Using SL-Rat Technology and Its Impact on Municipal Consent Decrees

May 24, 2018

Chesapeake Water Environment Association
Collection Systems Committee Spring Seminar

Validated by U.S. EPA Study

- “The results of this demonstration of the SL-RAT show promise for the application of this technology as a tool for cost-effective, pre-cleaning assessment and post-cleaning quality assurance. The application of this technology in an overall collection system O&M program should enable wastewater utilities to optimize their sewer cleaning efforts and free up valuable resources to more effectively implement critical CMOM and asset management programs.”

- “Rapid assessment approaches and tools provide an avenue to significant pre-cleaning inspection cost savings that could be achieved through reduced inspection and non-productive cleaning costs.”

Source: U.S. EPA “**Demonstration of Innovative Sewer System Inspection Technology: SL-RAT™” June 2014**

Acoustic Inspection Applications

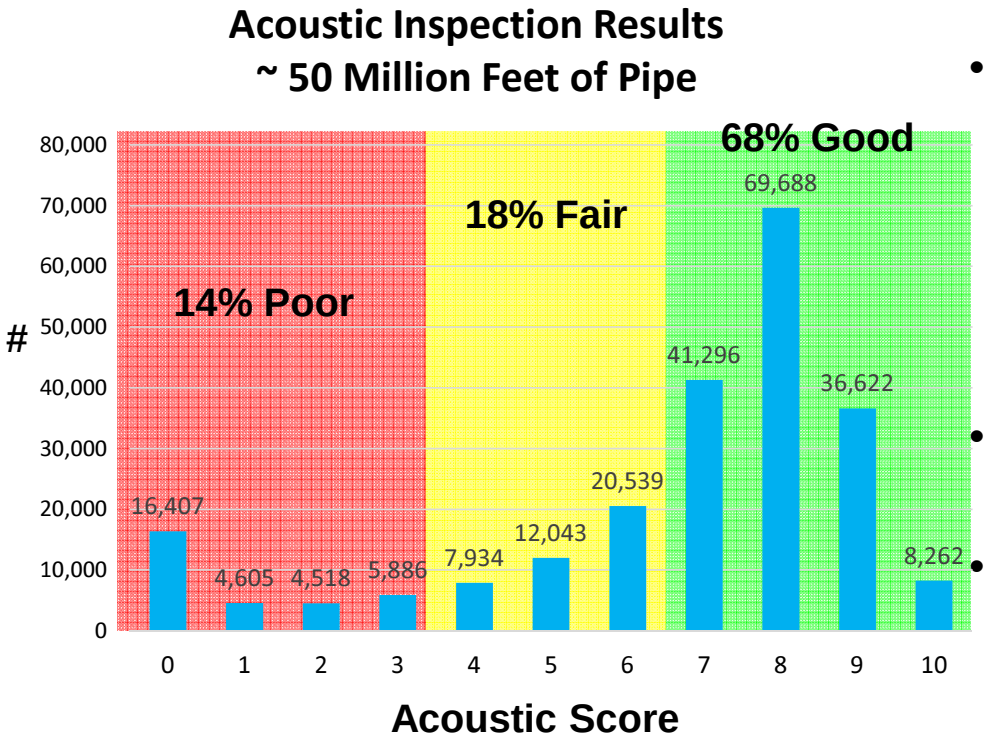
- **Focus Cleaning Effort – Reduce Cleaning by Over 50% and Enable Condition Based Maintenance**
- **Reduce Pre-Cleaning for CCTV inspection**
- Post Cleaning – Quality Assurance
- Quick Collection System Condition Assessments When Taking Over New Areas

Cost Evaluation

SL-RAT Acoustic Inspection Cost

- **U.S. EPA Study (June 2014) $0.149/ft**
- **Less than 1/10th the cost of CCTV inspection cost performed in same study**
- **Cleaning cost is typically $1.00/ft**

How Much Cleaning Is Wasted?



- Target Historical Problematic Areas
  - **>65% Pipes Essentially Clean**
  - **<15% Need Immediate Action**
- Cleaning a Clean Pipe ⇒ Wastes Resources
- Not Cleaning a Dirty Pipe ⇒ SSO

FINANCIAL IMPACT

- **Assumptions:**
  - **Cleaning cost is $1.00/ft**
  - **Acoustic inspection cost (SL-RAT) is $0.15/foot**
  - **Inspect 10,000 feet of sewer pipe per day (using acoustic inspection)**
  - **50% reduction in cleaning**

FINANCIAL IMPACT (cont'd)

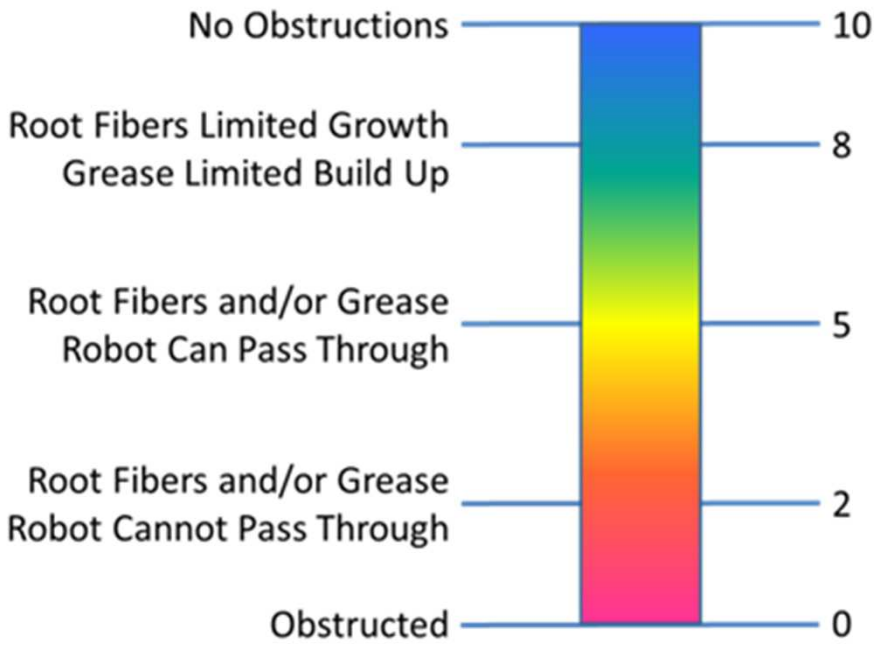
- Upfront equipment cost **~$25,000**
- 10,000 ft/day of inspections → 50,000ft/week
  Acoustic operating cost – **$7,500/week** (@$0.15/ft)
- Cleaning reduction (50%)
  25,000 ft/week → ~**$25,000/week** (@$1.00/ft)
- **PAYBACK PERIOD of LESS THAN TWO WEEKS**

ACOUSTIC INSPECTION TECHNOLOGY

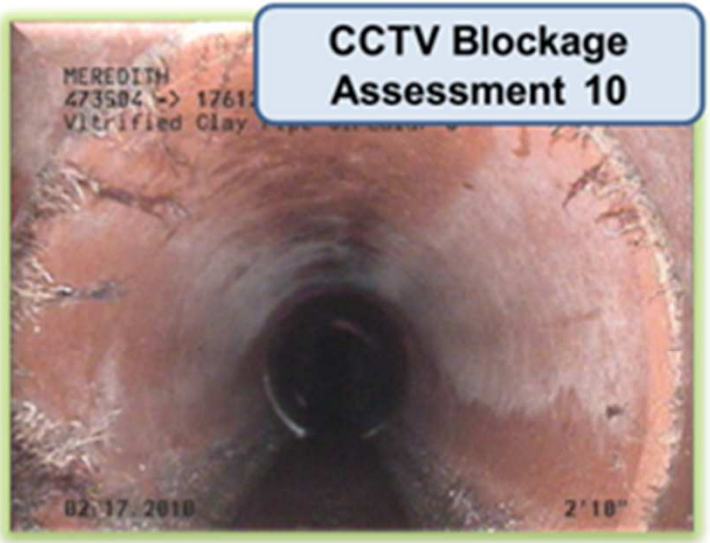
- How Does it Work?

