HORIZONTAL DIRECTIONAL DRILL ANALYSIS
WETLAND C-17 CROSSING
PADEP SECTION 105 PERMIT NO.S:
PA-CA-0047.0000-SR & PA-CA-0047.0000-SR-16
(SPLP HDD No. S2-0075)

WETLAND C-17 CROSSING
PADEP SECTION 105 PERMIT NO.S:
PA-CA-0047.0000-SR & PA-CA-0047.0000-SR-16
(SPLP HDD No. S2-0075)

This reanalysis of the horizontal directional drill (HDD) installation of a 16-inch and 20-inch diameter pipeline crossing under Wetland C-17 is in accordance with Stipulated Order issued under Environmental Hearing Board Docket No. 2017-009-L for HDDs listed on Exhibit 2 of the Stipulated Order.

ORIGINAL HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 20-INCH

- Horizontal length: 1,250 foot (ft)
- Entry/Exit angle: 10-12 degrees
- Depth of cover: 40 ft
- Pipe design radius: 2,000 ft

ORIGINAL HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 16-INCH

- Horizontal length: 1,350 ft
- Entry/Exit angle: 10-12 degrees
- Depth of cover: 40 ft
- Pipe design radius: 1,350 ft

GEOLOGIC AND HYDROGEOLOGIC ANALYSIS

HDD S2-0075 is located within the Glenshaw Formation, part of the Conemaugh Group, which consists of repeated sequences of sandstone, siltstone, shale, claystone (including red beds), limestone, and coal. It contains four major marine zones that are, from highest to lowest in stratigraphic position: the Ames, Woods Run, Pine Creek, and Brush Creek. The formation decreases in thickness from about 410 ft in the northeast to approximately 280 ft in the southwest.

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

HYDROGEOLOGY, GROUND WATER, AND WELL PRODUCTION ZONES

Published soil data indicate the regional depth to water in the overburden soils is 2 to 80 inches. The local groundwater flow gradient is likely south from elevated terrain north of the HDD location.

In the subsurface, groundwater is stored and moves within the network of fractured Glenshaw Formation bedrock. Regional systematic joints are oriented northwest and west-northwest, and may represent preferred pathways for groundwater flow. Groundwater was encountered during the geotechnical borings at 42 ft below ground surface (bgs) (2,001 ft above mean sea level (amsl)) in boring B-01 and at 15 ft bgs (2,106 feet amsl) in boring B-02.

The Pennsylvania Groundwater Information System search for the area of interest revealed groundwater yields for wells around HDD location ranging from 5 to 20 gallons per minute (gpm). The yield for the closest well to the HDD location was listed at 24.5 gpm. Published data (Geyer and Wilshusen 1982) notes that yields of more than 50 gal/min may be expected from sandstone within the Glenshaw Formation.

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

WETLAND C-17 CROSSING
PADEP SECTION 105 PERMIT NO.S:
PA-CA-0047.0000-SR & PA-CA-0047.0000-SR-16
(SPLP HDD No. S2-0075)

INADVERTENT RETURNS DISCUSSION

An HDD has not been initiated at this location.

Sunoco Pipeline, L.P. (SPLP) HDD consultants reviewed the HDD designs and geotechnical data for this area. Based upon this review, it was determined that the original permitted HDD profile is too shallow at this location. The design of the horizontal run of the HDD is a maximum of 40 ft bgs, streambed, and wetlands. Based on the hydro-structural characteristics of the underlying geology and the bore path through shallow soils and marginally into bedrock, the crossing of wetlands and stream by these HDDs is susceptible to inadvertent returns of drilling fluids to the land surface, stream, and wetlands during HDD operations.

ADJACENT FEATURES ANALYSIS

The crossing of Wetland C17 is located in rural Cambria County, approximately 4.1 miles south-southwest of Ebensburg, PA. The pipeline route follows parallel to the previously existing SPLP pipeline.

This HDD location is within unmanaged deciduous forested lands. The HDD would cross under one (1) stream and three (3) wetlands, none of which are designated as high quality or exceptional value. A 25 acre impoundment occurs immediately north of the pipeline route at this location.

Based on a review of 2015 aerial photography, the nearest residence is 0.46 miles east, of the east end of the HDDs. Water well records indicate no private wells within a 450 ft buffer surrounding the HDDs and there are no surface developments indicative of a potential well within this buffer area observable in the aerial photography.

ALTERNATIVES ANALYSIS

The HDDs as permitted are an alternative plan of installation to a conventional open trench construction plan. Using the HDD method avoids direct impacts to the stream, wetlands, and associated forested woodlands and riparian habitats.

Open-cut Analysis

SPLP specifications require a minimum of 48-inches of cover over the installed pipelines below ground and below the bottom of watercourses. To meet this cover requirement, during construction through the stream and wetlands at this location would require a minimum authorized open cut work space 75 ft in width to accommodate the 16 and 20-inch pipelines, allowing for each pipeline to be installed with sufficient separation for integrity management. The assessed area of impact by this open cut plan would directly affect 0.01 acres of state water bottoms, 0.81 acres of emergent wetlands, and 0.35 acres of forested wetland.

Due to the existing saturated ground conditions, a significant volume of produced groundwater is anticipated to fill all the excavations during the open cut process. These water volumes can be pumped to a discharge filtration structure; however, the current feasible filtration ability does not exceed 50 microns, therefore, cloudy water (from suspended fine clay and silt particles) will be discharged downstream during the entire duration of this crossing until completion regardless of all control methods employed.

WETLAND C-17 CROSSING
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Re-Route Analysis

The pipeline route as currently permitted is parallel to an existing SPLP pipeline.

There are no existing utility corridors to the north that provide a practical alternative route. Any alternate route north of the existing utility corridor would require the clearing of a new "greenfield" corridor several miles in length before it could rejoin the current route.

Approximately 0.3 miles west of the Wetland C17 HDD location, the current route crosses a utility corridor that proceeds east, with this corridor located south of the existing SPLP easement. Following this easement for 0.8 miles, then turning northeast for 0.3 miles through an agricultural field to intersect the current pipeline route is a potential alternative route. SPLP has no existing rights for this route; therefore, if the private landowners are agreeable and new utility easement could be acquired, use of this route would create a new utility corridor affecting 10.0 acres of private lands in total and would affect at minimum 8.0 acre of existing woodlands and 2.0 acres of croplands. If the landowners are not agreeable, then condemnation procedures would be required to acquire the easement. Field assessments for regulated natural resources would have to be completed to determine the presence or absence of sensitive resources or regulated resources. At minimum this route would require a major modification of the existing Chapter 102 and 105 permits issued by the Pennsylvania Department of Environmental Protection.

HORIZONTAL DIRECTIONAL DRILL REDESIGN

Additional geologic investigations have been completed and utilized in the redesign of the planned HDDs. These redesigns adjusts the HDD profile deeper to place the HDD pathway through bedrock having better structural integrity than a shallower profile and increases the overall length of the HDD due to pipe design requirements. A summary of the redesign factors is provided below. The original and redesigned HDD plan and profile drawings are provided in Attachment 2.

Revised Horizontal Directional Drill Design Summary: 20-inch

- Horizontal length: 3,220 foot (ft)
- Entry/Exit angle: 16 degrees
- Depth of cover: 86-125 ft
- Pipe design radius: 2,000 ft

REVISED HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 16-INCH

- Horizontal length: 3,230 ft
- Entry/Exit angle: 16 degrees
- Depth of cover: 124-126 ft
- Pipe design radius: 2,000 ft

As shown on Figure 2, the redesigned HDD profile for the 20-inch pipeline is 1,970 ft longer, with an depth of cover increased by 46-85 ft from the permitted design. In addition, the entry/exit angles have been increased from 10-12 degrees to 16 degrees allowing for a sharper and quicker descent into more competent rock. As shown on Figure 4 the redesigned HDD profile for the 16-inch pipeline is 1,879 ft longer, with an depth of cover increased by 84-86 ft, and designed for a sharp and quick entry and exit from the horizontal depth.

WETLAND C-17 CROSSING
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(SPLP HDD No. S2-0075)

CONCLUSION

HDD specialists and geologists employed by SPLP have investigated the HDD design and subsurface geologic conditions and concluded that the original HDD design for the 16 and 20 inch pipelines, as summarized in the introduction, have a high risk of inadvertent returns (IRs) to the land surface, wetlands, and stream if implemented; therefore, the HDD for the 16-inch and 20-inch diameter pipeline have been redesigned as set forth above to maximize the potential to complete each HDD without an occurrence of an IR.

Upon the restart of these HDDs, SPLP will employ the following HDD best management practices as follows:

- SPLP will mandate annular pressure monitoring during the drilling of the pilot hole, which assists in immediate identification of pressure changes indicative of loss of return flows or over pressurization of the annulus, managing development pressures that can induce an IR;

- SPLP will mandate short-tripping of the pilot and reaming tools to ensure an open annulus is maintained to manage the potential inducement of IRs;

- SPLP will require monitoring of the drilling fluid viscosity, such that fissures and fractures in the subsurface are sealed during the drilling process;

- During the reaming phase, the use of Loss Control Materials can be implemented if indications of a potential IR are noted or an IR is observed, and

- If necessary, the pilot hole and reaming phases at the point of entry for the HDD may utilize casing, hammered into the substrate down to structurally better rock, to prevent vertical or lateral movement of drilling fluids at shallow depths.

WETLAND C-17 CROSSING
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(SPLP HDD No. S2-0075)

ATTACHMENT 1

GEOLOGY AND HYDROGEOLOGICAL EVALUATION REPORT

HDD HYDROGEOLOGIC REEVALUATION REPORT

Mariner East II
Spread 2
HDD S2-0075
Wetland CC17
Cambria Township, Cambria County, Pennsylvania

Prepared for:

Sunoco Pipeline, L.P.

Prepared by:

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

September 2017

HDD HYDROGEOLOGIC REEVALUTION REPORT

Mariner East II
Spread 2
HDD S2-0075
Wetland CC17
Cambria Township, Cambria County, Pennsylvania

September 2017

Prepared for:

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

Prepared by:

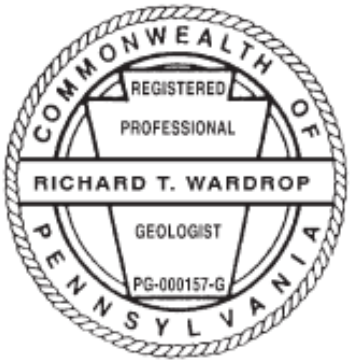
Joseph A. Maule, P.G.
Senior Geologist

Reviewed by:

Richard Wardrop, P.G.
Lead Hydrogeologist

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.



Richard T. Wardrop

September 19, 2017

Richard T. Wardrop, P. G. date

Lic. No. PG000157G

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1.0 INTRODUCTION

Sunoco Pipeline, L.P., (SPLP) retained Groundwater & Environmental Services, Inc. (GES) to prepare HDD Hydrogeologic Reevaluation Reports (HRRs) 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 hydrogeologic reevaluation for HDD S2-0075 and HDD S2-0075-16 (the 20-inch and 16-inch HDDs for this location, respectively), hereinafter collectively referred to as HDD S2-0075. The planned alignment for HDD S2-0075 is in Cambria Township, Cambria County, approximately four miles southwest of Ebensburg. The alignment runs approximately west to east, due south of a private pond located west of State Route 219 and under Route 219. A map depicting the location of the HDD is presented as **Figure 1**.

As described in the Stipulated Order (pages 3 and 4), the HRRs will provide information to eliminate, reduce, or control the release or inadvertent return (IR) of HDD drilling fluids to the surface of the ground or impact to water supplies at the location during HDD operations. The HRRs are not intended to evaluate potential adverse effects of nearby man-made structures from HDD operations. In particular, this HRR does not address any potential adverse effects on the man-made dam and impoundment directly north of HDD S2-0075 (referred to as the "Pond" on drawing PA-CA-0047.000-SRa, rev. 9/14/17) from HDD operations.

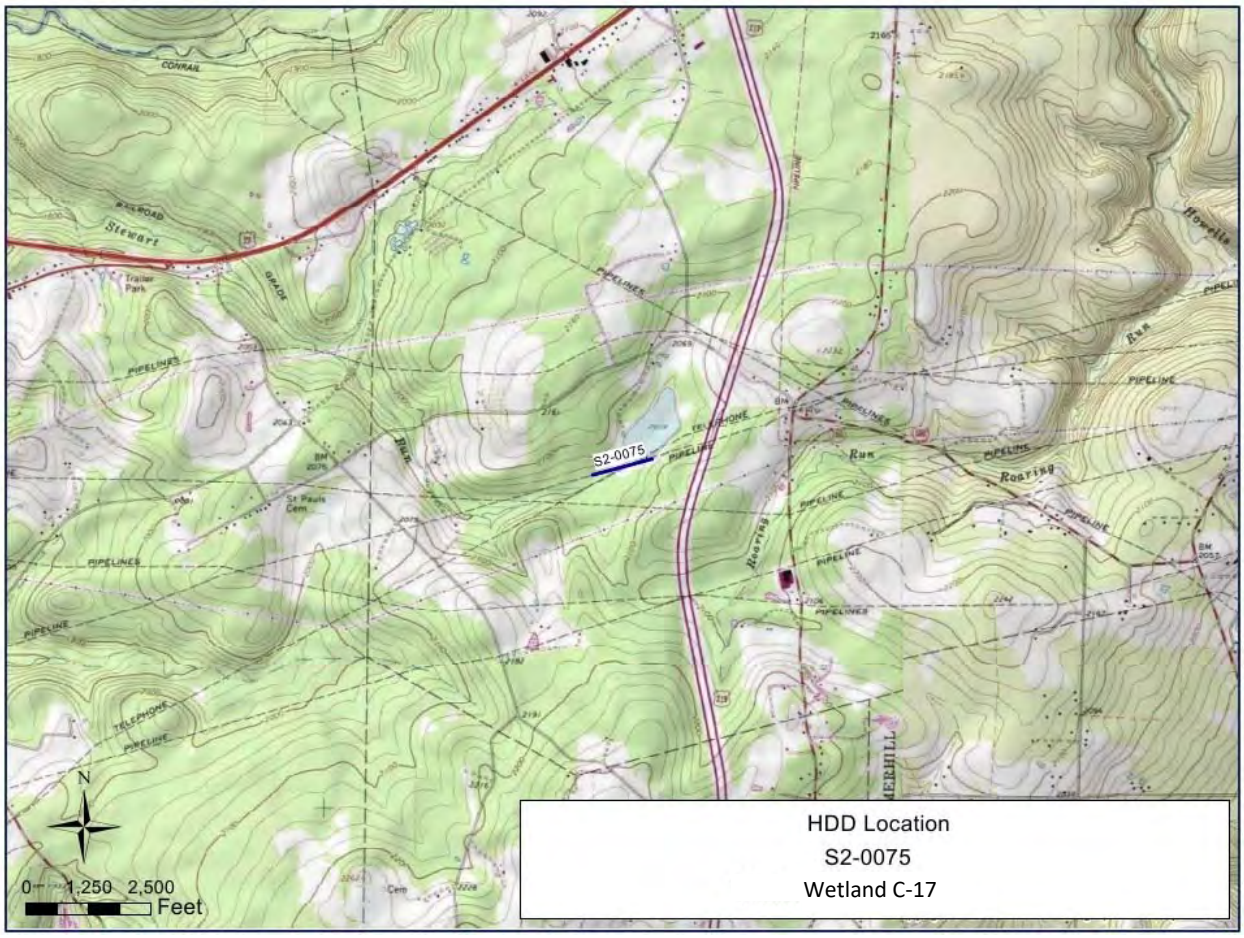


Figure 1. Site Location Map (modified from USGS Nanty Glo 1:24,000 Topo. Quad., rev. 1982)

2.0 HDD GEOLOGY / HYDROGEOLOGY

The discussion presented in this report is based on an alignment and profile developed by Tetra Tech/Rooney, revised on 3/17/2017 (original boring). GES has also been provided a proposed alternative profile for HDD S2-0075 and HDD S2-0075-16, revised 9/14/17 (revised boring) (see **Attachment A**). The revised boring profiles were developed to increase the depth of the borehole by extending the east and west entry/exit points and making the profile longer. The purpose is to minimize the risk of IRs by installing the pipes deeper into competent bedrock. For the purpose of this assessment, GES utilized both HDD designs to evaluate the hydrogeologic conditions at HDD S2-0075.

