HORIZONTAL DIRECTIONAL DRILL ANALYSIS
SWEDESFORD ROAD CROSSING
PADEP SECTION 105 PERMIT NO.: E15-862
PA-CH-0219.0000-RD and PA-CH-0219.0000-RD-16
(SPLP HDD No. S3-0381)

SWEDESFORD ROAD CROSSING
PADEP SECTION 105 PERMIT NO.: E15-862
PA-CH-0219.0000-RD and PA-CH-0219.0000-RD-16
(SPLP HDD No. S3-0381)

This reanalysis of the horizontal directional drill (HDD) installation of a 20-inch diameter and 16-inch pipeline crossing under Exton Lane, East Swedesford Road, stream S-B81, wetland B71, stream S-B79, and Lincoln Highway has been completed in accordance with Stipulated Order issued under Environmental Hearing Board Docket No. 2017-009-L. This HDD is number 18 on the list of HDDs included on Exhibit 2 of the Stipulated Order.

This HDD has not been initiated. As discussed below in the alternative analysis section, Aqua America (Aqua), the local water authority, contacted Sunoco Pipeline, L.P. (SPLP) regarding their Hillside Drive production well along Swedesford Road and inquired on potential negative effects to this public water supply well that could result from implementation of the HDDs as planned. As a result of further studies conducted by SPLP, the plans for pipeline installation in this area have been altered to further reduce the potential impact to this public water supply well.

PIPE INFORMATION

20-Inch: 0.456 wall thickness; X-65
16-Inch: 0.438 wall thickness; X-70

Pipe stress allowances are an integral part of the design calculations performed for each HDD.

ORIGINAL HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 20-INCH

- Horizontal length: 4,947 foot (ft)
- Entry/Exit angle: 10 degrees
- Maximum Depth of cover: 78 ft
- Pipe design radius: 2,000 ft

ORIGINAL HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 16-INCH

- Horizontal length: 4,888 ft
- Entry/Exit angle: 10 degrees
- Maximum Depth of cover: 88 ft
- Pipe design radius: 1,600 ft

GEOLOGIC AND HYDROGEOLOGIC ANALYSIS

As shown on published geologic maps (PA DCNR Map Viewer and Bobyshell, 2006), the bedrock along the HDD S3-0381 includes three different geologic formations, from north to south, the Ledger Formation, Chickies Formation, back into the Ledger Formation and terminates in the Conestoga Formation. The Ledger Formation and Conestoga Formation have karst limestone and dolomite developments.

Karst geology is present at this HDD location, and pursuant to the Stipulated Order the use of geophysical surveys should be considered in karst areas. The use of geophysical surveys during re-evaluation was considered but ultimately not implemented because this HDD has been converted to open cut and conventional bore construction for a majority of its length. Because the length of the HDD portion of this segment of the pipelines has been reduced significantly, from over 4,000 ft, down to a much shorter HDD, No. S3-0382, the results of geophysical surveys in such a small area will not provide additional information that will meaningfully reduce the risk of an IR at the shorter revised HDD location at

the southeast end of this crossing. The implementation of engineering controls, alternate drilling technology, and drilling best management practices will be required to minimize the occurrence of IRs.

Attachment 1 provides an extensive discussion on the geology, hydrogeology and results of the geotechnical investigation performed at this location.

HYDROGEOLOGY, GROUND WATER, AND WELL PRODUCTION ZONES

In most of Chester County, groundwater occupies and moves within secondary pore spaces created by bedrock discontinuities (open fractures, joints, bedding plan partings, fault zones, etc.). In the carbonate bedrock, such as the Ledger Formation and Conestoga Formation, these discontinuities can become enlarged through dissolution of bedrock creating relatively large conduits for groundwater flow. The interconnected fracture porosity in the Chickies Formation, if present, is less developed. Well yields in the Ledger, Conestoga and Chickies Formations are variable based on the ability of the driller to encounter interconnected, water-filled fractures.

Well yields in the Ledger, Conestoga and Chickies Formations are variable based on the ability of the driller to encounter interconnected, water-filled fractures. Using the Pennsylvania Groundwater Information System (PAGWIS) a survey of Ledger, Conestoga and Chickies Formation domestic wells in West Whiteland Township was performed. Average well depths vary from 120 to 180 ft below the ground surface (bgs) and well yields vary from 7 gallons per minute (gpm) in the Chickies Formation to 56 gpm in the Ledger Formation.

Attachment 1 provides an extensive discussion on the geology, hydrogeology and results of the geotechnical investigations performed at this location.

INADVERTENT RETURNS DISCUSSION

SPLP has submitted a permit modification proposing a revised design for pipeline installation along the original HDD S3-0381 alignment. This revision utilizes open trenching, conventional bores and a greatly reduced HDD installation (953 feet versus 4,937 feet) at the south end of the original drill alignment. The shorter HDD No. S3-0382, while still in the karstic Ledger and Conestoga Formations is outside the capture zone of the Aqua water supply well. The risk of losing drilling fluid and of IRs associated with drilling through karst terrain remains for HDD S3-0382. To mitigate this potential, SPLP will utilize a new drilling and reaming technology that is a combination of HDD and conventional auger boring methods called “flex-bore”.

A “flex-bore” machine does not utilize bentonite as an additive to create a “mud slurry” to carry cuttings during the pilot and reaming phases. Instead, it utilizes high pressure air and water. The flex-bore machine is a small compact hydraulic unit that can both push and rotate a pilot tool and specialized hole cutter. During the pilot hole phase, a standard, but smaller, diameter drilling tool and bottom hole assembly is used to drill the designed profile. Once the pilot hole is completed, a second hydraulic unit is attached to the drill stem for pulling in combination with the unit at the point of entry that is pushing. During the pilot phase the air and water conveys the cuttings along the annulus back to the point of entry where they are captured in a container and removed. During the reaming phase, the flex-bore cutter is attached in front of a casing pipe and is pushed/pulled through the designed profile guided by the pilot hole. During the reaming phase, only high pressure air and water is used to carry cuttings; however the flex-bore cutter “ingests” the cuttings which are carried back to the point of entry through the casing pipe where the cutting are collected and removed. No bentonite is used, therefore there is no potential to discharge a foreign material to the land surface or surrounding geology during the process.

The flex-bore technology cannot replace a traditional HDD rig under all circumstances due to its limitations for tool steering at extreme depths and distances because the pilot phase equipment is miniaturized and does not have the rigidity required to have exert the necessary force in the desired steering direction at distances that large conventional HDD rigs routinely complete.

ADJACENT FEATURES ANALYSIS

This HDD location is approximately 2,000 feet due east of the geographic center of Exton, Pennsylvania, and is set primarily within a very developed area, having both residential areas (cul-de-sac and developments) and industrial/commercial areas (shopping malls and assorted businesses). The original HDD would have crossed under two streams and one wetland. The crossing of streams S-B79, S-B81, and wetland B71 is located approximately 600 feet north/northwest, of the pipe crossing of the Lincoln Highway.

During the original planning by SPLP for advance of the HDD S3-0381 drills, a survey of landowners within 150 feet of the ROW was performed and no landowners responded positively to an offer to have their wells tested. A PAGWIS search in the area did not identify any wells within 450 feet of the HDD S3-0381 (original HDD) alignment.

In accordance with the terms of the Order, SPLP has identified all landowners with property located within 450 feet of the revised HDD alignment. There are ten (10) landowners with property located within 450 ft. SPLP sent each of these landowners a notice letter via both certified and first class mail on November 1, 2017, that included an offer to sample the landowner's private water supply/well in accordance with the terms of the Order and the Water Supply Assessment, Preparedness, Prevention and Contingency Plan. The letter also requested that each landowner contact the Right-of-Way agent for the local area and provide SPLP with information regarding: (1) whether the landowner has a well; (2) where that well is located, and it's depth and size if know; and (3) whether the landowner would like to have the well sampled. In accordance with paragraph 10 of the Order, copies of the certified mail receipts for the letters sent to landowners have been provided to Karyn Yordy, Executive Assistant, Office of Programs at the Department's Central Office.

If any landowner with the 450 ft HDD radius fails to respond, agents for SPLP will initiate direct contact by phone or in person to engage the owners for a determination of potable water source. Based on the response to the mailings and direct contact, the landowners with private water wells determined to possibly be at risk during the HDD will be offered alternative water supplies until the HDD is complete.

Since the use of alternate boring technology is planned that does not utilize bentonite, the potential risks to private water supplies are minimal.

ALTERNATIVES ANALYSIS

On behalf of SPLP, Tetra Tech, Inc. (Tetra Tech) previously requested that PADEP (in letters dated 5/30/2017 and 7/24/2017) review a change in installation methodology for a portion of the initially proposed HDD to an open cut crossing with some shorter auger bores and a shorter HDD. The requested change in installation methodology followed the receipt of communications from Aqua America (Aqua), the local water authority, regarding their Hillside Drive production well along Swedesford Road. An HDD was initially designed for this area due to the dense population and topography. At Aqua's request, alternate depths were considered for the HDD design. A shallower HDD was determined to not be feasible due to the changes in topography/elevation along the route. Consideration of deeper depths required additional information on the underlying geology. Accordingly, SPLP performed hydraulic and geologic testing in the area adjacent to the Hillside Drive production well and in the centerline of the

proposed HDD. Evaluation of the drill cores found highly fractured rock throughout the formation and pump test results indicated that the deeper area intended for the HDD was within the zone of capture for Aqua's well. Therefore, installing the pipeline via HDD at a deeper depth was also determined to not be feasible. Therefore, the best method to further reduce the risk of an IR within the zone of influence of the Hillside Drive well is a combination of open cut, conventional bore, and HDD outside of the Hillside Drive well radius of influence. Through the utilization of these three installation methods, SPLP will be able to avoid impacts to the Hillside Drive well and maintain its avoidance of impacts to resources and sensitive areas.

Overall, the application will propose changes including an open trench installation with four conventional bore sections and one shorter HDD. The HDD will be conducted for stream S-B79 and Lincoln Highway which is over 2,300 feet from Swedesford Road. Conventional bores will be added at: stations 15111+00 to 15112+50 (Exton Lane), stations 15114+00 to 15116+00 (utilities avoidance), stations 15221+00 to 15122+50 (Swedesford Road), and stations 15135+00 to 15141+00 (cultural resource sensitive area by stream S-B81 and wetland B71). A conventional horizontal bore cannot replace the revised, shorter, HDD since the features being avoided result in a bore length requirement beyond the technical limits of this method.

The pipeline alignment will remain within Sunoco's permanent easement and the requested modification only requests a larger limit of disturbance to accommodate the revised installation technique, as well as revised vertical depths of the pipeline. Coordination with the land owners and municipality regarding the revised installation methods has been conducted and agreements will be in place prior to construction.

Open-cut Analysis

As introduced above, conversion of this HDD to open cut, conventional bore, and a reduced HDD construction method will result in direct but temporary impacts to streams S-B79 and S-B81. SPLP specifications require a minimum of 48-inches of cover over the installed pipeline beneath the bottom of the watercourse. To meet this cover requirement, during construction through all affected aquatic resources (streams S-B79 and S-B81 and wetland B71), an open cut workspace with a width of 75 feet will be required to accommodate pipeline and provide sufficient space for trench excavation, spoil storage, and allowing the pipeline to be installed with sufficient separation from the existing 8" pipeline for integrity management. The conventional crossing of these resources will require the damming the streams using a upstream and downstream geotube, while simultaneously pumping around all stream flows, and pumping out of all produced groundwater discharge from the excavated shallow soil horizons and water seepage below the geotube dams installed in the channel for the entire duration of the open cut crossing event.

The assessed area of impact by this open cut plan will directly affect approximately 0.259 acres of wetland, all PFO disturbance, which will require on-site replanting or off site mitigation. The change would also affect 0.038 acres of stream bed and 0.468 acres of FEMA designated 100-year floodway. Both affected streams have a perennial flow regime and are tributary to PAFBC-designated waters that are suitable quality for stocking trout.

Re-Route Analysis

In accordance with state and federal guidance, SPLP has routed the Project to be co-located with existing pipeline and other utility corridors to avoid new "greenfield" routing alignments, to the maximum extent practicable. This avoids and minimizes new and permanent impacts on previously undisturbed land, land use encumbrance, and site-specific and cumulative impacts on land, environmental, and community resources. The Swedesford Road Crossing HDD is co-located within the existing SPLP 8" pipeline ROW and rerouting would cause new greenfield impacts. In addition, given the length and general perpendicular direction of streams S-B79 and S-B81 (unnamed tributary to Valley Creek and Valley

Creek, respectively), no practicable re-route option lies to the north or south of the proposed route that would not ultimately cross these streams. In addition, due to the developed congestion of the area including residences, businesses, roads, and other utilities, there are no practical reroutes for the pipeline in this area.

A copy of the PADEP permit modification package, which includes the details on the conversion of the original HDD to open cut, conventional bore, and a much shorter HDD is included with this reanalysis as Attachment 2.

RECONSIDERATION OF THE HORIZONTAL DIRECTIONAL DRILL

Revised Horizontal Directional Drill Design Summary: 20-inch

- Horizontal length: 953 ft
- Entry angle: 12-15 degrees
- Maximum depth of cover: 54 ft
- Pipe design radius: 2,000 ft

Revised Horizontal Directional Drill Design Summary: 16-inch

- Horizontal length: 953 ft
- Entry angle: 14-16 degrees
- Maximum depth of cover: 67 ft
- Pipe design radius: 1,600 ft

Attachment 3 contains an overview map of the original area of HDD S3-0381 and notations for the areas converted to open cut, conventional bore, and location of HDD S3-0382.

CONCLUSION

In response to communications from Aqua as well as the limited workspace, SPLP has submitted for review and approval a change in crossing methodology from the original HDD design to a combination of open cut, five conventional bores, and one short length HDD in the area encompassed by the original design of HDD No. S3-0381. Alternate “flex-bore” technology will be utilized to avoid IRs for the redesigned short HDD.

SWEDESFORD ROAD CROSSING
PADEP SECTION 105 PERMIT NO.: E15-862
PA-CH-0219.0000-RD and PA-CH-0219.0000-RD-16
(SPLP HDD No. S3-0381)

ATTACHMENT 1

GEOLOGY AND HYDROGEOLOGICAL EVALUATION REPORT

HDD HYDROGEOLOGIC REEVALUATION REPORT

Mariner East II
Spread 3
HDD S3-0381
Swedesford Road
West Whiteland Township, Chester County, Pennsylvania

Prepared for:

Sunoco Pipeline, L.P.

Prepared by:

Groundwater & Environmental Services, Inc.
440 Creamery Way, Suite 500
Exton, Pennsylvania 19341

October 2017

HDD HYDROGEOLOGIC REEVALUTION REPORT

Mariner East II
Spread 3
HDD S3-0381
Swedesford Road
West Whiteland Township, Chester County, Pennsylvania

October 2017

Prepared for:

Sunoco Pipeline, L.P.
535 Fritztown Road
Sinking Spring, Pennsylvania 19608

Prepared by:

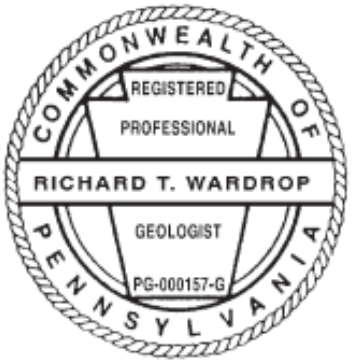
Richard T. Wardrop, P.G.
Principal Hydrogeologist

Reviewed by:

David Demko, P.G.
VP, Client Programs

Groundwater & Environmental Services, Inc.
440 Creamery Way, Suite 500
Exton, Pennsylvania 19341
(610) 458-1077

By affixing my seal to this document, I am certifying that the information is true and correct. I further certify I am licensed to practice in the Commonwealth of Pennsylvania and that it is within my professional expertise to verify the correctness of the information.



October16, 2017

Richard T. Wardrop, P. G. date

Lic. No. PG000157G

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ATTACHMENTS

1.0 INTRODUCTION

Sunoco Pipeline, L. P. (SPLP), retained Groundwater & Environmental Services, Inc. (GES) to prepare Hydrogeological Reevaluation Reports for horizontal directional drills (HDDs) listed on Exhibit 2 of Stipulated Order EHB Docket No. 2017-009-L signed August 10, 2017. This report discusses the hydrogeological reevaluation for the 16-inch and 20-inch installations at HDD S3-0381, Swedesford Road, PA-CH-0219.0000-RD (HDD S3-0381) near E. Swedesford Road in West Whiteland Township, Chester County, PA. Alternatives to HDD installation have been considered. One alternative replaces HDD S3-0381 with a combination of open trench, conventional boring and a much shorter HDD, HDD S3-0382 (953 feet long), Lincoln Hwy E, PA-CH-0245.0000-RD (HDD S3-0382, see **Attachment A**). A map depicting the location of the HDD with topographic information on the surrounding area is presented as **Figure 1**.

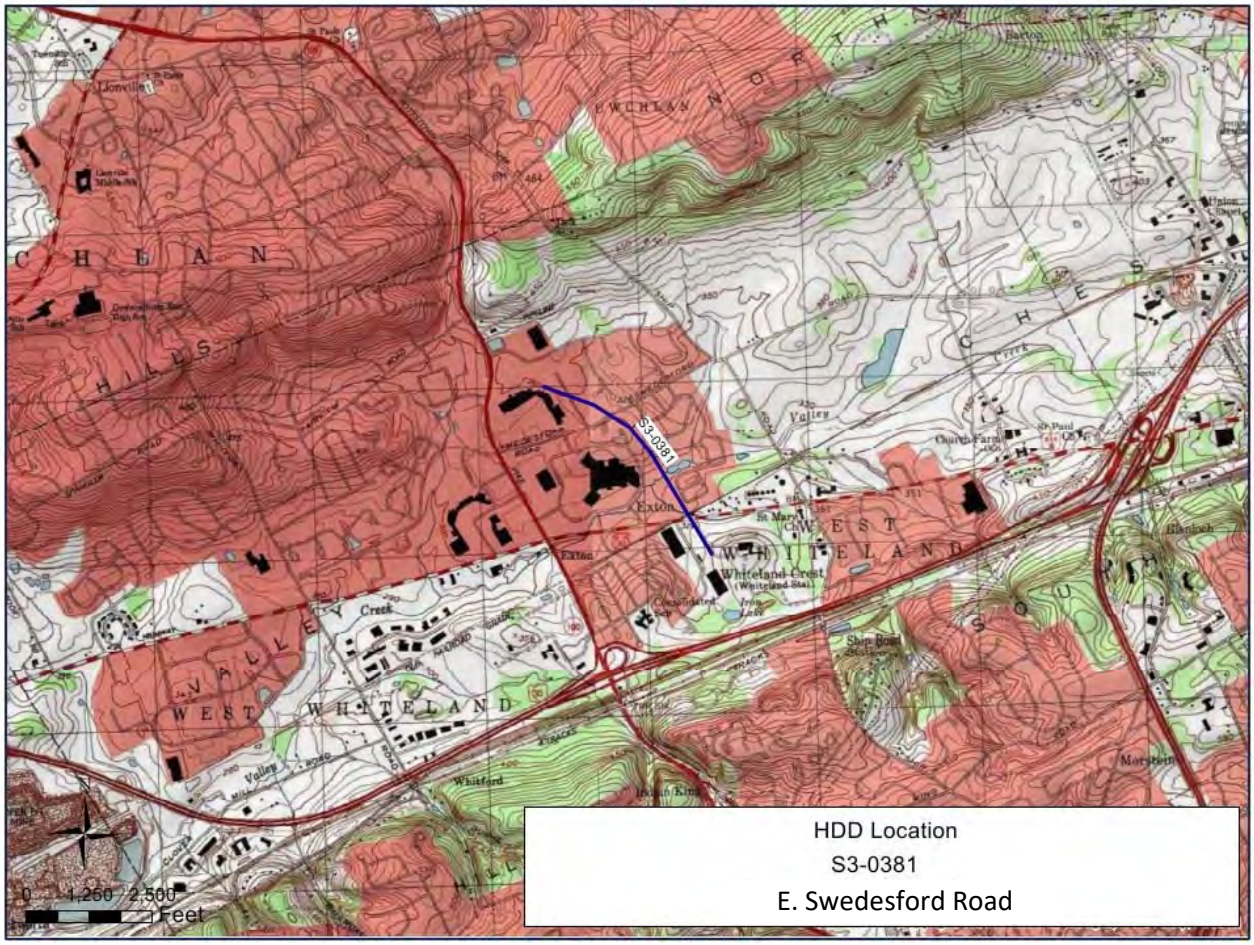


Figure 1. Site Location Map (modified from USGS Downingtown 7.5 min. quad. rev. 1984)

This report presents the following information:

- Geologic and hydrogeologic characteristics in the area of the HDD.
- Summaries of studies performed pertinent to reevaluation, including fracture trace analysis previous geotechnical borings, and an aquifer testing program.
- A reevaluation summary with conclusions.

2.0 HDD GEOLOGY / HYDROGEOLOGY

2.1 Physiography

2.1.1 Topography

The topography in the area surrounding HDD S3-0381 is characteristic of the Lowland Section of the Piedmont Physiographic Province with relatively broad valleys separated by low hills. The area surrounding the HDD is comprised of suburban development, ball fields, light commercial structures and the Exton Mall, as depicted on **Figure 1.** Aside from the entry/exit points, the minimum depth of the originally planned 16-inch and 20-inch pipe below ground surface (bgs) is approximately 36 feet. The existing 12-inch pipeline lays above the planned alignment for the 20-inch pipeline.

2.1.2 Hydrology

The local drainages are tributaries to Valley Creek, which flow southwest, and south to its confluence with the East Branch of the Brandywine River, approximately 5 miles southwest of the proposed alignment. The originally planned drill was 5,037 feet long over relatively flat terrain ranging in elevation from 340 to 360 feet above mean sea level (ft. amsl), with entry/exit points at elevations of 345 and 346 ft. amsl.

Measuring from the northwest entry/exit point the original drill passed beneath three tributaries to Valley Creek (S-B79, S-B80 and S-B81) and an associated wetland (W-B71). Here the land surface is between 300 and 325 feet amsl. A few small emergent wetlands occur along the corridor from Station 42+00 to the south entry/exit point at 50+37. The nearest impoundment is Pond P-B11 due east of Station 31+00 for the original HDD S3-0381 alignment.

A local municipal water utility, AquaPA Pennsylvania, Inc., (AquaPA) operates two public water supply wells located approximately 300 feet to the east of the proposed drill pathway.

