Leak Detection and Water Loss Control

Maine Water Utilities
September 9, 2010

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Leak Detection and Water Loss Control

"Utilities can no longer tolerate inefficiencies in water distribution systems and the resulting loss of revenue associated with underground water system leakage. Increases in pumping, treatment and operational costs make these losses prohibitive. To combat water loss, many utilities are developing methods to detect, locate, and correct leaks." - AWWA

Costs for Leaks

- AWWA believes the cost in the U.S. of unbilled distributed water is on the of $1-2 billion per year. The total cost is considerably higher when factors such as property damage are included.

EXCESSIVE LEAKAGE COST SYSTEMS AVERAGE DAY PRODUCTION (MGD)					
% LOSS	MILLION GALLONS PER DAY				
	0.5	1.0	2.0	4.0	5.0
5	$4,600	$9,200	$18,400	$36,800	$46,000
10	9,200	18,400	36,800	73,600	92,000
15	13,800	27,600	55,200	110,400	138,000
20	18,400	36,800	73,600	147,200	184,000
25	22,800	45,600	91,200	182,400	228,000
ANNUAL DOLLAR ($) LOSS – BASED ON PRODUCTION COSTS OF $0.50 PER 1000 GALLONS					

Waste Per Quarter @ 60 PSI Water Pressure			
Diameter of Stream	Gallons	Cubic Feet	Cubic Meters
— 1/4"	1,181,500	158,000	4,475
— 3/16"	666,000	89,031	2,521
— 1/8"	296,000	39,400	1,115
— 1/16"	74,000	9,850	280
A continuous leak from a hole this size would, over a three month period, waste water in the amounts shown above.			

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Primary Motives for Water Loss Management

- Revenue enhancement
- Conservation of water resources
- Reduced liability risk

Revenue Enhancement/ Cost Reduction

- Increased efficiency = lower costs
- No unnecessary interest expense associated with capital improvement expenditures
- Better position for requesting rate increases

Conservation of Water Resources

- Water is a limited resource
  - Regulatory agencies are choosing strategy of demand management over increasing water supplies
- Avoid exceeding draw-down limitations
- Reduce need for mandatory water use limitations

Water Loss Control

Two Main Causes for Water Loss:

- Leaks
- Inaccurate Meters / Billing

These losses inflate a water utility's production costs and stress water resources since they represent water that is extracted and treated, yet never reaches beneficial use.

Leak Detection and Water Loss Control

- Why do leaks happen?
- How do we detect leaks?
  - Technology
    - Equipment
  - Software
- Reducing Unaccounted for Water

Types of Leaks

- Service Line
- Valve Leaks
- Supply Lines

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Why do leaks happen?

- Pipe Material, Composition, Age
- Jointing Methods
- Initial Installation
- Water Conditions
  - Temperature
  - Velocity
  - Pressure
- External Conditions
  - Stray Electric Current
  - Contact with other structures
  - Frost Loads
  - Freezing Soil around the pipe

Water Loss In Gallons					
Leak this Size	Loss Per Day	Loss Per Month	Leak this Size	Loss Per Day	Loss Per Month
.	120	3,600	●	6,640	199,520
•	300	10,800	●	6,964	209,520
•	693	20,790	●	8,424	252,720
•	1,200	36,000	●	9,585	296,640
●	1,920	57,600	●	11,324	339,720
●	3,095	92,880	●	12,750	361,600
●	4,295	128,880	●	14,952	448,560

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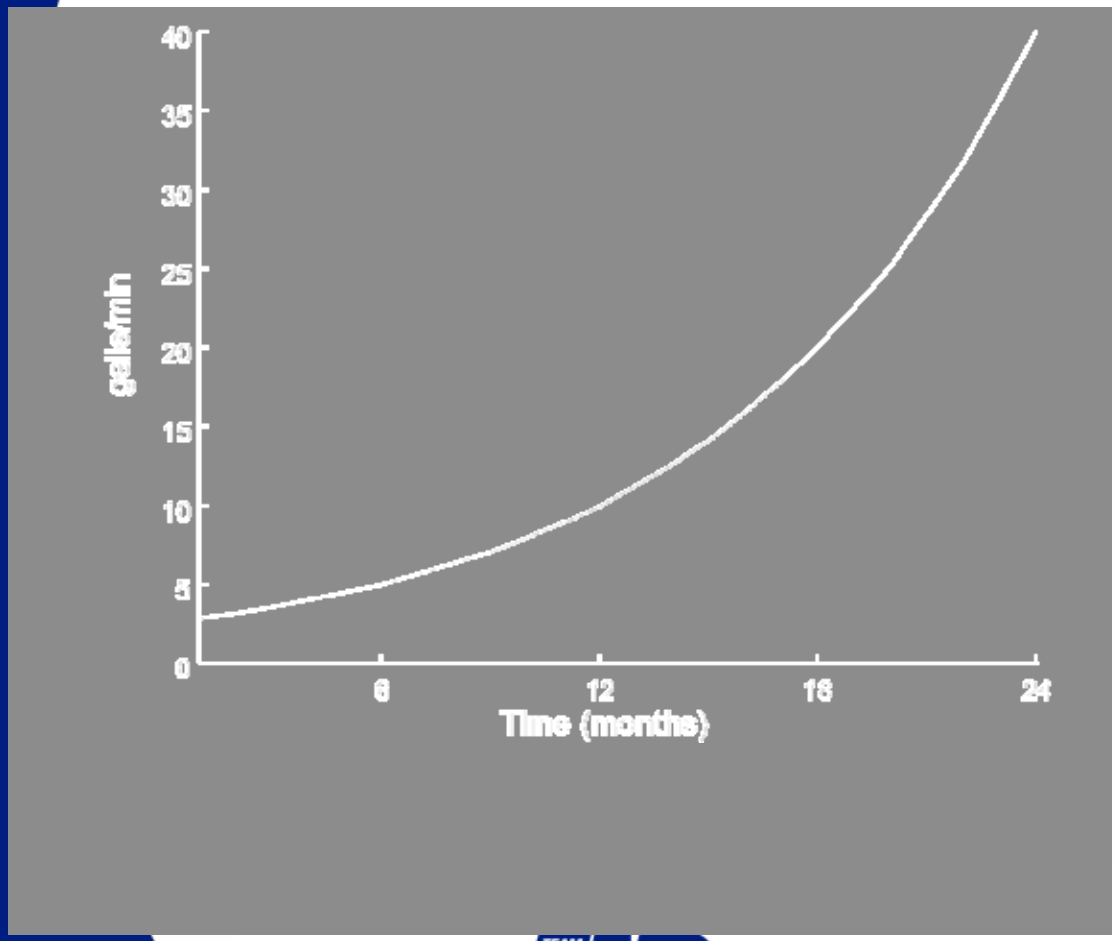
The Problem of Water Loss

- Mains leak at 400 gpm:
  - Runs for 48 hours
  - Loses about 1 million gallons
- Typical service line leak:
  - Loses 1 million gallons every 3 months
  - Runs undetected for years
  - Occurs about every 700 water services

Finding Smaller Leaks Saves More Money



- A typical leak enlarges at a constant rate over a period of 24 months.
- Identifying & repairing leaks in early stages:
  - Fewer mains breaks
  - Fewer emergency repairs
  - Amount of lost water is reduced

Reduced Liability Risks

- Pipelines are a buried asset – an increasingly complex infrastructure
- Liability is significant for cities
- Upgrades by 2020 will cost up to $1 trillion (US GAO)
- Avoid dangerous & costly mains break disasters
- Avoid embarrassing public relations scenarios

HOW DO WE FIND LEAKS?

