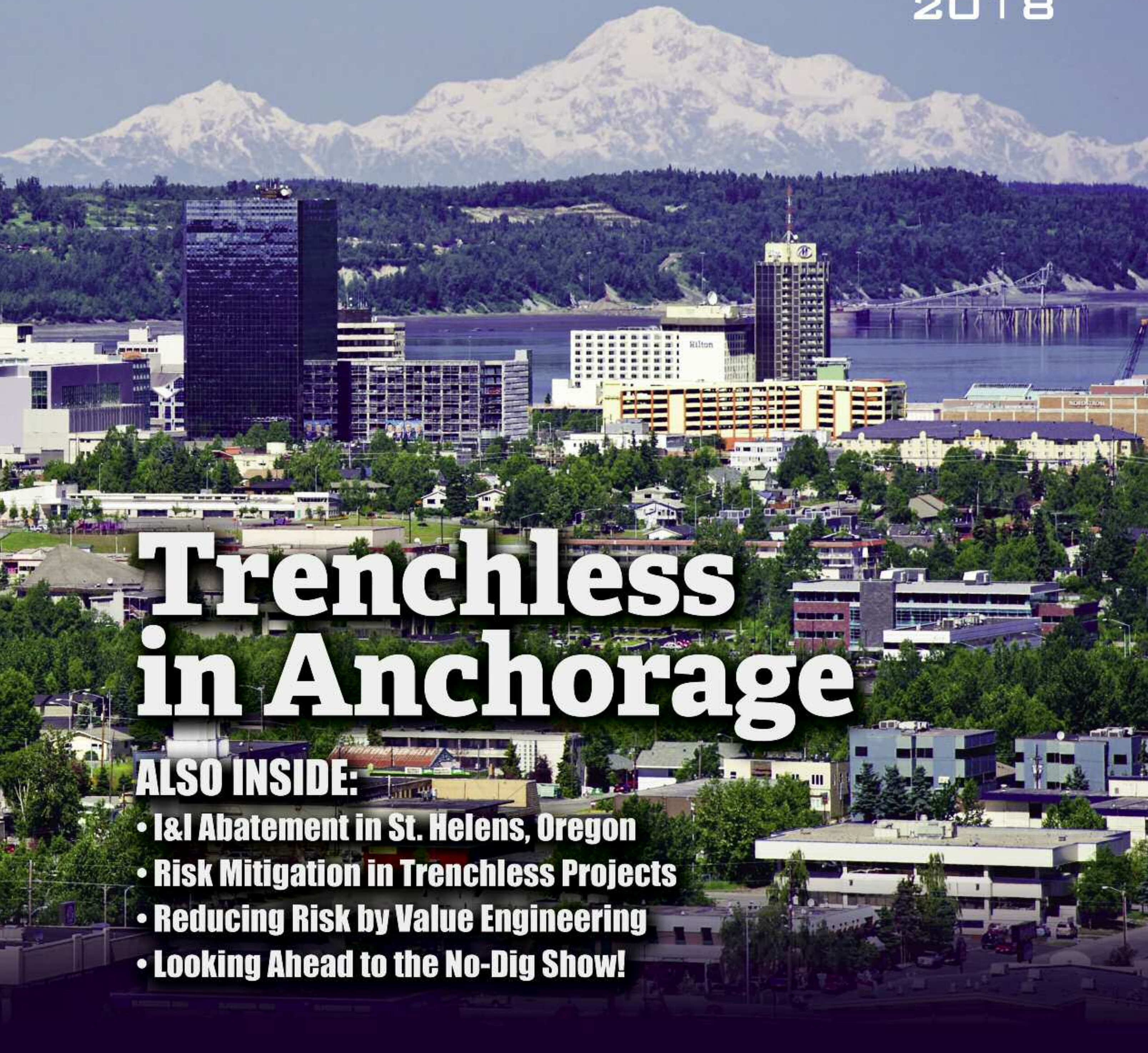
NASTT PACIFIC NORTHWEST CHAPTER

Pacific Northwest Trenchless Review

2018



Trenchless in Anchorage

ALSO INSIDE:

- I&I Abatement in St. Helens, Oregon
- Risk Mitigation in Trenchless Projects
- Reducing Risk by Value Engineering
- Looking Ahead to the No-Dig Show!

MARCH 26, 2018 · 5:30-7:30PM · PALM SPRINGS, CALIFORNIA

2018 EDUCATIONAL FUND AUCTION & RECEPTION

NASTT

In conjunction with NASTT's No-Dig Show

No-Dig

NASTT'S 17TH ANNUAL EDUCATIONAL FUND AUCTION & RECEPTION

The Annual Educational Fund Auction helps raise money for very worthy causes. Since 2002, NASTT has raised over **ONE MILLION DOLLARS** and used those funds in support of our many educational initiatives. Due to your generosity, NASTT is able to provide targeted trenchless training courses to the industry, publish trenchless resources manuals and sponsor university students' attendance at NASTT's No-Dig Shows, as well as award scholarships.

EXCITING AUCTION ITEMS

Come to the auction and bid on great items like trips, tickets, electronics, industry items and more!

HAWAIIAN VACATION RAFFLE

The winner of this raffle will receive a dream Hawaiian vacation, a $5,000 value! Tickets are $25 or five for $100 with a maximum of 1,000 tickets being sold. Don't miss out – preorder your tickets by visiting nastt.org/no-dig-show/auction.

Need not be present to win.

Raffle generously sponsored by Vermeer

COSTUME CONTEST

Dress like your favorite '50s icon for the auction's Seventh Annual Costume Contest! Prizes will be awarded- don't miss out!

Auction Reception sponsored by

INTERPLASTIC CORPORATION · DitchWitch ditchwitch.com · BENNETT trenchless engineers

50/50 RAFFLE

A great way to win some cash for yourself and help out our student chapters! The winning ticket will be drawn immediately following the live auction and you must be present to win. The winner splits the cash pot with the students.

FOR MORE INFORMATION VISIT

NASTT.ORG/NO-DIG-SHOW/AUCTION

NASTT

Pacific Northwest Trenchless Review

WINTER 2018

Contents

Featured...

Also...

COVER PHOTO: Visit Anchorage/Ken Graham Photography

Published by:
PTR COMMUNICATIONS INC.
Unit 1 – 73 Fontaine Crescent
Winnipeg, Manitoba
Canada R2J 2H7

President
Elaine Chouinard
204.255.6524
elaine@ptrcommunications.com

Editor
Mike Stimpson
807.346.0510
mike@ptrcommunications.com

Advertising Sales
Darlene Madill
218.324.2801
darlene@ptrcommunications.com

Layout & Design
Jim Schmidt
Lunch Pail Productions

PTR Communications Inc.
Unit 1 - 73 Fontaine Cres.,
Winnipeg, Manitoba
Canada R2J 2H7

Printed in Canada 01/18

A Year of Success and Change

Brendan V. O'Sullivan - *Chair, NASTT PNW Chapter*

Welcome to the seventh edition of the Pacific Northwest Trenchless Review. The Pacific Northwest is booming. The secret is out, and folks keep moving in! With that, the challenge of addressing aging infrastructure is ever present. Municipalities throughout the region are turning to trenchless technologies to rehabilitate, replace and expand their infrastructure.

The North American Society of Trenchless Technology (NASTT) is at the forefront of trenchless education, and the Pacific Northwest Chapter (PNW-NASTT) is here to further the mission to "advance trenchless technology and to promote its benefits for the public and the natural environment by increasing awareness and knowledge through technical information dissemination, research and development, education and training" throughout Alaska, Idaho, Oregon and Washington.

Looking back… 2017 was another year for the books! PNW-NASTT kicked the year off with the 2017 Trenchless Symposium held in SeaTac, Washington, in January. The two-day symposium was, once again, a great success. Despite one of the biggest snow storms on record to hit our members in Oregon and Washington, we had 27 people attend the NASTT New Installations Good Practices Course on day one and over 60 attendees for the technical presentations on day two.

I want to personally thank our immediate past chair, Chris Sivesind, and the Planning Committee for their hard work coordinating this event, the 15 vendors that filled the exhibit hall, and the industry professionals who dedicated their time to give great presentations. The symposium continues to be an excellent educational opportunity and networking event for everyone involved with the trenchless world, be they utility owners/operators, engineers, contractors, manufacturers, or suppliers.

We had great turnout at our annual general meeting at NASTT's 2017 No-Dig Show in Washington, D.C., and hope to see more faces from the PNW-NASTT this coming March at NASTT's 2018 No-Dig Show in Palm Springs, California. We will be holding a chapter meeting at 4 p.m, on Sunday, March 25, at the Palm Springs Convention Center prior to the Conference Kick-off, so mark your calendars now!

This year saw a lot of change in our chapter, and we have appointed three new board members. We welcome Carl Pitzer (Vice Chair) from Thompson Pipe Group – Flowtite in Seattle, Washington, AJ Thorne (Secretary) from the City of Gresham in Gresham, Oregon, and Heidi Howard (Treasurer) from Staheli Trenchless Consultants in Lynnwood, Washington.

With an eye on the horizon, the PNW-NASTT will be kicking off 2018 with a NASTT Good Practices Short Course on cured-in-place pipe (CIPP) in Anchorage, Alaska, on January 9 at the Crown Plaza Anchorage—Midtown. Be sure to visit our chapter website (www.pnwnastt.org) for registration details for this event and information regarding future chapter activities. Our next symposium is tentatively scheduled for early 2019 in Portland, Oregon.

These are exciting times. As the trenchless industry continues to grow, existing techniques are refined, and new techniques are developed, it will be crucial to continue the NASTT mission. This can only be accomplished with the involvement of those in the industry, and we are looking forward to welcoming new members to our chapter as we move into 2018. If you want to get involved, please contact me at Brendan.O'Sullivan@murraysmith.us or (503) 225-9010.

Regards,
Brendan V. O'Sullivan
Chair, NASTT PNW Chapter

A Promising Future

Frank Firsching - *NASTT Chair*

Hello, Pacific Northwest Chapter members. As 2017 draws to a close, I'm excited for the future during my term as Chair of the Board of Directors. Plans are under way for NASTT's 2018 No-Dig Show which will be held March 25-29 in Palm Springs, California. We received a record number of abstracts for the technical program, and the exhibit hall is set to sell-out yet again.

