Taking It To The Streets
HDD in downtown Atlanta, GA
Case Study I

Bradford Miller, PG
Haley & Aldrich, Inc.

Case history I

1. Project setting and location
2. HDD design challenges
3. Site geology, explorations, geophysics
4. HDD design
5. Construction

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Installation of replacement 115kV circuit for Georgia Power

- 1,870 ft HDD below historic Auburn Avenue
- Replaced direct-buried power cable installed 1959
- Work performed in advance of new Atlanta Streetcar loop along Auburn Avenue

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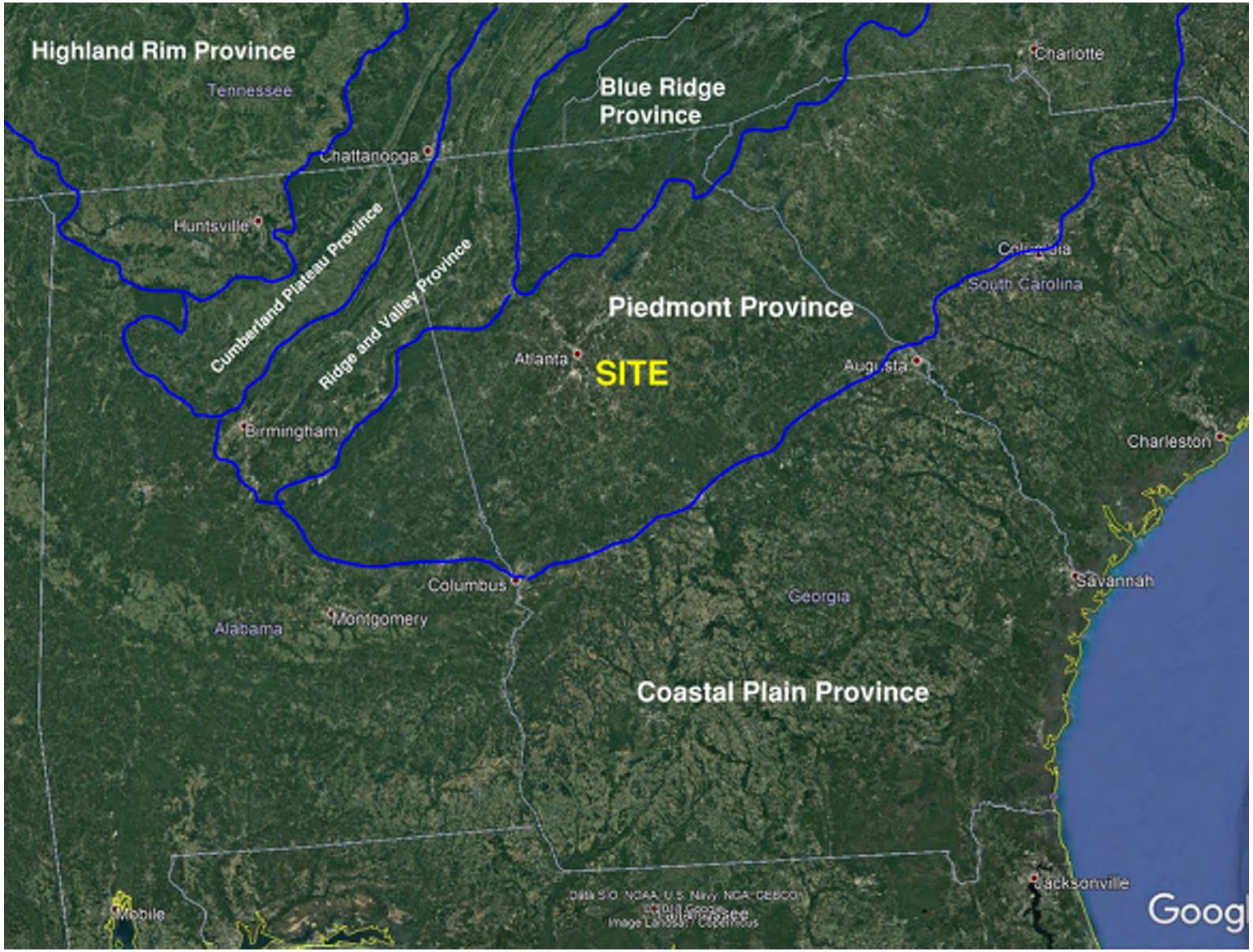
Team players

