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Charlotte Deploys New Acoustic Inspection Technology to Reduce Cleaning Costs and SSOs

By Alex Churchill

The City of Charlotte, N.C., is responsible for maintaining service to more than 229,000 connections through 4,100-plus miles of sewer collection pipe spread over the 524 sq miles of Mecklenburg County. Maintaining this collection infrastructure has been a challenging task for this growing southeastern city.

In an effort to make the daunting task of maintenance easier, Charlotte-Mecklenburg Utilities Division (CMUD), partnered with the University of North Carolina at Charlotte in 2005 to develop new technologies for pipe inspection.

The basic research took two years and led to a further five-year field partnership between CMUD and InfoSense, the company that was



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formed to commercialize the University's patented acoustic inspection technology. Through all the development, CMUD has steadfastly supported the concept. Senior engineer John Fishburne says, "The acoustic inspection device created was the result of years of partnership between CMUD, academia and private enterprise. When that collaboration happens, good things — revolutionary things — can happen."

Fast forward to 2012 and InfoSense's Sewer-Line Rapid Assessment Tool (SL-RATTM) has inspected more than 1 million ft of pipe.

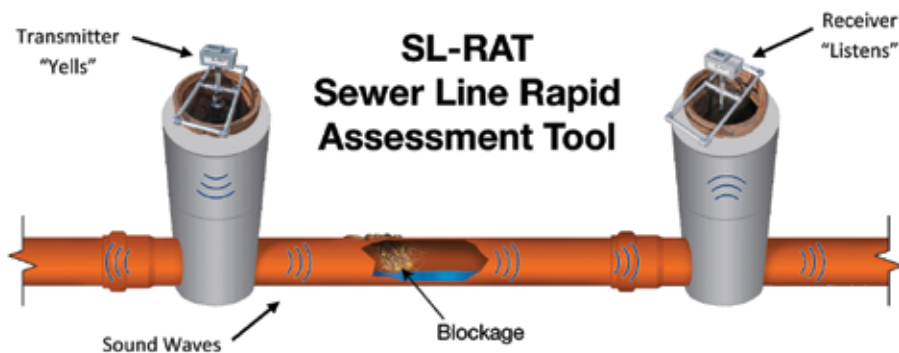
PROBLEM: ASSESSING WHERE TO CLEAN

The SL-RAT quickly provides collection system operators with valuable pipe condition information to prioritize the allocation of pipe cleaning and rehabilitation resources. Sewer overflows are most often caused by downstream blockages resulting from a long-term buildup of roots, fats, oils or greases within the pipe. These overflows are a symptom. The problem is how to economically determine where and when to clean a particular pipe segment prior to blockage and subsequent overflow. An overflow occurring in a given pipe segment is a rare event with an annual relative likelihood of occurrence of less than 0.5 percent in most situations.

Existing options for assessing pipe condition are typically either too expensive for widespread use or are not proactive enough at detecting problems to effectively assist in reducing sanitary sewer overflows (SSOs). For example, manhole inspection is only effective at detecting segments, which have either reached or are very close to functional failure, that is, the pipe is sufficiently blocked such that an overflow will occur. Therefore, manhole inspection cannot consistently focus cleaning resources on blockages prior to an SSO occurring. In addition to manhole inspection, many operators use historical SSO data combined with manhole inspection and limited CCTV inspections to develop cleaning schedules, or alternatively they just clean a higher percentage of their pipes. All of these options are expensive and have limited impact on reducing overflows.

ACTIVE ACOUSTIC INSPECTION CAN PROVIDE A BLOCKAGE ASSESSMENT IN LESS THAN THREE MINUTES

Through the partnership with CMUD, InfoSense has been able to develop the Sewer Line Rapid Assessment Tool (SL-RATTM) to provide wastewater collection system operators and contractors with a



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practical new tool that can quickly and economically assess gravity fed wastewater pipes for blockage. With this better information, expensive cameras and cleaning resources can be better focused and deployed.