2.2 Geology

2.2.1 Soils

Soils overlying the bedrock formations are reflective of their lithologies and resistance to weathering. These include the Edgemont channery loam that develops over quarzites, Conestoga silt loam that develops over weathered limestone and the Urban land – Udorthents developed over limestone. Taken together these soils can be up to 99-inches thick over the parent bedrock and water tables can occur greater than 80 inches below ground (ref. USDA NRCS - https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx).

The mantel thickness measured in five geotechnical borings advanced to support the HDD design ranged from 18 to 52 feet thick or greater (as some borings did not achieve top of rock). The textures of the materials described in the overburden range were silty sands to sandy silts with minor amounts of gravel.

2.2.2 Bedrock Lithology

As shown on published geologic maps (PA DCNR Map Viewer and Bobyshell, 2006), the bedrock along the HDD 381 includes three different geologic formations, from north to south, the Ledger Formation, Chickies Formation, back into the Ledger Formation and terminates in the Conestoga Formation (see **Figure 2**, Geologic Map of the HDD S3-0381 Area). Geotechnical borings have not confirmed the presence of the Chickies Formation bedrock along the planned HDDs.

The Ledger Formation is a light-gray, locally mottled, massive, pure, coarsely crystalline dolomite that is siliceous in the middle part; beds weather to rust-stained, granular cherty layers. Joints create a blocky pattern and are moderately to well developed, sometimes with large distances between fractures. The

formation is moderately resistant to weathering but pinnacles are characteristic in the soil mantle typical of a karst terrain. Drilling can be problematic due to variable conditions (Geyer and Wilshusen, 1982).

The Conestoga Formation is a medium-gray, impure limestone having black, graphitic shale parting and is conglomeratic at its base. In the Chester Valley layers, these include micaceous limestone, phyllite, and alternating dolomite and limestone. Jointing develops in irregular patterns and can be widely spaced. Surface weathering is highly variable due to the variable resistance of the lithologies and the mantle is pinnacled in most places (Geyer and Wilshusen, 1982).

The Chickies Formation, if present, consists of light-gray to white, hard quartzite and quartz schist containing and some slate facies. It is described as being highly resistant to weathering and causes ridges of moderate relief to form on the landscape. Open joints between large blocks create porosity needed to transmit groundwater. Drilling rates can be slow through this resistant formation (Geyer and Wilshusen, 1982).

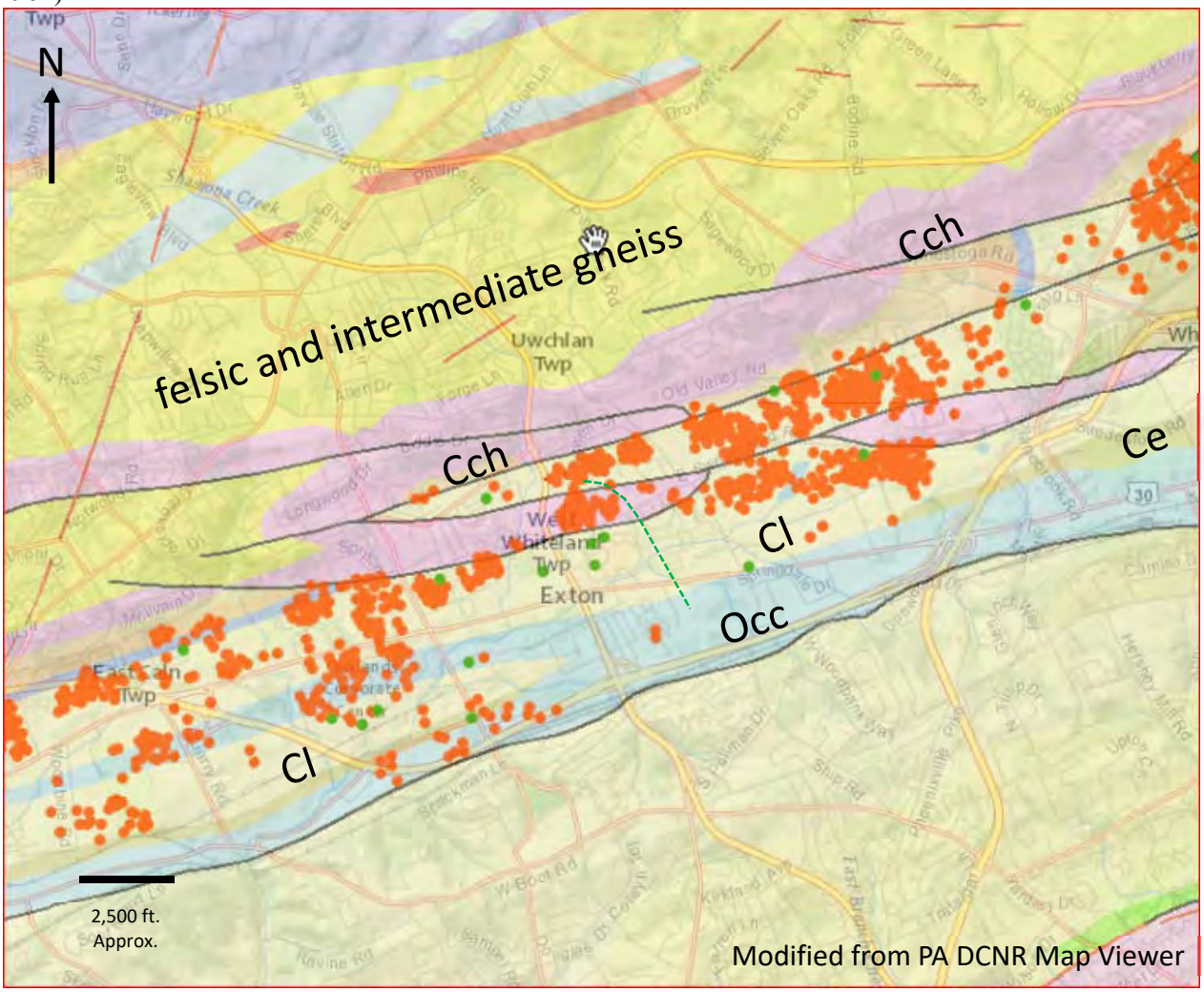


Figure 2. Geologic Map of the HDD S3-0381 Area

2.2.3 Structure

As shown on **Figure 2**, structures are complex in the region and several faults are shown in the area of the drill. Schistocity measurements in the Octoraro Formation, south of the drill, showed strikes along regional fabric to the east-northeast and steep dips ranging from 63 to 83 degrees to the south (Bobyshell, 2006).

2.2.4 Fracture Trace Analysis

Fracture traces analysis via high altitude aerial photography was performed for the area of interest to identify potential zones of bedrock weakness along drill paths. **Figure 3** shows the fracture trace mapping that was performed for HDD S3-0381. This mapping was performed on aerial stereographic pairs flown in the late September 1937. As such, much of the land surface appears undeveloped; therefore, fracture traces are more easily seen. The path of HDD S3-0381 is shown in red on **Figure 3** and transects four of the mapped fracture traces. These intersections with the drill path indicate potential vertical zones of weakness in the bedrock. None of the traces pass across the alignment of the revised HDD S3-0382.

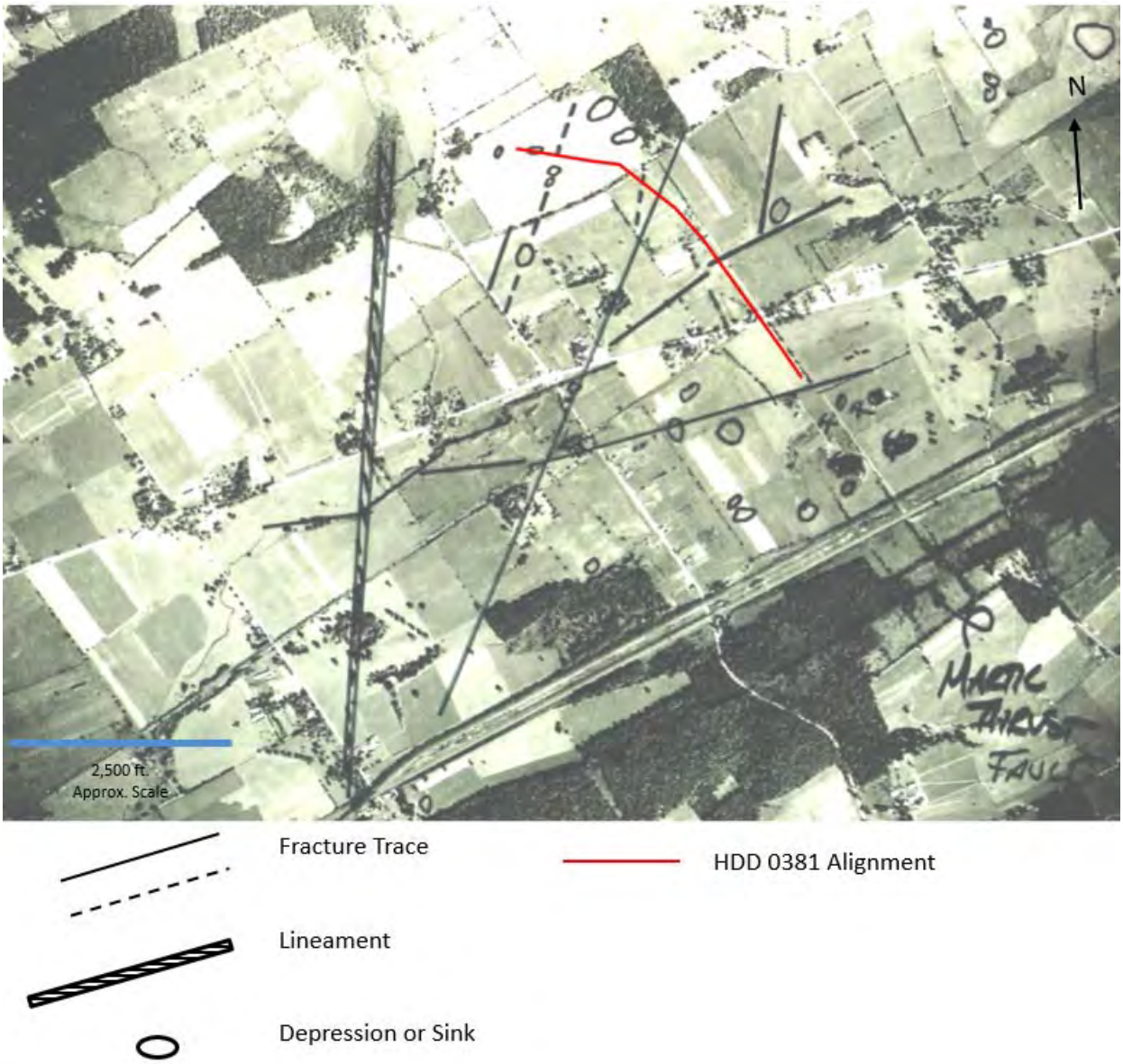


Figure 3. Fracture Trace Mapping in Area of HDD S3-0381

2.2.5 Karst

The alignment of HDD S3-0381 passes through Ledger Formation and Conestoga Formation limestones and dolomites which are locally known for karst development (Geyer and Wilshusen, 1982).

2.2.6 Mining

There are no references to deep mining in the area of HDD S3-0381. Iron ore banks were historically mined in the area but none were mapped along the corridor of the drill (ref. US-mining.com, http://www.us-mining.com/pennsylvania/chester-county).

2.2.7 Rock Engineering Properties

The carbonate rocks (Ledger and Conestoga Formations) are prone to sinkhole development and solution openings, and should be thoroughly investigated before construction (Bobyshell, 2006). The Chickies Formation, if present, can be difficult to excavate. Slopes are stable, dependent on fracture density, and the bedrock can provide good foundation support.

2.2.8 Results of Geotechnical Borings

Core borings were advanced in one of the five geotechnical borings in June 2015 for design of HDD S3-0381 (see **Attachment B**). At the bottom of that boring 10.8 feet of core was drilled from 19.2 feet to 30.0 feet. The bedrock was logged as "Dolomite". Recoveries ranged from 68 to 100% with the last 7.8 feet at 100%. Rock Quality Index measurements (RQDs) ranged from 12 to 68% showing no trend with depth.

2.3 Hydrogeology

2.3.1 Occurrence of Groundwater

In most of Chester County, groundwater occupies and moves within secondary pore spaces created by bedrock discontinuities (open fractures, joints, bedding plan partings, fault zones, etc.). In the carbonate bedrock such as the Ledger Formation and Conestoga Formation these discontinuities can become enlarged through dissolution of bedrock creating relatively large conduits for groundwater flow. The interconnected fracture porosity in the Chickies Formation, if present, is less developed.

2.3.2 Ground Elevation between HDD entry/exits

The originally planned drills for HDD S3-0381 were 5,037 feet long over relatively flat terrain ranging in elevation from 340 to 360 feet above mean sea level (ft. amsl), with entry/exit points at elevations of 345 and 346 ft. amsl. The proposed new HDD S3-0382 would occur over the southern 953 feet of the HDD 381 original alignment. The northern entry/exit points for both the 16-inch line and the 20-inch line would be 313 ft. amsl. The southern entry/exit point for the 16-inch line would be 339 ft. amsl and the southern entry/exit point for the 20-inch line would be 340 ft. amsl. Given the short distance of these drills, the paths in profile are curving throughout with no horizontal section. The low point for the middle of the 16-inch drill along the curved path would be 254 ft. amsl and the low point for the 20-inch drill would be 268 feet amsl.

2.3.3 Water Level

Of the six geotechnical borings advanced in support of the HDD S3-0381 design, three had recorded groundwater levels that were representative of the local water table, not perched zones, listed as follows in **Table 1**.

Table 1. Geotechnical Boring Groundwater Elevation Observations

Geotechnical Boring ID	Recorded Groundwater Elevation (ft. amsl.)
S3-HDD 370 SB-02	318
S3-HDD 381 SB-02	311.5
S3-HDD 381 SB-03	297
S3-HDD 381 SB-04	<316 (dry below 18 ft. bgs)
S3-HDD 381 SB-05	<336 (dry below 15 ft. bgs)

The planned depth of the pipe along its horizontal section for HDD S3-0381 at these positions in approximately 268 feet amsl, in all cases, well below these water levels. Similarly, the drills for HDD S3-0382 will achieve a maximum depth at elevation 254 ft. amsl for the 16-inch bore and at 268 ft. amsl for the 20-inch bore. The closest water level measurement to HDD S3-0 382 are from the S3-HDD 381 SB-03 advanced in June 2015, which was 297 ft. amsl. Thus, it is anticipated that HDD S3-0382 would be below the water table along much of the profiles. Additional geologic profile and water level data became available during the study described in **Section 2.3.5**.

2.3.4 Well Yields

Well yields in the Ledger, Conestoga and Chickies Formations are variable based on the ability of the driller to encounter interconnected, water-filled fractures. Using the Pennsylvania Groundwater Information System (PAGWIS) a survey of Ledger, Conestoga and Chickies Formation domestic wells in West Whiteland Township was performed. Average well depths and yields are listed on **Table 2**. As shown, the carbonate aquifer wells in West Whiteland Township tend to produce more water than the Chickies wells with the Ledger Formation wells producing nearly double that of the Conestoga Formation wells.

Table 2. Depths and Yields of Chickies and Carbonate Formations in West Whiteland Township

Formation	Ledger	Conestoga	Chickies
Average Depth (ft.)	123	207	179
Total Observations	75	38	10
Average Yield (gpm)	61.4	36.6	27.6
Total Observations	56	28	7

2.3.5 Water Supply Wells within 150 feet and 450 feet of ROW

During the original planning by SPLP for advance of the HDD S3-0381 drills, a survey of landowners within 150 feet of the ROW was performed and no landowners responded positively to an offer to have their wells tested. In terms of the current well survey program, a survey of land owners within 450 feet of the ROW, no data regarding wells within the extended 450 feet of ROW is available at this time; pending responses from landowners. A PAGWIS search in the area did not identify any wells within 450 feet of the HDD S3-0381 alignment.

2.3.6 Aquifer Pumping Test

During preparation of the Chapter 105 permit package SPLP notified local public water companies in proximity to the 20-inch and 16-inch pipe alignments. The notification for HDD S3-0381 caused AquaPA of Bryn Mawr, Pennsylvania, to respond to the notification. AquaPA has two water wells located on a small property due east of the alignment, and south of Swedesford Road. AquaPA expressed a concern for water quality impacts during future pipe installation. As such, a plan was developed to test potential aquifer hydraulic connection between a few optional HDD depths. The result of the pumping test are included in in a letter report from C. Sollenberger (Tetra Tech) to M. Gordon (SPLP) dated March 24, 2017, submitted to DEP as part of the Swedesford Road permit modification package, October 3, 2017. The plan involved drilling of a 200-foot deep borehole, geophysical logging of the borehole, and installation of discrete

monitoring points within the borehole. This nest of monitoring points was located on the eastern edge of the pipeline right-of-way between the AquaPA wells and the planned pipelines. Once the monitoring point nest was installed, a 7-day pumping test was conducted using the two AquaPA wells to stress the aquifer. The monitoring point nest was constructed with three monitoring zones: one from 0 feet to 95 feet; one from 99 to 112 feet; and one from 116 to 131 feet (the planned depth interval for HDD S3-0381 at that time).

The three monitoring points within the nest and the two AquaPA wells were monitored for water level and turbidity throughout the pumping test. The average total discharge rate over the period of the pumping test averaged 411 gpm. Pre-test static water levels were taken to establish levels prior to a period of continuous pumping, and for each monitoring point, the level was approximately 309 ft. amsl similar to the level measured in geotechnical boring SB-02.

Based on the data collected during the aquifer-testing plan, all three monitoring points in the nest of monitoring points appeared to be in hydraulic connection with the AquaPA supply wells and connected vertically with each other. The proposed interval for the HDD construction was determined to be within a conservatively large calculated capture zone of the AquaPA production wells and, as such, alternative methods for pipeline installation were indicated. These included changing the vertical position of the HDDs (up and down), open trenching, and providing AquaPA with the resources to develop one or more alternative water supply wells.

A capture zone derived from the pumping test is depicted on **Figure 4.** As shown, the zone is approximately 1,000 feet wide and reaches 100 feet southeast of the AquaPA wells. This capture zone is based on the assumption that the direction of the groundwater flow gradient under non-pumping conditions would mimic the slope of the local topography (southeast) and the porous media was homogeneous and isotropic. A margin of safety was built into the capture zone analysis in that the maximum theoretical capture zone, derived from pumping test data was doubled. If anisotropy was considered in the assessment, preferred pathways of groundwater would most likely align with the regional fabric of the bedrock (east-northeast) causing the capture zone to expand east-northeast and west-southwest but not reach as far southeast.

Figure 4. AquaPA Swedesford Road Well Capture Zone (from Tetra Tech, 2017)

2.4 Summary of Geophysical Studies

No surface geophysical studies have been performed along the alignment of HDD S3-0381 to date. A downhole geophysical survey was performed prior to monitoring point installation in preparation for the pumping test described in **Section 2.3.6**.

3.0 OBSERVATIONS TO DATE

3.1 On This HDD Alignment

3.1.1 ME I

ME I inadvertent returns (IRs) are listed in the ME II IR PPC Plan for the Ledger, Conestoga or Chickies Formation in Chester County.

3.1.2 ME II

No ME II HDD construction has occurred along the HDD S3-0381 alignment, to date.

3.2 On Other HDD Alignments in Similar Hydrogeologic Settings

3.2.1 ME I

None of the ME I IRs listed in the IR PPC Plan for Chester County occurred in carbonate rock or Chickies Formations.

3.2.2 ME II

The entry point for the 20-inch HDD S3-400 is located approximately 1,400 feet south-southeast of the southern entry/exit point for drill HDD S3-0381 and HDD S3-0382. Moving southeast from the northern entry/exit point for HDD S3-400 for approximately the first 880 feet, the drill has passes through the Conestoga Formation, before entering the Octoraro Formation, a phylllite with some schist, south of the Amtrak rail corridor. Due to the karst character of the Conestoga, the drill has gone through voids, has had difficulties staying on alignment, has experienced high groundwater production, and significant losses of drilling fluids. Despite the losses of drilling fluids, no IRs have been detected to date. Other potential challenges of drilling though the Conestoga would be development of sinkholes or lowering of water level in local domestic supply wells.

The pilot drill for HDD S3-360 north of Shoen Road in West Whiteland and Uwchlan Township is in the Harper Phylite and Chickies Formation. The "Ketch Fault" reportedly runs perpendicular to the drill in the Chickies approximately 1,800 feet north of the south entry/exit point. The south entry/exit point for HDD S3-360 drill is close to the mapped Ledger Formation / Harper Phyllite contact. The pilot hole for the HDD S3-360 20-inch line was discontinued after 1,575 feet along the 2,833 designed drill due to a lowering of the local water table and associated impact on local residential water supplies. Local groundwater hydraulics and a large difference in elevation between the entry and exit points caused the water supply impact here. A hydrogeologic evaluation for HDD S3-360 was described in letter report from D. Demko, M. Helmke, and R. Wardrop (all of GES) to M. Gordon (SPLP) and was submitted to DEP on September 1, 2017 as required by a Consent Order Agreement between SLPL and DEP dated July 24, 2017. .

4.0 SUMMARY AND CONCLUSIONS OF HDD HYDROGEOLOGIC EVALUATION

4.1 HDD Site Conceptual Model

Based on the information provided in this reevaluation report, the originally planned drill path for HDD S3-0381 will encounter karst bedrock conditions, characteristically exhibiting less competent materials and void structures. The potential to both lose drilling mud and promote the increased potential for IRs is present in this terrain. Additionally, there is a greater potential for IRs to occur where fracture traces, documented from air photo geologic structural analysis, cross the alignment. Information collected during a pumping test program conducted using a multi-level monitoring point, installed within the LOD, near the two AquaPA public water supply wells along Swedesford Road, has demonstrated hydraulic communication with the water supply wells at multiple depths, indicating the potential for these water supply wells to be impacted (increased turbidity) by the installation of HDD S3-0381.

The most representative geotechnical boring relative to HDD S3-0382 is HDD S3-381-SB-04, which was advanced to an elevation of 305 ft. amsl with rock cores obtained over the bottom 12 feet of the bore. The proposed lowest elevations for the 16-inch and 20-inch lines for HDD S3-382 are at elevations 254 and 268 ft. amsl, respectively. In addition, area specific water level elevation data are not available for review for the area of HDD 382. Therefore, assessment of the potential for groundwater flowback discharge and associated local lowering of the water table during the advance of the pilot hole cannot be performed.

DPS is proposing a revised design for pipeline installation along the original HDD S3-0381 alignment. This revision utilizes open trenching, conventional bores and a greatly reduced section of HDD installation (953 feet versus 5,037 feet) at the south end of the original drill alignment. (See **Attachment A**) The shorter HDDs, while still in the karstic Ledger and Conestoga Formations are outside the capture zone determined by TetraTech (2017). The risk of losing drilling fluid and of IRs associated with drilling through karst terrain remains for HDD S3-0382, but is greatly reduced by the fact that the HDD drills are shortened to 953 feet in length.

