Record Direct Pipe Job Solves Challenges of Unique Project

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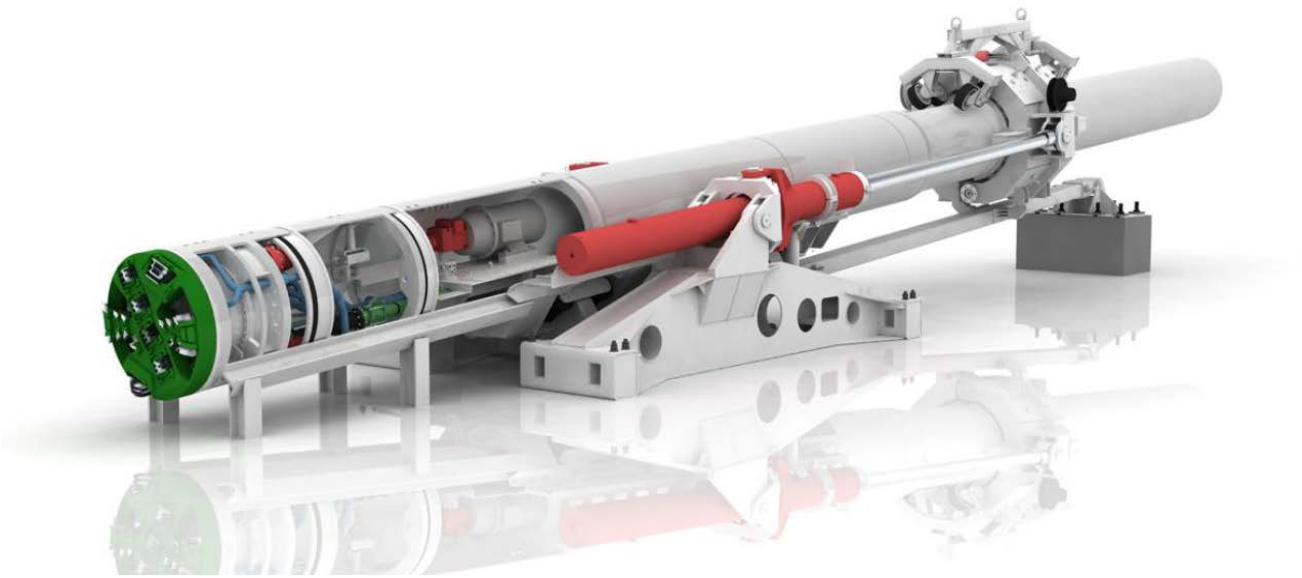
Track VII-C, Feb. 1, 10:30-10:55 a.m.

