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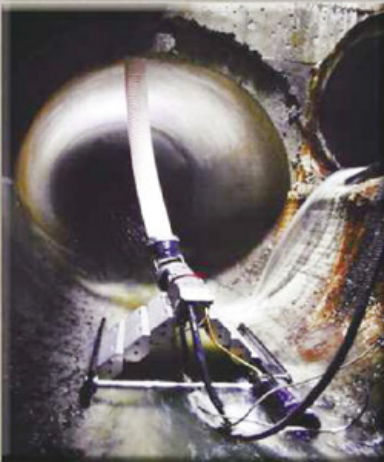
BC's Magazine for Trenchless Construction

2025

Bridging the Knowledge Gap
.....
DAT Framework in Action
.....
Richmond Box Culverts
.....
Seismic Design Criteria



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CHAIR

Robert Epp

repp@infrastruct.ca

MAGAZINE LIAISON

David O'Sullivan

david@pwtrenchless.com

PUBLISHER



662 Dudley Avenue
Winnipeg, MB Canada
R3M 1R8

EDITORIAL

Andrew Pattison

204.275.6946

marcomap@shaw.ca

ADVERTISING SALES

Bert Eastman

204.997.6371

bert@atobpublishing.com

Wayne Jury

204-803-1300

waynej@atobpublishing.com

PRODUCTION TEAM

harper media

your social media strategy & web marketing partner

700 - 200 Main Street
Winnipeg, MB
R3C 1A8

DIRECTOR

Aaron Harper

204.318.1121 xt. 101

aharper@harpermedia.ca

LAYOUT ART & DESIGN

Joel Gunter

204.318.1121 xt. 108

joel@harpermedia.ca

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From Sea to Sky: A West Coast Welcome to No-Dig North



Message From The NASTT-BC Chair

Robert Epp, NASTT-BC Chair



As delegates, partners, and colleagues from across Canada, the United States, and more than two dozen international chapters arrive in Vancouver, we at NASTT-BC extend a warm and grateful welcome. This year's No-Dig North is more than a technical conference – it is a celebration of the global trenchless community, and we are proud to host it here on the West Coast.

We also acknowledge with gratitude that this gathering takes place on the unceded homelands of the Coast Salish nations, including the territories of the St'át'imc, Skwxwú7mesh (Squamish), xʷməθkwəy̓əm (Musqueam), and Səlilwətaʔ/Selilwitulh (Tsleil-Waututh) peoples. Hosting an international event on these lands is a privilege, and we honour the communities who have cared for them since time immemorial.

A PLACE WORTH SHARING

Vancouver is a city defined by its contrasts. Where else can you walk from the ocean's edge to the base of snow-capped mountains in a single afternoon? Our backdrop stretches from Sea to Sky, a phrase that not only describes the landscape but also the spirit of this region. From the bustling seawall and the historic charm of Stanley Park to the sweeping beauty of the Coastal Mountains, we are proud to share this place with you. And while the scenery may impress, it is the culture of the West Coast that we are most excited for you to experience. This is a region that embraces diversity, sustainability, and innovation. Our industry reflects those same values, bringing together people with different expertise, working collaboratively to solve

*A celebration
of the global
trenchless
community.*

today's toughest infrastructure challenges with solutions that protect our communities and our environment.

IT'S PASSION THAT DRIVES US

Behind this event, and behind every NASTT initiative in BC, is a group of people who dedicate their time as volunteers.

“*It's more than an industry,
it's a movement powered by
people who care deeply.*”



Engineers, contractors, municipal staff, suppliers, and consultants, all giving their energy freely because they believe in trenchless technology and the difference it makes at street level to the community at large.

We volunteer because we've seen firsthand the value of trenchless: reducing costs for communities, protecting the environment, and extending the life of vital infrastructure. It's more than an industry, it's a movement, and it's powered by people who care deeply about advancing it.

LOOKING AHEAD: TT101 IN NORTHERN BC

Not everyone who wanted to attend Vancouver could be here. That's why we are excited to announce that in February 2026, NASTT-BC will host two Trenchless Technology 101 (TT101) events; one in Prince Rupert BC and one in Prince George BC.

Each session will feature four subject matter experts (SMEs) delivering practical, accessible presentations on the fundamentals of trenchless technology. The curriculum will include:

- **Introduction to Trenchless Technology:** An overview of the methods, applications, and advantages of trenchless solutions.

- **Manhole Rehabilitation:** Strategies and technologies to extend the service life of aging manhole infrastructure.
- **Culvert Rehabilitation:** Trenchless approaches to restoring critical water crossings with minimal disruption.
- **Cured-In-Place Pipe (CIPP):** An introduction to one of the most widely adopted trenchless rehabilitation methods, including key design and construction considerations.

This course is designed for municipal staff, engineers, contractors, and suppliers who want a solid foundation in trenchless practices. By bringing TT101 to the North, we are expanding access to education, ensuring that communities across BC, including those in remote and coastal regions and communities, can benefit from the same trenchless strategies that are transforming infrastructure in larger urban centres.

YOUR ROLE IN GROWING THE COMMUNITY

We invite you to take full advantage of No Dig North, attend sessions, explore the exhibit hall, and connect with your peers. But when you head home, we also encourage you to share what you've learned.

Conferences don't end when the exhibit hall closes. The lessons, stories, and

friendships made here will shape projects and decisions for years to come. By passing along what you've learned, you help broaden the reach of trenchless knowledge, ensuring that even those who could not be here benefit from the ideas exchanged this week. Whether that means mentoring a young engineer, advising a client, or telling a colleague about TT101 in 2026, your role as a messenger is critical to the strength of our industry.

CLOSING THOUGHTS

From everyone at the NASTT-BC Chapter, NASTT National and our friends from the ISTT around the globe thank you for being part of No-Dig North in Vancouver, British Columbia.

Whether you've come from across town or across the globe, we are proud to host you and grateful for the opportunity to showcase our beautiful city and our growing trenchless industry.

Here's to a successful conference, lasting connections, and to the future of trenchless technology, from Sea to Sky and far beyond.

Robert Epp

Robert Epp
CHAIR, NASTT-BC





MESSAGE FROM NASTT CHAIR

Greg Tippet, P.Eng., NASTT Chair

Dear NASTT-BC Members & Supporters,

As Chair of the NASTT Board of Directors and a member of the BC Regional Chapter, I want to take a moment to thank you for your continued commitment to the trenchless industry and your active engagement within your regional community. Our success as a society depends on the strength of our Regional Chapters.

One of the most inspiring aspects of our organization is the dedication of our volunteers. Whether you're serving on a committee, mentoring a young professional, organizing local events, or simply showing up to lend a hand at chapter activities, your time and energy are what make this society thrive. Your expertise, generosity, and passion for trenchless technology are the heartbeat of our mission, and I want to express my deep appreciation for everything you do.

While our regional events are essential to strengthening local networks, NASTT also provides you with opportunities to engage with trenchless leaders on a global scale. First up is the **2025 No-Dig North & ISTT International No-Dig**, taking place in our backyard in **Vancouver, October 27-29**. This combined conference will bring together trenchless professionals from around the world, offering a unique platform to showcase North American innovation alongside global advancements. It's a rare and valuable chance to learn

A rare and valuable chance to learn from international peers!

from international peers and share the outstanding work being done across our region.

Then, in 2026, we'll head to **Palm Springs, California for the NASTT 2026 No-Dig Show, March 29-April 2**. Palm Springs promises to be an exciting and memorable destination, and our team is already hard at work planning a world-class event with technical sessions, networking opportunities, and the unmatched energy that makes the No-Dig Show such a cornerstone of our industry calendar. If you've ever considered presenting, volunteering, or exhibiting at a national level, now is the perfect time to start planning for your involvement.

These events, local, national, and international, are only made possible by the engagement and leadership of



members like you. As we grow and expand our impact, I encourage you to consider how you might get involved in the months ahead. Whether it's submitting a paper, nominating a deserving peer for an award, supporting student and young professional programming, or participating in one of our many outreach initiatives, your voice matters and your presence makes a difference.

On behalf of the entire Board of Directors, thank you for being a valued member of the BC region and the larger NASTT family. Your contributions help move our industry forward, one innovative, trenchless step at a time. I hope to see you in Vancouver this fall or Palm Springs soon after!

Greg Tippet

Greg Tippet, P.Eng.
NASTT Board of Directors Chair

NASTT Municipal & Public Utility Scholarship

APPLICATION DEADLINE: NOVEMBER 1



The NASTT No-Dig Show Municipal & Public Utility Scholarship awards employees of North American municipalities, government agencies and utility owners who have limited or no training funds with a Full Conference and Exhibition registration to the NASTT No-Dig Show. Hotel accommodations for three nights at the host hotel are provided for selected applicants. Recipients have full access to all exhibits and technical paper sessions.

Join us in Palm Springs! Applications should be submitted by November 1, 2025 at nastt.org/no-dig-show



**NORTH AMERICAN SOCIETY FOR
TRENCHLESS TECHNOLOGY**

The No-Dig Show is owned by the North American Society for Trenchless Technology (NASTT), a not-for-profit educational and technical society established in 1990 to promote trenchless technology for the public benefit. For more information about NASTT, visit our website at nastt.org.

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NASTT-BC 2025-2026 BOARD OF DIRECTORS

Angus Botting
Geoscan
angus.b@geoscan.ca

Jesse Doolin
MJP Consultants
jesse@mjpconsultants.com

Ash Faghieh
CCI Inc.
ashkan.faghieh@ccisolutions.ca

Mike Ireland
Michels Canada
mikeireland@michelscanada.com

David O'Sullivan
PW Trenchless Construction Ltd.
david@pwtrenchless.com

Danica Vulama
Metro Vancouver
danica.vulama@metrovancover.org

ADMINISTRATOR:

Charlotte Wong
nasttbc@gmail.com





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UNDERGROUND INFRASTRUCTURE SUSTAINABILITY:

**No-Dig North, Vancouver Convention Centre
October 27 – 29, 2025**

*Explore the Future of Trenchless Innovation at the
NASTT 2025 No-Dig North & ISTT International No-Dig*

Join industry leaders from across North America and around the world at the 2025 No-Dig North & ISTT International No-Dig conference, happening October 27-29 at the Vancouver Convention Centre. No-Dig North is an annual event that brings together professionals in engineering, construction, manufacturing, and municipal planning to exchange ideas and discover cutting-edge trenchless technologies that support sustainable, cost-effective infrastructure development. With this year's partnership with ISTT, the conference brings a global vision of trenchless technology into focus.