4.2 Conclusions and Recommendations

The risk of losing drilling fluid and of IRs associated with drilling through karst terrain for HDD S3-0381 would be greatly reduced by installing all but the southernmost 953 feet, using open trench and conventional bore procedures. The risk of losing drilling fluids, of IRs, of groundwater flowback discharges and of lowering the local water table could not be assessed given the available information. Deeper cores, to the elevation of the planned lowest point along HDD S3-0382 and representative water level measurements are needed to assess those risks. A geophysical study is required to determine the extent of karst development along the profile of HDD S3-0382, especially in light of installation challenges that are being experienced at HDD S3-400 due south of HDD S3-0382, including excessive groundwater discharge; loss of fluids, with no IRs to date; and difficulties steering the pilot hole.

5.0 REFERENCES

Bobyshell, H., (2006) *Bedrock Geologic Map of the Chester Valley and Piedmont Portion of the Germantown, Malvern, Norristown, and Valley Forge Quadrangles, Chester, Delaware, Montgomery, and Philadelphia Counties, Pennsylvania*, Pa Geol. Surv., 4th ser., OFBM-06-04.0.

Geyer, A. R. and J. P. Wilshusen, (rev. 1982) *Engineering Characteristics of the Rocks of Pennsylvania.* PaDER, ORM, Pa Geol. Surv., 4th ser., EGR-1.

PA DCNR (Department of Conservation and Natural Resources) Map Viewer (http://www.gis.dcnr.state.pa.us/maps/index.html).

PAGWIS, Pennsylvania Groundwater Information System (http://dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm).

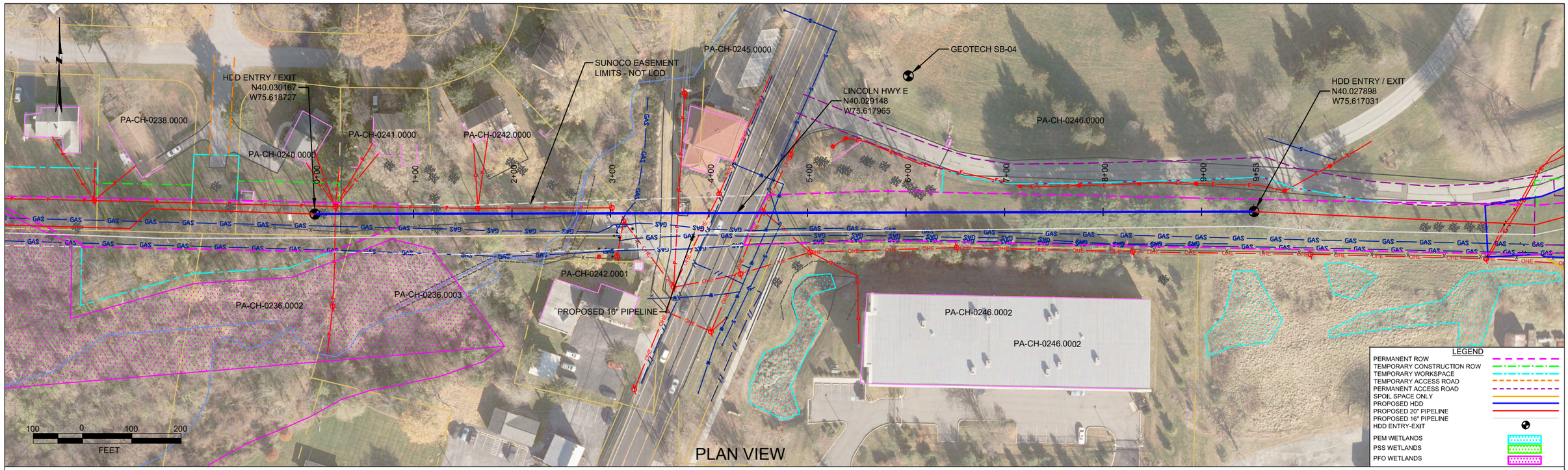
Penn State Mine Atlas (http://www.minemaps.psu.edu).

USDA NRCS WSS, United States Department of Agriculture, Natural Resources Conservation Service – Web Soil Survey for Cambria County. (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx).

USGS (United States Geological Survey), Downingtown, Pennsylvania, 1:24,000 topographic quadrangle map, rev. 1984.

Attachment A

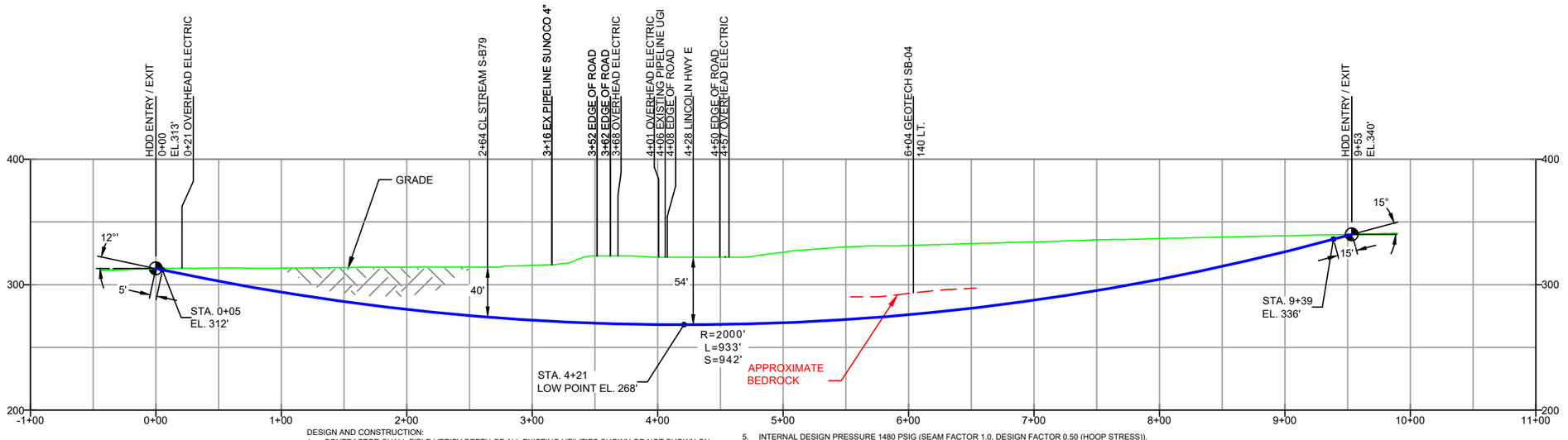
Proposed HDD S3-0381 Plan and Profiles



PLAN VIEW

PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382



GEOTECH SB-04
-NG EL. 334'
-TOPSOIL (0' - 0.5')
-ML (0.5' - 14.0')
-SM (14.0' - 18.0')
-DOLOMITE (18.0' - 30.0')
-COMPLETION DEPTH EL. 304"

NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (Le):953'
   HDD PIPE LENGTH (S=):962'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

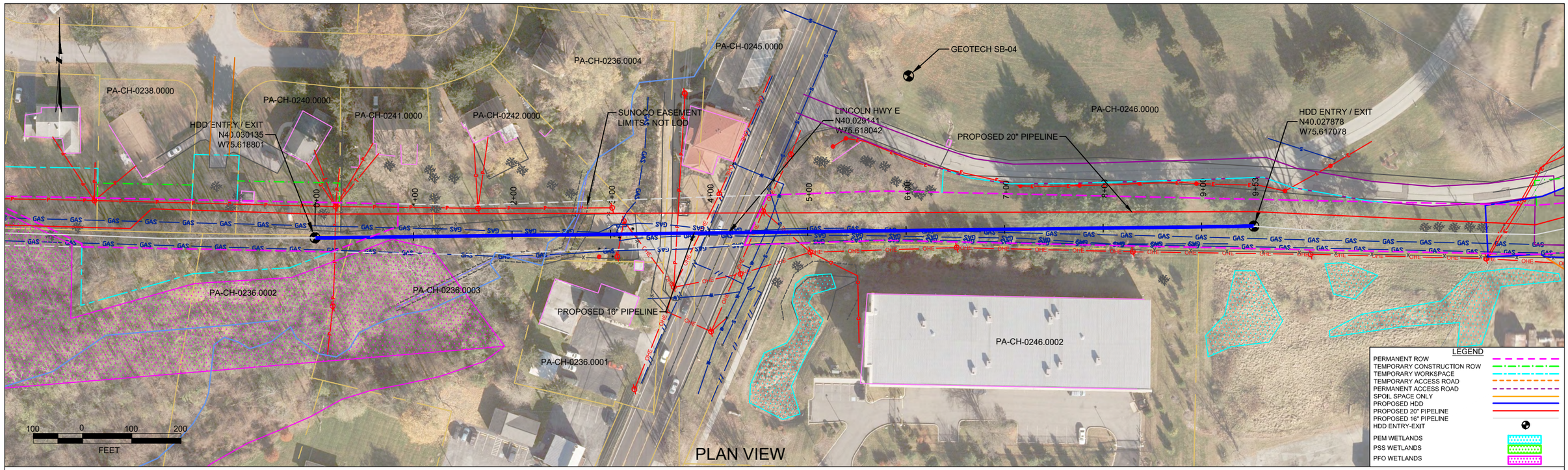
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

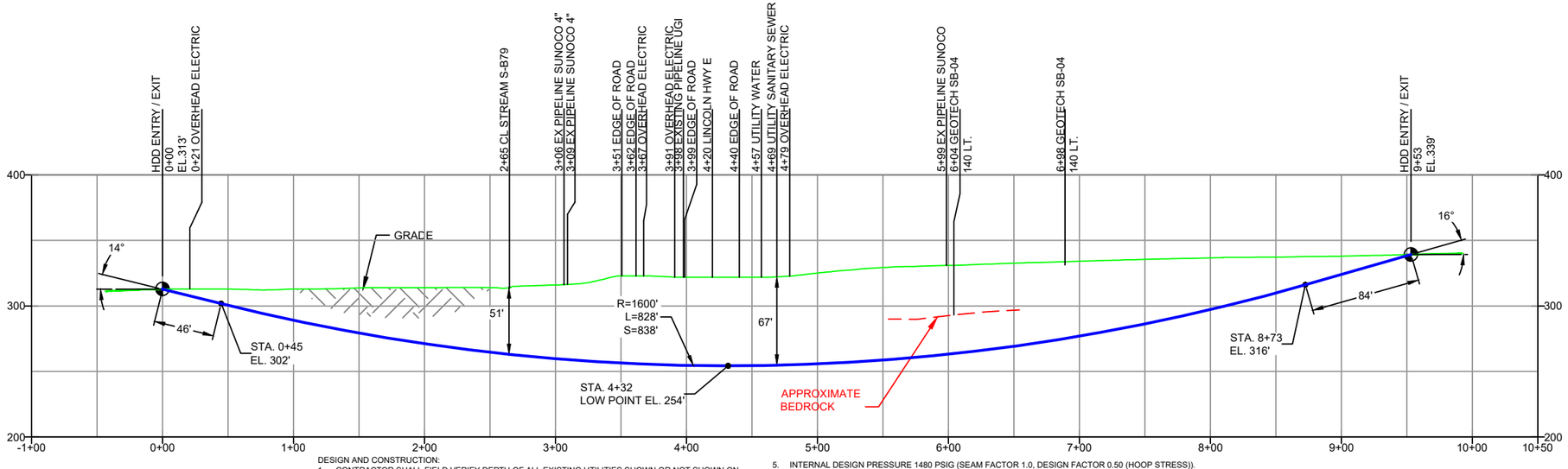
SCALE: 1"=100'

DWG. NUMBER: PA-CH-0245.0000-RD



CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382-16

PROFILE VIEW



GEOTECH SB-04
-NG EL. 334'
-TOPSOIL (0' - 0.5')
-ML (0.5' - 14.0')
-SM (14.0' - 18.0')
-DOLOMITE (18.0' - 30.0')
-COMPLETION DEPTH EL. 304"

NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):953'
   HDD PIPE LENGTH (S=):968'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
1	DESIGN CHANGE (14 DEG ENTRY) & CORRECTION TO PIPE SPECIFICATION	DLM	06/06/17	RMB	06/06/17	AMC	06/06/17
0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

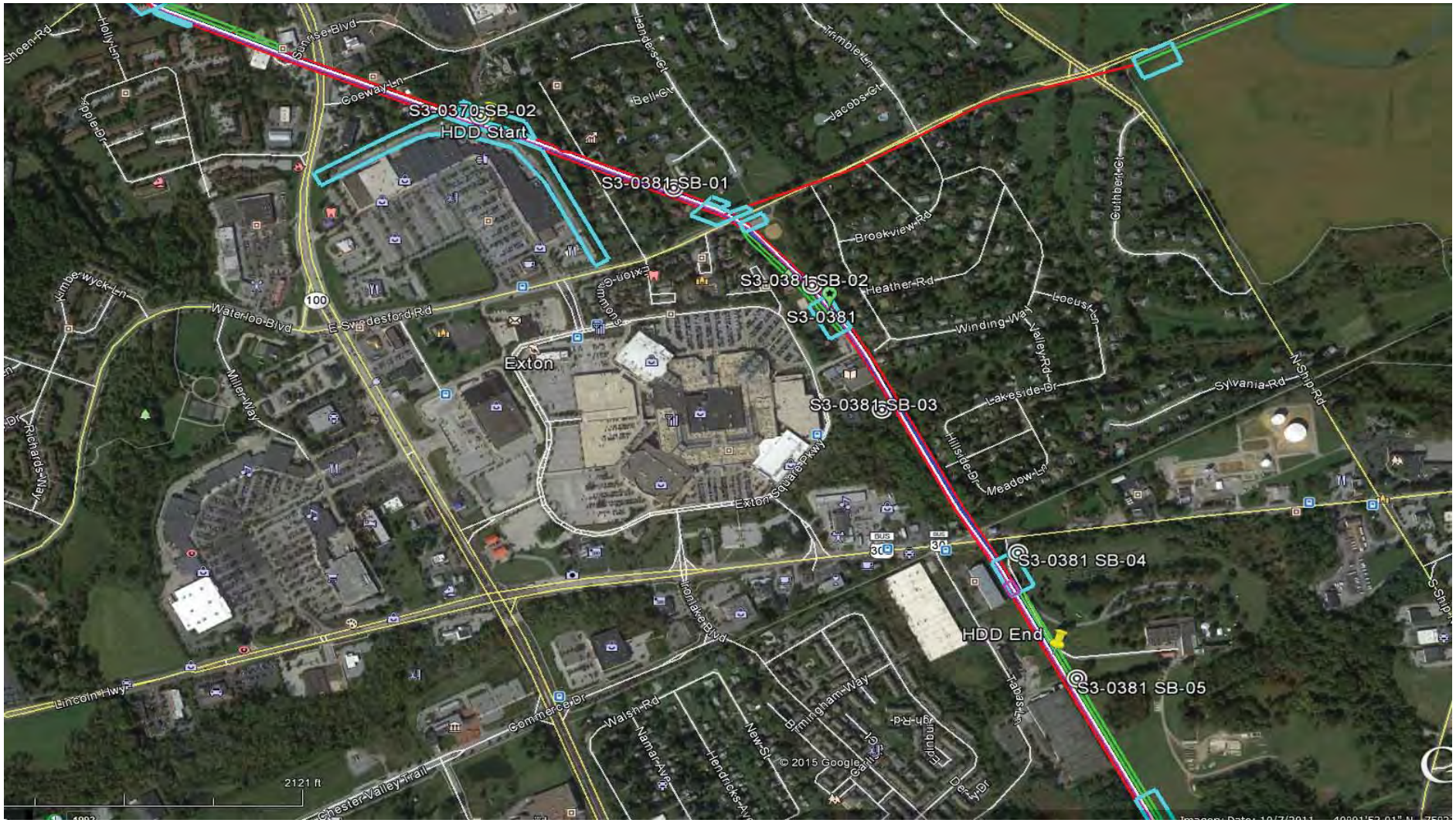
HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO.: PA-CH-0245.0000-RD-16

Attachment B

Geotechnical Information for HDD S3-0381



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0381
CHESTER COUNTY, WEST WHITELAND TOWNSHIP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT

TETRA TECH
240 Continental Drive, Suite 200
Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	BEHIND FAIRVIEW PLAZA (SUPERCUTS), EXTON, PA		Page 1 of 1
HDD No.:	S3-0370	Dates(s) Drilled: 06-14-15	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 28.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 2' 12.471" N	75° 37' 42.989" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.1			TOPSOIL (1")					
1	3.0	5.0	0.1		21	ML	MOTTLED (SHADES OF BROWN) SILT AND FINE TO MEDIUM SAND,	2	8	6	7	**14**
							WITH A LITTLE FINE TO COARSE GRAVEL.					
2	8.0	10.0			22		BROWN SILT WITH A LITTLE FINE SAND. (USCS: ML).	2	3	3	5	**6**
				11.5								
3	13.0	15.0	11.5		24		DR WEATHERED TO A BROWN SILT WITH A LITTLE FINE SAND, TRACE	1	4	5	7	**9**
							FINE QUARTZ GRAVEL, TRACE MICA.					
4	18.0	19.5			24		DR WEATHERED TO A BROWN AND BLACK SILT WITH A LITTLE FINE	2	5	9	15	**14**
						ML	SAND, TRACE FINE GRAVEL.					
5	23.0	25.0			24		DR WEATHERED TO A BROWN TO ORANGE BROWN SILT AND FINE	2	4	4	5	**8**
							SAND, TRACE FINE QUARTZ GRAVEL. (USCS: ML).					
6	28.0	30.0		30.0	16		SAME.	3	4	6	9	**10**
							WET ON SPOON AT 23'.					
							WATER LEVEL THROUGH AUGERS AT 28'.					
							CAVED AT 27', WATER LEVEL ON CAVE AT 25'.					

Notes/Comments:

Pocket Pentrometer Testing
8': 3.0 TSF 15': 2.5 TSF
10': 3.75 TSF 18': 2.75 TSF
13': 4.0 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

TETRA TECH
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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	300 QUINN CT., EXTON, PA		Page 1 of 1
HDD No.:	S3-0381	Dates(s) Drilled: 06-15-15	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 2' 7.761" N	75° 37' 28.220" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.2			TOPSOIL (2")					
1	3.0	5.0	0.2		24	ML	VARIEGATED BROWN, LIGHT BROWN, DARK BROWN, ORANGE BRWN	5	5	5	9	**10**
							SILT WITH SOME FINE SAND, TRACE FINE GRAVEL. (DR)					
2	8.0	10.0			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	2	3	6	9	**9**
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL. (USCS: ML)					
3	13.0	15.0			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	1	4	5	7	**9**
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL					
4	18.0	19.5			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	1	2	4	7	**6**
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL. (USCS: ML)					
5	23.0	25.0			24		DR, VARIEGATED BROWN, LIGHT BROWN AND WHITE SILT WITH SOME	2	5	8	11	**13**
							FINE SAND, TRACE QUARTZ FINE GRAVEL.					
6	28.0	30.0			18		DR, VARIEGATED BROWN, DARK BRWON AND WHITE SILT WITH A	1	2	4	4	**6**
				30.0			LITTLE FINE SAND.					
							WET ON SPOON AT 25'					
							NO WATER LEVEL THROUGH AUGERS.					
							CAVED AND DRY AT 29'.					

Notes/Comments:

Pocket Pentrometer Testing

4': 2.25 TSF 13': 2.5 TSF 25': 1.75 TSF
8': 3.0 TSF 20': 2.25 TSF 28': 1.25 TSF
10': 2.5 TSF 23': 3.75 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

TETRA TECH
240 Continental Drive, Suite 200
Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	MEADOW BROOK MANOR PARK, EXTON, PA		Page 1 of 1
HDD No.:	S3-0381	Dates(s) Drilled: 06-12-15	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 38.0	Total Depth (ft): 52.2
Boring Location Coordinates:		40° 2' 1.433" N	75° 37' 17.663" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		15	ML	BROWN SILT AND FINE SAND.	2	4	4	6	**8**
2	8.0	10.0			15		BROWN SILT AND FINE SAND.	2	3	4	3	**7**
				11.5								
3	13.0	15.0	11.5		24	ML	DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	2	4	6	8	**10**
							UNWEATHERED GRAY PHYLLITE GRAVEL.					
4	18.0	19.5			14		DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	3	7	8	11	**15**
							UNWEATHERED GRAY PHYLLITE GRAVEL. (USCS: ML).					
5	23.0	25.0			24		DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	2	7	7	9	**14**
							UNWEATHERED GRAY PHYLLITE GRAVEL.					
6	28.0	30.0			19		DR, LIGHT BROWN, BROWN, AND YELLOW BROWN SILT WITH SOME	2	7	6	7	**13**
							F-SAND, TRACE UNWEATHERED FINE PHYLLITE GRAVEL. (USCS: ML)					
7	33.0	35.0			24		DR, BROWN SILT AND FINE SAND, WITH A TRACE FINE UNWEATHERED	1	7	11	17	**18**
							PHYLLITE GRAVEL.					
8	38.0	40.0			18		DR, BROWN SILT AND FINE SAND, WITH A TRACE FINE UNWEATHERED	6	6	3	3	**9**
				41.5			PHYLLITE GRAVEL.					
9	43.0	45.0	41.5		24	SM	DR, BROWN AND GRAY FINE TO MEDIUM SAND WITH SOME SILT,	5	11	10	12	**21**
				47.5			WITH A LITTLE UNWEATHERED FINE GRAVEL.					
10	48.0	48.0			<1		GRAY DOLOMITE OR LIMESTONE.	50/0"				**>50**
11	52.0	52.2					GRAY DOLOMITE OR LIMESTONE.	50/2"				**>50**
							AUGER GRINDING AT 47.5'.					
							AUGER REFUSAL AT 52'.					
							WET ON SPOON AT 38'.					
							WATER LEVEL THROUGH AUGERS AT 41'.					
							CAVED AT 47', WATER LEVEL ON CAVE AT 31'.					