2.1 Physiography

HDD S2-0075 is located within the Allegheny Mountain Section of the Appalachian Plateaus Province, which is characterized by wide ridges separated by broad valleys.

2.1.1 Topography

The topography in the area of HDD S2-0075 is relatively flat along the entire profile and slightly increasing elevation towards the eastern entry point. The original boring profile is slightly concave near the western center and then transitions to gently sloping upward to the west. The original boring profile for the 20-inch line is located approximately between Stations 5048+25 and 5060+75 on the pipeline, for an overall length of 1,250 feet. The design for the 16-inch closely parallels the 20-inch line.

The revised boring profile for the 20-inch line is located approximately between Stations 5043+05 and 5074+75 on the pipeline for an overall length of 3,170 feet.

The area surrounding the HDD is comprised of rural properties. The site location is depicted on **Figure 1**.

2.1.2 Hydrology

The nearest surface water bodies to the HDD S2-0075 location are three streams that the boring will be beneath: S-CC1, S-CC2, and S-CC8 (Stewart Run). Stewart Run appears to be the primary discharge from the Pond and crosses the original boring at Stations 5059+38, 5059+62, and 5059+92. The original boring shows the drill will enter/exit 83 feet from the eastern edge of S-CC8 and will cross less than 15 feet below Stewart Run, at the shallowest location (Station 5059+92).

The revised boring plan and profile shows the boring will cross S-CC8 at one location (Station 5059+38) and will be 125 feet below the stream. Streams S-CC1 and S-CC2 each cross the revised boring at Stations 5073+61 and 5071+60, respectively.

The Pond is located less than 50 feet north of the HDD S2-0075 profile between Stations 5075+55 and 5060+75. The depth of the pond is unknown at this time.

The primary wetland complex CC-17 is a PEM and PFO wetland and crosses the boring profile from Stations 5053+20 to 5059+60. Based on the original boring, the borehole would be approximately 20 feet below wetland CC-17 on the eastern extent and 40 feet at the western extent of the wetland. The revised boring profile indicates the borehole will be a minimum of 120 feet below wetland CC-17.

Wetlands CC-16 and CC-19 are PEM wetlands and cross the boring profile at 5049+25 and 5048+75, respectively. As these wetlands are near the west entry/exit point of the original boring profile, there is less than 20 feet of soil overburden between the wetlands and borehole. The revised boring profile is a minimum of 110 feet below both wetlands.

Wetland CC-15 is located at Station 5046+50 and the borehole will be approximately 78 feet below this wetland.

2.2 Geology

2.2.1 Soils

Overburden in the area of HDD S2-0075 can range from three to six feet thick or more and is primarily composed of channery silt loam and silt loam from weathered limestone, sandstone and shale. Eastern and western entry/exit points are likely to encounter bedrock at an approximate depth of 5 feet below ground surface (bgs). The soil horizon across the central area of the profile are likely to encounter bedrock at an approximate depth of 4.5 to 5.5 feet bgs ((USDA NRCS Web Soil Survey for Cambria County (http:\\websoilsurvey.nrcs.usda.gov)).

2.2.2 Bedrock Lithology

Bedrock underlying the area of HDD S2-0075 belongs to the Pennsylvanian age Glenshaw Formation, part of the Conemaugh Group. It contains repeated sequences of sandstone, siltstone, shale, claystone (including red beds), limestone, and coal. Shale is the primary rock type. (Geyer and Wilshusen, 1982 and McElroy, 1998).

Figure 2 is a map depicting site bedrock geology for the area surrounding HDD S2-0075 (DCNR Map Viewer, http://www.gis.dcnr.state.pa.us/maps/index.html).

As noted, HDD S2-0075 is located within the Glenshaw Formation, part of the Conemaugh Group, which consists of repeated sequences of sandstone, siltstone, shale, claystone (including red beds), limestone, and coal. It contains four major marine zones that are, from highest to lowest in stratigraphic position: the Ames, Woods Run, Pine Creek, and Brush Creek. The formation decreases in thickness from about 410 feet in the northeast to approximately 280 feet in the southwest.

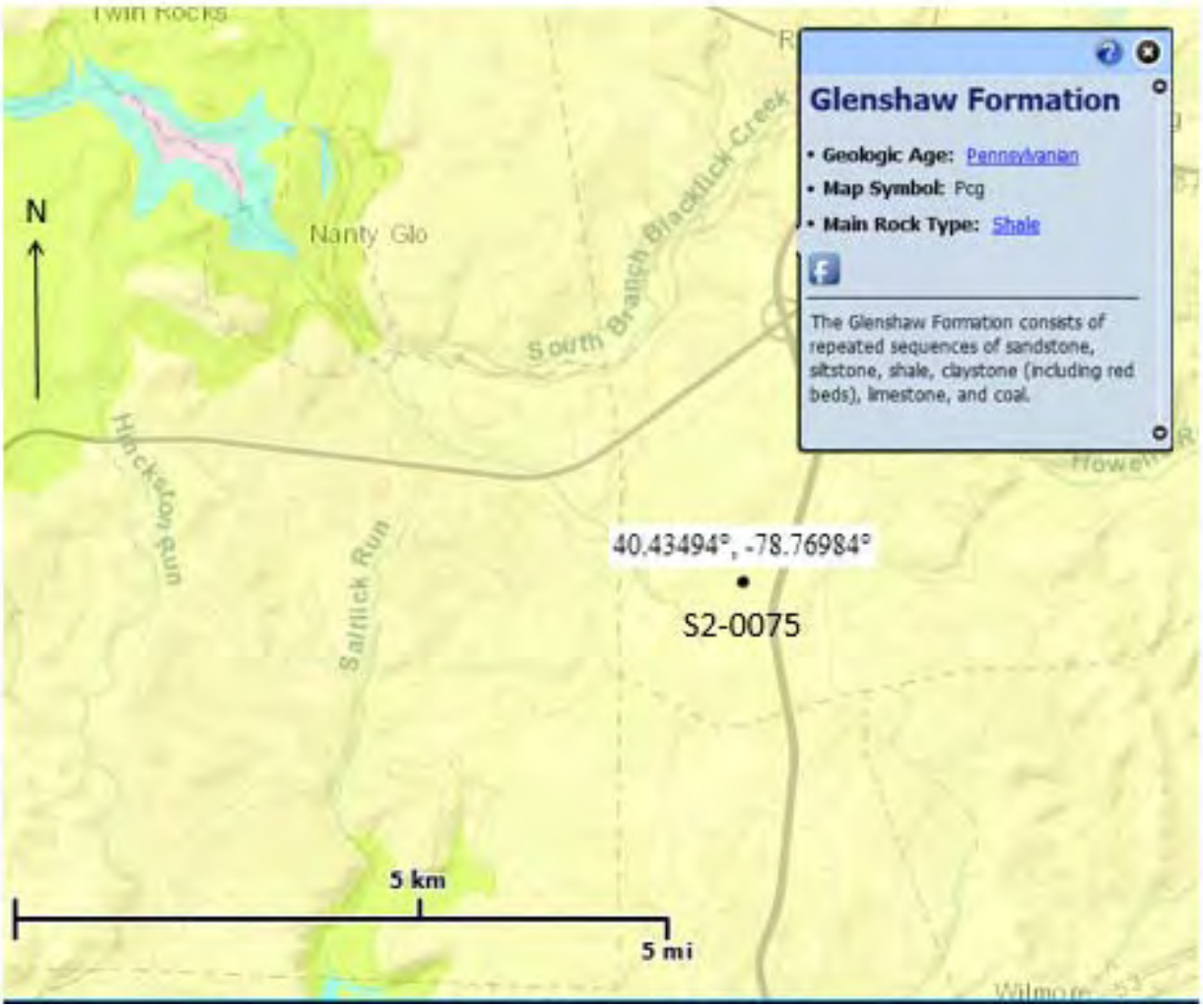


Figure 2. Site Geology (modified from PA DCNR Map Viewer: http://www.gis.dcnr.state.pa.us/maps/index.html)

2.2.3 Structure

Glover (1990) provides structure contour maps for persistent coal beds in Cambria County. Using this resource and structure contours mapped for the Lower Kittanning coal, HDD S2-0075 is located within the limbs of the Ebensburg Anticline to the southeast and Johnstown Syncline to the northwest. Here the beds trend northeast and are dipping approximately 2.1 degrees northwest. **Figure 3** shows the HDD S2-0075 location on the structure contour map.

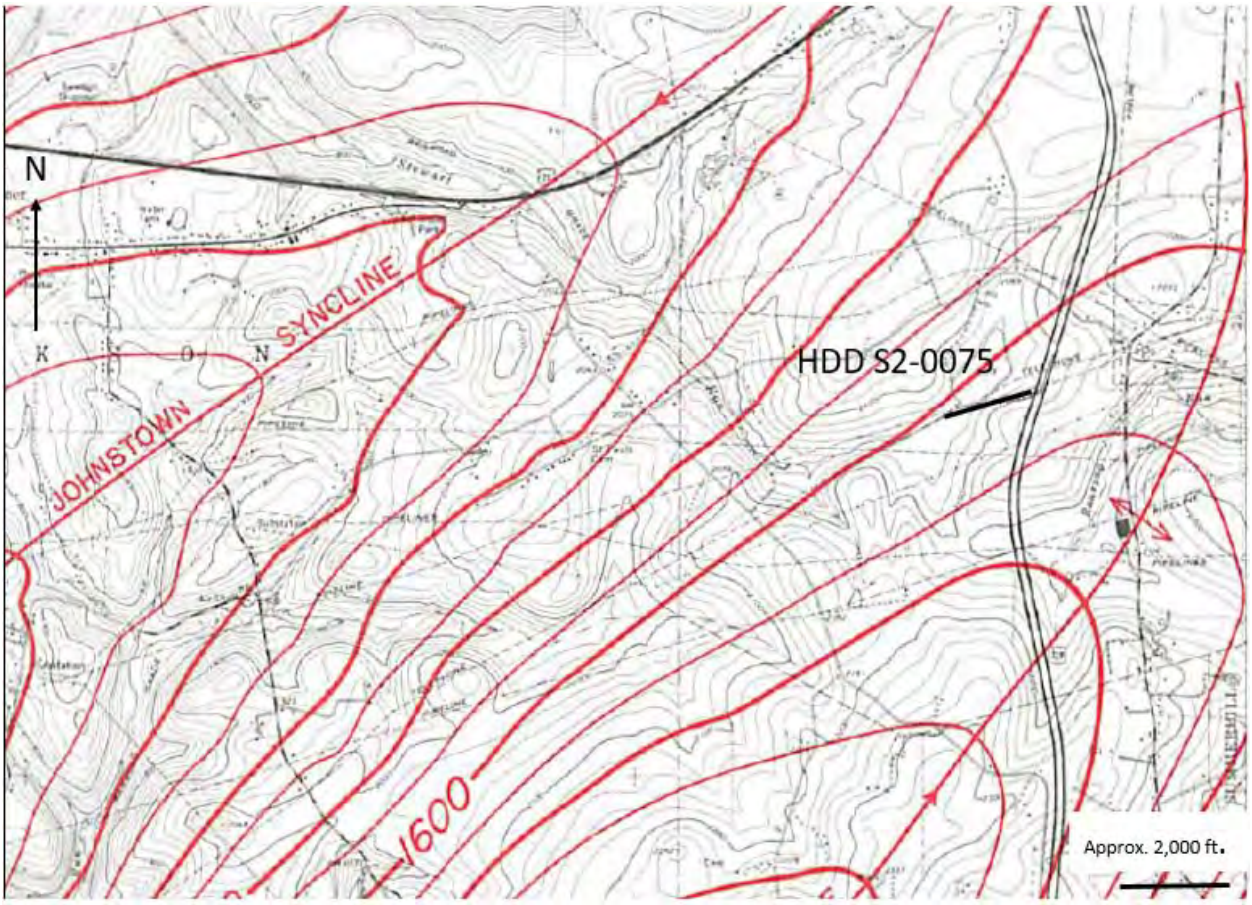


Figure 3. Structure Contour Map on the Lower Kittanning coal. (modified from Glover, 1990)

Discontinuities in the form of joints and faults are imprinted in the broadly folded bedrock in the region. These fractures can act as conduits for groundwater movement and/or represent areas of weakness in the rock. Fold axes can be areas of increased density of fracturing (McElroy, 1998). Nickelsen and Hough (1967) conducted regional mapping of joints in shale, coal and sandstone in the Appalachian Plateau. In the vicinity of HDD S2-0075, two systematic joint sets were mapped with approximate trends of northwest and west northwest. Less frequent non-systematic joints were mapped approximately orthogonal to the systematic joints.

2.2.4 Fracture Trace Analysis

Fracture trace analysis using high altitude aerial photography was performed for the area of interest to identify potential zones of bedrock weakness along drill paths. Fracture traces (one mile in length or less) and lineaments (greater than one mile in length) are the surficial expression on natural landscapes of vertical zones of bedrock fracture concentration. Fracture trace analysis is partly subjective; therefore, every mapped fracture trace does not necessarily represent a zone of bedrock fracture concentration.

Figure 4 shows a fracture trace map prepared for this reevaluation. This mapping was performed using aerial stereographic pairs flown in the spring of 1939. As such, much of the land surface appears undeveloped therefore; fracture traces are more easily seen. Three general orientations are present in the set of fracture traces. Two of the orientations generally match the joint alignments mapped by Nickelsen and Hough (1967): a northwestern trending set (systematic joint set) and a set perpendicular to that trending northeast (non-systematic joint set). The third pattern is generally oriented north to south.

The proposed path of the revised boring is shown in red on **Figure 4** and transects three of the mapped fracture traces. Two of these traces intersect at the approximate location of the drill path at its western end and one crosses the path at the eastern end. Fracture trace intersections can be areas of enhanced groundwater production and associated weakness in the bedrock.

