MSTT
Midwest Society for Trenchless Technology

Midwest Journal of Trenchless Technology

The Official Publication of the Midwest Society for Trenchless Technology

2014

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Totally Rad Slopes Auction

March 16
2015

NASTT's 14th Annual Educational Fund Auction & Reception

NASTT

Cowabunga dude! It's time for NASTT's fundraising social event of the year – the 14th annual Educational Fund Auction and Reception! Since 2002, NASTT has raised over $750,000 to support our educational initiatives. Due to your *awesome* generosity, NASTT is able to sponsor students' attendance at the No-Dig Show, award scholarships and provide targeted training courses to the membership at-large.

HAWAIIAN VACATION RAFFLE

'80s SKI THEME COSTUME CONTEST

50/50 RAFFLE

LIVE & SILENT AUCTIONS

For more information about the auction visit: nastt.org/auction

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Advancing the Science and Practice of Trenchless Technology

Jeff Boschert, P.E.

Join us in celebrating the second annual publication of the Midwest Journal of Trenchless Technology, an important support for the oldest NASTT chapter in the United States (The Midwest Society for Trenchless Technology or MSTT). Our continued commitment to research, development and education supports the use of trenchless installation methods.

Most of the articles in this edition are condensed from papers presented at the most recent No-Dig Show. For the complete papers, visit www.nastt.org.

We're proud to have earned your support of all we do, the growth of the trenchless industry and our part in it. Your support is critical. We encourage you to join NASTT/MSTT and get involved. For more information on the annual No-Dig Show, education & training programs and membership, see pages XX and XX.

The new Carbon Calculator is just one of the benefits of NASTT membership. A project's carbon footprint is the measure of impact it has on the environment and in particular climate change. Compared to conventional open-trench construction practices, trenchless installation methods can significantly reduce the carbon footprint of a project. With the growing concern for and attention to "green" construction practices, the simple-to-use Carbon Calculator is an easy, convenient way to demonstrate one of the benefits of a trenchless installation.

Please join me in welcoming our two newest officers, Gary Smolinski of OHM Advisors (Livonia, Michigan) and John Milligan of Vermeer Corporation (Pella, Iowa). Gary is serving as Treasurer while John is serving as Secretary. For more information about Gary and John, see page XX.

I can never thank our Executive Director, Leonard Ingram, enough for his efforts in all aspects of this organization. He is a truly an indispensible resource.

This is your organization and your publication, so please support us and let us hear what you think. To provide feedback, place an ad or submit an article in next year's publication, please contact Leonard, me or one of our directors.

Sincerely,

Jeff Boschert, P.E.
President, MSTT
(314) 229-3789
jboschert@ncpi.org

Our Purpose:

Advance the science and practice of Trenchless Technology for the public benefit, to promote and conduct education, training, study and research in said science and practice for the public benefit.

Greetings From the Executive Director

Leonard E.
Ingram, Sr.

On behalf of the Midwest Society for Trenchless Technology (MSTT) Officers, Board of Directors, and Members, we would like to thank the advertisers, the presenters and the publisher who helped to make this second publication of the MSTT Journal a great success. The Journal provides excellent trenchless technology case studies and other information about trenchless projects in the Midwest area.

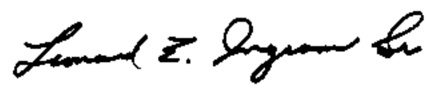
MSTT is a non-profit organization with the purpose of promoting trenchless technology through education for the benefit of the public. MSTT serves the states of Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin. Since 2004, MSTT has conducted 25 two-day "Trenchless Technology, SSES and Buried Asset Management" seminars in 13 different cities and nine states with approximately 1,300 classroom attendees participating

MSTT conducted a successful two-day seminar in Red Wing, Minnesota (Minneapolis/St. Paul), at the Treasure Island Resort & Casino on May 21 and 22, 2014. The "Trenchless Technology, SSES and Buried Asset Management" seminar was attended by engineers, contractors, manufacturers and local municipal employees who learned about trenchless technology techniques, methods, theory, equipment and various case studies. These seminars are experiencing growth in exhibitors, presenters and attendees with new innovative trenchless technology ideas, methods and equipment. The seminar in Red Wing was honored to have as the guest presenter Mr. Rex Huttes, P.E., Principal Engineer, Metropolitan Council Environmental Services (MCES). Mr. Huttes' presentation was "Trenchless Technology In The Minneapolis/St. Paul Area". MSTT and ASCE Minnesota Section were co-sponsors for the seminar.

The next MSTT seminar is planned for Louisville, Kentucky, on November 5 and 6, 2014. Please plan to participate if at all possible to help promote trenchless technology in the area. Seminar registration is available at www.mstt.org/current_seminar.html.

If you are not already a member of MSTT, you can join through our parent organization, the North American Society for Trenchless Technology, online at www.nastt.org. Some of the benefits for membership include subscription to Trenchless Technology magazine, the NASTT Carbon Calculator and reduced seminar registration fees. I look forward to seeing you enjoy the benefits of membership in MSTT.

Sincerely,



Leonard E. Ingram, Sr.
Executive Director, MSTT
(334) 872-1012

No-Dig Headed for Denver

Derek Potvin
Chair, NASTT

It has been a great year for NASTT, and our record-breaking 2014 No-Dig Show held in Orlando, Florida, was definitely a major highlight. We had over 1,800 attendees, an excellent technical program, and an exceptionally successful Educational Fund Auction, all thanks to our dedicated volunteer members including your MSTT Chapter members.

The Midwest Chapter is home to so many trenchless advocates, including Dr. Raymond Sterling, who was honored at this year's Gala Awards Dinner with his induction into NASTT's Trenchless Hall of Fame. Ray is a past chair of NASTT and ISTT and teaches NASTT's Sewer Laterals Good Practices Course. Congratulations to Ray and all of the Midwest Chapter on this great honor.

This year's 13th Annual Educational Fund Auction and Reception was a Pirates of the Caribbean-themed night of fun and fundraising. MSTT Chapter member Bernie Krzys serves on the auction committee and volunteers as the Auction's MC every year. Bernie really gets the crowd fired up, and this year he helped the auction raise more than $130,000 for NASTT's Education Fund!

To date, the auctions have raised over $750,000 for educational initiatives like sponsoring students' attendance at NASTT's No-Dig Shows, awarding scholarships, publishing trenchless resources and providing targeted training courses to the membership at-large.

NASTT is all about education, and our training program is made up of dedicated members who spread the trenchless good news story. This year we already have 24 training courses on the books and more are scheduled every month. I'd like to thank our MSTT Chapter members for hitting the road on behalf of NASTT to bring these courses to audiences across North America. Dr. Ray Sterling taught NASTT's Laterals Good Practices Course in Winnipeg, Manitoba, along with Dr. Jason Lueke. MSTT Chapter member Dr. Alan Atalah taught NASTT's HDD Good Practices Course in Edison, New Jersey, along with Dennis Doherty. Finally, MSTT Chapter member Dr. Glenn Duyvestyn taught NASTT's HDD Good Practices Course right here in the Midwest in Des Moines, Iowa, along with Dr. Sam Ariaratnam.

In August, NASTT partnered with MSTT corporate member LMK Technologies to bring NASTT's CIPP Good Practices Course to the Midwest. Expert instructors Kaleel Rahaim and Chris Macey taught the course at the LMK training facility in Ottawa, Illinois. We'd like to thank NASTT Board of Directors member and Midwest Chapter Vice Chair Larry Kiest for hosting this great training event.

Plans for NASTT's 2015 No-Dig Show in Denver, Colorado, March 15-19, are well under way. The technical program will have many valuable and informative presentations, and the exhibit hall will be full of new products and services to support the trenchless industry. Also, be sure to join us in Denver for NASTT's 14th Annual Educational Fund Auction and the 1980s ski-themed auction reception, 'Totally Rad Slopes'! Again, I cannot thank our MSTT Chapter volunteers and members enough for your dedication and support. You are truly Trenchless Champions!