Traditional Leak Detection Methods:

- Traditional walking survey
- “Wait-till-water-appears”
- Advanced acoustic solutions

Traditional Walking Survey

- Used for 150 years
- Limited effectiveness
- Still the primary tool by most utilities

"Wait-Till-It-Appears" Method

Westchester County, NY

- 400 gpm
- Cost of water lost during 48 hours up to $4,032
- PR benefits: none

Manhattan, NY

Equipment

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Advanced Digital Leak Detection Solutions

- **DigiCorr –** Digital Leak Noise Correlator
- **ZCorr –** Digital Correlating Loggers
- **DLD –** Digital Leak Detector
- **MLOG** – Network Leak Monitoring

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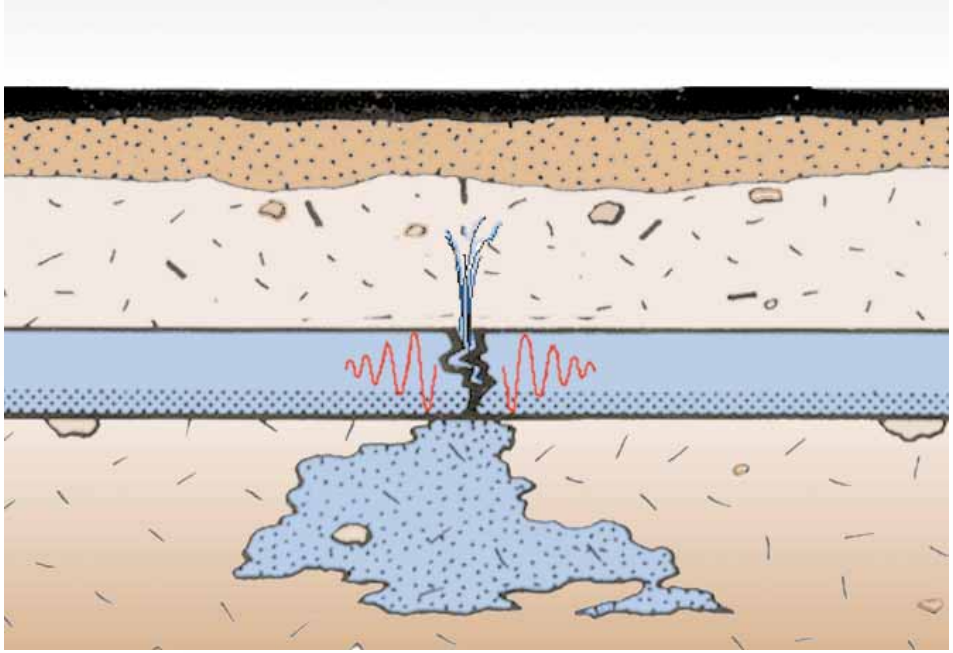
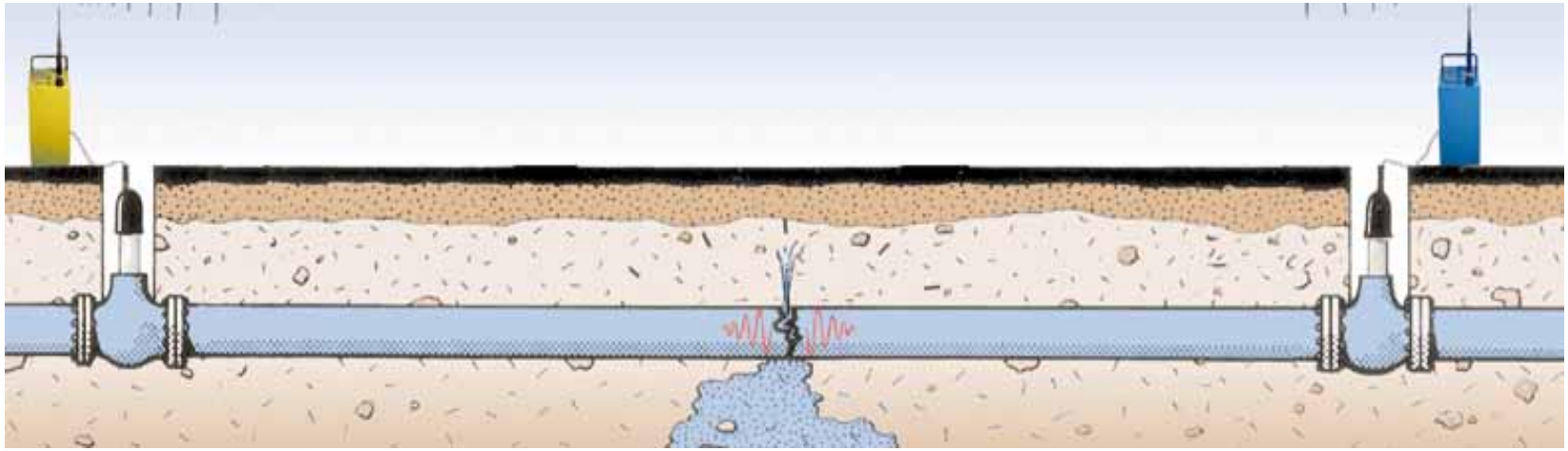
Principals of Correlation Technology

- Vibration energy (sound) is emitted when a leak occurs.
- The leak sound travels away from the leak site through the fluid.



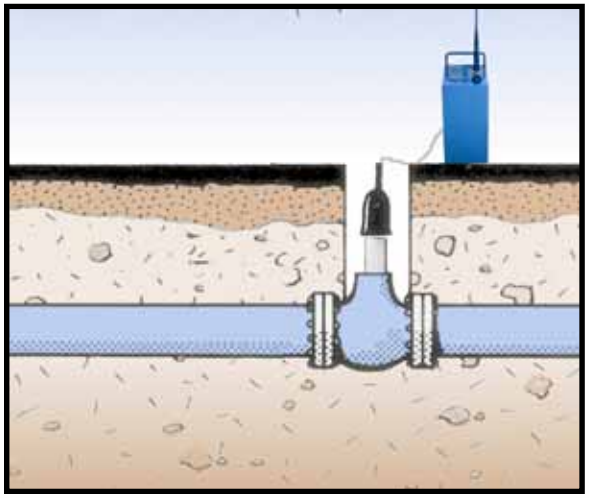
Principals of Correlation Technology (cont'd.)

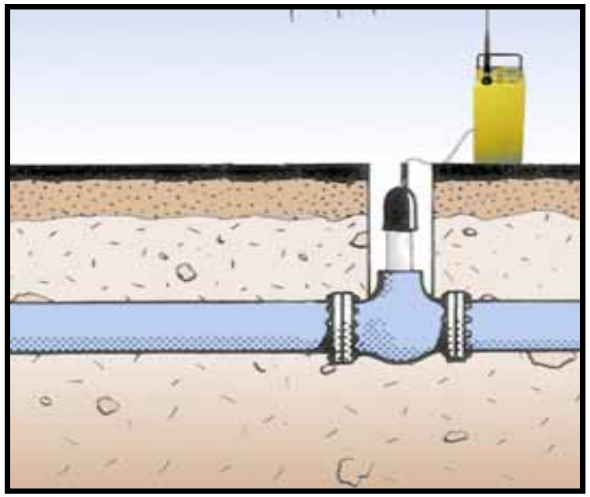


Acoustic vibrations are sensed in two ways:

- Outside of pipe using *accelerometers*; and
- Within the flow using *hydrophones*.

Principals of Correlation Technology (cont'd.)

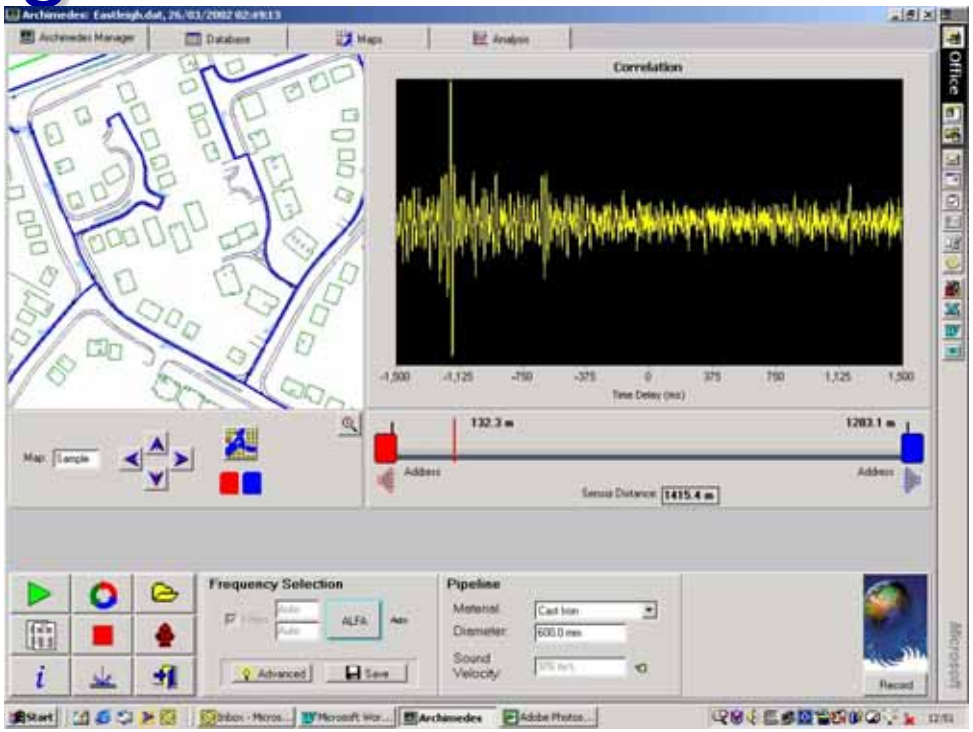




- As the sound travels in either direction through the pipe, it will arrive at each sensor at a given time. Vibration energy (sound) is emitted when a leak occurs.
- The difference between the arrival time at sensor #1 and the arrival time at sensor #2 is referred to as the *time delay*.
- The time delay is computed using a signal processing technique called ***correlation***.

