

Using Acoustic Inspection to Prioritize Sewer Cleaning



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PRESENTATION OUTLINE

- Acoustic Inspection Overview
- Acoustic Inspection Economics
- Case Studies
- Conclusion

WHAT IS THE PROBLEM?

- Overflows are a Symptom – Not the Problem



PROBLEM: INFORMATION



- Cleaning a pipe costs about the same as inspecting a pipe
- >80% of pipes less than 12", accounts for >90% of SSOs
- Historical GIS – Helpful – But Insufficient
- Where & When to Deploy Cleaning Resources
- Cost Effective & Timely Condition Information

INSPECTION METHODS



Manhole Inspection



ACOUSTIC



Zoom Camera

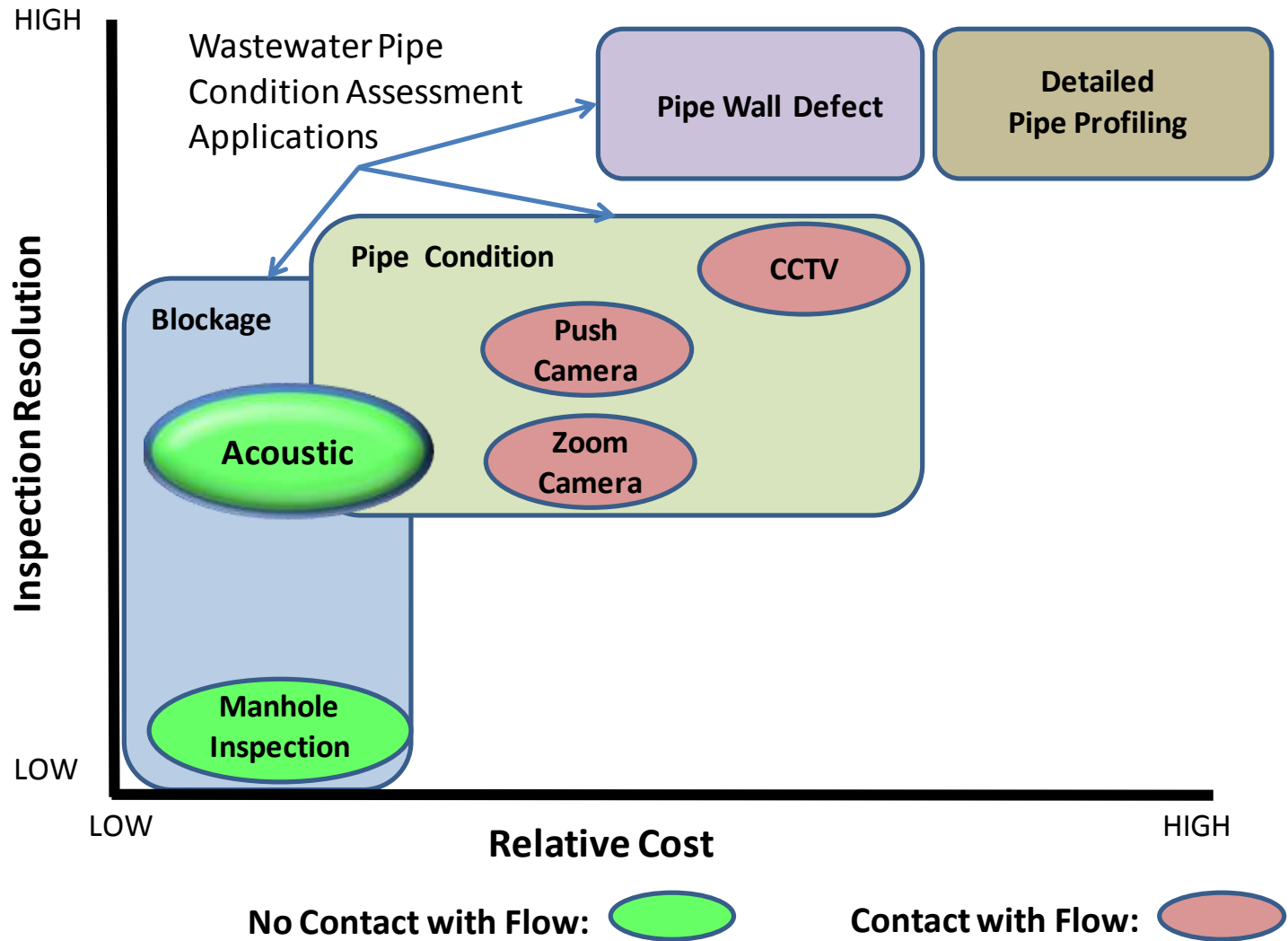


Push Camera



- CCTV/Robotic Camera
- Pipe Wall Defect Scanners
- Pipe Profiling / Robotic Multi-Sensor

INSPECTION METHODS



ACTIVE ACOUSTIC PIPE INSPECTION BACKGROUND

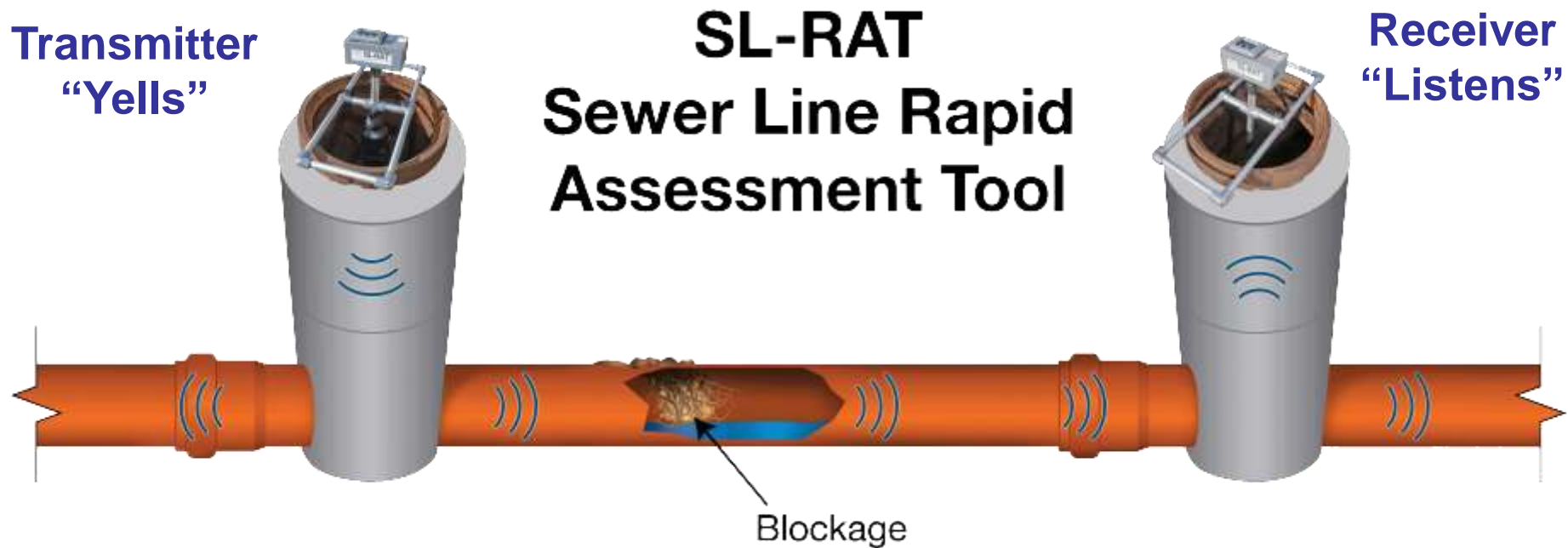
- Patented technology
- Gravity-fed sewer focus
- Developed in Charlotte with CMUD as key partner



- Over 20M feet inspected
- Rapid assessment helps better focus cleaning and CCTV resources

