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Fall 2021

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INFLOW & INFILTRATION SOLUTIONS AND EQUIPMENT

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Southern city bundles tasks to improve collection system health

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From Pipe to CAP - Eliminate Inflow & Corrosion

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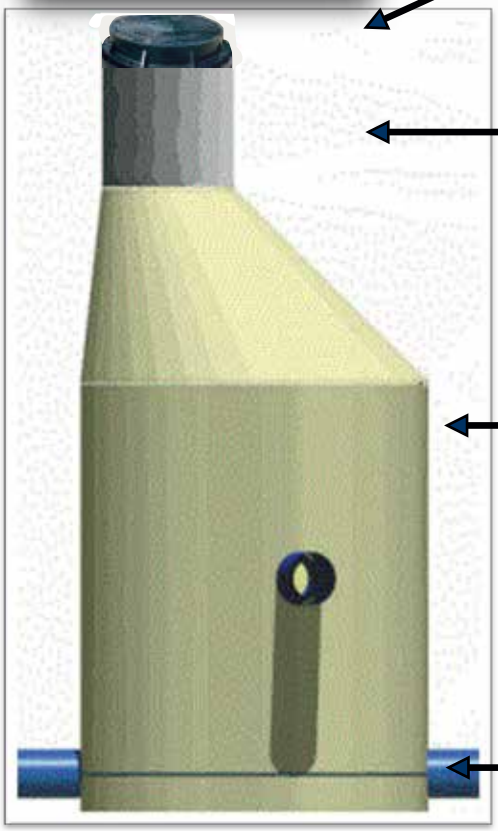

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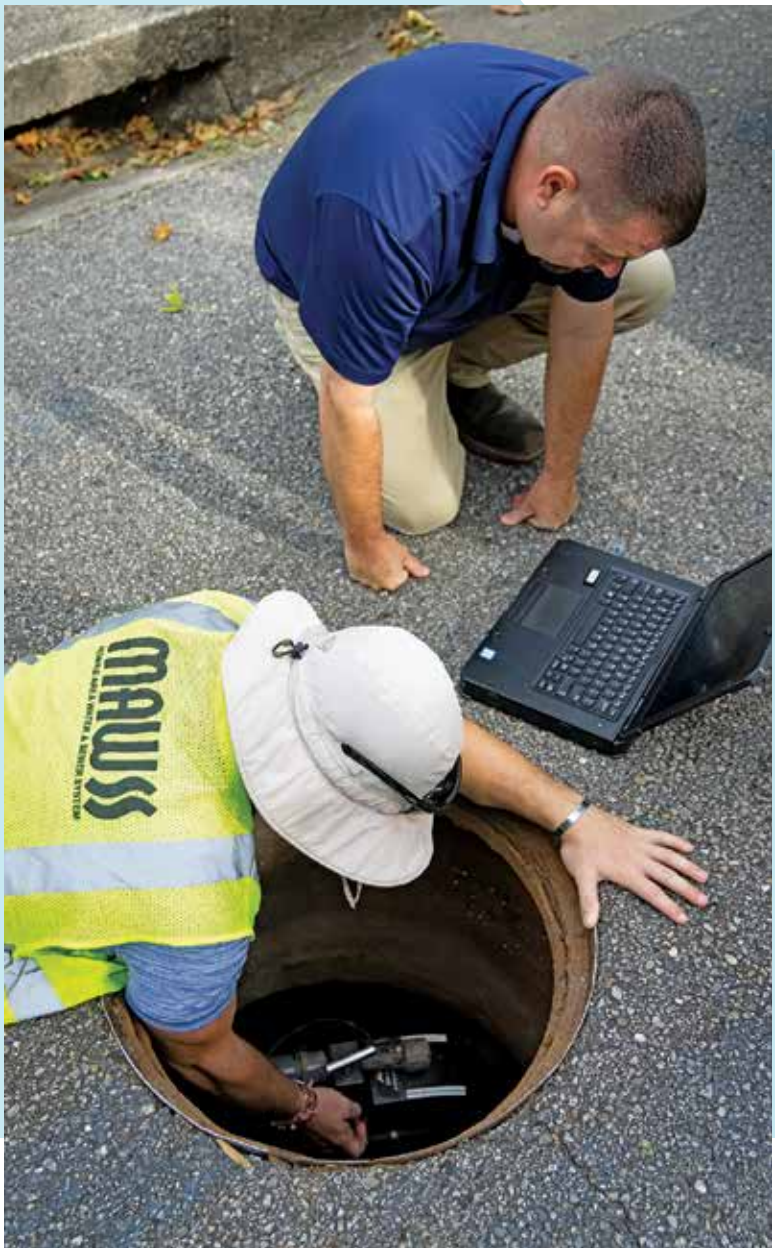
COVER PHOTO: The Mobile (Alabama) Area Water & Sewer System crew has a well-staffed and proactive field investigation department that handles the monitoring and assessment of data coming in from ADS TRITON+ flow monitors around the city. (Photography by Jeff and Meggan Haller)



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A Package Plan

Bundling tasks and methodical approaches helps a southern city reap the benefits of I&I reduction

STORY Suzan Chin-Taylor | **PHOTOS** Jeff & Meggan Haller

Inflow and infiltration itself is anything but consistent and methodical, but if you're going to mitigate it successfully, those are some of the most important qualities your utility can possess.

By incorporating a blend of flow monitoring, a highly systematic approach, robust investigation activities and consistent follow-through to client feedback, the Mobile (Alabama) Area Water and Sewer System has successfully reduced I&I while creating a comprehensive plan to improve overall collection system health and performance that is affordable, sustainable and scalable.

MAWSS serves a population of approximately 200,000 citizens, which equates to approximately 90,000 customer accounts throughout the metropolitan area of Mobile. Established through a legislative act in the early 1950s, the utility is responsible for delivering water and sanitary services — along with wastewater treatment at two centralized plants and three decentralized plants —

OPPOSITE: The Mobile Area Water and Sewer System team includes, from left, Donald Seltzer, John Connelly, Robert Johnson, Matt Welch (public service supervisor I), Charles Benning, Calressia Clark (director of field operations and logistics), Jordan Brown, Joseph Tuite (public service supervisor II), Dominick Pettway, Rico Thomas, and Jason Saxon.

PROJECT SHOWCASE

Jordan Brown (left) and Matt Welch perform maintenance on a TRITON+ flow monitor (ADS Environmental Services).

which collectively process approximately 40 mgd. The sanitary collection system is comprised of 1,246 miles of gravity sewer, 28,859 manholes, 99,200 service laterals and 233 miles of force mains.

The utility has established a robust inflow and infiltration remediation program through its in-house staff of 13 dedicated employees to finding sources of I&I, 13 lift station employees, 10 video investigation employees, 27 sewer repair employees and six construction inspectors. It also has the help of an outside consulting engineer for larger capital projects. All maintenance, inspection, smoke testing and flow monitoring is handled internally. The department has benefited from an extraordinarily strong customer response and service approach. Through its preventive maintenance program and customer response teams, much of the information it has been able to derive regarding the health of its system has come from its field and video investigative teams.

