Western Regional Trenchless Review 2019

HDD Installation of Water Pipelines

Pilot Tube Guided Auger Boring Project

CALTRANS Culvert Rehabilitation

T&D Services, Inc.
dba T&D Trenchless

Services Provided:

HDD
Guided Boring (remote hydraulic steering and pilot tube)
Pipe Ramming
Auger Boring
Pilot Tube Microtunneling
Pipe Jacking
Pipe Bursting

Since 2001 T&D has provided trenchless construction solutions for Electric, Gas, Oil, Telecom Water, Storm Sewer, Sanitary Sewer and Geothermal projects for many general contractors and owners. We have highly experienced staff and a great safety history.

Please contact us with any questions:

Tom Van Dyke, President
Office: 951-304-1190 • Fax: 877-812-7927 • Email: info@trenchless.biz • www.trenchless.biz

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MESSAGE FROM THE WESTT CHAIRMAN

Brian Avon, P.E., Chairman, WESTT

This past year has been another fantastic one for WESTT, and it's not over yet. Our upcoming 2019 Mini No-Dig conference will be held this November 20 at the Ko'olau Ballrooms and Conference Center in Kaneohe, HI. We will also be offering NASTT's Good Practices Short Courses on New Installations and Rehabilitation on November 21 at the Hyatt Place Waikiki Beach in Honolulu, HI. The entire Board of Directors is very excited about this year's event as we are teaming with the Hawaii Water Environment Association (HWEA) to produce what is sure to be the largest event that we have had to date. Details about the event can be found on our webpage at **www.westt.org**.

In March, we held our annual board meeting at NASTT's 2019 No-Dig Show in Chicago. The meeting was well attended and many of our members volunteered to help our continued efforts. WESTT is holding elections for new board members. If you wish to get more involved in the organization I encourage you to run. The current board is filled with passionate individuals who work to advance the practice of Trenchless Technology through education, training, and research. I am truly honored to get to work with this very talented group of individuals. Interested parties should contact our Election Chair, Kate Wallin, at **kate.wallin@bennetttrenchless.com**. The nominating period will be closing at the end of November.

We continue to have success with our committees. If you wish to get more involved but are not interested in a board position please reach out to our committee chairs directly. The committees and newly elected Chairs include:

- Mini No-Dig Conference Planning Committee – Lisa Arroyo, Chair
- Magazine Committee – Michelle Beason, Chair
- Nominations and Elections Committee – Kate Wallin, Chair
- Student Chapter Involvement Committee – Jacquie Jaques, Chair

> *"Thank you for your continued support of WESTT."*

In past years, as part of our ongoing efforts to provide value to our membership, we have sent NASTT Good Practices publications to all WESTT members. To continue those efforts in September of this year, the WESTT Board of Directors sent all members a copy of the new 3rd edition of NASTT's Pipe Bursting Good Practices book. Special thanks to Cindy Preuss for making this happen.

As I finish up my final year as Chair I would like to thank the WESTT Board of Directors, committee chairs, and other member volunteers for their continued involvement. It has been an honor to work with so many passionate individuals who share the goal of advancing the practice of Trenchless Technology through education, training, and research for public benefit.

A special thank you to Lisa Arroyo as my Vice Chair. I know that as Chair she will continue to push the boundaries of what our organization can do.

To stay connected and hear about upcoming events, visit our website (**www.westt.org**) or LinkedIn account (WESTT NASTT). If you want to get involved in WESTT activities, please reach out to me or any of our Board members.

Thank you for your continued support of WESTT.

Brian Avon

Brian Avon, P.E.,
Chairman, WESTT

APRIL 5-9 | DENVER, COLORADO

NASTT NO-DIG SHOW 2020

Got Aging INFRASTRUCTURE?

Attend the NASTT 2020 No-Dig Show for trenchless solutions to YOUR aging infrastructure.

Technical Papers | Networking Events | Innovations | Industry Exhibits

"In the work I do for the City of Seattle we are faced with many system challenges. These challenges can be difficult to navigate and figure out how best to manage them trenchlessly. The No-Dig Show gave me the opportunity to talk with multiple contractors and businesses to pick their brains on how their product or process can help Seattle manage some of the toughest sites."

Maria Stevens | Senior Civil Engineering Specialist, City of Seattle, Seattle Public Utilities

NODIGSHOW.COM

MESSAGE FROM NASTT CHAIR

Craig Vandaelle, NASTT Chair

Hello WESTT Members! As the year marches along we're looking forward to the continued growth of the trenchless industry and our Society. We've been busy since the No-Dig Show was held in Chicago back in March. The summer and fall months have been full of planning and events all over North America.

We are looking forward to your upcoming 15th Annual Western Regional No-Dig Conference. The conference returns to Hawaii where the local trenchless market is busy with many interesting trenchless projects in motion and a number in the planning and design phase. I'm sure the excitement from the local, national and international innovation will infuse this year's conference with energy and new ideas. Partnering with the Hawai'i Water Environment Association's (HWEA) 10th Biennial Collection Systems Conference also adds a new and exciting element to the event and new networking opportunities. You are sure to come away from the experience with practical solutions you can put into place on your next project.

> *"Thank you again for your support and dedication to NASTT and the trenchless technology industry."*

NASTT exists because of the dedication and support of our volunteers and our 11 regional chapters. Plans are now underway for the 2020 conference being held in Denver, Colorado, April 5-9. Our No-Dig Show Program Committee members volunteered their time and industry knowledge to peer-review the 2020 abstracts. These committee members ensure that the technical presentations are up to the standards we are known for. A personal "Thank You!" to the Western Chapter Members who have volunteered for this important task this year: Samuel Ariaratnam, Lisa Arroyo, Brian Avon, Glenn Boyce, Craig Camp, Anil Dean, Jennifer Glynn, Dave Haug, Tiffanie Mendez, Mary Neher, Collins Orton, Cindy Preuss, Kate Wallin and Matt Wallin.

The last time we held the annual conference in Denver was in 2015 and that remains our highest attended conference on record. We expect to beat the record in 2020 and we hope you will join us at this ground-breaking conference. 2020 also brings us to NASTT's 30th anniversary! We are excited to celebrate this milestone as we continue with our mission to be the premier resource for trenchless education and training.

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.

Craig Vandaelle

NASTT Chair

MEMBERSHIP IN NASTT

Carolyn Hook, NASTT Membership Outreach & Database Manager

MEMBERS TALK NASTT MEMBERSHIP

As the Membership Outreach and Database Manager at the North American Society for Trenchless Technology (NASTT), it's my job to be able to speak about the value of NASTT membership and all it offers beyond professional credibility and information. NASTT is a community of peers where members are connected to go-to people in the trenchless industry – innovators, experts and a network of students and future trenchless professionals.

At every stage of their career, NASTT members have access to a comprehensive set of tools ensuring success.

- **Engage in learning**. NASTT member-only pricing for top-notch training courses, conferences and webinars.
- **Expand your knowledge set**. Largest online trenchless library of technical papers.
- **Increase your visibility**. Opportunities to speak at conferences, write for publications, volunteer to serve and give back.
- **Propel your career**. Career resources, including NASTT's Job Board.
- **Empower your position**. *NASTT's No-Dig Show* - North America's premier Trenchless Technology Conference and Trade Show.
- **Connect locally**. Regional educational and networking events.
- **Find answers at your fingertips**. Subscriptions to *NASTT's Trenchless Today*, *NASTT's Regional Chapter magazines*, *ISTT's Trenchless International* and *Trenchless Technology*.

NASTT is the largest community of trenchless professionals in USA and Canada committed to promoting better and more responsible ways to manage underground infrastructure and advance trenchless technology for the benefit of the public and the natural environment.

That's what I would say. But what about NASTT members, do they agree? It's also my job to know what NASTT members think about membership. So, I asked a few to share their insights. Here's what I found out.

NASTT Transforms Careers

"Having come from an entirely different industry focusing on natural gas, the common link of construction bonds the two industries closely together. Membership has made me a well-known nationally recognized expert in the use of trenchless and its applications in two industries. When I do not know the answer, I can call on an established network of key contacts and access a library of technical papers. Membership allows me to maintain a current and state-of-the-art awareness of trenchless methods and potential improvement areas that I address through my R&D activities." – *George Ragula, Distribution Technology Manager, PSE&G*

NASTT Provides Leverage for Corporations, Municipalities, Educational Institutions and More

"NASTT is far and away the leading educator and networking pool in the trenchless industry. If your company plays a part in the trenchless industry, you will benefit from NASTT membership much more than you realize." – *Joe Lane, Vice President, International Operations, Infrastructure, Aegion Corporation*

"We advertise that our staff are members of NASTT for RFPs and on Trenchless resumes." – *David Crowder, C.E.T., C.D., Senior Associate, Trenchless Practice Leader, R.V. Anderson Associates Limited*

"I get to network and share ideas with other like-minded professionals. I've learned about new technologies that make us work more efficiently." – *Tayo Olatunji, PE, PMP, CCM, Supervisor Construction Projects, DC Water*

"The bottom line is that active membership benefits me professionally and, in turn, my company can provide unique and cost-effective solutions to challenging projects." – *George Ragula*

"You Belong in NASTT!"

Regional Chapters Bring NASTT to Your Backyard

"The quality and dedication of local volunteers makes working in the industry much easier, more fun and extremely fulfilling." – *Joe Lane*

"Regional chapters make it easy to meet locally with engineering consultants and municipal staff who share the same passion for trenchless technology, learn new ideas and discuss other trenchless topics."
– *David Crowder*

"Seeing the impact that trenchless technology has on our communities and the country makes chapter participation worthwhile." – *Alan Goodman, Strategic Accounts Sales Manager, HammerHead Trenchless Equipment*

What about you? How has NASTT membership made a difference in your career? Email me at chook@nastt.org and let me know. You Belong in NASTT!

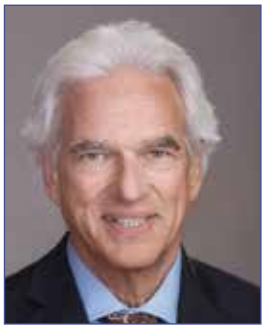
WESTERN REGIONAL CHAPTER

ELECTED OFFICERS:

BRIAN AVON – CHAIR
Carollo Engineers

bavon@carollo.com

Brian Avon is an Associate Vice President and Trenchless Technology Practice Lead at Carollo Engineers, Inc. Brian earned his B.S. in Business Administration and Management from the University of Southern California and his B.S. in Civil Engineering from the University of the Pacific. He has more than 14 years of experience in the planning, design, and construction management of water and sanitary sewer pipelines, with extensive experience in the condition assessment of pipelines and design of CIPP, pipe bursting, horizontal directional drilling, auger bore, and microtunnel projects.



NORM JOYAL – TREASURER
McMillen Jacobs Associates

joyal@mcmjac.com

Norman is a Principal in the Trenchless Practice Group of McMillen Jacobs Associates in their Walnut Creek, California office with over 30 years of trenchless and geotechnical experience. Norman is responsible for the engineering design of trenchless installations that include microtunneling, HDD, Direct Pipe®, pilot tube guided boring, pilot tube pilot tube-guided pipe ramming, pilot tube guided auger boring, conventional pipe jacking and auger bore installations, and the AXIS system. Norman has been an active participant in No-Dig for the last 20+ years and is currently the out-going treasurer for the WESTT chapter affiliation.

LISA ARROYO - VICE CHAIR
Arroyo Trenchless, Inc.

lisa@arroyotrenchless.com

Lisa Arroyo is the founder and owner of Arroyo Trenchless, a general engineering construction company in California. Prior to starting Arroyo Trenchless, Lisa was the Wastewater System Manager for the City of Santa Barbara.
During her 17-year tenure with the City of Santa Barbara Lisa oversaw the operation and maintenance of the City's wastewater treatment plant, collection system and laboratory. She managed a multi-million dollar Capital Improvement Program and a $20 million operating budget. Lisa has experience with both CIPP and directional drilling methodologies and has long been a champion of trenchless technology, as it is an effective and economical solution for improving wastewater collections systems.
Lisa holds Bachelor of Science degrees in mathematics and civil engineering, and she is a licensed professional civil engineer in California. Lisa was elected to the Board of Directors for the WESTT Chapter in 2016, and was elected to the NASTT Board of Directors in 2018. She is also a member of NASTT's Program Committee.

TIM TAYLOR – TREASURER-IN-TRAINING
Carollo Engineers

ttaylor@carollo.com

Tim is currently the Infrastructure Practice Director and a Senior Vice President with Carollo Engineers. He has been working on water and wastewater infrastructure projects for over 33 years. Tim has been heavily involved in the planning, design, construction and project management of projects for water distribution systems, wastewater gravity sewer collection systems, large and small pump stations, storage reservoirs, as well as incorporating trenchless construction techniques for projects across the nation. He has also worked on pipeline condition assessment and rehabilitation projects for many clients.
Tim is registered to practice Civil Engineering in multiple states and has been working for Carollo Engineers for over 25 years.

BOARD OF DIRECTORS 2019-2020

JENNIFER GLYNN – SECRETARY
Woodard and Curran Inc.

jglynn@woodardcurran.com

Jennifer Glynn is a Senior Technical Practice Lead and Associate Principal for Woodard & Curran out of their Walnut Creek, California office. Jen has over 23 years of experience in Project Management and Infrastructure Design, with an expertise in Condition Assessment and Trenchless Rehabilitation.
Jen has been authoring papers and presenting at conferences both domestically and internationally for the past 19 years. She is a past Executive Board Member for NASTT and is currently an NASTT training course instructor for two classes: Introduction to Trenchless Rehabilitation and Pipe Bursting Good Practices. She is also a member of the AWWA Water Main Rehabilitation and Water Main CIPP Standards Committees.

