



CRITICAL CONVERSATIONS IN AGING INFRASTRUCTURE



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CRITICAL



: OF, RELATING TO, OR BEING A TURNING POINT OR SPECIALLY IMPORTANT JUNCTURE // A *CRITICAL* PHASE

: INDISPENSABLE, VITAL

: BEING IN OR APPROACHING A STATE OF CRISIS

: CRUCIAL, DECISIVE

IS OUR DRINKING WATER
INFRASTRUCTURE
IN CRITICAL CONDITION?



Where Do We Stand?

Just the Facts

- According to the ASCE Infrastructure Report Card (2017):
- Nation's drinking water infrastructure received a “___” rating



2021 REPORT CARD
FOR AMERICA'S INFRASTRUCTURE
ASCE



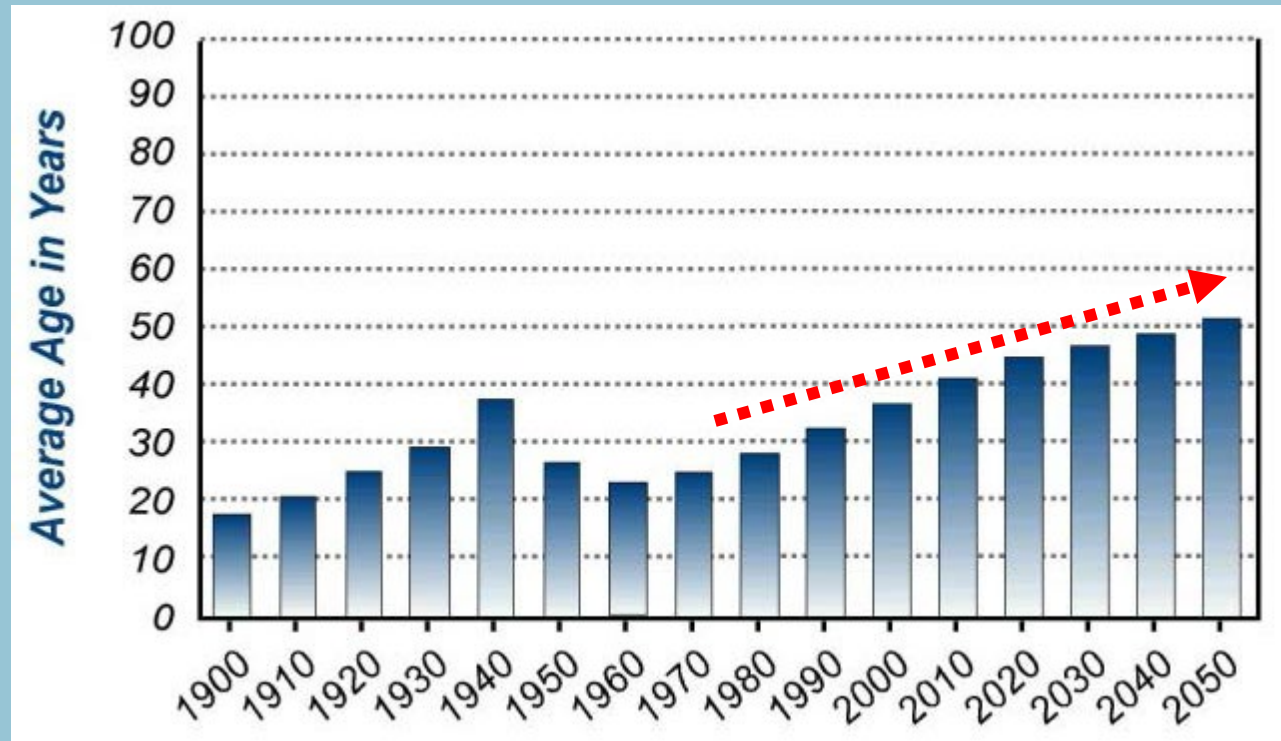
Where Do We Stand?

- 250,000 – 300,000 Water Main breaks per year
- ▶ The est. 6 billion gallons of clean drinking water per day lost to leaking pipes is around 15% of the daily drinking water usage and could support 16 million homes
- Drinking Water is delivered via 2.2 million miles of pipes across the Country. An est. 43% of installed pipes are between 20 & 50 years old, 23% greater than 50 years old, and nearly 10% of pipes were classified as “beyond their useful life” at 75-100 years.
- Utilities had been averaging a pipe replacement rate of 0.5% per year in 2015 (200 years to replace the system). By 2019, replacement rate has improved to 1.5%

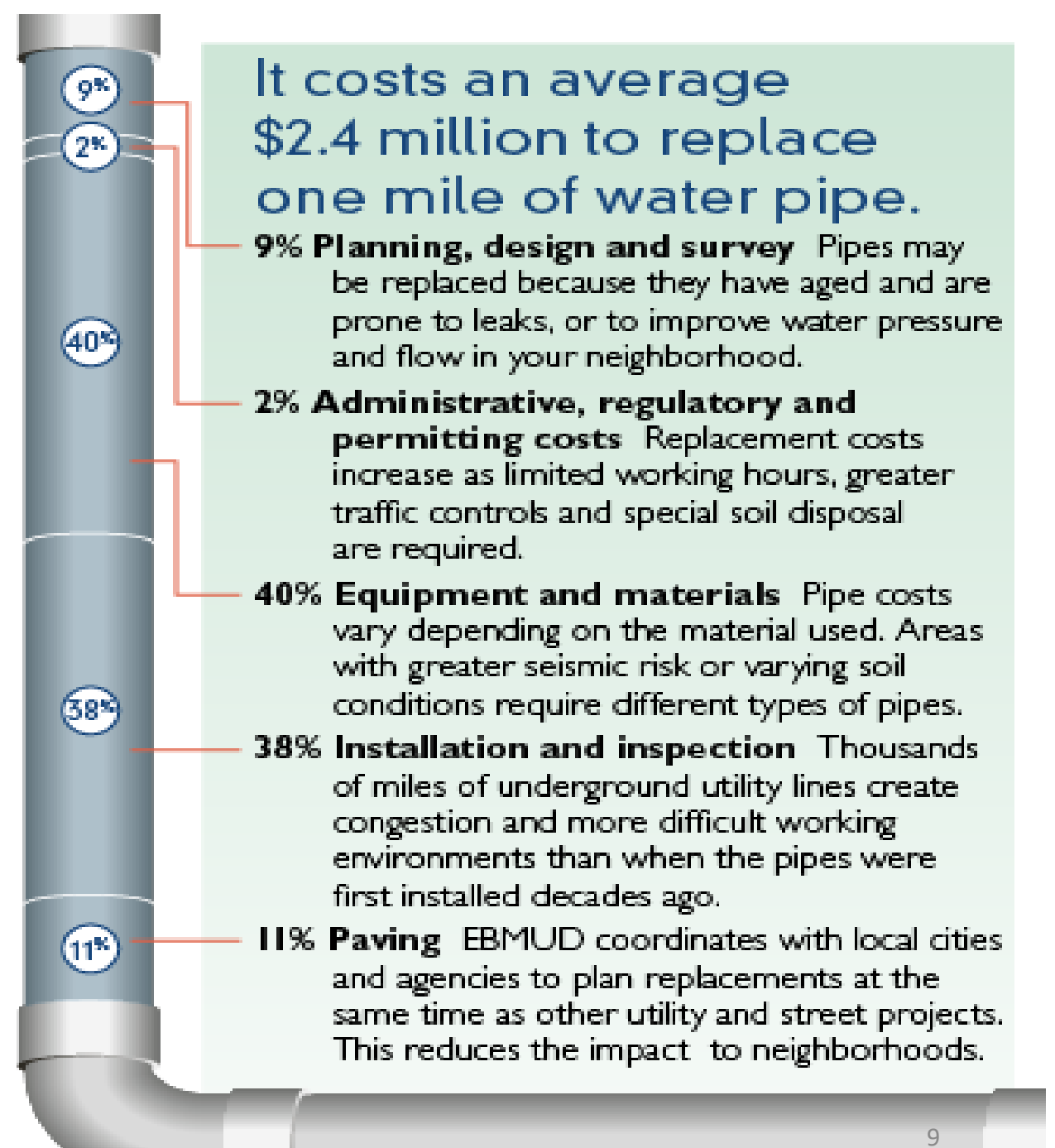
Aging Infrastructure

By 2050, average age will be 50 yrs old

*Varies widely by region



Cost of Replacing Pipe



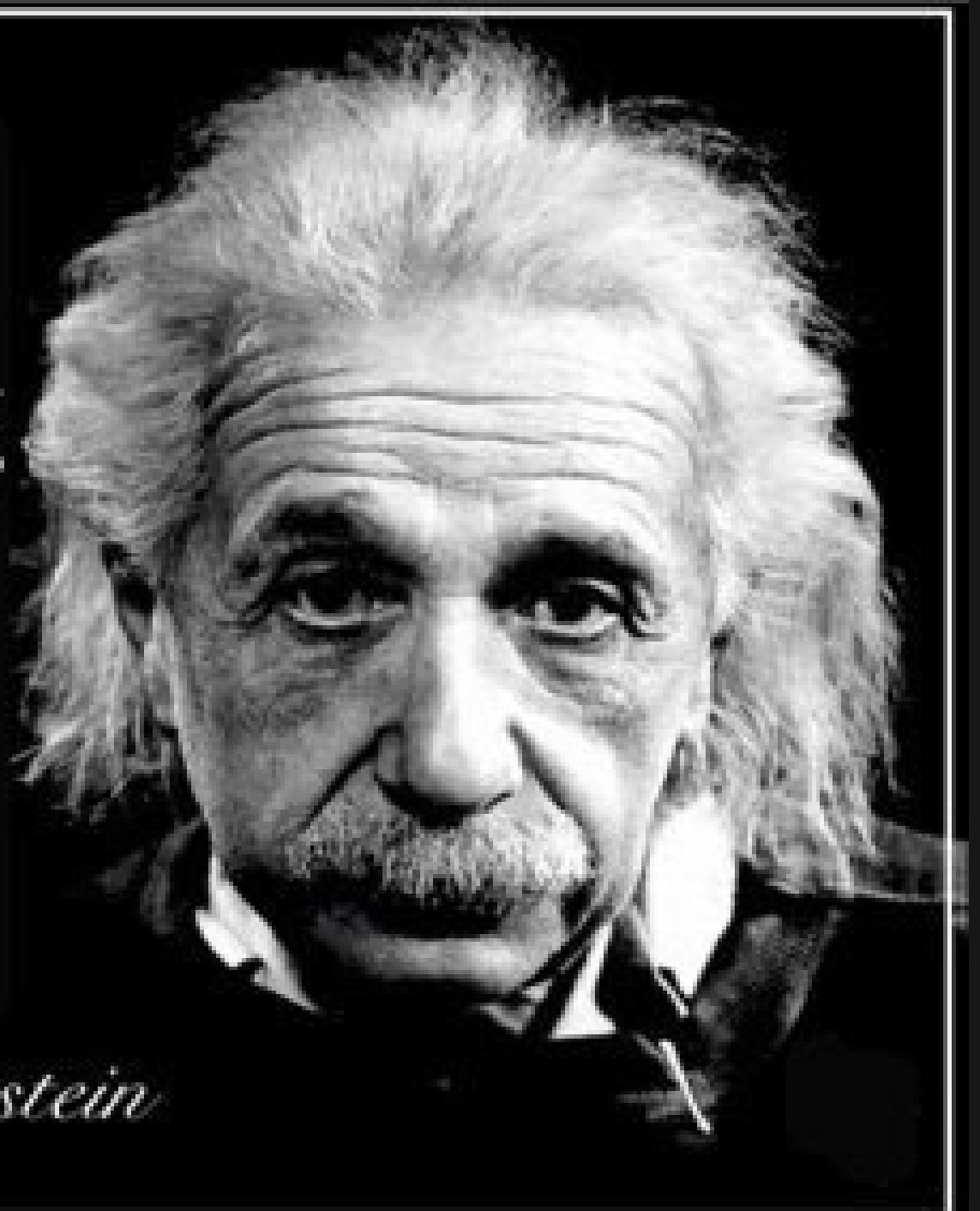
So How Bad is it?

