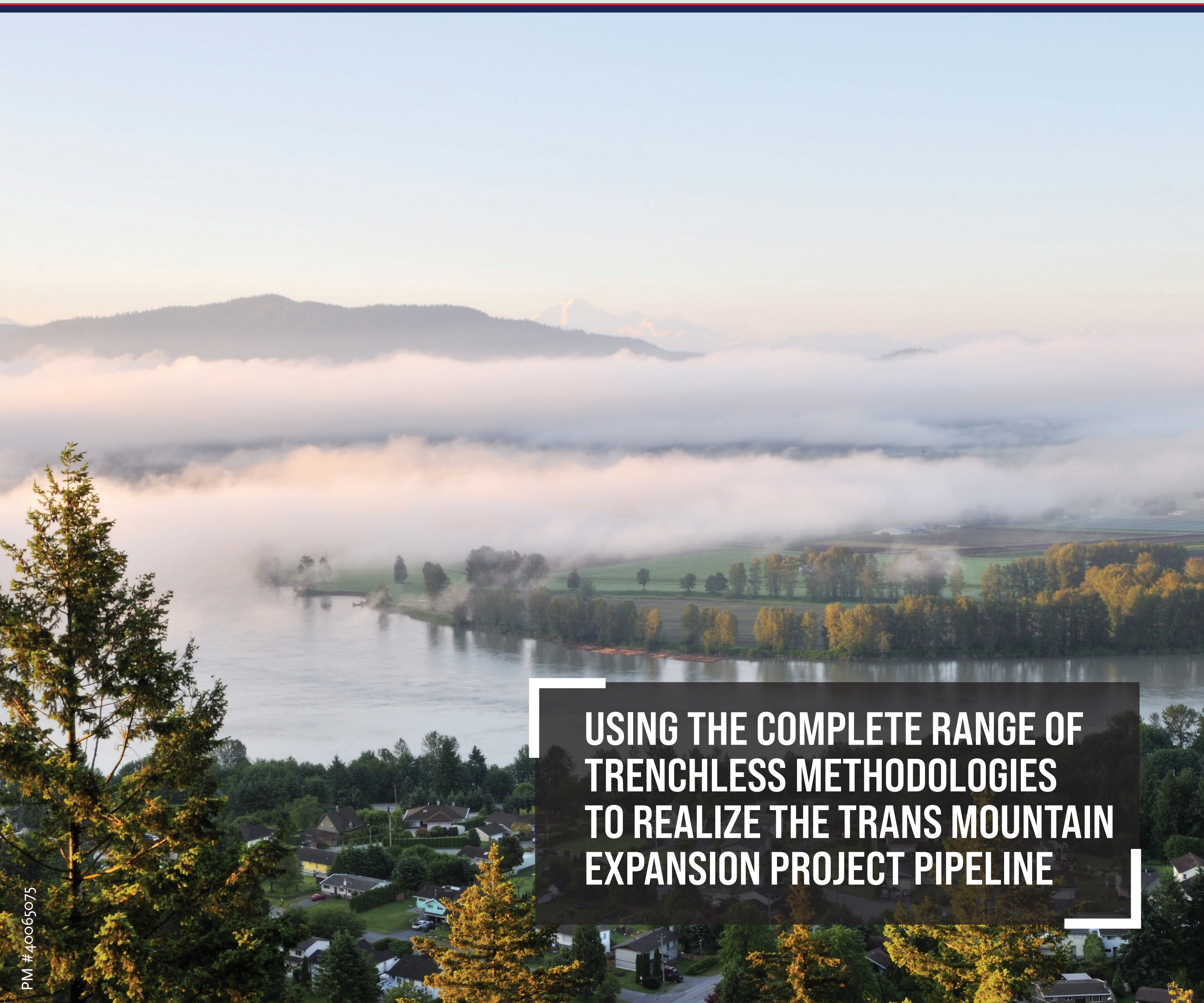
2021 | NORTHWEST
SPRING/SUMMER

TRENCHLESS JOURNAL

THE OFFICIAL PUBLICATION OF THE NORTHWEST CHAPTER OF THE NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY



USING THE COMPLETE RANGE OF TRENCHLESS METHODOLOGIES TO REALIZE THE TRANS MOUNTAIN EXPANSION PROJECT PIPELINE

PM #40065075

THE RISK MANAGEMENT INSPECTION TOOL | 2021 NASTT-NW BUYERS' GUIDE


ANY SIZE. ANY LENGTH.
ANYWHERE.

Craig Kelman & Associates
www.kelman.ca
Managing Editor: Monique Doyle
Design/Layout: Dia Chea
Marketing Manager: Chad Morrison
Advertising Coordinator: Stefanie Hagidiakow

Return undeliverable Canadian addresses to:
lauren@kelman.ca

Publication Mail Agreement #40065075

2021 | NORTHWEST

TRENCHLESS JOURNAL

THE OFFICIAL PUBLICATION OF THE NORTHWEST CHAPTER OF
THE NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY

IN THIS ISSUE:

7 NO-DIG NORTH – VANCOUVER, BC
9 NO-DIG SHOW 2022 – CALL FOR ABSTRACTS
11 CALL FOR MAGAZINE SUBMISSIONS
13 TRANS MOUNTAIN CORPORATION USES THE COMPLETE RANGE OF TRENCHLESS METHODOLOGIES TO REALIZE THE TRANS MOUNTAIN EXPANSION PROJECT PIPELINE
22 RISK MANAGEMENT INSPECTION™: A TOOL FOR EFFECTIVE MANAGEMENT OF HDD RISKS TO AVOID CLAIM
26 2021 NASTT-NW CHAPTER BUYERS' GUIDE

DEPARTMENTS:

MESSAGE FROM THE MAGAZINE COMMITTEE 6
MESSAGE FROM NASTT 8
ADVERTISER PRODUCT & SERVICE CENTRE 30

VIEW US ONLINE
NASTT-NW.COM

ON THE COVER: Fraser Valley at foggy sunrise. | dreamstime.com

IN THIS ISSUE

"We are pleased to present A Tool for Effective Management of HDD Risks to Avoid Claims on pages 22–25."

Welcome to the Spring/Summer issue of the *Northwest Trenchless Journal*, the official publication for members of the NASTT-NW Chapter. In this issue of the magazine, we put the spotlight on the Trans Mountain Expansion Project Pipeline and the range of trenchless methodologies used for it. To read more about this recent No-Dig presentation, see page 13.

In addition, we are pleased to present A Tool for Effective Management of HDD Risks to Avoid Claims on pages 22–25.

And be sure to check out the 2021 NASTT-NW Chapter Buyers' Guide, beginning on page 28.

Remember that you can find the most recent details about the status of No-Dig North and registration information by visiting *www.nodignorth.ca*. You can also find the Northwest Chapter on LinkedIn, at *www.linkedin.com/groups/4430433*.

Our Chapter magazine is published twice a year. The next issue of the *Northwest Trenchless Journal* is scheduled for distribution in the fall.

We are always interested in relevant, regional content to share with members. We welcome submissions such as technical papers and project profiles. Please contact Carlie Pittman at *pittmanc@ae.ca* before the end of August 2021 for more information and to let us know if you would like to contribute to the next issue of this magazine.

The North American Society for Trenchless Technology will be hosting the second annual No-Dig North in Vancouver, BC, November 8–10, 2021.

Monday, Nov. 8
Pre-Event Good Practices Courses
Opening Reception

Tuesday, Nov. 9
Registration and Exhibit Hall Open
AM and PM Sessions

Wednesday, Nov. 10
Exhibit Hall Open
AM and PM Sessions

NOVEMBER 8–10, 2021
Vancouver, BC Canada

For more information, please visit ***www.nodignorth.ca.***

THE VALUE OF STRONG VOLUNTEERS

This year I began my term as Chair of NASTT's Board of Directors, and I am looking forward to seeing the continued progress and expansion of NASTT, the Northwest Chapter, and the trenchless industry. 2020 was a year that truly was unprecedented! We've seen challenges with communication and physical meetings due to the global pandemic; however, the perseverance of our membership, sponsors, and trenchless community have enabled this Society to rise above the circumstances and set our future for success. Due to unparalleled creativity and sheer effort, we will continue to experience growth and recovery as we work toward our common goals in 2021.

The NASTT 2021 No-Dig Show was recently held in Orlando, Florida at the end of March. We are excited to offer an On-Demand option for the many Canadians who were unable to be onsite in Orlando. Virtual attendees will have access to all 150+ pre-recorded technical presentations and the ability to network with each other while learning more about each of our exhibitors through our virtual exhibit showcase. Virtual attendees can register for the New Installation track, Rehabilitation track, or attend the full conference. The on-demand presentations will be available through June 30, allowing for plenty of time to view as many presentations as you would like. CEUs are also available to virtual attendees. Visit the conference website at *nodigshow.com* for more information on all the ways you can virtually participate in the 2021 No-Dig Show.

> "The on-demand presentations will be available through June 30."

We've also begun planning for the 2022 No-Dig Show being held in Minneapolis, Minnesota in April of next year. Do you have a project, service, or product that you'd like to educate the trenchless industry about? Submit your abstract by June 30 for an opportunity to present at the 2022 No-Dig Show. Visit *nastt.org* for details.

NASTT exists because of our dedicated volunteers. With training and education at the forefront of our mission as a Society, we look forward to offering many creative options for trenchless training and education throughout the year including our Virtual Good Practices Courses and our virtual or in-person Regional Chapter meetings, conferences, and webinars. Stay tuned as we roll out a wide range of opportunities to meet your professional needs.

