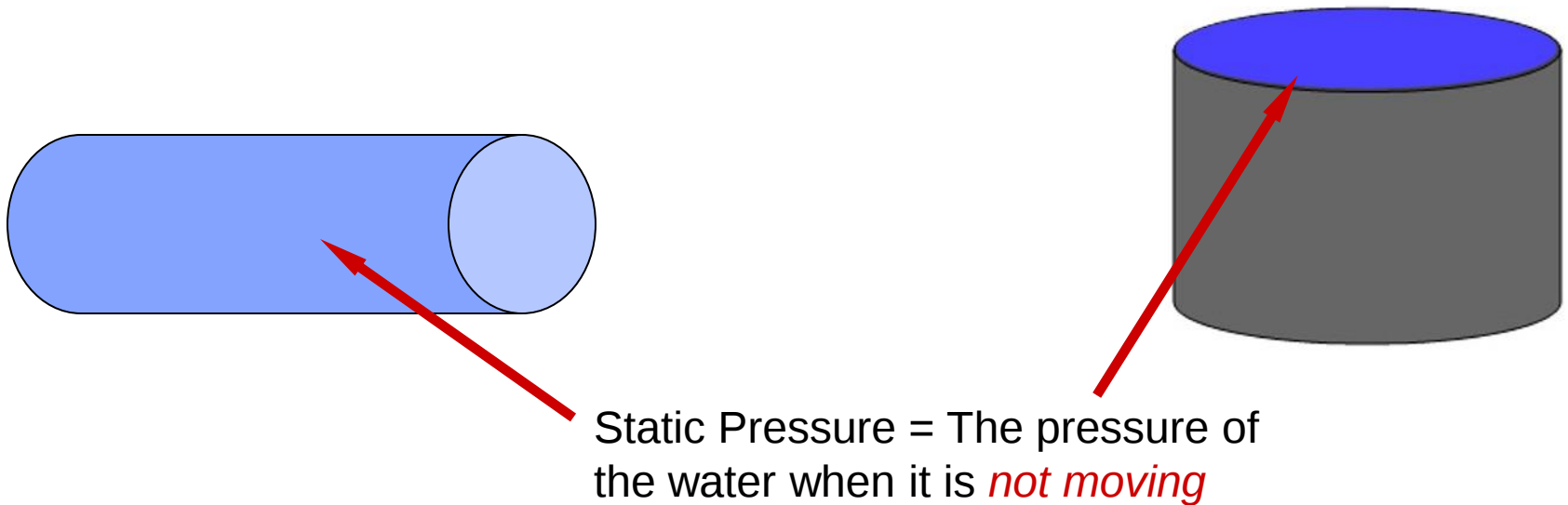


The Static Pressure that is always present

$$\text{Static Pressure} + \text{Dynamic Pressure} = \text{Line Pressure}$$

Static Pressure

If the water in the pipe or tank is not moving,
the pressure inside is called **Static Pressure**