DigiCorr

- Pinpoints leaks using digital correlation technology
- Portable, 5-minute deployment
- Rapid response; surveying



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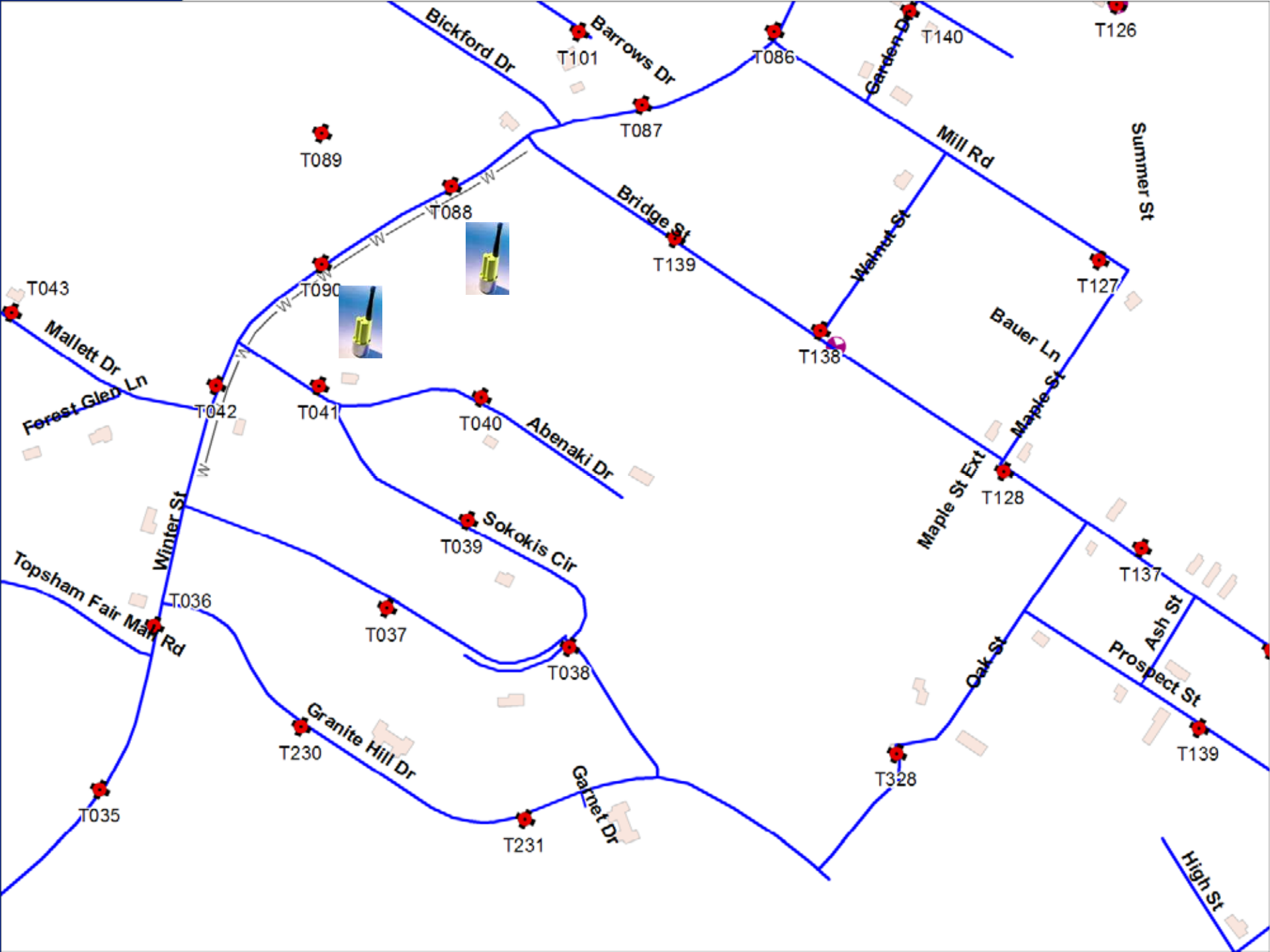
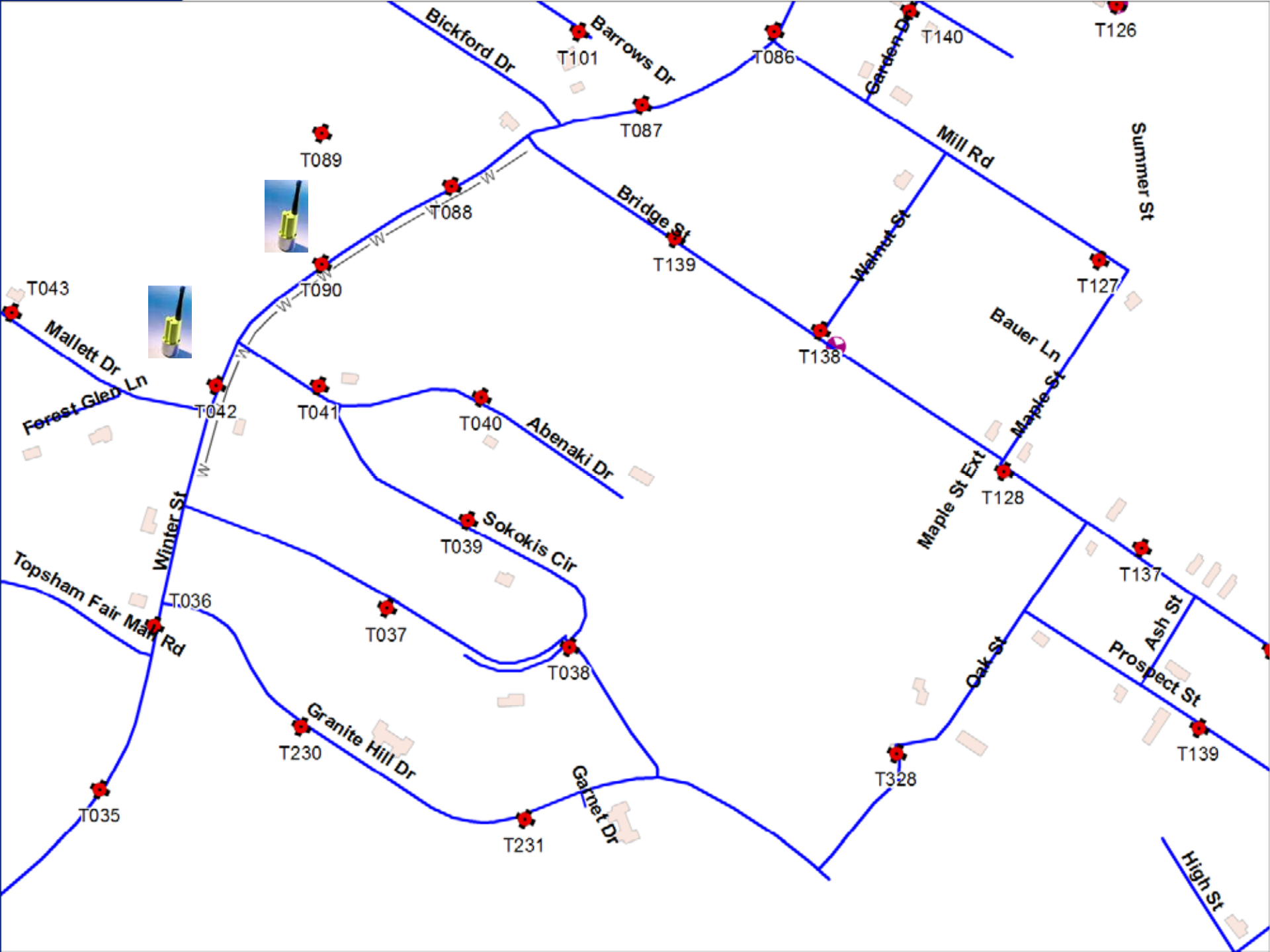