Sincerely,

Derek Potvin
Chair, NASTT

MSTT Board of Directors

President:
Jeff Boschert
Jeff Boschert, P.E., is President of the National Clay Pipe Institute (NCPI), a technical resource for sewer system managers and designers of gravity sanitary sewer lines. He holds a BSCE from Missouri University of Science and Technology. Jeff joined NCPI from Missouri DOT in 2004 to serve as leader of NCPI's trenchless initiatives and has become a leading expert in the field of pilot tube guided boring. In 2012 he took on the added responsibility of conducting research and educational outreach, and he is now actively working with municipalities as they rediscover the benefits of vitrified clay pipe. In addition to his work with MSTT, he represents the industry on multiple ASCE and ASTM committees. In 2013 and 2014, Mr. Boschert presented papers at NASTT's No-Dig show and ASCE's Pipelines conference.

Vice President:
Larry Kiest
Larry Kiest Jr. is an inventor and entrepreneur who has worked in the underground and trenchless industry for 30 years. Larry started his career in the 1980s as a Licensed Master Plumber and has since designed and produced patented gasket sealing and lining technology for cured-in-place pipe (CIPP). In 1993 he founded LMK Enterprises (now LMK Technologies, LLC), which manufactures its proprietary lining materials, fabricates its lining equipment, and supports a research & development team. Larry is an internationally respected leader in the trenchless industry and holds 117 patents. Larry is responsible for issuing ASTM standards F2561 and F2599 and is currently balloting two proposed ASTM standards. In 2013, Trenchless Technology Magazine named him "Trenchless Technology Person of the Year."

Treasurer:
Gary Smolinski
Mr. Smolinski is the construction manager at Orchard, Hiltz, and McCliment, Inc. (OHM Advisors), an integrated engineering, architecture and planning firm that is committed to advancing communities. As construction manager, Gary directs the construction engineering and management operations for OHM Advisors' Construction Department. He has over 25 years of experience working with multiple municipalities throughout southeast Michigan. While advancing in his career at OHM Advisors, he has excelled in his field construction experience utilizing trenchless technology on various municipal construction projects in the civil construction industry.

Secretary:
John Milligan
John Milligan began his career with Vermeer in 1992 as a sales liaison with Latin America and eventually the Asia Pacific region, spending his first 15 years in various international and domestic sales-management positions. After leading the quality team within the trenchless and utility product segments at Vermeer, Milligan took over as Business Manager for the Water & Sewer Segment, responsible for coordinating and executing the sales, engineering and manufacturing efforts related to the AXIS® guided boring system. He has been with the AXIS program since before its market launch in 2009. John was born and reared in São Paulo, Brazil, and earned a double major in Business Management and Business Marketing from Cedarville University in Ohio.

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Coming Events

November 5-6, 2014
MSTT Trenchless Technology Seminar
Louisville, Kentucky
Information: Leonard Ingram, mastt@engconco.com

November 6
NASTT's Condition Assessment for Watermains Webinar
Your Computer
Information: mhill@nastt.org

December 10-11, 2014
SESTT Trenchless Technology Seminar
Jacksonville, Florida
(Date may change)
Information: Leonard Ingram, mastt@engconco.com

March 15, 2015
NASTT's Trenchless Technology Short Course – New Installation
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org

March 15, 2015
NASTT's Trenchless Technology Short Course – Rehabilitation
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org

March 15-19, 2015
NASTT's 2015 No-Dig Show
Colorado Convention Center
Denver, Colorado
Information: www.nodigshow.com

March 18 & 19, 2015
NASTT Good Practices Courses
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org


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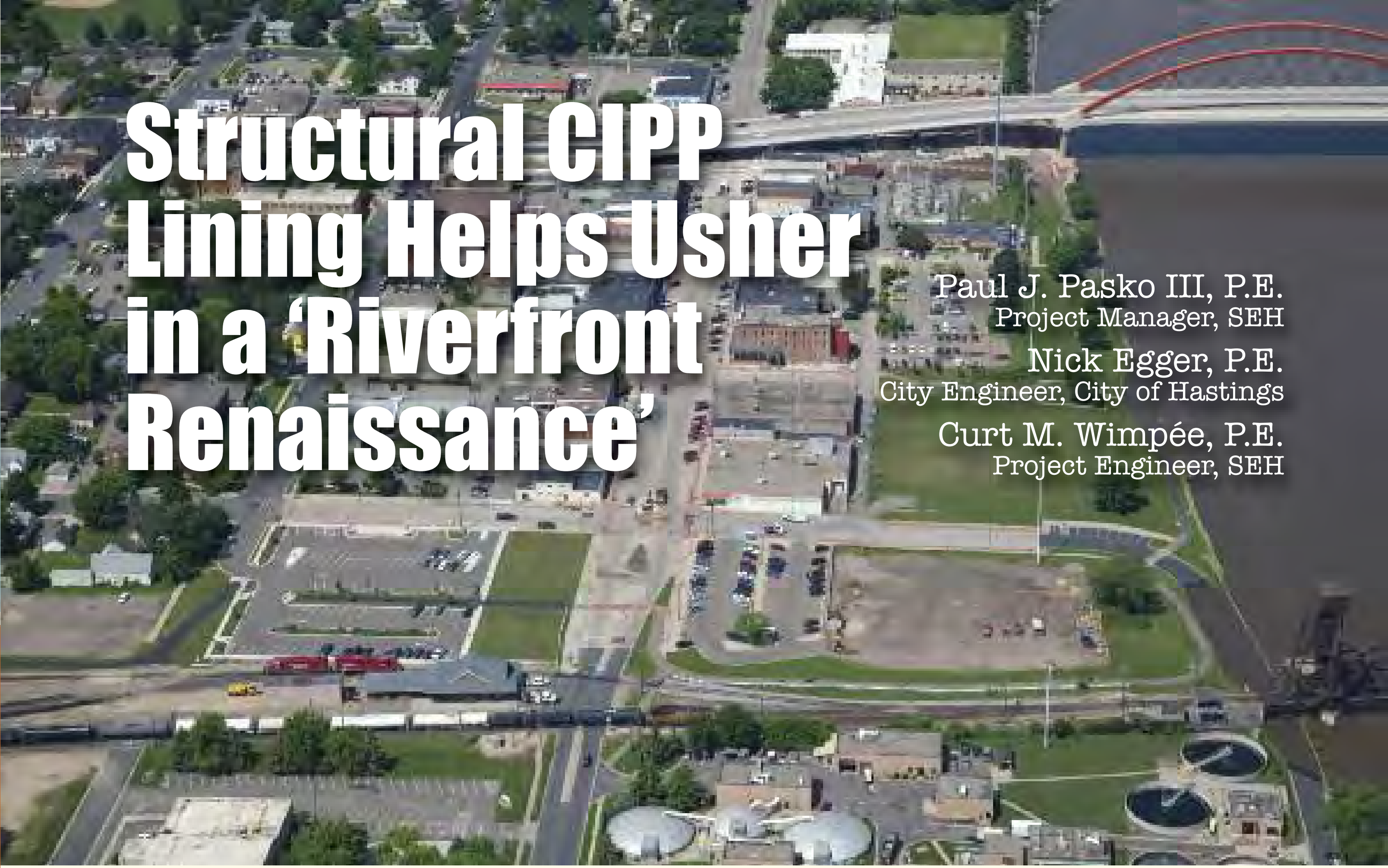


Structural CIPP Lining Helps Usher in a 'Riverfront Renaissance'

Paul J. Pasko III, P.E.
Project Manager, SEH

Nick Egger, P.E.
City Engineer, City of Hastings

Curt M. Wimpée, P.E.
Project Engineer, SEH

Like many historic riverfront communities, Hastings, Minnesota, is in need of various downtown infrastructure improvements. However, it was not feasible for the City to construct these improvements – which include plans to renew Levee Park and downtown streets – without first rehabilitating the 100-year-old water main pipe beneath them. The rehabilitation would have to be completed with minimal impact to downtown businesses and popular weekend activities.