No-Dig North is the largest trenchless technology conference in Canada where municipalities, contractors, consulting engineers, public utilities, industrial facilities, and damage prevention professionals attend to learn new techniques that will save money and improve infrastructure. This show offers topic tracks over the course of two days with peer-reviewed, non-commercial presentations, including case studies detailing environmentally friendly trenchless solutions and cost-saving opportunities. Additionally, an exhibition hall and networking events are offered throughout the week for opportunities to exchange ideas with colleagues. NASTT's suite of Good Practices Courses is offered on the first day of the conference as well.



Networking and access to industry expertise is a central feature of the annual No-Dig North



The exhibit hall features the latest innovations in trenchless technology from around the globe

For information and registration link please visit:
<https://nastt.org/no-dig-north/>



Meet Us in Vancouver

October 27-29 | Vancouver Convention Centre

No-Dig North is the premier annual conference focused on trenchless technology in Canada. Attendees include engineers, contractors, manufacturers, and municipal representatives who seek to learn about and discuss sustainable, cost-effective solutions for infrastructure needs. The 2025 No-Dig North and ISTT International No-Dig conference is coming to Vancouver, BC at the Vancouver Convention Centre, October 27-29, 2025.

Learn more at
nastt.org/no-dig-north



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Bridging the Knowledge Gap



By: Chris Morris, PW Trenchless Construction Inc.

The chances are you're reading this because you already have some interest in or some knowledge of trenchless. After all, trenchless technologies are famously attributable to a huge range of advancements and achievements in construction, maintenance and rehabilitation over the last century. However, the chances of you having direct experience in trenchless methods are considerably slimmer, and the chances of you having received formal education or training in a trenchless field, very minimal indeed.



THE CHALLENGE FOR THE INDUSTRY

The doors opened by trenchless innovations have never held more importance in the advancement of our societies. As our populations grow and our cities continue to expand, the resulting demand placed on our infrastructure is higher than ever. Thus, the continuous need to improve and refine our approach to construction, maintenance and repair of our subsurface assets has never been greater. New utilities are installed under rivers, railroads and complex terrain with minimal impact at surface level. Newly rehabilitated sewers, watermain, culverts and tunnels continue to serve communities with most of their users having no knowledge of the work that has been done beneath their

We advance by innovating, learning and educating together, as a trenchless industry.

feet. Yet, despite all of this, reconsider my original point; formal training in trenchless is not commonplace, and is not routinely taught in most engineering programs. Unlike other sectors where academic institutions and professional associations lead continuing education, trenchless has grown up as a contractor-led industry. Contractors develop methods, test them in the field, and share the lessons learned. They fund, facilitate, and ultimately drive the learning

opportunities that keep the industry moving forward. Organizations such as NASTT serve as a platform for transfer of this knowledge on both a national and regional level. Despite this, as new engineers graduate and join the industry, they often do so having received little or no trenchless education. This knowledge gap has been well known since the infancy of the trenchless sector in North America and continues to be a challenge to the industry to this day.



PW Trenchless organizes half-day free educational delivered by key industry stakeholders including contractors, consulting engineers and product/system manufacturers



The most recent PW Trenchless session in July 2025 discussed asset management, highlighted failure modes and delivered detailed information on a specific rehabilitation solution

THE PAST, PRESENT AND FUTURE

The trenchless knowledge gap is not a new concept. Using the trenchless sector in British Columbia as an example, from its inception in the early 1990s, trenchless “education” had been limited to a small number of contractors and product suppliers delivering sales demonstrations.

The beginnings of the first collaborative efforts to deliver training were made at the 1997 No Dig Show in Seattle, WA, during which NASTT-NW chapter was founded. The newly formed chapter (which eventually became NASTT-BC, in British Columbia), aimed to promote trenchless construction in British Columbia through unbiased education. To address the learning needs of engineers and government staff, who often had limited opportunities to attend larger conferences, NASTT-BC organized more accessible half-day sessions, road shows in partnership with Centre for the Advancement of Trenchless Technologies (CATT) and Trenchless Technology magazine, and localized conferences. Key contributions include the introduction of the WRC CCTV coding standard in BC, which was later adopted by NASSCO and now widely used in North America.

In more recent years, several other organizations in Canada were formed, including the Canadian Underground Infrastructure Innovation Centre (CUIIC) in 2022 from the University of Alberta, which holds regular academies delivered by experts from multiple disciplines across the industry (see pgs. 44-45). In many cases,

there is a cost involved to attend these programs, however, fees for municipal attendees are often significantly reduced. This is a very positive step in promoting engagement in these sessions from our asset owners.

Despite the extremely positive contributions from these organizations, there remain limits to their reach, which include the frequency of events, location and budgetary restrictions on cities and municipalities to allow their employees to attend. Some organizations within the industry have begun to take this into their own hands, and PW Trenchless is a key example. In September 2024, PW began hosting regular half-day education sessions in the Greater Vancouver area, with cities, municipalities, consultants and other contractors attending in strong numbers. The sessions are held for free, and are delivered by key industry stakeholders including contractors, consulting engineers and product/system manufacturers. The format has developed over time, and the sessions aim to approach interlinking subjects from different angles. For example, the most recent session in July 2025 discussed asset management, highlighted failure modes and delivered detailed information on a specific rehabilitation solution. This approach provides broad context and promotes a comprehensive understanding of the capabilities, benefits and limitations of specific trenchless method as the solution to an infrastructure challenge. The next session is planned for December 2025. So, what does the future hold for our industry and trenchless education? Whether trenchless becomes

a widely adopted part of engineering programs remains to be seen, however seems unlikely, in the short term. What is clear is just how much industry-led education has contributed to the ongoing success of the trenchless industry. The ongoing contribution of organizations such as NASTT, CUIIC and individual organizations in transferring knowledge and experience to those responsible for our underground assets, cannot be understated. Perhaps one day, their contributions will lead to wider adoption from educational institutions and wider knowledge of trenchless among new starters in the industry. For now, the message is clear – We advance by innovating, learning and educating together, as a trenchless industry. 🏗️

For further information on upcoming seminars and networking events, or to subscribe to the PW Trenchless Newsletter, please visit:

<https://www.pwtrenchless.com/contact-us/>

ABOUT THE AUTHOR:



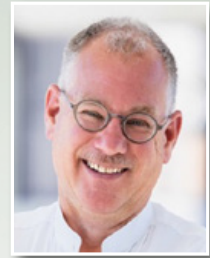
Chris Morris manages Business Development at PW Trenchless Construction. With a background in trenchless construction, CIPP and

municipal projects, he writes technical proposals and highlights the company's role in advancing trenchless methods. Chris enjoys making technical work approachable, showing the value of sustainable infrastructure and the stories behind every project.

Expert Insight:

A Conversation with Professor Mark Knight

Despite the overall lack of trenchless education in engineering curricula, there are a small number of leading universities with strong trenchless programs. Examples are Queens & Waterloo universities, the University of Alberta, Arizona State, and Louisiana Tech University with its Trenchless Technology Center. Professor Mark Knight, who formerly delivered the trenchless program at the University of Waterloo, provided some insight into the challenges the industry faces.



From your experience, why has trenchless technology not been a core part of most engineering programs?

A (Knight): Engineering programs are accredited, and the curriculum is dictated by external accreditation bodies. That leaves very little flexibility to add new courses at the undergraduate level. Professors tend to teach what they know, which slows the adoption of newer topics like trenchless. Even when new courses can be developed at the graduate level, it takes tremendous effort to build and maintain them, especially if you're not actively researching in that area. Typically research and specialist knowledge becomes the intellectual property of the professor, therefore when they leave a post, this knowledge tends to leave with them. So, while trenchless education has grown over my career, it has lagged behind compared to more widely researched and taught topics.

Q: What are some of the barriers to Cities adopting trenchless technologies more broadly?

A: There are many. Consulting engineers often default to "cookie-cutter" designs because they're low-cost and low-risk, and it's what they know. Owners don't like being locked into a single supplier, which creates procurement challenges for innovative methods. Maintenance departments resist change because they don't want to retrain crews or stock new materials. On top of that, corporate culture plays a role; Organizations often stick with what they know unless a major cost or time saving forces them to consider alternatives.

Q: How important is contractor-led education?

A: It's critical. Academics can provide theoretical context, but contractors bring the case histories, the practical challenges, and the cost considerations. They live this every day, and that's what municipal staff and consulting engineers need to hear. Education has to happen at multiple levels; One-off sessions, conferences, continuing education credits. Contractors are an essential piece of that puzzle.

Q: Do you think these initiatives can influence municipal decision-making?

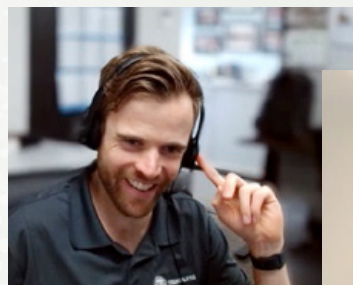
A: Absolutely. Decision-makers are more likely to adopt trenchless if they see successful case histories and understand the cost and time savings. But adoption is still cautious. New technologies follow an exponential curve: very slow at first, then rapid, once enough success stories accumulate. Education and exposure accelerate that process.

Q: What advice would you give to young engineers or municipal staff starting out in this field?

A: Always be willing to learn and be humble. Listen to contractors. They do this work every day. Don't let ego get in the way of good engineering decisions. Find mentors and places where you can learn from experienced people, and remember, education doesn't stop when you graduate. The day I stop learning will be the day I'm horizontal.

Q: If you could leave one key message for decision-makers about trenchless technology, what would it be?

A: Think of trenchless technologies as tools in a toolbox. There is no silver bullet. Each method has its technical envelope where it works best. Sometimes open cut is the right answer, sometimes slip lining, sometimes cured-in-place. The key is to understand the options, weigh cost, efficiency, and risk, and choose the right tool for the job.





SAVE THE DATE!

