NATIONAL ASSOCIATION OF STATE UTILITY CONSUMER ADVOCATES NASUCA

Industry Review Part 2

Badger Meter

Proposed Agenda

- Opening Remarks
- Introductions
- Three topics
  - Types of Meters
  - Water Quality
  - Remote Monitoring of Pipe Network
- Closing Remarks

9/11/25
Reading Methods
Remote Disconnect
Customer Portals

Meters

01 Types

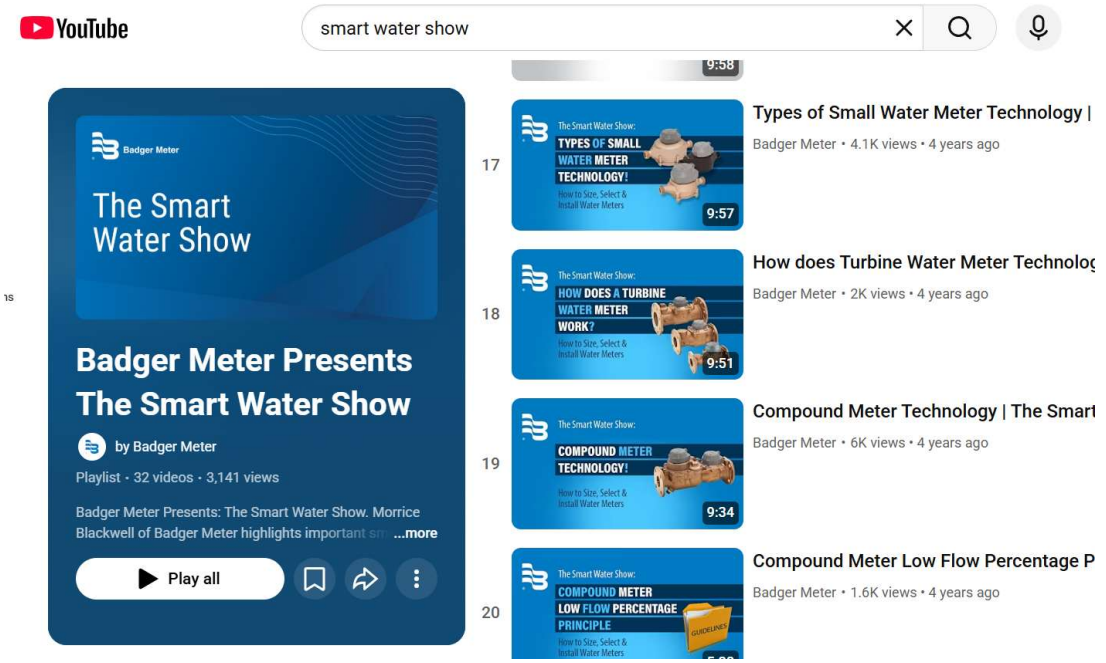
02 How it Works

03 Warranties & Accuracy

04 Ranges

05 Trends

06 Smart Water Show



https://youtube.com/playlist?list=PLeUp8rblipNgyoKlC87xczbL0hc8mFjBf&si=arm8wnvxXITcXPxh

Types of Meters

SMALL & LARGE ELECTROMAGNETIC METERS

1/4" and 78" Sizes

CLAMP ON ULTRASONIC METERS

NUTATING DISC METERS

5/8" to 2" Sizes

SMALL ULTRASONIC METERS

5/8" to 1" Sizes

FLOW RESTRICTION VALVE

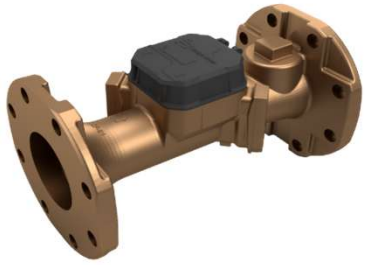
5/8" and 3/4" Sizes

TURBO METERS

1 1/2" to 12" Sizes

COMPOUND METERS

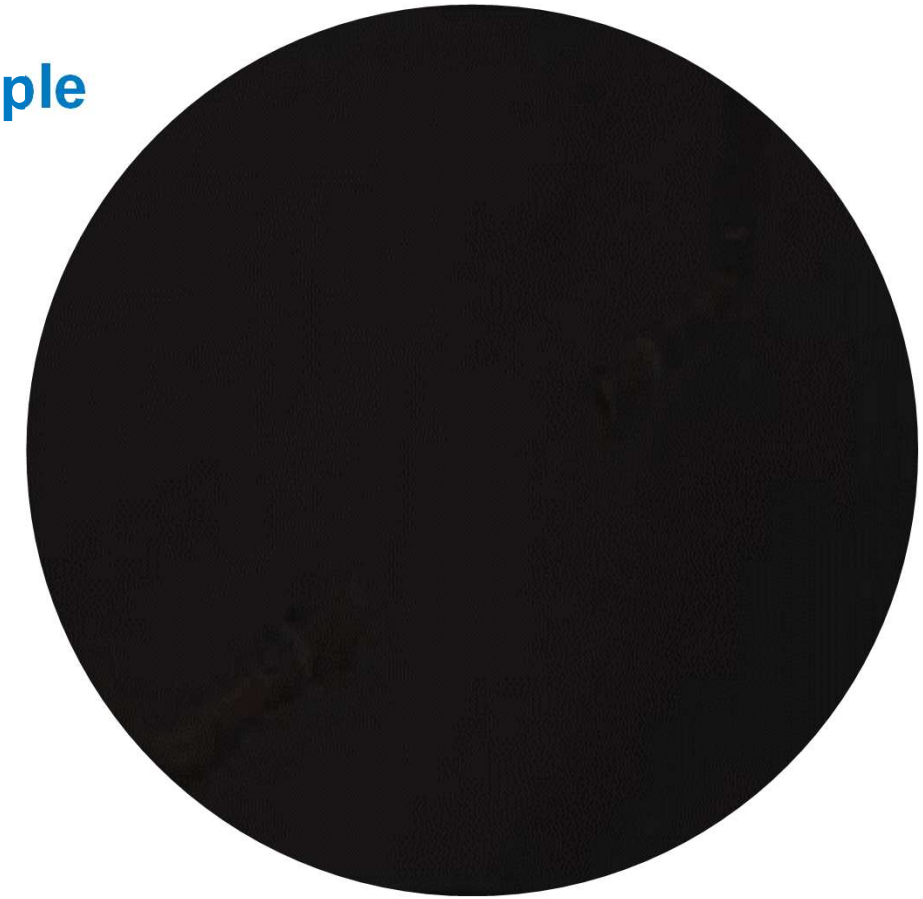
2" to 6" Sizes



LARGE ULTRASONIC METERS

1 1/2" to 8" Sizes

Measuring Principle



Nutating Disc - Warranty / Accuracy

01 Badger Meter M25 – 5 years

Model 25, 5/8 in. and 5/8 x 3/4 in.	Five (5) years from date of shipment or registration of 750,000 gallons, whichever occurs first.

02 Sensus SRII – 5 years

SR II® and accuSTREAM™ 5/8", 3/4" & 1" Meters...
are warranted to perform to AWWA New Meter Accuracy Standards for five (5) years from the date of Sensus shipment or until the regis¬tration shown below, whichever occurs first. Sensus further warrants that the SR II meter will perform to at least AWWA Repaired Meter Accuracy Standards for fifteen (15) years from the date of Sensus shipment or until the registration shown below, whichever occurs first:

	New Meter Accuracy	Repair Meter Accuracy
5/8" SR II Meter and accuSTREAM Meter	500,000 gallons	1,500,000 gallons

03 Neptune T10 – 5 years

Size	Low Flow	Low Flow New Meter Accuracy
5/8"	1/8 gpm @ 95%	5 yrs or 500,000 gallons