Notes/Comments:

Pocket Pentrometer Testing
S6: 1.5 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

TETRA TECH
240 Continental Drive, Suite 200
Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CHESTER COUNTY LIBRARY, 450 EXTON SQUARE PKWY, EXTON, PA		Page 1 of 1
HDD No.:	S3-0381	Dates(s) Drilled: 06-12-15	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 7.0	Total Depth (ft): 23.2
Boring Location Coordinates:		40° 1' 53.372" N	75° 37' 12.338" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (4")					
			0.3	4.5		ML	SOFT GRAY AND DARK BROWN SILT WITH SOME FINE SAND.					
1	3.0	5.0	4.5		13	SM	GRAY FINE TO COARSE SAND WITH A LITTLE SILT, WITH A LITTLE	1	1	3	4	**4**
				6.5			FINE QUARTZ GRAVEL.					
2	8.0	10.0	6.5		24		DR, WHITE TO LIGHT BROWN FINE SAND WITH SOME SILT, WITH A	17	35	28	10	**63**
							LITTLE F-C UNWEATHERED DOLOMITE GRAVEL.					
3	13.0	15.0			24	SM	DR, VARI-COLORED (WHITE, BROWN, LIGHT BROWN) FINE SAND	4	7	8	6	**15**
							AND SILT. (USCS: SM).					
4	18.0	18.3			2		DR, WHTE AND LIGHT BROWN FINE SAND AND SILT, WITH A LITTLE	50/3"				**>50**
				23.0			FINE UNWEATHERED DOLOMITE GRAVEL.					
5	23.0	23.2	23.0	23.2	<1		LIGHT BROWN PARTIALLY WEATHERED DOLOMITE.	50/2"				**>50**
							AUGER REFUSAL AT 23'. AUGERS STARTED GRINDING AT 16'.					
							WET ON SPOON AT 7'.					
							WATER LEVEL THROUGH AUGERS AT 8'.					
							CAVED AT 12', WATER LEVEL ON CAVE AT 5'.					

Notes/Comments:

Pocket Pentrometer Testing
3': 0.75 TSF
4': 1.5 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

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fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CHESTER COUNTY LIBRARY, 450 EXTON SQUARE PKWY, EXTON, PA		Page 1 of 1
HDD No.:	S3-0381	Dates(s) Drilled: 06-11/12-15	Inspector: J. CCOSTELLO
Boring No.:	SB-04	Drilling Method: SPT - ASTM D1586	Driller: GREG
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): SEE BELOW	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 1' 44.117" N	75° 37' 2.012" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6")					
1	3.0	5.0	0.5		20		DR, REDDISH BROWN SILT WITH SOME FINE SAND, TRACE FINE	1	2	2	3	**4**
							GRAVEL.					
2	8.0	10.0			24	ML	DR, BROWN SILT AND FINE SAND, TRACE MICA.	1	2	2	2	**4**
3	13.0	15.0			24		DR, VARIEGATED YELLOWISH BROWN, BROWN, AND WHITE SILT	1	3	12	8	**15**
				14.0			WITH A LITTLE FINE SAND, TRACE GRAY ROCK FRAGS. (USCS: ML)					
			14.0	18.0		SM	BROWN FINE SAND AND SILT.					
4	18.0	18.3	18.0	19.0			PARTIALLY WEATHERED LIGHT GRAY DOLOMITE.	50/3"				**>50**
							AUGER REFUSAL AT 19'.					
							ROCK CORING					
RUN 1	19.0	19.8	19.0		6.5	ROCK	MODERATELY FRACTURED WHITE TO LIGHT GRAY DOLOMITE.	TCR: 68%, SCR: 68%, RQD: 68%				
RUN 2	19.8	22.2			22		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY	TCR: 76%, SCR: 38%, RQD: 21%				
							DOLOMITE.					
RUN 3	22.2	27.0			60		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY	TCR: 100%, SCR: 27%, RQD: 17%				
							DOLOMITE.					
RUN 4	27.0	30.0			36		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY	TCR: 100%, SCR: 69%, RQD: 49%				
				30.0			DOLOMITE.					
							CORE TESTING RESULTS (RUN 2, DEPTH 20 TO 20.5'):					
							COMPRESSIVE STRENGTH: 13,700 PSI					
							UNIT WEIGHT: 170.9 PCF					
							PERCHED WATER CONDITIONS OVER ROCK AT 15.0'.					
							CAVED AND DRY AT 18'.					

Notes/Comments:

Pocket Pentrometer Testing
S1: > 4 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	500 LINCOLN HYW, EXTON, PA		Page 1 of 1
HDD No.:	S3-0381	Dates(s) Drilled: 06-12-15	Inspector: J. CCOSTELLO
Boring No.:	SB-05	Drilling Method: SPT - ASTM D1586	Driller: GREG
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 16.5
Boring Location Coordinates:		40° 1' 36.077" N	75° 36' 57.617" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		21	ML	BROWN TO YELLOWISH BROWN SILT AND FINE SAND, TRACE	1	3	3	11	**6**
							FINE GRAVEL.					
2	8.0	10.0			21		BROWN SILT WITH SOME FINE SAND, TRACE FINE GRAVEL.	1	3	7	11	**10**
				11.5			(USCS: ML).					
3	13.0	14.8	11.5			SM	DR, DARK BROWN AND GRAY MICACEOUS FINE TO MEDIUM SAND	1	1	2	50/3"	**>50**
				16.5			AND SILT, TRACE FINE ROCK FRAGMENTS.					
							AUGER REFUSAL AT 16.5'. REFUSAL MATERIAL APPEARS TO BE					
							DARK GRAY LIMESTONE (BASED ON AUGER CUTTINGS).					
							LIMESTONE ROCK OUTCROPS ARE LOCATED IN VICINITY OF SB-05.					
							CAVED AND DRY AT 15'.					

Notes/Comments:
Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
N: Number of blows to drive spoon from 6" to 18" interval.

SWEDESFORD ROAD CROSSING
PADEP SECTION 105 PERMIT NO.: E15-862
PA-CH-0219.0000-RD and PA-CH-0219.0000-RD-16
(SPLP HDD No. S3-0381)

ATTACHMENT 2

PERMIT MODIFICATION MATERIALS

TETRA TECH

PITT-07-17-021

July 24, 2017

Project Number 112IC05958

Mr. Domenic Rocco
Program Manager
Department of Environmental Protection
Waterways and Wetlands Program
Southeast Regional Office
2 East Main Street
Norristown, Pennsylvania 19401

Re: **Sunoco Pipeline L.P. – Pennsylvania Pipeline Project (Mariner East II)**
Chapter 102 Permit No. ESG 01 000 15 001 Modification Request
Request for additional LOD associated with revised pipeline installation technique
West Whiteland Township, Chester County, PA

Dear Mr. Rocco:

On behalf of Sunoco Pipeline LP (SPLP), please accept the enclosed information as a request for a modification to the above-referenced Chapter 102 authorization. The modification requested is a change in installation methodology for a portion of the project from a long horizontal directional drill (HDD) to an open cut with some shorter auger bores and a shorter HDD. This change in methodology is the result of concerns from Aqua America (Aqua), the local water authority, regarding their Hillside Drive production well along E Swedesford Road (Attachment 1). The concerns identified by Aqua would be addressed by this modification.

A HDD was initially designed for this area due to the dense population and topography. When Aqua expressed its concerns regarding the Hillside Drive well, alternate depths were considered for the HDD design. However, a shallower HDD was determined to not be feasible due to the changes in topography/elevation along the route. Consideration of deeper depths required additional information on the underlying geology. SPLP performed hydraulic and geologic testing in the area adjacent to the Hillside Drive production well and in the centerline of the proposed HDD. Evaluation of the drill cores found highly fractured rock throughout the formation and pump test results determined that area intended for the HDD was within the zone of capture for Aqua's well. Therefore, installing the pipeline via HDD at a deeper depth was also determined to not be feasible. Based on this evaluation, the best method for installation of pipeline in this area is a combination of open cut, conventional bore, and HDD (outside of the Aqua well radius of influence). Through the utilization of these three installation methods, SPLP is able to avoid impacts to the Hillside Drive production well and maintain its avoidance of impacts to resources and sensitive areas.

The proposed changes include an open trench installation with five conventional bore sections and one shorter HDD. The HDD will be conducted for Stream S-B79 and Lincoln Highway which is over 2,300 feet from Swedesford Road. Conventional bores will be added at: Stations 15111+00 to 15112+25 (Exton Lane), Stations 15113+75 to 15117+00 (utilities avoidance), Stations 15121+00 to 15122+25 (E Swedesford Road), and Stations 15135+00 to 15137+00 (CR sensitive area by stream S-B81) and 15137+00 to 15141+00 (stream S-B81 and wetland WL-B71).

The pipeline alignment will remain within Sunoco's permanent easement and the requested modification only concerns a larger limit of disturbance to accommodate the revised installation technique, as well as revised

Tetra Tech, Inc.
661 Andersen Drive, Pittsburgh, PA 15220
Tel 412-921-7090 Fax 412-921-4040 tetratech.com

vertical depths of the pipeline. Coordination with the land owners and municipality regarding the revised installation methods has been conducted and agreements will be in place prior to construction.

The updated E&S plans indicate the larger LOD associated with revised installation technique. The profiles for the HDDs and Bore are also attached (Attachment 2).

We look forward to your review and approval of this modification.

Sincerely,

Robert F. Simcik, P.E.
Project Manager
Tetra Tech, Inc.

RFS/clm

Enclosures: Attachments

cc:
File 112IC05958
Joseph Sofranko, Chester County Conservation District
Josh Proceno, Tetra Tech
Matt Gordon, Sunoco Pipeline L.P.
Monica Styles, Sunoco Pipeline L.P.
Chris Embry, Sunoco Pipeline L.P.
Chris Cable, Tetra Tech
Brad Schaeffer, Tetra Tech
John Hohenstein, SERO DEP
Chris Smith, SERO DEP
Don Knorr, SERO DEP

Attachment 1

Aqua Letter

Simcik, Robert

From: GORDON, MATTHEW L <MATTHEW.GORDON@energytransfer.com>
Sent: Monday, July 17, 2017 3:55 PM
To: Roda, Ann; Rocco, Domenic; Atkinson, Aneca
Cc: Schaeffer, Brad; Simcik, Robert; STYLES, MONICA L
Subject: FW: Horizontal Directional Drilling Near Hillside Drive, Exton, PA

Categories: Blue Category

Per our call last week here is the requested information from Aqua. We will include with the resubmission of the permit modification request for West Whiteland.

Thanks
Matt Gordon

From: GORDON, MATTHEW L
Sent: Monday, July 17, 2017 1:55 PM
To: CSCrockett@aquaamerica.com
Cc: Watkins, Deborah M. <DMWatkins@aquaamerica.com>; GORDON, MATTHEW L <MATTHEW.GORDON@energytransfer.com>
Subject: Re: Horizontal Directional Drilling Near Hillside Drive, Exton, PA

Thanks

Matthew Gordon
Energy Transfer
On Jul 17, 2017 1:39 PM, "Crockett, Christopher" <CSCrockett@aquaamerica.com> wrote:
Dear Matt,

Aqua Pennsylvania (Aqua) requests that Energy Transfer Partners (ETP) to avoid the use of horizontal direction drilling (HDD) near our Hillside Drive wells in Exton, PA. Based on aquifer testing jointly performed by ETP and Aqua, it appears that HDD will have adverse impacts on our public water supply wells at this location, resulting in permanent loss of these wells. ETP should evaluate alternative pipe installation techniques to avoid HDD impacts on these wells.

Thank you for your consideration.

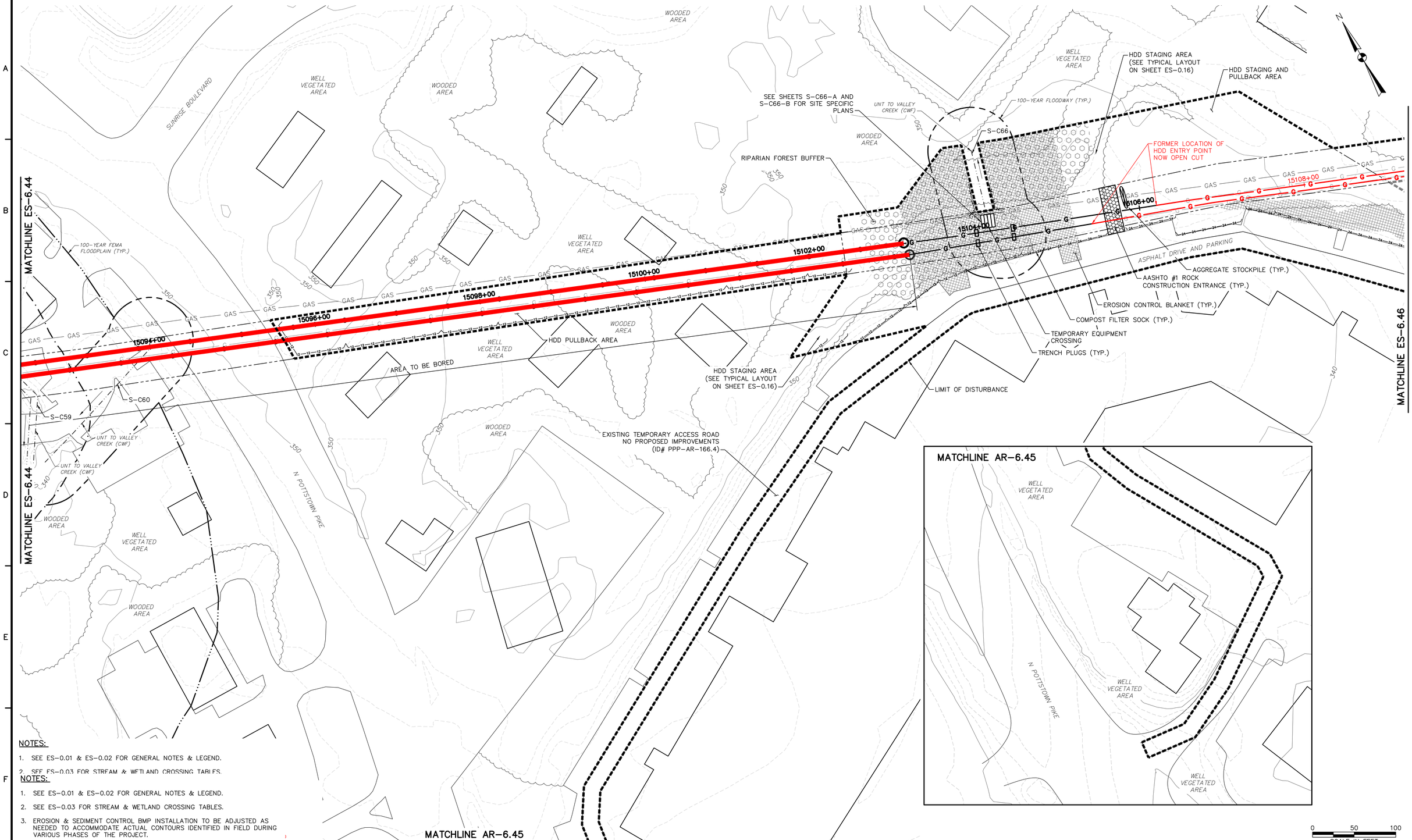
Sincerely,

Chris Crockett, Ph.D., P.E.

AQUA.
Christopher S. Crockett, Ph.D., P.E.
Vice President/Chief Environmental Officer
Aqua America
762 W. Lancaster Ave., Bryn Mawr, PA 19010
O: 610.645.4207 M:215.850.5304

Attachment 2

Revised E&S Control Plan sheets
and
HDD and Bore Profiles



NOTES:

1. SEE ES-0.01 & ES-0.02 FOR GENERAL NOTES & LEGEND.
2. SEE ES-0.03 FOR STREAM & WETLAND CROSSING TABLES.

NOTES:

1. SEE ES-0.01 & ES-0.02 FOR GENERAL NOTES & LEGEND.
2. SEE ES-0.03 FOR STREAM & WETLAND CROSSING TABLES.
3. EROSION & SEDIMENT CONTROL BMP INSTALLATION TO BE ADJUSTED AS NEEDED TO ACCOMMODATE ACTUAL CONTOURS IDENTIFIED IN FIELD DURING VARIOUS PHASES OF THE PROJECT.

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REVISIONS

NO.	BY	DATE	REMARKS
1	RS	3/28/17	INCORPORATED THE SPECIAL CONDITIONS SET FORTH IN DEP'S CHAPTER 102 AND CHAPTER 105 PERMITS
2	RS	5/25/17	REDLINE REVISIONS
3	RS	5/26/17	CONVERT HDD TO OPEN CUT

COMMONWEALTH OF PENNSYLVANIA – REGISTERED PROFESSIONAL – ENGINEER – ROBERT F. SIMCK

SUNOCO PIPELINE L.P.
SINKING SPRING, PENNSYLVANIA

PENNSYLVANIA PIPELINE PROJECT CONSTRUCTION SPREAD 6

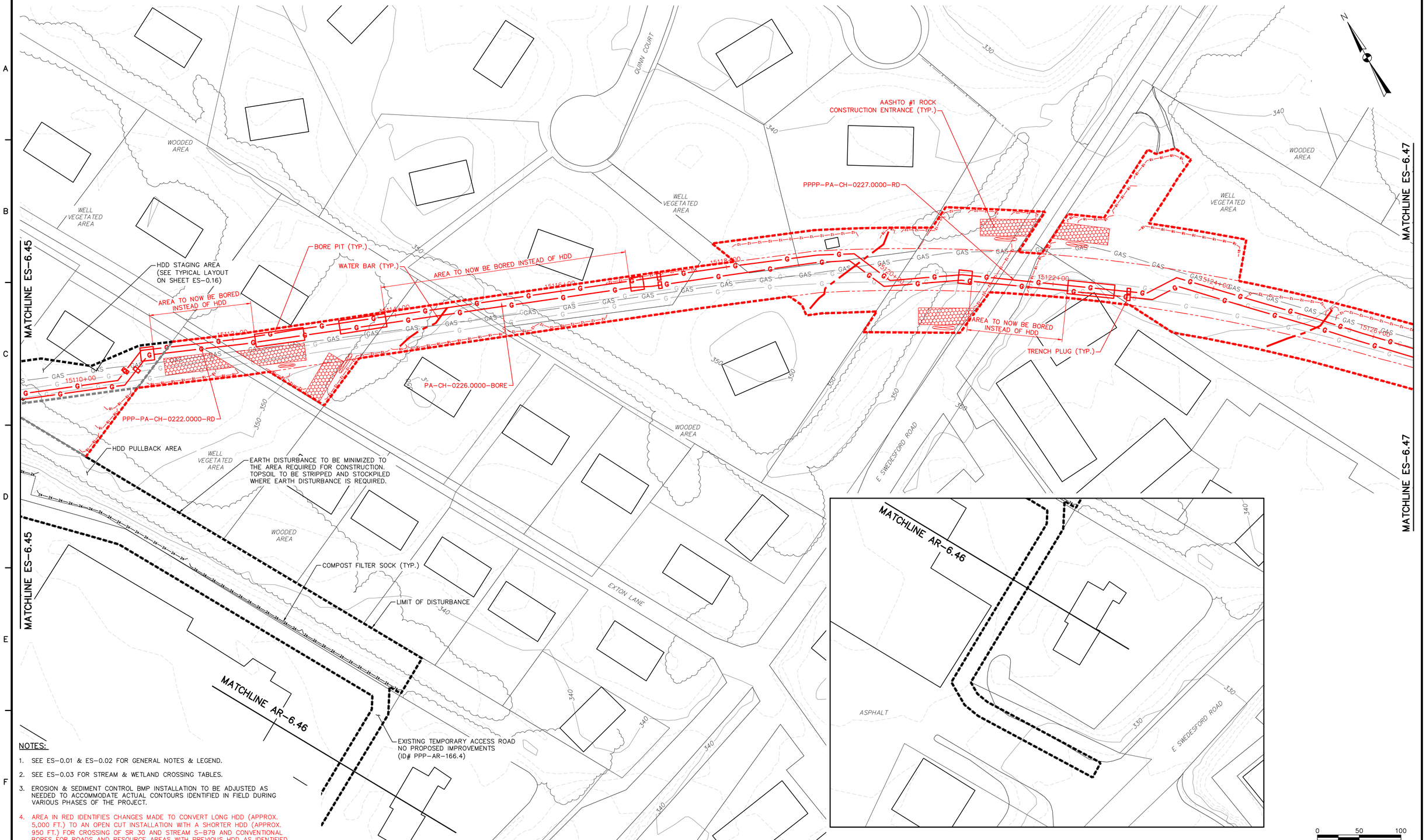
1-20" & 1-16" WELDED STEEL NATURAL GAS PIPELINES

CHESTER COUNTY CONSERVATION DISTRICT EROSION & SEDIMENT CONTROL & SITE RESTORATION PLAN SHEET 45 OF 74

DATE:	2/6/17
PROJECT NO.:	112C05958
DESIGNED BY:	JB
DRAWN BY:	BH
CHECKED BY:	RS

ES-6.45
SHEET 6.45 OF 99

R:_Marcellus Shale Projects\Sunoco\5958 – Penn Pipeline Project\17 – Chester\E&S\5958ES006.45.dwg PIT NICHOLE.NAJESKI 7/21/2017 1:36:45 PM



NOTES:

1. SEE ES-0.01 & ES-0.02 FOR GENERAL NOTES & LEGEND.
2. SEE ES-0.03 FOR STREAM & WETLAND CROSSING TABLES.
3. EROSION & SEDIMENT CONTROL BMP INSTALLATION TO BE ADJUSTED AS NEEDED TO ACCOMMODATE ACTUAL CONTOURS IDENTIFIED IN FIELD DURING VARIOUS PHASES OF THE PROJECT.
4. AREA IN RED IDENTIFIES CHANGES MADE TO CONVERT LONG HDD (APPROX. 5,000 FT.) TO AN OPEN CUT INSTALLATION WITH A SHORTER HDD (APPROX. 950 FT.) FOR CROSSING OF SR 30 AND STREAM S-B79 AND CONVENTIONAL BORES FOR ROADS AND RESOURCE AREAS WITH PREVIOUS HDD AS IDENTIFIED ON PLAN.