Bickford Dr
T101
Barrows Dr
T086
Garden Dr
T140
T126
T087
T089
Mill Rd
Summer St
T088
Bridge St
T139
Walnut St
T127
T090
T043
Mallett Dr
Forest Glen Ln
T042
T041
T040
Abenaki Dr
T138
Bauer Ln
Maple St
Maple St Ext
T128
Winter St
T039
Sokokis Cir
T137
Topsham Fair Mall Rd
T036
T037
T038
Ash St
Prospect St
Oak St
Granite Hill Dr
T230
T139
T328
T035
T231
Garnet Dr
High St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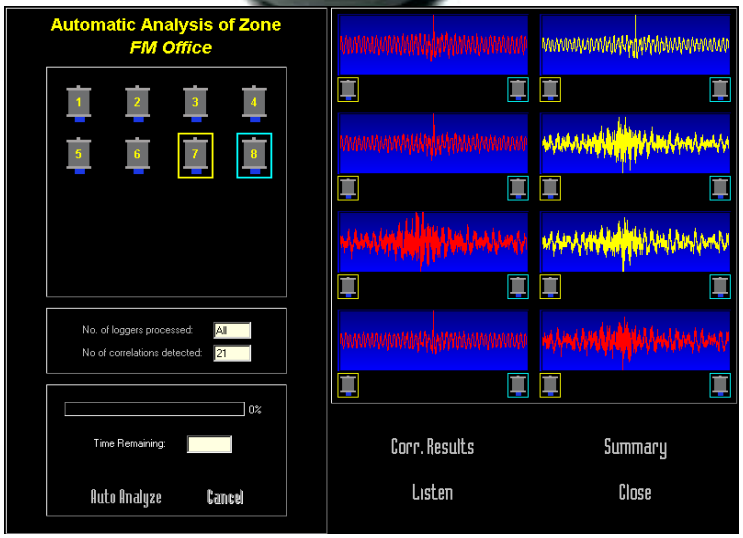
T042
T041
T040
Abenaki Dr
T138
Bauer Ln
Maple St
Maple St Ext
T128
Winter St
Sokokis Cir
T039
T137
Topsham Fair Mall Rd
T036
T037
T038
Ash St
Prospect St
Oak St
T139
Granite Hill Dr
T230
T328
T035
T231
Garnet Dr
High St

ZCorr

- Optimized for surveying
- Leaks are detected and pinpointed overnight in a designated zone
- Automatic digital correlation analysis among all loggers



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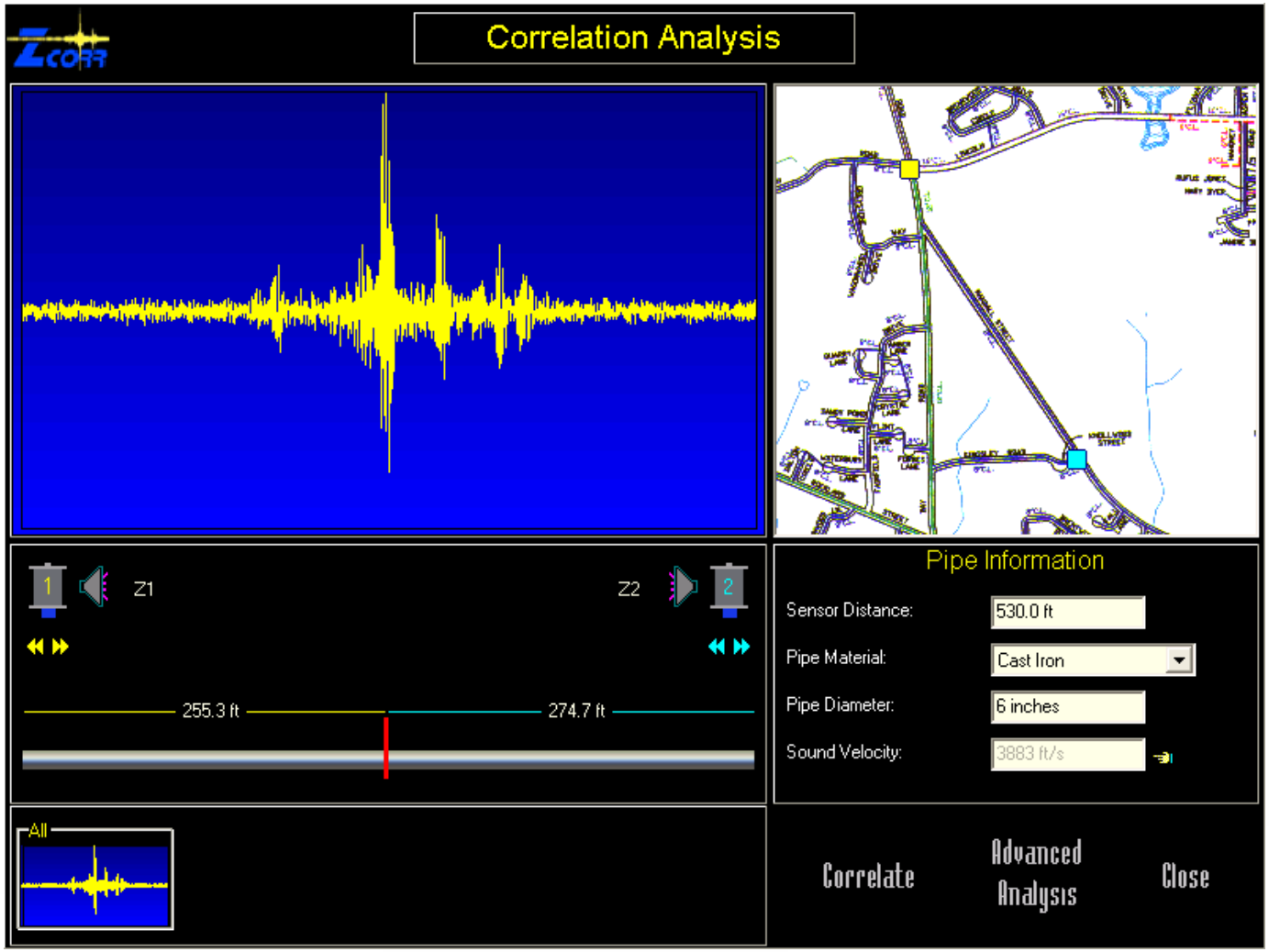
Zcorr Correlation



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DLD Digital Leak Detector

- Dynamic range compression
- Hears leaks where other instruments cannot
- Precise digital filters block ambient noise
- Automatic rejection of electrical interference
- Waterproof
- Lightweight (~ 2 LB)

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DLD Audio Processor Unit

- LISTEN
- VOLUME
  - Software adjustable
- FILTERS
  - Digital selection

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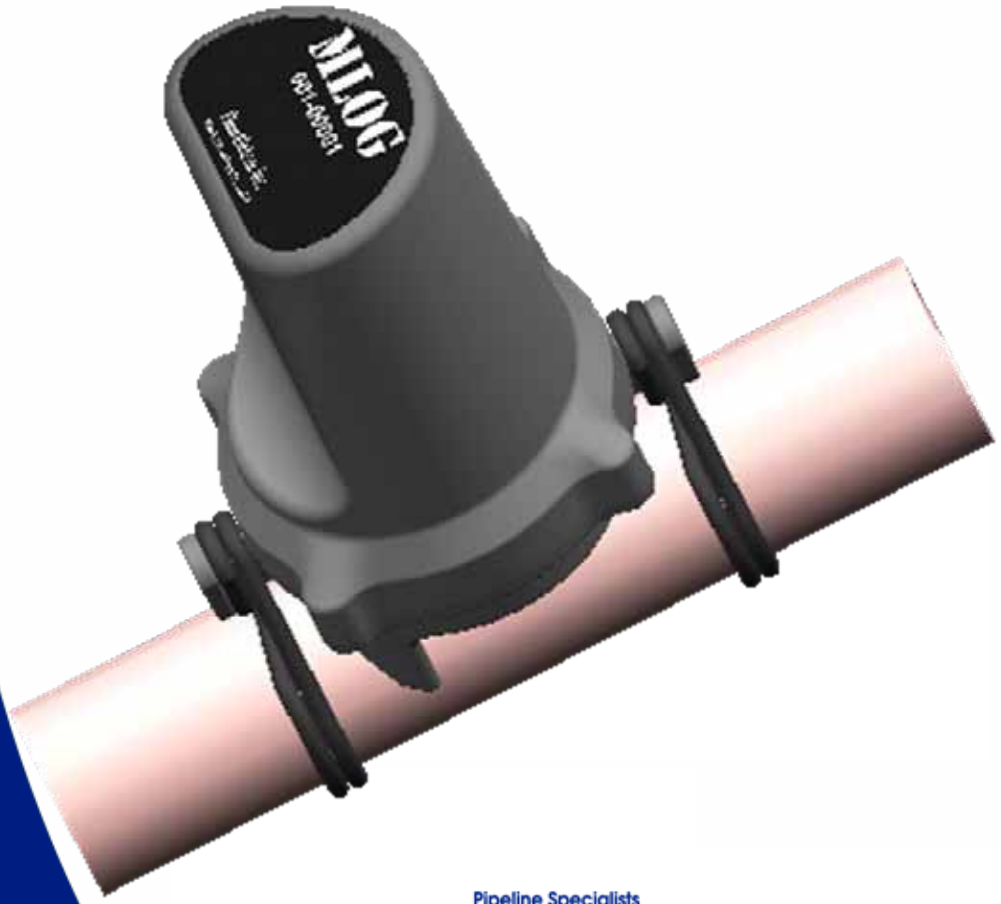
MLOG – Network Leak Monitoring



