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Supplement to:
MUNICIPAL SEWER & WATER

I&I

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Island community's innovative approach cuts unwanted flow

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Large-scale manhole rehab in Iowa

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A CURE FOR UNNECESSARY TREATMENT

There's no single solution to inflow and infiltration, but the right approach will help reduce the load

By Luke Laggis, Editor

Welcome to *I&I – Inflow & Infiltration Solutions and Equipment*. It's the premiere issue of the magazine, and a serious issue for your utilities.

Inflow and infiltration cause significant problems, furthering degradation of infrastructure, contributing to sewer overflows, and increasing flow to treatment plants, all of which come at a high cost. Preventive maintenance and rehabilitation can be expensive, but proactive utilities can save millions in the long run by taking the necessary steps to keep I&I out of their collections systems.

This magazine features projects, technical columns, case studies and how-to stories demonstrating the tools, technology and approaches utilities are using to improve their systems.

One of the stories in this issue, "A Comprehensive Approach," reveals some startling facts about the severity and impact of I&I. They should make everyone in the public sector stand up and take notice.

One study cited in the story shows only 30 percent of flow to treatment plants is sewage. Another shows that in the state of Tennessee, I&I represents approximately 1.4 billion gallons of flow to treatment plants per year. I won't go too far into the rest of the story, but I'd like to take a few of its numbers a little bit further.

The EPA estimates it costs utilities somewhere between $2 and $5 per thousand gallons to treat that excess flow.

In a fairly unscientific manner of illustrating this point, let's assume all 50 states absorb roughly the same volume of I&I as the largely rural state of Tennessee — some are certainly lower, and some no doubt considerably higher.

If we multiply that volume by the high end of the EPA's estimated cost for treatment, we see an overall volume of approximately 70 billion gallons, representing roughly $350 million in unnecessary treatment costs. And that's $350 million per year. Year after year. Plus the cost of treatment plant upgrades that may not be necessary if not for all that excess flow.

Eliminating that I&I and reallocating the funds required for treatment wouldn't solve the nation's wastewater infrastructure problems, but it would make a big difference. We're currently throwing that money away without solving the problem, and all the while the cost of making those necessary infrastructure improvements is growing.

Some I&I is inevitable, but there are much better alternatives to just accepting the problem and treating every gallon of water that flows into porous collections systems. We're highlighting those alternatives with this magazine.

Some I&I is inevitable, but there are much better alternatives to just accepting the problem and treating every gallon of water that flows into porous collections systems.

This first quarterly issue of *I&I* focuses on manholes. The next will cover pipes, followed by inspection and monitoring. All four themes are critical pieces of the puzzle, and we hope to address them in a way that gives you a better picture of how to approach the problem.

If you want to talk about I&I, tell me your story, or share what's worked for your utility, you can get in touch any time. I'd be happy to hear from you.

Thanks for checking out the new magazine. I&I

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A COMPREHENSIVE APPROACH

Work smarter against inflow and infiltration with better infrastructure intelligence

By Venay Sehgal Bhatia

Finding and removing excessive inflow and infiltration isn't easy, and it's not cheap. With shrinking budgets and continued deterioration of aging infrastructure, there are compelling reasons to support a proactive and intelligent approach to combating I&I.

Municipalities often decide to focus their financial resources "in the ground" (i.e. rehabilitation) instead of into planning and investigating. Yet, an analysis-driven strategy can dramatically increase the amount of I&I resolved for a given budget.

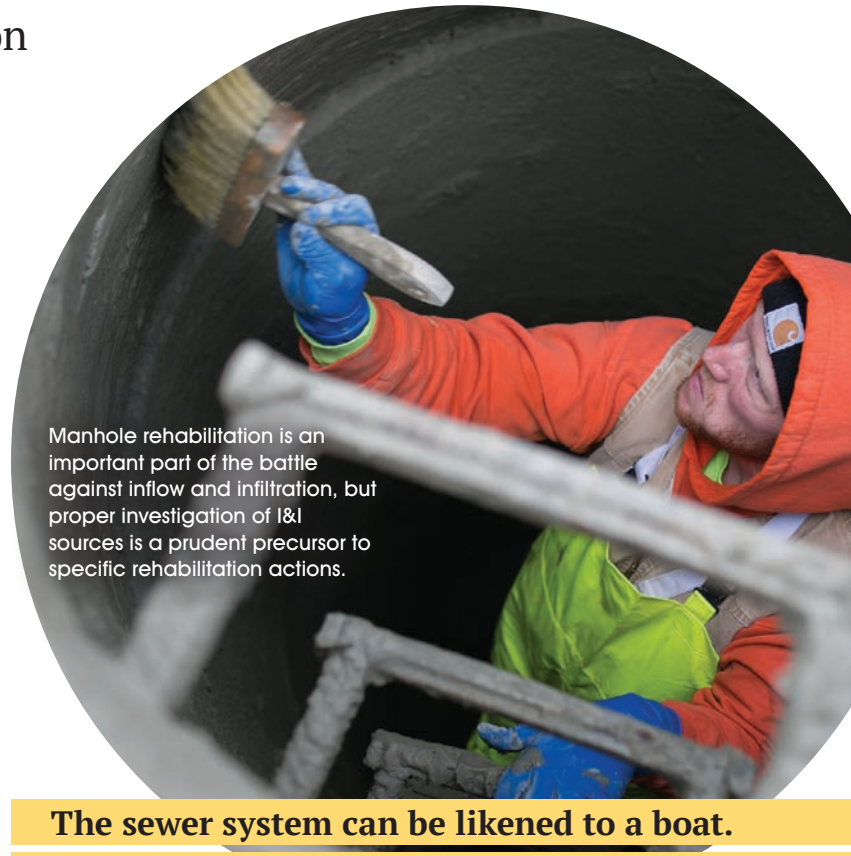
FINANCIAL IMPACT

A recent study of all municipal sewer systems in the state of Tennessee showed that I&I represents approximately 104.6 billion gallons per year. This amount accounts for 45 percent of the annual flow to treatment plants. Processing this extra water is estimated to cost at least $188 million annually statewide. This figure is conservative compared to the Environmental Protection Agency's recommendation in 2014 for using an operations and maintenance rate of $2 to $5 per 1,000 gallons — resulting in a cost estimate between $208 million and $522 million.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges into the waterways of the U.S. and setting wastewater standards for the industry. The cost of consent decree penalties can surpass the cost of establishing a comprehensive inspection program.

In 2012, Memphis, Tennessee, was cited for violations against the CWA. The EPA entered into a consent decree with the city requiring them to pay a total of $1.29 million in civil penalties to resolve the CWA violations. In some cases, the EPA can waive these fines if municipalities demonstrate that they have a strategy in place to address I&I. In either case, the failure to address I&I can have catastrophic environmental and financial implications.

Flow monitoring can be used as a tool in condition assessment to identify and prioritize areas for further inspection to quantify the severity of I&I problems.



Manhole rehabilitation is an important part of the battle against inflow and infiltration, but proper investigation of I&I sources is a prudent precursor to specific rehabilitation actions.

The sewer system can be likened to a boat. If only some of the leaks are fixed, the boat will still sink. Likewise, groundwater doesn't discriminate where it enters the system.

IMPACT ON CAPACITY

In 1999, publicly owned wastewater treatment plants served 189.7 million people and treated 32.1 billion gpd. Today, that number is higher. The quality of our water sources depends on the capacity of wastewater treatment plants and ensuring that extraneous water entering the system is minimized. This extraneous water includes water entering the system through I&I.