Our Society is only as strong as our members and volunteers. I have gotten to see first-hand the time and sacrifice that each of you have made. Since our committees align with the strategic plan, I challenge our membership to participate in the NASTT committees. Education and the college curriculum will continue to evolve as we focus on bringing trenchless technology to every corner of North America. I thank you for your dedication and your commitment during what can only be described as one of the most challenging and unusual years of our lifetime!

Alan Goodman
NASTT Chair

APRIL 10-14 | MINNEAPOLIS, MN

NASTT NO-DIG SHOW 2022

Call for Abstracts

Submission Deadline: June 30, 2021



The North American Society for Trenchless Technology (NASTT) is now accepting abstracts for its 2022 No-Dig Show in Minneapolis, MN at the Minneapolis Convention Center on April 10-14, 2022. Prospective authors are invited to submit a 250-word abstract outlining the scope of their paper and the principal points of benefit to the trenchless industry. The abstracts must be submitted electronically at NASTT's website by June 30, 2021: nastt.org/no-dig-show.

Abstracts from the following subject areas are of interest to the No-Dig Show Program Committee:

Potable Water and Pressure Systems

- Pipeline Inspection, Locating, and Condition Assessment
- Pipe Rehabilitation
- Pipe Bursting
- Emerging Technologies
- Case Studies

Wastewater, Storm water and Non-pressure Systems

- Advanced Pipeline Condition Assessment
- I&I and Leak Detection
- Pipeline and Laterals Rehabilitation
- Pipeline Inspection, Locating, and Condition Assessment
- Cured-in-Place Pipe Lining
- Sliplining
- Pipe Bursting
- Spray Applied Linings
- Grouting
- Manhole Rehabilitation
- Case Studies

Energy Pipeline Systems

- Pipeline Inspection, Locating, and Condition Assessment
- Aging System Rehabilitation
- New Trenchless Installation
- Standards and Regulations

Trenchless Research and Development

- University and Industry Initiatives
- Education and Training

Industry Issues

- Subsurface Utility Engineering
- Submittal Requirements and Quality Assurance/Quality Control
- Project Budgeting and Prioritization
- Funding for "Green" Technologies
- Selection Criteria for Contractors
- Social Costs and Impacts
- Carbon Footprint Reduction
- Sustainable Construction Practices
- Industry Trends, Issues and Concerns
- Differing Site Condition Claims

New Installations – Tunneling, Boring and Pipe Ramming

- New Concepts or Trenchless Equipment, Materials and Methods
- New Applications for Boring Techniques (Auger Boring and Pipe Ramming)
- Pilot Tube Boring (Tunneling)
- Case Studies

Horizontal Directional Drilling (HDD)

- New Concepts and Applications for Horizontal Directional Drilling Equipment, Materials and Methods
- Case Studies

Microtunneling

- New Concepts and Applications for Microtunneling Equipment, Materials and Methods
- Case Studies

Questions?

Please contact:

Michelle Hill
NASTT Program Director
E: mhill@nastt.org
P: 888-993-9935

For more information visit

nodigshow.com

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.

Call for Submissions

If you would like to submit your project paper or other content and photos for an upcoming issue of this Northwest Chapter magazine, please contact Carlie Pittman, Magazine Committee Chair, at *pittmanc@ae.ca*.

Editorial submissions for the *Northwest Trenchless Journal* are welcome and due for our next publication by early August 23, 2021.

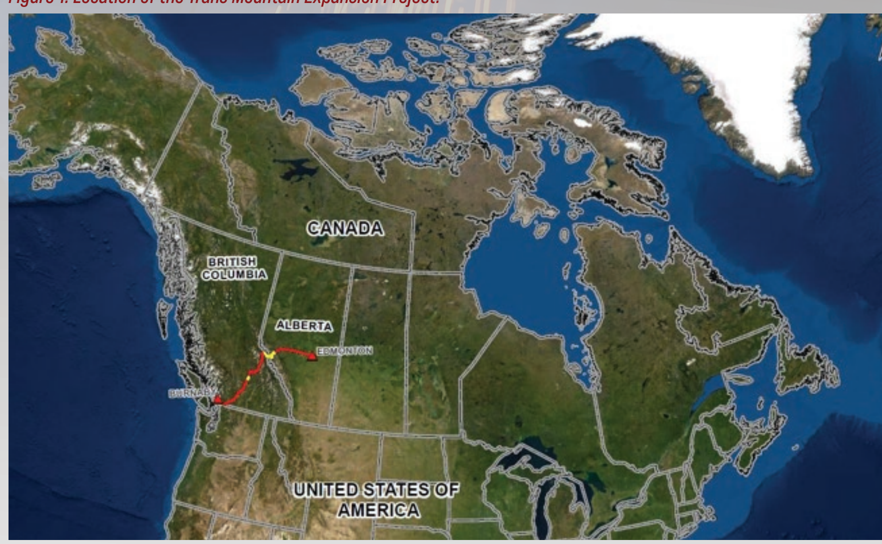
BACK TO CONTENTS

TRANS MOUNTAIN CORPORATION USES THE COMPLETE RANGE OF TRENCHLESS METHODOLOGIES TO REALIZE THE TRANS MOUNTAIN EXPANSION PROJECT PIPELINE

ABSTRACT

The original NPS 24 Trans Mountain Pipeline was constructed in 1953. Other than some basic tunneling, major trenchless construction was not available at that time for the oil and gas pipeline industry. In 2020, Trans Mountain Corporation started construction of the Trans Mountain Expansion Project (TMEP) pipeline. This pipeline project involves almost 893 kilometres (555 miles) of NPS 36 and 122 kms (76 miles) of NPS 42 pipeline for a total length of 1,015 kms or 630 miles. The pipeline extends from Edmonton, Alberta to Burrard Inlet in Vancouver, BC. Major trenchless crossing construction is helping to make this pipeline possible, including a 2,600 meter long (1.62 miles) TBM tunnel, as much as 1,300 meters (4,265 feet) of MTBM microtunneling, 2,500 meters (8,202 feet) of Direct Pipe, 33,000 meters (20.5 miles) of horizontal directional drilling (HDD), as well as horizontal directional boring (HDB), and all of the more conventional boring methods. A pipeline project with this magnitude of trenchless construction has never been attempted before in North America and possibly anywhere, and this is only the second time has a pipeline been constructed from Alberta to the BC coast. This paper describes the process of trenchless selection and design for this world-class project and some of the major routing, geological, and geotechnical issues that had to be overcome.

Figure 1. Location of the Trans Mountain Expansion Project.



INTRODUCTION

Figure 1 shows the location of the Trans Mountain Expansion Project (TMEP) pipeline route relative to North America. The pipeline is located in the two western provinces of Canada. The pipeline travels from Edmonton Alberta to Vancouver, carrying dilbit (diluted bitumen) to the port of Vancouver in Burnaby, BC. The route essentially follows the existing Trans Mountain Pipeline (TMPL) route. Construction of the original Trans Mountain Pipeline (TMPL) was completed in 1953 from Edmonton to the offload point at Westridge Terminal in Burrard Inlet, a total of 1,150 kilometres (715 miles).

This pipeline was constructed as an NPS 24 line to carry approximately 300,000 barrels per day (bpd). A key segment of this massive project was the crossing of the Fraser River in the Lower Mainland. As trenchless construction methods such as horizontal directional drilling (HDD) were not available at that time, the Fraser River crossing was constructed as a trench and fill operation. As the Fraser River became busier, TMPL determined that the crossing needed to be replaced. The design alignment essentially followed the alignment of the existing crossing. This crossing replacement was successfully constructed in 2003 as an HDD.

BACK TO CONTENTS

> **"THIS WORLD-CLASS PROJECT COMPRISES 980 KM (609 MILES) OF NEW PIPELINE, ALONG WITH AS MANY AS 44 HDDs."**

GEOGRAPHY

The pipeline route begins in Edmonton and traverses west through the Alberta Plains. The Alberta Plains are characterized by low topographic relief with glaciolacustrine and till sediments overlying poorly lithified sedimentary bedrock. The pipeline crossing three different mountain ranges: the Rockies, Columbia, and Cascade mountains. They are characterized by high topographic relief with colluvial, till, and bedrock exposures on the valley walls and thick sequences of fluvial and glaciofluvial sediments in the bottom of valleys. Between the Columbia and Cascade mountains, the pipeline traverses the extensive Interior Plateau. The Interior Plateau is characterized by moderate topographic relief with colluvial, fluvial, and glacial sediments overlying metasediment and volcanic bedrock. Finally, the route spans the lowlands of the Fraser River Valley before ending at the Westridge Terminal in Burnaby. The Fraser Valley is characterized by low topographic relief with fluvial and glacial sediments.

The TMEP pipeline profile is shown in Figure 3 in a very condensed format. Starting out at an elevation of 680 m (2,231 ft) at KP 0.0 (Baseline Road HDD) in Edmonton, the pipeline rises to a peak elevation of 1,229 m (4,032 ft) at KP 350 (near Hinton, AB and the Hardisty Creek Geohazard HDD), dropping to the central plateau with an elevation of approximately 400 m (1,312 ft) at KP 840 (Kamloops, BC and Thompson River HDD) and then rising again to an elevation of 1,360 m (4,462 ft) at about KP 1,000 (Dry Gulch HDD), then finally dropping off to sea level at the Westridge terminal KP (Burnaby Tunnel) at the termination of the Burnaby Pipeline Tunnel. This geography has presented numerous challenges that have been solved in some cases with the use of trenchless construction.

ROUTING

The alignment philosophy for the Trans Mountain Expansion Project (TMEP) is to follow, to the extent possible, the existing ROW for the majority of the length of the project from Edmonton to Vancouver.

Figure 2. TMEP Route Map.

