Implementing Engineering Technologies for Underground Infrastructure Asset Management

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Primary Goal: Avoid Catastrophic Events
Condition of Existing Infrastructure

ASCE Wastewater Report Card:

2001 D

2005 D-

2009 D-

Aging wastewater systems discharge a billion gallons of untreated sewage each year into surface waters.
The Top Priorities identified include maintaining and rehabilitating aging wastewater infrastructure, and a number of priorities associated with potential “catastrophic events”.
Failure of Critical Pipelines Can Have Substantial Consequences…

- Impacts service to customers
- Often laid under major roads - Substantial traffic problems
- Potential danger to public health
- Potential damage to the environment
- Repair can be very costly
- Public perception of utility!!
Lessons for Management – Pipes Wear Out

- **PERFORMANCE** – Key is knowledge of the wear out process and application of asset management principles

- **RISKS** – Pipe life is an unknown variable that must be assessed with renewal technologies to optimize program

- **COSTS** – Expenditures are needed to match replacement or rehabilitation. This will require full cost pricing in rates
Are Utilities Spending Dollars on Critical Pipeline Infrastructure?

- Broadly held view that a crisis is required to motivate spending
- Competition for funding with visible, tangible, and immediate benefit projects
- Proactive management requires a sustainable program based on known pipe conditions
Knowing Condition of Critical Pipelines is Key to the Process of Managing the System

- Life expectancy for a pipeline system is shorter than design life
  - Corrosion in the system
  - Construction/installation practices
  - Transient pressures
- Performance is dependent on major trunk-line systems – critical pipelines
- Leads to a growing sense of urgency to define the condition of critical conveyance systems
Various Technologies Exist for Condition Assessment of Pipelines

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<th>Traditional Methods</th>
<th>“New” Technologies</th>
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Closed Circuit TV

- Side scanning evaluation technology
- Pan & tilt optical zoom
- Push camera
- Digital camera
Sewer Scanning Evaluation Technology (SSET)

From Hydromax
Advantages of Side Scan

12-inch, reinforced concrete

“Unwrapped” side scan image

Frontal view

- Frontal view identifies what appears to be a severely deteriorated joint in need of repair
- The SSET unwrapped side scan image identifies an intact joint with only superficial surface defects. No repairs needed!
Digital Visual Sidewall Scanning

By Envirosight
Side Scan Image Provides More Detail
Advantages Over CCTV

- Faster than conventional CCTV (70 fpm vs 30)
- Digital storage more efficiently (16,000 ft on a single DVD)
- No stopping or panning/tilting for defects
- Accurate and detailed annotation
- Lower cost of ownership
- Consumes less digital capacity/bandwidth for archiving and sharing

From Envirosight
Laser Scanning Inspection

Accurate inspection of large pipes

From Hydromax USA
Benefits Of Laser Scanning

- Enables inspection with minimum lighting requirements
- Measurement of the exact shape of the conduit
- Identification of connection location and position
- Measure cross sectional area and perimeter of conduit
Typical Laser Results

From Hydromax USA
Profiling SONAR

- Used in
  - Submerged pipe
  - Pressurized pipe
- Creates a cross-section of the pipe
  - Quantifies sediment deposition
  - Quantifies pipe geometry
  - 3D pipe model generation
- Advantages
  - Low cost high volume pipe inspection with no bypassing costs
Sonar Profiler Inspection

Accurate inspection of large pipes with flow 1/3 to totally surcharged

A series of sonar cross sections showing progressive grease build-up

SCAN SHOWS BUILD UP OF GREASE

From Hydromax USA
Typical Sonar Results

From Hydromax USA
Sonar Results of a 30-inch Line

From Hydromax USA
Synchronized Data Collection

- Gas
- V-CCTV
- Laser
- CCTV
- Sonar
- IMU
Focused Electrode Leak Locator (FELL41)

One step infiltration/exfiltration detection using an in pipe electrode

From Hydromax USA
Focused Electrode Leak Locator Applications

- Acceptance testing for new sanitary sewers of non-conducting pipe
- Can be used in dry weather conditions
- Sanitary Sewer Evaluation Surveys - Identify pipe defects including potential sources of infiltration (driven by flow monitoring data)
Below-ground part of the operation within the dry-well of the pumping station.

In this case, the hydraulic winch is attached directly to it without the use of an insertion fitting as the pipe could be de-pressurized for installation of the equipment.

The Sahara cable can be seen appearing from the chamber access hatch.
Sahara System Allows for Real Time Data Processing
PipeSpy Locates an Underground Leak and the Corresponding Location on the Surface

- PipeSpy transmits signal to Sensor Head
- Detectable through ALL pipe materials
- Depths to 35 foot range
- Locates within 18-inches of linear alignment of pipeline
- Stakeout, mark out, and/or GPS coordinate exact leak location
Complete the Condition Assessment: \( R^3 = \text{Right Pipe, Right Time, Right Material} \)

- Over the Line Surveys – Soil corrosivity tests, remote visual inspections (SSET, Laser, Sonar or CCTV)
- Failure risk analysis
- Review existing pipeline data
- Develop plan, identify projects, cost estimates
- Prioritize based on known conditions
Managing Infrastructure Requires a Process

**Condition Assessment**
- Inspection Planning
- Field Inspections
- Assignment of Ratings
- Inspection Documentation
- System Supply/Demand Assessment

**Project Development**
- Identify Capital and O&M Projects
- Prepare Project Descriptions
- Develop Capital, O&M, and Failure Costs

**Prioritization**
- Assumptions Form
- Risk Mitigation / Simulation Ranking
- Weighted Matrix Scoring

**Prioritization Rankings to Reflect Level of RISK**

**Implementation Schedules**

**Key Results of Process**
- Facilities Assessed
- Results Documented
- Project Identification
- Develop Cost Assumptions
- Prioritization Process
- Risk Criteria Ratings
- Prioritization Results
- Timing Optimization
- Implementation Schedule
- Phased Work Plan Meets Budget
Basic Steps to Management of Critical Pipeline Infrastructure

- Condition Assessment
- Develop Program
- Prioritize; Based on Risk Analysis
- Implement Plan

R3 = Replace the Right Pipe, at the Right Time, with the Right Material
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$R^3 = \text{Replace the Right Pipe, at the Right Time, with the Right Material}$
Questions?

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