37TH INTERNATIONAL NO-DIG FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

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Unique Horizontal Drain Installation under a Building Using Pilot Tube Guided Auger Bore Methods

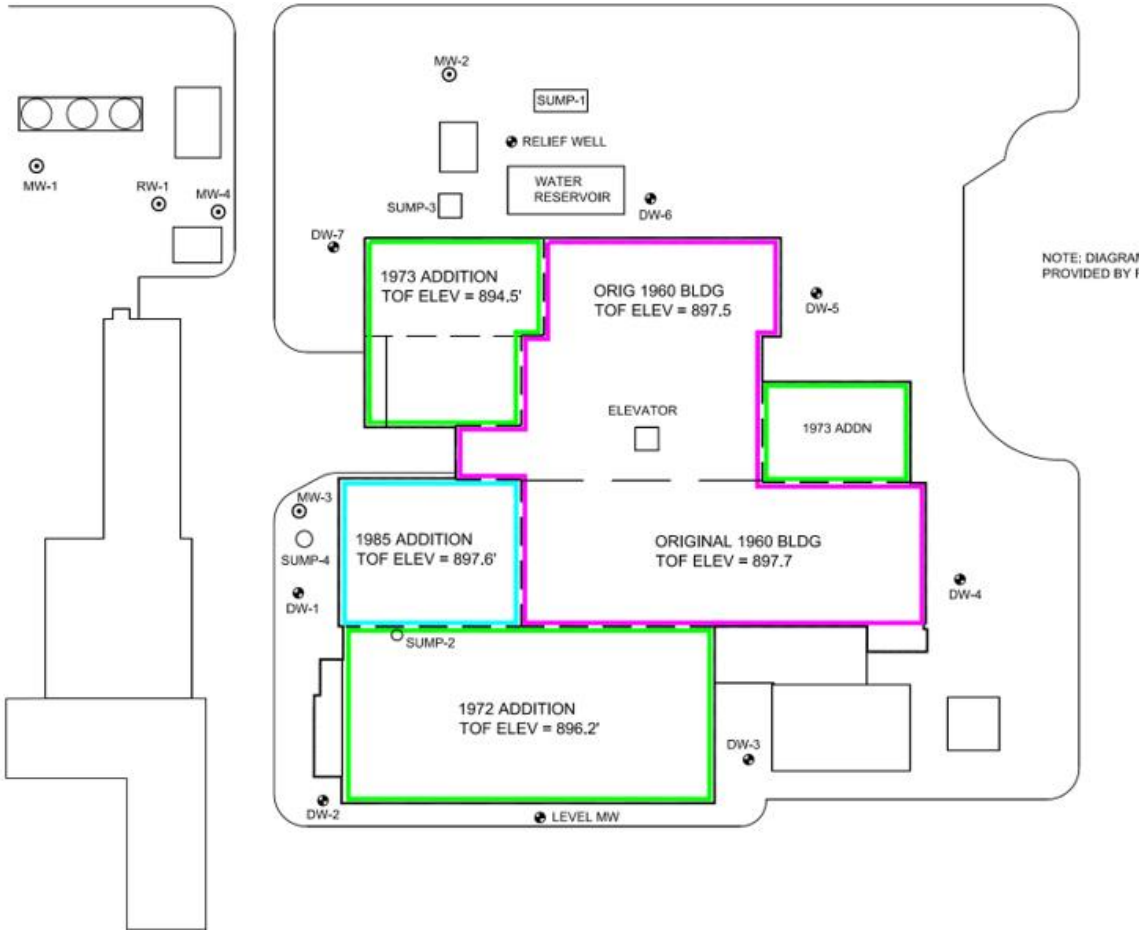
Michelle Macauley - Macauley Trenchless
Steve Torgerson - Trenchless Construction Services

AGENDA

- History of the site
- Trenchless considerations
- Trenchless design
- Pre-construction
- Construction
- Lessons learned

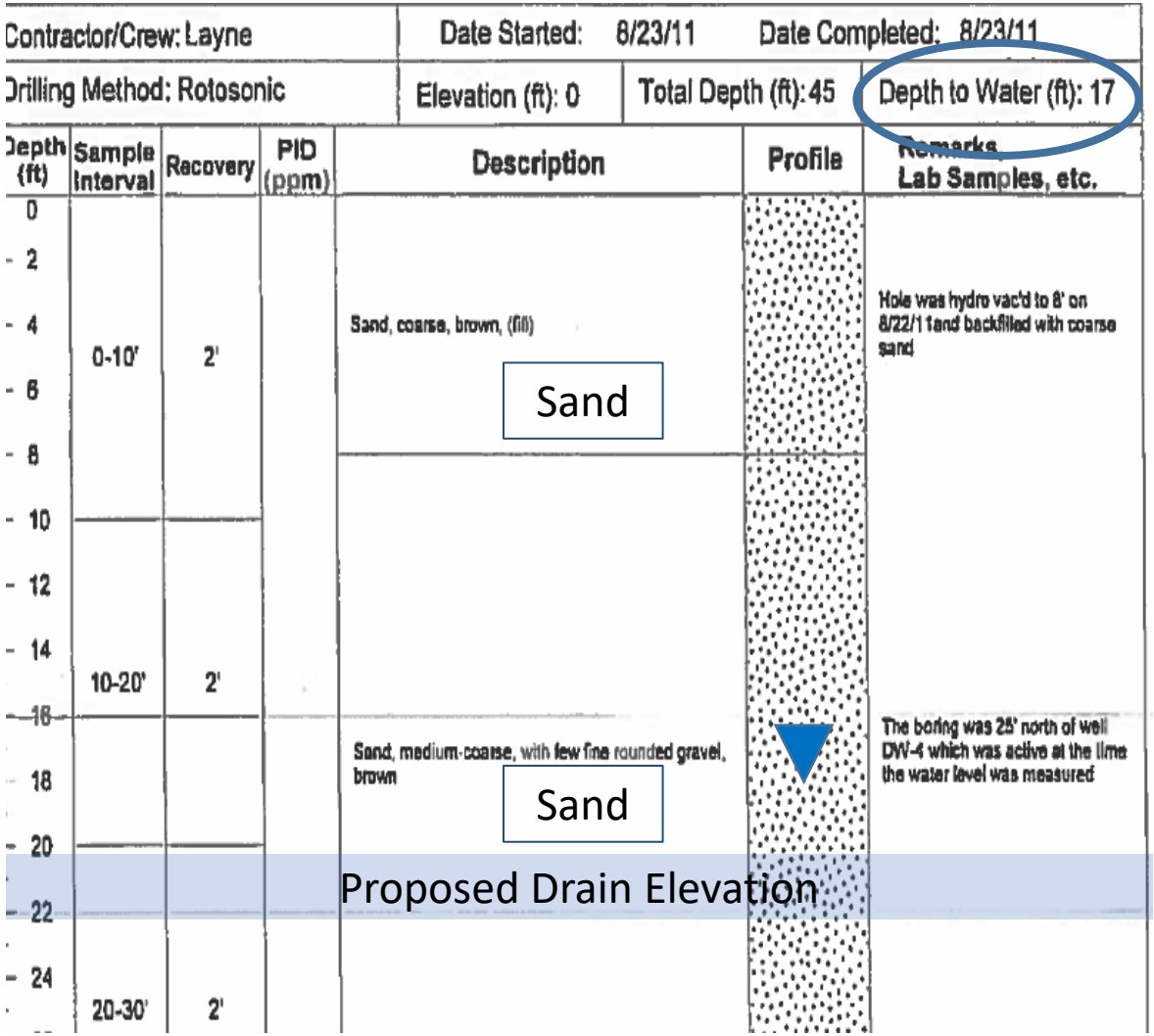
History of the site

- Built in the 1960s in a flood plain
- Additions added over decades at different elevations
- Original design included waterproof membranes, sub-slab drainage, and perimeter drains
- Subsequent additions experienced flooding



