2018 | NORTHWEST

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# TRENCHLESS JOURNAL

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


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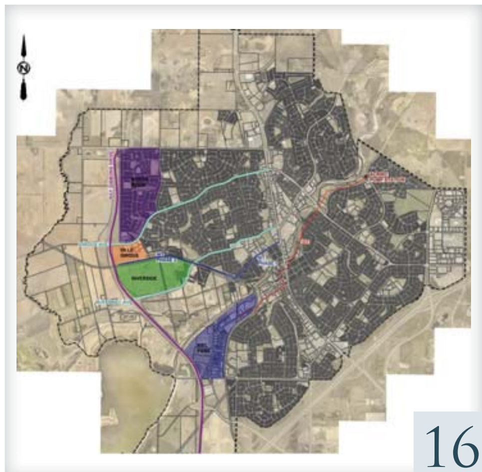
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## DEPARTMENTS:




ON THE COVER: View of the Athabasca River above the falls in Alberta.© Margiew | Dreamstime.com

# 2018: A BIG YEAR FOR NASTT-NW!

2018 is going to be big for NASTT-NW. This year our Chapter conference is going National! We are proud to be jointly presenting **TT2018 – TAC/NASTT-NW Tunnelling and Trenchless Conference**. Our success with other TAC partnerships has brought us the opportunity to bring this national conference to the Canadian Prairies in November. The conference planning committee is in full swing and the call for abstracts closed in April. This conference will include a pre-conference reception, a short-course, daily keynote speakers, a two-day technical program, local technical tours, and the presentation of the North American Society of Trenchless Technologies – Northwest Chapter Project of the Year Award. For more information, please visit the Conference's webpage – ***www.tt2018.ca***.

> "Our success with other TAC partnerships has brought us the opportunity to bring this national conference to the Canadian Prairies in November."

For many of us, we have just returned from another amazing NASTT No-Dig Show in Palm Springs, California. I was blessed to be able to attend this year and was able to chat with many of our members and take in the great presentations from our Chapter. As in past years, the Chapter held our AGM at No-Dig, in which we introduced our newly elected Directors to our local Chapter Board. We are excited and welcome Jeff Calloway from the City of Calgary and Shane Cooper from Uni-Jet Industrial Pipe Services. We also say goodbye to outgoing board members Hartley Katz and Charles Pullan, who are departing us after completing their terms. Their contributions to the Chapter while serving on the Board is greatly appreciated.

And lastly, we are just closing out another great Technical Lunch Program in both Edmonton and Calgary, where are had not only spotlighted some of our great local projects but also new products and national projects. We will be planning the 2018–2019 Program over the summer and I would like to extend an invitation to our Chapter members to submit topics for this program. If you have a specific topic or project that you would like to see us spotlight, please reach out and let me know.

We are always looking for volunteers, fresh ideas, and new perspectives! If you wish to participate as a volunteer or just provide suggestions on how to improve our Chapter, please do not hesitate to contact me directly at *gtippett@nastt-nw.com*.

Be sure to check our website, *www.nastt-nw.com*, and our Chapter LinkedIn page for additional information on what is happening within our Chapter.

***Greg Tippett***
Chair, NASTT – Northwest Chapter

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# GRASSROOTS INVOLVEMENT

Hello Northwest Chapter Members! As the year develops, we're looking forward to the continued growth of the trenchless industry and our Society. We've just wrapped up another impressive conference as NASTT's 2018 No-Dig Show in Palm Springs, California was very successful on all accounts. The exhibit hall featured close to 190 exhibitors and we welcomed more than 2,000 attendees from all over the world, who came to experience the world-class technical sessions and networking events that our Show is known for. NASTT's 17th Annual Educational Fund Auction was, once again, the trenchless social event of the year and we were able to raise nearly $100,000 for our educational programs! Thank you all for your generous support.

NASTT exists because of the dedication and support of our volunteers and our 11 regional chapters. Our No-Dig Show Program Committee members volunteered their time and industry knowledge to peer-review the 2018 abstracts. These committee members ensure that the technical presentations are up to the standards we are known for. Thank you to the Northwest Chapter Members who volunteered for this important task: David Krywiak, Jason Lueke, and Craig Vandaelle.

This year, we had 160 technical presentations over the course of three days on all aspects of trenchless technology. We also featured three industry forums hosted by trenchless experts in their fields and encouraged input from the audience members. These topics included: Water Main CIPP; Owner Differing Site Conditions Claims; and Close Fit Sliplining Technology.

Plans are now underway for the 2019 conference. If you would like to join the 2019 Program Committee to help us develop the technical sessions and special events for next year's Show, meet us in Chicago this summer! Please contact us at *info@nastt.org* for more information.

The North American Society for Trenchless Technology is a society for trenchless professionals. Our goal is to provide innovative and beneficial initiatives to our members. To do that, we need the involvement and feedback from our professional peers. If you are interested in more information, please visit our website at *www.nastt.org/volunteer*. There, you can view our committees and learn more about these great ways to stay active with the trenchless community and to have your voice heard.

Our continued growth relies on the grassroots involvement of our regional chapter advocates. Thank you again for your support and dedication to NASTT and the trenchless technology industry.

**Frank Firsching**
NASTT Chair

NASTT NORTHWEST CHAPTER

## 2017 NW Trenchless

# PROJECT of the YEAR


Congratulations to the Pembina Pipeline Corporation and CCI Inc. on being awarded the 2017 Northwest Trenchless Project of the Year for the Athabasca River Parallel HDD Installations Project!

For more information, please visit *www.ccisolutions.ca/2017-northwest-trenchless-project-of-the-year.*

**Project:** Athabasca River Parallel HDD Installations – Whitecourt, Alberta


**Authors:** Chelsea Griffiths, EIT, CCI Solutions;
Shane Monsour, Trenchless Specialist, CCI Solutions


Pembina Pipeline Corporation (Pembina) proposed the design and construction of the Phase III Pipeline Expansion Project, which follows and expands segments of Pembina's existing pipeline systems from Taylor, British Columbia to Edmonton, Alberta. The core of the Phase III Expansion Project was the Fox Creek to Namao (FCN) construction, which involved the installation of parallel NPS 16 (406.4 mm) and NPS 24 (609.6 mm) pipelines within a shared right-of-way (ROW). The project included more than 20 watercourse crossings requiring detailed engineering designs. One of the crossings identified was the Athabasca River, located approximately 8 km north of Whitecourt, Alberta.

Both new pipelines were designed to transport high vapour pressure (HVP) products, and increase transport capacity by 170,000 bpd and 500,000 bpd, respectively. With the parallel installations complete and placed into service on June 16, 2017, Pembina now has four

pipelines within the Fox Creek to Namao corridor, which allow them to transport four distinct hydrocarbon products (propane-plus, ethane-plus, condensate, and crude oil) within segregated pipelines.

### CHALLENGES FACED

The NPS 24 and NPS 16 HDD crossings of the Athabasca River were 1,552 m and 1,462 m long, respectively. Due to surficial geotechnical conditions at the proposed crossing location, temporary surface casing was proposed at both the entry and exit locations. Both HDD crossings were designed to be completed utilizing intersect methodologies and employed the use of two HDD rigs.

The conditions encountered during the construction of the HDD crossings led to significant challenges. Water ingress throughout the duration of both drills presented challenges in fluid management, access restrictions, and hole sealing. Borehole instabilities and stuck drill pipe required creative, skilled problem solving to overcome. After the loss of drill pipe down hole, sidetracking was employed to allow the drills to utilize the previously installed surface casing at entry and exit, greatly reducing the cost impact to the project.

The engineering team, HDD contractor, and client worked together employing multiple mitigation strategies during the construction phase to successfully complete both the NPS 16 and NPS 24 HDD crossings, an improbable outcome due to the conditions encountered.

