

I&I

INFLOW & INFILTRATION SOLUTIONS AND EQUIPMENT

Supplement to:
MUNICIPAL
**SEWER
&
WATER**

UTILITY SPOTLIGHT:
Indiana crew stays
ahead of sewer problems
with sensor network

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Expecting the Unexpected

Meticulous inspection
and rehab program keeps
Northeast utility on course

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**MANHOLES -
MACP**



GPS CAPTURES



HYDRANTS



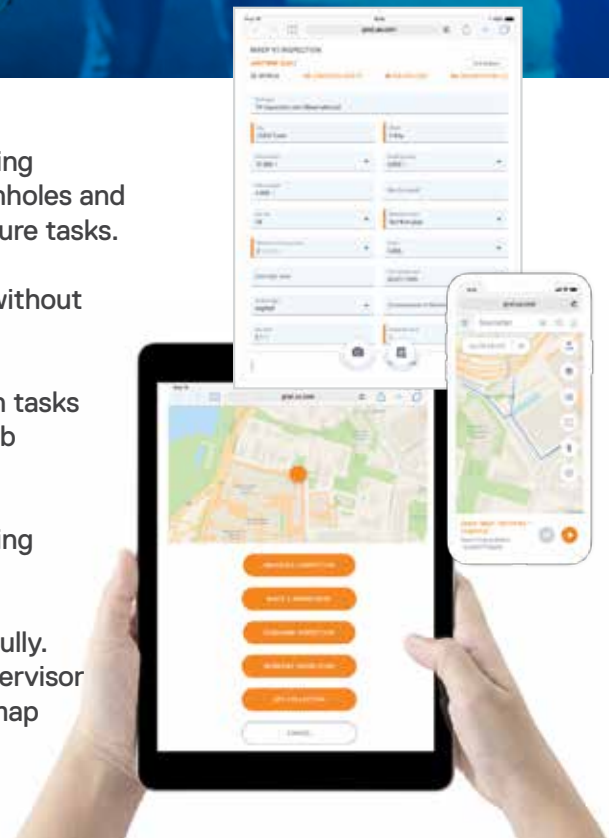
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SOLUTIONS AND EQUIPMENT

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Meticulous inspections allow a Northeast utility to stay ahead of the game.

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COVER PHOTO: Jacob Gidade, foreman with National Water Main Cleaning, applies Mainstay ML-72 cementitious lining (Madewell Products) to a sewer manhole riser for the Shrewsbury (Massachusetts) Water and Sewer Division. (Photography by Jake Belcher)



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Did you know that mechanical seals cost the same as applied seals but last 3.5 times longer?

The American Society of Civil Engineers (ASCE) reported a mechanical seal and an applied seal cost about the same, but mechanical manhole frame-chimney seals will last 3.5 times longer.* Contact a Cretex representative to learn more about the LSS Internal Chimney Seal advantages for new construction and rehabilitation projects.



* Data provided by the ASCE Manuals and Reports on Engineering Practice No. 92, "Manhole Inspection and Rehabilitation", 2008 Update.



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“Like we say in the sewer,
‘time and tide wait for no man.’”

— Ed Norton, *The Honeymooners*

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This root ball pulled from a South Bend sewer was named "The Blob" because it appeared to be trying to eat a worker's foot.



WHY SENSORS MAKE SENSE

An array of sensors in the combined sewers help the South Bend Wastewater Department keep the system flowing smoothly and prevent sewer overflows

By Steve Lund

Richard Radcliff loves his numbers.

"As a civil engineer, I'm all about measurement," says Radcliff, combined sewer overflow operations manager for the South Bend (Indiana) Wastewater Department.

The numbers generated by a network of sensors (CSO_{Net}, hosted by Xylem Vue) on the collection system, along with data visualization tools developed by South Bend and EmNet, enable Radcliff to see trends and spot issues before they become problems. As a result, dry-weather overflows of the combined sewer system have all but been eliminated, and wet-weather overflows substantially reduced.

"Our overflows per inch of rain keep going down and down," Radcliff says. Part of that reduction is from a sewer separation project, and other efforts to prevent I&I, but Radcliff thinks much of it comes his team's use of data collected by the sensors to manage the system better.

MULTIPLE SENSORS

Originally installed in 2007 and upgraded in 2017, the 150 sensors in the system measure flow, depth, velocity, positions of weirs and gate control valves, water temperature, river level, turbidity and oxidation reduction potential. The system has automated valves to direct the flow in the sewers and control stormwater basin levels.

"We've learned quite a bit from having the sensor data," Radcliff says. "For example, we discovered our interceptor pipe was not being completely filled before we would have wet-weather discharges. Using the sensor data, we identified places in the system where we could run parallel throttle lines and pinch valves.

"It's a 'smart' sewer system. As rain comes in, the pinch valves open up and allow more flow to go into the interceptor, until all that capacity gets filled. Then they start closing down. We've been able to optimize flow into the interceptor and help minimize wet weather discharges."

DATA FOR PLANNING

Radcliff hopes the sensor data will help improve the design and reduce the cost of the next phase of South Bend's long-term control plan. The first

phase was the creation of the sensor system, along with separation of the storm and sanitary sewers in some neighborhoods. The first phase reduced combined sewer overflows by 75%, according to the city's website.

The next phase will involve building storage areas in the collection system. The original estimated cost was \$700 million, more than four times the cost of the first phase, but data collection over the years has led to some modifications. The new Phase 2 is called the Smarter Alternative for a Greener Environment and has a much lower price tag at \$200 million. The city is waiting for federal approval of the new plan.

"We recognized that we could do this a lot better," Radcliff says. "It's like the old expression, 'You don't know what you don't know.' We got smarter over the life of the sensors that we put in. That's what allowed us to revise our long-term control plan and, we hope, save the city a considerable amount of money while concurrently making the environment better."

REVISED STORAGE

Radcliff says the revised plan still calls for underground storage, but not as much as in the initial plan. "We're still going to need tanks; the system still does overflow, but the sizes and the locations have changed," Radcliff says.

"The success we've had will allow us to build smaller and fewer tanks than we thought we would need. Sensors brought light to the collection system and allowed us to find blockages, find I&I and find problems. Sensors gave us a better focus on where the problems are."