NASTT exists because of the dedication and support of our volunteers and our 11 regional chapters. That includes the contributions of many Pacific Northwest Chapter members who serve on our No-Dig Show Program Committee and volunteer their time and industry knowledge to peer-review the abstracts. We're looking forward to the upcoming No-Dig Show in Palm Springs and these 2018 committee members from the Pacific Northwest chapter will ensure that the technical presentations are up to the standards we are known for: Dan Buonadonna, Jack Burnam, Michelle Macauley, Kimberlie Staheli and Diana Worthen.

The Pacific Northwest Chapter is also home to some of our Session Leaders. Session Leaders are Program Committee members that have the added responsibility of managing a session of the technical program and working with the authors and presenters to facilitate excellent presentations. I would like to extend a special thank-you to the Chapter members that will also serve as Session Leaders in 2018: Dan Buonadonna, Jack Burnam, Michelle Macauley and Diana Worthen.

> "NASTT has a very promising future because of our amazing volunteers. Thank you again for your continued support and dedication to NASTT and the trenchless technology industry."

Beyond the annual No-Dig Show, NASTT provides many trenchless training courses. We are focused on trenchless education and our highly experienced instructors and presenters are dedicated to trenchless education, providing their expertise strictly on a volunteer basis. They donate personal time to travel around North America to provide high-quality training on a host of trenchless technologies. I would like to thank Chapter member and Immediate Past Chair of the NASTT Board of Directors, Dr. Kimberlie Staheli, for her instructor volunteerism this year. Kim teaches our New Installations Good Practices Course.

The North American Society for Trenchless Technology is a society for trenchless professionals. Our goal is to keep our finger on the pulse of our industry and provide beneficial initiatives. 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 nastt.org/volunteer. There you can view our committees and learn more about these great ways to stay involved with the trenchless community and to have your voice heard. Please consider becoming a volunteer – we would love to have you get more involved.

NASTT has a very promising future because of our amazing volunteers. Thank you again for your continued support and dedication to NASTT and the trenchless technology industry.

Regards,
Frank Firsching
NASTT Chair

NASTT Pacific Northwest Chapter
Board of Directors

Director
Brian Gastrock
Coffman Engineers, Inc.
Anchorage, Alaska
gastrock@coffman.com

Chair
Brendan O'Sullivan
Murraysmith, Inc.
Portland, Oregon
503-225-9010
Brendan.O'Sullivan@murraysmith.us

Secretary
AJ Thorne
City of Gresham
Gresham, Oregon
Andrew.Thorne@greshamoregon.gov

Director
Kimberlie Staheli
Staheli Trenchless Consultants, Inc.
Lynnwood, Washington
kim@stahelitrenchless.com

Vice Chair
Carl Pitzer
Thompson Pipe Group
Seattle, Washington
cpitzer@thompsonpipegroup.com

Treasurer
Heidi Howard
Staheli Trenchless Consultants, Inc.
Lynnwood, Washington
heidi@stahelitrenchless.com

Immediate Past Chair
Chris Sivesind
Akkerman
Seattle, Washington
csivesind@akkerman.com

Upcoming NASTT Conferences, Courses and Events

January 9

NASTT Good Practices Short Course – CIPP
Crowne Plaza Anchorage – Midtown
Anchorage, Alaska

January 30

NASTT's Forum: Trenchless in New Orleans
Ernest N. Morial Convention Center
New Orleans, Louisiana

January 30 – February 1

UCT Conference & Exhibition
(Visit NASTT at Booth #218)
New Orleans, Louisiana

March 25

NASTT's Introduction to Trenchless Technology – Rehabilitation
Palm Springs Convention Center
Palm Springs, California

March 25

NASTT's Introduction to Trenchless Technology – New Installations
Palm Springs Convention Center
Palm Springs, California

March 25-29

NASTT's 2018 No-Dig Show
Palm Springs Convention Center
Palm Springs, California

March 28

NASTT's Gas Good Practices Course
Palm Springs Convention Center
Palm Springs, California

March 28-29

NASTT's HDD Good Practices Course
Palm Springs Convention Center
Palm Springs, California

March 28-29

NASTT's Pipe Bursting Good Practices Course
Palm Springs Convention Center
Palm Springs, California

March 28-29

NASTT's Laterals Good Practices Course
Palm Springs Convention Center
Palm Springs, California

March 28-29

NASTT's CIPP Good Practices Course
Palm Springs Convention Center
Palm Springs, California

March 28-29

NASTT's New Installation Methods Good Practices Course
Palm Springs Convention Center
Palm Springs, California

For more information and the latest course offerings, visit:

nastt.org/training/events

THE BIGGER PICTURE
Keyhole Key Box Replacement in Anchorage

James Armstrong
Anchorage Water and Wastewater Utility

Anchorage Water and Wastewater Utility (AWWU) is located in Anchorage, the biggest population center in Alaska with just over 300,000 residents. AWWU serves approximately two-thirds of the Anchorage population through more than 1,500 miles of pipes in one of the largest municipalities (1,700 square miles) in the United States.

Anchorage, being located in a subarctic environment, elected to bury water lines below the area's usual frost penetration depth of 10 feet to prevent freezing. The depth of bury along with inadequate planning for future maintenance and access has created difficult and expensive conditions to properly maintain the water and sewer systems.

In being a responsible steward to our customers and the environment, AWWU embraced the use of trenchless technologies such as cured-in-place pipe (CIPP) to reduce the cost associated with and simplify the rehabilitation of water and sewer mains.

The typical cause of our projects is excessive corrosion of our metallic (ductile and cast iron) mains. With our focus on repairing the water mains, our rehabilitation designs often overlooked the water services due to impacts and costs. AWWU, like similar water utilities elsewhere, is responsible to

Screenshot of key box replacement in progress maintain the water system from the source to the property line of each customer.

We knew from experience and from our knowledge of corrosion that the copper water services were in good condition. The largest omission to our assessment of the service condition was the fact that we install iron-containing key boxes and key box rods at the property line. Similar to our metallic iron mains, the key boxes and key box rods were rusting away too. We have taken steps to prevent this in our current design standards with installation of anodes and stainless steel key box rods.

The key box is used by AWWU to turn off service to a customer for repairs or delinquency; without it, we would need to shut down the water main and impact many customers. With the key box being located at the edge of the rights-of-way or easement this is often behind street curbs and in landscaped areas or within heated driveway surfaces. Thus removing and replacing key boxes become very intrusive to our customers and sometimes costly to us and our rate payers.

To exemplify how replacing the key box can become exorbitantly expensive: Landscaping costs came to a head on one AWWU project in which a customer had planted or allowed a native birch tree to grow near their "unsightly" key box top. The tree and key box were in such proximity that removal of one with standard construction methods would have meant the removal of the other. When the "replacement cost" of the tree was calculated at $33,000 by an arborist, it was decided to forgo replacement of the key box.

With over 20,000 linear feet of water mains rehabilitated with CIPP, the Engineering Department — which plans, designs and executes most of AWWU's rehabilitation projects — began to receive feedback from the Operations and Maintenance Department (O&M) about their call-outs to areas in which the water main was rehabilitated. The O&M callouts that floated to the top and pointed out that a flaw in the typical rehabilitation design related to "spinners." A "spinner" is when a key box rod becomes separated from the curb stop (water service control valve), usually because of corrosion to the key box rod.

In 2015, AWWU completed a project that included the rehabilitation of 9,000 linear feet of water line in Bayshore Subdivision. The water lines were originally constructed in green belts and in backyards

AWWU decided to build on the experience of a Canadian city to develop a process for removal and replacement of key boxes.

Steps in replacing a key box: preparation, including removal of strips of turf; crew's work on the key box; job completed, turf replaced.

with a minimal 10-foot-wide easement. Re-establishing landscaping in the areas of work took longer than anticipated and in some areas took multiple attempts. Residents and the homeowners association became agitated about the landscape work, but eventually everything was corrected to their satisfaction. Shortly after gaining buy-in from the HOA, AWWU O&M had to gain access to a "spinner" through the freshly planted greenbelt. This again disturbed the landscaping and greenbelt area. Repair of the greenbelt cost AWWU nearly as much as repair of the spinner.

Due partially to our work in Bayshore, AWWU Engineering took a renewed interest in how rehabilitation projects handled the key boxes and devised a solution to include removal and replacement with minimal surface impact. Our neighbors to the south, in Calgary, Canada, previously deployed a key-hole key box replacement process that utilized extension tools and vacuum excavation of a tight hole (approx. 12 inches in diameter) around the key box. We decided to build on their experience to develop our own process and place that into a water line CIPP project.

The Rosemary to ARCA water project (Project) was chosen as our pilot project for this "new" technique. Located in east Anchorage in a developed subdivision, the Project includes CIPP lining of approximately 820 linear feet of 12-inch and 1,670 linear feet of 8-inch metallic water main, as

> "This project is paving the way forward for other types of water main life extension techniques"

well as the installation 350 linear feet of 10-inch HDPE pipe via horizontal directional drilling.