CINDY PREUSS – PAST CHAIR
HydroScience Engineers

cpreuss@hydroscience.com

A Principal with HydroScience, Cindy Preuss has 20+ years' experience in planning, designing, and managing public water and wastewater projects. Upon attending her first No-Dig conference in 2005, Cindy's passion for trenchless pipeline design has built steadily. She served a full term on the NASTT Board of Directors, is one of NASTT's Good Practices Course instructors, and holds the current Past-Chair position with WESTT.
Cindy's areas of expertise include condition assessment of gravity sewer systems, sanitary and storm sewer collection and pressure system design, storm water permitting, and both water and recycled water pipeline infrastructure improvements. Cindy's experience in trenchless technology includes both pipeline rehabilitation and new installations. Also a Past-Chairman of the Northern California Pipe Users Group (PUG), Cindy has enjoyed meeting and networking with industry professionals from all sectors of the infrastructure renewal industry, as well as publishing and presenting on case studies in an effort to share experiences and lessons learned from her various design projects.

NASTT COURSE: REHABILITATION AND NEW INSTALLATIONS 101

Rehabilitation and New Installations 101: These two 4-hour introductory courses are ideally suited for both newcomers to the industry and for anyone who is interested in seeking a refresher course on trenchless technology methods. The Rehabilitation section provides an overview of the methods available to public works and utilities to rehabilitate water and sewer systems with minimal excavation. The New installations section addresses numerous trenchless methods commonly used in North America to install new pipe and conduit, including: auger boring, pipe ramming, pipe jacking and pilot tube methods.

Date: Thursday November 21, 2019 | Location: Hyatt Place - Waikiki Beach
Breakfast: 7:00 AM to 8:00 AM | Start time: 8:00 AM

Self-parking included in registration.

DIRECTORS AT-LARGE:

MIKE ROCCO – AUI Inc.

rocco@auiinc.net

Michael Rocco has over 30 years' experience in Trenchless Technologies and is the Trenchless Manager for AUI,Inc., headquartered in Albuquerque, NM. He obtained his Bachelor's Degree from the University of New Mexico in 1993 and received his CPE status - Certified Professional Estimator- from the American Society of Professional Estimators - ASPE - in 2016. His experience includes rehabilitation of water, storm sewer and sanitary sewer pipelines by Slip-lining, Pipe Bursting and Spiral Pipe Rehabilitation trenchless methods. He has been employed with AUI, Inc., for over 27 years and works in the estimating, project management and marketing departments.

JACQUIE JAQUES – Sekisui SPR Americas

jacquie.jaques@sekisui-spr.com

Jacquie Jaques is the Regional Manager for Sekisui SPR Americas for the Western US. Jacquie has over 25 years of industry experience working with manufacturers and contractors specializing in trenchless pipeline condition assessment and rehabilitation solutions. She started her career working for PSG Sewer Services, a technical services company specializing pipeline cleaning and condition assessment. During that time, she worked with municipalities, FEMA and OES on post-earthquake pipeline condition assessment inspection that enabled agencies to obtain federal funding for projects.
Additionally, Jacquie was a founding member and secretary for the "Green Book Pipeline Rehabilitation Task Force" which evaluated new trenchless technologies that were germane to public works construction. She is a current Education Liaison for the WESTT Board and is active in numerous industry committees. She has authored several industry papers and magazine articles and as has presented at national and regional conferences.

MICHELLE BEASON – National Plant Services Inc.

mbeason@nationalplant.com

Michelle received a BS in Civil Engineering from Purdue University, and is a registered California PE with almost 27 years of water and wastewater experience. She has worked as a Project Engineer for Black &Veatch, as an Asset Management Engineer with the East Bay Municipal Utility District, she owned her own Engineering & Construction firm for 5 years, and for the last 10 years has specialized in multi-sensor inspections and trenchless rehabilitation of sewer, storm, and water assets. She is currently the Regional Manager for National Plant Services, Inc., covering the 12 Western States, including Hawaii and Alaska.
Michelle is also active in many industry organizations. In addition to serving as a Board Member of WESTT, she is a Board Member of NASSCO, and is Chair of the NASSCO Infrastructure Assessment Committee which manages all revisions to NASSCO's PACP/ MACP/LACP coding.

GAYLEEN DARTING – Sacramento Regional Sanitation District

(NOTE: Board Term ended on 10-8-19. Thank you Gayleen for all of your service!)

Gayleen Darting is an Associate Civil Engineer and Project Manager with the Sacramento Regional County Sanitation District. She has 13 years' experience working with sewer agencies with a focus on water recycling for last 5 years. Prior to that, she worked in land development in California's central valley. She earned her Bachelor of Science from the University of the Pacific in 2001 and her Civil Engineering license in 2004 from the State of California. In addition to being on the Board of Directors of WESTT, she is a member of WateReuse and the American Society of Civil Engineers. In her free time, she enjoys camping, gardening, and traveling.

BOARD OF DIRECTORS 2019-2020

KATHRYN WALLIN – Bennett Trenchless Engineers

kate.wallin@bennetttrenchless.com

Kate Wallin is a Senior Scientist with Bennett Trenchless Engineers, located in Folsom, CA. She has been involved with trenchless design since 2005 and has provided design and construction management services on projects using horizontal directional drilling, microtunneling, pipe ramming, guided boring, and earth pressure balance pipejacking. Kate has cultivated relationships with owners, engineers, permitting agencies, contractors, and manufacturers for new installations using trenchless technology to improve the standard of practice in the field. She is a coauthor on the 2017 revisions of the Horizontal Directional Drilling Good Practices Guidelines and Presentation as well as the 2018 Trenchless 101 – New Installations course and book. Kate was very honored to be the recipient of the 2011 Trent Ralston Young Trenchless Achievement Award.

COMMITTEE CHAIRS:

WESTT Mini No-Dig Conference Committee:
Lisa Arroyo

WESTT Trenchless Review Magazine Committee:
Michelle Beason

WESTT Board Elections Committee:
Kate Wallin

Student Chapter Liaison Chair:
Jacquie Jaques

JOINT CONFERENCE:

WESTT 15th Annual Western Regional No-Dig &
HWEA 10th Biennial Collection Systems Conference

Wednesday, November 20, 2019

Ko'olau Ballrooms and Conference Center
45-550 Kionaole Road, Kaneohe HI 96744
TEL: 808-954-7000

The Hawaii Water Environment Association (**HWEA**) Collection System Committee and the Western Chapter of the North America Society for Trenchless Technology (**WESTT**) are proud to welcome you to participate in this year's exciting joint conference. This conference will include a wide variety of topics related to wastewater collection systems, and trenchless technology, with an emphasis on collection system technologies, policies, and regulations.

HIGHLIGHTS:

- Informative, two-track technical program
- Continuing Education Units (CEUs) and CWEA Contact Hours opportunity
- Exhibit Hall featuring vendor booths
- Buffet Luncheon, with featured speaker
- Pau Hana Happy Hour Networking Event
- Pre-Conference Activity (optional, additional fee applies)
- Post-Conference Training: Trenchless Technology Good Practices Course (optional, additional fee applies)

Hawaii Water Environment Association 10th Biennial Collection System Conference

Wednesday, November 20, 2019

Koolau Grand Ballroom, Kaneohe, Hawaii

BEGIN TIME	END TIME	PROGRAM OF EVENTS (Revised 10/14/19)	
		TRACK 1 **Location: Grand Ballroom**	**TRACK 2** **Location: Mauka Room**
8:00 a.m.	**8:30 a.m.**	**REGISTRATION / WAKE-UP COFFEE & PASTRIES**	
8:30 a.m.	**9:30 a.m.**	**OPENING SESSION AND KEYNOTE SPEAKERS (Grand Ballroom)** **Lyle Tabata, County of Kauai** **Eric Nakagawa, County of Maui** **Bill Kucharski, County of Hawaii** **Lori Kahikina, City and County of Honolulu**	
9:30 a.m.	**10:00 a.m.**	**NETWORKING BREAK**	
10:00 a.m.	**10:30 a.m.**	**Designing and Operating Pump Stations for Enhanced Reliability, Energy Efficiency and Lower O&M Costs** Roy Abe - HDR	**A Case in Corestones – Challenging Pipejack Beneath Interstate 8 in San Diego** Kate Wallin - Bennet Trenchless Engineers
10:30 a.m.	**11:00 a.m.**	**Kapolei Pump Station Pump Selection** Kyle Yukumoto - RM Towill	**Sliplining Major Interceptor Sewers at Littleton Englewood Wastewater Treatment Facility Saves Time and Money** Michael Rocco - AUI, Inc.
11:00 a.m.	**11:30 a.m.**	**Hydraulic Transient Evaluation and Mitigation Approaches** Mike Flannigan - Brown and Caldwell	**Mechanized Pipe Rehabilitation Design and Case Study** Bijan Khamanian - Hobas Pipe USA
11:30 a.m.	**1:00 p.m.**	**LUNCHEON (Glass Ballroom)** **Introduction to NASTT** **Presentation Topic: An Overview of the Wastewater Industry's War on Wipes** Melody LaBella - Central Contra Costa Sanitary District	
1:00 p.m.	**1:30 p.m.**	**CCCP to the Rescue! Restoring a Buckling 84-in. CMP Storm Drain on Island of Kaua'i** Michelle Beason - National Plant Services, Inc.	**Redding, California Successfully Uses Static Pipe Bursting for Over 3 Miles of Gravity Sewer Mains and Laterals** George Mallakis - TT Technologies
1:30 p.m.	**2:00 p.m.**	**HDD under Pearl Harbor Provides Joint Base Pearl Harbor-Hickam with New Water Supply Line** Devin Nakayama - Yogi Kwong Engineers	**Pipe Bursting Sewer Mains and Laterals** George Mallakis - TT Technologies
2:00 p.m.	**2:30 p.m.**	**NETWORKING BREAK**	
2:30 p.m.	**3:00 p.m.**	**Comparing Two Horizontal Directional Drilled Crossings With and Without a Surface Casing in Cache Creek, BC** Rachel Martin - McMillen Jacobs Associates	**Nothing Rosy about a Failed Sewer: Rehabilitation of the Rose Canyon Trunk Sewer** Greg Watanabe - GHD
3:00 p.m.	**3:30 p.m.**	**Aging Infrastructure - Scaling a Condition Assessment Program to Fit Your Budget** Tim Taylor - Carollo Engineers	**What are the Benefits of Using Certa-Lok®, a Segmented PVC Pipe for Trenchless Applications?** Rowena Patenaude - NAPCO
3:30 p.m.	**4:00 p.m.**	**What Happens After the Installation is a Success?** Brian Avon - Carollo Engineers	**Manhole Rehabilitation; Five Quality Assurance Steps for a Successful Application** Joe Keating - Sauereisen
4:00 p.m.		**PAU HANA - HAPPY HOUR**	

Thank you to 2019 Joint Conference Co-Host!

HWEA
HAWAI'I WATER ENVIRONMENT ASSOCIATION
wef Member Association

Hawaii Water Environment Association (HWEA)

The Hawaii Water Environment Association (HWEA), formerly known as the Hawaii Water Pollution Control Association, is a non-profit organization, which was founded on August 9, 1962 in Honolulu, Hawaii. HWEA presently has a total membership of about 450, and is part of the national and international organization Water Environment Federation (WEF) of over 41,000 members.

HWEA members are water professionals committed to preserving and enhancing Hawaii's water environment. Our mission is to develop and provide industry leaders, educate a diverse spectrum of water professionals, and increase understanding of the importance and value of water to the environment, public health and the economy. The members of HWEA include environmental and sanitary engineers, planners, treatment plant and collection system operators, chemists, microbiologists, ecologists, regulators, public health officials, construction managers, business owners, scientists, researchers, educators and concerned citizens.

HWEA has an executive board comprised of seven officers: President; Vice-President; Treasurer; Secretary; Past President; Professional Wastewater Operators Representative (PWO Rep), and WEF Delegate. From 2017-2020, HWEA also retained a Delegate At-Large in the WEF House of Delegates. All positions require one year of service, except the PWO Rep and the Delegates, who serve for a 3-year term. HWEA has 16 specialty committees which are typically led by two co-chairs.

The HWEA Collection Systems Committee was established in 1999. The mission of the committee is to protect public health and the environment by promoting the safe and efficient collection and transport of wastewater. The committee provides a forum to review, discuss, and address local and national issues involving wastewater collections systems, including technological advancements, and regulatory policies. HWEA's Collection System Committee promotes Trenchless Technologies primarily through their bi-annual Collection Systems Conference (which WESTT participates in), and through the presentations and vendors see at HWEA's annual Pacific Water Conference.

HWEA is a unique organization due to our membership's "can-do" attitude and role in the remote island state. HWEA does not maintain paid staff, so the board and committees are comprised solely of hard-working, dedicated volunteers. Although our annual conference draws around 1,000 attendees (including speakers and vendors), the planning and running of the event is executed entirely by volunteers! This also means that as a volunteer with HWEA, you will likely get to know people in a different field, from contractors, to regulators, or students. For young professionals, this is a great chance to learn and rub elbows with more seasoned professionals who hold important leadership positions in the industry. HWEA is exceptional in the amount of active young professionals that are involved at events, in committees, and even on the executive board.