### GETTING TO WORK

The new parallel installations are 286 km long and transport products from Fox Creek to existing processing facilities in the Namao area. Within the acquired ROW, the two pipelines crossed numerous watercourses, roads, and surficial features. CCI Inc. (CCI) was engaged by Pembina in 2014 and worked closely with our client through to the end of construction in 2017. Construction of the horizontal directionally drilled (HDD) crossings began in August of 2016 and was completed in April 2017. CCI's scope of work included 68 detailed crossing designs at 34 crossing locations, including stress analysis, annular pressure modelling, feasibility assessments, and risk assessments. Along with engineering, CCI completed geotechnical investigations at a majority of the crossing locations and at all of the major watercourse crossings. Throughout the duration of the HDD design and construction, CCI provided contract support, assisting with the tender process, contractor negotiations, clarifications, and award. During HDD construction, CCI assisted with cost tracking for the HDD activities and provided knowledgeable HDD Inspectors to act as the Client Representative on site for the duration of HDD activities.

One of the most difficult major crossing locations on the FCN project was the Athabasca River, located approximately 8 km north of Whitecourt, Alberta. The NPS 24 and NPS 16 crossings of the Athabasca River were 1,552 m and 1,462 m in length, and required finished borehole diameters of 24" and 36", respectively.

An extensive geotechnical program was completed at the crossing, with seven boreholes completed along the crossing alignment. These boreholes identified surficial materials of sand, clay, clay (till), and gravel. The gravel identified was extensive, on both the north upland (exit location) and within the valley bottom to the south (entry location). The two boreholes on the north upland identified a significant difference in the thickness of the gravel layer, prompting the completion of an additional geophysical program which utilized electrical resistivity tomography (ERT) in an attempt to define the gravel layer and assist with determining the ideal exit location, as well as the requirements for surficial casing during construction. Bedrock at the crossing location consisted primarily of mudstone and sandstone, with some of it described as fractured and water bearing at, or above, rig elevation. Utilizing this geotechnical data, CCI's geotechnical department created a no-drill zone (NDZ), which provided a minimum 37 m of cover beneath the lowest point in the river channel thalweg, putting the drill at least 15 m into competent bedrock. The NDZ also maintained the drill at, or below, 640 m geodetic elevation as it passed beneath the current river channels and the active flood plain.

Final detailed HDD designs included 35 m of NPS 48 (1219.2 mm) and NPS 36 (914.4 mm) casing on entry and 50 m of casing at the exit locations. Both crossings followed similar drill paths and utilized moderately high entry (18°) and exit (16°) angles (based on industry standards) to reduce the length of casing required. The NPS 24 installation was designed 3 m deeper than the NPS 16, and extended 50 m longer than the NPS 16 on entry and exit to accommodate equipment layout and drilling operations to occur concurrently within a shared workspace. The drills were offset horizontally to meet Pembina's specification for minimum separation requirements, allow for adequate steering tolerances, and minimize the risk of fluid communication between the drills. The geometry of the drills included approximately 80 m of elevation gain from entry to exit, and 120 m of total elevation change from the bottom tangent to the exit location.

Both drills were designed utilizing intersect methodology due to the casing requirements at entry and exit. Annular pressure analysis was run from both the entry and exit locations, and it was identified that expected downhole drilling pressures during the pilot holes quickly exceeded the strength of the overburden formation when drilling from the exit location due to the large elevation change in the topography. Due to this, the intersects were planned within the exit tangent of the drills, with a large portion of the pilot hole being completed from the lower entry side.

Pipe section layout utilized additional workspace to facilitate the layout of both the pipelines, travel, and required pipe support equipment. The NPS 24 utilized two pipe sections, which required a stoppage during pipe pullback operations to complete the closure weld, inspection, and coating. Due to the high exit angle of both drills, additional support equipment was necessary for the safe support of the sections, which reached a maximum height of 9 m within the overbend.

The planned construction schedule included very aggressive timelines due primarily to environmental requirements which restricted access and construction to a set operational window. The schedule involved four rigs to be mobilized and utilized for drilling operations of the NPS 16 and NPS 24 pipelines concurrently. Direct Horizontal Drilling (DHD) was contracted by Pembina to complete the construction of the HDD crossings, including casing installation and extraction. Mobilization to the prepared work pads began in August 2016. Entry and exit rig spreads were setup simultaneously with two full spreads, including mud cleaning and recycling equipment. Specifications for the rigs utilized are as follows:

NPS 16 Entry / NPS 24 Entry
Pullforce – 1,100,000 lb.·f
Rotary Torque – 100,000 ft.-lbs
Pump Capacity – 6 cm/min

NPS 16 Exit / NPS 24 Exit
Pullforce – 440,000 lb.·f
Rotary Torque – 60,000 ft.-lbs
Pump Capacity – 5 cm/min

Surface casing (NPS 48 and NPS 36) was successfully installed on entry to 29 m, where a competent formation was encountered, slightly shorter than the proposed 35 m. On exit, NPS 60 and NPS 48 casing were installed, sized up from the required minimum diameter to allow for the use of telescoping in the event the casing



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could not be installed to the required depth without employing this methodology. Exit casing was initially installed to lengths of 66 m and 64 m, exceeding the recommended 50 m due to the variance in the gravel formation on exit.

The NPS 24 drilling activities began prior to the NPS 16, and the 12 ¼" pilot was completed with minimal problems. There were delays when the entry rig had to wait for exit casing installation to be completed so the intersect could be attempted. Once exit casing was complete the exit rig drilled to 166 m, where it intersected the entry pilot in five hours. The first ream pass enlarged the borehole to 24", leaving a plug at exit to ensure borehole stability, followed by a 36" final ream. During the 36" ream the borehole started to produce water at 5m$^3$/hr, and the rig was shut down for a period due to warm conditions, rain, and access restrictions caused by the sloppy conditions. After a final wiper pass, pipe pull was successfully completed with a maximum pullforce of 115,000 lbs.·f, indicating a clean borehole free of cuttings.

### A REDRILL REQUIRED

The NPS 16 drilling began and encountered fluid losses to the parallel bore at approximately 540 m MD from entry. Once the intersect was completed, the bore began producing water to the entry location at a variable rate from 5–7 m$^3$/hr for the duration of the drill. The shutdown due to weather conditions occurred during pilot immediately after completing the intersect and resulted in high rotary and stuck drill string. It was then determined that the string was unrecoverable and both rigs rotated out of the drill string, retrieving approximately 590 m of drill pipe on entry and 170 m of drill pipe on exit, abandoning the remaining drill pipe in the hole. Due to the amount of drill pipe retrieved, the existing entry and exit casing were still able to be utilized for the second attempt at pilot hole. Both the entry and exit re-drills were successful in side-tracking out of the existing hole once outside the casing. After the second successful intersect, issues arose when attempting to trip both bits out to exit; it was determined that collapsed cobbles at the end of the casing were resulting in deflecting the bottom hole assembly (BHA) outside of the casing. Additional casing was installed on exit from 64 m to 68 m, and the BHA was successfully pushed out to exit and reaming operations commenced.

DHD began forward reaming 24" to approximately 500 m when the rotary torque increased significantly and the exit rig twisted off the reamer. Both rigs tripped to surface with the exit rig retrieving the tail string with a failure just beneath a tool joint and the entry rig successfully retrieving the reamer. The BHA was tripped across the hole to exit and encountered problems getting into the exit casing again; additional casing was installed to 87 m and additional attempts to push out the bit to exit were made. At this time, due to extreme weather conditions, bans were in place on the access roads preventing heavy loads and limiting vacuum trucks and drill pipe loads. Consideration was given to tripping the exit BHA to entry; however, the road bans prevented mobilizing drill pipe and managing fluid returns to entry. After three days and multiple attempts to get the entry BHA out of the exit casing, road bans were lifted, allowing the contractor to mobilize drill pipe from exit to entry to trip the BHA in from the exit to entry, and bits are quickly tripped through the borehole and successfully pushed out on entry. The 24" ream was quickly completed, along with a successful wiper pass. After multiple construction issues and mitigation strategies, failures and successes, the NPS 16 pipeline was installed with no issues during pullback operations and a maximum pullforce of 98,300 lbs.·f.

**"The planned construction schedule included very aggressive timelines due primarily to environmental requirements which restricted access and construction to a set operational window."**

Entry casings for both the NPS 16 and NPS 24 drills were successfully removed, exit casing removal attempts were unsuccessful and drills were cemented at entry and exit to restrict production of water from hole and to seal the exit casing abandoned in the hole.