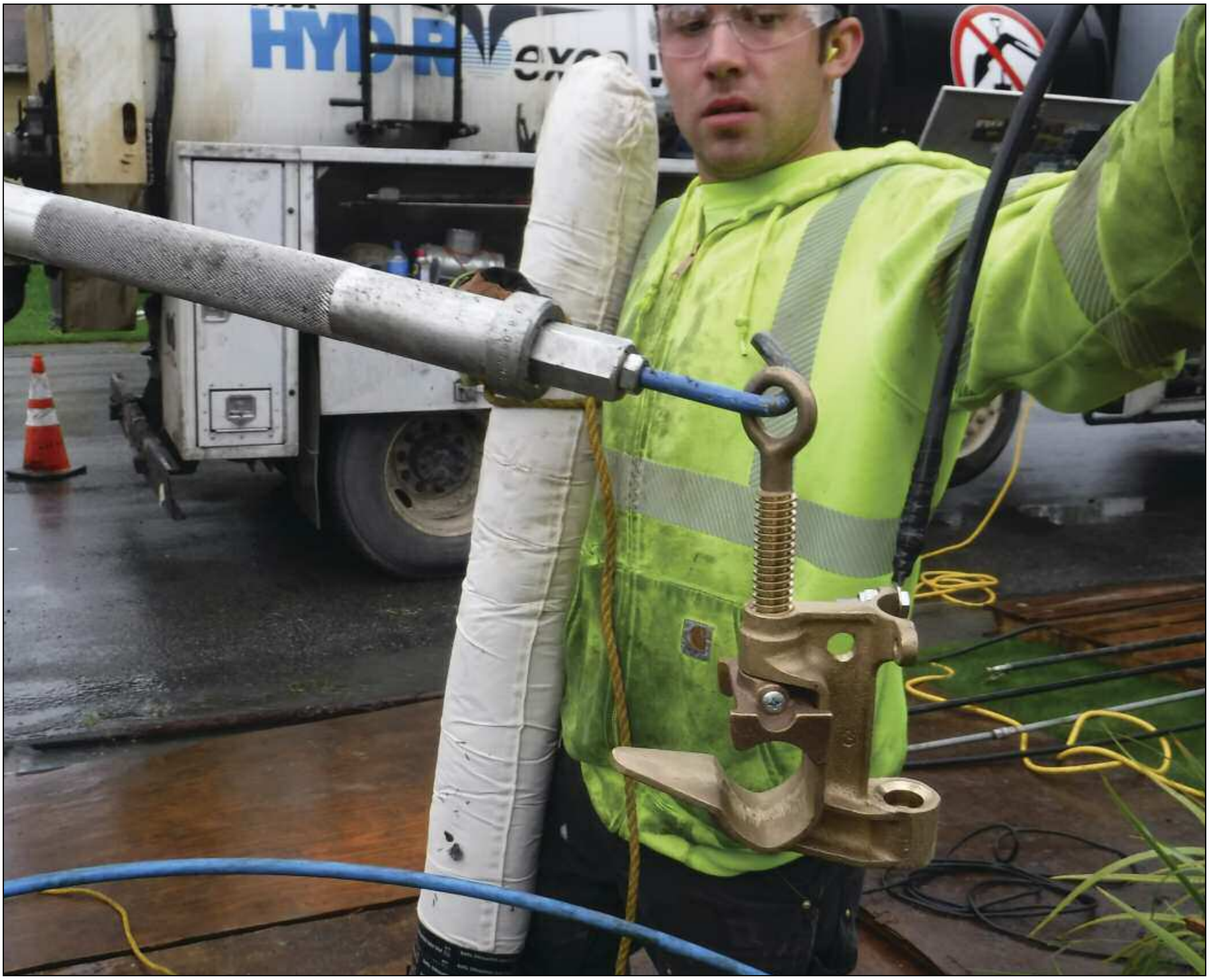
The soils in the CIPP portion of the Project consisted mostly of saturated running silty sand with gravel. AWWU's experience in the area led us away from traditional open-cut removal and replacement to CIPP for the rehabilitation of the main because of the existing soils. The soil information also fed into and changed how we thought that the key hole key box replacement should be done when compared with how Calgary completed their key box replacements.

THE PROCESS

Working in people's developed and landscaped yards required the contractor to reduce and protect their work area. In this case they used 1-inch tongue-and-groove plywood to protect the landscaped areas and utilized smaller equipment to limit the work area and associated damage. The contractor then went about removing the grass in clean-cut strips and set them aside to be reset after completion of the work. This careful handling of the sod prevented the generation of comments from homeowners about the grass types not matching.

Due to the difficult soils we anticipated, the contract requirements differed from that of Calgary's with the addition of a two-piece 24-inch steel caisson. By including the caisson in the contract, we could control groundwater and running soils better to ensure that the excavation stayed small and tight to match the contract intent.

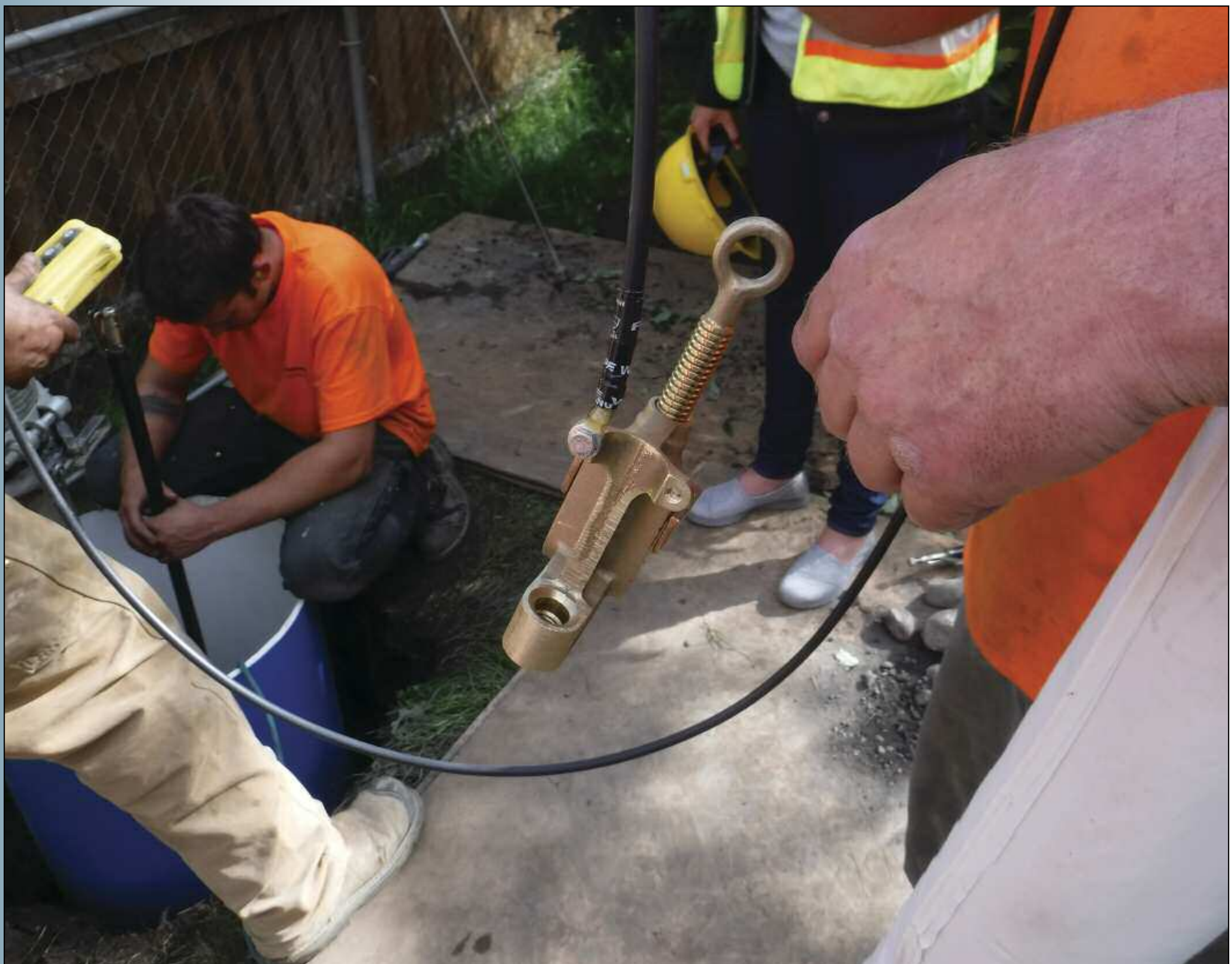
After extraction of the grass, the contractor excavated an approximately 30-inch-diameter hole that was 30 inches deep and lowered the bottom section of the caisson into the excavation. The caisson was then backfilled to stabilize it. A vacuum excavator then proceeded to be used to lower the caisson and excavate around the key box. Once the bottom section of the caisson was low enough, the top section of the caisson was pinned to it and the excavation process continued. Upon reaching the copper service line, the bottom of excavation is prepared for the key box removal and replacement with



A clamp typically used in the electrical industry is used by Anchorage crews in key box work.

specialized tools.

Working within a 24-inch caisson nearly 10 feet below the ground surface required unique tools. Calgary modified and manufactured their extended-reach tool set. We however, found tools available for purchase that would work for our project, and these tools were placed into the contract requirements. The contractor elected to modify and manufacture additional tools and use those that were specified in the contract. The specified tools were originally developed for the gas industry but later modified for the water industry. The tools included vice grips, plyers, grinders, saws, cameras, and the like that had a working reach of 12 feet.



An anode is prepared for installation in a keyhole excavation.

In 2012 AWWU started requiring the installation of anodes on all services, so to bring these services up to our current standard we needed to find a way to install an anode on a ¾-inch copper pipe, 10 feet down in a 24-inch hole. Once again Calgary had the solution. They found a clamp typically used in the electrical industry that was pole-mounted so that electrical workers could stay away from hot wires while attaching grounding or bypass wiring with an isolation pole. These clamps were used to affix the wire coming from an anode to the copper pipe.

Crew members ensure a mature crabapple tree survives the key box replacement process.

CONCLUSION

The key hole key box replacement methodology employed for this project allowed for AWWU to get new key boxes and rehabilitated mains. In doing the work we discovered that about one-third of the key boxes had failed and that an additional one-third were nearing the end of their useful life. The cost to complete the replacement was similar in cost to replacing a service pipe.

With a much smaller footprint than our past practices provided, we were able to save mature birch and crabapple trees and the potential additional cost those trees could have had on the project.

The new key boxes, additional anodes and CIPP water mains will last a great many years. AWWU feels that we have truly ensured the longevity of our distribution system in a responsible, efficient and sustainable manner, which is a large part of our mission.

This project is paving the way forward for other types of water main life extension techniques. AWWU also completed a project in which 200 anodes were installed on a water main the use of a 24-inch caisson and remote tools.

Like physicians' surgery techniques moving away from open-cut to laparoscopic surgery, we too are embracing smaller cuts to get at where the problems really lie.

I&I Abatement: Using the Trenchless Toolbox for Project Success

Brendan O'Sullivan
Murraysmith, Inc.

Sue Nelson
City of St. Helens

Sharon Darroux
City of St. Helens

(To be presented at NASTT's 2018 No-Dig Show - Palm Springs, California)

The City of St. Helens, Oregon, (population 13,240) is located on the banks of the Columbia River, approximately 30 miles north of Portland. Its geologic conditions are unique in that it sits on shallow bedrock of hard basalt that has an estimated compressive strength in excess of 40,000 psi. Due to the presence of the hard bedrock, infrastructure is relatively shallow, and the ground has very low infiltration rates. This leads to perfect conditions for inflow and infiltration (I&I) into their ageing sanitary sewer system. The City recently completed a multi-year I&I Abatement Program to reduce sanitary sewer overflows during wet weather events and reduce treatment plant costs.