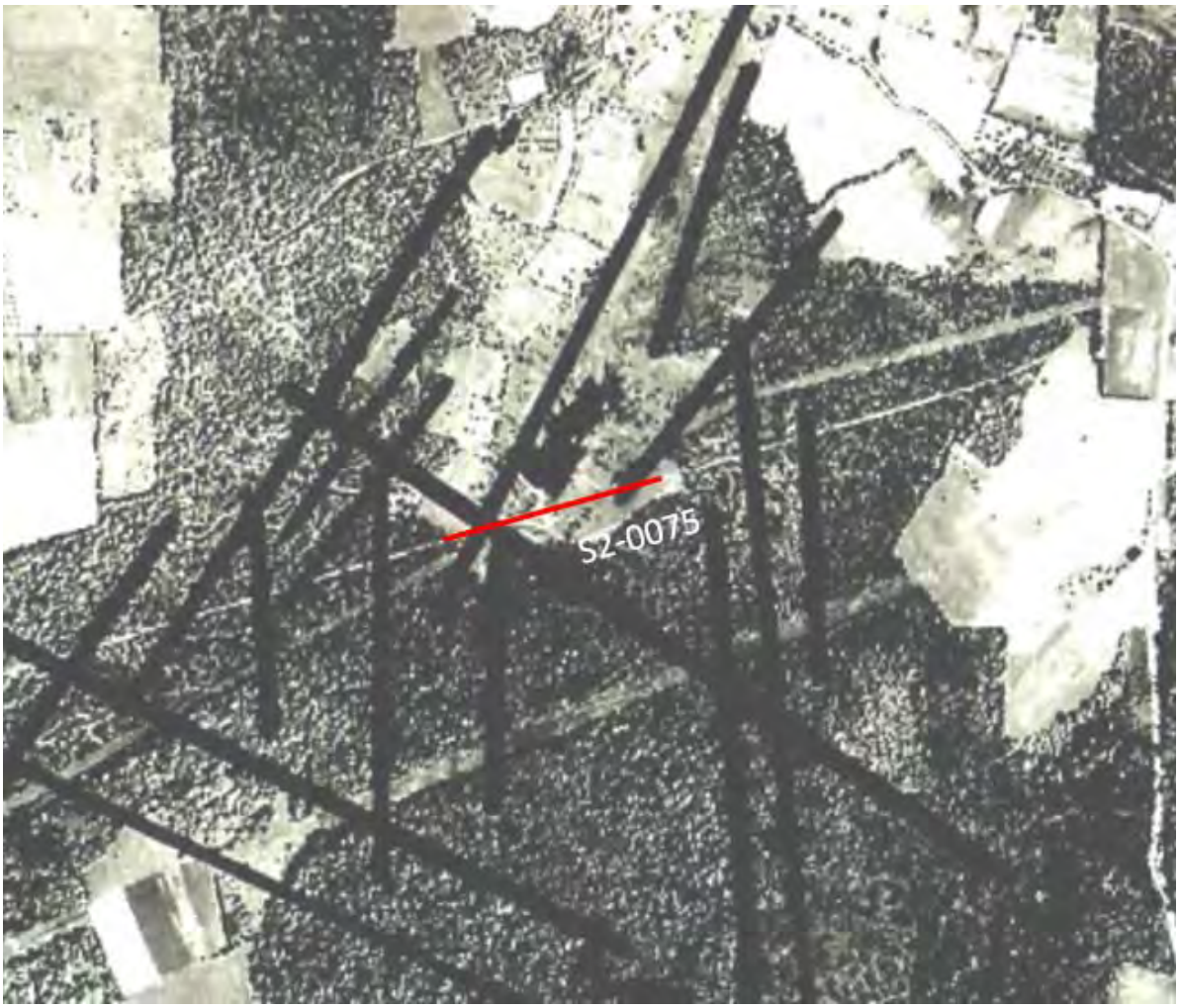


Figure 4. Fracture Trace Map

2.2.5 Karst

Based on published geologic data, no karst features are anticipated within the region of HDD S2-0075 as limestone units are relatively thin and discontinuous.

2.2.6 Mining

Although coal mining has been extensive in this region, a review of published mining and geological data indicate that no documented deep mining has occurred within the LOD of the original or revised boring. Glover (1990) shows the limit of deep Lower Kittanning coal mining over 1,000 feet from HDD S2-0075 to the northeast. The Penn State Mine Map Atlas (http://www.minemaps.psu.edu/) shows the limits of Lower Kittanning coal mining closer to the western entry of the revised boring (see **Figure 5).** The structure contour for the Lower Kittanning coal at that position is approximate elevation 1,575 ft amsl and the lowest position of the revised boring is at 1,930 ft amsl, 355 feet above the coal seam.

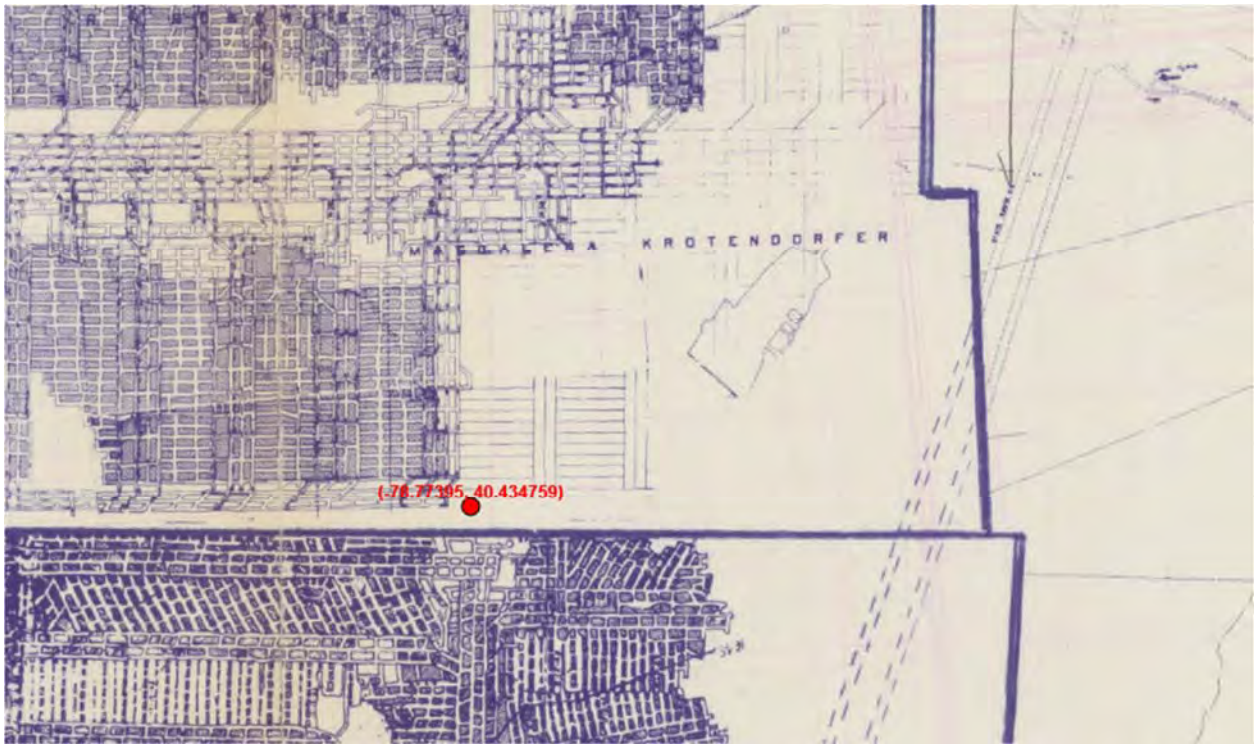


Figure 5. Limits of Lower Kittanning Coal Seam Deep Mining Near HDD 0075
(http://www.minemaps.psu.edu/)

2.2.7 Rock Engineering Properties

The Glenshaw Formation rock properties as represented by Geyer and Wilshusen (1982) are, as follows:

- Well bedded; thick to massive sandstone, well bedded to nodular limestone, thin and fissile shale, and very poor bedded claystone.
- Joints are poorly to moderately well formed; open and vertical; closely to moderately spaced; and moderate distribution.
- Sandstone, siltstone, and limestone are moderately resistant weathering, whereas, claystone, shale, and coal weather extensively and deeply.
- Fast to moderate drilling rates.

2.2.8 Results of Geotechnical Borings

Original Geotechnical Borings

Two geotechnical borings (SB-01 and SB-02) were installed to support the original boring profile design. The locations for these borings are shown on the original plan and profile in Attachment A. Both borings were installed to a depth of 30 feet bgs. Boring SB-01 was located at Station 5049+90, 165 feet east of the entry exit point for the original boring, with a surface elevation of 2,054 ft amsl and Boring SB-02 was located at Station 5057+9, 285 feet west of the original eastern entry/exit point with a surface elevation of 2,054 ft amsl. Shale bedrock was only encountered in SB-02 at a depth of 28.5 feet bgs, at elevation 2,025.5 ft amsl, and no core was taken to verify competent bedrock. Unconsolidated overburden in both borings is comprised of clayey soils.

PSI/Intertek Geotechnical Borings

Two new geotechnical borings were advanced in August 2017 to provide additional information for the redesign of the drill. Details associated with these geotechnical borings are provided in **Attachment B**. Boring B-01 is located at N40.434080, W78.776970 (Station 5034+76), approximately 865 west of the west entry/exit point for the revised boring, and was advanced to a depth of 100 feet. Boring B-02 is located at N40.437009, W78.762551 (Station 5076+15), close to the eastern entry/exit point for the revised drill and installed to a depth of 135 feet. The deepest portions of the revised profile for HDD S2-0075 (at 1,930 ft amsl) are 14 feet deeper than B-01 and 53 feet deeper than B-02.

Boring B-01 has a surface elevation of about 2,043 ft amsl. At this boring the overburden material consisted of three feet of unconsolidated topsoil and sandstone fragments overlying 21 feet of stiff to very stiff lean clay. From 24 feet below ground surface (bgs) to 45 feet bgs the boring advanced through medium dense to dense sand. Poorly graded sand is present from 25 feet bgs to the top of weathered bedrock at 45 bgs. According to the Intertek-PSI log the entire core from about 45 ft bgs to 100 ft bgs was comprised of sandstone. Recoveries ran from 78 to 100% and Rock Quality Index measurements (RQDs) mostly ran from 42 to 79 % with no trends with depth. A particularly low RQD was recorded for the five-foot run from 55.5 ft to 60.5 ft. bgs centered on elevation 1,985 ft amsl and an approximate 1.1-foot void was logged starting at elevation 1978.8 ft amsl. During the advance of the boring, water levels ranged from 42.0 feet to 79.5 feet bgs.

Boring B-02 has a surface elevation of 2,121 ft amsl. At the surface, unconsolidated colluvium consisted of a 15-foot-thick layer of lean clay above three feet of silty sand. From 15 ft to 21 ft bgs a six-foot-thick zone of weathered shale was logged; described as medium dense and moist. More competent shale bedrock with intermittent sandy layers was logged beginning at a depth of 24.1 ft bgs to about 69 ft bgs (elevation 2052 ft amsl). Grey sandstone was logged for the remainder of the boring, to a final depth of 135 ft bgs (elevation 1986 ft amsl). Except for the first few feet of coring, recoveries for B-02 were consistently high, ranging from 96 to 100 percent. None of the recoveries in the sandstone were below 98 percent. RQDs for the shale section of the boring were poor, but improved with depth, ranging from 0 to 61 percent. RQDs for the sandstone ranged from 62 to 96 percent with no trend with depth.

Water levels measured during the advance of B-02 were about 15 ft bgs for two measurements. During boring installation, a loss of drilling water occurred at 116.5 ft bgs (2,005 ft amsl) with no apparent reduction in core recovery or RQD.

2.3 Hydrogeology

Published soil data indicate the regional depth to water in the overburden soils is 2 to 80 inches. The local groundwater flow gradient is likely south from elevated terrain north of HDD S2-0075 and from seepage under the earthen dam of the private pond.

2.3.1 Occurrence of Groundwater

Groundwater is stored and moves within the network of fractured Glenshaw Formation bedrock. Regional systematic joints are oriented northwest and west-northwest. These may represent preferred pathways for groundwater flow.

Examination of the core in photographs for B-01 showed six high angled fractures over 54.5 feet of core and a few short intervals of vuggy rock where carbonate minerals have weathered out of the rock. By far the most frequent discontinuity present in the core, representing secondary porosity for groundwater movement, were near horizontal bedding plane partings, which were more frequent from 40.5 to 60.5 ft bgs and at the bottom of the boring from 90.5 to 100.0 ft bgs.

Examination of the core for B-02 in photographs showed four discernable high angled fractures over 111 feet of core and no vuggy rock. Again, the most frequent discontinuity present in the core, representing secondary porosity for groundwater movement, were near horizontal bedding plane partings which were more frequent at the top of the core from 24 to 69 ft bgs in the shale interval as opposed to the sandstone from 69 to 135 ft bgs.

2.3.2 Ground Elevation Between HDD Entry/Exits

The surface elevation of west entry/exit for the revised boring is approximately 2,054 ft amsl and the surface elevation of the east entry/exit for the revised boring is 2,110 ft amsl. Both planned entry/exit points for the original boring were 2,054 ft amsl.

2.3.3 Water Level

Groundwater was encountered at 42 ft bgs (2,001 ft amsl) in boring B-01 and at 15 ft bgs (2,106 feet amsl) in boring B-02. The water level for B-01 seems low for a static water level in the area of interest. These levels forecast that most of the either the original or revised borings for HDD S2-0075 drills would be below the water table.

Pennsylvania Groundwater Information System (PaGWIS) reported multiple wells within a half mile of HDD S2-0075, but only one well is located within 1,000 feet of the revised boring profile. PA Well ID 80484 is a residential well located approximately 875 feet north-northeast of the eastern entry/exit for the revised boring and is completed at 60 feet bgs. The static water level reported for this well is 50 ft bgs.

2.3.4 Well Yields

The PaGWIS search for the area of interest revealed groundwater yields for wells around HDD S2-0075 ranging from 5 to 20 gpm. The yield for the closest well identified in section 2.2.3 was listed at 24.5 gpm. Published data (Geyer and Wilshusen 1982) notes that yields of more than 50 gpm may be expected from sandstone within the Glenshaw Formation.

2.3.5 Water Supply Wells within 150 and 450 feet of ROW

During the original planning by SPLP for advance of the HDD S2-0075 drills, a survey of land owners within 150 feet of the ROW was performed and no land owners responded positively to an offer to have their wells tested. In terms of the current well survey program, no data regarding wells within the extended 450 feet of ROW is available at this time; pending responses from property owners.

2.4 Summary of Geophysical Studies

No geophysical studies were conducted for this reevaluation as there is no indication of karst development in the area and deep mining has not been identified beneath the HDD alignment.

3.0 OBSERVATIONS TO DATE

3.1 On This HDD Alignment

3.1.1 ME I

No IRs were reported along the alignment of the HDD S2 0075 drills on the list of IRs for ME I documented in the IR PPC Plan for Cambria County.

3.1.2 ME II

No drilling activities have been initiated yet at HDD S2-0075 as part of the ME II pipeline installation.

3.2 On Other HDD Alignments in Similar Hydrogeologic Settings

3.2.1 ME I

No IRs were reported on the list of IRs for ME I documented in the IR PPC Plan for site underlain by Glenshaw Formation bedrock.

3.2.2 ME II

To date, MEII pipeline installations within the Glenshaw Formation have been completed at the following HDD locations:

- S2-0016 Livermore Road – 20”
- S2-0050 Buffalo-Pittsburgh Highway (Rt. 119) – 20”
- S2-0060 Rt. 22 William Penn Highway – 20”
- S2 -0062 Wetland (Clair Road) – 20”

For these installations, an IR only occurred at S2-0016 Livermore Road – 20”. The root causes for this IR were limited overburden over the drill (38 feet) while passing under the Spruce Run flood plain and a large elevation difference between the two exit/entry points and the flood plain (approximately 77 ft and 213 ft). In terms of overburden between water resources and the drills, the original boring plan for HDD 0S2-0075 showed 40 feet of cover for most of the drill. The revised boring plan shows a large improvement in terms of reducing IR risk as the overburden is at least 125 feet for most of the drill. These thicknesses do not apply for the drills near the entry and exit points.

In terms of elevation difference between water resources and exit/entry points, the original plan showed a maximum difference of 17 feet between the eastern exit/entry point and local wetlands. On the revised plan the eastern exit/entry point gained elevation from 2,054 to 2,110 ft amsl, as it was moved east. Therefore, the maximum difference between the eastern entry/exit point on the revised boring plan and local wetlands along the path of the drill is about 62 feet.