“...restoring existing water systems as they reach the end of their useful lives and expanding them to serve a growing population will cost at least \$1 trillion over the next 25 years, if we are to maintain current levels of water service.”

**Buried No Longer, AWWA*

Insanity:
doing the same thing
over and over again
and expecting
different results.

- Albert Einstein





- Poor Planning

- Corrosion

 - Age of Materials*

- Improper Installation

- Inability to Adapt

- System Dynamics

 - Temperature & Movement*

- Manufacturing Defects



Let's Talk "Planning"





Understanding how EPA DEVELOPS NEW DRINKING WATER REGULATIONS

EPA works to ensure that drinking water is safe by developing National Primary Drinking Water Regulations (NPDWRs) for new contaminants under the Safe Drinking Water Act. Below demonstrates the steps EPA takes when developing new drinking water regulations:

STEP 01 IDENTIFICATION

IDENTIFY
unregulated contaminants.

PUBLISH
a list of unregulated contaminants in a Contaminant Candidate

PRIORITIZE
the contaminants using monitoring data, risk assessments and other

TURN OFF NOTICE

BOROUGH OF ALPHA WATER/SEWER
1001 EAST BOULEVARD
ALPHA, NJ 08565
(908)454-0088 EXT 120
taxcollector@alphaboronj.org

WATER SERVICE NOTICE TO OCCUPANT

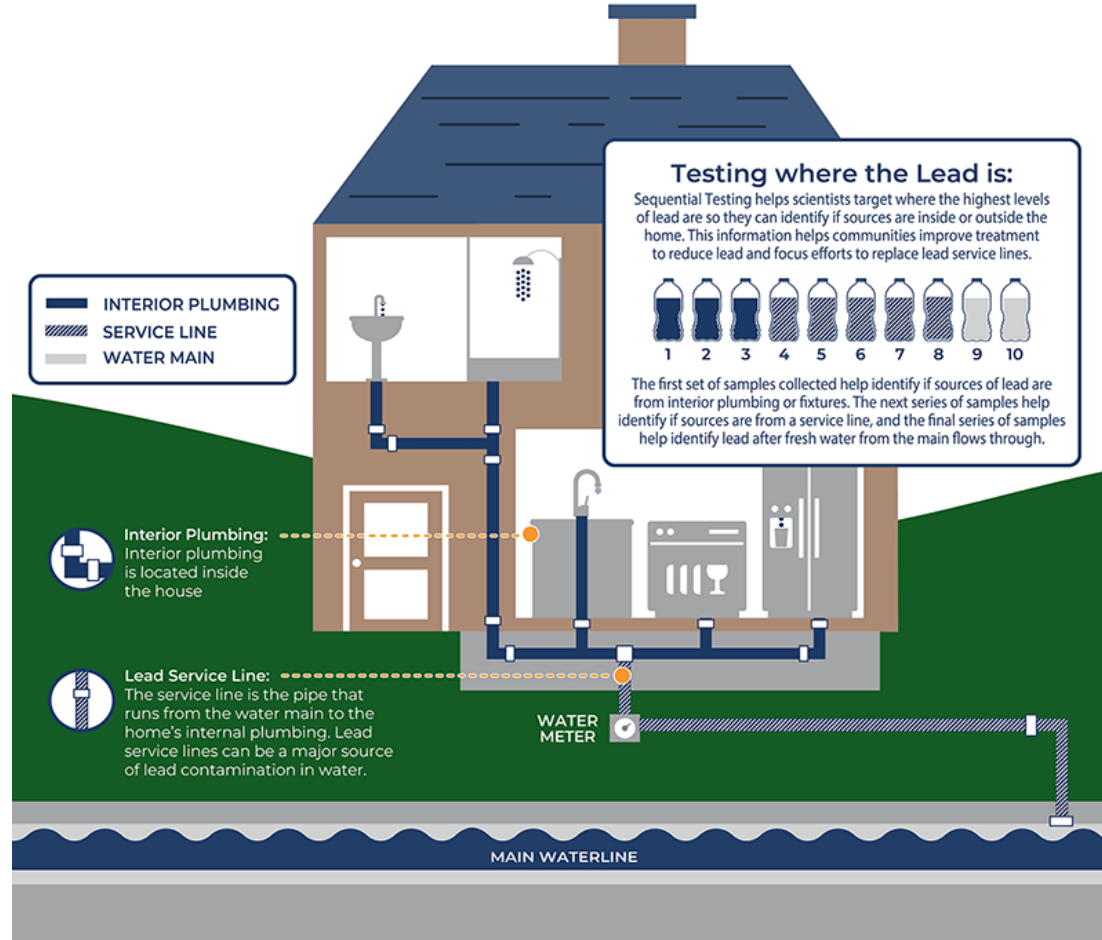
Your water is subject to be turned off due to Non-Payment if not paid by 3/26/2020.

If your water is shut off additional charges will be required to have it restored. The additional charges will include a \$50 turn off fee and \$50 turn on fee.

Please contact the water/sewer department with any questions or payment amount.

Due to COVID-19 all public access to the Borough of Alpha Municipal Building has been suspended.

All payments must be made online or placed in the drop box located in the rear of the municipal building. NO CASH is to be left in the drop box – check or money order only.



Lead Service Line Inventory

Lead

3,335

Any portion of the service line is known to be made of lead

Galvanized

1,759

The service line is not made of lead, but a portion is galvanized and the system is unable to demonstrate that the galvanized line was never downstream of a lead service line.

Non-Lead

653

All portions of the service line are known NOT to be lead or GRR through an evidence-based record, method, or technique.

Unknown

1,484

The service line material is not known to be lead or GRR. For the entire service line or a portion of it (in cases of split ownership), there is not enough evidence to support material classification.

Verified Service Lines



4,837

07,231

Replaced

653

Total number of lead service lines replaced.

Zoom to

Pan

Account ID: 2266

Address:

Utility Side Verified: Yes

Customer Side Verified: Yes

Replacement Status: Scheduled Replacement

Utility Side Scheduled Replacement Date: 5/19/2021, 5:00 PM

Customer Side Scheduled Replacement Date:

Notified Customer: Yes

Last edited by Content Admin on 1/9/2023, 12:16 PM.

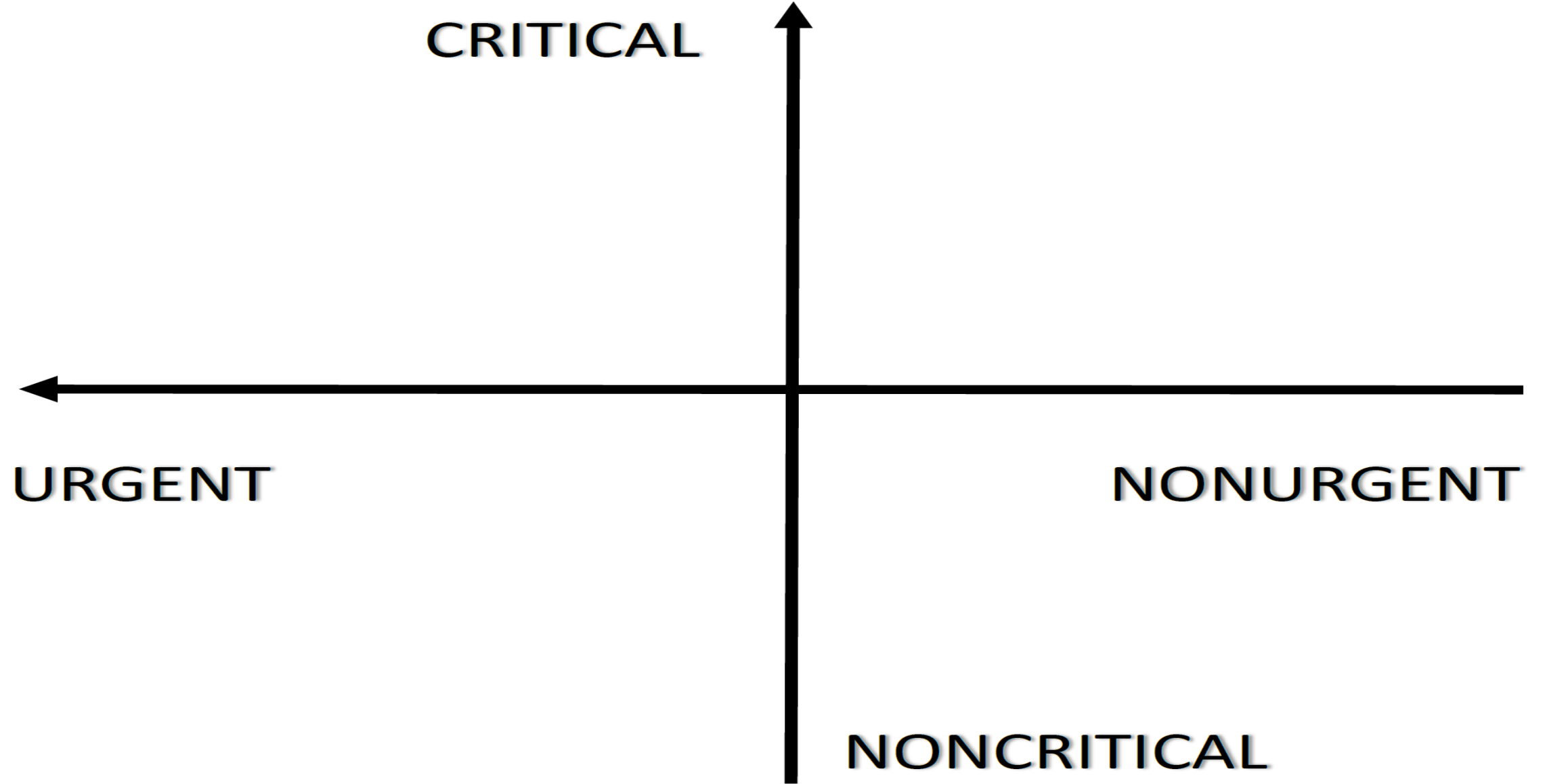


Lead Service Lines	
	Account ID: 401 Address:
	Account ID: 414 Address:
	Account ID: 18 Address:
	Account ID: 47 Address:
	Account ID: 129 Address:
	Account ID: 171 Address:
	Account ID: 215 Address:
	Account ID: 313 Address:
	Account ID: 478 Address:
	Account ID: 719 Address:
	Account ID: 771 Address:
	Account ID: 811 Address:
	Account ID: 845 Address:
	Account ID: 922 Address:
	Account ID: 952



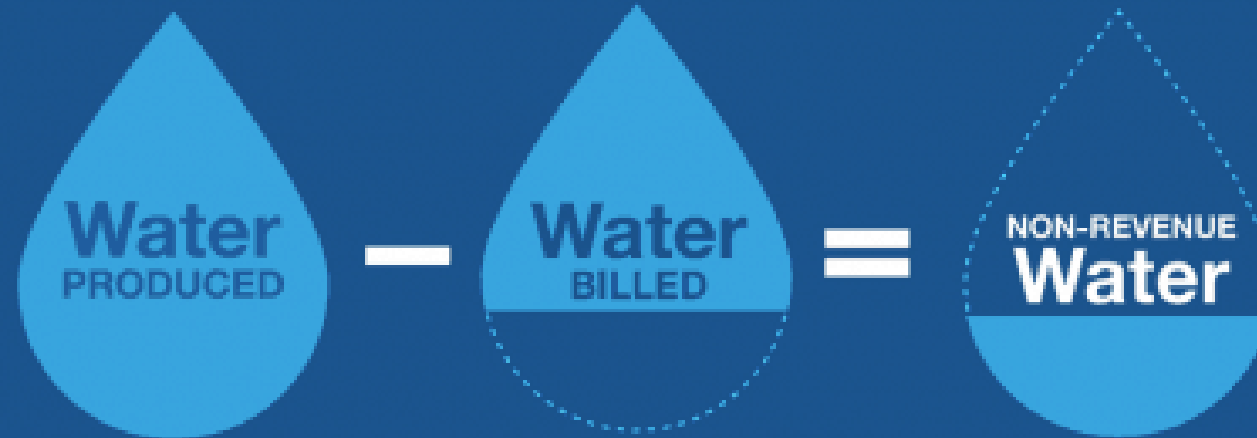
THE EISENHOWER MATRIX

*How to Make
Decisions on What's*
URGENT & IMPORTANT



Hear That?