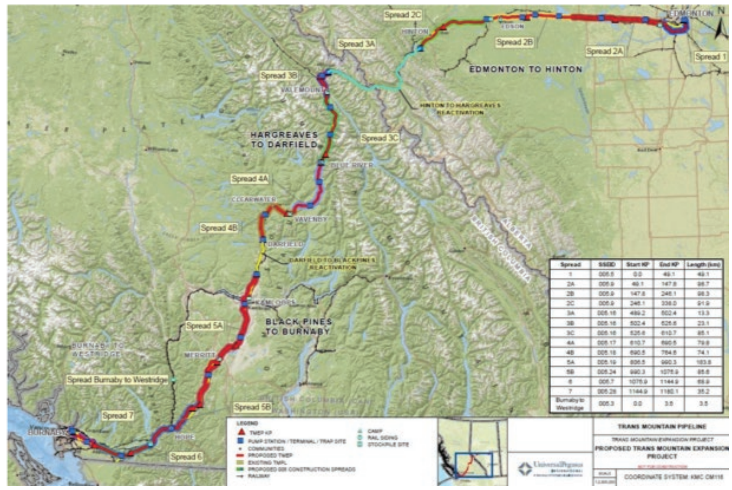


Figure 3. Pipeline Profile.

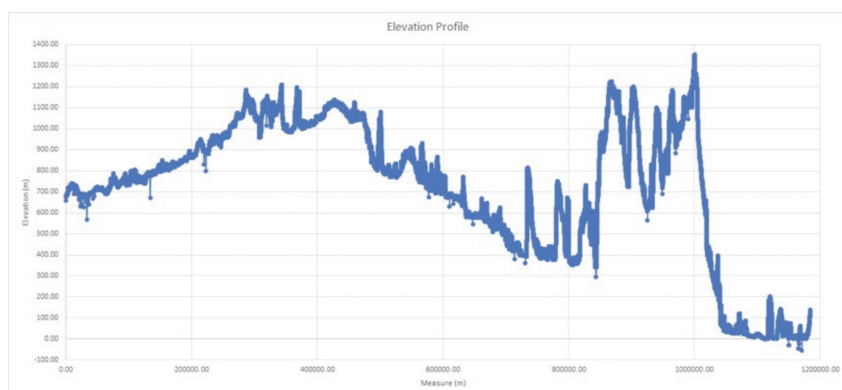


Figure 1 shows the location of the pipeline starting in north central Alberta and ending up in Burrard Inlet in Burnaby, BC. In 2012, the project design was started with Universal Pegasus International carrying out the pipeline routing and design, with BGC Geotechnical doing the geotechnical engineering on the project. BGC had for years been monitoring all of the trenched water crossings on the existing TMPL alignment, for depth of cover as well as other risks, and therefore were very familiar with all of the potential water crossings.

This world-class project comprises 980 km (609 miles) of new pipeline, along with as many as 44 HDDs, seven Direct Pipes®, a 2.6 km tunnel, a number of microtunnels, and numerous bored crossings as noted in Table 1. It crosses a number of mountain ranges while 73% of the route utilizes existing right of way.

The original NPS 24 Trans Mountain Pipeline was built in 1953 at a time when the concept of trenchless was essentially non-mechanized tunneling. At least one location of the route was

BACK TO CONTENTS

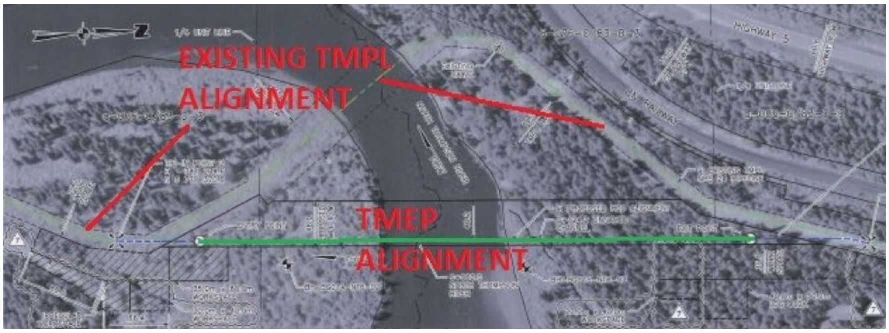
installed through a short, small drill and blast tunnel, comprising the extent of trenchless construction used on the original route. The Trans Mountain Expansion Project is essentially a twinning of this existing 1,150-kilometre pipeline between Strathcona County (near Edmonton), and Burnaby. It will create a pipeline system with the nominal capacity of the system going from approximately 300,000 barrels per day to 890,000 barrels per day.

On June 18, 2019 the Government of Canada approved the Trans Mountain Expansion Project. The Project is subject to 156 conditions enforced by the Canada Energy Regulator (CER). Several of these conditions pertained to the use of trenchless installations.

Routing for the TMEP alignment started in early 2013. The project routing specialists approached the design team to determine what to look for at water crossings on the route in the field. One of the major tasks was to determine the new crossing alignment, considering that the original crossings were all crossing using open cut trenched construction. With the diameter of the pipe, the instructions were that the minimum length of any simple crossing would be about 500 meters (1,640 ft). Then they would need a similar length for the laydown area. As it turned out, the minimum size was around 400 m (1,312 ft) and that was in Alberta for a few short road crossings.

Trenched methods for water crossings required a good location to cross, avoiding major water course meanders with stable banks, and at a narrow point in the river. Crossings were almost always aligned at 90 degrees to the river, to keep the crossing as short as possible, and most of the time there were bends in the alignment on both sides of the river. HDD crossing alignments are based on totally different criteria. Since the route was to follow as closely as possible to the existing TMPL alignment, this tended to determine the trenchless crossing location, alignment, and length. A good example of this is in Spread 4, the North Thompson River 6 crossing shown in Figure 4. The existing TMPL alignment was clearly not suitable for many reasons, which were primarily the location of the highway and railway limiting the length of the crossing. Therefore, the challenge was to pick the right alignment that was not too long yet allowed for sufficient depth under the river as well as an alignment that suited the lay down area for the drag section. In this case, the lay down area for the pipe was along the pipe alignment, which simplifies the effort.

Figure 4. North Thompson 6 HDD.



The pipeline is primarily NPS 36; however, there is a portion of the pipeline that is NPS 42. This section of the pipeline is approximately 122 km (76 miles) long. This section of the pipeline project has two HDDs. Blue River HDD has a length of over 800 m (2,625 ft) and is a significant trenchless crossing with a proposed depth of over 50 meters (164 ft). The preliminary design was for either a shorter DP or an HDD. Landowner discussions and agreements created the need for a deeper and longer HDD. The second HDD on this NPS 42 Spread is the North Thompson River crossing, which also crosses the CN Railway. This HDD crossing is almost 700 m (2,297 ft) long.

DRIVERS FOR TRENCHLESS CROSSINGS

Considering the length and route of the pipeline, the list of drivers for the use of trenchless methodology is extensive on a major cross-country pipeline project.

As noted previously, the TMEP project utilizes all the methods of trenchless construction. Some of the major drivers for trenchless crossings are:

1. *Requirement from major infrastructure owners and stakeholders*: When crossing major highways and all Railways per the guidelines from Alberta Transportation, CN/ CP Railways, Ministry of Transportation (MoTI), trenchless method is required.
2. *Requirement from utility owners:* When crossing under pipelines owned by vendors like Enbridge/TransCanada, Pembina, ATCO, etc., trenchless method with specific clearance under vendor's pipeline is required. The type of trenchless, i.e., auger bore, or HD bore is determined depending primarily on the subsurface conditions as well as depth for the minimum clearance required as well as other factors such as cost.
3. *Requirement for watercourses:*
   - 1.a. As per the requirement from DFO to avoid disturbance within the riparian zone, and to have minimum impact to environment, trenchless method of crossing is used.
   - 1.b. Major watercourses (classified SI/ S2)/named rivers are to be crossed using trenchless crossing as per NEB requirements
   - 1.c. Within the available workspace, or longer crossings duration for isolated open cut crossing in certain cases is more than the window permitted by environmental. Accordingly, certain crossings deploy trenchless as crossing method to meet the environment condition of restricted time window.
   - 1.d. Crossing for watercourses that meander and have deeper depth of cover requirements due to scour, use trenchless methods to avoid pipe exposure due to bank erosions, etc.
2. *Requirement from environment:* A trenchless method is deployed for some environment conditions like land with archeology conditions, land with endangered species, etc., which cannot be disturbed, and to avoid cutting of certain trees. Also, water crossings where reclamation of the riparian zone is considered expensive and probably time consuming or simply a contractor will be required to come back later to make repairs. This makes trenchless options very appealing.
3. *Constructability reasons:* Trenchless is considered as the most efficient method (both for time and cost) in some cases such as:
   - 3.a. Crossing under cluster of pipelines/crossing under pipeline corridors.
   - 3.b. Extending the existing bore to avoid relocation of power poles.

BACK TO CONTENTS

3.c. It is economical to bore under municipal roads to meet all the conditions per crossing agreement.
3.d. Crossing under landowner's pet burial land/driveways or any other landowner negotiations.
3.e. Crossing wet area/pond to avoid dewatering or a wet open cut or isolated crossing.
3.f. Crossings using trenchless method to meet the schedule requirements.

4. Geotechnical/Geohazard reasons: In mountainous terrain, sometimes a trenchless crossing is considered in order to avoid geohazard areas. For example, Hardisty Creek in spread 2 which avoided trenching in unstable slopes.
5. *Landowner reasons:* First Nations, golf courses, ski resorts, tree lines, etc.
6. *Constructability issues:* Encountered during construction and 'timing window' constraints.