Nutating Disc - Trends

01 Larger Meters out (turbine, compound)

02 Residential meters slowly shifting

03 Customer driven on larger meters

04 Increasingly vendor driven on residential meters

05 Rationale

- Weight & Safety
- Range
- Alerts, alarms, sensors
- Warranty on Accuracy

Metering Technology Comparison

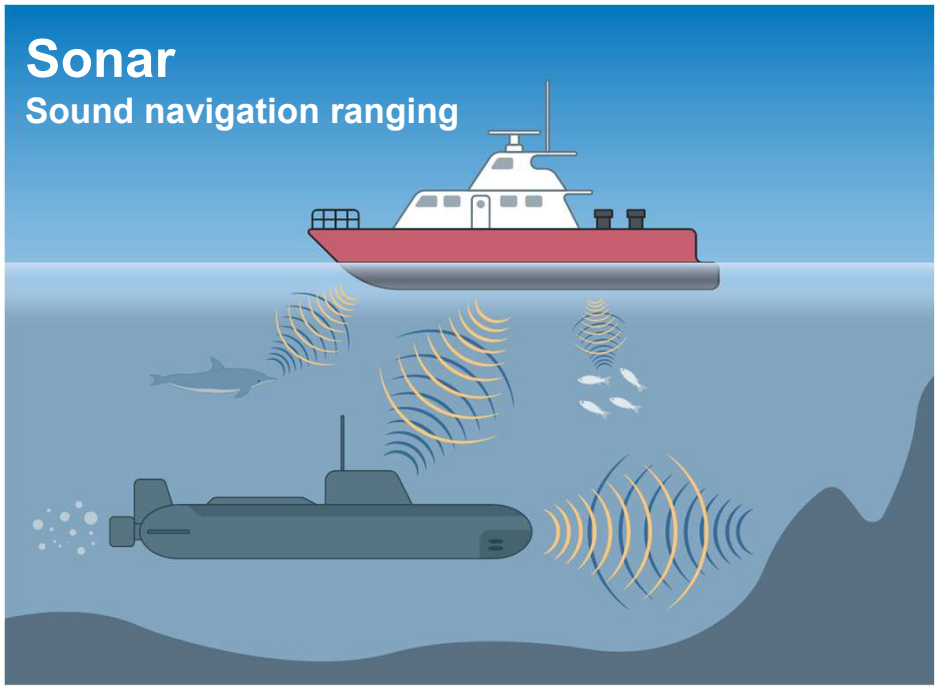
Meter Type	Size	Operating Range	Max Continuous Duty	Extended Low Flow
Disc	5/8”	0.5 to 25 GPM	15 GPM	0.25 GPM
Ultrasonic	5/8”	0.08 to 30 GPM	30 GPM	0.04 GPM

Meter Type	Size	Operating Range	Max Continuous Duty	Extended Low Flow
Compound	3”	0.5 to 450 GPM	400 GPM	0.25 GPM
Ultrasonic	3”	0.75 to 560 GPM	560 GPM	0.37 GPM

Ultrasonic Meters

Badger Meter

Fluid Acoustic Applications in Nature and Engineering



Using sound waves in an open area, it is possible to identify:

- Object locations
- Distance and size of objects
- Relative velocity of movement

Transmitted signal

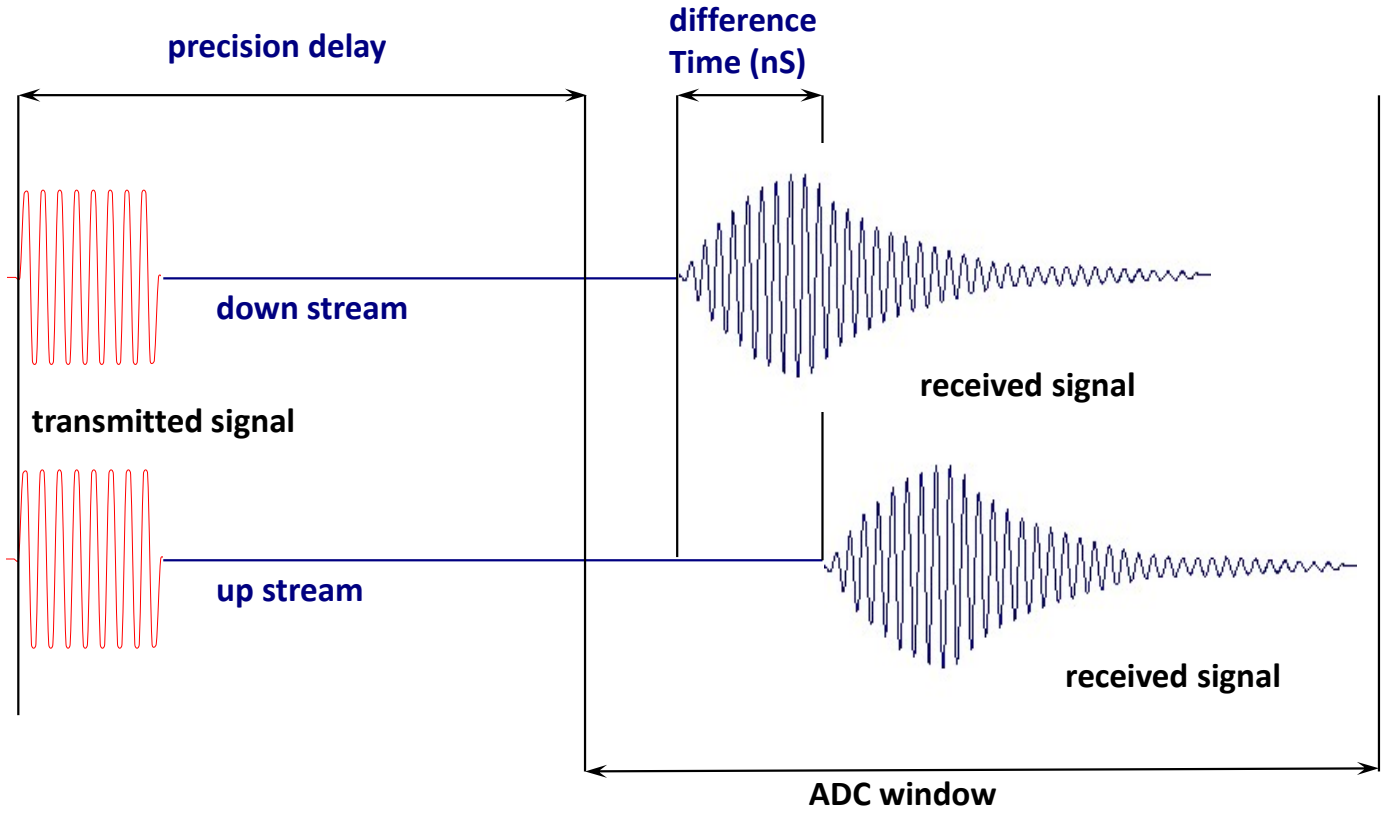
Reflected signal

Transit time relies on time differences between upstream and downstream sensors

Just like a crew team rowing in a river, it takes more time to travel in the direction opposite flow than it does in the direction of flow. This time differential increases proportional to increases in the speed of flow.

1. There are two sensors, an upstream and downstream sensor.
2. Ultrasonic waves move proportional to fluid velocity.
3. The flow meter calculates flow measurements by measuring the difference between tiny time shifts of the signal in both directions.