- Owner: Southern Companies/Georgia Power
- HDD Contractor: Mears Group, Rosebush, MI
- General Contractor: W.A. Chester, LLC
- Geotechnical/HDD Designer: Haley & Aldrich, Inc.
- Geophysics: Hager-Richter Geoscience, Inc., Fords, NJ

Atlanta, Georgia – Outer Piedmont Province



Before (2012) and after (2015)

Proposed HDD route under Auburn Avenue, view to east. Note road lane closure in preparation for nighttime geophysical survey

Same vantage point, but after HDD and Atlanta Streetcar project was completed

(2015, Brian Coffey photo)

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Specific HDD project challenges

Project route at HDD entry pit location. View from east to west, and uphill.

- Downtown urban setting near universities, two major hospitals, interstate highways, ramps and cross-streets
- Pipe assembly area ¼ mile from pullback location
- Unmarked/unknown utilities in old part of town
- Encountered “water pocket”
- 68 ft elevation change between HDD entry and exit ends

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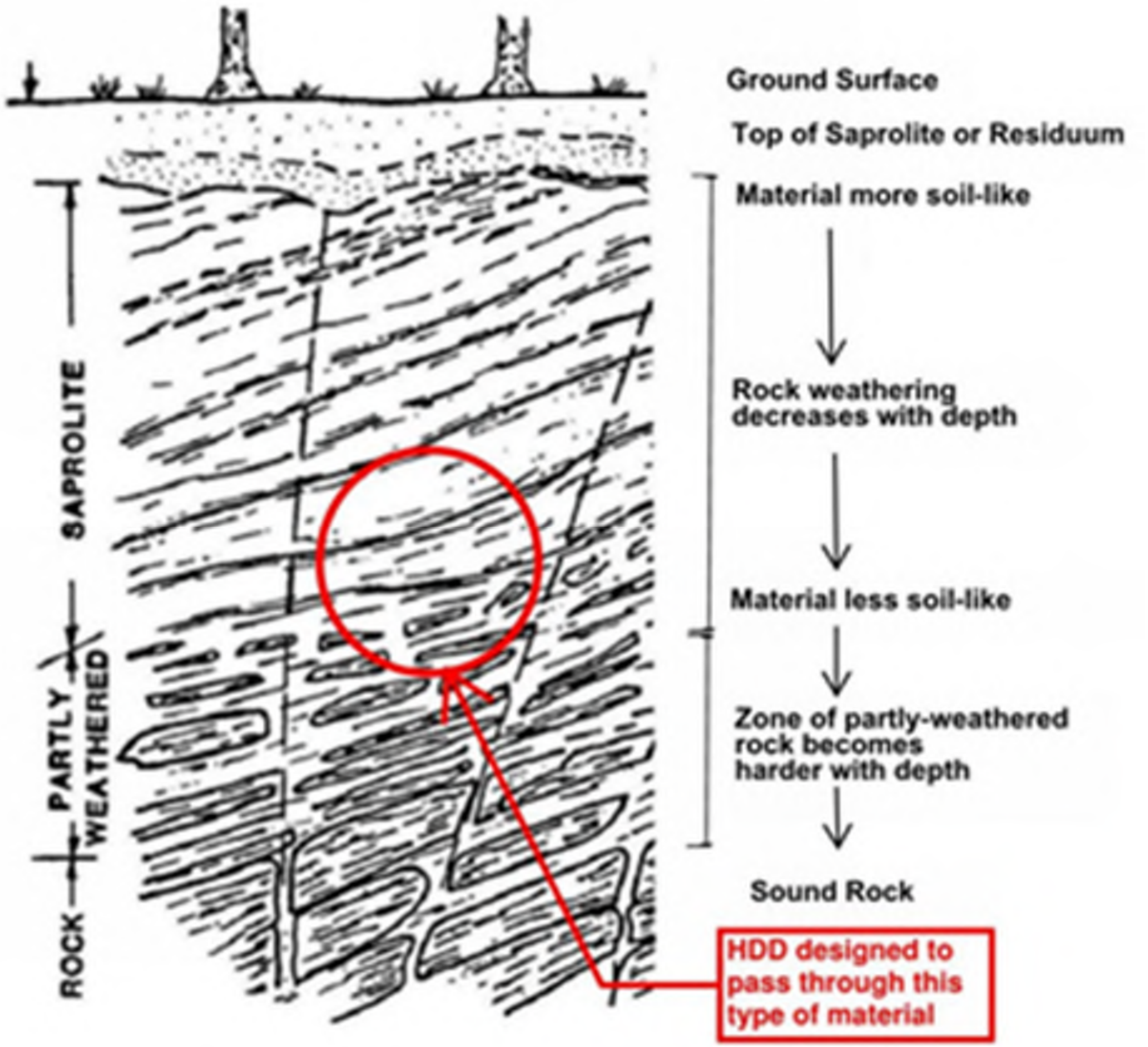
Site geology