According to an article published by the Chalmers University of Technology's Division of Water Environment Technology, 35 percent of flow entering wastewater treatment plants comes from I&I, another 35 percent is stormwater, and the remaining 30 percent is sewage. In other words, 70 percent of total flow into treatment facilities is water that wouldn't need treatment had it not entered a sewer line. It robs valuable capacity from treatment plants, and such capacity shortfalls can lead to damaging and costly sanitary sewer overflows.

TOTAL SYSTEM APPROACH

As early as 1981, the EPA documented problems with sewer rehabilita-

tion programs. Reducing I&I through rehabilitation was often found to be ineffective because of inadequate system knowledge and the arbitrary application of fixes. When rehabilitating indiscriminately, municipalities run the risk of fixing what's not broken. In the long run, this approach may be strategically catastrophic. A more effective, data-driven approach must be implemented to combat I&I.

Rehabilitation shouldn't focus solely on sewer mains, but also on laterals, manholes, and the connections between these structures. A study of several municipalities suggests that I&I reductions of just 10 to 30 percent are achieved when solely rehabilitating pipes. When pipes are rehabilitated, infiltration simply finds a new path into the sewer by migrating through service laterals and manholes. The same study suggests that when high-priority areas are targeted for a combination of main, lateral and manhole rehabilitation, municipalities can realize I&I reductions of up to 50 to 65 percent. The sewer system can be likened to a boat. If only some of the leaks are fixed, the boat will still sink. Likewise, groundwater doesn't discriminate where it enters the system.

When creating a strategy to address I&I, significant emphasis should be placed on detecting I&I and preparing corrective rehabilitation actions. George Kurz, P.E., DEE, introduces the concept of a total system approach in his paper, "Sewer Renewal — A Strategic Plan" as part of the EPA's Capacity, Management, Operations, and Maintenance (CMOM) Program. Kurz points out that accurate flow monitoring, visual inspection and interpretation are essential for success. Kurz researched 31 project areas that included 126 miles of lining — and associated laterals and manholes — in Nashville and Brentwood, Tennessee. Pre- and post-flow monitoring showed that more than 50 percent of the annual I&I and peak I&I was eliminated when the total system approach was implemented.

LOCATE AND IDENTIFY

Flow monitoring is usually one of the first steps taken to better understand the problem areas within a collections system. Electronic velocity and depth recording devices, or flowmeters, are strategically placed throughout the collections system. Flow monitoring studies generally last from 60 to 120 days, and compare wastewater flow in the system with a baseline flow estimate to determine the amount of I&I in the sewer system.

Flow monitoring can be used as a tool in condition assessment to identify and prioritize areas for further inspection to quantify the severity of I&I

A crew prepares to launch an Envirosight camera and crawler. Video inspection can pinpoint I&I sources after flow monitoring has established the most heavily impacted sections of your system.

Traditional CCTV isn't the only means of sewer inspection. The Sewer Line Rapid Assessment Tool (SL-RAT) from InfoSense uses active acoustics to provide a quick view of pipe conditions.

MOVING BEYOND TRADITIONAL VIDEO INSPECTION

If the number, size and type of defects observed by video inspection do not appear to justify the volume of I&I identified in the flow monitoring, further investigation may be needed. In these situations, employing other technologies can help identify previously undetected defects.

- ***Sewer Scanning Evaluation Technology*** is an alternative technology to CCTV that removes the responsibility of rating the structural integrity of the sewer from the camera operator and gives it to the engineer. The 360-degree visual scan enables the entire surface of the pipe to be observed in flat view, giving the engineer the capability to measure the opening of joints and cracks as well as pinpoint telltale staining and deposits.
- ***Electrical leak location*** identifies pipe defects by measuring the electrical resistance of the pipe wall. Most sewer pipes are electrical insulators and will have high resistance to electrical currents. A defect in the pipe that leaks water will also leak electrical current, whether or not water infiltration is visually apparent at the time of the test.
- ***Acoustic, or sonar, detection*** is increasingly being used to find leaks. Acoustic sensors use measuring devices to detect vibrations and sound waves emitted by defects and leaks. The sensors can be stopped during the inspection and pulled back and forth to reinspect a section of pipe or confirm a reading. This process provides utilities with real-time verification of potential problems.

problems. Once target areas have been identified, municipalities should further inspect using a sewer crawler to detect the I&I culprits.

Segments of the sewer system should never be designated for pipe lining or rehabilitation without completing a video inspection first. A comprehensive approach to locating defects involves inspecting all aspects of a collections system, including manholes, sewer mains and laterals.

- **Manholes —**The EPA estimates that there are about 20 million manholes in the U.S. — one manhole for every 400 feet of pavement. Many of these manholes are seriously decayed or in need of immediate rehabilitation or replacement. Manholes generate a disproportionate amount of I&I and play a unique role in the structural integrity of roadways. Field inspectors should evaluate the manhole lid, frame condition and the frame connection for any defects or leak sources.

After manually inspecting the manhole cover, the field inspector can employ a manhole inspection camera or a zoom survey (pole) camera to inspect within the manhole. A manhole inspection camera captures visual and dimensional data, and presents the operator with deliverables such as a flat scan with detailed image data covering every inch of the manhole wall, a dense point cloud for 3-D visualization of the manhole structure, and a virtual view inside the manhole. A zoom camera uses a video camera mounted on a telescopic pole, making inspection inside the manhole possible. During inspection the operator should document all cracks and deficiencies found and make a decision about whether findings are a source of I&I.

- **Sewer main —** Groundwater seeps into sewer pipes through cracks, leaky joints and other defects. A CCTV inspection is by far the most detailed method of pinpointing and characterizing I&I in pipelines. An operator watching the footage can stop to study any observed defect. The video can identify cracks, fractures or breaks, root intrusions, leaking water (usually infiltration from groundwater), and general deterioration. CCTV inspection can determine the specific location and cause of infiltration. Furthermore, CCTV inspection can be very economical when compared to other I&I inspection methods because it is accurate in pinpointing infiltration sources without requiring other inspection methods.

As early as 1981, the EPA documented problems with sewer rehabilitation programs. Reducing I&I through rehabilitation was often found to be ineffective because of inadequate system knowledge and the arbitrary application of fixes.

- **Laterals —** Solely inspecting and rehabilitating sewer mains is not enough when addressing I&I. Service laterals are often culprits of heavy I&I, particularly where a lateral connects to the sewer main. Careful inspection of private laterals can help identify sources of I&I. One study reports that when service laterals are renewed following sewer lining, an additional reduction of 20 to 25 percent of I&I is expected.

MAKE AN IMPACT

With deteriorating sewer systems and increasing need for capacity, mitigating I&I is essential. The city of Brentwood implemented a comprehensive program to address I&I that resulted in positive financial and environmental results. Brentwood rehabilitated 21 percent of its sewage collections system after carefully studying the location of pipe defects and I&I entry points. Rehabilitation efforts have resulted in an approximate reduction of 713.3 million gallons of I&I per year, or 42 percent. Additionally, the city is saving approximately $1.3 million each year.

By implementing a total system approach of inspecting for sources of I&I and then planning rehabilitation efforts accordingly, municipalities can achieve a significant reduction of I&I. Once municipalities identify I&I problem areas, they can create a plan to address the defects found in a comprehensive manner, thereby adding to their success rate.