Transit Time Technology



Ultrasonic Meters

01 Empty Pipe

02 Reverse Flow

03 Pressure – Neptune, Badger

04 Temperature

05 Acoustics – Kamstrup

06 Accuracy

Metering Technology Comparison

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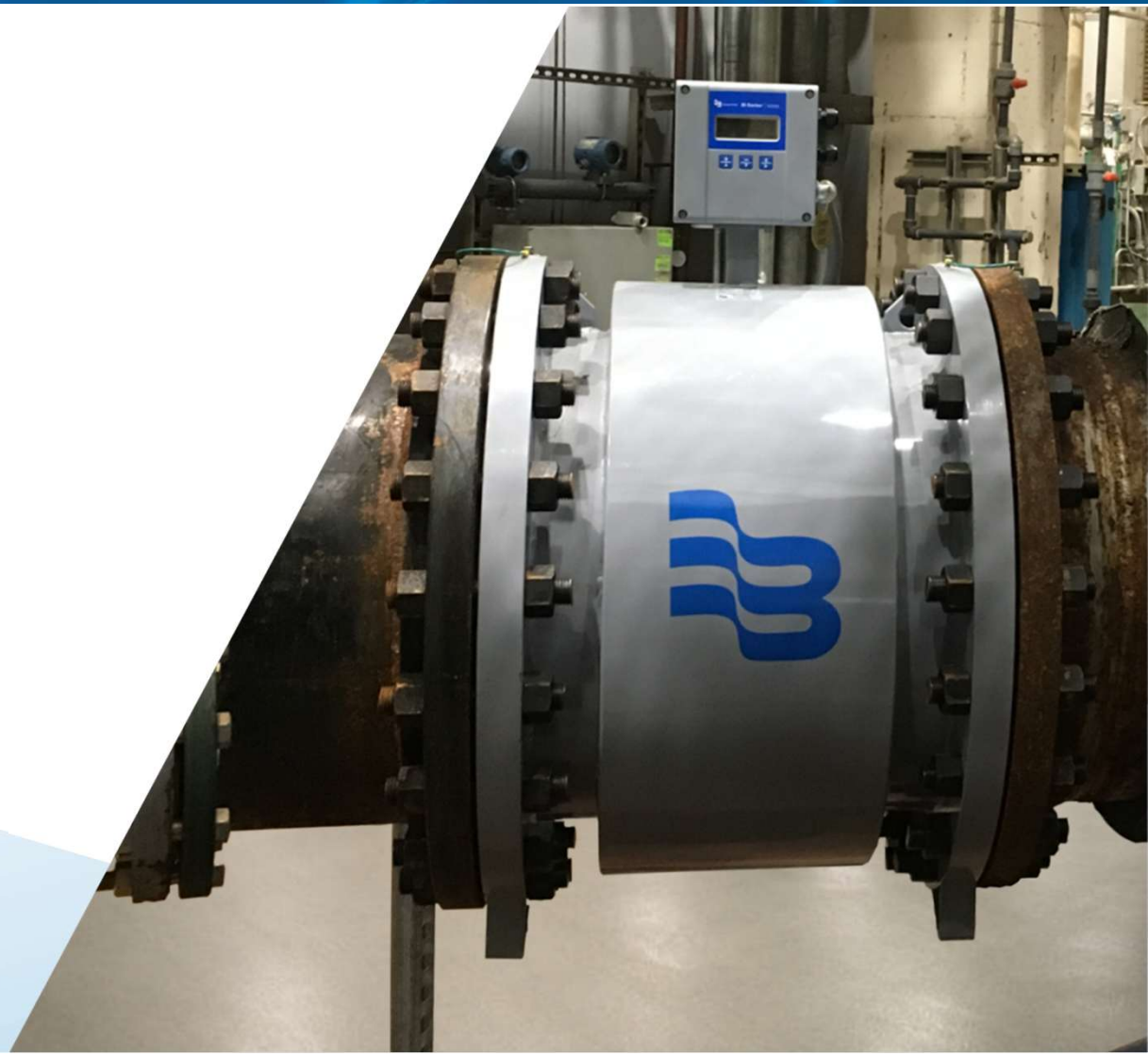
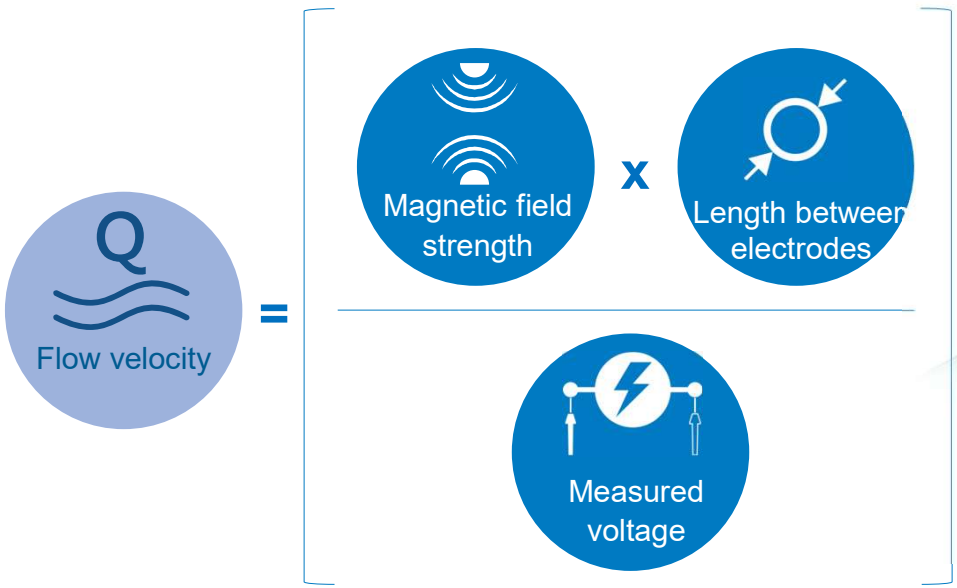
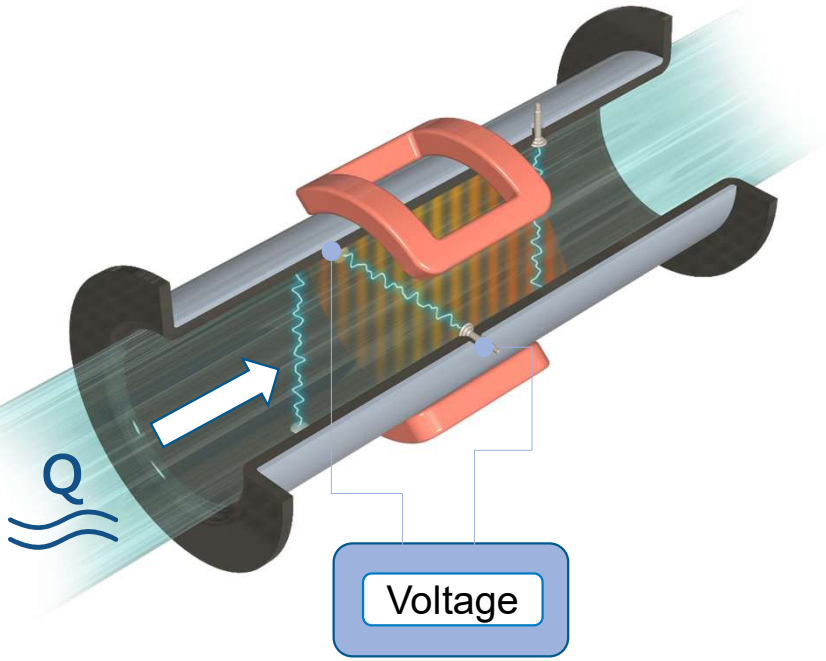
Mag Meters



Badger Meter

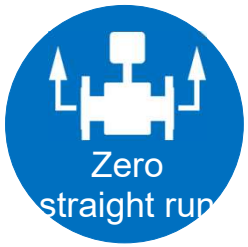
General Operating Principle
Faraday's Law

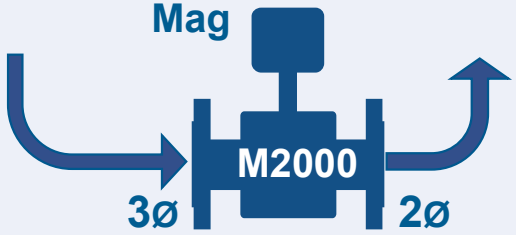




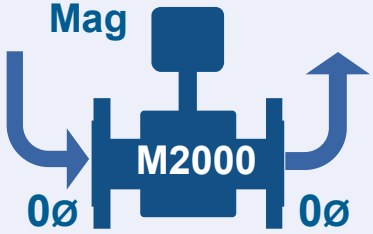
The meter applies a known magnetic field strength to a meter of known diameter. The conductive fluid flowing through the field produces a voltage. By measuring the resulting voltage, the meter calculates flow velocity.

Inline Mag Meters Deliver Best-in-Class Measurement Performance

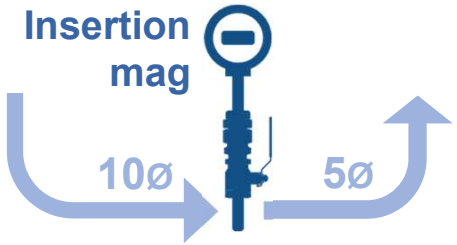




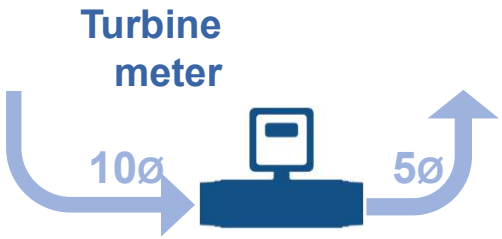
- ✓ **Accuracy of ±0.2% ±1 mm/s**
- ✓ **Flow Range 0.03…12 m/s**



- ✓ **Accuracy of ±1% ≥ 0.15 m/s**
- ✓ **Flow Range 0.03…12 m/s**



- ✗ Accuracy of ±1% ≥ 0.6 m/s
- ✗ Flow Range 0.3…6.1 m/s



- ✗ Accuracy of ±1%
- ✗ Flow Range 0.5…10 m/s

- ✗ Accuracy of ±0.5% ±8 mm/s
- ✓ **Flow Range 0…12 m/s**
- ✓ **Non-invasive installation**

Typical Applications

- Raw water
- Potable water
  - Within treatment facilities
  - Booster pump stations
  - District metering / distribution network
- Wastewater
  - Within treatment facilities
  - Pump stations / force mains
- Reclaimed water
- HVAC glycol water (heating/cooling loops)
- Process water
- Chemical solutions (neutralization)

Advances in Water Quality Monitoring Technology

Badger Meter

Remote Water Quality Monitoring

01 Custody transfer

02 Post-treatment

03 Routine sampling points

04 Critical customers

05 Advanced parameters

06 Problematic Areas

Water Quality Parameters		
Free Chlorine	Suspended Solids (TSS &TS)	Permanganate
Combined Chlorine	UV254 / UVT	Ammonium
Total Chlorine	Biological Oxygen Demand (BOD)	Total Ammonia
pH	Chemical Oxygen Demand (COD)	Free Ammonia
Conductivity	Benzene / Toluene / Xylene (BTX)	Chlorophyll a
ORP	Total Organic Carbon (TOC)	Temperature
Dissolved Oxygen	Dissolved Organic Carbon (DOC)	Fingerprint / Contamination Alarm
Fluoride	Sulfide	Ortho-Phosphate
Dissolved Ozone	Sulfite	Resistivity
Chlorine Dioxide	Hydrogen Sulfide	Potassium
Peracetic Acid	Nitrate	Monochloramine
Hydrogen Peroxide	Nitrite	Pressure
Turbidity	Color	AOC