Working with the numbers and visualizations that the sensor network produces, Radcliff can see problems developing that sometimes don't show up in a physical inspection. In one incident he called to alert a crew on the



Richard Radcliff, CSO operations manager for the South Bend (Indiana) Wastewater Department

Current After-Hours On Call Person
Liftstation After-Hours On Call Person

SOUTH CROSSING STATUS BOARD

RC	Description	Depth (ft)	Critical SP (ft)	Flow (GPM) or Pump Run Time	Velocity (ft/s) or Pump Run Time	HQS (ppm)	Last Upd	Mode (M)	Sensor	HI'	HIIP'
001	RC1 Secondary Line (CSO 048)	0.38	3.11				3 min	G-15.2	1		
	RC1 Upstream - Primary	1.82	3.00				3 min	G-3a.1a/c	2		
	Interceptor by Boat Launch E	2.16	3.00				3 min	L-15.1.2	1		
	Interceptor by Boat Launch W	2.25	3.00				3 min	L-15.1.2	2		
002	RC2 Upstream	4.55	5.40				4 min	G-30.1	1		
	Interceptor by Farmers Market	2.05	4.00				4 min	L-30.2	1		
003	RC3 Upstream (Monroe LS)	5.88	6.00	P1 RT: 56 P2 RT: 32							
	RC3 Downstream - Int. St Louis	3.87	4.00				56 min	L-13.1	1		
	CSO 014	0.38	0.70	Valve: 100			5 min	L-13.1	2		
004	RC4 Upstream	1.40	3.50				5 min	G-8.1	1		
	RC4 Downstream - Int by CSO 025	15.55	7.00				5 min	L-8.1	1		
005	RC5 Parshall Flume Upstream			4.66				L-5A-50.32	1		
	RC5 Upstream Laminar	1.46	0.00	(53) 3385	1.47	1.22	4 min	L-5A-50.32	1		
	RC5 Downstream	2.21	0.00	5252.3	1.46		56 min	L-5A-50.31	1		
006	RC6 Upstream										
	RC6 Downstream	8.31	0.00	260.75	2.70		38 min	L-5A-50.30	1	50	
	Keller Park Liftstation			P1 RT: 2 P2 RT: 1							
007	RC7 Upstream										
	RC7 Downstream - CSO 045	652.8	683.8	1/113 (Calc)	2.37						
008	RC8 Upstream - Colfax Liftstation			P1 RT: 18 P2 RT: 10							
	RC8 Downstream - AM General										

Legend:
 100% Disabled Polymer Final Feed & VFD Fault
 80% Olive Liftstation Running On Flows
 90% Disabled Polymer Mix Train 2 High Level

Sensors in the South Bend sewers constantly update the numbers shown on this screen and many other similar screens.

“I don’t know how you could manage a collection system without a sensor network. You’d just be blind.”

Richard Radcliff

you miss with your eyes, but the numbers don’t lie.”

A quarter of a manhole cover is tiny compared to some of the things Radcliff and his crew have found in the collection system. At one point he saw a bump in the trend line for a section where the water level went from 2 to 3 feet to 4 feet, then back to around 3 feet. They found a large amount of grit in the section where the water level bumped up. After a CCTV inspection, they found a root mass that was slowing down the flow and causing the grit to be deposited.

They also found large chunks of concrete and rocks that formed a dam inside the 96-inch interceptor sewer. The only way to remove that was to send a diver in to tie ropes around the obstructions so they could be hauled out. “To me, looking at numbers, I know what normal looks like,” Radcliff says. “It could be a manhole cover, a root mass, whatever. It’s apparent to me from a distance.”

Radcliff has given a PowerPoint presentation called “Discovering Sewer Monsters” at an Indiana Water Environment Association conference and other events. One obstruction found in the sewers he named “The Blob,” because it resembled the monster from an old sci-fi film. Another he called “Jaws” because it reminded him of a shark. He adds theme music to the presentation to enhance the effect.

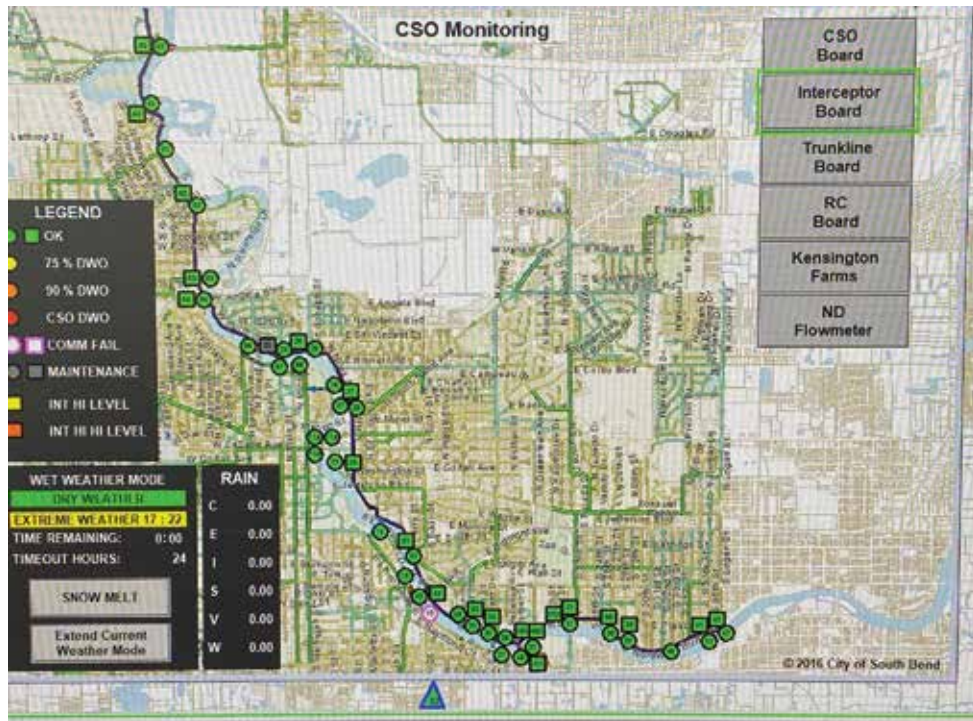
TARGETING MAINTENANCE

The sensor data also helps South Bend prioritize maintenance near the 35 overflow points in the system. “It may not be necessary to go to every site every single day,” Radcliff says. “If any sites appear to be above normal ranges, we can go to those sites. It allows me to optimize flow in the system and optimize maintenance and operations.”

Over time, sensors have shown that some areas are problem-free, so the sensors could be moved to places where they might be more useful. “As a result of looking at the data, it’s clear that some sites we don’t need to worry about,” Radcliff says. “We’ve moved sensors around, we’ve deleted some in some areas, and we’ve added some to others. It’s a living, ongoing system.”

Before the monitoring system was installed, South Bend was averaging 35 dry-weather overflows a year, each one resulting in a hefty fine from the EPA. Now the system almost never has dry-weather overflows. Radcliff can’t imagine managing a sewer collection system without a network of sensors.