The I&I Abatement Program began in the early 2000s when the Oregon Department of Environmental Quality (DEQ) approached the City with a mandate to pass the five-year, 24-hour winter storm event and 10-year, 24-hour summer storm event without sanitary sewer overflows. The first step in meeting the mandate was to learn more about the performance of the sanitary sewer system. A hydraulic modeling study and capacity evaluation was completed in 2007 that revealed three key details. One, the hydraulic capacity of the system had a service level less than the 1.5-year rainfall event. Two, the five-year, peak-hour event produced an average flow of 25 million gallons per day (MGD), of which 24 MGD was attributed to I&I. Three, the study was able to identify which basins in St. Helens contributed the largest amount of I&I to the sanitary sewer system.

In 2008, the City began implementing the I&I Abatement Program. The program was designed to be a holistic approach to address sanitary sewer deficiencies on both public (Mainline Program) and private property (Lateral Sewer Program). The program had four main goals: (1) reduce the number of overflow events, (2) restore the capacity of the sanitary sewer system for future use, (3) improve existing and install new storm sewers to eliminate flooding and convey the stormwater flows away from the sanitary sewer system, (4) and provide the maximum improvement value by focusing on the largest basin contributors of I&I.

Funding for the program came from multiple sources, including City funds, the American Recovery and Reinvestment Act of 2009, and the Oregon DEQ Clean Water State Revolving Fund.

MAINLINE PROGRAM

The Mainline Program was divided into three phases. Phases 1 and 2 focused on the rehabilitation and replacement of

existing sanitary sewers, and installations of new sanitary and stormwater collection sewers. Phase 3 involved the replacement of two existing, undersized storm culverts with a new large-diameter culvert to convey the anticipated stormwater flows after I&I flow diversion.

Design for Phases 1 and 2 of the project began in 2008 with a condition assessment of existing assets and evaluation of CCTV inspection data. CCTV inspections, and the rehabilitation projects in general, concentrated on the basins identified as the largest contributors to I&I. Focusing available resources on the most deficient portions of the sanitary system ensured the most cost-effective reduction of I&I flows. Typical deficiencies observed in the CCTV videos included root intrusion, separated joints, cracked pipe, and offset joints. Pipes were evaluated to identify the extent and severity of deficiencies to objectively determine the condition of the sewer pipes and identify the rehabilitation needs. Once the rehabilitation needs of the sanitary sewer pipes were established, an appropriate rehabilitation or replacement method was selected for each pipe segment.

Criteria for evaluating and selecting rehabilitation methods were based on the results of the condition assessment, existing pipe material, and geographic location of sewers. The geographic location posed one of the most difficult challenges for method evaluation and construction, as many sewer mains are located in the back or side yards of residential properties, making access an important design consideration. Methods evaluated included conventional open trench, cured-in-place pipe (CIPP), pipe bursting, and sliplining. To minimize the impact of construction to the public, trenchless rehabilitation techniques were the preferred option because they typically have a smaller and lighter footprint than traditional open-trench excavation methods.

To address and reduce I&I, the Mainline Program focused on three key components of the sanitary sewer system: mainline sewers, lateral connections, and manholes. The most widely used method for rehabilitating the mainline sewers was CIPP lining, followed by open-cut replacement and size-on-size pipe bursting. All CIPP liners were designed per ASTM F1216 for fully deteriorated conditions, and were fabricated of needle-punched felt tube, impregnated with poly-

ester resin and steam-cured. The thickness of the liners ranged from 4.5 millimeters to 9 mm depending on pipe diameter, pipe ovality, depth of cover, and the groundwater table.

When the existing sanitary pipe was determined to be in too poor of a state to allow for CIPP lining, pipe bursting and open trench were deemed as appropriate replacement techniques. Each method presented its own challenges to consider during design. Access for open-trench replacement of sewers located in back and side yards was difficult because of limited or no access due to existing structures, trees, and landscaping. The sometimes-delicate issue of accessing public utilities through private property was at the forefront of the City's mind, and they proactively engaged impacted property owners early in the process.

Of the many challenges to consider during pipe bursting, none were more important than analysis of the soil displacement forces to ensure that existing surface structures and adjacent foundations or utilities would not be negatively impacted during the pipe bursting operations. Following principles and guidelines set forth in the NASTT Pipe Bursting Good Practices Guidelines, these displacement forces were investigated and used to evaluate risk and potential impacts.

One aspect of the Mainline Program was the lateral connections. A primary source of infiltration into a sanitary sewer system is at the mainline-lateral junction and the first joint of the lateral. The shallow nature of the sewer system made it cost-efficient to make new, water-tight lateral connections directly to the installed mainline CIPP or HDPE pipe and replace deficient lateral joints. The majority of new connections were performed manually by open-cut method on the same day as the CIPP installation. In rare cases where the lateral junctions couldn't be accessed due to topographic constraints, the laterals were reinstated in situ, utilizing a robotic cutter on the same day as installation.

The final component of the sewer infrastructure to be addressed was the sanitary sewer manholes. The most common deficiencies were benches and channels in either poor or non-existent condition. Deterioration of concrete surfaces in the manholes was due to hydrogen sulfide attacks and microbial induced corrosion (MIC). Deficiencies in the concrete were addressed with the application of protective polyurethane coatings or manhole replacement. As an additional measure of protection, a microbial control additive was added to all grout used for bench and channel reconstruction to reduce MIC and increase the longevity of the rehabilitated manholes.

Alongside the rehabilitation of the sanitary sewer system, the existing storm system also had to be addressed due to the additional water it would have to handle as the sanitary system was made water-

CIPP (6" to 12" Dia.)	65,000 LF
Open Trench (6" to 10" Dia.)	5,230 LF
Pipe Bursting (6" Dia. on size)	2,500 LF
Slip Lining (8" Dia.)	260 LF
Lateral Piping (4" to 6" Dia.)	1,950 LF
Lateral Reconnections (4" to 6" Dia.)	1,223 LF
Chemical Grouted Lateral Connections	29
Manholes – Replaced New	51
Manholes – Rehabilitated in Place	50
Cleanout – Replaced New	53
Total Sanitary Sewer Main	**74,940 LF**

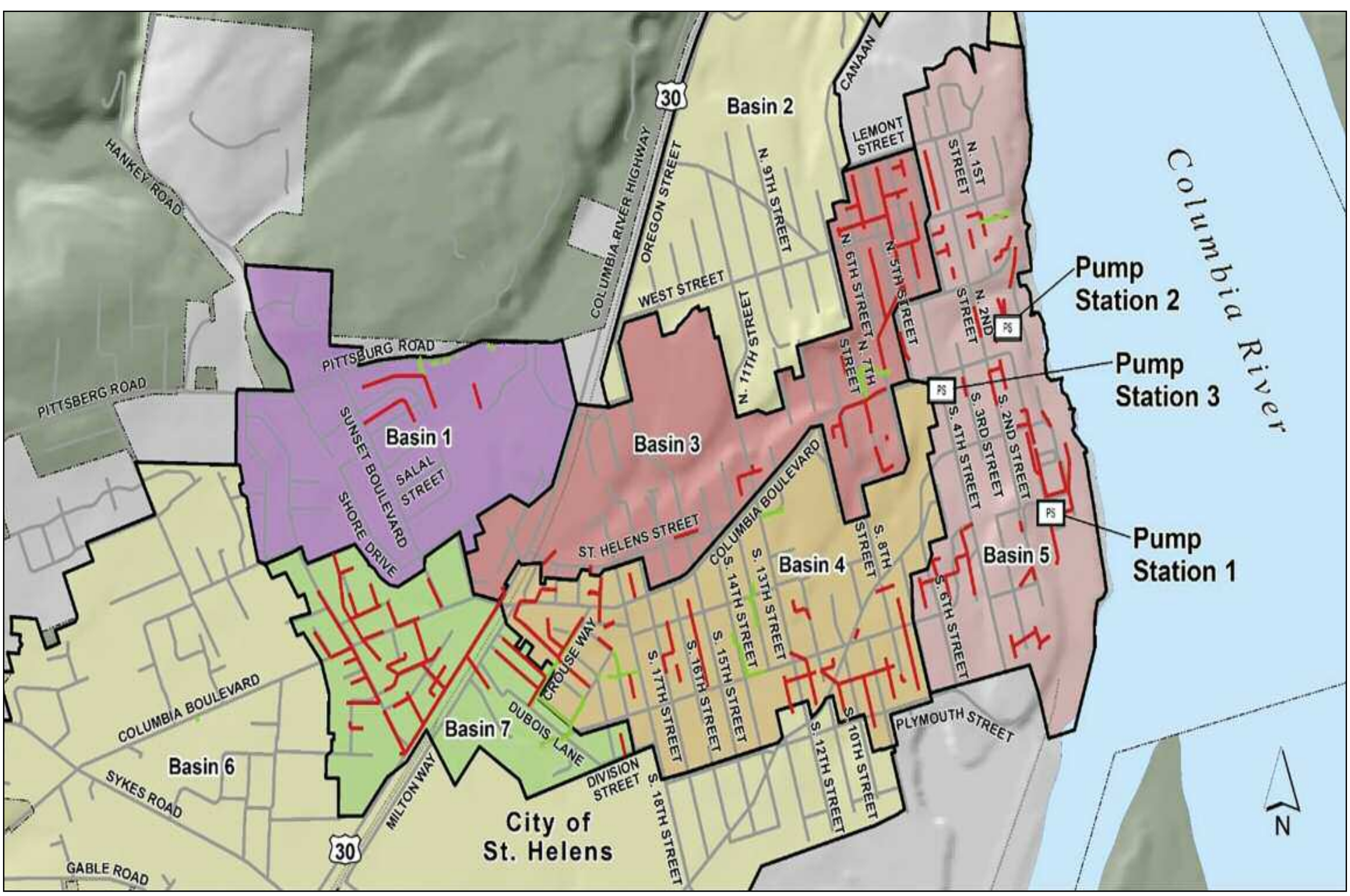
Table 1: Mainline Program – Sanitary Quantities

Open Trench (6" to 36" Dia.)	9,295 LF
Open Trench (66" Dia.) – Phase 3	240 LF
Pipe Ram (66" Dia.) – Phase 3	265 LF
Manholes – New	55
Catch Basins	58
Storm Drainage Structures	7
Total Storm Sewer Main	**9,800 LF**

Table 2: Mainline Program – Storm Quantities

tight through rehabilitation. With areas of the city in relative topographic low points, there was concern that localized flooding could result from the removal of I&I from the sanitary sewers after mainline rehabilitation. To address this concern, extensions of the storm sewer were designed to provide adequate stormwater collection and drainage. The installation of new storm sewer facilities was incorporated into the mainline rehabilitation projects associated with Phases 1 and 2 to minimize duration impacts of construction.