NASTT-BC TRENCHLESS TECHNOLOGY EDUCATION & OUTREACH EVENTS

December 2025

TRENCHLESS TECHNOLOGY LUNCH & LEARN (PW TRENCHLESS)

VANCOUVER BC - Venue/Date TBD

www.nastt-bc.org

February 2026

TRENCHLESS TECHNOLOGY 101 – TT1-101 (NASTT-BC)

PRINCE RUPERT BC - Venue/Date TBD

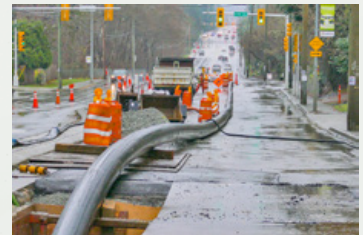
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TRENCHLESS TECHNOLOGY 101 – TT1-101 (NASTT-BC)

PRINCE GEORGE BC - Venue/Date TBD

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THE DAT FRAMEWORK: DIAGNOSE-ADVISE-TREAT IN ACTION



By Robert Epp, infraStruct

INTRODUCTION: WHY MANHOLE REHAB MATTERS

Manholes are critical junction points in municipal and community wastewater systems, yet they are often the most neglected assets. Across Canada, infiltration and inflow (I&I) from groundwater and stormwater put unnecessary strain on wastewater treatment plants. Every litre of water entering through deteriorated manholes adds treatment cost, consumes capacity, and accelerates structural deterioration.

For many British Columbia communities where budgets are already stretched, these challenges are magnified. One Vancouver Island community faced these realities across more than 50 manhole assets. Following a condition assessment and I&I source investigation completed by Kerr Wood Leidal (KWL), an open tender was issued for rehabilitation work. InfraStruct was the successful sub contractor, chosen for its proven verifiable track record, thousands of manhole rehabilitations completed across Western Canada, and factory certification to install advanced polyurethane and cementitious systems.

THE DAT FRAMEWORK IN ACTION

At InfraStruct, every project begins with our proprietary **DAT methodology – Diagnose, Advise, Treat**. It's a framework we developed to bring clarity and consistency to complex infrastructure problems.

Diagnose:

The first step in any rehabilitation project is understanding the problem. Using KWL's I&I investigation findings and our own site assessments, we confirmed multiple infiltration sources at barrel joints, cracks, and pipe penetrations. Studies have shown that up to

40% of infiltration in sewer systems originates from manholes (Prime Resins, 2008), a trend that aligned with field conditions observed in this community.

Advise:

Working collaboratively with KWL, we recommended a trenchless rehabilitation strategy focused on infiltration abatement and structural restoration, avoiding the cost and disruption of full replacement. The solution provided:

- Preservation of existing infrastructure through selective rehabilitation.
- Permanent elimination of infiltration at its source.



Manhole rehab work was performed with quick and mobile short-duration site setups

- Improved adhesion potential for future linings or coatings.
- Minimal surface disruption, as each manhole could be accessed by tailgate with short-duration setups.
- Optimal use of rehabilitation budgets, maximizing value for long-term performance.

Treat:

Using Prime Resins PR920 and PR900 hydrophobic polyurethane foams for infiltration cut-off, combined with cementitious grout for structural restoration, our certified crews sealed active leaks, reinforced deteriorated structures, and re-profiled benching to optimize hydraulic flows.

The DAT connection was evident throughout the process: we diagnosed the infiltration, advised the most effective and least invasive solution, and treated each structure with precision and transparency.

FIELD EXECUTION & SAFETY LEADERSHIP

Execution required coordination, adaptability, and safety-first planning. With WorkSafeBC Alternate Measures permits already in hand for confined space entry into live assets, mobilization began without delay. Field crews worked in tandem with tailgate access, grouping manhole locations strategically to minimize community disruption and traffic control costs. Every asset was documented with before-and-after 360° imagery, ensuring full transparency for KWL and the community.

"No two manholes were the same. Some leaks were manageable; others were gushing. That's where DAT really made the difference, it gave us a structured process to decide what material to use, how to approach each leak, and how to keep the operation safe and efficient in the field."



Full condition assessment and mapping of the wastewater system prior to installation

ANTICIPATED OUTCOMES & BROADER IMPACTS

While post-rehabilitation inspections are scheduled for this winter, early indications point to reduced infiltration and improved asset performance. The expected benefits include:

- **Lower treatment costs:** Reduced groundwater intrusion into the system.
- **Extended service life:** Structural restoration enhances durability.
- **Environmental protection:** Stopping infiltration mitigates overflow and contamination risks.
- **Operational efficiency:** Optimized manholes reduce strain on downstream infrastructure.

"There's no logic in treating rainwater or groundwater at a wastewater treatment plant. Stopping infiltration at the source saves everyone: the operators, the end users, and the environment. That's what this project was all about."

- Glenn Votkin - President, infraStruct



Factory-certified crews sealed active leaks, rebuilt compromised structures, and optimized benching



A targeted rehabilitation program using polyurethane injection and cementitious restoration was implemented

INDUSTRY VALIDATION: POLYURETHANE IN PRACTICE

Independent research supports the use of polyurethane injection as a permanent infiltration solution. Prime Resins notes that hydraulic cement patches only provide temporary relief and can trap water, undermining future lining systems. In contrast, polyurethane foams react with water to expand, bond, and stabilize surrounding soils – creating durable, watertight barriers.

As Scott Kelly of Prime Resins wrote in **Trenchless Technology**, “If the right chemical grout is chosen and the correct installation techniques are used, the repair will actually outlast the structure.”

That principle underpins every DAT application, including this one.

“The best moment for us is seeing the water stop in real time. One minute you’ve got infiltration running steady into the system, and the next it’s sealed tight. That’s when you know the process works.”

LOOKING FORWARD: DAT AS A MODEL FOR REHABILITATION

This Vancouver Island project demonstrates how effective collaboration between engineers and certified contractors can deliver lasting value. KWL provided the investigation, design guidance, and oversight; InfraStruct delivered the execution through the DAT methodology – diagnosing, advising, and treating each asset with purpose and precision.

The DAT framework continues to guide how we approach rehabilitation projects nationwide, ensuring that every solution we deliver is data-informed, community-sensitive, and built to last. ✚

“We spent weeks detailing nearly every manhole in this community. By the time we were finished, everything was sealed, benching optimized, and the system was running so much more efficiently.”

– Glenn Votkin - President, infraStruct

ABOUT THE AUTHOR:



Robert Epp, is VP of Business Development for infraStruct and currently serves as Chair NASTT-BC, advocating for greater use of trenchless technology methods across BC and Western Canada. Robert takes pride in utilizing trenchless technology applications, problem solving underground infrastructure challenges and water infiltration mitigation in even the most challenging applications.

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City of Richmond Rehab - Box Culverts

By: Tonia Jurbin, P.Eng. (Retired) (for: PW Trenchless Construction Inc.)

Underneath the City of Richmond, a network of some 60kms of cast in place box culverts are slowly but surely leaking, sinking and causing the roads built on top of them to settle as the surrounding backfill slowly infiltrates into the culverts rather than staying around the outside as originally installed. 'It's like building a road on a trampoline' is how David O'Sullivan President of PW Trenchless puts it.

Richmond, located at the mouth of the Fraser River is made up of several islands in the estuary. The underlying soils generally consist of river gravel, sand, silt, clay, swamp and peat bogs, all of highly variable thicknesses and densities. In this environment post construction differential settlement estimates are often given over a 25 year period because not only is there much variation, many of the soil layers are also highly compressible under loading.

SOME BACKGROUND

From the late 1960s to the late 1970s, the City installed the precast box culverts at a rate of about 22m a week

“Very few things are truly waterproof in BC's lower mainland.”

to fill in the many large ditches that made up the drainage system for this low lying island city. Also relevant, the box culvert segments were poured with additional joints in the floor at the mid-section, or, roughly every 11m.

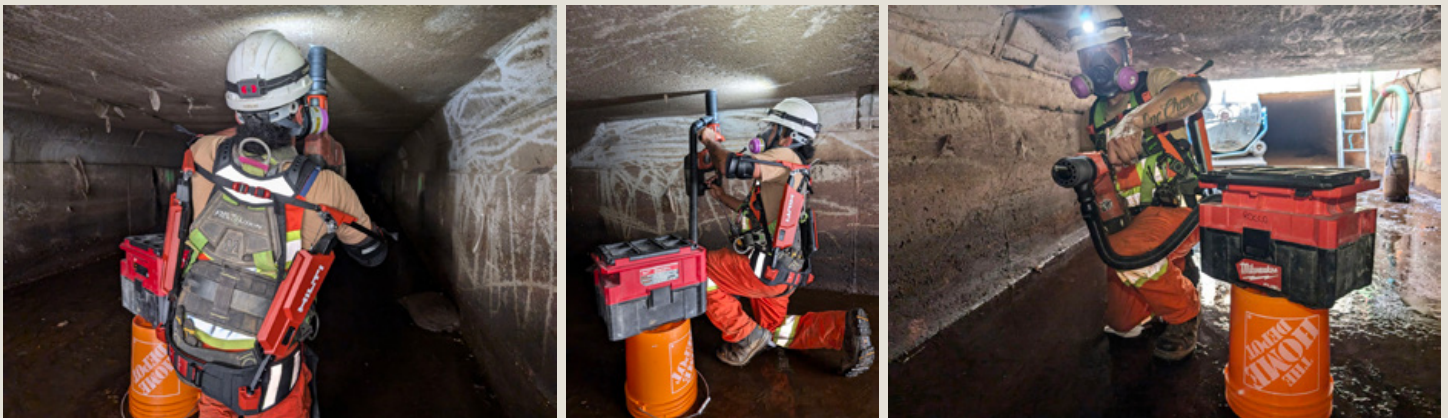
Over the years the compressible soils continue to settle under the loading of the concrete which is much heavier than what was excavated to build it. The joints start to separate, and the sediment carrying water infiltrates the culvert. This slowly starts to shift and settle, causing voids around the structure which in turn leads to potholes and settlement in the roads.

It is fair to speculate given the slow continual growth of leaks and infiltration, especially during the infamous heavy rains in the region, that unaddressed, the damage to the overlying roads will continue, and likely accelerate over time.

THE INVESTIGATION

Fast forward to 2017 when the City retained MJP & Associates of Richmond, BC to do a walk through, or more like a 'slouch-through' inspection of a 2.4 km section of the ageing system. To facilitate the inspection, the City also retained PW Trenchless of Surrey, BC, trenchless rehabilitation specialists, to set up the safety and support for these inspections. This included confined space equipment and rescue cover, radio checks, lighting, site access and accompanying the team through the process to ensure the safe collection of useful information.

