Risk Based Predictive Maintenance Solutions for Cleaning Sewer Mains

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Agenda

01 Background
02 Goals
03 Cleaning Philosophies
04 Cleaning Frequency Optimization
05 Code-based Data Collection
06 Visualization and Grouping
07 Cleaning Optimization Tools
08 Results
01 Background
Background

What? Collection System Improvement Program

Why? Reduce SSO’s and Increase Operational Efficiency

Where? City of Winston-Salem, Forsyth County North Carolina

Who? City/County Utilities (CCU) serving
  - 100k sewer connections
  - 225 FTEs working in collection and treatment
  - 1750 miles of gravity sewer lines
  - 50 Pump stations

When? 5-year “CSIP” kicked off in July 2016 (assessment and fast start activities Mar-Jul 2016)
Mission
To improve collection and conveyance of wastewater while protecting the environment and community we serve by complying with all regulatory requirements.

Vision
We will be a top-performing utility supported by a trained, knowledgeable, and proactive staff, dependable equipment, efficient processes, effective information management, and fair and affordable rates.
Winston-Salem CSIP Goals

- Reduce SSOs
  - Reportable and non-reportable
- Develop a risk based schedule
- Clean the Entire System
- Leverage Data Collected

- Use Limited Resource Efficiently
  - Clean the right pipe at the right time
  - Move from reactive to proactive
Historical SSOs

Total SSOs

- State reportable
- EPA reportable
Historical SSOs

SSOs by Cause

- High percentage of O&M caused SSOs
02 Goals
Schedule Optimization
Each pipe has an optimum cleaning frequency

- Too Little
  - Risk of overflow
- Just Right
  - Efficient use of resources
  - Limit risk of overflow
  - Extend useful life
  - SAVE MONEY
- Too Much
  - Inefficient resource use
  - Increase wear
Data Review

Pull Available Data to Develop a Risk Based Schedule

- SSOs
- Cleaning History
- Service Requests
- CCTV
- Annual Cleaning “Heat” Maps
- Contractor Work
  - Cleaning
  - Root Control
03 Cleaning Philosophies
Route-Based Cleaning
Asset-Based Cleaning
Cleaning Performance Indicators

- Production
  - Footage cleaned
  - Set-ups performed

- Effective
  - SSO reduction
  - Cleaning QC (pass rate)

- Efficient
  - Cleaning at the right time
Route vs Asset Based

Route Cleaning

Pros
- Productivity Based
  - Clean more footage
- Less windshield time
- Limited data needs

Cons
- “Over-cleaning”
  - Damaging Pipes
- Not an effective use of resources

Asset Cleaning

Pros
- Cleaning pipe based on need
- Better use of limited resources
- Not “over-cleaning”

Cons
- Potentially less productive
- More windshield time
- DATA NEEDS
Keys to SSO Reduction VIA Sewer Cleaning

- **Office**
  - Frequency optimization process
  - Optimized Work Order creation and assignment process

- **Field**
  - Quality Equipment
  - SOPs – techniques and data collection
  - Training – techniques and data collection
  - QA/QC Program – techniques and data collection

- **Both** = Balance between quantity and quality of cleaning
Asset-Based Cleaning

**Tools Needed**

- Measure the maintenance condition of a pipe
- Determine asset cleaning frequency
- Group assets onto work orders in geographic clusters
04 Code-Based Data Collection
Code-Based Cleaning Data

FINDINGS
- Grease
- Roots
- Debris

SEVERITY
- Clear
- Light
- Medium
- Heavy
One-to-One Work Orders

**Before**
- Asset 1
- Asset 2
- Asset 3

Cleaning findings

**After**
- Asset 1
- Asset 2
- Asset 3

Cleaning findings
05 Cleaning Frequency Optimization
Cleaning Optimization Premise

- Based on two concepts:
  - Data driven decisions
  - Pipes have cleaning “windows”
Data Driven Decisions

- **Clear**: Decrease frequency
- **Light**: Frequency is right
- **Medium**: Increase frequency
- **Heavy**: Increase frequency
Cleaning Schedule
Windows

<table>
<thead>
<tr>
<th>Date</th>
<th>Target Start Date</th>
<th>Time</th>
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<td>60 Month</td>
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Visualization and Grouping Tool
Facilitates balance between WO risk and location

Visualize Pipes to Schedule

Benefit: Allow the User to quickly and effectively balance risk and geographic location when assigning work
07 Cleaning Optimization Tools (COTools)
Cleaning Optimization Tools Setup

**Data Staging**
- CCTV Software
- CMMS

**CCTV**
- History
- Schedule
- Exempt Assets
- List of Schedule Adds & Modifications

**Import Data**

**Algorithm Generated Recommendations**

**Approve or Reject Recommendations**

**Export Schedule Adds & Modifications**

**COTools**
- Define Decision Making Thresholds
### COTools User Interface

**Pending Decision Filter**
- **On** and **Off** buttons

**Recommendation Table**
- **EQNUM**
- **Decision Type**
- **Old Value**
- **Proposed Value**
- **Status**
- **WO**
- **PMNUM**
- **DWWACTVCD**

**Import All Data**

**Run Algorithm**

**View/Hide History**

**View/Hide Recommendations**

**Export Decision Log**

**Exit**

**Pipe History Table**
- **EQNUM**
- **WON**
- **Event**
- **Performed Date**
- **Action**
- **Findings**
- **Comments**
- **WOStatus**
Results
Cleaning Schedule Optimization

- **Strategic Goal**: Reduce SSOs
- **Primary Cause**: Maintenance Related
- **Tactic**: Use data to maintain assets at “right time”

**Benefits:**

- Focus limited resources where they are needed most
- Reduce LOE to make decisions
- Utilize data that already exists or is being collected
- Extend useful lifetimes of pipeline assets
Questions?

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