Past Solutions for Flooding

- Vertical dewatering wells installed around perimeter in 1990s
- Worked well until 2010
- Investigation found that the wells had reduced capacity due to being fouled with iron-fixing bacteria
- Additional wells were installed in 2014 but only worked for a few years

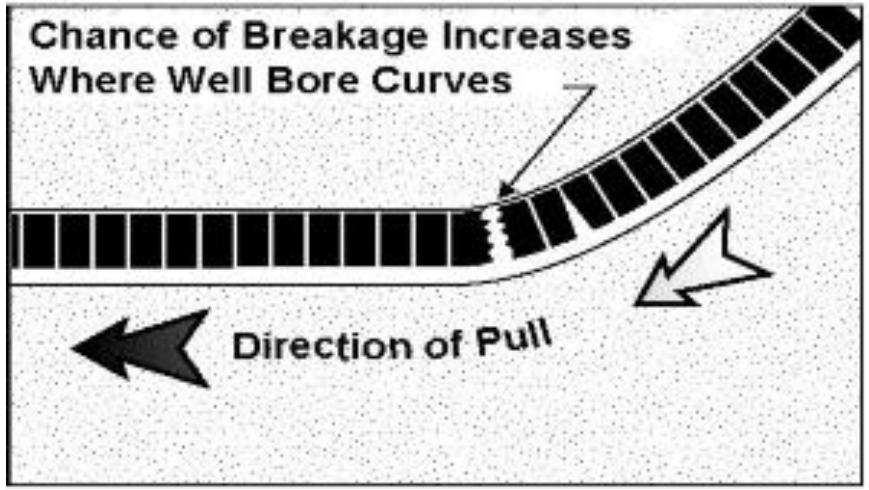


Trenchless Considerations

- 400-foot installation length
- Both 6-inch and 10-inch diameter installations
- No construction access inside the building during horizontal drain installation
- Granular soils with a high groundwater level
- Installed well screen needed to be robust to allow for post-installation (long-term) cleaning.

Trenchless Options

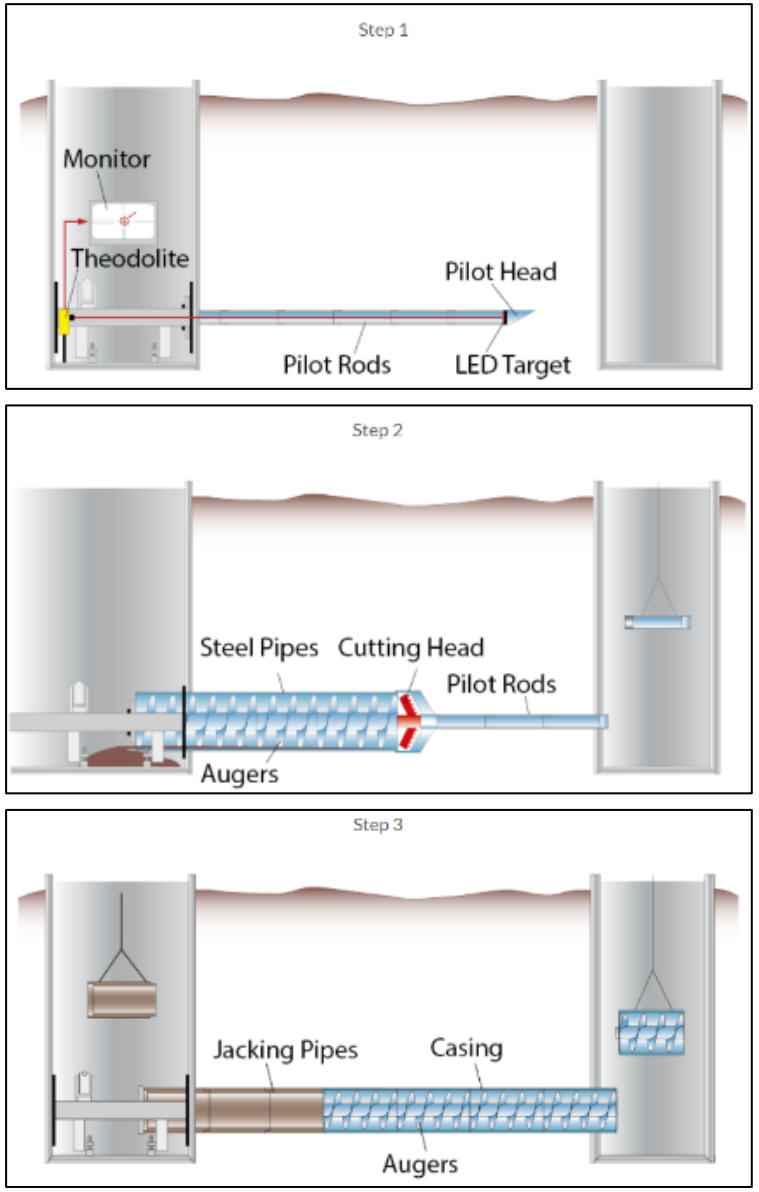
- Horizontal Directional Drilling
  - Settlement potential with overcut borehole
  - Low accuracy (no access to building)
  - Curvature of pullback could damage drains
- Auger Boring
  - Low accuracy
  - Oversize casing
- Pilot Tube Guided Auger Boring
  - Very accurate
  - Unique install w/oversize casing