Remote Water Quality Monitoring: The Battle

01 Custody transfer

02 Post-treatment

03 Routine sampling points

04 Critical customers

05 Advanced parameters

06 Problematic Areas

- Data Hungry
- Proactive resolutions
- Alerting
- Find and Fix

- Not required
- Cost
- Liability
- Routine Sampling

Installation Options

Water Quality Network Monitoring

pipe::scan

01 Modular sensor system to monitor pipes under pressure

02 Measures up to 10 parameters, including organics

03 NSF/ANSI/CAN 61 and 372-certified

04 No reagents, waste stream or bypass line

05 Full-scale event detection with real-time alarms

06 Six-months service time

BEACON® Data View

01 Linked Asset View

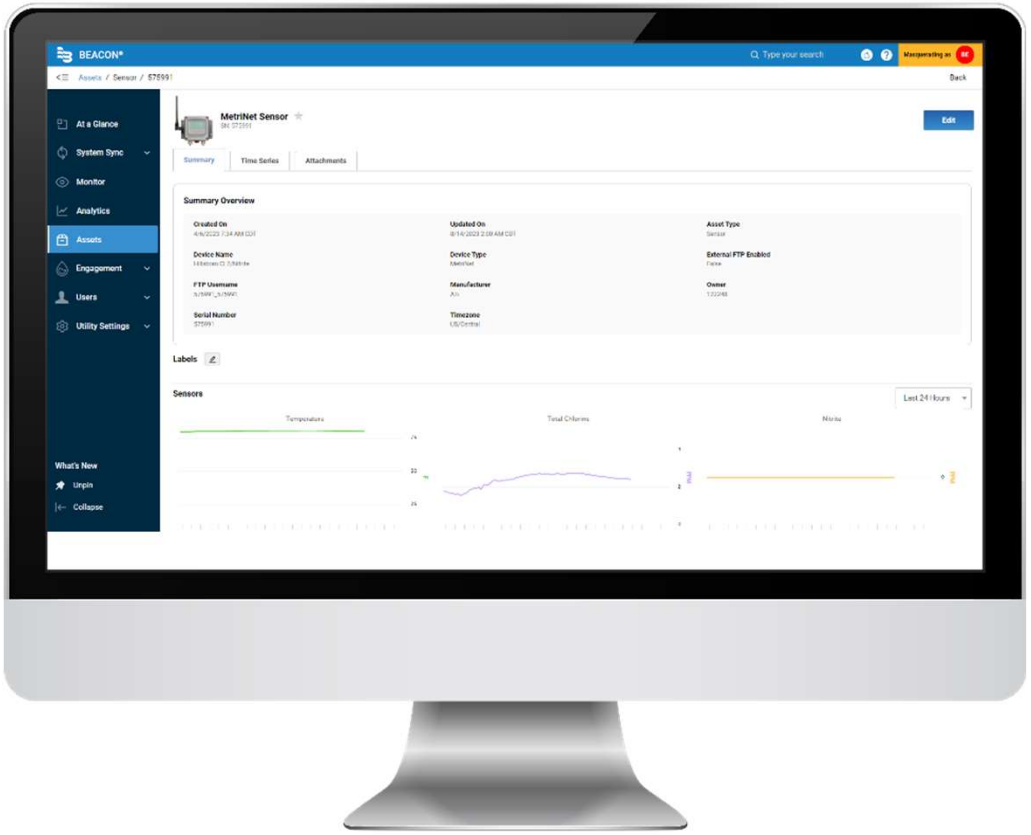
02 Configurable Data Trending
Single or Multi-parameter

03 Time Series Graphs

04 Configurable Alarms and
Notifications

05 Attachments (Picture, Documents)

06 Pressure / Flow Overlays



BEACON®

Type your search

Assets / Sensor / 575991

Back

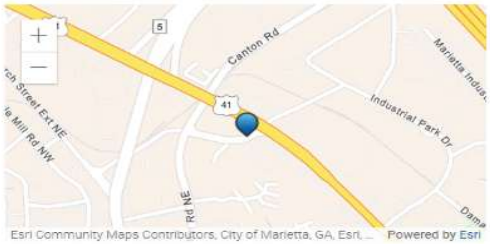
MetriNet Sensor

SN: 607786

No Active Events

Summary | Time Series | Attachments Preview | Events

Summary Overview



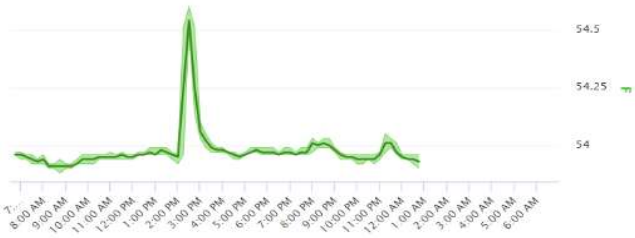
Created On 12/18/2023 2:08 PM EST	**Updated On** 3/7/2024 1:08 AM EST	**Asset Type** Sensor
City Marietta	**Device Name** 607786	**Device Type** MetriNet
External FTP Directory /beacon/ati-q52-0101/	**External FTP Enabled** True	**External FTP Host** ati.syrinix.io
External FTP Protocol SFTP	**External FTP Username** beacon	**External Sync Latest Attempt** 3/7/2024 6:38 AM EST