Only after a thorough understanding of the sewer system is achieved can a prioritized set of improvements be planned, designed and constructed. In this way, visual inspection tools are imperative to the success of minimizing I&I.

Venay Sehgal Bhatia is the digital marketing manager for Envirosight. I&I

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“Every manhole is different. It’s almost like you’re a doctor and every patient has something different ... You’ve really got to know about the solutions that are out there before you can even offer a recommendation ...”

Brad Steenhoek

Brad Steenhoek, owner of Iowa-based Save Our Sewers, cleans up the last bit of loose material around a manhole before raising it back up to grade.

PROJECT SHOWCASE

Setting the Standard

Iowa contractor employs a variety of methods to help utilities rehabilitate manholes and eliminate infiltration

STORY Kyle Rogers | **PHOTOS** Scott Morgan

Perhaps no municipality has taken greater advantage of Brad Steenhoek's expertise in manhole rehabilitation than Ames, Iowa. In the last two years alone, Steenhoek's company, Save Our Sewers, has rehabbed more than 1,000 manholes in the city.

"We've done close to $5 million worth of work for Ames in that time," he says.

And within that scope of work, Steenhoek has employed his full arsenal of manhole rehab products and methods — everything from the Mr. Manhole system he adopted immediately to launch his manhole-focused business to the many offerings from Cretex Specialty Products.

"Every manhole is different. It's almost like you're a doctor and every patient has something different diagnosis-wise," says Steenhoek, who incorporated his business in 2010. "You've really got to know about the solutions that are out there before you can even offer a recommendation or a price for how to fix something. In my opinion, there is no one vendor, no one product, no one method that truly can work on every manhole. I've found a lot of municipalities that just lack the knowledge about what techniques and products are on the marketplace. They're amazed at what we can offer versus someone that comes in and just tries to sell them on coating."

ARSENAL OF TECHNIQUES

Steenhoek spent a lot of time during the startup of his business on education, doing demonstrations of the Mr. Manhole method for municipalities and engineering firms to show them how

The depth of a new manhole chimney is shown after replacement.

reliable and cost-effective the system could be. Over time he gained a foothold in the market.

"There are a lot of municipalities now that have seen the Mr. Manhole tool, and they've seen the rebuild process and the materials that go along with it," he says. "It's sometimes the only thing they'll allow because it's a standardized process with good raw materials. There was no standardization with how a lot of these guys were doing it before. It was just find whatever you can in the back of your pickup truck, throw it on the ground and pour some concrete or asphalt around it."

The Mr. Manhole process uses a dry-cut saw that runs on a standard skid-steer or track loader. It cuts a circle through the road surface surrounding the manhole frame and is able to cut from 44 to 58 inches — 28 to 72 inches with the aid of adapters — up to 48 inches deep. The cylinder strength of the ready-mix pour is all that is needed once the manhole is rebuilt.

"Round holes are a structurally superior design versus a square cut around these manhole frames and covers, and it uses less material and looks better," Steenhoek says. "You do the work and you pour it. There are no internal chimney seals, no epoxies or coatings. It kind of sells itself. Once an engineer sees it, it's an attitude of, 'Wow, where has this been? Why isn't everybody doing it this way?'"

But Mr. Manhole isn't the only process Save Our Sewers now employs, especially when a manhole's problems are more extensive.

"All of my men are PACP, MACP and LACP certified through NASSCO.

Brad Steenhoek with a finished manhole replacement in Ames, Iowa.

COMPANY:
SAVE OUR SEWERS
Cedar Rapids, Iowa

SPECIALTY:
Manhole rehabilitation

NOTEWORTHY PROJECT:
Rehabbing more than 1,000 manholes for the city of Ames, Iowa

When we open up the lid, we already know what's allowed in the project specs and then we can determine the best rehab method based on the training we all have," he says. "The only thing consistent in this business is how inconsistent every manhole is put together. There are no two manholes alike. The NASSCO training gives you a cafeteria-type repair method with all these different options and you pick the remedy based on the type of failure and structure. You obviously learn more out in the field actually doing it, but NASSCO at least gives you a good baseline to start with where you can say yes, a manhole needs this, or no, it doesn't need that."

Save Our Sewers uses a wide range of products and systems, including:

- A number of products from Cretex Specialty Products, such as the X-85 external mechanical chimney seal and the full line of LSS internal mechanical chimney seals. The company also uses a grade ring system called Pro-Ring, which is made of expanded polypropylene. It provides a cost-effective alternative to concrete grade systems while still maintaining durability.
- De Neef Construction Chemicals chemical grout.
- Raven Lining Systems' 405 epoxy.
- Riser-Wrap by GPT Industries, a product that encapsulates a riser sys-

tem with a liquid sealant covered by a heat-shrink polyethylene membrane to protect against I&I.
- Ameron T-Lock, a PVC liner that can be installed mechanically on the interior of a manhole to provide corrosion protection.
- A monoform system that provides a full structural restoration of a manhole with easy-to-install forms that are placed in the interior and allow for a fresh concrete pour between the forms and the deteriorated wall.
- A Quadex product from Hydro-Klean that is used to plug leaky areas.
- Xypex, a concrete add mixture that fights corrosion and waterproofs new concrete installations.

Steenhoek uses an old, deteriorating brick manhole as an example of how the various methods can come together for a complete manhole rehab: It begins with using the Mr. Manhole system to make the cut and gain access to the manhole, followed by chemical grouting to stop the infiltrating water. The Quadex product is used to patch areas where the chemical grout doesn't work. Once the water is stopped, crews use the Monoform system to pour a fiber mesh-reinforced concrete mix with the Xypex additive. After that sets, crews remove the forms.

"When you look down, that manhole looks like a brand-new precast manhole versus the old brick structure," Steenhoek says.

Crews then install the chimney, add Cretex Pro-Rings, put the chimney seals on, put the frame and cover on, and make the final concrete pour to repair the road.

"If we're in a really corrosive situation, we can also integrate the Ameron T-Lock PVC liner. We add that liner to the form before we pour it to provide a better product for corrosion resistance and I&I," Steenhoek says. "If they don't have the budget to pay for the PVC, we can come in and coat it with the Raven 405 epoxy. We're talking the full scope. All the way from the flow line to the top of the road, every inch of the surface is rehabilitated."

BIG PROJECT IN AMES

Save Our Sewers' work in Ames, Iowa, shows how all the company's techniques can contribute to a city's large-scale manhole rehab effort. Beginning in fall 2015, Ames had a single contract with the company that called for rehabbing 650 manholes, both on roadways and grassy areas.

"It's by far the largest we've taken on," Steenhoek says. "We'd done projects before where it was 100 to 200 manholes, but never 500-plus."

The contract called for 421 roadway manholes and another 100 in grassy areas. Thanks to a fairly mild winter that didn't limit workdays too significantly, Save Our Sewers had the contract wrapped up in May 2016. And Ames extended the contract when Save Our Sewers finished the project under bid as a result of reduced concrete use with the help of the Mr. Manhole tool, the primary system used on most of the manholes.

"When we open up the lid, we already know what's allowed in the project specs and then we can determine the best rehab method based on the training we all have. The only thing consistent in this business is how inconsistent every manhole is put together." Brad Steenhoek

A Save Our Sewers crew member uses the Mr. Manhole system to cut out a manhole scheduled for replacement.