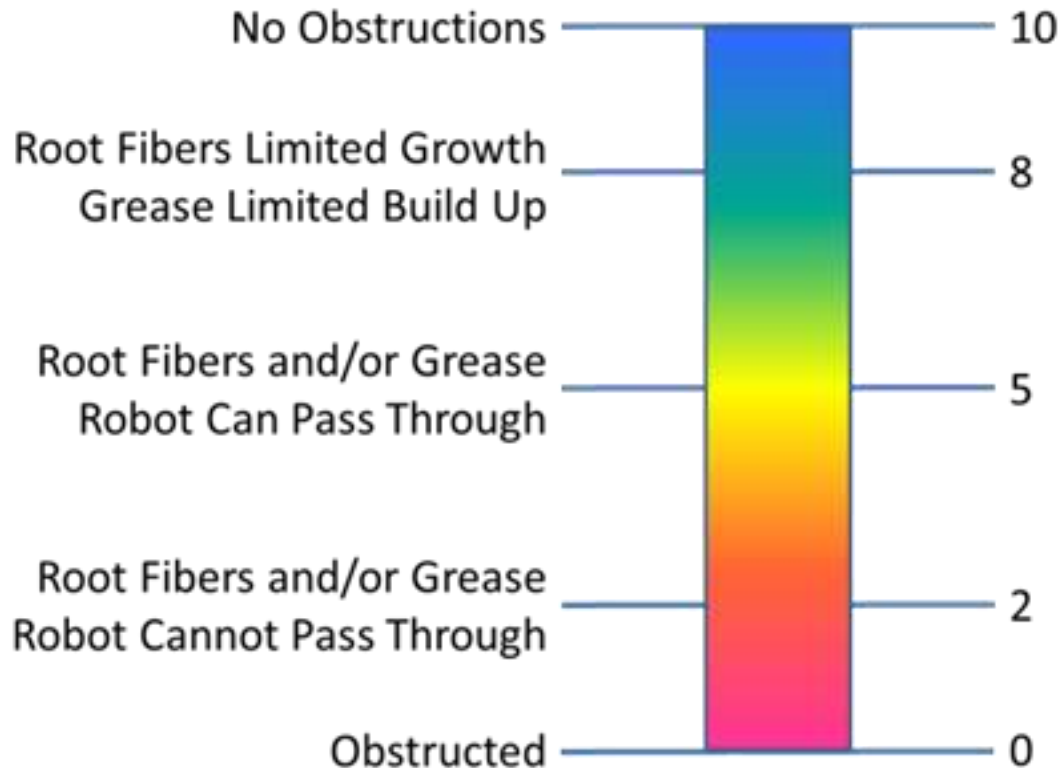
ACOUSTIC INSPECTION TECHNOLOGY

- How Does it Work?



ACOUSTIC INSPECTION TECHNOLOGY

- Scoring System



ACOUSTIC INSPECTION TECHNOLOGY

- Scoring System



CCTV Robot was Able to Pass Through Root Fibers



ACOUSTIC INSPECTION TECHNOLOGY

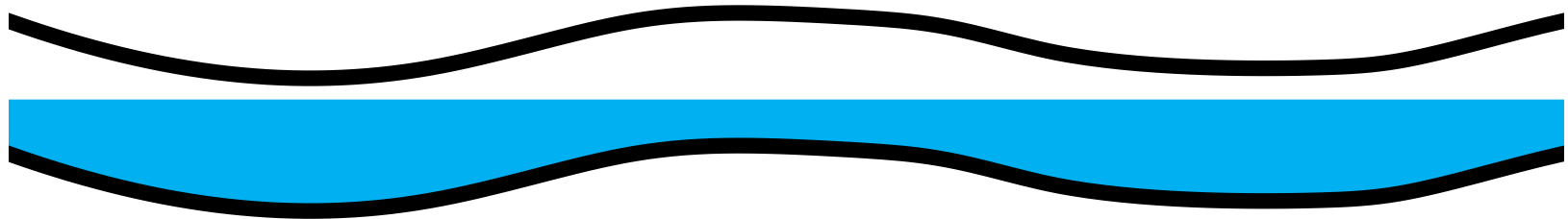
- What acoustic inspection does NOT tell you:
 - Type of blockage
 - Could be one big thing, or a lot of small things
 - Aggregate score of entire pipe segment
 - Location of blockage
 - Presence of small structural defects (fine cracks, joints, etc.)