SOQ 2005, DTD Inc,

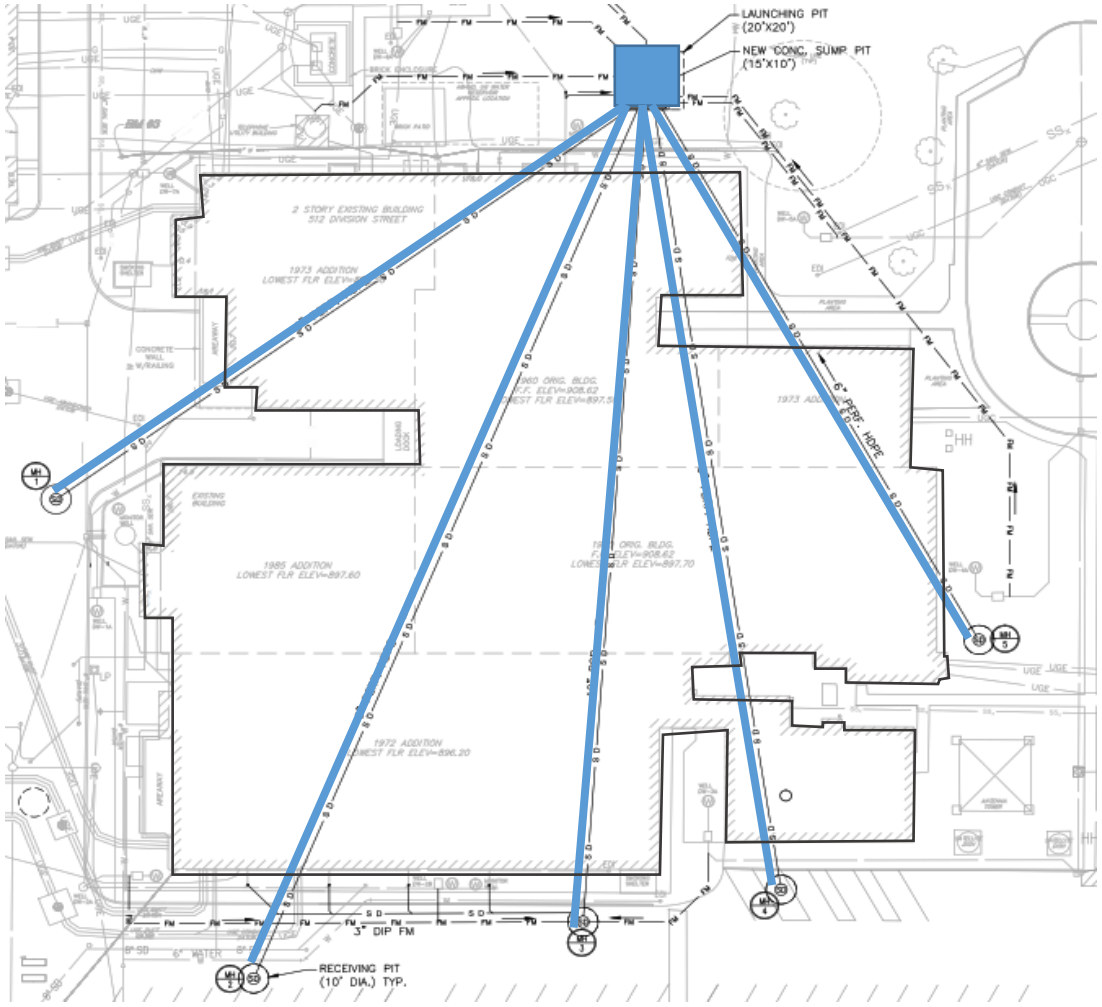
Benefits of Pilot Tube Guided Auger Bore

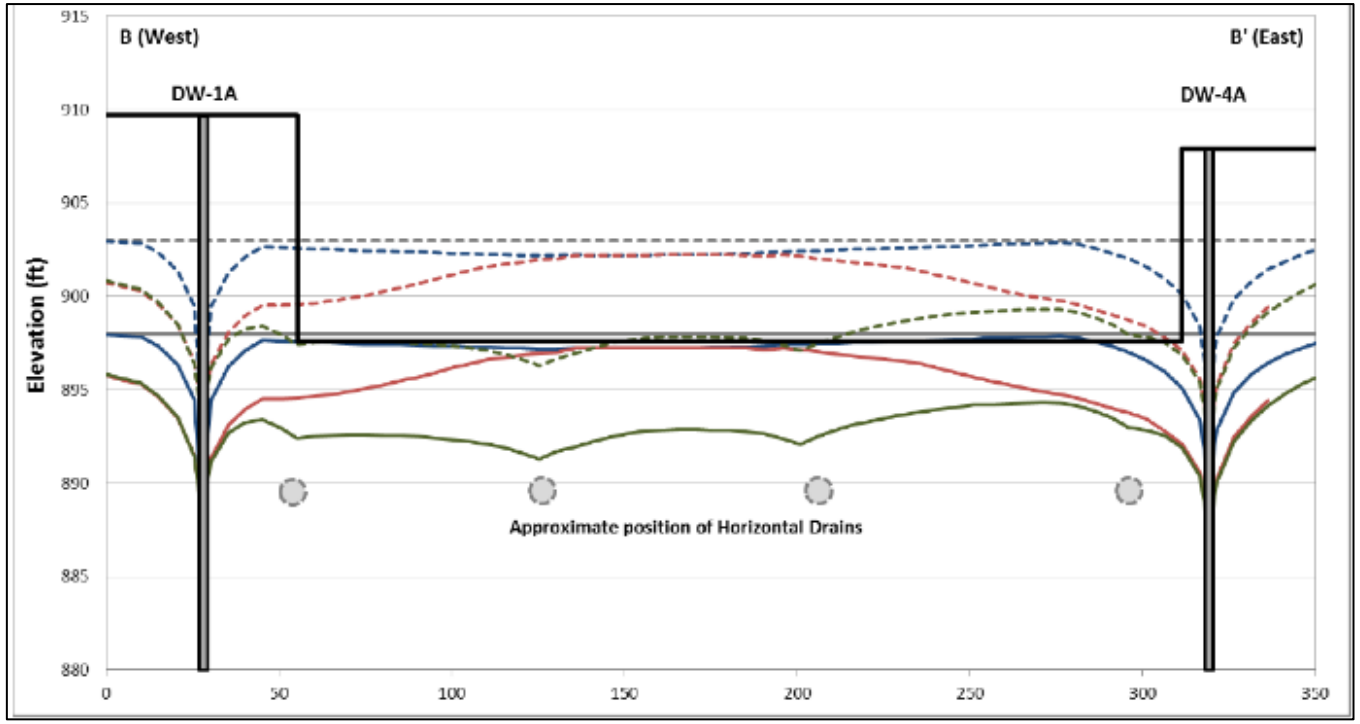
- All steering and guidance is located in the launch pit
- Straight pit-to-pit installation method, no curves
- No drilling fluid is typically used during installation that could foul the well screens
- The amount of over-cut is considerably smaller than HDD, which reduces the potential for settlement