CLOCKWISE FROM TOP LEFT: Operator P.J. Hachey cuts the top of a concrete chimney to the proper height before attaching the cast iron ring and lid; a freshly capped manhole ready for concrete; machine operator Shawn Kinney (left) and Brad Steenhoek move a chimney section into place. The circular excavation around the manhole is filled with new concrete once it's set to grade.

"Because of the savings of going circular versus a rectangle or square structure, we were way under on our concrete usage," Steenhoek says. "We saved about $200,000, so they extended it from the original bid quantity and we did about 650 manholes when it was all said and done."

The complete project finished at the end of June 2016, well under the yearlong timetable Ames officials wanted to adhere to. Then, this past summer, Save Our Sewers completed another contract for Ames, tackling every manhole in the city's 100-year flood plain, about 400 on top of the 650 that had been completed the year before. Steenhoek says that batch of manholes required more of the full range of his company's offerings rather than any one system or method. Sometimes a single method provided a solution, other times it was a combination.

"A lot of it is on the front end," Steenhoek says. "You really can't do anything without a good inspection first. Typically it's an engineering firm handling that part, but in situations where we're working more directly for the city, that's when our NASSCO certifications help us guide them on what has to be used to solve their failed structures."

One of the most chronic issues among the municipalities Save Our Sewers has worked for is corrosion, Steenhoek says. That's because the manholes often lack a flow line or benching that would allow for the sewage to move quickly from the inlet pipe to the outlet pipe.

"You get scouring within the manhole, and with the raw sewage just sitting there you also get a lot of hydrogen sulfide buildup, and the gas starts to deteriorate the manhole," he says.

That's when a comprehensive rehab coupled with the anti-corrosion tools Save Our Sewers uses is the ideal solution. But municipalities' budget issues also have to be heavily factored into how to tackle rehabs, Steenhoek says.

"In all fairness, not all manhole rehabs will last. They all have a life expectancy, so what really determines it is how long do you want it to last and how is it going to affect your budget? Between those two, you have to come up with a price and repair method for the municipality that matches. You take their budget and the problems they have and you try to make it work." I&I

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Manhole inserts, which have been around since the late 1970s, are designed to drastically reduce unwanted inflow, along with the dirt, grit, sand, oils and pollutants that come with it.

A SIMPLE INSERT CAN SAVE YOUR SYSTEM

Inserts are a low-cost, high-efficiency way to reduce inflow through manholes

By Craig S. Gaul and Bob O'Connor

Inflow is the first "I" in I&I, but it regularly takes a back seat to infiltration.

The inflow of stormwater into collections systems is often the result of illegal or improper connections, but excess flow entering the system through manhole covers can also pose significant threats. It's a problem that plagues communities throughout the U.S.

When rainfall or snowmelt cause unwanted water to enter the collections system through manhole covers, the amount of actual flow can far exceed the design capacity of the wastewater treatment plant. It strikes quickly and can carry dirt, debris, sand, grit, oils and other pollutants that also end up in the collections system. One of the most efficient and cost-effective ways to reduce inflow through manhole covers is to install manhole inserts. The units are lightweight and can be installed under existing manhole covers by one person in just a few minutes. Removing the units to access manholes is just as easy by using the attached lifting strap.

Manhole inserts have been around since the late 1970s, yet can go unnoticed when it comes to solutions for addressing inflow and infiltration in manholes. The focus is usually toward the infiltration side of the equation, which is certainly important in its own right, but inserts play an important role in the overall picture of combating inflow. Each time it rains, unwanted clean water is entering sanitary collections systems by passing through manhole cover pick holes or the area between the frame and cover, ultimately ending up at the treatment plant. Manhole inserts are designed to drastically reduce that unwanted inflow and also contain the dirt, grit, sand, oils and pollutants that come with it.

Tests have shown that up to 45 gallons of water per minute can enter a collections system through a single standard 24-inch-diameter manhole cover with two 1-inch-diameter pick holes.

INFLOW IN OHIO

Greenville is a small town in west-central Ohio with a population of about 13,000. Its heritage goes back to the early days of statehood and is best known for being the place where the Treaty of Greenville was signed in 1795, opening up exploration to the northwest. As with many small older communities across the country, they reached a point in the early 2000s where nearly every rain event was overwhelming the sewer plant and causing basement backups. Any significant rain would take one to two days for the system to recover. Something had to be done.

A flow study was completed in 2004 and a plan was put together to try to eliminate some of the easiest inflow and infiltration. Greenville Creek runs through the town and the study identified the south side of the creek as the area where most of the inflow and infiltration initiated.

The focus is usually toward the infiltration side of the equation ... but inserts play an important role in ... combating inflow. Each time it rains, unwanted clean water is entering sanitary collections systems by passing through manhole cover pick holes or the area between the frame and cover, ultimately ending up at the treatment plant.

The town has approximately 880 manholes, many of them with covers that had vent or pick holes in them. In 2005, then street supervisor Tim Harless decided to install polyethylene manhole inserts into about 400 manholes on the south side. After several months and many rain events he noticed that basement backups, which had been a common occurrence during rainfall events, had virtually disappeared. It was a welcome end result that he attributed primarily to the inserts. He was so satisfied with the outcome that the decision was made to install inserts in the remaining manholes the following year.

Today, wastewater supervisor Vaughn Downey reports that the rain event surge to the treatment plant has been reduced by a conservative estimate of 20 to 25 percent over the last 10 years, and the recovery rate has decreased from one to two days to about one hour. He attributes a good portion of this success to the installation of manhole inserts and also to the diligence of the street department in identifying and fixing problems as they are found.

COVERED, NOT SEALED

Several in-house tests conducted by manufacturers of both manhole inserts and manhole covers have shown that up to 45 gpm of water could potentially enter the collections system through a single 24-inch-diameter manhole cover with two 1-inch-diameter pick holes and only 1 inch of water over the cover. A cover without pick holes can still allow up to 25 gpm with that same 1 inch of water over it because the water can penetrate through the gap between the outside edge of the cover and the inside portion of the frame, which is typically about 1/8-inch wide. Anyone who has had water leaking into their home knows all too well how water can find its way through the smallest of openings. Keep in mind that these tests were performed under controlled conditions using clean manhole frames and covers.

One municipality performed its own testing in actual field conditions using from 1 to 10 inches of water over the manhole cover while developing three different sets of circumstances. For the first test the bearing surface was sealed, to simulate dirt and grit deposits between the frame and cover, and the pick holes were left open. Test two had a clean frame and cover, but the pick holes were plugged, and for the third test, the ring and cover were clean. Results with 1 inch of water over the cover ranged from 12 gpm for test one to 15 gpm for test two and 27 gpm for test three. Moving to 5 inches of water produced rates of 20, 24 and 42 gpm, respectively. At the 10-inch mark, inflow increased to 25, 29 and 47 gpm.

In order to look at this problem from a dollars and cents standpoint, the cost to treat all that water entering the WWTP must be established. If an amount of $2 per 1,000 gallons is used, with the best-case scenario of 12 gpm of inflow from the municipal field test, a total cost per manhole per day can be calculated. At 12 gpm of inflow x 60 minutes (720 gallons per hour x 24 hours), 17,280 gallons per day is entering the WWTP from a single manhole. Dividing the total inflow per hour by 1,000 = 17.28 and then multiplying that number by the treatment cost of $2 = $34.56 per day to treat surface water at 1 inch deep over just one manhole.