INTRODUCTION TO DIRECTPIPE®

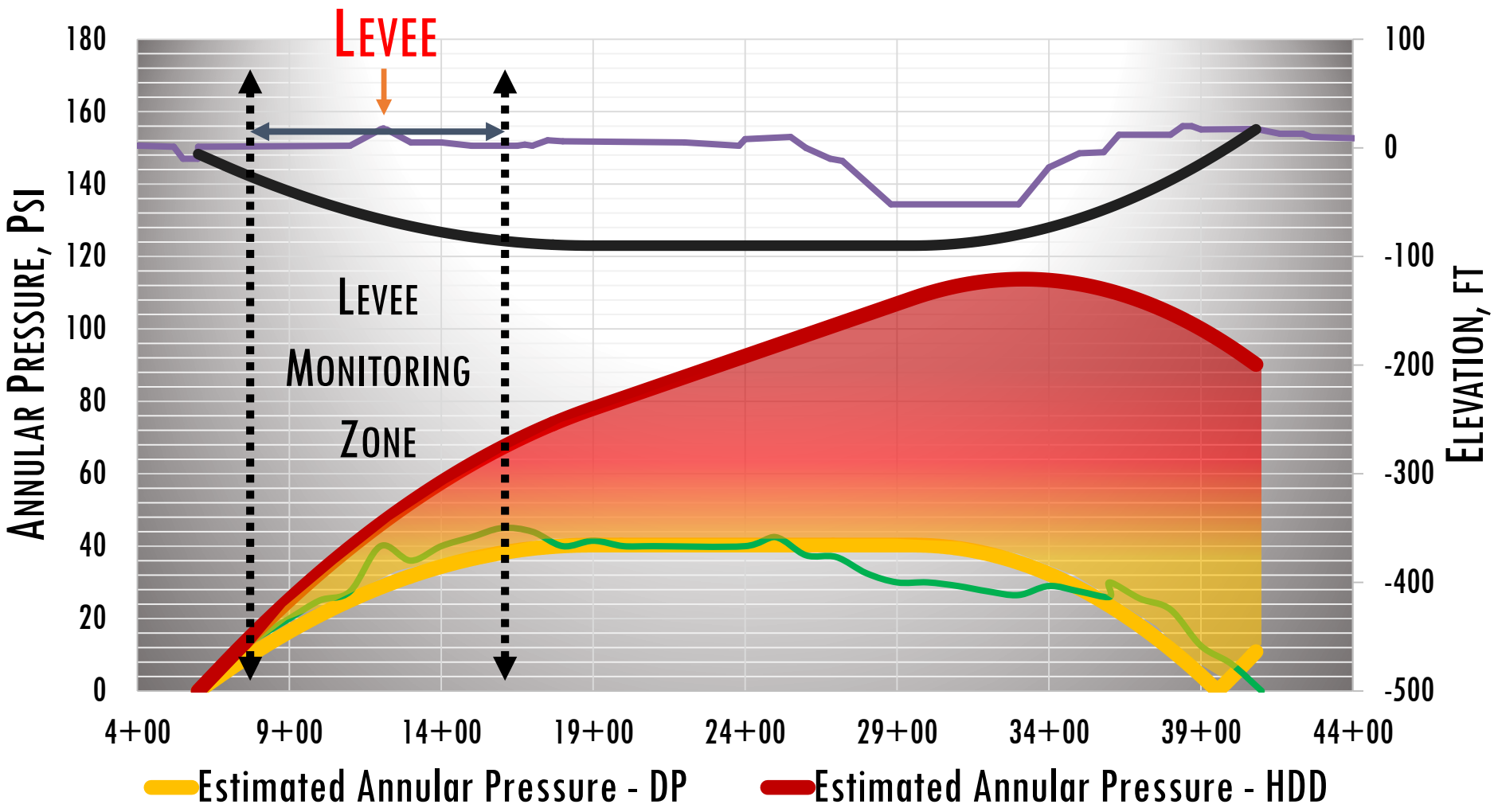
The DirectPipe® Method is a Combination of Two Already Proven Technologies.