*The authors would like to thank the entire project team for combining their efforts and utilizing their experience and expertise, resulting in the successful installation of both the NPS 24 and NPS 16 HDDs.*



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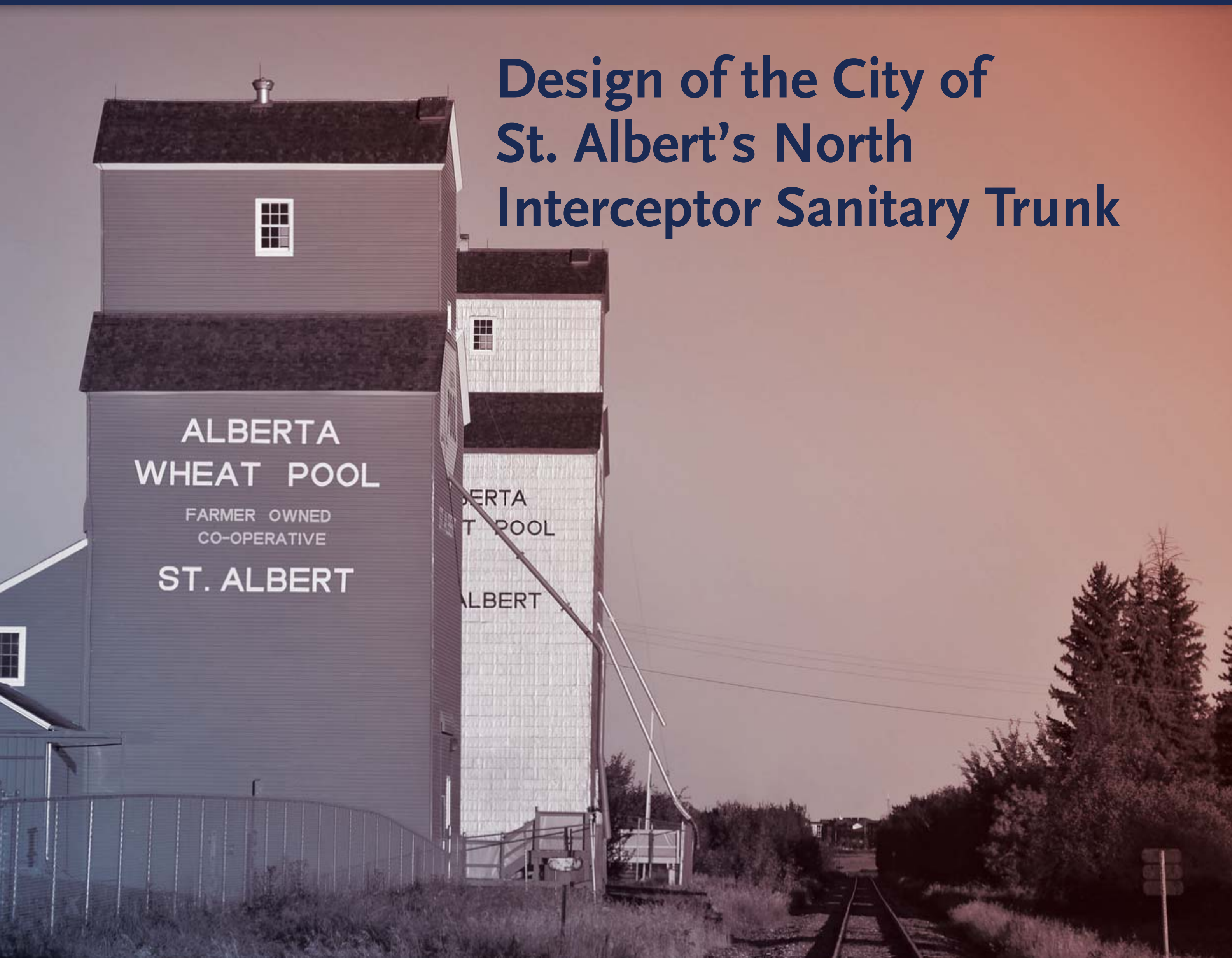
# Call for Submissions

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 September 2018.

# Design of the City of St. Albert's North Interceptor Sanitary Trunk

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**ABSTRACT**

In 2015 the City of St. Albert embarked on a program to implement Phase 3 of the North Interceptor Sanitary Trunk (NIT). With the current South Interceptor Trunk near capacity, the NIT line was critical to allow future development of the City. The scope of the project ultimately included the design of 2,600 m of 1,500 mm diameter sanitary sewer by microtunelling; 400 m of 1,200 mm diameter pipe by open trench; a triple barrel siphon crossing of the Sturgeon River by horizontal directional drilling; relocation of numerous shallow utilities; and installation of 19 manhole structures and chambers ranging from 3–15 m in depth. Several challenges during design had to be overcome including complex geology, shallow graded pipes, hydraulics with an outlet capacity that necessitated an inline storage solution, coordination with various stakeholders, relocation of a well utilized transit station, and finding an alignment within mature established neighbourhoods. The project was tendered to prequalified trenchless contractors in the fall of 2016, with construction of this two-year project commencing in spring of 2017. This paper provides an overview of the project and discusses key design features and mitigation strategies used to deliver the design and tendering of the largest capital project in the history of the City of St. Albert.



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## INTRODUCTION

The 2013 City of St. Albert Utilities Master Plan Update (UMP) identified the need for the North Interceptor Sanitary Trunk sewer (NIT) to be constructed to facilitate the servicing strategy for future development within St. Albert. Completion of this project will allow for system relief of the existing 1,050 mm diameter South Interceptor Sanitary Trunk sewer (SIT) and will provide new opportunities for St. Albert to continue diversified growth and development throughout the city.

The North Interceptor Sanitary Trunk was staged in three phases to deliver conveyance and storage capacity to service growth areas within the city limits. Phase 1 of the North Interceptor Sanitary Trunk was completed in 2006; and a portion of Phase 2 completed in 2011. The remainder of Phase 2 will be completed as development occurs and necessitates the infrastructure. These phases currently allow for servicing from three locations; Ville Giroux Neighbourhood (future), North Ridge (partial flows), Riverside. Phase 1 terminates at St. Albert Trail via a flow controlling orifice plate that allows no greater than 40 l/s into the Liberton sub-trunk. The location of the existing trunks and servicing areas are outlined in Figure 1.

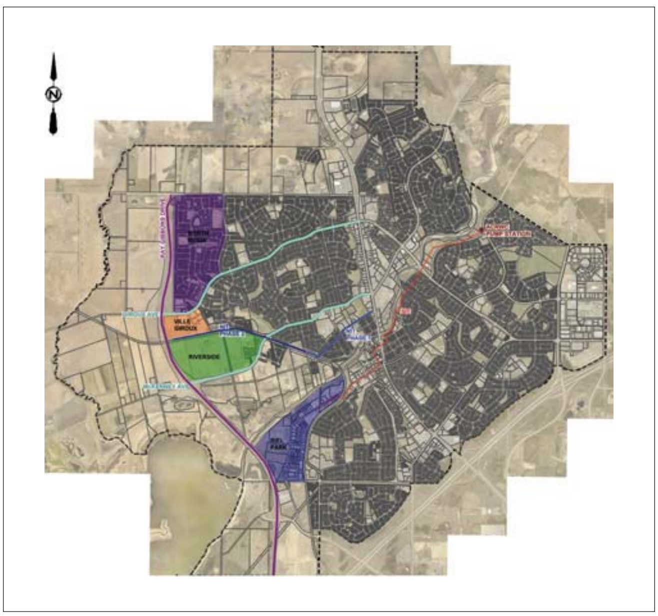

*Figure 1 – Overall St. Albert with Existing Trunks and Service Areas*

The purpose of this project (Phase 3) is to add capacity to the City's existing sanitary sewer system to support growth in South Riel, the entire area west of Ray Gibbon Drive, lands to the north and south of McKenney Avenue, and downtown redevelopment. This will be accomplished through the completion of the final phase of the North Interceptor Sanitary Trunk between the present Phase 1 termination point at St. Vital Avenue and St. Albert Trail, to the existing stub at the Alberta Capital Region Wastewater Commission (ACRWC) St. Albert Pump Station. This would encompass the construction of approximately 3.2 km of sanitary trunk.