To accomplish these objectives, the City teamed with downtown area property owners, its engineering consultant (SEH Inc.), contractor (Fer-Pal Construction USA LLC), local area private plumbers, and other stakeholders. In the end, this innovative trenchless project would include not only a minimally disruptive water main rehabilitation but also an effective communications campaign and unique bidding process.

Weighing the Options

For this project, the City wanted to take particular care in minimizing disruptions to two highly popular local events. The first was the Saturday Night Cruise-In, a bi-weekly classic car show drawing hundreds of cars, car enthusiasts, and tourists to the streets of downtown Hastings. The second was the annual Rivertown Days celebration in mid-July.

The traditional dig-and-replace method was not optimal for the City because it would be too disruptive to not only these downtown activities but also daily busi-

The project had to be completed without disrupting popular events such as a bi-weekly car show. (Photo courtesy Paul Kampe) ness activity. Also, the dig-and-replace method was considerably more costly than the City's budget would allow. Directional drilling and pipe bursting were not chosen because of difficulties using these tools in Hastings's shallow bedrock. The City chose structural cured-in-place-pipe (CIPP) lining as the method that best suited its needs.

Critical Communications

The communications aspect of this project was a critical component, as the City needed property owners to understand an available City-funded program that allowed them to hire their own private plumber to complete a portion of the work.

At project onset, SEH and the City designed a multi-channel communications campaign that utilized a variety of mediums: a live meeting, a project-specific City web page, videos posted on that web page, local cable TV stories, and an informational packet sent to property owners as well as a community of local private plumbers using the City's email ListServe tool.

By taking advantage of the City-funded program, property owners were reimbursed for hiring private plumbers – provided each plumber followed the City program's guidelines and prescribed requirements.

With the private plumbing work completed and ready upon their arrival, the CIPP contractor was immediately able to temporarily remove and cap each water meter and connect each affected building to their temporary water system. Making this connection and capping the meter prior to the main line rehabilitation work assured that no water would flow backward into the main pipe and disrupt CIPP curing. The communications campaign was highly successful. All affected property owners implemented the program.

Bidder Qualification

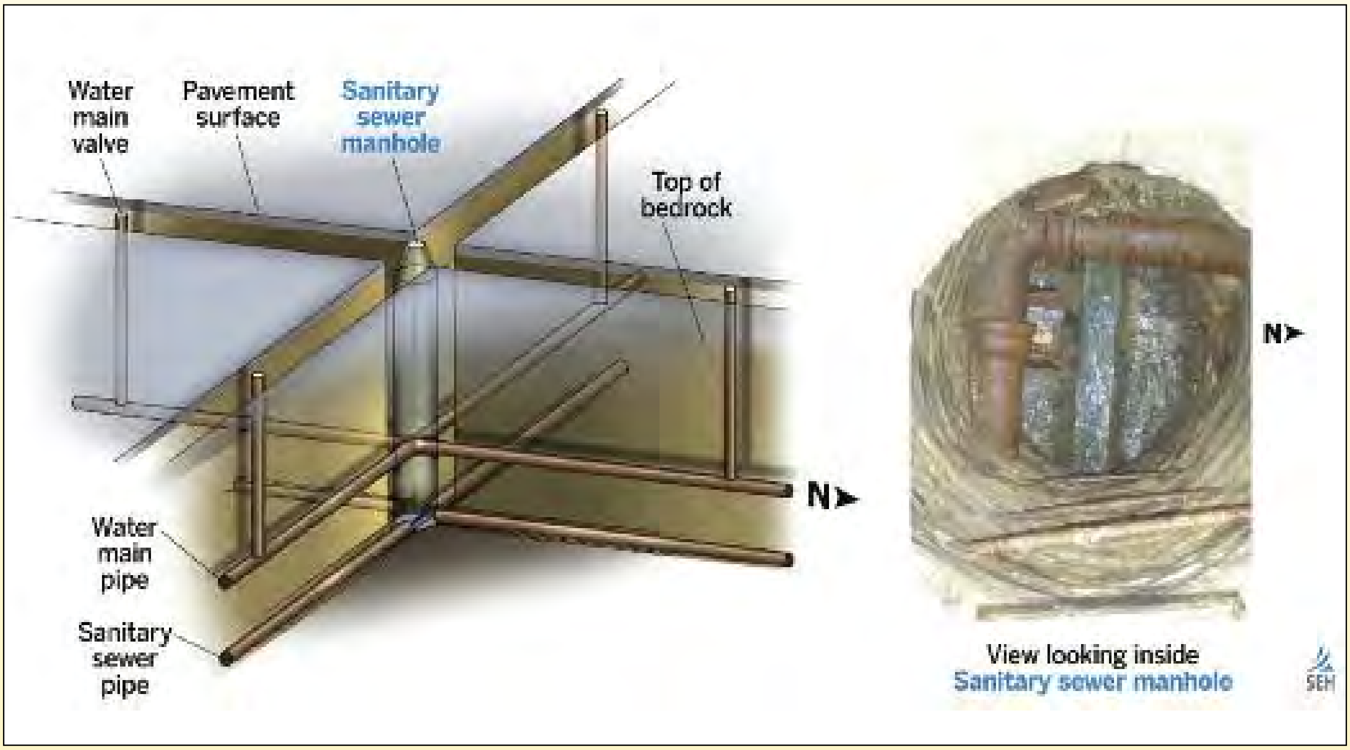
Due to the project's high profile and accompanying risk, the City wanted to ensure their contractor had significant experience installing the specialty structural pipe liner required for the project.

Hastings prepared a qualification process – due with each bid – that measured the quality and experience of each bidder. Each bidder had to provide information of their financial ability, equipment and personnel available, how the general contractor and subcontractor would communicate and schedule their work together, and also the past performance and experience of each bidder.

Two contractors submitted bids. The low bidder was disqualified based on unsatisfactory numerical scores calculated by the qualification process. The City awarded its contract to the second bidder, Fer-Pal, based on their satisfactory process score.

Surgical Construction

In the early 1900s, the sanitary sewer and water main pipes



Upon discovering water main pipe in several manholes, SEH designed ductile iron offsets around the manholes.

were installed in the same hand-excavated trench in the shallow bedrock, with some of the sanitary sewer manholes having water main pipes passing right through them. Leaving this configuration in place was unacceptable under modern-day permitting requirements through the State's Department of Health. To conquer this challenge, SEH was able to design ductile iron offsets around these manholes while the existing pipes running through the manholes were left in place and bulkheaded.

Once Fer-Pal began work, the project team met face-to-face each week to communicate progress and issues, as well as ensure that Hastings' Saturday Cruise-In could carry on uninterrupted. The outcomes of those meetings were conveyed by the City to property owners using the same web page and email ListServe tool developed to explain the City-funded program.

The construction process began by digging small pits at intersections along the center of the street. By decreasing the size of the excavations, the project team was able to control the cost of rock excavation and reduce traffic disruption when compared to the dig-and-replace method.

After installing CIPP liner from these pits, the contractor used a robotic drill to reinstate building services from inside the rehabilitated pipe. Such an approach avoided the need to dig an additional pit in front of each building to reinstate service. In the end, there were only a few disturbances in front of buildings served by the pipe.

Often in CIPP projects, a temporary water main network is laid at the surface and atop the sidewalks. However, to avoid conflict with storefront access, the City and SEH developed a plan to take advantage of the many alleys in the area and use them as the corridor to serve buildings from the rear. Fer-Pal's crews implemented this plan in the field while maintaining alley access for deliveries, garbage pickup, parking, and emergency services.

Collaboration between the City, SEH, and business owners to prepare for connection to the temporary water main system was successful. However, bacteriological testing of the temporary system was more challenging.

Lining was installed via 12 small pits located in the middle of the street.

RIP

The Mark Series, 1994-2014

Mark Series, an innovator, accomplished traveler and trusted companion of thousands of contractors worldwide, passed in October 2014. Our beloved Mark was 20 years old at the time of passing, but was a hard-working tool that served customers worldwide well. A moment of silence please, before turning your attention to the next generation of DCI locating systems, the F Series.