ACOUSTIC INSPECTION TECHNOLOGY

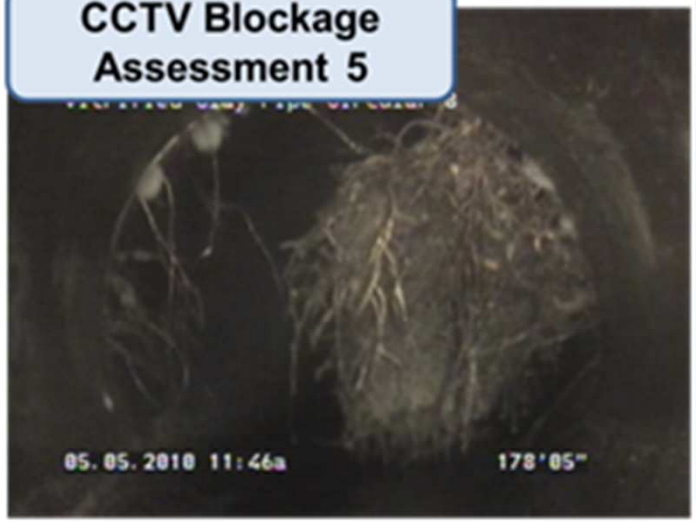
- Scoring System



CCTV Blockage Assessment 10



CCTV Blockage Assessment 5



CCTV Robot was Able to Pass Through Root Fibers

CCTV Blockage Assessment 7

CCTV Blockage Assessment 2

DOWNLOADING DATA

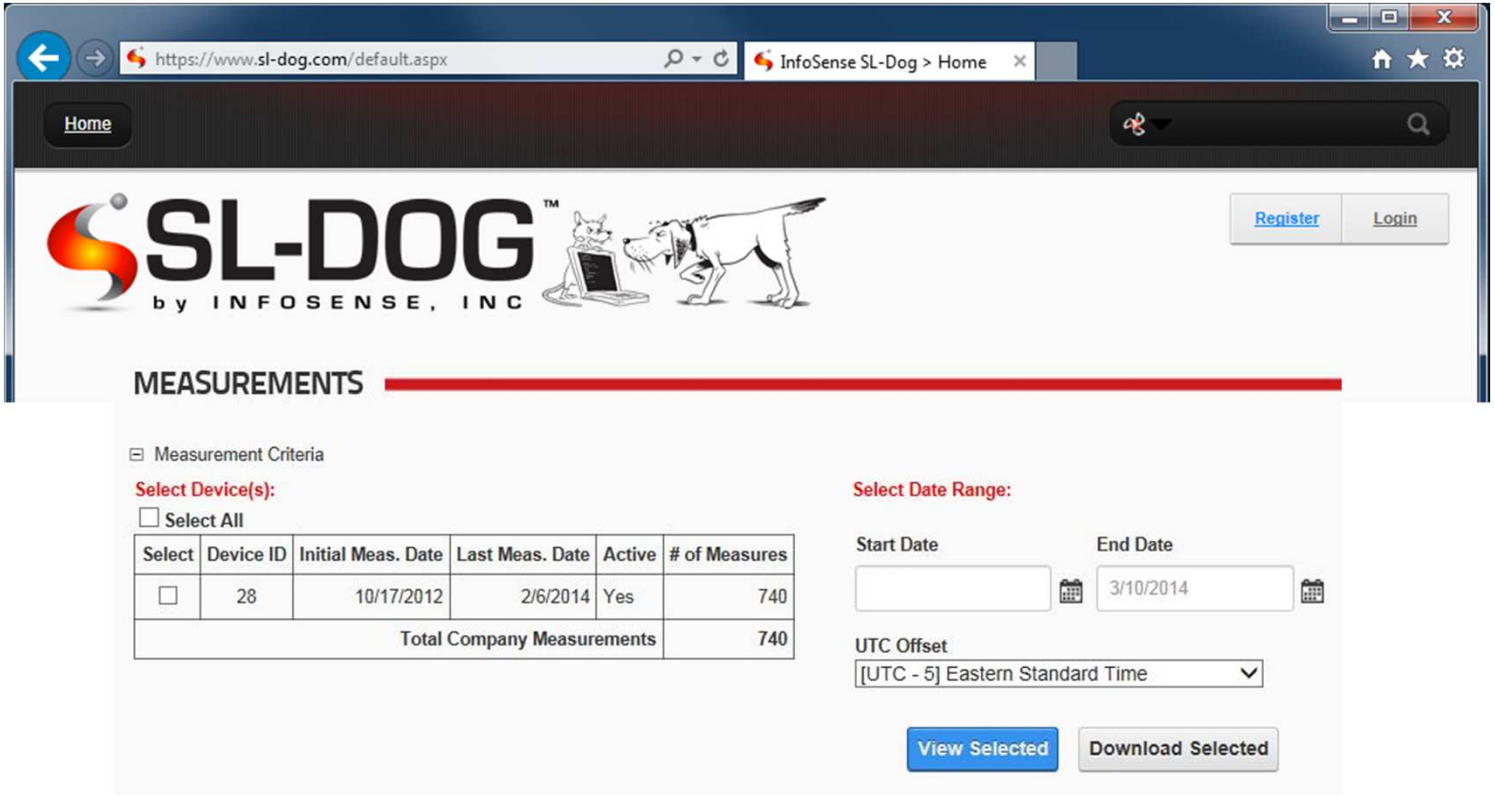
- **Step 1. Make sure data is synchronized between RX and TX devices**

  This can be done manually from the menus on the devices, or by turning both units off and on again.

- **Step 2. Connect SL-RAT (RX) to a PC using the USB connection**

USING WEB PORTAL

- **All historical data can be accessed on the SL-DOG web portal at http://www.sl-dog.com**



USING WEB PORTAL

MEASUREMENTS

New features added September 2014 for more details click here!