Labels

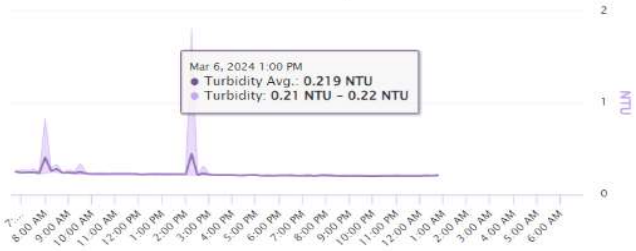
Sensors

Last 24 Hours

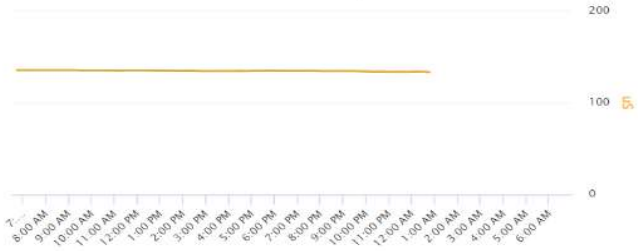
Temperature



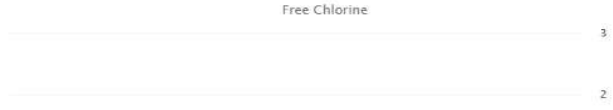
Turbidity



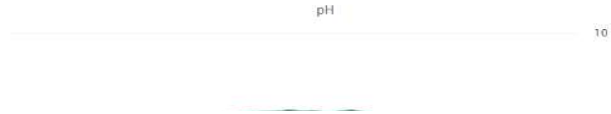
Conductivity



Free Chlorine



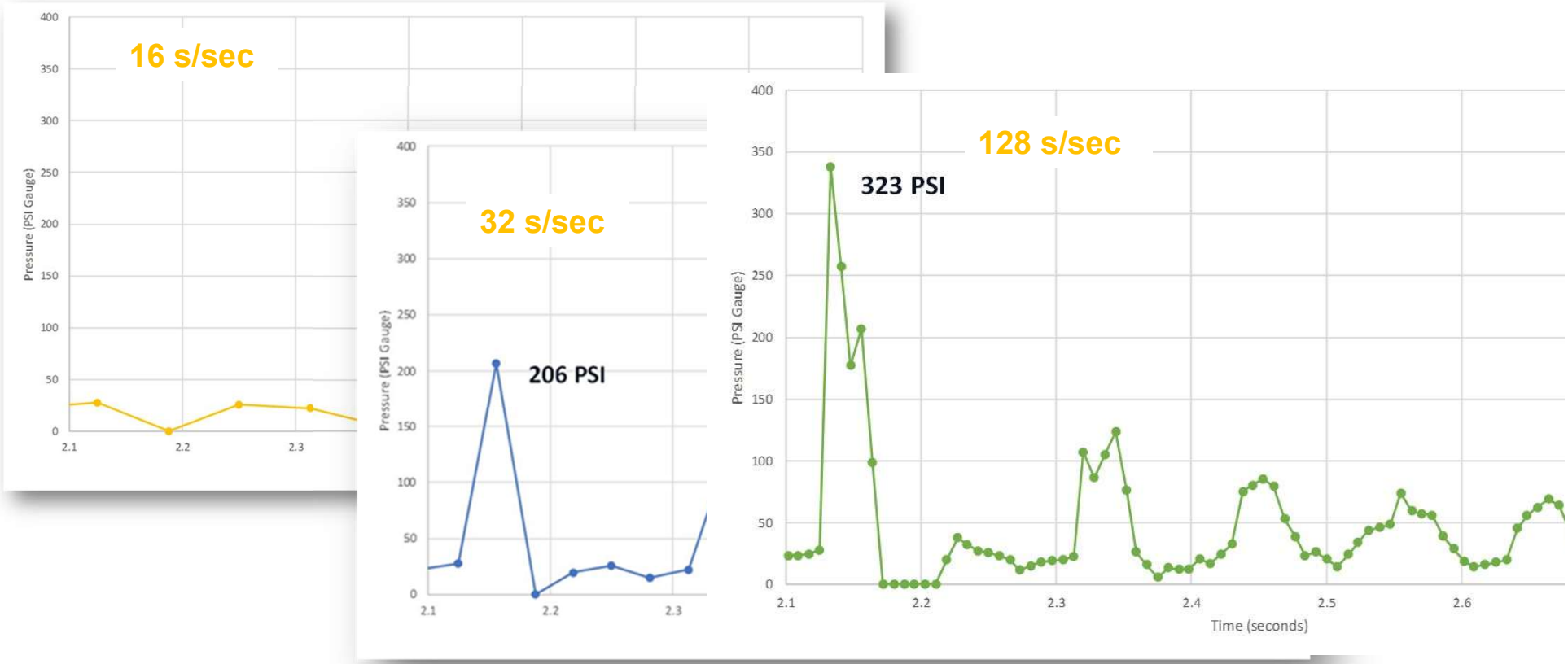
pH



Advances in Pressure Management

Badger Meter

High Resolution Data

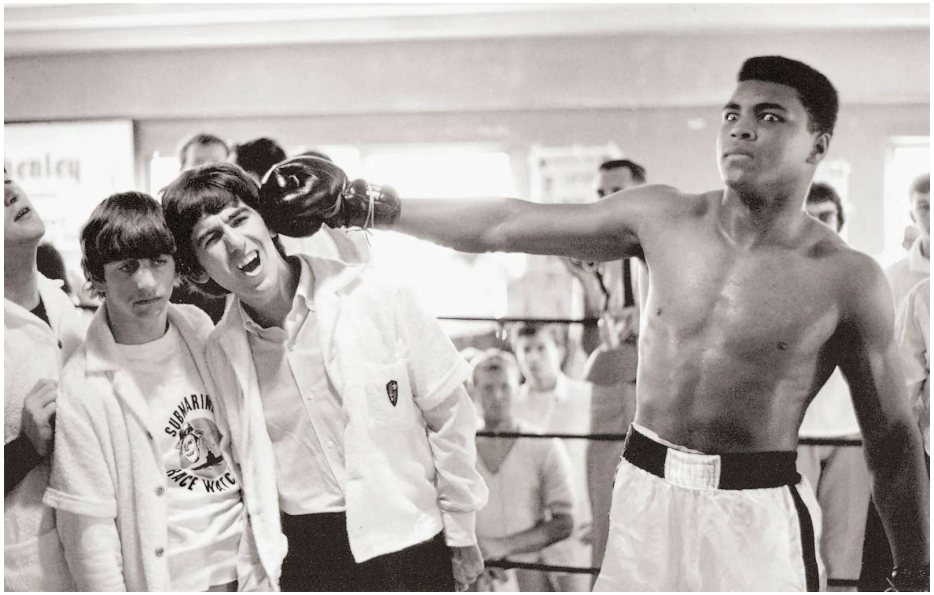


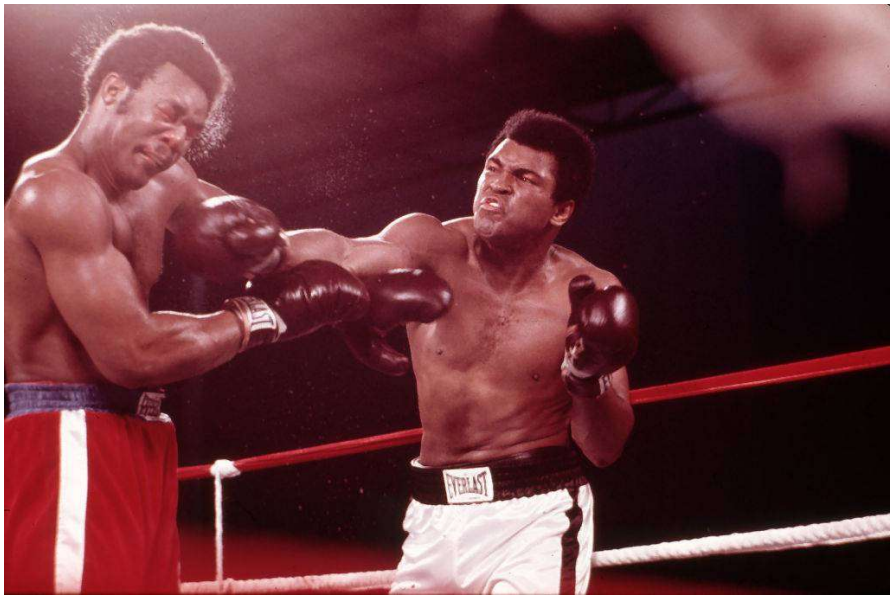
Dynamic Load Factor

"The maximum allowable shock pressure is 50% of the design pressure. This criterion is based on the following reasoning: The pipeline is considered a single mass-spring system for which a simplified structural dynamics analysis can be carried out. The ratio of the dynamic response (i.e., pipe wall stress) to the static response is called the dynamic load factor (DLF). The dynamic load factor of a mass-spring system is equal to 2. It is therefore recommended that a maximum shock pressure of no more than 50% of the design pressure be allowed."

Pothof, Karney (2012). Guidelines for Transient Analysis in Water Transmission and Distribution Systems