Since the island state is small, the industry is almost like an "ohana". Many HWEA members have work that overlaps in the three branches of the water industry (waste, potable and storm water). Our networking events may draw people from different specialties, but many will know each other, even if they do not live on the same island. Some of our members are so enthusiastic about their work that they are involved in multiple committees, or other associations, such as American Water Works Association (AWWA) or the American Society of Civil Engineers (ASCE). In fact, the Pacific Water Conference is held jointly with the Hawaii Section of AWWA, as is the Young Professionals Committee.

As HWEA looks forward, we foresee continued growth in attendance at our events and are looking for innovative ways to provide education to our members and the public, like this joint conference with WESTT.If you would like more information or to get involved, please find us at: **www.hwea.org**.

WESTT Chapter Supporter Spotlight:

Northern California Pipe Users Group (PUG)

The WESTT Board of Directors recognizes the valuable support and collaboration over the years from the Northern California Pipe Users Group (PUG). The PUG emphasis has been in sharing new technologies and the latest trends in trenchless and open-cut pipeline construction and repair.

Recently, Jimmy Dang PE, CHST, Technical Services Manager – Plant, at the Oro Loma Sanitary District gave an update on current PUG activities and outreach events:

- *When, where, and why was PUG formed?*
  The Northern California Pipe User's Group (PUG) started as a group of System Owners, and Engineers sharing information and technologies and started in 1992. Over the years the group has grown to over 70 member agencies, established non-profit status, offers field trips, courses, and the seminar in addition to the monthly meetings, and has opened the door to contractors, vendors, and suppliers.

- *What is the mission of PUG?*
  PUG's mission is "Sharing Technologies Together" and is dedicated to providing its members with current technical information and training opportunities to stay up to date with industry news and technology.

- *Who are the organizers/leaders of PUG?*
  PUG is managed by a group of volunteer Board members. The current Board of Directors can be found at www.norcalpug.com/about/board-members.

- *How long has PUG been working with WESTT?*
  We have been partnering for at least the last 10 years in providing joint training events to our membership.

- *How does PUG benefit the industry? (good segway into the donations for this conference)*
  By sharing technologies together, we are providing a forum for professionals to discuss ideas and provide solutions to people that bring challenges to the group. We host monthly meetings, hold an annual seminar in February, provide an annual training in October, and also coordinate industry related field trips and social events.

- *How does PUG promote Trenchless Technologies?*
  The PUG membership is constantly working on new and innovative projects and by having a forum of industry professionals, we are able to link the experts and designers together to help explore the available technologies in the industry. A lot of pipeline rehabilitation methods involve trenchless technologies so we focus a lot of our monthly events around lessons and challenges learned on actual construction projects and deliver the messages to the membership.

- *What does PUG do to grow the industry and educate our members?*
  PUG typically grows by word of mouth and advertising for all the events we host annually. As noted above, we provide monthly meetings where we have industry professionals come in and share their knowledge and experience. Our annual training in October offers technical content to the membership, and of course, our annual seminar in February provides additional learning opportunities.

- *What are the exciting initiatives for 2020 and beyond?*
  PUG is always open to new and innovative technologies and wish to share as much information as possible to our membership. We have lots of events planned for 2020 but participants will have to wait and see when the time is right!

Post-Disaster Trenchless Installation of Water Pipelines in Napa, California

City of Napa Highway 29 Water Main Replacement Project

By: Jon Marshall, PE, Carollo Engineers, Inc.
Michael Hether, PE, City of Napa Water Division

1. INTRODUCTION

The City of Napa is located in northern California, approximately 50 miles north of San Francisco and is nearby several active earthquake faults (Figure 1). Napa's water system serves a population of approximately 80,000 people through 370 miles of transmission and distribution pipelines. On August 24, 2014

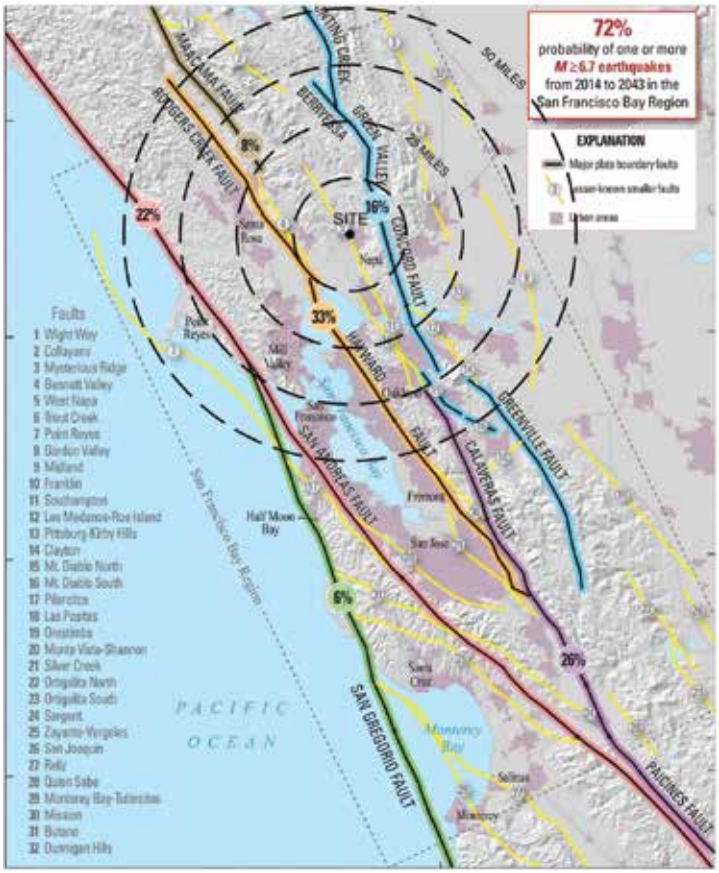


Figure 1: Project Vicinity and Nearby Faults

at 3:20 a.m. the 6.0 magnitude South Napa Earthquake struck 5 miles south/southwest of Napa and 7 miles below ground. Ground shaking was recorded at 0.80g in the City of Napa. Vertical ground deformation was recorded up to 10 centimeters (Figure 2) and horizontal deformation over 1 foot. This was the largest earthquake to hit the Bay Area since the Loma Prieta earthquake in 1989. The earthquake caused substantial damage to above ground structures (Figure 3) and more than 240 water pipeline leaks were identified (Figures 4 and 5). Luckily no damage occurred at the water treatment plants, pump stations, or dams and only 1 of the 12 storage tanks was damaged.

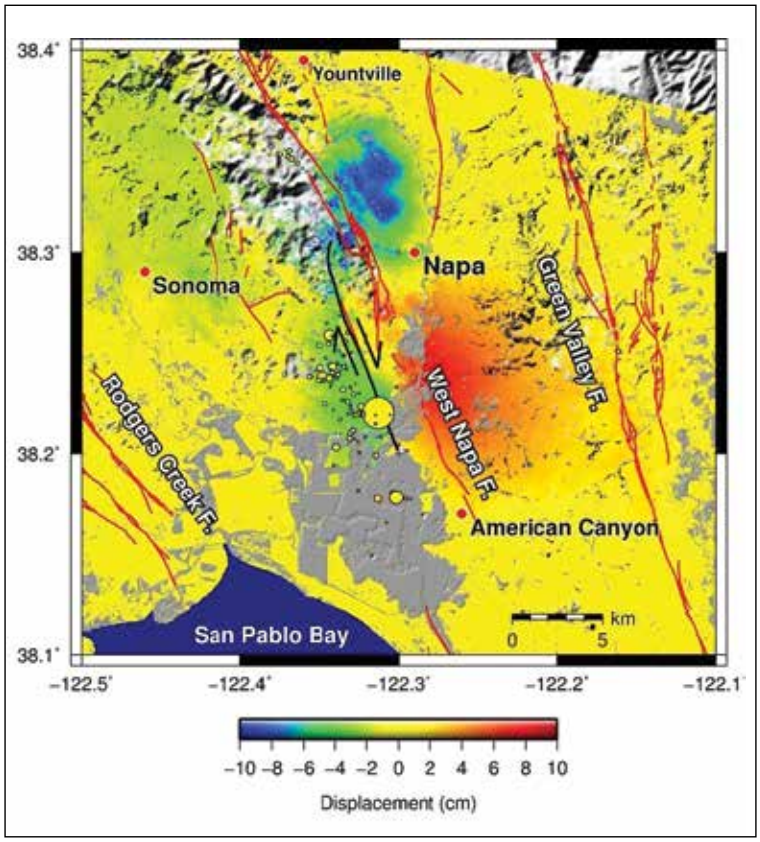


Figure 2: Ground Deformation from the South Napa Earthquake

Several leaks were located beneath Highway 29 and because of their location beneath the highway, they were unable to be repaired and left isolated. This resulted in limiting the City's ability to move water across the highway, which is a natural physical barrier in the distribution system. The pipelines that cross Highway

Figure 3: Damaged Alexandria Square building in Napa

29 were originally installed when the highway was a rural two lane road, compared to it currently being a 4 line expressway. To restore water service, the City decided to abandon the isolated leaking sections of pipelines in place and install new highway crossings using horizontally directionally drilled pipelines.

2. THE FEMA PUBLIC ASSISTANCE PROCESS

In a catastrophic disaster, and if the state's governor requests, federal resources may be mobilized through the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) for federal assistance to state or local governments to pay part of the costs of rebuilding a community's damaged infrastructure. Federal assistance may include funding for debris removal, emergency protective measures and public services, repair or replacement of damaged public property, loans needed by communities for essential government functions and grants for public schools. In California FEMA coordinates with the California Office of Emergency Services (Cal OES) to implement the Public Assistance (PA) Grant Program.

There are 14 steps in the process to obtaining federal funding, all which must be followed in order and documented. In general the steps include assess the damage and losses, the Governor requesting and President approving funding, submitting the funding request, review, and approval, entering into an agreement, disbursing funding, submitting regular updates, and closeout.

One of the biggest challenges with the federal funding process was changing the scope of the project. Three crossings were originally identified for the project, however during design development another leak beneath the highway was identified, isolated, and a fourth trenchless crossing was added to the project. While the leak was identified after the earthquake, it is thought to have occurred from post-earthquake relaxation, where the ground continues to gradually settle during the weeks and sometimes months after an earthquake. Modifying the overall project description caused a delay to the overall project of about a year. Reasons for the delay include justifying the earthquake as the cause of the leak and engaging FEMA staff, many of who were tasked with hurricane and flooding relief efforts. In addition, because of the change in project description, the overall project was re-reviewed, which resulted in additional scrutiny and review of each crossing, and ultimately FEMA approval was granted.

3. REGIONAL GEOLOGY

Napa County lies within the Coast Ranges geomorphic province of California. The regional bedrock geology consists of complexly folded, faulted, and sheared sedimentary, igneous,

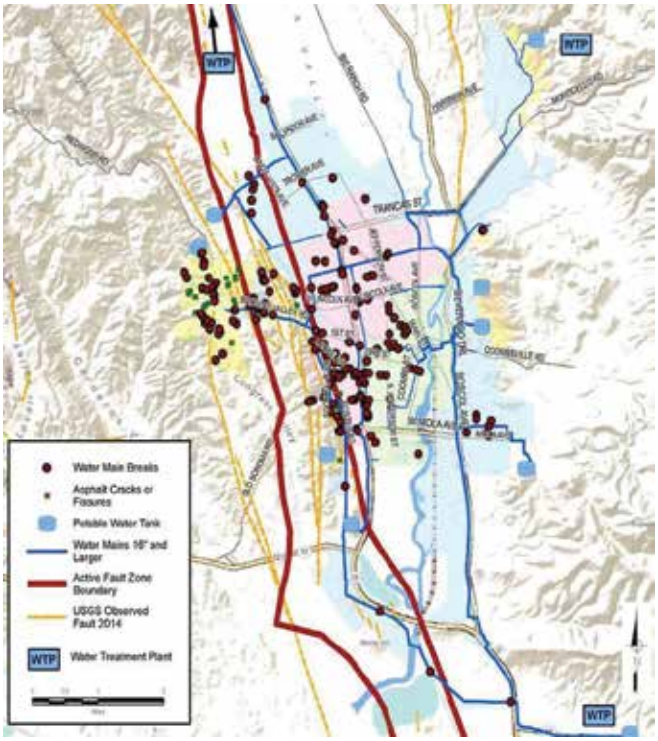


Figure 4: Earthquake Caused Water Pipeline Leaks

Figure 5: Utility worker inspecting earthquake damage

and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex. Within central and northern California, the Franciscan rocks are locally overlain by a variety of Cretaceous and Tertiary-age sedimentary and volcanic rocks which have been deformed by episodes of folding and faulting. The youngest geologic units in the region are Quaternary-age (last 1.8 million years) sedimentary deposits. These unconsolidated deposits partially fill many of the valleys of the region.

The upper portions of the valleys contain loose deposits of rock fragments, sands and silts, which have migrated by gravity downslope from the adjacent hillsides to form the colluvial deposits along the lower slopes and upper edges of the valleys. The lower portions of the valleys have been filled with finer grained alluvial material over time through the sediment transport process during rainfall events.