Phase 3 of the Mainline Program involved the replacement of two undersized, deficient culverts that drain the two largest storm sewer basins in the city. The single replacement pipeline was 66 inches in diameter and was installed under a 50-foot roadway, containing multiple utilities and a recreational vehicle park that is occupied year-round. Based on the existing surface and geotechnical conditions, it was determined that the new pipeline would be installed via pipe ramming and open-cut methods. Ultimately successful, Phase 3 ran into a few challenges during construction, including (1) the new pipeline experienced settlement due to soil consolidation during ramming operations through fill material, and (2) the pipe ram was halted when it ran into a buried outcrop of the extremely hard blue basalt rock. The latter required a change in construction method, since the rock outcrop could not



St. Helens I&I Abatement Program Map

be removed from the interior face of the pipe ram, the remaining pipeline installation was successfully mitigated by switching to a mass earthwork operation and rock excavation. Even with these significant challenges, Phase 3 was completed within budget.

The Mainline Program was completed between 2008 and 2017 through six separately bid construction packages of the traditional Design-Bid-Build method for a total of $8.4M. The final construction quantities are shown in Tables 1 and 2.

LATERAL SEWER PROGRAM

Recognizing that a large, potential contributor of I&I to the sanitary sewer system was from private laterals, estimated to be in the range of 40 to 50 percent by empirical studies, the rehabilitation of laterals on private property was a critical element to the I&I Abatement Program. The City tackled the challenge of lateral sewer rehabilitation in a unique and inventive way. In the City, sewer laterals are privately owned from the building to the lateral's connection to the public sewer main. To address lateral repair on private property, the City had to be creative in how they approached the project.

Like the Mainline Program, the City focused on the older basins and performed CCTV inspections of over 2,300 laterals, which accounted for approximately 60 percent of the sewer laterals in the City. The projects were bid out through four separate CCTV inspection contracts. One of the most important aspects of the Sewer Lateral Rehabilitation Program was the City's clear communication with property owners through mailings, face-to-face contact, and public meetings.

To avoid the inevitable "that's not my sewer" comment from property owners, all CCTV inspection videos had to be uninterrupted from start to finish, beginning with a video of the structure frontage. This made it difficult for owners to dispute the results of the CCTV inspection. Access to sewer laterals was typically from a cleanout on the property. If a cleanout could not be found, the lateral would be accessed from the soil stack/roof vent. If this access was not viable, a two-way cleanout would be installed.

The City learned early in the process that they needed to drop the engineering jargon to effectively communicate with property owners about the goals of the Sewer Lateral Rehabilitation Program and the potential impacts. Documenting the condition of laterals was paramount in achieving success. Lateral deficiencies were ranked using a system developed by the City's Engineering department, assigning numerical values to types of deficiencies. By tabulating the scores of individual deficiencies of a lateral, the City would arrive at a recommendation to repair or not. For example, many older properties still utilized Orangeburg pipe, a bituminous fiber pipe, as sewer and drain pipe after World War II due to it being a cheap material that was readily available. The presence of Orangeburg pipe as a sewer lateral triggered an automatic requirement to replace.

But how do you convince someone they need to repair a facility on their property that they can't see? The City's Municipal Code was already structured to require property owners to address known deficiencies, and a timeline of 120 days was established for making the repairs after being notified by the City. The City sent out notices of repair requirements, which also included a map showing the approximate location of the lateral and its deficiencies, a plumbing permit application, a copy of the applicable plumbing code, and a brochure of Frequently Asked Questions. Vigilance was key, and reminders were sent every 30 days. Most repairs were completed around the 60-day mark. The City also encouraged property owners to perform repairs by providing financial assistance to qualified low-income homeowners in the form of zero-interest loans.

The Sewer Lateral Rehabilitation Program found that 24 percent of the 2,300 inspected laterals required repair. Through constant communication and an open-door approach, the City achieved a 94 percent owner repair rate. The entire program was accomplished within a budget of $550,000 and was completed during Phases 1 and 2 of the Mainline Program.

PROGRAM RESULTS

Based on the empirical data available to date, the abatement program has had many successes. Approximately 12 miles (or 21 percent) of the City's 57 miles of sanitary sewer mainlines have been rehabilitated. The rehabilitation of the deficient sanitary sewer mainlines and sewer laterals, and the rehabilitation and new installation of the storm sewers has resulted in an 80 percent reduction in sanitary flows pumped to the treatment plant from the three pump stations within the program area.

The number of sanitary sewer overflows has been drastically reduced. The City experienced an average of 2.5 sanitary sewer overflow events per year between 1995 and 2009. Between 2010 and 2017, the number of overflow events experienced have dropped to less than 1.0 per year. Since the completion of Phase 3 of the Mainline Program, there have been no reported overflows of the storm sewer in the upstream basins.

Utilizing the trenchless toolbox and a focused holistic approach to addressing deficiencies in the sewer systems, the City was able to accomplish the goals set forth at the onset of the I&I Abatement Program and did so within the available budget. Project success!

The Rainier Valley Wet Weather Project

Reducing Risk by Value Engineering with Various Trenchless Methods

Carl Pitzer
Thompson Pipe Group

Similar to many metropolitan areas around the nation, Seattle is under a consent decree to prevent untreated discharges from its combined sewer overflow (CSO) system entering into the many bodies of water and waterways around the city.

A CSO is a single pipe or conveyance structure used to convey both waste water and storm water to a treatment plant. When the Seattle area experiences heavy rainfall these pipes can fill up quickly with the combined sewer and storm water. Instead of backing up and causing flooding in houses and businesses that the sewer line serves, there is a mechanism built into the system to discharge the overflow into local waterways.

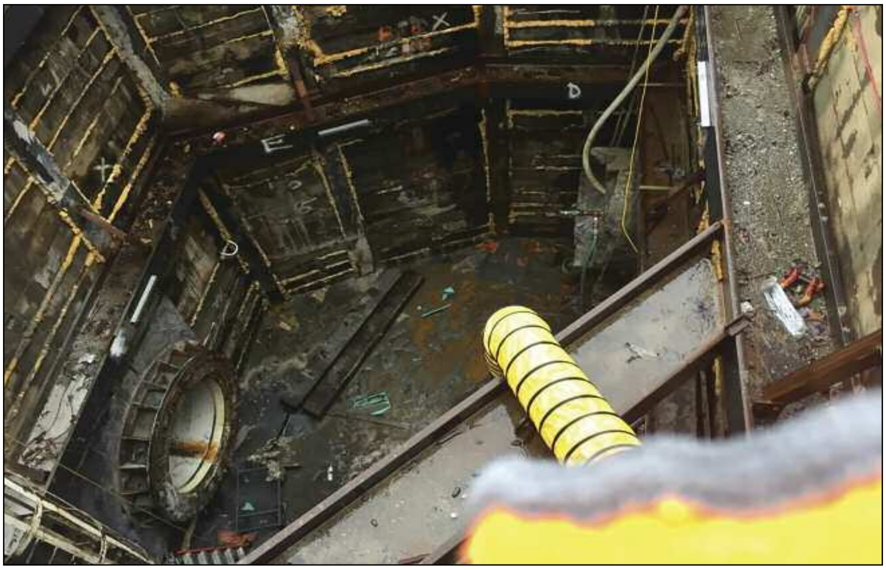
Seattle is under decree to complete its CSO program in 2030. To meet this deadline, many projects have taken shape and many more have been planned since the consent decree for Seattle was approved in 2013.

One such project underway is the Rainier Valley Wet Weather and Storage project. The Rainier Valley collection area serves a section of South Seattle between the Duwamish River and Lake Washington. When heavy rains soak the area the CSO discharges into the nearby Duwamish River. The project will consist of building a 340,000-gallon storage tank to store the overflow and transport it to the Magnolia treatment plant over time for treatment after the rain event has passed.

The approach to use a storage tank was taken for a number of reasons including minimal disruption to the community and that property was available for the structure. Other approaches such as separating the sewer and storm sewer pipes would require extensive open-cut operations and traffic revisions. These methods were found to be too costly and too disruptive to the local community.

JW Fowler was awarded the contract to construct the project. Keeping in the spirit of providing a project to the community with the least amount of disruption, the initial design called for three areas of trenchless work at two different sites, the Bayview and Hanford sites.

The first trenchless method the design called for was to use a CIPP lining to rehabilitate a section of 48-inch brick sewer at the Bayview site. This sewer would carry the overflow from the Bayview siphon discharge to the sewer line conveying the water to the nearby Magnolia plant for treatment. The second method was to use a 48-inch pipe ram with steel casing and CIPP liner to connect the Bayview siphon inlet structure to the Bayview discharge structure. A trenchless method was chosen at this site to eliminate disruption to traffic on Rainier



Avenue South, a main thoroughfare in the area. The final trenchless method the original design called for was a 72-inch pipe ram with a 36-inch carrier pipe to convey water to the Hanford CSO tank. The disparity in pipe ram versus the carrier pipe was to allow for accurate grade of the carrier pipe.

After JW Fowler won the contract they performed a review of the documents and proposed a couple of changes. While the 48-inch CIPP worked well, some changes were proposed to the 48-inch & 72-inch pipe rams. Vibrations from the pipe-ramming operation had the potential to cause damage to nearby foundations. The 48-inch pipe-ramming operation called for ground freezing of the soils near an existing building to provide support for the building's foundation. Though ground freezing is sometimes chosen to provide support to foundations, the close proximity of the pipe ram and ground freezing had some inherent risks. Ground freezing may sometimes choose its own path, and the risk in this scenario was that the ground freezing would intersect the pipe ram. If the pipe ram operation were to strike frozen ground it could cause damage to the structures the frozen ground was intended to support.