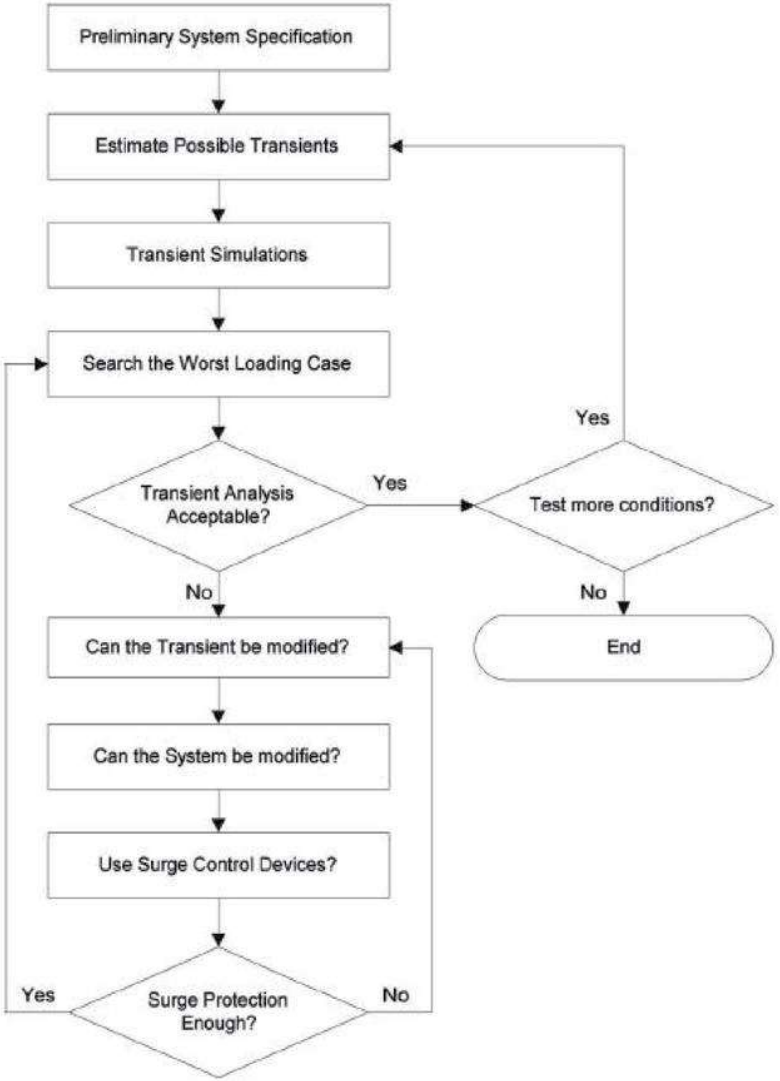
Dynamic Load Factor: Static vs Dynamic

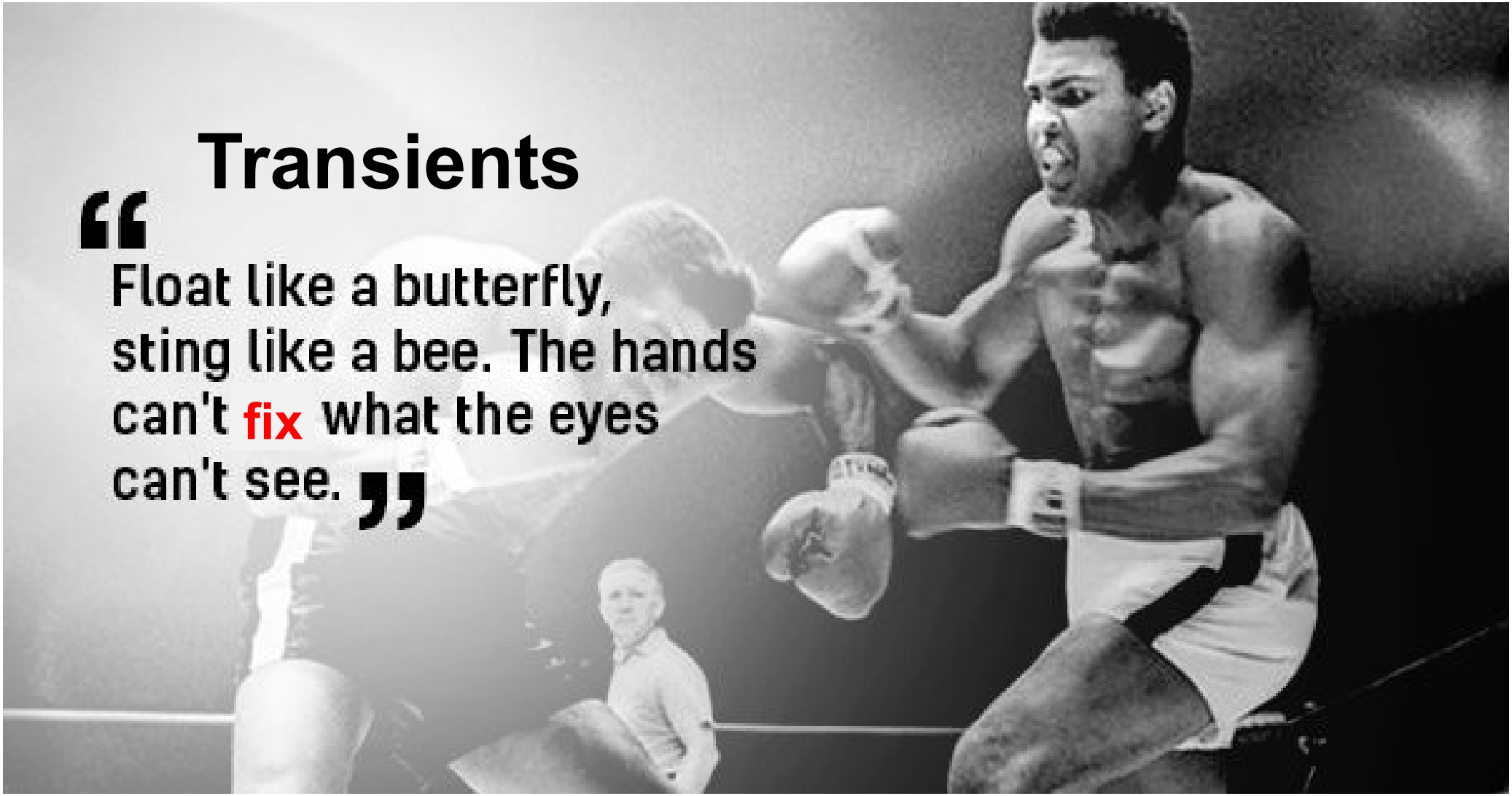




Dynamic Loads – Well, fix'em

Jung, B. S. and B. W. Karney (2009). "Systematic surge protection for worst-case transient loadings in water distribution systems." Journal of Hydraulic Engineering 135(3): 218-223




Transients
“Float like a butterfly, sting like a bee. The hands can't fix what the eyes can't see.”