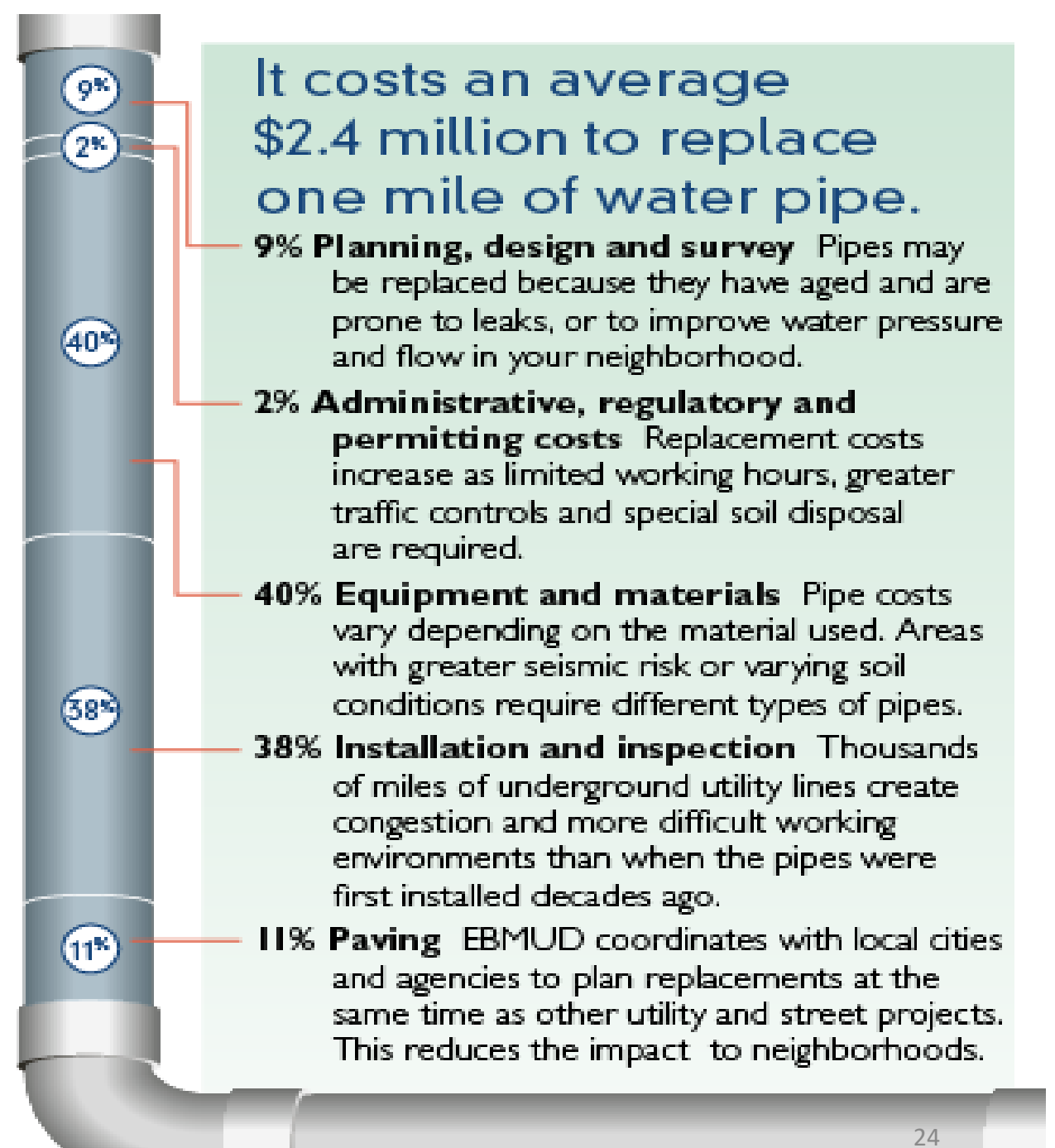
It's the sound of non-revenue water and your budget going down the drain.

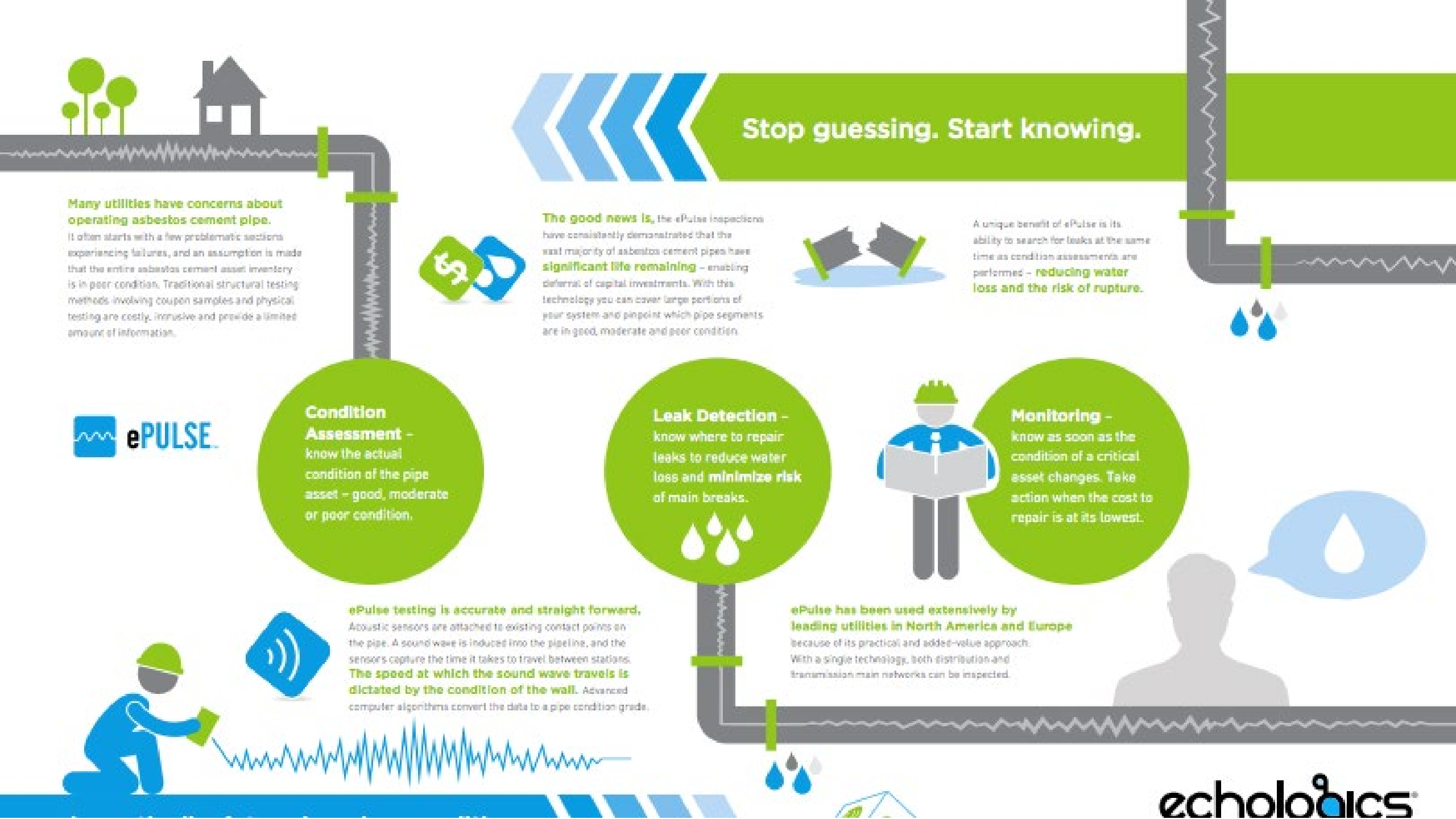


How Much of Your Water is Non-Revenue?

Average of **24%** Per Year

Cost of Replacing Pipe





Stop guessing. Start knowing.

Many utilities have concerns about operating asbestos cement pipe.

It often starts with a few problematic sections experiencing failures, and an assumption is made that the entire asbestos cement asset inventory is in poor condition. Traditional structural testing methods involving coupon samples and physical testing are costly, intrusive and provide a limited amount of information.



The good news is, the ePulse inspections have consistently demonstrated that the vast majority of asbestos cement pipes have **significant life remaining** – enabling deferral of capital investments. With this technology you can cover large portions of your system and pinpoint which pipe segments are in good, moderate and poor condition.



A unique benefit of ePulse is its ability to search for leaks at the same time as condition assessments are performed – **reducing water loss and the risk of rupture.**



Condition Assessment – know the actual condition of the pipe asset – good, moderate or poor condition.

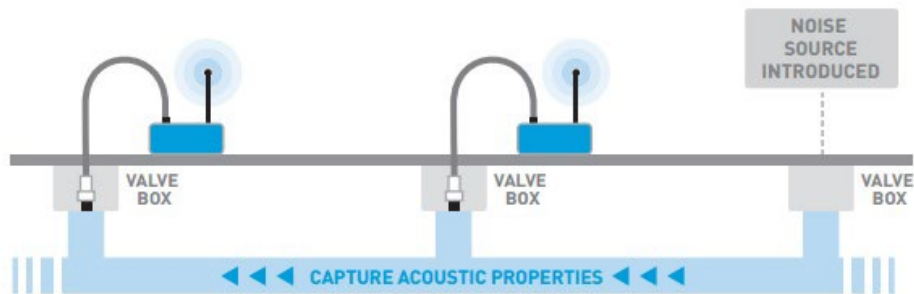
Leak Detection – know where to repair leaks to reduce water loss and minimize risk of main breaks.