DIGITAL
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Industry leaders. Passionate visionaries. And genuinely nice guys.

To reduce disruptions, temporary service was connected in the back alley rather than the front door.

Passing the Tests

The City provides its citizens water directly from its wells – only adding fluoride. The system is therefore susceptible to bacteriological growth if not carefully monitored. Compounding the treatment concerns, the temporary water system was sized for fire flows but exhibited very low usage typical of a downtown retail business environment. These conditions, combined with the temporary water lines all laid on paved surfaces that became hot under the midday sun, created the perfect scenario for bacteria growth.

All of the system passed initial tests except for one small lateral. After chlorination and retesting yielded additional failures, the City requested the contractor retest other areas and found that previously passing legs were now failing.

To combat this problem and to ensure that clean water was flowing, all parties reached agreement that the contractor would take these areas off-line overnight to supercharge the system with chlorine and flush it again. This action proved successful and the system finally passed all tests. As a precautionary measure, the contractor continuously flushed the system with a one-inch hose at the far end of all major legs for the duration of the project to help keep water flowing and promote cooler water temperatures.

Ultimately, this million-dollar project, which had small carbon and physical footprints, will facilitate the City's future downtown revitalization efforts – known within the community as the "Riverfront Renaissance." SEH estimates that the City saved 40 percent of what it would have cost to rehabilitate its downtown water main pipe using dig-and-replace method. The social impact of the project, which sidestepped numerous potential pitfalls with local businesses and area stakeholders, is incalculable.

The Lauritzen Gardens Project

Preserving a Sensitive Area with a 585-Foot Single Drive at Depths Reaching 50 Feet

David Gill
The Logan Clay Products Company

Chris Koenig
HDR Engineering

Chris Cain
HDR Engineering

Tim Papstein
Horizontal Boring & Tunneling Co.

Kenton Moore
City Of Omaha

Omaha, Nebraska, stretches along the Missouri River for seven miles and is under a consent order with the Nebraska Department of Environmental Quality to improve water quality in the river. One component of the required work includes separating sanitary and storm sewers in selected areas. One project defined by this program is a sewer separation project which took place in a very sensitive setting: Omaha's Lauritzen Gardens.

A portion of the 100-acre site is referred to as the Balefill because a municipal solid waste landfill was operated on the site until 1982. Solid municipal waste was compacted, bound into bales and placed at the site. Closure of the Balefill was completed in 1983.

The Gardens were established on this site in 1993 and are the result of a public-private partnership. Lauritzen Gardens is a privately funded enterprise with several community leaders on its Board of Directors, making it a politically and environmentally sensitive area.

The Lauritzen Gardens Sanitary and Storm Sewer Separation Project called for a single pilot tube microtunnel drive of 587 feet through a hillside at depths of up to 50 feet to install a 30-inch ID storm sewer. Although typically utilized in sanitary applications for its corrosion resistance, vitrified clay jacking pipe was selected for this storm water installation for its axial compressive strength.

The designer needed to avoid the landfill area on one side and a large apartment complex on the other, or this path would not have been chosen. Soil bores were taken at each end of the crossing near what became the pit locations. Due to the steep hillside, the amount of trees, and the depth of cover in this area, no additional bores were taken along the length of the

Site Condition and Plan

A tree-covered hill obstructed the line of sight.

planned drive. The geotechnical report indicated conditions consisting of Peorian loess of medium stiff to stiff consistency.

The planned first phase of construction involved pushing the pilot tube through the entire length of the drive. When all goes well, the completed pilot tube is upsized by a reaming head attached directly to the pilot tube rod on one end and temporary steel casing on the opposite end. The auger-boring machine increases the bore diameter while removing spoil following the guided path created by the pilot tube. On this project, the plan was to use a 24-inch temporary casing for a distance of 60-80 feet and then upsize to a 38½-inch-OD temporary casing. This intermediate step between the pilot tube and the finished size of the tunnel was planned and necessary because of the hardness of the soil.

At first, the project went according to plan. The jacking frame was set to the desired height, grade and alignment from the established survey control points and for the first 260 feet, the pilot tube progressed on line and grade without difficulty.

Conditions outside those indicated in the geotechnical report were encountered 260 feet into the crossing during the initial pilot tube pass. The initial 260 feet of the drive proceeded as expected, but approximately 280 feet short of the receiving shaft, pilot tube advancement halted. The equipment did not reach its maximum thrust capability, but the jacking pressure applied to the pilot tube was sufficient to cause the pilot tube to flex in a serpentine motion, making it difficult for the operator to maintain the target. The crew from Horizontal Boring & Tunneling Co. made another attempt using a five-inch-OD head and one using a 4½-inch-OD head, including a bullet-shaped head for hard soils. The conditions encountered were later determined to be in excess of 4.5 tons per square foot.

The decision was made to attempt an intersect to complete the pilot tube pass through the entire crossing.

The original plan called for an auger-boring machine to install the temporary casing and product pipe because of its torque and thrust capabilities. The unit selected produces over a million pounds of thrust and up to 199,481 foot-pounds of torque and was selected to turn a long string of 36-inch auger.

The adjusted plan called for the intersect pilot tube drive to start from the downhill jacking site. At approximately 180 feet into this drive, 100 feet from successful intersection, the hard clays were encountered from the opposite direction. In spite of the hard clays, the pilot advancement continued and remained on target, until the point of intersection where the target shifted and the thrust pressure decreased suddenly and dramatically. As the operator continued to push the pilot tube string, it transitioned into the previous path and the target was lost. Despite the inability to see the target, the contractor chose to continue the advance until it exited on the uphill side of the crossing.

The two holes were not perfectly aligned. Because of the imperfect alignment, adjustments to the initial plan were made in an effort to mitigate the kink in the pilot tube bore. Because of the hard clay soil conditions, a 24-inch-diameter auger was attached to the pilot tube via a swivel. The new plan called for pushing 24-inch temporary casings through the entire length.

When the 24-inch temporary casing reached the intersect point in the original pilot tube path, the auger began to bind against the casing, indicating the auger was following the pilot tube through the slight bend, while the casing was continuing in a straight line. In order to alleviate some of the pressure, a bit was inserted to provide greater overcut in an attempt to get the casing to follow the pilot tube alignment. Use of a rock bit did not alleviate the bind, and the swivel between the auger and pilot tube was destroyed.

To get a 24-inch casing through the crossing, the augers were removed from this casing and moved to the other pit (on the downhill side), where a second auger boring machine was set up to drive the remaining length in the opposite direction. The casings didn't meet up as desired, so the 24-inch temporary casing string could not be tied together. The crew began to remove casing from the downhill shaft by pulling it out while the other string of casing was augered and pushed down through from the uphill shaft. Using this push-pull technique, the crew was able to achieve a continuous 24-inch temporary casing through the entire run, although the bend was still present, daylight could be seen through the bore.

Jacking the 30-inch VCP in the final step was the smoothest part of the installation.

The decision was made to push the 38½-inch casing with a 36-inch auger from the uphill shaft downward, while pushing out the 24-inch temporary casing. To connect and center the 38½-inch casing on the 24-inch casing, Horizontal Boring & Tunneling fabricated a tool that would go inside the 24-inch casing and accommodate a swivel that attached to the hex on the rotating 36-inch auger. A rock bit was used and the crew began to push casing. Again, the crew encountered grinding near the point of the intersect and the swivel connection was destroyed. The crew resumed the push-pull technique by pulling the 24-inch temporary casing out from the downhill -side with one boring machine while pushing the 38½-inch casing downhill from the topside. Visual inspection indicated the wider casing was on grade, but deviated from alignment. The result was that the downstream end of the drive was out of alignment by approximately three feet.

With the path established by the 38½-inch temporary casing, VCP was used to jack the casings out of the tunnel. The crew attached a two-inch PVC line on top of the VCP to convey grout, filling the annular space. With an established alignment and hard clay soils, this became the smoothest portion of the project and was completed in just two days.