“If someone asked me to manage a system that didn’t have sensors, I’d say it’s all but impossible. I don’t know how you could manage a collection system without a sensor network. You’d just be blind. You’d never be able to quantify the effect of the changes you make.” **I&I**



One of the data visualization tools used in South Bend.

road to a problem at a site. They said they had just checked it, and it was OK. Radcliff didn’t think so and arranged to meet them at the site.

“This place is 25 feet deep,” he says. “We set up confined-space equipment and sent a man down there. When we brought him back up, he had a quarter-piece of manhole cover that had lodged in there. It wasn’t enough to stop the flow, but over time, stuff could have built up on that piece of manhole cover and caused a blockage, and possibly an illegal overflow.”

DISCOVERING “MONSTERS”

His colleagues wondered how he knew what was in there; he said he didn’t know what it was; only that something wasn’t right. “I’m in an office two miles away, and this is 25 feet underground,” Radcliff says. “I saw the level rise a tenth of a foot, and I knew that wasn’t normal. This is the kind of thing

SEEING THE LIGHT

New CIPP system helps Pennsylvania contractor stay productive amid labor shortage

By Anthony Drew

Technological advancements can be revelatory for business owners, municipalities and their employees, lighting a new path forward in an ever-changing world.

Josh Shelton, owner of Shelton Plumbing in New Kensington, Pennsylvania, understands very well the impact that new knowledge and technology can have on him and his crew. That's why he stays in touch with plumbing contractors throughout the country and builds relationships with the manufacturers who research and develop new products for the industry.

Ultimately, that's how his team ended up working with Waterline Renewal Technologies' new LightRay LRI UV-casted CIPP system before it was recently released to the public, agreeing to give the manufacturer feedback.

"We've built a lot of trust in each other," says Shelton. "They gave us the opportunity to see what we could do with it and report back the things we

like and don't like, and that's single-handedly one of the reasons why I absolutely love working with this company. Not only the company but existing installers across the county who will take a call at 10 o'clock at night to shoot ideas about projects they want to get into. We all kind of help each other to be successful."

He says he's impressed by Waterline Renewal Technology's professionalism and respect for installers, and welcomed the opportunity to see what the LightRay LRI system can do. "There are times where it

kind of blows me away — the people that take the time out of their day to talk to me about issues or to overcome obstacles. There's no holding back on their end. Anybody at any time will stop at nothing to help someone like myself, a small town plumber trying to make my way in the world."

As far as Shelton's experience with UV-casted CIPP technology goes, it's been positive all around. He says it has increased the quality of life for his employees, customers and the public surrounding his job sites.

"Sometimes I get lost for words with how much it has changed the lives of my employees," he says. "We've got some that have been here for 15 years, and the aches and pains of 15 years of hard work has taken its toll. But morale right now is high because we're doing more work than we ever have with so much less manual labor. It's an amazing piece of equipment."



LightRay LRI was able to cast 47 feet of 4-inch pipe in 10 minutes at this job, according to Josh Shelton.

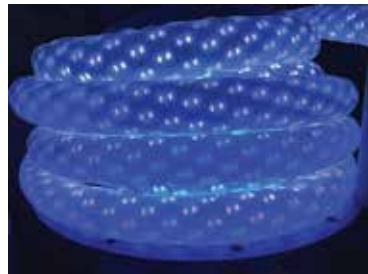


Job sites can be simplified with UV systems like the LightRay, meaning there's less equipment for crews to operate and a smaller zone to control.

SAVE TIME CASTING

The LightRay comes in a dual pull-in-place and spot repair system called the LR3, or a lateral inversion system called the LRI. The LR3 offers operators flexibility to either pull-in-place or spot repair by changing the proprietary cold LED repair packer. Non-VOC, non-thermal UV casting resin (activated by UV light) is pre-impregnated into a fiberglass liner and shipped ready to install — temperature stable and without need for refrigeration — for 3-, 4- and 6-inch pipe diameters.

The flexibility of the system's liner material exceeds the requirements of ASTM F1216, according to Waterline Renewal Technologies, and the design of its light train allows it to navigate multiple bends up to 90 degrees.



The LightRay LRI has a 50-foot light train, and its design allows it to navigate multiple bends up to 90 degrees.

Shelton's team has used both the LightRay LR3 and LRI, but most recently has been doing inversion CIPP work with the LRI. "We were very well versed in the two-step process of inversion lining," he says. "With the LightRay LRI system, there is a specialized system where at a certain point installing the bladder, you attach the light train, which is 50-feet long, and then you continue the inversion process with the bladder, pulling the lights with it to the far end of your liner."

Shelton says it's about a 10-minute cast time for 4-inch pipe, or 15-minute cast time for a 6-inch pipe, and you can cast 50 feet at a time. Beyond 50 feet, it's still a simple process. "If, say, you need to install 75 feet, and you do the first 50 feet, you're basically going to keep positive pressure but reduce it ever so slightly, and you can then start to retract your bladder, pulling the light train with it to the next section of liner that you need to cast. Then you reinflate to your holding pressure and start another casting process. You can't really beat the time."

GETTING MORE DONE

Saving time on the casting process has never been more valuable for Shelton Plumbing than it is right now. With an ongoing worker shortage and a huge influx of rehab work — largely due to a local ordinance in New Kensington mandating strict inspections of sewer laterals and building drains for home sales and refinancing — Shelton says he's turning down four to five calls per day related to lining projects.

"I can't overpromise and under-deliver, and we're on par keeping up with what we know we can handle," he says. "Everything else we have to turn away. Truth be told, you can't find individuals who want to work. But now that you have this UV technology, it's easier to train. It's easier

"You can line and repair and restore a system with minimal disruption to somebody's property in a fraction of the time."

Josh Shelton



The LightRay's shorter casting time and simplified job site allow Shelton Plumbing to streamline its pipe lining process and get more jobs done in a day.

"Morale right now is high because we're doing more work than we ever have with so much less manual labor. It's an amazing piece of equipment."

Josh Shelton

to operate. There are so many pieces to UV technology that will help us do better, and be better, at our jobs."

In addition to the quick casting times, the LightRay LRI system promises a simpler job site with less equipment, and a smaller zone that his team needs to control for safety reasons. "I don't have to use a dry steam generator, which also requires electricity and water. Plus you have the blow-off of the steam where you have to be really careful about how you're setting up that project. There's a whole slew of pieces of equipment you don't have to think about anymore. And with it being UV casted and a pre-impregnated liner material, you're really pulling the material outside a box, measuring and cutting it to fit, and your team has so much less to worry about."

In a field that has traditionally seen a high turnover rate for new hires and apprentices, factors like these are allowing Shelton Plumbing to retain the employees it can find. "I'm keeping my guys because they're not only happier, but now I'm able to pay them more money because we're doing more work in a faster amount of time. To me, no matter what piece of equipment we have at our disposal, to do our jobs better — that's really what all this is about."

