Acoustic Inspection of Sanitary Sewer Lines

2012 VRWA Conference
April 4, 2012

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Presentation Outline

- What is the Problem?
- Sewer Line Inspection Methods
- Acoustic Inspection Technology
- Field Performance
- Acoustic Inspection Applications
- Summary
What is the Problem?

- Overflows are a Symptom – Not the Problem

Problem – Condition Information

- Overflow locations – “Random”
- Historical GIS – Helpful – But Insufficient
- Where & When to Deploy Cleaning Resources
- Cost Effective & Timely Condition Information
How Much Cleaning is Required?

Sixteen Municipalities’ Overflows/100mi vs. % System Cleaned Annually

2012 VRWA Annual Conference

Sewer Line Inspection Methods

- Manhole Inspection
- Acoustic
- Zoom Camera
- Push Camera
- CCTV/Robotic Camera
- Pipe Wall Defect Scanners
- Pipe Profiling / Robotic Multi-Sensor
**Sewer Line Inspection Methods**

- **Acoustic**
- **Blockage**
- **Pipe Condition**
- **Manhole Inspection**
- **Pipe Wall Defect**
- **Detailed Pipe Profiling**
- **CCTV**
- **Push Camera**
- **Zoom Camera**

### Relative Cost

- **No Contact with Flow:** LOW
- **Contact with Flow:** HIGH

### Inspection Resolution

- **LOW**
- **HIGH**

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**Acoustic Inspection Technology**

- **How it Got Started** – UNCC & CMU "Brainstorming" Session
- **Sewer Lines** – Natural Acoustic Wave Guides
- **Obstructions** – Acoustic Signals Absorb & Reflect
- **Diagnostic Tool** – Evaluates Aggregate Blockage
Acoustic Inspection Technology

- How Does it Work?

Transmitter "Yells"

SL-RAT Sewer Line Rapid Assessment Tool

Receiver "Listens"

Blockage

Demonstration Video
**Key Features of Acoustic Inspection**

- No Flow Contact / No Confined Space Entry
- Low Cost—Pennies/foot
- Rapid Onsite Results – Under 3 min./segment
- Portable < 30 lbs
- GIS Integration – GPS Enabled
- Archive Pipe Segment Blockage Assessment

**Limitations of Acoustic Inspection**

- Currently Does Not Indicate What is Causing the Blockage
  - FOG, Rootballs, Non-dispersibles, etc.
- Generally Does Not Assess Condition of Pipe Walls
- Does Not Pinpoint the Blockage – Gives an Aggregate Score for at Segment – Identifies Pipe Segments
- Under High Flow Conditions a Segment can be Assessed as Being Dirtier
Field Performance

- Two Central Questions Performance & Operational Cost
  - Evaluated During 2010 CMU / InfoSense Acoustic (SL–RAT) Field Trial
  - NC–AWWA 2010 Spring Fling & Annual Meeting
- Blockage Assessment Performance Evaluation Based on Comparison with CCTV

CCTV Blockage Assessment

- No Obstructions: 10
- Root Fibers Limited Growth
  - Grease Limited Build Up: 8
- Root Fibers and/or Grease
  - Robot Can Pass Through: 5
- Root Fibers and/or Grease
  - Robot Cannot Pass Through: 2
- Obstructed: 0
**CCTV Blockage Assessment**

- CCTV Blockage Assessment 10
- CCTV Blockage Assessment 5
- CCTV Blockage Assessment 7
- CCTV Blockage Assessment 2
- CCTV Robot was Able to Pass Through Root Fibers
- CCTV Robot was Not Able to Pass Through Obstruction

**Field Performance**

Acoustic Standard Threshold
- 61% Reduction in Cleaning
- All Pipes Requiring Cleaning are Cleaned

Acoustic Critical Threshold
- 85% Reduction in Cleaning
- Identify Pipes in Critical Need of Further Action

- CCTV & Acoustic Inspection
  - >50% Pipe Segments Did Not Require Cleaning
- Acoustic Assessment Correlated with CCTV
- Acoustic Provides Conservative Assessment
Field Performance

- Typical Industry Values: Cleaning Crew $1.00/foot
- Estimated Acoustic Inspection Crew

<table>
<thead>
<tr>
<th>Number of Crew Members</th>
<th>2</th>
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<tbody>
<tr>
<td>Annual Fully Loaded Salary Per Crew Member</td>
<td>$68,000</td>
</tr>
<tr>
<td>Annual Equipment Costs (Including Truck &amp; SL-RAT)</td>
<td>$24,000</td>
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<tr>
<td>Work Days Per Year</td>
<td>251</td>
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<tr>
<td>Onsite Work Hours Per Day</td>
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<tr>
<td>SL-RAT Average Number of Segments Inspected Per Hour</td>
<td>6</td>
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<tr>
<td>Average Sewer Line Segment Length in feet</td>
<td>220</td>
</tr>
<tr>
<td>Cost Per Foot</td>
<td>$0.09/ft</td>
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</table>

Field Performance

- Cleaning Program – Current Practice
  - Cost Model
    - Cleaning Cost / Foot $1
  - Performance Model
    - Linear Regression for 16 Municipalities Overflows vs %System Cleaned
  - Benchmark
    - 2 Overflows/100mi
    - 45% System Cleaned – Low Confidence
    - 75% System Cleaned – Modest Confidence
Field Performance

- Acoustic Inspection Prior to Cleaning
- Only Clean Segments Below Standard Threshold
- Illustrative Case
  - 52,000 ft Basin
  - 30,000 ft Assessed by Acoustic as "Clean"
  - Remaining 22,000 ft were Cleaned
  - 58% Reduction in Cleaning

Acoustic Inspection Applications

- Focus Cleaning Effort – Reduce Cleaning by Over 50%
- Pre-Maintenance Inspection – Perform Low Cost Basin Assessments
- Eliminate Repeat & Downstream Overflows
- Post Cleaning – Quality Assurance
Example – Identify Hot Spots in Basin Cleaning Project

Historical Archive – SL-DOG

- Sewer Line Data Organizer – SL–DOG
- Convert Assessment Data to Actions
- Better Schedule Cleaning Activities
- Better Management of Inspection Activities
- Improve Your Collection Cleaning Effectiveness
Summary

- Inspection is much Cheaper than Cleaning
- Acoustic Inspection is an Effective Method to Make Blockage Assessments
  - Quick
  - Cheap
  - Easy / Safe
- Acoustic Inspection Does Not Replace Cleaning or Detailed Inspection
  - Helps Determine how to Effectively Deploy Cleaning and CCTV resources

Additional Information

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