In lieu of the 48-inch pipe ram, JW Fowler decided to use a 60-inch MTBM they owned followed by Flowtite FRPM jacking pipe. Using FRPM jacking pipe allowed for a single-pass jacking operation. This eliminated the need for a two-pass operation and associated risks such as grouting the annular space between the originally proposed carrier and casing pipe. By utilizing the MTBM the risk of potential vibrations affecting neighboring structures would also be minimized and ground freezing would no longer be needed.

The second proposed change was eliminating the 72-inch pipe ram due to expected vibrations and the impacts it would have on an existing 102-inch SPU storm drain that the tunnel would pass under. Grouting the annular space between a 72-inch casing and 36-inch carrier was also an operation that could be eliminated.

The Rainier Valley project is still underway and the method to complete this trenchless piece of work has not been chosen at the time of writing this article.

A constant in the trenchless world is the unknown. Utilizing the knowledge of experienced designers and contractors in trenchless work is key to help reduce risks over the course of a project. The value of value engineering in trenchless work is the ability to adapt to ever-changing conditions. An initial design has its merits based on the information presented at the time of design, but this should not bar potential changes down the road after a contractor or design-build team has been selected to carry out a project. Knowledge of the area, tools at hand, additional information becoming available, and many other factors come into play after a project is awarded. The coordination between owner, designer, and contractor are vital in the success of trenchless projects.

Risk Mitigation in Trenchless Design and Manifestation in Construction

(Presented at NASTT's 2017 No-Dig Show - Washington, D.C.)

Kimberlie Staheli, Ph.D., P.E.
Mark Hutchinson, P.E.
Brad Moore, P.E.
Staheli Trenchless Consultants, Inc.

On any pipeline project, trenchless installation typically carries the highest construction risk of any pipeline installation method. As such, many Owners, Engineers, and Construction Managers are focusing effort and substantial investments on managing trenchless construction risks. To effectively implement risk reduction strategies, it is critical that all parties have a clear idea of the risk management approach that has been chosen for a project. Successful implementation of risk management strategies emerges only when Owners, Engineers, and Construction Managers work in concert to employ a project-wide risk management approach.

IDENTIFYING RISKS ON A PROJECT BASIS

The key to managing trenchless risk starts with identification and expectations. There are many stages in a trenchless project where risk is introduced. Identifying where those risks are introduced, the probability those risks will occur, the consequence of the risks should they occur, the mitigation measures necessary to minimize the risk or consequences once it occurs, and the cost of mitigation are the pieces of information needed to evaluate project risk. The project risk approach involves deciding which risks are going to be addressed in design – included within the design and paid by the Owner in the cost of the project during bidding, and the risks that are going to be paid during construction should they come to fruition – risks that the Owner decides to take.

Identification of primary risks (e.g. risks that impact the feasibility of using a trenchless method which are typically governed by geotechnical conditions or existing pipe conditions) is based on project experience and is often specific to a particular region because of the geotechnical conditions or existing pipe materials, dimensions geometry and repairs. Individual risks may have vastly different impacts on different trenchless techniques; therefore, it is important that the impacts of risks are well understood.

Every trenchless method has a different risk profile and depending on application will present a different risk to a project. Therefore, risk may drive the selection of one trenchless method over another depending on how risk-averse an Owner is and how willing they are to negotiate change orders as compared to paying higher up-front costs for a construction project. Using the technical risks associated with a project are often used to choose the most appropriate trenchless technique on a project. Managing project risk is largely dependent on investigation of existing conditions, then adequately preparing the stakeholders for the types of risks that could occur on a project, and what changes and impacts might be should the risk occur, and receiving buy-in from the project team of the risk allocation moving forward.

Probability of Occurrence			Impact Cost	
1	< 20%		1	< $100,000
2	20% < X< 40%		2	$100,000 < X < $250,000
3	40% < X < 60%		3	$250,000 < X < $500,000
4	60% < X < 80%		4	$500,000 < X < $1,000,000
5	80% < X < 100%		5	$1,000,000 < X < $5,000,000

Definitions of Probability and Impact for Evaluation of Relative Risk Assessment

MANAGEMENT OF RISK PRIOR TO BIDDING (DURING DESIGN)

Risk management on a trenchless project often begins during the design phase, with first the geotechnical investigation, and surveys of the existing pipe system, considering the range of trenchless and non-trenchless construction methods. During this time, it is critical that the project team has a high level of knowledge and understanding of risk management. The key decision makers must also be knowledgeable in trenchless methods and the impacts of the critical risks on a project. However, since trenchless technology is still evolving at a rapid pace, this often takes a tremendous amount of education for stakeholders to increase their base of risk knowledge.

In the first stages of design, risk analyses are often implemented when evaluating the trenchless technique that presents the lowest risk to the crossing under consideration. For the analysis, a key step is defining the definitions of probability and impact cost. These definitions are not critical to the outcome of the analysis. Their importance is that they are applied without bias across each risk factor and technology throughout the evaluation. Table 1 is one example of common definitions for risk probability and impact cost that have been used in trenchless method risk analysis.

Variations in Table 1 typically occur in the impact cost, depending on the size of the project and trenchless crossing under consideration. Clearly, as the size of the trenchless crossing increases, the magni-

TRENCHLESS CROSSING RISK ASSESSMENT - Installation Method Comparison

30-inch Carrier Pipe within a casing - 150LF

FEATURES/RISKS	MICROTUNNELING - 42"		PIPE RAMMING - 48"		Open Shield Pipe Jacking - 48" +	
	PROBABILITY	IMPACT	PROBABILITY	IMPACT	PROBABILITY	IMPACT
Encountering Soft Soils	4	5	4	2	4	5
	Very loose sands along alignment may not have sufficient bearing capacity and cause MTBM to sink.		Potential to impact line/grade. Use oversized casing. Possibly shallow/deepen alignment to avoid density differentials between contacts.		Very loose sands along alignment may not have sufficient bearing capacity and cause shield to sink.	
Loss of Face Stability	4	3	2	1	4	5
	Very loose sand may not provide adequate resistance to slurry pressures. Use additives in slurry, ground improve, deepen alignment.		Not a concern with method unless face access is required.		Limit face openings or use closeable doors/sand shelves to control. Must fully dewater entire alignment.	
Groundwater Causes Loss of Face	2	1	2	1	2	2
	Shallow groundwater head at crown. Not a concern with method.		Use soil plug to counterbalance water pressures.		Must fully dewater alignment.	
Encountering Gravel and Cobbles	2	1	2	1	2	3
	Very loose gravel possible. OK if MTBM head opening limit volume/size of material entering crushing chamber.		Not a concern with method.		Loose soils with gravels may run into face if cobbles must be removed by hand and difficulty increases with groundwater.	
Risk of Surface Settlement	4	3	1	3	4	3
	Shallow cover increases chance of settlement coupled with loose sands and gravels.		Unlikely with adequate soil plug and little groundwater pressure head.		Shallow depth with loose soils. Must dewater alignment.	
Risk of Pipe Becoming Stuck	1	2	1	1	1	2
	Jacking forces not a concern at this length. Mitigation - Pipe ram back to rescue machine.		Telescope ram smaller casing or pipe ram back from other direction.		Jacking forces not a concern at this length. Mitigation - Pipe ram back to rescue machine.	
Weighted Risk Score	**50**	**$ 2,130,000**	**18**	**$ 440,000**	**64**	**$ 3,150,000**

Figure 1. Weighted Relative Risk Table for Selection of Trenchless Method

Risk Identification	Risk Response	Final Design Mitigation
Materials and Equipment cause delays	**Transfer**	• Ensure long lead time in specifications for construction schedule • Provide adequate contract duration.
Settlement and Vibration from drilling rigs cause damage to homes	**Mitigate**	• Require pre- and post- construction surveys • Monitor during construction by Contractor and Owner • Set trigger levels in specification at which the Contractor must change methods
Deviations in Specified Alignment of HDD pipeline cause: *Need for Additional Easement* *Need for Additional Capacity* *Need for New Pipeline*	**Mitigate**	• Verify specified bend radii are achievable • Carefully crafted contract provisions for alignment tolerances that are achievable and understandable • Provisions in contract for notifying when reaching threshold values • Provisions in contract for re-drilling if outside specified tolerances • Careful monitoring during construction. • Requires full-time monitoring during construction of pilot bore by experienced staff that understand implications of out-of-tolerance pipe.
Encountering differing site conditions during drilling	**Accept**	• Clearly define DSC in contract • Rapid negotiation to allow continued construction and minimize delay time.

Table 2 Final Risk Mitigation Strategies – Gravity HDD

tude of the impact costs likely increase. Although the early risk analysis is a relative measure of risk, the designer should understand that estimating realistic impact costs is important to the future of the project.

Figure 1 presents a risk analysis that was used to select a technology that would be specified to cross a fish bearing stream. For this crossing, features/risks for the crossing were identified, the probability of a feature/risk occurring was assigned a value, and the impact of a risk determined for a particular technology based on the experience of the design team and their knowledge of the local conditions and contractor's practices.

A weighted risk score was then determined by multiplying the probability factor by the impact factor and a risk cost was developed by multiplying the percent probability of risk occurrence by the estimated impact cost. From this table, it is clear that for this particular example, pipe ramming presented the lowest weighted risk profile for installing a casing beneath the fish bearing waterway.

Documentation of the construction options considered, reasons for acceptance or rejection is critical. This document can then be used later when the construction contractor proposes alternate methods. The document can be used as a starting point for those discussions and risk allocation. Hopefully moving the project forward rather than rehashing old decisions.

Table 2 is a truncated final trenchless risk strategy matrix that documents the actions that are intended to be executed to address identified risks. The final risk implementation strategies reflect decisions made by the Owner on how they choose to address the risk during the construction of the project. It contains examples of prescriptive elements that will be included in the specification while allowing the Contractor to control the vast majority of the means and methods on the project. This partial table is an example for a large diameter HDD pipeline to be installed as a gravity sewer with an intersect and two HDD rigs.