- Southern Outer Piedmont region soils derived from extensively-weathered schists, gneisses, granites and mylonites (typically feldspar and quartz-rich rocks)
- Moderate to high-angle orientation of foliation/fabric
- Highly weathered rock termed “saprolite.” Weathering decreases with depth
- Soil grain-size centers around #200 sieve, with variations in hardness and plasticity
- Sand/silt mixture can behave like fissured clay



Weathering Profile of Piedmont Bedrock (Modified by Miller 2014, after Sowers, 1994)

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Georgia “clay” (residuum of weathered rock) in local excavation

Geotechnical program for HDD design

- Test borings with HQ-diameter rock core
- Lab Testing (soil and rock samples)
- Geophysics
- Petrography (rock identification)
- Thermal conductivity testing on weathered rock materials (for ampacity calculations and cable derating)

Highly-weathered bedrock

Classified as low-to-high plasticity SILT (ML/MH) or low plasticity CLAY (CL) and displaying distinct rock fabric. Fines content ranged from 19.2% to 45.4%.

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Rock core – note missing recoveries

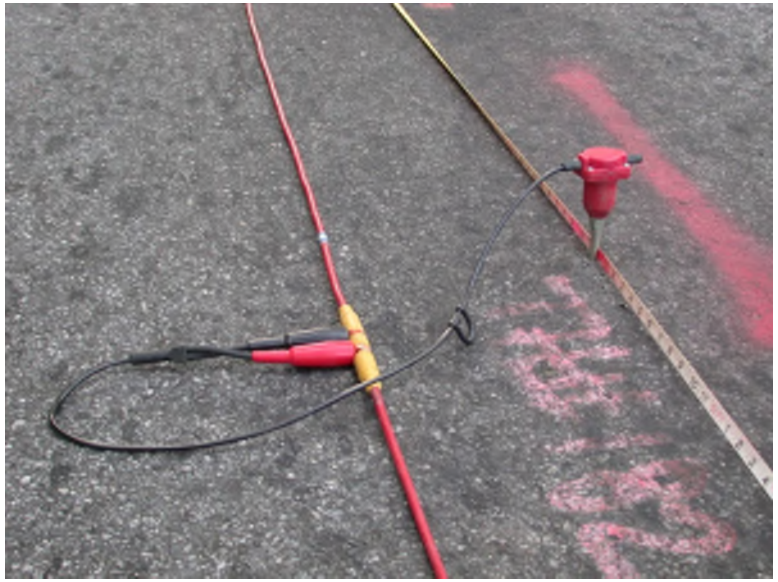
Use of geophysics

- Site advantages for geophysics:
  - Paved access along entire linear HDD route
  - Generally shallow HDD installation
  - Utilities already pre-marked along route
  - Geophysics filled gaps between existing test borings
  - Created a linear image of the different zones of weathered rock using seismic refraction and compressional wave velocity