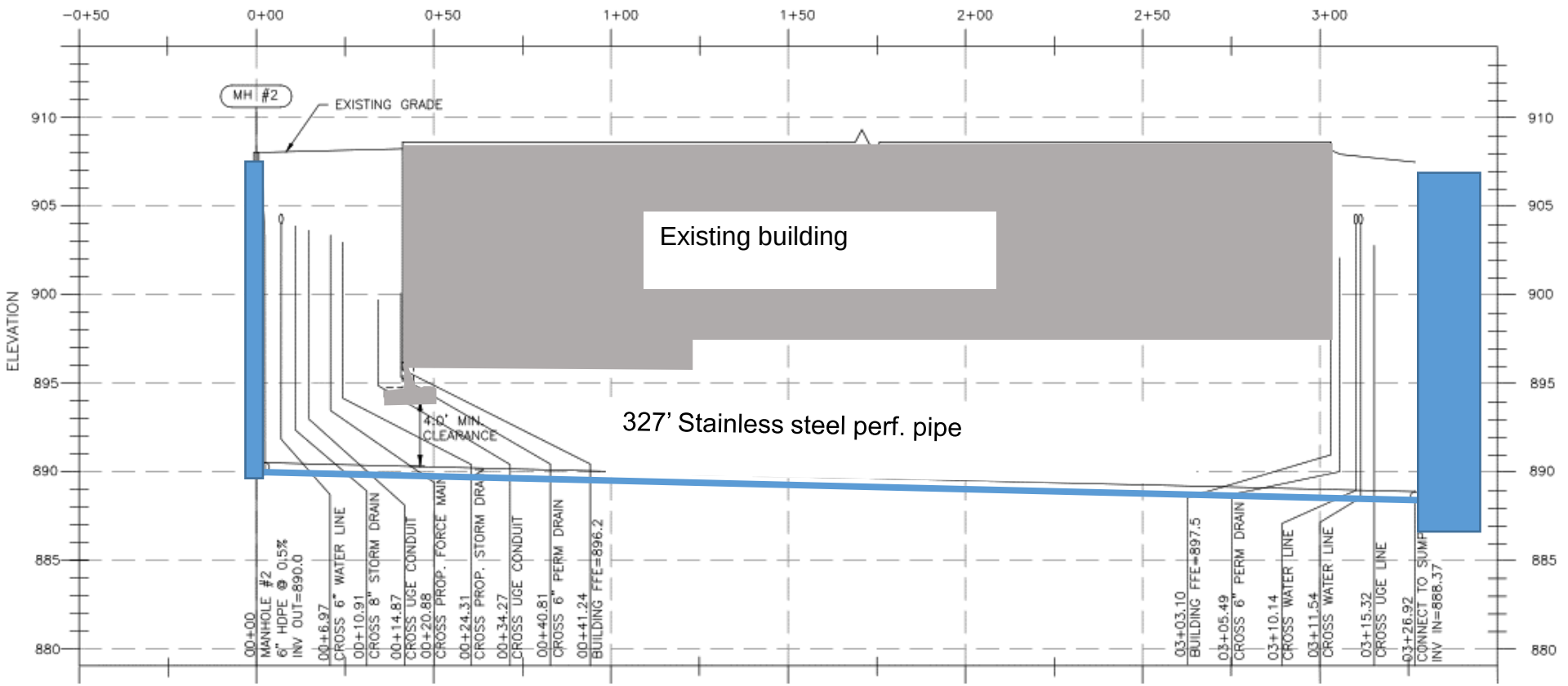
Pilot tube process from Bohrtec website

Trenchless Design



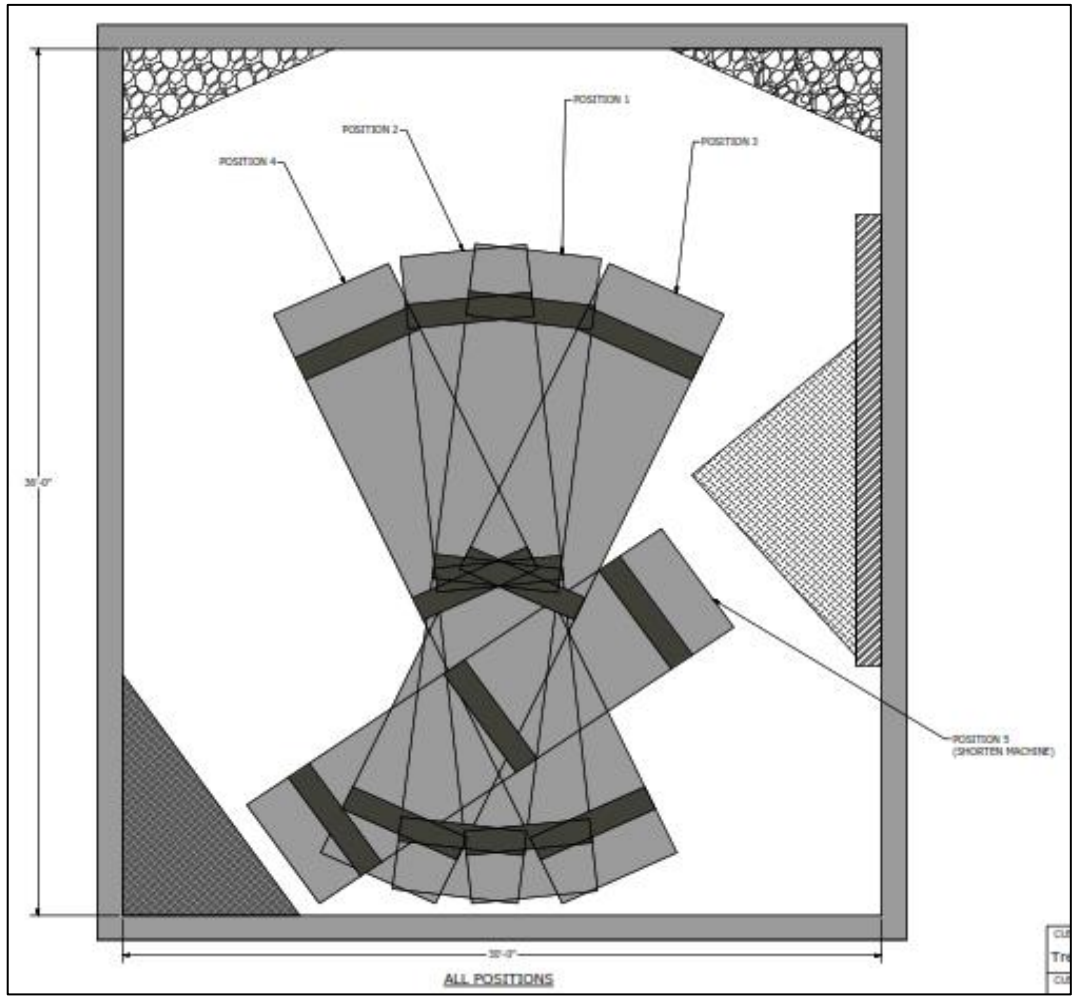


Trenchless Design



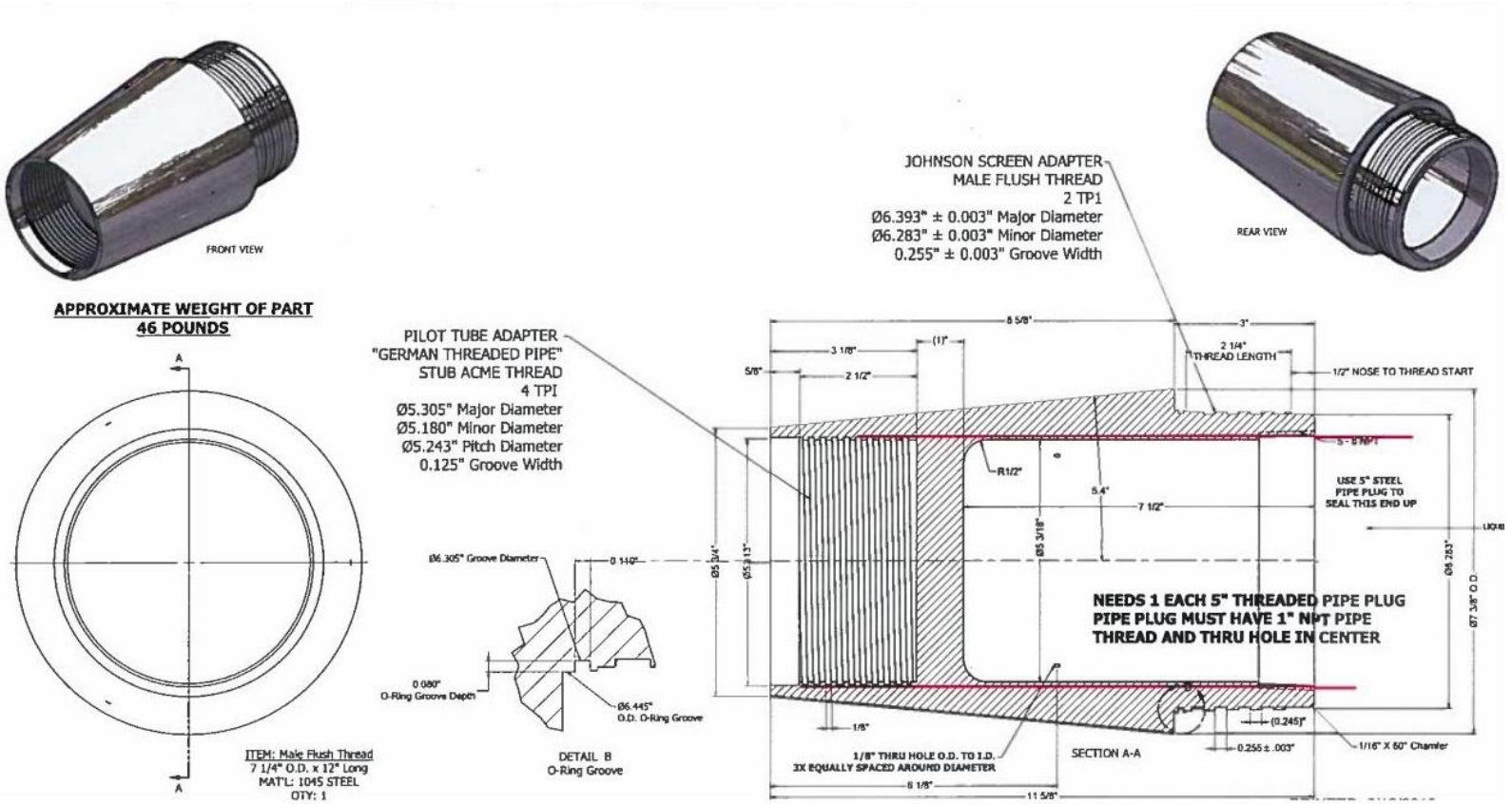
Pre-Construction Considerations

- Contractor submits a change
  1. Pilot tube install
  2. Follow with sizing tool
  3. Product pipe jacked
- Trenchless work plan indicating:
  - the equipment layout
  - the reaction wall locations for each splay within the shoring and
  - the well casing/ adapters
- Pre-Construction verification of screen strength
  - Expect minimal increase in jacking force (7 3/8” vs 6”)