A GOOD I&I SOLUTION

Shelton Plumbing has performed quite a few rehab projects where there was serious water infiltration, whether from laterals or interior building drains.

"There's a lot of times where we discover interior French drains from when a house was originally built in the '50s or '60s, and usually right at the foundation there's a cross-type fitting, and a lot of root infiltration comes from there. We have to eliminate that and block that off. Then it's brought to the customer's attention that they might have to seek alternative methods to remediate any foundational water issues. That's typically what's happening; you block it off in one place and water wants to migrate somewhere else."

When New Kensington was initially faced with more rigorous inspections on building drains and laterals, with taps being a pass or fail on an inspection, Shelton Plumbing started using CIPP systems for a lot of the laterals and longer runs.

"But with the LightRay LR3 patch system, basically you can do a 1-foot repair up to a 20-foot repair because there's a 20-foot-long packer," says Shelton. "We can restore interior building drains with minimal access, sometimes using all existing access points, and you can line and repair and restore a system with minimal disruption to somebody's property in a fraction of the time."

Another benefit of the system is being to locate reinstatements easier, due to the material's flexibility. "The material is very flexible, so you can do transitions, 3 to 4 inch, 4 to 6 inch, very easily. And when you're installing the liner, and you're inflating and holding it at its nominal pressure, if there's a branch connecting into it, it'll basically stretch and flex out into that branch line, creating a very visible indentation there. Wherever you would start your reinstatement process, it would be very simple to identify." **I&I**



Camera systems using lateral launch technology have made a big impact on cross-bore detection.

CURBING CROSS-BORE CATASTROPHE

Utilities, municipalities and contractors need to work together to avoid cross-bore disasters

By Sheila Joy

Directional drilling is a fast and efficient way to install underground pipe and conduit, but when a gas line is bored through a sewer lateral, disaster can ensue.

Cross bores — when a line bores through a sewer line — have been the cause of catastrophic events in the past. As a result, utilities, municipalities, contractors and the trenchless industry are joining forces to ensure proper pre- and post-inspections are conducted and disaster is avoided.

“There are always more connections than what surface observation suggests,” says Jason Walborn, business development manager for Professional Pipe Services, or Pro Pipe, headquartered in Mission Viejo, California. “I have seen typical streets that have, for example, eight homes, eight clean-outs and eight green corresponding lateral marks from an 811 call. The reality, however, is that subsurface there are more like 10 sewer laterals. We are doing everything we can to coach facility owners on how to spatially map their subsurface infrastructure during routine maintenance to improve accuracy for 811 locate requests.”

Camera systems using lateral launch technology have made an incredible impact on finding those missing conditions. “We use state-of-the-art lateral launch cameras to locate potential cross bores in the laterals prior to the commencement of drilling,” Walborn says. “Cameras are launched from the main up each lateral to identify and record potential conflicts. The data, including GPS position and time stamp, are captured, recorded and provided to the utility or system owner to address and/or proceed with the drilling. Equally important, however, is the process of post-drill inspection to confirm laterals have not been breached during the installation of the utility.”

While gas or communication lines are typically the utilities most of us think of when we hear the term cross bore, directional drilling of other utilities can negatively impact the integrity of laterals as well. Jerry Weimer of Jerry Weimer Consulting, formerly the wastewater collection supervisor for the city of Cincinnati, wrote the Cross Bore Prevention Detection Program for Cincinnati. He shared how waterlines, installed using directional drilling, compromised laterals during his employment for the city.

“The worst thing that can happen is an operator runs across a cross bore and doesn’t do anything.”

Jerry Weimer

“Those waterlines hit just about every lateral,” Weimer says. “The city started getting calls. One house would back up, then the next, and so on — it was like a game of dominoes. Since the compromised pipes were waterlines, they were not part of the Cross Bore Prevention Program, as no real prevention, detection or standards were in place for installing this type of utility.”

The partnership between utility owners and municipalities is critical if cross-bore events are to be identified and addressed appropriately to keep communities safe. Weimer also shared how the city of Cincinnati and Duke Energy came together to develop a comprehensive and mutually beneficial cross-bore program. “It is rather uncommon for a city and utility to

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work so closely together on cross-bore prevention,” Weimer says. “In this case, both Duke Energy and the city recognized the importance of a comprehensive prevention program, so they shared the costs to get cross-bore inspection work done economically and responsibly. Since the city is under a consent decree to televise a certain number of feet of pipe, it gets the assessment data needed while sharing the cost with Duke Energy. It’s a win-win for the city, the utility and the customers.”

NASSCO, whose mission is to set standards for the assessment, maintenance and rehabilitation of underground infrastructure, identified the need to set standards for proper cross-bore prevention and detection. As a result, NASSCO recently introduced a cross-bore work group to address this topic. Specifically, the work group is developing protocol targeted to operators when cross bores are found during routine sewer inspection and cleaning.

“The worst thing that can happen is an operator runs across a cross bore and doesn’t do anything,” says Weimer, who also serves on NASSCO’s cross-bore work group along with Walborn.

“Our job is to get standard processes in place to support operators in identifying cross bores and provide the proper protocol to report them quickly to protect the public, the operator, the plumbers and the public,” Walborn says. “Awareness is the No. 1 objective of our work group.”

The standard assessment and cleaning of mainlines and lateral lines could also potentially uncover cross bores masked by roots. If a cross bore is hiding behind roots that have infiltrated the pipe and the roots are then cut, disaster could ensue.

“A significant benefit of a regular chemical root control maintenance program is the ability to kill the roots without cutting or damaging the pipe,” says Mike Hogan, president of Duke’s Root Control. “Our product, for example, which has a thick, shaving-cream consistency, is released from a manhole into the main, killing roots in the entire system. The foam compresses pipe surfaces, penetrates cracks, joints and the connecting sewers. Killing roots in laterals using chemical root control assists in identifying and

“There are always more connections than what surface observation suggests.”

Jason Walborn

revealing laterals compromised by cross bores without mistakenly cutting the roots away and breaking through a gas or other utility line.”

In addition to municipalities and utilities working closely together, the relationship between utilities and contractors is extremely important for the implementation of a successful cross-bore program.

Harley Peterson, a project manager with the SoCalGas Sewer Lateral Inspection Program, shares the importance of his relationship with contractors. “We work with a few contractors on our cross-bore program,” he says. “Pro Pipe is the largest contractor and does the majority of the work. We started working with them back in 2011, and the reason our relationship has been so successful is because of our mutual partnership and Pro Pipe’s willingness to adapt to our needs. Pro Pipe has their own fleet of camera trucks and crews, so we never need to wait to get out into the field. They also work with us to identify challenges and develop unique solutions. The result has been better quality data and a higher level of confidence that we are keeping homes and business protected.”