- Leak detecting sensors mounted every 10th service near the water meter
- Maintenance-free, 15 years
- AMR or Radio communications

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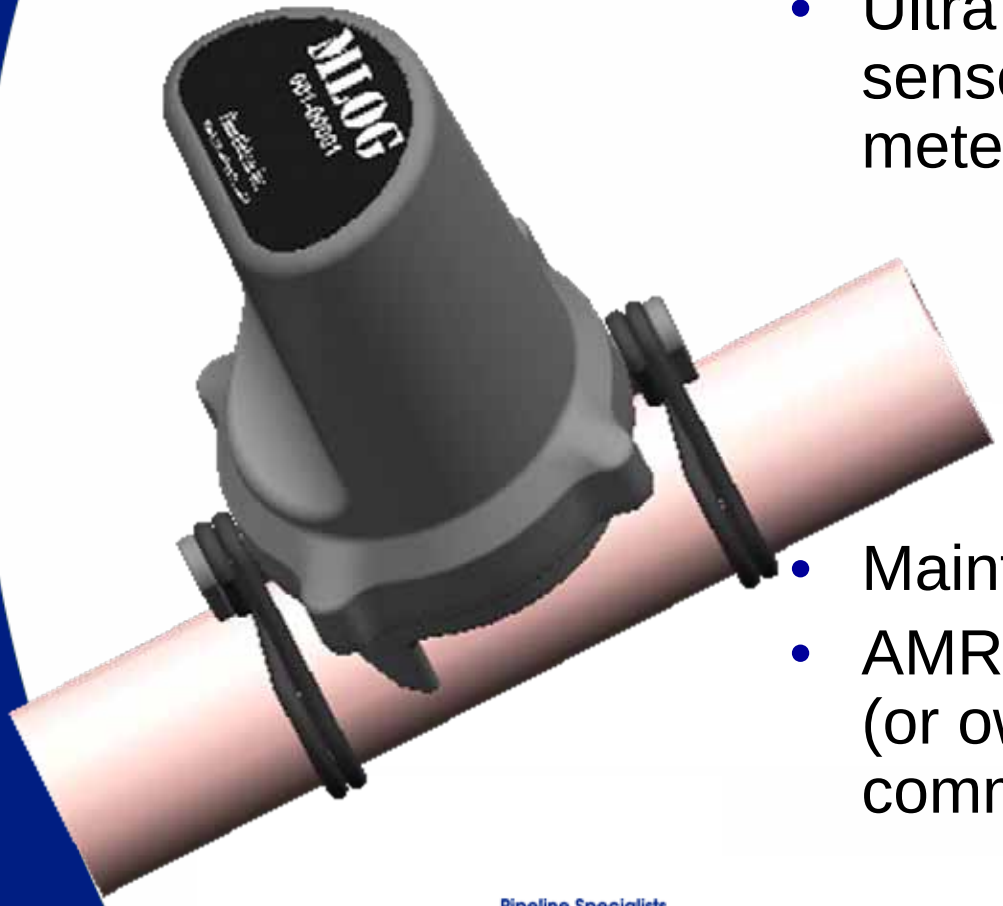
MLOG: Intelligent Vibration Sensor



- Ultra low-cost, waterproof sensor installed near a water meter
- Maintenance-free, 15 years
- AMR interface
  (or own mobile radio communication)

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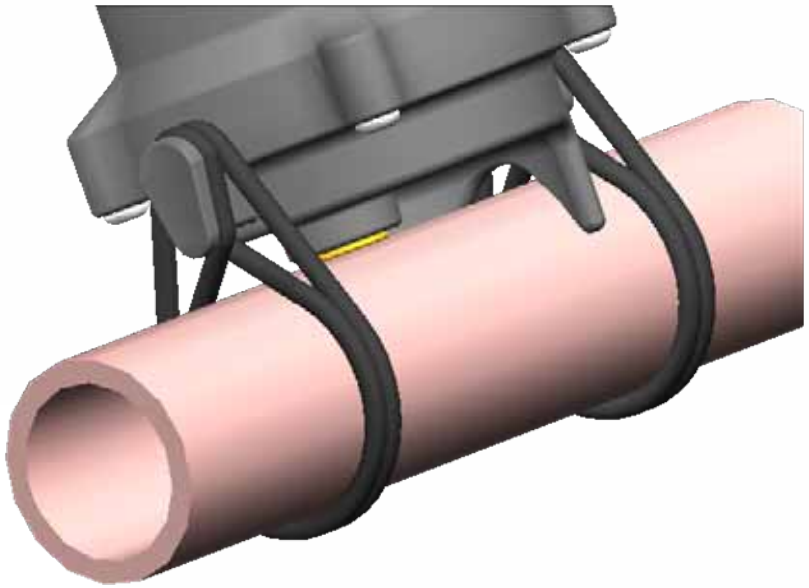
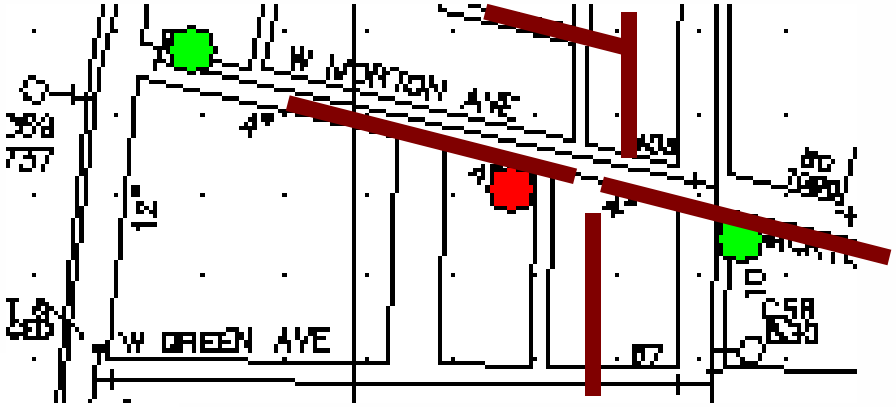
MLOG Installation

- Mounts to small pipes using:
  - a nylon tie wrap; or
  - an ‘O’ ring
- No field setup/calibration procedure required
- Installed near the meter, on the street side



MLOG Deployment Strategy

- MLOGs installed:
  - Every 500 feet of mains on average
  - Every 10th service on average
  - Use street corners



MLOG sensors detect leak sound thru multiple pipes: sound path ——— can be long (1,000+ feet)