  - Pre-construction testing of screen strength
  - Johnson Screens on-site
- Typically cannot reverse, except in pilot mode



Specialty Adapters

APPROXIMATE WEIGHT OF PART
46 POUNDS



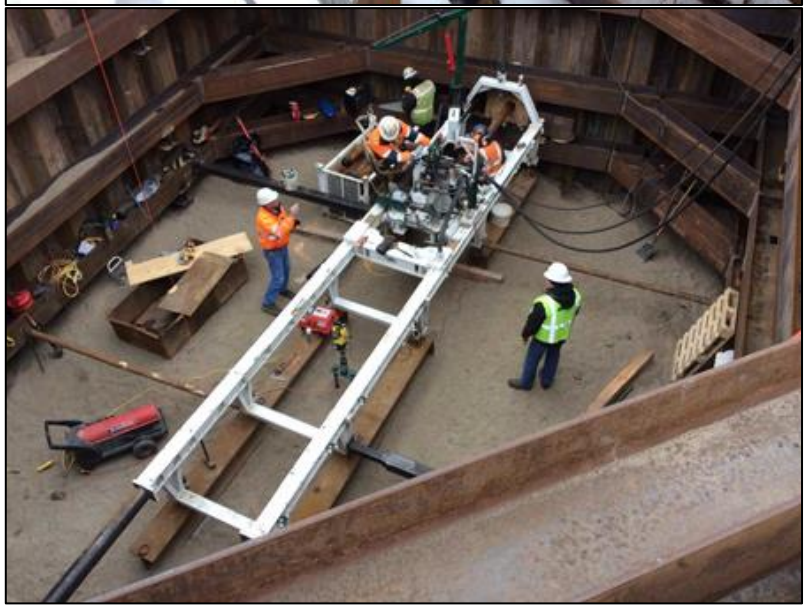
Construction

- Delays
  - Mobilized November 26th (in Minnesota)
- Order of construction
  1. Excavate launch shaft
  2. Additional dewatering
  3. Storm drain line install
  4. Excavate the launch shaft further
  5. HD 4 through HD 1

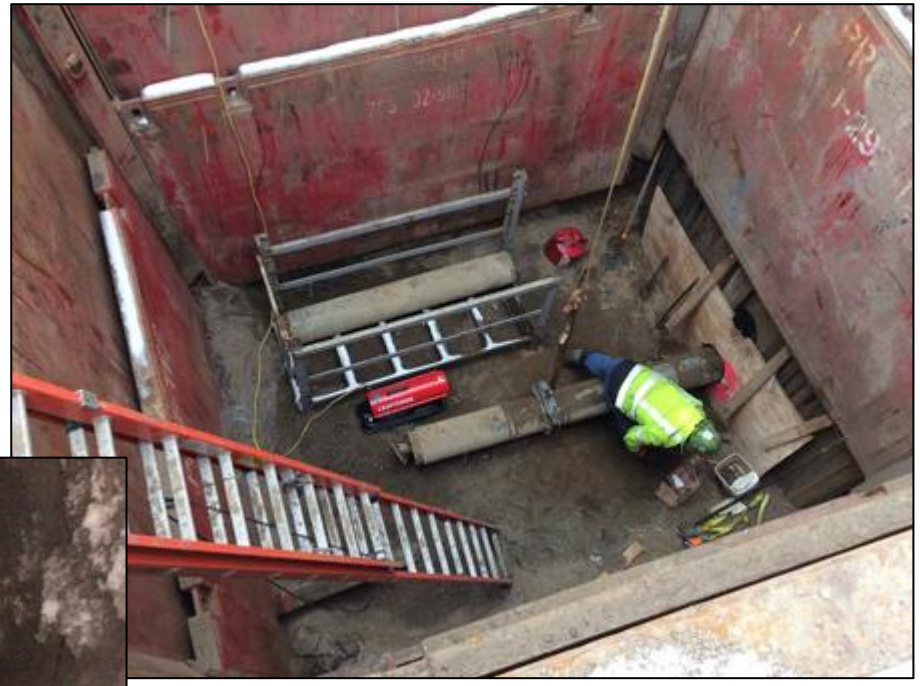
Added complication:
Looming Government Shutdown
starting December 22nd