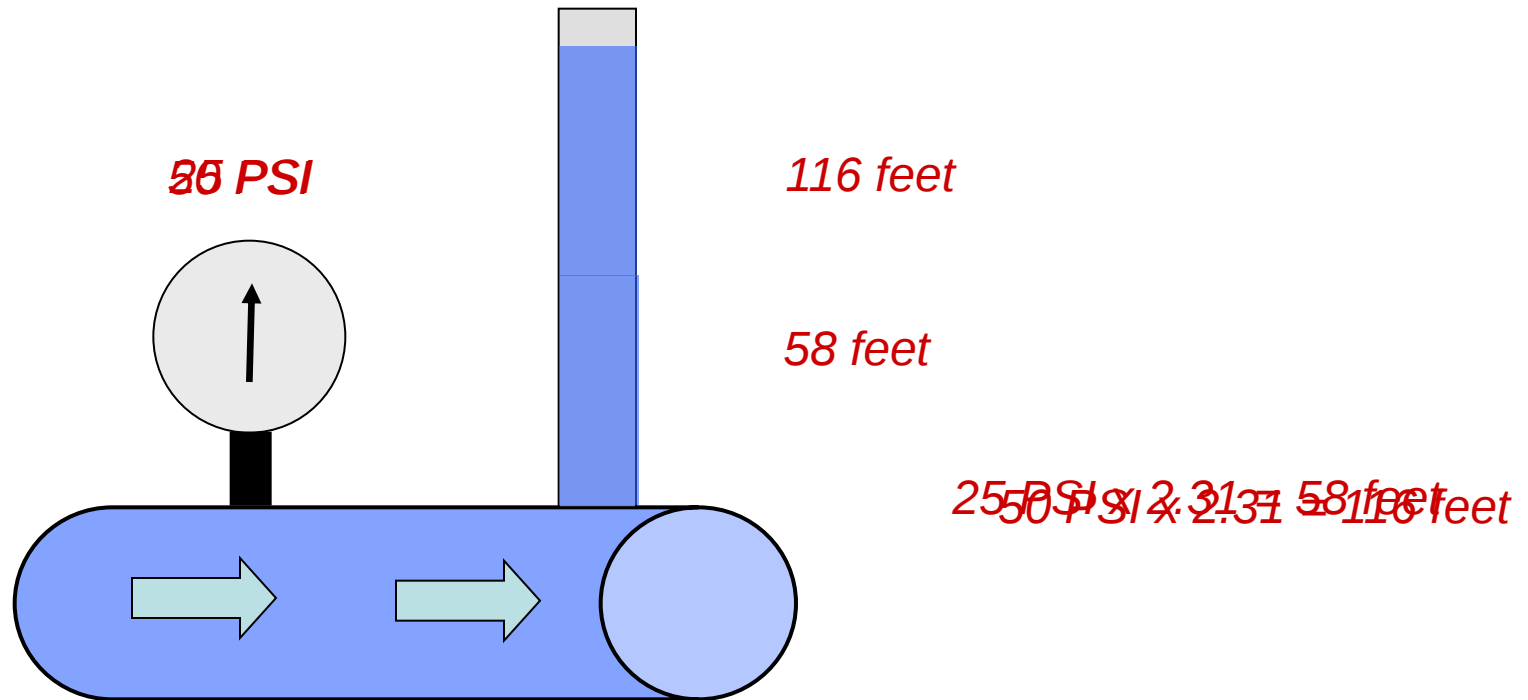


Pressure Head

When we want to express the Line Pressure at a point in a pipeline, we can state it in one of two ways:

- First, we can say it in terms of pressure; for instance, 50 PSI
- Or, we can state it in terms of *Pressure Head*, which is expressed in terms of feet or inches

Pressure Head



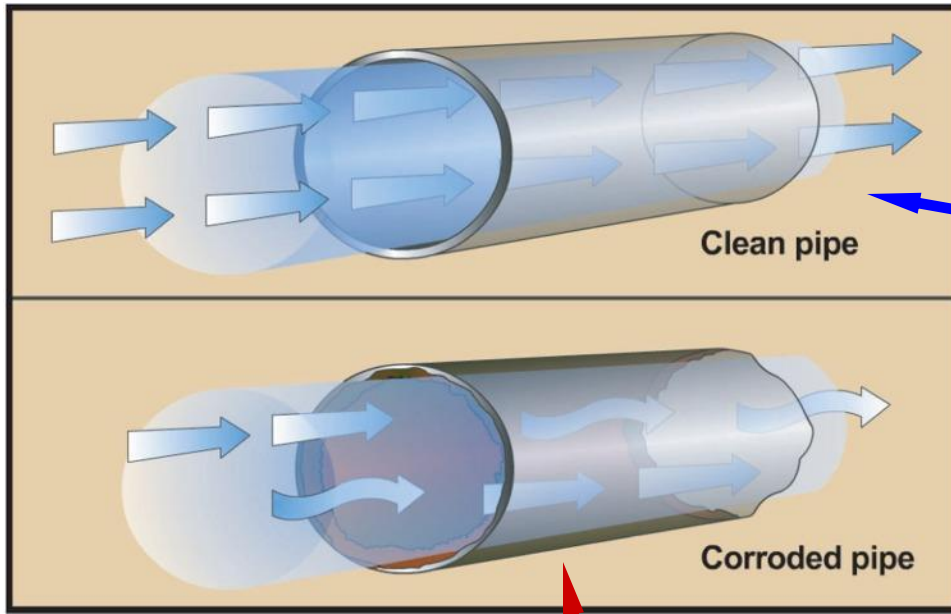
Line Friction

When a liquid is traveling through a pipe, it experiences some of the same effects that we do when we run, namely *friction*. Friction is the result of two surfaces, suppose the ground and the runner's shoes, that contact each other and slow the runner down.

The reason a car takes longer to stop on a wet or icy surface is because the friction is reduced. If the friction was reduced to zero, a car could travel forever without applying the accelerator.

Now, imagine, a pipe with water flowing through it: Pretend the water is a shoe, and the inside of the pipe is the ground. Since both are contacting each other, the water will be slowed down—this is called **Line Friction**.