⊞ Measurement Criteria

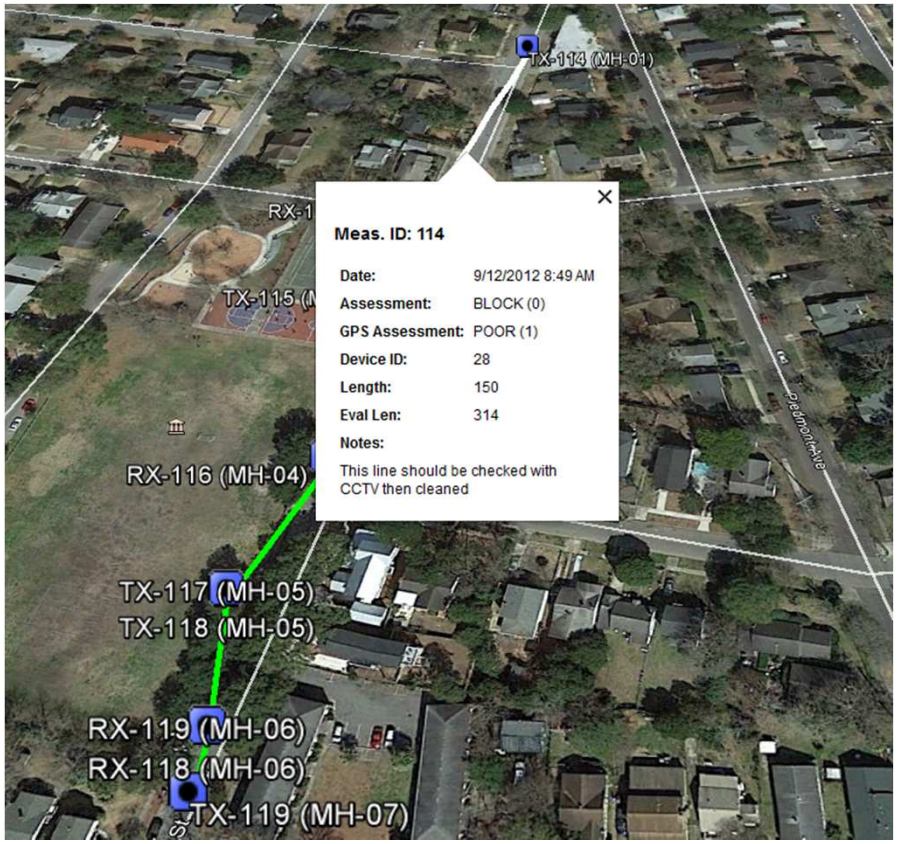
Select All | Export to Google Earth | Export to CSV | Enhanced Export | Export SHP | Enhanced Export

1 2 Page Size: 50 58 measurements found

	Meas. ID	RX Oper. ID	RX Hw ID	TX Oper. ID	TX Hw ID	Date/Time * = estimated	Meas. Dur. (sec)	Oper. Pipe Lng (ft)	Eval. Pipe Lng (ft)	Meas. Status	Pipe Status	Field Assess	GPS Assess	Notes	Rx Lat/Lon	Tx Lat/Lon
☑ ✎	119	1	28	1	29	9/12/2012 9:12:48 AM	79	50	51	Valid	Good	8 GOOD	8 GOOD	☐ ✎	**Lat:** 32.807091 **Lon:** -79.958845 **ID:** MH-06	**Lat:** 32.806953 **Lon:** -79.958858 **ID:** MH-07
☑ ✎	118	1	28	1	29	9/12/2012 9:08:22 AM	80	150	123	Valid	Good	8 GOOD	7 GOOD	☐ ✎	**Lat:** 32.807091 **Lon:** -79.958845 **ID:** MH-06	**Lat:** 32.807428 **Lon:** -79.958868 **ID:** MH-05
☑ ✎	117	1	28	1	29	9/12/2012 9:04:10 AM	79	50	150	Valid	Good	7 GOOD	8 GOOD	☐ ✎	**Lat:** 32.807805 **Lon:** -79.958673 **ID:** MH-04	**Lat:** 32.807428 **Lon:** -79.958868 **ID:** MH-05
☑ ✎	116	1	28	1	29	9/12/2012 8:57:58 AM	80	150	235	Valid	Fair	4 FAIR	5 FAIR	☐ ✎	**Lat:** 32.807805 **Lon:** -79.958673 **ID:** MH-04	**Lat:** 32.80844 **Lon:** -79.958546 **ID:** MH-03
☑ ✎	115	1	28	1	29	9/12/2012 8:54:09 AM	79	150	143	Valid	Good	7 GOOD	7 GOOD	☐ ✎	**Lat:** 32.808825 **Lon:** -79.958463 **ID:** MH-02	**Lat:** 32.80844 **Lon:** -79.958546 **ID:** MH-03
☑ ✎	114	1	28	1	29	9/12/2012 8:49:17 AM	112	150	314	Late	Block	0 BLOCK	1 POOR	☑ ✎	**Lat:** 32.808825 **Lon:** -79.958463 **ID:** MH-02	**Lat:** 32.809641 **Lon:** -79.958145 **ID:** MH-01

USING WEB PORTAL

- Plot of data using Google Earth

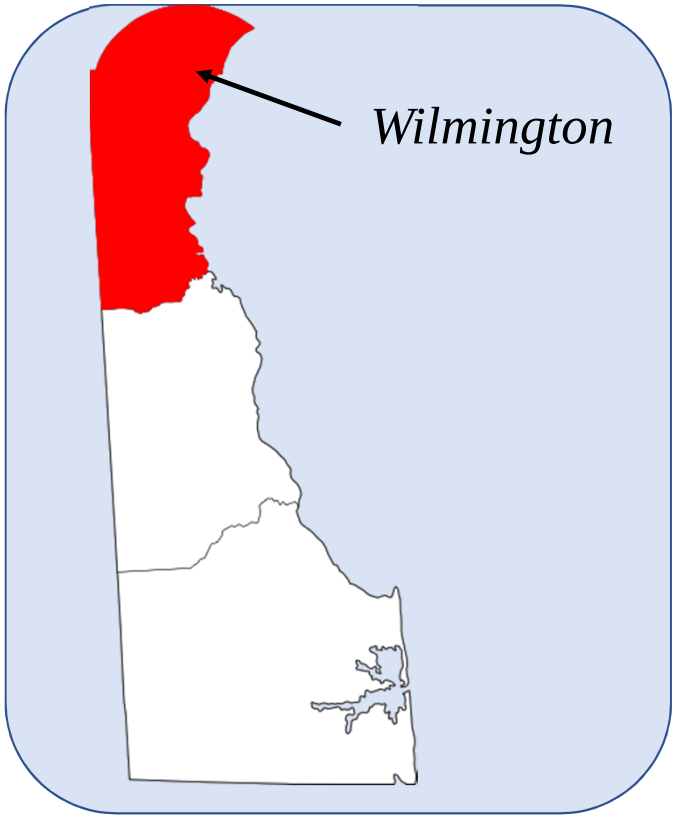


Legend:
SL-RAT In Field Pipe Assessment
0:
1-3:
4-6:
7-10:

SL-RAT Users

- St Louis – 9 SL-RAT's Re-wrote C-MOM and renegotiated EPA Consent Agreement based on using the SL-RAT
- Little Rock Water Reclamation Authority 6 SL-RAT's – Consent Agreement with non-federal agency. Using the SL-RAT to get and stay under a 66 SSO/year cap
- Columbia SC 2 SL-RAT's– Integral part of Clean Water 2020 Program
- City of Springfield IL Using to comply with requirements of US EPA Consent
- Starkville, MS – used to SL-RAT prioritize areas for rehab and maintenance
- City of Oak Ridge, TN 2 SL-RAT's Using as part of program set up after going under US EPA Consent Agreement
- City of Lancaster, SC – Using to prioritize work and reduce SSO's to comply with US EPA Consent
- Baltimore County, MD - You would have more details than I do
- Augusta GA 4 SL-RAT's Used to improve system performance and comply with GA EPD Consent