It's easy to see the impact that even 100 manholes can have on WWTP flows during a rain event. Manhole inserts should be considered an investment, rather than a cost, since the price of the insert can be recouped in as little as 24 hours of rain.

Craig S. Gaul is president of Parson Environmental Products, and Bob O'Connor is president of Municipal & Contractor Sealing Products. I&I

PROJECT
SHOWCASE

Stemming the Tide

Island community takes an innovative approach to tightening its collections system and reducing treatment volume

STORY Giles Lambertson | **PHOTOS** Michael Pronzato

OPPOSITE PAGE: Sullivan's Island Water & Sewer Department operator John Myers checks a gas monitor while Chief Operator Darrell Noisette prepares to enter a manhole for a visual inspection. RIGHT: Work begins on Gull Street on the island.

In a perfect world, average daily flow to the wastewater treatment plant on Sullivan's Island, South Carolina, would be 182,000 gpd. That's what the utility distributes daily in potable water and, theoretically, should receive back through its closed collections system.

However, the actual flow to the plant averages 552,000 gpd, according to Greg Gress, who manages the island's water and sewer department. The 370,000 additional gallons enters the system through bad connections (inflow) and cracked or otherwise faulty pipe (infiltration). To begin to stem this invasive tide of I&I, Gress championed a trenchless pipeline repair solution — injection of chemical grout.

Grouting of utility lines has been around for more than a half-century. What made Gress' initiative noteworthy was that he opted to grout first and resort to point repairs and lining of existing pipe only when there was no other choice. He felt he had good reasons to proceed in this fashion and the initial phase of the repair project has borne out his reasoning.

Gress didn't act precipitously. When the Illinois native took the job with the barrier island community in 2004, I&I was already a problem. Sewer lines are uniquely stressed in the sandy setting of a barrier island. In addition to the instability of the footing and invasive nature of sand, the system is jeopardized by the constant salinity of the water and tidal surges during heavy storms. "Hurricanes are always on my mind," Gress says.

GROWING CONCERN

A decade after Gress came to town, the treatment plant was nearing its capacity and state environmental officials were hovering to pounce in the event of sanitary sewer overflows. "We've had a few discussions with regulatory agencies," Gress says. "We are not operating under a consent order. We are trying to prevent a consent order. I initiated the project, but we'd had the discussions and I knew where their heads were."

> **"Greg is a forward-thinking utility director. He's not satisfied with just any answer unless he can prove it."**
>
> Pete Fleetwood

Rather than launch an expensive project to replace all 81,000 feet of 8-inch vitrified clay pipe — most of it laid in 1968 — and 26,000 feet of 6-inch laterals, he leaned toward grouting lines to reduce inflow and infiltration "and buy us time to do structural repairs on our schedule."

PHOTO COURTESY OF SULLIVAN'S ISLAND WATER & SEWER DEPT.

The Sullivan's Island team includes (from left) Eric Bond, John Myers, Greg Gress and Darrell Noisette.

UTILITY:
SULLIVAN'S ISLAND, South Carolina

PROJECT:
Grouting and lining 38,000 feet of pipe to reduce I&I in one of the community's most problematic basins

RESULT:
A 40 percent reduction of I&I

COST:
$1.5 million

With the blessing of town leadership, Gress studied the situation for a couple of years, making field trips to places like Winter Park, Florida, to learn from their grouting experience and compare cost estimates. He learned that lining a pipe costs about $65 per foot versus $20 per foot for grouting — not much to debate there.

What's more, the preliminary work for lining a sewer pipe can, in itself, be a problem. That's because to clean a pipe prior to inspection means blasting the pipe with water at 2,000 to 4,000 psi, which can worsen existing leaks and create new ones. "There's vacuum and pressure on every pass, like a plunger in a toilet bowl, making the situation worse," Gress says.

He liked that the grouting process gives multiple views of the interior — first the initial inspection video, then the view during actual grouting, and finally a post-work video. This chance for repeated viewing of the pipe's condition, combined with the cost differential, led Gress and Sullivan's Island officials to go with grout as the primary option.

Gress actually favored having his department do the grouting work in-house, figuring the process would cost no more than $7 or $8 per foot using town labor. He hesitated, however, because the necessary equipment was going to cost three-quarters of a million dollars. "But the reason we fell off the fence on the side of using a contractor was a phone call from our attorney who said he'd been notified by the regulatory agency that a 'friendly' consent order was coming," Gress says. "Contracting out the work was the quickest thing we could do."

COOPERATIVE EFFORT

The project was designed for three phases, the first one targeting 38,000 feet of pipe in two especially problematic basins. The town chose to collaborate on the project with contractors and a separate engineer serving as project manager using a construction manager at risk (CMAR) arrangement. James Shelton, a vice president of the ARCADIS design and consultancy firm, was chosen to direct the work of four contracting teams.

Shelton allied with Gress in pushing grout as the first step in repairing the lines. Shelton said the only real surprise on the job was seeing how willing Gress was to try new things. A prime example was the process by which the team devised a way to seal longitudinal fractures using a special packer and an altered chemical grout recipe.

"Greg kept saying, 'Why can't we do this?'" Shelton recalls. "We repeated the conventional wisdom of, 'You never do that.' He'd say, 'We should figure out a way to make this work.' And so we did. It took a little trial and error but we figured out how to do it and it worked really well."

Pete Fleetwood of Bio-Nomic Services, one of the contractors, says such on-the-fly cooperative decisions made the project a real team effort. "Greg is a forward-thinking utility director. He's not satisfied with just any answer unless he can prove it. He was very good to work with." The innovative longitudinal fracture solution, Fleetwood recalls with a smile, came about over barbecue and a couple of beers.

BIG IMPACT

The contractors' four crews wrapped up the first phase in June 2015, having lined 5,000 of the 38,000 feet of pipe and grouted the rest. Some point repairs were made following a decision-making hierarchy that Gress established. It was based on cost of repairs. If more than two point repairs were needed in a segment, it was deemed more cost-effective to line the whole segment.

PHOTO COURTESY OF SULLIVAN'S ISLAND WATER & SEWER DEPT.

Darrell Noisette pauses to view an infiltration source while inspecting a sewer main on Sullivan's Island.

Darrell Noisette wraps up after cleaning a sewer main.

PHOTO COURTESY OF SULLIVAN'S ISLAND WATER & SEWER DEPT.

A camera cable, hoses carrying the two-part grout mix, and air lines for the grout packer pass over a roller on a manhole. The grout packer is attached in the sewer line.

Darrell Noisette (left) and John Myers connect extension tubes to the vacuum boom on a Vactor jet/vac truck before removing debris from the sewer line.

The project ended up costing slightly more than $1.5 million, with grouting work claiming half of it. Warranty work has just been completed and Gress awaits the report. This much he already knows: In the first phase, the town had hoped to achieve a 30 percent reduction of inflow and infiltration. In fact, the work reduced I&I by nearly 40 percent.

The effort was so successful that rainwater now puddles in some yards where it formerly found its way into lateral footings and poured into the town's collections system.

On the other hand, a good portion of the remaining I&I is from the private side, that is, through laterals on private property. "We believe we are getting a good bit from that side," Gress says. "How much is coming from the private side is a difficult thing to segregate. What we do know is that following the first couple rain events after phase one, we saw sinkholes developing there. We have to do something to address that."

"The state is telling other communities that it will give money for repair projects if the community will do it this way."