Regional geologic mapping by the California Geological Survey indicates the project site is underlain by alluvial deposits of Pleistocene age (more than 11,700 years old). Alluvial deposits are generally composed of poorly-sorted silt, sand and gravel deposited by streams and rivers, and can be in the forms of alluvial fans, stream terraces, and basin and channel deposits.

Two geotechnical borings and soil laboratory analysis were performed for each crossing. Subsurface soil conditions at the four crossings predominantly consist of medium stiff to stiff fine-grained, cohesive soils (silts and clays) with lesser interbedded coarse-grained, non-cohesive soils (sands and gravels). The soils are well suited for horizontal directional drilling.

4. DESIGN OF THE HIGHWAY 29 CROSSINGS

The City decided that horizontal directional drilling using fusible PVC pipe was the preferred installation method and pipeline material in large part because the City had recently successfully completed two similar projects. Factors that went into the decision making were subsurface conditions, existing utility locations, surface impacts, site constraints, and owner preference. The four locations of the horizontal directional drilling are shown in Figure 6. At each crossing, a 12-inch diameter pipeline is needed for hydraulic reasons to convey water across the highway. Caltrans requires a casing, so an 18-inch diameter casing was originally anticipated.

Figure 6: Locations of 4 HDD Installations Across Highway 29

Figure 7: Pipe String in Temporarily closed parking lane

However, after discussions with the pipeline manufacturer, a 16-inch diameter casing was selected with the weld beads removed from the interior of the casing pipe and exterior of the carrier pipe.

The Caltrans trenchless crossing design guidelines and the issued encroachment permit encroachment permit require a casing for the pressurized 12-inch water mains. The Caltrans Encroachment Permit Manual (Section 623.2) requires a 10 foot minimum depth of cover throughout the entire Caltrans right-of-way for directionally drilling this casing size. However, in order to minimize systemic settlement and hydrofracture risks the design depth of cover averaged over 25 feet.

Entry and exit angles were designed at 12 degrees, except for one location where an entry angle of 16 degrees was designed to provide clearance from existing utilities. Given a minimum design depth of cover throughout the entire right-of-way the total HDD installation lengths were between of 350 to 520 linear feet to accommodate entry and exit angles, radius of vertical curves, existing utilities, and crossing angles under the highway (crossings are required to be 30 degrees from perpendicular.

Subsurface soil conditions at the four crossings are conducive to HDD construction and are consistent with the soil conditions from the City's recently completed HDD project. Clean open graded gravels, cobbles or boulders were not encountered in the project geotechnical investigation. In the absence of such high risk (and sometimes fatal flaw) soil conditions, geotechnical conditions will not control HDD bore path design. The design of the four undercrossings bore paths was governed by:

Figure 8: Fusing PVC Pipe and Sliplining the Casing Prior to Pullback

- a minimum depth of cover beneath Highway 29 of 20 feet (to control hydrofracture and limit systemic settlement);
- a minimum depth of 10 feet below all Caltrans rights-of-way;
- Caltrans required skew angle of less than 30 degrees from normal;
- existing utility clearances;
- minimum bending radius for HDD drill rods (typically, radius in feet = 100 x rod diameter in inches);
- allowable minimum bending radius for the 16-inch C905, DR18 PVC casings of 363 feet;
- appropriate HDD rig set up and equipment area; and
- appropriate pipeline fusion and laydown area.

Two crossing locations include both a horizontal and vertical curve. While efforts were made to avoid these compound curves, the limited project space and other constraints necessitated them. In designing compound curves, it is critical to account for the reduced radius of curvature that occurs when bending in two directions. The following equation, from the HDD Best Practices Manual, was used to derive the actual curve (combined horizontal and vertical curve):

$$Compound_{Radius} = \sqrt{\left[\frac{\left(R_{A^2} \times R_{B^2}\right)}{\left(R_{A^2} + R_{B^2}\right)}\right]}$$

Constructing a compound curve directional drill was a concern during design development. To address this concern, the pilot bore steering operator was required to have previously completed installation of a compound curve drill. Properties used to calculate formation limit and drilling fluid pressures are summarized in Table 1 (on page 20):

ASTM F1962 methods were used to estimate pulling loads and to confirm that pipe stresses would be within acceptable limits

	Properties	Values
Drilling Fluid and Drill Pipe Properties	Pilot Borehole Diameter	9.9 inches
	Drill Pipe Diameter	5.5 inches
	Drilling Fluid Unit Weight	11 lbs/gallon
	Drilling Fluid Viscosity	50 centipoise
	Flow Rate of Drilling Fluid at Drill Bit	29 pounds/100 ft^2
Soil Bore path Properties	Unit Weight	100-110 lbs/ft^3
	Friction Angle	34-38 degrees
	Cohesion	0-90 lbs/ft^2
	Shear Modulus	1,500-5,000 ksf

during installation. A maximum pulling force of 14,700 pounds was estimated to be required for pipe pullback, which included a safety factor of 2.0 to account for possible deviations from idealized conditions (e.g. from sloughing, design bore path deviations, and stoppages), and assuming the pipeline will be fully ballasted with water during pullback within a drilling fluid having a specific gravity of 1.5.

An interesting design note is the installation of the Old Sonoma Road crossing, which is located beneath a planned 36-inch diameter microtunnel installation of sanitary sewer pipeline by Napa Sanitation District (NSD). Several coordination meetings with the City, NSD, and each agencies design team were used to ensure the designs were not in conflict. In addition, the teams shared information with each other about existing utilities in the area. To mitigate the potential for settlement and interference with the future microtunnel, the crossing was design to have a future clearance of 5 feet, which was more than 3 times to outer diameter of the casing pipeline. In addition, the design included grouting the annual space between reamed hole and the casing to a distance of 100 feet, which included the location of the future microtunnel crossing.

5. CONSTRUCTION

Prior to advertising the project for construction, the City requested qualifications from directional drilling companies and established a pre-approved list of qualified drilling contractors that were allowed to perform the drilling operation. The City received four bids and awarded the construction contact to Garney Pacific, Inc., with Downing Diversified as the directional drilling subcontractor, with a bid price of $2,200,000. The City hired Alta Engineering Group to perform construction management of the directional drilling work and the City self-performed construction management of the conventional open-cut construction work beyond each directional drill.

An initial requirement was to pothole all utility crossings and utilities within 4 horizontal feet of the directional drill. This was required because the existing utility information conflicted between different versions of record drawings and there was ongoing work in the project area during design and the final location of utilities was not known at bid time. One project challenge was locating a recently installed gas pipeline. The pipeline location was known, however the depth was not known. During design, the gas pipeline

Figure 9: Beginning Pullback on Old Sonoma Rd

was reportedly installed by a jack and bore operation and thought to be 10 feet deep. Initial potholing did not find the pipe.

To prevent schedule delay, the City and Contractor re-sequenced work to construct this crossing last to provide more time to confirm the gas pipeline location. Construction as-built drawings were subsequently found by the gas pipeline utility showing the pipe was installed by directional drilling, not jack and bore, which was a field change and located approximately 23 feet deep. Potholing resumed and found the gas pipeline approximately 22 feet deep. The bore path was revised to provide 10 feet of vertical clearance below the directionally drilled gas pipeline. The drilling was then scheduled. This change resulted in additional cost for utility potholing, but not a delay, because the City and Contractor were able to work together to resequencing the work and keep overall construction moving.

The drilling contractor selected to slightly modify the designed drill path, generally installing a deeper drill than design, which was allowed in the contract documents. Additionally, the entry and exit angles for all bores were revised steeper to 16 degrees at all crossings, which was acceptable.

The Contractor used the areas provided in the traffic control plans to temporarily occupy a parking lane to string out and fuse pipe prior to pullback (Figure 7). This allowed the pullback operation to be performed in very short 2-4 hours windows for each pullback.

The contractor proposed to install the casing and carrier pipe in single pullback operation by sliplining the carrier into the casing and attaching them both to a single pullhead. This was coordinated with the pipeline manufacturer, a special pullhead was used as recommended by the pipeline manufacturer, the request was accepted, and ultimately successfully installed. The sliplining is shown in Figure 8.

Figure 10: Nearing Pullback Completion on Old Sonoma Rd

The pilot bore and pullback operations went very smoothly. Figures 9 and 10 show an example of the pullback at the Old Sonoma Rd Crossing.

The contractor proposed to use walkover system to continuously monitor the alignment and depth of the bore. This approach was a concern, especially for the compound radius drills, because of the freeway crossing and ability to actually continuously monitor the bore path while above the bore head. The contractor came up with a plan to sequentially shut down lanes of traffic during the pilot bore so that the walkover system operator could continuously "walk above" the head of the pilot bore. This was reviewed and found acceptable.

Similarly, per Caltrans requirements settlement monitoring by a licensed land surveyor at specific points along the alignment was required across the state highway. Settlement monitoring was performed throughout construction and at regular intervals post-construction with the last required monitoring date of 6 months after pipeline pullback. Settlement was not observed.

The potential for hydrofracture was a concern around the drill exist location due to nearby existing utilties. To reduce the risk of hydrofracture, the drill exit angle was steepened by the contractor and drilling fluid pressure reduced as the drill approached the exit location. The contractor was required to use, and did use, a downhole pressure monitor to continuously monitor the pressure of the drilling fluid to ensure it did not spike, or exceed anticipated values. In addition, drill entry and exit pits were excavated to provide a preferred location for hydrofracture to occur. In addition, hydrofracture calculations

were provided by the contractor as a submittal to compare the anticipated potential of hydrofracture with contractor's planned construction to the assumptions during design. These proactive measures, coupled with the relatively short length of the bore resulted in no hydrofractures.

6. SUMMARY

The City of Napa was rocked by a 6.0 earthquake in 2014. The City of Napa Highway 29 Water Main Replacement Project is a replacement of critical water infrastructure that was damaged by the earthquake through the design of four (4) HDD installations beneath Highway 29 that will "reconnect" water service across the freeway. The design includes a 12-inch diameter fusible PVC carrier pipe and fusible PVC casing. Two of the four crossings include compound horizontal and vertical curves, which were unavoidable. The project is funded through Federal Emergency Management Agency (FEMA) disaster mitigation funds, which created additional, unique challenges to implementing the project such as obtaining approval to modify the project description due to damage discovered subsequent to the original request for aid. The biggest recommendation for other agencies in similar situations is to not change the project description with FEMA once it has been set. Additional recommendations are to continually outreach to utilities during construction on existing utility locations and provide prompt direction to the contractor to avoid project delays and potential cost impacts.

7. ACKNOWLEDGMENTS

We would like to acknowledge Tyler Grossheim at Carollo Engineers, Inc., Dana Stockom-Smith at the City of Napa, Dave Mathy at DCM Consulting, Eric Debanian with Miller Pacific Engineering Group, Jim O'Toole with ESA. We thank James P. Murphy, Trenchless Lead at Universal Pegasus International for his review comments on an earlier draft of this paper.

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Pilot Tube Guided Auger Boring Project in Non-Displaceable Soils: San Anselmo CA

By: Kate Wallin, Bennett Trenchless Engineers

INTRODUCTION

This summer, the Ross Valley Sanitation District (RVSD) completed its 5 year-long mission to rehabilitate or replace approximately 4,800 feet of gravity sewer pipeline in San Anselmo, CA. Bennett Trenchless Engineers provided trenchless design review services on the final project segment, which included 490 feet of 18-inch VCP pipe installed in two drives by pilot tube guided auger boring (PTGAB). The project had many logistical challenges including crowded utility corridors, a very short 9-week construction window due to the nearby elementary school, and constrained work areas within residential neighborhoods. Trenchless methods were specified in the deepest section of the project to avoid conflicts with existing subsurface utilities and to reduce impacts to traffic along a heavily travelled corridor.

Auger head with bullet teeth to excavate in hard ground

The largest challenge on the project was selecting a trenchless construction method that would be feasible in the anticipated geotechnical conditions. The geotechnical borings encountered very stiff to hard sandy fat clay and moderately hard sandstone at pipeline elevation with groundwater at or below pipe invert. Traditional auger boring did not provide the necessary accuracy, as the project required a relatively flat grade and therefore an accurate installation method. Microtunneling was also considered as a potential trenchless installation method because of its higher accuracy. However, the available work areas were not large enough to accommodate the ancillary equipment necessary for microtunneling operations. Pilot tube guided auger boring provided the necessary accuracy and compact layout that could accommodate the site constraints, but typical PTGAB construction is recommended only for soils that can be easily displaced by the slanted face pilot tube bit. Due to recent advancements in tooling, bits are now available for guided boring machines that excavate during the pilot phase, instead of just displacing soil outward. This allows PTGAB projects to be completed in very dense or hard soils and rock up to 12,000 psi. To ensure a successful project, the District conducted pre-qualifications to identify trenchless subcontractors who were experienced with the PTGAB method in rock.

RVSD awarded the project specifying this new hybrid method for the trenchless construction to KJ Woods (San Francisco, CA) with T&D Construction (Murrieta, CA) as their trenchless subcontractor. Construction of the shafts for the first 255-foot trenchless drive began in July 2019. The shafts were constructed with trench boxes due to the low groundwater and stable ground conditions. Pilot tube operations began on July 11 using a 5-inch diameter TriHawk V drill bit and an Akkerman GBM. Initial advance rates were low, in part because the drilling fluid ports on the drill bit became repeatedly plugged with soil. Pilot tube installation continued for three more days with slow advance rates and intermittent issues with clogged fluid ports. Approximately 155 feet into the bore, target visibility had degraded due to loss of grade from erosion of the bore invert, because of prolonged rotation. Trenchless Contractor T&D Construction decided to withdraw the pilot tubes, move over one foot, and relaunch the pilot tubes using a high-pressure, Ditch Witch XP 44 drilling fluid pump. The pump allowed for an increased penetration rate, reducing the total drilling fluid volume needed and the rotation time, in order to minimize erosion of the bore invert on the second attempt. Relaunch of the pilot bore began on July 17 and with successful completion on line and grade within 2 days.