Although some of the work MAWSS does do is reactive — to be expected in a city of this size — the department does have a well-staffed and progressive, proactive investigation department that operates three CUES-equipped CCTV mainline video and lateral-launching trucks out in the field daily. In addition to its regularly scheduled CCTV inspections and rotations, this field investigation department also handles the monitoring and assessment of data. This comes in from 75 ADS TRITON+ flow monitors and 20 Mission Communications rain gauges positioned in pivotal areas of the city.

MAWSS also has a smoke testing team, which prior to the COVID-19 pandemic was performing smoke testing daily. "We were able to resume our smoke testing, which was really good news," says Calressia Clark, director of field operations and logistics for MAWSS. "We know private laterals do contribute to I&I, and smoke testing is an excellent way for us to pinpoint the exact location and get our customers involved in helping us to stop I&I and overflows through the use of the Private Lateral Program."

MAWSS performs private lateral investigations and will repair issues in these laterals on the public side. To be proactive, the utility also sends notifications to property owners.

The intention is to get information out to the public, alerting them when there are plumbing issues on their property that need to be repaired. Using Infor as the asset management and work order system, in conjunction with ArcView GIS from Esri, allows the utility to input, analyze and carefully monitor all data. This enables Clark to develop projects for the department while determining whether they can use internal annual contracts for repair or pass the project on to consultants for design, bid and build projects.

BETTER USE OF DATA

When Clark joined the utility in 2007, there were 67 flow monitors in the system. Although data was being collected, not much was being done with it to determine next steps for system maintenance. As the years progressed, it was decided that MAWSS needed to expand and add some other investigative techniques to better understand the sources of I&I. The department launched a smoke-testing program that included a private lateral program and — analyzing the data from smoke testing, manhole inspections, CCTV inspections and flow monitoring — it was able to more accurately compare dry versus wet weather flows. This enabled it to prioritize problem areas, which are typically 75,000 to 150,000 feet of isolated areas upstream of the flow monitors. Clark and her team were now better equipped to pinpoint areas to address within each of the system's basins.

"I'm pushing trenchless rehab so hard because you can do so much more with so much less."

Calressia Clark

Calressia Clark, director of field operations and logistics

MOBILE AREA WATER & SEWER SYSTEM

LOCATION: Mobile, Alabama

DEPARTMENT: Field Operations and Logistics

EMPLOYEES: 129

POPULATION SERVED: 200,000

CUSTOMER ACCOUNTS: 90,000

SYSTEM: 1,246 miles of gravity sewer, 233 miles of force mains, 28,859 manholes, 99,200 service laterals, 4 SWATs, 40 mgd via treatment plants

WEBSITE: www.mawss.com

WORKING INWARD

When Clark puts together a rehab project, she approaches it in a very systematic way, beginning work upstream of the prioritized monitoring areas in an effort to repair/rehabilitate the issues that smoke testing has revealed. Everything within that section of the basin will be rehabilitated to seal the system. This includes the mains, manholes and laterals, all in one comprehensive project.

"The best way to deal with I&I issues is, if you can't replace it all, rehab it all, and try to get the system sealed as much as possible," says Clark. Bundling the projects in each basin and taking care of all the assets within it prevents the potential of groundwater migrating and entering through another unsealed area of the system. Rehabbing all the elements together also provides MAWSS with great economy of scale, while ensuring less disruption to the community.

The biggest benefit is the knowledge that when the project is complete, the team has pretty much taken care of any possible I&I issues for that area for the foreseeable future.

As a case in point, there was an area along the Dog River just south of Interstate 10 where a basin was being influenced by tidal aspects of the river. Even after the sewer main had been rehabilitated using CIPP, the utility continued to experience system overflows after rain events, as well as when the area experienced a high tide, due to leaky laterals.

"It's so easy to get sidetracked off your I&I issues, because you often run into structural issues in your system that have to be repaired now, while I&I only appears to be a problem when it's raining."

Calressia Clark

BLD Services was the contractor awarded to work with MAWSS on this project. They quickly discovered that during a normal tide in the area, there still was too much water coming in to allow for CIPP installations. They had to find workarounds to deal with Mother Nature on some of the repairs. MAWSS had the option of using well-point dewatering/replacement for the project, but was reluctant due to the added cost.

BLD's team discussed the option of holding off on rehabilitating these lines until the winter, hoping that cold fronts with strong north winds could blow the water out of the Dog River and surrounding waterways. This would effectively lower the tide and reduce the infiltration entering the service laterals, allowing time for CIPP rehab work. The winter waiting worked, and over the course of a few years — with seasonal timing — the laterals in the Dog River area were rehabbed and overflows were reduced.

ACCOUNTABILITY TRACKING

For every project, Clark and her team perform accountability tracking to determine how successful the rehab and remediation of I&I has been. Flow monitoring has been especially helpful in auditing how well a rehab project has performed in any given area.

Although inflow is much more difficult to remove from a system than infiltration, Clark has been able to glean valuable insight from monitor data collected during rain events. She found that when an area in the system recovers quickly after a rain event, the utility's approach of working from the upstream in to seal all parts of the system is more effective — the gain in the amount of I&I mitigation is greater and faster.

Robert Johnson uses a GPS by Leica Geosystems to plot some of the 28,859 total manholes included in the department's system.

MITIGATING SSOs DURING SEVERE WEATHER

To prevent SSOs in the collection system and decrease surcharging at the wastewater treatment plants during heavy wet-weather events, the Mobile Area Water and Sewer System elected to install several Severe Weather Attenuation Tanks (SWATs) and Basins (SWABS). These stormwater retention vessels are situated adjacent to lift stations at critical locations throughout the city's seven sewer drainage basins.

Because Mobile experiences above average annual rainfall, the purpose of the SWAT/SWABs is to hold extraneous stormwater during wet-weather events, storing the water somewhere until it can be systematically released back into the trunk lines and conveyed to the wastewater treatment plants for processing.

Once flow levels in sewer lines within the collection system become elevated, the wastewater overflows into a lift station and is automatically pumped into the SWAT/SWABs. When flow levels in the trunk mains decrease, the retained water will be released back into the collection system where it can continue on its way to a predetermined point in the respective area of the collection system.

This process will continue, as soon as possible, until the tanks/basins are completely drained in preparation for the next rain event. The addition of the SWATs to the system has served the utility well in helping to mitigate SSOs during severe weather events.

Another thing the utility has learned while working to mitigate I&I is that correlation doesn't equal causation when it comes to wet-weather events. After one line overflowed during a wet-weather event, Clark noticed a nearby manhole was still overflowing long after the rain had stopped the following day. She began to question if the issue was truly related to the wet-weather event, or if it was some other cause. These are the types of things that Clark and her team are now beginning to examine more closely. They're focusing on doing the extra work to determine the true sources of infiltration to prevent spending resources chasing flawed assumptions.