The most common question pertaining to cross-bore inspection and remediation is always who is responsible. The answer: When it comes to keeping our communities safe, we all are. **I&I**

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Arthur Rodrigues, left, foreman, and Lofli Boudchich, laborer, with National Water Main Cleaning, lower CUES CCTV camera equipment into a sewer manhole for pipeline inspection following NASSCO PACP guidelines.



“In examining an entire segment of a system, even where you might not expect to find something wrong, you find things. That’s the beauty of what we are doing here.”

Patrick Cotton



Expecting the Unexpected

Meticulous inspections allow a Northeast utility to stay ahead of the game

STORY Giles Lambertson | PHOTOS Jake Belcher

Groundwater and runoff infiltrating the Shrewsbury, Massachusetts, sewer system is an aggravation. Yet it's also offering an opportunity. In the course of a multiyear examination and rehab of the system, Shrewsbury officials are bringing back the system's designed level of service, thereby opening the way for more customers.

"The town benefits by being able to develop more of the needs areas," says project manager Patrick Yeo, an engineer with Weston & Sampson, a municipal consulting company working closely with Shrewsbury water and sewer officials. "When the hydraulic capacity downstream from the sewer plant is enlarged, developers can open new areas to businesses. We aren't increasing the capacity in the sewer line. We are *restoring* capacity by removing infiltrating water."

Every municipal I&I undertaking is trying to accomplish that, of course — rid the system of unwanted water so that paying customers can use the pipeline. When the community addressed the issue in 2009, the capacity numbers for interceptor lines were discouraging. The average daily flow was 3.8 mgd, which sometimes spiked to more than 10 mgd after a significant rain, or in the spring when snowmelt and rainfall combined to assault the system.

The city averages 48 inches of rain a year — 10 inches above the national average — plus 49 inches of snow, according to local official record-keepers. Where it doesn't raise surface water levels, the precipitation soaks the ground and too much of it ends up in the sewer system through cracks and unsealed joints in the pipeline, thereby crowding out legitimate sewer system capacity.

BITE-SIZED CHUNKS

So, in 2009, sewer and water officials proposed a thorough evaluation of the sewer system through flow metering. "It would be a 12-year program. The whole town was to be broken up into sub-areas and the system carefully monitored and evaluated," says Dan Rowley, superintendent of the Shrewsbury Water and Sewer Division. "Every

Dan Rowley, left, superintendent of the Water and Sewer Division for the Town of Shrewsbury's Department of Public Works, reviews plans with Patrick Cotton, center, team leader with Weston & Sampson, and Patrick Yeo, project manager with Weston & Sampson.



“I would say a lot of communities around here have challenges. Shrewsbury was ahead of the game when the mandate came down.”

Dan Rowley

three years, the town would complete an investigation of a set of sub-areas and spend the next six months or a year making cost-effective repairs to correct the I&I in those areas.”

This long-term systematic approach to remediate infiltration recognizes both the financial and practical implications of overhauling 165 miles of sewer main. The network of pipe is laid on the uneven terrain of a notably hilly community that requires 38 pump and lift stations to keep effluent moving. Furthermore, Shrewsbury was incorporated nearly 300 years ago, in 1727, so the condition of the infrastructure is a factor.

“Actually, the lines are fairly new, most of them dating from the 1960s,” says Rowley. Some of the reinforced concrete pipe of that era still is in use, but a major upgrade of interceptor lines a decade ago replaced the most critical sections of pipe with a PVC product. The town closed its wastewater treatment facility some 40 years ago and sends its wastewater to a regional plant in Westborough.

BENEFITS OF BUDGETING

The financial piece of the comprehensive I&I project is handled by staging the work across a dozen years. Some \$250,000 to \$280,000 is budgeted each year for the investigative work, with \$800,000 to \$1 million set aside every three years for needed repair work discovered in the inspections.

Rowley says the cost of the I&I work is not reflected in a big sewer rate increase coming in 2022. The 27% jump in rates — plus 5% increases in each

**SHREWSBURY (MASSACHUSETTS)
WATER AND SEWER DIVISION**

CUSTOMERS: 9,960

MILES OF SEWER MAIN: 165

LIFT STATIONS/PUMPS: 38

MANHOLES: 4,370

AVERAGE FLOW TO WWTP: 3.4 mgd

PEAK DEMAND: 9 mgd

DEPARTMENT EMPLOYEES: 15 in water and sewer operations

WEBSITE: www.shrewsburyma.gov

of the four following years — is “driven by capital improvements in some of the 38 pump stations and by the fact that costs are constantly going up.” He notes that customers haven’t had a rate increase since 2011, when the quarterly residential base rate of \$30 was set, along with a fee of \$7.50 per 1,000 gallons used.

Public informational meetings and hearings are held and residents for the most part are receptive to the town’s ongoing I&I program and the sewer commission’s rate structure, the superintendent says. Another Weston & Sampson consultant and team leader, Patrick Cotton, credits

Rowley with building and maintaining public support by keeping community residents in the loop about department projects.

“Dan does a great job notifying residents where crews will be working in the town, where construction work is going on or annual spring work,” Cotton says. “If there is going to be any kind of interruption of service, door-to-door notice is given, with something posted on a homeowner’s door one week before it will occur and again 24 hours before it happens.”

The water and sewer department’s website is full of “news flash” announcements and ongoing informational reports. Rowley’s evident concern for the town and its residents is a consequence of his longstanding relationship to the community. While he has only served as superintendent for two years, Rowley has been involved in public work for two decades, much of it in Shrewsbury. He worked in various departments in the community for several years before leaving in 2015 for a superintendent position elsewhere. Four years later, he was asked by Shrewsbury officials to return.

CURRENT REPAIRS

The current contract to perform the inspection and repair work on the sewer system is held by National Water Main Cleaning out of its Massachusetts office. The work entails cleaning lines, camera inspections and trenchless manhole and pipeline rehab work. Weston & Sampson inspects the manholes employing in-house engineers. Yeo says the company closely examines some 200,000 linear feet of pipe and a thousand manholes each three-year cycle. In the current repair phase, an estimated 31,000 linear feet of sewer are being rehabbed and “a lot of manholes” refurbished and resealed. The contractor has its own equipment, and crew members are supervised by the town’s engineering consultants.

Whenever possible, repairs are made by inserting cured-in-place pipe liners running from one manhole to the next one along with the sealing of pipe joints. If a pipe essentially is sound, a bad section is spot-repaired rather than the entire length lined. On average, just 5% of damaged sewer pipe is dug up and replaced. Manholes are pressure cleaned, any active leak grouted, a cement-like liner sprayed on the inside of the chimneys and an epoxy coating sometimes applied as well to ensure ongoing structural integrity.