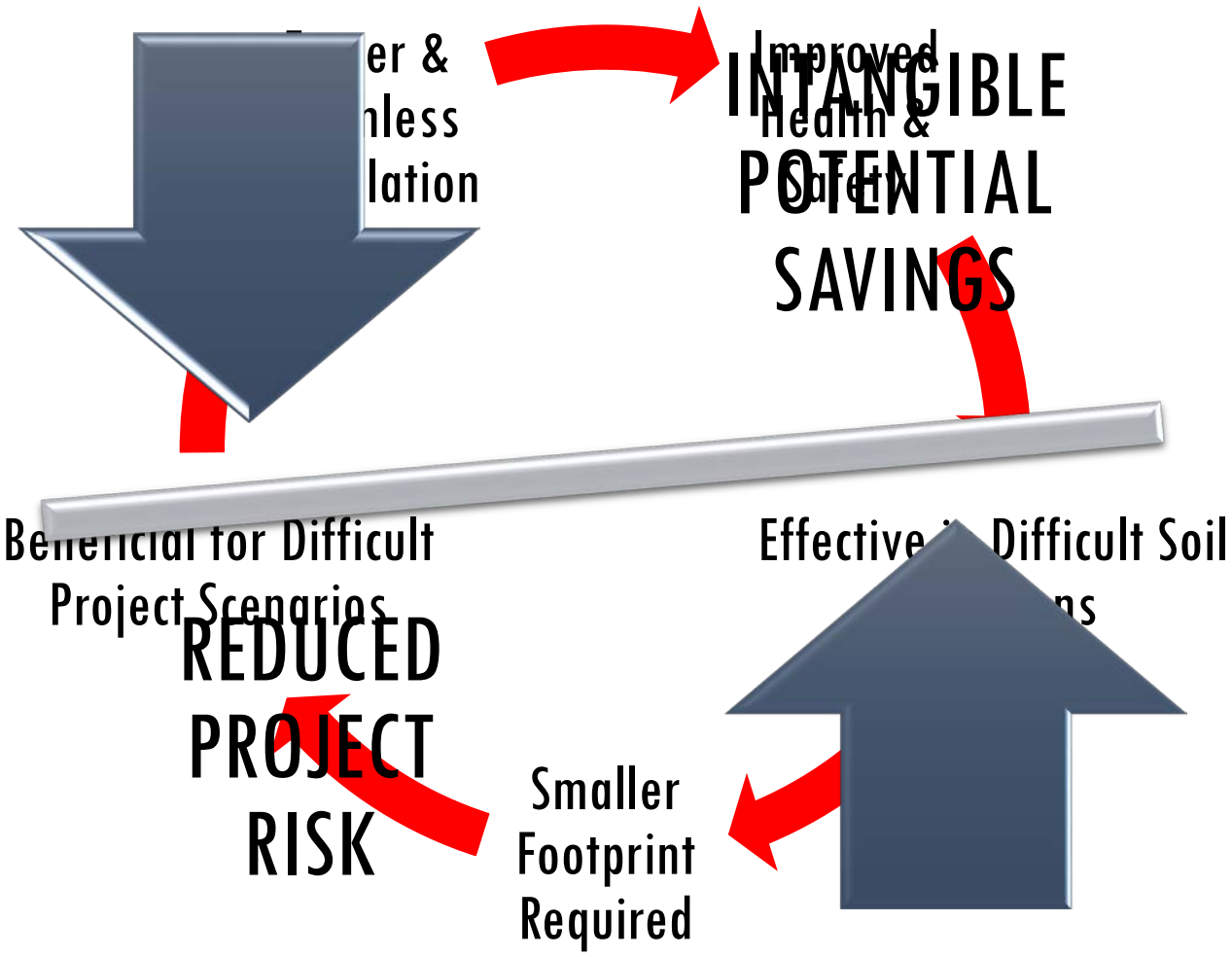
Resulting in Particularly High Installation Speeds.

CRITERIAL	HDD	DIRECT PIPE
Cobbles & Boulders	High Risk Of Failure	Can Negotiate Up To 1/3 Size Of The Cutterhead
Clay Formation	Low Factor Of Safety Against Hydraulic Fracture	Better Factor Of Safety Against Hydraulic Fracture
Depth	Generally Greater Than 25-ft	Can Be Designed At Depth Of 3 X Pipe Diameter
Length	Longer To Achieve Greater Depth	Can Be Designed Shorter
Installation Stresses	Tension, Bending And Combined	Compression, Bending And Combined; Column Buckling
Min. Install Radii	Governed By Operation Stresses	Governed By Installation Stresses
Annular Pressures	Sum Of Hydrostatic Pressure And Cutting Transfer Pressure	Only Hydrostatic Pressure
Foundation	Traditional Deadman	Engineered For Site Conditions & Anticipated Loads
Pipe Stringing	Typically Exit Side	Entry Side

Annular Pressure Comparison



UNDERSTANDING THE BENEFITS OF DIRECTPIPE®



Laney Directional Drilling Experience

LOCATION	OWNER	CROSSING	LENGTH	DIAM.	COMP.
Saylorsburg, PA	Williams	Aquashicola Creek	1,423	48"	07|13
Port Arthur, TX	City of Port Arthur	Sabine Neches Waterway	3,506	30"	05|15
Freeport, TX	Phillips 66	Oyster Creek	1,850	16"	08|15
Cameron, LA	Cheniere	Future Plant Site	930	36"	01|16
Cameron, LA	Cheniere	Future Plant Site	1,610	36"	02|16
Cameron, LA	Cheniere	Future Plant Site	1,777	36”	02|16
Freeport, TX	Freeport LNG	Hurricane Levee	2,100	42"	04|16
Freeport, TX	Freeport LNG	Hurricane Levee Conduit	2,100	8“ & 12"	05|16
Port Neches, TX	Sunoco/STV	Salt Lake Canal	1,866	42”	07|16