This paper will provide an overview of various design features of the project including:

1. the selection of an alignment for the trunk through a built up urban environment;
2. environmental considerations;
3. discussion of geotechnical conditions;
4. hydraulic design and sizing the trunk for inline storage on conveyance;
5. stakeholder consultation including the public, user groups, and the City's transit system;
6. contractor prequalification and tendering; and
7. close with an update on the project that is currently in construction.

## ALIGNMENT SELECTION

One of the more significant challenges associated with the design of North Interceptor Sanitary Trunk (NIT) was the determination of an alignment for the new trunk. Phase 3 of the North Interceptor Trunk was envisioned as a 1,200 mm to 1,500 mm diameter pipe connecting the existing 1,200 mm diameter stub at St. Vital and St. Albert Trail, to a 1,500 mm stub at the Alberta Capital Region Wastewater Commission (ACRWC) St. Albert Pump Station. The alignment of the proposed trunk passed through existing urban developments in the vicinity of St. Albert Trail and the Inglewood Neighbourhood, and potentially within developed and natural areas north of the Sturgeon River. The trunk also needed to cross the Sturgeon River to reach the ACRWC St. Albert Pump Station.

As presented in the City's Utility Master Plan, the third phase of the NIT was envisioned to be a gravity trunk between the upstream tie in at St. Vital and the downstream connection at the ACRWC Pump Station. The profile resulted in a grade of slightly greater than 0.1%, which was within the City Standards. However, when the profile elevation was reviewed with the existing ground elevation, several issues were identified.

The first issue was the minimal amount of cover for most of the line. The river valley is significantly lower than the rest of St. Albert, and with the minimal grade of the line, the line lost most of its cover closer to the river. With much of the proposed trunk located within the river valley, there was approximately a third of the line that would have less than a meter of cover. The second issue was that the trunk was aligned with the toe of the slope near the east end of the project. Nearing the top of the slope are residential houses in the Oakmont neighbourhood. Excavations at this location may impact the slope stability and risk creating slip planes within the slope. The third issue was the elevation of the Sturgeon River made a direct gravity connection between the Phase 1 connection and the ACRWC Pump Station problematic as the trunk would literally pass though the river, necessitating the need for a siphon crossing.

Nine conceptual alignments were developed by the design team considering the constraints of the site, topography, available work space, materials, and geotechnical information. These concepts were based on the premise of installing a trunk from St. Vital Avenue to the stub at the ACRWC St. Albert Pump Station, maintaining a direct route and utilizing available space within the roadways and river valley. Each alignment was developed including a detailed description of its route; scope of required work; quantitative summary of lengths, depths, and structural components; advantages and disadvantages; and key issues. These conceptual alignments were evaluated in an intergraded value engineering, risk analysis, and constructability review workshop.

During the workshop, the alignment options were evaluated considering several criteria including: technical benefit; constructability; operability; public impact; impact on the environment; and future sustainability. The criteria were rated against each other to determine the relative level of importance using a pairwise comparison resulting in the weightings provided in Table 1.

| CRITERIA | DESCRIPTION | WEIGHT |
|---|---|---|
| Technical Benefit | How well the option satisfies project requirements | 34.5% |
| Operability | Ease of operation and maintenance, life cycle costs | 23.5% |
| Future Sustainability | Ability to rehabilitate and expand, sustain future socio-economic | 20.5% |
| Impact on Environment | Temporary impacts, impact to waterways, permanent impacts | 12.7% |
| Constructability | Ease of construction, geotechnical impacts, adjacent infrastructure | 5.6% |
| Impact on Public | Disruption to residents, odour issues, impact to recreational users | 3.2% |

*Table 1 – Criteria Weightings*

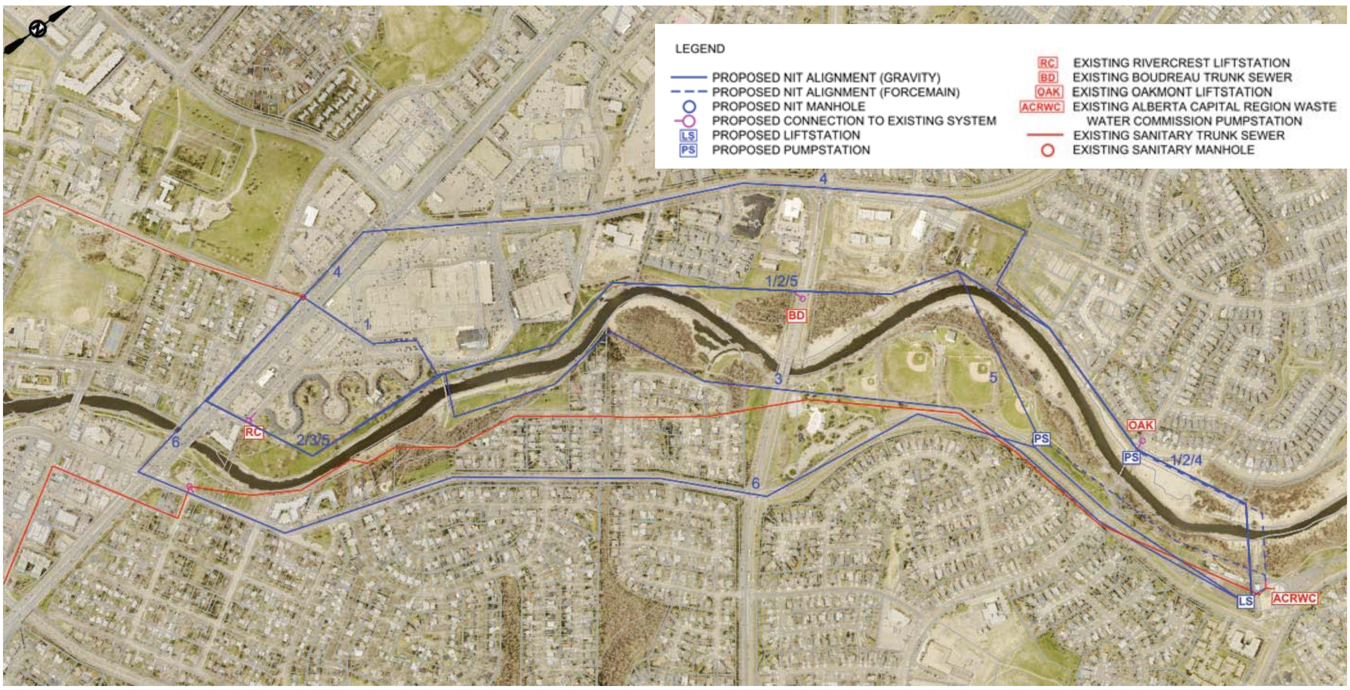


*Figure 2 – Alignments of 6 Option Alignments Considered During Workshop*

High-level screening of the concept alignments was made early in the evaluation process to eliminate those options that were not feasible. Six concepts were evaluated quantitively against the decision-making criteria without considering any variants. It was determined during the workshop that the key decision to make was the alignment. The beginning and end treatments of each alignment (use and location of lift/pump station, optimization of alignments) would be determined at later stages of the design. A summary of the alignments considered during the workshop are summarized in Figure 2.

After careful evaluation and sensitivity analysis of all conceptual options for the North Interceptor Sanitary Trunk, the value-based decision-making processes concluded that Concept 6 was the highest value alignment to proceed with into preliminary design. This option involved lowering the NIT to allow adequate depth of cover beneath the Sturgeon River for gravity conveyance; however, this resulted in the necessity of a new lift or pump station to convey the flows to the ACRWC Pump Station. It was also clear from the workshop that the alignment on Sturgeon Road had several advantages over the others, including construction access, being entirely on City-owned land, and lower impact to residents and the environment.

On further review of the results of the workshop, and corresponding alignment and system profile, AE investigated in more detail the feasibility of incorporating a siphon crossing into

Option 6 for the Sturgeon River crossing. If the siphon crossing was determined to be feasible, it would eliminate the need for a new lift or pump station, reducing construction cost and overall long-term operation and maintenance costs.

## ENVIRONMENTAL CONSIDERATIONS

Impacts to the environment were considered when selecting the alignment, and had to be addressed during the detailed design. These included the number of river crossings, working in the river front, and reducing the number of existing lift stations.