4.0 SUMMARY AND CONCLUSIONS OF HDD HYDROGEOLOGIC EVALUATION

4.1 HDD Site Conceptual Model

The logs for all four geotechnical borings in the area of interest showed the overburden is predominately clay. The log for B-01, drilled in August 2017, shows a thickness of sand from 24 ft bgs to the top of weathered sandstone at 45 ft bgs. This sand layer is capped by 21 feet of clay with varying amounts of lesser sand, silt and gravel, which will reduce IR risk if the thickness of clay there is representative of the subsurface near the western exit/entry for the revised boring. Boring B-01was drilled approximately 865 feet west of the western entry/exit for the revised boring. Three borings in the area of interest (one from earlier study and two advanced in August 2017) show the elevation of bedrock to range from approximately 1,998 to 2,097 ft amsl. The horizontal, deepest portion of the original boring was planned to be at an elevation of 2,008 ft amsl, suggesting some of that section of pipe would be shallower than bedrock. The revised boring plan shows a longer section of horizontal pipe at the deepest part of the profile at an elevation of 1930 ft amsl, suggesting all of that section of pipe would be within bedrock. Depth to bedrock will vary from position to position on the landscape and the top of bedrock elevations derived from three borings can only be partially representative over the distance of the drills.

The bedrock in geotechnical boring B-01, located approximately 865 feet west of the revised western exit/entry point was logged as entirely sandstone to an elevation of 1,943 ft amsl. At its deepest elevation the revised boring is at 1930 ft amsl. The bedrock in boring B-02, located near the revised eastern entry/exit point was logged as shale from elevation 2,052 to 2,097 ft amsl and as sandstone from elevation 1,943 to 2,052 ft amsl. Rock core recoveries in B-01 ran from 78 to 100% and RQDs mostly ran from 42 to 79 % and there was no trend in RQDs with depth. A particularly low RQD was recorded on the log for B-01 for the five-foot run from 55.5 ft to 60.5 ft. bgs, centered on elevation 1,985 ft amsl, and an approximate 1.1-foot void was logged centered at elevation 1978 ft amsl.

The bedrock in geotechnical boring B-02, located near the western entry/exit point for the revised boring was logged as shale bedrock with intermittent sandy layers beginning at an elevation of 2,052 to 2,097 ft amsl. Grey sandstone was logged for the remainder of the boring, to a final depth elevation of 1986 ft amsl. At its deepest elevation the revised boring is at 1930 ft amsl. Except for the first few feet of coring, recoveries for B-02 were consistently high, ranging from 96 to 100 percent. None of the recoveries in the sandstone were below 98 percent. RQDs for the shale section of the boring were poor, but improved with depth, ranging from 0 to 61 percent. RQDs for the sandstone ranged from 62 to 96 percent with no trend with depth.

Elevations of shale and sandstone beds will vary from position to position on the landscape and the determination of these elevations, derived from three borings, is only be partially representative over the distance of the drills. Therefore, contractors should be prepared to manage HDD drilling through the more competent sandstone and less competent shale.

Fracture trace analysis indicates there is some probability that the drills will pass through zones of increased bedrock fracturing at one fracture trace intersection (two fracture traces) near the western entry/exit and at a single fracture trace near the eastern entry/exit for the revised boring. Contractors should be prepared for drilling through rock less competent than indicated by the recent geotechnical borings (B-01 and B-02) as they are not located at the positions of the fracture traces

Water table elevations are anticipated to be above the elevation of the drills for both the original and revised boring plans. For the revised boring plan, the static water level in boring B-02, located near the eastern entry/exit point approximately 2,106 ft amsl. The static water level at B-01 was at an elevation of 2,001 ft

amsl, 105 feet lower, and the western entry/exit point on the revised boring plan is at an elevation of 2,054 ft amsl. If these elevations are representative of actual conditions, the pilot hole could create a drain with a local lowering of the water table in the area of the eastern side of the drill. Contractors should be prepared to manage the groundwater discharge and prevent drainage resulting in a lowering of the water table. If the water table were lowered, it would return to pre-construction conditions as long as the annuli between the 20-inch and 16-inch pipes and surrounding bedrock are sufficiently sealed. Residential well use in the immediate vicinity of the drill is thought to be minimal, based on a pre-construction survey and a PaGWIS search. As such, a localized temporary lowering of the water table might not represent an impact to local water supplies. Groundwater yields in Glenshaw water wells can be as high as 50 gpm. Sufficient porosity to accommodate this type of yield is indicated by the void encountered in geotechnical boring B-01 at 65 ft bgs. Contractors should be prepared to manage dilution of drilling fluids with groundwater.

The revised boring profile is projected to be a minimum of 125 feet below most streams and wetlands, with the exceptions of streams S-CC7 (32 feet) and S-CC1 (21 feet) where the drill paths approaches the surface at the entry/exit points. Contractors should be prepared to manage these areas of thin cover during entry and exit, especially where sand overburden could be encountered.

4.2 Conclusions and Recommendations

Based on the revised boring profile (**Attachment A**) and recent geotechnical borings (**Attachment B**) the revised boring for HHD S2-0075 is longer, goes deeper into more bedrock, and as such reduces the risk of IRs affecting the stream and wetlands over its path. Based on this hydrogeologic reevaluation, installation procedures and/or additional revision to the boring design should be considered to further reduce the risk of IRs and reduce the risk of lowering the water table on the east end of the drill. These conclusions are based on the following:

1. Variability in rock strength due to differences in lithology (basically sandstone versus shale) and potential zones of fracture concentration in bedrock indicated by fracture traces.
2. Variability in soil strength due to the potential occurrence of sand layers at the surface or under thin clayey soils.
3. Potential for local lowering of the water table in the area at the east end of the revised boring due to drainage towards the west caused the pilot hole.

Some of the uncertainty associated with these conclusions could be reduced by advancing a geotechnical boring at the western entry/exit for the revised boring and installing water level piezometer at both entry/exit points for the revised boring to obtain more precise static water level measurements.

5.0 REFERENCES

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.

Glover, A. D, (1990), *Coal Resources of Cambria and Blair Counties, Pennsylvania – Part 1, Coal crop lines, mined out areas, and structure contours*., Pa. Geol. Surv., 4th. Ser., M-096.

McElroy, T. A. (1998), *Groundwater resources of Cambria County, Pennsylvania*, Pa. Geol. Surv., 4th. Ser., W67.

Nickelsen, R. P. and Hough, V. D. (1967) *Jointing in the Appalachian Plateau of Pennsylvania*, GSA Bull. v. 78, p. 609-630.

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).

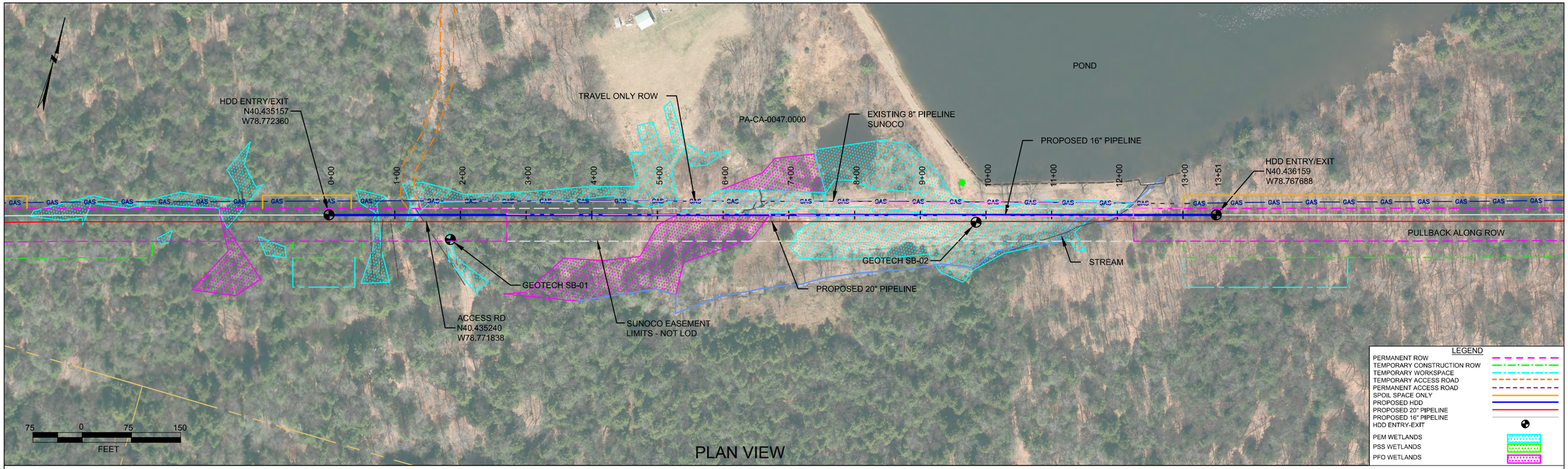
Penn State Mine Atlas (http://www.minemaps.psu.edu).

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), Nanty Glo, Pennsylvania, 1:24,000 topographic quadrangle map, rev. 1982.

Attachment A

Original and Revised Plan and Profile

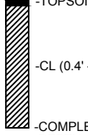


PLAN VIEW

PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075-16

GEOTECH SB-01



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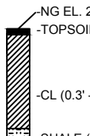
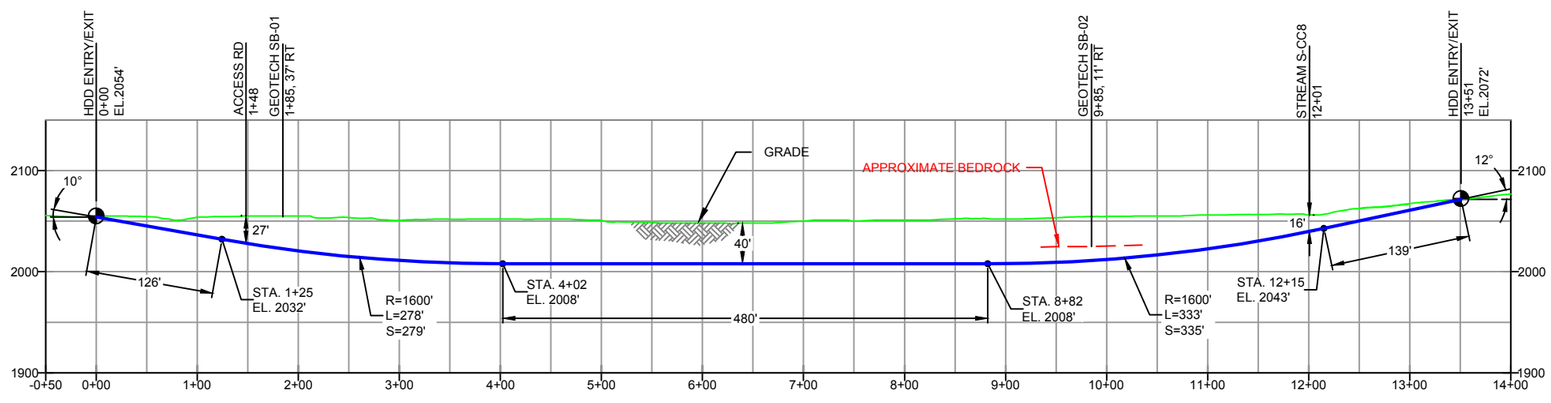


NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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=): 1351'
   HDD PIPE LENGTH (S=): 1359'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

Sunoco Logistics Partners L.P.

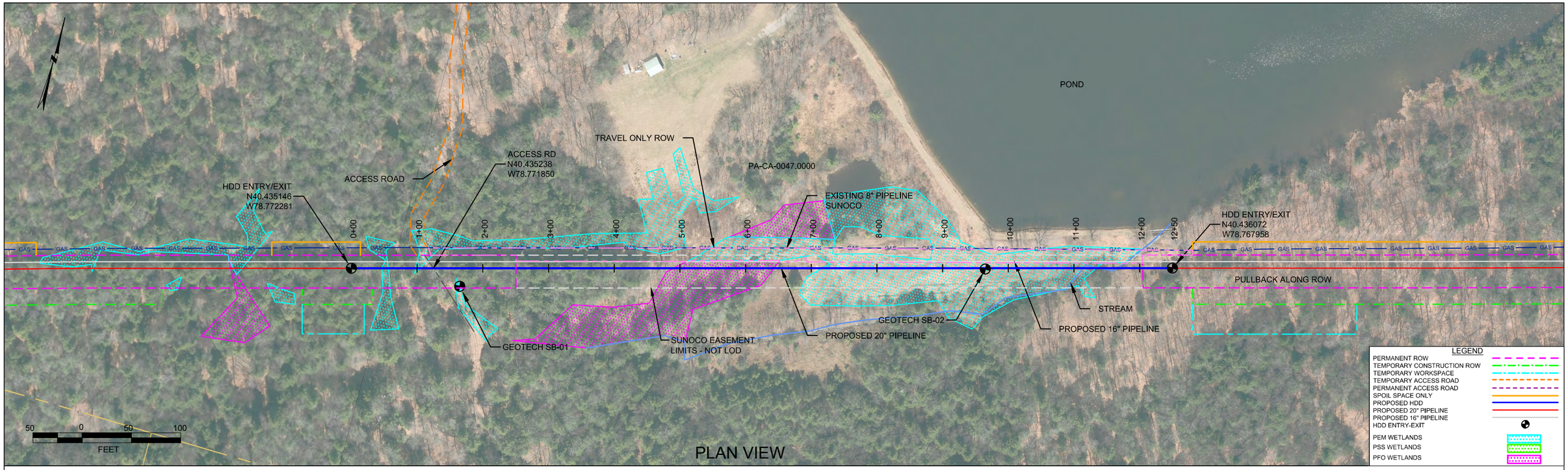
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

DWG. NO: PA-CA-0047.0000-SR-16



PLAN VIEW

PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075

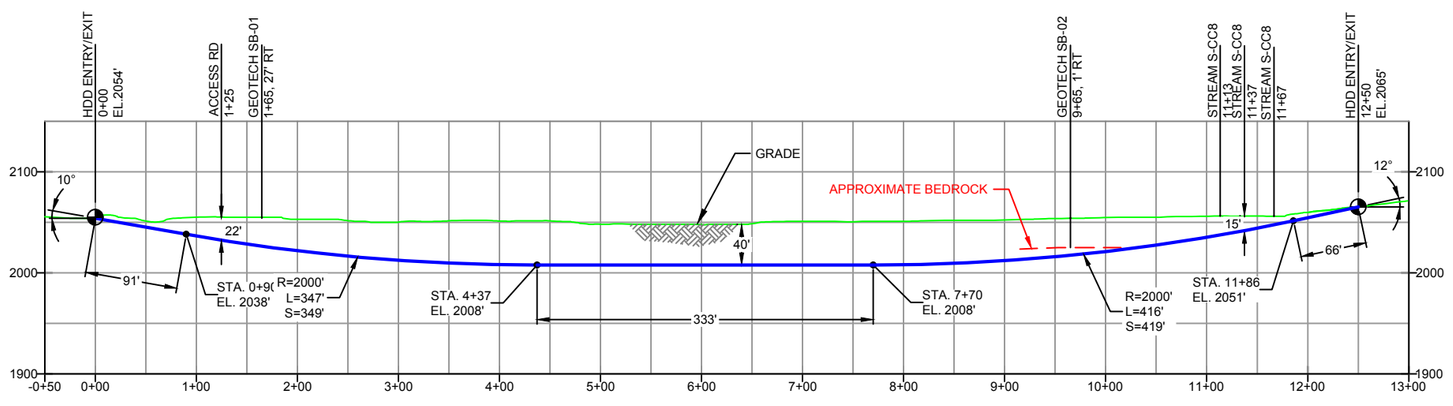
GEOTECH SB-01

-NG EL. 2054'
-TOPSOIL (0' - 0.4')
-CL (0.4' - 30.0')
-COMPLETION DEPTH EL. 2024'