Monitoring – know as soon as the condition of a critical asset changes. Take action when the cost to repair is at its lowest.

ePulse testing is accurate and straight forward. Acoustic sensors are attached to existing contact points on the pipe. A sound wave is induced into the pipeline, and the sensors capture the time it takes to travel between stations. **The speed at which the sound wave travels is dictated by the condition of the wall.** Advanced computer algorithms convert the data to a pipe condition grade.

ePulse has been used extensively by **leading utilities in North America and Europe** because of its practical and added-value approach. With a single technology, both distribution and transmission main networks can be inspected.

echolobics®



Pipe Segment	Site	Length	Pipe Type	Nominal Thickness	ePULSE Measured Thickness	% Change from Nominal
#	#	(ft)		(inch)	(inch)	%
1	1	361	AC	0.76	0.64	-16%
2		444	AC	0.76	0.64	-16%
3		258	AC	0.66	0.42	-36%
4		352	AC	0.66	0.42	-36%
5		329	AC	0.66	0.41	-38%
6		341	AC	0.66	0.47	-29%
7		250	AC	0.76	0.60	-21%
8		253	AC	0.76	0.62	-18%
9		512	AC	0.76	0.62	-18%
10		448	AC	0.76	0.64	-16%
11	2	320	AC	0.76	0.60	-21%
12		362	AC	0.76	0.63	-17%
13	2	237	AC	0.66	0.43	-35%
14		369	AC	0.66	0.42	-36%
15		646	AC	0.76	0.63	-17%
16		374	AC	0.66	0.47	-29%

ePulse[®]

Scans Part or All of a Main



VS.



Replace vs Repair

With well-developed repair strategies, many water utilities currently find a largely reactive approach cheaper (in the short term) than establishing a systematic rehabilitation program.





Types of Repair

- **Open cut replacement of pipe section(s)**
- **Repair w/ mechanical sleeves or repair clamps**
- Spot repairs using cured-in-place-pipe (CIPP)
- Joint repairs using internal sleeves or external devices.

Direct vs Indirect Costs



WHAT IS THE AVERAGE COST OF
A REPAIR?



WHAT PERCENTAGE OF THIS IS
THE ACTUAL REPAIR PRODUCT?

But What's Your Time Worth?

Less time in the ditch = safer conditions
and less \$ spent on repair



Direct vs Indirect Costs

Based on direct costs alone, it is less costly to continually repair damaged mains than to replace them



Other Planning Considerations

- ENGINEERING

IN-HOUSE -OR- OUTSOURCED

- BID/ AWARD PROCESS

MODIFICATIONS TO EXISTING METRICS

Bid Award Time!





- Poor Planning

- Corrosion

 - Age of Materials*

- Improper Installation

- Inability to Adapt

- System Dynamics

 - Temperature & Movement*

- Manufacturing Defects

CORROSION

TYPES OF CORROSION

- GENERAL CORROSION – (ATMOSPHERIC)

THIS TYPE OF CORROSION IS CHEMICAL OR ELECTROCHEMICAL IN NATURE. HOWEVER, THERE ARE NO DISCRETE ANODE OR CATHODE AREAS. THIS FORM OF CORROSION IS UNIFORM OVER THE SURFACE EXPOSED TO ITS ENVIRONMENT.

- CONCENTRATION CELL CORROSION – (GALVANIC)

THIS TYPE OF CORROSION IS CAUSED BY AN ELECTROCHEMICAL CORROSION CELL. THE POTENTIAL DIFFERENCE (ELECTROMOTIVE FORCE) IS CAUSED BY A DIFFERENCE IN CONCENTRATION OF SOME COMPONENT IN THE ELECTROLYTE.

CORROSION

Issues with hot soils?

Painting Fire Hydrants Every 3-5 Years?



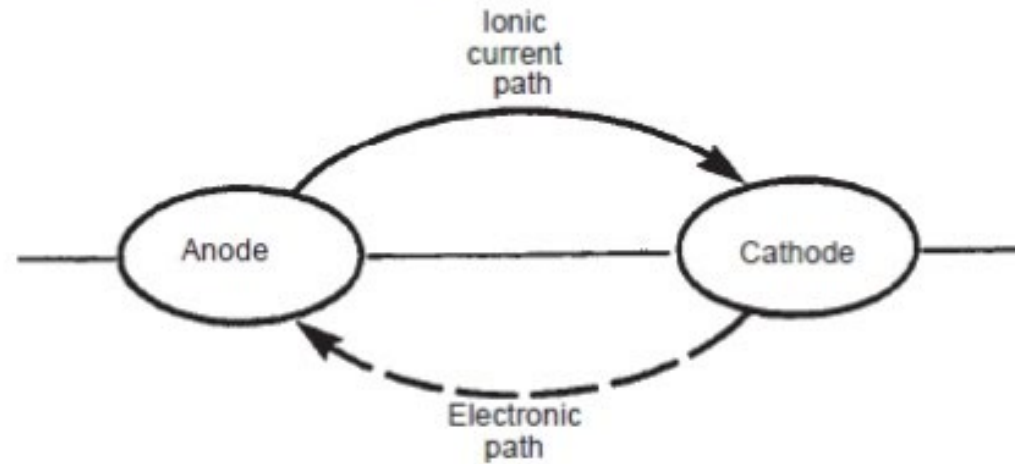
Corrosion



Four requirements of corrosion

- Anode
- Cathode
- Current flow
- Electronic path

} Cell



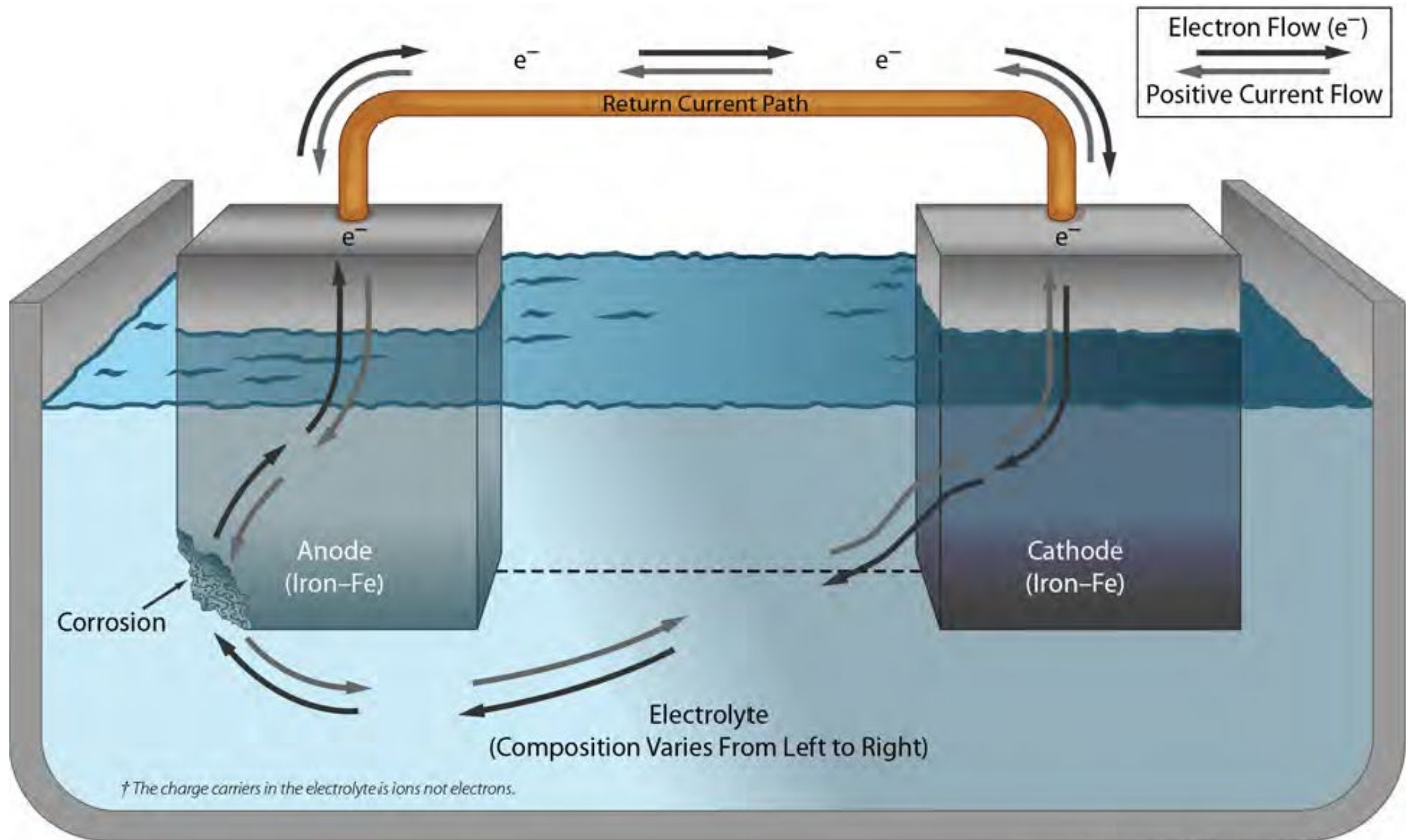


Figure courtesy of **NACE International**

**All Four Elements of the Cell Must be
present For Corrosion to Occur!**

Remove Any One Element and Corrosion.....

STOPS!

Corrosion Rates

The corrosion rate or acceleration rate of a Galvanic coupling is affected by several factors:

Potential difference between the metals

Nature of the environment

Spatial effects such as area, distance and cell geometry

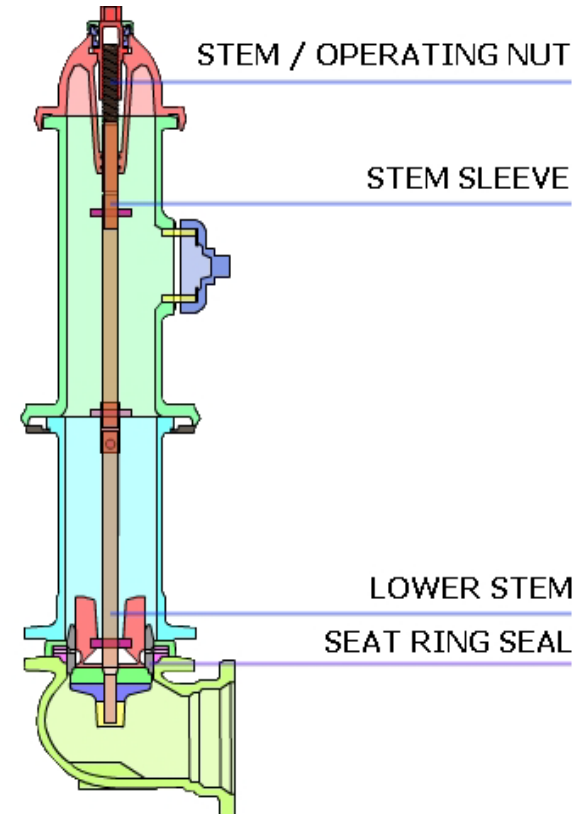
Electrolyte resistivity





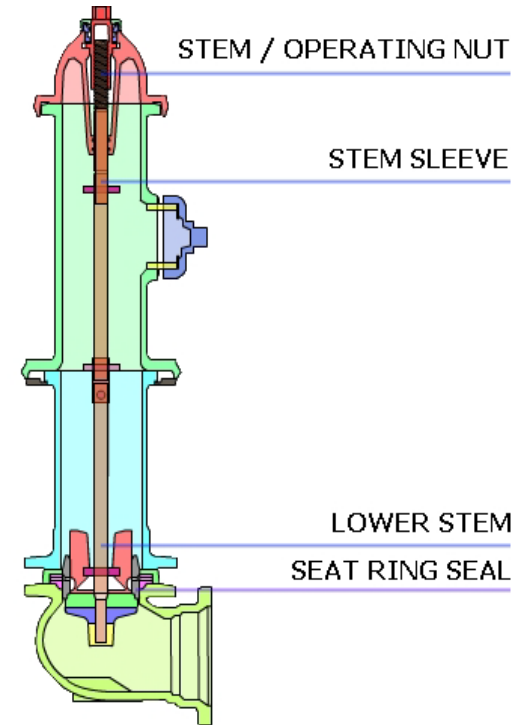
The Four Areas of Electrolysis & Hydrant Failure

1. STEM/OPERATING NUT - The stem "rusts" to the operating nut, and is the cause of "hard to operate" in many cases. Results of this condition are rounded off pentagon or square wrench nut, twisted off operating nuts, and twisted stem stress to the point of failure of the stem anti-rotation device. The hydrant can become locked and completely inoperative. Moisture is typically admitted by the stem sleeve cracking.