The findings set the stage for a rehabilitation program that sliced the work up into several phases. The project under discussion here is the third and most recent phase of the work. In 2024, the City retained PW Trenchless to rehabilitate an 800m



Respirator, dust suppression system and Exo Skeleton



Close up of floor foam



Close up of grout return



One of many service pipes into the box culvert

section of culvert along No. 4 road, from Alderbridge Way to Westminster Highway. The contract included an optional item to extend the work from Alderbridge Way to Granville Avenue, which was awarded and is underway in 2025. In the earlier phases of this maintenance work, culverts were rehabilitated using sliplining techniques with Glass Reinforced Pipe (GRP), and traditional open cut methods were used on the earliest phase.

During this third phase the average 3.4m wide x 1.37m culvert with 76 joints over 800 metres underwent rehabilitation from the inside of the culvert. The plan was to install a barrier, a sort of foamy grout curtain around the outside of all of the joints without digging up 800 metres of road to do it.

THE LATEST SOLUTION

The first step was to isolate the length of the tunnel to be rehabilitated by installing dams at both ends. The next step was to clean out all the sediment using mostly high pressure water to move the material to one of the two access hatches, or one of the 15 existing manholes, and then remove it by vacuum excavation. The team removed some 50 years' worth of sediment – enough to fill about 35 hydrovac trucks.

Once the tunnel was sealed at both ends and cleaned out, 14 holes ranging from

10mm to 15mm were strategically arranged in a staggered pattern along both sides of the 76 joints at the top, sides and bottom of the culvert. This prep work took the PW crews about 2 ½ weeks.

Enter Infrastruct Products and Services based out of Mission, BC to start sealing the leaks. This work started by isolating each of the joints by injecting a two-part poly urethane resin expanding foam into each of the holes creating a sort of grout curtain around the joint. The product used for this stage of the work expands up to 18X the initial volume and cures to a 'rigid' finish.

This process 'sealed' the majority of the infiltration at each joint, very few things are truly waterproof in BC's lower mainland, but the process sealed the majority of infiltration at each joint. The density of this product once cured is about 3.5 pounds/ft³ so not a major contributor to further settlement. It takes about 8 hours for a full cure but the working time is only about 35 seconds. Confirmation of the delivery is done during the application by watching for foam return in the adjacent drill holes. Some finesse is required for this work, as over-injecting can cause heave. On this project the injection was done to rejection and by watching for return from adjacent holes.

While these holes were being injected the PW crews were busy removing the upper 4 inches of lumber in the floor joints. The floor joint lumber might have been 2X6's or 2x8's or 2x10's but only 4 inches had to be removed. Once done the edges of the floor joints were chipped to remove any loose



Typical Working Conditions



Access Hatch



Floor joint cleaned out then stuffed with oakum



Strutting placed on floor joint after application of resin and oakum

concrete and to allow a better bond for the next step. The chipped concrete and excess water was removed by creating a mini dam on either side of the floor joint, and using a shopvac with a floor pump to remove all the debris and most of the water. The joint did not need to be bone dry as the final step does require some moisture for everything to set together.

The floor joints were then stuffed with resin-soaked oakum, a modern twist on an old ship repair technique. Historically oakum was made from untwisting old ropes which were covered in tar and used as caulking, mostly for ships but also used in plumbing applications for sealing couplings. In modern times the oakum is made from hemp or jute. Again,

this work has to be done quickly as the hydrophilic resin used sets in about 5 minutes. Once the joint is filled with the resin impregnated oakum the crews worked quickly to get forms on top of the joint and tighten the whole system with wedges and struts. The resin Infrastruct uses expands about 9X by volume and cures overnight. The result is a flexible adhesive gasket which is not diggable but can be cut if necessary.

The City provided a list of cracks and other defects including any exposed rebar along the length of the tunnel. During the final inspection, any remaining defects found during the joint treatment were corrected. The cracks or leaks causing active infiltration were sealed

with another product, a hydrophobic resin that follows the water path, reacts with the water in the cracks and sets in seconds. The exposed rebar was coated with cementitious grout.

When Infrastruct demobilized, PW used CCTV cameras to inspect all the connecting services into the culvert. The data from this final inspection was submitted to the City for further consideration. The last step was to form the hatch lids that were cast on site, lowered into place and backfilled.

HEALTH & SAFETY

Low headroom presented some unique health and safety challenges. With barely 1.37m, or less than 3 ½ feet, it can be back



Oakum Sample



Dam at end of project



Sediment in culvert beyond the dam

“ *Low headroom presented some unique health and safety challenges.* ”

breaking work drilling the holes in the roof of the culvert. The overhead holes were drilled from a seated or kneeling position and the workers were outfitted with EXO skeletons to assist supporting their backs, arms and shoulders. The EXO skeleton suits used weigh about 2.4 Kilograms (5.3 pounds) and cost \$1,860 CDN. All the workers rotate all the jobs, drilling, mucking, moving materials etc. There was also a dust suppression kit attached to the hammer drills and the crews were outfitted with full face respirators as well.

Microbreaks for stretching are important and were emphasized during tailgate meetings. A microbreak in this case could be as simple as slouch walking to one of the access hatches or manholes where one can stand, or sitting, or even lying back on

one of the materials carts for a little back stretch. Of course, all confined space rules apply along with the fall arrest harnesses which are more for rescue than risk of falling.

FINALLY.....

Without giving too much away regarding the contract details, we can divulge that the results speak loudly for themselves. The 2024 phase of the project cost about 25 percent of the earlier GRP sliplining phase, and less than 8 percent of the earliest phase open cut attempt. The other very obvious advantages to doing this work as a trenchless project was the minimal disruption to the travelling public as well as considerably lower GHG emissions when

compared to the traditional open cut work.

In 2025, the City awarded an optional item from the 2024 contract, which extended this work from Alderbridge Way to Granville Avenue. The work is well underway and is scheduled for completion in October 2025. ✚

ALL PHOTOS COURTESY OF TONIA JURBIN P.ENG. (Retired)

ABOUT THE AUTHOR:



PW Trenchless Construction Inc. is an experienced General Contractor established in January 2000, specializing in

both trenchless and traditional open cut utility construction methodologies. The company has pioneered trenchless technologies in BC throughout its history and stands apart from other trenchless contractors in the local marketplace by completing all civil works for trenchless projects in-house, using own equipment and forces.



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TYPICAL CRITERIA	HDD	Direct Steerable Pipe Thrusting	Microtunneling	Pilot Tube Boring
Pipe Diameter	2 - 48 inches	30 - 60 inches	30 - 120 inches	4 - 48 inches
Depth Range	15 - 200 feet	25 - 130 feet	15 - 100 feet	8 - 30 feet
Length Range	200 - >10,000 feet	500 - 4,000 feet	200 - 3,000 feet	50 - 300 feet
Maximum Length	>10,000 feet	>5,000 feet (7,500 feet maximum)	2,000 feet with intermediate jacking stations	+/- 400 feet
Minimum Depth of Cover	>25 feet	As low as 2X pipe diameter	As low as 2X pipe diameter	As low as 40 feet
Design Angles	Entry: 8 to 14 degrees / Exit: 8 to 16 degrees	Launch: 0 to 8 degrees / Reception: 2 to 10 degrees	Typically < 2.5%	Typically < 2 degrees
Entry/Launch Approach	Surface entry	Near surface launch	Shaft launch	Shaft launch
Min. Install Radii	Governed by installation & operating stresses	Governed by installation & operating stresses	Generally flat or sloped	Generally flat
Pit/Shaft Design	Shallow pit, non-engineered	Engineered shoring for shallow launch pit; shallow, non-engineered reception pit	Engineered shoring for launch & reception shaft	Engineered launch & reception shaft
Foundation	Traditional deadman	Engineered for site conditions & anticipated loads	Engineered for site conditions & anticipated loads	Engineered conditions & anticipated loads
Pipe Stringing	Typically exit side	Launch side	Pipe segment storage on launch side	Pipe segment storage on launch side
Installation Stresses	Tension, bending, hydrostatic buckling & combined	Compression, bending, & combined; column buckling	Compression & buckling	Compression & buckling
Annular Pressures	Hydrostatic drilling fluid pressure & cutting transport pressure	Hydrostatic lubricating pressure & slurry over pressure	Hydrostatic lubricating pressure & slurry over pressure	Hydrostatic lubricating pressure
Gravel, Cobbles and Boulders	High risk of failure for > ~30-40% gravel	Can negotiate limited rocks up to 1/3 size of the cutterhead, and up to ~30 - 40% gravel	Can negotiate limited rocks up to 1/3 size of the cutterhead, and up to ~30 - 40% gravel	High risk of failure
Clay Soils	Risk of hydraulic fracture	Low risk of hydraulic fracture	Low risk of hydraulic fracture	Low risk of hydraulic fracture
Relative Cost	\$\$	\$\$\$\$	\$\$\$\$	\$\$

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KEY OVERVIEW GUIDE: NEW INSTALLATIONS

Guided Auger Boring	Auger Boring	Pipe Ramming	Pipe Jacking	Hand Mining/Tunneling
Size	12-72 inches	12 - 120 inches	42 - 144 inches	42 - 144 inches
Depth	8 - 30 feet	5 - 25 feet	10 - 40 feet	10 - 40 feet
Length	50 - 300 feet	50 - 300 feet	200 - 1,000 feet	100 - 600 feet
Depth/Length	+/- 500 feet w/ guidance	+/- 400 feet w/ guidance	1,500 feet with intermediate jacking stations	1,000+ feet
Minimum Diameter	As low as 2X pipe diameter	As low as 1X pipe diameter	As low as 2X pipe diameter	As low as 2X pipe diameter
Deflection	Typically < 2.5%	Typically < 2.5%	Typically < 2.5%	Typically < 2.5%
Access	Shaft launch	Shaft launch	Shaft launch	Shaft launch
Ground Conditions	Generally flat or sloped	Generally flat or sloped	Generally flat or sloped	Generally flat or sloped
Shoring for launch & reception shaft	Engineered shoring for launch & reception shaft	Engineered shoring for launch & reception shaft	Engineered shoring for launch & reception shaft	Engineered shoring for launch & reception shaft
Design for site conditions & anticipated loads	Engineered for site conditions & anticipated loads	Engineered for site conditions & anticipated loads	Engineered for site conditions & anticipated loads	Engineered for site conditions & anticipated loads
Segment storage on launch side	Pipe segment storage on launch side	Pipe segment storage on launch side	Pipe segment storage on launch side	Tunnel liner segment storage on launch side
Compression & buckling	Compression & buckling	Compression & buckling	Compression & buckling	Compression & buckling
Lubricating pressure	Hydrostatic lubricating pressure	Hydrostatic lubricating pressure	Hydrostatic lubricating pressure	Hydrostatic lubricating pressure
Risk of failure	Can negotiate up to 1/3 size of the cutterhead	Casing can be sized to swallow up cobbles & boulders	Medium risk of failure. Can access tunnel heading for removal of obstructions	Medium risk of failure. Can access tunnel heading for removal of obstructions
Hydraulic fracture	Low risk of hydraulic fracture	Low risk of hydraulic fracture	Low risk of hydraulic fracture	Low risk of hydraulic fracture
Cost	\$	\$\$	\$\$\$	\$\$\$