GEOTECH SB-02

-NG EL. 2054'
-TOPSOIL (0' - 0.3')
-CL (0.3' - 24.0')
-SHALE (28.5' - 30.0')
-COMPLETION DEPTH EL. 2025.5'

NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=): 1250'
   HDD PIPE LENGTH (S=): 1258'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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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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

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REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

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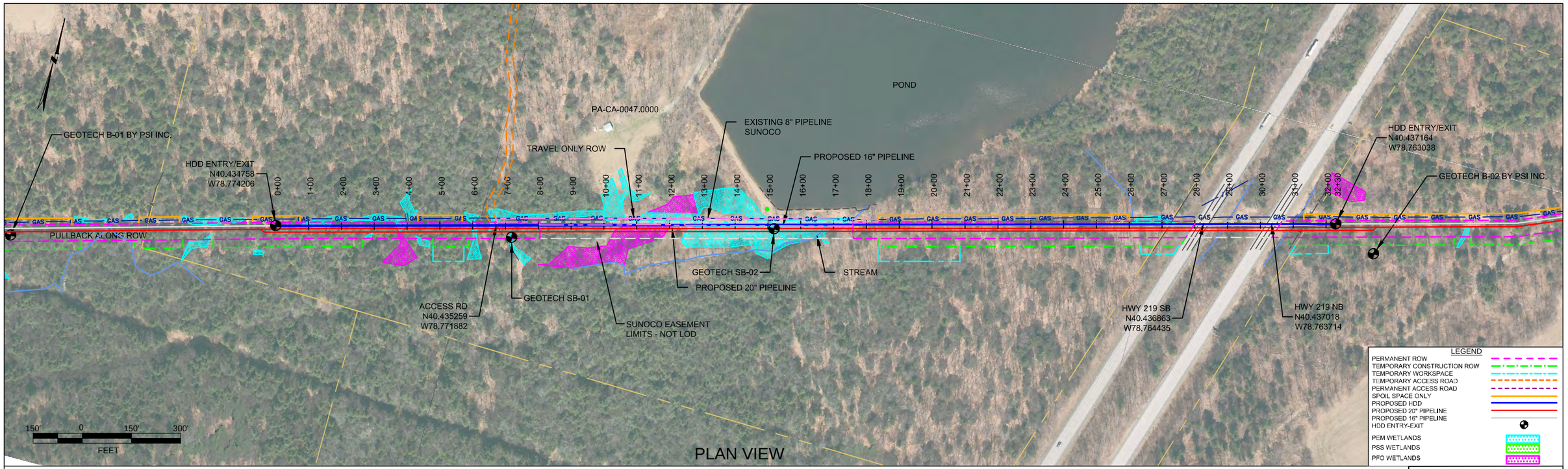
SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NUMBER: PA-CA-0047.0000-SR

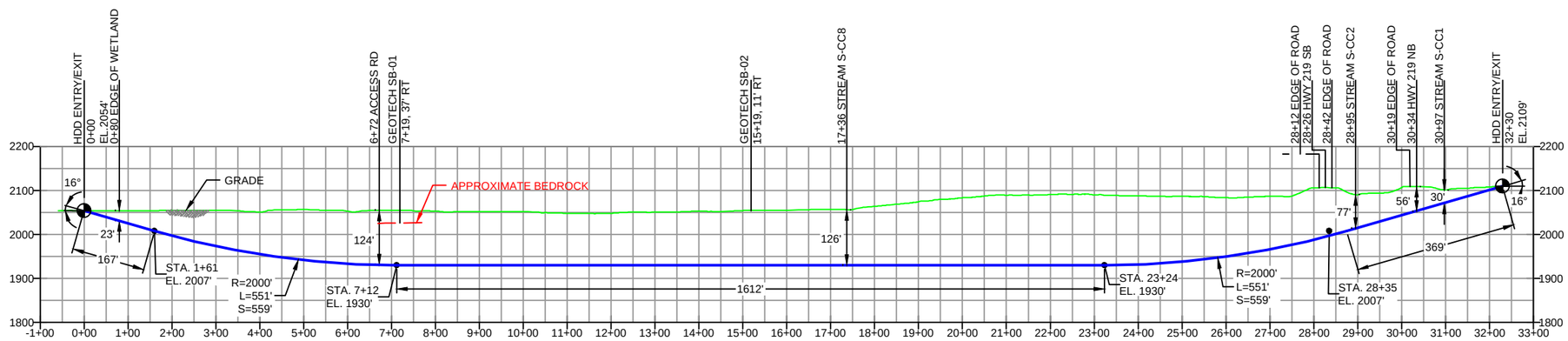


PLAN VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075-16

PROFILE VIEW

PRELIMINARY DESIGN ONLY



GEOTECH SB-01

-NG EL. 2054'
-TOPSOIL (0' - 0.4')
-CL (0.4' - 30.0')
-COMPLETION DEPTH EL. 2024'

GEOTECH SB-02

-NG EL. 2054'
-TOPSOIL (0' - 0.3')
-CL (0.3' - 24.0')
-SHALE (28.5' - 30.0')
-COMPLETION DEPTH EL. 2025.5'

NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-01

-NG EL. 2044'
-TOPSOIL (0' - 1')
-COLLUVIUM-SANDSTONE GP (1.0' - 3.0')
-COLLUVIUM-LEAN CLAY CL (3.0' - 21.0')
-COLLUVIUM-LEAN CLAY CL-ML (21.0' - 24.0')
-COLLUVIUM-SAND SP (21.0' - 45.0')
-GROUNDWATER (42.0')
-WEATHERED ROCK GP (45.0' - 45.5')
-BEDROCK-SANDSTONE (45.5' - 100')
-COMPLETION DEPTH EL.1944'

NOTE: REFER TO TEST BORING LOG B-1 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-02

-NG EL. 2118'
-COLLUVIUM-LEAN CLAY CL (0.0' - 15.0')
-COLLUVIUM-SILTY SAND SM (15.0' - 18.0')
-GROUNDWATER (15.0')
-WEATHERED ROCK GP (18.0' - 24.0')
-BEDROCK-SANDSTONE (24.0' - 135')
-COMPLETION DEPTH EL.1983'

NOTE: REFER TO TEST BORING LOG B-02 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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   HDD HORZ. LENGTH (L=): 3230'
   HDD PIPE LENGTH (S=): 3266'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
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11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

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REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
4	EXTENDED DRILL - DESIGN CHANGE BY CONTRACTOR	MRS	09/15/17	RMB	09/15/17	CAG	09/15/17
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

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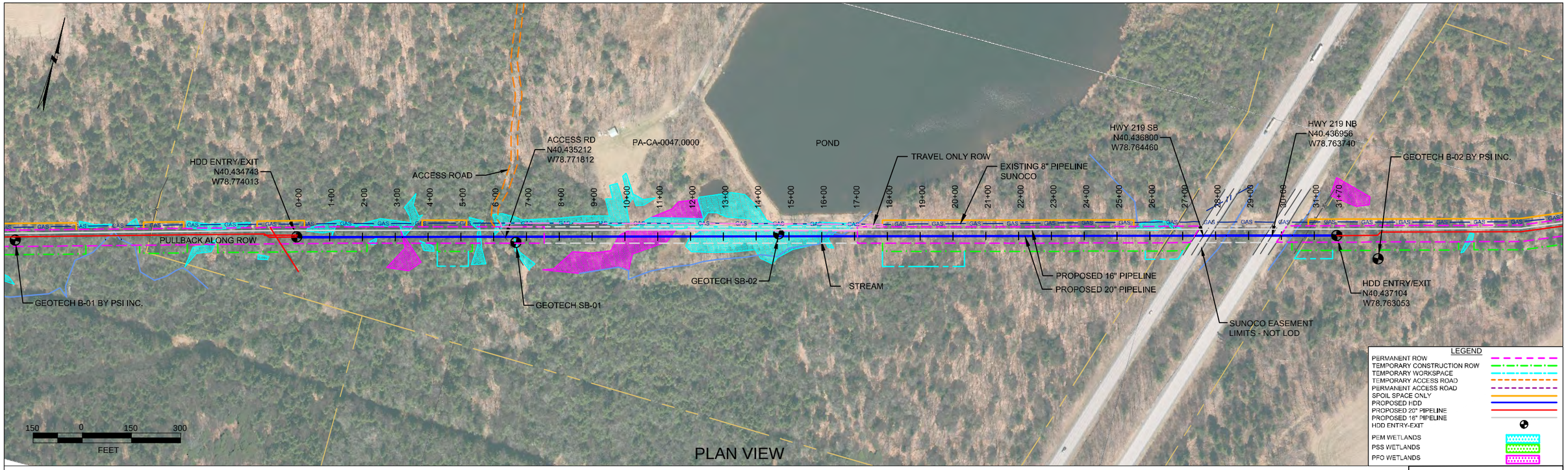
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NO: PA-CA-0047.0000-SR-16 REDESIG

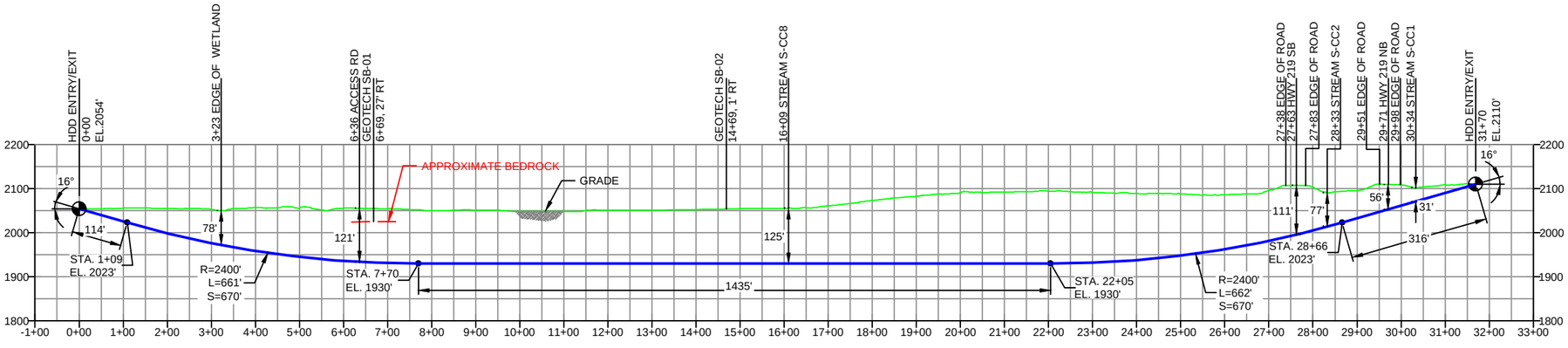


PLAN VIEW

PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075

PRELIMINARY DESIGN ONLY



GEOTECH SB-01

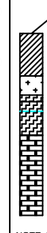
GEOTECH SB-02

NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-01

NOTE: REFER TO TEST BORING LOG B-1 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-02



NOTE: REFER TO TEST BORING LOG B-02 PSI INC. PROJECT # 08031066 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 THAN10 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=):3170'
   HDD PIPE LENGTH (S=):3205'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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
4	EXTENDED DRILL - DESIGN CHANGE BY CONTRACTOR	MRS	09/14/17	RMB	09/14/17	CAG	09/14/17
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NUMBER: PA-CA-0047.0000-SRa

Attachment B

Geotechnical Report

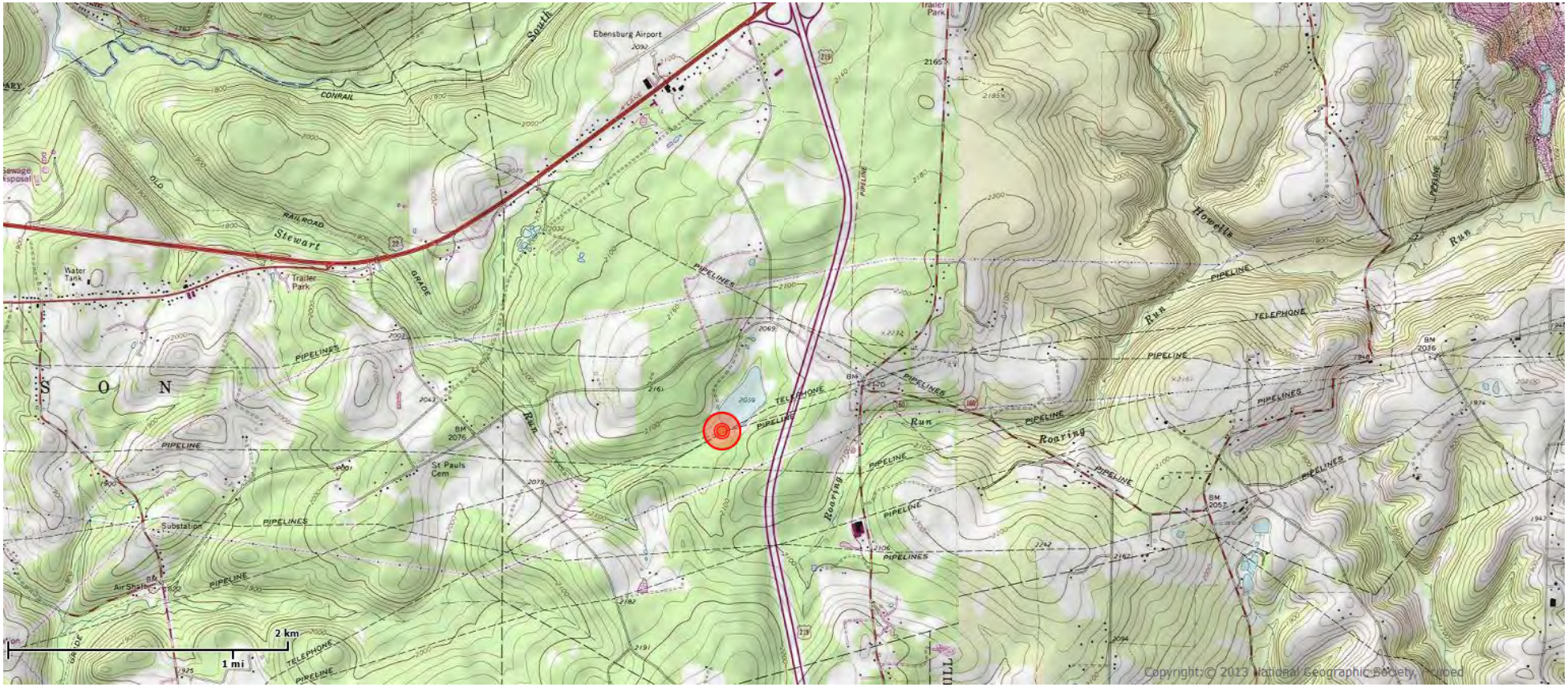
September 2017

pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES

Visit us at http://www.dcnr.state.pa.us

Figure 1: Site Vicinity Map

Make online reservations at
www.visitPAparks.com
or call toll-free 888-PA-PARKS



Created using PA DCNR Map Viewer

Map created on Thu Aug 31 2017

FIGURE 2: BORING LOCATION PLAN

Wetlands CC17 - PPP2
Stagers Road, Cambria County, PA
PA-CA-0047.000 SR-16
DPS PO #2107025
PSI Project No.: 08031066