Due to the meandering nature of the river, the conceptual alignments had the potential to have multiple river crossings. The number of river crossings required was reviewed and the following considerations were used to evaluate the concept alignments:

- The fewer the number of river crossings, the lower the chance of a release of a deleterious substance during construction or operation. This can be mitigated by incorporating continuous or fused pipe in the siphon crossing pipes.
- Maintenance under rivers may be challenging and may have additional operational or cost implications.
- Due to topography and the fixed tie in points to Phase 1 and the ACRWC Pump House, greater ground cover could be realized the further west on the alignment a river crossing occurred.

The NIT must travel parallel to the Sturgeon River to reach the ACRWC Pump Station. During the development of the conceptual alignment, the following considerations were review with respect to the river front area:

- Working in the river front will require temporary work space in the river valley which will have construction impacts (the river's most sensitive timing window is April 16 to June 30).
- The project is within the sharp-tailed grouse survey zone and the sensitive raptor zone, which means vegetation clearing in the river valley is likely to impact both and mitigation measures should be implemented as part of disposition requirements.
- Maintenance may require disturbance of the river valley and its user groups throughout the city.
- Spills may affect the river valley.

When developing the conceptual alignments for the NIT, additional consideration was given to the elimination of existing lift stations. Using the proposed NIT to take one or more existing lift stations offline could have the following environmental advantages:

- The fewer overall lift stations, the lower the greenhouse gas (GHG) emissions related to operation; some of the alignments have the potential to reduce the number of lift stations.
- Removing lift stations reduces risks of release of deleterious substances.

The following are a list of regulatory applications that were required under the environmental legislation:

- Public Lands Act (Disposition/TFA).
- Water Act (Code of Practice Notification).
- Environmental Protection and Enhancement Act (EPEA; Notification).
- Fisheries Act (DFO Project Review) – Since trenchless techniques were used, no DFO Project Review was required, and a self-assessment criteria was complete.
- Historical Resources Act (Online clearance) – No historical resources within the preferred alignments.

## GEOTECHNICAL CONDITIONS

During the concept review, all existing geotechnical reports and borehole information related to the proposed project area were collected and reviewed as part of a geotechnical desktop investigation. The information collected demonstrated that the soil was similar on both sides of the river, and had a high water table. This information was reviewed during the concept workshop to aid with selecting the preferred alignment option.

Once the preferred concept was selected, seven boreholes were drilled along the alignment, at proposed shaft locations. The boreholes were drilled at a depth of twice the depth of the proposed manhole, to provide adequate data regarding the soil conditions and water table levels. Piezometers were installed at all borehole locations, and water levels measured.

To confirm the soil was consistent on either side of the river, and reinforce the alignment selected, two additional boreholes were drilled on the opposite side of the river. These boreholes were used to compare soil conditions from either side of the river, helping confirm the selected alignment will be in the most favorable local ground conditions. The results of the two boreholes demonstrated that there was no advantage to either side of the river as both contained silty clay material with a high water table.

The information obtained from the first seven boreholes was used to determine the location of the remaining seven boreholes. The remaining boreholes were drilled along the alignment in areas that had gaps in information and between boreholes that had major differences in results. Once again, piezometers were installed at these locations.

To assist with the bidding process, a baseline geotechnical report was produced. This report identified that the proposed alignment will be in a silty clay (fill) material, with some small pockets of organic silty clay. As well, the borehole logs demonstrate a soft ground condition throughout the alignment with a high water table. These findings are consistent with the soil expected in the area, and confirmed the requirements of an Earth Pressure Balance Machine while tunnelling, as well as water-tight shafts.

## HYDRAULIC DESIGN

The preferred alignment was modeled and iteratively optimized based on developing information. The modelling established the required grade, pipe size, connections, flow requirements for the North Interceptor Sanitary Trunk (NIT). The final recommended option presented in this report is based on reliability, effectiveness and cost benefit for the City and the related stakeholders. The scope of the hydraulic analysis included the following:

- Updating the wet weather flow (WWF) parameters to be consistent for the areas with weeping tiles (developed prior to 1990);
- Validating the WWF parameters for historic storms, and comparing the monitored flows against the modelled flows obtained from the Utility Master Plan (UMP) parameters vs. revised parameters;
- Plot the Infiltration/Inflow rates (I/I rates) from the UMP model and the revised parameters model on a map to identify the change in I/I rates. Ensure that the I/I rates for the new parameters model are consistent with I/I rates generally produced by the areas with weeping tiles;
- Identifying the storage requirements and size of the NIT;
- Identifying the feasibility of providing storage for Intermunicipal Development Plan (IDP) growth areas in the NIT;
- Projecting infill re-densification within existing older areas throughout the City;
- Conceptual sizing of siphon for the River crossing and South Interceptor Trunk (SIT) crossing; and
- Alleviating flows in SIT by interconnecting it to the NIT and using the storage available in NIT.

The wastewater flows from St. Albert discharge to the Alberta Capital Region Wastewater Commission (ACRWC) trunk though a lift station whose ultimate capacity will be 2,400 l/s. Alberta Capital Region has indicated that the capacity of the lift station will be upgraded in the future to accommodate demand of the City of St. Albert up to but not exceeding 2,400 l/s. Additional flows more than the 2,400 l/s must be stored in the North interceptor trunk and be released at a controlled rate.

The UMP Model for the ultimate development scenario was updated with the New WWF parameters for areas developed prior to 1990. The IDP growth areas were then added to the model. However, the storage volume requirements were very high and required the North Interceptor Sanitary Trunk to be a double barreled 3.0 by 2.4 m box culvert. Considering the storage volume requirements, the IDP areas were removed from the model and the ultimate development condition was analyzed for various NIT alignments, and the storage in the NIT sized adequately. This necessitated that the IDP growth areas would store the flows before discharging to the North Interceptor Sanitary Trunk to avoid overloading the trunk.

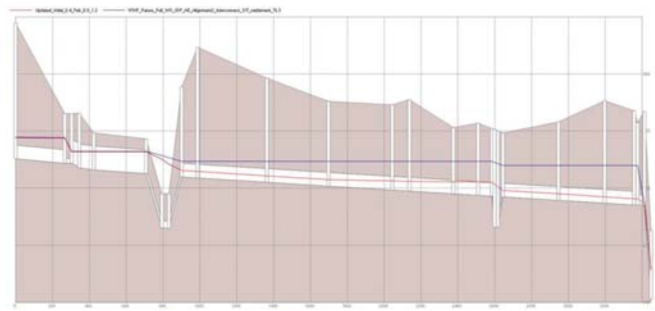

*Figure 3 – HGL for Ultimate Growth Scenario – 0.4 I/I with 0.9 Orifice and 1200 mm Pipe Size*

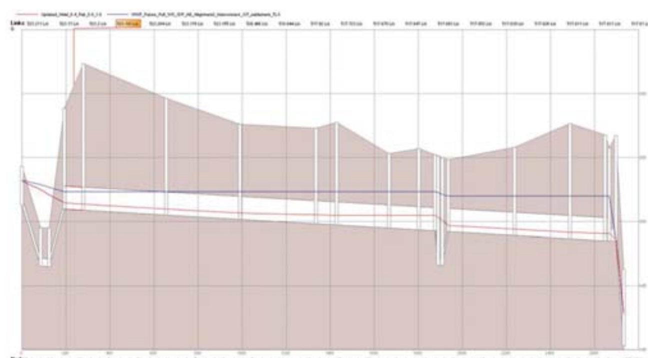

*Figure 4 – HGL for Ultimate Growth Scenario – 0.4 I/I with 0.9 Orifice and 1800 mm Pipe Size*

During preliminary design NIT was modelled both as a 1,200 and 1,800 mm diameter pipe. Both sizes of trunk provided adequate storage and conveyance for the ultimate design conditions. Figure 3 and Figure 4 outline the hydraulic grade lines for the ultimate flow conditions for both pipe sizes. The recommendations during preliminary design was to install 1,200 mm diameter pipe for the entire length of NIT. The recommendation to proceed with the 1,200 mm diameter trunk was based on the assumptions that the IDP areas are developed and designed with their own storage; that I/I standards are enforced for new developed areas; and that the City commits to long term implementation of I/I reduction programs in older areas of the City. During detailed design, the diameter of the trunk was changed to 1,500 mm for all sections that would be installed by tunnelling methodology, and maintain 1,200 mm diameter for sections installed by open trench techniques.