Case Study - New Castle County, DE



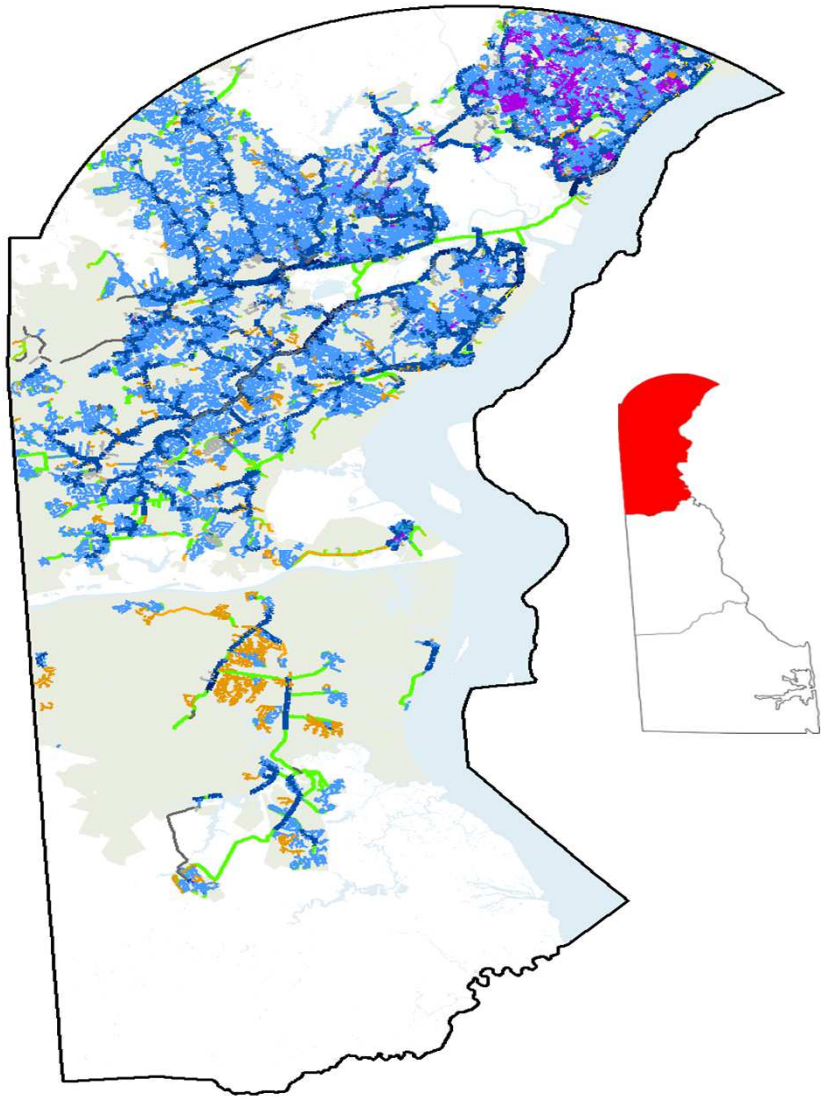
Located in northern Delaware

494 square miles

½ million residents

New Castle County, DE Quick Stats

- Sanitary Sewer System
  - Mid-sized system
  - Separate – Sanitary Sewer
  - 65 MGD
  - 122,000 customer accounts
  - 550,000 population
  - 1,760 Miles of sewer
    - 6” to 84” in diameter
  - 169 Pump Stations
  - 44,000 Manholes



DNREC Secretary's Orders

Original Order (October 2003):

- Delaware Department of Natural Resources and Environmental Control (DNREC)
- DNREC Secretary's Order was executed in 2003 to address Brandywine Hundred and Sanitary Sewer Overflows (SSO's) countywide
- EPA Region III – audit of sanitary and storm water programs during 2006 and 2007
- EPA required a new amended Secretary's Order to more aggressively address SSO's in 2008

DNREC Secretary's Orders

Amended Order (October 2008):

- Elimination of last outfall to Delaware River by December 31, 2018
  - last 1 of 7 funded by the EPA in the 50's/60's and removed in 70's & 80's

- Penalty: $100,000 fine

- Capacity Management Operation Maintenance Program (CMOM)
  - NCC CMOM completed in December 2008
  - Mandates New Castle County cleans 500 miles of sewer per year
  - CMOM Enhancement Programs
    - Trunk Line Preventative Maintenance Program
    - Chemical Root Control Program
    - CCTV System Investigation Program

Preventative Maintenance Program (PM)

- PM program, as currently defined, cleans 500 miles of gravity sewer collection system per year.
  - Approach implemented in late 1980's
  - Shift from Reactive Maintenance to focus on Preventive Maintenance
  - **400 sewershed areas**
  - Mapped cleaning schedules with standardized frequencies: 6 month,1 year, 2 year, 3 year, 4 year, 5 year.
  - Decreased SSO's and mainline blockages dramatically

First Maintenance Management System

Preventative Maintenance Program (PM)

- Prioritization based on cleaning demand of sewer sub-area
  - build up of materials, roots, grease, and debris, etc.
  - Work order History
  - Visual determination
  - CCTV & Zoom
  - Quality control and frequency adjustment
- Analysis of sequencing
- Schedule of cleaning projects – affected by many factors
  - Weather – extreme cold/wet
  - Equipment downtime – jet/vac combination units
  - Manpower resources – off-road work

Preventative Maintenance Program (PM)

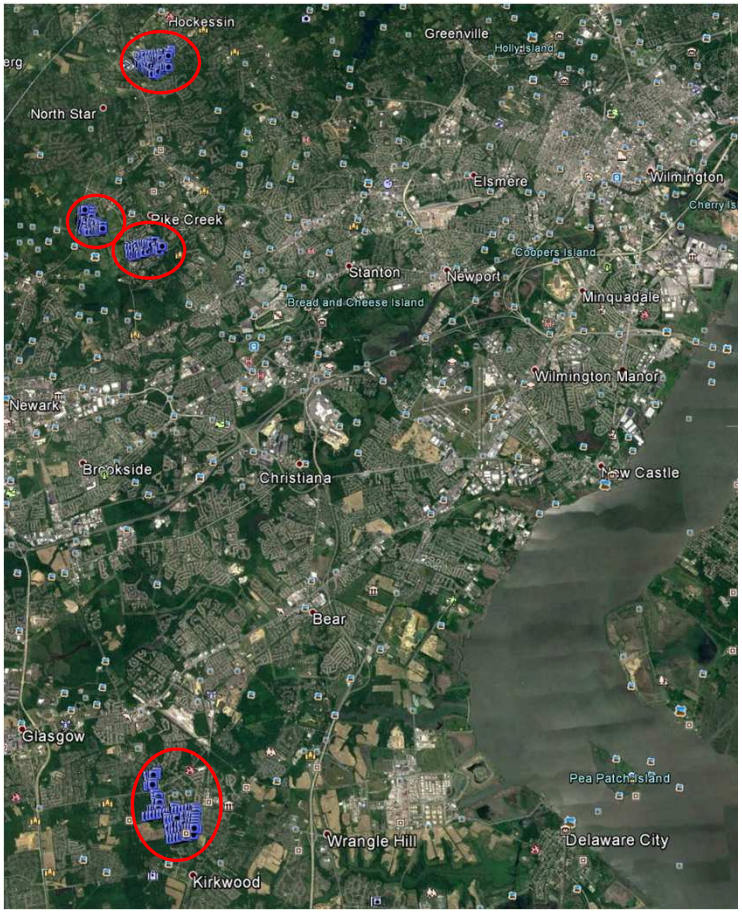
- New Castle County does not own water distribution systems

It's all about the water!!