Line Friction

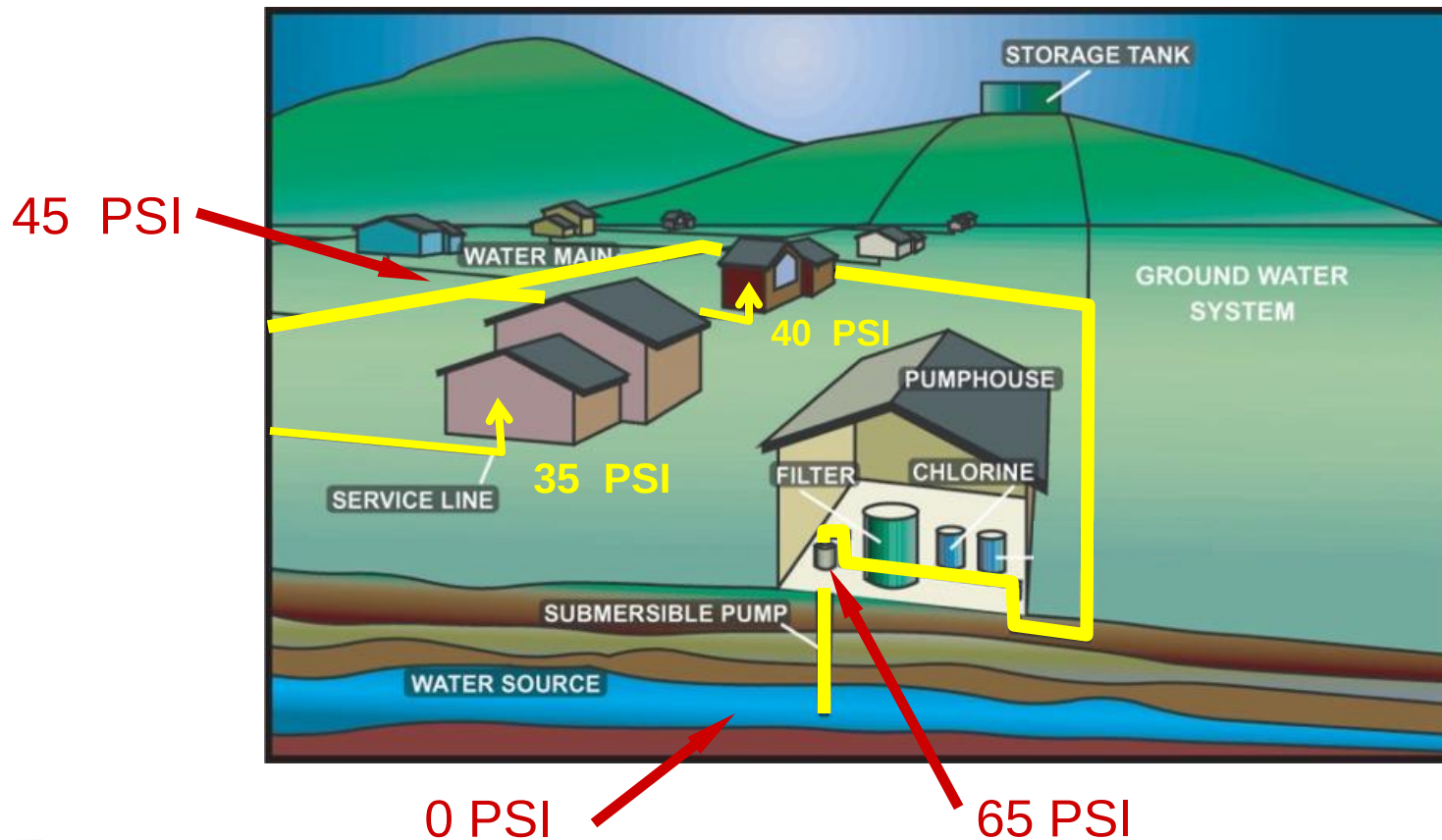


Low Line Friction

High Line Friction



Effects of Line Friction



Contamination of the Water Supply

Cross Connections

- Occur anytime the water supply is connected to an outside liquid, gas, or substance
- If the flow goes in the opposite direction, the outside liquid, gas, or substance can travel into the water supply
- This reverse flow is called ***Backflow***