Geophysical survey details

Length of overall survey	1,810 ft
Number of 48-geophone spreads	Four spreads
Geophone spacing	10 ft
Depth-to-Bedrock Accuracy	+/- 2 ft or 10% of depth to rock
Seismic source	12# sledgehammer on steel plate
Work Time Restrictions	8 PM to 3 AM
Traffic Control?	Yes

- Performed at night with cross-street closures
- Used Generalized Reciprocal Method and Seismic Refraction Tomography post-processing of data
- Compressional-wave, velocity-based solution rather than conventional "layered" model
- Calibrated with test boring data
- Urban noise interferences were issue



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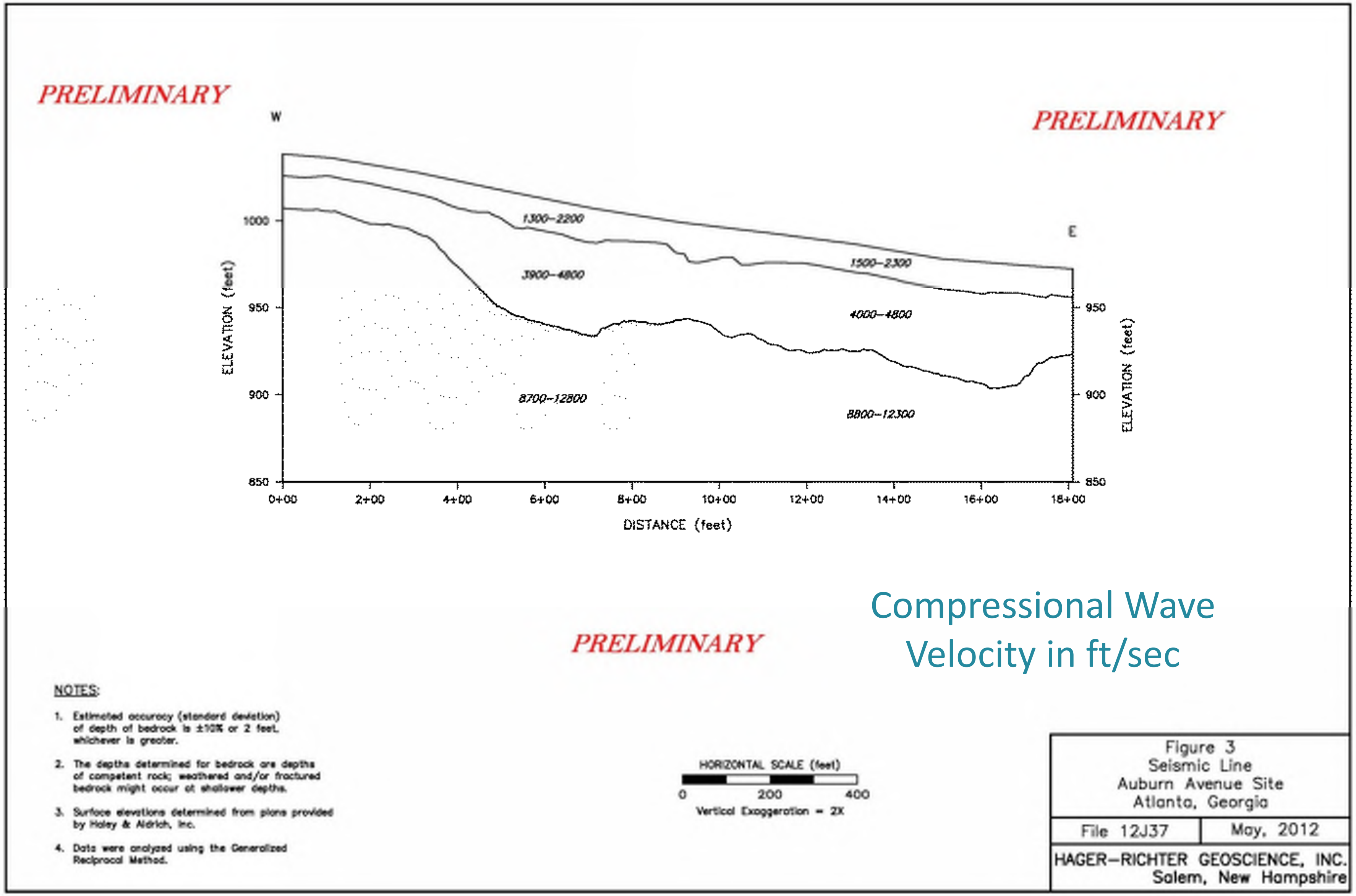
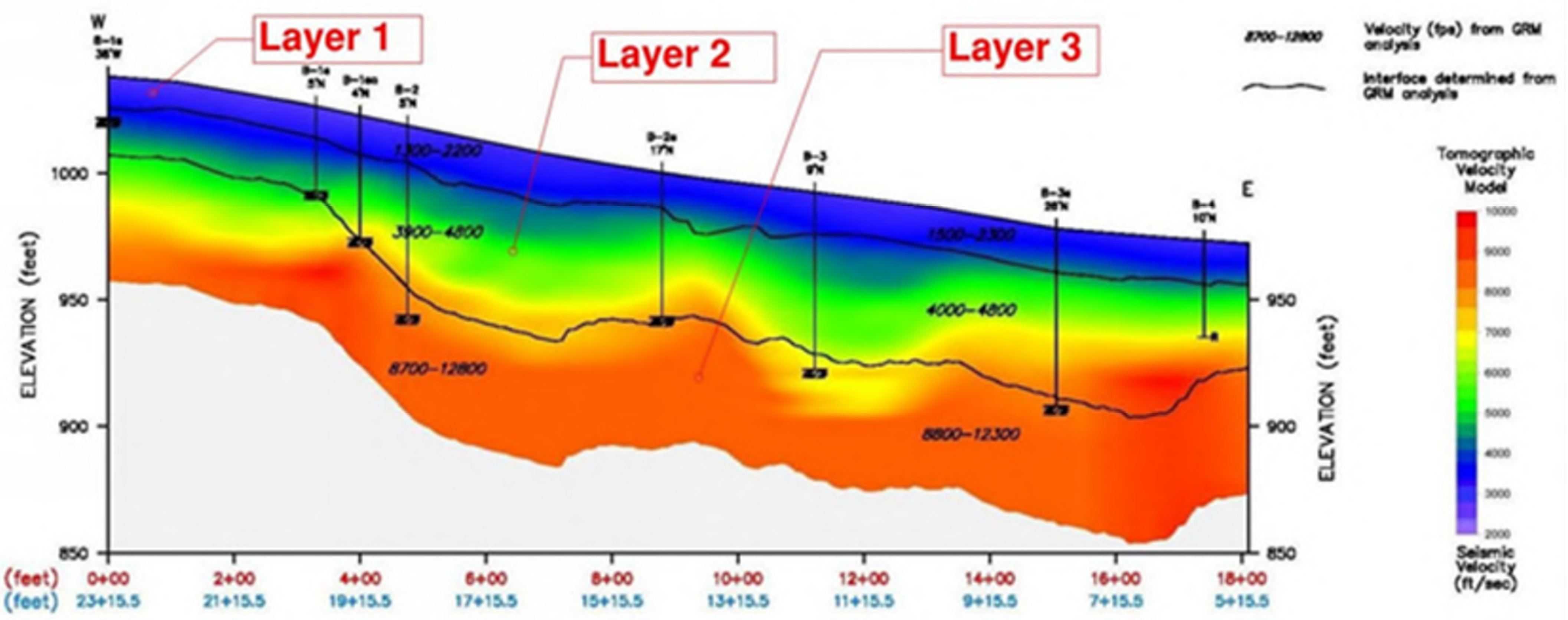
Geophysical seismic line results