Pilot 2016 - Getting to know the SL-RAT

- Inspect 56,000 linear feet
  - 300 inspection segments (60,000 linear feet)
  - Focus on smaller diameter pipes (6”-12”)
  - Focus on 4 areas

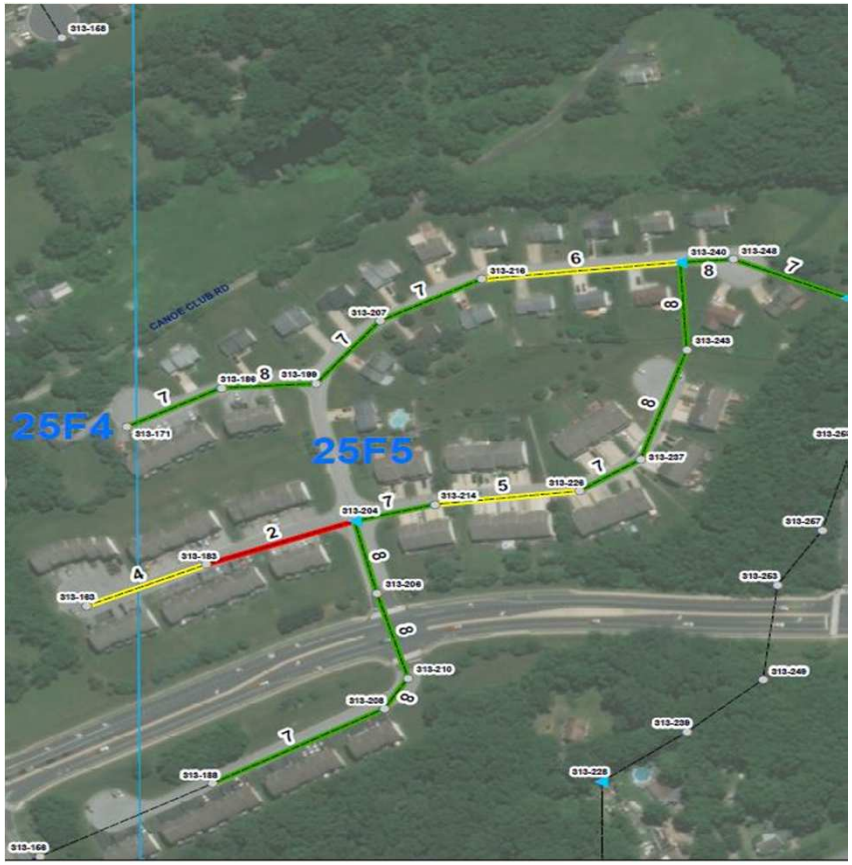
- Summary Of Pilot Results
  - Great productivity – up to 13,000 feet in one day
  - Average inspection rate of 7 per hour
    1,450 linear feet per hour
  - Total inspection time in the field was under 50 hours
  - 13 days of inspection work (very few “full” days)



Pilot 2016 - Getting to know the SL-RAT

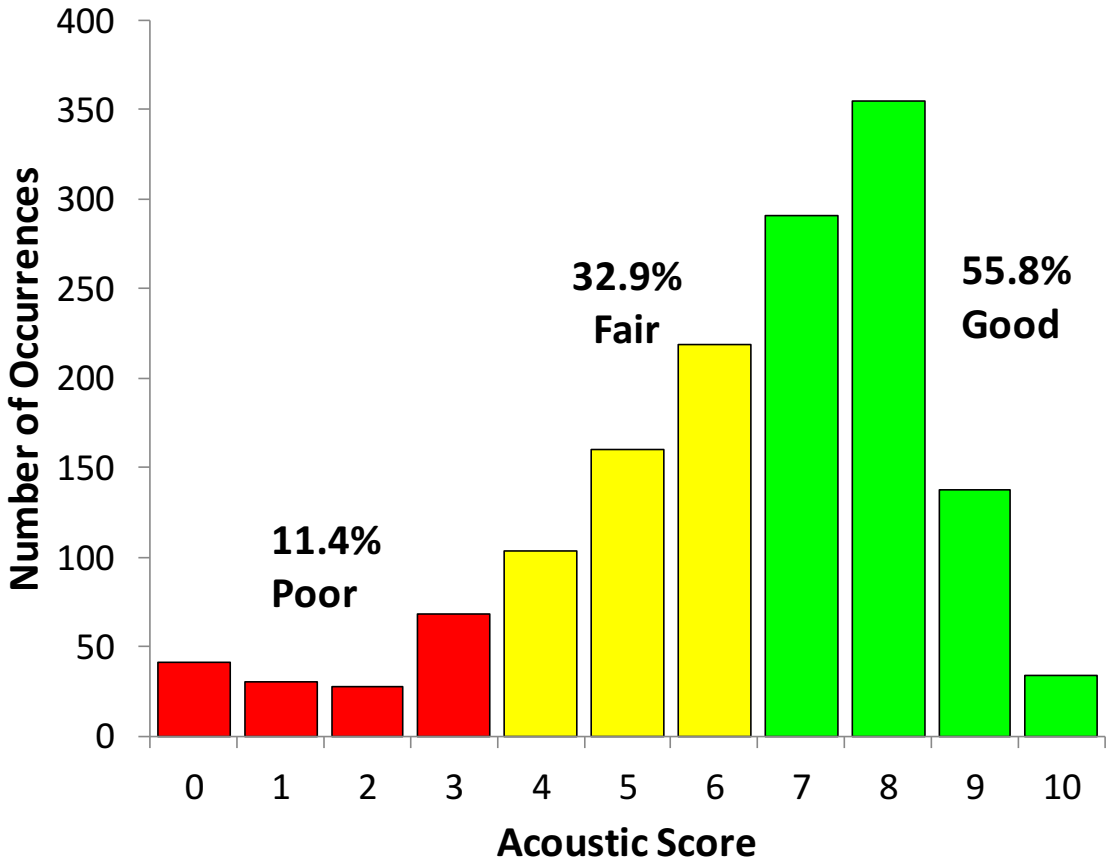
- See if acoustic technology was appropriate for prioritizing cleaning operations

- Based on success of initial study, further SL-Rat inspection work was initiated
  - Total of 1,450 acoustic inspections performed by end of fiscal year 2016
  - More than 320,000 linear feet



SUMMARY OF RESULTS

New Castle County, DE Acoustic Inspections



Opportunity for PM Program Improvement

Conclusions

- The acoustic inspection is simple, reliable, and easy to use.
- Investigations confirm that an inspection score of 7-10 indicates a clear/clean sewer main, and a score of 0-6 indicates a sewer main that should be cleaned
- Determines how to Effectively Deploy Cleaning and CCTV resources
- Acoustic Inspection is much Cheaper than Cleaning
- Acoustic Inspection should only be used on small diameter pipe