In previous years, placing the pipeline on a bridge in some fashion was an option. That option is generally less available. In fact, pipeline owners are being asked to remove their pipeline from the bridges, and in order to cross the waterbody a trenchless application is required. However, one aerial crossing will be constructed on the project.

TRENCHLESS METHODOLOGIES UTILIZED ON THE PROJECT

Virtually all trenchless methodologies have been utilized on the Trans Mountain Pipeline Expansion Project to deal with the myriad of trenchless requirements.

Therefore, the total length of trenchless construction on the project equals approximately 74 km (46 miles) or about 7.5% of the total length of the pipeline. The project currently has nine crossings over 1,000 metres (3,280 ft) long and 26 crossings between 500 and 1,000 metres in length. The longest HDD is at the Fraser River HDD in the Lower Mainland at 1,457 m (4,780 ft). The longest DP is 497 m (1,639 ft) with the longest designed HDB (with vertical curvature) at 250 m (820 ft). While the majority of the HDDs have a 19 mm wall thickness, the Blue river HDD has a wall thickness at 22.2 mm (0.87 inches) as this crossing is in a section of pipeline that is NPS 42. One other consideration early in the project was that with the high number of HDD crossings anticipated and the potential terrain challenges, it was decided to have a design curve radius of 1,000 m (3,280 ft) for the project for the NPS 36 pipe where the normal rule of thumb would be about 1,100 m (3,610 ft). It is 1,200 m (3,937 ft) for the NPS 42 pipe where the normal rule of thumb would be a bit higher at 1,280 m (4,200 ft). The intent has been to keep the crossings reasonably short but also to assist with the flexibility in the crossing designs.

Construction started in late 2019 and continues today with planned completion scheduled for 2022. Prior to construction start, the total length of the project was split into seven "spreads" which are essentially separate construction projects with different mainline contractors. Spread 1 has the major trenchless work contained as part of the mainline contract. However, spreads 2 through 6 have the major trenchless work separated out of the mainline contract and these major trenchless contracts are now being administered by Trans Mountain directly.

Considering the risks involved, primarily to the overall schedule, Trans Mountain wanted to have control over these high risk aspects of the project. Spread 7 was awarded to a joint venture of Kiewit and Ledcor Pipelines and included all the major trenchless work and the Burnaby Tunnel. Additionally, other major and conventional bored trenchless installations were developed based on joint planning with the general construction contractors to provide construction execution efficiencies

Not surprisingly given the scale/length of the project, a wide range of subsurface conditions ranging from soft weak soils, to very granular coarse material to hard bedrock, were encountered and were characterized by numerous geotechnical feasibility investigation studies which served as a critical input in prudently selecting the trenchless method to be deployed. Also, of critical importance in finalizing the selection of the trenchless method at a given location,

Table 1. Numbers of Different Crossing Methodologies and Approximate Total Lengths.

	Crossing Methodologies	No. of Installations	Crossing Lengths (meters)
1	Horizontal Directional Drilling (HDD)	44	32,753 m (20.4 miles)
2	Direct Pipe® (DP)	7	2,447m (8027 ft)
3	Horizontal Directional Bores (HDB)	60	17,700 m (11 miles)
4	Tunnel (TBM)	1	2,607 m (8,553 ft)
5	Microtunneling (MTBM)	5	1,300 m (4,265 ft)
6	Horizontal Auger Bores (HAB)	192	17,300 m (10.8 miles)
7	Down the Hole Hammer (DTH)	1	135 m (425 ft)

Table 2. Selected Trenchless Crossings and Reasons for Trenchless.

Crossing Name (Spread)	Length (m)	Method	Reason for Crossing	Subsurface Conditions
North Saskatchewan River SP1	1,062 (3,484 ft)	HDD	Major River Valley	Clay till and bedrock
Calgary Trail SP1	1,367 (4,485 ft)	HDD	Major Road System	Clay till and bedrock intersect
Guardian Rd SP1	702 (2,303 ft)	HDD	Major Road	Clay till
Hardisty Creek SP2	1,007 (3,303 ft)	HDD	Geohazard	Gravels and bedrock intersect
Clearwater River SP 4	400 (1,312 ft)	DP	Major River & Park	Sands
Blue River SP3	816 (2,677 ft)	HDD	River and Major Resort	Sands
Thompson River SP5	1,366 (4,488 ft)	HDD	Major River	Sand and silt
Lightning Rock SP 6	800 (2,624 ft)	HDD	First Nations Lands	Bedrock
Sandy Hill SP 6	800 (2,624 ft)	MTBM	Residential Area	Sands silts and clays
Fraser River SP 7	1,457 (4,780 ft)	HDD	Major River	Various
Burnaby Mountain SP7	2,600 (8,530 ft)	TBM	Removing Pipeline from Roads	Conglomerate

BACK TO CONTENTS

Figure 5. Spread 1 – City of Edmonton.

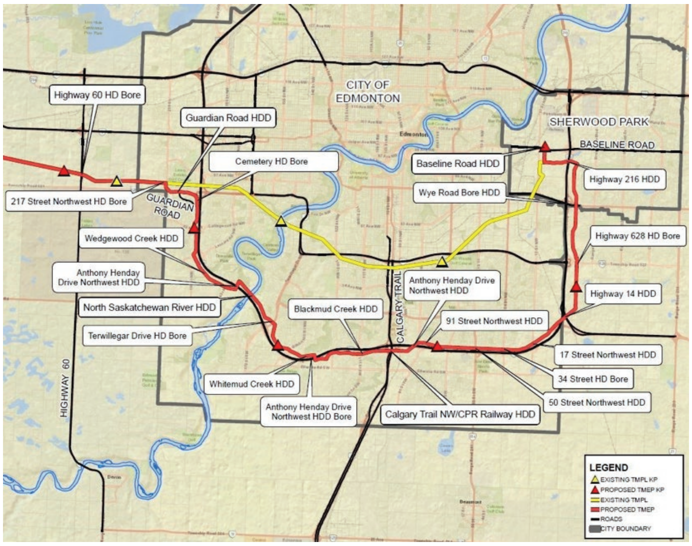
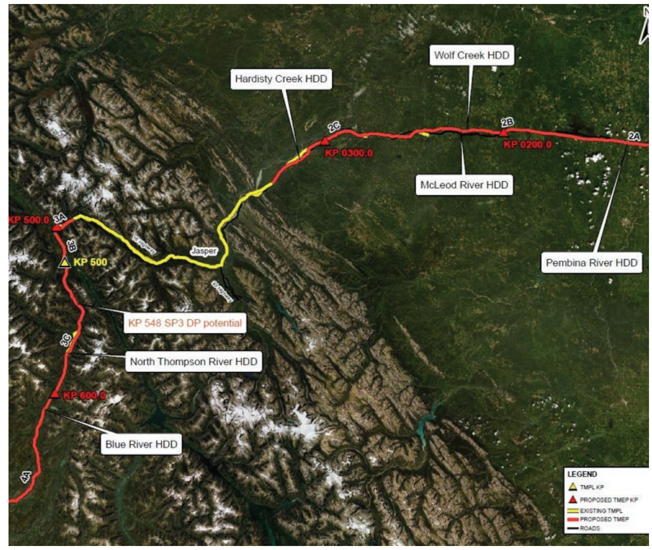


Figure 6. Spread 2 & 3 Trenchless Crossings.



were considerations of topography and subsurface ground water conditions. For example, the Spread 2 Hardisty Creek HDD is in fact a crossing specifically required by the geohazard study. The HDD passes below a specific geohazard that included Hardisty Creek. This crossing was successfully constructed in summer 2020.

Site-specific ground surface monitoring surveys for select crossings, together with a protocol of data analysis, were developed/undertaken as part of both engineering oversight or permitted crossing requirements. Rigorous attention was paid for the management of drilling and boring cuttings including the characterization and disposal of acid rock and metal leaching material.

CONSTRUCTION 'SPREADS'

Spread 1

With this spread being in a developed urban area it has the most trenchless crossings on the project. Despite being the second shortest spread of the project, there are 14 significant HDDs with the longest being the Calgary Trail HDD. The second longest with the most challenging geometry is the North Saskatchewan River HDD with a length of 1,062 m (3,484 ft). However, it was felt that the most challenging crossing in this spread was a major road crossing. Due to conflicts with other utilities and a proposed bridge piled foundation, the Guardian Road HDD, at just over 700 m, had a significant geometric challenge. The crossing was essentially all curves, with a vertical curve transitioning to a horizontal curve and then back into a vertical curve at exit. Only 127 m (417 ft) of the 702 m (2,303 ft) length was straight; the rest was in 1,000 m (3,281 ft) radius curves. The transition from vertical curve to horizontal curve was only about 8 m both times. As a contingency for this, extra-heavy wall pipe at 21.5 mm (0.85 inches) was used to allow for additional curvature flexibility.

A major section of pipeline expansion was completed by Trans Mountain in 2008, called the Anchor Loop project. This section both east and west of Jasper, Alberta, included a 158 km (98 mile) section between Hinton, Alberta and Hargreaves, BC. The Anchor Loop project planning and permitting was started in 2004 and essentially twinned the existing NPS 24 inch TMPL line and passed through Jasper National Park and Mount Robson Provincial Park. This addition eliminated capacity constraints at the time by installing a larger 36-inch diameter pipe which is currently in operation today. The existing NPS 24 TMPL line was filled with an inert gas and maintained for future use. This section of pipe will be reactivated as part of the TMEP project and put back in service. The interesting aspect of this section is that at the time of design the HDD feasibility report stated that HDD was not feasible in any of the crossings due to the coarse nature of the gravel and cobble deposits. This was at a time when the trenchless technology for pipelines included only auger boring and HDD, and prior to the full development of microtunneling technology and the development of the Herrenknecht Direct Pipe® technology as well as other trenchless techniques.