TRANSFER OF PROJECT FROM DESIGN TO CONSTRUCTION

There are ever-increasing challenges with transferring the projects that are designed around project risk strategies from the designer to the construction manager. Historically, it is atypical to have a contract that contains specified items that are part of the contract strictly to avoid a problem from occurring. Contractors and Construction Managers customarily only mitigate a risk when it is no longer a risk—it is a real problem that has occurred during construction that must be solved. There are few organizations that have systems in place that allow transfer of information from the designer to the construction management (CM) team that allow explanation of project risks for particular technologies, the risk sharing philosophies that were developed during the design, and the risk mitigation strategies that were incorporated into the contract documents to address the risks.

Structured communication to convey risk allocation and corresponding specifications can help at all phases of the project: design, bidding, and construction. During design this can take the form of meetings between the designer and construction manager where topics include risk issues and mitigation. The Construction Manager can lead project review of the design elements at 60% or 90% design and provide comments to the designer regarding schedule, means and methods, contract language, identified risks, key submittals and quality control elements, A main element of these discussions can focus on risk mitigation measures, and appropriate documentation that should be collected if the risks result in problems during construction.

During bidding structured communication should take the form of Bid Walks, Pre-bid meetings highlighting contract terms and conditions, and risk allocation. The response to any bid questions or clarification of the submittal should be agreed upon by the Design Engineer of Record, Construction Manager and Owner, then distributed to all bidders. During the construction phase the communication starts with the preconstruction meeting, pre-sub-

mittal meetings, pre-activity meetings, and regular site visits by the design team during critical pre-identified points in the project.

CONCLUSIONS

One way to improve the transfer of knowledge and the implementation of the risk management strategy on a project is to include construction management staff in the design process and to include design engineers in the construction management process. Construction management staff would provide a tremendous value to a design at a 30 to 60 percent design stage where they could provide input on constructability, contractor means and methods, identification of project risks, and risk mitigation strategies that they have seen employed. The Construction Management staff would also have access to Contractors to gather information that might be needed by the design team to accurately reflect risk cost in the construction cost estimate and contingency budget. An additional benefit would be the Construction Management staff learning the critical elements of the project (not solely risk elements) to provide a better understanding of the critical elements of construction and an understanding of the engineering design process.

Likewise, having the Design Engineer of Record available during construction could assist in the interpretation of the specification, explaining the intent of risk mitigation measures, perform expedited submittal reviews, or quicker resolution of changed conditions. The Engineer could also provide background information on the risk management strategy that was adopted by the Owner and how the risk was intended to be mitigated at the time the project was designed. It is important that an Engineer in this role understands that they are implementing a design and not changing the design as issues arise or risks come to fruition.

There is a need for overall project risk management that extends from initial design of a trenchless project throughout construction. It is also critical that both the design and construction management teams share a risk management philosophy to successfully implement the risk mitigation strategies that were developed during the design and chosen by the Owner for implementation through the Contract documents.

An Industry Survey and Analysis of the Effectiveness of Differing Prequalification and Qualification Packages

Matthew P. Olson, E.I.T.
Kimberlie Staheli, P.E., Ph.D.
Brad Moore, P.E.
Staheli Trenchless Consultants, Inc.

(Presented at NASTT's 2017 No-Dig Show - Washington, D.C.)

Trenchless technology is a family of construction techniques for installing or rehabilitating underground infrastructure with minimal disruption to surface traffic, businesses, and residents. Trenchless construction methods can vary from traditional cut-and-cover techniques in numerous ways, whether it be the necessity of highly specialized equipment, heightened importance of efficiently orchestrating sequence of work and staging, or by the complexity of construction risks present in the project. One must have skilled personnel to be successful as a trenchless contractor. Skilled estimators, superintendents, foreman, operators, and support crew must all know their functions well and work collaboratively to complete a project successfully. Due to the inherent risks involved in trenchless technology, project owners seek to engage with qualified contractors who can identify potential risks prior to construction, determine ways to mitigate those risks, and successfully execute the work.

This article discusses a range of prequalification and qualification packages, goals and effectiveness of various types, and differences in viewpoints from a diverse set of industry professionals. This articles is intended to lead to greater communication between industry professionals of differing arenas, leading toward streamlined contract acquisition and trenchless industry growth.

TYPES OF PREQUALIFICATION OR QUALIFICATION PACKAGES

There are many ways owners and engineers can attempt to eliminate unqualified contractors from working on their project. Most often these strategies take the form of either prequalifying the contractor prior to bidding or award of the contract, or requiring minimum qualifications of the contractor within the contract itself. From here, numerous variations to standard prequalification or qualification packages can be made that differentiate one package from the next. For the purposes of this study, the prequalification and qualification packages are broken down into four root categories, each category containing sufficient flexibility for the owner and design team to influence where the "line of acceptable quality" is drawn in the sand. These four categories are as follows:

- Category 1: Prequalification and selection of short list prior to bidding.
- Category 2: Prequalification as part of the bid package, for review prior to award
- Category 3: Qualification requirements within the submittal section of the trenchless specification
- Category 4: Qualification requirements within the quality assurance section of the trenchless specification

SURVEY

The survey was sent to three contractors, six engineers, and six owners to attempt to gain a diversified response. Respondents included three contractors, two engineers, and three owners. The first section of the survey contained definitions of the four categories of prequalification or qualification packages to minimize variation in understanding from person to person. Next, general questions were asked to capture a brief understanding of each respondent's background and preference for prequalification or qualification packages. Following, categorical questions directed at each of the four categories were provided to allow each respondent to describe their own personnel experience with different types of packages. The questions were as follows:

General Questions:

1. What trenchless technologies are you or your firm, company, or municipality most experienced with?
2. Approximately how many years have you or your firm, company, or municipality worked in the trenchless industry?
3. On a percentage basis, how frequently do you encounter a trenchless project with prequalifications or qualifications?
4. Are there any other categories of prequalifications or qualifications that I have neglected to mention that you would like to share?
5. Rank the category of prequalifications/qualifications you

encounter most frequently (start with most frequent, end with least frequent).

6. Rank the four categories of prequalifications/qualifications by favorability based on your personal experiences (start with most favorable, end with least favorable).

Categorical Questions:

Category 1 – Prequalification and selection of short list prior to bidding

Category 2 – Prequalification as part of the bid package, for review prior to award

Category 3 – Submittal of qualifications required by specification

Category 4 – Qualifications requirement in Quality Assurance section of specification

The following questions were posed for each category:

a) What do you feel is the goal of each category of prequalifications?

b) Is that goal commonly achieved?

c) What are some advantages of each category of prequalifications?

d) What are some disadvantages of each category of prequalifications?

SURVEY RESULTS AND ANALYSIS

General Questions

The survey respondents have experience with trenchless technologies as described in Table 1. All respondents stated their experience with trenchless technologies is greater than 10 years, with the majority being greater than 20 years.

Technology	Number of Respondents		
	Contractors	Engineers	Owners
HDD	3	2	3
Auger boring	2	1	1
Slick Boring	1		
Pipe Ramming	2	1	1
Open Shield Pipe Jacking	1	1	2
Pipe Bursting	1	1	1
Slip Lining	2	1	2
Pilot Tube	2	1	1
CIPP		1	2
Pipe Reaming	1		
CCTV		1	
Microtunnel		1	3
Large Diameter Tunneling			1

Table 1. Trenchless Technologies Practiced by Survey Respondents

% Occurrence	Number of Respondents		
	Contractors	Engineers	Owners
0 to 25	2		
26 to 50			
51 to 75	1		1
> 75		2	2

Table 2. Percent Occurrence of Trenchless Projects with a Prequalification or Qualification Requirement

Frequency	Contractors	Engineers	Owners
Most	3	3	2 & 3
↓	1	1	2 & 3
	2 & 4	4	4
Least	2 & 4	2	1

Table 3. Frequency of Occurrence Ranking for Categories of Prequal/Qual Packages for Trenchless Projects

Table 2 identifies the number of respondents that encounter some sort of prequalification or qualification package with their trenchless projects. Owners and engineers stated they frequently use some sort of prequalification or qualification package, yet the contractors are obtaining a significant portion of their work without having to prove qualifications.

Table 3 displays the results of General Question 5, an average ranking of the frequency of occurrence of the four categories of prequalification or qualification packages. Contractors, engineers, and owners experienced Category 3 qualifications most frequently. It was found that in certain states it is not legal to use Category 1 prequalification packages for publicly funded projects.

Table 4 displays the results of General Question 6, an average ranking of the favorability of the four categories of prequalification or qualification packages. It makes logical sense that the owners preferable method qualifying contractors is also the most frequent form of qualifications package experienced. After all, owners are the group responsible for approval of the contract and its components.

Favorability	Contractors	Engineers	Owners
Most	2	1	2 & 3
↓	1	4	2 & 3
	3	3	1 & 4
Least	4	2	1 & 4

Table 4. Favorability Ranking for Categories of Prequal/Qual Packages for Trenchless Projects

#	Advantages	Disadvantages
1	Eliminates "cowboys" or unqualified contractors	May not include contractors with unique means and methods
2	Does not increase risk of bid protest	May diminish competition too quickly
3	Greater owner confidence in contractor	The "extra work" required to prequalify may discourage some otherwise qualified contractors
4	Provides owner with detailed info on niche markets	An otherwise qualified bidder may be left out or miss the prequalification process due to timing or any other number of reasons
5	Allows bidders to gauge their bidding competition more precisely	The process typically takes longer than other categories
6	Provides longer review period	
7	Promotes greater investment from the prequalified contractors during bidding phase (levels the playing field)	

Table 5. Category 1 Pros and Cons

Categorical Questions

The following sections discuss the survey results and provide observations for each category of prequalification or qualification package.

Category 1 - Prequalification and selection of short list prior to bidding

There were two goals for Category 1 packages that were repeatedly identified by the survey respondents: separating the prequalification process from bidding, and obtaining a known bidding pool prior to bidding. For the owner and engineer, knowing the bidding pool prior to the bidding phase allows for adjustments should the results of the prequalification process be unfavorable. For the contractor, knowing the list of approved contractors for upcoming work contracts allows them to better allocate bidding effort as required to better suit their bidding competition. There were numerous advantages and disadvantages listed in the survey results, as listed in Table 5.

Category 2 - Prequalification as part of the bid package, for review prior to award

The most frequently listed goal of Category 2 is the ability to streamline the prequalification and bidding processes into one phase, saving time in the long run. Other goals that were identified and worth noting include: allowing anyone to bid, but clearly identifying prequalifications required for approval; lessening the potential for manipulation of qualification parameters post-award; providing an avenue to refrain from award to an unqualified lowest bidder. Pros and cons of Category 2 are listed in Table 6.