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NO.	BY	DATE	REMARKS
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2	RS	5/25/17	REDLINE REVISIONS
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1-20" & 1-16" WELDED STEEL NATURAL GAS PIPELINES

CHESTER COUNTY CONSERVATION DISTRICT EROSION & SEDIMENT CONTROL & SITE RESTORATION PLAN SHEET 46 OF 74

DATE:	2/6/17
PROJECT NO.:	112C05958
DESIGNED BY:	JB
DRAWN BY:	BH
CHECKED BY:	RS

ES-6.46

SHEET 6.46 OF 99

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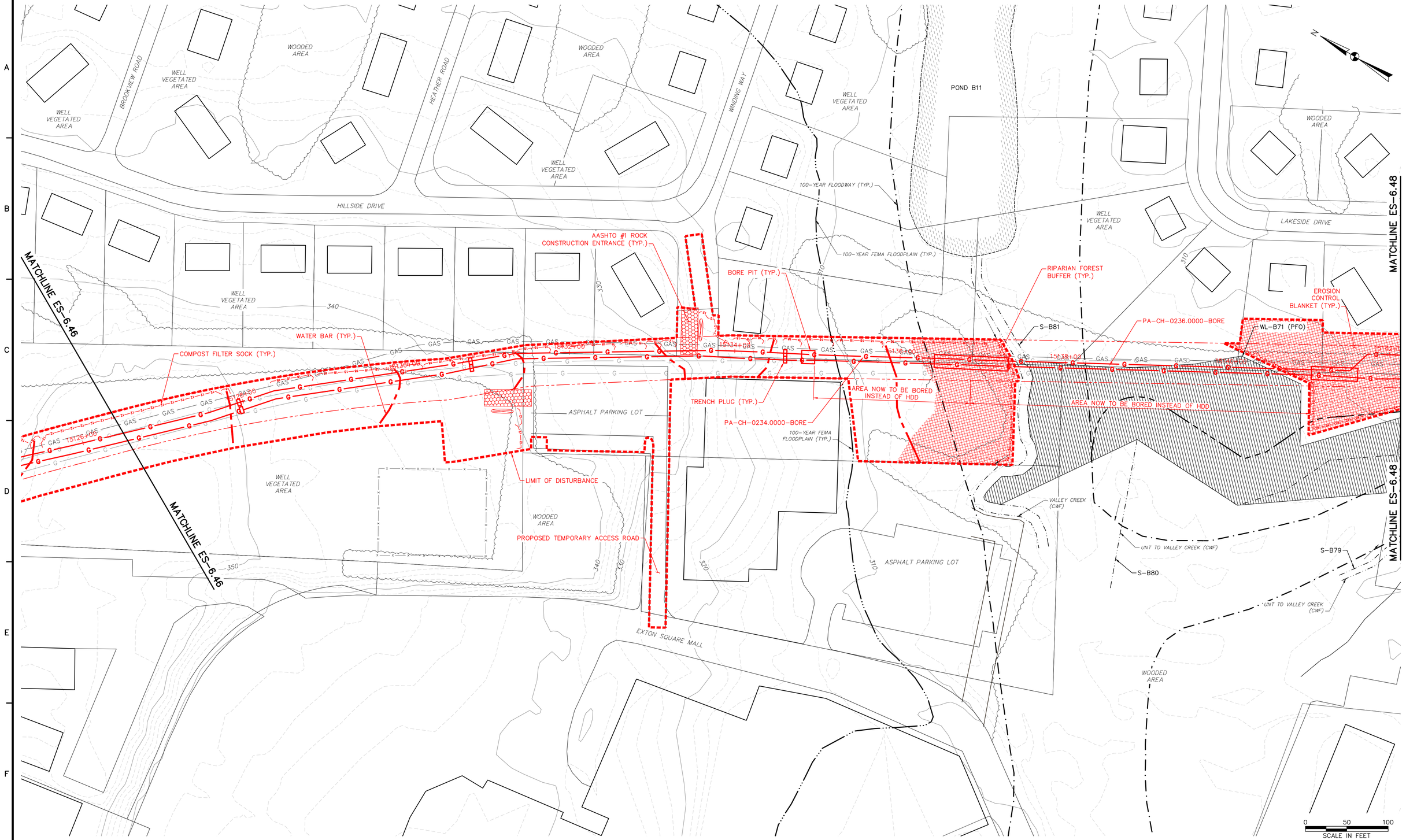

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REVISIONS			
NO.	BY	DATE	REMARKS
1	RS	3/28/17	INCORPORATED THE SPECIAL CONDITIONS SET FORTH IN DEP'S CHAPTER 102 AND CHAPTER 105 PERMITS
2	RS	5/25/17	REDLINE REVISIONS
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CONSTRUCTION SPREAD 6

1-20" & 1-16" WELDED STEEL NATURAL GAS PIPELINES

CHESTER COUNTY CONSERVATION DISTRICT
EROSION & SEDIMENT CONTROL &
SITE RESTORATION PLAN
SHEET 47 OF 82

DATE:	2/6/17
PROJECT NO.:	112C05958
DESIGNED BY:	JB
DRAWN BY:	BH
CHECKED BY:	RS

ES-6.47
SHEET 6.47 OF 99

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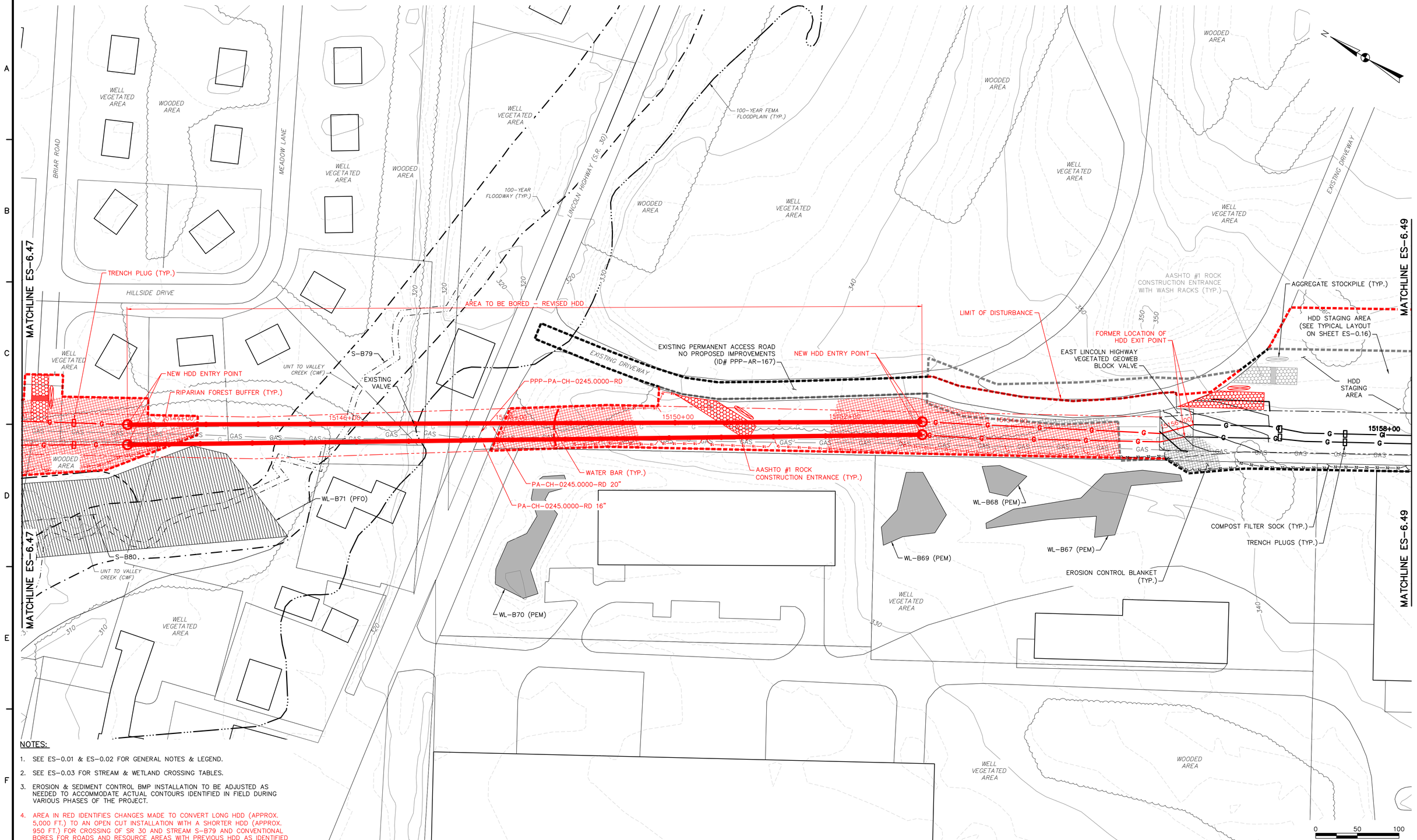

NOTES:

1. SEE ES–0.01 & ES–0.02 FOR GENERAL NOTES & LEGEND.
2. SEE ES–0.03 FOR STREAM & WETLAND CROSSING TABLES.
3. EROSION & SEDIMENT CONTROL BMP INSTALLATION TO BE ADJUSTED AS NEEDED TO ACCOMMODATE ACTUAL CONTOURS IDENTIFIED IN FIELD DURING VARIOUS PHASES OF THE PROJECT.
4. AREA IN RED IDENTIFIES CHANGES MADE TO CONVERT LONG HDD (APPROX. 5,000 FT.) TO AN OPEN CUT INSTALLATION WITH A SHORTER HDD (APPROX. 950 FT.) FOR CROSSING OF SR 30 AND STREAM S–B79 AND CONVENTIONAL BORES FOR ROADS AND RESOURCE AREAS WITH PREVIOUS HDD AS IDENTIFIED ON PLAN.

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REVISIONS

NO.	BY	DATE	REMARKS
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PENNSYLVANIA PIPELINE PROJECT CONSTRUCTION SPREAD 6

1–20" & 1–16" WELDED STEEL NATURAL GAS PIPELINES

CHESTER COUNTY CONSERVATION DISTRICT EROSION & SEDIMENT CONTROL & SITE RESTORATION PLAN SHEET 48 OF 74

DATE:	2/6/17
PROJECT NO.:	112C05958
DESIGNED BY:	JB
DRAWN BY:	BH
CHECKED BY:	RS

ES–6.48

SHEET 6.48 OF 99

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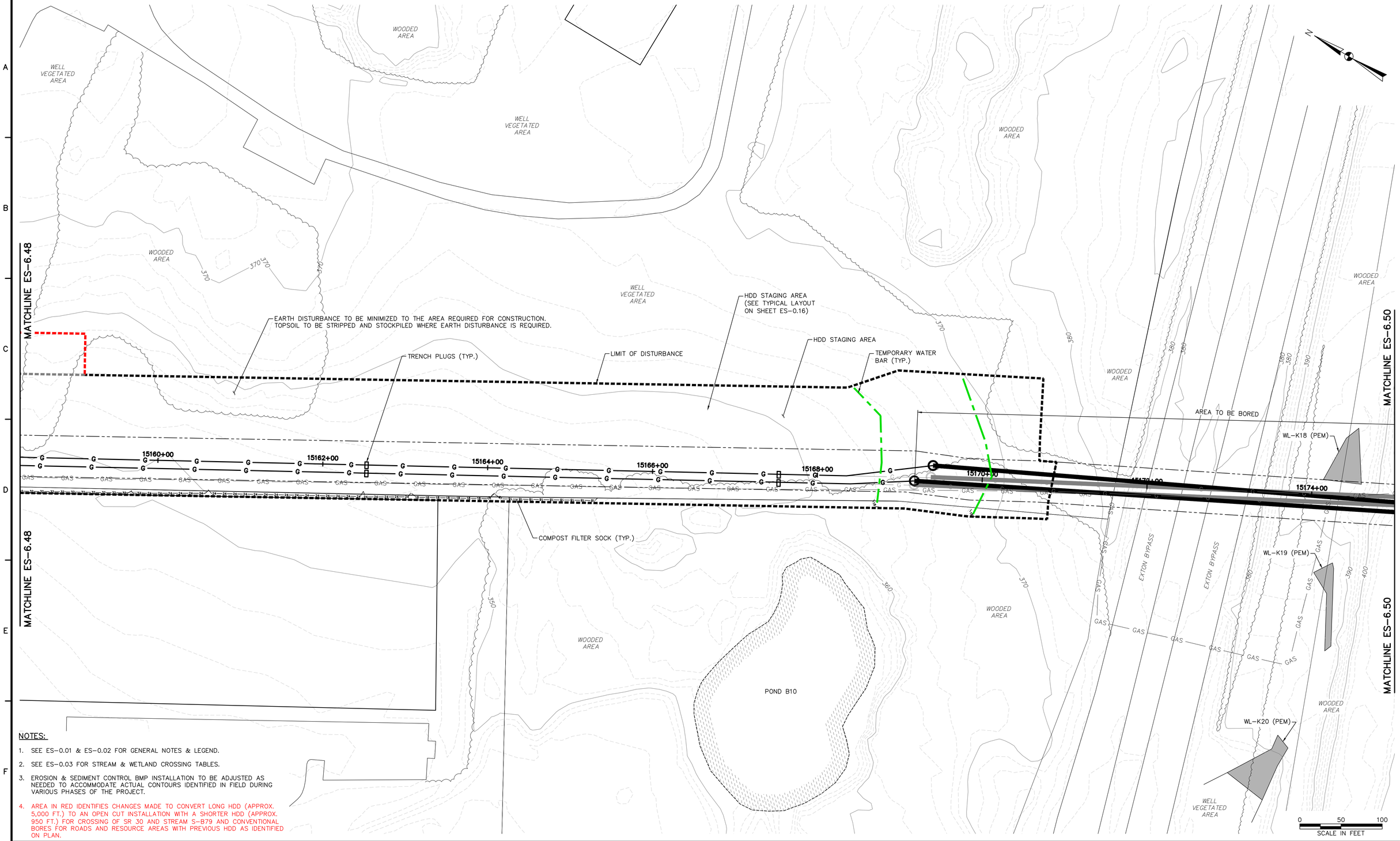

NOTES:

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2. SEE ES-0.03 FOR STREAM & WETLAND CROSSING TABLES.
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SUNOCO PIPELINE L.P.
SINKING SPRING, PENNSYLVANIA

PENNSYLVANIA PIPELINE PROJECT CONSTRUCTION SPREAD 6

1-20" & 1-16" WELDED STEEL NATURAL GAS PIPELINES

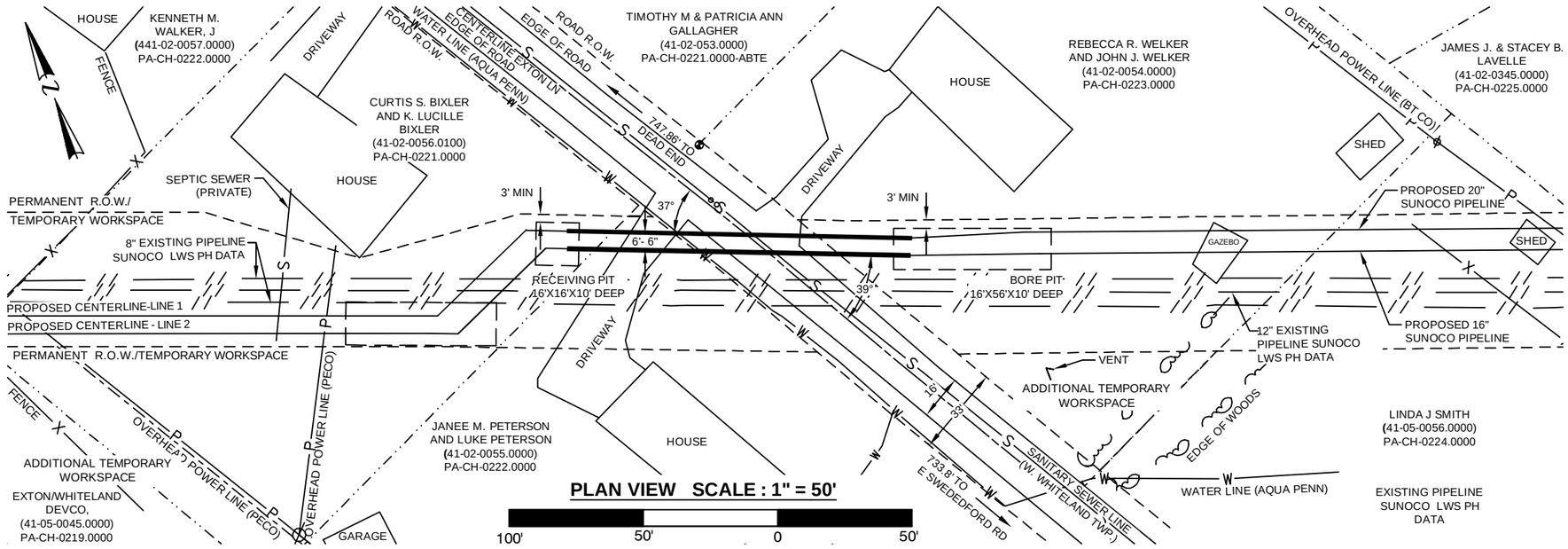
CHESTER COUNTY CONSERVATION DISTRICT EROSION & SEDIMENT CONTROL & SITE RESTORATION PLAN SHEET 49 OF 74

DATE:	2/6/17
PROJECT NO.:	112C05958
DESIGNED BY:	JB
DRAWN BY:	BH
CHECKED BY:	RS

ES-6.49
SHEET 6.49 OF 99

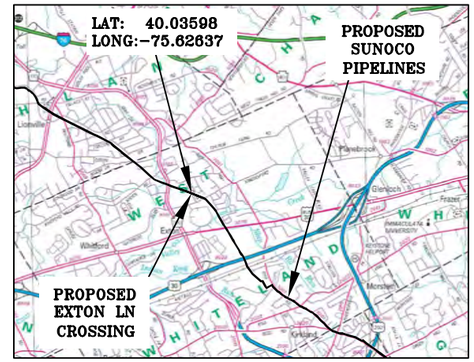
R:_Marcellus Shale Projects\Sunoco\5958 – Penn Pipeline Project\17 – Chester\EAS\5958ES006.49.dwg PITT NICHOLE.NAJESKI 7/21/2017 1:34:55 PM

WEST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA



PLAN VIEW SCALE : 1" = 50'

100' 50' 0 50'

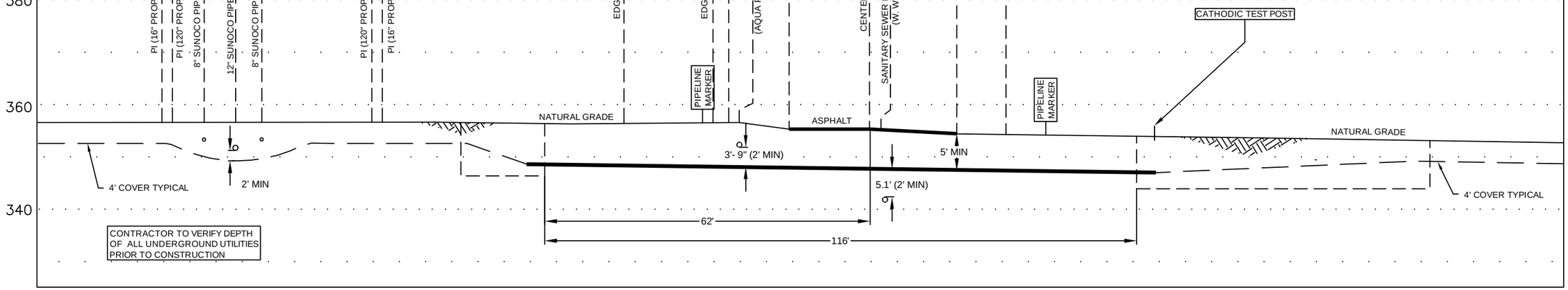


AERIAL VIEW
SCALE: 1" = 2MI

DRAWING LEGEND

- PROPERTY LINE
- PERMANENT R.O.W.
- EXISTING PIPELINE
- P — OVERHEAD POWER LINE
- X — FENCE
- W — WATER LINE
- S — SEWER LINE
- EDGE OF WOODS
- ROAD R.O.W
- ADDITIONAL TEMPORARY WORKSPACE
- POWER POLE
- MANHOLE
- VENT

EXTON LANE



ROAD NOTES
(APPLIES TO BOTH 16" & 20" PIPELINES)

1. 20" WELDED STEEL PIPE 20" OD x .456 WT., X-65, API 5L, PSL2, ERW, DRL
2. 16" WELDED STEEL PIPE 16" OD x .438 WT., X-70, API 5L, PSL2, ERW, BFW
3. COATING: 14-16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PSI: 1480 PSIG TEST PSI: 1850
6. WELDING PROCESS(ES): ALL WELDING IS DONE IN ACCORDANCE TO PENNDOT AND APPROVED SUNOCO PROCEDURES.
7. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO PIPELINE SPECIFICATIONS
8. PIPELINE CROSSING SHALL BE AS NEAR TO PERPENDICULAR TO THE ROADWAY CENTERLINE AS PRACTICAL
9. INSTALL CATHODIC PROTECTION TEST LEADS AS SPECIFIED ON THE ALIGNMENT SHEETS OR SUNOCO CORROSION TECHNICIAN
10. WELDED JOINTS INSIDE R.O.W. SHALL BE 100% X-RAYED
11. ROAD R.O.W. WIDTHS SHOWN ARE BASED ON VISUAL EVIDENCE.

CONSTRUCTION NOTES

1. CONTRACTOR WILL MAINTAIN 4' OF COVER TO THE TOP OF PIPE OUTSIDE OF ROAD R.O.W. USING FIELD BENDS
2. CONTRACTOR SHALL USE THE "ONE CALL" SYSTEM PRIOR TO BEGINNING WORK. CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND VERIFY ALL PARALLEL AND CROSSED UTILITIES PRIOR TO EXCAVATION OR CONSTRUCTION (AND MONITOR DURING EXCAVATION OR CONSTRUCTION). THIS DRAWING SHALL NOT CONSTITUTE VERIFICATION OF LOCATION, QUANTITY, SIZE, DEPTH, OR TYPES OF EXISTING UTILITIES.
3. EMERGENCY CONTACT INFORMATION: SEE INCLUDED COMPANY INFORMATION
4. UPON COMPLETION, UTILITY WILL BE REGISTERED WITH PENNSYLVANIA ONE-CALL SYSTEM
5. ALL WORK AND MATERIALS SHALL CONFORM WITH PENNDOT AND ALL FEDERAL REGULATIONS AND STANDARDS
6. PUBLICATION 213 PATA 5 & PATA 10A APPLIES
7. SUNOCO PIPELINE, L.P. WILL BE AVAILABLE 24/7 FOR EMERGENCY AT 800-786-7440 IF SUCH A PROBLEM SHOULD ARISE.
8. THIS PLAN IS FOR PERMITTING PURPOSES ONLY.

PER PUBLICATION 16M; DESIGN MANUAL PART 5, CHAPTER 1.3.D FOR UNCASED PIPELINE:

1. CATHODIC PROTECTION TEST LEADS ARE INSTALLED AS SPECIFIED ON THE ALIGNMENT SHEETS PER SUNOCO'S CORROSION PROGRAM.
2. PLASTIC PIPE WILL NOT BE USED; ONLY WELDED STEEL.
3. DUCTILE IRON OR REINFORCED CONCRETE WILL NOT BE USED; ONLY WELDED STEEL.
4. THE WALL THICKNESS SHOWN ON THE DRAWINGS MEET OR EXCEED ALL APPLICABLE FEDERAL AND INDUSTRY STANDARDS.
5. THE OPERATING STRESS LEVELS INDICATED ON THE DRAWINGS ARE IN ACCORDANCE WITH THE FEDERAL PIPELINE SAFETY REGULATIONS.
6. IT IS ACKNOWLEDGED THAT IF IN THE FUTURE THE CROSSING NEEDS REPLACEMENT, THE REPLACEMENT LINE WILL BE BORED AT A NEW LOCATION.