Storm Drain

- Started on November 28th
  - Anticipated high quantities of groundwater
  - Planned to use water auger
  - Encountered clay, which plugged auger
  - Jacking forces climbed
  - Water soluble lubricant clumped and caused system to repeatedly plug
  - Switched to regular bentonite-based lubricant since storm drain wasn't a drain --- Jacking forces reduced
- 2 days for pilot tube installation, 2 days for auger/casing, 2 days for 10-inch drain installation

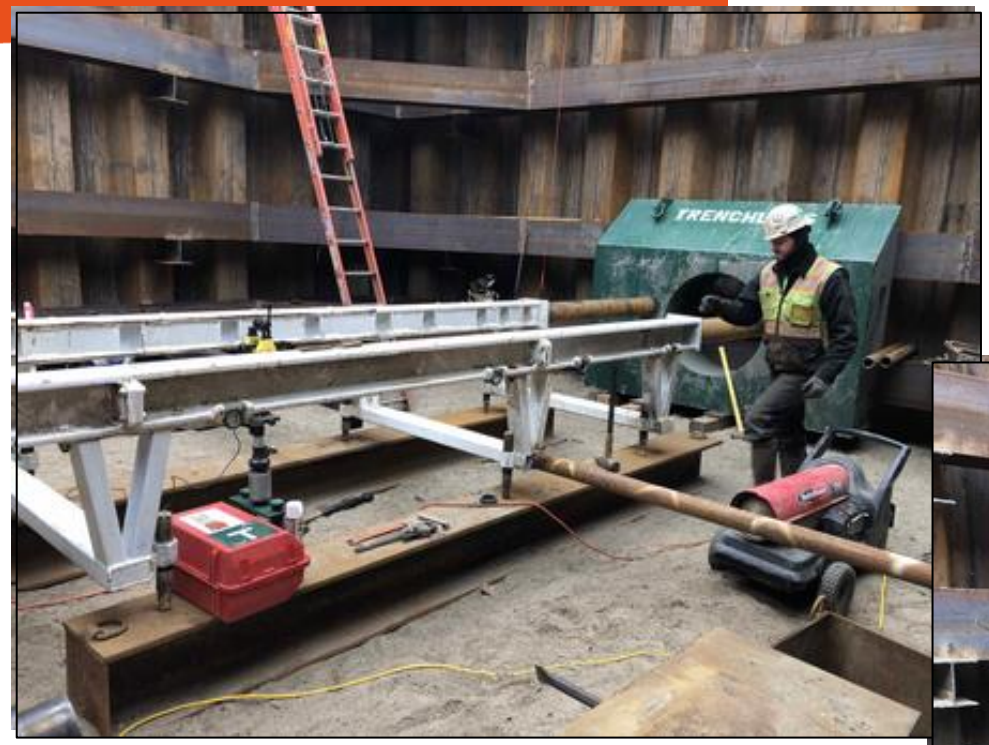


Storm Drain Construction



Horizontal Drains 4 and 3

- HD 4
  - Started on December 10th
  - Went very well
  - 3 days for horizontal drain installation
- HD 3
  - Started on December 13th
  - Went very well
  - 2 days for horizontal drain installation



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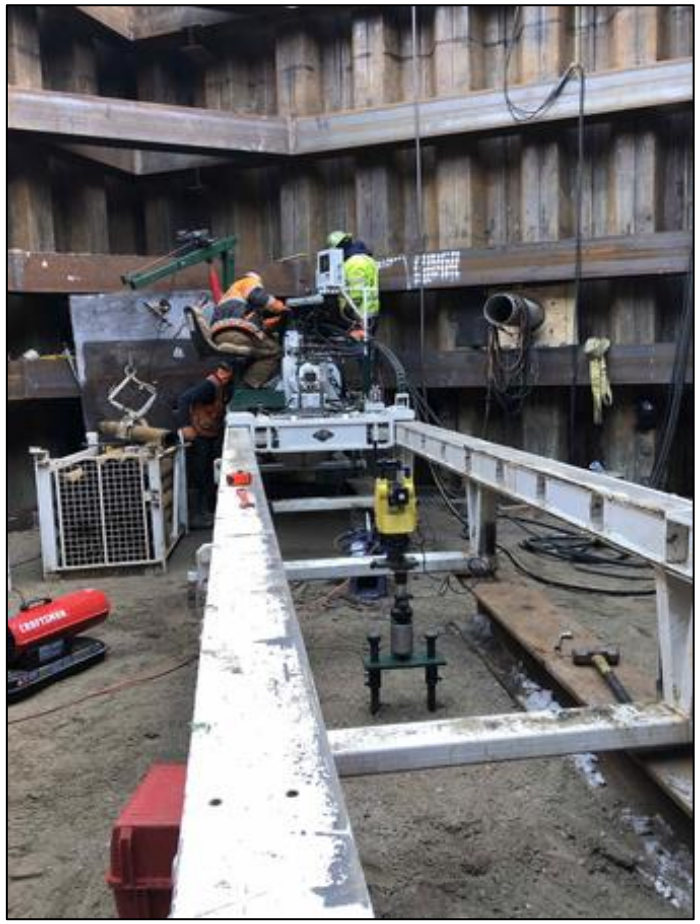