High Resolution Pressure Data Devices

Syrinix – 128 hz
Direct tap or hydrant

Telog – 256 hz
Hydrant

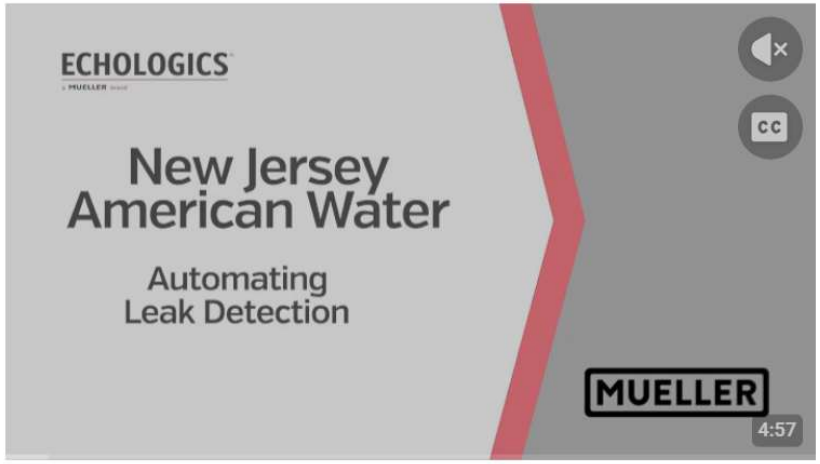
Orbis – 1000 hz
Direct tap or hydrant

Mueller – 1000 hz
Direct tap

Acoustics

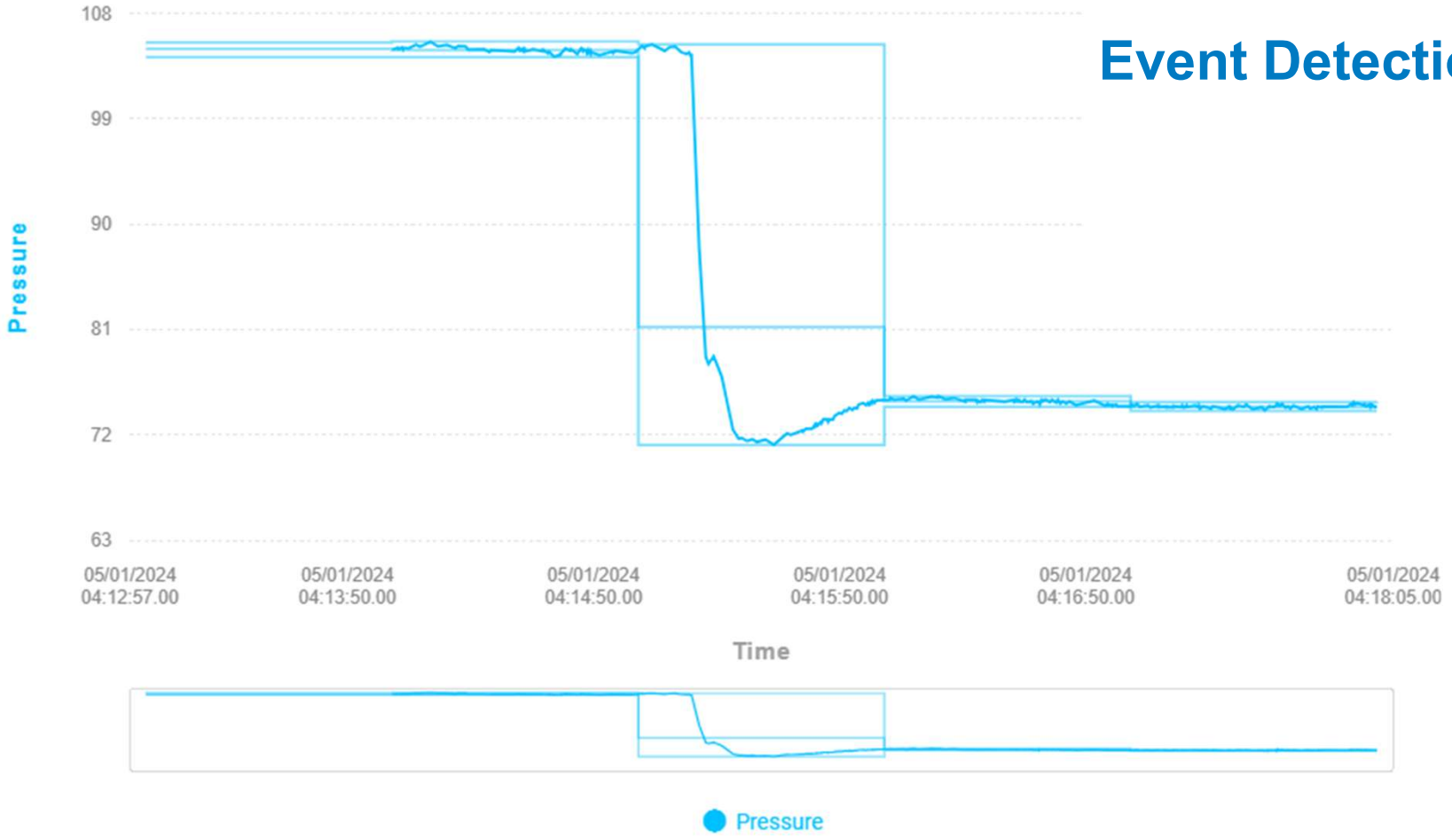
Badger Meter – Distribution Network

Kamstrup – Service Lines

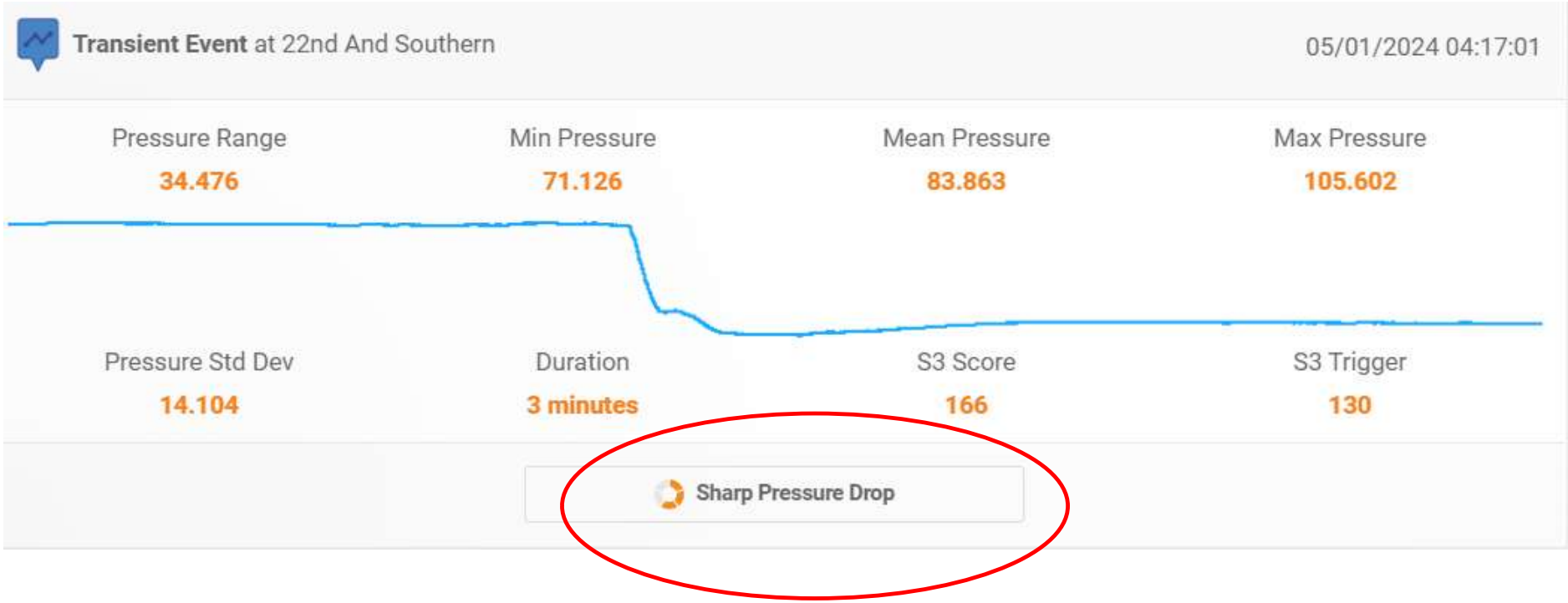


Mueller – Distribution Network

Event Detection



Event Classification



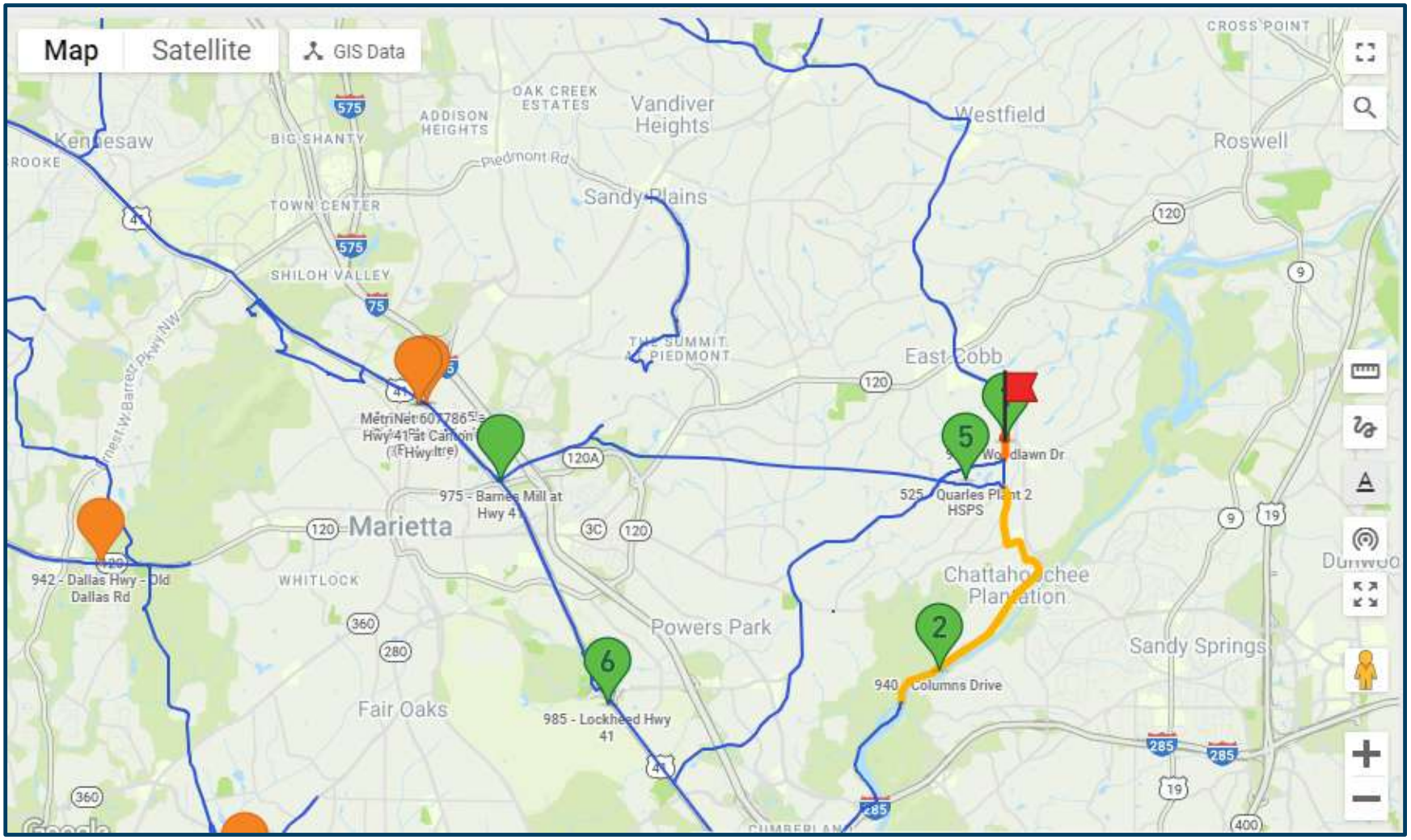
Event Triangulation

Pressure Event Across 8 Sites in **Main Pressure Zone** 03/24/2024 11:24:12

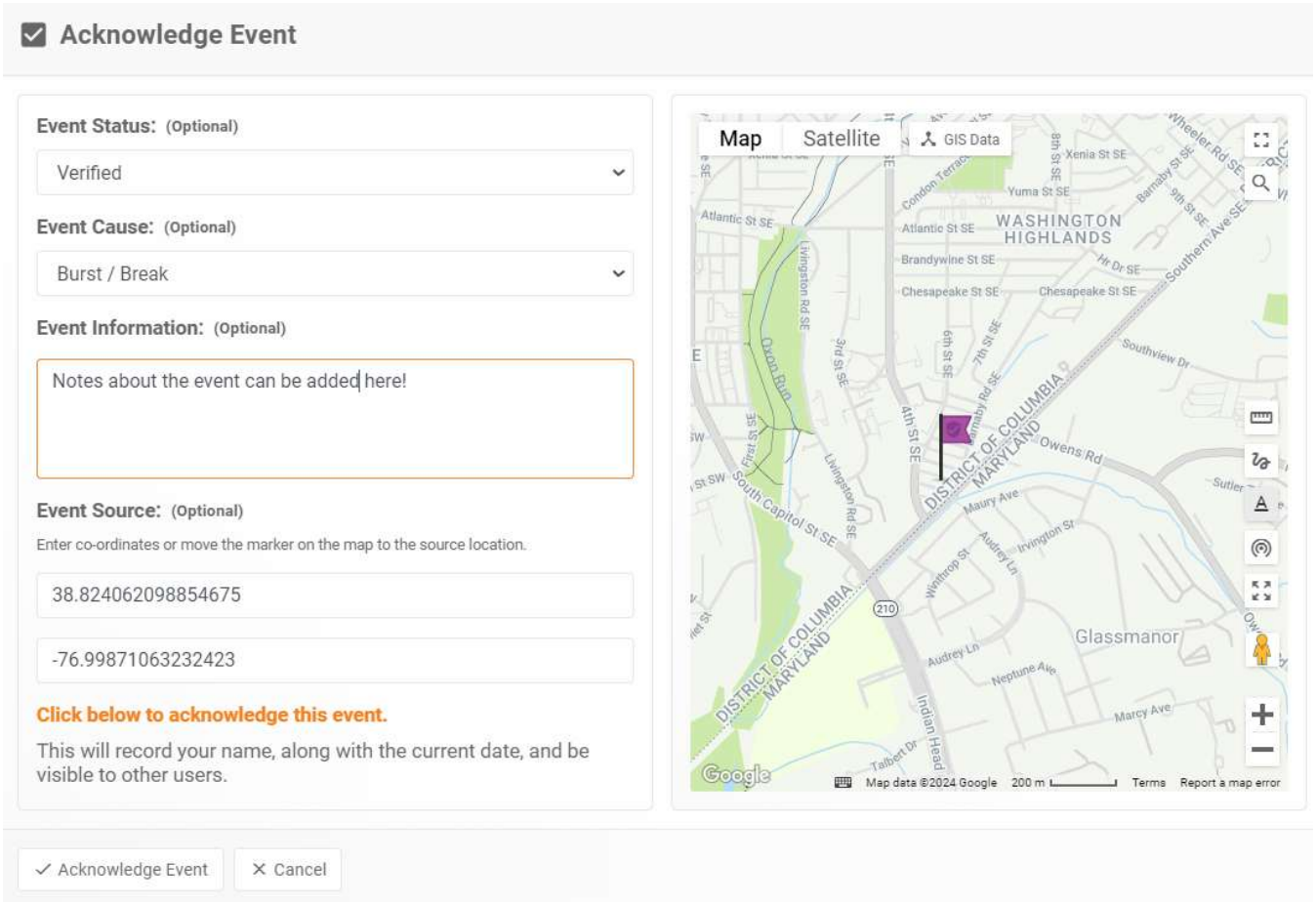
Sharp Pressure Drop - Possible Burst Event

Detected at **978 - Woodlawn Dr** , **940 - Columns Drive** and **6 other sites**

Triangulated Latitude	Triangulated Longitude	Radius
33.96875503	-84.41596725	272 ft

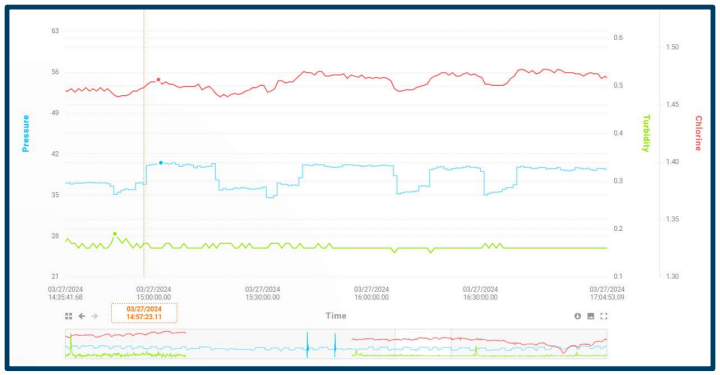

Map
Satellite
GIS Data
Kennesaw
BIG SHANTY
ADDISON HEIGHTS
OAK CREEK ESTATES
Vandiver Heights
Westfield
Roswell
CROSS POINT
Piedmont Rd
Sandy Plains
TOWN CENTER
SHILOH VALLEY
THE SUMMIT AT PIEDMONT
East Cobb
Marietta
WHITLOCK
Powers Park
Fair Oaks
Chattahoochee Plantation
Sandy Springs
Dunwoody
942 - Dallas Hwy - Old Dallas Rd
975 - Barnes Mill at Hwy 4
525 - Quarles Plant 2 HSPS
940 - Columns Drive
985 - Lockheed Hwy 41
5
2
6

Event Acknowledgement

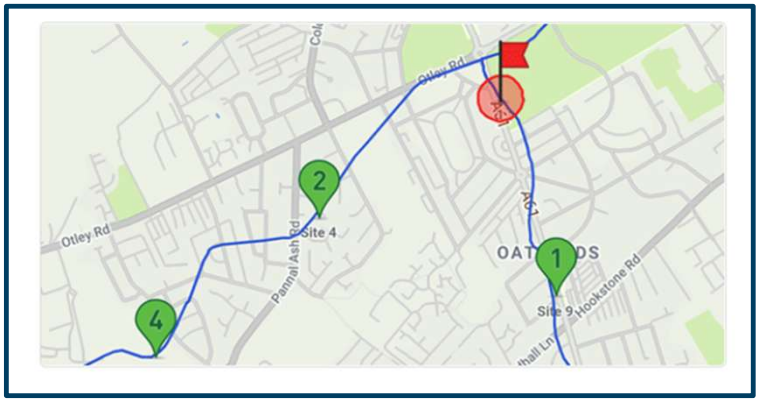


Additional Features

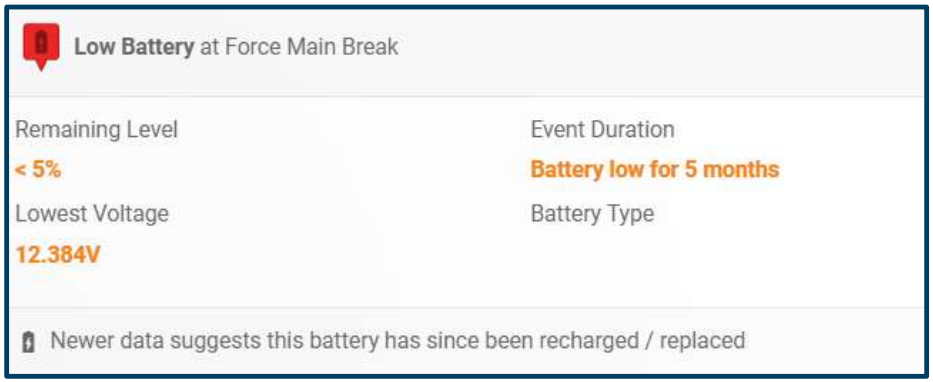
Water Quality Data Overlays



Break Alerting



Device Status and Battery Alerts