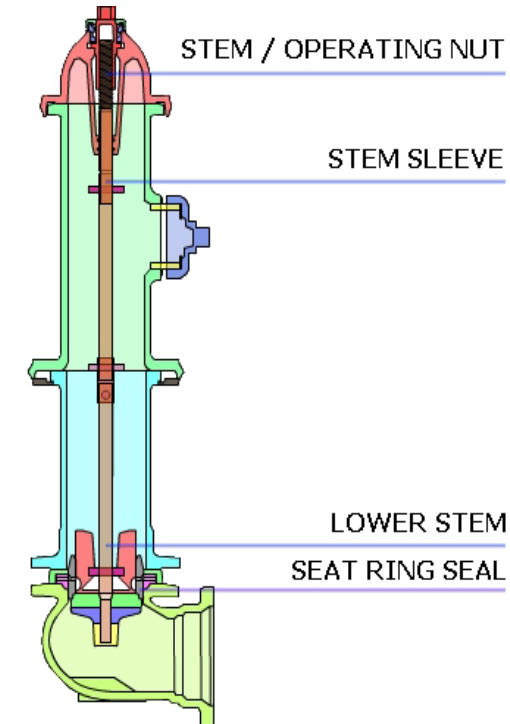
The Four Areas of Electrolysis & Hydrant Failure

2. STEM SLEEVE - The stem sleeve is a thin brass tube slid over the steel upper stem, to provide a smooth seal for the bonnet/stem juncture. Electrolysis occurs between the brass stem sleeve and the underlying steel stem. The lower 1/2" of the stem sleeve is not sealed against moisture. Water collects underneath the sleeve, rust forms and grows, and the stem sleeve cracks. Now water is able to flow through the sleeve and into the operating nut area and wash out the lubricant, resulting in the problems in 1. above. The stem sleeve can become so loose that it migrates upward and locks up the operating nut. A dry, unlubricated sleeve can also make the hydrant very difficult to operate.



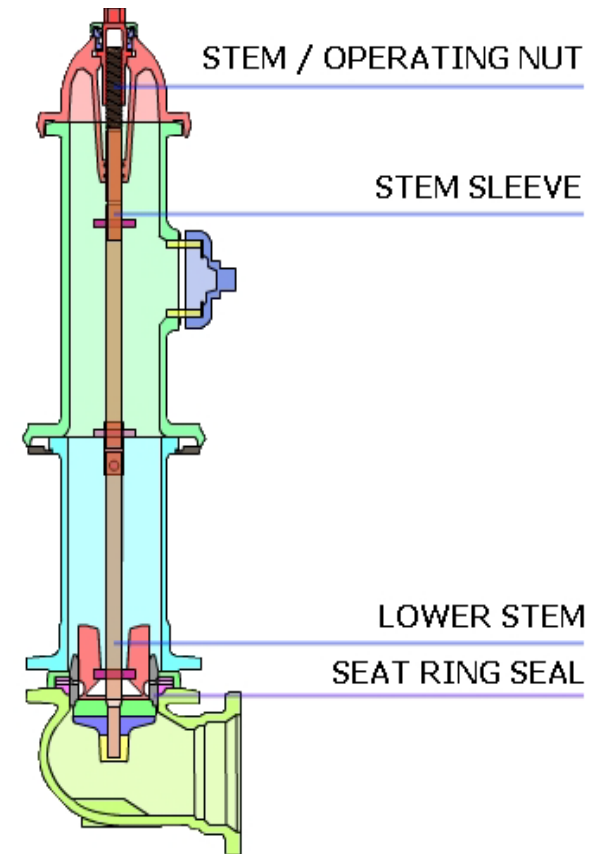
The Four Areas of Electrolysis & Hydrant Failure

3. LOWER STEM - One of the worst areas for stem rust, due to the bottom few inches contain the anti-rotation device, the drain valve, and hydrant valve. Electrolysis occurs between the brass drain valve and the steel stem. Rust here typically disables the anti-rotation device, or allows the stem to bend when opening pressure is applied from above. Stems that are designed to slide thru the drain lever can become locked to the point that they bend or break the drain lever. Rust here is further aggravated by opening the hydrant, the resulting stream of water flowing thru the elbow flushes away old stem rust, and new rust is now initiated. Coastal areas are particularly vulnerable to lower stem rust, since the lower barrel of the hydrant is typically filled with standing water from a high water table. Water allowed in through the drain holes becomes mixed with mud, bacteria, acids, etc. and is highly corrosive to the stem. It can also contaminate drinking water.



The Four Areas of Electrolysis & Hydrant Failure

4. SEAT RING SEAL COMPRESSION AREA - A nightmare area for the fire hydrant repairman. Sadly, this is a very common occurrence. Electrolysis occurs in the contact area of the brass seat ring and the cast iron hydrant elbow. A pitted surface here will not allow proper sealing of the seat o-rings or gasket, and the hydrant will leak. New seat o-rings, new seat ring, new main valve, etc. will not fix the problem. Leaks here may be undetected because water flows out the drain holes and is not visible from the groundline. Repairs are further complicated by the "locking" of the seat ring by the rust from the mating hydrant elbow., making the seat ring very difficult to remove for repairs. Most seat wrenches provided by the manufacturer are not effective in removing these locked in seat rings. Over torque of the seat wrench can result in injuries and even further damage internal parts

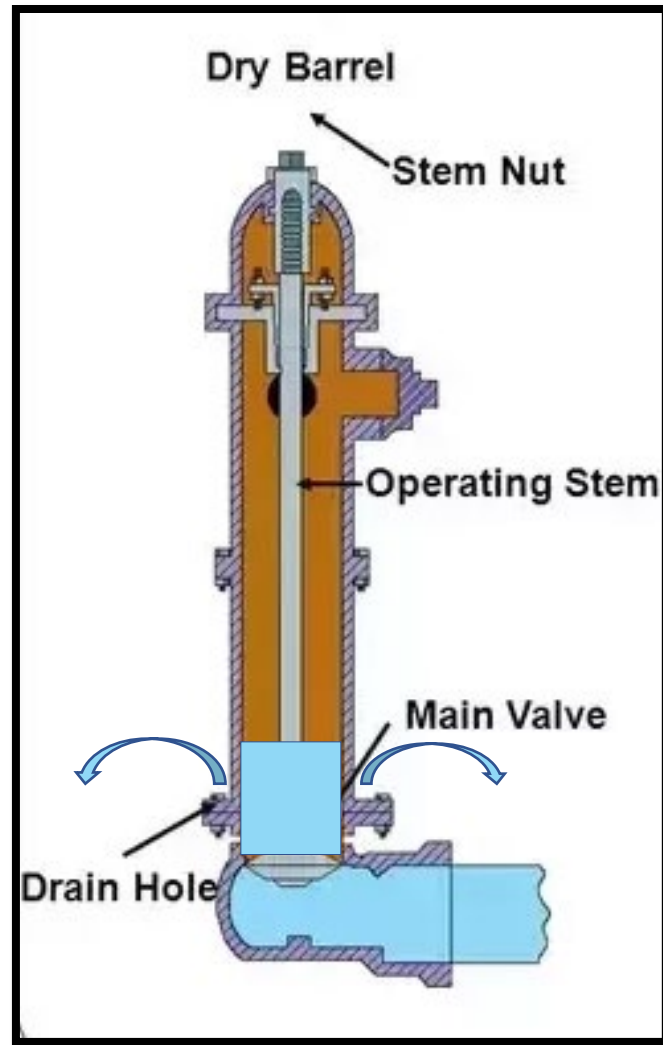


**All Four Elements of the Cell Must be
present For Corrosion to Occur!**

Remove Any One Element and Corrosion.....

STOPS!

- When a valve seat leaks
- The water continuously leaks out of the drain holes
- Can freeze causing it to be inoperable
- Enormous amounts of waste of a valuable resource



National hydrant leak data

	No. Hydrants	Avg Loss GPM (Est)	Gallons Lost	Gallons Lost	Gallons Lost	Gallons	Block 1 Denver Water	Total Est Loss	Conservative Est. of
Leak Detection Survey Referenced	Leak Detected	Per Hydrant	Per Day (Est)	Per Month (Est)	Per Year (Est)	Per 1000	Price (per 1000g)	Billable Water Revenue	Managing Lost Water
City of Orland, CA (11-14)	80	3.5	403,200	12,264,000	147,168,000	147,168	\$2.36	\$347,316.48	\$73,584.00
Town of Ipswich, MA (8-14 - 9-14)	4	1	5,760	175,200	2,102,400	2,102	\$2.36	\$4,961.66	\$1,051.20
Town of Ashland, MA (11-14 - 12-14)	5	2.25	16,200	492,750	5,913,000	5,913	\$2.36	\$13,954.68	\$2,956.50
Town of Weston, MA (12-17)	4	4.75	27,360	832,200	9,986,400	9,986	\$2.36	\$23,567.90	\$4,993.20
Shrewsbury Water System, MA (12-15)	10	6.9	99,360	3,022,200	36,266,400	36,266	\$2.36	\$85,588.70	\$18,133.20
Colorado Survey	4	1	5,760	175,200	2,102,400	2,102	\$2.36	\$4,961.66	\$1,051.20
Example Utility #1	420	1	604,800	18,396,000	220,752,000	220,752	\$2.36	\$520,974.72	\$110,376.00
Example Utility #2	2000	1.2	3,456,000	105,120,000	1,261,440,000	1,261,440	\$2.36	\$2,976,998.40	\$630,720.00

WATER LOSS

HOW MUCH ARE WE TALKING ABOUT?

Total Number Of Hydrants	2,000		
Ratio of Leaking Hydrants (from publicly disclosed leak survey results)	0.5	/	5
% of Hydrants Leaking	10.00%		
Leak Rate (from publicly disclosed leak survey results) is between 1.5 - 2.5 GPM	1.50	GPM	
Total Number Of Leaking Hydrants	200		
Gallons of Water Lost Per Hour	18,000		
Gallons of Water Lost Per Day	432,000		
Gallons of Water Lost Per Month	13,139,712		
Gallons of Water Lost Per Year	157,680,000		

Example of estimated water loss with 2,000 fire hydrants

Total Number Of Hydrants	8,000		
Ratio of Leaking Hydrants (from publicly disclosed leak survey results)	0.5	/	5
% of Hydrants Leaking	10.00%		
Leak Rate (from publicly disclosed leak survey results) is between 1.5 - 2.5 GPM	1.50	GPM	
Total Number Of Leaking Hydrants	800		
Gallons of Water Lost Per Hour	72,000		
Gallons of Water Lost Per Day	1,728,000		
Gallons of Water Lost Per Month	52,558,848		
Gallons of Water Lost Per Year	630,720,000		

Example of estimated water loss with 8,000 fire hydrants

CURRENT HYDRANT PROBLEM: RELIABILITY

Newark, NJ (2013) - 15% of City's Hydrants would cause Delays in Emergency Response

Detroit, MI (2015) - Over a two Month Period, roughly 15% of the City's Hydrants were Surveyed, of which, 279 Hydrants were flagged as "inoperable" by City Firefighters

"The way we find out a Hydrant isn't working is when we pull up to one and connect to the Hydrant"
-Dan Dugan, President D.C. Firefighters Association

CAUSE

- * INFERIOR MATERIALS/ COMPONENTS
 - WEATHERING, CORROSION, OXIDATION & RUST
- * DAMAGE FROM VANDALISM, TAMPERING & IMPACT
- * INADEQUATE PREVENTATIVE MAINTENANCE



CURRENT HYDRANT PROBLEM: WATER LOSS

Electrolysis occurs in the contact area of the brass seat ring and the cast iron hydrant elbow. A pitted surface here will not allow for proper sealing of the seat O-rings or gasket, and the hydrant will leak. New seat O-rings, new sets rings, new main valve, etc. will not fix the problem. Leaks here may be undetected because water flows out the drain holes and is not visible from the groundline. Millions of gallons of water are lost Annually due to this [alone]. *Source: Quality Hydrant Company (link below)

One Norther California City detected leaks in 80 of their existing Fire Hydrants at an average rate of 3.5gpm, which would equate to 147,168,000 gallons of clean drinking water lost each year.