Recommendations

- Integrate acoustic inspection into the 500 mile per year cleaning requirement. Per CMOM
- Information Based PM Program at the Asset Level – (Hotel Cleaning vs. Gymnasium Cleaning)
- Focus using SL-Rat on areas with PM cleaning frequencies of 4 and 5 years
- Clean any segments with score <7.
- Baseline SL_RAT score for each Asset
- Continue with contracted services (short term), purchase and integration of acoustic technology within Sewer Maintenance Section (long term)
- Keep Trunk Line Program

SL-RAT Inspection Procedure

- Develop field maps using GIS
- Inspect and record SL-RAT data using template:

SL-RAT AREA NAME								
Segment ID	Inspection No.	Linear Feet	1st Test Score	Cleaned?	2nd Test Score	CCTV?	Comments	On/Off Road
197-107 197-110	557	182	8	-	-	-		On
197-110 197-113	556	294	2	Y	7	-		Off
197-111 184-254	553	223	4	Y	5	Y	MWLS 70%	On

- Clean any segments with score <7.
- Re-inspect cleaned segments.
- CCTV any segments that scored <7 for second time.
- Review CCTV/Database using PACP coding
- Upload all data to CityWorks WO's and PM Inspections

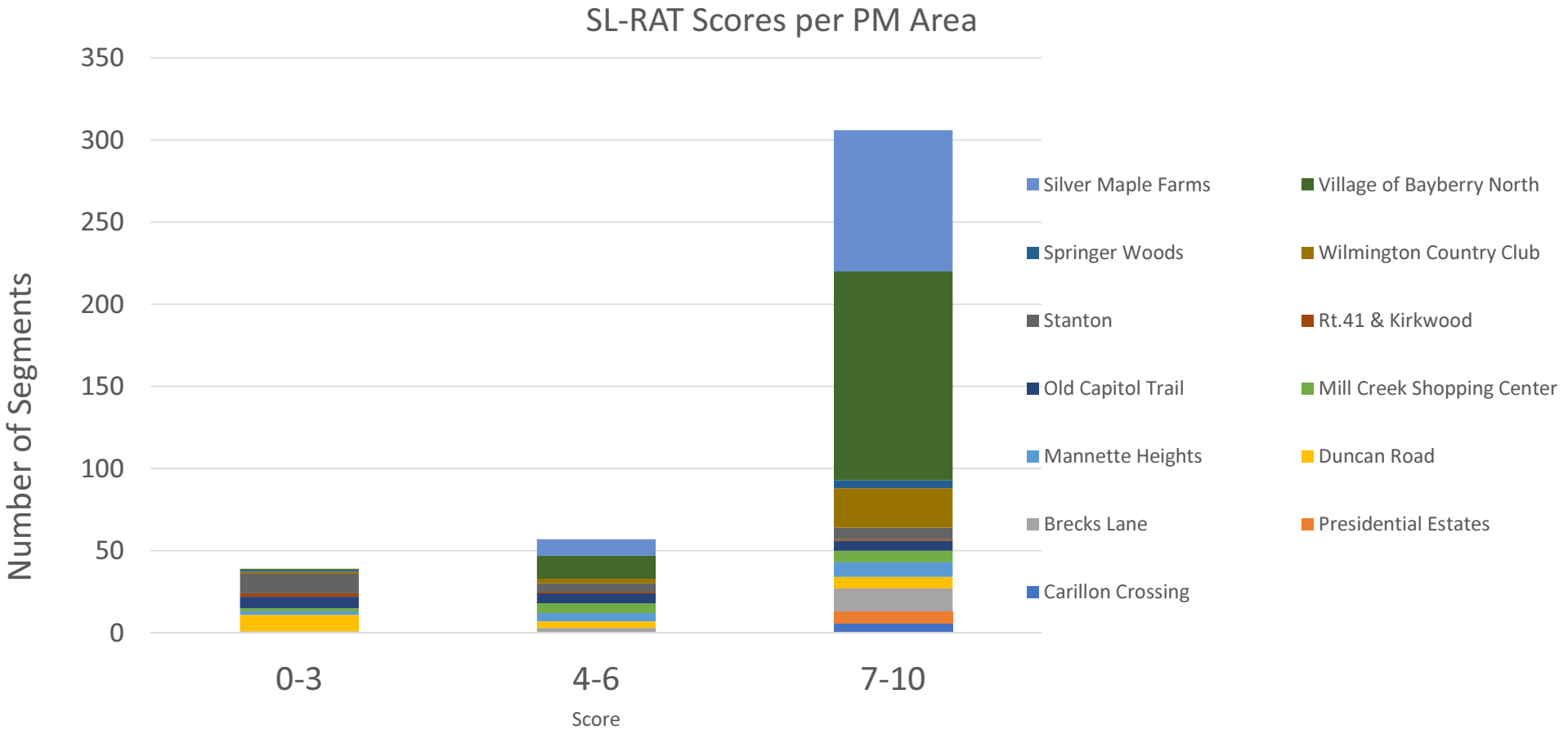
PM SL-RAT Areas

FY18 – Example #1

- PM Areas
  - Brecks Lane – 3,015 LF
  - Carillon Crossing – 1,821 LF
  - Duncan Road – 4,393 LF
  - Mannette Heights – 6,254 LF
  - Mill Creek Shopping Center – 3,074 LF
  - Old Capitol Trail – 4,752 LF
  - Presidential Estates – 1,331 LF
  - Rt.41 & Kirkwood – 2,682
  - Silver Maple Farms – 16,598 LF
  - Springer Woods – 1,186 LF
  - Stanton – 6,299 LF
  - Village of Bayberry – 27,580 LF
  - Wilmington Country Club – 9,020 LF
- **Total LF Acoustic Tested – 76,395 LF**