Total Footage	**17,162**
Miles	**3.25**

Freeport FLNG Expansion Project

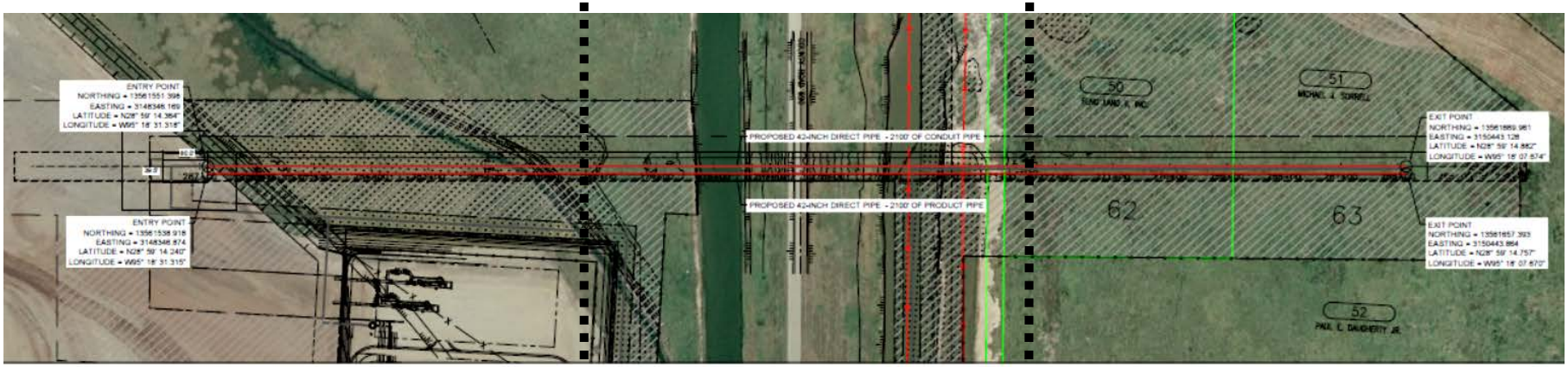
- Direct Pipe® installation of two (2) 42-inch parallel steel pipelines installed.
- Beneath the East Storm Levee which is part of the Freeport Hurricane Protection System located in Brazoria County, TX.
- At the end of the second installation, the 42-inch steel conduit was extracted to help the longevity of the pipeline.

Crossing Name	Use	Length (Feet)
Levee Crossing #1: 42”x 1.00”WT; Grade X-65	High Pressure Gas	2,100
Levee Crossing #2: 42” x .75” WT; Grad x-70	Conduit Only	2,100
Pipelines Installed Within the 42-inch Steel Conduit		
12-inch Steel Pipeline (Concrete Coated)		2,100
8-inch Steel Pipeline (Concrete Coated)		2,100
4-inch Steel Pipeline (ARO Coating)		2,100

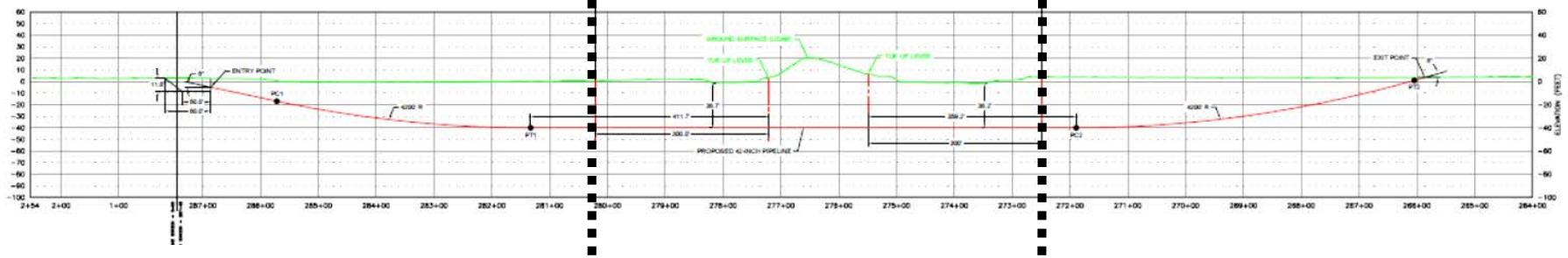
Project Challenges

- Maintaining the proper annular pressure limits on the first crossing where a failed HDD attempt had occurred.
- Due to the HDD attempt, the subsurface had been disrupted and drilling fluids had remained downhole in the vicinity of the tunneling path.
- Working inside of the FLNG facility around the other contractors (framing crews, pile driving crews, excavating crews, etc.) also faced a challenge in order to access the jobsite.
- Due to having high security parameters set in place, all loads had to have detailed coordination and the personnel were required to have safety training and badges in place in order to enter the jobsite.
- This project was different because a pipeline extraction had not occurred after successfully pulling back a bundle.
- This was the first time a successful extraction had been completed in North America. In addition, Laney completed both Direct Pipe® crossings using one launch pit which was unique.