Upsizing the microtunnelled pipe segments from 1,200 to 1,500 mm in diameter reduced construction risks associated with the installation. A larger diameter microtunnel boring machine has higher torque and provides more options for the contractor to deal with any cobbles and boulders that may be encountered. The larger diameter MTBM typically allows access to the cutting face to remove unexpected obstructions. Additionally, the larger diameter MTBM allowed for longer tunnel drives between launch and retrieval shafts. From a hydraulics perspective, the 1,500 mm diameter pipe increased the available storage in NIT providing additional capacity for potential uncertainty in projected I/I rates, uncertainty in long-term development projections and timelines, and flexibility in operation allowing some flows from the South Interceptor Trunk to be conveyed in NIT on a temporary basis if required.

The original concept for the preferred option from the decision support workshop involved the construction of NIT at a depth suitable for crossing the Sturgeon River. This resulted in the necessity of a lift station somewhere between the river crossing and connection to the ACRWC Pump Station. In the development of the concept alignments for NIT, the preliminary review of a siphon crossing determined that there may not be sufficient driving head to meet operational requirements. However, knowing that a new lift station would increase the capital and long-term operation cost of the project significantly, the design team conducted a detailed review of the feasibility of a siphon crossing.

During detailed design, the team confirmed that the siphon crossing would be feasible and exceeds the minimal operational requirements of Alberta Environment's Wastewater Guidelines of 1 m/s velocity for average design flows for existing and ultimate conditions, and for ultimate wet weather flows with estimated flows between 1.5 and 1.9 m/s. This resulted in a triple barrel siphon crossing consisting of two 400 mm diameter, and one 650 mm diameter DR9 HDPE pipes. Inlet and outlet chambers were designed with adjustable weirs and stop logs to manage flows and adjust driving head across the siphon to calibrate flows across the siphon if necessary.

## STAKEHOLDER COORDINATION

The selected alignment of the North Interceptor Trunk passes immediately adjacent to numerous local businesses as well as private residences in the Inglewood, Sturgeon, Braeside and Woodlands neighbourhoods. Furthermore, it would be passing by parks, trails, greenspaces, major roadways, and transit stations. It was apparent that stakeholder opinion and involvement would be critical to ensure the success of the project from a public relations standpoint.

In order to be proactive with addressing stakeholder concerns, public engagement was implemented throughout both the design and construction phases. A public engagement planning strategy was completed, identifying the key stakeholders for each phase, and a program for project involvement, exchange of information, and information / learning opportunities.

During the alignment selection, a workshop was held with key stakeholders including the City's environmental group, recreation and parks, economic development, utilities and public works, planning and development, and engineering. Information from each group helped define the project requirements and ultimately lead to the preferred selection of the trunk alignment.

In the early stages of design, a public open house was held. Information was presented to community members of St. Albert which included why the project was required, the preferred alignment selected, the pipe size, the anticipated construction methodology, as well as details on the project funding.

As design continued to progress, multiple meetings were held with the transit group to coordinate the temporary relocation of the City's central transit station. This collaborated effort led to seasonal constraints on the project construction, limiting the amount of time the transit station could be temporary relocated (during the off-peak summer months). Ongoing efforts assisted with the development of a temporary transit station.

Further coordination was conducted with City recreational groups including the running clubs, cross-country ski clubs, baseball clubs, events and festivals groups, and parks groups. Constructive meetings were held with these groups to determine scheduled events for the 2017 and 2018 season. The timing and location of these events led to required sequencing of specific project stages. From this, available site workspace and timeline restrictions were specified in the project design.

*"Throughout the summer, the contractor fabricated a microtunnelling machine specifically made for the soil in St. Albert."*

Once the construction was awarded, a review of the contractors proposed methodology sequencing and schedule were reviewed. This information was then presented to the community at an open house, with a breakdown of impacts to both residents and businesses.

A final open house was held to inform transit users of the temporary relocation of the transit centre. This included information of the new location, schedule, routes and transfers, accommodations made at the new site, and to answer and general inquires and concerns.

Ongoing communications have been maintained with residential neighbours who are currently experiencing construction activities. This includes hand-delivered construction notices, website updates, and door to door visits.

The extended efforts of stakeholder communication have resulted in positive feedback, and minimal complaints during construction as residents and businesses have felt involved throughout the project, understanding of the project sequencing, progress and delays, and have also been provided direct contact points with the contractor and the city should they have any immediate concerns.

## CONTRACTOR PREQUALIFICATION AND TENDERING

With the North Interceptor Sanitary Trunk (NIT) being one of the largest capital projects in the history of the City of St. Albert, it was decided that we would prequalify both general and tunnelling contractors. Prequalification would mitigate some of the risk associated with construction by awarding the work to contractors that have the appropriate experience and capability to undertake the work. Two prequalification packages were publicly released in April 2016 – one for General Contractors and another for Tunnelling Sub-Contractors

Each prequalification package requested submission of information that included 1) Understanding of the Project and Key Issues; 2) Contractor Qualifications and Experience; 3) Past Performance on Similar Projects; and 4) Innovation and

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Value Added. Mandatory requirements included proof of insurance requirements and confirmation of Certificate of Recognition (or equivalent) issued by the Alberta Construction Safety Association. Scoring criteria and minimum requirements for qualification were set prior to submission. Project team members from both Associated Engineering and the City of St. Albert reviewed the submissions and evaluated the contractors. The prequalification process resulted in five prequalified general contractors, and five prequalified tunnelling subcontractors.

To limit the potential for change orders during construction, the decision was made to create the tender form based on lump-sum items. This was done specifically with larger pay items like the shafts/manhole and microtunnelling installations in mind. Within the design and contract specifications, permission was given to the contractor to shift the manholes and alignment within reason. Lump-sum measurement and payment clauses were written to allow the contractor the flexibility to make minor changes and maintain price for the installation. Tender documents were sent directly to prequalified general contractors, with the stipulation that only the prequalified tunneling sub-contractors could be used to undertake the microtunnelled sections of the project.

To provide further clarification prior to the tender close, a pre-tender meeting was held with the prequalified general and sub-contractors, and was open to all other contractors/suppliers who would like to attend. A general review of the project was conducted and inquiries regarding the tender documents were answered.

## CONSTRUCTION UPDATE

The project was awarded in December 2016, with construction commencing in March of 2017. The first stages of the project included the triple barrel siphon crossing, shaft construction, and the open cut portion through the transit centre. The siphon crossing was complete in March, and construction of the first shaft began in April. From May through September, the transit centre was relocated and the open cut portion of the work was complete.

Throughout the summer, the contractor fabricated a microtunnelling machine specifically made for the soil in St. Albert. During that same time, the design team was engaged with the contractor selected manufacture to review the product material selected for the trunk. A reinforced fiberglass pipe was selected and tailored to meet the soft soils expected near the river valley.

As of the end of 2017, overall the project was at 40% complete with six of the 11 shafts underway and 135 m of 2,600 m having been tunnelled. To ensure the completion of the project at the end of 2018, the contractor plans on utilizing a second microtunnelling machine beginning in spring 2018.

Save the Date!

## 2018 TAC/NASTT-NW Tunnelling and Trenchless Conference

The Northwest Chapter of the North American Society for Trenchless Technology and Tunnelling Association of Canada are pleased to present TT2018, the 2018 TAC/NASTT-NW Tunnelling and Trenchless Conference. Featuring the theme Innovation in Underground Infrastructure, the two-day conference will include plenary presentations, technical sessions, and a trade exhibition all designed to highlight innovation in tunnelling and trenchless technology – throughout Canada and around the world.

Fantasyland Hotel at the West Edmonton Mall will play host to the TT2018 conference. Edmonton, and in particular the West Edmonton Mall, offers conference delegates much in the way of activities and social options. More information on the full TT2018 technical and social program will be available later in 2018.

**November 7, 2018** – Short Course and Conference Reception

**November 8–9, 2018** – Conference & Tradeshow

Please join us in November 2018 and see for yourself all that trenchless and tunnelling has to offer!
For more information please visit the Conference's web page at *www.tt2018.ca*.