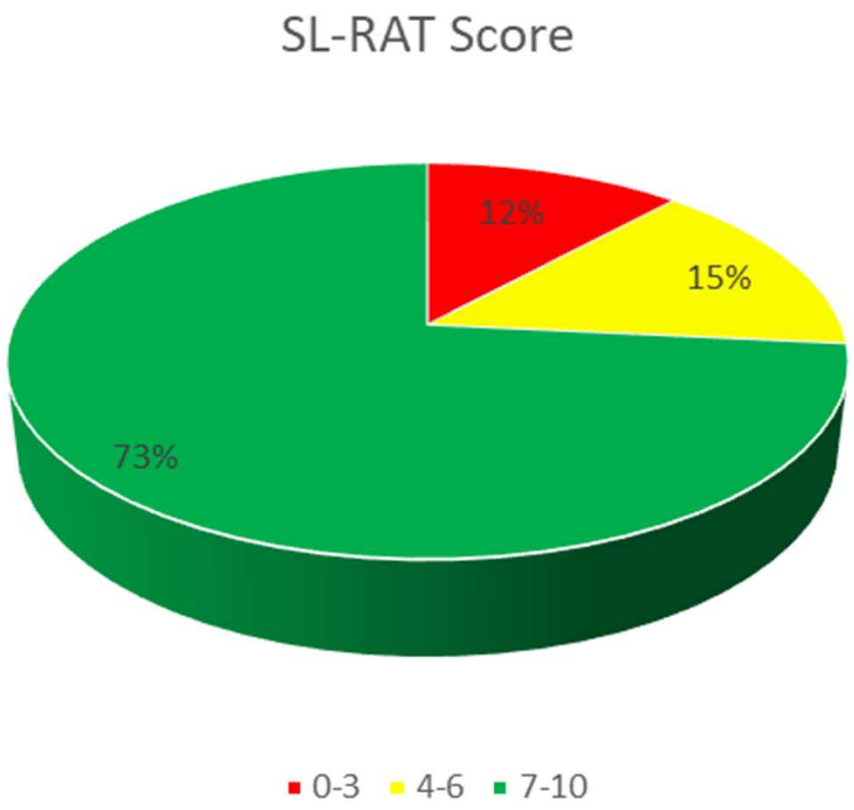
SL-RAT Score Breakdown – Overall

FY18 – Example #1



SL-RAT Score Breakdown – Overall

FY18 – Example #1



- **Score 0 – 3 – 9,014 LF – 12%**
- Score 4 – 6 – 11,256 LF – 15%
- **Score 7 – 10 – 56,125 LF – 73%**
- **Overall Total – 76,395 LF**

SL-RAT Cost Metrics Breakdown

FY18 – Example #1
Total– 76,610 FT

SL-RAT

Cleaning – 20, 270 LF

SL-RAT $.25/FT = $24,220

CLEAN $1.10/FT = $22,297

TOTAL COST = $46,517

AVERAGE COST: $0.61/FT

CCTV $.95/FT = $16,081

STOPPED CLEANING
CLEAN PIPE!!!!!

Preventative Maintenance

CLEAN $1.10/FT =$84,271

TOTAL COST = $84,271

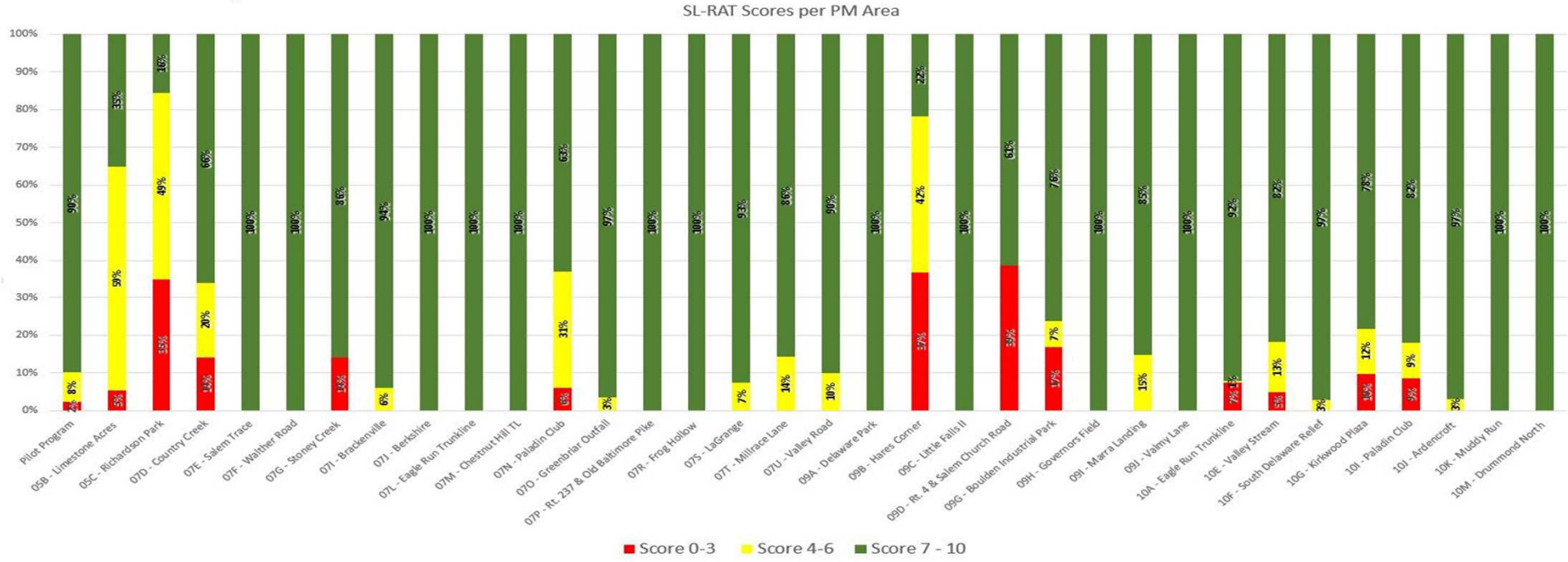
AVERAGE COST: $1.10/FT

TOTAL TASK SAVINGS
$37,754

- *Task Savings/LF = $ 0.49*
- *Crew Days saved (4,500 LF/Day) = 12.5 days*

SL-RAT Score Breakdown – Overall

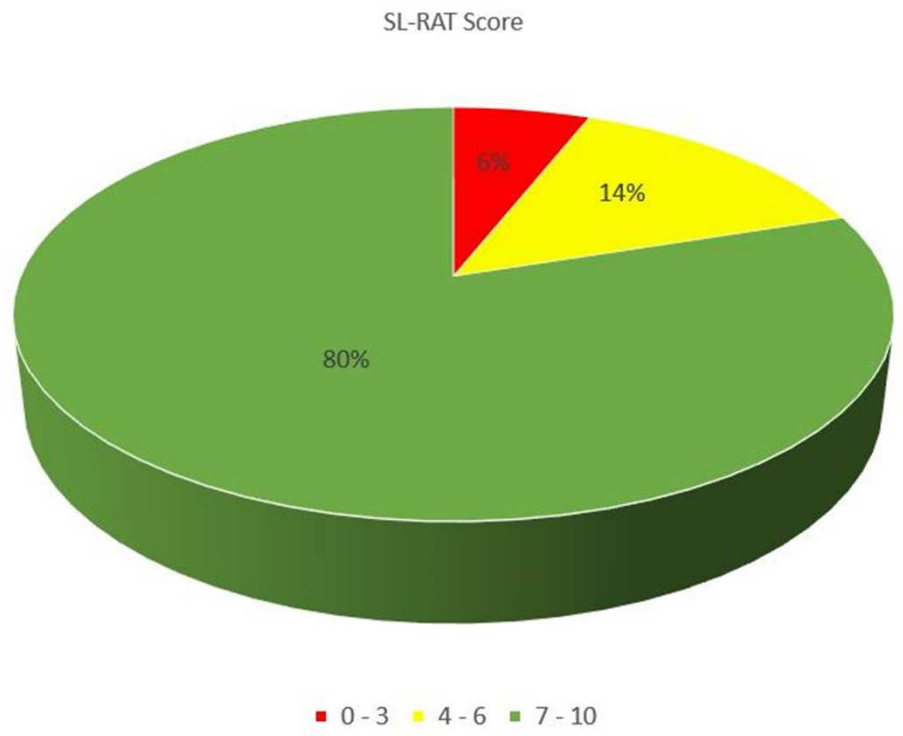
FY18 – Example #2



- **Score 0 – 3 – 14,696 LF**
- Score 4 – 6 – 31,983 LF
- **Score 7 – 10 – 185,781 LF**
- **Overall Total – 232,465 LF**

SL-RAT Score Breakdown – Overall

FY18 – Example #2



- **Score 0 – 3 – 14,696 LF - 6%**
- Score 4 – 6 – 31,983 LF – 14%
- **Score 7 – 10 – 185,781 LF – 80%**
- **Overall Total – 232,465 LF**

SL-RAT Cost Metrics Breakdown

FY18 – Example #2
Total– 232,465/FT

SL-RAT

Cleaning – 46,679LF

SL-RAT	$.25/FT =	$69,786
CLEAN	$1.10/FT =	$51,347

TOTAL COST = $121,133

AVERAGE COST: $0.52/FT

CCTV	$.95/FT =	$8,162

STOPPED CLEANING CLEAN PIPE!!!!!