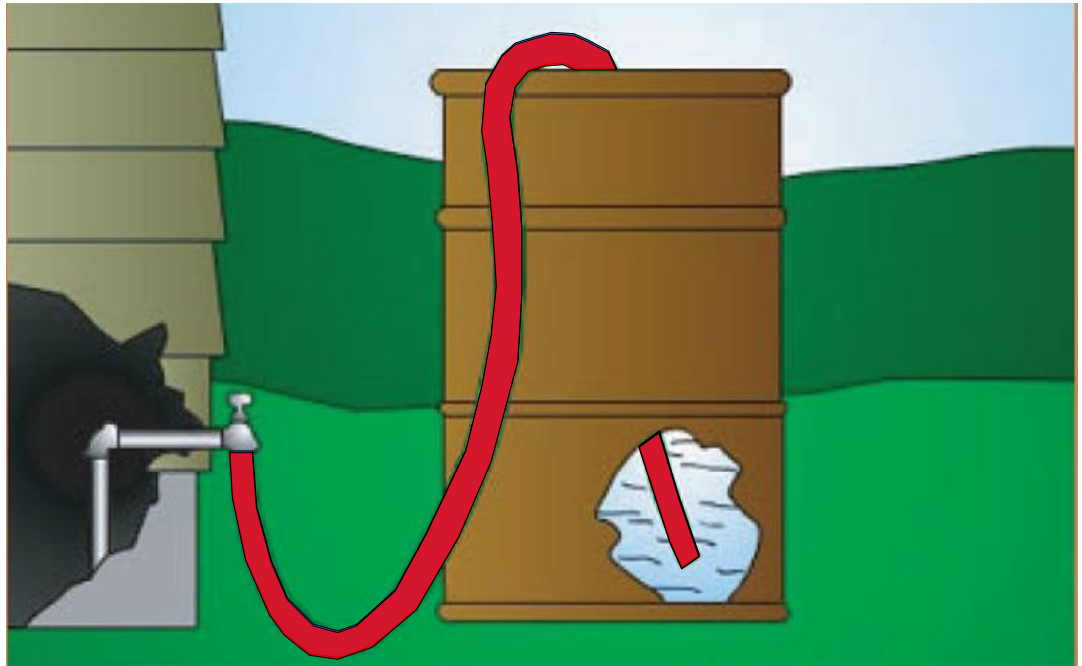


Backflow

Backflow occurs when a negative pressure (below atmospheric) develops in the distribution system

This can be caused by:

- Undersized pipes
- High withdrawal rates
- Pipeline breaks
- Hilly terrain



~~Backflow~~

SAMPLE MATH PROBLEM 1

Convert 57 PSI to Feet of Pressure Head:

$$57 \text{ PSI} \times 2.31 =$$

131.7 Feet

SAMPLE MATH PROBLEM 2

Convert 160 Feet of Pressure Head to PSI:

$$\frac{160}{2.31} =$$

69 PSI

SAMPLE MATH PROBLEM 3

Convert 7 Grains per Gallon (gpg) to mg/L:

$$7 \times 17.1 =$$

$$119.7 \text{ mg/L}$$

SAMPLE MATH PROBLEM 4

Convert 150 mg/L to Grains per Gallon (gpg):

$$\frac{150}{17.1} =$$

8.7 gpg

SAMPLE MATH PROBLEM 5

Find the average daily water production for the 4 days shown:

Day 1: 20,000 gallons

Day 2: 15,000 gallons

Day 3: 10,000 gallons

Day 4: 5,000 gallons

$$\frac{20,000 + 15,000 + 10,000 + 5,000}{4} =$$

12,500 gallons

SESSION THREE

SESSION THREE SAMPLE QUESTIONS BEGIN NOW

SESSION THREE SAMPLE QUESTION

1. Which of the following terms refers to excessive internal pressure, which may be several times the normal operating pressure, and can seriously damage hydropneumatic tanks, valves, and the piping network?
 - a. Air charge
 - b. Flow rate pressure
 - c. Water hammer
 - d. Hydraulic charge

c. Water hammer

SESSION THREE SAMPLE QUESTION

2. The most important responsibility of an operator is to provide . . .
- a. Adequate water pressure
 - b. Palatable drinking water
 - c. Adequate amounts of water
 - d. Safe drinking water

d. Safe drinking water

SESSION THREE SAMPLE QUESTION

3. After a new water main is installed and pressure tested it should be . . .
- a. Flushed with clean water for 24 hours and put into service
 - b. Filled with a solution of 25 ppm to 50 ppm Free Chlorine for at least 24 hours prior to flushing and tested for bacteria
 - c. Filled with clean water and allowed to sit for 5 days at full pressure before allowing the water into the system
 - d. Photographed so that mapping can be avoided until the system is complete
- b. Filled with a solution of 25 ppm to 50 ppm Free Chlorine for at least 24 hours prior to flushing**

SESSION THREE SAMPLE QUESTION

4. What is the most important reason for maintaining a continuous positive pressure throughout the distribution system?
- a. Prevent damage to water meters
 - b. Keep pipe joints sealed
 - c. Prevent contamination from backflow
 - d. Maintain chlorine residual

c. Prevent contamination from backflow

SESSION THREE SAMPLE QUESTION

5. What is the physical connection, direct or indirect, which provides the opportunity for non-potable water to enter a conduit, pipe or receptacle containing potable water?
- a. Well testing
 - b. Pump injection
 - c. Bell joint clamp
 - d. Cross connection

d. Cross connection

SESSION THREE SAMPLE QUESTION

6. What safety measure must an operator follow prior to working on electrical equipment?
- a. Lock out and tag out all electrical switches
 - b. Put on canvas gloves
 - c. Remove fuses from switch box
 - d. Tell one coworker not to turn on the switch

a. Lock out and tag out all electrical switches

Questions?

END OF SESSION THREE