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Seismic Design Criteria for HDPE Pipe Water Mains

Technical Document Important for Utilities in Earthquake Prone Areas

By: Steve Cooper, SCA Communications

A pioneering report provides documentation for the required wall thickness of a fully fused, high-density polyethylene (HDPE) water main pipeline to withstand the lateral spread from an earthquake. Researched and authored by Michael O'Rourke, Ph.D., P.E., F.SEI, M.ASCE Professor Emeritus Civil Engineering at the Rensselaer Polytechnic Institute, the *Design of HDPE Water Mains for the Lateral Spread Seismic Hazard* (MAB-9) can be found at the website of the PPI Municipal Advisory Board: www.plasticpipe.org/MABpubs

"This critically important document provides the criteria for the proper design of an HDPE water main system," stated Camille George Rubeiz, P.E., F. ASCE, co-chair, HDPE Municipal Advisory Board, and senior director of engineering for the PPI Municipal & Industrial Division. "It is the first report of its kind that provides the rationale, data and formulas for determining the proper wall thickness for a fused, highly ductile and highly flexible HDPE water main in a seismically sensitive area, subjected to an induced lateral spread.

"According to the latest United States Geological Survey, nearly 75 percent of the United States could experience an earthquake during the next 100 years that would cause significant damage to underground water mains. Professor O'Rourke's analysis of possible seismic events, lateral spreads and wave propagation hazards with formulas and charts provides the much needed data to help design a resilient water system."

The MAB serves as an independent, non-commercial adviser to the Municipal &

Experience suggests that HDPE pipe does very well in earthquakes.

- MICHAEL O'ROURKE, PH.D., P.E., F.SEI, M.ASCE PROFESSOR
EMERITUS CIVIL ENGINEERING,
RENSSELAER POLYTECHNIC INSTITUTE

Industrial Division of PPI, the major North American trade association representing the plastic pipe industry

The two primary seismic hazards to buried pipelines are wave propagation and permanent ground deformation. Because earthquakes are caused by movement at a fault, the resulting movement results in waves traveling away from the fault. These waves stretch and bend pipeline infrastructure at or near the ground surface and is referred to as the wave propagation (WP) hazard.

"The WP hazard occurs in all earthquakes and is most commonly quantified by the resulting ground strain," O'Rourke explained. "The WP hazard is also transitory in that after the shaking ends, the ground returns to its original pre-quake position. If the earthquake is large, it can also result in permanent offsets at the surface or movements of the ground (lateral spread hazard) both referred to as permanent ground deformation (PGD). The report addresses the lateral spread hazard and the strains due to PGD which are larger and hence more important than those due to WP."

O'Rourke's document contains formulas, calculations, empirical data, and illustrations plus nomenclature and definitions, all of which can be used in designing the HDPE water piping system.

"Experience suggests that high-density polyethylene pipe does very well in earthquakes," O'Rourke said, "but engineers like to have ways to calculate and substantiate their design. Listening to what somebody else says that, 'Oh yes, the pipe is great', but they still are faced with the question of 'what wall thickness do I



The ductility of HDPE pipe provides high resistance to earthquakes and is also an important factor for ease of installation



Heat fusing HDPE pipe sections provides a leak-free joint plus heightened security and protection from seismic events

need?' 'I have this particular diameter pipe and it's going to be buried this far underneath the ground so what wall thickness do I need for some expected seismic event?' The goal is to have HDPE pipe that will be able to withstand the expected earthquake loads on this inherently ductile material. With that in mind, MAB thought it would be useful to develop a document that provides designers with some relationships,

tables, formulas, et cetera, that they can use to figure out how thick the wall would need to be for an expected lateral spread. And that's the purpose of the MAB-9.

"HDPE is known as a continuous pipe, which means the pipe segments, which are 40 feet to 50 feet long, are fused together," he continued. "The ductile iron or cast iron pipe has joints every 15 or 20 feet, and the damage from a seismic event frequently occurs at those joints. Continuous pipe, whether it's welded steel or high-density polyethylene, usually does better than segmented pipe in earthquakes. HDPE has the added advantage over steel (and all other materials) in that it is highly ductile, flexible and corrosion resistant and so it can move with the earth as opposed to trying to resist the deformations that the earth is imposing on it."

Rubeiz elaborated, "MAB-9 is essential for many reasons. Proper wall thickness is very important, especially with earthquakes, and ground movement. Plus, there continues to be a dire need to replace the aging infrastructure, especially pipes that are older and brittle that many seismic events will cause them to crack. HDPE pipe and the information contained in MAB-9 will help in those replacement programs to provide a proper and resilient water main system.

"Being intrinsically able to withstand seismic shifts along with corrosion resistance,

Nearly 75 percent of the United States could experience an earthquake during the next 100 years.

- CAMILLE GEORGE RUBEIZ, P.E., F. ASCE,
CO-CHAIR, HDPE MUNICIPAL ADVISORY BOARD



RIDGECREST, Calif. - A formerly straight section of pipe broken by shifting earth during a 7.1 earthquake that shook Southern California in July 2019, cracking buildings, breaking roads and causing power outages. The quake, centered 11 miles from the Ridgecrest area, is the largest quake to hit Southern California in at least 20 years. It was followed by a series of large and small aftershocks, including a handful above magnitude 5.0. (Credit: Gene Blevins/ZUMA Wire/Alamy Live News)

leak-proof fused joints creating a monolithic HDPE piping system, having a high degree of flexibility, and high ductility, are among the many reasons HDPE pipe is recognized to be the best product used for seismic installations and, of course, trenchless and open cut installations," Rubeiz stated.

"We would also like to thank the other MAB members and supporting engineers who provided their time and expertise to the project - Robert Diamond, P.E., City of Palo Alto, CA; Casey Haynes, P.E., City Utilities, Springfield, MO; Bill Heubach, P.E., M. ASCE, Seattle Public Utilities, WA;

Harvey Svetlik, P.E., GPPC, TX; and Gerry Groen, P.Eng., Infra Pipe Solutions, ON."

Additional information can be found at www.plasticpipe.org/mabpubs or www.plasticpipe.org/municipalindustrial

ABOUT PPI:

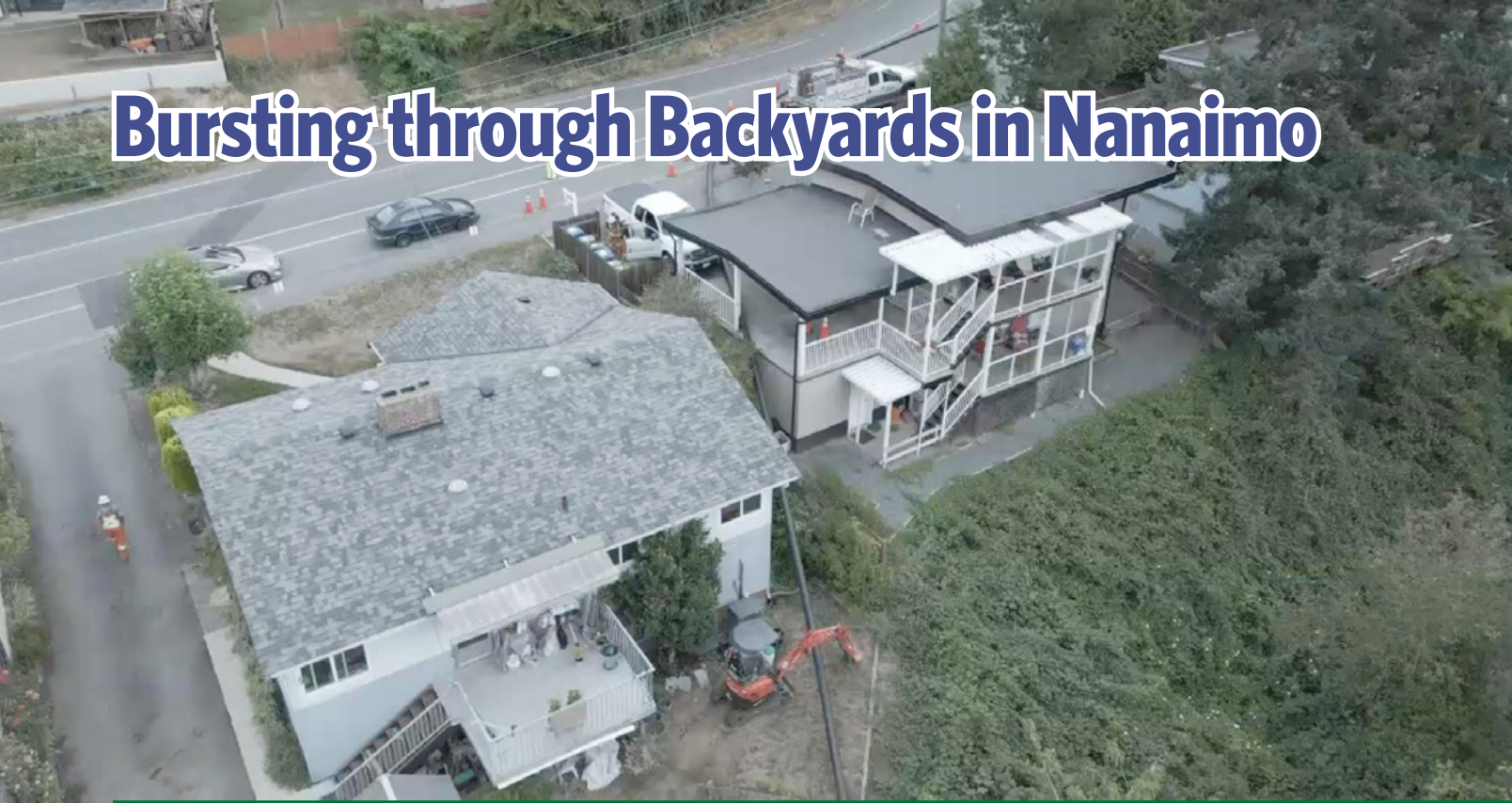


The Plastics Pipe Institute, Inc. (PPI) is the major North American trade

association representing the plastic pipe industry and is dedicated to promoting plastic as the materials of choice for pipe and conduit applications. PPI is the premier technical, engineering and industry knowledge resource publishing data for use in the development and design of plastic pipe and conduit systems. Additionally, PPI collaborates with industry organizations that set standards for manufacturing practices and installation methods.