The bore was then reamed to 23-inch diameter to install 22-inch OD temporary steel casings using an auger boring machine that the contractor had custom-made to be powered by a GBM hydraulic power pack instead of a diesel engine. The modified machine was more compact than a traditional auger boring rig and therefore was able to work within the small shaft required by the available work area. While reaming the first 10 feet of the bore, the contractor encountered difficulties with spoil removal from the augers. The head was retracted to install ports in the auger head to allow for the addition of water at the face. The water helped to prevent the face from getting packed off by lubricating the spoils, easing spoil removal along the augers back to the shaft. A vac-truck was necessary during reaming to maintain a dry shaft due to the high quantities of drilling fluid returning

> *Similar to pilot bore drilling in HDD, drilling fluid is required for PTGAB projects in rock to help cool the drill bit, lubricate the annulus, and carry spoils back to the shaft.*

Shafts constructed using trench boxes due to low groundwater and stable ground conditions

Bits are now available for guided boring machines that excavate during the pilot phase

Reaming of the 255-foot bore through the hard, sticky clay and granular rock took a total of 7 days

to the shaft. Reaming of the 255-foot bore through the hard, sticky clay and granular rock took a total of 7 days. After auger removal, the temporary steel casings were displaced with 18-inch ID No-Dig vitrified clay jacking pipe (VCP) in 2 days.

Installation of 205 feet of pilot tube for the second drive was completed in one shift using the same drill bit, GBM, and high-pressure drilling fluid pump as the successful first drive. Reaming operations, however, encountered difficulty with high torques within the first 40 feet which led to damage to the auger boring rig. After repairing the rig, the Contractor decided to retract the augers and weld an overcut band to a pilot tube section to widen the annulus around the pilot tube and reduce friction between the pilot tubes and the sticky clay. After cycling the overcut band through the bore twice, reaming operations were resumed and completed within 4 days. Clay pipe was then installed in 2 days, completing the trenchless components of the project.

Project had many logistical challenges including constrained work areas within residential neighborhoods.

Pilot tube guided auger boring provided the necessary accuracy and compact layout that could accommodate the site constraints

LESSONS LEARNED

The changes in methodology from typical soil-displacement pilot tube installation to allow pilot tube guided auger boring in rock borrows heavily from horizontal directional drilling (HDD) methods. Similar to pilot bore drilling in HDD applications, drilling fluid is required for PTGAB projects in rock to help cool the drill bit, lubricate the annulus, and carry spoils back to the shaft. Likewise, the drilling fluid pumping rate and pressure must be adequate to carry the spoils out of the narrow annulus at a rate that supports the rate of advance. The typical lubrication pump used with most traditional PTGAB projects does not provide adequate pumping rates or pressures to successfully drill in rock/hard ground. As seen in this project, a drilling fluid pump with a higher throughput is required for a successful PTGAB in rock project during both pilot bore and reaming operations.

Another aspect of PTGAB in rock that shares similarities with HDD projects is spoil handling. The drilling fluid pumping rate that is necessary is significant and the returns can rapidly overwhelm a shaft if not adequately managed. Use of a vac-truck throughout construction should be anticipated to maintain a dry and safe working shaft. Additionally, it is vital to have a reliable water source to replenish drilling fluid stores during all phases of construction.

As with any trenchless project in rock using rotary excavation methods, high torques should be anticipated. The appropriate selection of tooling and machinery is crucial for a successful installation. Providing adequate work area, both inside the shaft and at the ground surface, is recommended to ensure that the necessary and appropriate equipment can be mobilized.

As with most trenchless installation methods, manufacturers and contractors continue to innovate to provide solutions to increasingly challenging construction projects. Advances in tooling now allow for successful pilot tube installations in non-displaceable soils and rock. However, for this innovation to be successfully applied, the project team must be aware of the method's requirements and constraints. For Owners and design engineers that wish to specify projects using this new technology, it is important to understand the limitations and construction considerations for a project using PTGAB in rock.

Project included 490 feet of 18-inch VCP pipe installed in two drives by pilot tube. Installation took only two days

ABOUT THE AUTHOR:

***Kate Wallin** is a Senior Scientist with Bennett Trenchless Engineers located in Folsom, CA. Kate has 14 years of experience designing and inspecting trenchless projects including HDD, microtunneling, pipe ramming, and pilot tube construction methods.*

CALTRANS – Culvert Rehabilitation Project: San Bernardino County, CA

By: Jacquie Jaques, Sekisui SPR Americas

PROJECT LOCATION IN THE SAN BERNARDINO MOUNTAINS

Rehabilitating storm drains and culverts for transportation departments can be a challenge, particularly when working in difficult site conditions. Nu-Line Technologies, Inc., of Encinitas, CA was recently awarded a project by Caltrans District 8. The project was located near Running Springs, CA in the San Bernardino Mountains. The scope of work included the rehabilitation of 24-inch and 30-inch CMP storm culverts along the State Highway 330. Nu-Line Technologies bid this project using Sekisui's SPR™EX Spiral Wound liners. Sekisui's PVC Spiral Wound liners are approved by Caltrans per Design Information Bulletin #83-4 Alternative Pipe Liners per Section 15-536 MACHINE SPIRAL WOUND POLYVINYL CHLORIDE (PVC) PIPELINER (EXPANDABLE OR CLOSE-FIT DIAMETER).

CHOOSING THE RIGHT SOLUTION – SPR™EX

Sekisui Spiral Wound liners were the best trenchless rehabilitation solution for this project. First, Spiral Wound liners could be designed as a structural repair solution for fully deteriorated pipe conditions as well as increase overall hydraulic capacity due to the improved Manning's coefficient. The SPR™EX construction footprint is small and the set up fast and efficient. The installation equipment is highly portable, allowing the contractor to do difficult and remote access set up.

> *"Creates a tight fit liner which requires no annular space grouting."*

Furthermore, due to the environmental and biological concerns from construction materials and methods, it was imperative that the contractor use the most environmentally friendly construction materials. The project required the Contractor to submit a Water Pollution Control plan as part of their pre-construction submittal package. As Spiral Wound liners are mechanically installed, there was no concern about potential styrene contamination as would be the case if the contractor used a resin impregnated liner. All these constructability advantages rendered Spiral Wound liners the most cost-effective lining solution for this project.

MOUNTAINSIDE CHALLENGES

Traffic control was of concern due to heavy seasonal tourist traffic which had to be carefully managed. The Contractor had to provide traffic control as well as job site management to guarantee safety along the construction corridor.

Access to the culverts was even more challenging. The inlets were typically located off the shoulder in wooded areas with the outlets located down steep inclines in dense brush. The SPR™EX installation equipment was typically set up at the upstream inlet.

Seasonal tourist traffic had to be carefully managed

Construction footprint is small with fast and efficient set up

Liner is wound from access point to access point

Winding creates a structural liner within the host pipe

Crews were also located at the downstream outlet where they were able to hand carry equipment necessary to terminate the liner and to install end seals. Due to slope and host pipe deformation the contractor had to make intermittent adjustments to the installation equipment to control the lining process.

ENVIRONMENTAL STEWARDSHIP

As mandated by the California Department of Wildlife (CSOFAW) and Caltrans Special Provisions, the Contractor was required to have a Biologist on site during key phases of the project. The CMP culverts to be rehabilitated were located within or near the habitats of regulated species including the Southern Rubber Boa and several nesting and migratory birds. The Biologist was responsible for preparing a biological information program to inform personnel and to guarantee compliance with the laws and regulations protecting said species The Contractor's Biologist had to be on site during the pre-construction, clearing and grubbing phase to properly identify the habitat locations.

Based on the species, the Contractor was required to maintain specific distances from their habitat. In the case of the nesting and migratory birds, no work could be done during the nesting season and could only be executed once the birds had fledged. If any species was harmed by the Contractor's work or if any other environmental or biological compliances were violated, the Biologist was required to inform Caltrans who would inform the California Department of Wildlife. Based on their assessment, the Biologist would be responsible for recommending alternative staging or construction sites. Additional measures would then be implemented to further protect the habitats. Since SPR™EX is a mechanical, environmentally friendly solution, the rehabilitation process posed no chemical contamination threat to the sensitive area.

SPR™EX AND PROJECT COMPLETION

SPR™EX is a tight fit lining solution for 8 – 42-inch diameter gravity pipelines. The liners are initially installed at a fixed diameter smaller than the host pipe. The liner is then wound from access point to access point. Typically, winding occurs from upstream to downstream however reverse set ups can be done. The liner is formed via a static winding machine that joins subsequent strips of profile and creates a structural liner within the host pipe.

Once the liner reaches the termination structure, the liner is torsionally restrained, then expanded by severing the secondary or "sacrificial" lock. This action allows the SPR™EX liner to expand, creating a tight fit liner which requires no annular space grouting. Furthermore, the entire installation process can be done in live flow conditions typically without the need for by-passing.

Although the site location proved to be difficult, Nu-Line Technologies successfully rehabilitated the CMP culverts using SPR™EX. "Due to the sensitive environmental areas, we found utilizing the SPR™EX product was the obvious choice in executing the project in a timely manner and limiting exposure in these work areas," Says Connor Moore, Project Manager with Nu-Line Technologies Inc. "We are extremely pleased with the end result as was Caltrans District 8."

With site access and environmental challenges at play, Nu-Line Technologies Inc. was still able to complete the project with SPR™ EX on time and on budget.

ABOUT THE AUTHOR:

Jacquie Jaques *is Regional Manager, Sekisui SPR Americas, for the Western US. She has over 25 years of industry experience working with manufacturers and contractors specializing in trenchless pipeline rehabilitation. She is a current board member of WESTT and is active in numerous industry committees.*

Waste Activated Sludge Pipeline Rehabilitation:

14,000 Linear Feet of Slip Lined Fusible PVC®

By: Marvin Lee, AEGION

The City of Peoria, AZ is a major suburban area for the greater Phoenix Metropolitan Area and located in the northwestern part of the Metro. The city is home to approximately 168,000 residents. In the 1950s, increased economic activity and the presence of Luke Air Force Base led to tremendous growth throughout the entire Salt River Valley. This further triggered a postwar construction boom, setting the stage for Peoria to become a suburb of the capital city of Phoenix as growth moved west. Today, Peoria's economic development focuses on growing the resort and leisure living sectors. In springtime, Peoria Sports Complex serves the San Diego Padres and Seattle Mariners for their player development program. In 2008, the city earned its place as one of the Top 100 Places to Live according to Money Magazine.

To support the city's growth, water conservation is key for Peoria. Peoria actively protects and preserves its diverse water supply through aquifer recharge, planning and building reliable water infrastructure, and direct reuse of reclaimed water for landscaping and other non-drinking water demands. In the past decade, this effort has cut Peoria's water consumption by 15 percent.

Currently, water treated at Beardsley Road Water Reclamation Facility, one of Peoria's three water reclamation facilities, produces a waste activated sludge (WAS) that cannot be processed at the plant. The sludge fills a holding tank before being cyclically pumped 14,000 feet along Beardsley Road to a manhole where it then flows by gravity line over 10 miles to Butler Drive Water Reclamation Facility, which has the ability to process the sludge. With rapid growth in Northern Peoria, Beardsley Road Reclamation Facility will likely be upgraded in the near future to have the same sludge processing capability, making this line obsolete.

Majority of 13 installs were over 1,000 feet, longest was 2,300 feet

The existing pipeline was 8-inch ductile iron installed in 1999. Peoria had several other ductile iron sewer lines citywide that experienced severe corrosion and had to be rehabilitated or replaced. Based on this history and the importance of this line, the city took the proactive approach and hired Dibble Engineering (Dibble) to provide an assessment on the Beardsley WAS line. Dibble took samples from four locations, and while the pipeline itself had yet to fail, significant deterioration and corrosion were observed. The engineer found that Hydrogen Sulfide gas (H_2S) was deteriorating the top of the pipe, most likely due to air pockets and clogged air vacuum valves that allowed the H_2S to accumulate. The city needed to rehabilitate the 20-year-old line before a failure occurred.

City engineers considered several rehabilitation options, including cured-in-place lining, slip-lining with fused thermoplastics, as well as compressed fit HDPE liner. Slip-lining with HDPE solid wall pipe was the initial solution before the engineers considered slip-lining with fused polyvinyl chloride pipe (FPVCP). HDPE pipe and FPVCP are both fused thermoplastic solid wall pipe systems and often specified as equivalents. HDPE pipe is more elastic and, thus, can accommodate tighter bend radius and alignment while FPVCP's higher tensile strength results in larger

inner diameter (ID) compared to HDPE pipe. On the other hand, the compressed fit HDPE liner is a specifically sized high density polyethylene pipe (HDPE) whose outer diameter is larger than the inner diameter of the host pipe it is lining. During installation, the outer diameter is temporarily reduced by passing through a multi-stage roller box that compresses the pipe. Once installed it expands its initial orientation memory, resulting in zero annular space between the liner and the host pipe. The city eventually requested quotes for the three options: slip-lining with HDPE pipe, slip-lining with FPVCP, and compressed fit HDPE liner.