Important lessons are frequently learned on more challenging projects. In this case, the primary lesson learned is the critical nature of the survey control points. A very small misalignment created a cascading series of challenges that required the expertise of the entire team.

Condensed from a paper presented at NASTT's 2014 No-Dig Show in Orlando, Florida.

Westlake Saves a Sewer Interceptor... AND $1.5 Million!

Angus W. Stocking, L.S.

The City of Westlake, Ohio, got an interesting "wakeup call" in 2006, when a sanitary sewer interceptor line in nearby City of Lorain failed dramatically.

"It forced the evacuation of several dozen homes for months," says Westlake Director of Engineering Robert P. Kelly, "and we realized we'd better take a closer look at our system, because we have a similar interceptor arrangement in Westlake and our pipe is about as old as theirs."

> ***"Westlake could save money by focusing on problem areas and leaving the rest of the interceptor alone"***

The interceptor in question was built in the 1960s and runs from west to east along Westlake's northern limits, increasing in size from 36 inches to 60 inches. Dozens of 18-inch to 24-inch trunklines, serving the entire city, drain northerly into the interceptor. The arrangement is efficient and has many advantages. But there are a few weaknesses as well; for one thing, a failed interceptor could affect all of Westlake. "There are about 70,000 people depending on our system," says Kelly. "We simply could not allow a problem to develop."

Interceptors are also particularly prone to microbiologically induced corrosion (MIC), an insidious plague of concrete sewer systems. In Westlake, the south-north trunk lines dump directly into the interceptor and are constructed with 24-inch drops to keep flows moving quickly, which unfortunately creates a great deal of turbulence. Turbulence, combined with organic waste, warm temperatures, and oxygen, leads to high concentrations of hydrogen sulfide gas. The gas feeds colonies of Thiobacillus bacteria which excrete sulfuric acid—some strains of Thiobacillus can thrive in acid concentrations as high as seven percent. The acid attacks concrete directly, turning it into crumbly calcium sulfate (gypsum). Once established, MIC works from the inside out to destroy concrete integrity in just a few short years.

The interceptor had been cleaned and thoroughly inspected at the 40-year mark. But five years later, the Lorain interceptor failed and Westlake retained URS Corporation to perform video inspection, do detailed analysis, and prepare an emergency evacuation plan in the event of failure … just in case. What URS found was disturbing.

"When we inspected at year 40," says Westlake Field Engineer James J. Smolik, "we televised the lines—everything was in good shape." But five years later, URS found significant MIC damage.

"We could walk inside the interceptor and chip away concrete," Kelly says. "It was a real problem." MIC had eaten away 1/2-inch to 1 1/2-inches of the concrete pipe's inner surface. "And," says Smolik, "since the pipe thickness is only six inches, we knew we had a problem."

There was some good news. MIC was confined almost entirely to within 25 feet of trunk line entry points. So, conceivably, Westlake could save money by focusing on problem areas and leaving the rest of the interceptor alone. In theory, this would save about half of the cost of cured-in-place pipe (CIPP) rehabilitation, because the overall footage of rehabilitated pipe would be reduced by more than half. "We actually did a whole design based on that idea," says Kelly.

But there were problems with that approach. CIPP is, of course, a well-proven technology for pipe rehabilitation but it was not a good choice for the particular situation in Westlake. For one thing, CIPP runs are generally manhole-to-manhole, and there is not much money saved by specifying shorter, partial runs. CIPP is also not a good fit when pipe diameter changes, as it does several times in the Westlake interceptor. And finally, manholes that serve the interceptor are quite deep in places, and they would have to be excavated and dismantled to maneuver in felt linings—more work than Westlake wanted to do for a partial rehabilitation.

These small challenges added up to one big problem. Westlake was trying to avoid state or federal money for this project, and had approximately $2 million available. "When we added up all the costs of our CIPP design," says Kelly, "it came to over $3 million! We did not know what to do."

In search of ideas, Smolik attended the Pumper & Cleaner Environmental Expo in Louisville, Kentucky. After a great deal of research and conversation, he returned with two good ones.

The first was ConmicShield®, a concrete additive that permanently inhibits MIC. ConmicShield is easily dosed into concrete and bonds molecularly with the concrete. Even though ConmicShield is not toxic to humans or animals, the treated concrete is anti-microbial, and permanently prevents the growth of Thiobacillus bacteria for the concrete's entire lifecycle.

ConmicShield protection is not new; it was used in shotcrete for a major trunk sewer rehab in 1997 in Atlanta. It has since been adopted by a number of very large municipalities, including Chicago in the world's largest manhole rehabilitation project to date.

His second discovery was Centri-Pipe® (centrifugally cast concrete pipe) lining technology, offered by AP/M Permaform. In essence, Centri-Pipe is a way to centrifugally apply a layer or multiple layers of high-strength structural grout onto deteriorated pipe interiors at diameters ranging from 30 to 120 inches. The grout products developed by AP/M Permaform are designed specifically for structural reinforcement, long pumping distances, rapid curing for quick return to service and high build of pipe crowns. Centri-Pipe is also not completely new—AP/M's patented variation called Permacast® has been used in manhole rehabilitation since 1985—but the Westlake interceptor was one of the first applications of this magnitude in horizontal pipe.

Using Centri-Pipe technology to apply ConmicShield-treated cementitious grout looked like a good way to overcome the challenges Westlake was facing. Centri-Pipe is a truly trenchless rehabilitation technology, and since the equipment can be introduced to pipe interiors via manholes, excavation is avoided. More importantly, the SpinCaster can be started and stopped at any point in the pipe, and adjusted as needed for changes in diameter—it looked like a perfect way to focus on the interceptor's problem areas, and realize the savings city officials were looking for.

"We thought it would work, so we put it to bid," says Kelly. "There were not a lot of contractors who could do this, but we found one … and the total costs came in at $1.6 million. We saved at least $1.5 million by avoiding rehabilitation of the undamaged pipe."

A Job Done Right

United Survey, which awarded the contract, diverted flows around individual trunk line entry points by using 12-inch pumps to move waste overland. The pipe area that was subject to rehabilitation was cleaned and scoured with a high-pressure spin washer to remove loose material. As a final step before applying new grout, Westlake designers called for a ConmicShield rinse of the cleaned interior to be certain MIC could not develop behind the new liner.

After analyzing the interceptor's interior diameter, water load, extent of damage and other factors, engineers determined that a half-inch liner of PL-8000 grout with ConmicShield would be optimum. This would repair and strengthen the interceptor, and prevent corrosion while preserving flow characteristics.

In all, Westlake rehabilitated just 3,961 linear feet of interceptor, as opposed to the 7,200 lf that would have been required by manhole-to-manhole rehabilitation. The work began in 2009 and was completed about a year later; this meant that seasonal adjustments had to be made as the work progressed.

"The work went on during sub-zero days and when it was 90 degrees in summer," explains Smolik. "The contractors learned to use hot water in winter, and on some hot days they actually put ice in the mix!"

Smolik did quality control by paying attention to the amount of dry mix used as work was done. He would calculate the amount needed per foot of rehabilitated pipe, and would check that the right amount had been used as work was performed. By watching the mix, and spot checking as needed, he could be sure that an even half-inch was being applied. If the amount of dry mix used appeared to be off, sections of pipe were cored to verify thickness and patched as needed.

Kelly notes that as the year progressed, the contractor grew more and more proficient. "Toward the end of the project, they could line about 500 feet a day—very impressive."

Trying relatively new techniques and products is not always a comfortable position for city engineers, but the Westlake interceptor project shows that the rewards can be huge.

"This cost less than half of what the manhole-to-manhole cost would have been," says Kelly, "and I believe the finished product is at least as good, maybe better. Because of these savings, we were able to use our own funds, and do the work within a year. Those are huge wins!"

Angus W. Stocking is a licensed land surveyor and full-time infrastructure writer.

The Westlake interceptor project proves that trying "new" things can yield big rewards.