IMPACT OF PIPE SAGS

Straight Pipe



Partial Pipe Sags



Full Pipe Sag



KEY FEATURES OF ACOUSTIC INSPECTION



- No Flow Contact / No Confined Space Entry
- Simple to use – train operators in minutes
- Low Cost–Pennies/foot
- Rapid Onsite Results – Under 3 min./segment
- Portable < 30 lbs
- GIS Integration – GPS Enabled
- Archive Pipe Segment Blockage Assessments

ACOUSTIC INSPECTION APPLICATIONS

- Focus Cleaning Effort – Reduce Cleaning by Over 50% and Enable Condition Based Maintenance
- Eliminate Repeat and Downstream Overflows
- Post Cleaning – Quality Assurance
- Quick Collection System Condition Assessments When Taking Over New Areas

ACOUSTIC INSPECTION ECONOMICS

- **In order for rapid pipe inspection to be economical, two conditions must be satisfied:**
 - **Substantially cheaper than current inspection methods**
 - **Significant number of pipes do not require immediate attention**

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

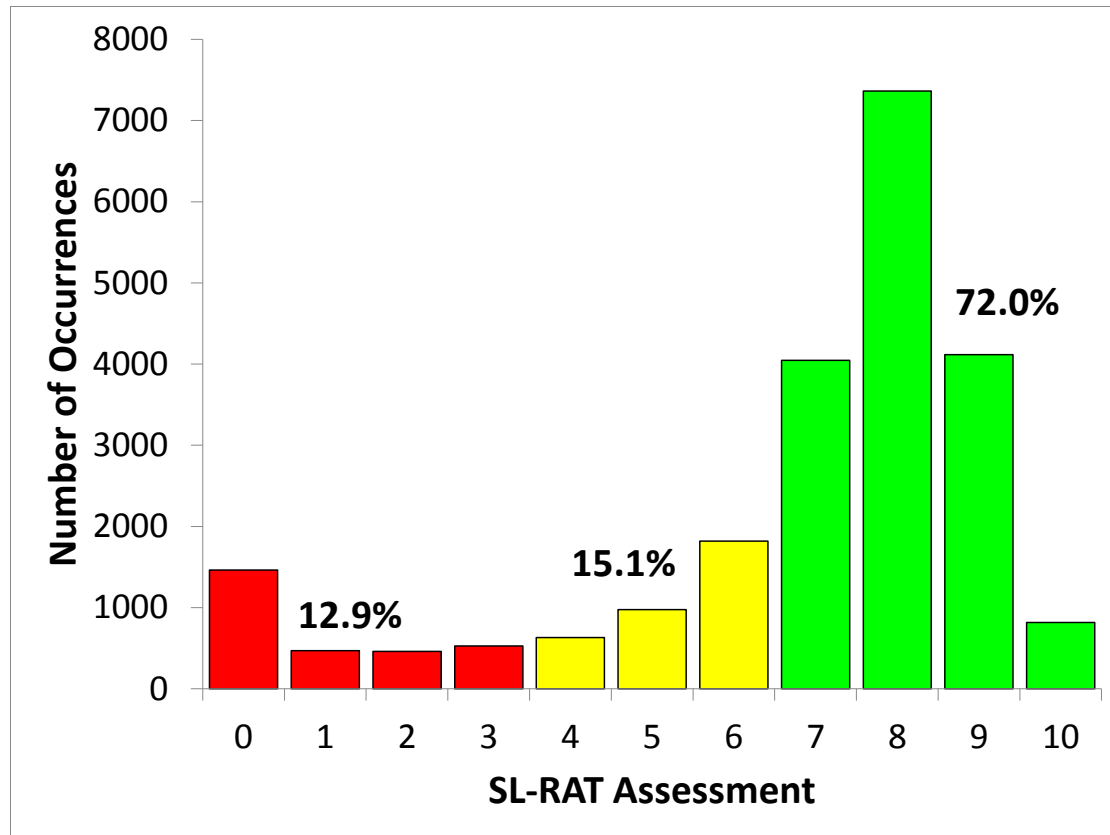


EPA Study available for download at:

<http://nepis.epa.gov/Adobe/PDF/P100IY1P.pdf>

HOW MUCH CLEANING IS WASTED?