Comparing material and fusion costs, the compressed fit HDPE liner option came in at approximately $500,000; HDPE option was at $200,000; and FPVCP option cost $130,000. To put this into perspective, new open cut installation for the replacement pipe would have cost upwards of $2 million more than a slip-line rehabilitation, mostly due to pavement repair costs and trench management. Although the city liked the idea of maximizing the liner ID, compressed fit HDPE liner became cost-prohibitive when it was compared to slip-lining with HDPE and FPVCP. Ultimately, the city chose to slip-line the existing 8-inch ductile iron pipe with 6-inch FPVCP because it provided the best blend between costs and traffic impact while resulting in an acceptable ID. Additionally, the engineers also liked FPVCP's compatibility with standard fittings and connections.

Generally, 2-inch annular space between the host pipe's ID and the slip lining pipe's outer diameter (OD) is recommended. The gap between the 8-inch ductile iron pipe (8-inch ID) and the 6-inch iron pipe size (6.63-inch OD) was tighter than normal, but maximizing the new pipe's ID was important to accommodate the forecasted flow capacity of the pipeline. Due to the size reduction of the pipeline, the whole system was designed to include new, smaller pumps. The bottle neck of the system was the amount of raw water going into the facility's wet well from the clarifiers – 120 gallons-per-minute. The smaller FPVCP and new pump configurations would have no problem emptying the tank. This design was more cost-effective than new open cut replacement with existing pumps, or compressed fit HDPE liner.

> *"Open cut installation would cost $2 million more than a slip-line rehabilitation, mostly due to pavement repair costs and trench management"*

The project was released under a Job Order Contract (JOC) with Achen-Gardner, a well-respected heavy civil general

FPVCP was fused on the street surface in a closed lane. The 110°F days were a challenge

contractor in wet utility and roadway construction throughout Arizona. JOC simplifies the contracting process through multi-year contracts for a wide variety of construction projects, and Peoria uses them for applicable projects with a maximum project cost of $3 million. This particular project was unique and unusual to the city. Therefore, Peoria wanted qualified contractors' feedback for setting up the project and to have an all-inclusive price for the work. This contracting method was more suitable compared to the conventional Design-Bid-Build (DBB) method. Achen-Gardner was perfect for the job given their extensive resume on pipe-specific projects. The contractor worked with the city and engineer to design a construction plan, with Dibble also providing construction administration services.

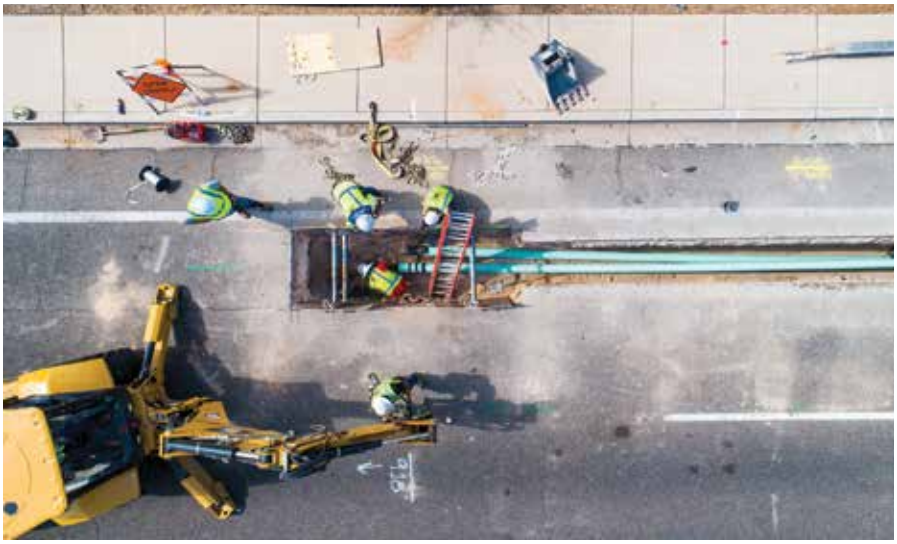
Funding for the project had to be spread over two fiscal years, and the schedule dictated that a certain section be completed during the summer break to eliminate impact to a nearby school. Achen-Gardner started immediately after Memorial Day, May 27, 2019. After setting up a temporary bypass, the contractor video surveyed sections of the pipeline and found it to be relatively straight and round but could only record about 2,500 feet of the 14,000 feet due to the extensive corrosion on the existing ductile iron. Following CCTV, the pipe was cleaned with jetting and blades, while several sections required chain knocking or flailing to clear. The available equipment only allowed the cleaning in 900-foot sections, so additional potholes were added to facilitate access and allow cleaning of the whole pipeline. For future projects, the contractor would consider other methods for cleaning longer lengths of pipe to limit the additional potholes required.

Underground Solutions (UGS) then fused the FPVCP on the street surface in a closed lane. The traffic control was straightforward. Fencing was used around open pits, while steel plates were used to cover open pits near intersections. While only a single lane was needed for fusion and insertion, both east bound lanes were closed, and traffic divided between the two west-bound lanes. The city was initially concerned about the impact of the lane closure, but later realized that it would expedite the construction while providing and very safe work environment with plenty of room to operate within. A total of three miles of the two east bound lanes were closed. The busier eastern end of Beardsley Road connects to Arizona Loop 101, so the project moved from east to west and lanes were reopened as sections were completed. The contractor prepared 4x13-foot pits with 40-foot long tail ditch per UGS's recommendation. After the pits were dug and the pipe strings were ready for installation, Achen-Gardner pulled them into the host pipe with a 5-ton cable winch. There were thirteen pulls in total. The majority of the installs were over 1,000 feet, and the longest one was 2,300 feet. Standard ductile iron fittings were not used because corrosion was a concern, so connections were completed with glued PVC fittings with restraint harnesses, providing a belt and suspenders approach.

The street portion of the project was completed in early September 2019 following pressure testing at 160 psi for two hours, approximately two months ahead of schedule.

There were some notable challenges in the construction process:

- The construction took place in summer with some 110°F days. Temperature is a key variable in the FPVCP fusion process. Although the heat helped with melting FPVCP ends prior to joint fusion, it also extended the joint cooling time, resulting in overall slower fused joint production. A tent was provided to mitigate the weather effects.



Compact site: 4x13-foot pits with a 40-foot long tail ditch were used

- One of the slip-lined sections had limited working area. Ideally, FPVCPs are fused into one pull-length string and pulled into the host pipe in one shot. When working area does not provide sufficient laydown area, FPVCP sections are fused and pulled in turns. While fusion time remains the same, the pull-in time is affected. For example, one section had only 60 feet of laydown space, which translated to 5.5-hour construction for a 460-foot pull. As a comparison, the longest pull, which was 2,300 feet, was completed in 2.5 hours.
- Given the tight annular space between the host pipe and the slip-lining pipe, a regular 6-inch pull-head could not be used. UGS re-designed and fabricated a specially-made internal pull-head for the job.
- Two sections provided curveballs. The WAS line was supposed to have a vertical realignment underneath a high-pressure gas line crossing; However, the original pipe installer went over the gas line, and used deflections in the joint (up to 8 degrees) to achieve the realignment. The stronger and more rigid FPVCP still had enough flexibility to line through this section with no issues. At another intersection, the host pipe was supposed to go straight through, but ended up with a 22.5-degree horizontal realignment from lane 1 to lane 2 in order to cross over three 48-inch storm drains. Achen-Gardner split the initial pull length that was supposed to go straight through the intersection into two separate pulls. Working on the eastern side first, they removed the 22.5-degree fitting, and pulled pipe up to that point. Then they dug an additional tail ditch in line with the crossing and pushed in a FPVC section through the host pipe up to the western fitting in order to pre-load the pipe. The eastern end connections were completed, and the pits were closed up. Achen-Gardner moved to the western side where the process was repeated. The 22.5-degree fitting and some of the original pipe were carefully removed from around the pre-loaded FPVCP. Pipe from the west was slip-lined toward the pit, connected with the crossing section, and then closed up. This allowed for minimal disruption to the busy intersection.

FPVCP was new to the City of Peoria, Dibble Engineering, and Achen-Gardner, but a collaborative effort resulted in an effective design, allowing the construction team to implement a slip-lined solution that was minimally intrusive to the neighborhood, saved significant costs from traditional open/cut replacement methods, and provided a long-term pipeline free from corrosive concerns. The successful rehabilitation of the WAS line will help to maintain continuous operation of Peoria's reclaimed water system and support the city's water conservation efforts.

ABOUT THE AUTHOR:

***Marvin Lee** is the Applications Engineering Systems Leader at Underground Solutions. He received his BS in Chemical Engineering in 2015 from UC Berkeley. He is responsible for determining project scope and constructability of fused PVC pipe installations. He has worked in trenchless water construction industry for 4 years.*

CCCP to the Rescue!

Restoring a Buckling 84-inch CMP Storm Drain on Island of Kaua'i

By: Michelle Beason, PE, National Plant Services, Inc.
Lyle Tabata, Deputy County Engineer, County of Kaua'i HI

INTRODUCTION AND BACKGROUND

On Tuesday August 2, 2016, at approximately 3:00pm, a sink hole was reported on a section of roadway on Pua Nani Street in the Ulu Mahi subdivision. Kaua'i County Roads Division staff responded promptly, as did the Department of Water (DOW). An emergency repair was completed which involved excavation to identify the cause and extent of the damage. The cause of the problem was found to be a failure of the storm drain corrugated metal pipe invert which caused the pipe to deflect and deform at the pipe joint, providing a pathway for soil to fall into the pipe. Excessive soil loss in this area resulted in a sink hole and an eventual break on a DOW PVC lateral service line, which further eroded the soil back fill around the culvert. The 20+ foot depth of the damaged stormdrain pipe further complicated matters, since the repair area was beyond the reach of available construction equipment that could be mobilized through roadways in the residential neighborhood. The immediate and temporary fix was to over-excavate a little around the damaged drain pipe joint, and bridge the damaged section of pipe with a geo-fabric material which would prevent further loss of the backfill material, repair the DOW service lateral, then backfill and install temporary pavement.

The storm drain system was inspected at this time, and it was determined that the entire lower section of Pua Nani Street stormwater drainage pipe required a complete repair or replacement to 7 sections totaling approximately 800 LF. The follow up survey of the storm drain system revealed that the 84-inch Corrugated Metal Pipe (CMP) was compromised at the invert of the pipe. Entire sections of the pipe invert were corroded or nonexistent and the pipe was buckling in on itself from the invert, resulting in reduced diameter, gaps between pipeline joints, and structural weakness that posed a significant risk of further collapse (Figure 1). If not addressed as an emergency repair, the County risked further loss of backfill, and another potential sink hole with further catastrophic roadway failures.

Figure 1. Sinkhole location.

The replacement cost was estimated at $2.5 - $3.5 Million, would require digging the street at depths up to 20 feet, and would close the road, preventing homeowner vehicle access during the replacement. Replacement would also require installation of a temporary potable water service to each residence and fire hydrant system along this entire street. However, an additional issue, as mentioned above, was that the necessary equipment to dig to the required depths could not be brought into this neighborhood.

Alternatives to this trench and replace method included a design to replace the 84-inch CMP by slip lining a smaller diameter 60-inch HDPE pipe; or spiral wound bolted steel panel pipe material. Both options would result in capacity losses that would not meet the required design capacity for the system. CCCP was finally chosen as the best alternative for this challenging rehabilitation project.

INSPECTION AND DESIGN

A detailed pre-inspection survey was performed by National Plant Services and A/PM Permaform Staff on January 18, 2018, to determine the feasibility of the repair, and the required design parameters for the seven failing sections of CMP pipeline. While a few of the sections had changed shape from circular to elliptical, it was determined that all sections could be structurally restored using CCCP, after first repairing the invert. The calculated design thickness of PL-8000 material ranged from 0.75- 1.5 inches based on the existing pipe shape and size, and the site and loading conditions.

WIN Structural Consulting, the Hawaii Registered Engineer on the project, required soil borings and Standard Proctor Tests (AASHTO T-99) to verify the dry soil density of the surrounding soils to ensure the soil conditions would be suitable for the CCCP method at the calculated design thicknesses. The design required a dry soil density of at least 70 percent. Boring locations were selected along the pipe alignment at 3 areas of concern. Geolabs, Inc., from Honolulu, performed the borings and T-99 tests. The 3 locations tested were found to have sufficient soil density, and the design was finalized based on ASTM A979 / A979M, "Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field".

PIPE STABILIZATION AND INVERT REPAIRS

The corroded invert was the cause of the buckling pipe sections and the sinkhole. The typical flow line in the invert was covered in rust, and most of the invert was failing or missing completely. At some locations, the pipe invert on each side of the corroded void was pushing inward on itself, resulting in a reduced diameter of each of the 20-foot long pipe sections. Each section had changed in size differently, depending on the condition and extent of the loss of the invert, resulting in gaps at the joints where soil was exposed.

The first step was to ensure that the pipe was safe for workers to enter. To accomplish this, the worst section of culvert (the location of the sinkhole and severe offset joints) had to be stabilized. The structural engineer reviewed the design, and cross bracing was designed and placed every 4 feet.