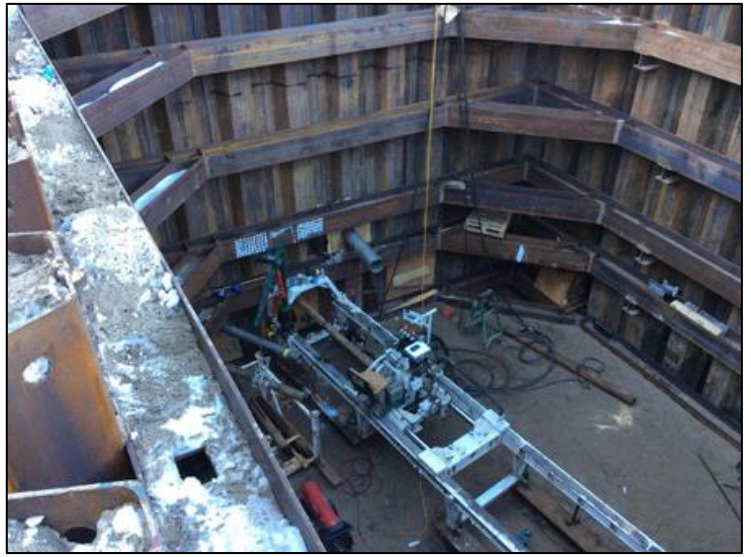

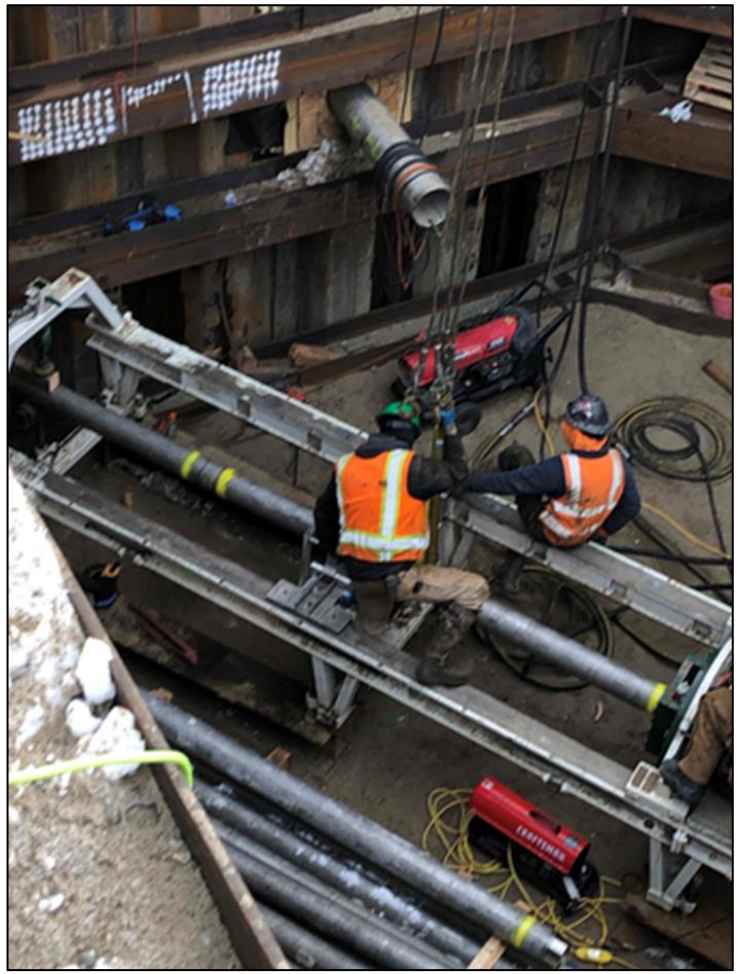

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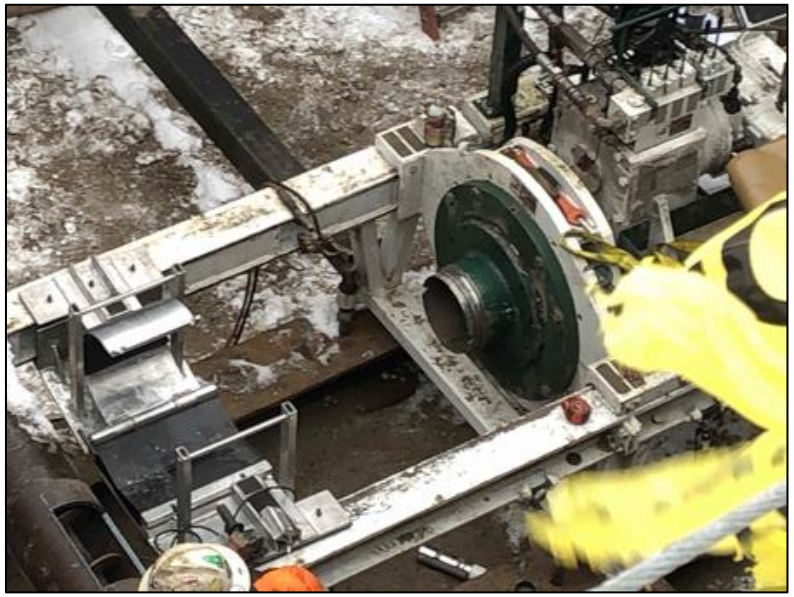
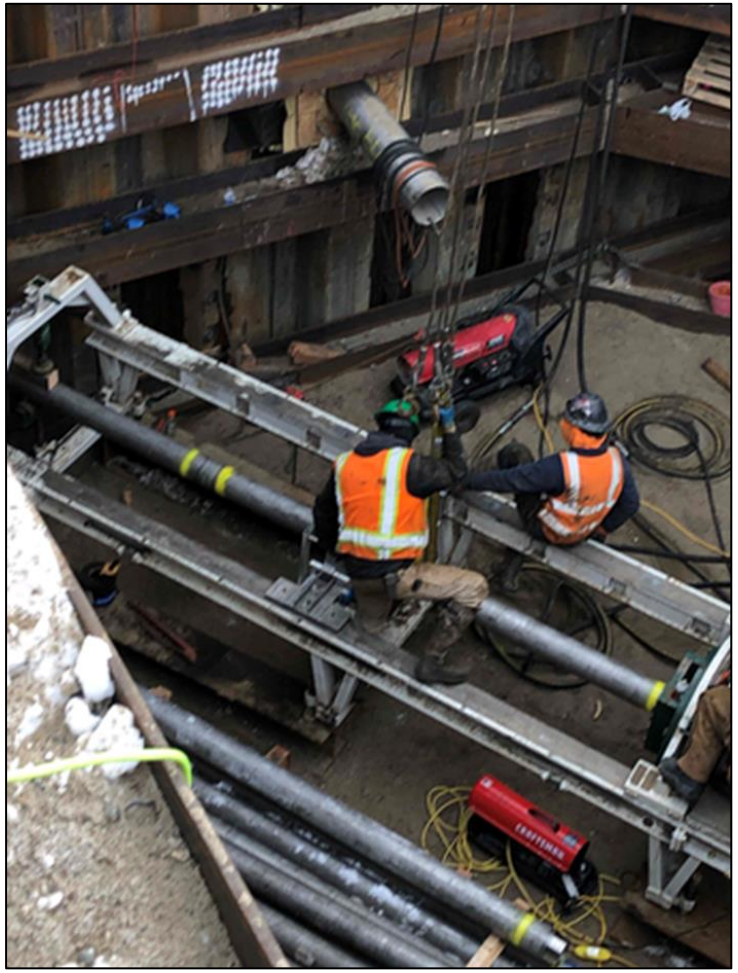