Going Down the Drain

Vertical CIPP Rehabilitates Historic Building Downspouts

HammerHead Trenchless Equipment

The Franklin Delano Roosevelt Campus of the Veterans Affairs Hudson Valley Health Care System is one of the largest community care programs for veterans in the United States. Located in Montrose, N.Y., the hospital provides care in 30 office buildings with graceful architecture and exterior brick veneers.

The drains from the roof gutters had reached the end of their lifecycle, but the 40- to 50-foot vertical drops of three-inch cast-iron pipe were concealed within the walls of the buildings. They made a 90-degree transition to four-inch horizontal pipe at basement crawlspaces in concrete slab on grade, leading rain water to the sewer system.

Replacing the drains from within the building would entail substantial demolition and interfere with hospital operations. The other choice, bypassing the drains with exterior installations, would blemish the buildings' aesthetic appeal.

Cured-in-place-pipe presented a perfect solution. Whispering Pines Development Corporation of Vails Gate, N.Y., was contracted to rehabilitate the existing drainage system. To accomplish this project, they chose HammerHead Trenchless Equipment's line of CIPP products, which are currently only offered in the North American market.

Equipment included two HammerHead Mini-Hydra Drum CIPP lining inversion drums, four application nozzles, four 150 psi portable air tanks, Picote chain flails for cleaning the existing pipes, a Picote CIPP reinstatement system, and more than 7,100 feet each of composite liner and calibration tubing, with epoxy resin and hardener.

HammerHead's HH Flex Liner permits upsizing one step, seamlessly making the transition from three-inch pipe to four-inch-diameter pipe.

HammerHead CIPP specialist Cory Steckmann served as onsite consultant and trainer for Whispering Pines employees. The team opened an access into an existing vertical pipe at its elbow to the gutters inside the attic. Then they cleaned the pipe of tuberculation with a pneumatically powered chain flail.

The crew cut felt tubing to length for the "wet out" process. The liner was clamped at one end and then a pump was used to create a vacuum within the liner. They poured resin in through the open end, sending it through adjustable rollers mounted on the wet out table to uniformly impregnate the liner.

When the wet-out process was complete, the team rolled the liner on the reel of a specially designed "inversion drum." They folded the end over the inversion drum's nozzle like a cuff and clamped it in place. Once the nozzle was in place against the pipe opening, they charged the drum with compressed air. The pressure caused the liner to exit the drum inside-out into the existing pipe, unwinding itself from the reel as it went. This step, called the "inversion process," unfolds the resin-impregnated side of the felt outward against the pipe's interior surface.

The nozzle was then disconnected so they could wind an inflatable hose, called a calibration tube, onto the drum's reel. They inverted the calibration tube into the liner that was just installed. Pressurizing the calibration tube to 10 psi pushed the liner uniformly against the pipe throughout its length. Air and ambient temperature were specified for this project.

Ambient cure time for this product combination was five hours. When the cure time was up, the crew removed the nozzle and pulled out the calibration tube. Then they verified the quality of the installation with a video camera before reconnecting the pipe and returning it to service.

The crew performed wet-out and inversion of four runs in a morning. It took only about an hour per 50-foot run to prep the pipe for lining, invert the lining and calibration tube and set up a portable air tank to maintain pressure throughout the cure time. In the afternoon the crew removed calibration tubes, video-inspected the installations and reconnected the four drainpipes.

The fully loaded HammerHead Mini-Hydra Drum is compact and lightweight enough to manually carry up flights of stairs and around obstacles in a tight workspace.

Overcoming Obstacles:
A Case Study of Incorporating Expert Opinion and Spatial Analysis into Water Distribution Failure Prediction Modeling

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As more water distribution pipes are reaching the end of their useful lives, utilities and consumers have to address the problems associated with pipe breaks. A recent study released by the Environmental Protection Agency (EPA 2013) estimates the 20-year financing needs to maintain and replace U.S. water distribution assets to be upwards of $280 billion. The study also estimates that the average utility's distribution pipe replacement rate is just one percent.

Utility operators are tasked with developing maintenance, replacement and rehabilitation (MR&R) programs that minimize the long-term costs associated with deferred rehabilitation and replacement. Decision support systems (DSS) based on historical records are valuable tools for developing these programs, yet surveys indicate they have not yet been widely adopted, partially due to the large data requirements. By synthesizing maintenance histories, Geographic Information System (GIS) analyses, and expert knowledge of the network history and performance, utilities with limited and uncertain data can develop reliable capital improvement planning tools. The following presents a case study of developing a DSS for a large utility and provides guidance for small utilities wishing to develop prioritization models.

DSS for Large Utilities

Medium and large utilities with several hundred to thousands of recorded failures can develop statistical models to predict pipe failures based on previous performance. Specifically, Weibull Hazard Rate-based models have been introduced by many researchers and consultants, due to their capability to capture the "bathtub-shaped curve" of infrastructure degradation and to incorporate parameters that explain differences in failure rates. The most common parameters used are material, installation date, diameter, length, and

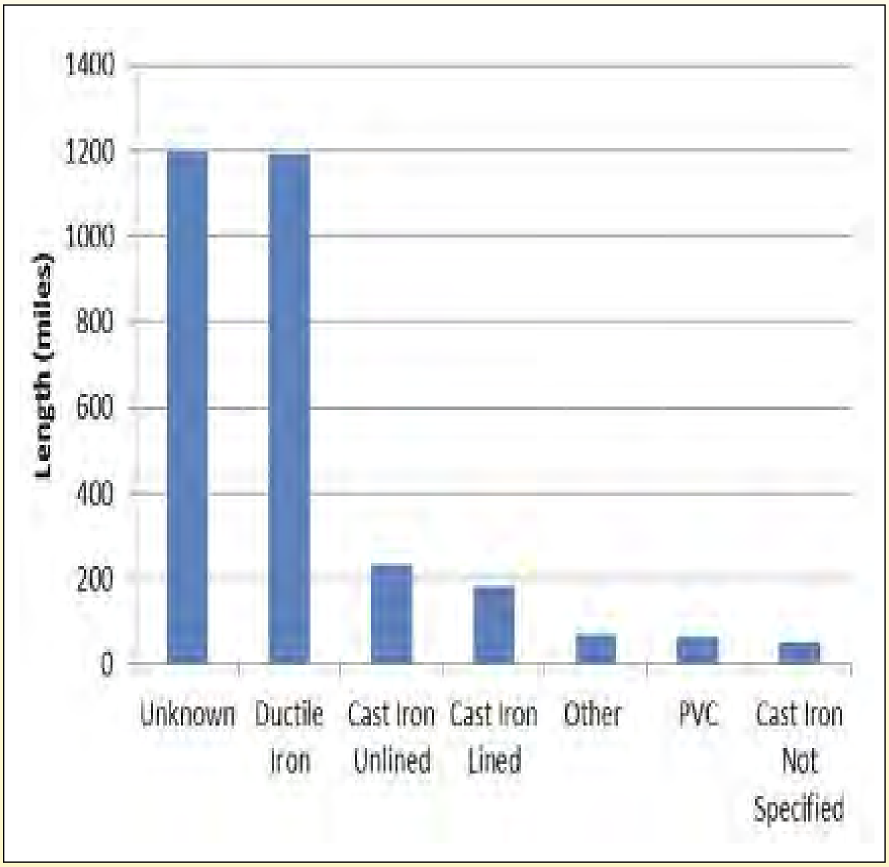

Figure 1. Pipe Materials – Utility A

number of previously recorded failures. Some models include additional parameters that describe pipe operating and environmental conditions including pressure, bedding depth, groundwater levels, and infrastructure above the pipe.

Of concern is that the parameters most commonly used in models including material, installation date, and pipe length, are often difficult to acquire with certainty. For example, Utility A in the Southeast United States has over 600,000 residents with 2,800 miles of pipe. The maintenance database for Utility A spans 10 years with over 2,600 recorded failures. Though the utility has plenty of failures with which to train a statistical model, many material properties are unknown, shown in Figure 1. Similarly, over 40 percent of the installation dates are not known. Utility A is like most older utilities that do not have exact information stored in databases regarding the age and composition of their network.