The next step was to stabilize the offset joints to prevent soil from falling into the pipe, and to ensure there is no future differential settlement or movement between sections that would damage the final CCCP liner.

WIN Structural Consultants designed a series of Z-metal ties to connect the pipe sections together. Once those metal ties were screwed in place, high-strength

Figure 2. Stabilization of Offset Joints

Figure 3. Nelson Stud and Wire Mesh Prior to Invert Concrete

mortar was placed to further seal the exposed soil and stabilize the joint. Crews then grouted the soil area to prevent future infiltration. Although there was no water or moisture present at the time of repair, this area had to be sealed off from a future potential infiltration source (Figure 2).

Once the pipe was safe to enter, and the exposed soil encapsulated to prevent potential locations for sinkholes at the offset joints, it was time to pave the invert in preparation for spincasting. There was significant debris that had to be removed, the CMP pipe walls pressure washed thoroughly, and all jagged protruding invert metal was cut out.

Since this is an active storm water culvert on the "Garden Island" of Kaua'i, there is a constant flow of water, and a bypass had to be set up to divert water from the work areas. A dam was placed at the upstream side, then a series of sump pumps were installed which pumped water up and out of the manholes, and into a drainage inlet to another stormwater pipe. Frequent storms posed many challenges for this bypass, as flows would overwhelm the dam and flood the pipe, washing more debris into the areas that had already been cleaned. Leaves, grass, and other debris would also clog the pumps, and some pumps were destroyed. To remedy this problem, a series of wire nets and cages were set up to try to prevent debris from clogging the pumps.

Figure 4. Significant groundwater infiltration

The invert paving design called for Nelson studs to be welded at each corrugation at least 3-inches into good metal on each side of the corroded invert. Wire mesh was then placed to connect the rows of Nelson studs before pouring a 4-inch thick base of high-early-strength concrete (Figure 3).

Figure 5. PL-8000 Spinner

Figure 6. A first pass of mortar in a pipe section.

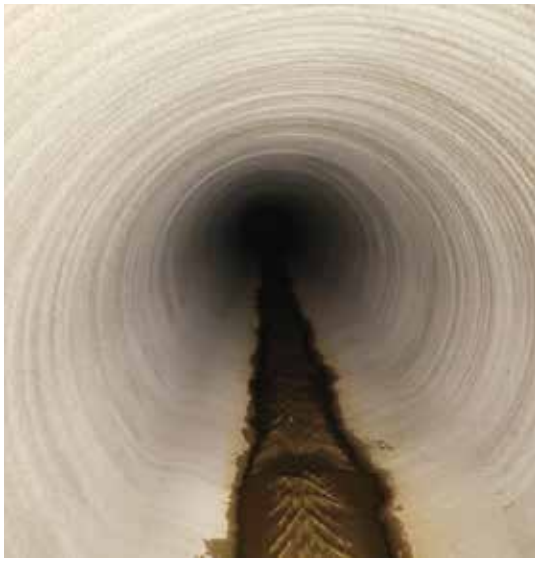


Figure 7. Completed liner section.

UNANTICIPATED GROUNDWATER INFILTRATION

No infiltration was present during the pre-inspection and preparatory work, and the soil exposed at each offset joint was dry. However, once the invert was paved, water started seeping in at joints throughout the entire length of the project, even with the bypass and sump pumps drilled into the invert at every manhole. The groundwater, which had previously entered the pipe through the corroded invert, now had nowhere to go, and was building up around the outside of the pipe. With the invert paved, Crews performed a series of soundings to determine the stability and bedding around the pipe. Large voids were revealed behind the pipe. The large voids were given a structural fix of Avanti AV-275 foam grout, while the infiltration areas and areas with wet sand backfill received AV-100 grout. Spincasting work in most sections was delayed as the large voids were structurally grouted.

While waiting for the structural foam grout to arrive, grouting was attempted throughout the pipe length at every infiltration point. However, when an area was grouted, a leak would sprout up through another pipe joint (Figure 4). This was one of the most difficult challenges of this project, and one, along with wet weather events, that caused the most significant time delays.

After numerous attempts, Crews took a methodological approach, starting at the uppermost section, grouting first, then quickly spincasting that section of pipe until the design thickness was reached. Only then would crews move to the next downstream section, repeating the process.

SPINCASTING WORK

The CCCP process uses a centrifuge with a spinning head rotating at approx. 10,000 RPM. The mortar mixer is located on the surface, and crews mix continuous batches of mortar with water. The prepared PL-8000 mortar is then pumped down through an adjacent manhole to the spincasting skid assembly. When the concrete is fed through the spinner, it slows down slightly, but is still rotating at a high speed (Figure 5). The high RPM of the spinner throws the mortar against the pipe wall where it sticks and compacts to form a smooth layer of mortar. A winch is used to pull the skid back at a controlled speed, to lay an even and continuous lift of material.

Multiple lifts or passes were done to complete each pipe section (Figure 6). When working with large diameter CMP pipe, the first lift is usually no more than a quarter-inch thick due to the smooth slippery surface of the host pipe. Subsequent lifts were up to a half inch thick.

QUALITY CONTROL

The most important quality control measures to ensure a successful project are: 1. Stabilizing the host pipe against future movement, 2. Stopping any infiltration that will impact the concrete coating, as described above, 3. Ensuring the mortar material meets design requirements for strength, 4. Ensuring the pump, spinner, and winch assembly are working properly to lay even lifts of material, and 5. Installing the minimum design thickness.

Testing

The mortar is tested prior to leaving the factory to ensure the design strength is as required. It's also important to mix a measured quantity of water with the mortar. Specialized mortar mixer/pumps have water meters to allow introduction of the exact amount of water required per bags mixed. Cube samples are taken each day from random pallets and casted per ASTM C-109. The cube samples are broken using compression testing at 24 hours, 7 days, and 28 days to help verify the material meets the design parameters. For this project, the average compressive strength far exceeded the design requirement of 8,000 psi.

Design Thickness

It's crucial to monitor the thickness to ensure the minimum design thickness of the mortar is reached in order to achieve the structural strength as designed. Screws were installed along the pipe walls at regular intervals, at precise lengths just shy of the design thickness, so that the last lift or pass would cover the screw head. With the winch controlling the spincasting sled at a constant rate, a uniform thickness is applied over the entire pipe surface until the design thickness is reached. Crews also tally the bag count used per section to ensure the correct quantity of mortar is placed. These calculations also help with planning the pallets needed for each section of lining so that they are readily available for each day.

CONCLUSIONS

The CCCP method was the best alternative for this project because of the non-circular shape of some of the pipe sections, the large diameter of the culvert, the severe offset joints, access restrictions that prohibited trenched methods, and because CCCP would maintain more of the overall dimensions and thus the design capacity required for this culvert. It also significantly reduced the impacts to homeowners over other alternatives.

CCCP has a small equipment footprint, utilizes existing manholes for access, and significantly increases the structural strength of a pipeline with a liner thickness of between 0.75 - 1.5 inches.

CCCP was also the most cost-effective alternative, saving this project more than $1 million dollars over a conventional trench and replace alternative. The completed liner is shown in Figure 7.

REFERENCES:

"Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or (50-mm) Cube Specimens", C109/C109M-05, ASTM International

ABOUT THE AUTHOR:

***Michelle Beason, PE**, is Regional Manager for National Plant Services, Inc., covering the 12 Western States, including Hawaii and Alaska. She received a BS in Civil Engineering from Purdue University, and is a registered California PE with almost 27 years of water and wastewater system maintenance and trenchless rehabilitation experience. Michelle is a Board Member of WESTT and a Board Member of NASSCO.*

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Make it a Double...Upsize

AUI, Inc. Successful at 100% Static Pipe Bursting Upsize In Farmington, NM

By: TT Technologies Inc.

Pushing boundaries has been one of the consistent story lines in the evolution of trenchless technology and the growth of trenchless contractors and engineers. The drive to see what's possible is in many ways responsible for the expanding capabilities of trenchless methods, the development of new ones and the widening exposure and acceptance of trenchless technology as a whole.

AUI, Inc, Albuquerque, NM is a contractor that epitomizes that drive. The civil and utility contractor has been using a variety of trenchless construction methods for decades. Recently, AUI had the opportunity to achieve a significant pipe bursting feat for the city of Farmington, NM, a 100 percent or double upsize of an existing sanitary sewer main.

According to AUI Trenchless Manager Mike Rocco, the project had been in the works for several years. He said, "I was approached by the engineering firm of Cheney, Walters and Echols [Farmington, NM] about three years ago about the feasibility of pipe bursting and upsizing from 8-inch VCP to 16-inch fusible PVC. We met and decided under certain circumstances it would be possible to complete a 100 percent or double upsize, however, a soils report would be a vital piece of information to help determine the amount of soil and material that would need to be displaced. Once the soils report was completed, the engineers at TT Technologies sized the proper machine for the job."

The city of Farmington had several problems with the existing sewer line. In addition to the main missing pipe, it was undersized and surcharging at the manholes. The engineering firm specified pipe bursting as the rehabilitation method of pipe replacement. The existing sewer was 8-inch inside diameter and the capacity requirements was to upsize to 16-inch nominal diameter pipe and this would require a 100 percent increase in size.

For the West Main Street Water and Sewer Improvement Projects, AUI chose to utilize a Grundoburst 1900G static pipe bursting system from trenchless

> *The fact that we were able to burst, expand and increase an existing 8-inch clay pipe to a new 16-inch FPVC pipe was pretty cool!*
>
> – Mike Rocco, Trenchless Manager, AUI Inc.

Bursting runs were determined by manhole location. Longer runs included bursting through a manhole and onto to the next.

equipment manufacturer TT Technologies Aurora, IL.

According to TT Technologies pipe bursting specialist Dave Holcomb, to complete the significant upsize took planning and execution. He said, "An upsize of that nature is really challenging and can be disastrous if not done right. Mike Rocco and AUI planned things out well and did a good job putting the pieces together for a successful project."

CONTRACTOR BACKGROUND

WESTT member contractor AUI, Inc. is a wholly New Mexico owned and operated corporation with 34 years of experience in heavy civil construction in the southwest United States. Founded in 1981, AUI has evolved with the times and the industry to become a multi-disciplined and diversified contractor offering a wide variety of services that include structural concrete and bridges, concrete paving and channels, heavy earthwork and trenchless technology, including pipe bursting, slip-lining and manhole rehabilitation. Regionally, AUI is one of the leading providers of trenchless technology construction services.

AUI's in-house resources include Professional Engineers (PE), Project Management Professionals (PMP), Certified Professional Estimators (CPE), Safety, Health and Environmental Professionals (SHEP), Certified Construction Industry Financial Professionals (CCIFP), and Professionals in Human Resources (PHR). With a range of crews specializing in concrete, earthwork, asphalt paving, and utilities, AUI was the ideal contractor for the challenging West Main Street Water and Sewer Improvement Projects.

The projects included a sewer main replacement, manhole replacement and the installation of a new water main. The sewer main replacement project consisted of pipe bursting the existing 8-inch VCP sanitary sewer line and upsize to new 16-inch fusible PVC (FPVC) DR-18. This constituted an upsize of 100 percent. For the manhole section, AUI would rehabilitate the existing 4-foot diameter manholes with fiberglass inserts. And the installation of a 12-inch C-900, DR-18 PVC

Fusible PVC was chosen to replace the existing VCP sewer. The static pipe bursting process can accommodate a wide range of product pipes depending on the specific requirements of the job.

water line would be completed through traditional construction methods.

BURSTING DOWN THE HIGHWAY

For the bursting, a total of 3,910 LF of sewer main needed to be replaced. The depth of the existing sewer line ranged between 12 and 16 feet deep. And soil conditions, decomposed granite and sand with 2- to 4-inch cobbles, were conducive for pipe bursting.

Much of the bursting took place parallel to busy US Highway 64. According to Rocco keeping businesses open was only one of the concerns about the project. He said, "At first it was the fear of, will this really work, upsizing from 8-inch to 16-inch. We have never completed an upsize that large. Also, setting up the 6-inch pumps and 8-inch HDPE by-pass line for discharge and making temporary ramps for business access was very challenging."

Underground Solutions, Poway, CA, provided the 16-inch fusible PVC. Additionally, Underground Solutions was hired as a subcontractor to fuse the FPVC to the desired lengths usually 400- to 500-foot lengths and then pulled into the locations of the insertion pits for installation.

Rocco said, "Bursting run lengths were dictated by the distance between manholes. The shortest one was about 250 feet. That was the first burst. It was successful with the machine pulling at about 50 percent power. From there, we gradually increased our distance of pulls. If we had two manholes close together, we would burst through one manhole and then onto the next. The longest pull was approximately 620 feet."

Holcomb said, "One of the advantages of the static pipe bursting process is the ability to use a wide range of product pipes. Static pipe bursting is able to accommodate fusible pipes, as well as a variety of restrained joint pipe materials with special adapters and tooling. Fusible PVC used has been a quality choice for numerous pipe bursting projects."

AUI made two excavations on each run. The first was the machine pit where the hydraulic Grundoburst was placed. The length of the trench box was 36 feet long and 12 feet wide. From that pit, the existing VCP sewer main was rodded with

To complete the 100 percent upsize from 8-inch VCP to 16-inch FPVC, AUI used a Grundoburst static pipe bursting system from TT Technologies.

Quicklock bursting rods. The second pit was the insertion pit where the FPVC and the bursting head were connected to the bursting rods. AUI crews also excavated sewer services if required.