LEVEE

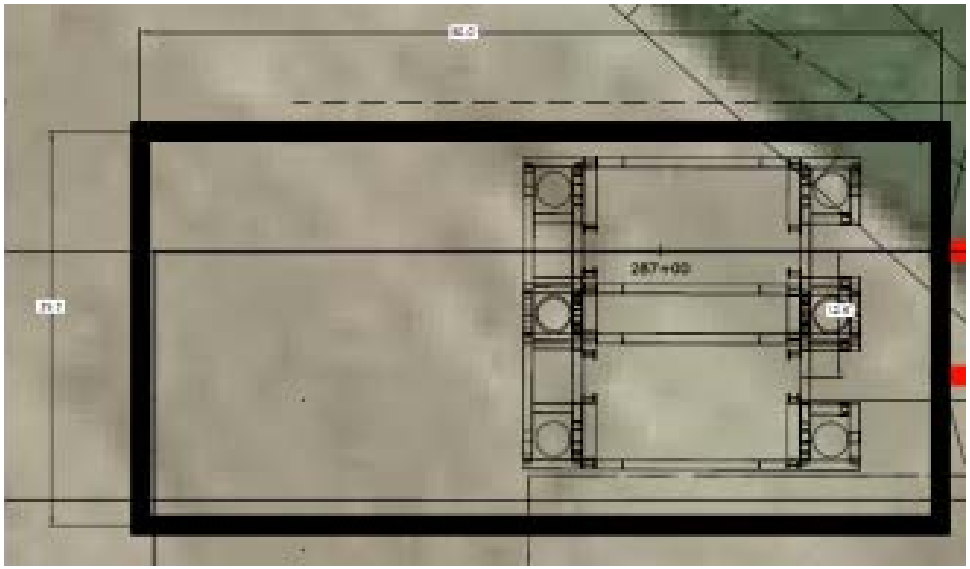


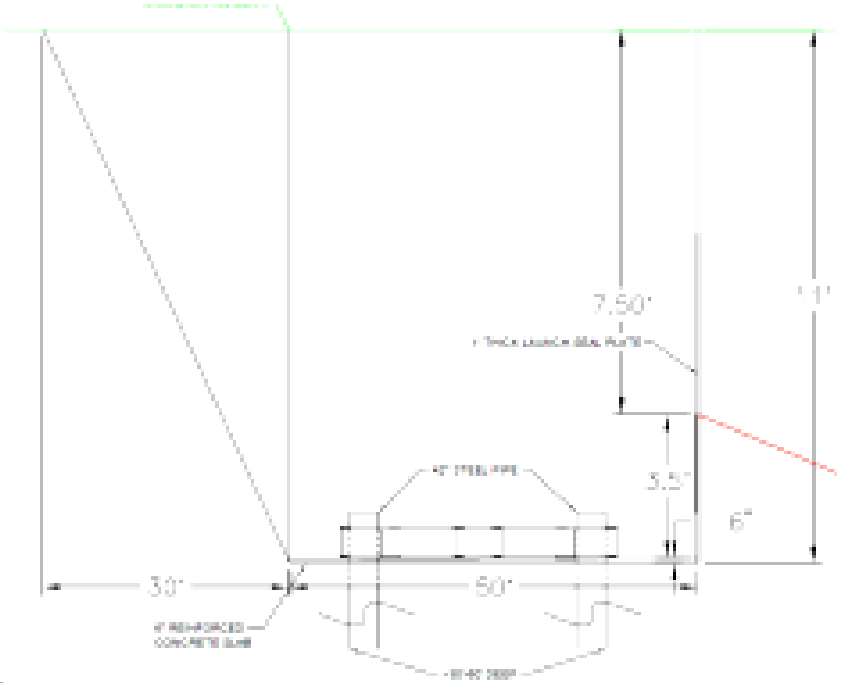
LEVEE MONITORING ZONE



Foundation Design

- The thruster was designed to be set-up inside an entry-pit approximately 39.5-feet wide, 80-feet long and 11-feet deep.
- A foundation approximately, 6-inch thick, 50-feet by 39.5-feet re-enforced concrete slab was poured inside the pit.
- The thruster frame was anchored to four (4) 42-inch steel pylons driven into the subsurface.