Acoustic Inspection Results ~6 Million Feet of Pipe



- Target Historical Problematic Areas
 - **>70% Pipes Essentially Clean**
 - **<10% 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/ft**
 - **Inspect 10,000 linear 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 → 50,000 ft/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**

CASE STUDIES

- **Charlotte, NC**
- **Augusta, GA**
- **Virginia Beach, VA**
- **METRO – Nashville, TN**

CHARLOTTE, NC



“You can see immediately what needs to be cleaned, so it takes the guesswork out and focuses your efforts.” – CharMeck Engineer

- ▶ **Goal:** Prep Downtown Charlotte, North Carolina prior to DNC
- ▶ **Approach:** Use SL-RAT to quickly identify/prioritize cleaning needs for crews
- ▶ **Effectiveness:**
 - 2 SL-RAT crews inspected 143k ft of pipe in ~ 2 weeks
 - Saved \$100k + versus traditional approach
 - Focused on 10-15% of pipes that are the most blocked & prioritized the remainder

AUGUSTA, GA

- **Founded 1822**
- **Combined operations with Richmond County in 1996**
- **Population Served 190,000**



- **1,040 miles of sewer pipe**
- **Covers 280 square miles**
- **Under GA EPD Consent Order**

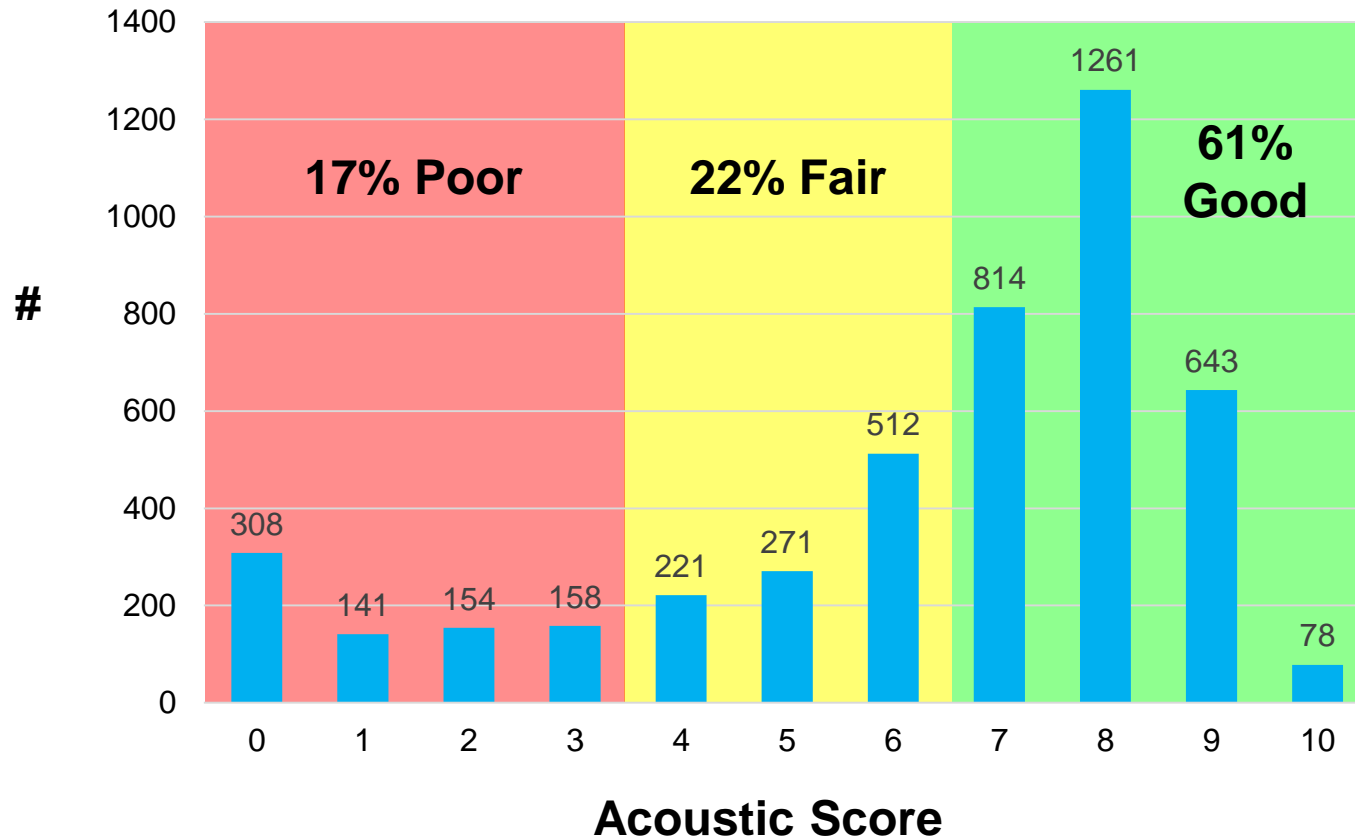
AUGUSTA, GA

- Using SL-RAT since February 2013
- Currently using 3 devices
- 20,000 segments inspected
- Over 5 million feet of pipe (950 miles)