CAUSE

- * CORROSION DUE TO INFERIOR MATERIALS/ COMPONENTS

Source Link: [http://www.qualityhydrant.com/default.aspx?Section=Presentation&Product=4%](http://www.qualityhydrant.com/default.aspx?Section=Presentation&Product=4%20)



"Saving water, saving costs, saving lives"

CURRENT HYDRANT PROBLEM: SECURITY

"The Distribution System is the top Vulnerability of Drinking Water Systems with Hydrants Specifically Referenced"
-Dept. of Homeland Security GAO Report, 2004

In July of 2019, the unauthorized Hydrant hook-up by a Spokane, WA Hydroseeding Company resulted in a cross-contamination of the potable water system with E. Coli

Bozeman, MT (2003) - Experienced one of the worst Water thefts in US History, with almost 3 Million Gallons of Water Stolen over a three-day period

CAUSE

- * INEFFECTIVE SECURITY MEASURES
 - UNAUTHORIZED ACCESS WITH STANDARD WRENCH, BOLT CUTTERS, AND OTHER COMMON TOOLS



CURRENT HYDRANT PROBLEM: MAINTENANCE

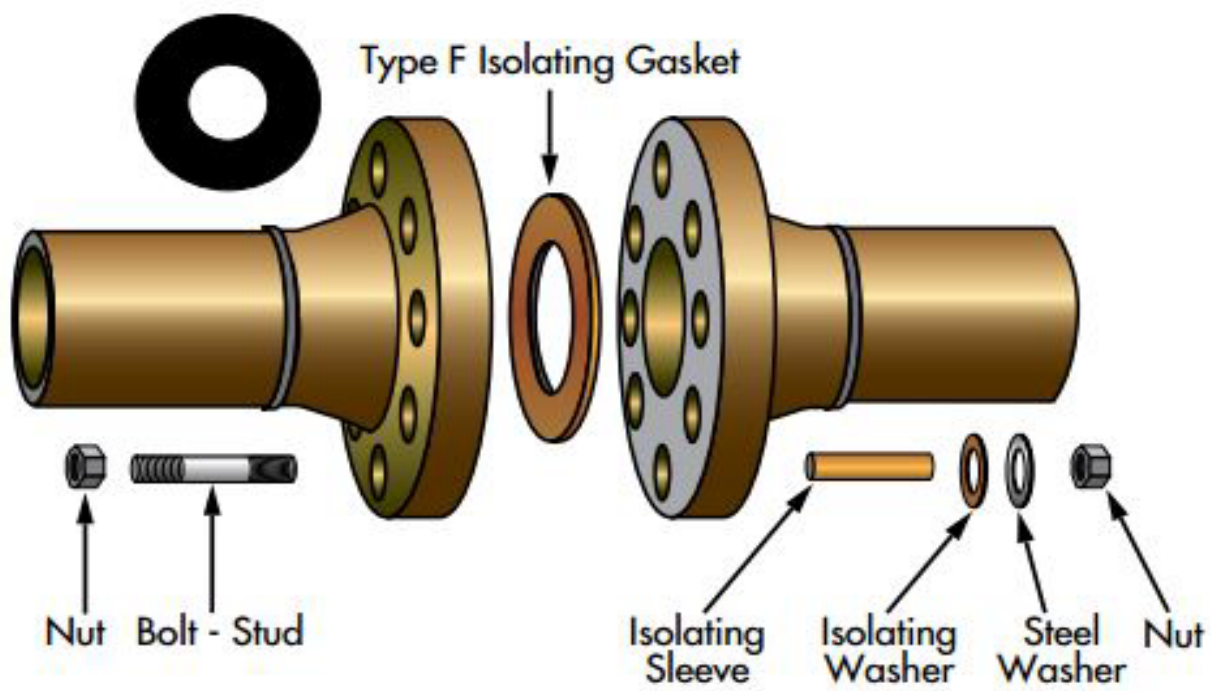
With the cost of parts, labor and other Hydrant related incidents, the average municipality will spend between \$200 - \$700 per hydrant per year to maintain all Hydrants in their system, excluding replacement and new installations.

The majority of Hydrant Manufactures recommend that their Hydrants be serviced at least once a year to be greased, and to check for functionality.

CAUSE

- * ATMOSPHERIC CORROSION & GALVANIC CORROSION
 - INSUFFICIENT COATINGS (SUN-FADING, RUST, ETC.)
 - DAMAGING ELECTROLYSIS DUE TO DISSIMILAR METALS
- * INADEQUATE LIMITED MANUFACTURES WARRANTY





• Eliminate high VOC paints and replaces with environmentally friendly coating system.

MEGA-BOND™ Restraint Coating System

Selection of Materials & Coatings





- Poor Planning

- Corrosion

 - Age of Materials*

- Improper Installation

- Inability to Adapt

- System Dynamics

 - Temperature & Movement*

- Manufacturing Defects



Installation

PVC PIPE ASSOCIATION TECHNICAL BRIEF

INSTALLATION OF PVC PIPE INTO A MECHANICAL JOINT (MJ)

ASTM D3139 is the standard for joints for gasketed plastic pipe. The standard defines “mechanical joint” as: “a joint in which a positive seal is achieved when a gasket is compressed by means of a mechanical device.” A mechanical-joint (MJ) connection is the most common method used to join PVC pipe to a valve or an iron fitting. An MJ connection includes a gasket, a follower-gland that compresses the gasket, a mechanical restraint device, and bolting hardware. For some types of MJ, the restraint device is incorporated into the follower gland.

RECOMMENDATIONS

An MJ installation process will be more successful if the following recommendations are followed:

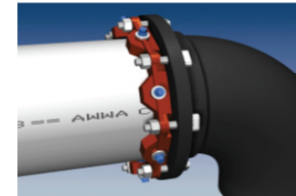
1. Compare the pipe’s print line to the restraint hardware information.
 - The print on the PVC pipe includes information about:
 - o Pipe material
 - o Pipe outside-diameter type
 - o Pipe size
 - o Product standard
 - This information should be cross-checked against the restraint packaging to ensure that the correct hardware is used with the installed pipe.
 - The use of correct hardware is important to prevent problems with the joint.
2. Prepare the PVC pipe’s spigot end.
 - To ensure proper sealing, the bevel at the end of the PVC pipe spigot should be removed.
 - The end of the pipe should be cut square.
3. Insert the PVC pipe’s spigot end into the appurtenance bell.
 - The squared-off end of the spigot should be bottomed in the appurtenance bell.
 - MJ’s typically have a shallow insertion depth, so the pipe’s insertion line should be ignored.
4. Install the MJ gland per the [AWWA C600 installation standard](#).
 - The guide provides information on:
 - o Cleaning of the hardware and lubrication of the gasket
 - o Placement of gasket and MJ follower-gland onto the pipe
 - o Pushing of gasket and gland into the valve/fitting socket
 - o Insertion and tightening of bolts (including bolt-torque ranges for different pipe sizes)
 - o Bolt-tightening pattern and guidance
 - Torque recommendations should be followed to provide proper connections.
 - The standard states: “The use of a torque-indicating wrench will facilitate this procedure.”
5. Install the restraint hardware per the manufacturer’s instructions.
 - Some MJ hardware incorporates the gripping mechanism into the design of the mechanical joint gland. After the mechanical joint gland is assembled to the appurtenance, the restraint is actuated by tightening a set of twist-off nuts.
 - When twist-off nuts are not present, torque recommendations should be followed.

For additional information, see [EBAA Iron’s document GI-6](#) “The Installation of Mechanical Joint Fittings.”

TORQUE WRENCH – YES

Under-tightening or over-tightening of bolts can result in leaks or other problems, so it is important to conform to published torque recommendations. Some MJ types include torque-limiting twist-off nuts – where these nuts are not present, use of a torque wrench is recommended to provide feedback to the installer about the tightening process.

References: ASTM D3139 “Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals,” 2011; AWWA C600 “Installation of Ductile Iron Water Mains and Their Appurtenances,” 2010; EBAA Iron website www.ebaa.com; “The Installation of Mechanical Joint Fittings,” EBAA Iron



MJ installed on AWWA C900 pipe

THE INSTALLATION OF MECHANICAL JOINT FITTINGS

The American Water Works Association (AWWA) has published a standard known as C600 since 1938. This standard is currently entitled "Installation of Ductile-Iron Water Mains and Their Appurtenances". Among other things, C600 covers the assembly of the standardized mechanical joint. Since it is not often that one sees an AWWA standard being read in the trench it seems appropriate to review this portion of the standard as a training tool for new and experienced installers alike. The format we will use is to print each step of the standard, followed by a brief explanation of the important aspects of that step.

ANSI/AWWA C600-05, § 4.3 Joint Assembly, Figure 3

1. *Clean the socket and the plain end. Lubrication and additional cleaning should be provided by brushing both the gasket and the plain end with soapy water or an approved pipe lubricant meeting the requirements of ANSI/AWWA C111/A21.11 just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.*

NOTE: In cold weather it is preferable to warm the gasket to facilitate assembly of the joint.

Cleaning the sealing surfaces is obvious importance. No one would expect a gasket to seal if it has rocks and sand under it. Take the time to clean both the pipe and the gasket cavity of the fitting. While you are cleaning, inspect the sealing surfaces. Deep scratches in the pipe, or a chunk of cement mortar lining (or iron) in the bell of the fitting will make the joint nearly impossible to seal.

Give the gasket a good inspection. Since you are assembling a joint that may be in service for 50 to 100 years, don't take a chance on a questionable gasket.

Lubrication of the gasket is also very important. Anyone who has tried to assemble a push-on joint knows that it is nearly impossible to do without proper lubrication. In this joint, the gasket is moved into position and compressed during the insertion of the spigot.

The mechanical joint seals by the force of the t-bolts pushing the gland which moves and compresses the gasket. With the gasket being trapped in a confined volume and the gland pushing from one side, the gasket experiences an increase in internal pressure. This pressure causes the gasket to exert enough force against the surfaces of the pipe and fitting to form a seal. Rubber is well known for its friction properties. If too much of the force generated by the t-bolts is being used to overcome this friction, then there may not be enough force left to create the necessary sealing pressure in the gasket. Lubrication simply allows the gasket to slide into its sealing position more easily so that the effort you are exerting by tightening the bolts is being transferred more efficiently.

It should go without saying, but be sure to keep rocks and sand out of the lube bucket.

Gaskets, being made of rubber, also have a tendency to creep or cold flow into their area of confinement. This characteristic is also referred to as gasket relaxation, but its effect is the same. In some ways the rubber can act like a solid yet at the same time can act like fluid when it tries to expand to fill an area. In the case of the mechanical joint gasket, this gasket relaxation is easily identified as a noticeable reduction in the torque of the t-bolts starting within minutes of finishing the joint assembly. This reduction is very pronounced when the joint is assembled with a dry un-lubricated gasket.