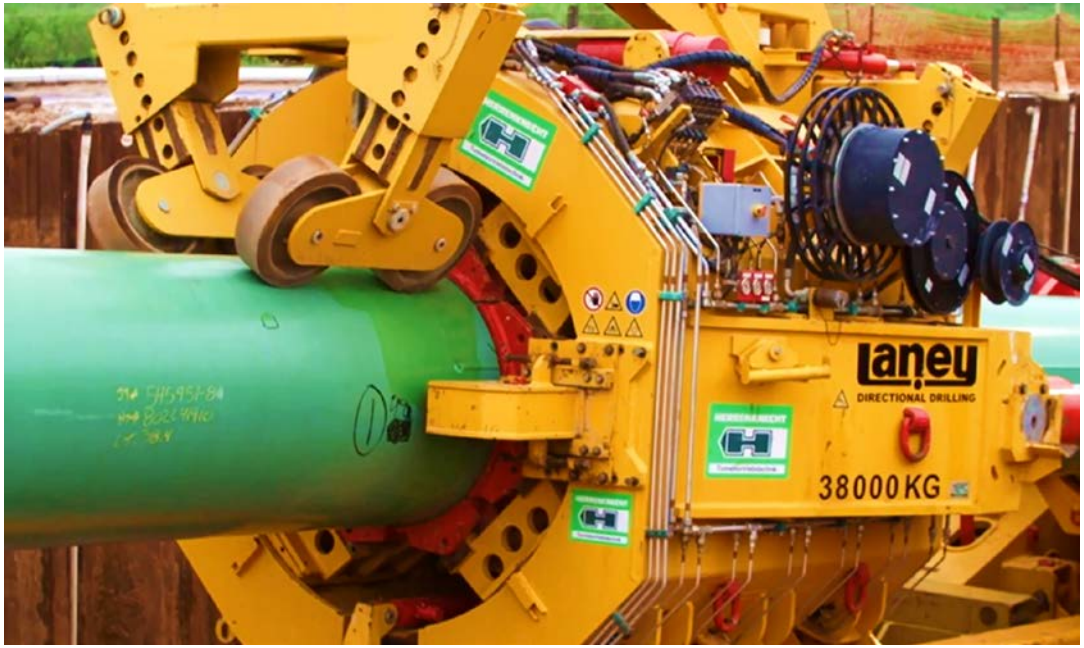




Foundation Construction

Equipment Selection

- Laney used the AVN800XC microtunnel boring machine, manufactured by Herrenknecht, AG.
- Herrenknecht HK750PT pipe thruster to install the steel pipeline.
- 42-inch Direct Pipe™ launch seal supplied by Herrenknecht, AG.
- Based on the geotechnical data provided, Laney employed a soft ground cutting wheel with a cutting diameter of 43.7-inches



Navigation

- Universal Navigation System Integral Module for the steering and guidance of the tunneling operation as well as the Gyro Navigation System (GNS).
- Outfitted with a GNS, the machine did not have any components installed inside the pipe and line-of-sight was not necessary between the components.
- The north-seeking gyro compass was permanently mounted inside of the MTBM and was used to calculate the direction of true North as a reference to the MTBM axis.
- The current position of the MTBM was also calculated via coupled navigation.
- Finally, the Hydrostatic Water Levelling (HWL) was used to obtain the elevation data