AUGUSTA, GA

Histogram of Acoustic Scores



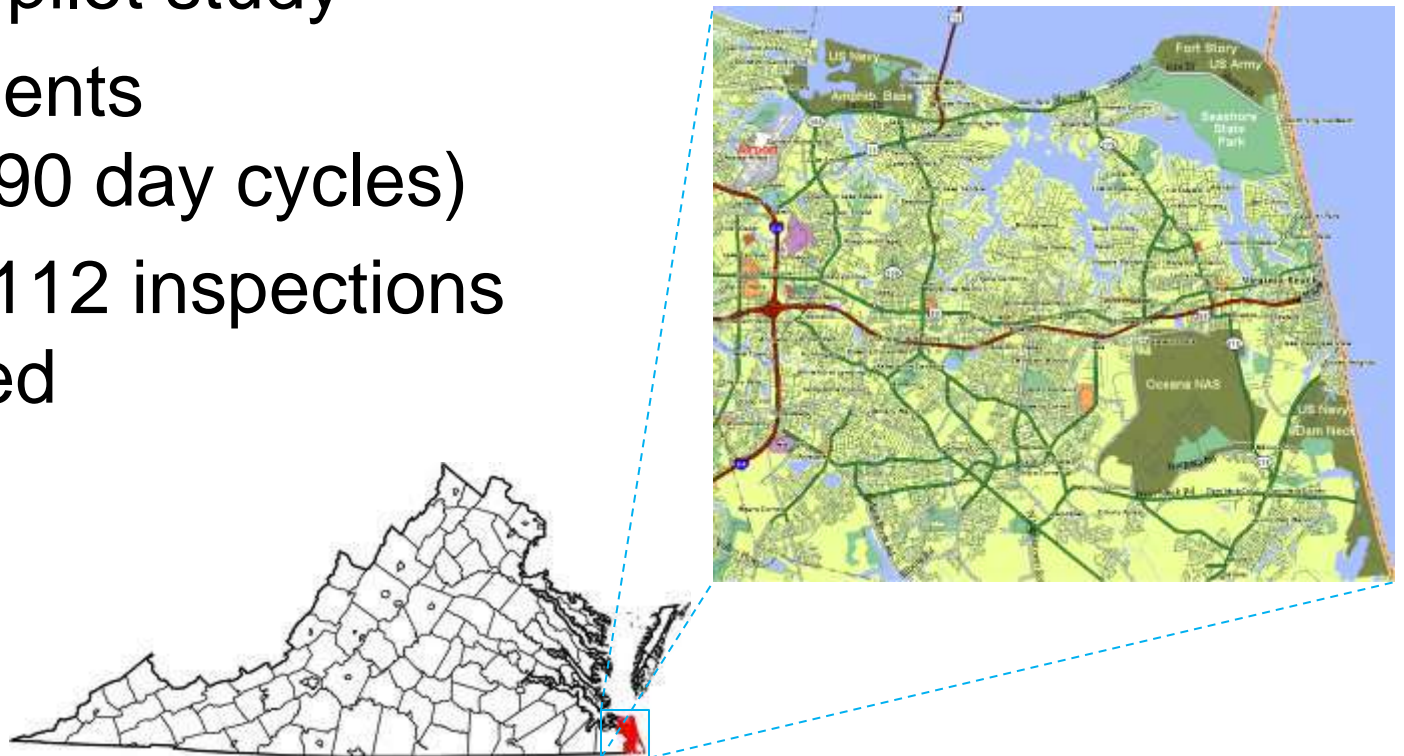
VIRGINIA BEACH, VA

- 1,200 miles of gravity sewer mains
- “Hot Spot” program created in 2006 to reduce SSOs
- Cleaning cycles range from 30 days to 1 year
- Current program includes 813,000 ft
- 68,000 ft need cleaned per month