THE RIGHT MIX OF FIX

MAWSS has found that utilizing traditional felt-and-resin CIPP trenchless rehabilitation from a variety of manufacturers such as BLD Services and LMK Technologies for mains and laterals has been most advantageous. Trenchless technology in many forms has great benefits for an older city such as Mobile, since replacement-type projects require extensive and cost-prohibitive restoration to comply with the latest regulations in the right-of-way of restoration from sidewalk to sidewalk.

"I'm pushing trenchless rehab so hard because you can do so much more with so much less," says Clark. For its manhole rehabilitations, MAWSS has been using a combination of cementitious or spray-applied polyurethane solutions from manufacturers like Sprayroq, StrongLite and Quadex.

STAYING THE COURSE

The old figurative question "How do you eat an elephant?" is answered: "One bite at a time." That's exactly the approach Clark has taken. With MAWSS' board continuing to fund improvements, Clark is staying dedicated to the cause. MAWSS has been able to reduce I&I, but she admits it is not always easy.

"It's so easy to get sidetracked off your I&I issues, because you often run into structural issues in your system that have to be repaired now, while I&I only appears to be a problem when it's raining. It's like that 'If a tree falls in the forest and nobody hears it, did it really make a sound?' scenario," Clark says.

For her and her team, what is buried is always in the forefront. Fortunately, management shares the dedication and vision for reducing I&I, and budgets operation and maintenance funding between $800,000 and $1 million each year to address the I&I investigative effort alone. This cost does not include initiating new technology integrations and putting together projects that can really make a difference now, and for generations to come. With operations and maintenance, annual contracts and capital projects costs, MAWSS spends approximately $6 million per year. I&I

Charles Benning is one of many Field Operations and Logistics employees dedicated to the department's vigorous inflow and infiltration remediation program.

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205-957-0020 | www.sprayroq.com

By Craig Mandli

ROOT PROBLEM ELIMINATED ON LAKESIDE EASEMENT

PROBLEM:

A neighborhood in Liberty, Missouri, had a heavily root-bound easement. Access was difficult, as the 1,280-foot line traveled across the backyards of houses situated on a lake. The line was laid unevenly, which gave roots more opportunity to invade. There were continual blockages, with several houses experiencing backups. The municipality put the easement on a saw, cut and flush routine program, conducted twice a year. However, they were called out for emergencies in between the maintenance visits as well, as there were constant problems.

SOLUTION:

Duke's Root Control applied **RazorRooter II** to the entire easement. The hose released and sprayed the foam in all directions, allowing it to adhere to roots and penetrate through wye connections to kill roots without harming trees or other aboveground vegetation.

Result: "A few months after the foam was applied in January, we ran our CCTV through the pipe, and the roots had decayed, like you see cigarette ashes crumble," says Gary Harter, operations manager for the City of Liberty. "Our camera made it right through the pipe. We haven't had any blockages since. This has saved our city a tremendous amount on time lost, wages and expenses. We can rededicate the time we were spending to different areas of the town."

800-447-6687; www.dukes.com

ADJUSTABLE RISERS KEEP MANHOLES AT GRADE

PROBLEM:

With a population of 66,000, St. Charles is Missouri's ninth-largest city and was the state's capital from 1821 to 1826. "We have old and new areas, which means we have a lot of odd-sized sewer structures," says Cory Rackley, lead equipment operator. "Adjustable risers make it much easier to raise all these differently sized manholes to grade."

SOLUTION:

Since 2008, Rackley has been using **Pivoted Turnbuckle Adjustable Manhole Risers,** made by **American Highway Products,** to raise manholes precisely to grade without excavation, significant traffic closures, or the need for equipment to lift and set heavy concrete rings. The riser is a sturdy, flexible, galvanized ring made with steel that uses a turnbuckle to adjust riser diameter. Installation is simple and fast; one man sets the riser in the original utility rims and uses a screwdriver as a lever to expand it to fit. Since the turnbuckle leverage applies thousands of pounds of force, the riser seats in the rim tightly, providing a new rim for the manhole with no rattling or looseness. When installed properly, Rackley has never seen one fail.

Result: At-grade risers are better for roads in many ways. They don't set low, so water doesn't collect around the manhole lid causing excessive infiltration; and they don't set high, so vehicle tires don't jar the lid and rim continually. And since risers are usually set just before paving runs, the newly raised manhole is surrounded by new, contiguous pavement, and that prevents water and freeze-thaw damage in the pavement around the manhole.

888-272-2397; www.ahp1.com

MUNICIPALITY PUTS ACCURACY OF AREA-VELOCITY METERS TO THE TEST

PROBLEM:

A moderately sized U.S. Northwest utility had limited budgets for measuring I&I. They had learned of lower-cost depth-only monitors that might be used for this purpose, but were unsure of their performance accuracy. They had previously been using industry-standard area-velocity meters. While A/V meters had always proved to be accurate, they could be more than twice as expensive as DOMs. The difference between A/V meters and DOMs is that the former measures flow (volume) through both depth and velocity measurements while DOM singularly measures flow depth-only and rely on Manning's equation or other algorithms for determining velocity. These algorithms required estimations of multiple variables influencing the velocity calculation.

SOLUTION:

The utility did a comparative study of the two technologies, co-locating A/V and DOMs. Data was collected for a month under a variety of weather conditions. Large variances were found in all locations, including a "false negative" where the DOM's calculated value indicated a flow decrease when the A/V meter measured a two-fold flow increase. An additional false positive indicated an eightfold increase when, in fact, A/V meters measured only a 40% increase.

Result: The utility decided to continue using **A/V meters** from **ADS Environmental Services** for their accuracy and reliability. They determined that while A/V meters were initially more expensive for I&I study, there was significantly greater risk should they use the questionable DOM data to make much more expensive capital improvement project investment decisions.

800-633-7246; www.adsenv.com

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SUPERIOR 5-E ELECTRIC SMOKE BLOWER FINDS FAULTS, ODORS, LEAKS AND INFLOW

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732-251-0800; www.superiorsignal.com/ii5

FAILING STREAM CROSSING SAVED WITH TRENCHLESS POINT REPAIR

PROBLEM:

An Atlanta suburb was experiencing severe infiltration from a failing corrugated culvert, installed years before as a stream crossing. The exposed 8-inch culvert was used as a sewer line between two manholes and a retaining wall was built directly on top of it. Rusting over the years caused a couple of dime-sized holes, allowing stream water to pour directly in. Traditional dig-and-replace methods required bypassing both the sewer and the stream to prevent sedimentation, in addition to demolishing and relocating the retaining wall. Contractor quotes were $90,000 and up, and would have required occupying adjacent homeowners' yards for days with equipment and debris.