Bursting through Backyards in Nanaimo



By: Tonia Jurbin, P.Eng. (retired)

The Regional District of Nanaimo includes Parksville, Qualicum and Lantzville with a population of about 170,000, the City of Nanaimo itself has about 100,000 people. For a municipality of this size, it's punching well above its weight with respect to the City's pipe rehabilitation program that routinely uses many of the trenchless technologies that are available.

There are people within the engineering department in Nanaimo with strong backgrounds, interest and experience in using trenchless rehabilitation techniques.

“There is a culture of innovation that spreads throughout our organization.”
- BILL SIMS, GENERAL MANAGER OF ENGINEERING & PUBLIC WORKS, CITY OF NANAIMO

In 1999, Bill Sims, now the General Manager of Engineering & Public Works, was a strong advocate for the use of trenchless

methods to replace and upsize an existing 14-inch AC pipe, which was originally installed in 1975. Located in a riparian area,



Every house service connection had to be accessed



Challenges included steepness of the work areas

“ At the time it was the largest pipe bursting project in the world and made international news! ”

and at considerable depth, an upside to a 26-inch pipe was required. Their consultants were advising to build additional pump stations but Sims was adamant that they find a way to rehabilitate the existing plant.

Once he learned about pipe bursting there was no going back, and the City set up a contract for a 400m pipe project. This was successful, so the project went ahead, and at the time it was the largest pipe bursting project in the world. Between May and October 1999, the City successfully upsized 4km of pipe, by several pipe sizes. This made international news and earned many awards including the prestigious NASTT No Dig Project of the Year, and the even more prestigious ISTT Award for Project of the Year.



No bypass was required for this project

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Small footprint of pipe bursting rigs helped navigate around the backyard clutter

Nanaimo does not shy away from new technology, Sims explains, “The City of Nanaimo is open to responsible and reasonable risk taking. There is a culture of innovation that spreads throughout our organization from sewer rehab to AI.” Truly well ahead of their time, in the 1980s the

City was developing their own means of splitting water services to replace in place, it’s called pipe bursting today. In the 1990s and early 2000s they were already using spray on epoxy linings and cast in place curing on a number of projects.

Like most asset management programs, infrastructure planning sets the priorities for what work must be carried out. In Nanaimo, there is enough collective experience and confidence to quickly decide whether trenchless methods are the best way to proceed at any given site.



Two straight runs of equal length affected 12 properties



All work was done within the backyard easements

They have set targets for their trenchless projects of about 3 weeks, compared with the 2 ½ month target to complete open cut projects. Additionally, the City understands that for the right projects, comparative cost savings of up to 40 percent may be realized.

UPSIZING PIPE

The project under discussion here involves the replacement of a 150mm sanitary concrete pipe, originally built in 1959. The condition of the existing pipe had deteriorated considerably, with spalling of the pipe wall in the invert. Replacement with a 200mm HDPE pipe, using pipe bursting methods, was therefore proposed. The HDPE provides a tight, closed system with a lower potential for failure over time when compared with the aging concrete pipes. Ironically, one of the reasons for upsizing the pipe to 200mm was not so much to increase capacity as the fact that the inspection camera had got stuck in the 150mm pipe so, there is an expectation that by using one size larger there will be less likelihood of cameras getting stuck in

“ For the right projects, comparative cost savings of up to 40 percent may be realized. ”



Upsizing a pipe by one size during pipe bursting does not add significant cost



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Nanaimo completed 4kms of upsizing pipe, earning many awards including NASTT No Dig Project of the Year, and the prestigious ISTT Award for Project of the Year.

the future. This is a common issue for cities with lots of 6-inch or smaller mains in their networks. Perhaps, as camera technologies advance, these issues may be alleviated, but in many areas the preference is to increase the diameter of these smaller pipes. Upsizing a pipe by one size during pipe bursting does not add significant cost to this kind of work.

When the project along Bush Street & Vancouver Ave was tendered, there were only two bids from trenchless contractors, PW Trenchless of Surrey BC was low bid, in fact \$300K lower than the local contractor on a \$500K contract.

The total length for the Bush Street project was 220m, to be carried out in 2 pulls from a more or less central existing manhole, snugly tucked away in the far edge of a very steep backyard. The challenges on this site were the steepness of the work areas, and a highly congested work zone with multiple obstacles and clutter, making access,

equipment operation and staging, a real challenge. Imagine a backyard with fences, greenhouses, sheds, gardens, planters, trees and garages, and the odd swing set. Now multiply that by 12 and imagine threading your way through that with supplies, equipment, hoses, baskets and crew.

There were two straight runs of almost equal length from the central existing manhole. The first run - eastwards to an existing 3m deep manhole and affecting five properties, and the second run - westwards to a much shallower 1.4m deep new manhole, affecting seven properties.

At the central existing manhole, a machine had to be walked down from driveway to the backyard and down to expose the house service connections in preparation for the pipe bursting.

Every house service connection had to be accessed. The contractor started accessing individual properties from the east and west extent through the fences

to reach the middle where the machine had to be walked down. A variety of earthmoving equipment was used to access tight work spaces with steep slopes. No bypass was needed for this project. The water was shut off for 8 hour intervals while the pipe was pulled into place and the electrofusion 'WYE' connections were completed.

In this case all the work was carried out within the backyard easements. The City was responsible for all the site restoration including restoring the fences, applying topsoil and seeding. The City mentioned that, given the access challenges for this length of pipe, the contractor was creative in how they set up the staging and laydown. Sims concludes, "PW's experience and deep, tireless commitment to furthering the industry is what makes this story a nonevent."

So, what's the real story here? This project had no drama, no big surprises, no unhappy property owners and the winning bid was \$300K lower than the local bid. The fact that this technology is still widely unfamiliar or viewed by some as highly risky, that is what is remarkable. In the 1990s HDD was the riskiest thing anyone ever heard of. It was a huge deal to be installing a conduit by HDD under the Fraser River, or completing an intersect method HDD bore which meets halfway across the St. Lawrence river; now it's routine. 🙌

ALL PHOTOS COURTESY OF TONIA JURBIN P.ENG. (Retired)

ABOUT THE AUTHOR:



Tonia Jurbin, P. Eng.
(retired) is a geotechnical engineer and freelance writer in Greater Vancouver
www.toniajurbin.com

Remarkable that this technology is still widely unfamiliar or viewed by some as highly risky.



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	TOP 10 Features & Benefits	HDPE	D. Iron	Sample References
1	Applications: Potable Water (Lead Free), Raw Water, Reclaimed Water, and Wastewater	✓	✓	AWWA C901, C906, C151, and NSF 61 + Health Effects of HDPE Pipes and Fittings for Potable Water Applications, NSF 2024
2	Open Cut Construction: Design and install per AWWA Standards and Manuals	✓	✓	AWWA M55, M41 + MAB-3, MAB-6
3	Trenchless Construction: Material of choice for HDD, Creek Crossings, Pipe Bursting, Sliplining, and Compression Fit	✓	✗	ASTM F585, F1962, F3508 + MAB-5, MAB-7, MAB-11
4	Fully Restrained Joint-Free System: Minimize need for fittings to facilitate horizontal and vertical deflections	✓	✗	AWWA M55, M41
5	Longevity & Corrosion: Pipes, Fittings, and Joints have the least potential for corrosion or tuberculation	✓	✗	Durability and Reliability of Large Diameter HDPE Pipe for Water Main Applications, EPA/WRF/WERF 2015 + The Critical Need for Corrosion Management in the Water Treatment Sector, NACE 2019 + PPIPACE.com + Long-Term Aging of Polyethylene Pipes, UKWIR 2020
6	Flow Capacity: New pipes have similar flow capacity per AWWA Standards and Manuals	✓	✓	AWWA M55, C906, M41 + PPIPACE.com
7	Water & Energy Conservation: Fused joints have zero allowable water leakage, zero infiltration, and lowest carbon footprint	✓	✗	AWWA M55, M41 + ASTM F2620, F3190, F3565 + MAB-1, MAB-2, MAB-8 + TEPFPA Polyethylene Plastic Pipe Systems vs Ductile Iron Environmental Impact Comparison, TEPFPA EPD Calculator
8	Cost Effective: Has the lowest initial cost, lowest life cycle cost, and lowest restoration cost for trenchless installations	✓	✗	Life Cycle Analysis of Water Networks, CSIRO 2008 + Annual Drinking Water Quality Report for 2014, Kittery Water District, 5/31/2015
9	Resilient: Ability to resist ground movements due to droughts, freeze/thaw, earthquakes, hurricanes, with ability for flow control/squeeze off	✓	✗	Recent Earthquakes: Implications for U.S. Water Utilities, WRF 2012 + Polyethylene Pipeline Performance Against Earthquake, Kubota 2018 + MAB-9
10	Permeation/BTEX: Pipes and elastomeric joints need to be properly engineered for contaminated conditions	✗	✗	AWWA C901/C906 and C111/C151, Sec. 4

Additional information including MAB-3 Model Spec Guide can be found at
www.plasticpipe.org/mabpubs



Breaking New Ground Below Sea Level:

SoiLok Permeation Grouting in Richmond, BC

By: Robert Epp, infraStruct

THE CHALLENGE: BUILDING IN RICHMOND'S SUBSURFACE

Richmond, British Columbia is a city built on the edge of the Fraser River delta. Nearly all of it lies below sea level, resting on unconsolidated sediments (such as Fraser River Sediments and post-glacial lake deposits), with a consistently high-water table. For decades, these conditions have posed a challenge to trenchless professionals: soil that sluffs when disturbed, groundwater that undermines excavations, and tidal pressures that push relentlessly against underground structures.