Greg Gress

The next phase of the project has been delayed to fiscal year 2019. Urgent repairs to the treatment plant have moved it ahead of pipeline repair on the town's to-do list, Gress says. "We had anticipated going right into phase two this year and put money in the budget to do so, but the treatment plant has a very strong need."

In the meantime, he is fielding questions from other municipal utility heads considering his approach to repairing pipelines. The calls are apt to multiply because Shelton reports that officials in the South Carolina Department of Health and Environmental Control have become advocates of the grout-first approach.

"The state is telling other communities that it will give money for repair projects if the community will do it this way," Gress says. "To come out of this and have the state feel as strongly as it does about this cost-effective approach is really satisfying." I&I

TAKING I&I TO SCHOOL

Grout school provides a hands-on education to help fight the flow of infiltration

By Luke Laggis

MUNICIPAL SEWER GROUT SCHOOL
Framingham, Massachusetts

NEXT SESSION:
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Visit www.avantigrout.com/on-the-road

When it comes to training your crews and handling rehabilitation work in-house, you can learn some things from the contractors who serve your utilities.

Frank Klima knows a thing or two about running a business, and training his people to do the job right. The president of Lake County Sewer in Willowick, Ohio, makes sure his people get a thorough education at Municipal Sewer Grout School, because it helps his bottom line. It also helps his customers' manholes and sewer lines.

"It pays for itself in the long run," Klima says. "If you have a truck — especially the ones we build — they aren't cheap and can break if handled incorrectly. Just the basics regarding how the panel operates, how the packer is inserted in the pipe, there is just so much they can learn from the instructors. Every guy picks up a little something different from each school."

The school is a joint venture between Aries Industries, Avanti International, CUES and Logiball; they teamed up to develop the two-day school to educate contractors and municipal utilities on the process of grouting. The school covers everything from mixing and optimizing grout performance to specification requirements and live demonstrations.

"We need to educate everyone about what they are going to be doing. Avanti, Aries, CUES and Logiball have the program down where it's a teaching program. Whether the person has been in the industry forever or they are just starting out, we like the idea of keeping our team up to date with technology and anything else out there we don't know," Klima says. "The payback is there when it comes to that guy jumping on a grout truck and knowing how to run it to get the job done. The overall benefit outweighs the cost."

PHOTO COURTESY OF AVANTI INTERNATIONAL

Over 500 students have gained knowledge and know-how through Municipal Sewer Grout School sessions held across the U.S.

PHOTO BY KOLMAN ROSENBERG

Well-trained technicians from Ohio-based Lake County Sewer prepare to lower a grouting unit into a sewer line.

> **"The payback is there when it comes to that guy jumping on a grout truck and knowing how to run it to get the job done. The overall benefit outweighs the cost."**
>
> Frank Klima

FINDING FOCUS

Lake County Sewer has several divisions, including manhole rehabilitation. The company got involved with grouting in 1991, and may have been

(continued)

PHOTO COURTESY OF AVANTI INTERNATIONAL

Municipal Sewer Grout School students get hands-on experience with a lateral packer.

PHOTO COURTESY OF AVANTI INTERNATIONAL

Grout school students get a crash course in how everything in a grout truck works.

the first contractor in the U.S. to offer lateral grouting from the mainline. The work has since become a focus.

"Lateral grouting seems to be the big niche that's going on now, with all the lining going on. Owners are learning that lining is not the answer to infiltration. Lining is a structural fix to a pipe and it's just going to move the infiltration from that area to the manholes or connections. That's what we are finding out and are learning from," Klima says. "We usually end up grouting laterals and manholes after liners have been installed. The expense to grout a sewer is not cheap either but it's about 1/3 of the cost of lining if you took a reality check on the cost of the two technologies. And I don't know of anyone who wants to spend what it costs to line and grout, but it is certainly something that would make the lining work complete. When I say complete — here we structurally took care of the pipe but we didn't stop the water from coming in. That's something owners and engineers need to understand."

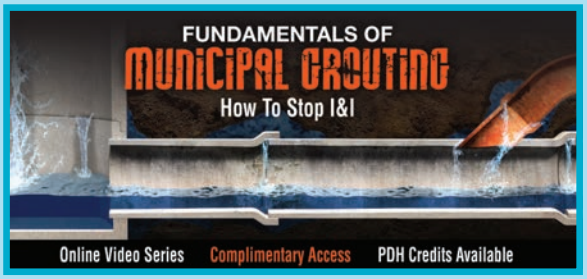
PROMOTING VALUE

Klima says that with the extra cost, it's not always easy to convince the client this is the way to go. The check writers and committee-level people don't always see the value in underground projects. "You can see a bridge. The bridge was deteriorating, and now it looks brand new and there are trees planted, and it looks all pretty. Underground is different — it's out of sight out of mind."

Frank Klima Jr., president, Lake County Sewer

PHOTO BY KOLMAN ROSENBERG

It's important to remember, he says, that for every gallon of water that finds its way into the sewer, that's an extra gallon that needs to be treated. And that comes at a significant cost. The upside is that eliminating that extra flow creates significant savings over the long term. "Any project you put out to bid to eliminate infiltration will pay for itself in the first year, or even the first months," he says. "So it's a no-brainer." I&I



ONLINE VIDEO SERIES PROVIDES INTRODUCTION TO GROUTING PRACTICES

Municipalities need economical, practical and long-term solutions to inflow and infiltration, and a new educational video series aims to help.

After years of collaborating on Municipal Sewer Grout School and other educational initiatives, experts from Avanti International, Aries Industries and Logiball have produced *Fundamentals of Municipal Grouting,* a 16-module video series designed to help those working to solve I&I problems.

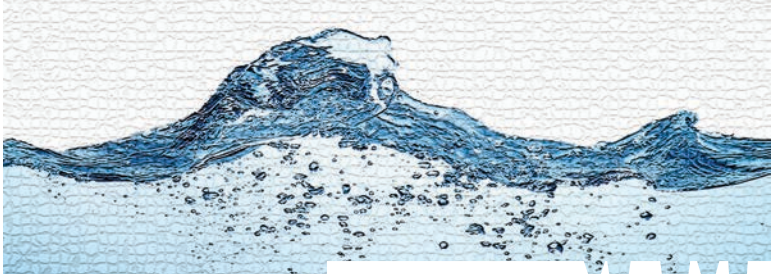
"For over a decade, these three companies have prioritized education by hosting grout schools, webinars and live field-day presentations," says Avanti President Daniel Magill.

Beginning with the history of sewers, the video series delves into grout chemistry and safety, conveyance technologies and techniques, and holistically targets all infiltration points of entry: mainline sewers, manholes, service laterals and connections. The broadcast-quality video series features comprehensive content unlike any other resource in the trenchless technology industry.

Municipal stakeholders and specialty contractors now have a self-paced training and education resource available for both technical and operational personnel at no cost. For engineers requiring PDH credits, a $49 administration fee is required.

Fundamentals of Municipal Grouting provides a good base knowledge of the practice, technologies and science behind injection grouting, and is a perfect primer for Municipal Sewer Grout School.

Visit www.municipalgrouting.com to view the complete video series.



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BEST PRACTICES

4 STEPS FOR SUCCESSFUL REHABILITATION

Correcting manhole condition issues, inside and out, will improve your whole collections system

By Kevin Morris

Manholes are critical factors contributing to the accelerated deterioration of collections systems. In addition to significant inflow and infiltration problems, cracked and eroded manholes allow soil, gravel and other abrasives to enter sewer systems and eat away at your infrastructure.