SOLUTION:

EnviroWaste Services Group's Atlanta branch installed an 8-inch by 8-foot **trenchless point repair,** manufactured by **Infrastructure Repair Systems.** The repair was accomplished in a single, partial day from above the manholes with only foot traffic through homeowners' properties. No bypassing of the sewer line or stream was required. EnviroWaste's installation of the repair kit not only sealed the pipe from infiltration, but also created new structural capacity for the existing pipe.

Result: By utilizing the kit, EnviroWaste Services Group was able to repair the culvert for less than one-tenth of the cost of dig-and-replace methods. The infiltration was eliminated and the county avoided potential SSOs with virtually no stress for surrounding homeowners.

727-327-4216; www.irsi.net

(continued)

DRAIN TOOLS CLEAN SOLID CEMENT THAT POURED THROUGH RESIDENTIAL SEWER LINES

PROBLEM:

Over 30 homeowners from North Winnipeg, Manitoba, were shocked when cement poured through their pipes. The city hired a contractor to grout a sewer trunk shaft when the combined sewer was breached. The grout entered the residential sewer lines, and damage was caused in their basements, bathrooms, bedrooms, living rooms and backyards. Residents were faced with anywhere from 4 inches to 4 feet of wet cement, and the residential lines were then blocked with the cement.

SOLUTION:

After calling many plumbing companies in the area who were not up for the challenge, Aloha Drain Services was called to inspect the incident. They were armed with the right tools and got to work removing the cement. Using **Internal Pipe Technologies' Gator Drain Tools,** they were successfully able to clear out the lines. They opened each pipe that was filled with solid cement grout using Gator Claw Heads and Reinstators. The lines were anywhere from 4 inches in diameter, then transitioned to 6 inches.

Result: Aloha Drain Services successfully cleared out the sewer lines of 30 houses. The Gator Claw Heads lasted for 750 feet of dry cement without wearing out. Because of the ruggedness and durability of the heads, homeowners could have a fully operating drain system without replacing the lines. For the service lines that required full repair, Aloha Drain Services lined the whole pipe from the main clean-out to the city connection with IPT CIPP liners with 4- to 6-inch transitions.

888-478-6649; www.internalpipetech.com

SEWER BLOCKAGE DETECTION USING ULTRASONIC LEVEL SENSORS AND DATA LOGGERS

PROBLEM:

A large East Coast metropolitan sewer district was looking for ways to help maintain its 68,000-mile sewer network and reduce problems associated with pipe blockages. With more than 15 million people generating over 1.2 billion gallons of wastewater each day, the sewer district was spending an average of $25.5 million every year clearing 75,000 blockages from its sewers — unclogging five house blockages and removing 33 tons of material from just one of its sewage works every day.

SOLUTION:

Last year, 3,700 **SonicSens 3** ultrasonic level sensors from **Fluid Conservation Systems** were installed and 5,000 more will be installed over the next year to help monitor the network through Sewer Depth Monitoring. SonicSens 3 uses ultrasonic technology to measure the level of wastewater in a chamber, information which can provide an early warning of blockages within the network. The sensor is installed within the chamber but avoids contact with the sewer contents, so the devices require less maintenance. SonicSens 3 was paired with Intelligens WW, a flexible data logger with the versatility to be tailored for a variety of specific user needs, for efficient data transfer.

Result: The sewer district now has an effective early warning system for sewer blockages. Should levels in a monitored area rise, the devices will alert the district to a developing problem within the network, helping to avoid flooding and pollution damage caused by blockage incidents. This is especially important as population growth and more extreme weather patterns put additional stress on sewer networks.

800-531-5465; www.fluidconservation.com

(continued)

SANITARY SEWER SYSTEM UPDATED WITH REMOTE MONITORING CAPABILITIES

PROBLEM:

The Minneapolis Public Works Department needed to modernize the sanitary sewer system to meet the city government's goals. Minneapolis had nine sanitary lift stations and 23 storm sewer pump stations spread throughout the city. None of the stations had remote monitoring capabilities, and the Public Works Department wanted to add this capability.

SOLUTION:

PRIMEX was chosen as the prime contractor to retrofit the existing stations by adding **remote monitoring capabilities.** The mandate was to develop and install a complete SCADA system that included the addition of digital cell routers on the Verizon network to improve monitoring. The upgraded system also incorporated a local computer memory at each site, ensuring that if for any reason the cell connection was down, the data would not be lost. The local Wonderware Edge graphical operator interface has native capabilities to both store and forward all data. When the Verizon communications are lost, the local OIT logs data to memory. Upon restoration of cellular communications, all of the historical information is backfilled into the historian so that there are no blackouts in data. This redundancy feature is the first of its kind and was successfully implemented for the city.

Result: The sanitary sewer system is now able to meet the department's goals. Remote monitoring was added to all systems and helped improve its data analytics and enhance its ability to more effectively manage both storm sewers and sanitary sewers.

844-477-4639; www.primexcontrols.com

CAMERA HELPS COMPANY REUSE EXISTING LINE

PROBLEM:

A company in Merritt, British Columbia, was awarded a job in Monck Park and called the professionals at Canadian Septic to install a new septic system. The existing gravity lines to the tanks were old, and they ran over 500 feet and through forested areas.

SOLUTION:

A technician from Canadian Septic used the **Wi-Fi Inspection Camera Reel** from **Hathorn.** They ended up having to go to one of the furthest restroom facilities in the park. There, the camera was put into the clean-out. Using the camera head from above ground in the woods, they traced and located the physical location where the clean-outs were, from inside the line.

Result: Canadian Septic was able to identify that there were no bellies present in the line. The camera allowed them to reuse the existing 4-inch gravity line. Hathorn's Wi-Fi Inspection Reel was the best tool for this inspection because of its durability, ruggedness and reliability. The camera allowed the company to save photos and videos directly to a phone, saving time and money when preparing reports for customers.

905-604-7040; www.hathorncorp.com

SCANNING TECHNOLOGY INDICATES RECENTLY REPLACED PIPE TO BLAME FOR I&I ISSUES

PROBLEM:

A Texas utility had dug up and replaced a length of pipe three years ago and, in recent investigations, found that the new construction pipe was one of the top 10 biggest contributors to its I&I.

SOLUTION:

The utility performed a pilot study on approximately 5,000 linear feet of pipe using **Electro Scan's FELL Technology** per ASTM Standard F2550 to certify watertightness of the pipes and effectiveness of various dig-and-replace projects within the municipality. The municipality also wanted to scan various plastic pipe materials to see if there was a difference in replacement effectiveness. Each line was also installed by a different contractor and was part of a different project.