Compressional Wave Velocity in ft/sec

Geophysical profile



	Geologic Material	Compressional Wave Velocity (ft/sec)
Layer 1	Unsaturated soils/completely weathered soils/residuum	1,290 to 2,330
Layer 2	Partially saturated saprolite/highly-weathered rock	3,300 to 4,800
Layer 3	Slightly weathered to competent bedrock	8,700 to 12,800

Interpretation and HDD design

- Test Borings
  - Auger ‘refusal’ = Intact rock. Varied from 25 to 73 ft deep below roadway
  - Intact rock strengths from 6,700 to 19,400 psi. Slake Durability up to 99%
- HDD Route
  - Based on the borings and geophysics, realigned HDD drillpath ‘up’ out of intact slightly-weathered and harder rock
  - New HDD drillpath designed to stay in highly-weathered rock zone
  - Saved construction time by not having to HDD pilot drill, backream, prep borehole in harder rock
  - Could use smaller HDD rig
  - Advantages: Overall faster HDD completion, at less cost and lower risk

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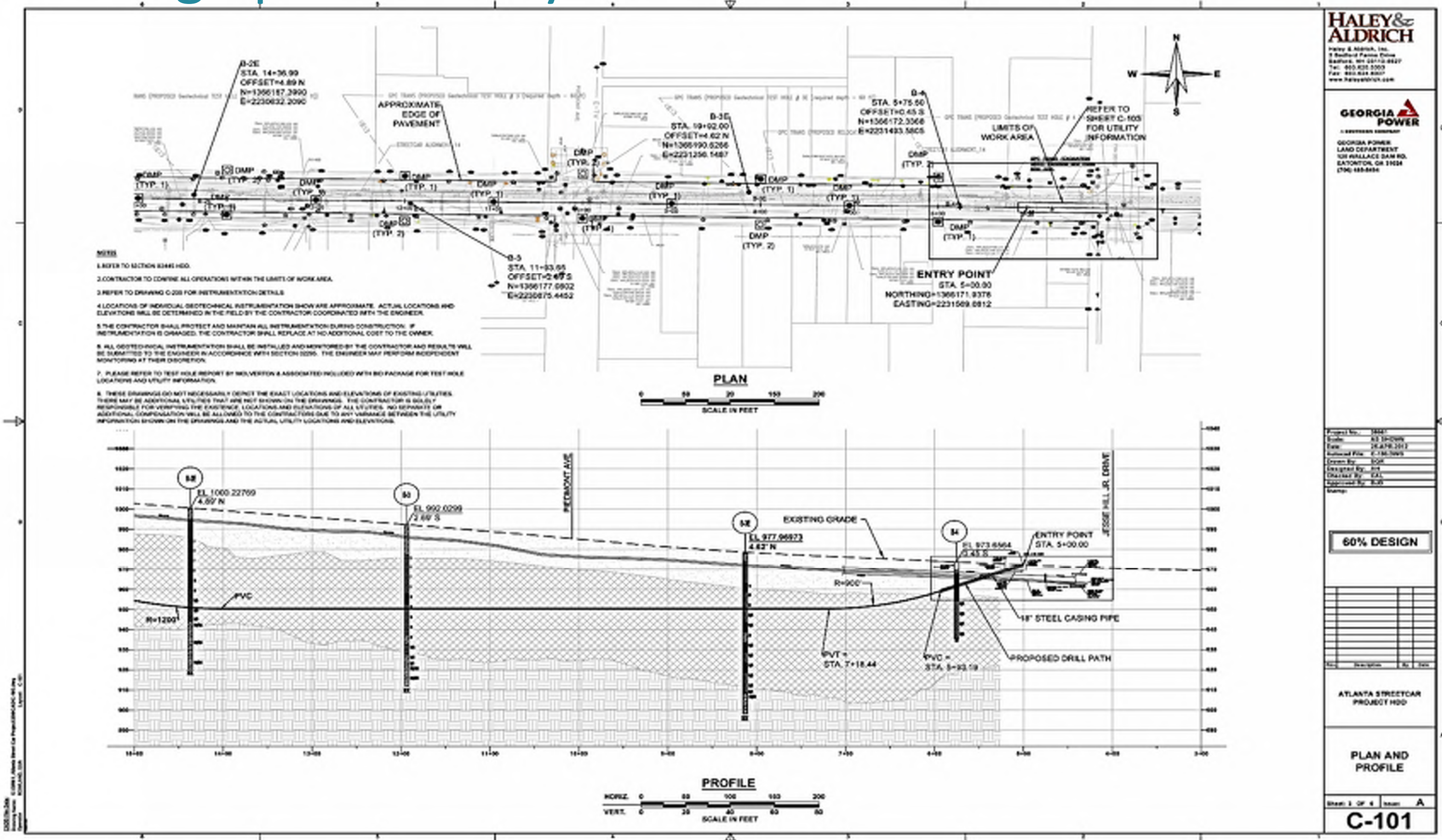
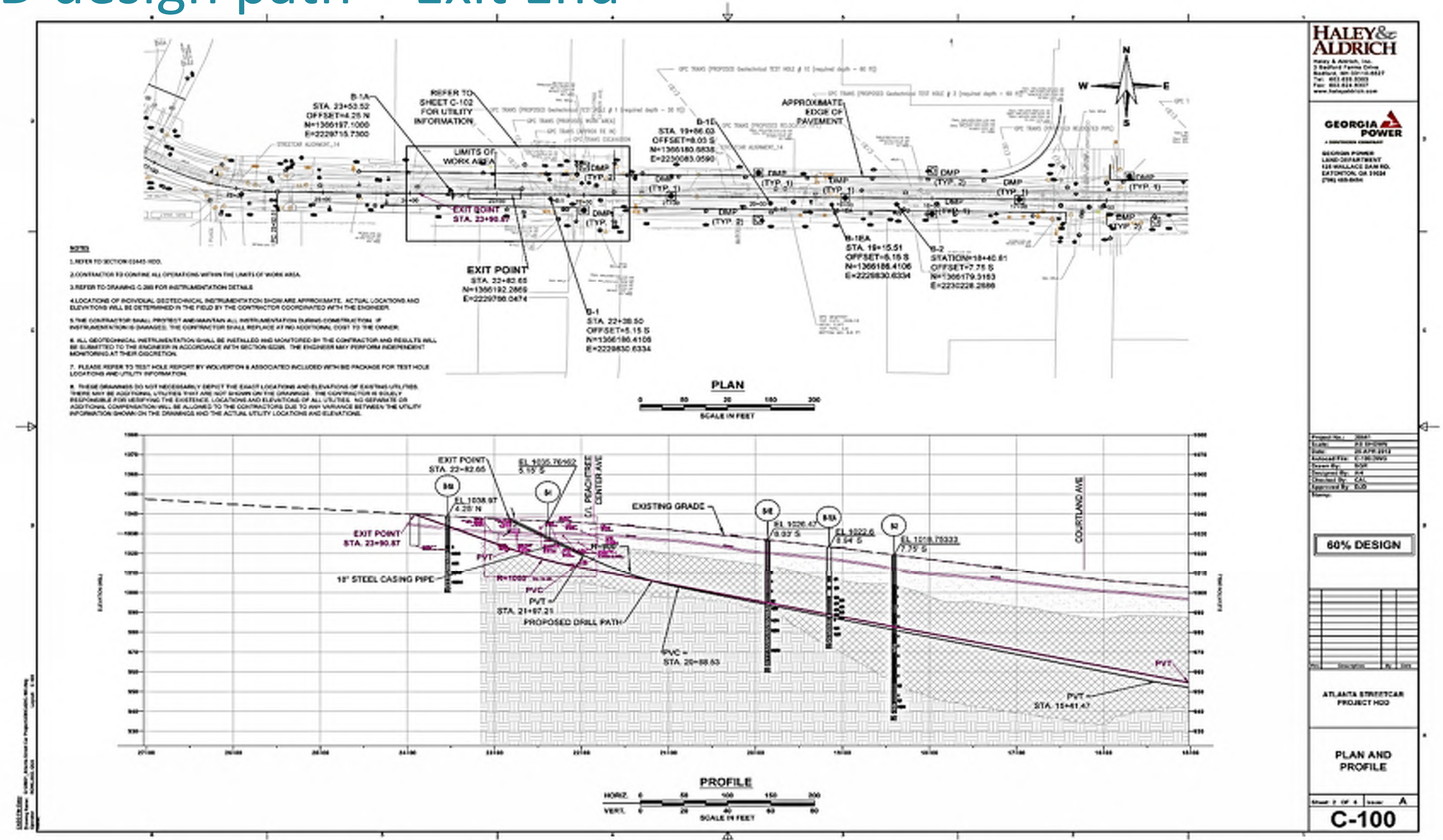
HDD design path – Entry End