All of this repair work is somewhat limited by the seasons. There is no excavation work done in streets (except in emergencies) from Dec. 1 to April 1, and any cementing repair work on manholes is deferred in winter months. But trenchless CIPP work and grouting continues year-round.

Jacob Gidade, foreman, National Water Main Cleaning, is applying Mainstay ML-72 cementitious lining (Madewell Products) to sewer manhole walls.



Dan Rowley

SEEKING OUT INFLOW

All of the foregoing activity targets infiltration. However, some outdoor inflow sources have been identified through smoke testing, with incursions from catch basins and driveway drains spotted. Some sump pumps and floor drains also have been identified as culprits. “We have smoke-tested the entire town,” Cotton says. “And occasionally we discover an internal source with the smoke.”

A pilot program to identify inflow was conducted in some neighborhoods because they seemed to be heavier contributors than other

“Budget for it. Try things you can do to anticipate a sewer problem. It’s easier to do a small repair than to deal with a major infrastructure failure.”

LEAVE NO STONE UNTURNED

The beauty of methodically approaching a problem is that everything about the problem is examined. Because no assumptions are made about the problem, there is nothing to preclude a thorough examination. Methodically — that’s how Shrewsbury sewer and water officials chose to confront their I&I challenge. They did so in accordance with state guidelines that lay out procedures for such evaluations.

In 2009, they launched a methodical 12-year inspection of the town system, area by area, carefully examining and evaluating the infrastructure in each area for three years and repairing it the fourth year. Then, they’d move on to examine another area.

“Instead of picking a small part of the system to investigate as representative of the whole, we

chose to inspect every pipe and every manhole, even those installed in recent years,” says Patrick Cotton, a Weston & Sampson consultant working side by side with the town. “You never know. You might have a crushed pipe somewhere that was damaged during a poor installation effort. This is a comprehensive approach with real benefits.”

Cotton calls it a proactive program because it anticipates problems rather than allowing them to develop. “We don’t wait for the sewer line to collapse. We try to find and fix a failing line before it leads to backups in basements. In examining an entire segment of a system, even where you might not expect to find something wrong, you find things. That’s the beauty of what we are doing here.”

Sometimes the discoveries are startling. For example, the contractor performing the inspec-

tions for the town discovered an entire neighborhood not connected to the system. Homes along Fieldstone Drive were developed as a standalone subdivision and septic tanks were installed to serve the residences. In addition, sewer lines and laterals were installed for eventual connection to the town’s sewer system.

However, a second phase of development never occurred. Consequently, the sewer infrastructure carefully placed in the ground to serve the neighborhood was never hooked to the sewer main. “It’s not connected on either end,” Cotton says.

These are the kinds of things you might discover when you methodically explore a sewer system.

Arthur Rodrigues lowers an OZ II camera (CUES) with a crawler into a sewer manhole for pipeline inspection. The current contractor examines some 200,000 linear feet of pipe and a thousand manholes on a three-year cycle.

neighborhoods. “Letters were sent to homeowners in some cases,” Cotton says. “The general approach is to investigate the public side of the system before the private side. Some people know they shouldn’t be doing it, and we will tackle that issue in coming years of the program.”

Shrewsbury isn’t the only town in Massachusetts confronting infiltration, but it is among the leaders in resolving the problem. The state Department of Environmental Protection mandated in 2017 that every community develop and implement an I&I program. Because its total system evaluation began in 2009, Shrewsbury is far ahead of schedule. “I would say a lot of communities around here have challenges,” Rowley says. “Shrewsbury was ahead of the game when the mandate came down.”

He recommends the town’s systematic approach to any town struggling with the problem. “Use the phased approach, the meter flow evaluation and the thorough investigation of a system. Budget for it. Try things you can do to anticipate a sewer problem. It’s easier to do a small repair than to deal with a major infrastructure failure.” **I&I**



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By Craig Mandli



SANITARY DISTRICT FINDS SOLUTION FOR I&I ISSUES

PROBLEM:

The Klamath Falls South Suburban Sanitary District in Oregon includes roughly 10 square miles and serves a population of approximately 25,000 people. It owns and maintains more than 100 miles of sewer pipe and more than 1,000 manholes. Most of the sewer mains were installed in the 1960s and '70s and consist of asbestos cement pipe. Excessive I&I was causing overflows and unnecessarily increasing the treatment plant processing costs. They had been using flowmeters, but these were hard to install, hard to move around and were expensive.

SOLUTION:

The district turned to the use of **SmartCover sewer monitoring** because the deployment was less invasive, as there is no confined-space entry for installation. Also, based on calibration against other flow systems, it delivered accuracy, trend analysis and modeling to hone in on specific I&I issues, especially for a sub-basin.

Result: For the relatively small staff, the SmartCover units helped with better targeting of available resources on addressing real issues of concern regarding I&I. By leveraging them, the district has been able to expand monitoring and enhance the granularity and detail of flow information that they receive. "Monitoring remote locations with SmartCover is key in our efforts to identify and combat I&I," says Mike Fritschi, manager of the Klamath Falls South Suburban Sanitary District. **760-291-1980; www.smartcoversystems.com**

MANHOLE RISERS A FIT FOR LARGE METRO SEWER NETWORK

PROBLEM:

Home to Birmingham, and more than 660,000 residents, Jefferson is Alabama's most populous county, and the sewer network includes 3,600 miles of pipe and 80,000 manholes. That last figure represents a sizable amount of annual maintenance; though manholes themselves are durable infrastructure, they do need to be kept at grade. If they're set low, water collects around the manhole lid causing excessive I&I. If they're set high, they become a traffic hazard jarring vehicle tires, lid and rim continually.

SOLUTION:

Pivoted Turnbuckle Manhole Risers from **American Highway Products** are used by sewer departments all over the United States and are based on a simple concept — tough, galvanized, flexible rings of steel are placed in old manhole rims and expanded with a pivoted turnbuckle (turned by hand with a screwdriver) that exerts thousands of pounds of force. This sets the riser tightly and precisely into old rims, even if they're worn or out of round.

Result: They're quick and easy to install in five to six minutes, according to Brian Champion, Jefferson County Commission sewer construction maintenance supervisor, making them safer for crews due to their relatively light weight and cost-effective compared to jackhammering and manual lifting. And they have a good track record. "We've looked at a lot of other options, and nothing else is made or designed as well as these risers — and quality matters," says Champion. "We keep these in stock and have been using them at least 18 years." **888-272-2397; www.ahp1.com**



MANHOLE INSPECTION FINDS NEARLY 90% OF SYSTEM'S I&I

PROBLEM:

Utica, New York-based Subsurface Utility Imaging, a company dedicated to location and inspection of underground infrastructure assets, was engaged to inspect the pipelines and 300 manholes of a municipal sewer system. CCTV and smoke testing were used for the pipelines, but co-founder Robert Korosec, PLS, needed a better option for the manholes.