Result: The survey indicated a potential leakage rate of approximately 100 gpm across five of the pipes that were scanned, with most defects found being leaking lateral connections and some sagging pipe sections. There were no CCTV callouts post replacement. The inspection gave the utility the information it needed to evaluate the effectiveness of the replacement projects with quantifiable data rather than interpreting a visual inspection. It was found that different pipe materials and different contractors did not change the outcome that the pipe sections leaked regardless of who did the install or what material was used. Electro Scan can be used to effectively evaluate rehabilitation and replacement projects, allowing municipalities to ensure they are investing in successful long-term repairs to their collections systems.
800-975-6149; www.electroscan.com

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

PROBLEM:

Utica, New York-based Subsurface Utility Imaging (SUI) — 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, and their poor condition, I felt we had to give it a try," Korosec says.

Result: 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. 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," Korosec says. 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 I&I

Eastern Pipe Services uses a Perma-Main Top Gun F-24 inversion machine by Perma-Liner for its main lining projects.

THE TRIUMPH OF TRENCHLESS

East coast pipe liner says traditional excavation's days are numbered

By Traci Browne

Business has been good for Eastern Pipe Services. As the name suggests, they do trenchless pipe lining and repair, video inspection, pipe vacuum and cleaning services covering the entire New England region.

While a lot of the company's inspection and lining repair work comes from area municipalities, it sees an influx of commercial property customers catching on to cured-in-place pipe repair for I&I issues of their own. Whether it is a big town project or a commercial job, the reasons for going with CIPP are similar — reduce costs and minimize disruption.

The benefits to lining are similar for both types of customers, but the process is a bit different for the contractor. Many municipalities separate pipe repair and remediation into two buckets for the bidding process: The inspection and cleaning of the lines, and then the actual repair and replacement work.

Mark Thompson, manager of operations for Eastern Pipe Services, says it's not unusual to have one vendor win the bid for the inspection, and another for the repairs. It is also common to have an engineer, hired by the city, making the final determination on the method of repair.

When commercial customers are battling with an I&I issue, Thompson says his company is more likely to be involved in the entire process from performing the inspection to the completing the repair work. Eastern's expert advice on how to fix the issue is welcomed by the customer.

> **"No one wants to go dig up Main Street. A trenchless solution requires very little police detail, no traffic diversion, and no repaving. It is cheaper and faster."**
>
> Mark Thompson

SHARING THE GOOD NEWS

When Weeks Medical Center in Lancaster, New Hampshire had I&I problems, it turned to Eastern Pipe Services for advice. I&I repairs are a big deal for commercial properties. Thompson says these customers often think they're looking at an $80,000 to $100,000 repair that will tear up their floors or parking lots for days. Instead, he has the honor of giving them the excellent news that Eastern can do lining without disrupting their business. On top of that, the repairs are just half the cost of trenching, depending on the size and length of the pipe.

That's a tremendous relief for commercial businesses that stand to lose thousands in daily revenue — if not tens of thousands, as is often the case for a hospital like Weeks — should they have to shut down for an extended period.

THE DECLINE OF EXCAVATION

It's benefits like these that make Thompson think we will eventually see the end of excavation for most repair work. Not only for sewer repairs, but repairs on water pipes as well. Compared to 10 or 15 years ago, pipe lining has become more advanced and much easier to work with. Back then, trenchless repair usually involved a rigid plastic liner that came on an enormous reel. That liner needed to be heated up and then pulled through the pipe. Today, the materials are far more advanced and rugged, and the installation process is much faster. The robotics used for reinstatements have much improved as well.

The substantial cost benefits are not only realized by commercial properties. Municipalities are taking advantage of the lower costs along with other significant benefits.

"No one wants to go dig up Main Street," says Thompson. "A trenchless solution requires very little police detail, no traffic diversion and no repaving. It is cheaper and faster."

When excavating, you can typically repair or replace about 200 feet of pipe a day, according to Thompson. His crews can manage 600 to 1,000 feet in the same amount of time.

Thompson says that, of course, there are times when drainage or sewers have to be replaced, such as when there are elevation issues. In those instances, you have no choice but to go in and dig up streets and disrupt traffic.

"But if we're talking about existing trenches, whether it's drainage or sewerage, we are finding that most municipalities are now trying to use the CIPP process."

A SAFER ALTERNATIVE

Lining is far less intrusive to the surrounding environment as well. Thompson used old asbestos pipes as an example. No one wants to remove

A culvert before (left) and after a CIPP lining job by Eastern Pipe Services.

and replace an asbestos pipe. For one, you don't want crews having to deal with hazardous materials. On top of that, you don't want the aggravation of having to dispose of it. By lining that asbestos pipe, there is far less danger to the crew and little or no negative impact on the surrounding soil.

Then there are areas that Thompson says you simply don't want to be digging in, whether that's due to the propensity for sinkholes to form or dealing with tricky substrates.

In fact, any time you're excavating, there are risks involved. From an employee standpoint, lining is a safer process because you eliminate the confined space element that comes with excavating. Thompson says the company no longer has to figure confined space training into the bidding process.

"There's always underground obstacles. You could accidentally hit a fiber optic cable or a gas line. I don't know how many times we've seen an excavator hit the main waterline. Now you have no water until it's repaired, and residents are boiling their water," says Thompson. "All that is off the table when you're doing trenchless."

For all these reasons and more, Thompson says the industry trend is moving toward lining when there is an existing pipe.

PROBLEMS ARE RARE

As far as horror stories where jobs went wrong with lining, or where the company discovered troublesome issues, Thompson drew a blank. "It's the same job over and over. Things rarely go wrong."

However, he did remember a couple of instances where a defect in the liner caused problems for him. But in both those situations, the manufacturer made things right. And that's about as exciting as it gets in the world of CIPP, which is a good thing.

For residential work, Eastern Pipe Services is a certified installer of Perma-Liner Industries. For anything larger than 8 inches in diameter, Eastern uses Manufactured Technologies Corp., formerly known as Mississippi Textiles.

As the trend moves toward lining, Thompson has some advice for excavation laborers who are interested in working toward a career in CIPP repair. "If I were hiring someone, we look for people that know how to lay pipe, know what a waterline and sewer line is and have excellent work ethics. If I saw that you've been working for the same construction company for years, then we would take you and teach you a whole different trade. And you know, when I say it's a different trade, it's a completely different animal than anything you will have done."

In March of this year, Eastern Pipe Services became part of the Wind River Environmental group. Wind River provides services in 16 states along the East coast. I&I

Workers install the PRO-RING manhole and catch basin grade adjustment system (Cretex Specialty Products) on top of a repaired manhole cone.

Manhole repair sites can be opened, repaired and closed in one day, reducing overall costs from 20% to 30%, based on conditions.

A LONG-TERM SEAL

An expanded polypropylene grade adjustment system withstands the test of time in Beloit, Wisconsin

By Lee Haessig

In undertaking any rehabilitation project, the hope is that you and your crew won't be back at that job site again anytime soon. That's why it's important to choose a solution that can withstand the test of time.

In the early winter of 2009, Cretex Specialty Products of Waukesha, Wisconsin, was looking for field test sites for a new product that was ready to be introduced to the underground construction market. That new product was the PRO-RING manhole and catch basin grade adjustment system.

