2106 - The City of Racine Utilizes New Inspection Technology to Measure Flow Reductions Before and After Rehabilitation

610 - Emerging Topics and Technologies in the Collection System
October 4, 2017 2:30 pm
Room N426A
McCormick Place
What will we Cover Today?

• Introduction
• Focused Electrode Leak Location (FELL) Inspection tool Background
• Methodology
• Results
  • Issues
  • Cost
  • Pre CIPP Project Inspection
  • Post CIPP Project Inspection
• Conclusions
Where is Racine?
Greater North Bay Subdivision (GNB)

- 5,543 feet of pipe main – 28 pipe segments – 8 & 10” concrete pipe
- 103 laterals serving single-family residential properties
- ‘Closed’ network served by 1 lift station
- Goal: estimate percent of reduction in peak flows (including I/I flows)
- Reduction expected due to late-2015 CIPP project
- Estimate to justify 2015 CIPP project and future projects too
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FELL Background

• Today City:
  • MEASURES flows using monitoring equipment
    • Relies on storms
  • ESTIMATES flows using CCTV inspections
    • Estimates vary among CCTV Operator/Viewer
    • flows often not seen due to varying groundwater levels

• City chose to estimate flow reduction with FELL because:
  • best chance to compare pre and post 2015 CIPP project flow rates w/o relying on:
    • Storms
    • Operator / Viewer

• FELL used was California based Electro Scan, Inc.
Algorithm assumes that:

- Ground water at a depth of 1 foot over the top of the pipe
- Subgrade soil exist in a theoretical condition
- Defect is a finite and constant width

Assumptions cause margin of error in estimated flows of up to 40%

Assumptions not true in GNB, but were constant during pre and post CIPP FELL inspections
• Because constant, while estimated flows could be 40% different than GNB’s lift station pumping data
  
  • City expected FELL estimated flows to be reasonable estimates of percentage of flow reduction within assumptions themselves
  
  • City can later compare FELL estimate of percent reduction to percent reduction measured at lift station

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• Methodology is ASTM 2550-13, Standard Practice for Locating Leaks in Sewer Pipes By Measuring the Variation of Electric Current Flow Through the Pipe Wall
• Light flush of main downstream to upstream manhole
• Once jetter head at upstream manhole, remove head - replace with the cone & trailing electrode ‘train’
• Jet truck supplies water to the end of hose -create the ‘knuckle’ of water upstream of cone immersing the electrode
• Jet truck’s reel pulls electrode thru main back to the downstream manhole
  • 30-60 feet-per-minute
• Data fed back to the FELL support truck via coaxial cable
• Once the data is on the truck’s computer, upload to the algorithm for processing /immediate review
• Algorithm estimates Gallons Per Minute (GPM) infiltration rate per defect for each pipe main
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Results

• Issues
  • Debris in 2 mains snagged / stopped electrode – operator successfully freed it
  • Flat longitudinal pipe slopes – operator pulled electrode slower to scan thru accumulated debris in pipe invert

• Cost
  • $6.13 LF of inspection - combining the pre & post CIPP project inspections
  • Cost included:
    • Project planning
    • Mobilizations
    • Inspections
    • Report preparation
Results Continued

• Pre CIPP Project Inspection (November 11 – 12, 2015)
  • 28 pipe segments = 5,543 feet
  • 1,286 potential defects
  • Estimated flow from defects = 1,186 gpm = 1.7 Mgpd
  • Defects occurred on 3’ intervals – pipe joints
Results Continued