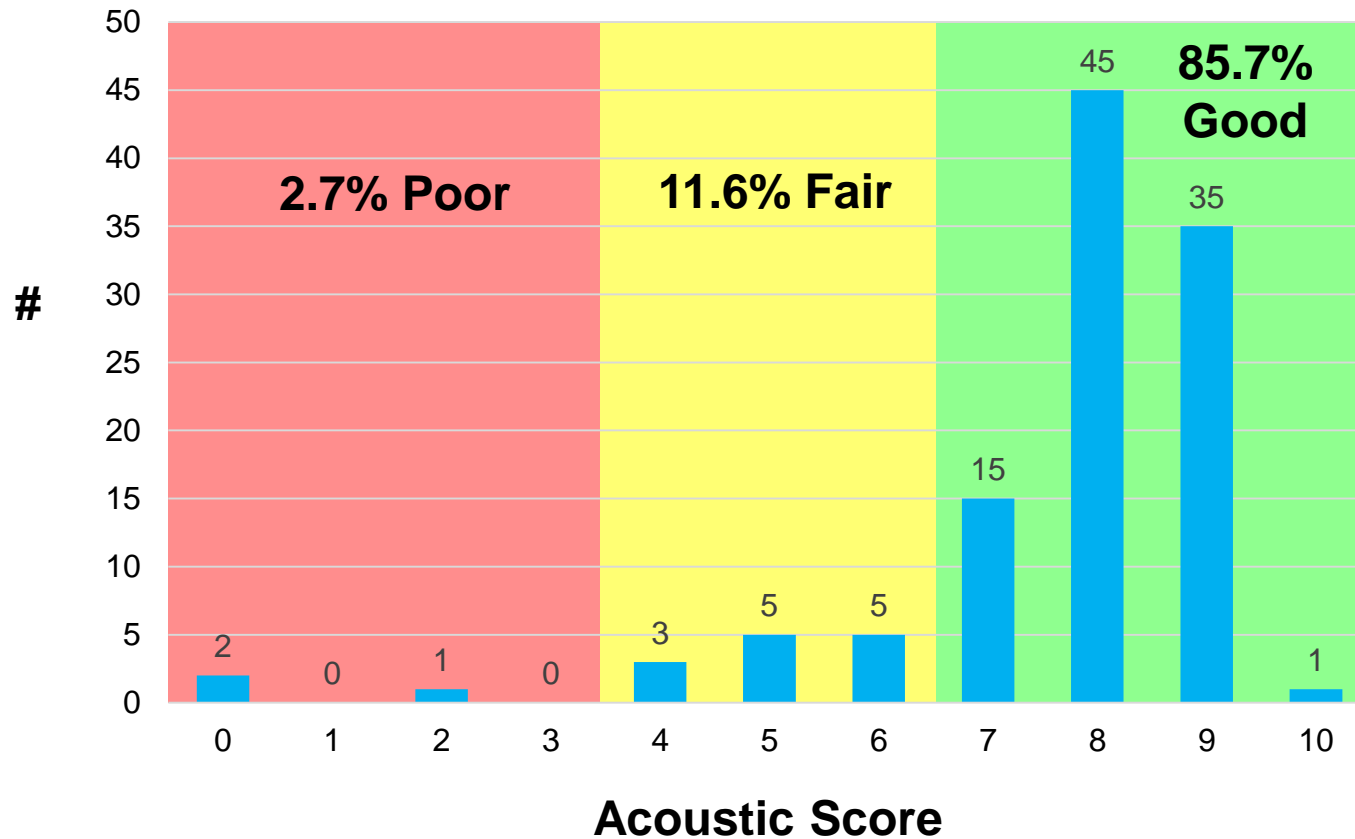
VIRGINIA BEACH, VA

- 4 month pilot study
- 62 segments
(30, 60, 90 day cycles)
- Total of 112 inspections performed



VIRGINIA BEACH, VA

“Hot Spot” Pilot Study Histogram of Acoustic Scores



METRO – NASHVILLE, TN ACOUSTIC PROJECT



- METRO under consent decree by EPA
- Bio-Nomic Services/Ace Pipe has inspected over 4,000,000 ft. since 2013
 - Expected 15 million ft. by 2017
- 6 Acoustic crews running daily
 - Averaging 50-70K ft. per day



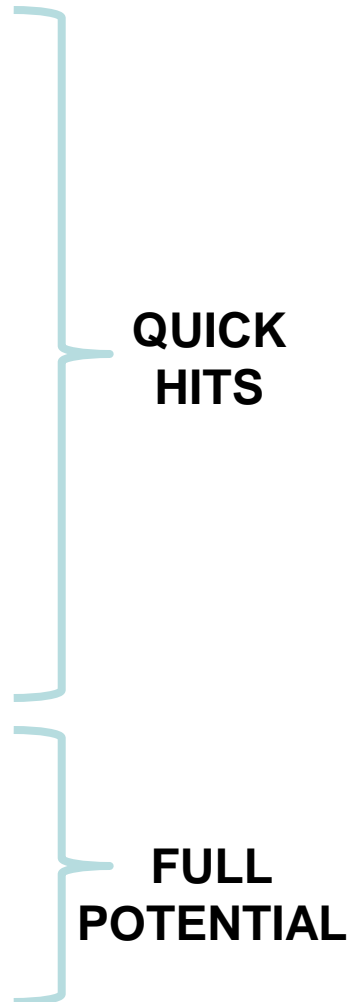
METRO – NASHVILLE, TN ACOUSTIC PROJECT

- SSO's down an estimated 60%!
- Approximately 4,000,000 feet tested to date
 - 10% scored 5 or lower
 - 90% scored 6 or higher
 - Less than 1% received a score of zero
- CCTV dollars saved:
At \$1/ft = \$3,600,000 savings
- In one month crews were able to test 800,000ft of pipe.
- Found an absolute need for GIS tracking and 3 tier data validation. GPS/TimeSheets/Maps
- CCTV 4M' @ 2000' per day, 2 crews = 4 years



APPLICATION OF ACOUSTIC INSPECTION

Application Area	How to Use Acoustics
Pre-Cleaning Assessment	Prioritize/focus cleaning often see >50% cleaning reduction – “focus on cleaning the dirtiest pipes”
Condition Surveys	Quickly & economically assess large areas for asset management & planning
Cleaning Interval Determination	Only clean specific segments when below blockage threshold
Post-cleaning QA	Low-cost method to check cleaning effectiveness and prevent downstream SSO's
Optimize SSES Contract Resources	Use acoustics to prioritize pre-cleaning & camera resources for contract advantage
Performance-Based Contracting	Use acoustic inspection to enable SSO targets in cleaning/inspection contracts
Condition Based Maintenance Program	The “holy grail” – economics of acoustics enables a CBM strategy to focus maintenance activity



CONCLUSION

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

QUESTIONS?



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