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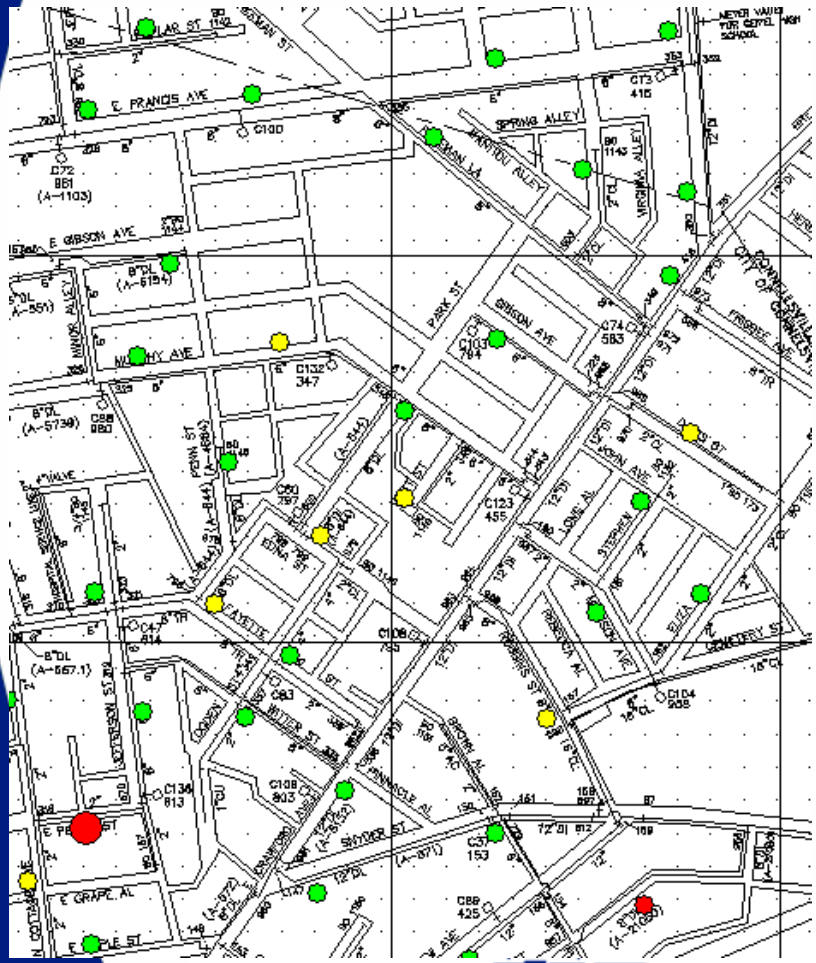
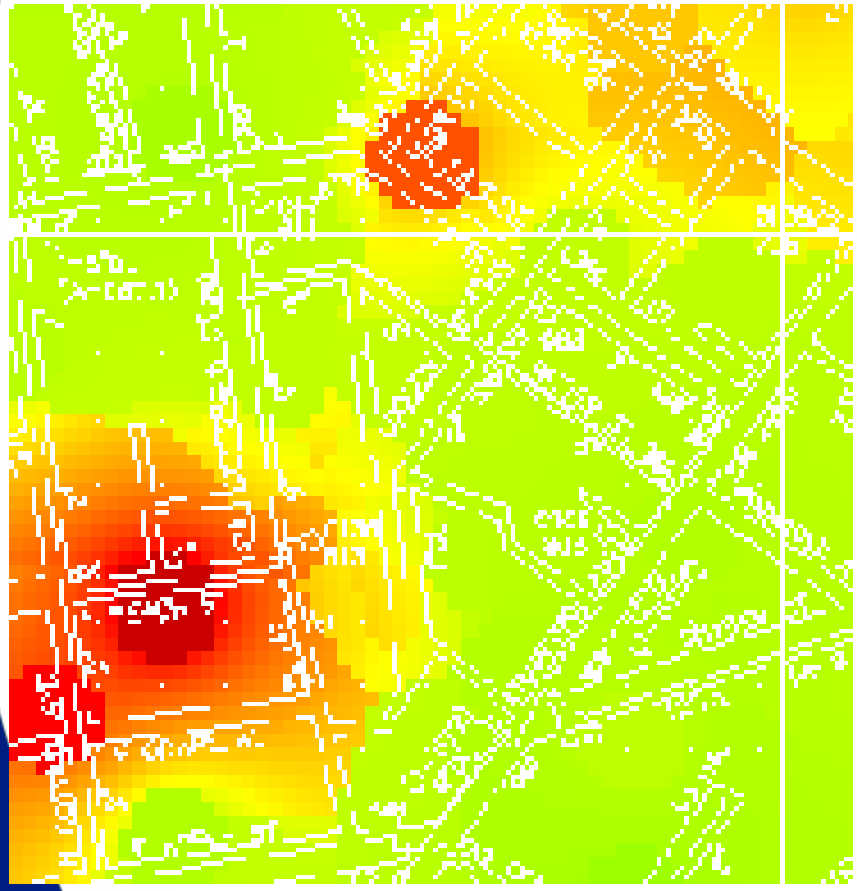
MLOGs Installed Across Network



- Leak status updated automatically after each 24-hour reading:

  - – Likely leak
  - – Possible leak
  - – Leakage unlikely

MLOG Color Map™



- MLOG Color Map shows areas of high *Leak Index*:
  - 2 leaks found
  - 60 gpm water saved
  - Annual value of $60,000

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Silent-Running Mains Break

- Mains leak discovered by MLOG at night
- Leak undetectable during day:
  - Usage masks sound
  - Crack closes at lower pressure
- 15 gallons per minute:
  - Worth $15,000 / year
  - 8mm gallons / year
  - 1.75% of this utility's annual production

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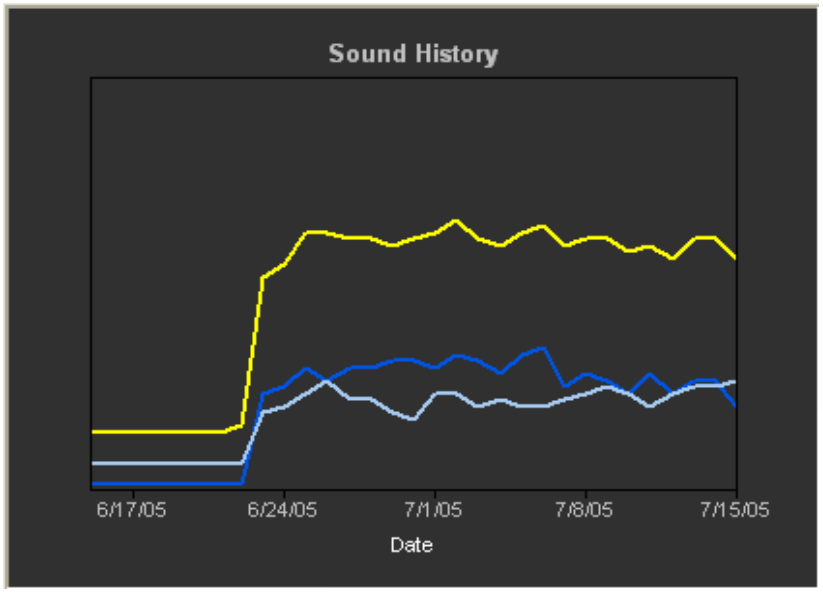
MLOG Detects Leaks by Sound



- Leak sound began on June 21 & was detected the next morning
- Leak alarms triggered by changing sound levels and frequency:
  - Sound level
  - High frequency sound
  - Medium frequency sound

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Meter Technology and Associated Leak Detection Capabilities

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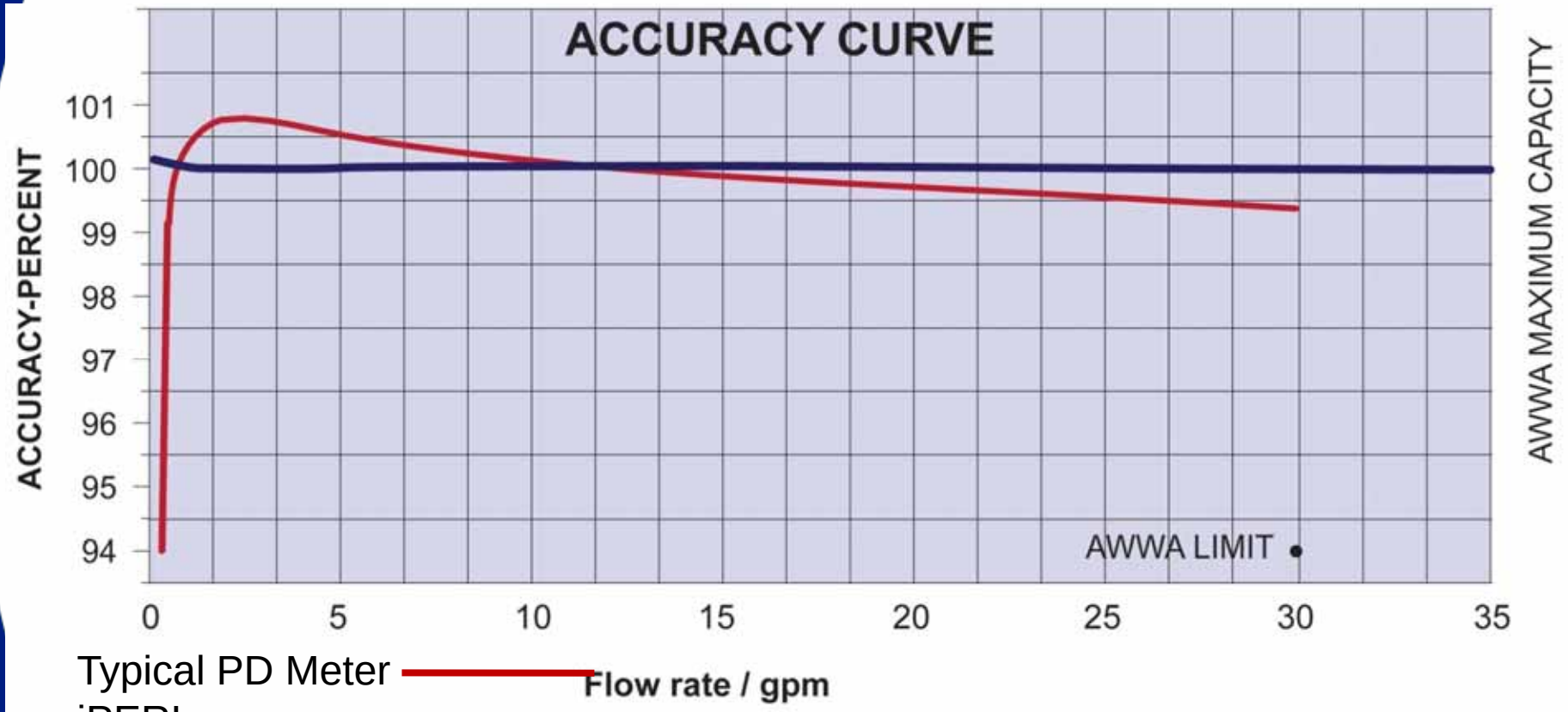
Can meters help?