As the pace of corrosion intensifies, associated costs and risks will continue to rise unless sanitary sewer system owners take action to rehabilitate your manhole infrastructure. Fortunately, you will often be able to repair, rather than replace, these structures by following a four-step process involving surface preparation, stopping inflow and infiltration, making structural repairs, and applying corrosion-resistant coatings and linings. Following these steps can help owners enhance the lives of their sewer systems while also reducing overall life cycle costs.

Structural repair is one of four general steps in the manhole rehabilitation process. Cementitious mortars, which can be troweled, brushed, sprayed or spin-cast, are the most common structural repair materials.

1 Surface preparation

Properly preparing corroded, contaminated surfaces is critical to ensuring long-term performance of manhole repairs. Surface preparation brings concrete and steel substrates back to a state in which they'll accept the application of restorative materials. This includes removing deteriorated areas affected by microbial-induced corrosion (MIC). The MIC process breaks down sulfates, creating corrosive gases and acids that lower the concrete's pH, causing it to deteriorate faster.

To prepare surfaces effectively, crews must remove any loose and contaminated substrate material, using methods such as pressure washing, grinding and abrasive blasting. To confirm the resulting concrete surface profile (CSP) is appropriate for the application of repair mortars, contractors commonly follow SSPC's and NACE's joint standard SSPC-SP12/NACE No. 6, which requires a CSP equal to medium-grit sandpaper. It's also helpful to follow the ICRI 310.2 standard, which uses rubber replica CSPs for comparison to the prepared surface.

As manholes deteriorate, I&I accelerates via leaks, voids and cracks, introducing ground and surface water, soil, and debris into the sewer system. Stopping I&I is critical to ensure long-term system repairs and minimize the unnecessary treatment of excess water.

Following surface prep, crews must check the pH of the concrete to ensure the surface is free of contaminants. If the pH is below 10, contaminants are still present on the substrate, and crews may need to take additional steps.

2 Stopping I&I

As manholes deteriorate, I&I accelerates via leaks, voids and cracks, introducing ground and surface water, soil, and debris into the sewer system. Stopping I&I is critical to ensure long-term system repairs and minimize the unnecessary treatment of excess water.

In extreme cases, the only way to stop I&I is digging around the manhole and waterproofing it from the outside. Trenchless technologies are a more cost-effective approach. They allow crews to drill holes through the concrete and inject a low-viscosity, water-activated polyurethane grout. The injected grout flows around the structure, following the path of the infiltrating water, and cures in place to create a watertight seal between the backside of the structure and the soil. This repair could either be a curtain wall that encapsulates the entire exterior of the manhole to halt multiple leaks or a point injection, which stops a specific area of infiltration.

Material options to stop I&I vary, but polyurethane grouts have a long life span and remain inert after curing so they aren't susceptible to MIC. In addition, you can find a range of polyurethane grout properties from very

rigid for static operating environments to flexible for dynamic environments subject to traffic loading and/or hydrostatic pressure.

3 Structural repairs

After halting I&I, you need to address any structural issues in the manhole and rebuild the surface to a level plane, restoring the deteriorated concrete closer to its original state.

The most common structural repair materials are cementitious repair mortars, which combine a cement material with an admixture to enhance its structural integrity. They're a better choice than stand-alone Portland cement, which is relatively weak for structural repairs and is highly susceptible to MIC.

Cementitious microsilica repair mortars use Portland cement as a base but also include a fused silica admixture to create a denser substrate. The denser finished repair slows the penetration rate of corrosive materials and moisture. Microsilica repair mortars offer sufficient strength to work as stand-alone liners in areas with mild hydrogen sulfide exposure. However, they are still prone to MIC, so a corrosion-resistant liner is often recommended.

Cementitious calcium aluminate repair mortars are more robust options that use calcium aluminate cement rather than Portland cement. These mortars offer improved life cycles compared to other materials and maintain a higher pH, which makes them more resistant to MIC. They can be used as stand-alone liners in areas of moderate H_2S exposure, but are still susceptible to MIC without a protective liner applied.

The most appropriate cementitious repair mortar depends on the severity of the substrate deterioration, the service environment, and the coating that will be applied later. The selection of repair mortars is dependent on whether the system will be left as a stand-alone liner or if it will receive a corrosion-resistant resinous liner on top of the repair mortar.

4 Coatings and linings

Once you've re-established a manhole's structural integrity, you'll want to place a robust protective barrier between the restored substrate and the corrosive waste flow in many cases.

Semistructural liners come in two styles: freestanding and bonded. A freestanding liner creates problems when it disbonds from the substrate. The high-strength liner may remain in place, but the substrate, hidden from view, may deteriorate as water can flow behind the liner. Corrosion can also continue if the substrate surface was not properly prepared. Continuing deterioration may not be evident until the manhole starts to collapse. In contrast, bonded liners rely on full adhesion to the substrate. If they start to fail, blisters and other indicators will make the need for repair evident, enabling more proactive fixes.

Epoxy, polyurea, and polyurethane materials all provide robust barriers that protect substrates from MIC, but lining and coating choices should be site specific. Selection factors include the substrate material, the environment and traffic conditions, along with the coating's chemical resistance and film-build capabilities.

Epoxies are a popular choice because of their versatility. They are strong and unaffected by moisture, making them ideal for application on damp substrates. However, in areas with heavy traffic loads, rigid epoxies are prone to cracking.

Polyurethane and polyurea coatings and liners are gaining popularity because of their physical toughness and improved elongation over epoxies. Flexible formulations can bridge cracks and withstand heavy traffic, along with minor soil movement and pipe shifting. Manufacturers offer various formulations to provide an array of desired characteristics. For instance, some products with high film-build characteristics can be spray-applied thick enough to fill surface voids without needing to complete surface repairs, thereby eliminating a rehabilitation step.

GOOD DECISIONS

Every manhole rehabilitation is different. Some structures will require minimal repairs and have no need for corrosion-resistant coatings and linings, while others will require major overhauls to stop I&I, rebuild structures, and protect the restored structures from corrosion. Most likely, your complete sewer system will require a combination of light and extensive repairs.

Following the four-step program outlined above and consulting with a reliable coating and lining supplier will help you realize long-term results from any repairs.

CLOCKWISE, FROM TOP: Properly preparing corroded, contaminated manhole surfaces is critical to ensuring long-term performance of repairs; the finished interior surface of a manhole after mortar application; a coated manhole after full rehabilitation.

Kevin Morris is the water and wastewater market segment director for Sherwin-Williams Protective & Marine Coatings, in addition to holding many accreditations as a coatings inspector and instructor. I&I

MANHOLE REHABILIATION By Craig Mandli

EPOXY AND ADHESIVE PROVIDE TRANSITION BETWEEN T-LOCK AND CONCRETE MANHOLE

PROBLEM:

Two manholes at the Los Angeles County Sanitation District's Joint Outfall "G," Unit 9 Trunk Sewer Rehab Phase 4 Project required epoxy coating of the base/bench with a reliable connection to the previously installed T-Lock PVC liner. Standard epoxy resins couldn't be used, as they don't adhere to PVC materials.

