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Foreman Troy Muron and city engineer Bob Kelly inspect a finished pipe lining on a video camera monitor. The city's sewer rehabilitation program has helped drive down I&I. (Photography by Larry Bennet)

FOCUS: SEWER

LEARNING BY DOING

A step-by-step approach helps an Ohio community refine its sewer rehabilitation methods, reduce I&I substantially, and save money

By *Jim Force*

Leak detection and repair has truly been a live-and-learn experience in Westlake, Ohio.

Aided by a unique testing protocol that pinpoints problem areas, the city has used different products, contractors and installation methods to fix infiltration and inflow (I&I) problems over the last seven years.

Each project provides valuable

lessons that are in turn applied to the next project, saving money and improving efficiency of the process. "Every time, we go back and see what we've learned," explains city engineer Bob Kelly. "Then we incorporate that into the next phase."

I&I issues began to overwhelm Westlake in the 1990s. "After a significant rainfall, we would get hundreds of calls reporting flooded

basements," Kelly says. "Some of the storm surges in the sanitary lines were 7 or 8 feet, higher than elevation of many of the basements."

In those days, I&I issues were addressed based on the number and source of emergency phone calls from homeowners. "Most of the problems were in the laterals from the sewer line to the house, so we started by digging a pit in the front yard, taking out and



PROFILE:
City of
Westlake, Ohio

POPULATION:
34,000

AREA:
15.97 square miles

FOUNDED:
1811 as Dover Township; name
changed to Westlake
in 1940

INFRASTRUCTURE:
125 miles of sanitary sewer;
125 miles of storm sewer

ANNUAL BUDGET:
\$500,000 to \$1 million
(construction)

WEB SITE:
www.cityofwestlake.org



Westlake crew members Joshua Muron, Bobby Vernatter, Neil Sobodinski and Troy Muron work on the wet-out assembly line on a CIPP lining project.



City engineer Bob Kelly examines a sample of CIPP lining. The city collects neighborhood data for about a year to develop the most cost-effective I&I solutions available.

“Every time, we go back and see what we’ve learned. Then we incorporate that into the next phase.”

Bob Kelly

stormwater intrusion, and in 2001 embarked on a pre-emptive I&I elimination program, working with its engineering partner URS Corp. of Cleveland. URS developed a unique method of dye testing so that leaks could be pinpointed from downspouts, foundations and cracked driveways (see sidebar). And instead of just responding to emergencies, the city began systematically going from one neighborhood to another, looking for leaks and repairing them.

Over time, as the city completed each project, Kelly’s crew gained knowledge that was applied to the next project. In other words, as the art evolved, the city made the fixes better and more cost-effective. In his role, Kelly is assisted by an

replacing the cleanout, and TV-scanning the lines,” says Kelly.

The city used grout to make the necessary repairs. Homeowners paid for their lateral repairs, while the city paid for any work on the sewer line. Results were good. In some cases, a 7-foot storm surge was reduced to a 7-inch storm surge, reports Kelly.

Still, the city sought a more efficient method for addressing



During residential dye testing, dyed water is sent through downspouts and gutters to simulate rainfall.

Photo courtesy City of Westlake

DYE TESTING PINPOINTS PROBLEMS

To pinpoint the sources of infiltration and inflow in Westlake, Ohio, URS Corp. developed a unique method of dye testing using water from fire hydrants.

A specially designed PVC manifold steps the water flow down from fire hose to garden hose volume, and can distribute the flow to several hoses at once. Different-colored dye solutions are then applied to downspouts, foundations, driveways and other potential sources of I&I.

CCTV units monitor the sewer lateral for traces of the dye, which can then be tied back to the source of the leakage. “We knock on doors and ask the homeowner to turn off the water for 15 to 20 minutes while we run the test,” says Scott Belz, field manager of the water resources group of URS. “They’ve already been notified of the procedure by the city, so they’re usually very cooperative.”

The reports from the testing generated by URS serve to guide the city’s rehabilitation efforts. “It’s made the rehab effort more precise, more cost-effective,” says Belz. “Based on the data, the city may be able to remedy the problem with spot repairs, rather than rehabbing an entire lateral or sewer line.”

Says Westlake city engineer Bob Kelly: “The more data, the better. Testing pinpoints the source. We’re really happy with the results.”

engineering director as needed, a part-time engineer, a part-time engineering technician, and a two- or three-member service crew as needed.

Salem-Radcliffe project

The city first employed its approach in the Salem-Radcliffe subdivision in 2001. United Survey Inc. (United Liner) of Cleveland lined sanitary laterals with the cured-in-place (CIP) method, using a felt liner with a polyester resin and steam curing.