SOLUTION:

Korosec and his crew used **Envirosight's CleverScan**, a system that uses automation and photo capture technology to gather high resolution images and 3D point clouds of manholes. "Given the large amount of manholes on this project," says Korosec, "and their poor condition, I felt we had to give it a try." With minimal training, SUI crews were able to put the system to work immediately, inspecting an average of 50 manholes per day and completing the manhole inspection portion of the contract in less than a week.

Result: Of the total project cost, just 40% of the contract was spent on manhole inspection. However, manhole inspection found far more sources of I&I. "The pipelines here were in pretty good shape, and we estimate were only contributing 5% to 10% of total I&I," says Korosec. Manhole inspections identified up to 90% of the I&I sources in this municipal network, allowing the city to prioritize easier manhole repairs and eliminate major sources of I&I. **866-936-8476; www.envirosight.com**



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TOWN FINDS EASY SOLUTION FOR ROOT INTRUSION ISSUES

PROBLEM:

The town of Brandon, Vermont, dealt with continuing root intrusion issues in an 8-inch gravity sewer that originated on Pearl Street, and runs along Maple Street. The route has a couple of Crimson King maple trees that the town considers aesthetically valuable, but have large and far-reaching root structures belowground.

SOLUTION:

RootX was deposited in the manhole at the end of the line on Pearl Street along with about 20 gallons of water. "We treat the line without having to spend about half an hour with the rodding machine and/or 15 minutes with the flusher machine dragged behind the truck," says Stive Cijka, chief operator for the town of Brandon. "We

have 12 river crossings and many are not in a spot to drive a truck up to with a flushing machine, but we can always carry a 40-pound box of RootX to the manhole to treat the line where our machinery cannot reach."

Result: "There are only two of us on the crew to maintain six pump stations, 22 miles of sewer line, and a 700,000 gpd design extended aeration wastewater plant," Cijka says. "Being I am 61 and my assistant is 55, we strive to work smarter not harder. The town manager has allowed us to buy a small pallet of RootX at a time to treat a substantial area, so in approximately 4.5 years we would have treated the whole system once." **800-844-4974; www.rootx.com**



(continued)



EPOXY COATING USED FOR DETERIORATED MANHOLES IN ENVIRONMENTALLY SENSITIVE AREA

PROBLEM:

A project near the city of Coquille, Oregon, required the rehabilitation of 15 badly deteriorated 48-inch diameter manholes located in an environmentally sensitive floodplain. The swampland in the floodplain did not allow for the delivery and utilization of spray equipment.

SOLUTION:

Neopoxy manufactures high-strength, corrosion-resistant sprayable and hand-applied NPR-5300 Series epoxy resins, specifically designed for manhole rehabilitation. Per Neopoxy's recommendation, Michels Pipeline used 3-gallon One-Step Kits of trowelable **epoxy resin NPR-5305**. The kits are easy to use since both parts of the epoxy system are premeasured and preloaded in the same container. Preparing the kit for application requires only an electric drill with a paint blade and a spatula. Using the specified 250-mil thickness, a crew of three hand applied the epoxy.

Result: The project was completed successfully. The coating passed the spark and adhesion tests, and the manholes were back in service within a few days. Through the application of epoxy, the lifespan of the manholes was extended by approximately 50 years. **510-782-1290; www.neopoxy.com**

AFFORDABLE MANHOLE INSPECTION PROGRAM SEES BIG RETURN

PROBLEM:

Greenwood Metropolitan District is a special purpose district in Greenwood County, South Carolina, originally started to provide sewer conveyance and treatment to the area. However, in 1999 GMD took over the collections systems that fed into its trunk lines. What the district received was a patchwork of 38 collections systems, including the city of Greenwood's system, which had pipe and manhole assets in excess of 100 years old.

SOLUTION:

One of GMD's first steps was identifying assets, including mapping manholes using Esri software. This hunt took almost three years, but the final tally showed more than 8,700 manholes, with about 75% of them constructed of brick and mortar. Additionally, a significant number of the manholes were noted to have heavy I&I. Crews completed visual inspections on all manholes using a simple digital video camera. Back at the office, the videos were then uploaded into **ITpipes Web** and coded using a configured template. Since ITpipes fully consumes Esri maps, location data and GIS header info is already attached to the manhole asset, making identification easier and reducing data errors.

Result: By inspecting all 8,700 manholes with this method, GMD was able to build a database in ITpipes Web with a holistic view of its entire sanitary sewer system. This web-based platform allows the district employees to have virtual access to videos and data of not only pipes, but also the manhole structures and the ground surface areas. More than 3,100 manholes had repairs made to help reduce I&I — many of which were simple repairs that made a large impact in reducing overflows during wet-weather events. **877-487-4737; www.itpipes.com**



COMPANY REPLACES RTUS TO HELP KEEP DRIVERS SAFE

PROBLEM:

One key priority for the Michigan Department of Transportation is to enhance the safety of all drivers by preventing freeways from flooding by taking inflows during rain and snowstorms. As part of this project, MDOT decided that 98 stations needed to have the remote telemetry unit replaced to better measure and report the amounts of water being pumped and to keep the roads safe.

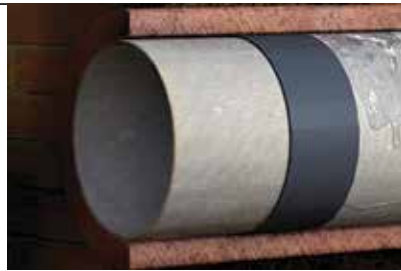
SOLUTION:

PRIMEX built the **RTUs** and delivered them based on the specific timing the general contractor specified, which included shipping five panels per week for a period of 18 weeks. Included in the buildout was integration of the MultiSmart Controller, cell modem, all wiring, relays and time-delay relays to manage the backup float control, phase monitor and emergency stop. As part of its standard testing procedures, PRIMEX configured all the programmable devices per customer preferences so a complete operational panel test could be completed prior to shipment.