Spread 2

Figure 6 shows the location of spread 2. The western point of this spread is the first part of the project that enters the mountains. This has a number of long, challenging crossings. Probably the most challenging trenchless crossings are the Hardisty Creek geohazard crossing and the Pembina River crossing. The Hardisty Creek crossing was on the list of most challenging crossings as the contingency crossing was particularly difficult due to the mountainous terrain. The Pembina River crossing, shown in Figure 7 (see page 18), was challenging due to the 108 m (354 ft) elevation difference from the entry elevation to the bottom of the drill profile. This crossing was originally designed with the extra-heavy wall pipe (21.5 m wall) as an added contingency in case the contractor had difficulties steering and went deeper with the drill. TMEP were made aware that a deeper drill, even as much as a few meters, would require the extra-heavy wall (21.5 mm) pipe. In the end, the heavy wall (19 mm) was utilized as the contractor did an excellent job at steering the pilot hole. The Hardisty crossing also went very well once all the required casing was installed.

Spread 3

A previously constructed "loop" separates spreads 2 and 3. This NPS 42 spread has very limited HDDs with the exception of two significant crossings. One of the crossings is in Blue River with the North Thompson River crossing about 30 km north. This NPS 42 section is just under 122 km long. The Blue River HDD is 816 m long while the North Thompson River approximately 700 m long. Both crossings are mostly in sands and silts.

Spread 4

Spread 4 includes significant HDDs and one Direct Pipe. The one challenging HDD is the crossing of the Raft River. This crossing has a significant elevation difference of about 20 m. An elevation difference is always a challenge but more so when the crossing is almost all sand. Therefore, a significant length of casing is required on the exit side, resulting in the requirement for an intersect drill. This drill alignment does not follow the existing TMPL alignment as it travels through a populated area. It was felt during the routing design that a new alignment was necessary. In addition, there is a highway crossing as a result of landowner negotiations. The crossing ended up being over 1,000 m long. The other significant crossing is the Clearwater River Direct Pipe. This crossing is entirely in sand with an elevation difference of 10 m. Due to land issues, this crossing was very restrictive in geometry and required a reduction in the design radius. The design radius for DP can be somewhat less restrictive in that the tunnel profile alignment is much more controlled compared to HDD. As a result, the radius was set at 900 m which is tighter than the project's 1,000 m radius standard, to make the crossing fit the geometry. Land issues were the main drivers for the use of Direct Pipe in this location. There was insufficient space to drill an HDD and even the Direct Pipe was a tight fit when it came to the length of the crossing. The "thrust section" is in three sections, which is not desirable but there was no viable option as laydown area was very limited.

Spread 5

This spread has a number of long HDDs which includes the Thompson River in Kamloops at 1,366 m (4,482 ft), one of the longest crossings and most challenging on the project. The crossing was entirely in sands and to complete the crossing took two attempts. The second attempt required a final ream size of 1.37m (54 inches) to complete the crossing. This spread also has the first use of microtunneling on the project near Hope, BC. At this location an HDD would not fit into the available space and the contractor has elected to use a 300 m long microtunnel option in the bedrock. Unlike a microtunnel for a sewer line, TMEP requires a 36-inch pipe steel pipeline to be inserted. The most cost effective and efficient way to do this is through a portal. Therefore, one of the microtunnel design requirements is to have at least one end constructed as a portal. This allows for a single pipe string insertion into the tunnel.

Figure 7. Pembina River Drill Profile, with Photo of Alignment and Drill Rig.

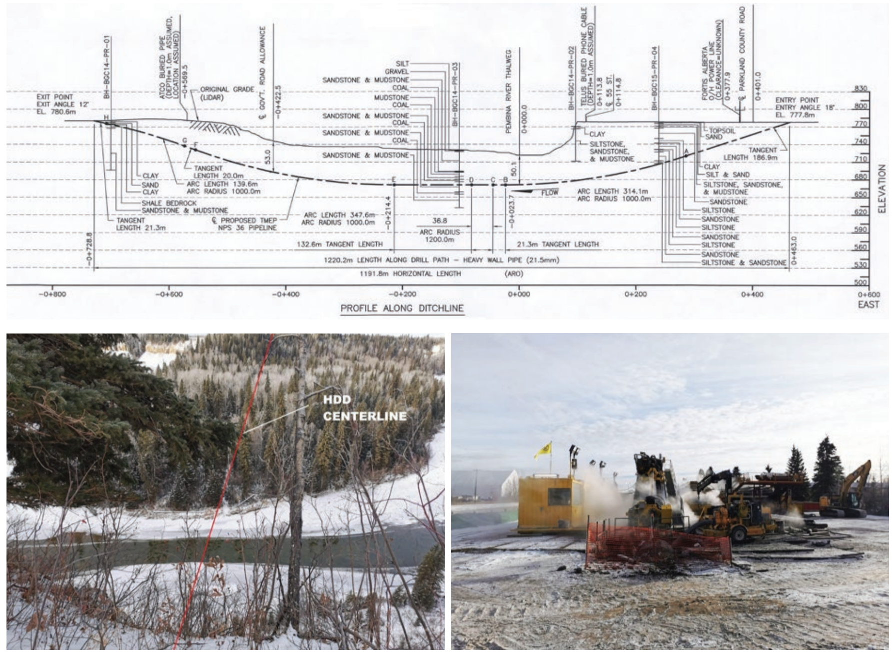
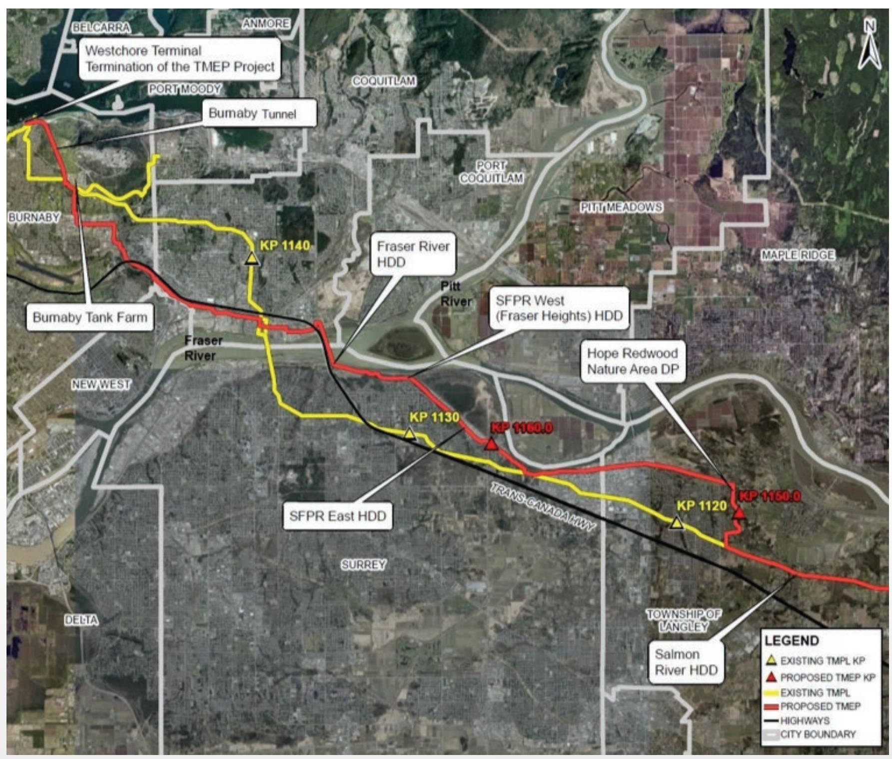


Figure 8. TMEP Spread 7 Trenchless Crossings.



Spread 6

This pipeline spread has a number of very challenging crossings which will include a major 800 m long microtunnel with a significant elevation change of about 60 m. In addition to this significant microtunnel this spread will have two Direct Pipe installations. These DPs are about 300 and 470 m in length.

Spread 7

Spread 7, shown in Figure 8, is routed through a densely populated area that is referred to as the Lower Mainland in the Greater Vancouver area. This pipeline spread has multiple long and challenging HDDs, a Direct Pipe, multiple typical guided horizontal auger bores, and the previously noted TBM tunnel.

Figure 9. Burnaby Tunnel Plan and Profile.