PROFILE

HORIZ. SCALE : 1" = 20'
VERT. SCALE : 1" = 20'

40' 20' 0' 20'

COORDINATE SYSTEM

PENNSYLVANIA STATE PLANE SOUTH NAD 83 US FEET

R.O.W. INGRESS
X=2563061.88
Y=263123.42

R.O.W. EGRESS
X=2563109.19
Y=263106.24

24/7 CONTACT INFO & PIPE MARKER INFO:

SUNOCO PIPELINE L.P.
525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-04-2016

SUNOCO
EXTON LANE

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

06/11/15	SCALE	
REVISED 06/05/17	AS NOTED	DWG #: PPP-PA-CH-0222.0000-RD

Prepared by TRICO SURVEYING AND MAPPING
BLOOMINGTON, INDIANA
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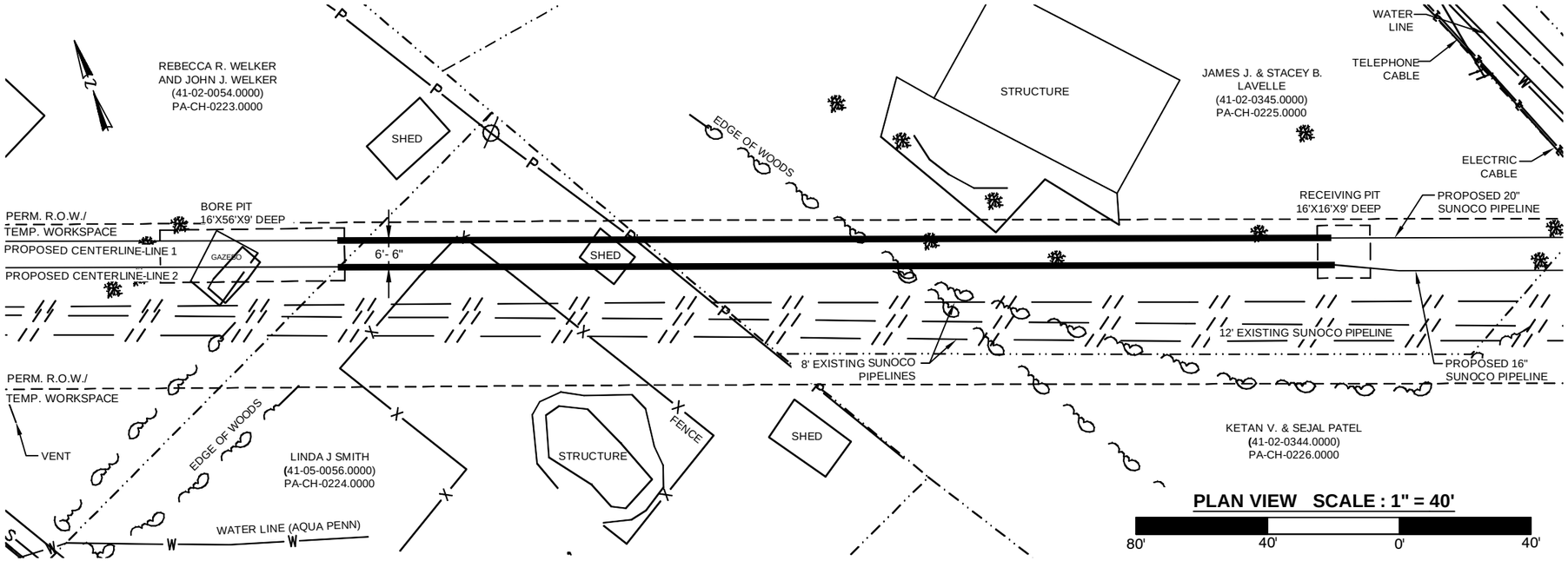
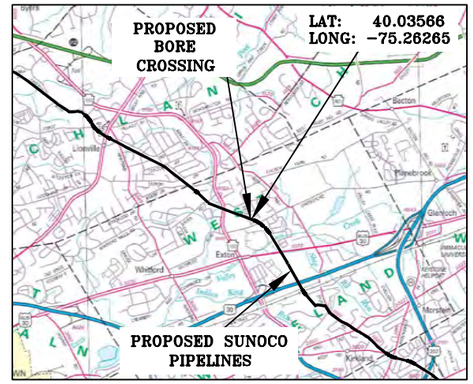
8

WEST NANTMEAL TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA

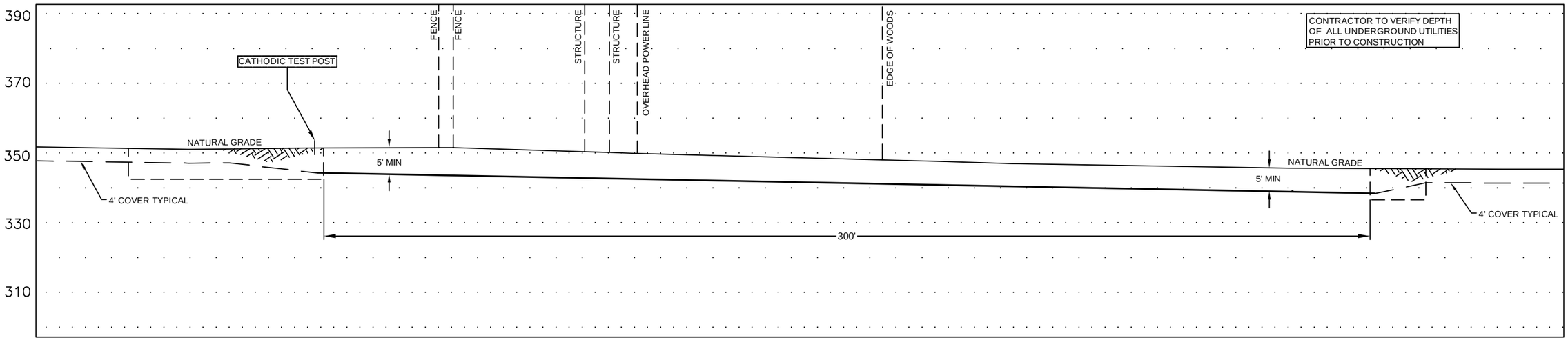




DRAWING LEGEND

- PERMANENT R.O.W.
- ADDITIONAL TEMPORARY WORKSPACE
- EDGE OF WOODS
- PROPERTY LINE
- OVERHEAD POWER LINE
- PIPELINE
- POWER POLE
- TREE
- FENCE
- WATER LINE
- TELEPHONE CABLE
- ELECTRIC CABLE
- SEWER LINE

BORE



PROFILE

HORIZ. SCALE : 1" = 30'
VERT. SCALE : 1" = 30'

60' 30' 0' 30'

CONSTRUCTION NOTES

(APPLIES TO BOTH 16" & 20" PIPELINES)

1. 20" WELDED STEEL PIPE 20" OD x .456 WT., X-65, API 5L, PSL2, ERW, BFW, DRL
2. 16" WELDED STEEL PIPE 16" OD x .438 WT., X-70, API 5L, PSL2, ERW, BFW
3. COATING: 14-16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PSI: 1480 PSIG TEST PSI: 1850 PSIG
6. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO PIPELINE SPECIFICATIONS
7. INSTALL CATHODIC PROTECTION TEST LEADS AS SPECIFIED ON THE ALIGNMENT SHEETS OR SUNOCO CORROSION TECHNICIAN
8. WELDED JOINTS SHALL BE 100% X-RAYED
9. CONTRACTOR WILL MAINTAIN A MINIMUM 4' OF COVER TO THE TOP OF PIPE USING FIELD BENDS
10. CONTRACTOR WILL MAINTAIN A MINIMUM 24" OF COVER FROM ALL EXISTING UTILITIES.
11. IN ADDITION TO THE SITE SPECIFIC INFORMATION PROVIDED IN THIS DRAWING, GENERAL REQUIREMENTS INCLUDED IN ALIGNMENT SHEETS, PERMITS AND APPROVAL FROM FEDERAL, STATE, AND LOCAL AGENCIES ALSO APPLY.
12. CONTRACTOR SHALL USE THE "ONE CALL" SYSTEM PRIOR TO BEGINNING WORK. CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND VERIFY ALL PARALLEL AND CROSSED UTILITIES PRIOR TO EXCAVATION OR CONSTRUCTION (AND MONITOR DURING EXCAVATION OR CONSTRUCTION). THIS DRAWING SHALL NOT CONSTITUTE VERIFICATION OF LOCATION, QUANTITY, SIZE, DEPTH, OR TYPES OF EXISTING UTILITIES.
13. EMERGENCY CONTACT INFORMATION: SEE INCLUDED COMPANY INFORMATION
14. SUNOCO PIPELINE, L.P. WILL BE AVAILABLE 24/7 FOR EMERGENCY AT 800-786-7440 IF SUCH A PROBLEM SHOULD ARISE.

COORDINATE SYSTEM

PENNSYLVANIA STATE
PLANE SOUTH
NAD 83 US FEET

R.O.W. INGRESS
X=2515893.34
Y=294421.08

R.O.W. EGRESS
X=2515917.34
Y=294398.30

24/7 CONTACT INFO & PIPE MARKER INFO:

SUNOCO PIPELINE L.P.
525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-15-2017

SUNOCO

BORE

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

05/12/17	SCALE	
REVISED 05/23/17	AS NOTED	DWG#: PA-CH-0226.0000-BORE

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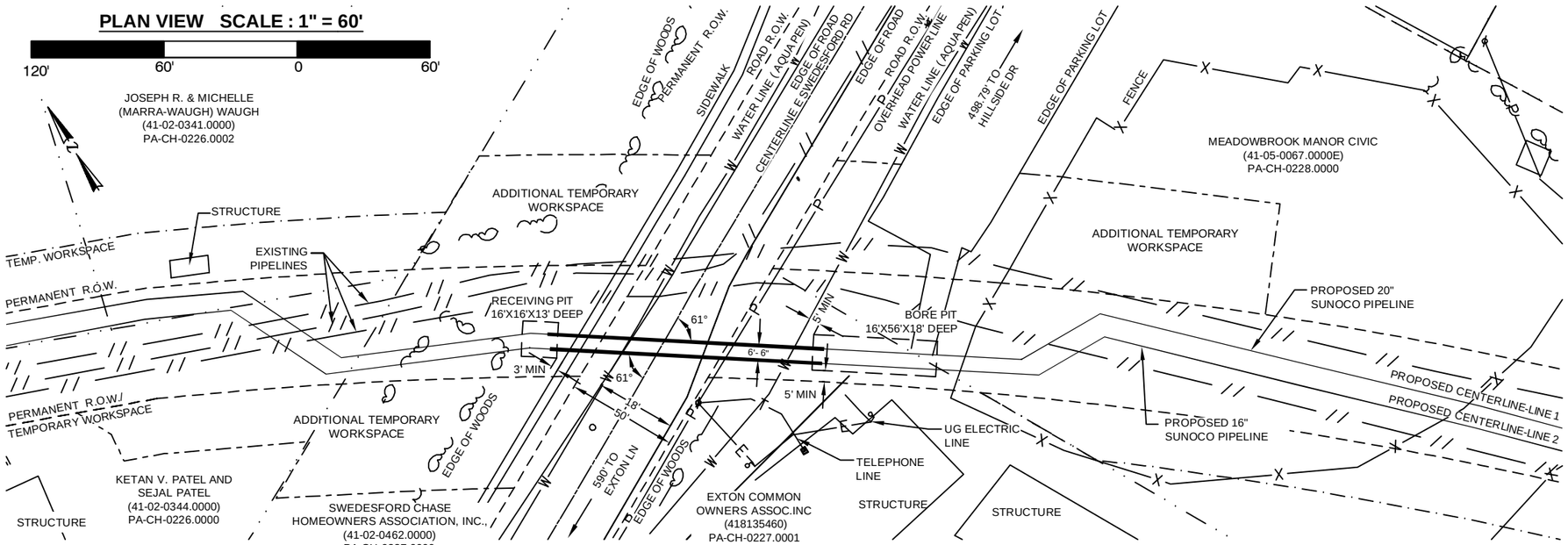
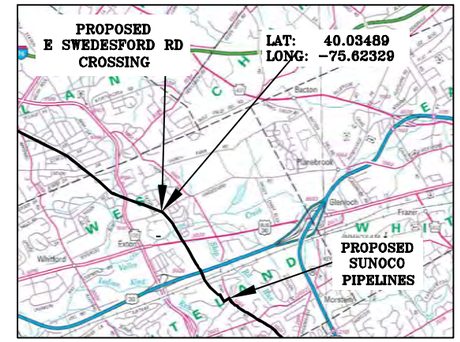
BLOOMINGTON, INDIANA
WWW.TRICOSURVEYING.COM

WEST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA

PLAN VIEW SCALE : 1" = 60'



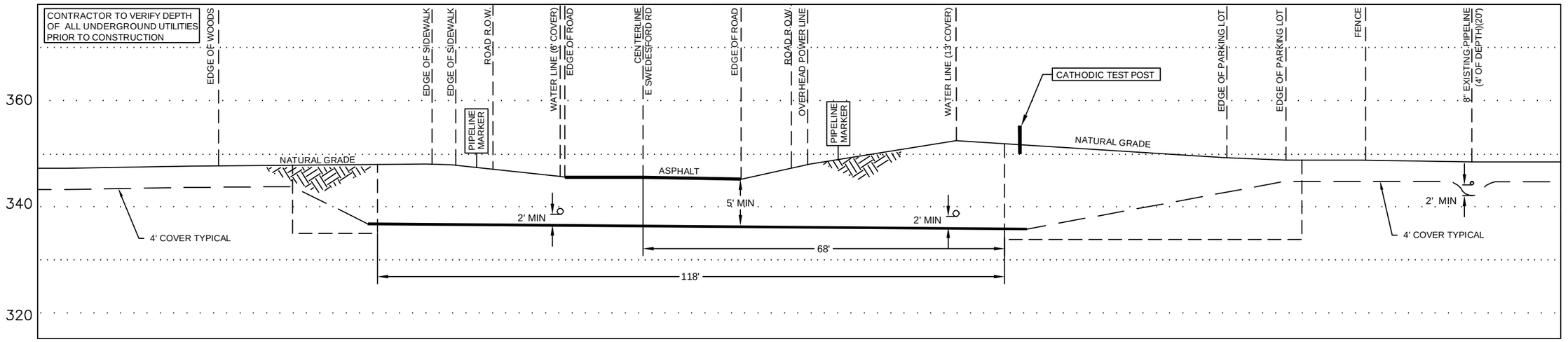


AERIAL VIEW
SCALE: 1" = 2MI

DRAWING LEGEND

- PROPERTY LINE
- PERMANENT R.O.W.
- TEMPORARY WORKSPACE
- P — OVERHEAD POWER LINE
- W — WATER LINE
- T — TELEPHONE LINE
- EDGE OF WOODS
- X — FENCE
- PROPERTY LINE
- ROAD R.O.W.
- ADDITIONAL TEMPORARY WORKSPACE
- PEDESTAL / POWER POLE
- MANHOLE

E SWEDESFORD ROAD



ROAD NOTES
(APPLIES TO BOTH 16" & 20" PIPELINES)

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3. COATING: 14-16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PSI: 1480 PSIG TEST PSI: 1850
6. WELDING PROCESS(ES): ALL WELDING IS DONE IN ACCORDANCE TO PENNDOT AND APPROVED SUNOCO PROCEDURES.
7. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO PIPELINE SPECIFICATIONS
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10. WELDED JOINTS INSIDE R.O.W. SHALL BE 100% X-RAYED
11. ROAD R.O.W. WIDTHS SHOWN ARE BASED ON VISUAL EVIDENCE.

CONSTRUCTION NOTES

1. CONTRACTOR WILL MAINTAIN 4' OF COVER TO THE TOP OF PIPE OUTSIDE OF ROAD R.O.W. USING FIELD BENDS
2. CONTRACTOR SHALL USE THE "ONE CALL" SYSTEM PRIOR TO BEGINNING WORK. CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND VERIFY ALL PARALLEL AND CROSSED UTILITIES PRIOR TO EXCAVATION OR CONSTRUCTION (AND MONITOR DURING EXCAVATION OR CONSTRUCTION). THIS DRAWING SHALL NOT CONSTITUTE VERIFICATION OF LOCATION, QUANTITY, SIZE, DEPTH, OR TYPES OF EXISTING UTILITIES.
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6. IT IS ACKNOWLEDGED THAT IF IN THE FUTURE THE CROSSING NEEDS REPLACEMENT, THE REPLACEMENT LINE WILL BE BORED AT A NEW LOCATION.

PROFILE

HORIZ. SCALE : 1" = 20'
VERT. SCALE : 1" = 20'

40' 20' 0' 20'

COORDINATE SYSTEM

PENNSYLVANIA STATE PLANE SOUTH
NAD 83 US FEET

R.O.W. INGRESS
X=2563932.84
Y=262752.18

R.O.W. EGRESS
X=2563981.76
Y=262721.47

24/7 CONTACT INFO & PIPE MARKER INFO:

SUNOCO PIPELINE L.P.
525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-04-2017

SUNOCO
E SWEDESFORD ROAD

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

06/11/15	SCALE	
REVISED 06/05/17	AS NOTED	DWG #: PPP-PA-CH-0227.0000-RD

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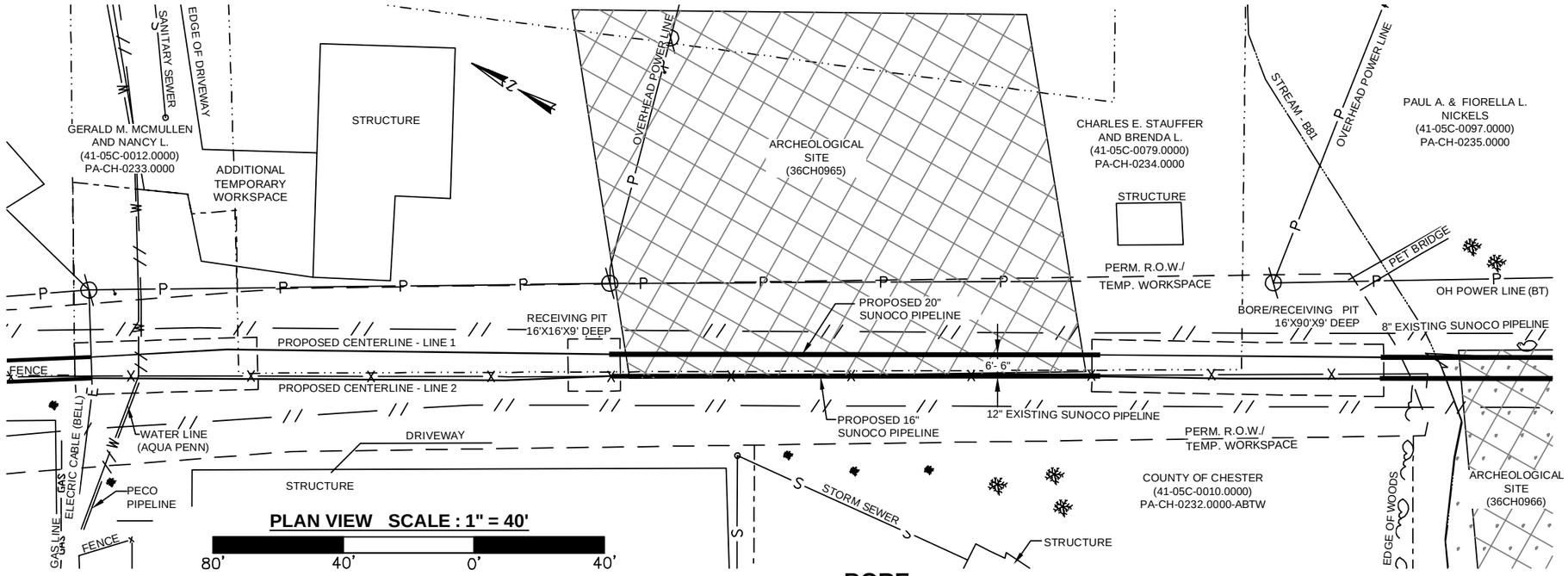
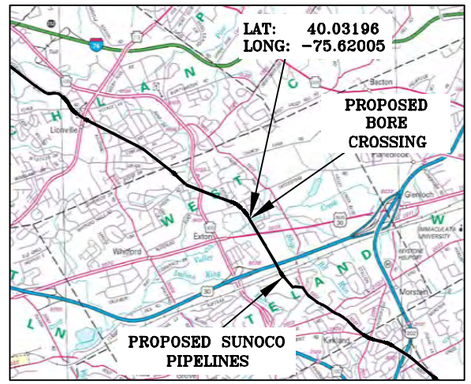
WEST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA

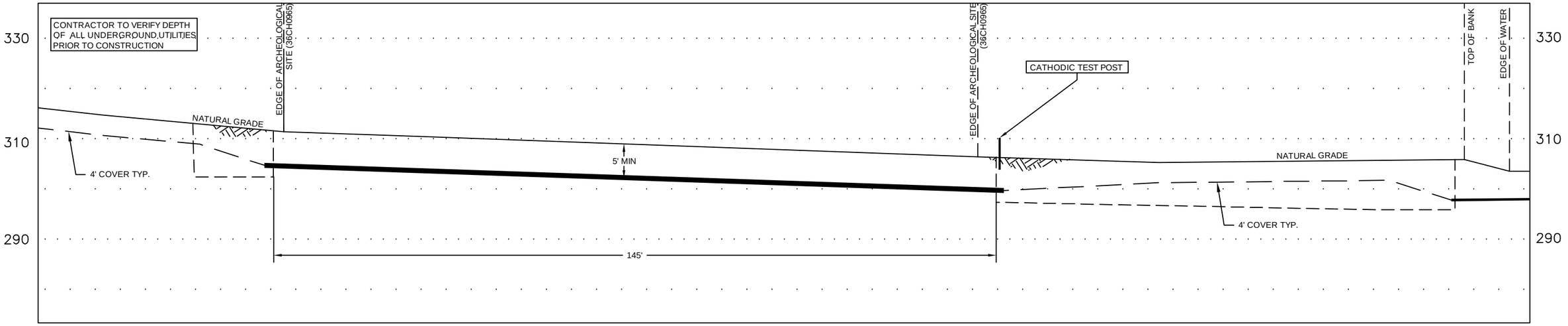




DRAWING LEGEND

- PERMANENT R.O.W.
- TEMPORARY WORKSPACE
- ADDITIONAL TEMPORARY WORKSPACE
- EDGE OF WOODS
- ROAD R.O.W.
- W — WATER LINE
- PROPERTY LINE
- P — OVERHEAD POWER LINE
- E — ELECRIC CABLE
- CENTERLINE WATERWAY
- PIPELINE
- POWER POLE
- TREE
- CENTERLINE STREAM

BORE



PROFILE

HORIZ. SCALE : 1" = 20'
VERT. SCALE : 1" = 20'

40' 20' 0' 20'

CONSTRUCTION NOTES

(APPLIES TO BOTH 16" & 20" PIPELINES)

1. 20" WELDED STEEL PIPE 20" OD x .456 WT., X-65, API 5L, PSL2, ERW, BFW, DRL
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4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PSI: 1480 PSIG TEST PSI: 1850 PSIG
6. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO PIPELINE SPECIFICATIONS
7. INSTALL CATHODIC PROTECTION TEST LEADS AS SPECIFIED ON THE ALIGNMENT SHEETS OR SUNOCO CORROSION TECHNICIAN
8. WELDED JOINTS SHALL BE 100% X-RAYED
9. CONTRACTOR WILL MAINTAIN A MINIMUM 4' OF COVER TO THE TOP OF PIPE USING FIELD BENDS
10. CONTRACTOR WILL MAINTAIN A MINIMUM 24" OF COVER FROM ALL EXISTING UTILITIES.
11. IN ADDITION TO THE SITE SPECIFIC INFORMATION PROVIDED IN THIS DRAWING, GENERAL REQUIREMENTS INCLUDED IN ALIGNMENT SHEETS, PERMITS AND APPROVAL FROM FEDERAL, STATE, AND LOCAL AGENCIES ALSO APPLY.
12. CONTRACTOR SHALL USE THE "ONE CALL" SYSTEM PRIOR TO BEGINNING WORK. CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND VERIFY ALL PARALLEL AND CROSSED UTILITIES PRIOR TO EXCAVATION OR CONSTRUCTION (AND MONITOR DURING EXCAVATION OR CONSTRUCTION). THIS DRAWING SHALL NOT CONSTITUTE VERIFICATION OF LOCATION, QUANTITY, SIZE, DEPTH, OR TYPES OF EXISTING UTILITIES.
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14. SUNOCO PIPELINE, L.P. WILL BE AVAILABLE 24/7 FOR EMERGENCY AT 800-786-7440 IF SUCH A PROBLEM SHOULD ARISE.