- Smart Meters
  - Data Logging
  - Leak Detection
  - Reverse Flow
- Reading Systems
  - Software
  - Additional Tools

FlexNet

Accuracy Curve



iPERL Intelligent Alarms

- Alarms to monitor the application as well as the health of the iPERL

Available for reporting:

- Can detect
  - Reverse flow
  - Tamper
  - Empty pipe
  - Leak
- Lifetime alarms
  - 6 month
  - 1 month
  - Battery failure

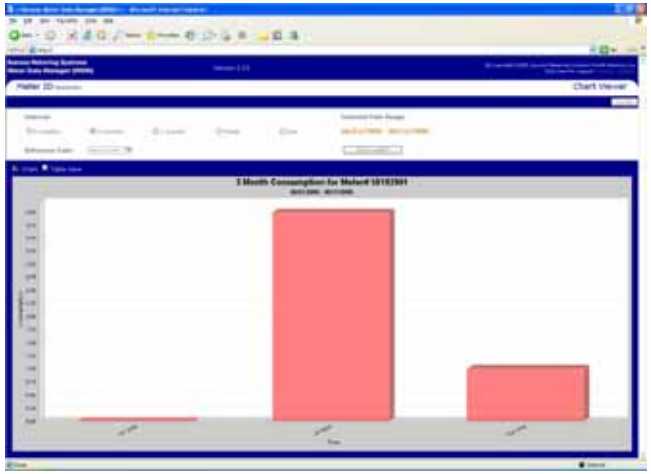
- Condition monitoring alarms
  - High temperature (-30 to 160)
  - Low field (magnetics)
  - High current (Too much Power)
  - Glide slope (battery)
  - ADC failure
  - Touchread failure
  - EMF range (Damaged)

Alarm History and Datalog

- All alarm conditions may be logged
- Records time of event and complete alarm state of device when event occurred
  - Allows progressive conditions to be analyzed
- Datalog
  - Interval data can be stored
    - Peak flow in interval
    - Volume in interval
  - Capacity for ~1500 data points
    - 49 days at 15 minute intervals
    - 12 years at 24 hour intervals

Meter and Data Management (MDM)

- Meter and Data Management software is used to:
  - Interface with billing software
  - Monitor consumption
  - Analyze system
  - Identify consumption trends
  - Monitor tampering
  - Assist in leak detection
  - Analyze individual accounts, groups of accounts, or entire system



Sensus Metering Systems
Meter Data Manager (MDM)

Version 2.28

Click here for support Sensus support

Meter ID EC2211461
Service Address 112 Rock Run RD

Endpoint ID 65010
Account ID 36000224

Chart Viewer

Chart | Table View

CLOSE

Interval:
(•) 6 months ( ) 3 months ( ) 1 month ( ) Week ( ) Day

Selected Date Range:
09-01-2007 to 02-29-2008

Reference/Ending Date: 02-05-2008 [ ] Use Date

VIEW CHART

Meter and Data Management

Sample reports include:

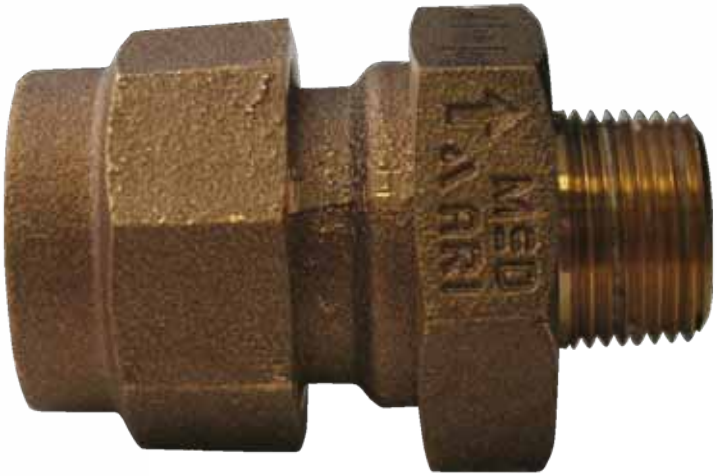
- High / Low
- Unread
- Master Report
- Non – Route
- Malfunction
- Bad Connection
- End Point Mismatch
- Consumption

MDM Software

Future Software Enhancements:

- Leak Detection Alarm
  - Monitors consumption over 24 hour period
  - As it transfers reading will also send an alarm flag
  - Can only be used it leak detection is purchased in the MTU itself
- Reverse Flow Detection
  - Works the same as the leak detection alarm
  - Will also only work if feature is purchased with the MTU
- Installation Report
  - Indicates that MTU message was successfully received following new installations

UFR (Unmeasured Flow Reducer)



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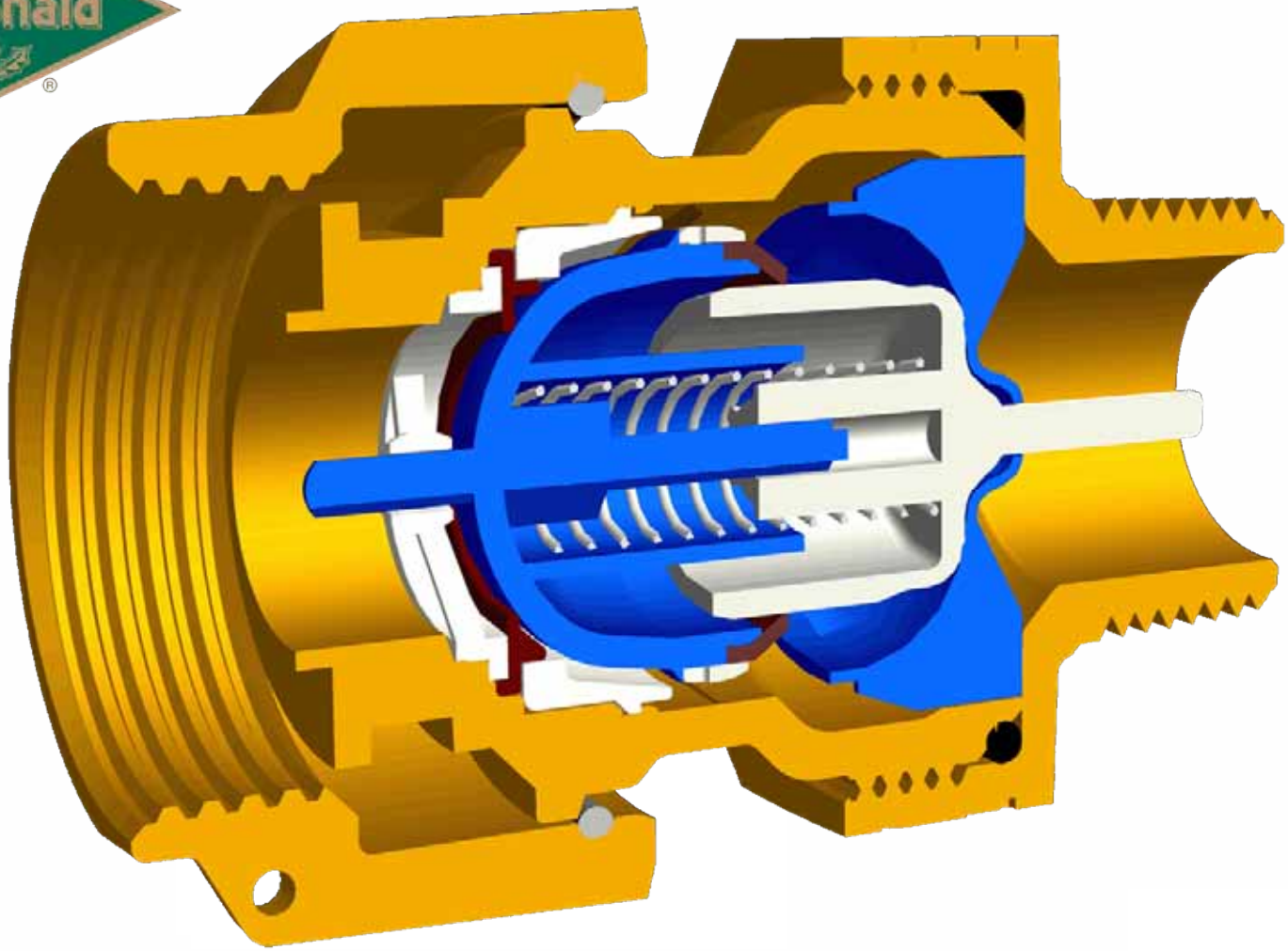
UFR (Unmeasured Flow Reducer)

The UFR captures low flow water and forces it through the meter in a way that causes nearly every drop to be registered by the water meter.