Category 3 - Qualification requirements within the submittal section of the trenchless specification

The most frequently identified goal for Category 3 was to inform the contractor during bidding of the qualification requirements. It is important the contractor bases their bid using quotes from qualified subcontractors. A second repeat goal was to ensure a qualified contractor performs the contract work. Table 7 lists advantages and disadvantages for Category 3.

Category 4 - Qualification requirements within the quality assurance section of the trenchless specification

Three goals for Category 4 were listed in the survey results: ensuring the installed product meets owner's requirements, keep-

#	Advantages	Disadvantages
1	Streamlines prequalification and bidding periods	Increased possibility of bid protest
2	Easier to reject an unqualified firm prior to award than after	Difficulty in pinpointing appropriate level of prequalifications during their draft
3	Little effort required of owner/engineer/contractor during bidding process	Contractors not meeting prequalifications exactly, say 99%, may be discouraged from bidding
4	Owner ensured of qualified contractor prior to award	How strict should the reviewer be if lowest bidder is unqualified?
5	Owner has greater confidence work will be constructed as designed	Not being able to accept the low bidder if low bidder is unqualified (higher contract price results)
6	Generates conversation between contractor/owner regarding contract concerns	Little time available for review of prequalifications

Table 6. Category 2 Pros and Cons

#	Advantages	Disadvantages
1	Does not slow down bidding process, yet informs bidders of qualifications requirements during bidding	How do you handle a qualifications submittal that does not meet the requirements?
2	General contractor has greater flexibility when selecting their subcontractors	Enforcement of the qualifications requirements and daily monitoring during construction by the construction management (CM) team is required.
3	Reviewer can review qualifications along with the contractors work plan submittal	There is no guarantee that the submittal package is entirely accurate.
4	Less upfront paperwork may encourage more bidders	
5	Provides the owner some assurance that a competent entity will do the work	

Table 7. Category 3 Pros and Cons

#	Advantages	Disadvantages
1	Contractor is in control of quality and can be consistent with their means and methods	The owner/engineer and CM team have the least control over qualifications of the entity performing the work.
2	Not having to produce qualifications may promote a greater quantity of bidders	The importance of minimum qualifications is significantly reduced
3	A contractual obligation to fulfill the minimum qualifications requirements remains	Difficult to prove a contractor unqualified when submittal of qualifications is not required
4		Relies on the honor system

Table 8. Category 4 Pros and Cons

ing quality in the realm of the contractor's responsibility, and limiting time and level of effort required during the bidding and submittal phases. If the requirements are in the contract, they are in the contract and enforceable by law. The only difference between categories 3 and 4 would be the actual submittal and review of the contractor's qualifications, but enforcement of inadequate qualifications is difficult either way. Table 8 lists advantages and disadvantages for Category 4.

CONCLUSION

A summary of key advantages and disadvantages of each category of prequalification/qualification package are provided in Table 9.

Characteristic	Category 1	Category 2	Category 3	Category 4
Advantages	Generates a known list of acceptable bidders prior to bidding phase.	Effective at limiting acceptable bidders to those above minimum qualifications. Streamlined effort for all parties when implementing a prequalification strategy.	Quickest process allowing for evaluation of qualifications.	May promote greater competition during bidding. Contractual requirement to meet minimum qualifications exists.
Disadvantages	Possibility to unnecessarily reduce bidding competition. High consequence for inappropriate minimum qualifications. Lengthens duration prior to award of contract. Certain states may not allow Category 1 for publicly funded projects.	Possibility for bid protests is increased.	Difficult to enforce. Requires diligent effort by CM.	CM/owner have least control enforcing minimum qualifications.

Table 9. Key Advantages and Disadvantages of Each Category

By Category

Asset Management
Pipeline Inspection & Condition Analysis Corporation (PICA)

Auger Boring
Michels Corporation

Condition Assessment of Pipelines
Pipeline Inspection & Condition Analysis Corporation (PICA)

Engineering Design
Murraysmith, Inc.
Stephl Engineering LLC

General Consulting
Staheli Trenchless Consultants

Grouting
Michels Corporation

Horizontal Directional Drilling
Michels Corporation

Inspection and Evaluation
Pipeline Inspection & Condition Analysis Corporation (PICA)
Stephl Engineering LLC

Joint Repair
Michels Corporation

Manhole Rehabilitation
Michels Corporation

Microtunneling Service
Michels Corporation

Microtunneling Systems & Equipment
Akkerman
Thompson Pipe Group

Pilot Tube/Guided Boring
Akkerman

Pipe
Thompson Pipe Group

Pipe Jacking
Akkerman
Michels Corporation
Thompson Pipe Group

Pipe Relining
Michels Corporation

Sewer Rehabilitation
Michels Corporation
Stephl Engineering LLC
Thompson Pipe Group

Sliplining
Michels Corporation
Thompson Pipe Group

Trenching
Michels Corporation

Tunnel – Large Diameter
Michels Corporation

Video Inspection
Pipeline Inspection & Condition Analysis Corporation (PICA)

By Company Name

Akkerman
58256 266th St., Brownsdale, MN 55918
akkerman.com
Contact: Chris Sivesind
csivesind@akkerman.com
1-800-533-0386
Akkerman develops, manufactures and supports pipe jacking and tunneling equipment and accurately installs a variety of underground infrastructure.

Michels Corporation
P.O. Box 128, 817 W Main Street, Brownsville, WI 53006
www.michels.us
Contact: Ben Nelson
bnelson@michels.us
425-250-1527
A diversified infrastructure and utility contractor self-performing construction throughout North America and abroad with licenses in all 50 states.

Murraysmith, Inc.
888 SW 5th Avenue, Suite 1170, Portland, OR 97204
www.murraysmith.us
Contact: Brendan V. O'Sullivan
503-225-9010
Murraysmith is a civil engineering firm serving public agencies throughout the Pacific Northwest with planning, design, and construction management services for water, wastewater, stormwater, and transportation infrastructure projects.

Pipeline Inspection & Condition Analysis Corporation (PICA)
4909 75 Avenue NW, Edmonton, AB, T6B 2S3, Canada
www.picacorp.com
info@picacorp.com
1-800-661-0127
"Good Decisions Start with Good Information." Our technology can "see" through liners, scales and tubercles to detect areas of concern.

2018 BUYER'S GUIDE

Staheli Trenchless Consultants
5405 196th St. SW, Lynnwood, WA 98036
www.stahelitrenchless.com
Contact: Heidi Howard
heidi@stahelitrenchless.com
425-205-4930
Offering innovation solution to trenchless challenges through risk mediation, trenchless design, forensic analysis and construction inspection.

Stephl Engineering LLC
3900 Artic Blvd. Ste.#204, Anchorage, AK 99503
www.stephlengineering.com
Contact: Matt Stephl
mstephl@stephleng.com
907-562-1468
Alaska's trenchless technology-engineering specialists since 1996 with services including engineering of Cured in Place Pipe Lining, Horizontal Drilling, Pipe Inspection and Sliplining.

Thompson Pipe Group
3011 N Laurel Ave., Rialto, CA 92377
www.thompsonpipegroup.com
Contact: Carl Pitzer
cpitzer@thompsonpipegroup.com
971-227-3920
Thompson Pipe Group is one of the largest providers of pressure and gravity pipe solutions in North America.

PLAN
YOUR EXPERIENCE.

"Attending the No-Dig Show provides me with unparalleled networking and professional development opportunities. As an engineer, learning about the latest advancements in the rapidly growing trenchless industry is critical to providing our clients with the best possible solutions to their underground infrastructure needs."

JEFF MAIER, P.E.
Director of Engineering
C&L Water Solutions, Inc.

NASTT'S 2018
No-Dig Show
MARCH 25-29
PALM SPRINGS, CALIFORNIA

INNOVATIONS

FOR MORE INFORMATION VISIT NODIGSHOW.COM

Index to Advertisers

PLEASE SUPPORT THE ADVERTISERS WHO HAVE MADE THIS PUBLICATION POSSIBLE

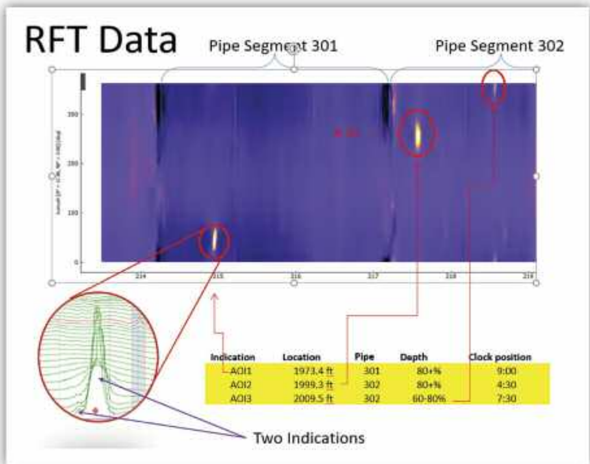
AT LAST!

HIGH-RESOLUTION CONDITION ASSESSMENT OF CONCRETE PRESSURE PIPE

Gone are the days where you had to accept "average wall thickness" or "Low-Medium resolution" condition assessments of your concrete pressure pipelines!

PICA's multi-channel Hi-Rez R.A.F.T. Tools can enter your pipeline through manholes or chambers and provide the most detailed data available today.

PICA has always set the bar high, and our new collapsible Tools are no exception. Designed specifically to inspect the steel can in most types of concrete pressure pipe, there is almost no defect that you cannot detect.



Delighting customers is one of PICA's strengths: "We were ecstatic with the resolution of the results," said the Operations and Maintenance Manager for a Southern California County, who ran our large diameter R.A.F.T. Tool in January in 5 miles of raw water transmission pipeline. "We believe that if we did not identify the three areas of corrosion with the R.A.F.T. tool, we would have experienced a serious pipeline failure within a year or two."

If you have concrete pressure pipe, even if it has been inspected by others, PICA wants to show you the PICA Hi-Rez advantage. Call us to reserve a date in our inspection calendar:

1-800-661-0127 or write to info@picacorp.com.

PICA
Pipeline Inspection and Condition Analysis Corporation