SOLUTION:

Neopoxy International recommended using a combination of solvent-free PVC adhesive/primer and hand-applied **epoxy resin NPR-5305.** Sancon Engineering applied a 1-inch-wide strip of PVC adhesive on the low edge of the T-Lock sheet. The next day, benches were coated with high-strength, corrosion-resistant epoxy NPR-5305, overlapping the PVC adhesive strip. The epoxy coating bridged the PVC material with the concrete manhole floor.

Result: The combination of PVC adhesive and NPR-5305 epoxy resin created a reliable transition between the PVC material and the concrete structure.

510-782-1290; www.neopoxy.us

PVC LINER USED TO REHAB MULTIPLE MANHOLES DAMAGED BY SINKHOLES

PROBLEM:

Municipal utility districts around the Houston, Texas, area were discovering sinkholes in the ground surrounding manholes. Hydrogen sulfide gas from force main discharges was causing the problems. Inspections determined that the integrity of the manholes was compromised and was quickly deteriorating, causing dirt and groundwater infiltration that in turn caused excess debris to flow into the wastewater treatment plant.

SOLUTION:

A corrosion-resistant **Danby PVC liner** was used to rehab the manholes by excavating out any remains of the manhole below the base while installing a liner plate for trench safety. The manholes were designed with 1-inch-thick walls with double-mat No. 5 rebar and 5,000 psi minimum concrete, lined with Danby PVC corrosion-resistant modular panels. An HDPE force main drop was also designed and installed. The manhole lids are designed for HS20 loading and were also constructed and lined using the Danby PVC liner to provide the corrosion-resistant protection necessary for a manhole with a force main. The liner easily accommodated the depth, shape and even the lateral connections found in these manholes.

Result: The liner and panels help produce structurally sound, corrosion-resistant reconstructed manholes and manhole lids.

281-598-1126; www.danbyrehab.com

LIGHTWEIGHT GRADE RINGS A FIT FOR OFF-ROAD MANHOLES

PROBLEM:

The District of North Vancouver, British Columbia, faced a problem in the spring of 2015 when they were tasked with rehabilitating existing manhole grade rings located off road in remote easements. They had a list of approximately 50 manholes that required attention, and using a traditional concrete grade ring system made the project look daunting.

SOLUTION:

The district had heard about the expanded polypropylene **PRO-RING system** from **Cretex Specialty Products.** It meets AASHTO M306 requirements for HS-20 and HS-25 traffic loading to withstand repeated impacts without damage, and is resistant to many chemicals. A traditional concrete grade ring would require several crew members or equipment to lift, while a 6-inch-thick PRO-RING weighs just 14 pounds. The entire ring system is assembled and bonded together in minutes using a construction adhesive/sealant to create a watertight, testable system. It is also available in round, square and rectangular shapes.

Result: The PRO-RING proved to be an effective solution, allowing crew members to easily handle and install the rings without risk of injury. It enabled the district to spend less time on the job site, use less material, and use a smaller crew.

800-345-3764; www.cretexseals.com

ACCESS ASSEMBLIES ENABLE SMOOTH PAVEMENT

PROBLEM:

Dips, raises and cracking in the streets of Elmira, New York, especially in the areas surrounding manholes, were garnering some bad press. Craig Southard, senior engineer for Elmira, hoped to find a solution that would also increase the life span of the pavement and make maintenance of city streets less labor-intensive.

SOLUTION:

Southard learned about **SELFLEVEL access assemblies** from **EJ** and ordered seven units. Judson Street, a street that would receive heavy traffic as the detour route for a major city thoroughfare, was selected as the test site. The SELFLEVEL eliminates steps that are par for the course with a typical one-frame assembly, such as measuring to ensure the frame lines up with the existing curb line, and shimming the frame to match the pitch of the road. The immediate result after installation is a smooth street. Even after a winter of continual freeze-thaw cycles, the street will remain smooth as the covers move with frost heaves to match the pitch in the road. The unit can be used for either new installations or retrofits.

Result: "It will save us money long-term, and will save us on maintenance, too," Southard says. "It's definitely a labor reduction internally of at least 50 percent. There's also no need for extension rings."

800-626-4653; www.ejco.com

PLUGS DIVERT FLOW FOR MANHOLE BENCH AND CHANNEL REHABILITATION

PROBLEM:

While performing the rehabilitation of sewer manholes in Baltimore County, Maryland, MIDAS Companies had difficulty controlling the flow while working on the manhole bench and channel.

SOLUTION:

MIDAS consulted with **Logiball** to see if they had a large flow-through plug that could provide an easier way to control the existing flow in order to allow a more efficient rehabilitation of the manhole bench and channels. Logiball proposed its **Type "D" Flow-Thru Plugs.** The double- action bladder allows for the inward bladder to seal against the pump suction hose or bypass pipe while the outer bladder seals against the host pipe wall.

Result: Use of the plugs allowed for a quicker and safer diversion of flow during the rehabilitation process.

800-246-5988; www.logiball.com

(continued)

MANHOLE REHABILIATION

STRUCTURAL POLYURETHANE LINER PROVES ITSELF IN DEMONSTRATION

PROBLEM:

Mishawaka, Indiana, was removing and replacing existing pipelines and manholes in a densely populated area of the city. Conco Spray Solutions was subcontracted to rehabilitate the manholes. Conco President Jennifer Hoop believed Sprayroq could be of great benefit and wanted to prove it though a demonstration. Hoop proposed that the city allow Conco to apply polyurethane lining material to one manhole scheduled for demolition, to demonstrate its strength and structural rehabilitation properties.

SOLUTION:

Conco was allotted a manhole with severe structural issues, inflow and infiltration. Following two hours of light prelining prep work, the old brick manhole received a 250-mil lining of **Sprayroq SprayWall structural polyurethane,** completed in a single pass in one hour. The manhole was returned to service immediately after the invert was sprayed.

Result: The city was impressed with the speed and application of the product, and its ability to provide savings in the quick return to service and true structural properties. Mishawaka recognized its viability for future rehabilitation and protection projects. During the manhole demolition, an excavator with an operating weight of approximately 65,000 pounds, ground pressure around 8.82 psi and bucket breakout pressure of 39,000 psi was used to subject the manhole to multiple hits. Even after this — with its brick structure crumbling — the lining material inside stood strong.

205-957-0020; www.sprayroq.com

RESIN USED TO REPAIR STORM DRAIN MANHOLES

PROBLEM:

Sinkholes had developed around storm drainage manholes in grassy areas of a military housing subdivision in Richmond, Virginia. Besides being unsightly, they posed a danger to neighborhood children. Flooding the sinkholes identified infiltration points further up the structure. The connection of the inlet pipe from the surface catch basin and the connection of the storm main near the bench were the source of most leaks. These connections have brick aprons that had been surface sealed. There were no rubber boots present. Water leaked between the bricks through cracks in the surface seal.

SOLUTION:

The crew injected **Prime Resins Prime Flex 920** through the manhole wall to fill voids and create a watertight curtain. Prime Flex 920 is an expansive hydrophobic polyurethane resin that forms a watertight mass. The grouting was done from inside the manhole because the repair locations were so deep — as much as 20 feet from the surface. Technicians repaired wide gaps around the main connection by soaking oil-free oakum with hydrophilic Prime Flex 900 XLV and pushing it into the gaps to seal the openings with a bond to the wet concrete.

Result: The crew tested their repair by flooding the sinkhole again and saw no infiltration. The contractor completed the repairs with 8 gallons of material.

800-321-7212; www.primeresins.com I&I

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— Ed Norton, *The Honeymooners*

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