Lights, Camera, Action!

A play in three acts – where the benefits of zoom cameras combined with traditional in-line CCTV are revealed

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Characters:

Fairfax County, Va. – Utility Owner
Malcolm Pirnie Inc. – Engineering Consultant
InfraMetrix LLC – Zoom Camera Contractor
Hydromax USA LLC – In-line CCTV Contractor
Video Pipe Services Inc. – In-line CCTV Contractor

Setting:

Fairfax County, Va., covers roughly 400 sq miles and is home to more than 1 million residents. It has a storm sewer system that has approximately 150,000 storm structures, 300 miles of storm channels and more than 2,000 miles of pipe. Portions of the system date back 100 years.

Plot:

Fairfax County (Fairfax) was challenged by multiple widespread failures in its storm sewer system that threatened the peace of mind and safety of the innocent residents and their valued property during significant rain events. The county knew it had a problem but, like many municipalities, it had limited resources to identify, attack and fix it. Fairfax needed to cost-effectively assess and prioritize the problem areas.

Prologue:

Fairfax partnered with national environmental engineering and consulting firm Malcolm Pirnie Inc. to devise an efficient and economical assessment approach. Our dynamic duo deconstructed the traditional assessment approach and, in so doing, confronted the fundamental question:

Do we need to see every foot of every asset?

The traditional approach to assessing buried infrastructure assets demands ubiquitous use of in-line cameras (CCTV) and answers the question above with "Yes." However, the acceptance of zoom camera technology by the U.S. EPA, the corresponding rise in availability of zoom cameras and technological improvements in zoom image quality offered another option to challenge the traditional CCTV approach. Each technology has advantages and disadvantages with respect to cost, productivity, quality, data compilation and ease of interpretation. The Fairfax/Malcolm Pirnie team posited that the answer to the question above was "No" if they harnessed the strengths of each tool.

Table 1

	IN-LINE CAMERA TECHNOLOGY	ZOOM TECHNOLOGY
METHOD	o Tractor-mounted pan/tilt camera	o Pole-mounted zoom camera
SAFETY CONCERNS	o Confined space entry training necessary	o Confined space entry not required o Minimal traffic disruption
INSPECTION CAPABILITIES	o Entire length from manhole to manhole o Limited by impassable defects, such as intrusions or significant holes and offsets o Pan and tilt view of defects and features o Ability to see into laterals	o Inspects to the limit of visibility o Limited by relative size, length, and any significant direction changes in the pipe o Operational and structural assessment of sewer
PREPARATION	o Pre-cleaning usually required o May require flow control	o No preparation required
SET-UP TIME	o 30 to 60 minutes	o 15 to 20 minutes
COMPLETION TIME LINE	o Average 5 segments per day o Approx. 1,200 ft of sewer per day	o Average of 20 segments per day o 4,500 ft of sewer per day
ADDITIONAL FEATURES	o Locating by sonde transmitter available o Immediate reports available o GPS locating and GIS mapping	o Manhole/structure inspection videos o GPS locating and GIS mapping o Rehabilitation recommendations available o Post-inspection data processing required

Fairfax and Malcolm Pirnie identified 70 miles of storm sewers in four geographically diverse watersheds to attack first. These areas were selected to represent tidal and non-tidal area, pipe of differing ages and materials, known problem areas and areas with no remarkable O&M history. The team hypothesized that zoom inspection would identify which assets did not require further investigation by the more labor intensive and expensive in-line camera technology thereby increasing the effectiveness of the inspection while driving down overall cost. The pilot program was divided into 11 project areas with seven areas receiving the combined zoom/in-line approach and four control areas receiving the traditional CCTV approach.

Act I: Out with the Good

Enter stage left: The short, dark and powerful Zoom Camera

InfraMetrix LLC zoom inspected sewers in the pilot project area using its CUES-IMX zoom camera (see below). The automatically adjusting light head adjusts illumination on the zoom focal point allowing 50-ft inspections in 6-in. sewers and up to 350 ft in larger sewers. This precision created a high degree of confidence in the inspection results. The efficiency of the zoom setup allowed inspection from both the upstream and downstream ends.

These dual perspectives on any defects or obstructions (something not easily accomplished with in-line CCTV cameras) provided another level of assurance to future rehab decisions. The zoom technology confirmed that most of the sewer segments had neither significant defects nor enough debris to require cleaning. The assessment for these segments ended with the zoom camera results.

Act II: Confronting the Bad

Enter: A battle-scarred, pan and tilt, remote controlled, tractor mounted CCTV camera connected to a studio and controlled from the surface by a PACP certified technician.

Sewers with serious defects, curved lines or requiring significant cleaning were classified using the zoom camera results based on a set of criteria established at the onset of the program. CCTV contractors Hydromax USA LLC and Video Pipe Services Inc. were dispatched to clean and provide secondary assessment of these sewer segments. This secondary assessment determined that about half of the pipes inspected via in-line CCTV required cleaning. Hydromax and Video Pipe then cleaned and televised the lines and delivered a NASSCO-compliant defect database of these bad assets.

Act III: Prepping the Ugly

The CCTV deliverable provided by both the zoom camera and in-line camera inspections facilitated a comprehensive review of the physical condition by Malcolm Pirnie engineers. This review included a meticulous evaluation of the results which, in turn, supported a targeted rehabilitation approach for problem assets within each project area.

The Moral of the Story:

The goal of the combined approach was to realize cost savings while still attaining program goals. Four of the 11 project areas served as controls and received in-line inspections only. The other seven areas received the combined approach. Data was organized to present a reliable comparison between the two approaches including the number of sewer segments, linear footage, and total cost.

Combined Approach Results

For the seven areas that used the combined approach, approximately 62 percent of the sewer segments were first inspected using the zoom camera. The remaining 38 percent were classified as totally obstructed due to buried inlet and manhole structures and were scheduled for additional work. Of those segments screened with the zoom technology, in-line inspection was necessary for only 36 percent of the segments.

Cost Analysis

Cost results are presented in Table 2. When in-line CCTV required pre-cleaning prior to inspection, the associated pre-cleaning costs were incorporated into the in-line inspection costs. Cleaning is not required for the zoom technology method. The average total cost per linear foot was estimated for project areas that used both the combination method, as well as

Table 2

	Length of Sewer		Total cost	Heavy Cleaning Cost	Average Cost	Average Inspection Cost (no cleaning)	Method
	(miles)	(feet)	($)	($)	($/LF)	($/LF)	
	22.2	117,216	573,202	161,905	4.89	3.51	In-line
	47.7	251,856	837,776	74,396	3.33	3.03	Zoom/ In-line
					Total Inspection/Cleaning Cost =	**$1,410,978**	
					Savings - based on Total Cost =	**$451,191**	
					Savings - excluding Cleaning Cost=	**$192,157**	

the standalone in-line method of inspection.

The average cost per linear foot for in-line inspection was $4.90, whereas the combined method only cost $3.30/lf. This 32 percent savings, or $500,000 against this scope of work, is powerful testimony to the advantages of the combined approach.

By excluding cleaning costs associated with the in-line method, the average cost per linear foot of in-line inspection was $3.51 while the average cost per linear foot using the combined method amounted to $3.03. This still represents 14 percent, $200,000, savings compared to the in-line method alone.

Zoom technology segregated the good, focused time and effort on the bad, and saved significant program budget to fix the ugly. Zoom technology proved its value in the ongoing saga of buried infrastructure managers vs. their arch enemies, ravaging time and dwindling budgets.

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