# Trunkline Sewer Failure – Lessons Learned

Jeremy Charlesworth CET, City of Lethbridge, Lethbridge, Alberta
Adam Campbell CET MBA, City of Lethbridge, Lethbridge, Alberta


## ABSTRACT

In July 2016, the City of Lethbridge discovered a sinkhole forming above a sanitary trunk main. After digging 13 m down to the pipe it was discovered that the top of the reinforced concrete pipe was gone. Video taken of the rest of the pipe from that spot showed 180 m of 450 mm diameter main had the top completely corroded causing an emergency renewal of the main. This main ran through an easement on a private condominium site which required extensive landscape rehabilitation after replacement of the pipe by open trenching. During the replacement, the City was able to employ the use of an overflow line that had sufficient capacity for dry weather flows, but insufficient for wet weather.

The paper will examine where the City of Lethbridge could have improved the system with asset management and inspections of the main, and how the City has started analyzing mains to ensure this doesn't happen again. It will also examine the advantages that a trenchless rehabilitation could have provided had the corrosion been caught earlier.


## INTRODUCTION

The City of Lethbridge is home to nearly 100,000 residents, a Class IV wastewater treatment plant, 600 km of sanitary sewer pipes, and 23 lift stations. The City also maintains and operates a Class IV water treatment plant, six storage reservoirs, and 600 km of water pipe.



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With the City located around the Oldman River Valley the water and wastewater treatment facilities are situated over 100 m below the residents. With flat topography in the occupied areas this creates a challenge in designing wastewater systems and requires both deep and shallow sanitary mains and many lift stations. Due to the retention time of wastewater both at lift stations and in the pipes this increases the potential for hydrogen sulfide ($H_2S$) gas.

Lethbridge experienced a post-war boom in the '50s, like many other cities, that expanded the underground infrastructure. During this time a significant amount of cast iron water pipe and concrete sanitary pipe was installed. In Lethbridge, the hot soil condition causes metallic pipe (cast iron and steel) to corrode quickly, while the $H_2S$ generated in the sewers starts the concrete corrosion process. Recognizing these problems, the City implemented an asset management plan and has been diligently replacing and rehabilitating pipe based on qualitative and quantitative data. While this has worked well the past few years, a weakness in our methodology was discovered.

## THE SINKHOLE

On July 15, 2016, City of Lethbridge Public Operations received a report of a sinkhole forming on the side of the road when a local lawn maintenance company nearly drove a lawnmower into the gaping chasm. A quick look on the City's GIS (Geographic Information System) revealed a 450 mm sanitary sewer running directly below the newly formed hole. When Water & Wastewater Operations crews checked the area it was determined the line was blocked or collapsed and sewer was being diverted into the nearby overflow line (Figure 1) with sufficient capacity for dry weather flows but insufficient for wet weather. Repeated flushing of the line did not get the wastewater moving again requiring the area to be dug. Checking as-builts for the line revealed it was reinforced concrete, installed in the '50s, and over 13 m deep. This depth was well over City forces' capabilities and required an external contractor to complete the work.

Local contractor Whissell Contracting Ltd. was hired on an emergency basis to repair the collapsed sewer. The sanitary sewer line ran through a private condominium site underneath a brick fence and landscaped yard. Conditions of the easement stated that the City had to repair any landscaping that was destroyed while working on the sewer line. As the sinkhole was directly below the brick fence (Figure 2 and Figure 3) it needed to be taken down before work could begin.

When the contractor reached the pipe and it was visible for inspection the City realized there may be more to this sinkhole than previously thought. The exposed section of pipe (Figure 4) looked more like a channel than a pipe with a hole in it. As the previously quick flowing sewer was blocked by an inflatable plug, a CCTV (Closed-Circuit Television) inspection was able to be performed. Previously, the City had not been able to video the line due to the steep grades and high flow in the pipe. Within seconds of the camera entering the pipe the condition looked grim (Figure 5). As far as the camera could see there was no top to the pipe. With this information the City decided on an emergency renewal of the pipe.

## EMERGENCY RENEWAL

While pipe was ordered the contractor started removing trees and landscaping to start digging further along the line. With the pipe being as deep as it is a fairly large area of excavation was cleared. CCTV inspections on the next sections of pipe revealed the rest of the line to be just as badly corroded as the first (Figure 6). It was then determined that all 180 m of the trunk line needed to

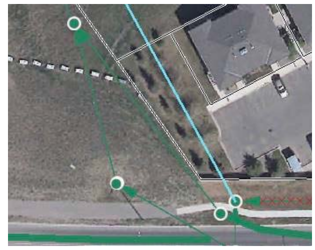

*Figure 1. Collapsed Line and Overflow*

*Figure 2. Sinkhole*

*Figure 3. Sinkhole Close Up*

*Figure 4. Exposed Pipe*


*Figure 5. CCTV Inspection*

Figure 6. Second CCTV Inspection

Figure 7. Corroded Manhole Barrel

Figure 8. Excavation

Figure 9. Second Manhole Installed

be replaced with PVC (Polyvinyl Chloride) pipe immediately. As pipe continued to be pulled out of the ground, the extent of the corrosion started to be revealed. Manhole barrels had entire sections missing from them (Figure 7) and pipe crumbled as it was pulled out of the ground.

Whissell continued excavating the main and brought in larger equipment from another location to deal with the depth of the sewer. To prevent sloughing and cave-ins, the excavated trench had to be quite wide, reaching over 25 m in areas (Figure 8 and Figure 9). This caused all of the condominium's landscaping on the west side of their site to be destroyed.

On August 25, 2016, the inflatable plug was removed as the sewer renewal had been completed. For over a month sewer flows were redirected through the overflow line. Had there been a rainstorm during the work the line would not have been able to handle the flows. Landscaping repairs started in the middle of October. Seeding, sodding, and planting trees was not able to be completed that year with snow right around the corner. It wasn't until May 2017 that the restoration was finally completed. In the end over a hectare of land needed rehabilitation (Figure 10 and Figure 11).

*"Had there been a rainstorm during the work the line would not have been able to handle the flows."*

Figure 10. Before Renewal

Figure 11. After Renewal

## ANALYSIS

After the repair was complete the City started to examine what led to the emergency repair. Examining the system revealed that 11 lift stations fed into this main causing the sewage to sometimes spend days reaching the main. $H_2S$ monitors had readings of $H_2S$ exceeding 400 ppm at times along the line. The high concentration of $H_2S$ caused everything above the sewage level to become severely corroded.

This corrosion had been taking place for a number of years but had not been noticed. Operators at the wastewater treatment plant revealed that a few years ago a large amount of dirt arrived at the plant, causing the primary clarifiers to torque out. At the time it was thought to be from an industrial user, but it was likely from the corroded pipe. It was extremely difficult to do CCTV inspections on the line due to the depth of the main, the high $H_2S$ in the main requiring specialized equipment for personnel, and constant high flow rate through the main. Typically when pipes collapse it becomes evident on the surface through the formation of a sinkhole. Due to the clay content of the soil, it held its shape and did not create a very large void as a sandier soil would do. The depth of the main also helped as the void would have to become quite large to finally be seen on the surface. Combine those factors with the root structure of the trees directly overtop the main in the only area that is irrigated or has any load on top of the soil and the voids could have been slowly forming for years.

## TRENCHLESS COMPARISON

Had the City caught the corrosion before it had become so severe, trenchless options could have been used providing numerous benefits. Based on budget estimates, using CIPP (Cured-In-Place Pipe) lining would have cost approximately 1/3 the cost of the emergency renewal and would have saved the City at least $240,000 (Table 1 and Table 2).