The PRO-RING is the world's first and only grade adjustment system made from expanded polypropylene — the same engineered polymer used in the automotive industry since the 1980s. This high strength, lightweight plastic is a suitable material to replace traditional construction methods, which use concrete grade rings, mortar and other masonry materials to adjust manhole frames to their final elevations.

FINDING A TEST SITE

Since the PRO-RING is engineered and designed to be watertight, a location with frame-chimney leakage was desired for the field test. A Cretex Specialty Products regional sales manager inquired to cities around Southeast Wisconsin looking for a location for the test installation.

As luck would have it, a manhole that would put the PRO-RING's watertightness to the test was located on Crist Road in Beloit, Wisconsin. This manhole was selected because it was in an area with an underground aquifer and had a significant leak. The leakage was estimated to be between 35 and 50 gpm and had been contributing a significant amount of clear water into the sanitary sewer collection system for years.

BENEFITS OF THE SYSTEM

The PRO-RING system was of significant interest to the city of Beloit due to the many benefits offered. The system is faster than traditional methods, with one worker being able to install the entire PRO-RING system in just minutes. The rings nest together, are easily sealed, and fit to within a quarter of an inch of finished grade. The system is safe, as it doesn't use heavy concrete rings, which minimizes injury risk and helps reduce comp claims and down time. The PRO-RING weighs 95% less than concrete rings and stands up well to physical abuse.

The PRO-RING system speeds up manhole installation and repair time, making it more cost effective. Manhole repair sites can be opened, repaired and closed in one day, reducing overall costs from 20% to 30%, based on conditions. No water, sand, mortar or bricks are needed — just a few simple tools.

PROJECT DETAILS

On Dec. 17, 2009, a local excavation contractor hired by the city to assist arrived on site along with representatives from Cretex Specialty Products and city staff. Once traffic control was in place, the area around the manhole was excavated to expose the manhole frame and leaking concrete grade rings. As the excavation progressed, the amount of groundwater present required that two submersible pumps be positioned to keep the water level below the top of the manhole cone.

Once the water level was controlled, the manhole frame and cover were removed along with the existing 20 inches of concrete grade rings to expose the top of the precast manhole cone.

Since the manhole was off road in turf, the amount of adjustment required was the same as what was removed — 20 inches. Three 6-inch grade rings and a 2-inch finish ring were required to achieve the total adjustment.

Because the top of the existing manhole cone had some damage and did not provide a uniform flat bearing surface, the top of the manhole cone was repaired using a non-shrink, high-strength repair mortar. Once the repair mortar had set up, the first grade ring was ready to be installed.

Following the installation procedures that had been developed for the PRO-RING, the recommended M-1 structural adhesive/sealant was applied

LEFT: Manhole at the field test site in Beloit prior to repair, showing significate leakage into the sanitary sewer collection system. RIGHT: A 2020 inspection of the Beloit PRO-RING installation showed no signs of any leakage or deterioration after 11 years.

to the first grade ring, and then it was placed onto the top of the manhole cone.

After the first grade ring was installed, the remaining rings were installed using the M-1 adhesive. The manhole frame and cover were then positioned on top of the finish ring using the M-1 adhesive. Once complete, the pumps were removed, and the excavation was immediately backfilled, taking care to not displace the ring stack or manhole frame and cover.

THE RESULTS

Since the original installation of the PRO-RING at this test location in 2009, representatives of Cretex Specialty Products have been inspecting the site and documenting the results. From the first post installation inspection performed in 2010, to the most recent inspection completed in the fall of 2020, the PRO-RING product is showing no sign of any leakage or deterioration after 11 years.

ABOUT THE AUTHOR: *Lee Haessig is the regional sales manager at Cretex Specialty Products. He can be reached at lhaessig@cretexseals.com.* I&I

PRIORITIZE SAFE DIGGING

Trench accidents can happen when proper safety precautions aren't taken, regardless of the crew's experience

By David Dow

In April 2021, a Long Island contracting company was ordered to cease all excavating operations and pay $136,000 in penalties, the result of a trench collapse accident that killed two workmen in late 2020.

The resulting agreement also commits the company to do the following:

- Develop an excavation safety checklist to identify hazards and protective measures for work in excavations and ensure that a competent person on site will consult and complete the checklist whenever employees enter excavations.
- Engage a qualified professional safety and health consultant to conduct at least one on-site assessment of excavation safety while employees are performing work in an excavation.
- Provide companywide training on ladder safety and hard hat use to its employees.

Safety precautions shouldn't only be driven by punishment or trying to avoid OSHA violations. Protecting your employees, and yourself, should always be a top priority. Don't make extra effort for only a few weeks after being reminded about a tragic accident like this. Systemic, lasting change is the only way to prevent these trench collapses from happening. Don't wait until after an accident to put safety procedures and training schedules in place.

If you've done this sort of work for many years, you may hear these stories about people dying in trenches and think, "That's someone else. I've been doing this a long time. I can tell when it's dangerous." But unfortunately, these accidents can happen to anyone and the training is not something anyone — no matter how experienced — should ignore.

The General Requirements Section of OSHA's Subpart P provides a number of commonsense steps to help ensure worker safety. As with any OSHA Standard or other safety procedure, it is important to always remember that these are the minimum requirements to ensure safe job sites.

SURFACE ENCUMBRANCES

To ensure stability and integrity, they need to be removed or supported while an excavation is open. Examples include rocks, trees, telephone and utility poles, fire hydrants, etc.

UNDERGROUND INSTALLATIONS

Examples include gas, electrical, water, sewer lines, etc. They must be:

- Located and marked before beginning work. Property owners and/or utility companies should be notified at least 24 hours prior to digging, unless a longer time is required by local law. Some states require 72 hours advance notice. Most other states require 48 hours' notice.
- Protected, supported or removed while the trench is open

Most states have so-called 811 one-call laws. Simply dial 811 to contact the one-call center in your state.

This site shows an example of unsafe excavation practices: The worker is in the trench without shoring and standing directly beneath the excavator as it operates.

ACCESS AND EGRESS

These are fancy words for entering and exiting a trench. These are the requirements:

- In trenches that are 4 feet or more in depth, provide a means of access and egress (exit).
- Spacing between ladders, stairs or ramps should not be more than 50 feet.
- No worker should have to travel more than 25 feet laterally to reach a means of egress.
- Ladders must be secured and extend 36 inches above the landing.

In addition, it is important to use wood or fiberglass ladders where there is a possibility of electric shock. Many utility companies and contractors always use wood or fiberglass ladders to ensure there is never a problem.

A "competent person" must design all structural ramps used solely by employees. Further, a competent person qualified in structural design must design all structural ramps used for equipment. Usually, this person will be a registered professional engineer.

Finally, the components used in structural ramps must be connected, be of uniform thickness, be constructed so that cleats and other connectors do not create a tripping hazard, and if ramps are used instead of steps, they must be provided with cleats or other surface treatments to prevent slipping.