To address these uncertainties, the expert knowledge of Utility A personnel was incorporated into the model. Pipe materials were estimated by geographic location and knowledge of development timelines in the utility. The pipe material was estimated based on time of installation. For example, pipes in newer developments built in the 1990s are likely to be ductile iron, while pipe installed in older areas of town in the 1940s are likely to be cast iron. Parameters were added to the Weibull model to account for when the material and/or installation date was known, as recorded in the database, and when the material and/or installation date were assumed using the technique above.

In addition to the material and installation date, the recorded pipe length in the GIS database is the length obtained by digitizing as-built maps and does not reflect the true length of the pipe segments in the field. Recorded segment lengths range from less than one foot to several thousand feet. Though pipe length has been identified by other researchers as one of the most significant model parameters, this parameter often serves as a surrogate for the clustering of accidents because longer pipes have a greater occurrence of multiple failures than short pipes.

Instead of including the pipe length as a parameter in the model, a new parameter that analyzes the local clustering of pipe failures using spatial analysis tools within ArcGIS and estimates the break rate for small subsets of the network is introduced. Cells are drawn around failure points, shown in Figure 2, and spatial analysis tools in ArcGIS are used to assign an average local break rate to every pipe in the network.

The break rate parameter proved to be one of the most significant parameters used in developing the model. Validation studies of the final model for Utility A, which included the local break rate, diameter, material, installation date, and assumption parameters resulted in predictions of a significant number of failures and successfully identified the highest-risk group of pipes.

DSS for Small Utilities

The methodology described above is not applicable for small utilities with fewer than several hundred recorded failures documented over a period of five or more years. Extensive failure records are needed to train valid statistical models. Research is ongoing to evaluate the feasibility of using models developed for large utilities to improve model performance for similar, yet smaller, utilities.

Alternative techniques that incorporate expert opinion can still be used to prioritize pipes for replacement and rehabilitation. For example, the KANEW model developed for the Water Research Foundation requires users with expert knowledge of network performance to estimate the lifecycle of families of pipe that have similar physical properties. This expert knowledge of network performance is incorporated into survival models to predict long-term replacement rates for families of pipe. As an alternative to prediction-based prioritization models, data mining and spatial clustering tools, which are included in data analysis software packages, can be utilized to identify high-risk pipes.

Conclusion

While limited and uncertain data can be significant hurdles for utilities considering adopting advanced Decision Support Systems, the case study of Utility A shows that by incorporating expert opinion and spatial analysis results, valid failure prediction models can be developed for large utilities that lack extensive network data. Though most small utilities cannot develop models as sophisticated as the one proposed, alternative tools and methods can be easily utilized to estimate replacement rates and identify replacement/rehabilitation pipe candidates.

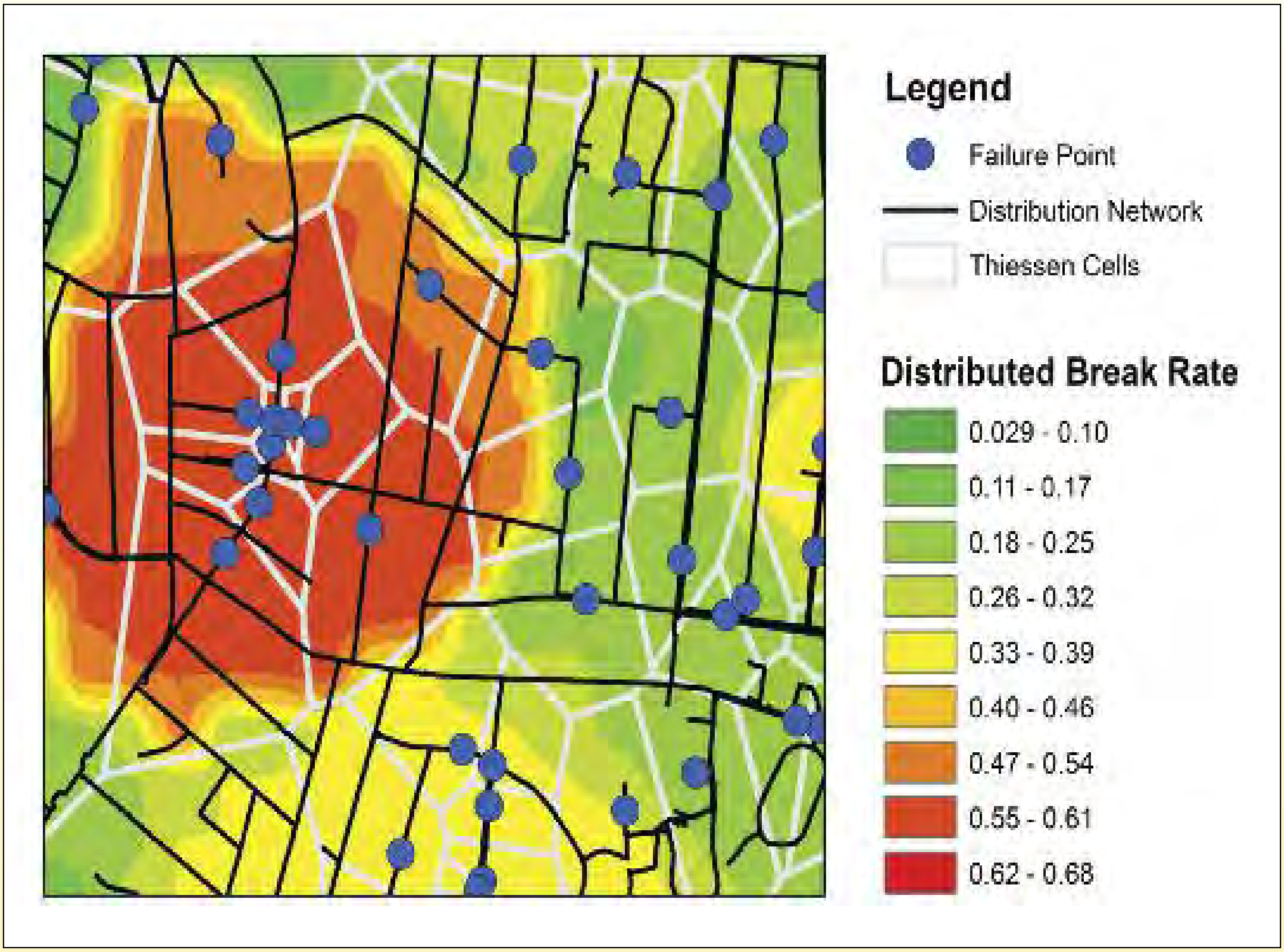

Figure 2. Break Rate Spatial Analysis

Trenchless Pipeline Design Considerations for Railroad Crossing

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Indiana University Purdue University

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Midwest Mole Inc.
Greenfield, Indiana

Demand for underground pipelines and rehabilitation of existing pipelines has been increasing due to urban expansion, continuous development, and deterioration of the existing infrastructure. However, when it comes to railroad crossings, many engineers and contractors do not have sufficient experience and familiarity with trenchless installations under railroads, unlike the typical municipal street crossings or other utility crossing applications.

There is a wide variety of trenchless technologies that offer different approaches to different challenges. It is the engineer's responsibility to determine the most appropriate construction technology to a particular project based on the uniqueness of the soils, location, space, and railroad company requirements.

Trenchless technology applications have been expanded to all types of utilities including water mains, wastewater collection, storm collection, communication cables, power cables, gas transmission and distribution, and petroleum product. These utility pipeline network systems provide essential resources to industry, business, and human life. Due to expansion in construction, it is evident that some pipelines must run parallel or across the railroad.

The American Railway Engineering and Maintenance-of-Way Association (AREMA) manual for pipeline installation recommends a number of trenchless technologies including boring and jacking. Other technologies are not specifically detailed in the manual. Figure 1 summarizes various decision-making factors based on types of product materials and pipe materials for both carrier and casing pipes recommended by AREMA. Figure 2 shows a typical launching pit for an auger boring (jack & bore) casing installation crossing railroad.