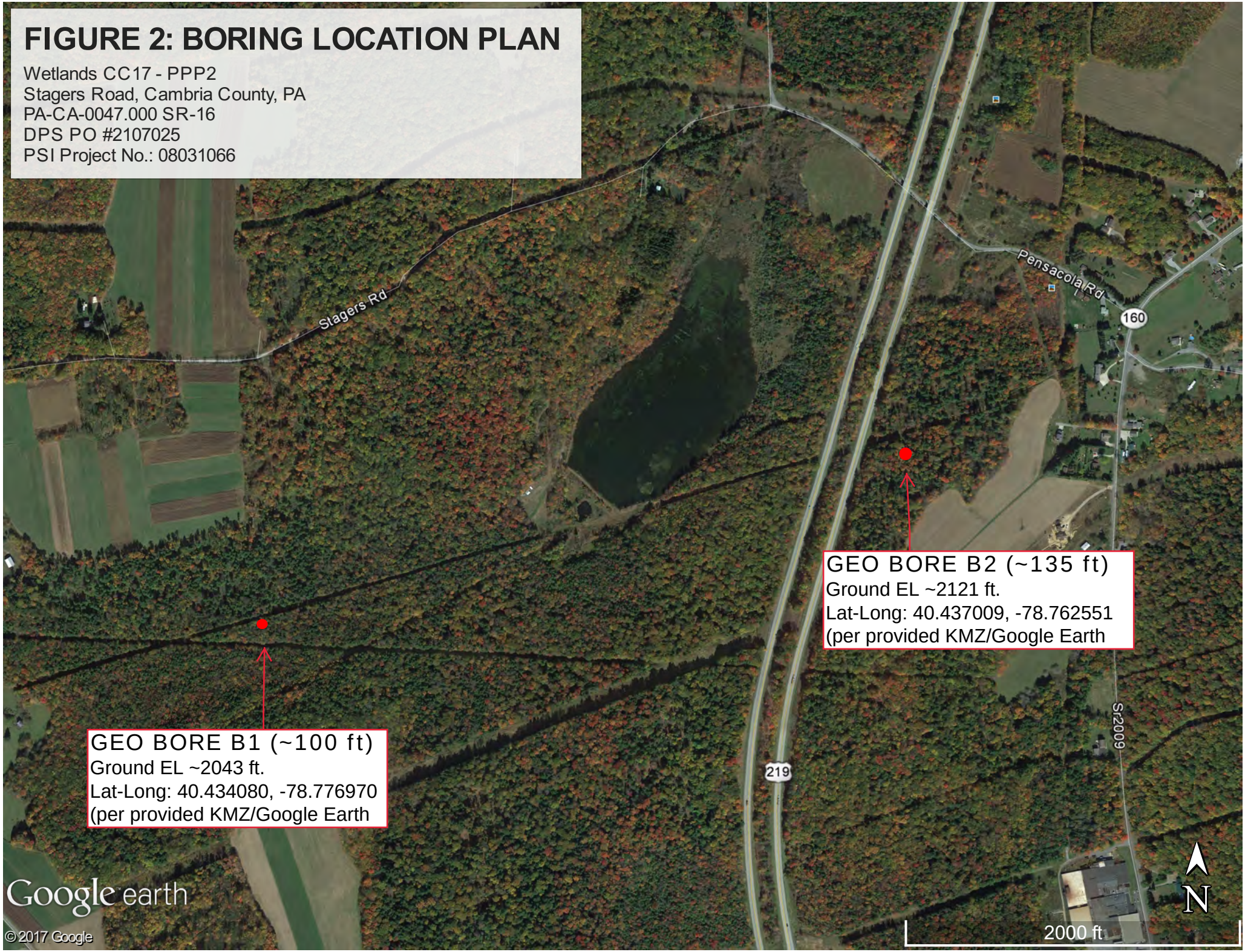
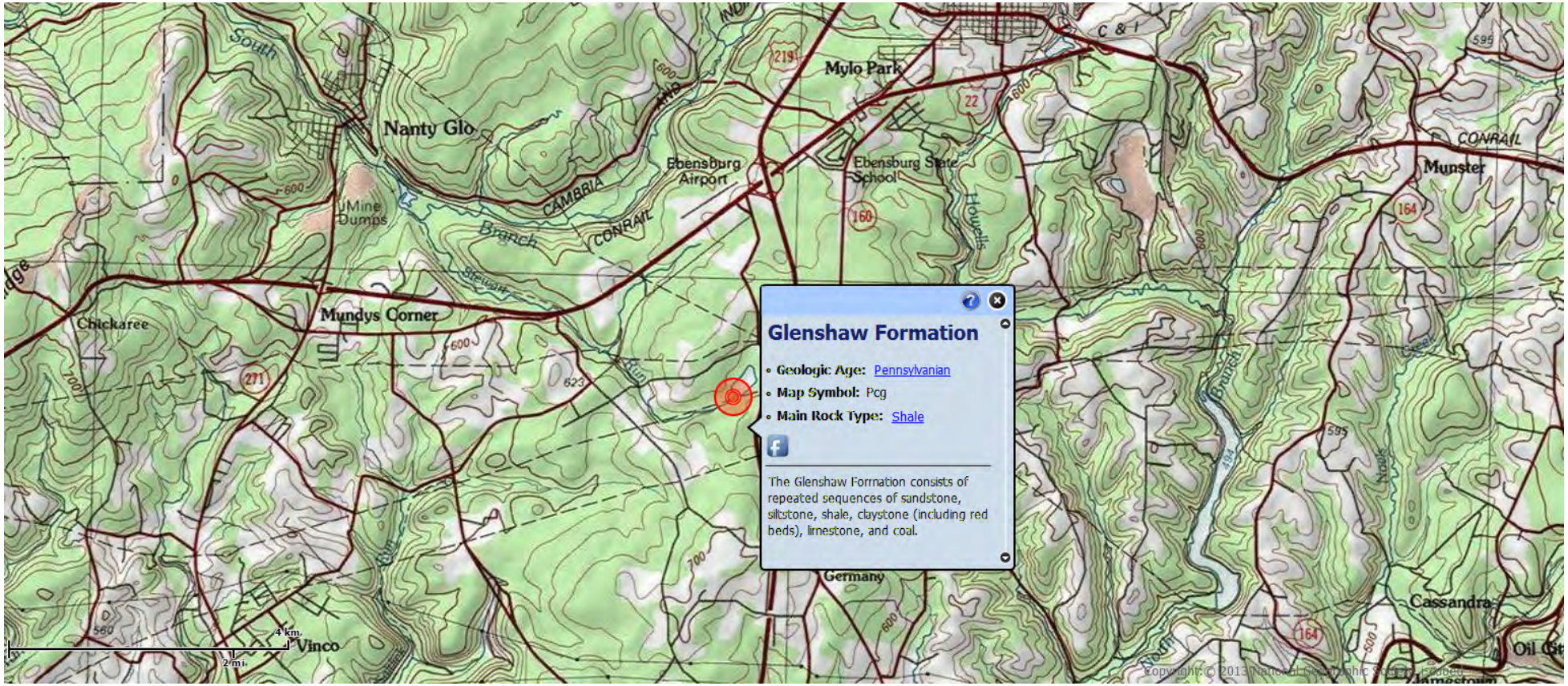


Figure 3: Site Geology Map



BORING B-01

DATE STARTED:	8/14/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/15/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2043 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

Water

During Drilling	42 feet
Pre-Core	42 feet
Upon Completion	79.5 feet

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0			S-1	10	Approximately 9 inches of **Cut Brush and Mulch**					
						COLLUVIUM - Loose, moist, light brown, **SANDSTONE FRAGMENTS**, sampled as a Poorly Graded Gravel	GP	1-3-3 N=6			
2040				S-2	18	**COLLUVIUM** - Stiff to very stiff, moist, light gray and light brown, **Lean CLAY**, with Sand	CL	5-7-8 N=15			
	5			S-3	18	**COLLUVIUM** - Stiff to very stiff, moist, light gray and light brown, **Lean CLAY**, with a Sandstone Cobble	CL	7-18-17 N=35			
2035											
	10			S-4	18	**COLLUVIUM** - Stiff to very stiff, moist, light gray and light brown, **Lean CLAY**, with Sand	CL	8-8-12 N=20			
2030				S-5	18	**COLLUVIUM** - Stiff, moist, light brown, **Sandy Lean CLAY**		5-7-8 N=15			
	15			S-6	18		CL	5-4-8 N=12			
2025				S-7	18			5-6-8 N=14			
	20			S-8	18	**COLLUVIUM** - Medium stiff, moist, light gray, **Silty Lean CLAY**	CL-ML	3-4-5 N=9			
2020											
	25			S-9	18	**COLLUVIUM** - Medium dense to dense, moist, light brown, **Poorly Graded SAND**, trace Sandstone Fragments	SP	4-6-8 N=14			
2015				S-10	18			3-7-7 N=14			
	30										

Continued Next Page

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Professional Service Industries, Inc.
850 Poplar Street
Pittsburgh, PA 15220
Telephone: (412) 922-4000

PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/14/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/15/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2043 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

BORING B-01

Water		
During Drilling	42	feet
Pre-Core	42	feet
Upon Completion	79.5	feet

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Additional Remarks
	30	S-11	18	**COLLUVIUM** - Medium dense to dense, moist, light brown, **Poorly Graded SAND**, trace Sandstone Fragments		7-11-13 N=24	
2010		S-12	18		SP	10-12-13 N=25	
	35	S-13	18	**COLLUVIUM** - Medium dense to dense, moist, light brown and light gray, **SAND**		13-22-10 N=32	
2005					SP		
	40	S-14	18			16-15-11 N=26	
2000		S-15	18	**COLLUVIUM** - Medium dense to dense, moist becoming wet, light brown and light gray, **SAND**	SP	12-13-11 N=24	
	45	S-16	1	**WEATHERED ROCK** - Very dense, dry, light brown, **SANDSTONE**, sampled as a Poorly Graded Gravel	GP	50/1"	>>
				BEDROCK - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6) Clay seam from 46.3 to 46.7 feet			>> 2 min.
1995		R-1	60			RQD=42 Rec=100%	1 min. 1 min. 1 min. 1 min.
	50			**BEDROCK** - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6), interbedded with a small amount of gray Shale			1 min. 1 min. 1 min. 1 min. 1 min. 1 min.
1990		R-2	49			RQD=44 Rec=82%	1 min. 1 min. 1 min. 1 min.
	55			**BEDROCK** - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6), broken and vertical fractures throughout run			1 min. 1 min. 1 min. 1 min. 1 min.
1985		R-3	52			RQD=14 Rec=86%	
	60						

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
Moisture ✕ PL ◪ LL ✚
0 25 50
STRENGTH, tsf
Qu ▲ Qp ✳
0 2.0 4.0

Continued Next Page

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PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/14/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/15/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2043 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

BORING B-01

Water		
During Drilling	42	feet
Pre-Core	42	feet
Upon Completion	79.5	feet

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	60					**BEDROCK** - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6)					1 min.
											2 min.
1980				R-4	47			RQD=40 Rec=78%			1 min.
											1 min.
	65					**VOID**					1 min.
						BEDROCK - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6)					1 min.
											1 min.
1975				R-5	56	**BEDROCK** - Light brown gray, **SANDSTONE**, fine to medium grained, very thin to thin bedded, slightly weathered, medium hard (4-6) Broken from 65.5 to 66.4 feet		RQD=74 Rec=94%			1 min.
											1 min.
	70										1 min.
											1 min.
1970											1 min.
											1 min.
											1 min.
	75			R-6	103			RQD=46 Rec=86%			1 min.
											1 min.
											1 min.
1965											1 min.
						BEDROCK - Light brown gray, **SANDSTONE**, fine to medium grained, thin to medium bedded, slightly weathered, medium hard (4-6)					1 min.
	80										1 min.
						Vertical fracture from 81.5 to 82.3 feet					1 min.
											1 min.
1960											1 min.
											1 min.
	85			R-7	116			RQD=60 Rec=97%			1 min.
											1 min.
											1 min.
1955											1 min.
											1 min.
	90										1 min.

Continued Next Page

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PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-01

DATE STARTED:	8/14/17	**DRILL COMPANY:**	PSI, Inc.		
DATE COMPLETED:	8/15/17	**DRILLER:**	R. Weaver	**LOGGED BY:**	C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	CME 55x300		
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger		
ELEVATION:	2043 ft	**SAMPLING METHOD:**	SS, 3' Centers		
LATITUDE:		**HAMMER TYPE:**	Automatic		
LONGITUDE:		**EFFICIENCY**	N/A		
STATION:	N/A	**OFFSET:**	N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

Water

During Drilling	42	feet
Pre-Core	42	feet
Upon Completion	79.5	feet

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	90					**BEDROCK** - Light brown gray, **SANDSTONE**, fine to medium grained, thin to medium bedded, slightly weathered, medium hard (4-6)					1 min.
											1 min.
											1 min.
1950				R-8	58			RQD=56 Rec=96%			1 min.
											3 min.
	95										2 min.
											3 min.
1945				R-9	54			RQD=42 Rec=100%			3 min.
											3 min.
											1 min.
	100					Boring terminated at approximately 100 feet Boring grouted upon completion					1 min.

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LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-02

DATE STARTED:	8/16/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/17/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	135.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2121 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

Water

During Drilling	15 feet
Pre-Core	15.2 feet
Delay	N/A

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Additional Remarks
2120	0	S-1	18	**COLLUVIUM** - Stiff, moist, light brown to red brown, **Lean CLAY**, with Sand, trace Sandstone Fragments		3-5-6 N=11	
		S-2	18			4-7-7 N=14	
2115	5	S-3	18		CL	5-5-7 N=12	
		S-4	11			3-4-5 N=9	
2110	10	S-5	18	**COLLUVIUM** - Stiff, moist, light brown and red brown, **Sandy Lean CLAY**, trace Sandstone Fragments	CL	4-5-6 N=11	
2105	15	S-6	18	**COLLUVIUM** - Medium dense, moist, light brown and red brown, **Silty SAND**	SM	4-6-4 N=10	
		S-7	18	**WEATHERED ROCK** - Medium dense, moist, light brown and brown, **Clayey SHALE**, sampled as a Clayey Gravel		4-6-9 N=15	
2100	20	S-8	18		GP	4-6-6 N=12	
		S-9	2	**WEATHERED ROCK** - Very dense, dry, dark gray and light brown, **Sandy SHALE**, sampled a a Poorly Graded Gravel	GP	50/2"	>>
2095	25	R-1	14	**BEDROCK** - Gray and light brown, **SHALE**, very fine grained, very thin bedded, weathered, soft (2-3), interbedded with Clay seams		RQD=0 Rec=67%	>> 1 min. 1 min. 2 min.
		R-2	58			RQD=0 Rec=96%	1 min. 1 min.
	30			*Continued Next Page*			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

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LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
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The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/16/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/17/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	135.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2121 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

BORING B-02

Water		
	During Drilling	15 feet
	Pre-Core	15.2 feet
	Delay	N/A

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
2090	30					**BEDROCK** - Gray and light brown, **SHALE**, very fine grained, very thin bedded, weathered, soft (2-3), interbedded with Clay seams					1 min.
											1 min.
											1 min.
											1 min.
				R-3	59			RQD=0 Rec=98%			1 min.
	35										2 min.
2085						**BEDROCK** - Gray and light brown, **SHALE**, very fine grained, very thin bedded to thin bedded, weathered, soft to medium hard (3-5), with sandy layers					2 min.
											2 min.
											2 min.
				R-4	59			RQD=22 Rec=98%			2 min.
	40										1 min.
2080											1 min.
											1 min.
											1 min.
											1 min.
											2 min.
	45										1 min.
2075				R-5	120			RQD=24 Rec=100%			1 min.
											1 min.
											1 min.
											1 min.
	50					**BEDROCK** - Gray and light brown, **SHALE**, very fine grained, thin to medium bedded, weathered, soft to medium hard (3-5), with sandy layers					2 min.
2070											2 min.
											2 min.
											1 min.
											1 min.
	55										1 min.
2065				R-6	115			RQD=44 Rec=96%			2 min.
											1 min.
											1 min.
											1 min.
	60					*Continued Next Page*					

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PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/16/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/17/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	135.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2121 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

BORING B-02

Water		
	During Drilling	15 feet
	Pre-Core	15.2 feet
	Delay	N/A

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	60										1 min.
2060						**BEDROCK** - Gray and light brown, **SHALE**, very fine grained, thin to medium bedded, weathered, soft, with sandy layers					2 min.
											1 min.
											1 min.
											1 min.
	65										2 min.
2055				R-7	113			RQD=61 Rec=94%			1 min.
											1 min.
											1 min.
											3 min.
	70					**BEDROCK** - Gray, **SANDSTONE**, fine to medium grained, thin to medium bedded, slightly weathered, medium to moderately hard (5-8)					2 min.
2050											2 min.
											1 min.
											1 min.
											1 min.
	75										2 min.
2045				R-8	118			RQD=68 Rec=98%			1 min.
											1 min.
											1 min.
											1 min.
	80										1 min.
2040						**BEDROCK** - Gray, **SANDSTONE**, fine to medium grained, thick bedded, slightly weathered, medium to moderately hard (5-8)					1 min.
											1 min.
											1 min.
											1 min.
	85										1 min.
2035				R-9	120			RQD=82 Rec=100%			1 min.
											1 min.
											1 min.
											1 min.
	90					*Continued Next Page*					

intertek psi
Total Quality. Assured.