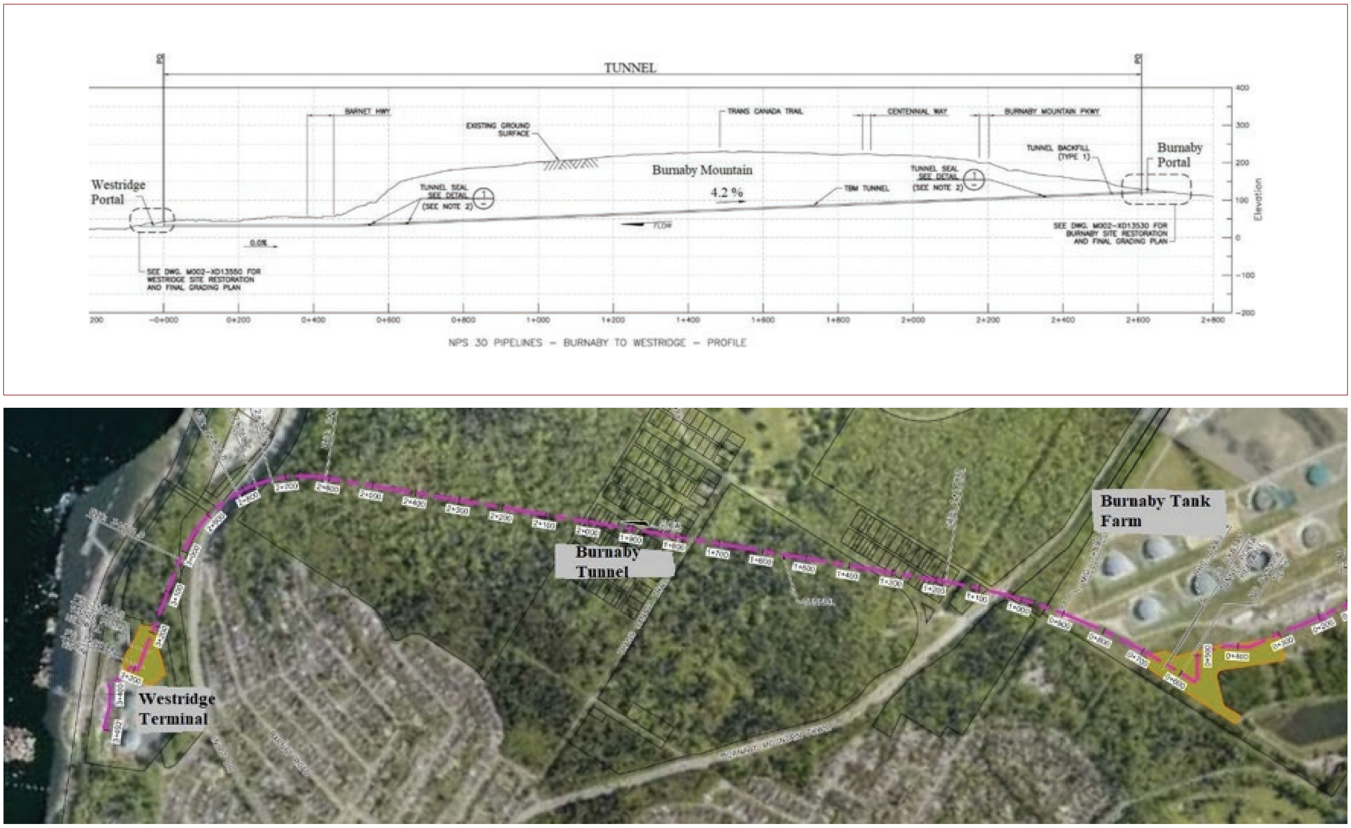
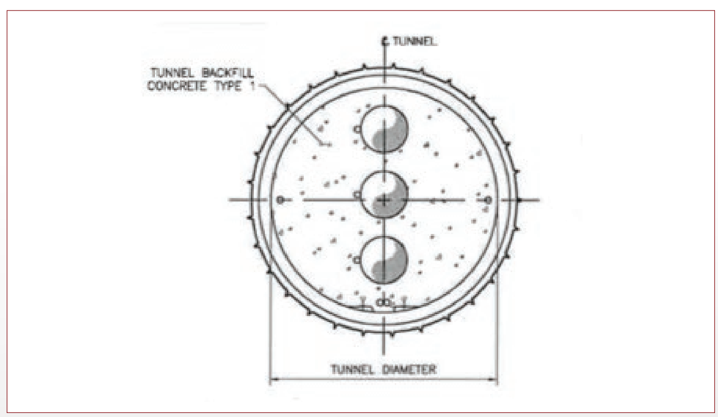


Figure 10. Herrenknecht TBM.

Figure 11. Pipe Placement in Tunnel.



One of the first issues to be dealt with at the start of routing and design was the routing for twin NPS 30 pipelines from the Burnaby Tank Farm down to the Westridge Terminal in Burrard Inlet (Figure 9). The existing NPS 24 pipeline is routed through the City of Burnaby Streets. The option for the two lines was to do parallel HDDs of 2,000 m each. Universal Pegasus discussed the use of a TBM tunnel to house all three pipelines which would remove the existing pipe from the city streets.

In 2013, UPI commissioned a feasibility report by Delcan Geodata for a tunnel under Burnaby Mountain to house multiple pipelines. The result: “It is concluded that a tunneling alternative is totally feasible.” This report then led to the completion of the design of a tunnel to house three pipelines and construction is planned for 2020/21. The alignment and profile are shown in Figure 9. The final tunnel length, portal to portal, is 2,607 metres. McNally was awarded the tunnel construction contract with construction to start in late 2020. The Herrenknecht TBM is shown in Figure 10 and the cross section of the tunnel (three pipelines) is shown in Figure 11.

The other major crossing issue was the crossing of the Fraser River shown in Figure 8. Right from the start of planning and design of the project, the Fraser River has been considered the keystone crossing in the project. Both DP and HDD construction were originally considered. The final design selected is a 1,457 m (4,780 ft) long HDD crossing just upstream of the new Port Mann cable stayed bridge. The Fraser River has previously been crossed by HDD methodology a number of times. One of those times was the NPS 24 replacement crossing for the Trans Mountain pipeline in 2003. This 2003 replacement crossing was 1,293 m long and replaced the 610 mm pipe with a new 610 mm pipe using HDD. That crossing was started 250 m back from the riverbank on the south side due to the CN railyard and 450 m back from the north riverbank due to the development along the shoreline. Although a similar alignment was considered early in the routing process, the amount of development and the reconstruction of the Trans Canada Highway eliminated that alignment.

This amazing pipeline project is currently under construction and proceeding on schedule. Approximately 20 HDDs have been completed, plus numerous HD bores and conventional bores. The next 12 months will be an interesting time as the remaining trenchless work continues and completes.

KEY ISSUES AND LESSONS LEARNED

- Create a list of major trenchless crossings with the most risk to the project and keep it current.
- The design carried over a number of years so it is a good idea to consider a review of selected methodologies closer to construction to see if a new technology might be applicable.
- In this review also consider updating some drawings where the urbanization has caught up to the entry/exit locations. This has occurred in a number of locations which necessitated changes.
- Over the course of eight years there is a lot of turnover of people on both sides (client and engineers) so maintaining continuity is important. Fortunately, the UPI trenchless team has been on the project from the start.
- Risk is a major concern and mitigating this as much as possible during the design in critical (i.e., additional wall thickness for steering flexibility).

REFERENCES

Baumgard, A., and Savigny, K.W., Cocciolo, P., (2004) – Post-Installation Geotechnical Issues Associated with Large Scale HDD Crossings, International Pipeline Conference (IPC) 2004, Calgary, Alberta, Canada.

Bennett, D., and Ariaratnam, S. (2008) – Horizontal Directional Drilling Good Practices Guidelines, North American Society for Trenchless Technology (NASTT), Third Edition, USA. ■ ■

RISK MANAGEMENT INSPECTION™:

A Tool for Effective Management of HDD Risks to Avoid Claims

Authors:
Kimberlie Staheli, Ph.D, P.E., Staheli Trenchless Consultants
Jake Andresen, MS, P.E., Staheli Trenchless Consultants

Trenchless construction of pipelines has a high relative risk when compared to traditional open cut and cover installation. The primary driver for this blanket high risk associated with trenchless construction is a) the uncertainty in the conditions which will be encountered, and b) severe consequence of striking unfavorable conditions.

Even though geologic site study and geotechnical borings can be used to characterize the soil at the site, the geotechnical engineer samples a fraction of the soils along a design alignment. For a given installation, the likelihood of encountering soils that may pose a risk to successful installation can be high, even if not directly encountered during geotechnical sampling. When risks manifest during construction, they may be associated with a reduced excavation rate, excessive tool wear, or unstable conditions which result in cost and schedule overruns. These in turn may trigger differing site conditions claims (DSC) for recovery of the cost of the required risk mitigation actions. Even on projects where the risks are known and identified, the low bidder has often not adequately accounted for the risk in the bid price. The trenchless industry, and horizontal directional drilling (HDD) in particular, is seeing greater instances and magnitude of construction claims. The Risk Management Inspection™ (RMI) approach has been developed with the goal of accurately and fairly tracking the instance, cause, and impact of risk occurrences on HDD and other trenchless projects.

Risk Management Inspection™: Changing the Approach to Inspection

The reporting requirements vary greatly by contract, ranging from little to none up to required automated data collection of various parameters such as the weight on bit, torque, mud pumping rates, and drilling rates. This data is typically used when there is a problem (after the fact), during claim analysis, as well as for continuing research or academic study. The common factor is that this information is being used too late. The problem and resulting claim has likely already occurred and may or may not have been resolved. The key to RMI is identifying the potential risks prior to setting foot on the job site, recording and understanding relevant installation parameters to track the occurrence and instance of such risks, and fairly managing the risk response and mitigation in a timely manner.

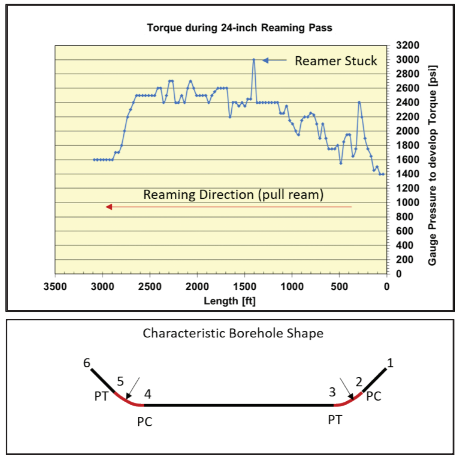


Figure 1. Torque pressure during 24-inch pull-ream (top) and characteristic bore shape (bottom).

The ultimate goal is to approach risks in a transparent manner so that the Owner understands what occurrences are adding additional cost to the project (in real time), the triggers for these risks, and to guide development of an effective risk and cost management approach with the Owner and contractor.