Tunneling Operations

Tunneling Operations

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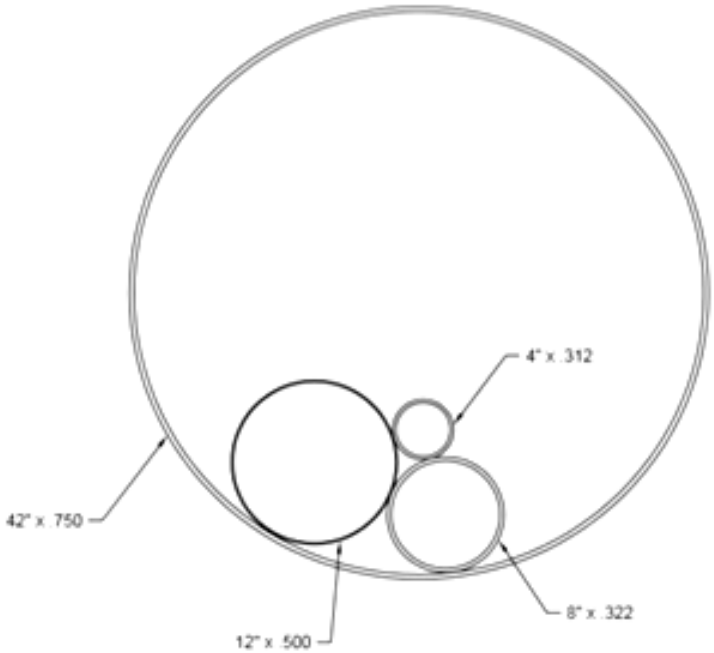
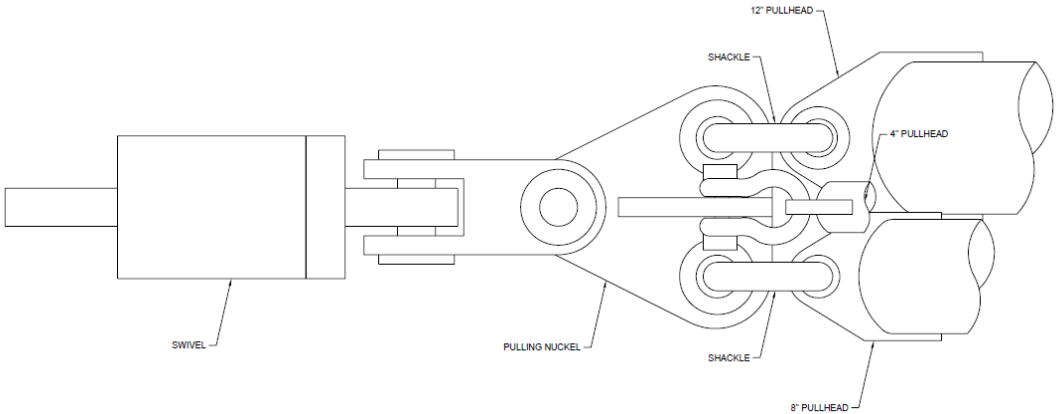
Bundle Extraction





Project Schedule

- Construction safety training and equipment mobilization started on Monday, March 7th, 2016.
- Rig-up and foundation activities lasted twenty (20) shifts completing on Tuesday March 29th.
- Tunneling began on Wednesday, March 30th and was completed utilizing 24 hour a day operations until completion on Monday April 4th, 2016.
- The total shifts required for crossing #1 was 53 over 42 days.
- As Crossing #1 approached completion, the Direct Pipe® assemble was relocate to the second launch location.
- Tunneling began on Thursday, April 14th and was completed utilizing 24 hour a day operations until completion on Monday April 18th, 2016.
- Pullback of the bundle started on Tuesday April 26th and was completed in (2) shifts.
- Pipe extraction was completed on Tuesday, May 3rd and required four (4) total shifts excluding one rain day.
- The total shifts required for Crossing #2 was 53 over 42 days.

Results and Conclusions

- Laney was able to complete the total project scope in significantly less time than anticipated.
- Pit construction was estimated to take 3,192 and was actually completed in 2,252.
- The installation of the Launch Seal took 432 hours instead of the 504 allowed.
- For the Crossing #1, the budgeted hours were 3,864 while actual construction required only 1,140.
- The exit & removal and installation of the 2nd launch seal was 3,360 while only 1,044 were required.
- For the Crossing #2, the budgeted hours were 3,864 while actual construction required only 1,330. Removal & pit demolition took 1,758 which was over the 840 days allotted.
- Total man hours budgeted were 15,624 and the actual work was completed in just over half that amount with a grand total of 7,956.
- ***In the end, Laney was able to finish the entire project 30% ahead of schedule, saving WHC significant time and money while successfully completing the project without having an inadvertent release of drilling fluids.***