Professional Service Industries, Inc.
850 Poplar Street
Pittsburgh, PA 15220
Telephone: (412) 922-4000

PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

DATE STARTED:	8/16/17	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	8/17/17	**DRILLER:** R. Weaver	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	135.0 ft	**DRILL RIG:**	CME 55x300
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	2121 ft	**SAMPLING METHOD:**	SS, 3' Centers
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	S. Simonette

REMARKS:

BORING B-02

Water		
	During Drilling	15 feet
	Pre-Core	15.2 feet
	Delay	N/A

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	90					**BEDROCK** - Gray, **SANDSTONE**, fine to medium grained, thick bedded, slightly weathered, medium to moderately hard (5-8)					1 min.
2030											1 min.
											1 min.
											1 min.
											1 min.
	95										1 min.
2025				R-10	119			RQD=93 Rec=99%			1 min.
											1 min.
											1 min.
											1 min.
											1 min.
	100										1 min.
2020											1 min.
											1 min.
											2 min.
											2 min.
	105										1 min.
2015				R-11	119			RQD=96 Rec=99%			1 min.
											1 min.
											1 min.
											1 min.
	110										1 min.
2010											1 min.
											1 min.
											1 min.
											1 min.
	115										1 min.
2005				R-12	120			RQD=74 Rec=100%			1 min.
						Lost water @ 116.5 feet					1 min.
											2 min.
	120										1 min.

Continued Next Page

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Professional Service Industries, Inc.
850 Poplar Street
Pittsburgh, PA 15220
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PROJECT NO.: 08031066
PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-02

DATE STARTED:	8/16/17
DATE COMPLETED:	8/17/17
COMPLETION DEPTH	135.0 ft
BENCHMARK:	N/A
ELEVATION:	2121 ft
LATITUDE:	
LONGITUDE:	
STATION: N/A	**OFFSET:** N/A
REMARKS:	

DRILL COMPANY:	PSI, Inc.
DRILLER: R. Weaver	**LOGGED BY:** C. Lehman
DRILL RIG:	CME 55x300
DRILLING METHOD:	Hollow Stem Auger
SAMPLING METHOD:	SS, 3' Centers
HAMMER TYPE:	Automatic
EFFICIENCY	N/A
REVIEWED BY:	S. Simonette

Water

During Drilling	15 feet
Pre-Core	15.2 feet
Delay	N/A

BORING LOCATION:
Rerer to Figure 2 - Boring Location Plan

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 / 25 / 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 / 2.0 / 4.0)	Additional Remarks
	120					**BEDROCK** - Gray, **SANDSTONE**, fine to medium grained, thick bedded, slightly weathered, medium to moderately hard (5-8)					2 min.
2000											2 min.
											1 min.
											1 min.
				R-13	60			RQD=78 Rec=100%			1 min.
	125										1 min.
1995											1 min.
											3 min.
											1 min.
											2 min.
	130										2 min.
1990				R-14	108			RQD=62 Rec=100%			1 min.
											1 min.
											1 min.
											1 min.
											1 min.
	135					Boring terminated at approximately 135 feet Boring grouted 8/17/17					1 min.

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PROJECT: Energy Transfer HDD (DPS) Wetland CC17
LOCATION: Wetlands CC17 (PPP2)
Stagers Rd., Cambria Co., PA
PA-CA-0047.000 SR-16/DPS PO #20170725

The stratification lines represent approximate boundaries. The transition may be gradual.

intertek psi
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GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

Degree of Brokeness

Characteristic	Description
Less than 1 inch	Very Broken
1 inch to 3 inches	Broken
3 inches to 6 inches	Slightly Broken
Greater than 6 inches	Massive

DEGREE OF WEATHERING

Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

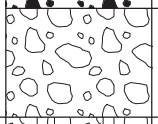
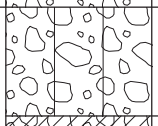
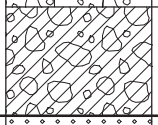
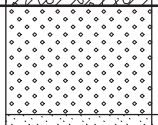
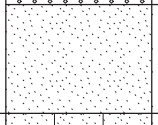
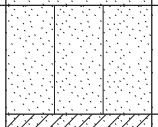
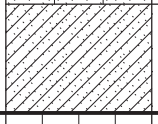
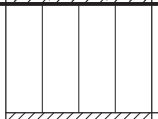
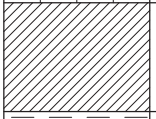
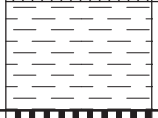
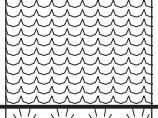
MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

Table 4–3 Hardness and unconfined compressive strength of rock materials

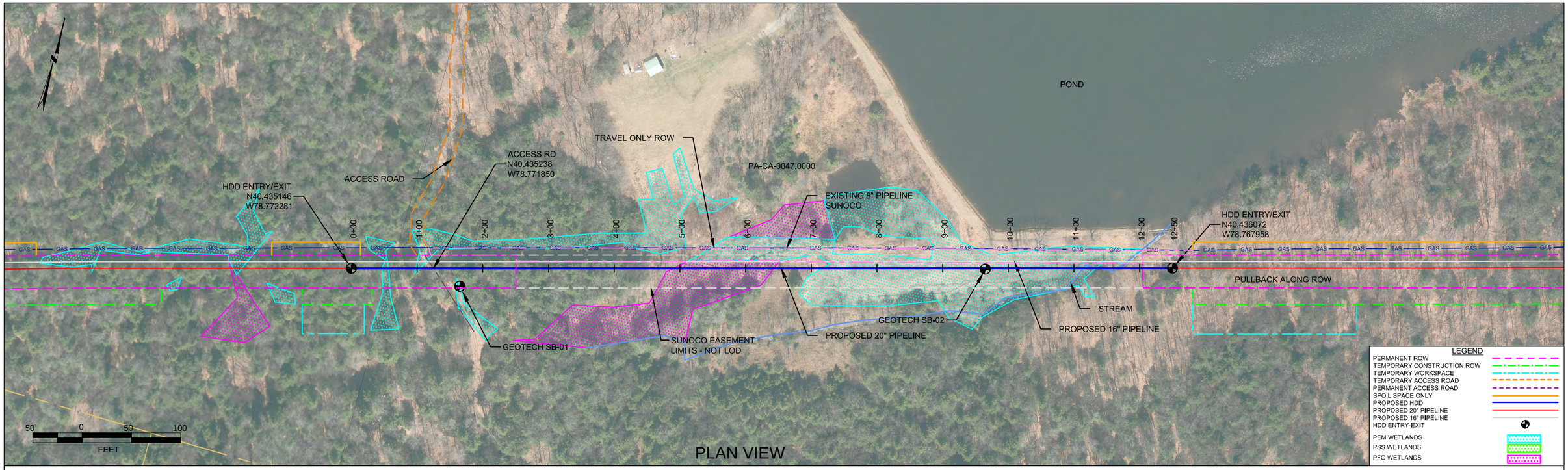
Hardness category	Typical range in unconfined compressive strength (MPa)	Strength value selected (MPa)	Field test on sample	Field test on outcrop
Soil*	< 0.60		Use USCS classifications	
Very soft rock or hard, soil-like material	0.60–1.25		Scratched with fingernail. Slight indentation by light blow of point of geologic pick. Requires power tools for excavation. Peels with pocket knife.	
Soft rock	1.25–5.0		Permits denting by moderate pressure of the fingers. Handheld specimen crumbles under firm blows with point of geologic pick.	Easily deformable with finger pressure.
Moderately soft rock	5.0–12.5		Shallow indentations (1–3 mm) by firm blows with point of geologic pick. Peels with difficulty with pocket knife. Resists denting by the fingers, but can be abraded and pierced to a shallow depth by a pencil point. Crumbles by rubbing with fingers.	Crumbles by rubbing with fingers.
Moderately hard rock	12.5–50		Cannot be scraped or peeled with pocket knife. Intact handheld specimen breaks with single blow of geologic hammer. Can be distinctly scratched with 20d common steel nail. Resists a pencil point, but can be scratched and cut with a knife blade.	Unfractured outcrop crumbles under light hammer blows.
Hard rock	50–100		Handheld specimen requires more than one hammer blow to break it. Can be faintly scratched with 20d common steel nail. Resistant to abrasion or cutting by a knife blade, but can be easily dented or broken by light blows of a hammer.	Outcrop withstands a few firm blows before breaking.
Very hard rock	100–250		Specimen breaks only by repeated, heavy blows with geologic hammer. Cannot be scratched with 20d common steel nail.	Outcrop withstands a few heavy ringing hammer blows but will yield large fragments.
Extremely hard rock	> 250		Specimen can only be chipped, not broken by repeated, heavy blows of geologic hammer.	Outcrop resists heavy ringing hammer blows and yields, with difficulty, only dust and small fragments.

Method used to determine consistency or hardness (check one):
Field assessment: _____ Uniaxial lab test: _____ Other: _____ Rebound hammer (ASTM D5873): _____
* See NEH631.03 for consistency and density of soil materials. For very stiff soil, SPT N values = 15 to 30. For very soft rock or hard, soil-like material, SPT N values exceed 30 blows per foot.

WETLAND C-17 CROSSING
PADEP SECTION 105 PERMIT NO.S:
PA-CA-0047.0000-SR & PA-CA-0047.0000-SR-16
(SPLP HDD No. S2-0075)

ATTACHMENT 2

ORIGINAL AND REVISED HORIZONTAL DIRECTIONAL DRILL PLAN AND PROFILES



PLAN VIEW

PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075

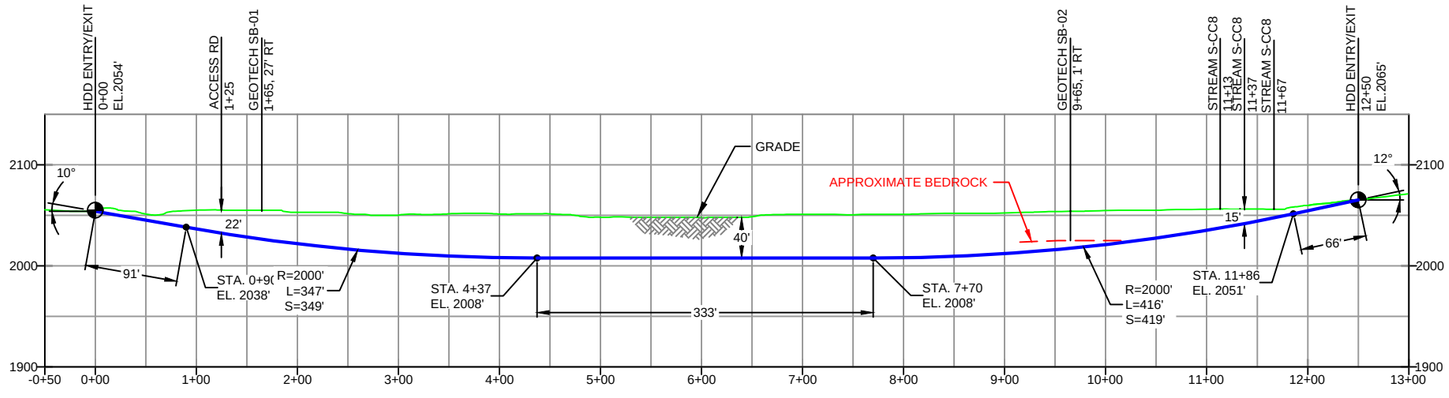
GEOTECH SB-01

-NG EL. 2054'
-TOPSOIL (0' - 0.4')
-CL (0.4' - 30.0')
-COMPLETION DEPTH EL. 2024'

GEOTECH SB-02

-NG EL. 2054'
-TOPSOIL (0' - 0.3')
-CL (0.3' - 24.0')
-SHALE (28.5' - 30.0')
-COMPLETION DEPTH EL. 2025.5'

NOTE: REFER TO TEST BORING LOG S2-0075 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 THAN10 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=):1250'
   HDD PIPE LENGTH (S=):1258'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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.

Figure 1. Original 20-Inch HDD Plan and Profile

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
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

Sunoco Logistics Partners L.P.