COORDINATE SYSTEM

PENNSYLVANIA STATE PLANE SOUTH NAD 83 US FEET

R.O.W. INGRESS
X=2515893.34
Y=294421.08

R.O.W. EGRESS
X=2515917.34
Y=294398.30

24/7 CONTACT INFO & PIPE MARKER INFO:

SUNOCO PIPELINE L.P.
525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-15-2017

SUNOCO

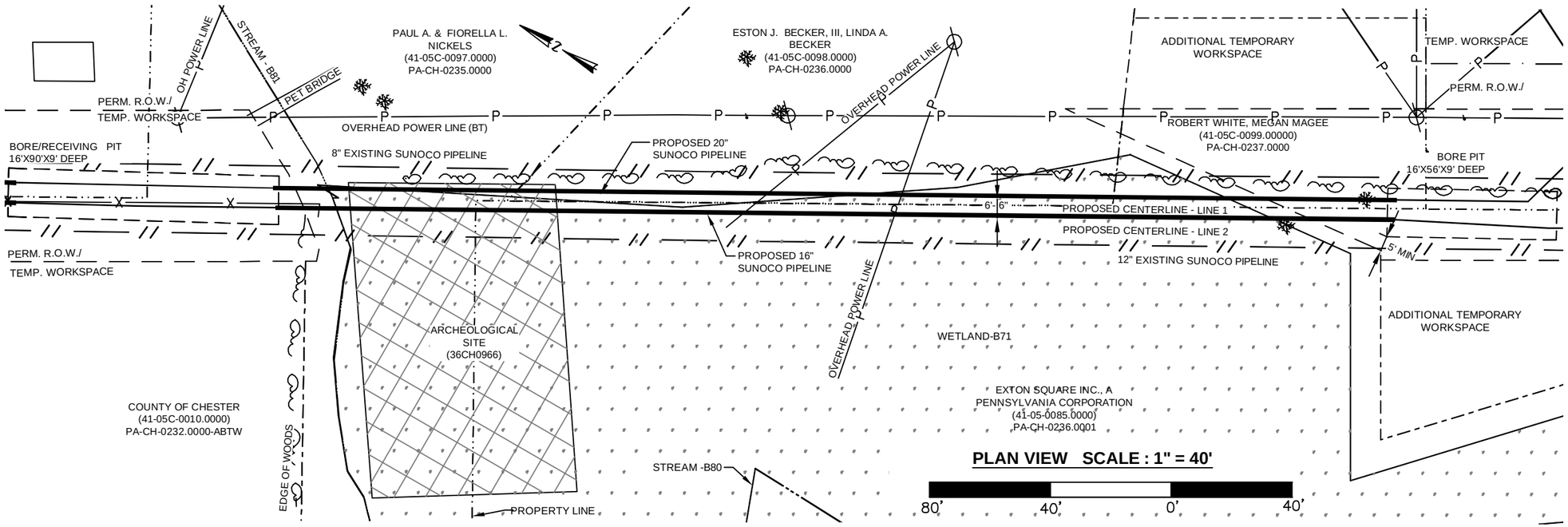
BORE

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

05/16/17	SCALE	
REVISED 05/24/17	AS NOTED	DWG#: PA-CH-0234.0000-BORE

Prepared by TRICO SURVEYING AND MAPPING
BLOOMINGTON, INDIANA
WWW.TRICOSURVEYING.COM

WEST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA



LAT: 40.03111
LONG: -75.61947

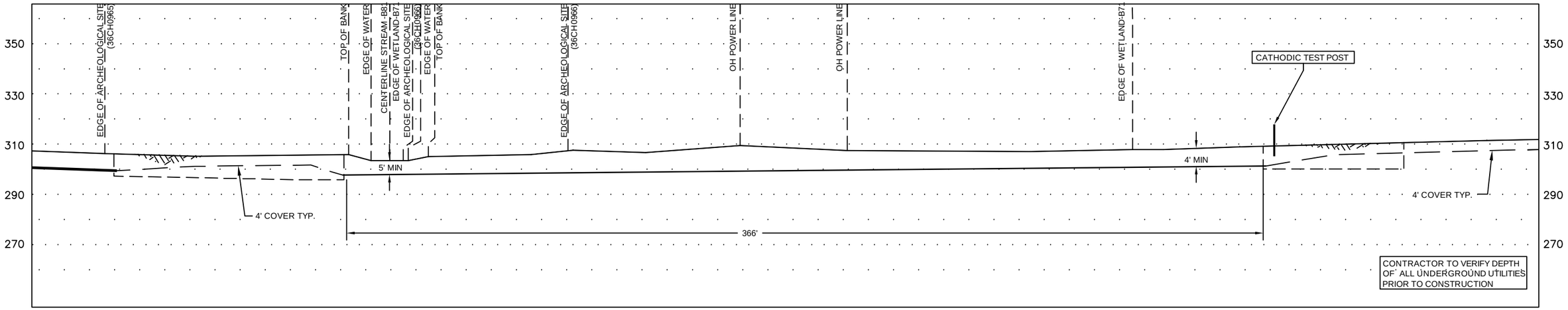
PROPOSED BORE CROSSING

PROPOSED SUNOCO PIPELINES

DRAWING LEGEND

- PERMANENT R.O.W.
- TEMPORARY WORKSPACE
- ADDITIONAL TEMPORARY WORKSPACE
- EDGE OF WOODS
- ROAD R.O.W.
- W — WATER LINE
- PROPERTY LINE
- P — OVERHEAD POWER LINE
- E — ELECRIC CABLE
- CENTERLINE WATERWAY
- PIPELINE
- POWER POLE
- TREE
- CENTERLINE STREAM

BORE



CONSTRUCTION NOTES

(APPLIES TO BOTH 16" & 20" PIPELINES)

1. 20" WELDED STEEL PIPE 20" OD x .456 WT., X-65, API 5L, PSL2, ERW, BFW, DRL
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PROFILE

HORIZ. SCALE : 1" = 40'
VERT. SCALE : 1" = 40'

80' 40' 0' 40'

COORDINATE SYSTEM

PENNSYLVANIA STATE PLANE SOUTH
NAD 83 US FEET

R.O.W. INGRESS
X=2515893.34
Y=294421.08

R.O.W. EGRESS
X=2515917.34
Y=294398.30

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525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-15-2017

SUNOCO

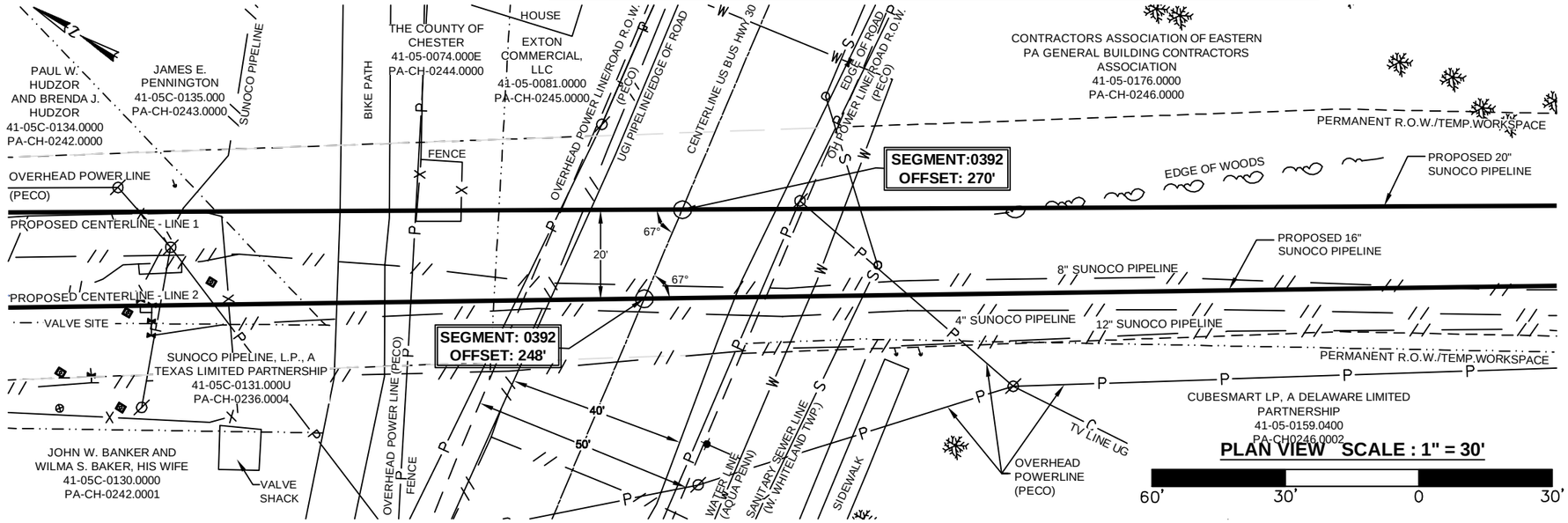
BORE

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

05/16/17	SCALE	
REVISED 05/24/17	AS NOTED	DWG#: PA-CH-0236.0000-BORE

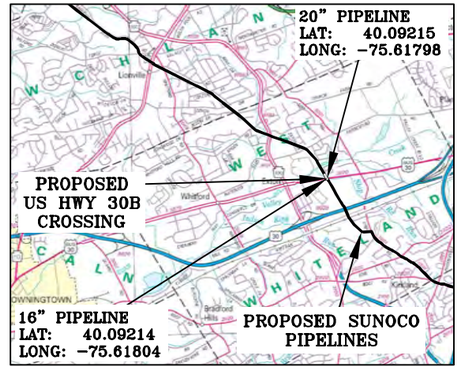
Prepared by TRICO SURVEYING AND MAPPING
BLOOMINGTON, INDIANA
WWW.TRICOSURVEYING.COM

WEST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA



PLAN VIEW SCALE : 1" = 30'

60' 30' 0 30'

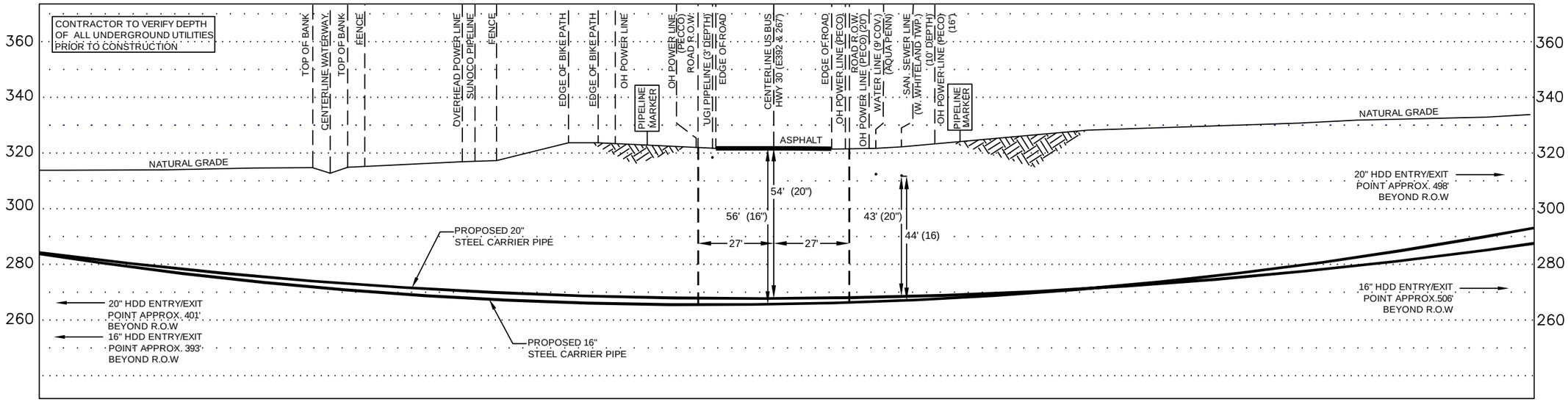


AERIAL VIEW
SCALE: 1" = 2MI

DRAWING LEGEND

- PERMANENT R.O.W.
- ROAD R.O.W.
- PROPERTY LINE
- P — OVERHEAD POWER LINE
- S — SEWER LINE
- W — WATER LINE
- X — FENCE
- C — TV LINE
- // — PIPELINE
- POWER POLE
- MANHOLE
- LIGHT POLE
- PEDESTAL
- VALVE
- FIRE HYDRANT

E LINCOLN WAY/US BUS HWY 30/S.R. 3070



ROAD NOTES

(APPLIES TO BOTH 16" & 20" PIPELINES)

1. 20" WELDED STEEL PIPE 20" OD x .456 WT., X-65, API 5L, PSL2, ERW, DRL
2. 16" WELDED STEEL PIPE 16" OD x .438 WT., X-70, API 5L, PSL2, ERW, BFW
3. COATING: 14-16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PSI: 1480 PSIG TEST PSI: 1850
6. WELDING PROCESS(ES): ALL WELDING IS DONE IN ACCORDANCE TO PENNDOT AND APPROVED SUNOCO PROCEDURES.
7. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO PIPELINE SPECIFICATIONS
8. PIPELINE CROSSING SHALL BE AS NEAR TO PERPENDICULAR TO THE ROADWAY CENTERLINE AS PRACTICAL
9. INSTALL CATHODIC PROTECTION TEST LEADS AS SPECIFIED ON THE ALIGNMENT SHEETS OR SUNOCO CORROSION TECHNICIAN
10. WELDED JOINTS INSIDE R.O.W. SHALL BE 100% X-RAYED
11. ROAD R.O.W. WIDTHS SHOWN ARE BASED ON VISUAL EVIDENCE.
12. BORE LENGTH: +/- 953' (20") / +/- 953' (16") (APPROX).

CONSTRUCTION NOTES

1. CONTRACTOR WILL MAINTAIN 4' OF COVER TO THE TOP OF PIPE OUTSIDE OF ROAD R.O.W. USING FIELD BENDS
2. CONTRACTOR SHALL USE THE "ONE CALL" SYSTEM PRIOR TO BEGINNING WORK. CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND VERIFY ALL PARALLEL AND CROSSED UTILITIES PRIOR TO EXCAVATION OR CONSTRUCTION (AND MONITOR DURING EXCAVATION OR CONSTRUCTION). THIS DRAWING SHALL NOT CONSTITUTE VERIFICATION OF LOCATION, QUANTITY, SIZE, DEPTH, OR TYPES OF EXISTING UTILITIES.
3. EMERGENCY CONTACT INFORMATION: SEE INCLUDED COMPANY INFORMATION
4. UPON COMPLETION, UTILITY WILL BE REGISTERED WITH PENNSYLVANIA ONE-CALL SYSTEM
5. ALL WORK AND MATERIALS SHALL CONFORM WITH PENNDOT AND ALL FEDERAL REGULATIONS AND STANDARDS
6. PUBLICATION 213 PATA 5 & PATA 10A APPLIES
7. SUNOCO PIPELINE, L.P. WILL BE AVAILABLE 24/7 FOR EMERGENCY AT 800-786-7440 IF SUCH A PROBLEM SHOULD ARISE.
8. THIS PLAN IS FOR PERMITTING PURPOSES ONLY
9. FOR HDD DESIGN SEE: PA-CH-0245.0000-RD & PA-CH-0245.0000-RD-16

PER PUBLICATION 16M; DESIGN MANUAL PART 5, CHAPTER 1.3.D FOR UNCASED PIPELINE:

1. CATHODIC PROTECTION TEST LEADS ARE INSTALLED AS SPECIFIED ON THE ALIGNMENT SHEETS PER SUNOCO'S CORROSION PROGRAM.
2. PLASTIC PIPE WILL NOT BE USED; ONLY WELDED STEEL.
3. DUCTILE IRON OR REINFORCED CONCRETE WILL NOT BE USED; ONLY WELDED STEEL.
4. THE WALL THICKNESS SHOWN ON THE DRAWINGS MEET OR EXCEED ALL APPLICABLE FEDERAL AND INDUSTRY STANDARDS.
5. THE OPERATING STRESS LEVELS INDICATED ON THE DRAWINGS ARE IN ACCORDANCE WITH THE FEDERAL PIPELINE SAFETY REGULATIONS.
6. IT IS ACKNOWLEDGED THAT IF IN THE FUTURE THE CROSSING NEEDS REPLACEMENT, THE REPLACEMENT LINE WILL BE BORED AT A NEW LOCATION.

PROFILE

HORIZ. SCALE : 1" = 40'
VERT. SCALE : 1" = 40'

80' 40' 0' 40'

COORDINATE SYSTEM

PENNSYLVANIA STATE PLANE SOUTH
NAD 83 US FEET

R.O.W. INGRESS
X=2565474.64
Y=260704.32

R.O.W. EGRESS
X=2565503.07
Y=260657.18

24/7 CONTACT INFO & PIPE MARKER INFO:

SUNOCO PIPELINE L.P.
525 FRITZTOWN ROAD
SINKING SPRING, PA 19608
PHONE NUMBER: 800-786-7440
NATURAL GAS PIPELINE

CENTERLINE REV DATE: 05-04-2017

SUNOCO

E LINCOLN WAY/US BUS HWY 30/S.R. 3070

WEST WHITELAND TOWNSHIP, CHESTER CO., PA

06/11/15	SCALE	
REVISED 05/17/17	AS NOTED	DWG #: PPP-PA-CH-0245.0000-RD

Prepared by TRICO SURVEYING AND MAPPING
BLOOMINGTON, INDIANA
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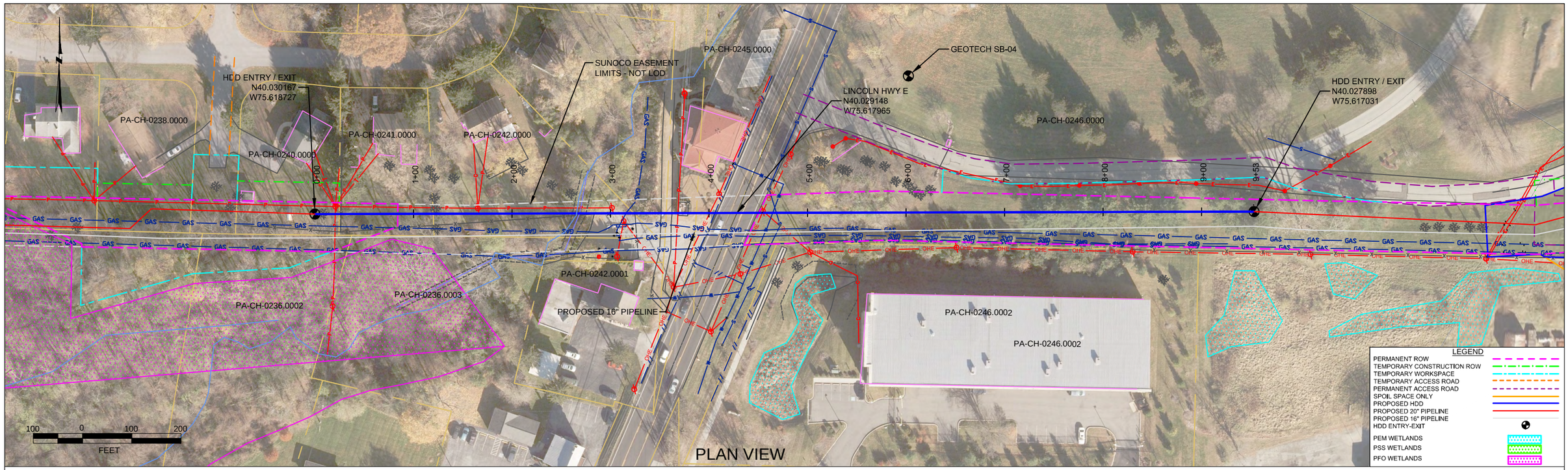
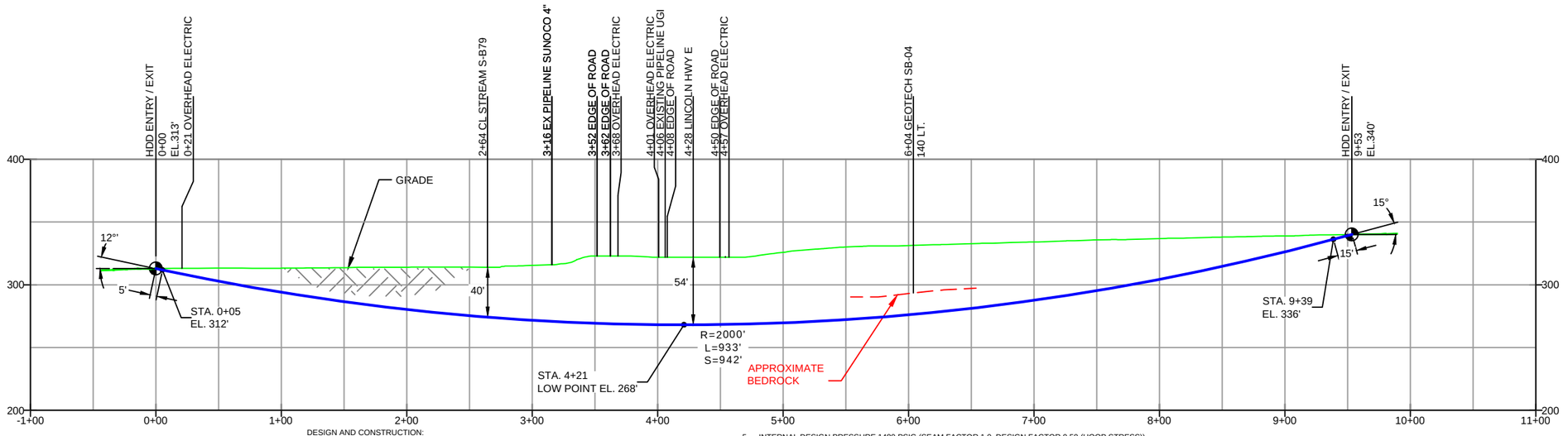


PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382

PROFILE VIEW



GEOTECH SB-04
-NG EL. 334'
-TOPSOIL (0' - 0.5')
-ML (0.5' - 14.0')
-SM (14.0' - 18.0')
-DOLOMITE (18.0' - 30.0')
-COMPLETION DEPTH EL. 304"

NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):953'
   HDD PIPE LENGTH (S=):962'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

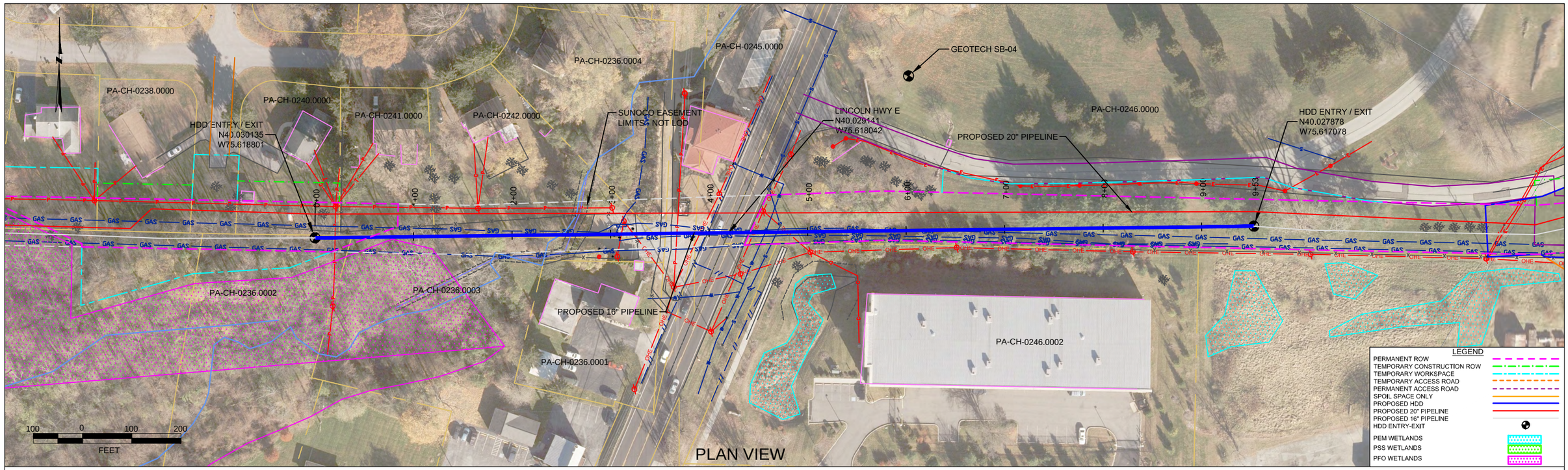
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

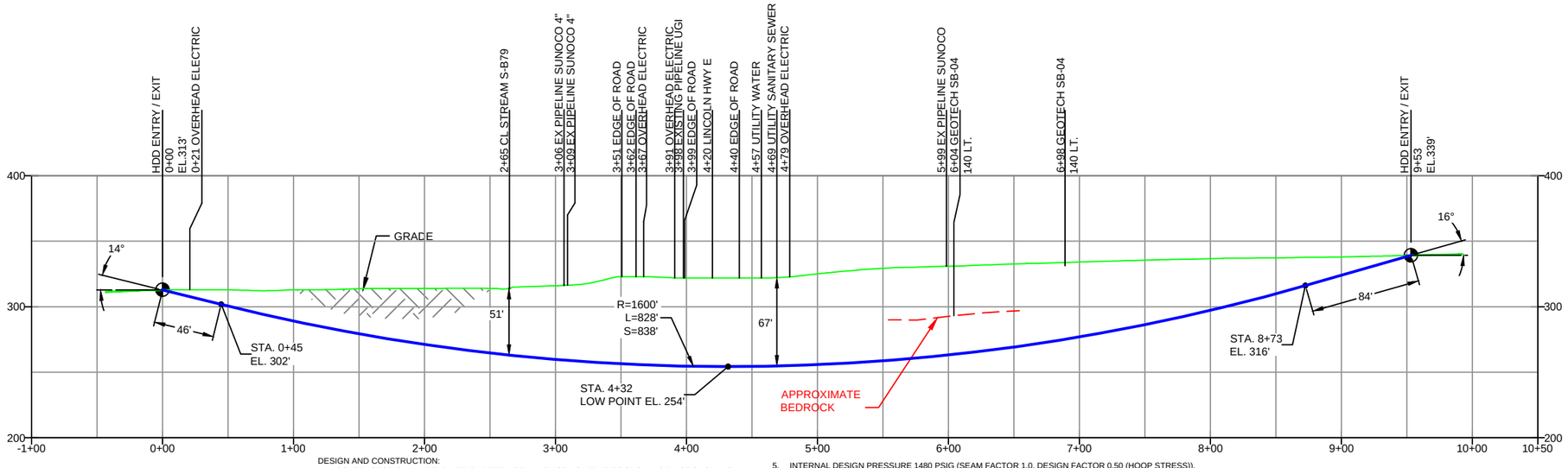
DWG. NUMBER: PA-CH-0245.0000-RD



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382-16

PROFILE VIEW



GEOTECH SB-04
-NG EL. 334'
-TOPSOIL (0' - 0.5')
-ML (0.5' - 14.0')
-SM (14.0' - 18.0')
-DOLOMITE (18.0' - 30.0')
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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):953'
   HDD PIPE LENGTH (S=):968'
   16" x 0.438" W.T., X-70, APISL, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
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NOTES
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
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5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
1	DESIGN CHANGE (14 DEG ENTRY) & CORRECTION TO PIPE SPECIFICATION	DLM	06/06/17	RMB	06/06/17	AMC	06/06/17
0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO.: PA-CH-0245.0000-RD-16

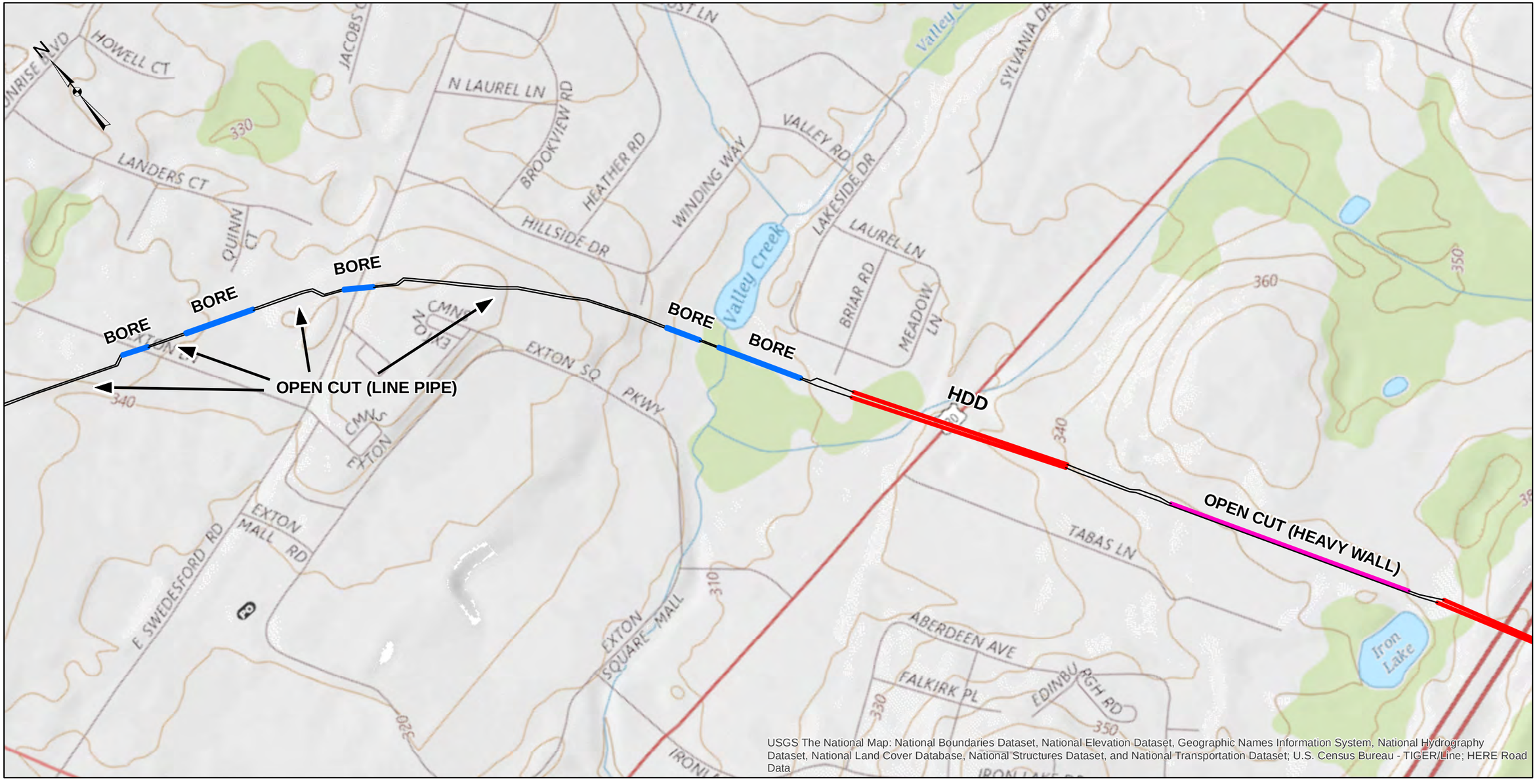
SWEDESFORD ROAD CROSSING
PADEP SECTION 105 PERMIT NO.: E15-862
PA-CH-0219.0000-RD and PA-CH-0219.0000-RD-16
(SPLP HDD No. S3-0381)

ATTACHMENT 3

HDD CONVERSION OVERVIEW MAP &

REVISED HORIZONTAL DIRECTIONAL DRILL PLAN AND PROFILES

SWEDESFORD RD / S3-0381 CONVERSION OVERVIEW



LEGEND

PIPE MATERIAL

- LINE PIPE
- OPEN CUT (HEAVY WALL)
- BORE
- HDD

GENERAL NOTES

1. TETRA TECH ROONEY AND/OR SUNOCO PIPELINE L.P. ARE NOT RESPONSIBLE FOR THE LOCATION OF THIRD-PARTY PIPELINES AND UTILITIES SHOWN ON THIS DRAWING. THIS INFORMATION IS PRESENTED ON A BEST-EFFORTS BASIS AND IS PROVIDED WITHOUT LIABILITY ON THE PART OF TETRA TECH ROONEY AND/OR SUNOCO PIPELINE L.P. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS IN THIS INFORMATION.

2. PRIOR TO COMMENCING ANY ACTIVITIES WHICH COULD IMPACT PIPELINES OR UTILITIES, CONTACT LOCAL ONE CALL AGENCY AT 811 OR 1-800-242-1778.

REVISIONS

REV	DESCRIPTION	DWN	CHKD	DATE
0	ISSUED FOR REVIEW	AW	RB	10/31/17

Sunoco Logistics

TETRA TECH ROONEY

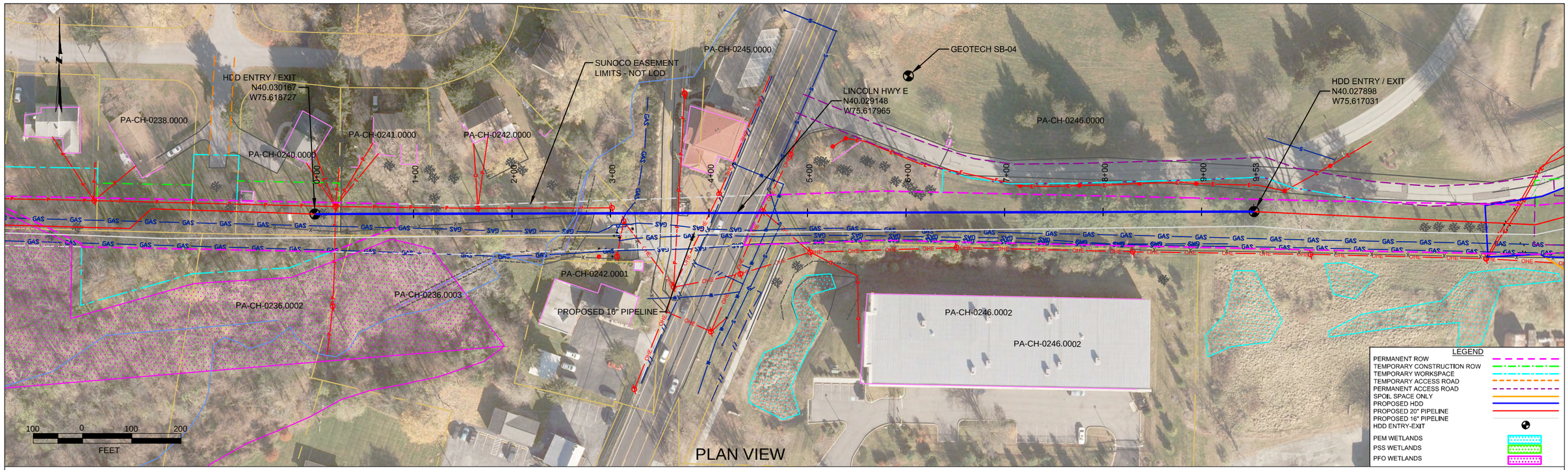
PENNSYLVANIA PIPELINE PROJECT

DRAWN: AW | DATE: 10/31/17 | CHECKED: RB

ENGINEER: AC | SCALE: AS SHOWN

SWEDESFORD RD / S3-0381 CONVERSION OVERVIEW

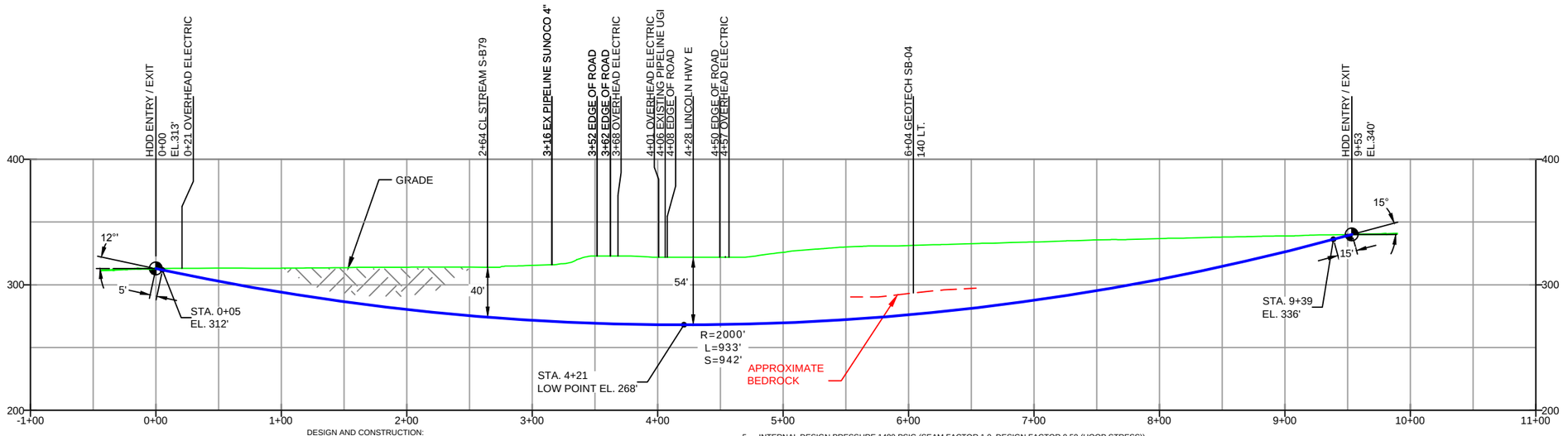
Document Path: W:\Sunocol\02959 - Mariner East Pipeline 2\CAD\MAPPING\GIS\MTS\MapMaps\Sunoco_PPP_SwedesfordRd_S3_0381_ConversionOverview.mxd



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382

PROFILE VIEW



GEOTECH SB-04
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NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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NOTES

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5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

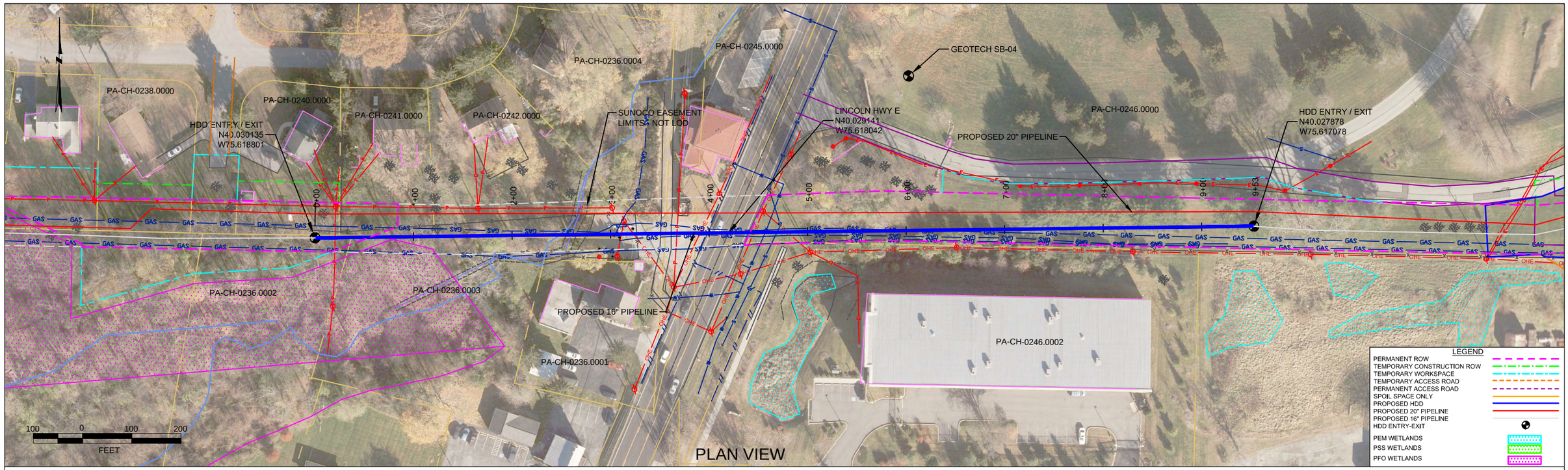
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

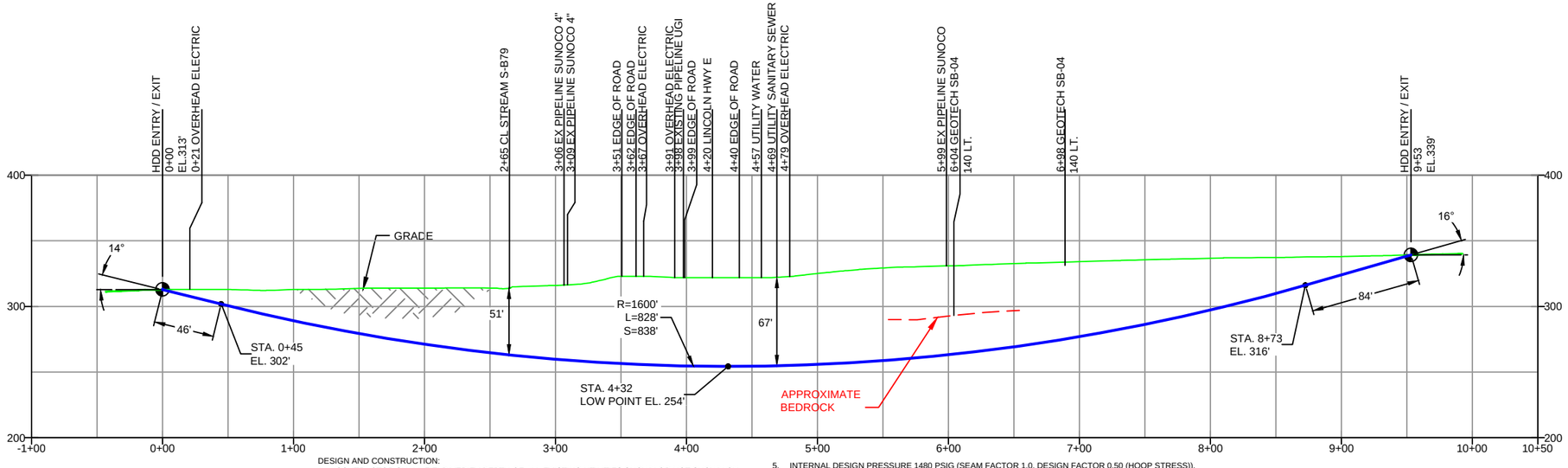
DWG. NUMBER: PA-CH-0245.0000-RD



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP
S3-0382-16

PROFILE VIEW



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NOTES
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REVISIONS

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0	ISSUED FOR CONSTRUCTION (PER MOD S6-083 REV1)	DLM	05/08/17	RMB	05/08/17	AMC	05/08/17

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
LINCOLN HWY E
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO.: PA-CH-0245.0000-RD-16