The SL-RAT combines two components — a transmitter and a receiver. The transmitter is placed in an open manhole and transmits a sequence of tones through the air gap within the pipe. The receiver is placed in an adjacent manhole and listens for degradation in tones it hears compared to the tones it should hear in a clean pipe. The technology exploits the fact that sound and water flow similarly through the free space within a pipe. Hence, if a known sound signal transmitted through a pipe segment is degraded, the sophisticated signal processing algorithms within the SL-RAT are able to analyze the result in less than three minutes and provide a simple assessment of blockage within the pipe on a scale of zero to 10. The SL-RAT combines this all in an operator- friendly package that weighs less than 18 lbs per component.

The SL-RAT inspection requires no prior preparation of the pipe other than opening the cover sufficiently to insert the speaker and microphone elements just below the plane of the manhole. The SL-RAT works in all pipe geometries, with all types of pipe material, and across a wide variety of pipe diameters. It has the ability to detect full pipe sags, as the water takes up all free space in the pipe and shows up as a full blockage to the SL-RAT crew. And, furthermore it is safer than alternative technologies because it does not require confined space entry or physical contact with the flow.

Unlike alternative inspection techniques, which often require substantial training and support from expensive pumping and jetting equipment, the SL-RAT typically uses a two person crew without additional support. It is not uncommon to inspect over 10,000 ft or 50-plus pipe segments in a day. The results of each inspection are immediately available to the field operator and each day's inspection data are easy to upload to an operator's desktop for further analysis — including integration with GIS systems. No need to view, classify, and store hours of video.

USING ACOUSTICS FOR PRE-CLEANING ASSESSMENT — CHARLOTTE PREPS FOR THE DEMOCRATIC NATIONAL CONVENTION

The City of Charlotte was chosen to host the 2012 Democratic National Convention. It has been an honor that the Carolinas have not seen since the 1860 event in Charleston and it requires a service obligation CMUD takes very seriously. To minimize the need for sewer maintenance activities during the Convention period, CMUD evaluated two alternative methods for scheduling the 860 sewer segments that account for 143,000 ft of pipe in the Central Business District (CBD).

The first alternative was to focus three combo truck crews along with their associated CCTV and supervisory resources in the CBD for approximately two months cleaning the entire area. Not only would this be disruptive to downtown residents and workers, it would cost CMUD upwards of \$150,000. The second option evaluated was to use two SL-RAT crews for approximately 10 to 12 days to perform a pre-cleaning acoustic assessment for a cost of approximately \$15,000 and then use that information to focus the cleaning crews to the problem segments identified by the SL-RAT's acoustic blockage assessment. CMUD's success-

The SL-RAT inspection requires no prior preparation of the pipe other than opening the manhole cover sufficiently to insert the speaker and microphone elements.

ful two-year experience with operating an acoustic inspection program based on InfoSense's technology and their confidence in the SL-RAT's blockage assessment measurements made the decision easy.

Brian Wilson and Jon Beam, both environmental program inspectors, were tasked with orchestrating the acoustic pre-cleaning assessment program. Beam states, "We've reduced our cleaning effort. We're saving money and saving time with the use of acoustics. You can see immediately what needs to be cleaned, so it takes the guesswork out and focuses your efforts."

The inspection crews consisted of two field technicians, an ATV for quickly getting between manholes and a good plan. Often this crew was supplemented with a manager to ensure GIS coordinates were correct and to assist in planning routes, traffic control and updating the results paperlessly into a Juno database as GPS was found to behave erratically in the CBD's highly built up urban environment. Robert Lasko, one of the experienced field technicians on the "Sound to the Ground" crew, had this to say about the acoustic inspection process: "I've been doing this long enough — the results are accurate — I'd put money on it. The planning and scheduling folks love it because it helps them focus on the problems."

As for the results, Wilson integrates the data seamlessly into their geographic information system and indicates that the project has "focused our cleaning resources on the 30 to 40 percent of pipes that could use scheduled cleaning, and even more specifically on the dirtiest 5 to 10 percent of pipes that show significant potential for full blockage or full sag remediation."

By focusing cleaning crews quickly and economically, acoustic inspection has proven its worth to Charlotte's field teams. CMUD expects to save more than \$100,000 through more focused cleaning from this one project alone. Again, the SL-RAT innovation shows concretely how collaboration between university research, local government and private enterprise can pay off in the form of better tools for our industry.

Alex Churchill is chief operating officer of InfoSense.



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