You can readily see the effect of lubrication and gasket relaxation by trying the following experiment: Install a fitting on each end of a piece of pipe. On one end, use an un-lubricated gasket and on the other end use a properly lubricated gasket. Carefully tighten the t-bolts on each end to the same torque. Now let the pipe and fittings stand undisturbed for an hour or even overnight. Then re-tighten the t-bolts while counting the number of turns required to attain the same torque set earlier. I can assure you that the non-lubricated end will require significantly more turns to recover the original torque.

In cold temperatures it is a good practice to warm the gasket just prior to the placement on the pipe. This can be done by keeping them in the cab of the truck or backhoe or in a cooler filled with hot water. (Be careful about setting the gasket on an engine or an engine cowlings. You want to warm the



gasket, not melt it.) Again, it stands to reason that a warm, soft lubricated gasket is going to compress and seal better than a cold, stiff, dry one.

2. *Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.*

In this step notice the word “press”. If the joint is properly aligned and the pipe spigot and fitting bell are within tolerance, it should not be necessary to pound the gasket in with a hammer. (Note: It is very difficult to press something with a 20 oz. ball peen hammer and getting a bigger hammer is not the same as pressing harder.) Gaskets are made to be very close to the outside diameter of the pipe. When a gasket is pounded into position, a loop of excess rubber is often formed, especially if the fit is tight. This means that some part of the gasket has been stretched with a related excess of gasket being stuffed into one area. A pinched gasket is usually an indication that one of the components is out of tolerance. A few minutes with a measuring tape will typically reveal the problem.

3. *Push the gland toward the socket and center it around the pipe with the lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening bolts.*

Before inserting the t-bolts, double check to see that they are the right length. This may sound somewhat simplistic but when a 4 ½” bolt is installed in a 6” fitting that should have a 3 ½” bolt, there is a strong chance that the nut will bottom out on the threads before the gasket is compressed. If this occurs, it doesn’t matter how tight you get the nut, the joint is still not going to seal. Since the threaded length of t-bolts varies between manufacturers, what worked last week on a joint may not work today. Double check the length and remember that the length is measured from under the t-head to the end of the threads.

4. *Tighten the bolts to the normal range of bolt torque [see table] while at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of the torque. In large sizes (30-48 in. [762-1,219 mm]), five or more repetitions may be required. The use of a torque indicating wrench will facilitate this procedure.*

ANSI/AWWA C600-93, § 3.4 Joint Assembly, Table 3

Pipe Size (in.)	Bolt Size (in.)	Torque Range (ft-lbs)
3	½	45 - 60
4 - 24	¾	75 - 90
30 - 36	1	100 - 120
42 - 48	1¼	120 - 150

Drawing the gland up evenly is important to assure uniform compression on the gasket as well as keeping the pipe centered in the bell. If the gland is cocked to one side, stop and correct the problem before continuing to tighten the bolts. Alternating around the gland, just like tightening the lug nuts on a car wheel, will help to assure a uniform seal. “Repeating the process” until all of the t-bolts are tight may take quite a few passes around the gland, especially in the larger sizes. On the larger sizes you may find that it is easier to have one person on either side of the pipe rather than having to jump back and forth. Just make sure that someone is tightening the very bottom bolt.

Although torque wrenches are typically too delicate to use as a ratchet, it is a good idea to keep one handy for use as a periodic check and to train someone new to the job. 75 to 90 foot pounds take a fair amount of physical strength to achieve consistently throughout a long day. A crew foreman may want to keep a torque wrench in the truck to double check his crew’s work before backfilling.

SUMMARY

As one can see, the steps involved in the proper assembly of a standardized mechanical joint are simple and straight-forward. Clean and inspect, lubricate, assemble, and tighten. When all of these steps are carefully followed in a true workman like manner your chances of leakage during testing and operation are greatly reduced. Rework should be all but eliminated with obvious economic benefit.





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Installation





AWWA C605

PRESSURE PIPE

TABLE OF CONTENTS

Introduction	3
Receiving	3
Unloading and Handling	4-5
Storage	6
Trenching	7
De-Watering	8
Field Cutting	8
Lowering Pipe into the Trench	9
Cleaning and Inspection	9
Lubrication	10
Joint Assembly	10-11
Installing Pipe through Casings	12
Installation of Fittings and Valves	12
Tracer Wire	12
Trench Construction	13
Foundation	13
Bedding	14
Haunching	14
Initial Backfill	15
Final Backfill	15
Compacting the Backfill	16
Overnight Precautions	16
Acceptance Testing	16-18
Special Considerations	18
Checklist	19
Uni-Bell Literature	20
Members	21

PRESSURE PIPE

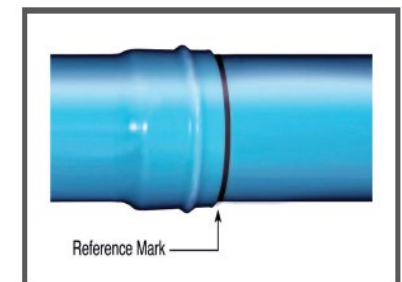
LUBRICATION:

Lubricant should be applied to the bevel of the spigot end and approximately mid-way back to the insertion line. Some manufacturers recommend applying lubricant to the gasket surface which makes contact with the spigot end. Use only the lubricants supplied or recommended by the pipe manufacturer.



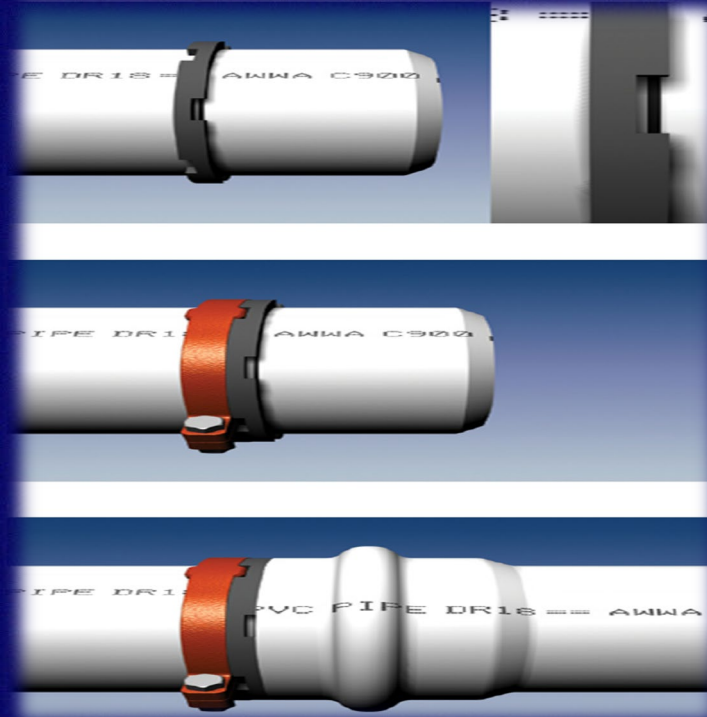
JOINT ASSEMBLY:

Push the lubricated spigot end past the gasket into the bell until the insertion line on the spigot is even with the edge of the bell. DO NOT OVERINSERT.



INSTALLATION GUIDE FOR GASKETED-JOINT PVC PRESSURE PIPE

Preventing Over-Belling



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- Poor Planning

- Corrosion

 - Age of Materials*

- Improper Installation

- Inability to Adapt

- System Dynamics

 - Temperature & Movement*

- Manufacturing Defects

HISTORY OF THE FIRE HYDRANT - DESIGN

“The main challenges of hydrant design --- **anti-freezing, hydraulic efficiency, ease of repair** --- were all known and dealt with, to varying degrees of success, early on, before 1900. The first steamer or pumper outlet came about around 1860 following the invention of the steam fire engine. *Although materials have improved and some of the elements of hydrant design have been refined, the basic form of both the dry barrel and wet barrel hydrants have endured relatively unchanged since the mid 1800s.*”

Source:

Firehydrant.org

1860'S VS 2020'S

ROAD TRAVEL



1860'S VS 2020'S



AIR TRAVEL





- Poor Planning

- Corrosion

Age of Materials

- Improper Installation

- Inability to Adapt

- System Dynamics

Temperature & Movement

- Manufacturing Defects

Engineered Solutions



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Issues with Oversizing Control Valves







WATTS ACV SIZING WORKSHEET

VERIFICATION OF PROPER SIZING

BASED OFF PERCENTAGE OF VALVE OPEN IN OPERATION

Mustang Series

Project Name/ Customer: **CU WILLIAMS VILLAGE EAST PRV**

Max. Poss. Intermittent Flow: **400** Gpm Line Size: **6** "

Maximum Continuous Flow: **280** Gpm System Inlet Pressure: **95** psi

Normal (Est.) Operating Flow: **150** Gpm Desired Outlet Pressure: **85** psi

Minimum Flow: **0-55** Gpm Pressure Differential Result: **10** psi

Outside Cavitation Zone **Possible Cavitation**

Valve Model Selected: **4" LFM115-74 PRESSURE REDUCING ACV with LOW-FLOW BY-PASS**

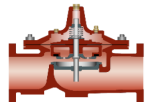
Valve CV Factor: **185** Gpm* Adjusted CV Factor @ 90% Open: **166.5** Gpm

Globe Body *Based off Watts Published Flow Data Charts

ΔP (Pressure Drop) $\sqrt{\Delta P} = 3.16$ *(Based off Pressure Differential)

CV Factor at Maximum Possible Intermittent/ Peak Flow: **126.49** Gpm < **166.5** Gpm

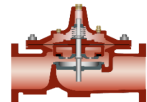
(**400** Gpm / $\sqrt{\Delta P}$ @ **3.16**) **GOOD / SAFE**



PERCENTAGE OF VALVE OPEN IN OPERATION

IDEAL OPERATION IS WITHIN 20% TO 80% OPEN

10% ABOVE SEAT - 90% OPEN IS NOT IDEAL BUT ALLOWABLE



FLOW RATE (Gpm)	PERCENT OF VALVE OPEN	ADDITIONAL NOTES/ RECOMMENDATIONS
400	75.97%	
280	53.18%	REDUCE FROM 6" TO 4" FLG VALVE
150	28.49%	INTREGAL LOW-FLOW BY-PASS with 1" LFF223 (50-145)
55	10.45%	

*Percent of Valve Open Calculated as follows; (Flow Rate / $\sqrt{\Delta P}$ / Adjusted Valve CV Factor

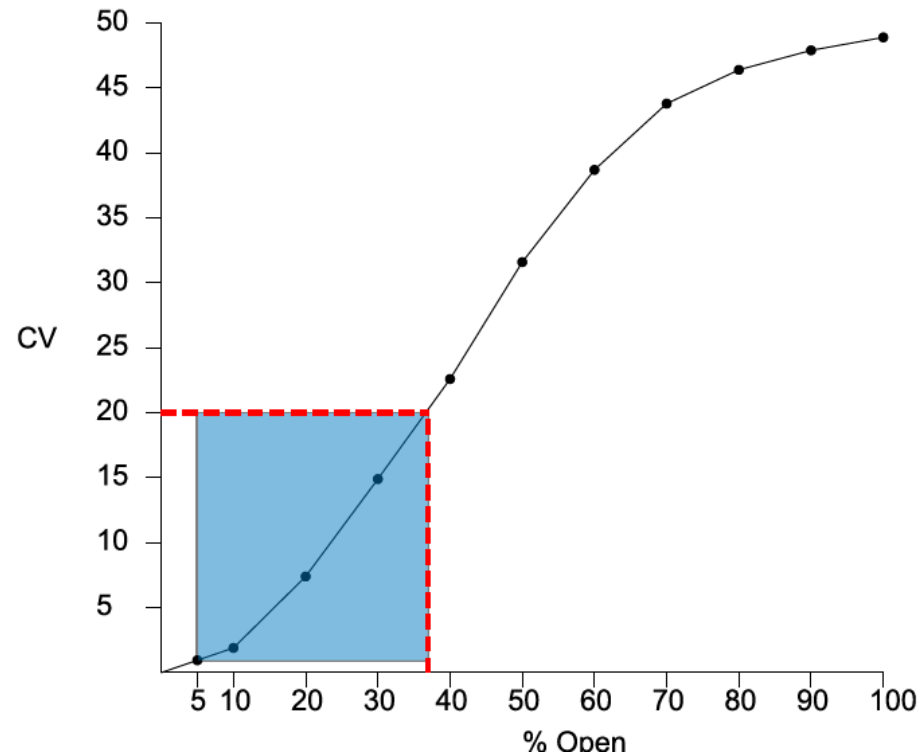
**Calculations Assume Line Media as Potable Water at 60 Degrees Farenheit