Traditional approaches to shoring and groundwater control, like driving sheet piles, are not always possible. In this case, a Metro Vancouver site in Richmond presented precisely that problem: an unlocated gas main crossing the alignment made sheet pile installation unfeasible. With no reliable technology able to control water infiltration beyond about four feet in Richmond soils, the project team was left with a serious obstacle, and an opportunity.

That opportunity was the trial application of SoiLok, a permeation grouting technology developed by Prime Resins.

PHASE 1: FIELD TRIAL AND LEARNING IN REAL TIME

The initial trial involved testing SoiLok 20, a low-viscosity resin engineered to penetrate sandy soils and set into a durable gel with adjustable cure times. Field conditions quickly showed that the sandy alluvial soils consumed more material than anticipated in the original quotation.

Rather than treating this as a setback, the project team, including infraStruct, the manufacturer, Ram Consulting, BD Hall Contracting and End User Metro Vancouver's representatives used it as a chance to refine the methodology in real time. Key adjustments included:

- **Perimeter Walls:** Creating treated soil "containment" to confine injections and prevent resin loss.
- **Staggered Injection Points:** Eliminating untreated gaps by alternating probe locations.
- **Bathtub-Shaped Bulb:** Targeting the lower two meters of soil to form a water cut-off bulb beneath the invert.
- **Full Mass Coverage:** Ensuring complete treatment within the grid rather than isolated columns.
- **Accelerated Gel Times:** Adjusting set times to reduce migration and lock resin into place.

These refinements increased resin consumption but produced far more reliable and predictable stabilization. The adaptability of SoiLok, and the team's willingness to pivot methodology mid-project based on new discoveries in these soil conditions, was critical to success.

PHASE 2: TEST SECTION VALIDATION

A 4 m x 4 m test section was selected to validate the updated methodology and measure performance. Objectives included confirming bulb size per probe, optimizing spacing, and establishing volumes per vertical foot.

- **Injection Results:** SoiLok created stabilized piers with diameters averaging 32–42 inches.



- **Excavation Success:** Hydro-excavation reached 11 feet depth with minimal water ingress previously impossible in Richmond's soils.
- **Shoring Confirmation:** Installation of a 1.8 m x 2.4 m x 4 m deep cage was completed without soil sluffing or roadway undermining. For the first time, a trenchless technology achieved stable excavation beyond four feet in Richmond soils under a high-water table. It turned heads and proved that SoiLok could perform where other approaches had consistently failed.

WHY IT MATTERS: A NEW TOOL FOR METRO VANCOUVER

This trial was not just a proof of concept; it was a game changer. SoLoK demonstrated that:

- No need for extensive dewatering which imposes cost and significant risk of ground subsidence.
- Difficult sandy soils can be permeated and stabilized in situ.
- Groundwater can be cut off in environments previously considered too challenging.
- Alternative solutions exist when conventional methods like sheet piles are not viable.

Equally important was the collaborative approach. Success came from open dialogue between the contractor (infraStruct), the consultant, the owner (Metro Vancouver), and the manufacturer (Prime Resins). Each played a role in refining the plan and validating the outcome, ensuring transparency and confidence

“*Could be a game changer
as infrastructure upgrades continue
in the Fraser River Basin.*”

- JORDON BERGEN SUPERINTENDENT

in the results. As Glenn Votkin President explained, “For the first time, excavation beyond four feet was achieved under Richmond’s water table without soil sluffing or undermining existing utilities.”

LOOKING FORWARD: A FOUNDATION FOR THE FUTURE

Richmond is not unique to these geotechnical conditions. Coastal municipalities across Metro Vancouver in the Fraser Basin from Hope to Richmond

and beyond, face similar geotechnical challenges. SoLoK’s success here signals a new way forward for groundwater control and soil stabilization in these environments.

The adaptability of the system, combined with the structured DAT methodology (**Diagnose, Advise, Treat**), gives engineers and municipalities a repeatable process they can trust. This project showed that SoLoK is not only feasible, but cost-effective and minimally disruptive, making it a strong candidate for future



A low-viscosity resin engineered to penetrate sandy soils

“We’ve never seen anything hold Richmond soils like this. It could change the way we approach these conditions altogether.”



New way forward for groundwater control and soil stabilization in these environments

applications in floodplain and below-sea-level infrastructure work.

In the words of one Metro Vancouver stakeholder: “We’ve never seen anything hold Richmond soils like this. It could change the way we approach these conditions altogether.”

CLOSING THOUGHTS

The Richmond SoiLok permeation grouting trial wasn’t just another project – it was a milestone. For the first time, soils below sea level in this city were stabilized with a trenchless technique, opening new possibilities for projects once considered impractical or too risky.

“We were able to do something no one else has ever done in Richmond soils, it turned heads and could be a game changer moving forward as infrastructure upgrades continue in the Fraser River Basin.” Jordon Bergen Superintendent concluded.

By working together, the contractor, consultant, owner, and manufacturer worked as a team and delivered something no one else had achieved before in Richmond soils. infraStruct prides itself on problem solving, and in doing so, collectively we all proved that innovation, adaptability, and collaboration are the true cornerstones of trenchless success.

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Horizontal Hammer Boring (HHB) in North America:

Delivering Alternate “Go-To” Solutions

By: Richard Revolinsky, Geonex Inc, (GEO)

Expecting the unexpected is status quo for the trenchless industry. Designers and Contractors alike carefully evaluate the project parameters to develop a plan utilizing the know methods to achieve success. Furthered by collaboration between equipment manufacturers and industry professionals, the approach and solutions to anticipated project hurdles is ever evolving. The unknowns, especially in trenchless construction, can be disastrous to a project plan and budget, but have led to some of the most creative solutions that were once novel, have now become tried and true industry standards.

Horizontal Down-Hole Hammer Boring is a trenchless method for new installations which utilizes a pneumatic hammer and tooling located within the lead casing. Each stroke of the hammer accelerates heavy steel tooling forward which both pulverizes the subgrade as well as catching an internal collar in the front casing to pull the casing further along the bore path. Compressed air is then released, conveying the pulverized material through openings in the face of the tooling, back into the steel casing where it is carried back to the launch pit by rotating auger. This method can be successfully deployed in ground consisting of solid bedrock, intermittent cobbles as well as mixed conditions without having to change tooling for differing conditions.

Winner of the NASTT Innovative Product of the Year Award in 2019, benefits of the Geonex system include the ability to operate in all ground with the same cutter head. Installation rates

“Expecting the unexpected is status quo for the trenchless industry.”

range from 7 feet per hour through hard rock to 20 feet per hour in mixed ground with boulders. Control via a wireless light-weight hand portable control unit, allows the operator to be safely positioned remotely from the rig, where required. The equipment is almost completely retractable, only leaving behind the peripheral cutter bit and starter casing allowing blind hole bores such as starter and receiving casings for horizontally drilled crossings to be undertaken.

Cased bores are limited to approximately 330 to 500 feet in length. Active steering is currently not available however when launched and correctly operated accuracy of approx. 0.5 percent over bore lengths is achieved. It is important to monitor that the hammer assembly and lead casing are installed on the designed alignment and use the hydraulically adjustable legs of the rig to make as required adjustments. Impact forces generated by the hammer disturb ground at the excavation face that trend to slight downward movement of the hammer along the bore.

Uncased open hole bores in competent rock can extend 1000 to 1500 feet and have the ability to be steered via the initial 6-inch pilot bore using sonde detection equipment for guidance. For

engineers and contractors, it puts on the table a “go to solution” for the installation of small diameter tunnels in the “rock and the hard places”.

The diversity of conditions in which the method is successful has led to several recent projects turning to



The GEONEX™ system won the 2019 NASTT Innovative Product of the Year Award

Horizontal Down-Hole Hammer Boring when traditional methods have been unsuccessful, restricted, and where anticipated risk encouraged seeking an alternative solution. Several recent North American projects demonstrate the success of using Horizontal Down-Hole Hammer Boring for specific challenges.

GOING FURTHER FOR TRANSMOUNTAIN

The Tunneling Company (TTC) based in Kamloops B.C., (a subsidiary of The Crossing Group), used Horizontal Hammer Boring (HHB) to boost their recent success on the Transmountain Pipeline project in B.C. Work on the Transmountain Pipeline project included a variety of trenchless construction applications in which TTC was already well versed, including HDD, Micro-Tunneling, Auger Boring and Pipe Ramming. When evaluating the ground conditions for the project, however, Horizontal Hammer Boring (HHB), offered a great opportunity for TTC to go further



Transmountain Pipeline Project included a variety of roadway and sensitive area crossings

for their client and aid in the ultimate completion of the Transmountain Pipeline project.

Initially The Tunneling Company was contracted to perform several crossings with alternate methods, however TTC

successfully petitioned Transmountain to allow them to utilize the Horizontal Hammer Boring method. Having experience in smaller diameters with the GEONEX Equipment, TTC invested heavily the technology, expanding their

GEONEX HORIZONTAL HAMMER BORING EQUIPMENT

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capabilities and their experience. GEONEX Inc., worked extensively with the TTC team to evaluate anticipated conditions to determine the feasibility of deploying the equipment. Ultimately, TTC was contracted to perform more crossings which included a variety of roadway and sensitive area crossings on the project, including locations where attempts with other methods were unsuccessful.

RIGHT THE FIRST TIME

In 2023 the GEONEX™ system was successfully used for the first time by well known Utah-based trenchless contractors C.H. Nix for a 300-foot installation of 24-inch casing under parallel railway and roadway that was intended to be used for electrical conductors for a new solar project.

After previous unsuccessful attempts using auger-boring, and with pipe ramming prohibited due to potential failure of the railroad, the GEONEX™ system offered an alternative solution to what was attempted previously. As C.H. Nix President/CEO Stephanie Nix-Thomas explained, “The ground was a hard, compact silty clay that was almost like rock, but if you add water it would quickly lose any form. Because of the risk using water would add to possible failure of the railroad, or roadway we had to find a different solution.”

“A go-to solution for the installation of small diameter tunnels in the rock and the hard places.”

Pounding the way to success, the installation in Boise was completed to the satisfaction of the General Contractor, the project owner, and to the C.H.Nix team. Adding the GEONEX™ system to the trenchless toolbox has enabled C.H. Nix to get more work in a wider variety of ground conditions, and to complete these riskier projects more quickly. According to Stephanie Nix-Thomas “There’s just so much tough ground that the system is perfect for, instead of fighting it we’ll be confident we can get through like we did in Boise.”