- Post CIPP Project Inspection (April 5 – 6, 2016)
  - 28 pipe segments = 5,543 feet
  - 96 potential defects
  - Estimated flow from defects = 302 gpm = 0.4 Mgpd
  - Defects at joints eliminated by CIPP
  - Defects occurred at laterals
  - 75% reduction of flow from pre CIPP Project inspection
  - 93% reduction in number of defects
  - I/I flow reduced in 86% of pipe segments
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• FELL estimated pre CIPP project condition flows = 10% of all daily flow at treatment plant
  • 10% not possible - GNB only has 0.4% of the City’s laterals and 0.5% of the City’s pipe main
• City collected data at GNB’s lift station for the storms over sewer shed shown on rows 1 and 2
  • Storms occurred at about the same time of the year before and after GNB’s CIPP project

<table>
<thead>
<tr>
<th>Row No.</th>
<th>Date</th>
<th>Rainfall (inches)</th>
<th>15-minute Peak Flow (GPD)</th>
<th>15-minute Factor</th>
<th>1-hour Peak Flow (GPD)</th>
<th>1-hour Factor</th>
<th>24-hour Peak Flow (GPD)</th>
<th>24-hour Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5/12/14</td>
<td>1.71</td>
<td>560,016</td>
<td>21.1</td>
<td>518,832</td>
<td>19.6</td>
<td>197,280</td>
<td>7.4</td>
</tr>
<tr>
<td>2</td>
<td>5/10/16</td>
<td>0.97</td>
<td>118,224</td>
<td>5.5</td>
<td>96,048</td>
<td>4.4</td>
<td>57,888</td>
<td>2.7</td>
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<td>3</td>
<td>5/10/16</td>
<td>1.71</td>
<td>208,416</td>
<td>9.7</td>
<td>169,322</td>
<td>7.8</td>
<td>102,050</td>
<td>4.8</td>
</tr>
<tr>
<td>4</td>
<td>Reduction in the percentage of flow from row 1 to row 3</td>
<td>-63%</td>
<td>-67%</td>
<td>-48%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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• Storm on row 1 had 76% more precipitation that the storm on row 2
  • On row 3 we linearly extrapolated the storm on row 2
  • Increasing its data by 76% to match the storm on row 1

• Comparing the storms on rows 1 and 3 reveals the reductions in flow shown on row 4

• Data from GNB lift station measurements **align** with FELL tools estimate of 75% reduction

• Without relying on:
  • Storms
  • Operator / viewer

• Consider including FELL results in Racine’s annual CMOM report to demonstrate Racine’s I/I reduction efforts

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Thanks / Questions?

• John Rooney P.E. – City of Racine – City Engineer | Assistant Commissioner of Public Works - 262.636.9460 – John.Rooney@cityofracine.org

• Paul Pasko P.E. – SEH – Principal | Project Manager - 952.912.2611 – ppasko@sehinc.com
Appendix
More Detail for FELL Results

Pre CIPP Project Inspection (November 11 – 12, 2015)
• 402 GPM came from “minor” flows (0.1 - 0.99 GPM)
• 652 GPM came from “moderate” flows (1.0 – 3.99 GPM)
• 133 GPM came from “severe” flows (4.0 GPM to 10.0 GPM)

Post CIPP Project Inspection (April 5 – 6, 2016)
• 15 GPM came from “minor” flows (0.1 - 0.99 GPM)
• 57 GPM came from “moderate” flows (1.0 – 3.99 GPM)
• 230 GPM came from “severe” flows (4.0 GPM to 10.0 GPM)
More Detail for FELL Results

Pre CIPP Project Inspection (November 11 – 12, 2015)
• 948 rated as “small” (100-400 mA)
• 304 rated as “medium” (400-700 mA)
• 180 rated as “large” (700–4000 mA)

Post CIPP Project Inspection (April 5 – 6, 2016)
• 36 rated as “small” (100-400 mA)
• 21 rated as “medium” (400-700 mA)
• 40 rated as “large” (700–4000 mA)
Basic Electric Circuitry for a Sewer Main

Pipe full of water at probe location.

HIGH resistance, except if there is a leak ...even a slight one.

LOW resistance path through the ground

Surface Electrode

Electric Current Meter

Voltage Source

Probe Cable

Probe