“We excavated a pit in the yard and lined both ways — from the cleanout to the street as well as from the cleanout to the house,” Kelly says. Downspout testing identified laterals needing work. The rehab team visually inspected manholes and used a sprayed-on product on those in need of sealing. After rehabilitation, the team monitored the flows. Kelly and staff reported these lessons learned in the Salem-Radcliffe project:

- The lining stopped short of the mainline and did not

Flow Data Results for Sanitary Sewer Rehabilitation Projects

Westlake, Ohio

PROJECT	RAIN (IN.)	SEWER LEVEL (IN.)	SEWER VELOCITY (FPS)
Salem-Radcliffe			
Pre-rehabilitation			
Average Dry Weather		1	
April 8, 2000		50	
Difference		49	
Post-rehabilitation			
Average Dry Weather		2	1
March 30, 2002		12	7
Difference		10	6
Overall Reduction in Sewer Level		80%	
Berkeley Estates			
Pre-rehabilitation			
Average Dry Weather		2.6	1.9
May 10, 2003	0.77	24	4.6
Difference		21.4	2.7
Post-rehabilitation			
Average Dry Weather		2.6	1.7
April 22, 2006	1.60	3.7	2.6
Difference		1.1	0.9
Overall Reduction in Sewer Level		95%	

address the mainline/lateral interface.

- Groundwater migrated down the lateral to the path of least resistance or protection from the liner, entering at the mainline/lateral connection.
- Flow monitoring showed a significant reduction in I&I (see table above), and flooding complaints ceased.

In a second project in Berkeley Estates in 2004, United Survey lined laterals from the mainline sewer to the house using a CIP process consisting of felt liner, polyester resin and ambient curing. As before, the work was based on downspout testing results. The tests also indicated where the mainline needed to be grouted.

To counter leakage at the mainline-lateral interface, the contractor grouted the interface. In addition, manholes were sealed using a cementitious product. The project provided these lessons:

- Liner failures, possibly due to ambient curing or the resin introduction process, made it difficult to grout the mainline-lateral connection. Septic systems previously served the area, and there

were no records to show how those homes were tied into the mainlines when they were converted to sewer. "Sometimes, the contractor had to excavate two pits to expose both the storm and sanitary laterals, and this was not included in the original bid document," Kelly explains.

- The cementitious sealant was more cost-effective than the spray-on variety.
- I&I decreased substantially, and no flooding complaints have been received.

Canterbury project

Most recently, Westlake completed the Canterbury area project in 2007 using AAA Pipe Cleaning Corp. of Cleveland. At first, the sanitary lateral lining system employed a CIP process identical to that of the Berkeley lining project. However, the resin was later changed to epoxy because of issues with getting the product through customs. Also the method of curing the CIP was changed to hot water. Downspout testing determined the laterals needing repair.

An excavated pit exposed both storm and sanitary laterals and



Crew members Neil Sobodinski, Joshua Muron and Bobby Vernatter help extract the calibration bladder assembly, which includes a recycle hose and extraction cord.

"We spend one year testing and gathering data in a neighborhood, then devote the next year to the construction and repair. Data collection is critical, as it enables us to pinpoint problem areas and focus the repair work. We used to do about 75 homes for \$1 million, but now we're able to do 130 to 140 homes for \$1.3 to \$1.4 million every other year."

Bob Kelly

provided access for lining the laterals and installing new cleanouts. Mainline areas identified in the testing were grouted. So were the mainline-lateral interfaces and laterals that showed signs of infiltration or staining. Manhole sealing used a cementitious product with a flexible urethane at the frame/wall interface.

In addition, the contractor vacuum-tested the manholes and performed flexural modulus and strength testing of the liner to ensure compliance with the specifications. Lessons learned this time included:

- Testing increased knowledge of strength flexibility of the liner product for meeting

the specifications.

- The improved methods for sampling and analysis produced more accurate results.
- Quality-control methods showed that samples taken at the edge of the pit were not consistent with results taken further inside the pipe that more closely represented in situ conditions.
- More information was needed from the I&I field-testing procedures that were used on this portion of the project. The additional information can identify blocked downspouts, failed connections or repairs that could limit the rehabilitation to spot repair. This would further reduce repair costs while significantly reducing I&I.

Highly cost-effective

Westlake's learn-by-doing approach has not only refined the I&I elimination process — it has proven highly cost-effective. “We spend one year testing and gathering data in a neighborhood,” says

Kelly, “then devote the next year to the construction and repair. Data collection is critical, as it enables us to pinpoint problem areas and focus the repair work. We used to do about 75 homes for \$1 million, but now we're able to do 130 to 140 homes for \$1.3 million to \$1.4 million every other year.”

The city has also changed the way it finances the projects. Originally, the city paid for the public section of the project, while the homeowner paid for the rehab work from the street to the property. Now, the city picks up the whole tab, and that has increased public support of the work and associated inconvenience.

“The city was picking up 80 to 90 percent of the cost anyway,” says Kelly, “and running the lining in both directions didn't cost that much more, so we decided there would be no cost to the homeowner. That's also made it easier to get the homeowners to accept the project — 99 percent are in support of what we're doing.” ♦

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