HDD design path – Exit End



HDD design

- 8-in. diameter steel, fluid-filled electrical duct was the installed product pipe
- Electrical conductor circuits later installed in the duct
- No thermal grout used for annulus
- Max. HDD depth about 55 ft below road
- Final hole diameter 12-in.
- Entry angle 12.9°
- Exit angle 9.9°
- Minimum bend radius for design 800 ft was controlled by product pipe

Construction

- HDD below centerline of Auburn Ave. One traffic lane kept open for most of route
- Drilled uphill - east end to west end
- Used intercept method to mitigate fluid "frac-out"
- Settlement & deflection along route monitored by crack gauges and survey points
- Utility "potholing" and utility surveys valuable, yet unmarked utilities were still encountered

Maxi rig set up on east (entry) end near historic masonry church and beneath overhead wires

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Construction

- 12" guide casings grouted in at HDD entry and exit
- Drill route lengthened about 120 ft to avoid utilities near HDD exit end, and 'flattened' drillpath to pass below sewer force main
- Day 3: Unexpected backflush flooded street, diluting the drill mud. Drill had encountered "water pocket" perched on shallow, denser rock surface
- Shuttled/reused excess mud to uphill exit end

"Backflush" event during pilot hole drilling flooded street with 15,000 gallons of groundwater. "Pocket of water" on shallow, denser rock surface was recharged by rainfall.

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Pipe fabrication

- Pipe fabrication ¼ mile east in vacant municipal lots/community gardens
- 8” steel product pipe

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Pullback

- 23 days construction from set-up to pullback
- Pullback performed at night
- Extensive vehicle and pedestrian traffic coordination and road closures needed
- Pipe string crossed roads, over walls, below I-75/I-85 overpass
- QC challenges with coupler welds and coatings in cold weather
- 27 hrs duration overall
- Tremie grouted 200 ft of east end borehole to avoid repeat of ‘backflushing’ event

Success!

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Key lessons

- Cooperative relationship between experienced HDD contractor, designer, general contractor and owner
- Geophysics valuable in urban settings but ambient “noise” can interfere with data collection
- Develop contingency plans for unmapped utilities in advance
- “Water pocket” backflush delayed work, but response was effective
- Pipe stringing in urban locations requires creativity, as unimpeded corridors are unlikely to be present

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