Role of the Construction Inspector

The construction inspector has never been more important. Unlike open cut where the problem is open to direct observation when encountered, there are many parameters associated with the unseen medium of trenchless construction that are critical to track, understand, and interpret during HDD construction to avoid problems. Information collected by an experienced HDD specialty inspector is invaluable to the evaluation of claims and damages. Daily cost for trenchless construction is high, therefore delays mount large cost overruns in a short amount of time. Many HDD challenges require close monitoring to provide a rapid response to risks encountered to manage cost associated with the problem. Although many HDD rigs are equipped with gages to monitor the performance of the drill, too often no one on the management team has the capability to analyze and understand the data during the drilling process. As such, problems that could be avoided come to fruition. Today's data logging systems are capable of fully monitoring all drill rig parameters independent of sitting in the tight confines of a drill cab. As such, Owners should consider requiring these systems on all their projects as the cost of data tracking equipment is nominal.

The purpose of the inspector is to intelligently observe and notify the Owner if unexpected incidents occur during construction. Key parameters should be recorded, tracked, and analyzed as the data is acquired to fully understand how the HDD equipment is reacting to the geotechnical conditions. These parameters should be evaluated to allow detection of problems before they occur. The inspector needs to be advised on these key design assumptions and expected data ranges to provide meaning to field observations in a timely manner. They should also know when the information collection is significant and requires interaction with the Design Engineer. Some rigs have data loggers that are able to track and record all drilling data, including torque, thrust/pull, drilling mud flow rates and volumes, downhole pressure, and rate of progression. These parameters all serve to alert the driller of the performance of the rig in the geotechnical conditions encountered. The driller's job is to interpret the data with respect to drilling the hole and the application of appropriate construction practice. The driller does not look at this data with respect to design or impact to cost and/or schedule. Without the appropriate background information, the driller simply does not have the information regarding the design intent and is only able to react to the data. These data sets are not often analyzed in real-time, by the inspector for comparison against design assumptions, good construction practices, or typical responses of various types of ground to the applied drilling procedures. If the inspector is not experienced in HDD, critical warning signs can be missed that can result in needless construction problems and provide a basis for claims.

Example of RMI Applied to a Specific HDD Risk

The following is an example of how tracking of a specific parameter on an HDD project (Reamer Torque) was used to track and

Figure 2. Characteristic curve of torque during a swab pass.

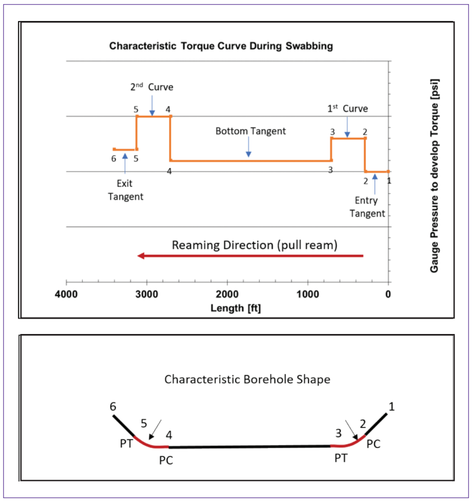


Figure 3. Torque during the 24-inch reaming pass and the initial swab pass.

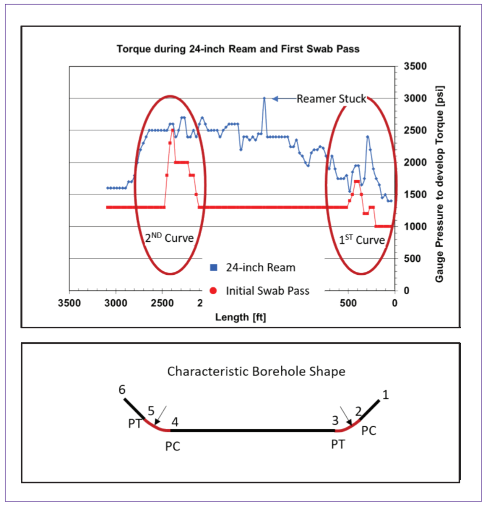
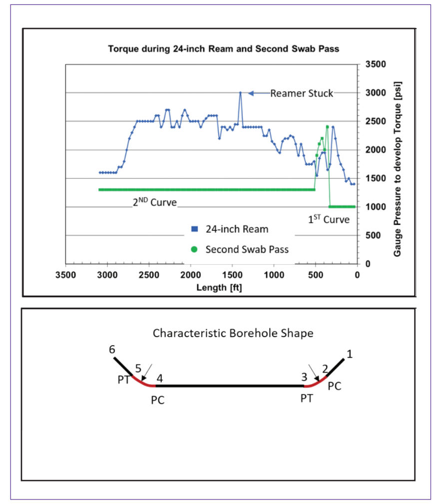


Figure 4. Torque readings during the 24-inch reaming pass and the second swab pass.



manage the risk occurrence of the product pipe becoming stuck during HDD pullback. The pullback is arguably the point of greatest risk for the Owner. The pullback is completed at the end of the project when up to 90% of the required work (pilot bore, reaming passes and hole preparation, pipe assembly and staging) has been completed. These costs have been expended and potentially paid, but there is no physical product if the pullback fails.

An important parameter is the torque required to rotate the drill pipe at a specific penetration rate. Changes in soil conditions can be observed as well as indications of other phenomena, such as excessive cuttings in the borehole which will increase the friction on the drill pipe. Torque is an important parameter to indicate whether the borehole is clean and ready for pullback. One important thing a specialty trenchless inspector can do is to graph the torque, thrust, penetration rate, and fluid pump rate during the pilot and reaming processes to compare to the swab or proof pass. A swab pass is a very important indicator of whether the borehole is appropriately prepared and fully cleaned to allow successful pull-back.

On a challenging HDD project, the torque readings were analyzed during reaming and swabbing to determine if the borehole was properly prepared. This project consisted of the installation of a 16-inch steel pipeline coated with fusion bonded epoxy. The HDD length was 3,085 feet and the borehole reamed to a 24-inch diameter. The geotechnical conditions were highly variable and consisted primarily of silty sand; however, seams of gravel and cobbles were encountered along the alignment. Figure 1 shows a graph of the torque readings that were recorded by the specialty inspector. It should be noted that torque readings can be highly variable and an experienced inspector is required to effectively track the torque in a format that is useful for data evaluation. The torque reading shown in Figure 1 is the average torque as recorded by the inspector and verified against the data collected with a data logging system.

During the final reaming pass, the reamer became stuck at approximately 1,400 feet into the reaming pass and the 24-inch reamer could not be pushed or pulled by the drill rig alone. Using the tail string, the reamer was pulled back towards the exit to free the reamer. The pull ream was then continued toward the entry location once the reamer was free from the bound conditions.

Because circulation was lost and the reamer became stuck, there were concerns as to whether the borehole was fully reamed and prepared for the pull-back. As such, a swab pass was conducted to evaluate the condition of the borehole. A swab pass or proof pass consists of a barrel reamer that is pulled from one end of the bore path to the other. A swab reamer does not allow fluid to pass through the reaming assembly and the elongated barrel shape compacts the borehole walls. The swab reamer should have a larger diameter than the product pipe but a smaller diameter than the final ream. Because the swab pass is being run through previously excavated bore, the swab should record a lower torque than the final reaming pass at the same reaming rate.

Swab passes performed on relatively stable boreholes have a characteristic curve shape, as shown in Figure 2. The torque is low as the reamer enters into the borehole along the tangent section, shown in Figure 2 as the line from point 1 to point 2. As the swab passes through the first curved section, the torque increases as the swab reamer traverses through the curve (shown as points 2 to 3 in Figure 2). The torque then levels off and becomes consistently lower as the reamer traverses through the bottom tangent, represented as the line from points 3 to 4 in Figure 2. An increase in torque is then seen as the swab traverses through the final curve, from points 4 to 5 in Figure 2, and finally decreases throughout the final tangent section to the exit of the reaming pass.

Figure 3 shows the torque as a function of length during the initial swab pass and the torque that was recorded during the reaming pass. There are three significant things to note from Figure 3. First, the torque significantly decreased at the location where the reamer became stuck, signifying that the pull-back and re-reaming of that section of the bore was successful at clearing any blockage. Second, the torque that was realized during the swab pass in the first curve, between points 2 and 3, was similar in magnitude to when the bore was reamed with the 24-inch pass. This should not be the case as the barrel swab was smaller than the borehole and indicates that there is a possible bore collapse in the first curve. Third, the torque during the second curve was comparable to the torque realized during the 24-inch reaming pass. Again, this indicates that the borehole may have collapsed and was not properly prepared for the pull-back.

These results were graphed real-time in the field and discussed with the contractor

BACK TO CONTENTS

and Owner. Alarmed by the torque recorded during the initial swab pass, the contractor elected to re-swab the bore while evaluating the torque to determine if the initial swab pass resulted in further cleaning of the borehole.

Figure 4 shows the torque during the 24-inch ream and the second swab pass. The second swab pass indicated that once again the bore had collapsed in the first curve during the swab (points 2 to 3); however, the increase in torque was seen later in the curve than had occurred in the first swab pass by approximately 50 feet. During the second swab pass, the second curve did not show indications of collapse, indicating that the first swab was able to clear the soil from the borehole. The rotary torque during the remainder of the borehole remained stable.

Since the borehole had been swabbed twice and the majority of the bore showed low torque, indicating a stable borehole, the contractor elected to pull the product pipe into the bore after the second swab pass. Pull forces throughout the first curve showed increased loading; however, since this was a short section of the overall bore length and occurred at the beginning of the bore, the pipe was pulled into the borehole without incident.