Horizontal Drain 2

- Started on December 15th
- Very oblique angle. The waler near the bottom of the excavation resulted in a long section of exposed pipe
- Within 15 feet of progress, well casing became cross-threaded
- Tried to pull casing, even though machine not geared for it; damaged pipe further
- Tried innovative approach to push the damaged drain casing out

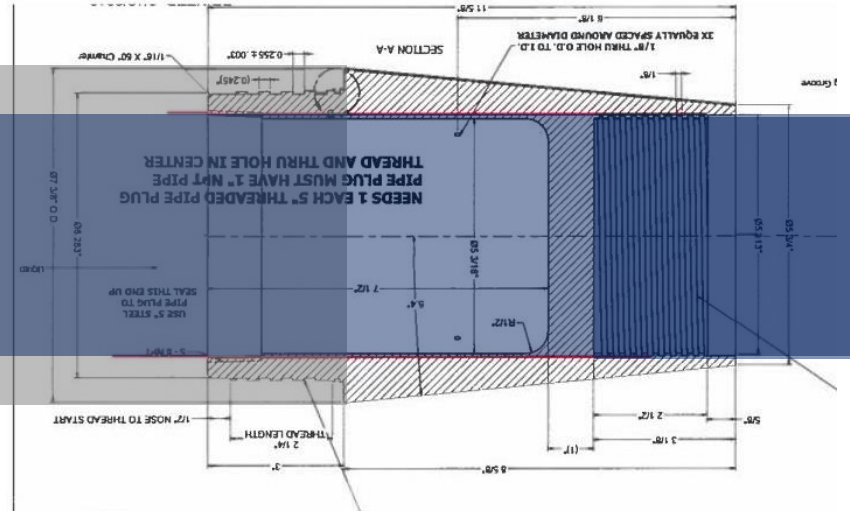
Horizontal Drain 2

- Innovative approach
  - Cut off exposed tail end of horizontal drain
  - Cut off threaded end of pilot tube resulting in a blunt end
  - Pilot tube was pushed inside remaining (damaged) portion of the horizontal drain
  - Pilot tube then pushed damaged section of drain screen out of the alignment

Horizontal Drain

Adapter

Pilot tube



Horizontal Drain 2 Conclusions

- Unexpected benefit: the damaged section of screen acted like an HDD pre-ream
- The installation of second screen was very easy
- Entire installation took 4 days
  - With a quick trip to Johnson Screen

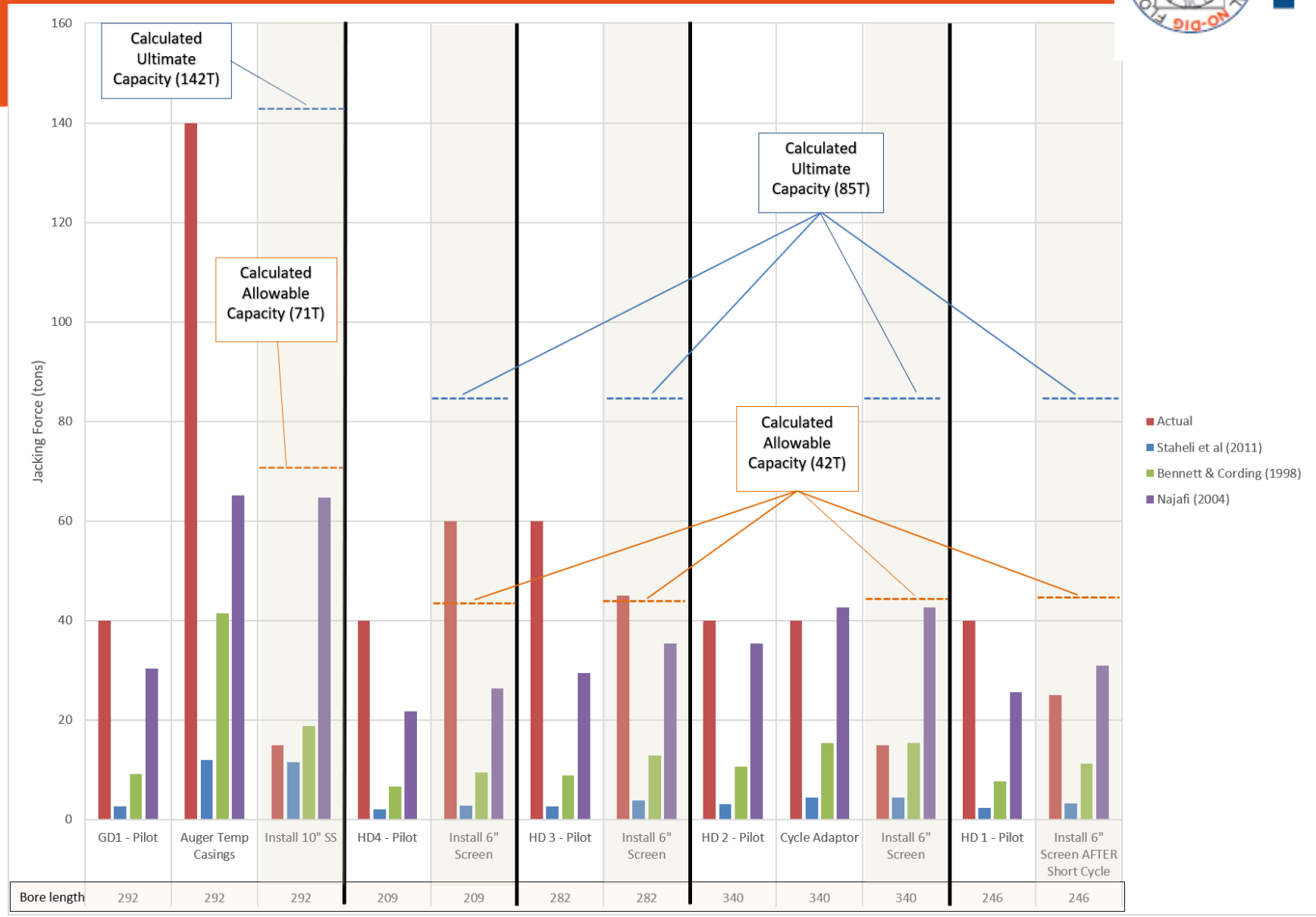
Horizontal Drain 1

- Started December 20th (two days before government shutdown)
- Last one: went very well
- Finished just in time
- Drove off with 26 minutes to spare before mandatory site closure due to government shutdown

Lessons Learned

- Cross-over adapter: Make with tool steel, not mild steel
- Shoring system: Waler placement is important
  - Caused jacking frame placement too far from the wall
  - Caused an increase in exposed drain pipe length
  - Created unforeseen lateral forces on the drain pipe, especially for the more oblique installations
- Dewatering contractor: should be required to provide drawdown curves showing the construction dewatering area of influence so the trenchless contractor can better plan for conditions

Jacking Forces



Thank you

Michelle Macauley

Macauley Trenchless

michelle@macauleytrenchless.com

Steve Torgerson

Trenchless Construction Services

st@trenchlessconstruction.com