Pipeline Management Solutions
Stop Age Discrimination in Pipe Replacement Strategies
Wisconsin Wastewater Operators Association
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Buried Infrastructure Challenges

Over 240,000 water main breaks per year in the US
Over 900 billion gallons of sewage overflows per year in the US
>$250 billion investment needed for water pipelines within 20 years
>$80 billion investment in wastewater pipelines within 20 years
70% to 90% of replaced pipelines have remaining service life

Sources: ASCE & EPA
THE PURE PRECISION PLAYBOOK
Risk

Likelihood of Failure (LoF)

Consequence of Failure (CoF)

Risk = LoF x CoF
Likelihood of Failure

Pipe Condition
- Material quality
- Manufacturing
- Design
- Environmental
- Operational
- 3rd party damage
- Installation
- Age
Consequence of Failure

Social
• Loss of trust
• Traffic disruption

Environmental
• Creeks and rivers
• Sensitive areas

Economic
• Repairs
• Damage
• Loss of product
Why do Pipes Fail?

- Operational Pressure
- Mechanical Overload
- External Loading
- Weakening of Pipe
- Failure
Cast Iron Pipes
- Cracking from joints (leadite)
- Longitudinal or circumferential cracking
- Graphitization, corrosion and pitting

Ductile Iron Pipe
- Broad areas of corrosion
- Internal or External
Age alone is a poor indicator of condition

36-inch Diameter – Pressure Rated for 150 psi
The Good News

96% of pipe is in good condition

3% has some deterioration

1% has significant damage

We only need to address 4% of our pipelines!

Find the Weak Link

Manage individual assets
Approach to Pipeline Condition Assessment

- **Understand**
  - Risk, Operational Characteristic, History

- **Assess**
  - Gather condition data

- **Address**
  - Repair/Rehabilitation

- **Manage**
  - Reinspection, Capital Planning

1. What is the risk?
   - Perceived or quantified
2. What is the condition?
   - Leak detection & pipe wall assessment
3. What do I do now?
   - Repair or replace
4. What do I do in the future?
   - Remaining useful life and capital planning
THE PURE PRECISION PLAYBOOK

Understand
• What is the risk?
• Perceived or quantified

Assess
• What is the condition?
• Leak detection & pipe wall assessment

Address
• What do I do now?
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Manage
• What do I do in the future?
• Remaining useful life and capital planning
No single technology or technique can identify all of the indicators of pipe deterioration.

Therefore, a holistic, risk based approach should be used.
Using Risk as a Guide for Condition Assessment

- MFL
- Gas Pocket Detection
- Leak detection
- Pressure Monitoring
- Correlators
- Ultrasonic Thickness Testing
- Pulsed Eddy Current Testing
- Soil surveys
- Remaining Useful Life
- Structural Analysis
- Test pits
- FRS 0001+00 TO
- TO 2636+49
Transient Pressure Monitoring
Small Diameter Leak Detection

- Leak Survey with Loggers
- Localize with Correlators
- Pinpoint with Handheld Mic
Leak and Gas Pocket Detection

- Precursor to failure
- SmartBall and Sahara
- Contribute to force main failure
- Operational impact
Tethered hydrophones can identify leaks and air pockets

Identifies leaks & air pockets not found with correlators

Dallas Water Utilities Award Winning Program
• 144 leaks repaired in large diam pipe following 111 miles of inline leak detection
In-line Acoustic Leak & Gas Pocket Detection

Free Swimming/ Non-Tethered Hydrophone Technology
• Locates leaks and gas pockets in transmission or force mains
• Launch and retrieve in live flow through 4” openings
• Average 1 leak per 3 miles in concrete pipe
• Average 1 leak per 2 miles across all pipe materials
Introduction to SmartBall

SmartBall is a free-swimming inspection platform that is used to help pipeline owners better manage their pipelines by:

- Identifying and locating hidden leaks and gas pockets with high accuracy
- Mapping the pipeline to confirm alignment
- Measuring the pressure along the pipeline to identify partial blockages and confirm pipeline elevations
- Identifying and locating potential undocumented features and pipe type changes
- Contributing current inspection data to engineering analysis used for capital planning
Pipe Wall Condition

Identify pipe wall defects

- Corrosion
- Wall loss
- Broken prestressing wires
- Broken bar-wraps
Electromagnetic inspection identifies each pipe joint and broken wire wraps.
Internal and External EM Inspection Tools

**Manned**
- Diameter: 36”+
- Dewatered
- Manned system
- Allows for visual and sounding inspection
- 3D Mapping

**External**
- Diameter: Any
- Pipe segments excavated to springline
- Manned system

**Long Range Robotics**
- Diameter: 18”+
- Depressurized pipeline
- 8,000 foot tether
- Robotic with EM, CCTV, SONAR, laser, etc.
- 3D Mapping

**Free-Swimming**
- Diameter: 16”+
- Pipeline In Service
- Free swimming
  - * SONAR
  - * CCTV recording
Internal Visual and Sounding Inspection

- Complements EM Inspection and Structural Analysis
- Identifies problems with joints not addressed by EM
- Finds non-wire break related to problems (i.e., over loading, cracking, spalling, etc.)
- Provides accurate lay schedule and pipe inventory
Engineering & Analytics

Structural Evaluation
• AWWA Design check
• Finite Element Modeling

Remaining Useful Life Projection
Pipe Performance Curves based on FEA Provide Structural Assessment

- **Yield Limit**
- **Strength Limit (Pipe Failure)**

**20 Wire Breaks at Current Operating Pressure 35 psi**

- 180 psi allowable for pipe with 20 Wire Breaks
- 90 allowable wire breaks at 50 psi
Pipeline condition data and statistical models estimate remaining useful life

- Reinspect in 10 years
- 30 to 40 years until significant number of failures
Validation

Pipe 127

PipeDiver EM Signal Contour Plot

PipeDiver Video

EM Data
Validation of Pipe 127
Take Aways

- Time to move beyond age, failure, and material based replacement strategies
- Cost effective pipeline asset management uses risk to guide data collection, not replacement
- Data collection technique selection should be life-cycle based
- Inspection and repair approach typically 5 to 10% of the cost of most replacement only strategies
- Advanced pipeline asset management strategies can provide significant financial benefits
Summary

Condition assessment is an important part of your asset management program

- Reduce risk
- Manage more effectively
Questions?
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