Construction of the main using trenching methods took a total of 41 days before the main was turned on, and an additional six days for additional backfilling and grading. Include landscaping and the total repair work took just over three months, whereas CIPP lining and manhole rehabilitation using an epoxy coating or mortar and sealant would have taken around a week. Had there not been an overflow line (which is not typically installed) bypass pumping would have been required. Forty-one days of bypass



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| Emergency Renewal Costs | |
|---|---|
| Material | $26,011.58 |
| Internal Labour | $17,336.42 |
| Contractor | $229,574.23 |
| Geotechnical | $6,392.84 |
| Landscaping | $86,462.55 |
| **Total** | **$365,777.62** |

*Table 1. Emergency Renewal Costs*

| Trenchless Estimated Costs | |
|---|---|
| CIPP Lining ($350/m) | $63,000 |
| Manhole Rehab ($20k ea.) | $60,000 |
| **Total** | **$123,000** |

*Table 2. Trenchless Estimated Costs*

pumping vs. seven days of bypass pumping is a sizeable difference in cost. The impacts to residents living nearby was substantial. Five parking spaces in the already crowded lot were removed, the excavation stretched meters from a front door, and of course there is the noise and dust that comes with trenching. Another advantage to using a trenchless method to rehabilitate the pipe is the impact on the landscaping. Compare the two pictures (Figure 12 and Figure 13) looking at the same corner of the condo site. The colour of brick used in the fence is not available anymore so the new section is a different colour; it will also take years before the trees grow as large as they were and the area looks the same.

## ASSET MANAGEMENT CHANGES

The City of Lethbridge budgets annually for video inspections of sewer mains. Previously, the mains were identified for inspection through asset data pulled from our asset management program that revealed where crews spent time maintaining the pipe. The data shows where they cut roots, grind mineral, flush mains, and where frequent backups are. This data combined with input from Operations regarding known

*Figure 12. Landscaping Before*

*Figure 13. Landscaping After*

trouble spots was used to set up the program each year. This meant that the pipes selected for relining were typically clay tile with root infiltration, cracking, and mineral buildup while pipes subjected to corrosion were not identified for rehabilitation.

After the dust had settled, the City of Lethbridge analyzed how processes could be improved so something of this scale doesn't happen again. Pipes running underneath private property were a concern along with major trunk lines that collected large portions of the City's sewer. First, lines that ran directly underneath buildings or through private property were identified using our GIS and asset management programs. These lines were further reduced based on age and material. Based on analysis of our system, concrete pipe from the '50s to '70s are of particular concern for corrosion, especially those downstream from a forcemain due to the increased $H_2S$.

Applying the criteria originally thought out would not have caught the overflow line if it was made out of concrete, yet it would have nearly the same impact to the neighbouring condo site as the trunkline. Depth of the line could have an impact larger than just the line itself due to the width of the trench required for deep lines. Trench shields could be used to keep the width narrow on shallower pipes, but past 3 m of depth sloped excavation is preferred.

The formula Eq.1 was used to determine the width of the excavation on these pipes where W is the width of excavation, and D is the depth of the pipe. This formula was derived from Part 32 Section 451 of Alberta's OHS code using "likely to crack or crumble soil."

$$W = 2(D - 1.5) + 1.5 \quad [1]$$



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*"The current practice of flagging sewer mains for inspection and relining based on asset management data is insufficient when it comes to corrosion."*

Using an overlay created with GIS using this formula it was easy to determine which excavated pipes would have an impact on neighbouring properties. With this new data pipes that met the criteria were immediately flagged for a closer look. When video work is impractical due to high flows or the slope of the line, the City has opted to rebuild these lines if they meet all the criteria. By replacing these concrete lines with PVC the City's risk is reduced.

Videos previously done were reviewed and in some instances signs of the corrosion found on 9th Avenue was occurring. City staff were not trained to identify the early signs of this type of corrosion. There was exposed aggregate, but without knowing the thickness of the material it was hard to determine the extents of the corrosion. After seeing how the concrete pipe corroded, it was easier to recognize the earlier stages of corrosion. The City has now started a program to reline a section of trunkline every year based on the analysis.

## CONCLUSION

The current practice of flagging sewer mains for inspection and relining based on asset management data is insufficient when it comes to corrosion. Corrosion is not detected until the main has failed past the point of using trenchless rehabilitation methods. Using GIS to pinpoint mains subject to corrosion leads to a greater chance of finding the corrosion before it is too late. It is equally important to classify the mains based on their risk. Mains crossing private property or under buildings are a larger risk, but trench width needs to be taken into account when identifying these mains. Without taking trench width into account high risk mains will not be identified if they are close to the property or building but not directly underneath. By changing the methodology used to determine mains for inspection it increases the odds that corroded mains will be caught, and the risk of a main causing extensive above ground rehabilitation failing is reduced.

## REFERENCES


- Government of Alberta (2009), Occupational Health and Safety Code 2009, Edmonton, AB: Alberta Queen's Printer




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2018 NASTT-NW Section

# 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.

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# Listings By Category

## ASSET MANAGEMENT
ASI Marine
Associated Engineering
LiquiForce
Stantec Inc.

## AUGER BORING
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
Earthworm Horizontal Drilling Ltd.
Michael Byrne Manufacturing
Michels Canada Co.
Stantec Inc.

## BORE MUD DISPOSAL
NorthStar Fluid Solutions LLC

## CASING SPACERS
Advance Products & Systems, LLC

## CATHODIC ISOLATION
Advance Products & Systems, LLC

## CIPP TUBE
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
Insituform Technologies Limited
LMK Technologies
Wallace Construction Specialties Ltd.

## CONDITION ASSESSMENT
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
ASI Marine
Associated Engineering
IVIS Inc.
LiquiForce
PICA Corp
Stantec Inc.
Thurber Engineering Ltd.

## CONSTRUCTION MANAGEMENT
Associated Engineering
CCI Inc.
LiquiForce
Sameng Inc.
Stantec Inc.

## CONSTRUCTION MATERIALS ENGINEERING & TESTING
Thurber Engineering Ltd.

## CORROSION PREVENTION
Advance Products & Systems, LLC

## COST ESTIMATION
Associated Engineering
LiquiForce
Michels Canada Co.
Sameng Inc.
Stantec Inc.

## CUTTERS
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
LMK Technologies

## DATA COLLECTION SYSTEMS
Associated Engineering
LiquiForce
Stantec Inc.
Thurber Engineering Ltd.

## DEWATERING
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
NorthStar Fluid Solutions LLC

## DIRECT PIPE
Michels Canada Co.

## DIRECTIONAL DRILL RIGS
HDD Broker, Inc.
Michael Byrne Manufacturing

## DIRECTIONAL DRILLING
CCI Inc.
Direct Horizontal Drilling Inc.
Drag'n Skin 2018 Inc.
Earthworm Horizontal Drilling Ltd.
HDD Broker, Inc.
Michels Canada Co.
Precise Crossings
Stantec Inc.

## DIRECTIONAL DRILLING ACCESSORIES
Drag'n Skin 2018 Inc.
Hardmetals Canada Inc.
HDD Broker, Inc.
Kayden Industries
Michael Byrne Manufacturing

## DIRECTIONAL DRILLING FLUIDS
Kayden Industries
NorthStar Fluid Solutions LLC

## DISPUTES REVIEW
CCI Inc.

## DRILL PIPE
Hardmetals Canada Inc.
HDD Broker, Inc.

## DRILL/AUGER BITS
HDD Broker, Inc.
Michael Byrne Manufacturing

## DRILLING CONSUMABLES
Hardmetals Canada Inc.
Michael Byrne Manufacturing
NorthStar Fluid Solutions LLC

## EDUCATION/RESEARCH
PICA Corp

## ENGINEERING DESIGN
Advanced Trenchless Inc.
(Aquatera Utilities Inc.)
Associated Engineering
CCI Inc.
LiquiForce
Sameng Inc.
Stantec Inc.
Thurber Engineering Ltd.

## ENVIRONMENTAL PERMITTING/ ENVIRONMENTAL IMPACT STUDIES
Sameng Inc.
Stantec Inc.
Thurber Engineering Ltd.

## ENVIRONMENTAL PRODUCTS
Drag'n Skin 2018 Inc.
Kayden Industries
Michael Byrne Manufacturing
NorthStar Fluid Solutions LLC

## ENVIRONMENTAL STUDIES
Associated Engineering
CCI Inc.

## EPOXY
Wallace Construction Specialties Ltd.

## FLOW MONITORING
IVIS Inc.
Stantec Inc.

## GENERAL CONSULTING
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CCI Inc.
IVIS Inc.
Stantec Inc.



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Economical | Environmental | Innovative


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*Patented Product since 2007

Works on all Pipe Type
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