SCADA Data Integration

10 Eric Experiences: Setting the Stage...

- Peoria, IL ~56,000 connections
- 770+ miles of main
- Lead, galvanized, 2" "mains"
- Older system
- 1% or less
- Multiple pressure zones
- 20%+ NRW

Distribution Monitoring: Eric's Findings

01 Double Pump Start

02 Customer Induced Transients

03 Uncalibrated VFD

04 Uncalibrated or failed PRV

05 Hydrant Misuse

06 Non Isolated Zones

07 Check Valve Health

08 Lack of Check Valve

09 Dead End Runs

10 Pumping Schedule (not optimized)

Return on Investment

Return on Investment (ROI)		
Assume	100	Main breaks a year
	40	Service line breaks a year
Assume	15%	Reduction in main breaks a year
	10%	Reduction in service line breaks a year
Means	15	fewer main breaks a year
	4	fewer service line breaks a year
Means	$68,400	Annual main break cost avoidance
	$8,240	Annual service line break cost avoidance
	$76,640	**Annual Total Cost Avoidance**
Investment		
	10	Devices
	$4,500	$ per device
	$7,500	Advisory Services
	$52,500	**Total Investment**

Main Break Cost Inputs	
3	Employees
4	Hours
$30	Hourly Rate
$200	Clamp
$3,500	Paving Restoration
$500	Misc (fuel, consumables, traffic signage, tools, permit)
$4,560	All in cost for main break
Service Line Break Cost Inputs	
3	Employees
4	Hours
$30	Hourly Rate
$200	Clamp
$1,000	Restoration
$500	Misc (fuel, consumables, traffic signage, tools, permit)
$2,060	All in cost for service line break
ROI Calculation	
Return	$76,640
Investmen	$52,500
1 yr ROI	**145.98%**
2 yr ROI	**291.96%**