EMERGENCY RESCUE EQUIPMENT

Such equipment must be available when a hazardous atmosphere exists or could reasonably be expected to exist. Employees entering confined spaces must be properly trained. Harnesses and lifelines are required whenever employees enter bell-bottom pier holes and other deep confined spaces. Lifelines must be attended at all times.

WATER ACCUMULATION

Water must be controlled to prevent cave-ins. Methods for controlling water vary with each situation. Employees are not permitted to work in trenches where accumulation exists unless:

- Special support systems or shields are used to protect employees from cave-ins.
- Water removal equipment is used and monitored by the competent person to prevent water accumulation.
- Safety harnesses and lifelines are used to protect employees.

Surface water must be diverted or controlled. The competent person must inspect the trench after each rainstorm.

STABILITY OF ADJACENT STRUCTURES

The objective is to protect employees from cave-ins.

- A support system, such as shoring, bracing or underpinning, must be used to support structures that may be unstable due to excavation operations.
- Excavating below the base or footing of a foundation or wall is not permitted unless:
  — A support system is provided to ensure the stability of the structure.
  — The excavation is in stable rock. (This is very rare.)
  — The operation is approved by a registered professional engineer.
- Support systems must be provided for sidewalks, pavements and other structures that may be affected by excavation operations.

Understanding the difference between shoring columns and trench boxes is crucial.

Shoring is designed to pressurize the trench wall and take away its ability to lean or cave in. Trench boxes are designed to be strong enough to take on the collapsing soil. So while a trench box is designed to simply hold back any soil that does collapse, shoring is meant to prevent a collapse in the first place.

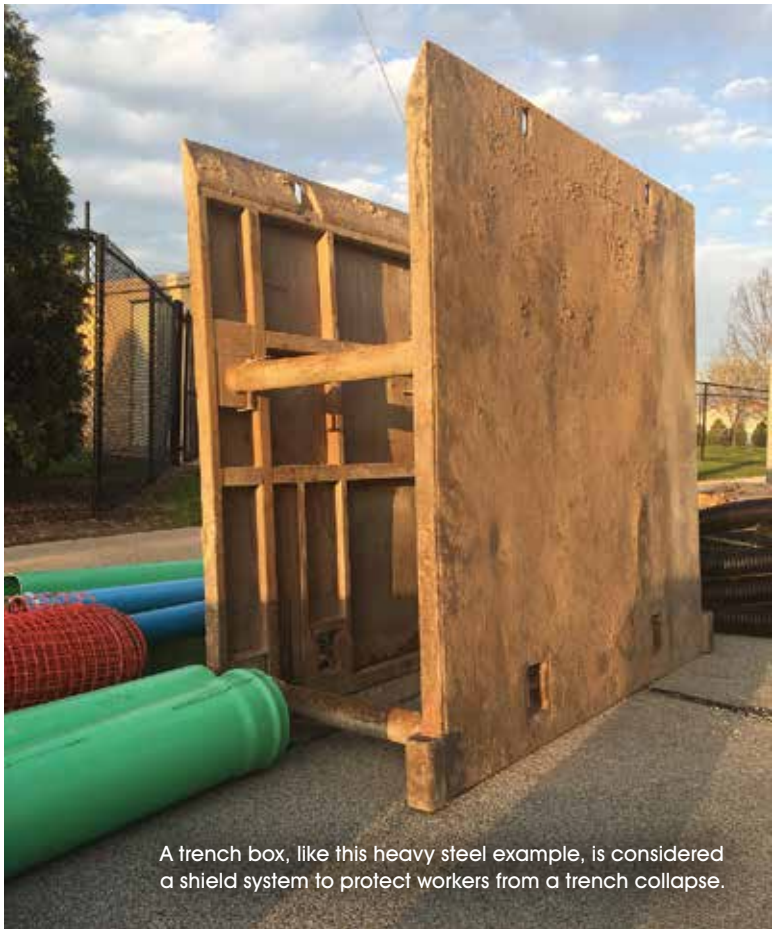
Shoring functions via a principle called an "arch effect." Basically, at the point where the shoring contacts the soil, it compresses outward in an arching pattern. So from point of contact, there is a dome of protection in the arch wall, the size of which depends on soil type.

This means you must know the maximum allowable separation between each column of shoring, which is to say how far apart horizontally two shoring bars may be placed. Manufacturers must provide those distances for each soil type.

The manufacturer specifications, or "tabulated data," also tell users when plywood is required with shoring. While it's generally not needed due to the arch effect, sometimes it will be required to prevent minor collapses from the arch wall surface soil.

Due to the relatively complex nature of shoring devices, it can be tempting to use only trench boxes, but you could be asking for trouble. Even though they're strong enough to take the collapse, they can be less convenient and less versatile depending on the situational factors of a given trench. If laterals or other utilities are a factor in digging the trench, it could limit the space for a bulky metal box.

Another factor is that different types of boxes have varying weight limits. Depth is the main factor here — weaker aluminum boxes, while often easier to maneuver, cannot be used past a certain depth because it cannot hold the weight of all the soil that could potentially cave in. Even the sturdiest steel construction boxes have limits, though they are in most cases deeper than any realistic trench.


A trench box, like this heavy steel example, is considered a shield system to protect workers from a trench collapse.

Boxes are also required to be stacked up to the top of the trench, so multiple boxes may be needed, which is a lot to haul or maneuver to and around a job site.

PROTECTION OF EMPLOYEES FROM LOOSE ROCK OR SOIL

Employees must be protected from being struck by soil or rocks that are falling or rolling from the edge and face of a trench. Spoils and equipment must be set back at least 2 feet from the edge of a trench.

FALL PROTECTION

It is required that walkways and bridges be provided over trenches that are least 6 feet above lower levels and are greater than 30 inches wide. Bridges and walkways must be equipped with standard guardrails and toe boards. Additional fall protection may also be required.

INSPECTIONS

A competent person must make all inspections.

The fact of the matter is that preventing trench collapses is not always a simple endeavor. OSHA regulations attempt to simplify it as much as possible, but if it were a piece of cake, workers wouldn't be dying.

Stocking collapse prevention devices and following trench safety procedures to the letter may be a hassle, but supervisors at all levels don't have the luxury of cutting corners — or fieldworkers will be those who pay, possibly with their lives.

Editor's note: Kim Peterson and Jared Raney contributed to this story. I&I

DRIVEN BY DATA

A South Carolina district puts heavy emphasis on monitoring and data in its fight against I&I

By Giles Lambertson

Taylors Fire and Sewer District relies on cumulative, accurate data from flow monitors like this Hach FL901 to determine its I&I mitigation strategies.

Fighting inflow and infiltration is a never-ending challenge, but that doesn't mean it's a hopeless endeavor. Taylors (South Carolina) Fire and Sewer District officials pin their hopes on data — lots and lots of data. The data-driven approach is identifying problem areas, saving money and improving the integrity of the sewer system.