How does the UFR work?

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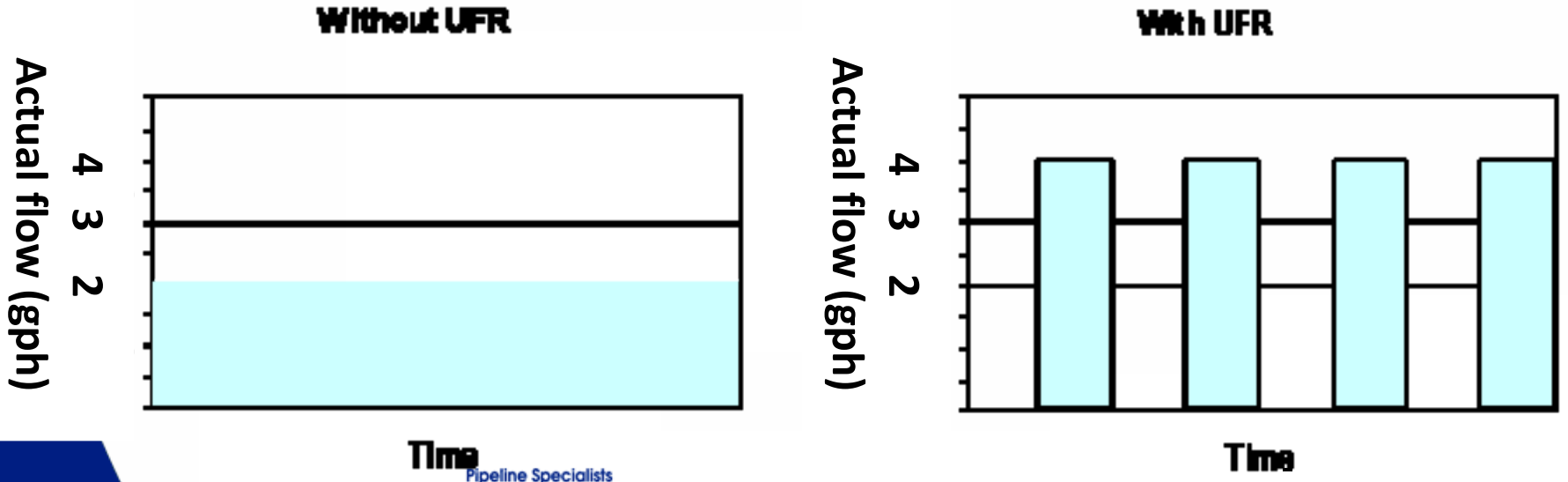
UFR – Principle of Operation

The UFR begins to operate at very low flow rates and creates pulses of flow that the water meter can measure.

Due to the change in the mode of water flow to pulses, the UFR enables the water meter to measure low flow rates.



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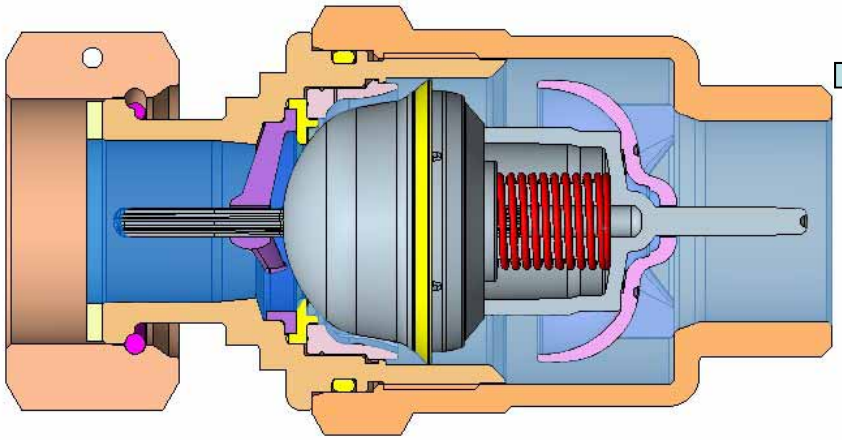
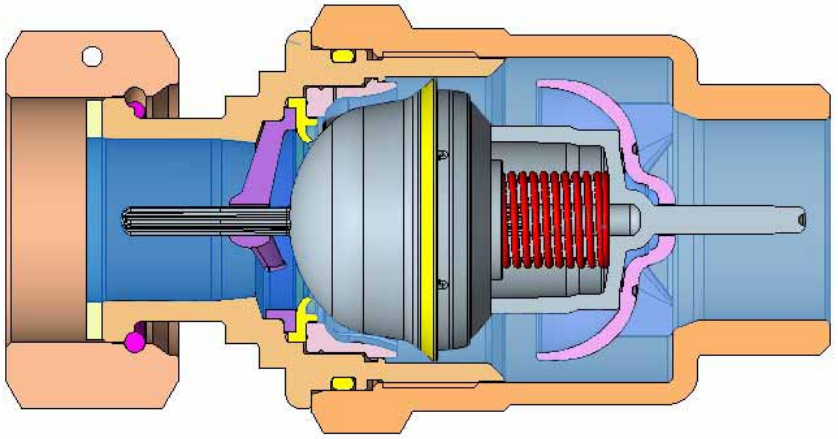
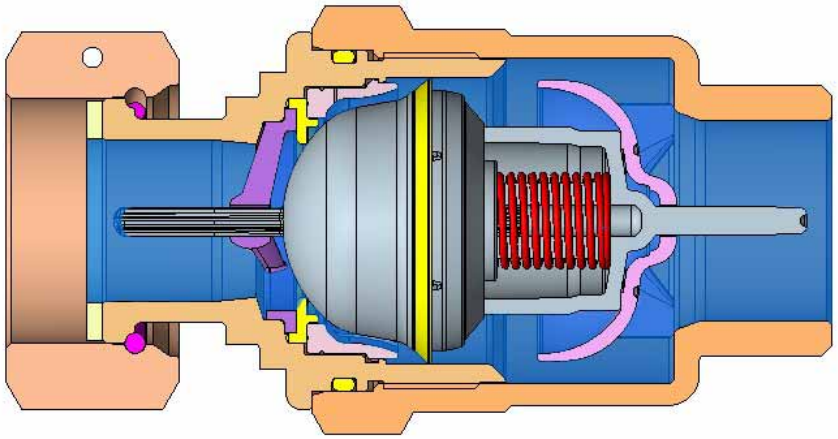
The UFR Operating Cycle



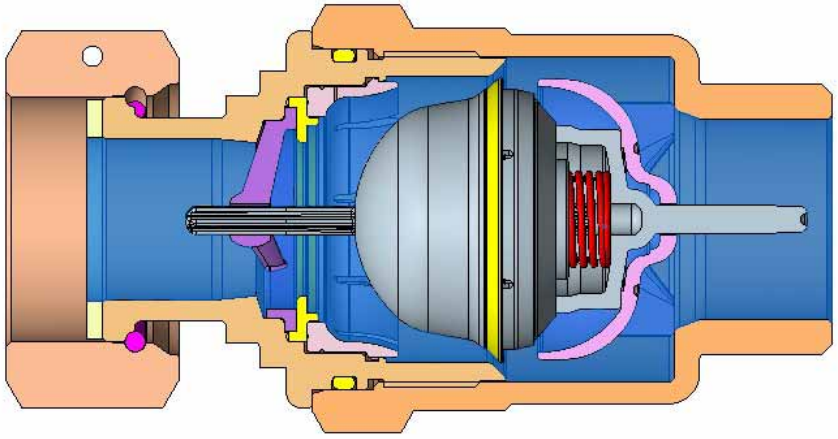
UFR Closed



UFR Still Closed



UFR Closes Again



UFR Opens