Specialty Inspectors

For the purposes of RMI, specialty inspectors are personnel with the background and ability to a) understand the data to be collected, b) capable of analyzing the data to predict potential problems in real-time, and c) capable of conveying and explaining this information to the Owner and contractor within the framework of the contract. Using an experienced specialty inspector during the construction of horizontal directional drills has tremendous value to the project. If the inspector collects appropriate data and performs experienced-based evaluations of the information collected during the drilling process, field problems can be avoided to ensure that the pipe is successfully installed. Without guidance from the design engineer and real-time evaluation, the data can only be used to evaluate a problem after it has occurred. Although post-construction data evaluation is critical to understanding the cause of a problem or failure, the ability to interpret the data real-time and provide feedback to the Owner is a key component of RMI.

2021

NASTT-NW Chapter Buyers' Guide

When making purchasing decisions about products and services in the trenchless technology industry throughout Manitoba, Saskatchewan, Alberta, and beyond, please support the companies whose advertising makes the *NW Trenchless Journal* possible. You will find them quickly with our convenient, easy-to-use Buyers' Guide.

On the following pages, you will find information that will help you meet your purchasing requirements throughout the year ahead. The initial section of this Guide lists categories of products and services along with the various companies that can provide them to you. The following section provides an alphabetical listing of those companies, as well as the contact information you will need to reach them.

Listings By Category:

360°-Scanning Cameras
RapidView IBAK North America

Asset Management
Associated Engineering
CUES
Stantec Inc.

Augur Boring
Michael Byrne Mfg.
Michels Canada
Stantec Inc.

CIPP Liner QC Testing
Paragon Systems Testing

CIPP Tube
FORMADRAIN Inc.
Insituform Technologies Limited

Condition Assessment
Associated Engineering
IVIS Inc.
RapidView IBAK North America
Stantec Inc.

Construction Management
Associated Engineering
Stantec Inc.

Cost Estimation
MAPEI Canada
Stantec Inc.

Cutters
CUES
RapidView IBAK North America

Data Collection Systems
Associated Engineering
Stantec Inc.

Dewatering
Michels Canada

Directional Drilling
Direct Horizontal Drilling Inc.
Michels Canada
Precise Crossings
Stantec Inc.

Directional Drilling Accessories
LaValley Industries
Michael Byrne Mfg.

Directional Drilling Fluids
MAPEI Canada

Drill Pipe
MAPEI Canada
Michael Byrne Mfg.

BACK TO CONTENTS

Drilling Consumables
MAPEI Canada
Michael Byrne Mfg.

Engineering Design
Associated Engineering
MAPEI Canada
Stantec Inc.

Environmental Products
MAPEI Canada

Epoxy
FORMADRAIN Inc.
MAPEI Canada
Michels Canada

Flow Monitoring
IVIS Inc.
Stantec Inc.

General Consulting
Associated Engineering
IVIS Inc.
Stantec Inc.

Grouting
CUES
Michels Canada

HDPE Fusing Services
3D Pipe Bursting

Horizontal Directional Boring
Brandt Tractor
Michels Canada
Stantec Inc.

Hydro-Excavators
Brandt Tractor
IVIS Inc.

Jetters
IVIS Inc.

Laser Profiling Systems
CUES
RapidView IBAK
North America

Lateral Rehab & Equipment
FORMADRAIN Inc.
IVIS Inc.

Manhole Rehab
CUES
Insituform
Technologies Limited
IVIS Inc.
MAPEI Canada
Michels Canada
Stantec Inc.

Microtunneling
MAPEI Canada
Michels Canada
Stantec Inc.

Microtunneling Equipment/Systems

Mud Systems
MAPEI Canada

Piercing Tools/Rod Pushers
3D Pipe Bursting
Brandt Tractor

Pilot Tube/Guided Boring Equipment
Michael Byrne Mfg.

Pipe Bursting/Splitting
3D Pipe Bursting
IVIS Inc.
Michels Canada
Stantec Inc.

Pipe Cleaning
IVIS Inc.

Pipe – Concrete
Lafarge Canada Inc.

Pipe Fusion
3D Pipe Bursting
Michels Canada

Pipe Handling Equipment
LaValley Industries

Pipe Inspection
IVIS Inc.
RapidView IBAK
North America
Stantec Inc.

Pipe Jacking
Michels Canada
Stantec Inc.

Pipe Ramming
Michels Canada
Stantec Inc.

Pipe Relining
FORMADRAIN Inc.
Michels Canada

Pipeline Inspection
Associated Engineering
CUES
IVIS Inc.
Michels Canada
RapidView IBAK
North America
Stantec Inc.

Pipeline Inspection/ Evaluation
Associated Engineering
CUES
RapidView IBAK
North America
Stantec Inc.

Regulatory Applications
Stantec Inc.

River Engineering
Stantec Inc.

Rock Bits
Michael Byrne Mfg.

Rock Drilling
MAPEI Canada
Michael Byrne Mfg.
Michels Canada

Sewer – Pressure/Vacuum
Insituform
Technologies Limited
IVIS Inc.

Sewer Robotics
CUES
IVIS Inc.
RapidView IBAK
North America

Site Investigation/Survey
Stantec Inc.

Sliplining
3D Pipe Bursting
MAPEI Canada
Michels Canada
Stantec Inc.

Software
CUES
RapidView IBAK
North America

Soil Stabilization
MAPEI Canada
Stantec Inc.

Sonar Profiling Systems
CUES

Specialty Tooling
Michael Byrne Mfg.

Spot Repair/Point Repair
FORMADRAIN Inc.
IVIS Inc.
MAPEI Canada
Michels Canada

Subsurface Utility Engineering
Stantec Inc.

Trenching
Brandt Tractor
Michels Canada
Stantec Inc.

Tunnel Boring Machines
MAPEI Canada

Tunnel – Large Diameter
MAPEI Canada
Michels Canada
Stantec Inc.

Tunneling Products
MAPEI Canada

Used/Rental Equipment
3D Pipe Bursting

Utility Locating
Brandt Tractor
IVIS Inc.

Vacuum Excavators & Excavating
Brandt Tractor
IVIS Inc.

Video Inspection
CUES
IVIS Inc.
Stantec Inc.

2021

NASTT-NW Chapter Buyers' Guide

Listings By Company Name:

3D Pipe Bursting
Darren Norton
780-387-1075
info@3dpipebursting.com
www.3dpipebursting.com

Associated Engineering
Herb Kuehne
780-451-7666
kuehneh@ae.ca
www.ae.ca

Brandt Tractor
Carmen Clark
306-791-5977
cclark@brandt.ca
www.brandt.ca

CUES
Gillian Wilson
503-622-3248
gwilson@cuesinc.com
www.cuesinc.com

Direct Horizontal Drilling Inc.
Rick Shipalesky
780-960-6037
rick.s@directhorizontal.com
www.directhorizontal.com

FORMADRAIN Inc.
Bruce Stevenson
1-888-337-6764
bruce@formadrain.com
www.formadrain.com

Insituform Technologies Limited
Andrew Foster
888-982-4717
afoster@aegion.com
www.insituform.com

IVIS Inc.
Dolores Eaton
780-476-2626
marketing@ivisinc.com
www.ivisinc.com

Lafarge Canada Inc.
Sean Tymkow
780-410-3682
sean.tymkow@lafageholcim.com
www.lafarge.ca/en

LaValley Industries
Craig Larson
218-444-3030
craigl@lavalleyindustries.com
www.lavalleyindustries.com

MAPEI Canada
1-800-426-2734
customerservicecan@mapei.com
www.mapei.ca

Michael Byrne Mfg.
Jim Weist
419-525-1214
jweist@byrnegroup.com
www.byrnegroup.com

Michels Canada
Mike Ireland
780-955-2120
mikeireland@michelscanada.com
www.michelscanada.com

Paragon Systems Testing
Tony Araujo
416-939-0429
tonya@paragonsystems.ca
www.paragonsystems.net/testing-services

Precise Crossings
Ken Shipalesky
780-962-6882
kenship@precisecrossings.com
www.precisecrossings.com

RapidView IBAK North America
Matt Sutton
800-656-4225
info@rapidview.com
www.rapidview.com

Stantec Inc.
Dan Chernishenko
780-917-7112
dan.chernishenko@stantec.com
www.stantec.com

ADVERTISER PRODUCT & SERVICE CENTRE

The NW Trenchless Journal is made possible by the companies below who convey their important messages on our pages. We thank them for their support of NASTT-NW and its publication and encourage you to contact them when making your purchasing decisions. To make it easier to contact these companies, we have included the page number of their advertisement, their phone number, and, where applicable, their website.

COMPANY NAME	PAGE	PHONE	WEBSITE/EMAIL
3D Pipe Bursting	6	780-387-1075	www.3dpipebursting.com
Associated Engineering Group Ltd.	11	604-293-1411	www.ae.ca
Brandt Tractor Ltd.	31	888-2BRANDT	www.brandttractor.com
CUES Inc.	4	503-622-3248	www.cuesinc.com
Direct Horizontal Drilling	2	780-960-6037	www.directhorizontal.com
Insituform Technologies	32	800-234-2992	www.insituform.com
IVIS Inc.	8	780-476-2626	www.ivisinc.com
Lafarge Canada Inc.	21	780-410-3682	www.lafarge.ca
LaValley Industries	12	218-444-3030	www.lavalleyindustries.com
MAPEI Canada	25	800-426-2734	www.mapei.ca
Michael Byrne Mfg.	21	419-525-1214	www.byrnegroup.com
Michels Canada	29	780-955-2120	www.michelscanada.com
Paragon Systems Testing	20	416-939-0429	www.paragonsystems.net
Precise Crossings Ltd.	12	866-962-6882	www.precisecrossings.com
RapidView IBAK North America	3	800-656-4225	www.rapidview.com
Stantec Consulting	10	780-917-7000	www.stantec.com