Taylors Fire and Sewer is a special-purpose district in Northeast South Carolina and principally serves the unincorporated Taylors area and surrounding county properties. It is solely a satellite collection system, delivering wastewater from more than 11,000 customers to a nearby, independently operated sewer treatment plant. The fire protection component is a separate division of the district.

Because it's a satellite system, the district is subject to external pressures. Interaction with adjacent collection systems can spark disputes about I&I sources. Overlaying jurisdictions periodically make noises about taking over the district. These tensions slowed the district's I&I efforts that began 15 years ago.

But a half-dozen years ago, district Director Samantha Babb, her supervisors, crew and a technical adviser began to mitigate stormwater and groundwater infiltration in earnest. It happened after they implemented a comprehensive data-driven program that focuses on the performance and condition of the sewer infrastructure across the district.

MINI-SYSTEM ASSESSMENT

In its painstaking collection of data, the district meticulously assesses the performance of an individual line and the condition of the line. Only after that information is cataloged and evaluated is a specific course of action decided upon to rehabilitate the line. Federal, state and internal standards are used in evaluating the functionality of each tributary.

To systematize data collection, the sewer district was divided into nine mini-systems, or sub-basins, that flow into the treatment plant. In each mini-system, determining the performance of feeder lines can involve as many as 60 different operational and maintenance criteria. That's a lot of detailed information.

"When we complete an assessment, we can discuss with an engineering group the exact condition of a mini-system and its tributaries," Babb says.

The district has completed assessments of six of the nine mini-systems. A 10th sub-basin is comprised of pass-through lines and residential septic tank systems.

A look at District Mini-System No. 3 (MS-3) illustrates the level of scrutiny involved. The sub-basin was originally scheduled for evaluation next July, but a wet-weather study by an outside environmental consulting firm identified MS-3 as the biggest offender in the service area. So, its evaluation was moved up to January of this year.

MS-3 is comprised of 889 acres within the overall district and contains more than 400 developed parcels of land, including residences and restaurants, slightly fewer than 14 miles of pipe and 367 manholes. As in every case, the process of assessing the performance of the mini-system was carefully documented. Its history was noted, objectives of the assessment stipulated, data collection procedures and dates spelled out, profiles of three recorded rainfall events recorded, and so on.

All in all, the performance assessment of MS-3 consumed 94 workdays. It would be followed by an assessment of the mini-system's infrastructure and, ultimately, consideration of how best to rehab the sub-basin to reduce groundwater and stormwater infiltration.

District officials say nothing "super critical" was uncovered during the MS-3 performance assessment, though significant infiltration of water into the sub-basin from an external source was discovered. An old industrial wastewater treatment plant in another district is suspected as the likely source. However, finding the point of infiltration and having the adjacent district correct the issues are problematic.

All of this preliminary evaluation and documentation in each mini-system obviously is time-consuming. Aside from data, there really is nothing to show for it. Yet, like the footings and foundation of a house, the cumulative data is what a tighter, more efficient collection system is built upon.

> **"Figuring out the magnitude and identity of the I&I is about half the effort. Once you've identified it, then it's about prioritizing the problem and selecting the most cost-effective solutions."**
>
> Samantha Babb

Babb was asked if gathering I&I information is harder work than fixing the problem. "It's about 50-50," the director says. "Figuring out the magnitude and identity of the I&I is about half the effort. Once you've identified it, then it's about prioritizing the problem and selecting the most cost-effective solutions. It lets you focus on where the real problem is, which saves money and time."

ENSURING ACCURACY

The district uses flowmeters by both Hach and ADS Environmental Services, along with a portable flow test stand built by the utility's technical consultant with assistance from TRI Environmental. The stand ensures its flowmeters are working properly and validates their accuracy. The portable stand can be carried to a field site on a trailer so district officials can replicate conditions below ground and evaluate performance.

The stand includes a length of PVC pipe with access ports cut into it, a holding tank, a generator, an electric pump and a flow control gate valve. A known flow rate is achieved in the test-stand pipe using a calibrated-flow rotameter. The test-stand gpm flow is compared to the gpm flow reading in

Ray Childs (left) and Trent Bowles install a Hach FL901 Flow Logger in a manhole.

the below-ground collection pipe. "The improved precision and accuracy using the test stand has proven very beneficial in accurately determining inflow and infiltration volumes," Babb says.

Flowmeters in the system are of two kinds. The first are meters that communicate via cellular network receivers, which are used in major tributaries in the system. The district is required to monitor the flow of its collection system as part of an intergovernment agreement.

Besides area/velocity flowmeters, level recorders can be inserted in key locations to document flow levels at a particular point of interest. "They give you a quick 24-hour assessment. We generally put them in place and leave them for a week, Monday to Monday," Babb says.

AN AGING SEWER NETWORK

Taylors Fire and Sewer District reached a point of unsustainable I&I the same way any collection system does: Its 147 tributaries or feeder lines were getting older, and not enough attention was paid to maintaining them. The area's natural springs are also a factor in the situation. "We have a number of natural springs nearby," Babb says, "that can contribute to I&I in older pipes if they are not well maintained."

The mostly clay pipe network was laid primarily in the late 1960s, which makes many of the pipes more than 50 years old. Not until 2015 or so did the district — under the direction of Babb — begin to systematically address I&I in its 134 miles of pipe. "We had some previous consultants and contractors, but we determined they weren't doing what was best for Taylors. So, we have

> **"Let the numbers tell you where the problems are. Otherwise, you're just throwing money into the dark."**
>
> Samantha Babb

our hands on it now, doing it in-house," says the director. As for the fruit of the data-driven approach? The current number of sanitary sewer overflows is 0.76 events per 100 miles of pipe.

TAKING INITIATIVE

Because an estimated 70% of I&I occurs on private property, part of the solution to invasive water is working with homeowners and commercial property owners. When an issue is spotted — a broken pipe, tree roots — owners of the property are made aware of the problem. Babb says the vast majority of those contacted by the district end up working to resolve an issue, which says something positive about the district's relationship with its customers.

District budgeting to battle I&I varies from year to year. Some $1.4 million has been set aside in the upcoming budget. Almost as important as the money, however, are the initiatives the Taylors Fire and Sewer District takes to get its money's worth.

Babb and colleagues have a successful strategy going to I&I mitigation, and it begins with doing the necessary work to get accurate information about what's happening inside the pipes. Collecting large amounts of data may not be an especially satisfying task day after day, but when the numbers are totaled up, they tell the story. "Let the numbers tell you where the problems are. Otherwise, you're just throwing money into the dark," Babb says.

Babb also emphasizes to trust the instruments. Properly calibrated and monitored meters — positioned at the optimum points in a pipe to catch the full flow — dependably record what is happening out of sight, day and night. "Let them tell you where to go to correct the problems." I&I

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