Flow (Q): 150 gpm
Inlet P (P1): 60 psig
Outlet P (P2): 2 psig

Pipe Size (D): 4
Pipe Schedule: 80
Fluid: Water

Temperature: 60 F

Selected Valve	Noise Cavitation
Ductile Iron 2 Straight Full Threaded	76 Constant



- 85+ dBa: Consult OSHA
- 60 dBa: Conversation
- 30 dBa: Soft Whisper

i20 PRV monitoring and control systems offer more accurate, stable, and smooth control of network pressures

PRV



Monitored PRV



+



Control
Logger

Remotely controlled PRV



+



Advanced pilot value (APV)

Automatically optimised PRV*



+



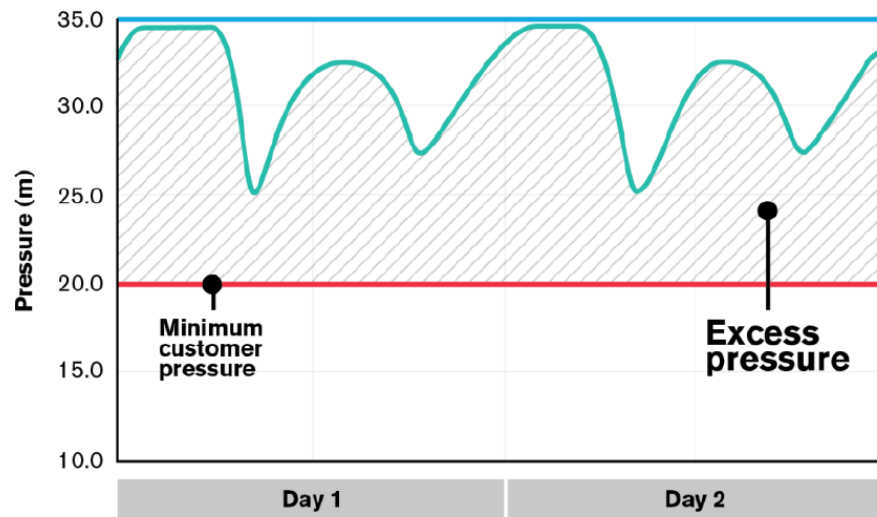
Control
point logger

MUELLER

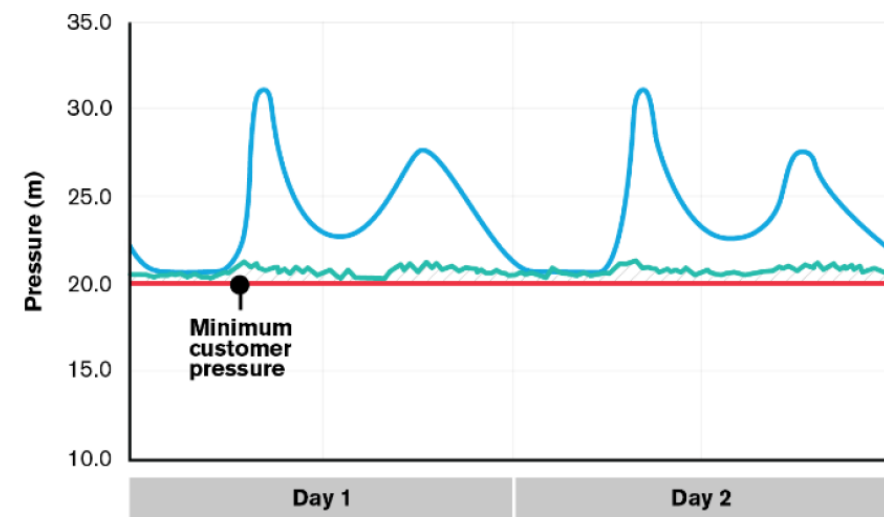
* Currently requires flow meter, solution without flow meter in development

i2O Advanced Pressure Management is used to reduce over-pressure which in turn reduces leakage, bursts and open-tap demand. It delivers fixed pressure at the control point by varying the PRV outlet pressure.

BEFORE: fixed outlet pressure at the PRV with over-pressure in the network

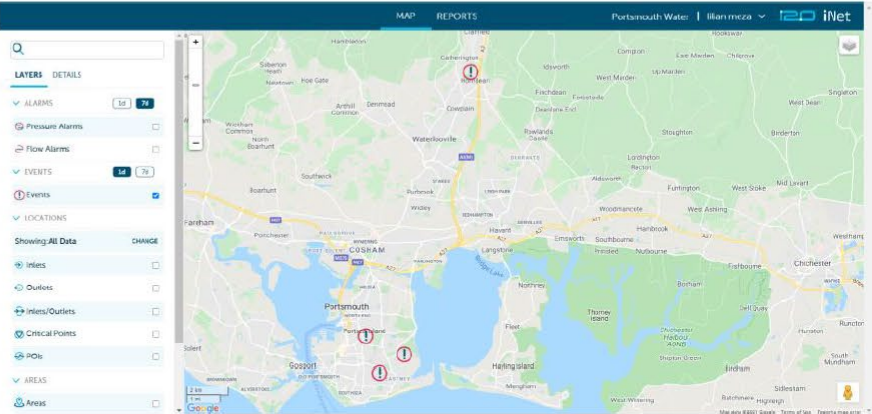


WITH i2O: varying outlet pressure with minimal viable pressure for customers



The eVader event detection algorithm uses AI/ML to identify anomalies in network performance

Detected Events on a map



Detected Events in/under a graph



Detected Events table

Events						
Location	Location Type	Metric	Started At	Ended At	Severity	Classification
Eveleigh Road ...	POI	Pressure	Jul 18, 2022 03:45		Amber	
Alverstoke AZ...	POI	Pressure	Jul 18, 2022 03:00		Amber	
Elson CP	Critical Point	Pressure	Jul 18, 2022 02:00		Red	
New Lane AZNP	POI	Pressure	Jul 18, 2022 02:00		Red	
Lee-on-Solent ...	POI	Pressure	Jul 18, 2022 02:00		Amber	
Bognor West A...	POI	Pressure	Jul 18, 2022 02:00		Amber	
Emmworth AZNP	POI	Pressure	Jul 18, 2022 00:15		Red	
WEST MARDE...	Outlet	Flow	Jul 17, 2022 15:15		Red	Flatline
WEST MARDE...	Inlet	Flow	Jul 17, 2022 15:15		Red	Flatline



Show Statistics ☐

TIME: Jul 31, 2023 18:30

PRV 77 BM BELL MOUNTAIN, DR. AND OLD GATE RD.

- ☒ Forward Flow Rate
- ☒ Reverse Flow Rate
- ☒ Net Flow Rate
- ☒ Forward Flow Volume
- ☒ Reverse Flow Volume
- ☒ Upstream Pressure
- ☒ Downstream Pressure
- ☒ Control Space Pressure

- ☐ Signal Strength
- ☐ Temperature
- ☐ Voltage
- ☐ External Voltage

Insights 1

1d

2d

7d

1m

3m

6m

1y

ALL

Jul 24, 2023

Aug 21, 2023





Making the Right Choice

There are fundamental differences between products

- Gasket
- Coating
- Bolt size
- Size ranges

- Ask your manufacturer
- Install different types and make your own decision



Making the Right Choice

- Manufacturers go to different lengths to provide a product to the industry
 - Is it a “Me-Too”?
 - How does it compare?
 - Ease/time of installation
 - Product engineering
 - Pressure ratings
 - Reliability

They're Called Band-Aids For a Reason

- Not a permanent fix?
- Goal is to fix leak as quickly as possible
- Inexpensive





Do Your Homework

- Do all products meet applicable AWWA standards
- Quality of materials/workmanship
- Customer service
- Reputation
- Industry history

Alternative Solutions



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Alternative Restraint Solutions



What Factors to
Consider ?

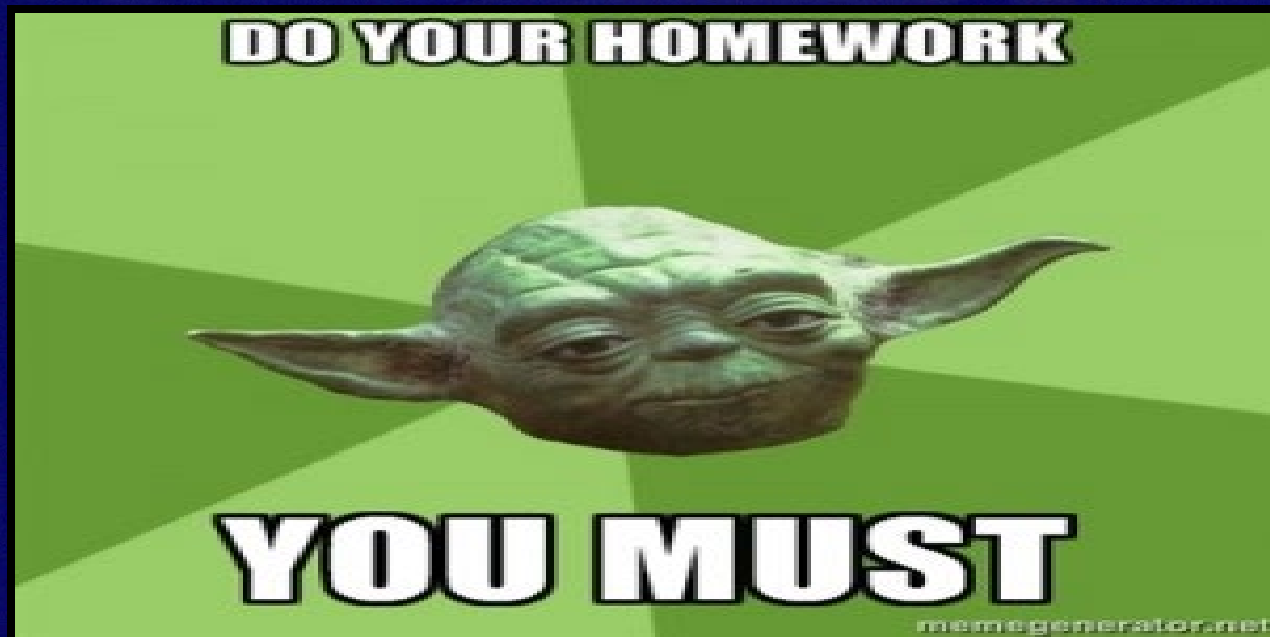
More Applications
and Improved Methods



Alternative Restraint Solutions



EBAM
IRON



EBAA
IRON



CRITICAL CONVERSATIONS IN AGING INFRASTRUCTURE *QUESTIONS?*



JON DAVIS
REPMASERS, INC./ UGO RESOURCES
1400 E. 69TH AVE. DENVER, CO 80229