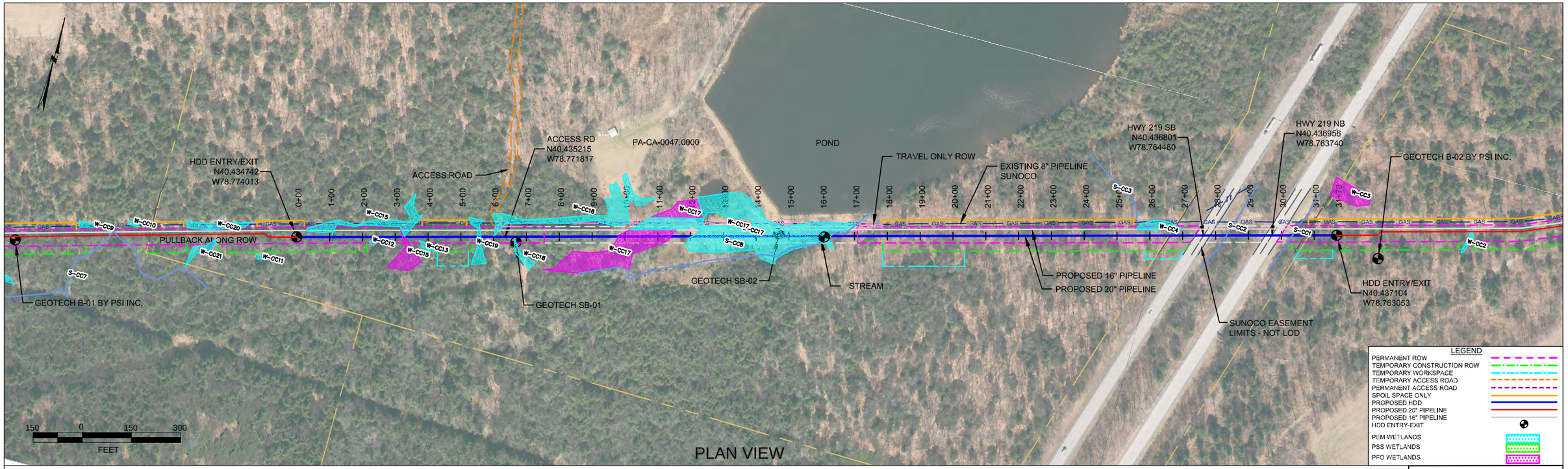
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

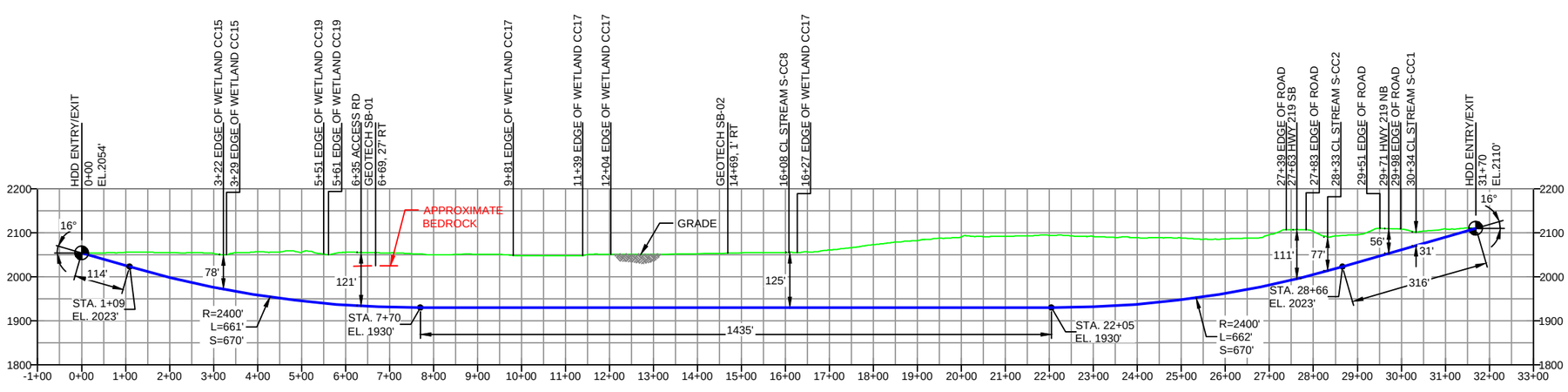
DWG. NUMBER: PA-CA-0047.0000-SR



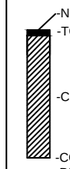
PLAN VIEW

PROFILE VIEW

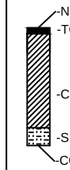
CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075



GEOTECH SB-01



GEOTECH SB-02



NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-01

NOTE: REFER TO TEST BORING LOG B-1 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-02

NOTE: REFER TO TEST BORING LOG B-02 PSI INC. PROJECT # 08031066 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 THAN10 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=):3170'
   HDD PIPE LENGTH (S=):3205'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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.

Figure 2. Revised 20-Inch HDD Plan and Profile

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.

REF. DRAWING					REVISIONS							
ES-2.32	TO	ES-2.34	EROSION & SEDIMENT PLAN	EP3	EXTENDED DRILL - DESIGN CHANGE BY CONTRACTOR	MRS	09/15/17	RMB	09/15/17	CAG	09/15/17
SHEET 19	TO	SHEET 22	AERIAL SITE PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
				EP1	REVISED PER PADEP COMMENTS	MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
				EP		JTW	02/26/16	RMB	02/26/16	AAW	02/26/16
				C	ADDED GEOTECH INFO	MRS	09/06/15	RMB	09/06/15	AAW	09/06/15
				B	ISSUED FOR BID	MRS	07/31/15	ADS	07/31/15	AAW	07/31/15
DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE

Sunoco Logistics Partners L.P.

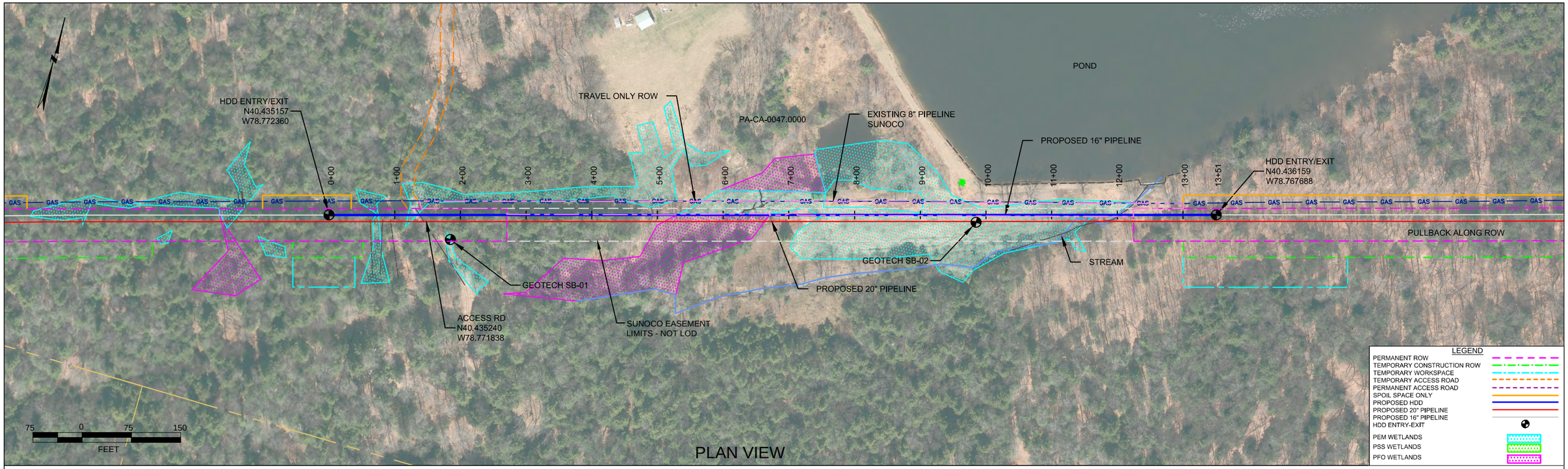
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NUMBER: PA-CA-0047.0000-SR

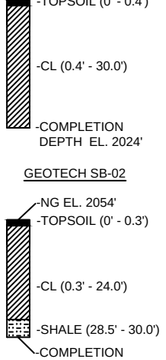


PLAN VIEW

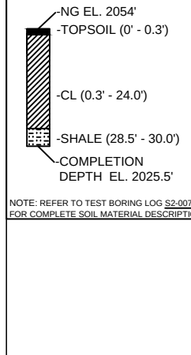
PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075-16

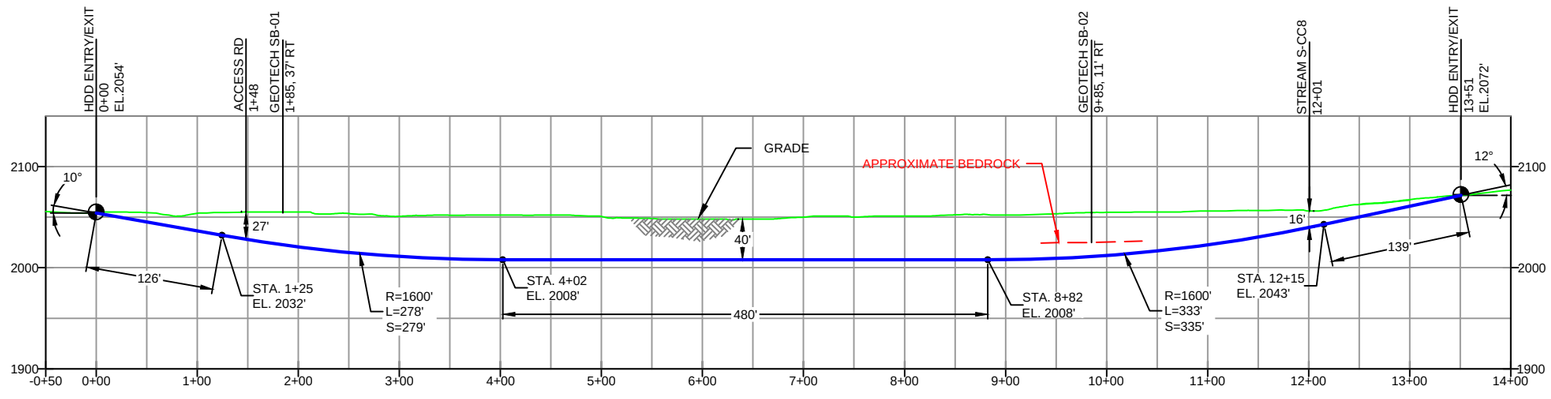
GEOTECH SB-01



GEOTECH SB-02



NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

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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=):1351'
   HDD PIPE LENGTH (S=):1359'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
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.

Figure 3. Original 16-Inch HDD Plan and Profile

NOTES

1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
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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
3	REVISED PROFILE WITH 2017 LIDAR	MRS	03/17/17	RMB	03/17/17	CAG	03/17/17
2	REVISED PER ENGINEERING COMMENTS	MRS	08/26/16	RMB	08/26/16	AAW	08/26/16
1	ADDED "TRAVEL ONLY ROW" ANNOTATION	MRS	02/15/16	RMB	02/15/16	AAW	02/15/16
0	ISSUED FOR CONSTRUCTION	MRS	12/21/15	RMB	12/21/15	AAW	12/21/15

Sunoco Logistics Partners L.P.

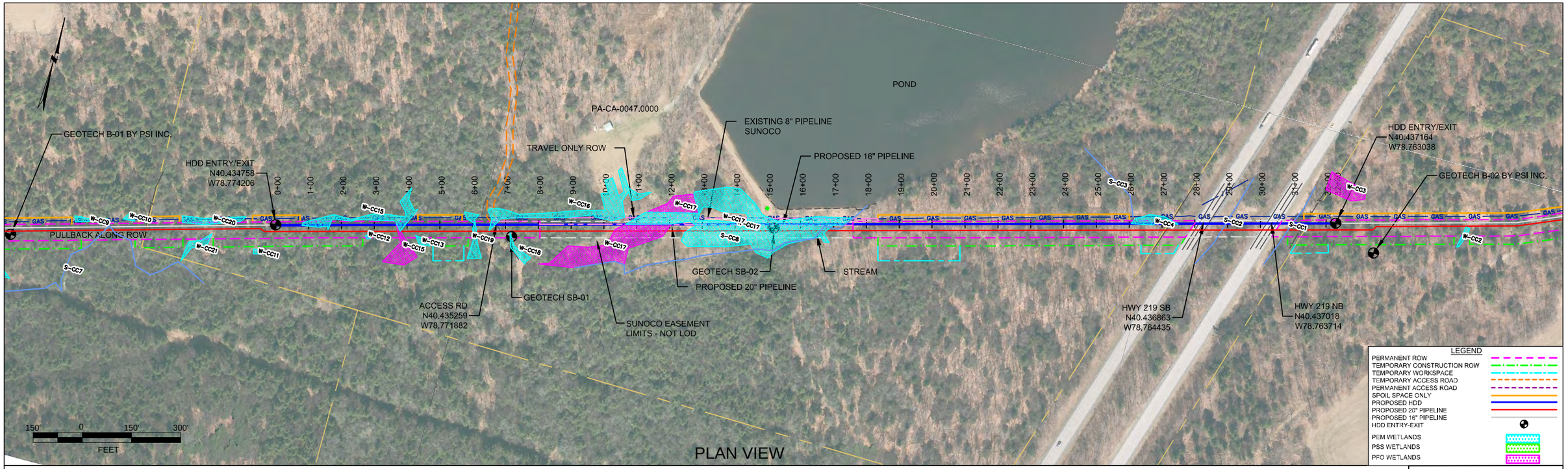
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND CC17
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

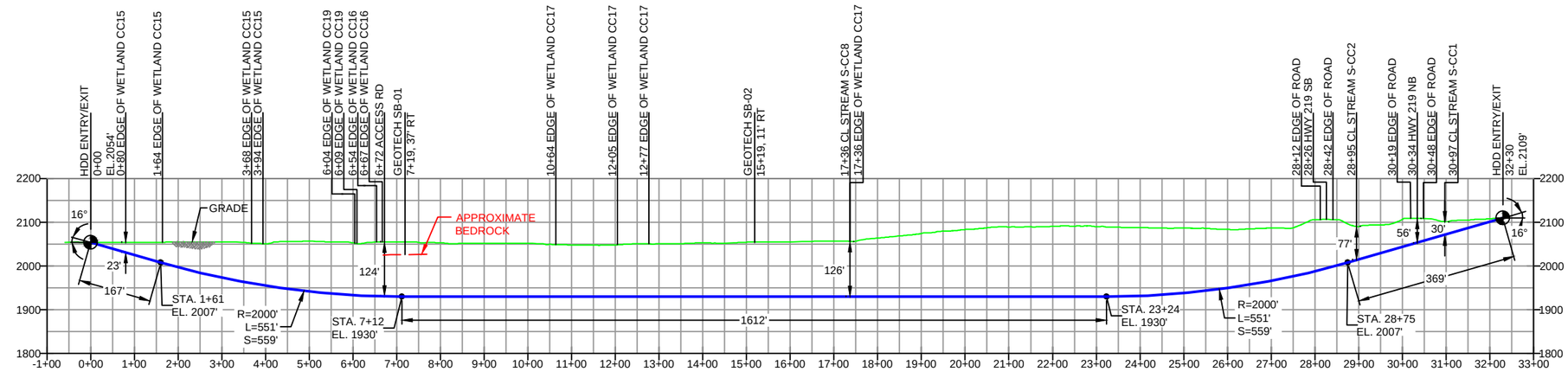
DWG. NO: PA-CA-0047.0000-SR-16



PLAN VIEW

PROFILE VIEW

CAMBRIA COUNTY PENNSYLVANIA, CAMBRIA TOWNSHIP
S2-0075-16



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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=): 3230'
   HDD PIPE LENGTH (S=): 3266'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
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GEOTECH SB-01

GEOTECH SB-02

NOTE: REFER TO TEST BORING LOG S2-0075 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-01

NOTE: REFER TO TEST BORING LOG B-1 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-02

NOTE: REFER TO TEST BORING LOG B-02 PSI INC. PROJECT # 08031066 FOR COMPLETE SOIL MATERIAL DESCRIPTION

Figure 4. Revised 16-Inch HDD Plan and Profile

NOTES

1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
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REF. DRAWING													
ES-2.33	TO	ES-2.33	EROSION & SEDIMENT PLAN	EP3	EXTENDED DRILL - DESIGN CHANGE BY CONTRACTOR	MRS	09/15/17	RMB	09/15/17	CAG	09/15/17
SHEET 21	TO	SHEET 21	AERIAL SITE PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
				EP1	REVISED PER PADEP COMMENTS	MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
				EP		JTW	03/15/16	RMB	03/15/16	AAW	03/15/16
				B	ADDED GEOTECH INFO	MRS	09/06/15	RMB	09/06/15	AAW	09/06/15
				A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE

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SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
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PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NO: PA-CA-0047.0000-SR-16