Preventative Maintenance

CLEAN	$1.10/FT =$255,712

TOTAL COST = $255,712

AVERAGE COST: $1.10/FT

TOTAL SAVINGS OVERALL

$134,579

- *Task Savings/LF = $ 0.59*
- *Crew Days saved (4,500 LF/Day) = 41 days*

SL-RAT Cost Metrics Breakdown

	SL_RAT/PM Area LF	% of total for year	Actual Cleaning LF	Full clean cost	SL-RAT Cost	Cleaning Cost	SL-Rat + Cleaning
Area1	76,610		20,270	$84,271	$24,220	$22,297	$46,517
Area 2	232,465		46,679	$255,712	$69,786	$51,347	$121,133
	309,075		66,949	$339,983	$94,006	$73,644	$167,650

TOTAL SAVINGS OVERALL
$172,333

Projected Savings FY18:	$172,333
Pipe Cleaning for FY18:	13 miles
SL-Rat for FY18:	46 miles
Total SL-Rat + Cleaning FY18:	59 miles
% of total PM for FY18:	12%

Moving Forward

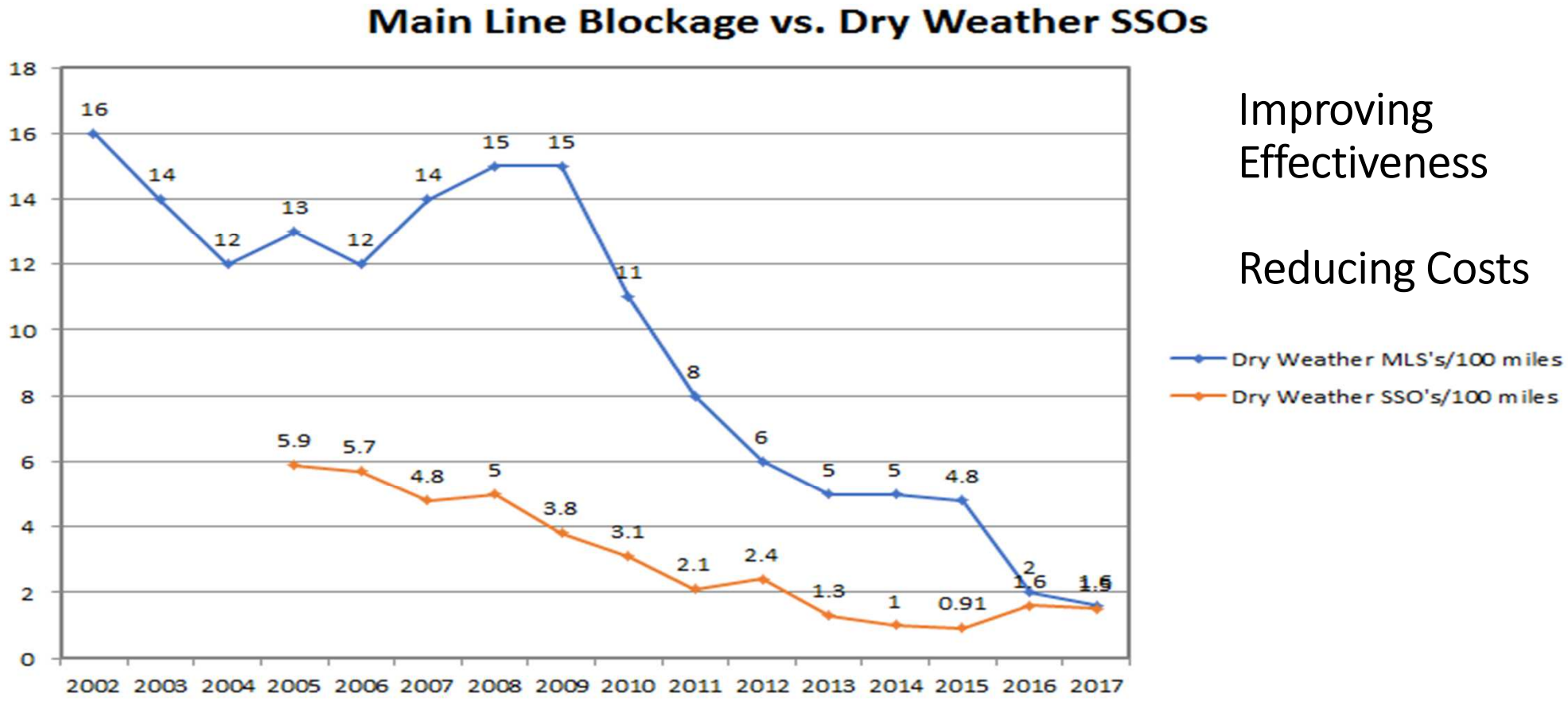
						SL_RAT & cleaning 50%		
PM Cleaning Frequencies	Miles/Year	Feet/year	% of total for year	Projected cleaning FY19	Full clean cost	SL-RAT Cost	Cleaning Cost	SL-Rat + Cleaning
EVERY 6 years	4	21,859	1%					
EVERY 1 years	152	802,560	29%					
EVERY 2 years	102	538,560	20%					
EVERY 3 years	93	489,298	18%					
EVERY 4 years	44	232,320	9%	116,160	$255,552	$87,120	$127,776	$214,896
EVERY 5 years	121	640,992	24%	320,496	$705,091	$240,372	$352,546	$592,918
	516	2,725,589	100%	436,656	$960,643	$327,492	$480,322	$807,814

Improving Effectiveness

Reducing Costs

Projected Savings FY19:	$152,830
Projected Pipe Cleaning for FY19:	83 miles
Projected SL-Rat for FY19:	83 miles
Total SL-Rat + Cleaning FY19:	165 miles
% of total PM for FY19:	33%

Moving Forward



Improving Effectiveness

Reducing Costs

Wrap-Up

- Acoustic Inspection is an Effective Method to Assess Pipes for Blockages (or no blockages)
  - Quick / Simple Protocol
  - Low Cost
  - Easy / Safe
- Acoustic Inspection Makes Financial Sense
- Acoustic Inspection Enables Information/Condition-Based Maintenance of Gravity Sewers at the asset level

- Acoustic Inspection Improves Effectiveness of entire PM Program.
  - Requires teamwork to achieve full potential – cleaning crews, GIS, inspection crews – must all work together
  - Forces discipline in visiting every manhole – identify issues, LOCATE BURIED MANHOLES, update GIS records, etc.

QUESTIONS?

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