Once the machine pit, insertion pit, by-pass pumping and pipe fusion was complete, the pipe bursting process began. Rocco said, "It would take a day to fuse the pipe. Then a day to dig and shore the pits. A day to burst and pull in the pipe and a day to backfill. So, over a four to five day period you would complete a bursting run. We worked four, ten-hour days on this particular project. Monday through Thursday which created less disruption for the business, especially over the weekend."

The sequence continued until all segments for bursting were successfully completed.

MANHOLE MAKEOVER

Once the bursting phase was complete, AUI crews turned their attention to the existing manholes that were severely deteriorated due to hydrogen sulfide and required rehabilitation or replacement. The original specification called for removing and replacing the manhole in kind, which would require open cut excavation and bypass pumping of the sewer.

Rocco said, "We proposed to basically slip-line the old manholes with new fiberglass inserts designed for H-20 loading, build up existing shelves with a Strong Plug to the top of the new FPVC pipe and install a new ring and cover. This was accepted by the city and saved time and money."

The fiberglass inserts were built by LFM Manufacturing Inc., Giddings, TX. In order to install the fiberglass inserts, AUI crews needed to build up the existing benches in the manhole and then remove and dispose of the existing manhole ring, cover and concrete collar. This was followed by the removal and disposal of the first existing concrete cone section.

AUI crews then sliplined the old barrel section of the manhole with the fiberglass insert. The annular space, approximately 1-inch, was then filled with lean fill concrete. A new 24-inch ring, cover and concrete collar complete the installation. Sixteen manholes were rehabilitated in total.

A LITTLE OPEN CUT

The final component of the project was completed through traditional open cut excavation. The existing 6-inch water line was abandoned in-place. The new installation included 5,871 LF of 12-inch C-900 PVC water line, valves and double pumper fire hydrants with 12-inch PVC moving into the city's right of way on US 64 highway.

Rocco said, "There were many components to this project. But the fact that we were able to burst, expand and increase an existing 8-inch clay pipe to a new 16-inch FPVC pipe was pretty cool! I have to give a ton of credit to our entire crew who worked tirelessly on this job to make this bursting project a success!"

Holcomb said, "This was a challenging pipe bursting project. A 100 percent upsize is a significant accomplishment and AUI was the ideal choice for it."

Repeaters Extend HDD Tracker Range Cutting Job-time

By: Subsite Electronics

Like any good businessman, Michael Melson knows time is money. The more productive his crew can be on a jobsite, the more profitable that HDD bore will be. That's why he invests in HDD equipment he can rely on, from his drill to his tracking system. But one of the newest tools in his arsenal is a simple signal repeating accessory that has made a big impact on his work. Repeaters, like the TK RECON™ Repeater from Subsite® Electronics, are designed to extend the telemetry range of HDD trackers. This recently came in handy for Melson.

"Every minute you're out there is an expense," said Melson, vice president of L&M Construction. "That's why a repeater is a must-have in your toolbox. It doesn't just extend the range of your tracker when you don't have line-of-sight back to your drill, it saves time and money."

"We had a 1,032-foot bore, crossing two streams, with 80 to 90 feet of elevation change," he recalled. "Line-of-sight was definitely an issue. Within 30 feet I was in heavy timber. Then, in the stream beds, I was 35 to 40 feet below the drill level and standing in water. There was no way the tracker was going to communicate with the drill."

> *Within 30 feet I was in heavy timber.*
>
> – Michael Melson, Vice President, L&M Construction

Melson said he could've used his two-way radios to communicate with the HDD operator, but in addition to being a hassle, the start-and-stop nature of communicating with radios would cut into forward progress.

Must-have where line of sight is an issue

Repeaters can be more effective than running a wireline

"Using a repeater solved it all," Melson said. "It sent the tracker signal back to the drill without any issues. It was just like I was standing there in front of the drill within a few hundred feet. It saved a ton of time. Not just with the back-and-forth on the radio, but I would've been walking back through the woods every two or three hours to change out the batteries in my two-way from the constant use."

Melson is quick to point out additional benefits of this technology. For example, he notes many bores traditionally done with a wireline can now be done as a simple walkover locate if you use repeaters (you can link several together to extend your tracker's range even further).

According to Melson, it is easier and cheaper than running a wireline. "The thing is so simple. One button. Just set it up and let it go. I ran it 12 hours straight without a charge on that job. They say it can go 50 hours."

ABOUT SUBSITE ELECTRONICS:

Subsite® Electronics provides underground construction professionals a comprehensive suite of electronic products, including utility locators, Horizontal Directional Drilling (HDD) guidance equipment, utility inspection systems, and equipment machine controls. Subsite has established itself as a premier source of electronic technology supporting the installation, maintenance and inspection of underground pipe and cable.

NMDOT Otero County Reline

Holloman Air Force Base, Alamogordo, NM

By: R. Justin Walton, Jr., Contech Engineered Solutions

Holloman Air Force Base (AFB) is located six miles southwest of the central business district of Alamogordo, New Mexico and supports U.S. national security objectives by deploying worldwide to support peacetime and wartime contingencies. After the events from the morning of September 11th, 2001, all of the entrances to the Air Force Base were closed except for the main entrance located off of US Highway 70. This highway splits into a divided 2-lane highway near Holloman AFB and stays very busy as a result of being located near the primary entrance and exit point for the base as well as a main route for the largest military installation in the U.S. – the White Sands Missile Range. In 2005, the New Mexico Department of Transportation (NMDOT) determined that a 20-cell concrete box culvert under the west bound lanes of US-70 near the main entrance was becoming structurally deficient and would need to be replaced. The initial plan from the engineers at District 2 in Roswell was to remove the concrete box culvert and construct a new bridge for the highway to cross over an existing arroyo. Arroyos are a common sight in the New Mexico landscape and can present serious flash flooding issues as they fill up and flow during rain events.

For a new bridge to be constructed, the NMDOT would be faced with a large expense as well as delays caused by the closure and bypassing of US-70. A costly bypass during construction would create major issues with access to Holloman AFB, which was very busy at that time operating as a critical base to support training efforts for Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom. To avoid this unacceptable detour for the base as well as the costly installation of a new bridge, the NMDOT decided that the best solution would be to rehabilitate the existing multi-cell concrete box culvert by utilizing a structural reline approach.

After reviewing other options, the NMDOT-approved, DuroMaxx® Steel Reinforced Polyethylene (SRPE) liner pipe manufactured by Contech Engineered Solutions was selected to reline the existing 20-cell concrete box culvert structure under the west bound lanes. Working closely together, Contech and the NMDOT came up with a cost-effective and straight forward solution for rehabilitation of the aging structure, which was built in the late 1980s and consisted of nineteen 5 x 5-foot cells and one 6 x 7-foot cell. As run-off water and soils in this particular part of New Mexico can be corrosive, the high quality HDB rated thermoplastic resins used in the manufacture of SRPE pipe made DuroMaxx® an excellent choice. Also, since the condition of the host concrete box culvert was deemed structurally deficient, with spalled and cracked areas throughout, it was imperative that the new reline pipe provide a 100 percent structural solution, carrying all of the dead and live loads above with no load reduction factor attributed to the deteriorating boxes.

Maintaining proper hydraulic capacity was also achieved due to the smooth interior of the SRPE pipe.

The concrete box culvert barrels were 58 feet long and required the same length of DuroMaxx to be installed in each barrel. For each of the 20 culverts, Contech provided three joints of pipe, two at 24 feet and one at 10 feet in length. One of the openings near the center of the structure was oversized and therefore lined with larger 66-inch diameter SRPE liner pipe to accommodate low flows occurring at the middle of the arroyo.

The SRPE liner pipe was manufactured with HDPE skid rails attached to the bottom of each pipe section via plastic extrusion welds to increase the ease of installation for the contractor. The pipe was joined together with sanitary grade water tight steel reinforced bell and spigot joints. Once the liner pipes were slid into position inside the host structure by pushing in with a small skid steer, the next step would be to grout the interstitial area between the inside of the host structure and the outside of the liner pipe. The recommended grouting details and proposed grout mix design were presented by Contech for use by the contractor, General Hydronics, for preparing their grout plan submittal.

Numerous two inch threaded grout ports were added to the liner pipe at the manufacturing plant so that the entire annular space between the pipe and the host culvert could be grouted from inside of the pipe – this was an important factor since pumping grout down through holes from the surface would have required traffic lane closures and delays. The lightweight grout was pumped into the annulus in three lifts – this staged grouting method ensured that the new liner pipe would not move or float during the grouting process and remain aligned inside the host structure. Also, screw type jacks were periodically spaced inside the liner pipe and located where the top of the jack could pass through grout ports located at the crown of the liner pipe and brace against the roof of the concrete box culvert to hold alignment vertically. For horizontal alignment, wire angles were used against the outside of the liner pipe to aid in blocking and bracing the liner pipe against the inside of the host structure while the grouting was performed. Finally, a concrete end wall was poured around the ends to finish off the installation.

The entire multi-cell concrete box culvert relining project was completed within four weeks, which was well within the required 60-day timeframe originally specified by the NMDOT. The end result was a success, and the NMDOT were able to revitalize a large buried bridge with a cost-effective solution.

Not long after this work was performed, an identical 20-cell concrete box culvert in the same area under the east bound traffic lanes of US-70 had reached a point where it too was needing structural help. The NMDOT knew right away what was needed to facilitate this rehabilitation without taking any part of the highway near Holloman AFB out of service and without having a costly detour built. In 2017, the structural reline for this second concrete box culvert located under the east bound lanes of US-70 was successfully completed in an identical fashion utilizing 54-inch and 66-inch diameter DuroMaxx SRPE liner pipe with welded skids and 2-inch threaded grout ports. Eddy Boles, utility supervisor for General Hydronics stated, "The DuroMaxx pipe with the skids and grout ports worked very well; the skids held the pipe in place and the grout ports made the grouting very simple."

ABOUT THE AUTHOR:

Justin Walton, Jr. *is a Civil Engineering graduate of Auburn University with 25 years of experience in the civil site development and drainage sectors, a member of ASCE, and is currently working as Area Manager – Pipe for Contech Engineered Solutions covering the South Central and Midsouth regions of the U.S.*

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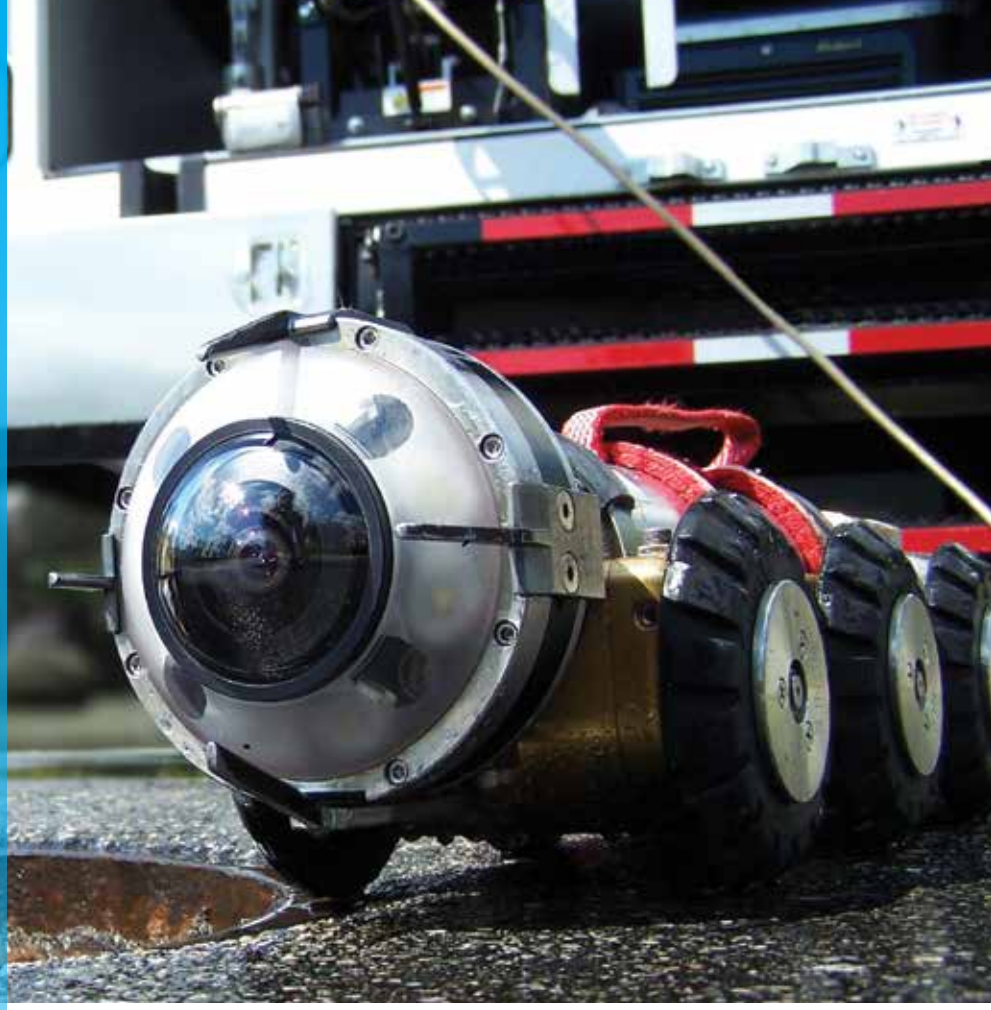

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