Result: PRIMEX updated the pump stations with new technology to ensure that the pumps not only work 24/7, but also continuously monitor all the critical station information to ensure that the pumps are working properly, and if they are not, will immediately notify work crews. The company was able to meet key deadlines while adapting to requests from MDOT and the general contractor as the project continued. **844-477-4639; www.primexcontrols.com**

HYDROPHILIC GASKET SEALING A SOLUTION TO DEFICIENCIES IN CIPP



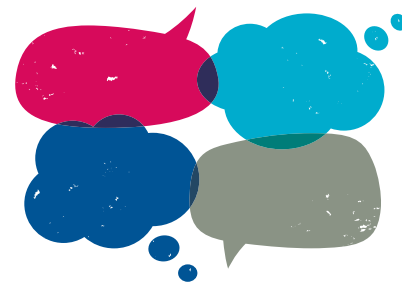
PROBLEM:

CIPP technologies used to rehabilitate the collection system will not eliminate wastewater treatment plant costs associated with I&I without the inclusion of pipe end seals. The city of Naperville, Illinois, used just such a structural lateral connection liner, but was in need of swelling compression gaskets to combat I&I.

SOLUTION:

LMK Technologies hydrophilic end seals offer a watertight solution and eliminates I&I due to the improved technology that has been applied from knowledge of the design flaws discovered with previously used sealing applications. The repair is low profile, and a larger surface area allows for a thorough seal while retaining rings offer stability. Uniform thickness and expansion ensure a high-quality repair, and long-lasting results eliminate maintenance and treatment fees associated with a faulty system.

Result: Until recently, the city had experienced heavy growth. However, as the population rose, the wastewater treated daily actually went down. This, in turn, saved treatment costs such as power, chemicals, labor and other related expenditures tied to daily wastewater treatment. In the city's case, a planned multi-million-dollar plant expansion has also been deferred due to creating more system capacity by sealing the sanitary sewer system. **815-433-1275; www.lmktechnologies.com **I&I****



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A COMMUNITY EFFORT

King County, Washington, dovetails data collection with strong community engagement

By Anthony Drew

In an effort to explore I&I remediation as an alternative to expensive sewer upgrades, King County, Washington, is embarking on a dual-purpose public outreach and data collection program.

The Thornton Creek Basin Sewer Study and Upgrade Project — run by the King County Wastewater Treatment Division — will ensure the 1.2-mile Thornton Creek sewer trunk that serves 9.6 square miles of North Seattle is able to handle its flow during heavy rains and prevent overflows. Whether that is accomplished by I&I remediation, a sewer upgrade or a combination of both remains to be seen.

Since 2005, three overflows have occurred in the Thornton Creek trunk. In addition, portable flowmeters recorded surcharged water levels in 2010 and 2012, upstream of the Thornton Creek trunk junction structure. Overflows and surcharge conditions indicated a need for additional downstream capacity to convey flows.

To kick off the project, King County completed its first community survey last summer, which served two purposes for the utility, according to Marie Fiore, strategic communications coordinator. The first purpose is to engage and educate the public about I&I problems and potential solutions, and the second is to collect data on problem areas where there might be flooding and/or limited stormwater infrastructure that would lead to the installation of basement drains, sump pumps and downspouts connected to the local sewer system.

“We had a tremendous turnout of over 700 responses to the survey,” she says. “We hope to use the survey responses, along with other data collected, to estimate the amount of flow that may be entering the local sewer system through inflow.”

The next phases of the project include field inspections from the fall of 2021 through winter of 2022 (flow monitoring and inspecting sewer pipes, maintenance hole covers and drainage connections); identification of I&I reduction alternatives in the spring of 2022; a second community survey slated for the summer of 2022; and the final identification of preferred I&I reduction methods in the winter of 2023. Together, the study phases aim to help King County identify a sustainable and cost-effective alternative to a major capital investment to the regional sewer system.

The utility is in the beginning phase of identifying I&I sources for the Thornton Creek basin, and additional data is still being collected from local sewer agencies. “Survey responses point to a combination of private property connections to the local sewer system and infiltration due to an aging 50-plus-year-old sewer system servicing the neighborhoods,” says Fiore. “King County is planning a sanitary sewer evaluation study of select local public sewer pipes to better understand the primary sources of I&I, using CCTV, smoke and dye testing to identify sources of inflow.”



Thornton Creek winds through a forested area within the study area near Meadowbrook Pond off of 39th Avenue Northeast in Seattle.

COMMUNITY ENGAGEMENT

As the project continues, King County officials plan to work closely with the community to learn about its needs and priorities for sewer system improvements, offering email updates on project progress. Meanwhile, teams of workers will contact residents in areas determined to have significant I&I to learn more about the sewer in the area, drainage conditions and potential private-side issues.

“The response we’ve received from our engagement efforts has been very encouraging,” says Fiore. “There is a real interest in the work that we are doing, and we want to communicate that we’re working hard to meet regulations, improve resiliency and upgrade vital infrastructure as efficiently as possible. The community expects us to protect public health and the environment. We hold their trust dear to us and we take our mission seriously.”

King County is also making headway with social marketing campaigns to educate the public about lateral pipe maintenance and the ramifications of inflow and infiltration. “A lot of homeowners don’t know or plan for side sewer maintenance, and even more don’t realize that a broken or cracked sewer pipe can add so much additional wastewater strain to the system. Public outreach, an open line of communication and education efforts can go a long way to mitigating I&I issues.”



This map of the Thornton Creek Basin Sewer Study and Upgrade Project shows the study area along with the regional sewer pipelines.

“There is a real interest in the work that we are doing, and we want to communicate that we’re working hard to meet regulations, improve resiliency and upgrade vital infrastructure as efficiently as possible.”

Marie Fiore

MOVING FORWARD

While it’s still in the early stages of the two-year effort, the project has identified flow reduction goals for King County’s 30-year planning horizon. “If it looks like I&I reduction alone won’t meet this goal, we will explore other options like achieving flow reduction goals for a shorter timeframe, and/or looking at alternatives that would combine upsizing of the trunk line with the most limited capacity and I&I reduction projects. The costs and benefits of I&I alternative flow reduction scenarios will later be compared to a traditional pipe capacity increase project alternative.”

Fiore says similar programs could be a good approach for utilities where there isn’t much population growth expected and I&I makes up a significant amount of system flow. “Initial analysis indicated that I&I accounted for over 85% of the 20-year peak flow in 2020. This said, achieving enough I&I reduction to reduce peak storm flows can be difficult, and anticipating how much future I&I projects can reduce these peak flows into the regional sewer system involves a greater amount of risk than a traditional sewer capacity increase project.”

For any utilities looking at a similar program, Fiore emphasized establishing a standard, or methodology, to measure I&I. “We use a 20-year recurrence developed from calibrated hydrologic basin models. Monitor several years of flows and rain gauge data to determine baseline existing I&I, and for comparison with post-rehabilitation monitoring.” **I&I**

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Pipe

- Cured in Place Piping (CIPP), PVC, PVC liners

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