AREMA's Committee 1, Part 5 "Pipelines" offers a description of the general requirements, construction, approval of plans, and execution of work. It is the engineer's responsibility to determine the most appropriate method design and the contractor's responsibility to provide technology, equipment, and operators to be applied in a specific project.

AREMA's Part 5, Pipelines, provides recommended practices that cover from the scope of work to the execution of work. Part 5 is divided in five sections; however, only the first three discuss underground pipelines. Those sections are on pipelines conveying flammable substances,

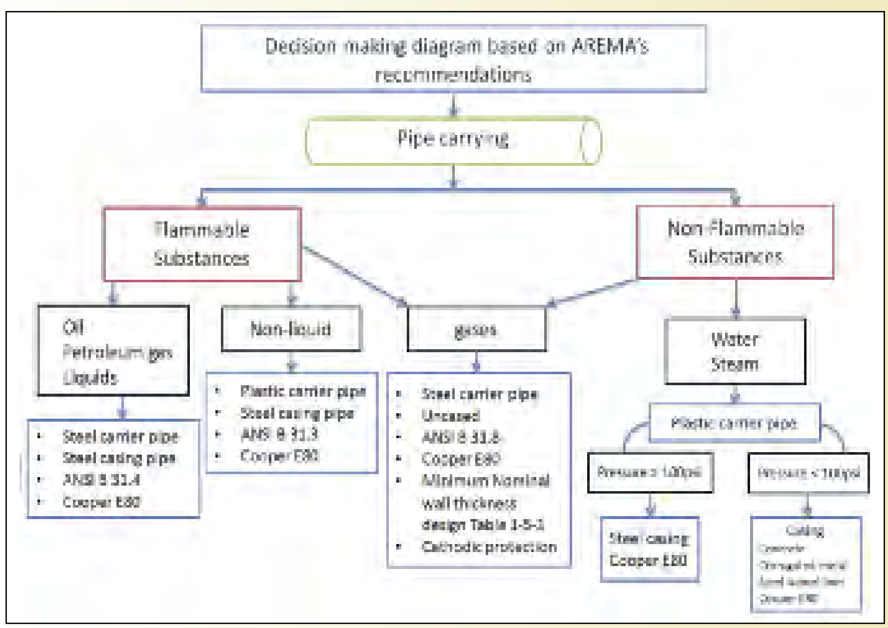

Figure 1. Diagram for Decision-Making Factors from the AREMA Manual

uncased gas pipelines within the railway right-of-way, and pipelines conveying non-flammable substances.

In all three cases, AREMA establishes that if practicable, the pipelines should be installed by boring or jacking. It is important to note that AREMA does not specify any particular technology name; therefore, any technology that applies the principles of jacking and/or boring may be utilized in railroad crossing.

The pipe should be installed preferably at a right angle but not less than 45 degrees. The burial depth of the pipe varies on whether the pipe is cased or uncased. If the pipe is cased, it should be installed at not less than 5.5 feet from the base of the rail to the top of the pipe. The carrier pipe and the casing should be insulated from underground electric conduits. In this case, the steel pipeline should be insulated to be protected from electrochemical corrosion. The casing must extend at least two feet beyond the toe of slope, or 3 feet beyond the ditch, or 25 feet from the centerline when the pipe is below ground.

Summary of the three main sections related to pipe installation are as follows:

* Specifications for Pipelines Conveying Flammable Substances, Section 5.1, Part 5 (AREMA 2002). This section provides specifications for pipelines that will be installed on or adjacent to railroads. The specifications may change as risks increase; that may be due to track speed, traffic density, traffic sensitivity, terrain conditions, grading, structures, pipe size, environmental risks, etc. It is required that all pipes are encased in a larger steel casing pipe. Steel pipe is required when carrying oil, gas, petroleum, and any other flammable substance. The steel pipe must comply with the requirements of ANSI B 31.4 ANSI B 31.4 provides codes and standards for Liquid Transportation System for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols. The steel casing should be capable of withholding the loads according to Cooper E80 loading.

* Specifications for Uncased Gas Pipelines within the Railway Right-of-way Section 5.2, Part 5 (AREMA 2002). In general, the pipeline should be installed using boring or jacking. Pipelines carrying flammable and non-flammable gases must be made of steel. The pipe must comply with the requirements of ANSI B 31.8. Gas Transmission and Distribution Piping Systems. In this section, AREMA provides a design table and that helps the engineer to determine the steel pipe wall thickness. Note that steel carrier pipes carrying flammable and non-flammable gases do not require casing but wall thickness of pipe should be designed using Table 1-5-3 on Section 5.2 of AREMA's guidelines. If the pipe is crossing the railroad, one must install the pipe at a depth not less than 10 feet from the base of the railway.

* Specifications for Pipelines Conveying Non-Flammable substances Section 5.3, Part 5 (AREMA 2002). This section is dedicated to the pipes that are to be used to transport water, steam, or any other non-flammable substances. In this section, it is specified that the deflection of the pipe, due to external and internal loads, should not exceed five percent of the outer diameter of the pipe. If the carrier pipe stress is under 100 psi, it is allowable to use concrete or corrugated metal pipes as casing pipes. The casing must extend at least two feet beyond the toe of slope, or three feet beyond the ditch, or 25 feet from the centerline when the pipe is below ground. The selected pipe material must be resistant to any chemicals that it may be in contact with. Plastic pipes should not be used if there is a possibility of any contact with petroleum contaminated soils; in such cases, the carrier pipe should be of steel.

In particular cases, AREMA allows the absence of casing as long as the burial depth is purposely increased, to install the pipe deeper.

In conclusion, AREMA provides the engineer with the basic guidelines to completely and successfully plan, design, and install a pipe under a railroad. It has been learned that it is possible to implement different trenchless technologies in the railroad industry. However, there is still a great open field of opportunities to further develop new methods to cross the railroads utilizing trenchless technologies.

Figure 2. Trenchless Launching Pit Installation for Crossing Railroad

La Crosse Puts an End to That 'Sinking Feeling'

Cretex Specialty Products

Johnson and 11th Streets in La Crosse, Wisconsin, were scheduled for replacement of the sidewalk, curb, gutter and pavement; but, first, a deeper problem needed to be addressed. "We had observed pavement and ground settlement in the street, curb, gutter and adjacent grass terrace area," explained Steve Asp, City Assistant Superintendent-Sewer. "There is a lot of flow during rain events because several other large storm water pipes tie in to the manholes on either side of the 72-inch pipe. We suspected soil migration through the joints of this storm line and tried patching them with mortar several years ago, but the issues of settling continued."

The 72-inch pipe, dating back to 1950, was still in great condition with imperceptible deterioration. It was determined that the stress on the pipe joints was due to the pipe's 28-foot depth and the sheer volume of flow during rain events. Asp researched his options: Lining the pipe was cost-prohibitive due to the pipe's depth, and would require excavating pits on either side of the pipe section. Chemical grouting of the joints – a short-term solution, at best – was also rejected.

Finally, Asp discovered HydraTite Internal Pipe Joint Seal, distributed by Cretex Specialty Products. The seal requires no excavation or water removal from the pipe, and features limited surface preparation, quick installation and a 50-year design life. The contractor chosen to do the work, Infratech based in Rogers, Minnesota, was trained and certified in the proper installation of the HydraTite Seal by a Cretex representative at the onset of the project.

Ultimately, seven HydraTite seals were installed in only seven hours by a two-man crew in the pipe and one top man. Access was through a 78-inch-diameter block storm manhole with a 24-inch frame and chimney opening. The HydraTite seal repaired any mal-alignment of the joints and formed an impenetrable barrier against further infiltration.

It was a rainy year in 2013 in western Wisconsin, but, equipped with the HydraTite Seal, La Crosse no longer has that "sinking feeling."

The first three bands were assembled at the pipe joint and then placed into the seal after it was opened and positioned. The other four seals were installed after the bands were assembled in the manhole and then moved into their proper location at each joint.

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