ALTERNATIVE TO AUGER BORING

In June 2023, Dunigan Brothers of Summit Twp, Michigan set out to install 140 feet of 24-inch steel casing for a 12-inch Waterline below a pair of high-speed Amtrak rail lines. Familiar with the area and observing the topography, Dunigan anticipated cobbles and wet conditions in

the 14-foot deep bore. “When you look at the site, it looks like the railway is laid in an old creek bed. We knew it would be wet and sloppy but had a feeling we’d hit rock so we made sure we had a back-up plan” said Patrick Dunigan II, VP of Operations at Dunigan Brothers Inc.

During excavation of the jacking pit, Patrick’s feelings were confirmed when they began pulling rounded cobbles up to 24 inches in diameter from the pit. Under the direction of the project owner, Dunigan proceeded with traditional auger boring but made it only about 13 feet before hitting the cobbles. “I reached out to GEONEX Inc. for rental pricing as a contingency plan before we even started digging. After reviewing the project details, they were certain they could be successful barring any steel obstructions. When we hit the cobbles, I confirmed pricing, presented a change to the owner, and with minimal delay, GEONEX Inc. was on-site with their technician and tooling to get this project back underway.” explained Patrick. “We could only accommodate 10-foot casing lengths so it took a little while to make all those welds and we finished the bore in 4 days. I was impressed how well the equipment performed in the sloppy soft spots as well as through the cobbles.”

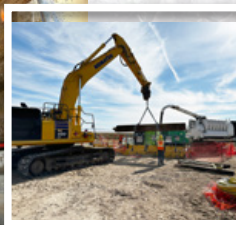
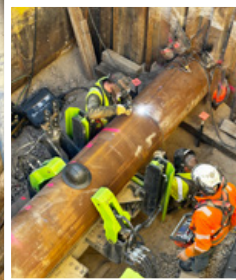
SUCCESS – YOU BETCHA!

The upper Midwestern states have a wide range of challenging geological conditions that make it extremely difficult, if not impossible, for HDD installations, and ground conditions can change on contractors in no time at all.

In June 2025 EBI Drilling, based in International Falls MN, completed the successful installation of two 150-foot 6-inch Steel Casings through solid rock (Syenite) with random fracture zones filled with gravel. EBI followed that up a month



Boise ID project installed 300 feet of 24-inch casing for electrical conductors under parallel road and railway





Technician uses the remote control to operate the GEONEX HZR610 drill machine set up for 10-foot casing lengths



Aerial view of equipment set up to bore under the high speed Amtrak railway

Horizontal Down-Hole Hammer Boring is a trenchless method for new installations.

later in July 2025 with the completion of six 24-inch Steel Casings at an FAA controlled airport in Reedsburg WI. Four 100-foot bores under taxiways and two 160-foot bores under the main runway. Subsurface conditions at the airport contained Sand, Weakly Cemented Sandstone, and

Sandstone. EBI completed this feat in just 6 days, minimizing the impact to the airport operations.

Terry Anderson, President of EBI Drilling, describes that being successful in this region means not giving up, which has led to their continued success. "It's a continuous learning curve. What tools work and where, and what doesn't. We were always trying new tooling on our rigs, but the ground was always different. We used downhole hammers on our HDD rigs which worked best to get through solid rock, but we did not, nor did anyone else, have a solution for mixed subsurface conditions or for large diameter rock drilling. When I saw a GEONEX Machine that could bust through the solid rock and other subsurface conditions without issues, I immediately knew these were the rigs for us."

The GEONEX™ system is gaining traction worldwide and earning a solid reputation as the versatile "go-to" addition to the trenchless technology toolbox. Gaining in popularity and profile, the GEONEX™ system has currently sold nearly 100 units globally in the USA, Canada, Finland, Sweden, Norway, Israel, Switzerland, Austria, Germany, Spain & Portugal.



From the Launch Pit: EBI's operator uses the GEONEX wireless remote control to operate their HZR610 Drill machine for a 320-foot installation below the highway



EBI Drilling utilizes their HZR220 to install 100 feet of 6-inch steel casing below railroad tracks in less than 8 hours. Before an additional 160 feet the next day

ABOUT THE AUTHOR:



Richard Revolinsky is the North American Operations Manager for Geonex Inc. He has served the trenchless industry for the past 10 years in various roles as Project Manager for Auger Boring and HDD projects and material sales. He is committed to furthering the Trenchless Construction industry with viable innovative solutions.

Canadian Underground Infrastructure Innovation Centre (CUIIC)

A Breakthrough Year: Driving Growth, Discovery, and the Future Ahead



By: Ali Bayat, Ph.D., PEng, Director, CUIIC

The Canadian Underground Infrastructure Innovation Centre (CUIIC) celebrated its most impactful year yet, expanding its national reach and strengthening its role as Canada's leading hub for research, education, and industry collaboration in underground infrastructure. Between July 1, 2024, and June 30, 2025, CUIIC achieved record membership growth, launched major research initiatives, and enhanced its educational programs – laying a solid foundation for continued advancement.

THE RISE OF A NATIONAL NETWORK

A key indicator of CUIIC's growing influence is the steady expansion of its collaborative network. Over the past year, membership has grown from 80 to more than 95 organizations across North America. This diverse community – including manufacturers, utilities, municipalities, consultants, contractors, and non-profit organizations – works together to advance the underground infrastructure sector. This growth further solidifies CUIIC's position as the leading national hub for the industry. The network operates under a robust governance framework, supported by six active committees and more than 110 dedicated members representing both industry and academia.

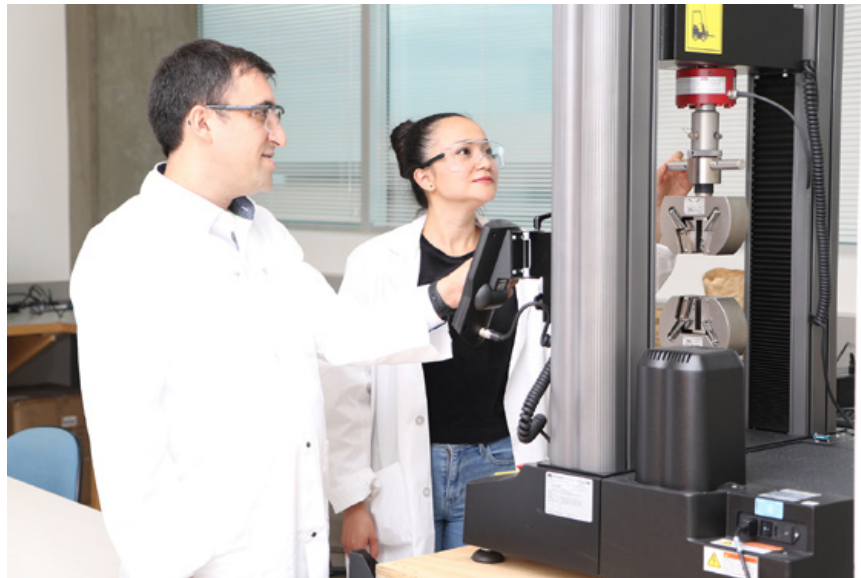
INNOVATING THE FUTURE, ONE STUDY AT A TIME

During the reporting period, CUIIC significantly expanded its research portfolio, driven by substantial grant funding and strengthened industry partnerships. Two flagship initiatives are currently underway:

Greenhouse Gas (GHG) Emission Reduction: CUIIC is leading a major project aimed at reducing GHG emissions in underground construction. Supported by an NSERC Alliance grant exceeding \$3 million and a \$300,000 Alberta Innovates

grant, the project exemplifies collaborative research. It brings together three Canadian universities – the University of Toronto, the University of Alberta, and Concordia University – alongside 21 industry partners to tackle a critical challenge in the sector. The initiative also provides applied training opportunities for at least ten students annually.

Sustainable Stormwater Management: CUIIC is advancing research in natural wetland retention and sustainable stormwater practices. Backed by \$600,000 from Alberta Innovates and \$730,000 in industry contributions, this project engages



CUIIC fosters innovation and research in underground infrastructure



Researchers and students working in a field on GHG and stormwater projects

15 industry organizations and five University of Alberta faculty members to develop innovative approaches to urban water management.

A BANNER YEAR FOR EDUCATION

Over the past year, CUIIC has successfully evolved from hosting standalone events to offering a comprehensive suite of CEU-accredited educational programs across four major Canadian cities. The Spring Academies stood out as a highlight, featuring specialized, hands-on courses in Geotechnical Considerations, Advanced HDD, and Pipe Rehabilitation, hosted in Vancouver, Mississauga, and Calgary.

CUIIC further expanded its educational impact through the National Webinar Series, delivering 12 interactive sessions with up to 300 registrants each. A key innovation this year was the launch of a searchable webinar archive, complete with live closed captioning, creating a permanent, accessible resource for industry professionals. Participant feedback underscores the value of these programs, with the vast majority of attendees reporting that they plan to apply the techniques directly in their professional practice.

LOOKING AHEAD: THE CUIIC SUMMIT AND FUTURE INITIATIVES

Looking toward 2026, CUIIC will introduce a consolidated educational summit model to enhance both

CUIIC achieved record membership growth laying a solid foundation for continued advancement.



Sponsors, speakers, and attendees on the first day of the CUIIC 2025 Safety Academy, September 2025

efficiency and impact. Standalone academies will transition into two major, multi-track “CUIIC Summits” annually – one in Eastern Canada and one in Western Canada. This approach will streamline logistics while offering attendees a comprehensive, “one-stop” learning experience. The inaugural **CUIIC Summit** is scheduled to take place in **Mississauga from March 5–7, 2026**, featuring a distinguished lineup of speakers and a premier educational program.

Strategic objectives for the upcoming year include:

- **Expanding the thematic scope** beyond trenchless technology to address emerging priorities such as artificial intelligence for predictive maintenance, advanced asset management, and climate resilience.
- **Enhancing member value** through the introduction of a tiered corporate sponsorship model and paid certification pathways, thereby

diversifying revenue streams and providing clearly credentialed benefits to members.

As we conclude a successful year and look ahead, CUIIC remains dedicated to advancing the underground infrastructure industry through collaboration, research, and education.

To learn more about our initiatives and programs, please visit us at

www.cuiic.ca

ABOUT THE AUTHOR:



Dr. Ali Bayat, Ph.D., P.Eng., is a Professor of Civil and Environmental Engineering, the University of Alberta Senior Engineering

Research Chair in Underground Infrastructure, and the Director of the Canadian Underground Infrastructure Innovation Centre (CUIIC).

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